ASQUITH & deWITT PTY LTD

Environmental Assessment Report

Property:

Tomago Road, Tomago

Applicant:

Redlake Enterprises Pty Ltd



CPP

CERTIFIED PRACTISING PLANNER

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Section 1
Executive Summary

Asquith & de Witt Pty Ltd have been engaged to assist Redlake Enterprises Pty Ltd (Redlake) in obtaining approval to develop their newly acquired site at Tomago Road Tomago. Redlake's prime objective at this time is to have the land filled, to allow the establishment of WesTrac Equipment Pty Ltd (WesTrac) facilities as soon as possible. The proposed WesTrac facility at Tomago will be the NSW headquarters for the company. Future development will involve subdivision for related and unrelated land use. This Project Application is for the entire development.

WesTrac hold the franchise for Caterpillar equipment in NSW, ACT, WA & North Eastern China. WesTrac is one of the largest Caterpillar dealerships in the world, having been established in 1989 is a subsidiary company of Australian Capital Equity Pty Ltd. WesTrac's core business is to supply new and used Caterpillar machinery servicing the construction, mining and forestry industries, as well as local government, quarry, rental and on highway trucks. Supporting the supply of new and used machines, with market-leading after-sales service, WesTrac has invested heavily in information technology, workshop equipment and tooling. Australia-wide, WesTrac employs more than two thousand four hundred people.

In order to ensure that WesTrac is able to meet its obligations to customers and maintain its stride for growth and provision for future employment opportunities it is imperative that the WesTrac NSW/ACT headquarters be established at Tomago as soon as possible.

The purpose of this Environmental Assessment is to allow the Department of Planning and other relevant agencies to make an assessment of the proposal.

The Director General confirmed on 6 July 2007 that the proposed development is a Major Project to which Part 3A of the Act applies. A copy of this letter is located at **Appendix A.**

The Director General issued requirements for this Environmental Assessment Report on 18 September 2007. A Schedule of the requirements and summary of compliance is located at **Appendix B**.

The key issues addressed as part of this EAR include the following:

- Flora and Fauna;
- Flooding;

- Traffic & Access;
- Geotechnical;
- Contamination;
- Heritage;
- Stormwater;
- Water Quality;
- Acoustics;
- Air Quality;
- Soil Erosion;
- Visual;
- Waste Management;
- Hazards and Risk;
- Aesthetics; and
- Relevant Legislation.

Consultation with key agencies, including the Department of Planning, Port Stephens Council, Energy Australia, the Hunter Water Corporation, the Department of Environment and Conservation and Roads and the Traffic Authority has been undertaken during the process of designing the proposed development, and preparing this report.

The proposed development, with an estimated value of $130,000,000 and the employment of 300 – 400 people as part of the WesTrac operations, as well as 400 - 600 construction jobs, represents a significant positive outcome for the region. In addition, substantial further employment opportunities will result from the future establishment of industry within the proposed industrial subdivision.

This EAR also includes a Draft Statement of Commitments (Section 8) covering the key areas as specified by the Director General Requirements.

Section 2
Author Certification

Name:	Craig Ian Marler
Position:	Senior Planner
Qualifications:	B.App.Sc (Environmental Planning) G.Dip.App.Sc (Building) MPIA CPP
Address:	Asquith & de Witt Pty Ltd Unit 7, 335 Hillsborough Road Warners Bay NSW 2282
Applicant:	Redlake Enterprises Pty Ltd
Project:	WesTrac operations facility and industrial subdivision.
Subject Land:	Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 & Lot 513 DP 585256.
Certificate:	I certify that I have prepared the content of this Environmental Assessment and to the best of my knowledge it is in accordance with the Environmental Planning and Assessment Act and Regulation and is not false or misleading.
Signature:	..... Craig Ian Marler
Date:	12.3.08

Section 3
The Site & Locality

3.1 SITE IDENTIFICATION DETAILS

The subject site is located on Tomago Road Tomago and comprises the following parcels of land:

- Lot 161 DP 774440;
- Lot 1 DP 1003492;
- Lot 1 DP 597372; and
- Lot 513 DP 585256.

Copies of the deposited plans are located at **Appendix C.**

The site is owned by Redlake Enterprises Pty Ltd. Copies of the Certificates of Title are located at **Appendix D.**

3.2 SITE LOCATION

The following plans show the site location.



Figure 1: Location of Tomago in Broader Context.

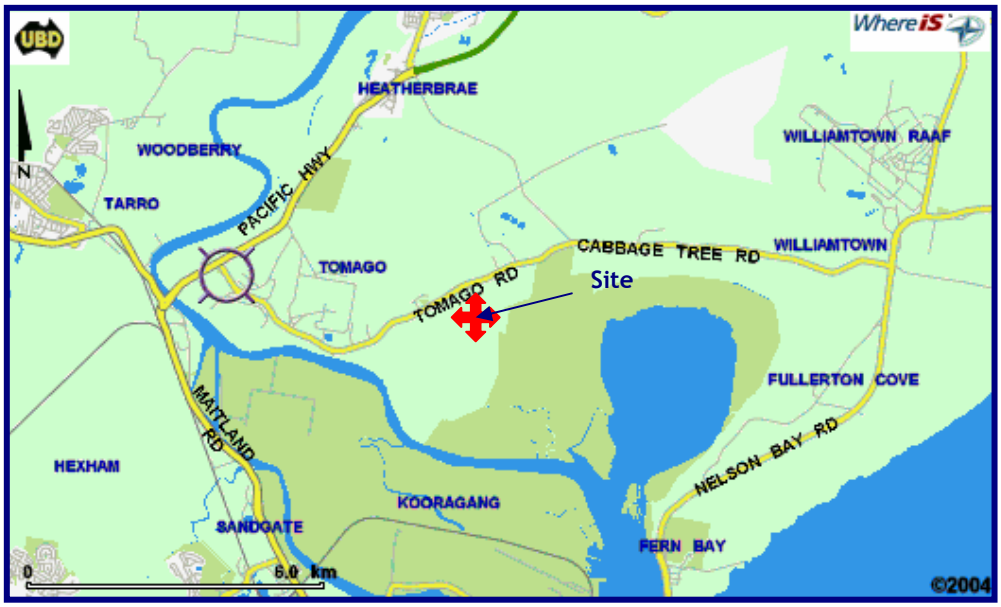


Figure 2: Site Location.

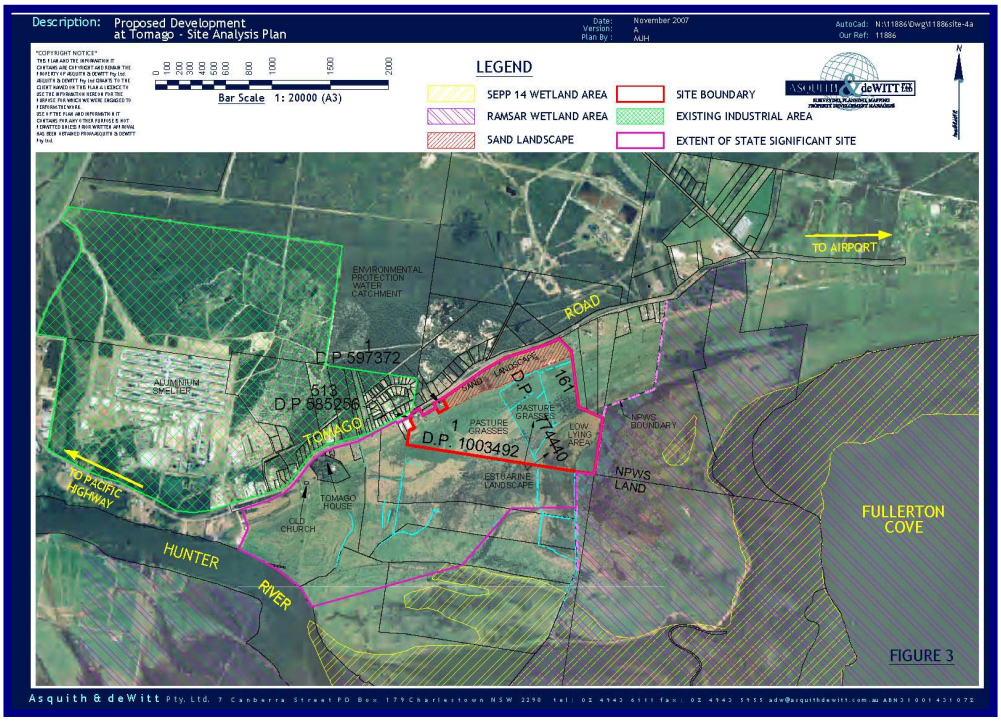


Figure 3: Aerial of Site and Surrounds.

The aerial view has been reproduced as an A3 Plan at **Appendix E.**

The site is located 8km south-west of Raymond Terrace, and 12km north-west of the Newcastle CBD. The site is located 1.3km from Fullerton Cove to the east, and 1.6km from the Hunter River to the south and south-west. The site is located with good access to major road links, to the Port of Newcastle, and also to Williamtown Airport, which is experiencing

strong growth. Access to the Port is important to WesTrac for the importation of equipment and parts.

Part of the site was previously earmarked by another party for the operation of a mini steel mill, but this project has not proceeded.

The site is located within an area that already caters for significant employment-generating industrial development, including the Tomago Aluminium Smelter, Williams River Steel, Hunter Galvanising and the recently proposed headquarters for Sandvic (also a Major Project under consideration).

The site is well located relative to WesTrac's main customer-base in the region, being mining companies operating in the Hunter Valley.

The subject site, located in the Port Stephens LGA comprises an area of approximately 115.69ha, and is a State Significant Site under the Major Projects State Environmental Planning Policy (SEPP). The site is predominantly zoned IN1 General Industrial under the SEPP. The following plan extracted from the SEPP shows the zoning of the site:

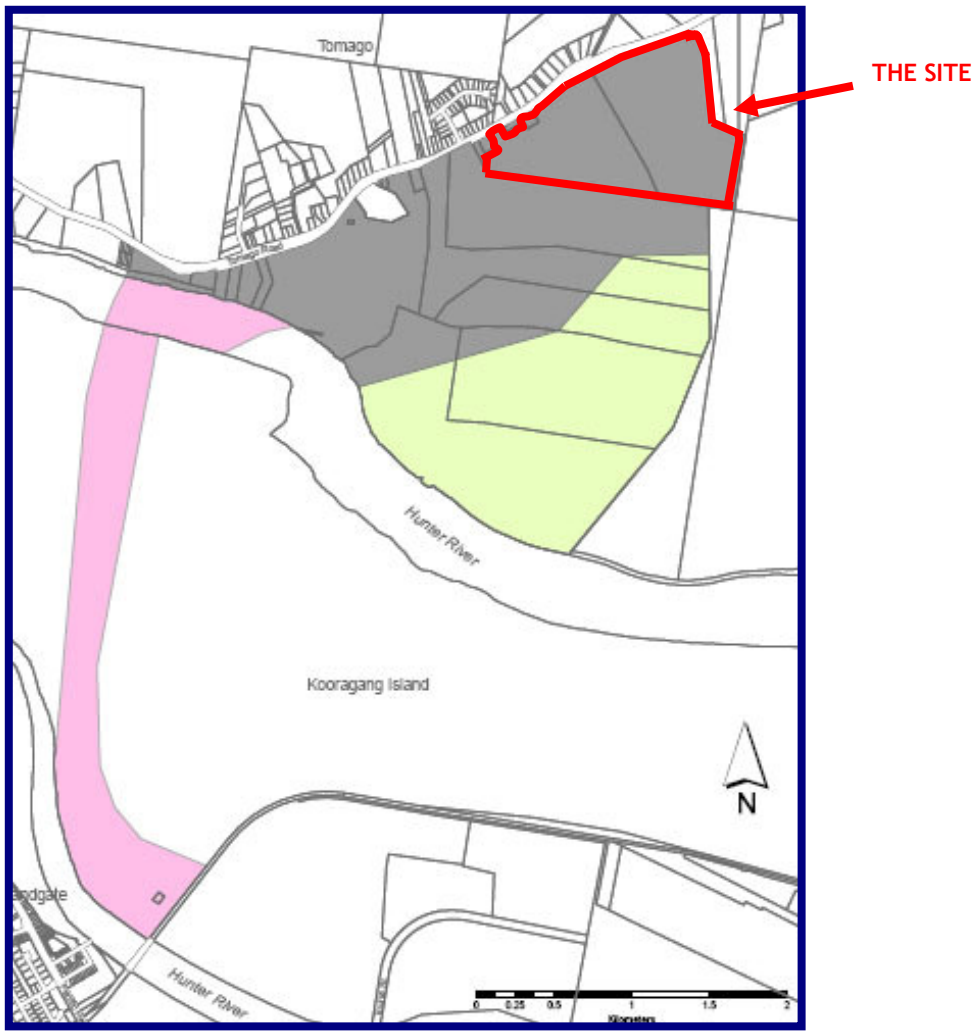


Figure 4: Extract of Zoning Map.

A small portion of the site has been retained for road widening, and zoned accordingly under the Port Stephens Local Environmental Plan. A small part of the site has also retained its 1(a) Rural Agriculture zone under the LEP. These zonings are of no significance to the development, and vice versa. The following plan shows these zonings:

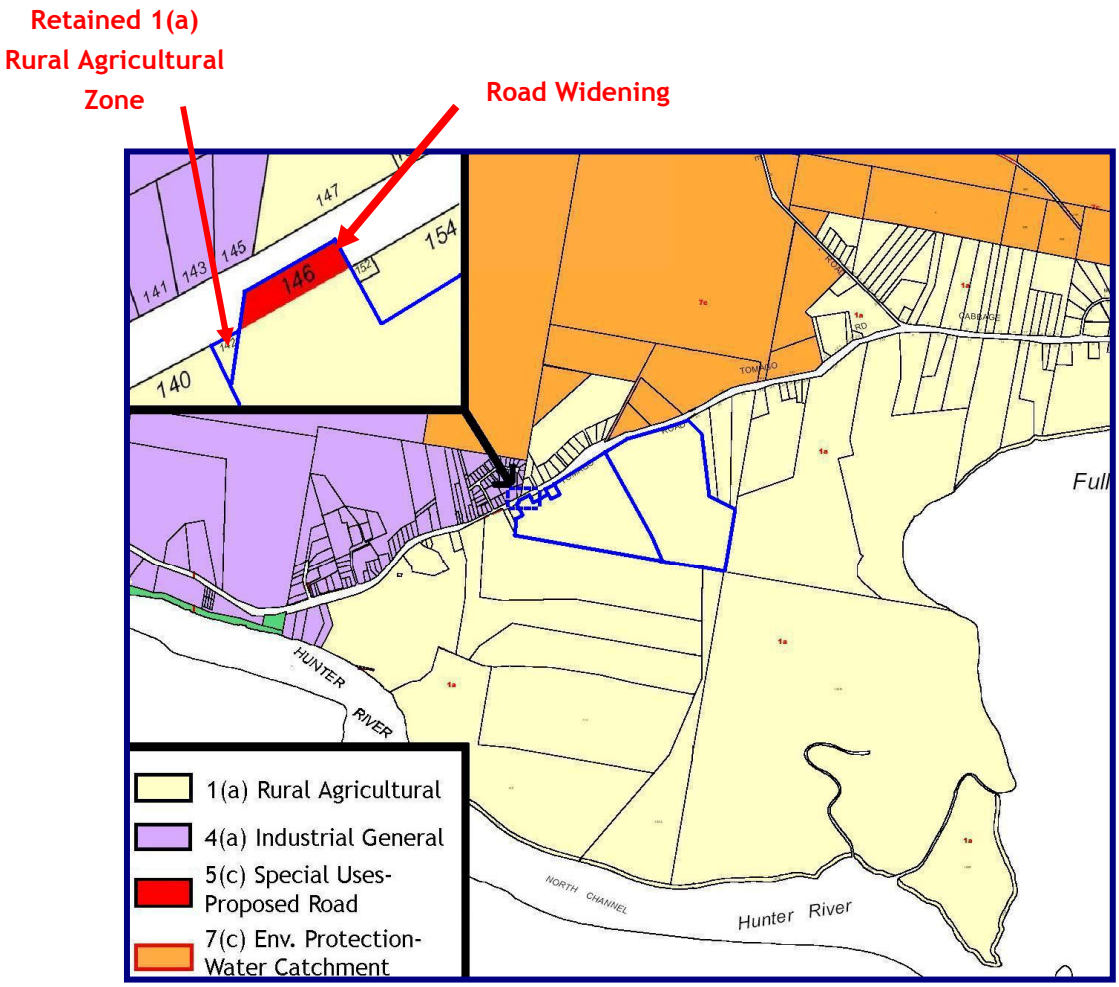


Figure 5: Map showing zonings under Port Stephens LEP.

The site has been nominated as employment lands under the recently released Lower Hunter Regional Strategy. The following plan is an extract of the Strategy, showing the site:

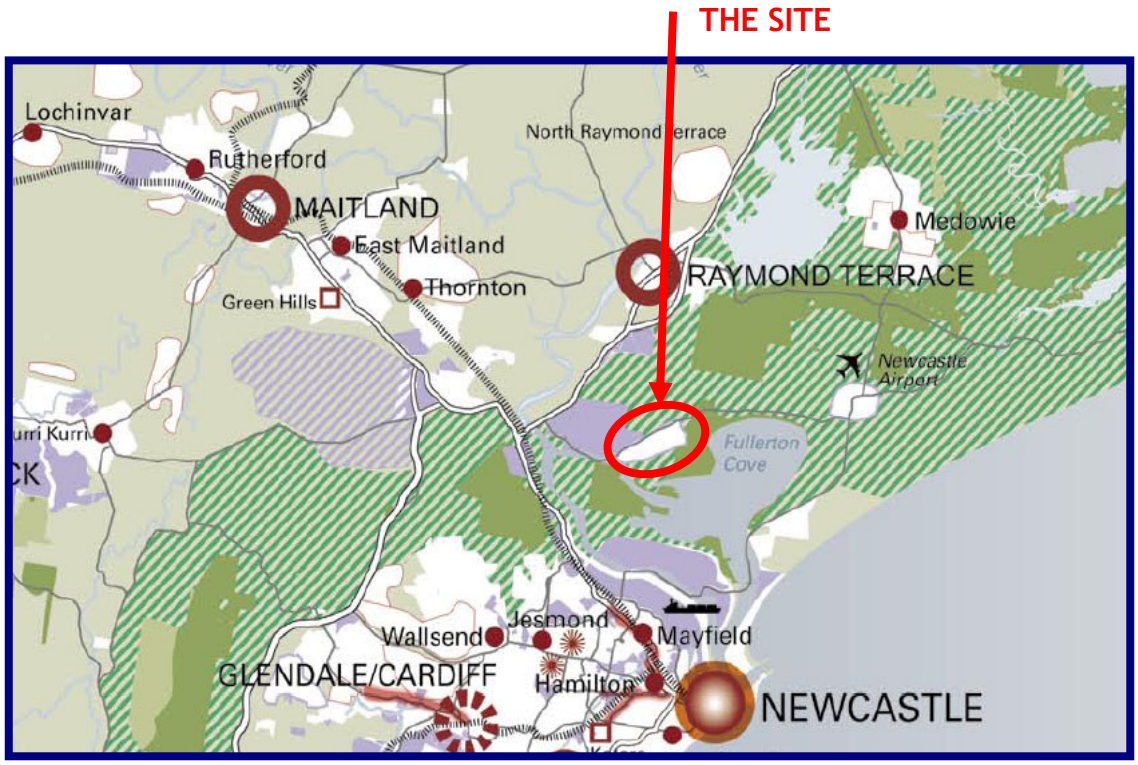


Figure 6: Extract from Lower Hunter Regional Strategy.

The more detailed plan below shows the site, where it can also be seen that the Strategy concurrently set aside a significant adjoining area to the south, for the purpose of conservation:

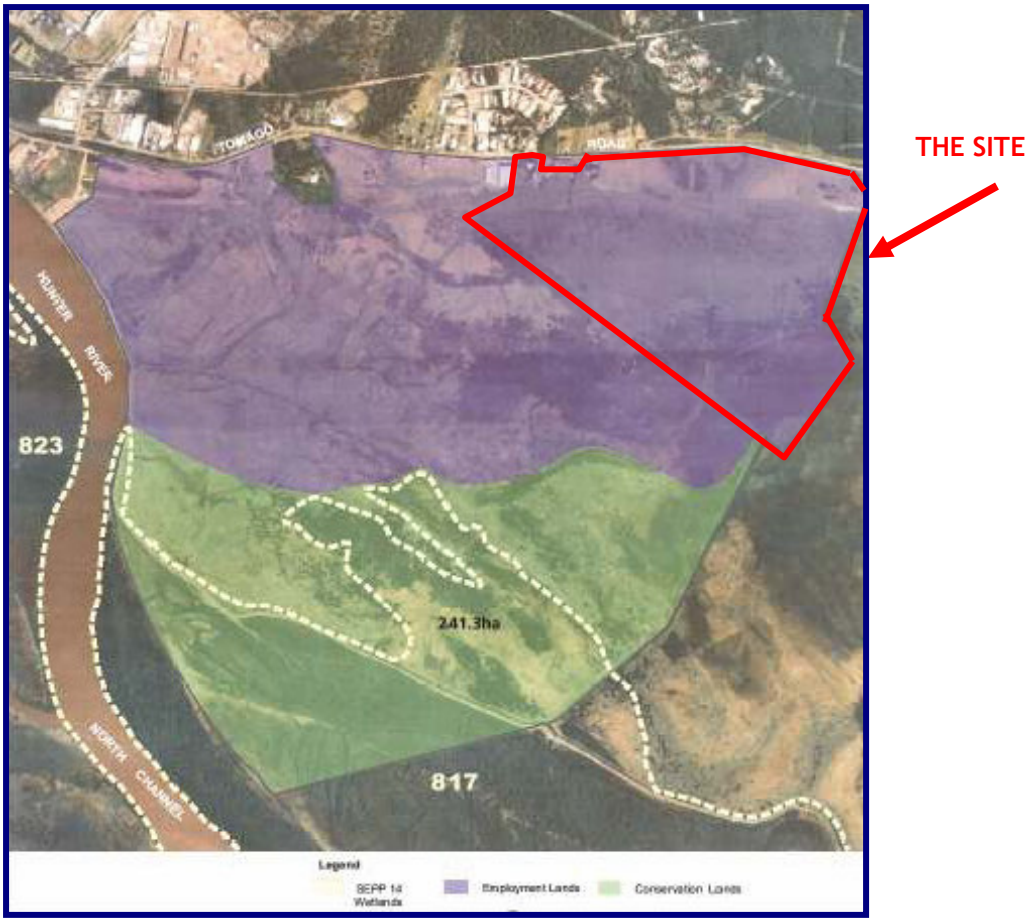


Figure 7: Extract from Lower Hunter Strategy in more detail.

Tomago was selected by WesTrac as the preferred location following a two-year search and a one-year due diligence process. The site was determined as being suitable not only due to its location to road and port access, but also because of its location relative to customers in the Hunter, and to an available workforce, being relatively central to Newcastle, Maitland and Port Stephens areas.

3.3 SITE IMPROVEMENTS & SITE PHOTOS

A timber-clad house in need of substantial repair is located on Lot 1 DP 1003492, and an iron-clad home in a state of disrepair and disuse is located on Lot 1 DP 597372. The site is otherwise clear of any significant structures.

The following photos provide an impression of the site, and have been taken from the sand ridge adjacent to Tomago Road.



Photograph 1: Looking south east across the site.



Photograph 2: Looking south across the site.



Photograph 3: Looking south west across the site.



Photograph 4: House located on Lot 1 DP 1003492.



Photograph 5: Dilapidated and Disused House located on Lot 1 DP 597372.

3.4 TOPOGRAPHY, VEGETATION & FAUNA

The site is of flat topography, and is generally only 0.5m AHD other than the sand ridge running parallel to Tomago Road.

As can be seen from the photographs above, the site is mostly cleared of vegetation and is predominantly covered in pasture grasses (reflecting its previous use for grazing). Given the general lack of vegetation, and its past use, the site does not support an extensive range of Fauna. Flora & Fauna are discussed in detail as part of the Environmental Assessment presented later in this report.

3.5 ADJOINING LANDS

Wetlands adjoin the rear of the site, including a Ramsar wetland to the south-east. Adjoining lands to the west are of a similar character, i.e. substantially cleared vacant lots used, or previously used, for grazing. Two immediately smaller adjoining lots to the west, fronting Tomago Road contain industrial buildings as shown in the photograph below.



Photograph 6: Adjoining industrial buildings to west of the subject site.

The site also adjoins a smaller house block which is located on Tomago Road and interrupts the subject site's full frontage to Tomago Road. The house is shown in the photograph below:



Photograph 7: Adjoining house located on Tomago Road.



Photograph 8: Adjoining Rural Zoned land to the east showing house and outbuildings

These surrounding uses can be seen in **Figure 3** above.

3.6 FLOODING

The site is subject to flooding and it has been determined via two dimensional flood modelling analysis that the 1:100 year level is predicted to vary from 2.29m AHD at the western boundary of the site, to 2.14m AHD at the eastern boundary of the site. With the land mostly at approximately 0.5m AHD other than for the low dune formation along the front, north east corner of the site, it can seen that a substantial quantity of fill will be required to achieve the 1:100 year level. It is estimated that around 1.8 million cubic metres will be required to fill the entire site.

3.7 TRAFFIC & ACCESS

Access to the site is via Tomago Road, which connects with the Pacific Highway some 5km to the west, and with Nelson Bay Road some 9km to the east. Tomago Road is constructed with tar seal and has a single lane of travel in each direction. The following photographs are of Tomago Road:



Photograph 9: Tomago Road looking west from in front of the development site.



Photograph 10: Tomago Road looking east from in front of the development site.

Tomago Road has traditionally supported relatively low traffic volumes, however, with the recent growth of Newcastle Airport, volumes are increasing. A traffic report has been prepared and this is discussed in more detail as part of the Environmental Assessment.

3.8 GEOTECHNICAL

Other than the low, dunal formation, the site contains predominantly low-lying estuarine clays. These factors, in combination with filling of the site will require careful consideration in regard to geotechnical issues.

The methods employed to fill the site require detailed consideration to ensure that an adequate building platform is created for roads and buildings in an efficient and cost-effective manner.

3.9 ACID SULPHATE SOILS & CONTAMINATION

Preliminary reports have shown that the site is not the subject of any significant contamination.

Preliminary geotechnical testing indicates that the low lying, estuarine/alluvial clays are potentially acid sulphate soils. The significant depth of fill, and adoption of a preloading method for filling

will leave the clays relatively undisturbed, with the exception of disturbance occurring during potential service trenching. Geotechnical advice will be required for the work method in this regard.

3.10 ARCHAEOLOGY AND HERITAGE

Investigations of the site have discovered a number of relics along the sandy ridge adjacent to Tomago Road. Investigations conclude, however, that the site is not a burial ground, and the finds do not contribute in any significant manner to the cultural understanding of Aboriginal people. It is anticipated that the relics will be collected by the LALC as part of the development process. The LALC have provided a letter supporting this approach. A detailed archaeological report has been prepared, and this is discussed as part of the Environmental Assessment.

There are no listed items of heritage significance and the site is not located within a Heritage Conservation Area.

3.11 DRAINAGE

Open-channel farm drains have been previously excavated into the site, draining toward the Hunter River. There is no runoff from large external catchments draining into the site.

3.12 UTILITIES

The site is not sewered. Water service is available in Tomago Road. Power is available to the site.

The method for treating and disposing of sewerage is discussed as part of the Environmental Assessment.

Energy Australia have expressed a potential desire to locate on part of the site an electricity sub-station. This possibility does not come as a result of the proposed development, but to service the needs of their customers generally. Redlake Enterprises is agreeable to enter into discussion with Energy Australia in this regard.

3.13 EASEMENTS & ROADWIDENING

The site is traversed by power easements located along the Tomago Road frontage. A power line exists within one of these easements, and the second is to cater for a future line. The easements are not well located to ensure the orderly and efficient use of land, and so as part of the proposed development it is intended to relocate them. Discussions have already been held with Energy Australia and they have raised no in

principle object to relocating the lines to suit the proposed site layout. The following photo shows the existing power line running across the site:



Photograph 11: Power line running across the site.

A small part of the site is subject to road widening, and this is shown on the zone plan extracted from Port Stephens Local Environmental Plan, see **Figure 5** above. The proposed road widening has no impact on the proposed development outcome.

3.14 HUNTER WATER SPECIAL AREA

Part of the site frontage contains an aquifer, and forms part of the Tomago Sand Beds, a potable water source providing some 20 to 25% of drinking water to the Lower Hunter. This area is therefore subject to the Hunter Water (Special Area) Regulations. A plan provided to us by Hunter Water showing the location of the Special Area is included in the Concept Engineering, Servicing and Stormwater Management Report at **Appendix F**.

It will be necessary to ensure that there is no interference to the aquifer, and that water supply is not impacted by way of loss or contamination. It will also be necessary to ensure that the provision of water to the Tomago Sand Beds is not reduced by the proposed development. This issue is discussed in detail as part of the Environmental Assessment.

3.15 OBSERVATIONS FROM ANALYSIS OF SITE AND CONTEXT

The subject site is well located relative to essential transport, in particular to road networks, the Port of Newcastle, and to the nearby Williamtown Airport. The site is separated from substantial residential areas, and located close to existing and emerging industry. For these reasons the site is ideal for industrial development, as recognised by the Lower Hunter Regional Strategy and the industrial zoning.

A number of constraints have been identified as requiring management, and these are discussed further as part of the Environmental Assessment.

Section 4
The Proposal

4.1 DESCRIPTION OF DEVELOPMENT

4.1.1 Summary Description

The proposed development is for the establishment of an integrated WesTrac facility which will become the company's NSW/ACT Headquarters. The proposal is also to establish an industrial subdivision that will likely cater for related, and also unrelated industrial land uses.

This project application seeks approval for the entire development although it is likely that this will be undertaken in stages, as shown on the submitted drawings. It is imperative to WesTrac that they are established on the site as soon as practicable. To this end the initial priority will be to carry out the necessary earthworks and filling relative to stage 1 as shown on the drawings.

The proposed development, with an estimated value of $130,000,000, will employ 300 – 400 people as part of the WesTrac operations, and 400 - 600 during construction. This represents a significant positive outcome for the region. Further substantial employment opportunities will result from the future establishment of industries within the proposed industrial subdivision. WesTrac will operate on a 24 hour basis.

The Minister for Planning has confirmed that the proposal is a major project to which Part 3A of the Act applies (see letter at **Appendix A**).

4.1.2 Detailed Description of Proposal

The proposed development is for the following:

- To fill the majority of the site to the 1:100 year flood level (fill area approximately 107 hectares);
- To develop, as Stage 1, approximately 23 hectares for the purpose of an integrated WesTrac facility for the following:
    - The manufacture/assembly and component rebuilds, display, sale, hire, maintenance and servicing of predominantly large earth moving and mining machinery but also smaller machinery;
    - The warehousing and distribution of associated parts to all branches in NSW / ACT;
    - The servicing of on highway trucks;

- The construction of the WesTrac/Institute for WesTrac NSW/ACT apprentices and general training in new technologies and procedures; and

- The construction of administration buildings and offices associated with the above functions.

- The subdivision of the balance of the land for sale to related and unrelated land users, in a number of stages.

The following two photos show examples of just some of the types of machinery that could be expected to be assembled, sold and serviced at the proposed new facility in Tomago. Ultimately many different types of machines will be on site.



Photograph 12: Typical large Earthmoving Equipment.



Photograph 13: Typical large Earth Moving Equipment.

4.1.3 Detailed Description of Components

The following provides a detailed description of the various components of the development.

Filling & Earthworks

Site filling and earthworks will be carried out in stages. Stage 1, of some 23 hectares, will be in preparation for the construction of the WesTrac Facility. Sand from the sand ridge along the frontage of the site will be used as fill for stage 1 and the importation of approx 30,000m^3 of additional fill will also be required. Filling for the remainder of the site (about 1.8 million cubic metres) will be completed over time to compliment market demand for industrial land. All fill will be transported to site via road (truck and dog).

The work method used to fill the site will be to preload for consolidation. Geotechnical advice in this regard indicates that 1 – 2m stockpile depths of preload material will result in acceptable consolidation rates. Soil and water management will be an important consideration during the earthworks for the protection of the receiving waters downstream.

Intersection Construction & Relocation of Power Lines and Easements

A Seagull intersection is proposed to allow access off Tomago Road onto the site. This is outlined in the traffic report prepared by Mark Waugh Pty Ltd enclosed at **Appendix G.** The submitted plans show the proposed

intersection. Intersection construction will meet the requirements of the Roads & Traffic Authority.

It is proposed to relocate the existing power line and easements to ensure the most efficient use of land for development purposes. Several meetings have been held with Energy Australia in this regard, and they are supportive of the concept. It is intended to comply with their standards and specifications. The submitted plans show the relocated easement.

WesTrac Buildings and Uses

Overview

EJE Architecture have undertaken with the client an extensive worldwide study of equivalent existing facilities, the objective being to ensure that a world class operation is established, allowing for efficient site operations, a safe work place and protection of the environment. Some half-dozen facilities around the world were visited during this study.

The site plan for the proposed WesTrac facility at Tomago is premised on access being provided safely and conveniently from the new central access road into the proposed industrial subdivision. The site layout is generally contained within a perimeter circulation road, which allows easy access to all areas of the site and encourages a positive separation of external access, vehicular movements and pedestrians. Staff parking has been centralised and specifically secured to provide safe access to the works for employees. Customer parking has also been placed to gain immediate access from the local road network in close proximity to the main Administration building/s and Parts Warehouse.

A detailed Architect's Design Statement has been included with the submitted documentation.

Administration Building

The proposed administration building will house all primary administration functions for the site as well as for WesTrac across NSW & the ACT. Some 97 people will occupy this building.

On Highway Trucks & BCon Workshop

The on-highway trucks building houses all equipment necessary for the maintenance, repair and servicing of on-highway trucks. A large number of on-highway trucks (i.e. prime movers) in NSW have Caterpillar engines, and this facility will cater for the service of this equipment. Some 11 staff will occupy this building.

The building Construction workshop is co-located with the on-highway trucks and houses all equipment necessary to assemble and service small & medium size machines are generally used to construct buildings and smaller civil and road works projects.

WesTrac Institute

The WesTrac Institute is a very important component of the operations of WesTrac. Apprentices will be trained at the institute, in a wide variety of mechanical fields. This facility and the existing facility in Perth will compliment each other, and cover all areas of the business. An apprentice trained by WesTrac obtains licence to work on Caterpillar equipment around the world. Any mechanic working on Caterpillar equipment must hold a specific qualification from a Caterpillar accredited training facility such as that proposed here. The proposed Institute will allow apprentices both theoretical and hands-on training at the same site, without the need for travel.

The WesTrac Institute will also provide ongoing training for post trade employees as well as external people.

Training in occupational health and safety, supervisory and management roles is also carried out by the WesTrac Institute.

Training assists the following industry sectors:

- Mining;
- Agriculture;
- Marine;
- Forestry;
- Local Government;
- Building and Construction;
- Quarrying;
- Heavy Construction;
- Small Business Operators;
- Road Transport; and
- Energy and Power Generation.

The WesTrac Institute Learning and Development Facilitators are qualified trainers and assessors and hold essential current qualifications. The facilitators also have recent and relevant industry experience across a broad range of Caterpillar products, other machines and the latest technological and management trends.

The WesTrac Institute employs some 9 staff and typically provides training for around 40 people at any one time.

The importance of the WesTrac Institute as a training facility has been recognised by the Federal Government, who have provided a grant in the amount of $6 million to partially fund the project. A further $3 million was provided to fund WesTrac Institute facilities in Perth. The one-off grant will be available for capital costs for premises, plant, equipment and machinery. The grant recognises not only the quality of the facility, but also the need to address a major skill shortage in Australia.

Cafeteria & Change Rooms

An integral part of the operations is the on-site cafeteria, providing meals to employees, and also providing space for employees in which to eat meals they have brought in themselves. The facility also caters to visiting guests. The cafeteria will not be marketed to the general public or passing trade.

The Cafeteria employs some 5 staff.

The proposed change rooms attached to the cafeteria have a GFA of 1050sqm and provide change and shower facilities to all staff.

Parts Warehouse

The parts warehouse is an important component of the operations, storing a substantial number of parts, with wide variety of sizes and shapes, and with a varying frequency of demand. As the franchise dealer for Caterpillar, servicing all of NSW and the ACT it is important that this building has substantial capacity.

It is also necessary that the internal layout of the building is efficient, to allow for safe and effective deliveries to and from the building, as well as to its internal customers.

The parts warehouse employs some 46 staff.

CRC Building

The Component Rebuild Centre, employing some 45 people, is where all components removed from machines around the state will be brought for

repair and/or rebuilding. This area is designed to ensure that maximum efficiency is gained through layout and workflow process.

General Workshop

The General Workshop, employing some 22 people, is where all machinery requiring repair, rebuilding, assembly or maintenance is handled.

Utility Buildings

- Washbays

  It is vital that all machinery is cleaned for repairs. The washbays are of sufficient size to cater for everything from the largest to the smallest machinery. The proposed washbays will employ 3 staff. The washbays are to be environmentally sustainable, using water captured on-site, and recycling the water used, until it is no longer viable to do so, at which point it will be disposed to sewer.

- Dyno

  The diagnostic centre, housing some 4 staff, is where engines will be tested in order to determine necessary maintenance or repairs and also where testing of performance will occur after rebuilding. The dyno is acoustically treated and located within the CRC Building.

- Sandblast

  The sandblasting workshop will house/employ some 3 staff. The function of the sandblast shop is to clean machines and parts of paint and rust. All operations are contained within the building and all waste products consisting of bead blast and sand is recycled as practicable.

- Spray booth

  The spray booth will allow spray painting of machinery and components in a controlled environment, to prevent air pollution and to allow dust and grit-free painting of machinery. The spray booth employs some 3 staff.

- Machine shop

  Eleven people will be employed in the machine shop, which will provide machining capability to WesTrac to reclaim and refurbish machine components during their various stages of rebuild and repair.

- Fabrication shop

  Eleven people will be employed in the fabrication shop, where the design and fabrication of various machine attachments and additions, including buckets, light brackets, bodyliners and machine modifications will be undertaken.

Hydraulic & HVOF Facility

The hydraulic and High Velocity Oxygen Fuel (HVOF) facility will employ some 15 people, providing a complete hydraulic repair centre, where components, from small hydraulic cylinders, through to complete pumps and hydraulic systems are overhauled. The HVOF section will comprise a high velocity type metal sprayer, used to reclaim chrome and metal rods to meet specific standards for reuse.

Oil & Fuel Farm

The oil and fuel farm will provide above-ground storage for 5000 litres of diesel and 5 x 5000 litres of oil. The storage will be located within a bunded area the size of which will be 110% of the total capacity, in order to contain any spillage in this unlikely event.

Sewer Plant

The sewer plant will be of a size and location to cater for not only the proposed WesTrac facility, but also the future needs of the industrial subdivision.

Solid Waste Depot

The solid Waste Depot will provide a central solid waste storage area, to cater for all such waste generated. This area will contain storage for both recyclable and non recyclable waste. It will be conveniently located allowing easy access for removal.

Oil Waste Depot

The waste oil depot will provide a sealed storage area for all waste oil. It will be bunded to prevent spillage, and collection will be undertaken by a waste oil recycling contractor.

Machine Display

The Machine display areas to be located at the front of the property, will house an important part of the business operations. They will be divided into new and used machinery areas. These areas will be easily accessible off the proposed internal road system.

Car Parking

Car parking will be provided on-site, in separate locations for staff and customers. A total of 391 carparking spaces and 22 motorbike parking spaces will be provided.

Access, Manoeuvring Area and Hardstand

Access to and around the site will be important for the movement of machinery, as well as for the safe movement of staff. An efficient ring road system has been designed, with adequate on-site manoeuvring area provided to cater for all machinery types. Hardstand is proposed as being adequate to cater for this usage.

Outdoor Storage

An outdoor storage area for large machinery parts that do not require cover is proposed. This is likely to include engines, transmissions and machine attachments.

Machinery Test & Demonstration Area

The machinery test and demonstration area will allow customers to see machinery operating, and will also provide space for machinery to be tested following maintenance or repair.

Landscaping

An extensive area of landscaping is proposed, and a landscape concept plan has been submitted with the application documentation.

Industrial Subdivision

The proposed industrial subdivision, involving some 130 lots, will be constructed in stages as shown on the submitted plans. The subdivision provides for a range of lot sizes. The number of rectangular-shaped lots has been maximised in the design.

The basis of the design is a series of circulating roads, or loops, accessed off a central spine road, that potentially could link to adjoining development to the south. The number of 4 way intersections has been limited to two, and these will be constructed with a roundabout for traffic control. No direct property access is proposed off Tomago Road or the spine road other than the access to the WesTrac Site. An access road parallel to Tomago Road is provided to accommodate high voltage overhead electricity lines within the road reserve, and to provide some lots that can take advantage of having visual exposure to a main road.

The design standard of the roads will satisfy Port Stephens Council requirements for a 13.0 metre wide carriageway and minimum verge width of 4.0 metres, and it is intended that the roads will be dedicated to Council. The footways provide adequate width for services and tree planting, which can be supplemented by on-site landscaping.

The proposed subdivision incorporates appropriate water quality facilities to address runoff from both roads and lots.

At this time there are no known users for the subdivision, and such would be the subject of separate approvals in the future.

The overall site and WesTrac Layout Plan appears at the end of this section and attached at **Appendix H** are the detailed development plans, including the site layout plan.

The WesTrac facility will employ some 400 people, and will operate 24 hours per day.

Machinery and parts will be delivered to the site by road transport, primarily direct from the Port of Newcastle. Increased activity will thus be generated for the Port, and the Newcastle Port Authority is supportive of the proposed development.

A Draft Statement of Commitments is contained in Section 8 of this report.

4.2 ALTERNATIVES & PROJECT JUSTIFICATION

Redlake Enterprises, on behalf of WesTrac, have searched for more than two years for an appropriate location for its operations. The subject site was determined as being the most suitable of those investigated, having regard to the following attributes:

- The site is zoned for industrial purposes, permitting the proposed use;
- The site is recognised as being of strategic importance in the Lower Hunter Regional Strategy for the provision of jobs;
- The site is located with good access to the port of Newcastle. This is important to the proposed development in regard to the importation of parts;
- The site is close to its primary customer base, being mining companies operating in the Hunter Valley;

- The site is located in close proximity to Newcastle Airport allowing for staff travel between the Tomago Headquarters and other branches, including Perth. (This is particularly important with regard to travel by apprentices between the Cat Institute proposed here, and that in Perth, as each facility offers a different range of training);

- The site area is suitable to the proposed development, and allows for the future establishment of related uses ensuring the development of appropriate synergies; and

- With good management practices the site has few physical or environmental constraints to development.

Many other sites considered for the proposed development had few of the attributes the subject site has. The long search by Redlake Enterprises and their commitment to an extensive due diligence process is strong evidence that there are no real viable alternatives.

The proposed development, with an estimated value of $130,000,000, will provide opportunities for the employment of 300 – 400 people as part of the WesTrac operations, and 400 - 600 during construction, represents a significant positive economic outcome for the region. In addition, substantial employment opportunities will result from the future establishment of industry within the proposed industrial subdivision.

The need for WesTrac to establish a central NSW Headquarters as quickly as possible is vital. The company's ability to continue to meet the demands of its existing clientele, and ensure future growth are threatened by any delays to the establishment of the facility.

In summary, it is considered that given the appropriate land-use zoning, the strategic planning objectives of the Lower Hunter Regional Strategy, combined with the manageable physical and environmental constraints, and taking account of significant employment opportunities and investment, the proposed development is well justified. In particular, it should be noted there is no realistic alternative that offers the attributes of this site.



SUBDIVISION MASTERPLAN - ALL STAGES

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REV	DATE	COMMENTS	DRN	CHKD
A	12.12.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
B	18.12.07	ISSUE FOR INCLUSION IN OVERVIEW DESIGN DOCUMENT	JPC	BJC
C	14.01.08	ISSUE FOR CLIENT CO-ORDINATION	JPC	BJC
D	07.03.08	ISSUE FOR CLIENT SIGN-OFF	JPC	BJC

CLIENT:	REDLAKE ENTERPRISES, LVL 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
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STRUCTURAL:	
LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

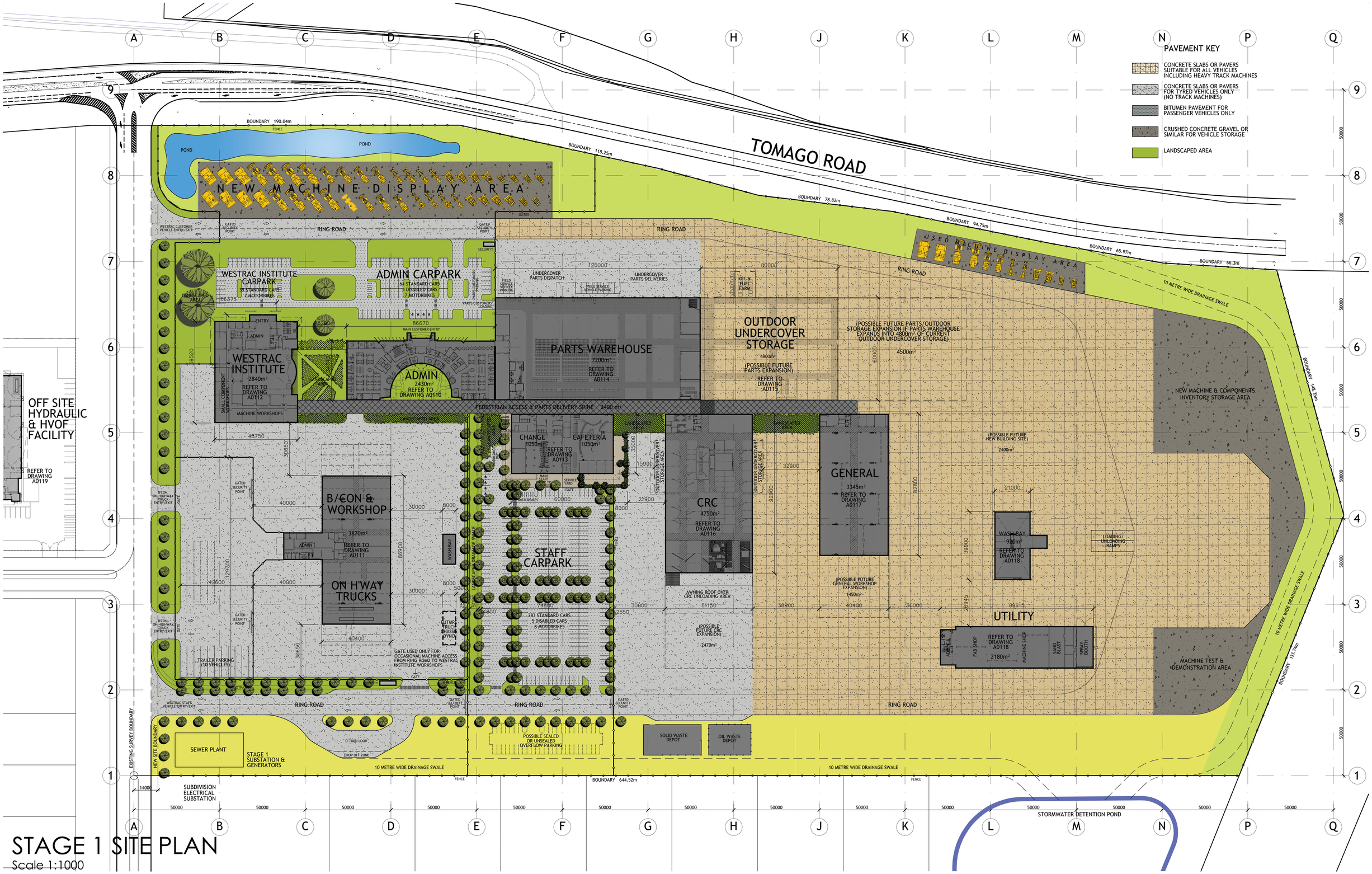
DRAWING :
SUBDIVISION MASTERPLAN - ALL STAGES

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WORK IN FIGURED DIMENSIONS IN PREFFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMPLETION OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

DRAWN :	DATE :	SCALES :
JPC	DEC 07	1:2500

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	CC	A1001	D



STAGE 1 SITE PLAN

Scale 1:1000

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REV	DATE	COMMENTS	DRN	CHKD
B	13.08.07	UPDATED MASTERPLAN FOR CLIENT COMMENT	RJD	BJC
C	21.08.07	UPDATED MASTERPLAN FOR CLIENT COMMENT	GCS	BJC
D	21.08.07	UPDATED MASTERPLAN FOR CLIENT COMMENT	GCS	BJC
E	06.09.07	GENERAL REVISION FOR REVIEW	JPC	KMG
F	24.09.07	ISSUE FOR CLIENT APPROVAL	JPC	KMG
G	06.11.07	GENERAL REVISION FOR REVIEW	JPC	KMG
H	13.11.07	ISSUE FOR CO-ORDINATION	JPC	BJC
J	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
K	19.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
L	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
M	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

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REDLAKE ENTERPRISES PTY. LIMITED
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WesTrac CAT

PROJECT :
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WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

DRAWING :
STAGE 1
SITE PLAN

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PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0102	M

Section 5
Planning & Related Statutory Provisions

The site and proposed development will be subject to a range of planning and related legislation and controls across local, regional, state and Commonwealth level. The following is an overview of those relevant to the proposed development.

5.1 LOCAL

The site is a State Significant Site zoned IN1 General Industrial under the Major Projects SEPP. The Port Stephens Local Environmental Plan is no longer applicable in terms of the site zoning.

The Major Projects SEPP confirms that the only other Environmental Planning Instruments that will apply to the proposed development are other SEPPs, where relevant.

5.2 REGIONAL

As previously identified, the site is included as 'Employment Land' under the Lower Hunter Regional Strategy. This Strategy is a document outlining the forward planning objectives for 2006-31. The proposed development is entirely consistent with the Hunter Strategy objectives to provide for employment opportunities.

The site is also covered by the Hunter Regional Environmental Plan, and the proposed development is consistent with the general principles of ensuring adequate provision of industrial lands, creation of employment opportunities and a sustainable economy.

In accordance with the Major Projects SEPP we note that the regional plans do not specifically apply. Notwithstanding this we have reviewed them and determined that the proposal will be consistent with their broad strategic aims.

5.3 STATE

5.3.1 EP & A Act

The Environmental Planning & Assessment Act 1979 is the primary planning legislation in NSW. Among other things, it sets out the process

for the assessment of development proposals such as that proposed by Redlake.

The proposed development is a Major Project, to which Part 3A of the Act applies. This means that the Minister will determine the proposed development following an assessment of the application by the Director General of the Department of Planning.

A review of all State Environmental Planning Policies (SEPPs) reveals that the following are of particular relevance to the proposed development:

5.3.2 SEPP 11 Traffic Generating Development

A referral to the RTA will be required under this SEPP, relative to the proposed development. The RTA will assess the proposal in terms of impacts on access from Tomago Road, and in terms of traffic volumes and the resultant impacts on Tomago Road.

RTA approval will be required for all works within Tomago Road, in particular the proposed intersection.

5.3.3 SEPP 33 Hazardous and Offensive Development

As previously indicated, paints, lubricants, oils, fuel and a range of other products will be stored on-site. The quantities to be stored will not trigger the requirements of the SEPP, particularly noting the likely distances to boundaries. This issue is addressed in more detail later in this report.

5.3.4 SEPP 55 Remediation of Land

This SEPP outlines the procedures for remediation of contaminated land. It is unlikely that this SEPP will be triggered.

5.3.5 SEPP 71 Coastal Protection

The overall aim of this SEPP is to protect the NSW Coastline. The site is located within the coastal zone and so consideration will need to be given to the matters contained within the SEPP.

5.3.6 SEPP Major Projects

As previously indicated, the site is a State Significant Site under the Major Projects SEPP. Accordingly, given that the value of the development far exceeds 5 million dollars, it will be a project determined by the Minister under Part 3A of the Act.

Amendment 15 to the SEPP outlines the pertinent planning controls for the Tomago Industrial Site. The site is zoned IN1 General Industrial and the following zone objectives apply:

(a) to provide for a wide range of industrial, warehouse and related land uses;

(b) to provide suitable areas for those industries that need to be separated from other land uses;

(c) to encourage employment opportunities;

(d) to minimize the adverse effect of industry on other land uses and the environment; and

(e) to enable other land uses that provide facilities or services to meet the day to day needs of workers in the area.

The proposed development is considered to be consistent with all of the above objectives, subject to careful management of environmental issues.

The proposed development is considered to be a permissible land use within the zone noting in particular that the following are permitted:

> *"…depots, drainage, earthworks, educational establishments, fill, heavy industries, light industries, office premises, signage, truck depots, vehicle body repair workshop, vehicle repair stations, warehouses or distribution centres…"*

5.3.7 NSW Threatened Species Conservation Act 1995

An ecological survey of sites is required to determine if a development proposal will have a significant effect on threatened species, threatened populations or endangered ecological communities. This has been completed, and is discussed in more detail as part of the Environmental Assessment.

5.3.8 Hunter Water (Special Areas) Regulation 2003

This Act applies to the site because it lies partly over the Tomago sandbeds (which provide potable water). The regulation applies controls over agriculture, sewage disposal and pollution. It will be necessary to ensure that water conveyed from the site to the sand beds is not contaminated. It will also be necessary to ensure that water is recharged to the acquifer running across the front of the site as a result of any water loss from the proposed impervious surface.

5.3.9 NSW Roads Act 1993

Part of the land is identified for road widening. Processes for widening are controlled by the Roads Act. Other works within the roadway will also require approval under this Act. The Road & Traffic Authority is the responsible authority. The proposed site intersection will require approval from the RTA.

5.3.10 Protection of the Environment Operations Act 1997

The purpose of this Act is to control pollution and set up a licence regime. The Department of Environment and Climate Change have confirmed that no licence will be required for the proposed development.

5.3.11 Contamination Land Management Act 1997

This Act requires that the EPA be notified of contamination likely to be of "significant risk of harm". It is considered on the basis of the work completed that the site will not classify as being of significant risk of harm.

5.3.12 National Parks and Wildlife Act 1974

This Act applies to adjoining land owned and managed by NPWS. The Act also has controls that apply to aboriginal relics and sites. The minister can issue stop work orders in relation to an action that may detrimentally affect an aboriginal object or place. Relics have been found on site, however it has been determined that the finds do not significantly contribute to the understanding of Aboriginal culture. Approval under the Act would normally be required for relics to be destroyed (Section 90). It should be noted that because the proposal is a matter to be dealt with by the Minister under Part 3A of the EP&A Act then Section 90 approval is not required. The LALC have been consulted, and have indicated that they want the opportunity to collect the relics before construction commences, but have otherwise agreed that the find is of limited significance.

5.3.13 Rural Fires Act 1997

Under this Act, the owner or occupier of land is obliged to take practicable steps to prevent the occurrence and spread of bushfires on their land.

The site is located within bushfire prone land, however, given the nature of the proposed development, the fact that the site is in fact substantially cleared, and considering the materials to be used in construction, it is not believed that there is any substantial threat from bushfire.

A Bushfire Safety Authority will not be required, having regard to the operation of Part 3A of the Environmental Planning & Assessment Act.

5.4 COMMONWEALTH

The EPBC Act 1999 requires consideration of the following:

- Actions that have a significant impact on matters of national environmental significance;
- Actions that have a significant impact on Commonwealth land; and
- Actions carried out by the Commonwealth.

The proposed development has been referred to the Commonwealth Department of the Environment & Water Resources. The referral has determined that the proposal is a 'controlled action' requiring assessment and approval. The proposal will be assessed under bi-lateral arrangements between the Commonwealth and the NSW Government through the Part 3A process. Attached at **Appendix I** is a copy of the required assessment addressing the Schedule 4 requirements of the EPBC Regulations 2000.

Section 6
Stakeholder Consultation

As part of the due diligence process relative to the purchase of the site, a Steering Committee was established to ensure all issues were fully understood, and to ensure agencies were kept informed of the progress of the development proposal. The Committee met generally on a monthly basis, over a period of approximately a year. The Steering Committee included the following representatives:

- Regional Land Management Council;
- Department of State & Regional Development;
- Department of Planning;
- Port Stephens Council;
- Energy Australia;
- Hunter Water Corporation;
- Department of Environment & Conservation; and
- Roads and Traffic Authority.

In addition to the above, consultation has also taken place with the LALC, Newcastle Ports Authority, Department of Agriculture, Fisheries Department, Mine Subsidence Board, Department of Primary Industry and National Parks & Wildlife Service.

Further, we note that the Department has written to the relevant agencies, providing a copy of the Preliminary Environmental Assessment.

The comments provided to the Department of Planning by the relevant authorities and forwarded with the Director General Requirements are consistent with the comments made by those authorities as part of the Steering Committee meetings. These will not be included again here.

The opportunity for the community to participate in such consultation will of course be available through the usual public exhibition process.

Section 7
Assessment of Environmental Impacts

7.1 DISCUSSION OF RELEVANT LEGISLATION

An overview of legislation has been presented in Section 5 of this report. The following, however, addresses specific aspects of the legislation where required.

As previously referenced, the proposed development is permissible within the industrial zoning applying to the land, and is consistent with the Lower Hunter Regional Environmental Plan, which identifies the site for employment lands.

A table assessing the Director General Requirements is located at **Appendix B.**

The required EPBC Assessment has been completed and is attached at **Appendix I**.

SEPP 11 Traffic Generating Development, and the Roads Act will require the involvement of the RTA in terms of traffic assessment and approval of the proposed intersection off Tomago Road. A traffic report has been prepared to address these issues, together with the parking requirements of the development. This is discussed under a separate heading of this report.

SEPP 33 Hazards have been considered under a separate heading later in this section.

SEPP 71 Coastal Protection-Development within the Coastal Zone must consider Clause 8, Matters of Consideration. The following points address these matters:

(a) The aims of this Policy set out in clause 2.

The proposed development is consistent with the aims of the Policy which are generally to protect and manage the natural, cultural, recreational and economic attributes, vegetation and visual amenity of the NSW Coast as it applies to the site.

(b) Existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and,

where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved.

The proposal is consistent with the aims of this policy, any existing public access will not be impeded by the proposed development.

(c) Opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability.

The proposal is consistent with the aims of this policy. The site is not strategically located to provide additional access points to the coastal foreshore.

(d) The suitability of development given its type, location and design and its relationship with the surrounding area.

It is considered that the site is suitable for the proposed development, and that this suitability is evident from the assessment presented in this report. The proposed development is consistent with the strategic planning for the locality, providing employment opportunities as envisaged by the Lower Hunter Regional Environmental Plan, and is consistent with the industrial zoning of the site. The proposal is consistent with the established industrial development in the locality, and the proposed future character of the area.

(e) Any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore.

The proposed development does not impact on the coastal foreshore amenity.

(f) The scenic qualities of the New South Wales coast, and means to protect and improve these qualities.

The proposal is consistent with the aims of this policy.

(g) Measures to conserve animals (within the meaning of the *Threatened Species Conservation Act 1995*) and plants (within the meaning of that Act), and their habitats.

The proposal is consistent with the aims of this policy. A Flora and Fauna assessment has been undertaken and is presented separately in this report.

(h) Measures to conserve fish (within the meaning of Part 7A of the *Fisheries Management Act 1994*) and marine vegetation (within the meaning of that Part), and their habitats

The proposal is consistent with the aims of this policy, having no impact.

(i) Existing wildlife corridors and the impact of development on these corridors,

The proposal is consistent with the aims of this policy and does not impact on any corridor.

(j) The likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards,

The proposal is consistent with the aims of this policy. The proposal is not subject to any likely coastal processes. The impact of flooding is discussed separately in this report.

(k) Measures to reduce the potential for conflict between land-based and water-based coastal activities.

The proposal is consistent with the aims of this policy and does not result in any conflict between land or water based activities.

(l) Measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals.

The proposal is consistent with the aims of this policy. An Aboriginal Archaeological assessment has been made, and is presented separately in this report. The LALC have concurred with the recommendations of the report.

(m) Likely impacts of development on the water quality of coastal waterbodies.

This matter is addressed separately in this report. Measures are proposed to protect water quality, noting the important RAMSAR and SEPP 14 wetlands nearby.

(n) The conservation and preservation of items of heritage, archaeological or historic significance.

The proposal is consistent with the aims of this policy. There are no items other than those referenced relative to Aboriginal Archaeology.

(o) Only in cases in which a council prepares a draft local environmental plan that applies to land to which this Policy applies, the means to encourage compact towns and cities.

The proposal is not the subject of consideration under this clause.

(p) Only in cases in which a development application in relation to proposed development is determined:

(i) The cumulative impacts of the proposed development on the environment.

The proposed development will have an insignificant cumulative impact on the environment given that it can be

demonstrated how each issue of the proposal will be adequately managed.

(ii) Measures to ensure that water and energy usage by the proposed development is efficient.

This matter is addressed later in this report. Water capture and re-use, and energy efficiency and security of supply have been important considerations in designing the proposed development.

The NSW Threatened Species and Conservation Act has been addressed as part of the Flora and Fauna assessment discussed hereunder.

The need to consider the Hunter Water Special Area Regulation in terms of ensuring no adverse impacts is discussed separately in this report.

7.2 FLORA, FAUNA & ECOLOGICAL

The subject site has a history of grazing, and so is substantially cleared of any vegetation other than pasture grasses. The land has been modified over time with a series of man-made drains which convey water from the site to the wetlands at the rear, a reflection of the use of the site for the grazing of cattle.

A detailed assessment of flora and fauna has been made by Ecobiological, and a copy of their report is located at **Appendix J**.

Field surveys conducted by Ecobiological identified the following threatened fauna on site:

- Eastern Freetail Bat (Mormopterus norfolkensis)
- Greater Broad-nosed Bat (Scoteanax rueppellii)
- Little Bent-wing Bat (miniopterus australis)
- Grey Headed Flying Fox (Pteropus poliocephalus)
- Grass Owl (Tyto capensis)
- Wallum Froglet (crinia tinnula)

The proposed development will result in the loss of a relatively small amount of habitat for these species, and the detailed report by Ecobiological concludes that the proposed development will have no significant impact on their communities.

Field surveys conducted by Ecobiological identified two endangered ecological communities on part of the site, being the Swamp Oak Floodplain Forest on the NSW North Coast, Sydney Basin and South East Corner Bioregion and Salt Marsh on the NSW North Coast, Sydney Basin and South East Corner Bioregion. The detailed report included in the

Appendix to the Environmental Assessment Report concludes that the proposed development will have no significant impact on this community.

In addition to the above, it was concluded that the following fauna could be found to use the subject site under the right conditions at various times through the year:

- Australasian Bittern (Botaurus poiciloptilis);
- Black-necked Stork (Ephippiorhynchus asiaticus);
- Black Bittern (Ixobrychus flavicollis);
- Masked Owl (Tyto novaehollandiae);
- Large Footed Myotis (Myotis adversus); and
- Eastern Bent Wing Bat (Miniopterus schreibersii oceanensis).

The detailed report by Ecobiological concludes with reference to the Threatened Species Conservation Act that the proposed development will have no significant impact on these species' use of the site.

The report by Ecobiological identifies the potential for impact of development on the adjoining wetlands including those of which are recognised by SEPP 14 or RAMSAR. The potential for impacts is from contaminated stormwater entering the wetlands, be it from the operations on-site or from the composition of the proposed fill material. There was also the possibility of an altered water flow regime from the site to the wetland.

Redlake Enterprises has adopted a conservative approach to the issue, selecting quality fill material of a neutral ph (fill material will be sand or rock derived from approved local sources). In addition, careful site planning has been carried out to ensure that the flow of water to the wetland from the site is not altered such that it could have an impact on the supply of water to the wetland. In addition, an extensive system has been established to treat water before it is allowed to flow from the site to the wetland. Detailed discussion on the issue of water quality is presented separately in this report (see Concept Engineering, Servicing and Stormwater Management Report at **Appendix F**).

The report by Ecobiological makes a number of recommendations for the monitoring of water quality to ensure on going maintenance of water quality measures and it is proposed to adopt these in full.

The proposed development is a controlled action under the Environment Protection and Biodiversity Conservation Act and an assessment of the proposed development as required is presented in **Appendix I** of this report. It can be concluded from the assessment that the proposed development with proposed environmental controls will have no significant impact on the adjoining RAMSAR wetland.

With the removal of grazing from the site, and the establishment of a proper stormwater treatment system and water quality management and monitoring system, improvement on the current quality of water flow can be expected. Indeed the proposed water quality measures will ensure no negative impact from the proposed development on the receiving environment.

The hydrology modelling undertaken for the proposed development establishes that there is no significant change between existing and post development simulations, that would result in any impact on the wetlands adjacent during the peak 100 year recurrence flood event for the Hunter River. Since it has been demonstrated that there are no issues during this peak event, that is an extreme rare event, it is concluded that there are no additional impacts from flood flows relating to the wetlands from existing to post development scenarios.

In addition, there is no alteration to hydrology, discharge flow regime and velocity and consequently no impact from stormwater discharge from the site during smaller, regular locationed storm events and daily conditions experienced at the adjacent wetlands, post development.

Advice from Spectrum Acoustics located at **Appendix O** shows that noise levels from the Stage 1 WesTrac operations will be below existing background levels at the wetlands. Accordingly there will be no impact on flora and fauna.

Noise levels from future users within the proposed industrial subdivision are also unlikely to have an impact based on the advice provided by Spectrum Acoustics. In addition, there is significant opportunity to manage future uses and noise impact to ensure this is the case. It is noted that future development will require approval and will be the subject of individual acoustic assessment at that time.

Light source from the WesTrac facility will have no significant impact on flora/fauna within the wetland given the distance from the rear stage 1 boundary to the wetland. However, notwithstanding this, it is proposed to prepare a Light Management Plan to address positioning of lighting, direction and shielding to prevent direct light toward the Wetland area.

Lighting from future users within the proposed industrial subdivision could also be managed through implementation of a Lighting Management Plan and accordingly have no significant impact on flora/fauna within the wetland.

Notwithstanding that it is considered the proposed development could occur to the boundaries where it adjoins the wetland at the South West corner without significant impact, a setback ranging between approximately 40m and 200m has been provided as a buffer. This is shown on the overall layout plan and engineering drawings.

The development of the subject land for industrial purposes was anticipated as part of the rezoning of the site from rural to industrial. Some 240 hectares of land zoned for agricultural use was set aside for conservation purposes. The area shaded green in Figure 7 of this report is the relevant area for conservation. This offset was the subject of a formal Memorandum of Understanding between Landholder, Minister for the Environment and the Minister for Planning.

7.3 TRAFFIC, ACCESS & PARKING

Traffic associated with the proposed development will result from three predominate sources at three different 'stages', including filling of the site, WesTrac operations when established on site, and other users as they are established within the proposed industrial subdivision. A traffic report has been prepared by Mark Waugh Pty Ltd and is included at **Appendix G**.

Filling of the site will be carried out by truck & dog, travelling to and from fill sources generally within a half hour travel distance. Filling will be carried out in a staged manner with stage 1 being to allow occupation of the site by WesTrac. A traffic management plan addressing construction traffic has been completed and included at **Appendix G.**

WesTrac operations will generate traffic associated with staff and visitor movements, delivery of parts to and from site, delivery of equipment (large scale low loaders as well as smaller machines) to and from site as well as from field maintenance crews. The delivery of large machinery requires careful consideration, and will generate the need for transporters from time to time counter flow over the north arm of the Hexham Bridge. As this can only be done at night, this will in turn necessitate the need to light Tomago Road to comply with road safety requirements. Accurate numbers of oversized vehicle movements to and from the site are difficult to provide, and will vary with demand. One movement in and one movement out per week may be a reasonable average. Given that these vehicles will be moved at night, when traffic levels are significantly reduced, it is considered that it is not so much a traffic impact issue but a traffic management issue. It will be necessary to comply with the requirements of the RTA for the movement of such loads and it is intended to do so.

As part of the current proposal, it is intended to construct an intersection off Tomago Road for site access. This intersection will be the primary site access to all future development on the whole of the site, and so will be sized accordingly. In order to allow construction of this intersection at the same time as filling operations it will likely be necessary to establish a temporary access, ensuring that trucks carrying fill are kept clear of these works. The intersection will be complete, however, before occupation of the site by WesTrac.

A small part of the site located to the West is earmarked for road widening and the proposed development is not affected by it and vice versa (the road widening is shown in Figure 5).

Given the relatively isolated location of the site from sensitive land uses it is not expected that traffic associated with filling or the future use of the site by WesTrac and future industry will have a significant adverse impact on the amenity of the area.

The traffic report by Mark Waugh Pty Ltd located at **Appendix G** concludes:

- Forecast traffic flows based on standard RTA guidelines for traffic generating developments indicate that the proposed development can be accommodated on the existing road network.

- The sensitivity of the traffic forecasts to the level of background growth assumed, as required by the RTA in considering future flow conditions can affect the timing of possible upgrading being required.

- The site and its operations are able to utilise the existing arterial road system through application of the RTA procedures for transporting over-dimension loads. This includes possibly the necessity to light sections of Tomago Road to allow oversize transport at night along the single carriageway to the Pacific Highway.

- Forecast traffic flows based on standard RTA guidelines for traffic generating developments indicate that the proposed seagull priority controlled intersection has adequate capacity to cater for the future flows associated with the proposed development.

The site layout has been specifically designed to provide the safest traffic and pedestrian environment possible. This has been achieved by an effective separation of light and heavy vehicle traffic and separation of vehicle traffic from pedestrians. This is evident on the plans submitted with the project application.

Having regard to the large footprint of buildings, including buildings whose use will not generate demand for parking, (such as the proposed canteen), it is considered inappropriate to assess the required car-parking for the development based on a rate per square metre. In accordance with the RTA Guidelines it is considered that a merit consideration of the parking based on the actual demand for parking is a reasonable response. A typical rate for parking in this regard can be assessed at 0.8 car spaces per employee. In this case using the likely maximum number of employees at 400 a parking requirement of 320 parking spaces is derived. In addition to this it is possible that a maximum of 40 people would be

attending the WesTrac Institute at any one time. Applying a similar rate of 0.8 spaces per car derives a parking demand for this facility of 32 spaces (it is quite likely however that the WesTrac Institute would generate an average demand less than this given that employees will also be on-site working and then leave work to attend the institute on the same site, so generating no additional parking demand). Accordingly the maximum WesTrac operations and WesTrac Institute parking demand by staff is expected to be 352 spaces. The proposed development actually has provision for 391 parking spaces and 22 motorbike parking spaces and so easily caters for this requirement, leaving a substantial allowance for any casual visitors to the site. The size of the site provides opportunity to informally address any growth or unusual demand for parking beyond that estimated. The lack of parking opportunity on Tomago Road and the distance from the road to the on-site facilities will be a very effective deterrent to street parking.

Incidental parking associated with loading and unloading, machinery repairs and the collection of parts etc can be comfortably met around the site as required.

7.4 FLOODING

As described previously, the site is subject to inundation by regional floods from the Hunter River. Filling of the site is necessary for development of both the subdivision and WesTrac facility. Patterson Britton & Partners were engaged to assess the flood impact of filling of the overall site.

Flood behavior along the Lower Hunter River has been previously defined by Mike 11, 1 Dimensional flood model in 1994. Since this time, flood modelling tools have significantly improved for the modelling of complex systems. Patterson Britton has used a 2 Dimensional model of the Hunter River and its floodplain to assess the flood impact. The 2D model has greater discretisation and the complexity to more accurately predict flood modeling simulation. Initially, prior to simulating any fill on the site, results from the 2D model were verified against the Mike 11 results and a high level of concurrence was reached for the existing simulation. The results of the modelling show that the peak 100 year recurrence flood is predicted to vary between 2.29m AHD at the western boundary of the site and 2.14m AHD near the eastern boundary of the site.

The model was then modified to reflect the filling of the overall site and simulated to determine flood impact. The maximum increase in peak level, assuming no inundation of the developed site by the peak 100 year recurrence flood level, is 120mm. This occurs immediately west of the proposed filling and development site. Increases in peak flood level in areas outside the RLMC land holding are less than 20mm. The proposed filling is not predicted to increase the provisional flood hazard across land where residential or industrial development currently exists. It is

considered that the potential flood impacts associated with the proposed development of the land are acceptable and will not manifest as significant adverse impacts on adjoining properties.

A copy of the flooding report is located at **Appendix K**.

7.5 VISUAL, AESTHETICS & LANDSCAPING

Terras Landscape Architects have carried out a Visual Impact Analysis of the proposed built form and their report is located at **Appendix L**.

The site has a small viewing catchment and the impact of development is therefore very localised. In addition the site is not prominently located on a ridge line or part of any other significant natural feature that requires preservation. The zoning of the land for industrial purposes is a reflection that a built form outcome for the site is appropriate. In addition development of the site will contribute to the existing variety of built form and typology of uses along Tomago Road.

Notwithstanding that the site is not visually prominent located it is considered appropriate for the proposed development to be enhanced through the incorporation of landscaping. It should be noted that the site currently offers little in the way of landscape presentation to Tomago Road.

Terras Landscape Architects have prepared a landscape plan and this has been included with the submitted plans and located together with a landscape report also at **Appendix L**. The objectives of the Landscape treatment of the site are as follows:

- To create a landscape buffer to the east and south of the site. This will be done using endemic plant species. Trees have been selected for their high and low canopies which will provide a dense vegetation screen between the development and neighbouring properties.

- The front entry carpark and landscaping around Administration and WesTrac Institute buildings will be manicured, with large specimen trees, formal avenues of tall Eucalypts, lawn areas and mass planted gardens.

- The staff carparks will be planted with a mixture of native evergreen trees and exotic deciduous trees to provide plentiful shade. Hedging plants along the perimeters will break views into surrounding areas of hardstand.

- Landscaping on the western boundary along the entry road will consist of an avenue of tall Eucalypts, screen planting along the fence line of Casuarina glauca and tall shrub species.

- A 3.5 metre acoustic fence made of timber will be constructed in the north eastern corner of the site to alleviate noise concerns.

- To provide attractive outdoor areas for staff and visitors that will be utilised for dining, relaxation and passive recreation.

The report by Terras advises that with these landscape treatments in place an attractive and functional landscape will be produced, addressing screening issues while allowing for corporate identity, and providing attractive outdoor areas for staff and visitors to enjoy, as well as shading car parks and enhancing the proposed buildings.

7.6 GEOTECHNICAL

Coffey Geotechnics has undertaken extensive subsurface testing of the site. This was initially commenced as part of the Due Diligence assessment undertaken prior to Redlake Enterprises Pty Limited purchasing the site. The knowledge gained from this testing has been used to devise a strategy for bulk earthworks and filling of the site for development use.

Topographically, the site comprises a low dunal formation up to 8.5m AHD in the northern eastern corner of the site, and a flat, low lying alluvial plain at an elevation of 0.1-1.5m AHD over the remainder of the site. These topographical features reflect two (2) distinctly different soil profiles through the site. The first soil type is the aeolian dunal sands that are part of the Tomago Sandbeds, covered by the Special Area zone boundary. The second soil profile is the alluvial clays and estuarine soil types associated with the floodplains of the Hunter River. These are waterlogged clays, downstream of the Special Area draining to the Hunter River.

In summary, from Section 6.3 of Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007, located in **Appendix M**, it is described that site preparation will involve removal of all shrubs and trees, including the major root bulbs; slashing, and removal of slashings by raking. Stripping of grasses and topsoil will not be undertaken, since this will assist to bridge across the underlying saturated clays. Geotextile fabric will be used for bridging within existing open drains, wherever there is no grass root mat or where the site has become boggy during stripping.

The clays over the low lying areas of the site will be susceptible to creep settlement under development load. To complete the majority of settlements as rapidly as possible prior to development commencement, preloading will be undertaken, by stockpiling material as a surcharge load over the underlying clays. The surcharge fill load placed will be equivalent to the development load. Preloading is to increase settlement rates for faster consolidation of the underlying soils. The surcharge fill

heights are dependent on the depth of clays, which is variable over the site. It is most likely also, that the preload process will be expedited by the installation of wick drains. Refer to Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007 in **Appendix M**.

Geotechnical advice has been provided on the fill type, directing that granular material with particles not greater than 100mm diameter is preferred for use on the site. In particular, no ash is to be used for filling; due to its leachate potential. The fill to be used must be pH neutral, and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. This will mitigate any potential impacts of runoff from the fill to the wetlands. Further conditions on the specification of the fill import material have been described in Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007, included in this report as **Appendix M**.

During the Due Diligence assessment process, suitable fill sources were located as follows:

- Hard Rock Quarries

  -Boral Seaham.

  -Hunter Quarries.

  -Hanson Quarries.

- Sands

  -Toll Sands.

  - Anna Bay Sands.

- Mine Overburden.

All sources are subject to geotechnical approval for use, prior to commencement of fill operations. This is not an exhaustive list, being determined for the purpose of Due Diligence only.

7.7 ACID SULPHATE SOILS & CONTAMINATION

7.7.1 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are soils which contain high concentrations of pyrite, which, in the presence of sufficient moisture, oxidises, resulting in the generation of sulphuric acid.

Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed, the oxidation of pyrite occurs and sulphuric acids are generated, the soils are said to be actual ASS.

Pyritic soils typically form as waterlogged, saline sediments rich in iron and sulphate. Typically, the environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (ie: 10,000 years ago) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (ie: >10,000 years ago) would already have oxidised and leached during periods of low sea level during ice ages, which exposed pyritic coastal sediments to oxygen.

Disturbance, or poorly managed development and use of acid sulphate soils can generate significant amounts of sulphuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth, and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters can have a detrimental effect on further aquatic ecosystems.

Reference to the Acid Sulphate Soils Risk Map for Beresfield/Williamtown indicates that the site is located near the boundary between an area where there is a low probability of occurrence of acid sulphate soil materials greater than 3 m below the ground surface, and an area where there is a high probability of acid sulphate soil materials between 1m and 3m below the ground surface.

Coffey Geotechnics have conducted screening test for Stage 1 and the results are contained within their report attached at **Appendix M**. The following conclusions have been reached:

> *"Based on the results of screening tests and SCR Suite analysis presented in Appendix B, it is considered that the majority of alluvial soils encountered below about RL 1.5m*

AHD are potential acid sulphate soils, and aeolian sands encountered above the proposed site finished level of about RL 2.5m AHD are not actual or potential ASS."

The results are considered typical for the locality and the same conclusions can be drawn relative to the land for industrial subdivision.

As previously advised the significant depth of fill proposed in order to provide a development above the flood level will leave the soils that are likely to contain acid sulphate relatively undisturbed, with the exception of potential service trenching. In this situation it will be necessary to treat the soils in accordance with the advice of a geotechnical engineer, and it may be necessary to have prepared an acid sulphate soils management plan.

The methods for treating acid sulphate soils are well understood, and it is not expected that their presence will be a significant problem to the development of the site.

7.7.2 Contamination

Coffey Geotechnics have also carried out a Preliminary Site Contamination Assessment in respect of the whole site, and a copy of their report is attached at **Appendix N**.

The following site history is from the Coffey report.

- Based on aerial photographs and title records, it is considered that the four lots were most likely used for residential/agricultural purposes between the late 1800's and the 1970's. The nature of the agricultural use of the land is not clear, however there is some evidence of crops in the aerial photographs viewed during this period. Anecdotal evidence from a local resident indicates that the properties have previously been used for turf farming.

- Historic title information indicates that portions of the site were owned by Tomago Aluminium for a number of years between 1983 and 2003. Aerial Photographs do not indicate that any large scale industrial works were undertaken at the site during this period. Anecdotal evidence from a local resident indicates that the properties were used by Tomago Aluminium as a buffer zone.

- Historic title information indicates that portions of the site were owned by a private landholder with an occupation listed as service station proprietor. No evidence of a service station ever having operated at the site was identified in the Workcover NSW Dangerous Goods records, aerial photographs or a walk over of the site.

- Fill material of an unknown source and contamination status was observed to the south east of Lot 1 DP 597372, as well as within an unsealed roadway running through Lot 1 DP 1003492.

- Potentially fibre cement containing asbestos material was observed in the vicinity of an abandoned shed located within the north western corner of Lot 1 DP 1003492, as well as within the vicinity of a former building located upon the peak of the sand dune within the northern corner of Lot 161 DP 774440 (this is within the stage 1 area and an approved asbestos remover has collected and disposed of the material from the peak).

- The NSW DECC has no notices for any of the properties comprising the site or the surrounding properties under the Contaminated Land Management Act (1997).

- The site is within 2km of the Tomago Aluminium Smelter, and as such the site may have been subject to contamination associated with atmospheric fallout from the smelter, given that the prevailing wind is frequently from the smelter towards the site.

In consideration of the above Coffey's advise the following:

The site history review revealed that contamination could potentially have been introduced to the site through:

- Atmospheric fallout of contamination from nearby Tomago Aluminium Smelter;

- Importation of contaminated fill material;

- Leaching or weathering of zinc, lead or asbestos from current/former buildings and structures; and

- Application of pesticides during use for agricultural purposes.

Sampling and laboratory analysis were undertaken to make a preliminary assessment of the presence of soil contamination associated with the potential contaminating sources.

Based on the findings of the investigation presented above, the following conclusions are made:

- The potential for widespread soil contamination associated with atmospheric fallout from the nearby Tomago Aluminium Smelter to be present at the site is low;

- The potential for widespread contamination, at concentrations exceeding the site investigation criteria, to be present in fill material

at the site is low. However, it is noted that the number of samples collected relative to the volume of fill observed to be present at the site is low, and as such the potential for contaminated fill material to be present at the site cannot be precluded;

- Asbestos cement fragments were found in surface soils in the vicinity of an abandoned shed located in the north western portion of Lot 1 DP1003492 (numerous fragments) as well as in the vicinity of a former building located upon the peak of the dune in the northern portion of Lot 161 DP 774444 (one fragment). Asbestos fibres were not detected in soil samples collected near where the asbestos cement fragments were found. With the exception of the identified asbestos contamination, the potential for widespread contamination, associated with the weathering of building materials, to be present at the site is low; and

- The potential for widespread soil contamination, associated with the application of pesticides, to be present at the site is low.

7.8 ACOUSTIC

As previously outlined, the subject site is well-located for industrial development, being separated from any significant residential areas and within proximity of existing industry.

There are, however, a number of residences located on large rural lots adjoining to the east, and a small number of dwellings to the north, that require consideration in terms of potential from noise impacts associated with the proposed development. Potential impact on fauna within the wetland should also be considered.

An acoustic assessment of the proposed development has been undertaken by Spectrum Acoustics, addressing the potential impacts, and a copy of the report is attached at **Appendix O**. The detailed analysis has measured existing background noise levels and determined noise outputs for the proposed development. The report concludes that the proposed development will have no significant adverse impact. The report recommends the inclusion of a 3.5 metre high acoustic fence located at the north east corner of the site. The fence is required to allow night time operations within the rear yard of the site without adverse impact to the neighbouring property.

Potential impact on fauna within the wetland has been addressed under Section 7.2 of this report.

Construction and land-filling operations have also been considered as part of the analysis, and it has been determined that the likely noise impacts are within acceptable limits.

Assessment of acoustic impacts from specific future occupants of lots within the proposed industrial subdivision will have to be undertaken at the appropriate time, when development applications are submitted. Notwithstanding this, the acoustic report has considered the likely noise emissions from these future stages in general terms, and determined that the proposed development of the site for industry is not an inappropriate use.

7.9 AIR QUALITY

The proposed development is not a heavy polluting industry and does not require a licence from the Department of Environment & Climate Change.

Emissions or potential emissions to air have been identified and are discussed hereunder.

Vehicle & Machinery

Emissions to air from vehicles and machinery will comply with the relevant vehicle standards. The finished site topography will ensure that no excessive engine use is required. All vehicles and machinery will be regularly maintained to ensure proper and efficient working order and thereby minimise emissions.

Given the large nature of the development site, the large distances to nearest dwellings, and the lack of dense residential areas it is considered that there will be no perceptible air quality impacts to adjoining properties.

Paint Shop

Any necessary painting of machinery will be carried out within the proposed spray booth, as shown on the submitted plans. WesTrac has experience with the operation of such booths, and they will be designed to meet relevant standards and to comply with Workcover requirements. Accordingly no unacceptable emission to air will result from painting operations.

Dust

The proposed development has the potential for dust emission during the construction phase, and also from site operations.

Dust can be controlled during the construction phase through implementation of appropriate management measures. Filling operations will involve the use of larger or heavier types of material, thus minimising the opportunity for smaller particulates to be carried by wind. Dust control measures will be established through a comprehensive

construction management plan that would be prepared prior to construction activity. Measures are expected to include the following:

- Covering of loads where required;
- Amending of operations under excessive wind conditions including ceasing of operations if required;
- Use of water tankers as required, to control dust;
- Rehabilitation through vegetation of surfaces to be left unsealed; and
- Truck wheel washes or other dust removal measures.

When the proposed WesTrac facility is established, dust will be controlled by ensuring that all service areas are sealed, or as a minimum treatment, covered with gravel, leaving no exposed material that can be carried by wind. Dirt tracked onto access routes will be cleaned away as soon as practicable. Vehicles will be regularly washed. Customer's machinery brought to site will in most circumstances be cleaned of excess dirt or dust prior to any work being undertaken on it.

In conclusion, given the nature of the proposal, the minimal sources of potential air emissions, and the controls that will be installed and implemented following a detailed management plan, it is considered that no adverse impacts will result.

7.10 HERITAGE AND ARCHAEOLOGY

The site is vacant, contains no listed heritage items, and is not located in a heritage conservation area. Preliminary investigation of the land title is consistent with the fact that there is no heritage listing, determining no matters of likely heritage significance.

A detailed archaeological survey (Aboriginal) of the site has been conducted by Indigenous Outcomes, and relics were found within the sand escarpment running along the front of the site, adjacent to Tomago Road. As part of the investigation a Section 87 permit to dig was obtained to ensure a thorough examination of the site. The primary purpose of the dig was to determine if the site has been used as a burial ground. It was established that this was not the case.

Full copies of the two reports prepared by Indigenous Outcomes are located at **Appendix P**. The first report, dated March 2006, communicates the location of relics on site, and rates the site as being of high cultural significance, on the premises that it may be a burial ground. However, further investigation, following the obtaining of a Section 87 permit, was completed in October 2006. The October report concludes that the find does not contribute in any significant manner to the understanding of

aboriginal culture, and that it is unlikely the site was ever used as a burial ground. The recommendation of the report is that the LALC be given the opportunity to collect the relics from the site prior to development. As part of the work carried out by Indigenous Outcomes, the LALC were fully consulted and involved in the field surveys. The LALC have provided a letter of agreement to this outcome, and this is also included at **Appendix P**. Redlake Enterprises intends to conform with the recommendations of the report.

7.11 STORMWATER, WATER QUALITY AND REUSE INCLUDING WASHBAY

The stormwater management system for both the WesTrac facility and the industrial subdivision have been designed to achieve a 'no impact' objective, and to acknowledge and incorporate the requirements of DGRs, Hunter Water Corporation (HWC) requirements, the series of Department of Environment and Conservation NSW (DECC) stormwater manuals and Council's development control plans. Included in the development of the system were an assessment of water quality, and the quantity and volume of stormwater runoff discharging to the downstream receiving waters, both pre, and post, development.

The stormwater management system for the WesTrac facility is described in Volume 3 of **Appendix F**. With knowledge gained from water reuse at existing sites, an in-house water balance model was established to track the water balance of operations through the WesTrac facility. The model was simulated on a daily time-step basis, over a 30 year period, using Williamtown rainfall and evaporation data. The analysis period included the driest and wettest years of rainfall on record for Williamtown. The average yearly rainfall for the analysis period was equivalent to the long term average for Williamtown. The results of the water balance modelling indicate that with between 1-5ML of rainwater tank storage, water recycling and reuse to levels of between 82.5% and 99.2% respectively, can be achieved.

HWC required that the stormwater management system acknowledge the Special Area, connected to the Tomago Sandbed groundwater reserves. The water balance model was used to demonstrate no negative impact on recharge volumes to the acquifer system and in fact a slight positive impact was demonstrated. That is, groundwater recharge would be increased following development.

The water balance model was used to track stormwater runoff volumes to the wetlands downstream over the 30 year analysis period. The model indicated oncurrence of runoff volumes to the wetland pre and post development for demonstration of 'no impact'. Further analysis also revealed consistency of volumes, on a yearly basis through wet and dry periods, for pre and post development simulations.

A MUSIC model was established to verify the quality of the runoff to the wetlands for 'no impact', post development. The pollutant levels in runoff were measured for the catchment as an existing, pre European settlement catchment and used as target objectives for the pollutant levels post development. This is a significantly high level of protection from runoff pollutants to the wetlands downstream, exceeding DECC target levels. A treatment train of gross pollutant trap, swale and constructed wetland was sized to meet the target objective, verified with MUSIC. The Treatment Train Effectiveness from the simulation indicated pollutant removal levels for TSS, TP and TN of 99.8%, 98.7% and 96.5% respectively. By comparison, DECC required TSS – 85%, TP-65% and TN-45%.

The stormwater management system for the industrial subdivision is described in Volume 4 of **Appendix F**. Based on the subdivision layout by Asquith & de Witt, there are three (3) basin locations for constructed wetlands. Modelling for water quality, quantity and reuse was on the basis of 95% imperviousness of the lots.

MUSIC was used to model water quality, volumes and reuse. Similarly, to the MUSIC model of stormwater from the WesTrac site, the pollutant levels in runoff were measured for the catchment as an existing, pre European settlement catchment and used as target objectives for the pollutant levels post development. This is a significantly high level of protection from runoff pollutants to the wetlands downstream, exceeding DECC target levels. A treatment train of rainwater tanks with reuse, gross pollutant traps, swales and constructed wetlands were sized to meet the target objective, verified with MUSIC. The Treatment Train Effectiveness from the simulation indicated pollutant removal levels for TSS, TP and TN of 99.8%, 98.7% and 98.3% respectively. By comparison, DECC required TSS – 85%, TP-65% and TN-45%. The post development flow volumes of 42.4ML/year from the site were also shown to be close by comparison to existing flow volumes of 49.5ML/year.

Peak flows for the development were modeled using XP-RAFTS. Modelling was undertaken for matching post development peak flows to pre development peak flow levels for the standard design storm recurrence intervals of 1, 2, 5, 10, 20, 50, 100 year storm events. Modelling indicated that detention volumes of 14,334m3, 17,362m3 and 8,975m3 are required for the three (3) basins respectively to attenuate post development peak flows to pre development levels.

It has been demonstrated in this report that the stormwater management system for the WesTrac facility and Industrial Subdivision has achieved the target objective of 'no impact', exceeding the requirements outlined in the current DECC stormwater manuals and Council's development control plans. The stormwater management system also meets the requirements of DGRs and HWC correspondence to date.

Two washbays are proposed for the site, and all vehicles and parts requiring washing will be taken to one of these, no washing outside of these bays will occur. All water from the washbays will be recycled a number of times before having to be discharged to sewer. Washbays will be supplied by with water harvested on site. A waste oil separator will be installed to each bay and solid waste will be discharged to an approved facility.

7.12 SOIL WATER MANAGEMENT

Erosion and sediment controls, described in a Soil and Water Management Plan, are necessary during construction for the protection of receiving waters downstream. Erosion and sediment control measures are temporary, and are required during filling operations, and until such time as building and construction areas are landscaped, revegetated and sealed. Soil and Water Management for the WesTrac facility and the industrial subdivision are described in Volumes 3 and 4 respectively of **Appendix F**.

Initially, the constructed wetlands to be established post development, subject to staging, will be formed for use as sediment collection dams. The first stage will be the site preparation for the WesTrac facility, a land parcel occupying approximately 23 hectares. The remainder of the industrial subdivision will be staged dependent on market demands.

To be conservative, a higher criteria level of protection has been adopted for the design sizing of the sediment basins for the site, reflecting the sensitivity of the receiving waters downstream. "Managing Urban Stormwater: Mines and Quarries – Consultation Draft 2007" (DECC) was referenced due to the scale of the site works. The 90th percentile rainfall event is the standard for mines and quarries. It is also described that 2-5 day rainfall events are suitable criteria for well managed sites in which prompt action can be guaranteed. At this site the 95th percentile, 5 day rainfall event has been selected, which is approximately 3 times the storage volume of that generated by using the 75th percentile, 5 day rainfall event typically used for development sites. This gives the basin an increased capacity, capturing runoff from a greater number of storm events. This minimises the potential risk of sediment laden water leaving the site and discharging to the wetlands downstream during construction.

Further details of the layout of sediment dams and soil and water management will be determined during the detailed design phase, in conjunction with the bulk earthworks strategy.

7.13 HAZARDS (SEPP 33)

A Threshold Screening Analysis has been undertaken by Barry Eadie Consulting in accordance with the guidelines Applying SEPP 33 the

purpose of which was to determine if the proposed development was considered to be potentially hazardous. Potentially hazardous development requires, under the policy, the preparation of a preliminary hazard analysis.

A copy of the report by Barry Eadie Consulting is located at **Appendix Q** concludes that the proposed development is not potentially hazardous.

All hazardous goods proposed to be stored on site will be stored in accordance with Workcover requirements.

7.14 SEWERAGE DISPOSAL

There is currently no sewer available to the site. Liaison with Hunter Water Corporation in this regard has commenced, including a meeting between interested parties to deliberate joint share arrangements for connection and upgrade of the existing infrastructure.

Cost benefit analysis indicates that a proprietary product will be used for sewerage treatment on-site. It is understood from HWC requirements that on-site treatment relying on transpiration beds, etc is not permitted, due to quality of effluent disposal, and risk of contamination by effluent of the water reserves in the Tomago Sandbeds. On-site treatment at the site for development is differentiated from traditional methods by the use of a Membrane Bioreactor Sewage Treatment System, capable of producing water quality that is equivalent to, or better than the quality of stormwater runoff from the facility, in accordance with the Guidelines for Disposal set down by the NSW Department of Health. Furthermore, the sewerage treatment facility is located a significant distance (approximately 320 metres) downstream of the Tomago Sandbeds Special Area, so as to avoid risk of potential contamination at the collection point. Full details are described in **Volume 3** of **Appendix F**.

The Water Industry Competition Bill 2006 indicates that a privately developed treatment system is permissible. This is the necessary option for the WesTrac facility, due to the timeframes within which WesTrac need the facility to be operational. It is accepted that HWC is currently reviewing overall sewer strategies for the industrial development of the Tomago area. This review will most likely be applicable to the timing of treatment for the industrial development adjacent to the proposed WesTrac facility, however, sewerage treatment provisions will be required for WesTrac prior to HWC determining the strategy for the area. Full details are described in **Volume 3** of **Appendix F**.

As a minimum, the unit will be a temporary measure servicing the WesTrac facility until sewer strategy planning by HWC is complete. Alternatively, additional package units can be added to the on-site treatment package plant for later stages of the industrial subdivision if required.

The proposed plant is a membrane bioreactor design, comprising a combination of sequential batch reactors and submerged membrane treatment. The system was selected for its stability in on-site conditions and for its compact footprint. With sequential processing and final membrane filtration a very high quality effluent is produced.

The plant can be controlled remotely, and will have a SCADA system compatible with control telemetry. In addition, all the key equipment can be manually operated from the main control panel. Primary disinfection is achieved by the membrane, and the deployment of secondary disinfection (UV), and tertiary chlorination, results in a very low bacterial content in the treated effluent. The plant will have on-line monitoring of turbidity, pH and disinfection efficiency, and will employ suitable remote alarm systems. The plant will be part of an onsite Environmental Management Program. There will be a comprehensive Operating Manual, and on-going training for operators. Typical effluent quality from the plant is shown in the Table below.

Treated Effluent (Econova) Quality

Parameter	Treated Effluent (1)
pH	7.25
Suspended Solids	<2
BOD	<3
Ammonia	0.02
Nitrate	0.43
Total Nitrogen	1.3
Total Phosphorus	0.27
Turbidity	0.78
E Coli cfu/100ml	<1
Faecal Coli cfu/100ml	0

Notes: all mg/l except pH
(1) Treated Effluent Source provided by Econova from Noosa North STP lab Caboolture Scientific Services Moayfield QLD

From the above table, the Econova system can be seen to treat and produce discharge with very low bacterial results, by the use of membrane technology. Site design is such that the discharge from the sewerage treatment facility will enter a swale for conveyance to a constructed wetland for further polishing prior to discharge to the receiving waters downstream. Despite the proven quality of discharge, any potential risk of contamination to the Special Area has been further mitigated by careful design of the perimeter drainage. Infiltration recharge areas to the Special Area are separated from the swale drainage by flowpath conveyance at a lower elevation. An embankment, 1m high, has been designed to a level that will not permit any backwater effects

from the swale discharge or the spillway levels of the constructed wetland to enter the infiltration area. Refer to **Volume 3** of **Appendix F**.

7.15 WASTE MANAGEMENT

The following table is a summary of the waste likely to be generated by the facility, and the storage and disposal methods for processing this. It is WesTrac's standard practice to seek the opportunity to recycle rather than dispose. All waste for disposal or for recycling is processed by approved contractors.

Waste	Storage Location	Disposal Method
Wood / Timber (pallets, wood blocks)	Collected in recycling area for removal	Collected in recycling area for removal off site
Oiled rags	Collected in dedicated identified bins within the workshops	Removed by same licensed contractor as waste oil and disposed of at approved facility
Coolant	Circulated to waste coolant collection tank	Removed by a Licensed contractor to a approved facility
Paper	Collected in various recycling areas around the site	Removed by a Licensed contractor to a approved facility
Cardboard	Collected in various recycling areas around the site	Removed by a Licensed contractor to a approved facility
Scrap Steel	Stored in fabrication shop	Removed from site by scrap metal merchant
Scrap Aluminium	Stored in fabrication shop	Removed from site by scrap metal merchant
Scrap Brass	Stored in fabrication shop	Removed from site by scrap metal merchant
Rubber tyres	Stored in inventory attachment area	Removed from site by tyre handler to approved disposal facility
Rubber drive belts	Stored in inventory attachment area	Removed from site by tyre handler to approved disposal facility
Cleaning Rags	General waste bins	Normal rubbish removal
Waste oil	Circulated to waste oil collection tank	Removed by a Licensed contractor to a approved facility
Oil filters	Collected in waste oil area	Removed by same licensed contractor as waste oil and disposed of at approved facility
Used Batteries	Bunded storage area awaiting pick up	Removed by a Licensed contractor to a approved facility
General waste	General waste bins	Normal rubbish removal
Paint	Stored behind paint shop in approved flammable cupboard	Removed by a Licensed contractor to a approved facility
Plastic wrap	General waste bins	Normal rubbish removal
Food Waste	Cafeteria garbage	Normal rubbish removal
Air conditioning gas	Recovered using approve A/C equipment stored with empty gas cylinders	Exchanged with licensed contractor

Sewerage (this is addressed under a separate heading above in this report).

Washbay waste including oil and solids (this is addressed under a separate heading above in this report.)

7.16 SOCIAL & ECONOMIC

The proposed stage 1 development is expected to generate some 400 –

600 construction jobs and the WesTrac NSW ACT headquarters to employ some 400 full time staff once operational. This is a significant employment contribution to the region, and is consistent with the Lower Hunter Regional Strategy to attract employment-generating development to the area, and specifically to this site.

The following addresses more specific social aspects of the proposed development.

Access & Mobility

The proposed development will comply with the requirements of the Building Code of Australia in terms of access and mobility.

Accommodation & Housing

The proposal will not result in a loss of low-moderate rental housing stock, as it does not involve the demolition of existing housing stock. Rents are not likely to increase as a result of the proposed development.

No special accommodation needs are likely to be required for any temporary workforce associated with the development.

Community Services and Facilities

The proposed development will not require any specific on-site community facilities or support services.

Community Structure

The development will not decrease the community's capacity to act cooperatively and will not cause divisions within the community.

The proposal does not physically separate one part of a community from another.

Crime & Public Safety

The proposed development is not a high-risk development requiring extensive measures to be incorporated to provide security to the occupants of the building outside of the common-sense practice of: incorporating appropriate lighting of communal spaces and carparks; design that allows for casual surveillance; and appropriate consideration of landscape design. The proposed development incorporates these design considerations.

The proposed 24 hour operation of the WesTrac facilities will provide a significant level of site security, and will contribute to security within the locality generally.

Interaction between New Development and Existing Community

The proposed development will be consistent with the established industrial area, and will not detract from any densely populated residential area.

Needs of Social Groups

The gender mix of the population will not be affected by the proposed development.

The proposed development requires no additional services primarily affecting women.

No special-needs group will need to be catered for as a result of the proposed development.

Recreation Facilities

No recreation area or facility will be lost as a result of the proposed development, and no change in quality of existing recreation areas or facilities will result. No additional demand on existing facilities will result from the proposed development.

The proposed development provides a high level of amenity for workers through the provision of a well-equipped cafeteria.

Social Equity

It is not expected that the proposed development will assist any specific disadvantaged social group. At the same time it is not expected that the proposed development will disadvantage any social group.

No existing residents will be displaced.

Investment

The proposed development will make a significant contribution through investment dollars to the local economy in the short, medium and long terms. The future development of the proposed industrial subdivision will provide ongoing opportunity for investment for some years to come.

Section 8
Draft Statement of Commitments

8.1 PLANS, DOCUMENTATION AND APPROVALS

The proposed development will be completed in accordance with the submitted plans and descriptions of proposed development provided in this Environmental Assessment Report.

It is noted that any changes to the proposed development will require further approval of the relevant authorities.

The proposed development will be carried out in accordance with all approvals granted by relevant authorities.

8.2 FLORA & FAUNA (INCLUDING WETLANDS)

The proposed development will seek to minimise the impact on Flora and Fauna by adopting the full range of recommendations of the report prepared by Ecobiological, included at **Appendix J**. This will involve the following:

- Avoiding use of potentially harmful chemicals;
- The conduct of pre-clearing surveys; and
- The use of management and Monitoring Plans.

More specifically the strategies involve the following:

MANAGEMENT STRATEGIES

- Avoiding the use of insecticides and herbicides in the study area to retain the integrity of the habitat for insectivorous Microchiropteran bats and to prevent deformities or death to Wallum Froglets in the area.
- Pre-clearing surveys will be carried out prior to any vegetation clearing in the area. The actual felling of any habitat trees will be attended by a suitably experienced fauna ecologist in order to

ensure the safety of any fauna to be found in the hollows. Trees having potential habitat hollows will be 'soft felled' by an experienced machine operator.

- Consideration will be given to incorporating an amphibian translocation plan into the management plan governing pre-clearing survey protocols in order to relocate a population of Common Green Tree Frog which may be placed at risk of extinction with the removal of the two stands of swamp oak, and the Bleating Tree Frog. This plan would incorporate appropriate hygiene protocols to prevent the spread of amphibian diseases.

- Prior to commencement of construction detailed management plans will be prepared to cover the following:

    - Pre-clearing survey protocols

    - A management and monitoring plan for the adjacent Ramsar wetland (Kooragang Nature Reserve) which will consider the following:

        - The nature and control of sediment run-off during construction phase;

        - The chemical content of the fill and of the groundwater seepage from that fill;

        - The volume, path and content of stormwater discharging from the site during and after development;

        - The handling of hydrocarbon waste from the site during construction and operation stages;

        - The existing flow regime of surface and groundwater flow from the site into the wetlands;

        - Impact of development on the quality of sub-surface drainage water that discharges into the wetland;

        - The current ecological character of the wetland in the immediate vicinity of the potential impact area;

        - The impact of weed invasion during and after construction phase; and

- Minimising the impact of lighting.

- An appropriate 100m buffer will be provided in the SE corner of the subject site adjoining the Ramsar site boundary.

ONGOING MONITORING

A monitoring plan will also be prepared to document the ongoing status of the protected Ramsar Wetland to the south of the subject site, with an ongoing comparison to an established baseline status.

8.3 TRAFFIC & ACCESS

The recommendations contained in the report of September 2007 prepared by Mark Waugh Pty Ltd, will be adopted, including the construction of the necessary intersections off Tomago Road and Old Punt Road. The full report is included at **Appendix G.**

The upgrade of the Tomago Road intersection with the Pacific Highway includes the following:

- Installation of traffic control signals with provision for pedestrians.

- Provision of paved area for cyclists.

- Provision of two right-turn lanes on the Pacific Highway for traffic turning into Tomago Road.

- Tomago Road widened to two lanes eastbound, near the highway.

- Relocation of bus stop facilities.

- Removal of the right-turn exit from Tomago Road to the Pacific Highway.

The upgrade of the Old Punt Road intersection with the Pacific Highway includes the following:

- Installation of traffic control signals.

- Provision of an improved left-turn lane from Old Punt Road to the Pacific Highway.

- Longer merge lane on the Pacific Highway from Old Punt Road.

The recommendations of the Traffic Management Plan for the import of fill material prepared by Mark Waugh Pty Ltd, and included at **Appendix G** will be adopted. This plan includes the following measures:

- All cyclist movements will remain as per the current situation with cyclists using the road carriageway.
- All parking associated with employees on the site can be contained within the site with no requirement to park on Tomago Road.
- All deliveries will approach the site from the west, turning right into the site and then departing by turning left onto Tomago Road.
- No loading/delivery to be completed along the Tomago Road frontage.
- No delivery vehicles will be permitted to stand on the roadway. All vehicles are to be unloaded within the site.
- NO alteration to the existing speed zone (90km/h) will need to be applied.
- General signage and line marking are included due to the nature of the passing traffic and the location and nature of the works.
- All signs shall be permanently mounted and shall be covered outside working hours. The signs shall be uncovered at the beginning of the working day before any trucks access the site.
- A copy of the Traffic Control Plan will be on site at all times.
- The site ganger will complete a daily traffic control checklist.

8.4 ACOUSTICS

The proposed development will comply with the requirements of DECC in relation to criteria for noise emissions. In particular the proposed development will comply with the recommendations of the report prepared by Spectrum Acoustics included at **Appendix O**.

A Construction Management and Environmental Management Plan will be prepared to manage noise emissions, and submitted, as required, prior to construction or commencement of operations.

More specifically, the following will be included:

- Fill of the WesTrac site will commence on the eastern site boundary and extend to the west to provide a noise buffer between trucks importing fill and residences east of the site.

- **Constructions Noise** - In accordance with DECC recommendations construction will only be carried out during daytime hours, and a construction noise criterion of background (LA_{90}) + 5dB will be adopted.

- **Operational Noise -** The Project-Specific Noise Levels (PSNL) for the development will be:

  - 43dB(A) $L_{eq\ (15\ min)}$ Day (7am-6pm)
  - 37dB(A) $L_{eq\ (15\ min)}$ Evening(6pm-10pm)
  - 35dB(A) $L_{eq\ (15\ min)}$ Day (10pm-7am)

- **Sleep Disturbance -** Disturbance to sleep will be minimised by ensuring that maximum internal noise levels do not exceed 50dB(A) and maximum external noise levels do not exceed 60dB(A), L_{max}.

- **Traffic Noise** - Recommended criteria, $L_{eq\ (1\ hour)}$ between 7am and 10pm (day) is 60dB(A) and between 10pm and 7am (night) is 55dB(A).

- A 3.5m high acoustic barrier will be erected along a portion of the eastern site boundary. An acoustic barrier comprises an earth mound or a fence or a fence on a mound, and requires a minimum mass of 15kg/m^2 and must make contact with the ground.

- Future industries will be required to submit noise impact assessments as part of the Development Application / approval process.

8.5 ARCHAEOLOGY

The proposed development will comply with the recommendation of the Archaeological report prepared by Indigenous Outcomes included at **Appendix P.** Specifically the LALC will be consulted, and given the appropriate opportunity to collect relics from the site prior to the commencement of Construction.

8.6 AIR QUALITY

All vehicles and machinery will be maintained to minimise emissions to air.

All spray-painting will be contained within the proposed spray booth. The spray booth will be designed to meet the specifications and standards of Workcover Authority and DECC.

Dust will be controlled during the construction phase through implementation of appropriate management measures. Filling operations will involve the use of larger or heavier types of fill material, thus minimising the opportunity for smaller particulates to be carried by wind.

A Construction Management and Environmental Management Plan will be prepared to manage potential air emissions and submitted as required prior to construction or commencement of operations. The plan in particular will address dust control.

Dust control measures will include the following:

- Covering loads where required;
- Amending of operations under excessive wind conditions including ceasing of operations if required;
- Use of water tankers as required to control dust;
- Rehabilitation through vegetation of surfaces to be left unsealed;
- Truck wheel washes or other dust removal measures;
- Ensuring that all service areas are sealed, or as a minimum treatment, covered with gravel;
- Dirt tracked onto access routes will be cleaned away as soon as practicable;
- Vehicles will be regularly washed; and
- Customer's machinery brought to site will in most circumstances be cleaned of excess dirt or dust prior to any work being undertaken on it.

8.7 WATER QUALITY

Water quality measures will be installed in accordance with the report prepared by Asquith & de Witt, included in this report as **Appendix F**.

The water quality objective for the site was to determine a solution of 'no impact' to the downstream receiving waters. The MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model was established to verify the quantity of the run off to the wetlands for 'no impact', post development. Reuse, a treatment train, gross pollutant trap, swale and constructed wetland was sized to meet the target objective verified with MUSIC.

Water quality will be monitored, and a management plan, as detailed in the Flora & Fauna Report prepared by Ecobiological contained at **Appendix J,** will be prepared to address the construction and operational phases. More specifically this management plan will include:

- The nature and control of sediment run-off during the construction phase particularly as a result of an exceptional storm event;
- The chemical content of the fill and of the groundwater seepage from that fill that would disperse into the wetlands over the long term;
- The volume, path and content of stormwater discharging from the site during and after development;
- The handling of hydrocarbon waste from the site during construction and operation stages;
- Existing flow regime of subsurface and groundwater flow from the subject site into the wetlands;
- At times of peak rainfall, sub-surface drainage through the fill is likely to discharge into the wetland – what will be the impact of the development on the quality of this water;
- The current ecological character of the wetland in the immediate vicinity of the potential impact area; and
- The impact of weed invasion during and after construction phase.

A monitoring plan will also be put in place to document the ongoing water quality status, measured against an established baseline.

All products stored on-site having the potential to contaminate stormwater in the event of spillage will also be contained within a bounded area to the requirements of DECC.

STORMWATER CONTROLS

Water quality control on site will be 2 proposed washpads. All vehicles and parts requiring washing will be taken to one of these, and no washing outside of these washpads will occur. WesTrac has standardised control over these facilities country wide at its existing operations.

A Construction Management and Environmental Management Plan will be prepared to manage potential water quality issues and submitted as required prior to construction or commencement of operations.

The stormwater treatment train will be used for removal of the pollutants from the stormwater runoff prior to discharging to the wetlands downstream.

- Gross Pollutant Traps will be installed at the entry to each of the constructed wetlands as a proprietary product for screening of heavy sediment and litter.

- A large open channel swale drain has been designed into the development layout for street drainage, drainage of the intersection and secondary flows during major storm events. End of line treatment basins have been spread over the site to reduce the distances drainable for stormwater runoff.

- Basins have been located to have discharge outlets to the existing discharge points from the site along the southern boundary, post development.

- The site will be filled for development of the subdivision to a level that is flood free.

- Geotechnical approval will be obtained on the fill type and its properties prior to being used on the site. However the preferred fill type is granular material with particles not greater than 100mm diameter. The fill will be pH neutral and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. No ash will be used for filling.

SOIL AND WATER MANAGEMENT PLAN

- The sediment basins have been designed for settlement of Type F soils. A higher criteria level of protection has been adopted for the design sizing of the sediment basins, reflecting the sensitivity of the receiving waters downstream. The 95th percentile, 5 day rainfall event has been selected as the standard for this site, which provides an increased capacity to capture runoff and minimised the potential risk of sediment laden water leaving the site and discharging to the wetlands.

- Access is to be limited to the designated all weather roads, any truck exiting out of the site shall be thoroughly cleaned and limit the exportation of clay and sediment on public roads, and entry is prohibited on remaining land.

- Works shall be undertaken in the following construction sequence:

1) Install sediment fencing and cut drains to meet the requirements of the SWMP. Waste collection bins shall be installed adjacent to site office.

2) Construct stabilised site access in location nominated by the Contractor and in accordance with Port Stephens Council's requirements.

3) Construct sediment basins for disturbed areas in accordance with the rate per hectare provided in the SWMP. Install risers and two pegs in the floor of the basin and have them marked to show the top of the sediment storage zone. Ensure the basin is cleared of sediment once the design capacity is reached.

4) Redirect clean water around the construction site.

5) Install sediment control protection measures at all natural and man-made drainage structures. Maintain until all the disturbed areas are stabilised.

6) Clear and strip the work areas in accordance with the Geotechnical advice provided.

7) Any disturbed areas, other than lot grading areas, shall immediately be covered with site topsoil within 7 days of clearing. Lot re-graded shall be covered with bitumen emulsion as specified.

8) Apply permanent stabilisation to site (landscaping).

- Sediment control conditions will include the following:

  - Proprietary sediment fencing shall be installed by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent to contain sediment fractions as near as possible to their source.

  - Sediment removed from any trapping device shall be relocated where further pollution to down slope lands and waterways cannot occur.

- Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days they shall be stabilised by covering with mulch or with temporary vegetation.

- Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor's approved SWMP.

- Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated.

- Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas.

• Site maintenance requirements include the following:

  - Waste bins are to be provided for all construction refuse. They are to be emptied at least weekly and refuse is to be disposed in accordance with the site manager's recommendations.

  - The site manager shall inspect the site at least weekly and shall:

    - Ensure that all drains are operating effectively and shall make any necessary repairs;

    - Remove any spilled material from area subject to runoff or concentrated flow;

    - Remove trapped sediment where the capacity of the trapping device falls below 60%;

    - Inspect the sediment basins after each rainfall even and/or weekly. Ensure that all sediment is removed once the sediment storage zone is full. Ensure that outlet and emergency spillway works are maintained in a fully operational condition at all times;

    - Ensure rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair bas appropriate;

- Construct additional erosion and sediment control works as may be appropriate to ensure the protection of down slope lands and waterways;

- Maintain erosion and sediment control measures in a fully functioning condition at all times until the site is rehabilitated;

- Ensure that the revegetation scheme is adhered to and that the all grass covers are kept healthy, including watering and mowing; and

- Remove temporary soil conservation structures as the last activity in the rehabilitation program.

8.8 FLOW REGIME

The proposed development will comply with the water balance prepared by Asquith & de Witt and enclosed at **Appendix F.**

The water balance model outcomes will be complied with and intend to provide the following:

- A water balance model including recycling, uses and quantities associated with the operation of the WesTrac facility, as a guide for WesTrac;

- An estimate for the rainwater storage requirements to ensure water security for the project;

- An estimate of recharge to the HWC Special Area;

- An estimate of the quantity of runoff discharging to the wetlands downstream; and

- An identification of the expected key risks to water management based on the outcomes of the water balance.

8.9 WATER REUSE

The proposed development will comply with the water harvesting and recycling plan outlined in the report prepared by Asquith & de Witt, included at **Appendix F**.

More specifically, the washpads proposed on site for the purpose of cleaning heavy vehicle equipment prior to workshop activities will be the primary water quality control on site. The process will involve using a biodegradable detergent which releases free oil after addition of an

emulsion breaker for efficient oil separation and collection, together with a detergent stripping stage using a foam fractionator. The resultant treated water will be recycled through a filtration and sterilisation stage. A portion of treated water is removed from the circuit and sent for final treatment to the site sewage treatment plant.

Water for washpad operations is derived from three (3) sources:

- Rainwater harvesting;
- Town water; and
- Recycled water.

The resultant wastewater will be pumped to a settling tank after dosing with a primary flocculant. The primary flocculant dose breaks all emulsions and presents free oil and wastewater to the skid mounted oil/water separator. Oil/water separation is achieved using a heavy duty coalescing plate separator.

Wastewater produced by the separator is further treated by a foam fractionator.

The treated washpad wastewater will be recycled after surfactant removal. Recycled water undergoes further treatment using chlorination and sand filtration. The recycled water feeds a low pressure wash unit with inline UN sterilisation. The spent washwater drains to the solids sump at the start of processing for reuse.

8.10 SOIL EROSION AND SEDIMENTATION

Erosion and sedimentation controls will be installed in accordance with the report prepared by Asquith & de Witt and enclosed at **Appendix F**.

More specifically, measures to be implemented during construction include:

- Disturbance only of areas to be immediately worked on and regeneration of dust and erosion free surfaces – landscaping, concrete, bitumen sealing as soon as practical thereafter.
- Provision of and continued maintenance of sediment fencing to low perimeter locations.
- Provision of mesh and gravel or geotextile inlet filters.
- Contract specifications requiring stabilised site access, low flow earth flow earth banks and wind erosion screens.

- A construction programme that provides for the sediment basin to be constructed at the outset with all site runoff, where practical, piped or channelled to this basin for primary treatment/settlement before leaving the site via a mesh supported geotextile filter/riser before discharging to the wetlands.

- Contract specifications requiring regular maintenance of all erosion and sediment control structures and devices for the full contract and maintenance period.

Furthermore, sediment control conditions will include the following:

- Proprietary sediment fencing shall be installed by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent to contain sediment fractions as near as possible to their source.

- Sediment removed from any trapping device shall be relocated where further pollution to down slope lands and waterways cannot occur.

- Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days they shall be stabilised by covering with mulch or with temporary vegetation.

- Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor's approved SWMP.

- Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated.

- Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas.

8.11 ACID SULPHATE SOILS

In the event that it is necessary to disturb acid sulphate soils, an Acid Sulphate Soils Management Plan will be prepared and submitted to the Department of planning prior to the disturbance of such soils.

8.12 SEWERAGE DISPOSAL

The proposed on-site sewerage system will be maintained in good working order and meet the water quality standards established by the MUSIC model, and outlined above in the water quality section of this Statement of Commitments and also in the report at **Appendix F.**

The NOVACLEAR MBR treatment process will operate on a fill and draw batch system where incoming waste is first stored within the balance tank, then transferred to the aeration tanks and decanted via the final MBR process.

The batch system is subject to biological treatment for a prescribed period of time with both anoxic and aerobic cycles possible. The sludge remains within the aeration and MBR tanks to provide the biological population for the subsequent cycle.

RAS pumps circulate the activated sludge between aeration tanks and between the MBR tanks and balance tanks for EBPR conditions. Excess biomass is pumped on a regular basis to a sludge holding tank for further digestion and disposal.

The NOVACLEAR MBR process involves a number of measures to monitor and control equipment, including the following:

- Influent flow meter between primary pump station and EQ tank.
- D.O meters for each cell to provide oxygen monitoring and blower control.
- Continuous NTU monitoring following tertiary filtration.
- Continuous UV intensity monitoring and lamp failure alarms.
- Continuous Cl^2 monitoring and set point failure alarms.
- High level alarms on all treatment tanks.
- Low level alarms on all dosing tanks.
- Final effluent flow meter following final irrigation pump.
- Motor overload protection with auxiliary alarm outputs on all pumps and air blowers where practical.
- Current sensing and amp meters on all submersible pumps where required.

All alarms will be locally activated on both the main electrical control panel and scada computer interface. All alarms will be presented as volt free contacts (or 4-20ma outputs for metering) within a dedicated marshalling box.

The SCADA system will be linked via an independent telemetry system to a remote console. An auto dialler will alert remote operators of system alarms or equipment failure.

8.13 WASTE MANAGEMENT

All waste, as identified in the EAR, will be stored on-site, with the waste stream separated into recyclable and non recyclable, and disposed of or recycled by approved contractors. The following table outlines the waste likely to be generated by the facility, and storage and disposal methods for processing this:

Waste	Storage Location	Disposal Method
Wood / Timber (pallets, wood blocks)	Collected in recycling area for removal	Collected in recycling area for removal off site
Oiled rags	Collected in dedicated identified bins within the workshops	Removed by same licensed contractor as waste oil and disposed of at approved facility
Coolant	Circulated to waste coolant collection tank	Removed by a Licensed contractor to a approved facility
Paper	Collected in various recycling areas around the site	Removed by a Licensed contractor to a approved facility
Cardboard	Collected in various recycling areas around the site	Removed by a Licensed contractor to a approved facility
Scrap Steel	Stored in fabrication shop	Removed from site by scrap metal merchant
Scrap Aluminium	Stored in fabrication shop	Removed from site by scrap metal merchant
Scrap Brass	Stored in fabrication shop	Removed from site by scrap metal merchant
Rubber tyres	Stored in inventory attachment area	Removed from site by tyre handler to approved disposal facility
Rubber drive belts	Stored in inventory attachment area	Removed from site by tyre handler to approved disposal facility
Cleaning Rags	General waste bins	Normal rubbish removal
Waste oil	Circulated to waste oil collection tank	Removed by a Licensed contractor to a approved facility
Oil filters	Collected in waste oil area	Removed by same licensed contractor as waste oil and disposed of at approved facility
Used Batteries	Bunded storage area awaiting pick up	Removed by a Licensed contractor to a approved facility
General waste	General waste bins	Normal rubbish removal
Paint	Stored behind paint shop in approved flammable cupboard	Removed by a Licensed contractor to a approved facility
Plastic wrap	General waste bins	Normal rubbish removal
Food Waste	Cafeteria garbage	Normal rubbish removal
Air conditioning gas	Recovered using approve A/C equipment stored with empty gas cylinders	Exchanged with licensed contractor

A waste management plan will be prepared prior to operation of the facility.

8.14 HAZARDOUS MATERIALS

Hazardous Materials will be stored in accordance with Workcover Authority requirements.

Storage layout will be within racking on shelves or in the case of oils and fuels as per the designated areas shown on the plans.

Storage conditions will be as shown on the plans.

8.15 UTILITIES

The proposed development will comply with the requirements of the relevant utility authorities, and evidence of the necessary approvals will be provided to the Department prior to construction.

8.16 OUTDOOR LIGHTING

All outdoor lighting will be designed to comply with the requirements of AS 4282, Control of Obtrusive Effects of Outdoor Lighting.

8.17 BCA

The proposed development will comply with either the 'deemed to satisfy' provisions of the Building Code of Australia, or alternatively provide a performance-based solution prepared by a suitably qualified person.

8.18 ROAD CONSTRUCTION AND DRAINAGE

Road construction and drainage works will comply with Port Stephens Council & Roads and Traffic Authority Standards.

8.19 LANDSCAPING

All landscaping will be carried out in accordance with the landscape concept plan prepared by Terras Landscape Architects, and included with the Project Application documentation. A detailed landscape plan will be prepared for each stage of the development and submitted with construction certificate applications.

8.20 VECTOR MANAGEMENT PLAN

A Vector Management Plan will be prepared prior to construction of buildings.

Section 9
Conclusion

The proposed development is located within an area declared as a State Significant site under the Major Projects State Environmental Planning Policy, and zoned IN1 General Industrial.

The proposed development is a Major Project under the Major Projects SEPP, as it substantially exceeds five million dollars in value. The proposed development outlined in this Environmental Assessment Report is a permissible use within the zone.

The site is strategically located relative to the Port of Newcastle, major road connections, Williamtown Airport and existing Industry north-west of the site. The site has good access to workforces, being centrally located to Newcastle, Maitland and Port Stephens. The site is isolated from any significant residential area. The site is also located close to its primary customer base, being mining companies operating in the Hunter Valley. These attributes make the site ideal for the intended development.

This Environmental Assessment has identified and addressed the key issues relevant to the proposed development, including those outlined in the Director General Requirements. It has been established that the site and receiving environment is appropriate for the intended development. A range of management measures have been recommended to ensure that no significant adverse impacts will result.

It is considered that this report identifies the proposed development as being of significance to the Hunter Region, and the state of NSW, both in terms of its initial investment value through construction, but also in terms of the ongoing contribution to the economy through the WesTrac business operations.

Importantly, the project represents a significant employment opportunity to the region. Further investment and employment opportunities will be generated as the market demands the land to be developed as an industrial subdivision in future stages.

The potential economic benefits and employment opportunities arising from this proposal, in combination with the comprehensive measures to be undertaken to minimise any adverse impacts on the receiving environment render the proposed development as justified, and worthy of approval.

Appendix A

DIRECTOR GENERAL MAJOR PROJECT CONFIRMATION

NSW GOVERNMENT
Department of Planning

Record of Minister's opinion for the purposes of Clause 6(1) of the State Environmental Planning Policy (Major Projects) 2005

I, the Director-General of the Department of Planning, as delegate of the Minister for Planning under delegation executed on 31 October 2005, have formed the opinion that the development described in the Schedule below, is development of a kind that is described in Schedule 3 of *State Environmental Planning Policy (Major Projects) 2005* – namely development within the Tomago Industrial Site that has a capital investment value of more than $5 million- and is thus declared to be a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies for the purpose of section 75B of that Act.

Schedule

The development proposed by Redlake Enterprises Pty Ltd for the construction and operation of a facility which would incorporate manufacturing, warehousing and distribution of earth moving and mining machinery, as well as a training centre, Tomago Road (Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256), Tomago as generally described in a letter dated 26 June 2007 from Asquith de Witt Pty Ltd, on behalf of Redlake Enterprises Pty Ltd, to the Department of Planning.

Sam Haddad

Sam Haddad
Director-General

Date: 6. 7. 2007.

Appendix B

COPY OF DGRS & COMPLIANCE TABLE

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Project	Subdivision of approximately 115 hectares of land at Tomago for industrial purposes and the construction and operation of an integrated facility for WesTrac earth moving and mining machinery incorporating manufacturing, warehousing, distribution, rental and training facilities.
Site	Tomago Road, Tomago
Proponent	Redlake Enterprises Pty Ltd
Date of Issue	18 September 2007
Date of Expiration	18 September 2009
General Requirements	The Environmental Assessment must include: • an executive summary; • a detailed description of the project including the: – need for the project; – alternatives considered; and – various components and stages of the project; • consideration of any relevant statutory provisions; • a general overview of the environmental impacts of the project, identifying the key issues for further assessment, and taking into consideration any issues raised during consultation; • a detailed assessment of the key issues specified below, and any other significant issues identified in the general overview of environmental impacts of the project (see above), which includes: – a description of the existing environment; and – an assessment of the potential impacts of all components of the project, including any cumulative impacts from other industrial developments in the area; • a description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the impacts of the project; • a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures; • a conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and the benefits of the project; and • a signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading.
Key Issues	• **Flora and Fauna** – including: – impacts on threatened species, populations or ecological communities, critical habitat (including riparian habitat) and native vegetation generally, and in particular; o impacts on species listed under Section 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999*; o impacts on migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999*; o impacts on RAMSAR Wetlands, particularly the Hunter Estuary Wetlands; and – proposed offset measures to avoid or mitigate any significant impacts; • **Water and Soils** – including: – details of the quantity of fill required for the site and the proposed source(s) of the fill; – a water balance for the site detailing water sources, water

	consumption, water recycling, the quantity and quality of waste water streams and the impact of any water release from the site on surface water and groundwater; – an assessment of flooding impacts associated with the proposal including details of the flood liability of the site and changes to flooding behaviour; – proposed erosion and sediment controls (during construction) and the proposed stormwater management system (during operations); – proposed management measures for containment of pollutants; and – soil contamination; • **Traffic** – including details of the traffic volumes likely to be generated during construction and operation, and an assessment of the predicted impacts of this traffic on the safety and capacity of the surrounding road network. Details of measures to minimise conflicts between heavy and light vehicles on site must be included; • **Noise** – including construction, operation and traffic; • **Air quality** – during construction and operation, as well as greenhouse gas emissions; • **Visual** – including landscaping, design (scale, height and bulk), signage and lighting; • **Waste Management** – including the quantity and type of all liquid and solid waste to be generated at the site and a description of how this waste would be handled, processed and, if necessary, disposed of; • **Hazards and Risk** – including an assessment of the potential hazards and risks associated with the proposed project. A preliminary risk screening must be completed in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* (SEPP 33) and *Applying SEPP 33* (DUAP, 1994), and where necessary, a Preliminary Hazard Analysis (PHA) undertaken; and • **Heritage** (Aboriginal and European).
References	The Environmental Assessment must take into account relevant State and Commonwealth government technical and policy guidelines. While not exhaustive, guidelines which may be relevant to the project are included in the attached list.
Consultation	During the preparation of the Environmental Assessment, you should consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised must be described in the Environmental Assessment. In particular, you should consult with: • Commonwealth Department of Environment and Water Resources; • Roads and Traffic Authority; • Department of Environment and Climate Change; • Hunter Water Corporation; and • Port Stephens Council The consultation process and the issues raised must be described in the EA.
Deemed refusal period	60 days

145 Newcastle Road
Wallsend NSW 2287

Address all mail to
PO Box 487 Newcastle
NSW 2300 Australia

Telephone (+61) 13 1525

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We're on it

5 September 2007

Received
17 SEP 2007
Strategic Assessments

Ann-Maree Carruthers
Senior Environmental Planning Officer
Major Development Assessment
NSW Department of Planning
GPO Box 39
SYDNEY NSW 2001

Dear Ann-Maree

Mixed Use Development, Tomago Road, Tomago – Port Stephens Local Government Area

Thankyou for the opportunity to comment on the Redlake Enterprises Pty Ltd proposal at Tomago. As mentioned in the submission EnergyAustralia has been part of the consultation process and I believe Redlake Enterprises Pty Ltd are well aware of the issues we feel important.

There is a 132kV overhead powerline traversing the area and the desire by EnergyAustralia to construct a second overhead line sometime in the future when load growth requires additional capacity. Asquith and DeWitt Pty Ltd have undertaken to incorporate a rerouting of the easements and are well progressed in terms of incorporating both the overhead lines into the development.

Full costs of relocation are to be borne by the developer. Electricity supply to the development will need to conform to EnergyAustralia Network Standards and be designed and installed as a Contestable Project. EnergyAustralia is aware Redlake have engaged a suitably qualified designer to assist them with their internal electrical distribution design.

For your information, EnergyAustralia has also expressed an interest in purchasing a portion of the development for the purpose of building a substation to service the Tomago industrial area and surrounds.

Should you wish further details or to discuss any of the issues raised, please contact me on (02) 4951 0183.

Yours sincerely

Greg Skinner
Region Manager Hunter & Central Coast
Network Customer Operations

Partner

362DA98;1
07/1579

Received
06 SEP 2007
Strategic Assessments

Director, Major Development Assessment
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Attention: Ms Ann-Maree Carruthers

PROPOSED MIXED USE DEVELOPMENT, TOMAGO ROAD, TOMAGO – PORT STEPHENS LOCAL GOVERNMENT AREA (PROJECT APPLICATION NO. MP07-0086)

Dear Ms Carruthers

I refer to your letter dated 17 August 2007 requesting key issues for consideration in the DGRs for the preparation of the Environmental Assessment of the subject project.

The RTA's primary interests are in the road network, traffic and broader transport issues, particularly in relation to the efficiency and safety of the classified road system, the security of property assets and the integration of land use and transport.

The RTA's requirements for the environmental impact assessment primarily relate to traffic generation to / from the site. In this regard the following guidelines would apply:

- DIPNR (Department of Infrastructure, Planning and Natural Resources) Environmental Impact Statement Guidelines
    - *Roads and Related Facilities* (Transportation and Traffic Issues)
- Roads and Traffic Authority's *Guide to Traffic Generating Developments*
- EPA's *Environmental Criteria for Road Traffic Noise*

Specifically, in relation to the proposed development, the RTA would require the following:

- A traffic study prepared in accordance with the RTA's *Guide to Traffic Generating Developments* when considering a formal application. The study should include (but not be limited to) the following:
    - Identify all relevant vehicular traffic routes and intersection for access to / from the subject areas.
    - Current traffic counts for all of the above traffic routes and intersections
    - The anticipated vehicular traffic generated from the proposed development.

Roads and Traffic Authority
59 Darby Street Newcastle NSW 2300 | Locked Bag 30 Newcastle NSW 2300 DX 7813 Newcastle | T: 02 4924 0240 | www.rta.nsw.gov.au

- Consideration of the traffic impact on the existing intersections and the capacity of Tomago Road and its intersections to safely and efficiently cater for the additional vehicular traffic generated.

- Any staging of the development should be considered to determine the infrastructure requirements over time. Particularly, the RTA would require the applicant to clearly outline the intended road infrastructure works for both the site filling stage, the Westrac development stage and the industrial subdivision stage. Note that it is likely the RTA would require the ultimate intersection with Tomago Road to be constructed upfront.

- Consideration of the operation and road infrastructure requirements related to wide and long load haulage from the area.

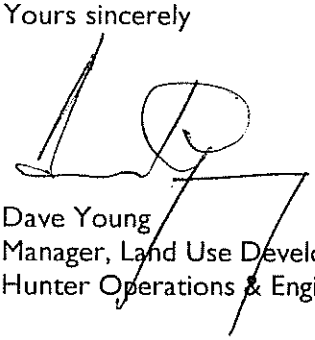
- The applicant should note that the property is subject to road widening. It is expected that the land is dedicated at no cost to the RTA or Council.

Further comments should also be obtained from Port Stephens Council in terms of assessment requirements for traffic and transport issues.

The RTA will respond further to the proposal on receipt of the Environmental Impact Assessment, and the traffic study when referred by the Department.

Please contact me on (02) 4924 0688 if you have any queries.

Yours sincerely



Dave Young
Manager, Land Use Development
Hunter Operations & Engineering Services

3 September 2007

Your reference : Attn Ms Ann-Marree Carruthers
Our reference : DOC07/33622 NE591 Part 3A
Contact : Trevor Henderson, 49086824

Received
06 SEP 2007
Major Projects Assessments

Department of Planning
PO Box 39
SYDNEY NSW 2001

- 3 SEP 2007

Attention: Ann-Maree Carruthers

Dear Ms Carruthers

Redlake Enterprises - Mixed Use Development, Tomago Road Tomago – Environmental Assessment Requirements

I refer to your letter of 17 August 2007 concerning the proposed development by Redlake Enterprises Pty Ltd and the attached preliminary Environment Assessment prepared by Asquith & deWitt Pty Ltd.

DECC has considered the details of the project provided and has identified the information it requires to assess the project in Attachment 1. The proponent should ensure that the EA is sufficiently comprehensive and detailed to allow DECC to determine the extent of the impact(s) of the proposal.

DECC considers the key issues that the proponent should address in the EA are:

1. Flora and fauna impact including the impacts on threatened species and their habitat. The assessment should include a description of measures taken to minimise potential impacts and actions that will be taken to avoid or mitigate environmental impacts, or compensatory measures to offset any unavoidable impacts.
2. Impacts on Aboriginal cultural heritage, including a description of actions that will be taken to avoid or mitigate impacts or compensate unavoidable impacts. The EA should demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts and developing options to minimise or mitigate impacts.
3. The proposed development, as outlined, is not Scheduled Development Works under the Protection of the Environment Operations Act, 1997 and the final land-use will not be a scheduled activity under that Act. Therefore the DECC has not included specific Environmental Assessment Requirements related to air quality, noise, water quality or waste management. However, the site is adjacent to valuable groundwater reserves and the DECC expects that particular attention will be paid to assessing and mitigating the impact of the proposed development on those resources.

PO Box 488G, Newcastle NSW 2300
117 Bull Street, Newcastle West, NSW 2302
Tel: (02) 4908 6800 Fax: (02) 4908 6810
ABN 30 841 387 271
www.environment.nsw.gov.au

The proponent should be aware that any commitments made in the EA may be formalised as approval conditions. Consequently pollution control or conservation measures should not be proposed if they are impractical, unrealistic or beyond the financial viability of the development. It is important that all conclusions are supported by adequate data.

DECC requests that three copies of the EA are provided for assessment. These documents should be addressed to the DECC's Manager, Hunter Region – Climate Change and Environment Protection, PO Box 488G, Newcastle 2300.

If you have any queries regarding this matter please contact Trevor Henderson on (02) 4908 6824.

The attached guidance material may assist in preparation of the EA.

Yours sincerely

MITCHELL BENNETT
Acting Manager, Hunter Region
Climate Change and Environment Protection

Attachment 1 – DEC's Recommended EA requirements

Impacts on threatened species and their habitat

1. A field survey of the site should be conducted and documented in accordance with the gazetted draft *Guideline for Threatened Species Assessment*.

2. Likely impacts on threatened species and their habitat need to be assessed, evaluated and reported on. The assessment should specifically report on the considerations listed in Step 3 of the draft guideline.

3. Describe the actions that will be taken to avoid or mitigate impacts or compensate for unavoidable impacts of the project on threatened species and their habitat. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

4. The EA needs to clearly state whether it meets each of the key thresholds set out in Step 5 of the guideline.

Impacts on Aboriginal cultural heritage values

1. The EA should address and document the information requirements set out in the draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* involving surveys and consultation with the Aboriginal community.

2. Identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area.

3. Describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on Aboriginal cultural heritage values. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

5. The EA needs to clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations.

Ann-Maree Carruthers - Key Issues & Assessment Requirments -Redlake Enterprises Pty Ltd (MP07-0086)

From: "Amanda Gale" <Amanda.Gale@portstephens.nsw.gov.au>
To: "Ann-Maree Carruthers" <Ann-Maree.Carruthers@planning.nsw.gov.au>
Date: 07/09/2007 18:03
Subject: Key Issues & Assessment Requirments -Redlake Enterprises Pty Ltd (MP07-0086)
CC: "Alison Walkom" <Alison.Walkom@portstephens.nsw.gov.au>

Ann-Maree - please find enclosed Council's response to request for issues / req'ts Thank you Amanda Gale

Telephone Inquiries:
Amanda Gale
File No: PSC2006-0695
Parcel No: 13928

7 September 2007

The Director
Urban Assessments
Department of Planning
GPO Box 3927
SYDNEY NSW 2001.

Attention: Ann-Maree Carruthers,

Dear Ms Carruthers,

Re: Proposal: **Details of Key Issues & Assessment Requirements**
Your Ref: **MP07-0086**
Property: **LOT: 1 DP: 597372, Lot 161 DP 774440, Lot 1 DP 1003492 and Lot 513 DP 585256, Tomago Road, TOMAGO 2322**

Thank you for your letter dated 17 August 2007 (received 24 August 2007) requesting Council's comments for the above development proposal.

The development proposal needs to satisfy relevant planning considerations under S79C of the Environmental Planning and Assessment Act 1979. No detailed assessment has been undertaken by Port Stephens Council.

It is Council's expectation that the following issues will be considered. This list is not intended to be all inclusive, as there may be additional issues identified through the assessment process.

- Provisions of the PS LEP 2000 and DCPs where relevant
- Suitability of the site – inclusive of Acid Sulphate Soils (Classes 3 & 4)
- Access – the RTA is the authority for access on Tomago Road
- Bushfire – land is identified as being partially affected by bushfire
- SEPP 74 – land is within the area identified by the SEPP
- SEPP 71 – land is within Coastal Protection Area
- Flora & Fauna – need to address flora and fauna issues inclusive of SEPP 14 Wetlands (located in proximity to the land) and National Park (adjoining the land) and endangered ecological communities identified over the land
- Comprehensive Koala Plan of Management – need to address as part of the flora and fauna assessment
- Land is within the Hunter Water Corporation – Special Areas
- Land is identified as Flood Prone Land and adjoins Proclaimed Flood Plain
- Prime Agricultural Land – land is identified as within Prime Agricultural land
- Land is within the Buffer Area to Tomago Aluminium
- Heritage – land is within proximity to a Heritage Item as identified in LEP 2000
- Effluent disposal – the need exists for sewer to be made available given the scale of development and associated environmental constraints over the land

Telephone Enquiries:

- Drainage – need to consider stormwater disposal and water quality strategies and the issue of legal discharge of stormwater onto adjoining properties
- Construction Management Plan is necessary inclusive of Waste management during and after construction
- Sediment & Erosion Control – suggest consideration be given to staging and the management of potential impacts associated with disturbed areas of development site
- Land fill – need to ensure landfill material proposed for the development is VENM with consideration given to source of landfill and necessary approvals required to essentially extract or obtain such a volume of landfill material proposed to be deposited on the land
- Vector Management Plan – suggest the need for preparation of a Vector Management Plan given the location of the site
- Assume S94A would be applicable for the scale of development with the need for road haulage levy contributions
- Subdivision – consider geometric road design and lot layout in accordance with Port Stephens DCP 2007, creation of energy efficient allotments / developments, consideration of design controls for future development on lots to assist in promoting high quality development outcomes, landscaping inclusive of street tree plantings and detention basin landscaping requirements and the need for street lighting consideration

If any further information or clarification is required, please do not hesitate to contact the undersigned, or alternatively Amanda Gale (Development Co-ordinator) on 02 49800129 or email - amanda.gale@portstephens.nsw.gov.au

Yours faithfully.

Scott Anson

SCOTT ANSON
DEVELOPMENT MANAGER
Per:

This e-mail, including any attached files, is intended to be read and used by the addressee only. If you receive this e-mail and are not the addressee, please notify the sender immediately and delete the email, destroy any printed copy and do not disclose or use the information contained within. This email is also subject to copyright. No part of it should be reproduced, adapted or transmitted without written consent of the copyright owner. The contents of this email may be a private communication and not representative of the views of Port Stephens Council. Emails may be interfered with, may contain computer viruses or other defects and may not be successfully replicated on other systems. We give no warranties in relation to these matters. If you have any doubts about the authenticity of an email purportedly sent by us, please contact Port Stephens Council immediately.

Director-General's Requirements Compliance Table
Industrial Development – Tomago Road, Tomago

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
GENERAL REQUIREMENTS:			
	The Environmental Assessment must include:		
1.	Executive summary	Included at Section 1	**Yes**
2.	A detailed description of the project, including the:		
	• Need for the project;	Included at Section 4	**Yes**
	• Alternatives considered; and	Included at Section 4	**Yes**
	• Various components and stages of the project;	Included at Section 4	**Yes**
3.	Consideration of any relevant statutory provisions;	Included at Section 5 and 7	**Yes**
4.	A general overview of the environmental impacts of the project, identifying the key issues for further assessment, and taking into consideration any issues raised during consultation;	Included at Section 7	**Yes**
5.	A detailed assessment of the key issues specified below, and any other significant issues identified in the general overview of environmental impacts of the project (see above), which includes:		
	• A description of the existing environment; and	Included at Section 3	**Yes**
	• An assessment of the potential impacts of all components of the project, including any cumulative impacts from other industrial developments in the area;	Included at Section 7	**Yes**
6.	A description of the measures that would be implemented to avoid, minimize, mitigate, offset, manage and/or monitor the impacts of the project;	Included at Sections 7 & 8 (and relevant reports attached as appendices)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
7.	A draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures;	Included at Section 8	**Yes**
8.	A conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and the benefits of the project; and	Included at Section 9	**Yes**
9.	A signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading.	Included at Section 2	**Yes**
KEY ISSUES:			
1.	**Flora and Fauna** - including:		
	• Impacts on threatened species, population or ecological communities, critical habitat (including riparian habitat) and native vegetation generally, and in particular;	Included at Section 7 (and flora and fauna report attached at Appendix J)	**Yes**
	- impacts on species listed under Section 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999;*	Included at Section 7(and flora and fauna report attached at Appendix J and EPBC Assessment attached at Appendix I)	**Yes**
	- impacts on migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999;*	Included at Section 7(and flora and fauna report attached at Appendix J)	**Yes**
	- impacts on RAMSAR wetlands, particularly the Hunter Estuary Wetlands; and	Included at Section 7(and flora and fauna report attached at Appendix J)	**Yes**
	• proposed offset measures to avoid or mitigate any significant impacts;	Included at Section 7(and flora and fauna report attached at Appendix J and EPBC Assessment attached at Appendix I)	**Yes**
2.	**Water and Soils** - including:		

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	• details of the quantity of fill required for the site and proposed source(s) of the fill;	Included at Section 4	**Yes**
	• a water balance for the site detailing water sources, water consumption, water recycling, the quantity and quality of waste water streams and the impact of any water release from the site on surface water and groundwater;	Included at Section 7 (and Concept Engineering, Servicing & Stormwater Management report attached at Appendix F)	**Yes**
	• an assessment of flooding impacts associated with the proposal including details of the flood liability of the site and changes to flooding behavior;	Included at Section 7 (and Flood Report attached at Appendix L)	**Yes**
	• proposed erosion and sediment controls (during construction) and the proposed stormwater management system (during operations);	Included at Section 7 (and Concept Engineering, Servicing & Stormwater Management report attached at Appendix F)	**Yes**
	• proposed management measures for containment of pollutants; and	Included at Section 7	**Yes**
	• soil contamination.	Included at Section 7	**Yes**
3.	**Traffic** - including:		
	• details of the traffic volumes likely to be generated during construction and operation;	Included at Section 7 (and Traffic Report attached at Appendix G)	**Yes**
	• an assessment of the predicted impacts of this traffic on the safety and capacity of the surrounding road network; and	Included at Section 7 (and Traffic Report attached at Appendix G)	**Yes**
	• details of measures to minimize conflicts between heavy and light vehicles on site.	Included in the description of the development at Section 4 and Section 7 (and Traffic Report attached at Appendix G)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
4.	**Noise** - including construction, operation and traffic.	Included at Section 7 (and Acoustic Report attached at Appendix 0)	**Yes**
5.	**Air Quality** - during construction and operation, as well as greenhouse gas emissions;	Included at Section 7	**Yes**
6.	**Visual** - including landscaping, design (scale, height and bulk), signage and lighting.	Included at Section 7	**Yes**
7.	**Waste Management** - including the quantity and type of all liquid and solid waste to be generated at the site and a description of how this waste would be handled, processed and, if necessary, disposed of.	Included at Section 7	**Yes**
8.	**Hazards and Risk** - including:		
	• An assessment of the potential hazards and risks associated with the proposed project;	Included at Section 7	**Yes**
	• A preliminary risk screening in accordance with *State Environmental Planning Policy No. 33 - Hazardous and Offensive Development* (SEPP 33) and *Applying SEPP 33* (DUAP, 1994) and where necessary, a Preliminary Hazard Analysis (PHA) undertaken.	Included at Section 7	**Yes**
9.	**Heritage** - Aboriginal and European.	Included at Section 7 (and Archaeological Report attached at Appendix P)	**Yes**
CONSULTATION:			
	During the preparation of the Environmental Assessment, you should consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised must be		

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	described in the Environmental Assessment.		
	In particular you should consult with: • Commonwealth Department of Environment and Water Resources;	Completed as part of referral mechanism under EPBC. Advice received that the project is a controlled action and the EAR address the relevant EPBC requirements in Section 7 (see attached Flora & Fauna report at Appendix J See EBPC Assessment Report at Appendix I	**Yes**
	• Roads and Traffic Authority;	Included at Section 6	**Yes**
	• Department of Environment and Climate Change;	Included at Section 6	**Yes**
	• Hunter Water Corporation; and	Included at Section 6	**Yes**
	• Port Stephens Council.	Included at Section 6	**Yes**
DECC's ENVIRONMENTAL ASSESSMENT REQUIREMENTS:			
1.	**The DECC considers the key issues that the proponent should address in the EA to be:**		
	• Flora and fauna impact including the impacts on threatened species and their habitat. The assessment should include a description of measures taken to minimize potential impacts and actions that will be taken to avoid or mitigate environmental impacts, or compensatory measures to offset any unavoidable impacts.	Included at Section 7 (and Flora & Fauna Report attached at Appendix J)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	• Impacts on Aboriginal cultural heritage, including a description of actions that will be taken to avoid or mitigate impacts or compensate unavoidable impacts. The EA should demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts and developing options to minimize or mitigate impacts.	Included at Section 7 (and Archaeological Report attached at Appendix P)	**Yes**
	• The site is adjacent to valuable groundwater reserves and the DECC expects that particular attention will be paid to assessing and mitigating the impact of the proposed development on those resources.	Included at Section 7 (and Concept Engineering, Servicing and Stormwater Management Report attached at Appendix F)	**Yes**
2.	**The key requirements include the following:**		
	Impacts on threatened species and their habitat:		
	• A field survey of the site should be conducted and documented in accordance with the gazetted draft *Guideline for Threatened Species Assessment*.	Included at Section 7 (and Flora & Fauna Report attached at Appendix J)	**Yes**
	• Likely impacts on threatened species and their habitat need to be assessed, evaluated and reported on. The assessment should specifically report on the considerations listed in Step 3 of the draft guideline.	Included at Section 7 (and Flora & Fauna Report attached at Appendix J)	**Yes**
	• Describe the actions that will be taken to avoid or mitigate impacts or compensate for unavoidable impacts of the project on threatened species and their habitat. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	Included at Section 7 (and Flora & Fauna Report attached at Appendix J and Concept Engineering, Servicing and Stormwater Management Report at Appendix F)	**Yes**
	• The EA needs to clearly state whether it meets each of the key thresholds set out in Step 5 of the guideline.	Included at Section 7 (and Flora & Fauna Report attached at Appendix J)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
2.	**Impacts on Aboriginal cultural heritage values:**		
	• The EA should address and document the information requirements set out in the draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* involving surveys and consultation with the Aboriginal community.	Included at Section 7 (and Archaeological Report attached at Appendix P)	**Yes**
	• Identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area.	Included at Section 7 (and Archaeological Report attached at Appendix P)	**Yes**
	• Describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on Aboriginal cultural heritage. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	Included at Section 7 (and Archaeological Report attached at Appendix P)	**Yes**
	• The EA needs to clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations.	Included at Section 7 (and Archaeological Report attached at Appendix P)	**Yes**
RTA ENVIRONMENTAL ASSESSMENT REQUIREMENTS:			
1.	The RTA's requirements for the environmental impact assessment primarily relate to traffic generation to / from the site. In this regard the following guidelines would apply:		
	• DIPNR (Department of Infrastructure, Planning and Natural Resources) Environmental Impact Statement Guidelines - *Roads and Related Facilities* (Transportation and Traffic Issues)	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	• Roads and Traffic Authority's *Guide to Traffic Generating Developments*	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
	• EPA's *Environmental Criteria for Road Traffic Noise*.	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
2.	Specifically, in relation to the proposed development the RTA would require the following:		**Yes**
	• A traffic study prepared in accordance with the RTA's *Guide to Traffic Generating Developments* when considering a formal application. The study should include (but not be limited to) the following:	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
	- identify all relevant vehicular traffic routes and intersections for access to / from the subject areas;	Included at Section 7 (and Traffic report attached at Appendix K)	**Yes**
	- current traffic counts for all of the above traffic routes and intersections;	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
	- the anticipated vehicular traffic generated from the proposed development;	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
	- consideration of the traffic impact on the existing intersections and the capacity of Tomago Road and its intersections to safely and efficiently cater for the additional vehicular traffic generated.	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
	- Any staging of the development should be considered to determine the infrastructure requirements over time. Particularly, the RTA would require the applicant to clearly outline the intended road infrastructure works for both the site filling stage, the Westrac development stage and the industrial subdivision stage. Note that it is likely the RTA would require the ultimate	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	intersection with Tomago Road to be constructed upfront.		
	- Consideration of the operation and road infrastructure requirements related to wide and long load haulage from the area.	Included at Section 7 (and Traffic report attached at Appendix G)	**Yes**
	• The applicant should note that the property is subject to road widening. It is expected that the land is dedicated at no cost to the RTA or Council.	The RTA's position on this issue is noted	**-**
PORT STEPHENS COUNCIL ENVIRONMENTAL ASSESSMENT REQUIREMENTS:			
1.	**It is Council's expectation that the following issues will be considered:**		
	• Provisions of the PS LEP 2000 and DCPs where relevant;	The Port Stephens LEP and DCP 2007 are not applicable to the proposed development. Notwithstanding this consideration has been given to their objectives in establishing the proposed development	**N/A**
	• Suitability of the site – inclusive of Acid Sulphate Soils (Classes 3 & 4);	Included at Section 7 (and attached Geotechnical – Appendix M and Contamination reports Appendix N)	**Yes**
	• Access – the RTA is the authority for access on Tomago Road;	Noted	**-**
	• Bushfire – land is identified as being partly affected by bushfire;	The proposed development when constructed will not be the subject of unreasonable bushfire threat having regard to the lack of relevant vegetation to pose a threat. A Bushfire Safety Authority if not required	**N/A**
	• SEPP 74 – land is within area identified by the SEPP;	This particular SEPP is of no particular relevance to the proposed development	**N/A**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	• SEPP 71 – land is within coastal protection area;	Included at Section 7	**Yes**
	• Flora & Fauna – need to address flora and fauna issues inclusive of SEPP 14 Wetlands (located in proximity to the land) and National Park (adjoining the land) and endangered ecological communities identified over the land;	Included at Section 7 (and Flora & Fauna report attached at Appendix J)	**Yes**
	• Comprehensive Koala Plan of Management – need to address as part of the flora and fauna assessment;	Included at Section 7 (and Flora & Fauna report attached at Appendix J)	**Yes**
	• Land is within the Hunter Water Corporation – Special Areas;	The Hunter Water Special Area has been addressed at Section 7 (and in detail in the Concept Engineering, Servicing and Stormwater Management Report attached at Appendix F)	**Yes**
	• Land is identified as Flood Prone Land and adjoins Proclaimed Flood Plain;	Noted and dealt with at Section 7 (and Flood Report attached at Appendix K)	**Yes**
	• Prime Agricultural Land – land is identified as within Prime Agricultural Land;	This issue has been addressed as part of the rezoning of the whole of the lands within the vicinity from rural to industrial and conservation. Accordingly the proposed development is considered to have no significant impact on the strategic supply and availability of rural lands	**Yes**
	• Land is within Buffer Area to Tomago Aluminium;	Noted, no particular consideration is required relative to the proposed development	**Yes**
	• Heritage – land is within proximity to a Heritage Item as identified in LEP 2000;	Noted, the proposed development is located a significant distance from any Heritage Item and no impacts could result	**Yes**
	• Effluent disposal – the need exists for sewer to be made available given the scale of development and associated environmental constraints over the land;	Sewerage disposal is addressed at Section 7 (and Concept Engineering, Servicing and Stormwater Management Report at Appendix F)	**Yes**
	• Drainage – need to consider stormwater disposal and water quality strategies and the issue of legal discharge of stormwater onto adjoining properties;	Included at Section 7 (and Concept Engineering, Servicing & Stormwater Management report at Appendix F)	**Yes**

Item	Environmental Assessment Requirement	Environmental Assessment Report Location / Comments	Compliance
	• Construction Management Plan is necessary inclusive of Waste Management during and after construction;	A construction Management Plan will be prepared prior to construction.	**Yes**
	• Sediment & Erosion Control – suggest consideration be given to staging and the management of potential impacts associated with disturbed areas of development site;	Included at Section 7 (and Concept Engineering, Servicing and Stormwater Management Report at Appendix F)	**Yes**
	• Land fill – need to ensure landfill material proposed for the development is VENM with consideration given to source of landfill and necessary approvals required to essentially extract or obtain such a volume of landfill material proposed to be deposited on the land;	Included at Section 4 & 7 (and Concept Engineering, Servicing & Stormwater Management Report at Appendix F)	**Yes**
	• Vector Management Plan – suggest the need for preparation of a Vector Management Plan given the location of the site;	A vector management plan can be prepared prior to construction	**Yes**
	• Assume S94A would be applicable for the scale of development with the need for road haulage levy contributions; and	Noted, to be determined by Consent Authority	**Yes**
	• Subdivision – consider geometric road design and lot layout in accordance with Port Stephens DCP 2007, creation of energy efficient allotments / developments, consideration of design controls for future development on lots to assist in promoting high quality development outcomes, landscaping inclusive of street tree plantings and detention basin landscaping requirements and the need for street lighting consideration.	It is noted that the DCP does not apply in a statutory sense however the proposed subdivision layout has taken account of the various requirements of the DCP	**Yes**

Appendix C

DEPOSITED PLANS

PLAN FORM 2 — Plan Drawing only to appear in this space — * OFFICE USE ONLY

DP 774440

Registered: 5.5.1988

C.A.:

Title System: OLD SYSTEM

Purpose: PA 60547

Ref. Map: 16365-9

Last Plan:

PLAN OF PART OF PORTION 16 BEING THE LAND IN CONV. No 91 BOOK 3165

Reduction Ratio 1: 4000 — Lengths are in metres

Metropolitan Water/Shire County: PORT STEPHENS

Locality: TOMAGO

Parish: STOCKTON

County: GLOUCESTER

(Delete if inapplicable)

I, WILLIAM SYDNEY PARKER of PALMER BRUYN & HALPOLE - HRMC 6X3955

a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that the survey represented in this Plan

is accurate and has been carried out under my immediate supervision in accordance with the Survey Practice Regulations, 1933, and was completed on 13-5-1983

Signature: [signature]

Surveyor registered under Surveyors Act, 1929, as amended

Datum Line of Azimuth: A to B

*Strike out whichever is inapplicable. Insert date of survey.

Parish for use only for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to user.

Signatures and seals only.

Council Clerk's Certificate

I hereby certify that *

(a) the requirements of the Local Government Act, 1919 (other than the requirement for the registration of plans), and

*(b) the requirements of section 340 of the Metropolitan Water, Sewerage and Drainage Act, 1924, as amended, (Hunter District Water, Sewerage and Drainage Act, 1938, as amended)

have been complied with by the applicant in relation to the proposed (Insert "new road", "subdivision" or "consolidation lot") set out herein

Subdivision No.

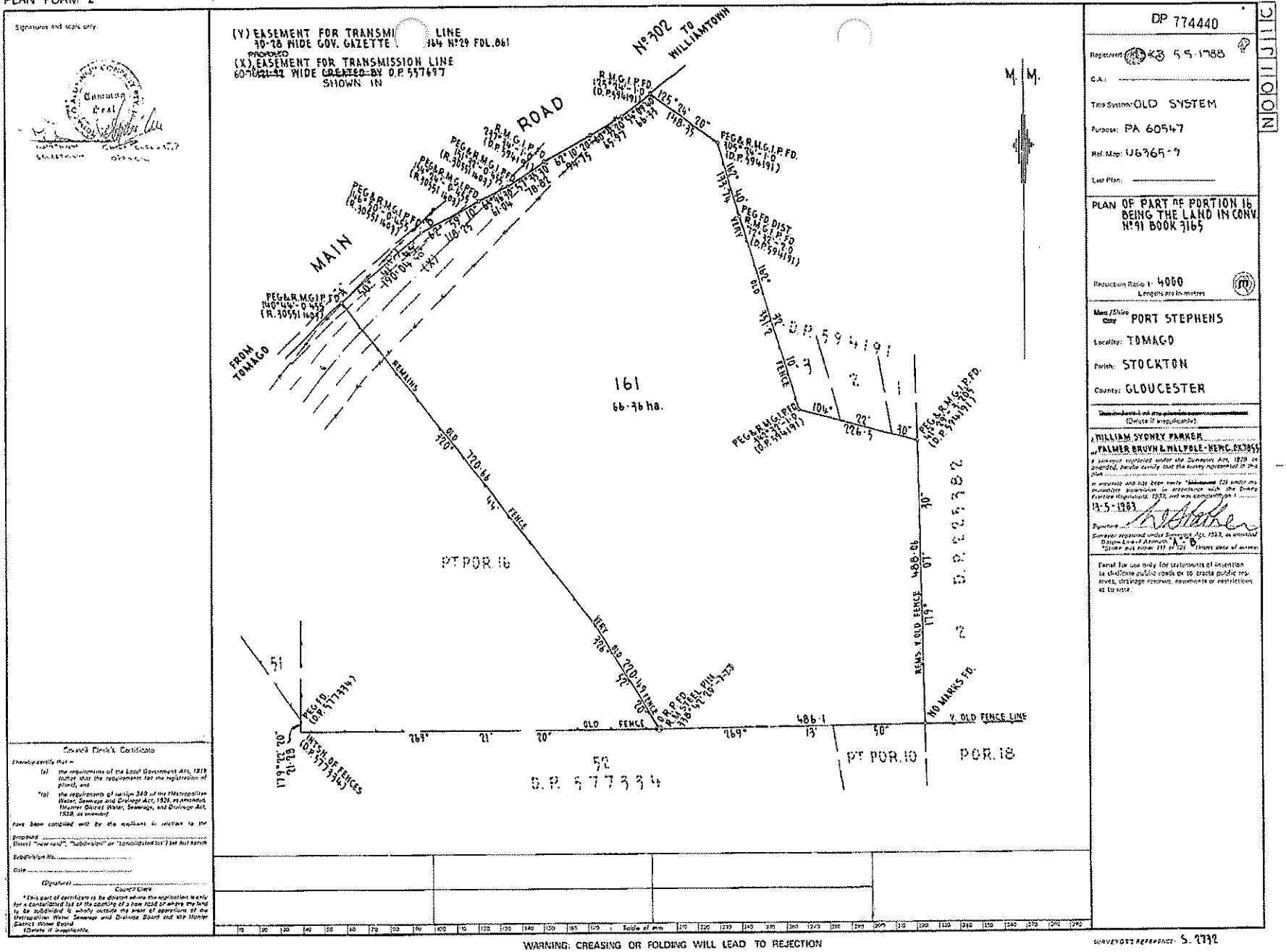
Date

(Signature)

Council Clerk

*This part of certificate to be deleted where the application is only for a consolidated lot or the opening of a new road or where the land is to be subdivided is wholly outside the area of operations of the Metropolitan Water, Sewerage and Drainage Board and the Hunter District Water Board.

(Delete if inapplicable.)



WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

SURVEYOR'S REFERENCE: S. 2772

10 20 30 40 50 60 70 Table of mm 110 120 130 140

This negative is a photograph made as a permanent record of a document in the custody of the Registrar General this day. 9th May, 1988

Req:R727515 /Doc:DP 0774440 P /Rev:28-Oct-1992 /Sts:OK.OK /Prt:16-Oct-2006 10:08 /Pgs:ALL /Seq:1 of 1
Ref:11886 /Src:M

PLAN FORM 1

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

*OFFICE USE ONLY

Council Clerk's Certificate

I hereby certify that:

(a) the requirements of the Local Government Act, 1919 (other than the requirement for the registration of plans), and

*(b) the requirements of section 349 of the ~~Metropolitan Water, Sewerage and Drainage Act, 1924, as amended,~~ Hunter District Water, Sewerage, and Drainage Act, 1938, as amended,

have been complied with by the applicant in relation to the proposed Subdivision

(Insert "new road", "subdivision" or "consolidated lot") set out herein

Subdivision No. 78/6

Date 21.2.78

(Signature) Council Clerk

*This part of certificate to be deleted where the application is only for a consolidated lot or the opening of a new road or where the land to be subdivided is wholly outside the area of operations of the Metropolitan Water, Sewerage and Drainage Board and the Hunter District Water Board (Delete if inapplicable)

Surveyor's Certificate

I, MICHAEL FG SHAW

of 3 MACKENZIE ST. MOREE

a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that the survey represented in this plan

is accurate and has been made *(1) ~~.....~~ (2) under my immediate supervision in accordance with the Survey Practice Regulations, 1933, and was completed on

3-12-1977

Signature

Surveyor registered under Surveyors Act, 1929, as amended.

Datum Line of Azimuth: X-Y R30551-1603

*Strike out either (1) or (2). †Insert date of survey.

PART OF

PLAN OF SUBDIVISION OF LAND IN ~~PT~~ CONV. No. 14 BOOK 2723

*Mun/Shire/~~City~~: PORT STEPHENS

Locality: TOMAGO

Parish: STOCKTON

County: GLOUCESTER

Reduction Ratio 1:1000

Lengths are in metres

D.P. 597372

Registered: 10-10-1978

C.A.: No. 78/6 OF 21-2-1978

Title System: OLD SYSTEM

Purpose: SUBDIVISION

Ref. Map: U6365-9

Last Plan:

INCIDENTS

Signatures, seals and statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to user.

A. Graham

A. Graham

EASEMENT FOR TRANSMISSION LINE 30.48 WIDE (NOTO GAZ. OF 13-3-1964 No 29 FOL. 861)

PROPOSED EASEMENT FOR TRANSMISSION LINE 121.92 WIDE (DP 557697)

M.M.

DP 597372

MAIN ROAD No 302

VARIABLE WIDTH

46.06

50

33

85.23

51

PEG FD (FD 86)

20.115

322°

PEG & RM CONC BUK FD (R30551-1603) 142° 20' 0.455

OLD 20

49.29

3.8 FCE

10

PEG FD (FD 38)

322°

44.89

(764)

PEG & RM GIPFD (R30551-1603) Y 136° 55' 35" 0.455

RM GIPIPE SET 341° 34' 0.455

PT. POR. 16

1

8143 m²

127

95.29

℄ OF EXISTING POWER POLES

86.57

OLD MIXED WIRE FCE.

℄ 23° 25' 40"

Table of mm

SURVEYOR'S REFERENCE MAITLAND 4

Plan Drawing only to appear in this space

Plan Drawing only to appear in this space

I, Bruce Richard Davies, Registrar General for New South Wales, certify that this negative is a photograph made as a permanent record of a document in my custody this 13th day of October, 1978

Req:R727532 /Doc:DP 0597372 P /Rev:05-Sep-1992 /Sts:OK.OK /Prt:16-Oct-2006 10:09 /Pgs:ALL /Seq:1 of 1
Ref:11886 /Src:M

PLAN FORM 2

Plan Drawing only to appear in this space

DP585256 OFFICE USE ONLY

D.P. 585256

Registered: 10-2-1977

D.A. No. 76/20 OF 16-6-1976

Title System: TORRENS & CAD SYSTEM

Purpose: SUBDIVISION

Ref. Map: U6365-9

Last Plan: D.P. 37876* / D.P. 577334 (D.P. 37076)

PLAN OF SUBDIVISION OF LOT 51 D.P. 577334 & PT. POR. 16.

Reduction Ratio 1:1000

Lengths are in metres

Local Government Area / Shire: PORT STEPHENS

Locality: TOMAGO

Parish: STOCKTON

County: GLOUCESTER

(Delete if inapplicable)

I, IAN GEORGE MARLER, LEIGHTON & HUTCHISON PTY LTD of 56 WATT ST., NEWCASTLE

a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that the survey represented in this plan is accurate and has been made by me or under my immediate supervision in accordance with the Survey Practice Regulations, 1933 and was completed on 31 MAY 1976

Signature: [signature]

Surveyor registered under Surveyors Act, 1929, as amended

Date of Survey: 31/5/76

*Delete one of (a) or (b) *Insert date of survey

Parcels for use only for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to user.

PURSUANT TO SEC 88A OF THE CONVEYANCING ACT 1919-84, IT IS INTENDED TO CREATE:

(1) RESTRICTION AS TO USER

SURVEYOR'S REFERENCE: 2889

Signatures and seals only

W. Burroughs

A. Graham

M. J. Graham

Council Clerk's Certificate

I hereby certify that –

(a) the requirements of the Local Government Act, 1919 (other than the requirements for the registration of plans), and

(b) the requirements of section 348 of the Hunter Water Board (Constitution) Act, 1991, as amended, the Hunter District Water Board (Water, Sewerage and Drainage) Act, 1938, as amended

have been complied with by the applicant in relation to the proposed Subdivision (Whether "new road", "subdivision" or "consolidation lot") set out hereon

Subdivision No. 76/20

Date 16 June 1976

(Signature) [signature] Council Clerk

*This part of certificate to be deleted where the application is only for a consolidation lot or the opening of a new road or where the land is to be subdivided in whole within the areas of operations of the Metropolitan Water Sewerage and Drainage Board and the Hunter District Water Board.

(Delete if inapplicable)

M.P.O.

MAIN ROAD

No. 302

PT. POR. 16

511 (3005m² by DEDN)

512 (900m² by DEDN)

RM GIP

PG & RH FD GIP (SCP 37-1) (D.P. 577334)

RH FD GIP (SCP 29-1) (D.P. 577334)

RH FD GIP (SCP 30-1) (D.P. 577334)

231°

115.45 BY DEDN

10.43

10.43

85.46

100.58 BY DEDN

33.69

10.43

180.01 BY DEDN

512°

400°

100.58 (100.58)

(41.32)

D.P. 577334

(X) EASEMENT FOR TRANSMISSION LINE (CREATED BY D.P. 551648) 121.92 WIDE

ϕ EASEMENT FOR TRANSMISSION LINE 30.48 WIDE (Y) (NOT IN CAT. OF 13-12-1944 No. 29 Post Bdy)

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

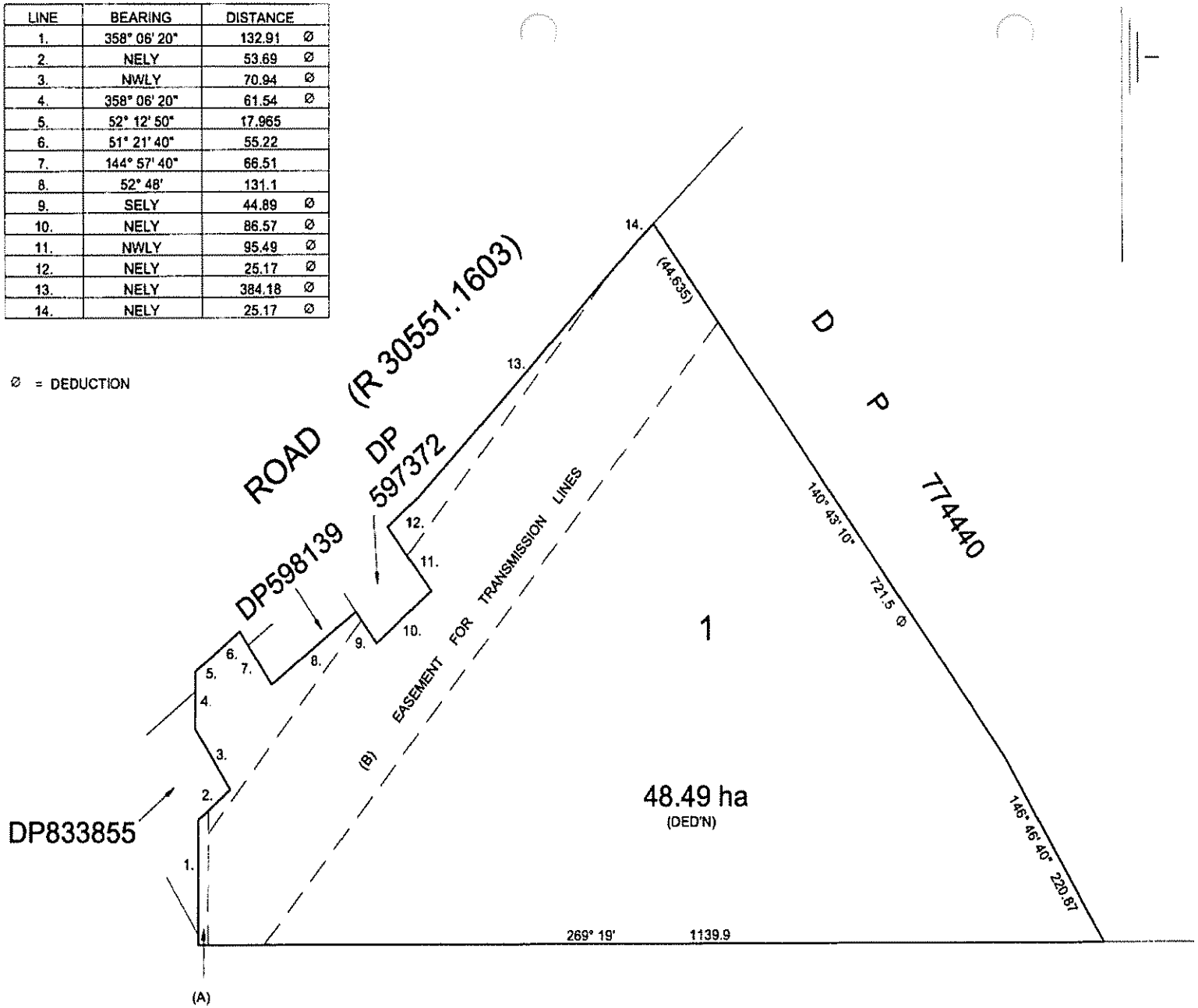
I, Bruce Richard Dowley, Registrar General for New South Wales, certify that this negative is a photograph made as a permanent record of a document in my custody this 11th day of February, 1977

[signature]

D 585256 DP 0585256 P /Rev:05-Sep-1992 /Sts:OK.OK /Prt:16-Oct-2006 10:11 /Pgs:ALL /Seq:1 of 1
Req:R727551 /Doc:DP 0585256 P /Rev:05-Sep-1992 /Sts:OK.OK /Prt:16-Oct-2006 10:11 /Pgs:ALL /Seq:1 of 1
Ref:11886 /Src:M

LINE	BEARING	DISTANCE	
1.	358° 06' 20"	132.91	Ø
2.	NELY	53.69	Ø
3.	NWLY	70.94	Ø
4.	358° 06' 20"	61.54	Ø
5.	52° 12' 50"	17.965	
6.	51° 21' 40"	55.22	
7.	144° 57' 40"	66.51	
8.	52° 48'	131.1	
9.	SELY	44.89	Ø
10.	NELY	86.57	Ø
11.	NWLY	95.49	Ø
12.	NELY	25.17	Ø
13.	NELY	384.18	Ø
14.	NELY	25.17	Ø

Ø = DEDUCTION



(A) EASEMENT TO DRAIN WATER 10 WIDE - BK 3887 NO 834
(B) EASEMENT FOR TRANSMISSION LINES 60.96 WIDE - DP557697

DP 1003492

Registered: 29.6.1999

Title System: OLD SYSTEM

Purpose: LIMITED TITLE CREATION

Ref. Map: U6365-9

Last Plan:

C.A. 80082

PLAN OF LAND COMPRISED IN

DEED BK. 4239 NO. 226

Lengths are in metres. Reduction Ratio - NTS

L.G.A.: PORT STEPHENS

LOCALITY: TOMAGO

PARISH: STOCKTON

COUNTY: GLOUCESTER

THIS PLAN WAS PREPARED SOLELY TO IDENTIFY THE LAND IN THE ABOVE DEED AND THE BOUNDARIES HAVE NOT BEEN INVESTIGATED BY THE REGISTRAR GENERAL

THIS PLAN IS NOT A CURRENT PLAN IN TERMS OF SEC. 7A CONVEYANCING ACT, 1919.

Req:R727541 /Doc:DP 1003492 P /Rev:26-Jul-1999 /Sts:OK.OK /Prt:16-Oct-2006 10:10 /Pgs:ALL /Seq:1 of 1
Ref:11886 /Src:M
1003492

Appendix D

CERTIFICATES OF TITLE

Information Provided Through
RH Landsearch P/L
Ph. 0411620648 *Fax.*

Title Search

EziSearch
An Approved LPI *NSW*
Information Broker

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 513/585256

SEARCH DATE	TIME	EDITION NO	DATE
21/11/2007	9:48 AM	5	9/7/2007

LAND

LOT 513 IN DEPOSITED PLAN 585256
AT TOMAGO
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF STOCKTON COUNTY OF GLOUCESTER
TITLE DIAGRAM DP585256

FIRST SCHEDULE

REDLAKE ENTERPRISES PTY LTD (T AD234548)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE MEMORANDUM S700000A
2 DP577334 EASEMENT TO DRAIN WATER APPURTENANT TO THE LAND ABOVE DESCRIBED

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

11886 PRINTED ON 21/11/2007

Information Provided Through
RH Landsearch P/L
Ph. 0411620648 *Fax.*

Title Search

EziSearch
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Information Broker

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 1/597372

SEARCH DATE	TIME	EDITION NO	DATE
21/11/2007	9:40 AM	6	23/7/2007

LAND

LOT 1 IN DEPOSITED PLAN 597372
AT TOMAGO
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF STOCKTON COUNTY OF GLOUCESTER
TITLE DIAGRAM DP597372

FIRST SCHEDULE

REDLAKE ENTERPRISES PTY LTD (T AD234575)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE MEMORANDUM S700000A
2 GOV GAZ 13-3-1964 FOL 861 EASEMENT FOR TRANSMISSION LINE AFFECTING THE LAND SHOWN SO BURDENED IN DP597372
O247920 EASEMENT VESTED IN SHORTLAND ELECTRICITY

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

11886 PRINTED ON 21/11/2007

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Title Search

EziSearch
An Approved LPI *NSW*
Information Broker

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 1/1003492

SEARCH DATE	TIME	EDITION NO	DATE
21/11/2007	9:43 AM	4	9/7/2007

LAND

LOT 1 IN DEPOSITED PLAN 1003492
AT TOMAGO
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF STOCKTON COUNTY OF GLOUCESTER
TITLE DIAGRAM DP1003492

FIRST SCHEDULE

REDLAKE ENTERPRISES PTY LTD (T AD234548)

SECOND SCHEDULE (4 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE MEMORANDUM S700000A
2 LIMITED TITLE. LIMITATION PURSUANT TO SECTION 28T(4) OF THE REAL PROPERTY ACT, 1900. THE BOUNDARIES OF THE LAND COMPRISED HEREIN HAVE NOT BEEN INVESTIGATED BY THE REGISTRAR GENERAL.
3 BK 3887 NO 834 EASEMENT TO DRAIN WATER AFFECTING THE PART OF THE LAND ABOVE DESCRIBED DESIGNATED (A) IN THE TITLE DIAGRAM.
4 NOTIFICATION IN GOVERNMENT GAZETTE DATED 19.03.1964 FOLIO 861. EASEMENT FOR TRANSMISSION LINE AFFECTING THE PART OF THE LAND ABOVE DESCRIBED SHOWN IN DP557697.

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

11886 PRINTED ON 21/11/2007

Information Provided Through
RH Landsearch P/L
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Title Search

EziSearch
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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 161/774440

SEARCH DATE	TIME	EDITION NO	DATE
21/11/2007	9:34 AM	4	23/7/2007

LAND

LOT 161 IN DEPOSITED PLAN 774440
AT TOMAGO
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF STOCKTON COUNTY OF GLOUCESTER
TITLE DIAGRAM DP774440

FIRST SCHEDULE

REDLAKE ENTERPRISES PTY LTD (T AD234575)

SECOND SCHEDULE (3 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE MEMORANDUM S700000A
2 BK 3598 NO 852 COVENANT
3 GAZ 13.3.1964 FOL 861 EASEMENT FOR TRANSMISSION LINE AFFECTING THE PART OF THE LAND ABOVE DESCRIBED SHOWN SO BURDENED IN THE TITLE DIAGRAM
O247920 EASEMENT VESTED IN SHORTLAND ELECTRICITY

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

11886 PRINTED ON 21/11/2007

Appendix E

A3 AERIAL OF SITE & SURROUNDS

Description: Proposed Development at Tomago - Site Analysis Plan

Date: November 2007
Version: A
Plan By : MJH

AutoCad: N:\11886\Dwg\11886site-4a
Our Ref: 11886

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USE OF THE PLAN AND INFORMATION IT CONTAINS FOR ANY OTHER PURPOSE IS NOT PERMITTED UNLESS PRIOR WRITTEN APPROVAL HAS BEEN OBTAINED FROM ASQUITH & DEWITT Pty Ltd.

0 100 200 300 400 500 600 800 1000 1500 2000

Bar Scale 1: 20000 (A3)

LEGEND

- SEPP 14 WETLAND AREA
- RAMSAR WETLAND AREA
- SAND LANDSCAPE
- SITE BOUNDARY
- EXISTING INDUSTRIAL AREA
- EXTENT OF STATE SIGNIFICANT SITE

ASQUITH & deWITT PTY LTD
SURVEYING, PLANNING, MAPPING
PROPERTY DEVELOPMENT MANAGERS

N

AsquithdeW.tif

ENVIRONMENTAL PROTECTION WATER CATCHMENT
ROAD
TO AIRPORT
1 D.P.597372
ALUMINIUM SMELTER
513 D.P.585256
SAND LANDSCAPE
D.P. 1003492
161
PASTURE GRASSES
1 PASTURE GRASSES
74440
LOW LYING AREA
NPWS BOUNDARY
TOMAGO
TO PACIFIC HIGHWAY
OLD CHURCH
TOMAGO HOUSE
ESTUARINE LANDSCAPE
NPWS LAND
HUNTER RIVER
FULLERTON COVE

FIGURE 3

Asquith & deWitt Pty. Ltd. 7 Canberra Street PO Box 179 Charlestown NSW 2290 tel: 02 4943 6111 fax: 02 4943 5955 adw@asquithdewitt.com.au ABN 31 001 431 072

Appendix F

CONCEPT ENGINEERING, SERVICING & STORMWATER MANAGEMENT REPORT

ASQUITH & deWITT PTY LTD

Volume 1 - Executive Summary - Concept Engineering, Servicing, Earthworks and Stormwater Management



Property:

Tomago Road, Tomago

Applicant:

Redlake Enterprises Pty Ltd

Version 1, November 2007

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This report has been prepared using the most up to date available survey information and current flooding analysis methods. No responsibility for loss occasioned to any person acting or refraining from action as a result of any material in this publication will be accepted by Asquith & deWitt.

Prepared by:

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Senior Environmental Engineer

Section 1.0 Introduction

Asquith & deWitt Pty Ltd has been engaged by Redlake Enterprises Pty Ltd, to complete reports on stormwater management and civil engineering requirements for the proposed development of a new WesTrac facility and industrial subdivision along Tomago Road, Tomago. This document summarises the outcomes of the following reports:

- **Volume 2 – Concept Engineering, Servicing and Earthworks Report – Overall;**
- **Volume 3 – Stormwater Report – WesTrac facility; and**
- **Volume 4 – Stormwater Report – Industrial Subdivision.**

Further detail of all issues can be found in the above documents.

Section 2.0 Stormwater Management

The stormwater management system for both the WesTrac facility and Industrial Subdivision have been designed to achieve a 'no impact' objective and to acknowledge and incorporate the requirements of DGRs, Hunter Water Corporation (HWC) requirements, the series of Department of Environment and Conservation NSW (DECC) stormwater manuals and Council's development control plans. Included in the development of the system were an assessment of water quality, quantity and volume of stormwater runoff discharging to the downstream receiving waters both pre and post development.

The stormwater management system for the WesTrac facility, is described in Volume 3 of **Appendix F**. With knowledge gained from water reuse at existing sites, an in house water balance model was established to track water balance of the operations through the WesTrac facility. The model was simulated on a daily time step basis, over a 30 year period, using Williamtown rainfall and evaporation data. The analysis period included the driest and wettest years of rainfall on record for Williamtown. The average yearly rainfall for the analysis period was equivalent to the long term average for Williamtown. The results of the water balance modelling indicate that with between 1-5ML of rainwater tank storage, water recycling and reuse to levels of between 82.5% and 99.2% respectively, can be achieved.

HWC required that the stormwater management system acknowledge the Special Area, connected to the Tomago Sandbed groundwater reserves. The water balance model was used to demonstrate no impact on recharge volumes to the aquifer system and consequently a slight positive impact was demonstrated. That is, groundwater recharge would be increased following development.

The water balance model was used to track stormwater runoff volumes to the wetlands downstream over the 30 year analysis period. The model indicated good agreement of runoff volumes to the wetland pre and post development for demonstration of 'no impact'. Further analysis also revealed consistency of volumes, on a yearly basis through wet and dry periods, for pre and post development simulations. A MUSIC model was established to verify the quality of the runoff to the wetlands for 'no impact', post development. The pollutant levels in runoff were measured for the catchment as an existing, pre European settlement catchment and used as target objectives for the pollutant levels post development. This is a significantly high level of protection from runoff pollutants to the wetlands downstream, exceeding DECC target levels. A treatment train of gross pollutant trap, swale and constructed wetland was sized to meet the target objective, verified with MUSIC. The Treatment Train Effectiveness from the simulation indicated pollutant removal levels for TSS, TP and TN of 99.8%, 98.7% and 96.5% respectively. By comparison, DECC required TSS – 85%, TP-65% and TN-45%.

The stormwater management system for the Industrial Subdivision, is described in Volume 4 of **Appendix F**. Based on the subdivision layout by Asquith & deWitt, there are three (3) basin locations for constructed wetlands. Modelling for water quality, quantity and reuse was on the basis of 95% imperviousness of the lots.

MUSIC was used to model water quality, volumes and reuse. Similarly, to the MUSIC model of stormwater from the WesTrac site, the pollutant levels in runoff were measured for the catchment as an existing, pre European settlement catchment and used as target objectives for the pollutant levels post development. This is a significantly high level of protection from runoff pollutants to the wetlands downstream, exceeding DECC target levels. A treatment train of rainwater tanks with reuse, gross pollutant traps, swales and constructed wetlands were sized to meet the target objective, verified with MUSIC. The Treatment Train Effectiveness from the simulation indicated pollutant removal levels for TSS, TP and TN of 99.8%, 98.7% and 98.3% respectively. By comparison, DECC required TSS – 85%, TP-65% and TN-45%. The post development flow volumes of 42.4ML/year from the site were also shown to be close by comparison to existing flow volumes of 49.5ML/year.

Peak flows for the development were modelled using XP-RAFTS. Modelling was undertaken for matching post development peak flows to pre development peak flow levels for the standard design storm recurrence intervals of 1, 2, 5, 10, 20, 50, 100 year storm events. Modelling indicated that detention volumes of 14,334m^3, 17,362m^3 and 8,975m^3 are required for the three (3) basins respectively to attenuate post development peak flows to pre development levels.

It has been demonstrated in this report that the stormwater management system for the WesTrac facility and Industrial Subdivision have both achieved the target objective of 'no impact', exceeding the requirements outlined in the most current DECC stormwater manuals and Council's development control plans. The stormwater management system also meets the requirements of DGRs and HWC correspondence to date.

Erosion and sediment controls, described in a Soil and Water Management Plan are necessary during construction for the protection of receiving waters downstream. To be conservative, a higher criteria level of protection has been adopted for the design sizing of the sediment basins for the site. At this site the 95thpercentile, 5 day rainfall event has been selected, which is approximately 3 times the storage volume of that generated by using the 75th percentile, 5 day rainfall event typically used for development sites. This gives the basin an increased capacity, capturing runoff from a greater number of storm events. This minimises the potential risk of sediment laden water leaving the site and discharging to the wetlands downstream during construction.

Further details of the layout of sediment dams and soil and water management will be determined during the detailed design phase, in conjunction with the bulk earthworks strategy.

Section 3.0 Earthworks

Coffey Geotechnics has undertaken extensive subsurface testing of the site. This was initially commenced as part of the Due Diligence assessment undertaken prior to Redlake Enterprises Pty Limited purchasing the site. The knowledge gained from this testing has been used to devise a strategy for bulk earthworks and filling of the site for development use.

The clays over the low lying areas of the site will be susceptible to creep settlement under development load. To complete the majority of settlements as rapidly as possible prior to development commencement, preloading will be undertaken by stockpiling material as a surcharge load over the underlying clays. The surcharge fill load placed will be equivalent to the development load. Preloading is to increase settlement rates for faster consolidation of the underlying soils. The surcharge fill heights are dependent on the depth of clays, which is variable over the site. It is most likely also, that the preload process will be expedited by the installation of wick drains. Refer to Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007 in **Appendix M**.

Geotechnical advice has been provided on the fill type, directing that granular material with particles not greater than 100mm diameter is preferred for use on the site. In particular, no ash is to be used for filling; due to its leachate potential. The fill to be used must be pH neutral and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. This will mitigate any potential impacts of runoff from the fill to the wetlands. Further conditions on the specification of the fill import material have been described in Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007 in **Appendix M**.

Flood impact modelling was undertaken by Patterson Britton (2007). It was assumed in the modelling that the whole of the proposed subdivision would be filled to the peak 100 year recurrence event flood level for the Hunter River. At this level, there is no inundation of the site by flood waters. The level, for the same flood impact, can be achieved by the construction of a levee bank on the downstream perimeter boundary (southern boundary) or by bulk import of fill. Peak flood levels vary from 2.29mAHD at the western boundary to 2.14mAHD at the eastern boundary of site.

Preliminary estimates indicate that the cut/fill operations for the WesTrac facility will be in the order of 180,000m^3 to subgrade level. Fill import quantities will be in the order of 30,000m^3 subject to additional material required for preload and top-up after settlement.

The majority of the industrial subdivision site is on low-lying land at an average elevation of approximately 0.5m AHD. A preliminary estimate of the fill quantity, based on the worst-case scenario of bulk import of all fill to the peak 100 year recurrence event flood level is 1,800,000m^3.

Section 4.0 Engineering & Servicing

In view of current practice, a seagull intersection is considered the most appropriate treatment. Due to the intersection being used by large oversize vehicles, modifications to the standard RTA Road Design Guide have been required to ensure the median islands are not trafficked. This has resulted in areas having line marked chevrons and islands to allow for adequate swept path clearances. Preliminary meetings have been held with the RTA regarding the intersection.

Lead-in water servicing is required. The point of connection will be to an existing 200mm water main in Tomago Road, at the western boundary of the site. Requirements have been advised by Hunter Water Corporation in their letter dated 20 August 2007.

There is currently no sewer available to the site. Cost benefit analysis indicates that a proprietary product will be used for sewerage treatment on site. It is assumed from HWC requirements that on-site treatment, relying on transpiration beds, etc is not permitted, due to quality of effluent disposal and risk of contamination by effluent of the water reserves in the Tomago Sandbeds. On-site treatment at the site for development is differentiated from traditional methods by the use of a Membrane Bioreactor Sewage Treatment System, capable of producing water quality that is equivalent to, or better than the quality of stormwater runoff from the facility, in accordance with the Guidelines for Disposal set down by the NSW Department of Health. Furthermore, the sewerage treatment facility is located a significant distance of approximately 320 metres downstream of the Tomago Sandbeds Special Area so as to avoid risk of potential contamination at the collection point.

The Water Industry Competition Bill 2006 indicates that a privately developed treatment system is permissible. It is the necessary option for the WesTrac facility due to the timeframes within which WesTrac need the facility to be operational. It is accepted that HWC is currently reviewing overall sewer strategies for the industrial development of the Tomago area. This review will most likely be applicable to the timing of treatment for the industrial development adjacent to WesTrac, however sewerage treatment provisions will be required for WesTrac prior to HWC determining the strategy for the area.

As a minimum, the unit will be a temporary measure servicing the WesTrac facility until sewer strategy planning by HWC is complete, or alternatively, additional package units can be added to the on-site treatment package plant for later stages of the industrial subdivision if required.

Existing overhead powerlines in Tomago Road are available to service the site. There are also overhead powerlines transecting the site. Liaison with EnergyAustralia has commenced with regard to the relocation of the power to suit the development layout.

ASQUITH & deWITT PTY LTD

Volume 2 - Concept Engineering, Servicing and Earthworks Report - Overall

Property:

Tomago Road, Tomago

Applicant:

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Version 1, November 2007



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Senior Environmental Engineer

Section 1.0 Introduction

Asquith & deWitt Pty Ltd has been engaged by Redlake Enterprises Pty Ltd, to complete reports on stormwater management and civil engineering requirements for the proposed development of a new WesTrac facility and industrial subdivision along Tomago Road, Tomago.

This report, Volume 2, focuses on the concept engineering, servicing and earthworks for the development of the site.

The NSW Department of Planning issued Director General's Requirements (DGRs) on 18 September 2007. This report addresses the following DGRs for the development of the WesTrac facility as shown below in **Table 1**.

Table 1 - DGRs addressed in this Report – Volume 2

Issue	Section addressing Issue
Details of the quantity of fill required for the site and the proposed source(s) of the fill;	3.0, 3.1 & 3.2

1.1 DEVELOPMENT DESCRIPTION

An industrial subdivision is proposed on a land area of approximately 115 hectares. The land is zoned industrial and is part of an industrial zone that includes a further 250 hectares (approx.) adjoining. The lands are yet to be developed, and were previously zoned for agricultural purposes. The subdivision will include a proposed WesTrac facility in the north eastern corner of the site. Refer to **Figure 1**.

1.2 SITE DESCRIPTION

The proposed subdivision will be created from the overall subject land to be developed, of Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256. The land is located on the northern floodplain of the Hunter River, on the southern side of Tomago Road, Tomago. Topographically, the site comprises a low dunal formation up to 8.5m AHD in the northern eastern corner of the site, and a flat, low lying alluvial plain at an elevation of 0.1-1.5mAHD over the remainder of the site. Refer to **Figure 2**.

The low-lying portion of the site is waterlogged, generally covered with standing water 0.1-0.3m deep along the southern boundary of the site. Open channel farm drains have previously been excavated into the site and drain toward the Hunter River. These drains have modified the existing hydrology. Vegetation is predominantly tall, thick grasses. Refer to **Figure 2**.

Land to the south, downstream of the site is SEPP14 and RAMSAR wetlands. The RAMSAR boundary, adjoining the south eastern corner of the site, is an existing boundary determined by RAMSAR. Refer to **Figure 1**.

Section 2.0 Background Information

The following documents have been used to complete the report on stormwater management requirements for the industrial subdivision:

- Asquith & deWitt subdivision layout plan.
- "*Managing Urban Stormwater: environmental targets*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: an integrated approach*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Urban design*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Harvesting and Reuse*" April 2006, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Treatment techniques*" – Consultation draft – October 2007, 2nd edition, Department of Environment & Climate Change NSW.
- Water Industry Competition Bill 2006 – NSW Government
- "Proposed WesTrac Industrial Development – Tomago Geotechnical Assessment" GEOTSGTE20301AA-AI, 15 November 2007, Coffey Geotechnics, refer to **Appendix M**.
- "Proposed Industrial Development 197-325 Tomago Road, Tomago, NSW" Preliminary Geotechnical/Due Diligence Assessment" N09814/01-AD, 29 August 2006, Coffey Geotechnics, refer to **Appendix M**.
- "*Proposed Industrial Development at Tomago Road, Tomago flood Impact Assessment*" Issue No.2, October 2007, Patterson Britton & Partners.

Section 3.0 Earthworks Strategy

Coffey Geotechnics has undertaken extensive subsurface testing of the site. This was initially commenced as part of the Due Diligence assessment undertaken prior to Redlake Enterprises Pty Limited purchasing the site. The knowledge gained from this testing has been used to devise a strategy for bulk earthworks and filling of the site for development use.

Initially the project has been divided into two (2) stages. The first stage is to subdivide the lot to create the site for the proposed WesTrac facility in the north eastern corner of the site. The earthworks strategy for the WesTrac facility stage is described below in **Section 3.1**. The second stage is the proposed industrial subdivision, and the earthworks strategy for this is described in **Section 3.2**.

There are two (2) distinctly different soil profiles through the site for the development of the WesTrac facility. The first soil type is the aeolian dunal sands that are part of the Tomago Sandbeds, covered by the Special Area zone boundary. The second soil profile is the alluvial clays and estuarine soil types associated with the floodplains of the Hunter River. These are waterlogged clays, downstream of the Special Area draining to the Hunter River. Refer to **Figure 2**.

In summary, from Section 6.3 of Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007, located in **Appendix M of the Application**, it is described that site preparation will involve removal of all shrubs and trees, including the major root bulbs; and slashing, and removal of slashings by raking. Stripping of grasses and topsoil will not be undertaken since this will assist to bridge across the underlying saturated clays. Geotextile fabric will be used for bridging within existing open drains, wherever there is no grass root mat or where the site has become boggy during stripping.

The clays over the low lying areas of the site will be susceptible to creep settlement under development load. To complete the majority of settlements as rapidly as possible prior to development commencement, preloading will be undertaken by stockpiling material as a surcharge load over the underlying clays. The surcharge fill load placed will be equivalent to the development load. Preloading is to increase settlement rates for faster consolidation of the underlying soils. The surcharge fill heights are dependent on the depth of clays, which is variable over the site. It is most likely also, that the preload process will be expedited by the installation of wick drains. Refer to Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007 in **Appendix M of the Application**.

Geotechnical approval will be required on the fill type and its properties prior to being used on the site. This is because there can be potential impacts of leachates emanating from the fill and migrating downstream with stormwater runoff. Geotechnical advice has been provided, directing that granular material with particles not greater than 100mm diameter is preferred for use on the site. In particular, no ash is to be used for filling; due to its leachate potential. The fill to be used must be pH neutral and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. This will mitigate any potential impacts of runoff from the fill to the wetlands. Further

conditions on the specification of the fill import material have been described in Coffey Geotechnics Report GEOTSGTE20301AA-AI dated 15 November 2007 in **Appendix M of the Application**.

During the Due Diligence assessment process, suitable fill sources were located as follows:

- Hard Rock Quarries
  - -Boral Seaham
  - -Hunter Quarries
  - -Hanson Quarries
- Sands
  - -Toll Sands
  - -Anna Bay Sands
- Mine Overburden

All sources are subject to geotechnical approval for use, prior to commencement of fill operations. This is not an exhaustive list, being determined for the purpose of Due Diligence only.

Soil and water management for the undertaking of earthworks in preparation of the WesTrac facility site, and for the industrial subdivision site are detailed in **Volume 3 - Stormwater Management Report - WesTrac facility** and **Volume 4 - Stormwater Management Report - Industrial Subdivision** respectively.

3.1 WESTRAC FACILITY

The site will be filled to a minimum elevation of 2.3mAHD around the perimeter of the WesTrac facility. This is closely equivalent to the 1:100 year ARI peak regional flood level for the Hunter River, determined by Patterson Britton (2007). The low-lying clays at the southern end of the site, are at an elevation of approximately 0.5-1.5mAHD and require the addition of fill to reach 2.3mAHD. The existing elevations of the dunal sand formation, up to 8.5mAHD, are not conducive to the end use of the WesTrac facility and subsequently cut/fill operations are required for the preparation of the site.

Fill materials to be used over the low lying area will initially be won from cut operations reducing the dunal formation to the finished levels required. Preliminary estimates indicate that the cut/fill operations will be in the order of 180,000m^3 to subgrade level. Fill import quantities will be in the order of 30,000m^3 subject to additional material required for preload and top-up after settlement.

The finished levels of the fill will form a dome shape, highest in the middle of the WesTrac facility and falling to the edges. Grades will vary between 0.5-6% over the site. Finished floor levels of all buildings will be 3.5m AHD, well above the 1:100 year peak flood level for the Hunter River. Refer to **Figure 3**.

3.2 INDUSTRIAL SUBDIVISION

Flood impact modelling was undertaken by Patterson Britton (2007). It was assumed in the modelling that the whole of the proposed subdivision would be filled to the peak 100 year recurrence event flood level for the Hunter River. At this level, there is no inundation of the site by flood waters. The level, for the same flood impact, can be achieved by the construction of a levee bank on the downstream perimeter boundary (southern boundary) or by bulk import of fill. Peak flood levels vary from 2.29mAHD at the western boundary to 2.14mAHD at the eastern boundary of site.

The majority of the industrial subdivision site is on low-lying land at an average elevation of approximately 0.5m AHD. A preliminary estimate of the fill quantity, based on the worst-case scenario of bulk import of all fill to the peak 100 year recurrence event flood level is 1,800,000m^3. Refer to **Figure 4.**

Additionally there is a rectangular shaped parcel adjoining property with frontage to Tomago Road. This lot is at existing elevations of approximately 3-3.2mAHD along the rear, adjoining boundary and therefore there will be no impoundment of stormwater as a result of the fill. Refer to **Figure 4.**

Section 4.0 Servicing Requirements

4.1 INTERSECTION

Access to the site has been analysed in a Traffic Impact Study prepared by Mark Waugh Pty. Ltd. entitled "Proposed Industrial Development Tomago, NSW - Redlake Enterprises Pty Ltd Traffic Impact Statement, July 2007". This report addresses the estimated traffic demands that may be placed on the existing network by the proposed development, and makes recommendations on suitable access arrangements from the existing road network. The Traffic Impact Statement analyses the performance of a type CHR intersection to RTA/Austroads requirements. In view of current practice, a seagull intersection is considered the most appropriate treatment. Refer to **Figure 5**.

Due to the intersection being used by large oversize vehicles, modifications to the standard RTA Road Design Guide have been required to ensure the median islands are not trafficked. This has resulted in areas having line marked chevrons and islands to allow for adequate swept path clearances.

The general configuration of the proposed intersection, shown in **Figure 5** is;

- Northbound through lane
- Right turn in deceleration lane and storage
- Dedicated right turn lane out and acceleration lane
- Dedicated left turn out and acceleration lane
- Southbound through lane
- Left in deceleration and turn lane with dedicated departure lane

The above configuration was modelled by Mark Waugh in SIDRA and the results indicate that the level of service of the intersection is good up to growthed 2017 plus development traffic demands.

Preliminary meetings have been held with the RTA regarding the intersection.

4.2 WATER

Lead-in water servicing of the proposed development will be from an existing 200mm water main in Tomago Road, at the western boundary of the site. Cross connection is also to be made to the existing 500mm watermain in Tomago Road. These requirements are as advised by Hunter Water Corporation in their letter dated 20 August 2007. An indicative route is shown for the extension of the water main to the intersection. No detailed design has been commenced. Refer to **Appendix A** and **Figure 6**.

4.3 SEWER

There is currently no sewer available to the site. Liaison with Hunter Water Corporation in this regard has commenced, including a meeting between interested parties to deliberate joint share arrangements for connection and upgrade of the existing infrastructure with other large, interested parties.

Cost benefit analysis indicates that a proprietary product will be used for sewerage treatment on site. It is assumed from HWC requirements that on-site treatment, relying on transpiration beds, etc is not permitted, due to quality of effluent disposal and risk of contamination by effluent of the water reserves in the Tomago Sandbeds. On-site treatment at the site for development is differentiated from traditional methods by the use of a Membrane Bioreactor Sewage Treatment System, capable of producing water quality that is equivalent to, or better than the quality of stormwater runoff from the facility, in accordance with the Guidelines for Disposal set down by the NSW Department of Health. Furthermore, the sewerage treatment facility is located a significant distance of approximately 320 metres downstream of the Tomago Sandbeds Special Area so as to avoid risk of potential contamination at the collection point.

The Water Industry Competition Bill 2006 indicates that a privately developed treatment system is permissible. It is the necessary option for the WesTrac facility due to the timeframes within which WesTrac need the facility to be operational. It is accepted that HWC is currently reviewing overall sewer strategies for the industrial development of the Tomago area. This review will most likely be applicable to the timing of treatment for the industrial development adjacent to WesTrac, however sewerage treatment provisions will be required for WesTrac prior to HWC determining the strategy for the area. Full details are described in **Volume 3 – Stormwater Management Report - WesTrac facility**.

As a minimum, the unit will be a temporary measure servicing the WesTrac facility until sewer strategy planning by HWC is complete, or alternatively, additional package units can be added to the on-site treatment package plant for later stages of the industrial subdivision if required. Refer to **Figure 6**.

4.4 POWER/TELSTRA

Existing overhead powerlines in Tomago Road are available to service the site. There are also overhead powerlines transecting the site. Liaison with EnergyAustralia has commenced with regard to the relocation of the power to suit the development layout. Refer to **Figure 6**.

Section 5.0 Compliance Checklist

The DGRs listed in **Section 1.0** have been addressed. The key engineering and servicing considerations for the design have been addressed as follows:

- Intersection – suitable arrangements can be made and liaison with the RTA has commenced (**Section 4.1**);
- Water - suitable arrangements can be made and liaison has commenced with HWC (**Section 4.2**);
- Sewer - alternative arrangements to acceptable standards have been made and liaison has commenced with HWC (**Section 4.3**); and
- Power, suitable arrangements can be made and liaison has commenced with EnergyAustralia (**Section 4.4**).

In addition, Coffey Geotechnics are providing sound advice for bulk earthworks strategy based on their field inspections and testing outcomes.

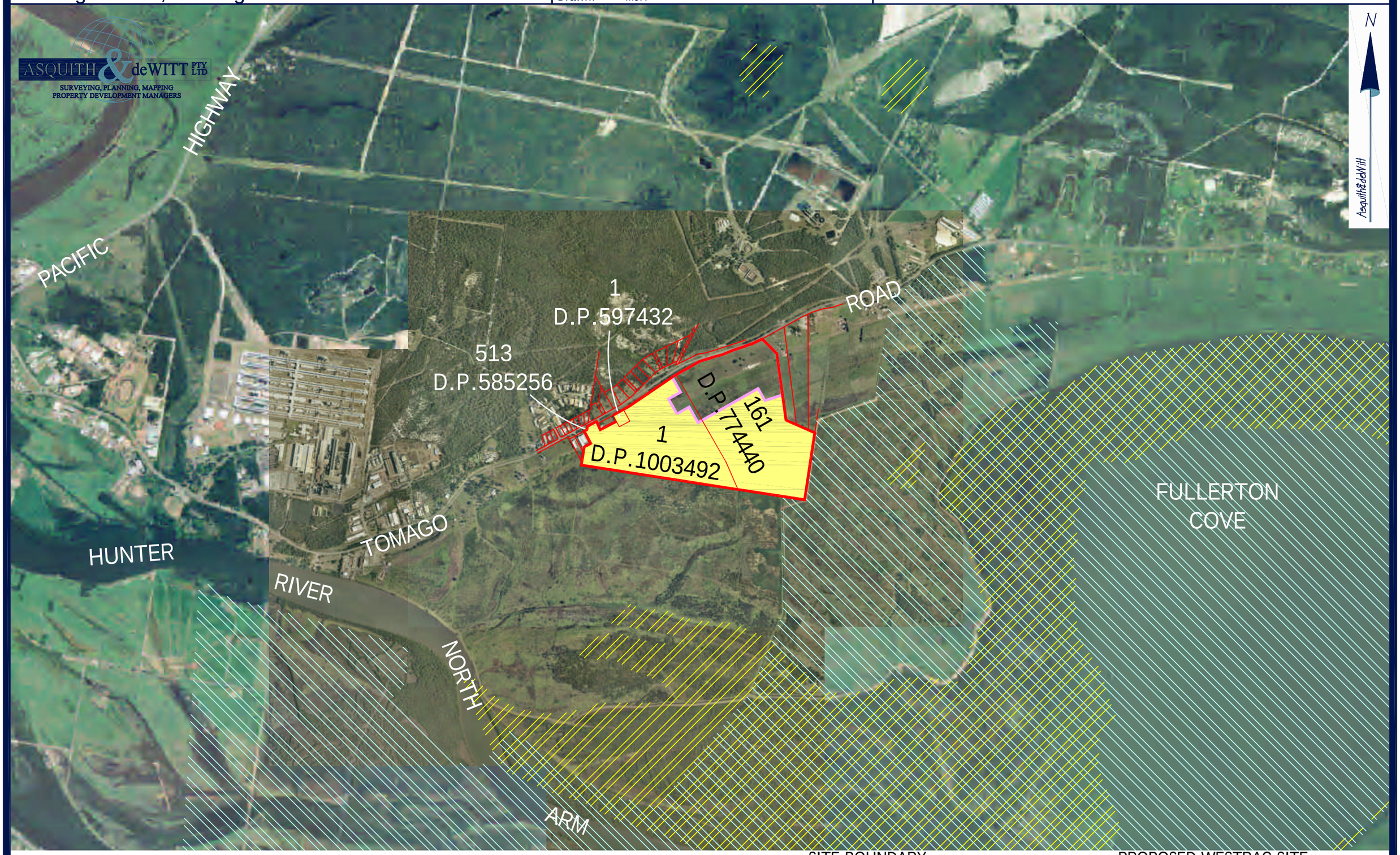
Appendix A – Figures

Plan of Proposed Development - Overall
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH

AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 2\11886fig-1a
Job No:	11886

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0 100 200 300 500 1000 2000 3000

Bar Scale 1: 25000 (A1), 1: 50000 (A3)

SITE BOUNDARY
SURROUNDING BOUNDARIES
INDUSTRIAL SUBDIVISION
SEPP 14 WETLAND AREA
RAMSAR WETLAND AREA
PROPOSED WESTRAC SITE

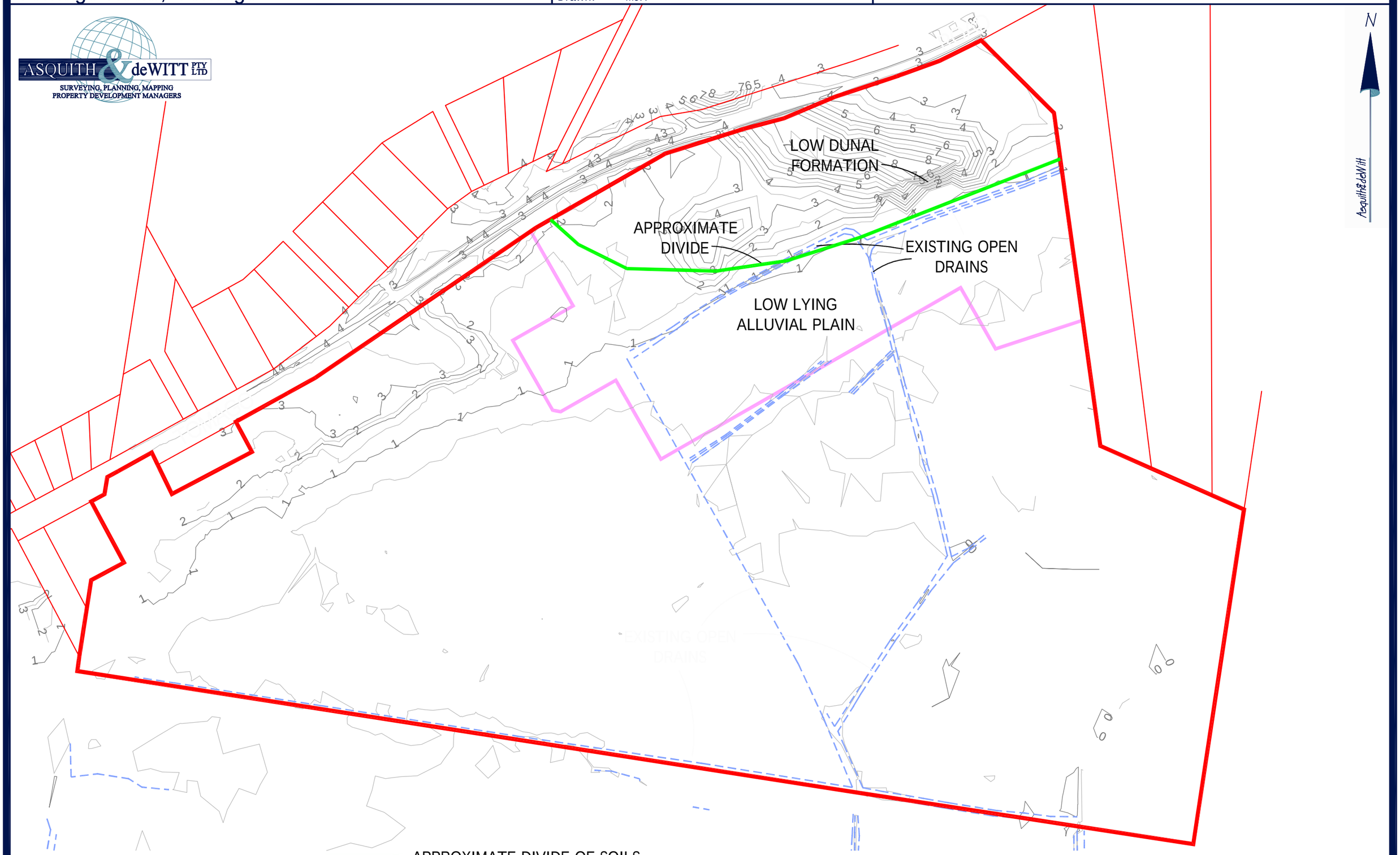
FIGURE 1
SITE LOCATION

Plan of Proposed Development - Overall
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH

AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 2\11886fig-2a
Job No:	11886

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- APPROXIMATE DIVIDE OF SOILS
- SITE BOUNDARY
- SURROUNDING BOUNDARIES
- OPEN DRAIN
- WESTRAC BOUNDARY

0 20 40 60 80 100 200 300 400 600

Bar Scale 1: 5000 (A1), 1:10000 (A3)

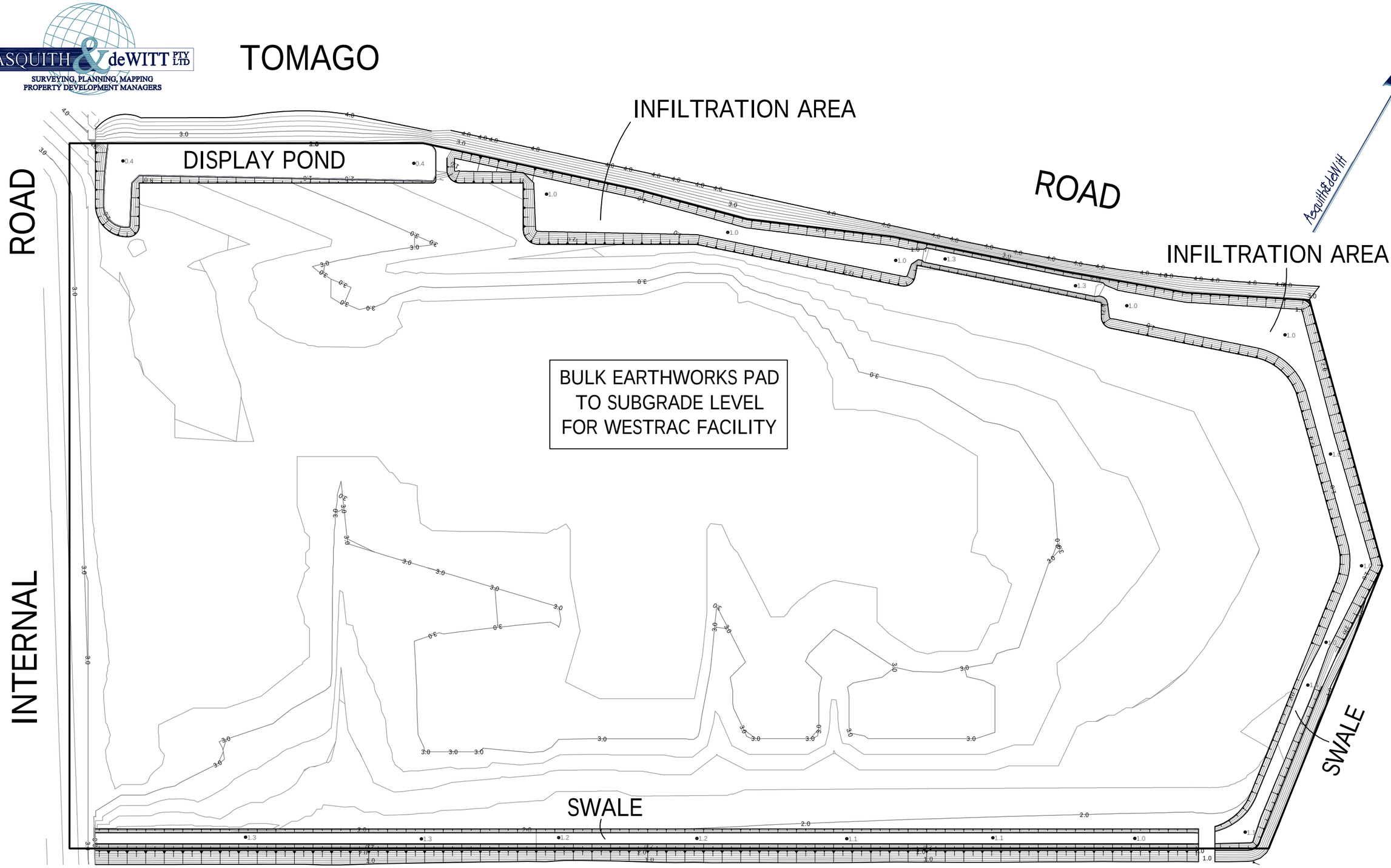
FIGURE 2
EXISTING SITE

Plan of Proposed Development - Overall
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH

AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 2\11886fig-3a
Job No:	11886

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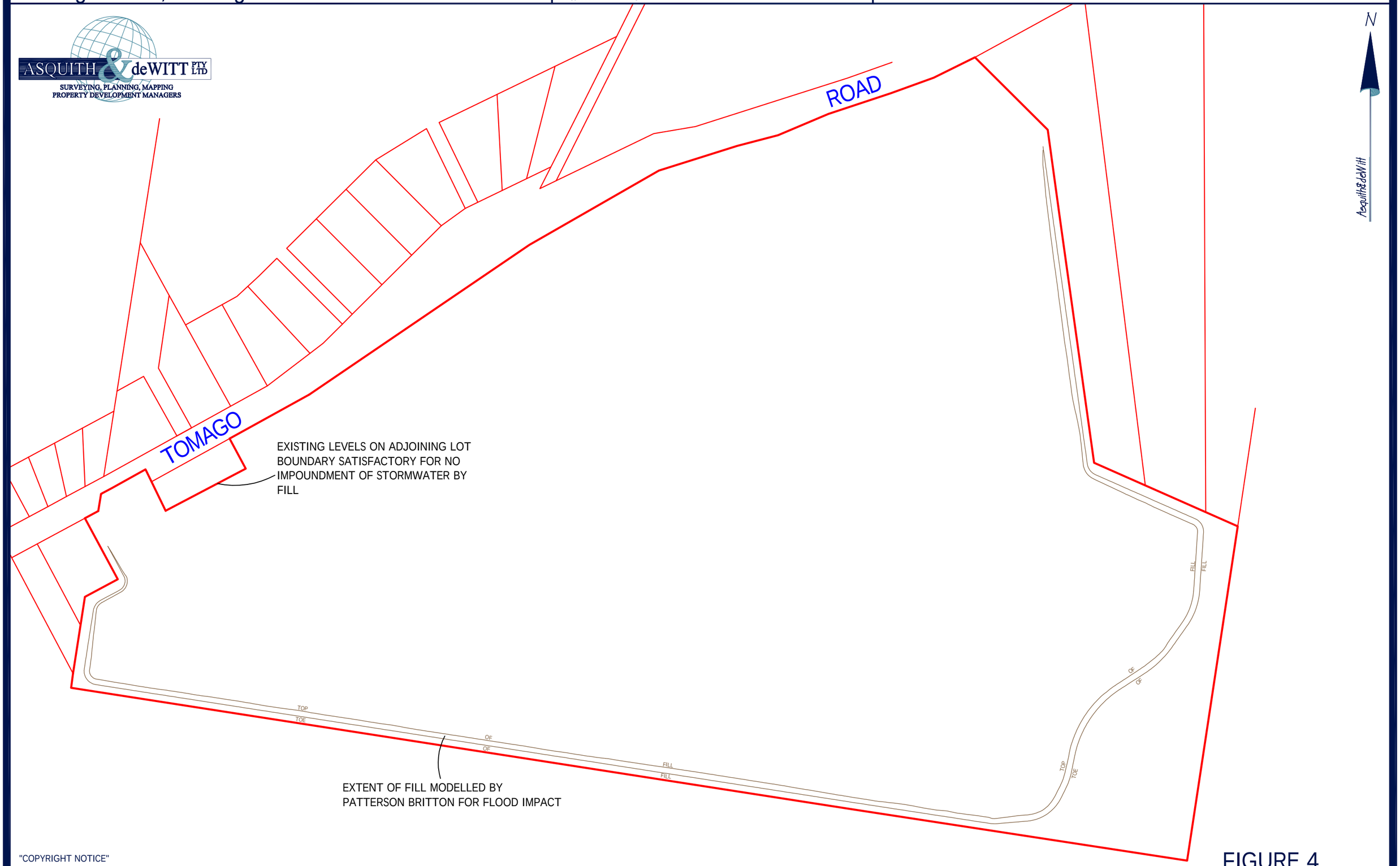
FIGURE 3
EXTENT OF FILL - WESTRAC SHAPING EARTHWORKS

Plan of Proposed Development - Overall
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH

AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 2\11886fig-4a
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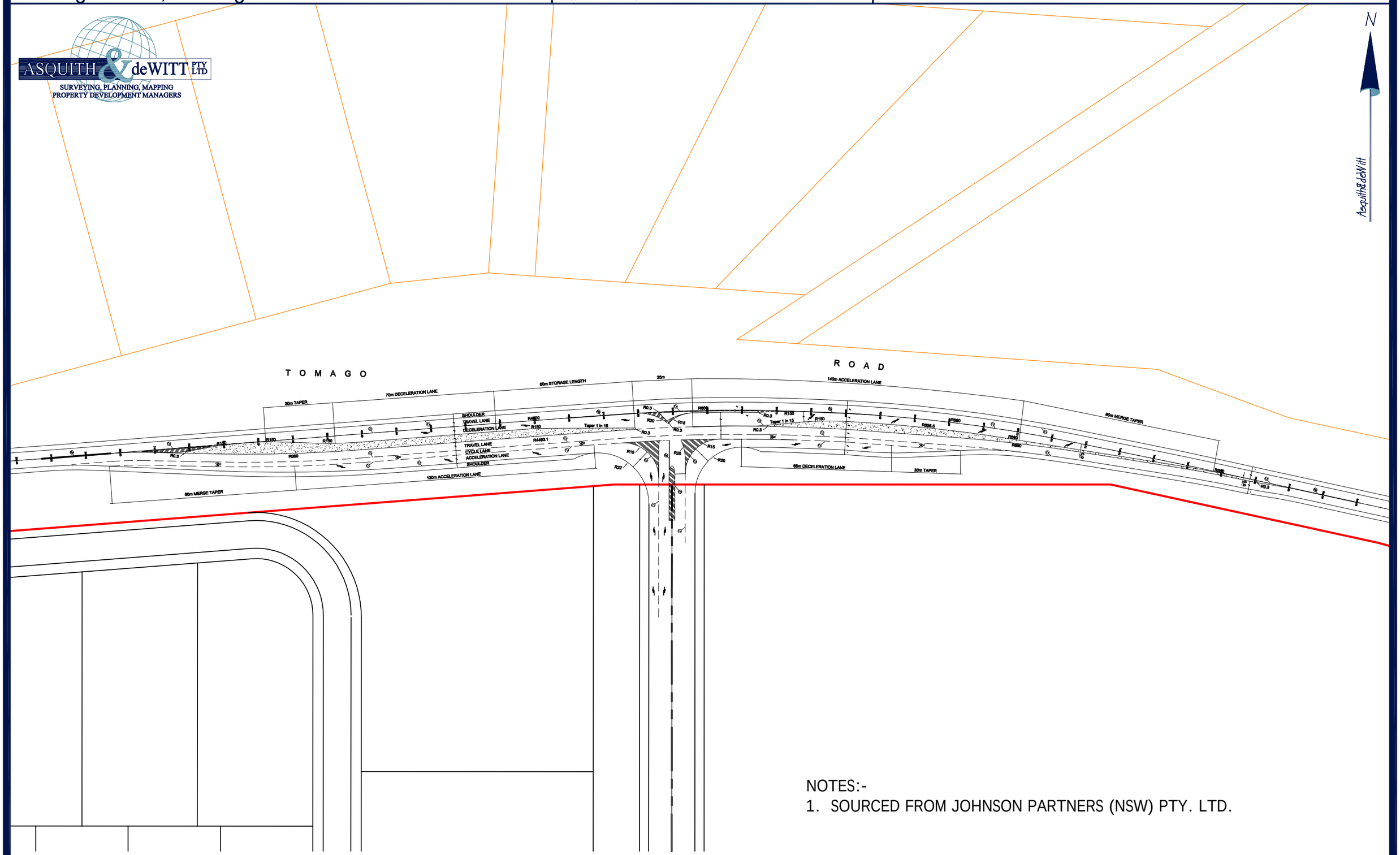
FIGURE 4
EXTENT OF FILL - OVERALL

Plan of Proposed Development - Overall
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH

AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 2\11886fig-5a
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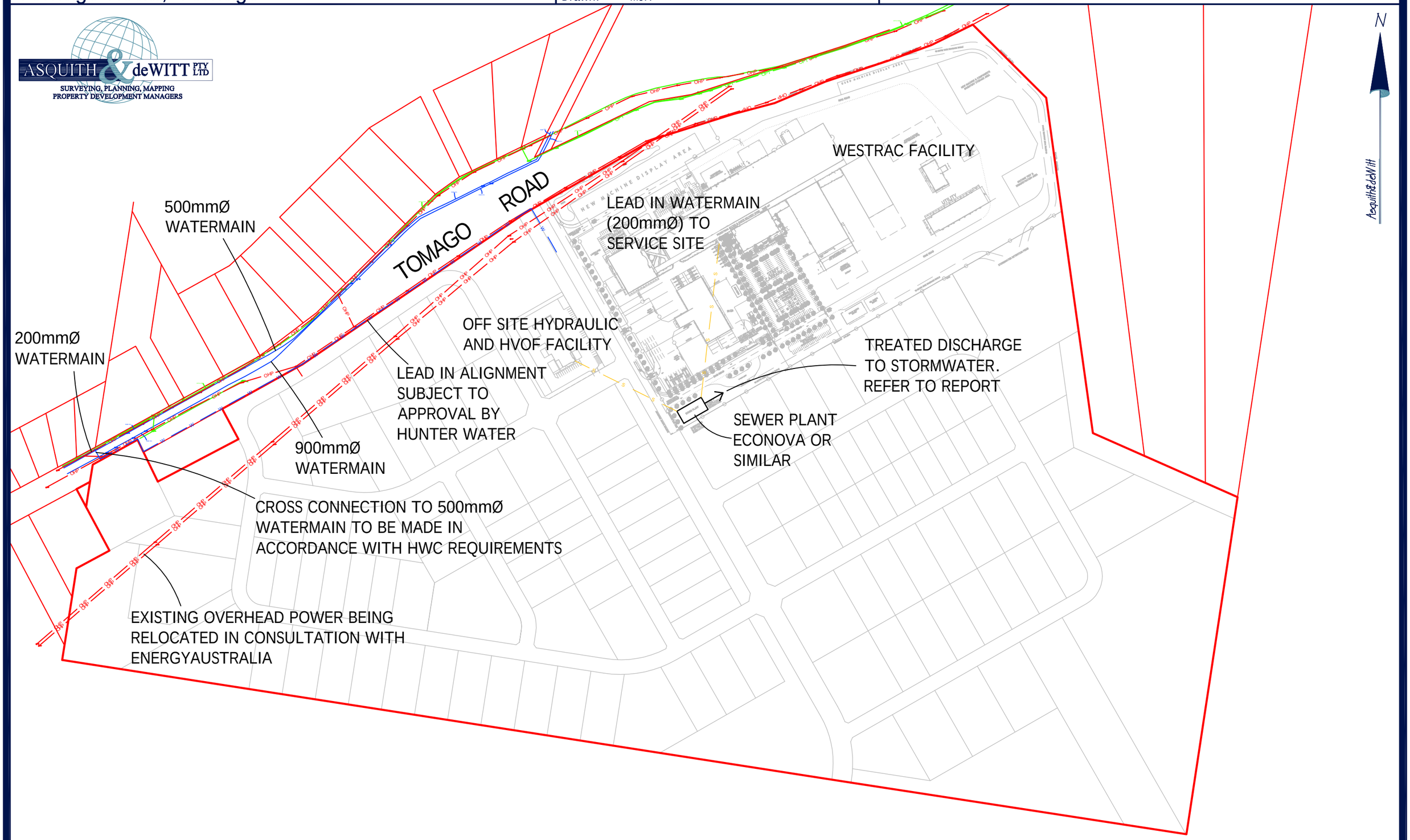
Bar Scale 1: 1500 (A3)

FIGURE 5
INTERSECTION (CONCEPT)

Plan of Proposed Development - Overall
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH
AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 2\11886fig-6a
Job No:	11886

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0 10 20 30 40 50 60 80 100 150 200

Bar Scale 1: 2000 (A3)

FIGURE 6
SEWER, WATER AND POWER SERVICING

Appendix B – HWC Correspondence

HUNTER WATER CORPORATION . PO BOX 5171 HRMC NSW 2310 . TEL 1300 657 657
36 HONEYSUCKLE DRIVE NEWCASTLE . ABN 46 228 513 446 . HUNTERWATER.COM.AU

20 August 2007 Ref:2007-789

Geoffrey Graham & NSW Treasury - Crown Property Portfolio
C/- Johnson Partners P/L
P O Box 3717
Tuggerah NSW 2259

Dear Sir/Madam

RE NOTICE OF FORMAL REQUIREMENTS FOR PROPOSED DEVELOPMENT

Hunter Water's requirements for the provision of water and sewerage facilities to Stage 1 development of subdivision of 4 in to 2 lots at Lot 1 DP 597372, Lot 1 DP 1003492, Lot 161 DP 774440 & Lot 513 DP 585256, Tomago Road, Tomago with development of proposed lot 100 of an Industrial Commercial Facility (encompassing administration, machinery sales office, workshops, parts warehouse and machine storage – building area 54,800m^2) are as follows:

1 Payment of a **developer charge** of $212,160. (Refer page 5 of the attached guide).

If the developer charge and any other fee specified in this notice is not paid by 30 June 2008 the total will be adjusted for inflation from 1 July 2008. This adjustment will be based on the weighted average of the capital cities CPI for the 12 months to the end of March 2008;

The developer charge calculated has been based on information supplied by Johnson Partners – a total industrial/commercial building plan area of 54,800m^2. This value has been used by Hunter Water in the Equivalent Lot Methodology to derive a water and sewer loading in Equivalent Tenements (ET).

It is understood that the proposed development intends to utilize a range of water recycling and rainwater harvesting techniques that may impact the actual water consumed and wastewater discharged to the reticulated sewer systems of Hunter Water. It will be necessary, therefore, for the developer to evidence to Hunter Water a detailed water balance for the development that articulates the volumes of potable water to be consumed and proportion discharged to sewer.

This detailed commentary, stating assumptions, basis for outcomes, internal systems and any other supporting documentation will be required to be submitted and approved by Hunter Water prior to issue of a Section 50 Compliance Certificate for the development.

Any change in the development or development loading on our systems will result in a change to the developer charge payable.

2 Construct **Major Works**, (refer to page 7 of the attached guide) on behalf of Hunter Water, to connect each of the lots to the existing water and sewer systems of Hunter Water in accordance with approved servicing strategies.

It will be necessary for the developer to engage the services of an Accredited Design Consultant to complete local water and sewer servicing strategies for the ultimate development.

Prior to completing the servicing strategies it will be first necessary to clarify with Hunter Water the basis for water and sewer loadings derived from this (Westrak) and the surrounding development area. Please refer to the attached guideline for completion of servicing strategies.

The scope of the servicing strategies should be determined in consultation with Hunter Water's Development Services Unit prior to proceeding.

Water and Wastewater strategy review fees should to paid upon submission of the reports to Hunter Water.

The following connection advice is to be treated as tentative only as the yet to be agreed water and sewer loadings may impact the actual connection location(s).

Water Supply
The nominal points of connection point for water are the 200mm diameter watermain in Tomago Road and a cross connection with 500mm diameter watermain in Tomago Road. (Please refer to the attached plan).

Wastewater Transportation
Hunter Water is currently liaising with various parties in the Williamtown and Tomago areas regarding the possible design and construction of a Williamtown Wastewater Transfer Scheme taking flows from Williamtown to Raymond Terrace Wastewater Treatment Works (WWTW).

The preliminary strategy determined by Hunter Water proposes a wastewater pump station located at Williamtown pumping via a single rising main along Tomago Road and Masonite Roads to Raymond Terrace WWTW.

There may be scope for development in this servicing strategy area to connect to this Transfer Scheme at the intersection of Masonite and Cabbage Tree Road (forming a common rising main).

The local strategy will need to be prepared giving consideration to the outcomes of the broader strategy undertaken by Hunter Water.

Wastewater Treatment
Raymond Terrace WWTW is planned to be upgraded by Hunter Water in 2009. The design process has commenced. Continued liaison with the developer and respective design consultants will be welcomed as inputs into our design and construction process.

Major Works assessment/administration fees should be paid with water and sewer reticulation designs submitted. Further design assessment fees will become payable, depending on final infrastructure arrangement, for pumping stations involved in the scheme; and

3 Part of the site is within the Tomago Sandbeds Catchment Area and all wastewater should be disposed of 'off-site' ie on site treatment and disposal is not permitted. Hunter Water's letter dated 5 April 2006 remains valid and identifies issues that are relevant for development within the Special Area.

4 There may be some advantage for a joint arrangement between the various developers in the Williamtown and Tomago areas to share the costs for the Williamtown Wastewater Transfer Scheme.

Hunter Water is in the process of facilitating discussions between developers with the aim that an arrangement can be agreed in a timeframe that meets each developers needs.

Evidence of any commercial arrangements for cost sharing needs be revealed to Hunter Water for reimbursement purposes.

Alternatively, you may deliver the necessary works alone and rely on Hunter Water to collect reimbursements from other developments if and when they connect. Hunter Water will collect reimbursements for a period of 15 years from handover of assets to Hunter Water. Construction costs, when available, should be provided to Hunter Water to be used as the basis for the final calculation of reimbursements (Refer page 9 of the attached guide);

5 Prior to providing final approval of designs, Hunter Water will require a Review of Environmental Factors (REF) to be submitted (refer Section 1 of Hunter Water's Water and Sewer Design Manual). A REF considers the likely impacts a development may have on the environment. At all times, methods for preventing or reducing adverse environmental impacts should be considered and where appropriate, incorporated into the project design. Hunter Water, where appropriate, may make a determination in accordance with the EP& A Act 1979.

6 Your proposed development has been identified as having the potential to discharge trade waste into Hunter Water's sewerage system. You are therefore required to contact Hunter Water's Trade Waste Section on 4979 9596 and make the necessary application for a Trade Waste Permit and pay the prescribed fees. The discharge of trade waste to the sewer will not be permitted without a permit authorising that discharge; and

7 You will be required to submit internal water and sewer hydraulic designs for this development for our review. (Refer to page 7 of the attached guide).

8 Please note that Hunter Water requires 3 copies of the final plan of subdivision and a DXF file of the subdivision showing only lot numbers and boundaries directly on the MGA grid. The lot boundaries should be produced directly from your calculation software, should be all edge matched and unbroken, and should also match as near as possible the final deposited plan of the subdivision. This information should be emailed to plan.check@hunterwater.com.au .

The above requirements are valid for 12 months from the date of this letter and are specific to this development. Within this period Hunter Water's fees are subject to CPI adjustment. Please refer to the attached *Guide to Hunter Water's Notice of Requirements for Developers*, which details the conditions under which water and sewer facilities are available to new customers.

Hunter Water reserves the right to amend its requirements if an error has been made in their determination.

Yours faithfully



Brett Lewis
Manager Development Services

Enquiries: Robert Daniels
Tel: 1300 657 657
Fax: (02) 4979-9711
Your Ref: 50050

Attachments:
1. SWIMS Plan locating development relative to Raymond terrace WWTW
2. SWIMS Plan indicating water main connection location
3. Hunter Water Correspondence of 5 April 2006
4. Guidelines for Preparation of Servicing Strategies

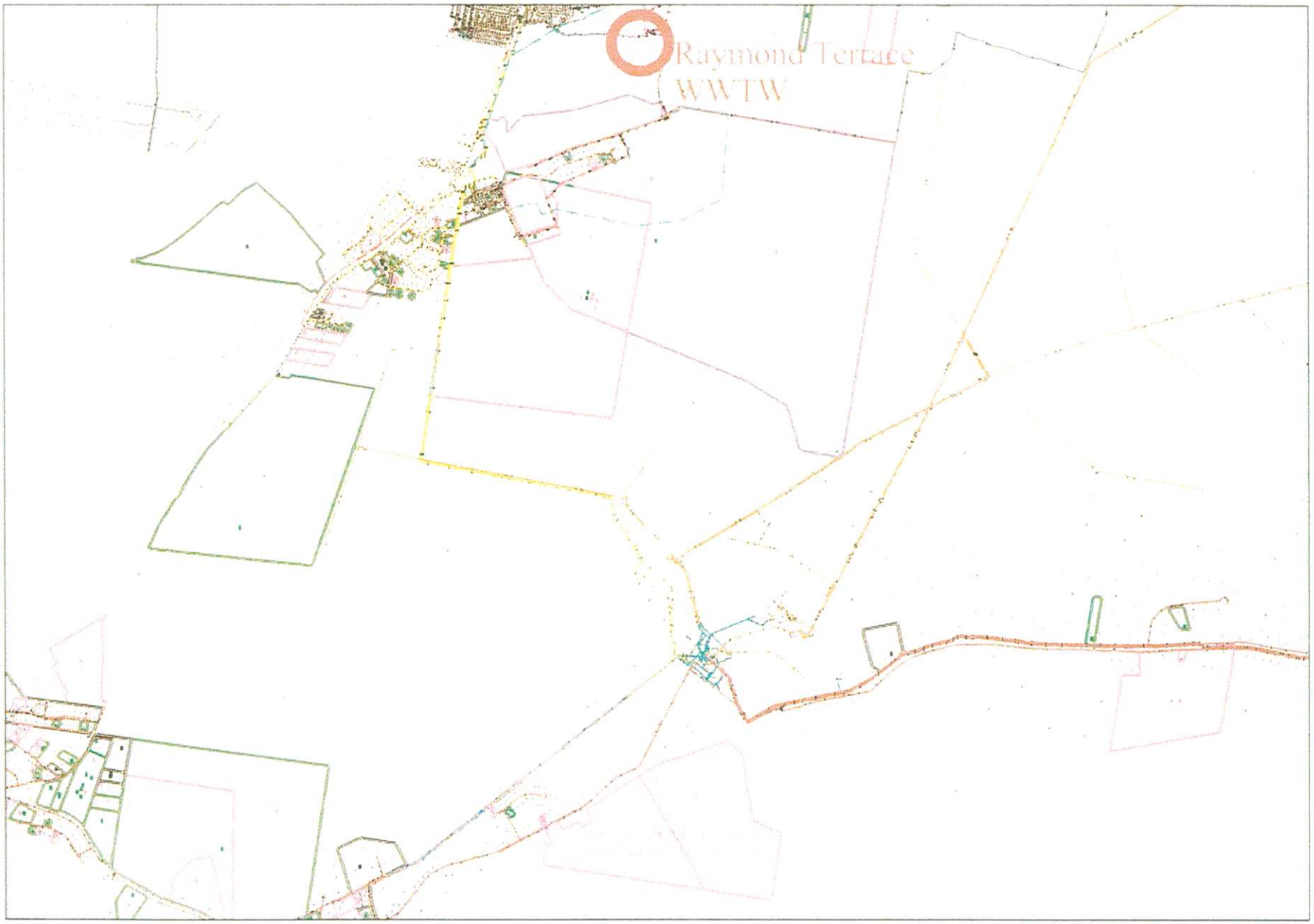
PAYMENT BY MAIL	Send the payment slip below with your cheque made payable to: Hunter Water Corporation Customer & Development Services Unit PO Box 5171 HRMC NSW 2310
PAY IN PERSON	Cash, cheque or credit card Present the slip below at any Hunter Water Corporation Customer Centre (Credit card limit of $5,000 per transaction per day) Present the slip below at Customer Service Centre Head Office 36 Honeysuckle Drive, Newcastle West (Credit card limit of $10,000 per transaction per day)
PAY BY PHONE	Credit card only Port Stephens & Newcastle Council Areas telephone (02) 4979 9725 OR (02) 4979 9716 Cessnock, Maitland & Lake Macquarie Council Areas telephone (02) 4979 9720 OR (02) 4979 9718 **QUOTE REFERENCE: 2007-789**

- **MINOR/MAJOR WORKS ASSESSMENT FEES AND/OR SUPERVISION FEES WILL NOT BE ACCEPTED UNLESS DESIGNS ARE SUBMITTED FOR REVIEW.**

Return this portion along with payment to Hunter Water

Our Ref: 2007-789
Customer Number: 15574 15573 15611

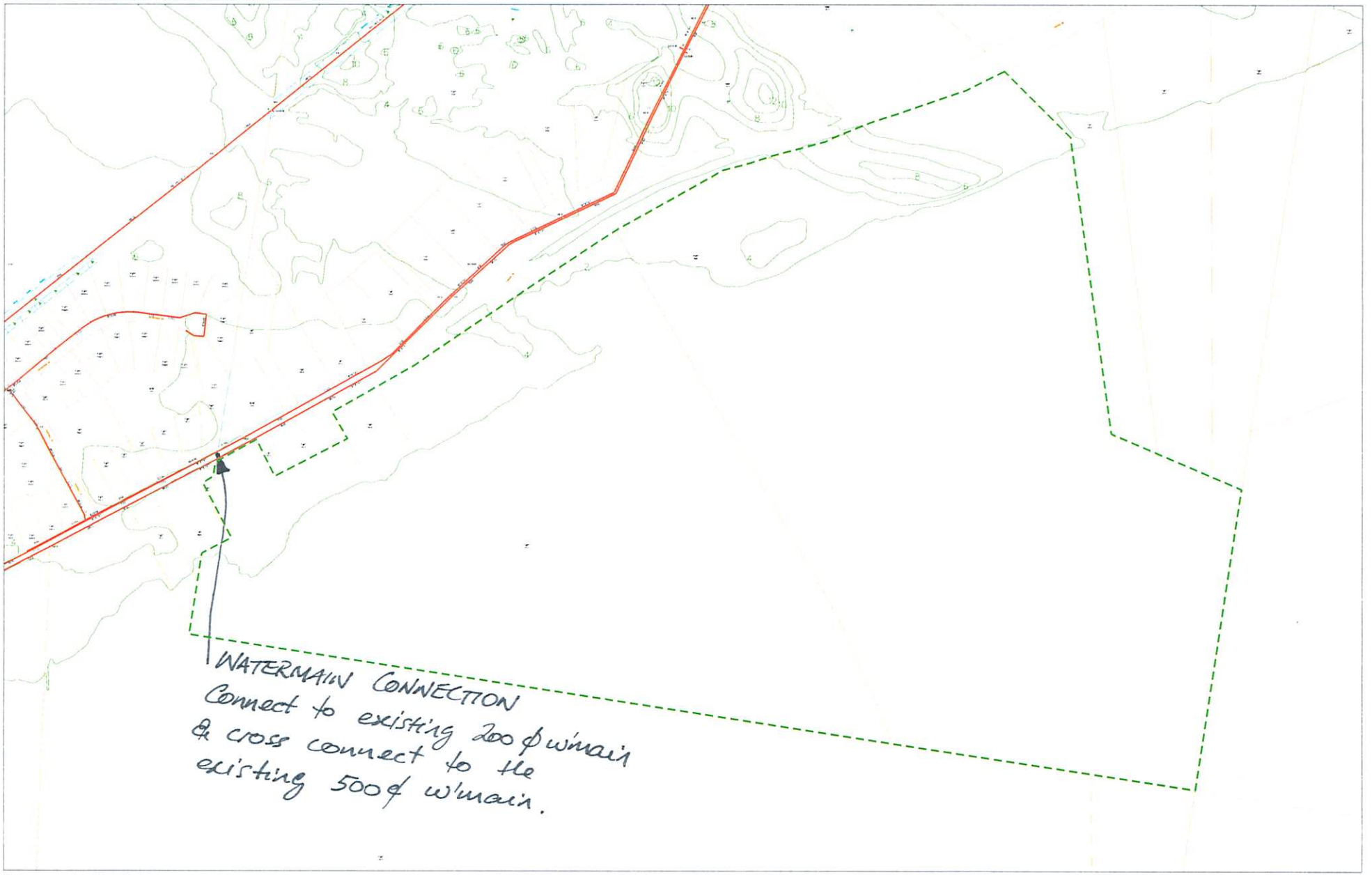
Re: Lot 1 DP 597372, Lot 1 DP 1003492, Lot 161 DP 774440 & Lot 513 DP 585256
Tomago Road
Tomago



Date: 10/07/2007 **Scale:** 1 : 37895.1

Notes: 2007-789 - SEWER - 5km to Raymond Terrace WWTW

HWC



Date: 25/06/2007 **Scale:** 1 : 8000

Notes: LOTS 1, 1, 161 & 513 TOMAGO ROAD, TOMAGO

HWC DOES NOT GUARANTEE THE ACCURACY OF THIS PLAN

ASQUITH & deWITT PTY LTD

Volume 3 - Stormwater Management Report - WesTrac facility

Property:

Tomago Road, Tomago

Applicant:

Redlake Enterprises Pty Ltd

Version 1, November 2007



Unit 7/335 Hillsborough Road,
Warners Bay NSW 2290
Ph: (02) 4978 5100 Fax: (02) 4978 5199
www.asquithdewitt.com.au

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This report has been prepared using the most up to date available survey information and current flooding analysis methods. No responsibility for loss occasioned to any person acting or refraining from action as a result of any material in this publication will be accepted by Asquith & deWitt.

Prepared by:

Scott Day B.E. (Env.), Hons. MIEAust CPEng NPER
Member No. 1465150 Civil and Environmental Colleges
Senior Environmental Engineer

Section 1.0 Introduction

Asquith & deWitt Pty Ltd has been engaged by Redlake Enterprises Pty Ltd to complete reports on stormwater management and civil engineering requirements for the proposed development of a new WesTrac facility and industrial subdivision on Tomago Road, Tomago.

This report, Volume 3, focuses on the stormwater management and water balance for reuse within the WesTrac facility. In particular, requirements associated with the Tomago Sandbeds are addressed in this report.

The NSW Department of Planning issued Director General's Requirements (DGRs) on 18 September 2007. This report addresses the DGRs for the development of the WesTrac facility as shown below in **Table 1**.

Table 1 - DGRs addressed in this Report – Volume 3

Issue	Section addressing Issue
a water balance for the site detailing water sources, water consumption, water recycling, the quantity and quality of waste water streams and the impact of any water release from the site on surface water and groundwater;	3.1, 3.2 & 3.3.7
proposed erosion and sediment controls (during construction) and the proposed stormwater management system (during operations);	3.4
proposed management measures for containment of pollutants;	3.3

Whilst this report has been prepared for the Department of Planning, Port Stephens Council (Council) stormwater management objectives have been considered where applicable.

1.1 DEVELOPMENT DESCRIPTION

WesTrac hold the franchise for Caterpillar equipment in NSW, ACT, WA & Northern China. WesTrac is one of the largest Caterpillar dealerships in the world, having been established in 1989, as a part-owned subsidiary company of Australian Capital Equity Pty Ltd. WesTrac's core business is to supply new and used Caterpillar machinery, servicing the construction, mining and forestry industries as well as local government, quarry, rental on highway trucks and marine markets. WesTrac employs more than 2000 people in Australia.

The proposed WesTrac facility at Tomago will be the NSW/ACT headquarters. The facility will employ 400 people. In order to ensure that WesTrac is able to meet its obligations to customers, and maintain growth and the provision for future employment opportunities, it is imperative that the WesTrac NSW/ACT headquarters be established at Tomago as soon as possible.

1.2 SITE DESCRIPTION

The proposed WesTrac facility will occupy approximately 26.3 hectares within the overall subject land to be developed, of Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256. This area will accommodate the WesTrac facility and associated road and trunk drainage infrastructure as well as the off site Hydraulic and HVOF facility, located in the proposed subdivision. Refer to **Figure 1**.

The land is located on the northern floodplain of the Hunter River on the southern side of Tomago Road, Tomago. Topographically, the site comprises a low dunal formation up to 8.5m AHD across the northern half of the site and a flat, low lying alluvial plain at an elevation of 0.5-1.5mAHD across the southern side of the site. These comprise distinctly different soil types and conditions, being sand and waterlogged clays respectively. Refer to **Figure 2**.

The low-lying portion of the site is waterlogged, generally covered with standing water 0.1-0.3m deep along the proposed southern boundary of the WesTrac facility. Open channel farm drains have been previously excavated into the site, and drain toward the Hunter River. Vegetation is predominantly tall, thick grasses. Refer to **Figure 2**.

Land to the south, downstream of the site is SEPP14 and RAMSAR wetlands. The RAMSAR boundary, adjoining the south eastern corner of the site, is an existing boundary determined by RAMSAR. Refer to **Figure 1**.

Section 2.0 Background Information

The following documents have been used to complete the stormwater management requirements for the WesTrac facility:

- EJE development layout plan.
- "*Managing Urban Stormwater: environmental targets*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: an integrated approach*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Urban design*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Harvesting and Reuse*" April 2006, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Treatment techniques*" – Consultation draft – October 2007, 2nd edition, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater Soils and Construction*" 4th Edition, Volume 1, March 2004 produced by Landcom (Blue Book).
- "*Urban Stormwater and Rural Water Quality Management Plan*", Port Stephens Council.
- Water Industry Competition Bill 2006 – NSW Government
- "Proposed WesTrac Industrial Development – Tomago Geotechnical Assessment" GEOTSGTE20301AA-AI, 15 November 2007, Coffey Geotechnics, refer to **Appendix M**.
- "Proposed Industrial Development 197-325 Tomago Road, Tomago, NSW" Preliminary Geotechnical/Due Diligence Assessment" N09814/01-AD, 29 August 2006, Coffey Geotechnics, refer to **Appendix M**.
- "*Proposed Industrial Development at Tomago Road, Tomago flood Impact Assessment*" Issue No.2, October 2007, Patterson Britton & Partners.
- Daily and 6 minute Rainfall Data and Evaporation Data for Williamtown from Bureau of Meteorology.
- "The Influence of Urban Density and Drainage Infrastructure on the Concentrations and Loads of Pollutants in Small Streams" Fletcher et al 2004.

Section 3.0 Stormwater Management Requirements

The stormwater management system for the WesTrac facility has been designed to achieve a 'no impact' objective and to acknowledge and incorporate the requirements of DGRs, Hunter Water Corporation (HWC) requirements, the series of Department of Environment and Conservation NSW (DECC) stormwater manuals and Council's development control plans. Included in the development of the system were an assessment of water quality, quantity and volume of stormwater runoff discharging to the downstream receiving waters both pre and post development.

The low dunal formation described in **Section 1.2**, is part of the Tomago Sandbeds. During the Due Diligence assessment for the site, HWC were contacted in relation to their requirements. HWC identified that the WesTrac facility would overlap part of the Hunter Water (Special Areas) Regulation 2003. The Special Area is nominated over the Tomago Sandbeds, which is an aquifer containing groundwater reserves used for drinking water supply to Newcastle. This issue has been addressed in **Section 3.1**.

Best management stormwater practices are already complimentary to WesTrac operations. At existing WesTrac facilities in NSW, it is evident that water and stormwater are regarded as a valuable resource. Operations at Mt Thorley operations have significant rainwater tanks, despite no obligation to do so, for the collection and reuse of stormwater runoff. Because water reuse is already a high priority for existing WesTrac operations, modelling has been undertaken to determine the size of rainwater tanks for acceptable levels of water reuse and supply security. The modelling has also been undertaken to demonstrate compliance with water reuse objectives required by the DGRs and DECC. This issue has been addressed in **Section 3.2**.

In order to meet water quality objectives for stormwater runoff other than roof water, permanent controls have been designed for the management of stormwater prior to discharge from the site. This issue has been addressed in **Section 3.3**.

Soil and water management during construction are important considerations for the protection of downstream receiving waters. The temporary controls required and mitigation measures to be used at this site during construction are described in **Section 3.4**.

3.1 HWC REQUIREMENTS - SPECIAL AREA

As described above in **Section 3.0**, HWC was contacted during the Due Diligence assessment process for the proposed development of the site. The Special Area, part of the Tomago Sandbeds, has been overlaid from plans provided by HWC, refer to **Figure 3**. The Special Area occupies approximately 9.59 hectares of the site proposed for development of the WesTrac facility.

In summary, the requirements in relation to the Special Area, as stated in the HWC letter dated 5 April 2006, are as follows:

- **Sewerage facilities** – that on-site disposal would not be permitted and that sewerage facilities within the Special Area boundary would need to be such that sewage would be either taken off site (ie pump-out system) or pumped to an existing Hunter Water sewerage system. Resolution of this issue is described in **Section 3.1.2** of this report.

- **Aquifer interference** – make a clear statement of any construction or operational activities that could interfere with the aquifer. Resolution of this issue is described in **Section 3.1.3** of this report.

- **Safe Storage and Handling of Fuels/Chemicals** – that storage and handling of chemicals and fuels must be undertaken in accordance with Australian Standards. Contingency response plans that outline emergency procedures for chemical spills need to be made available and incorporated into both the construction and operational aspects of the development. Resolution of this issue is described in **Appendix Q of the Application**.

- **Surface runoff** – A Stormwater Management Plan should be prepared as part of the development application. Resolution of this issue is described in **Section 3.1.4** of this report.

The complete letter from HWC is contained in **Appendix B**.

In further correspondence from HWC, dated 20 August 2007, HWC the following was also requested:

"It will be necessary, therefore, for the developer to evidence to Hunter Water a detailed water balance for the development that articulates the volumes of potable water to be consumed and proportion discharged to sewer." Resolution of this issue is described in **Section 3.2** of this report.
This complete letter from HWC is also contained in **Appendix B**.

3.1.1 Existing Site/Development

An important consideration in relation to the HWC requirements is that there are two (2) distinctly different soil profiles through the site for the development of the WesTrac facility. The first soil type is the aeolian dunal sands that are part of the Tomago Sandbeds, covered by the Special Area zone boundary. The second soil profile is the alluvial clays and estuarine soil types associated with the floodplains of the Hunter River. These are waterlogged clays, downstream of the Special Area draining to the Hunter River. The dunal sands are at a higher elevation than the floodplains and consequently there is no opportunity for runoff from the low lying floodplains to contribute runoff to the Tomago Sandbeds. Refer to **Figure 2**.

By inspection of the overall plan of Special Area, it is noted that there are several existing industrial subdivisions and development. In particular, there are large developments, including Williamtown Airport and Tomago Aluminium. These existing developments pose

far greater polluting risks than the WesTrac facility. This indicates that provided the site is effectively managed, with appropriate mitigation and protection measures installed, development is permissible over the Special Area.

3.1.2 Sewerage facilities

During the iterative design process to determine the layout of the WesTrac facility with EJE, a constraint was identified, being that the sewerage treatment facility would be located well clear of the Special Area zone. The sewerage treatment facility has been located in the south western extremity of the site, approximately 320 metres downslope from the edge of the Special Area. This is considered to be adequate protection of the Tomago Sandbeds against contamination, in accordance with HWC requirements. Refer to **Figure 4**.

As described in **Section 1.2**, the Special Area is a sand dune, rising up to an elevation of approximately 8.5 metres AHD. This elevation is unsuitable for the site layout of the WesTrac facility and consequently the finished surface levels for the site have been designed as a dome shape beginning at an elevation of approximately 3.5m AHD in the centre of the site, and as the floor levels for buildings, grading downslope to 2.3mAHD at the edges of the ring road.

In **Volume 2 - Concept Engineering, Servicing and Earthworks Report - Overall**, it was determined by cost benefit analysis that a proprietary product will be used for sewerage treatment on site. It is assumed from HWC requirements that on-site treatment, relying on transpiration beds, etc is not permitted, due to quality of effluent disposal and risk of contamination by effluent of the water reserves in the Tomago Sandbeds. On-site treatment at the site for development is differentiated from traditional methods by the use of a Membrane Bioreactor Sewage Treatment System, capable of producing water quality that is equivalent to, or better than the quality of stormwater runoff from the facility, in accordance with the Guidelines for Disposal set down by the NSW Department of Health.

The Water Industry Competition Bill 2006 indicates that a privately developed treatment system is permissible. It is the necessary option for the WesTrac facility due to the timeframes within which WesTrac need the facility to be operational. It is accepted that HWC is currently reviewing overall sewer strategies for the industrial development of the Tomago area. This review will most likely be applicable to the timing of treatment for the industrial development adjacent to WesTrac, however sewerage treatment provisions will be required for WesTrac prior to HWC determining the strategy for the area. As a result, the discharge from the sewerage treatment system has been included in the water balance model for development of the WesTrac facility described further in **Section 3.2**.

Specification of a Membrane Bioreactor Sewage Treatment System has been sourced from Econova. To be conservative, the estimated daily throughput for the plant is 35 KL/day, allowing for contingencies. Treatment is required for sewerage that is primarily domestic in composition. Throughput is based on measurement from existing WesTrac operations and projections for the Tomago site. Refer to **Appendix C** for details on the Econova system.

In addition to the domestic sewerage, a smaller side stream from the washpad recycle storage will also be treated by the plant. Generally washpad water would be treated and recycled and after treatment would contain low levels of contaminants, mainly anionic, biodegradable detergent residues, and traces of hydrocarbon. A slip stream daily flow of washpad water is sent for treatment with the domestic waste as a health and safety measure.

WesTrac has undertaken a considerable amount of research into the use of washpad chemicals, and treatment processes and chemical supply are nationally controlled. As a result all detergents are easily biodegradable and therefore can be treated well by the site sewage system.

Selection of the on site sewage system has taken all of the foregoing factors into account. The proposed plant is a membrane bioreactor design comprising a combination of sequential batch reactors and submerged membrane treatment. The system was selected for its stability in on site conditions and the compact footprint. With sequential processing and final membrane filtration a very high quality effluent is produced.

The plant can be controlled remotely and will have a SCADA system compatible with control telemetry. In addition all the key equipment can be manually operated from the main control panel. Primary disinfection is achieved by the membrane and the deployment of secondary disinfection (UV) and tertiary chlorination results in a very low bacterial content in the treated effluent.

The plant will have on line monitoring of turbidity, pH and disinfection efficiency, and will employ suitable remote alarm systems. The plant will be part of an onsite Environmental Management Program and there will be a comprehensive Operating Manual, and on-going training for operators. Typical effluent quality from the plant is shown in **Table 2** below.

Table 2 - Treated Effluent (Econova) Quality

Parameter	Treated Effluent (1)
pH	7.25
Suspended Solids	<2
BOD	<3
Ammonia	0.02
Nitrate	0.43
Total Nitrogen	1.3
Total Phosphorus	0.27
Turbidity	0.78
E Coli cfu/100ml	<1
Faecal Coli cfu/100ml	0

Notes: all mg/l except pH

(1) Treated Effluent Source provided by Econova from Noosa North STP lab Caboolture Scientific Services Moayfield QLD

From **Table 2**, the Econova system can treat and produce discharge with very low bacterial results, by the use of membrane technology. Site design is such that the discharge from the sewerage treatment facility will enter a swale for conveyance to a constructed wetland for further polishing prior to discharge to the receiving waters downstream. Despite the proven quality of discharge, any potential risk of contamination to the Special Area has been further mitigated by careful design of the perimeter drainage. Infiltration recharge areas to the Special Area are separated from the swale drainage by flowpath conveyance at a lower elevation. An embankment, 1m high, has been designed to a level that will not permit any backwater effects from the swale discharge or the spillway levels of the constructed wetland, from entering the infiltration area. Refer to **Figure 4**.

A small landscaped area of the WesTrac facility will be irrigated with the discharge from the sewerage treatment facility. Limitations of this area for irrigation are documented in **Figure 4**. Excess runoff, if any, will be to the swale drain along the southern boundary of the site.

From this analysis, it has been determined that the on-site treatment facility, producing discharge of quality suitable for stormwater discharge is legally permissible and complies with HWC requirements for application to the WesTrac facility. Additional risk management has been provided for protection of the Tomago Sandbeds and water reserves of Newcastle, by locating the system approximately 320 metres downslope from the fringe of the Special Area zone. Conventional, plumbed drainage will be installed to the buildings of the WesTrac development, where buildings are located over the Special Area.

3.1.3 Aquifer Interference

The area of stormwater catchment to the Tomago Sandbeds is limited to the Special Area and has been measured to be 9.59 hectares. The average rainfall for the area is approximately 1120mm per year. As a conservative overestimate of recharge full infiltration of rainfall over the Special Area has been assumed. The recharge contribution to the Tomago Sandbeds from the site is 9.59 hectares x 1120mm per year = 10.7ML per average year. There is no additional runoff from external catchments entering the Special Area within the site boundary.

Using the same assumptions, the total recharge volume contributed from the site to the Special Area over the 30 year water balance model simulation period is approximately 3,194ML. This simulation period contained dry, average and wet years, with an average annual rainfall of 1110mm, equivalent to the long term average for Williamtown. The water balance model is described in **Section 3.2**.

To mitigate any potential aquifer interference, an objective of the water balance model was to demonstrate equivalent or increased recharge of the aquifer following development. Increased recharge would be a positive impact, adding to the water supply security of Newcastle by increasing the water reserves available within the Tomago Sandbeds.

The WesTrac facility requires significant hardstand area for operations. Approximately 1 hectare of the Special Area will be excavated to an elevation of approximately 1m AHD and remain exposed as an infiltration area for aquifer recharge. Stormwater management and the catchment configuration has been designed to recharge the aquifer with treated runoff from hardstand areas and 35% of excess overflows from the rainwater tank system collecting roof water runoff. This capture area is equivalent to approximately 11.4 hectares, larger by comparison to 9.59 hectares identified by the overlay of the Special Area.

Water balance modelling indicates that after harvesting of roofwater for on site uses, recharge to the aquifer has been increased by approximately 2.2% from 3,194ML to 3,265ML over a 30 year analysis period. Refer to **Table 8** in **Section 3.2** for the full water balance modelling results.

Coffey Geotechnics has determined the permeability of the sands within the Special Area to be 1 x 10^{-4}m/s. This is consistent with tabulated values from "Managing Urban Stormwater: Treatment techniques" Consultation Draft (2007) produced by DECC, and was an expected result due to the Tomago Sandbeds being a significant aquifer recharged by rainfall. The permeability rate is equivalent to approximately 8 metres per day, however this may be limited by the groundwater levels estimated to be approximately 0.5m AHD. The aboveground capacity of the infiltration area for temporary ponding of stormwater runoff before overflow around the perimeter to the wetland downstream is 11,500m^3 at a stage depth of 1.3m.

The infiltration area has the capability to temporarily store and transmit large quantites of recharge to the aquifer. In the case of a 100 year, 1 hour storm event with an average intensity of 71mm/hr, it is shown from the model that a runoff quantity of approximately 6,930m^3 would be generated. This would be temporarily stored over the infiltration area at a depth of 0.6m. It is however the runoff from longer duration storms, generating larger runoff volumes, which will be the critical storms for determining the full extent of recharge. This will be subject to the groundwater levels, however it has been shown that there is significant capacity for the large majority of storm events to be infiltrated. Refer to **Section 3.2** for the full water balance modelling results.

The water balance model indicates that there will be a slightly positive impact on aquifer interference. This is because modelling has indicated that additional treated stormwater runoff from the development will recharge the aquifer, further securing Hunter Water's supply. It is a conservative overestimate to assume that 100% of rainfall is infiltrated to the groundwater reserves, so in this instance a very high level of compliance has been set and achieved. Details of treatment of the stormwater runoff can be found in **Sections 3.1.4** and **3.3** of the report.

3.1.4 Surface Runoff

Runoff to the HWC infiltration area will be treated prior to recharging the system. Essentially this area is comparable to a large bio retention filter. The surface will be landscaped and planted with some organic matter mixed through a sandy topsoil. Stormwater will pond over the sandy topsoil before entering the sand. The sand is effectively comparable to a large filter prior to stormwater recharge of the groundwater. From Figure 6.4 of "Managing urban stormwater: Treatment techniques Consultation Draft

– October 2007" produced by DECC, pollutant removal performance for a mean annual rainfall of 1200mm, is between 60 and 85%. This area will also be well maintained, visible from the site frontage and consequently effectively managed to maintain function. A typical bio retention filter is shown in **Figure 5**.

Runoff to this catchment is derived from rainwater tank overflows, Landscaping Area 1 and Hardstand Area 1, refer to **Figure 6**.

The issue of surface runoff is generally dealt with throughout this report. Specific, permanent treatment controls are addressed in **Section 3.3** of the report.

3.2 WATER BALANCE MODELLING

3.2.1 Objectives

The key objective of this water balance investigation was to develop a water balance model to simulate the water uses, recycling and quantities associated with the proposed WesTrac facility development on the site. In addition, the model is being used to demonstrate adequate recharge to the HWC Special Area and the discharge rate to the wetlands downstream of the development. Model outcomes will provide an indication of water supply security and town water makeup that will be required for the operation of the WesTrac facility.

The purpose of the model outcomes is therefore to provide the following:

- a water balance model including recycling, uses and quantities associated with the operation of the WesTrac facility, as a guide for WesTrac;
- An estimate of the rainwater storage requirements to ensure water security for the project;
- An estimate of recharge to the HWC Special Area;
- An estimate of the quantity of runoff discharging to the wetlands downstream; and
- An identification of the expected key risks to water management based on the outcomes of the water balance.

3.2.2 Rainfall/Evaporation Data

The water balance considers rainfall and runoff generated by statistically dry, average and wet rainfall years. The nearest Bureau of Meteorology (BOM) station to the WesTrac facility is Williamtown (Station Number 61078). A continuous set of daily rainfall and evaporation data from Williamtown was available for a thirty (30) year period from 1976-2005. The daily time step was selected for greater accuracy of the transient water storage levels in the rainwater tanks, display pond and constructed wetland over a range of meteorological conditions that occur throughout a year. Analysis of this data is described below in **Table 3**.

Table 3 – Comparison of Annual Rainfall between Long Term and Data Set 1976-2005 for Williamtown

	1976-2005 Data Set used for Modelling - Rainfall (mm) (Year)	**Long Term Statistics - Rainfall (mm) (Year)**
Driest Year	541 (1980)	541 (1980)
Average Year	1110	1120
Wettest Year	1739 (1990)	1739 (1990)

Williamtown BOM Station Number 61078 is located within 5km of the site. There are no significant topographical features between the Station and the site that would interfere with the assumption of adopting the Williamtown rainfall and evaporation values to the site. The comparison from **Table 3** indicates that the data set used for modelling is closely equivalent to the long term statistics for Williamtown BOM Station.

3.2.3 Runoff - Predevelopment

As described in **Section 1.2**, there are two (2) distinctly different soil types on site. To be consistent with the conservative assumptions of aquifer recharge in **Section 3.1**, we have assumed that there is no runoff from the dunal sand section of the site. In lieu of measured runoff quantity site data being available for the alluvial clays on the floodplain, initial and continuing loss equations were matched to the values presented in Table F2 of the 'Blue Book' (Department of Housing, 2004). The volumetric runoff coefficients presented are specific to hydrological group type 'D' assumed to represent the clays in the simulation. The equation was matched to produce similar runoff volumes, as set out in **Table 4**.

Table 4 - Volumetric Runoff Coefficients

Rainfall (mm)	Equation Curve match of existing low lying Area - alluvial clays	Hydrologic Group 'D' from Blue Book
20	0.48	0.39
25	0.57	0.50
30	0.63	0.56
40	0.70	0.64
50	0.74	0.69
60	0.77	0.74
80	0.80	0.79

The water balance model does not have the capacity to simulate the antecedent moisture condition and subsequently, following the equation curve matching demonstrated in **Table 4**, the initial loss was reduced from 10mm to 5mm, to represent the waterlogged nature of the clays. For the purposes of the modelling, some drying out, void storage and effects of vegetation are assumed to remain.

3.2.4 Results - Pre Development Model

An existing, pre development water balance model was established to simulate the runoff quantity from the site discharging to the wetlands downstream. Stormwater runoff is generally measured in timeframes shorter than a daily time step for the calculation of peak flows. For this simulation however, it is the runoff quantity from the site discharging to the wetlands downstream that is of interest.

Simulation of the existing, pre development model indicates runoff volumes, shown below in **Table 5**, discharging from the site to the wetland downstream.

Table 5 - Quantity of Runoff Discharging from Site - Pre Development

Simulation	**Quantity of Runoff Discharging from Site (ML)**
1979, Dry Year - 10th percentile	65
1984, Average Year -	91
1998, Wet Year - 90th percentile	141
Full 30 year simulation	2,800

An objective of the post development model simulation was to maintain these quantities of runoff to the wetland, post development.

3.2.5 Runoff - Post Development

The site is to be filled and capped with imported material. Runoff characteristics of the site will be changed as a result of the extensive hardstand, impervious areas associated with the WesTrac operations. Stormwater controls however, will be used to mitigate the increased imperviousness of the site, and maintain existing, pre development discharges.

Infiltration areas for recharging the aquifer will be calculated assuming that all runoff landing on the catchment enters the aquifer. This is consistent with the assumption for the existing, pre development model simulation. Runoff quantities from the hardstand areas are subject to an initial loss of 0.5mm. Runoff quantities from the swale and landscaped areas have been modelled on the basis of the values presented in **Table 4**. Although the landscaped areas will be topsoiled, they will be continuously irrigated resulting in similar runoff quantity properties.

The catchment areas for input into the model are shown below in **Table 6**.

Table 6 – WesTrac Catchments

Catchment	Area (m^2)
Roof	41,015
Hardstand 1	72,560
Hardstand 2	55,530
Infiltration Area – HWC	13,850
Swale (Southern Boundary)	22,400
Landscaped Area 1	8,440
Landscaped Area 2	2,700
Display Pond	4,750
Constructed Wetland	11,000
Total	232,245

Location of these catchments is shown in **Figure 6**. All roof water is to be captured with the rainwater tank system, most likely to be located under the spine/pedestrian access. The total catchment is slightly larger than the site area. This is due to the inclusion of the constructed wetland as part of the water balance model, although this is located outside the site. Stormwater treatment for the off site Hydraulic and HVOF facility is described in **Section 3.3.4**.

3.2.6 Outputs

There are a number of water uses associated with the intended WesTrac operations at Tomago, many of which can be managed by water collected in a rainwater tank. These uses are shown below in **Table 7**.

Table 7 – WesTrac Operational Water Uses

Item	Quantity (KL/day)	Source
Canteen, Showers	6.7	Town Water
Toilet Flushing	10.5	Roof water/Rainwater Tank
Washpad – WesTrac	5	Roof water/ Rainwater Tank/Hardstand Area
Washpad – B/Con	5	Roof water/ Rainwater Tank/Hardstand Area
Dyno/Transmission Testing	12*	Roof water/Rainwater Tank
Total	**39.2**	

*-This is an allowance for 2 Dynos, extrapolated on current water usage rates for the Dyno at Mt Thorley.

In addition to these uses, water from the rainwater tank system will be used for the top up of the Display Pond and irrigation of landscaped areas. The quantity of these uses is however, dependent on rainfall and evaporation and has been related in the water balance model accordingly. The Display Pond will be maintained at 80% full. The landscaped areas will be irrigated at a rate of 0.5mm/m^2 whenever rainfall doesn't exceed 2mm per day. This is a large quantity which may be reduced by WesTrac for areas not in full view.

A first flush loss allowance for rainfall falling on the roof has been made of 0.001m/m^2. This runoff will not enter the rainwater tank system, being discharged directly to collection tanks associated with each building. First Flush runoff stored in these tanks will be drawn down slowly by a restricted orifice, discharging the first flush to stormwater runoff.

3.2.7 Results – Post Development Model Simulation

The water balance model for the post development simulation integrating inputs, sources, uses and outputs has been represented with a link diagram as shown in **Figure 7**. The key outcomes from the post development model were to:

- Simulate the quantity of runoff discharging to the HWC infiltration area by comparison to existing;
- Simulate the quantity of runoff discharging to the wetlands downstream by comparison to existing; and
- Provide rainwater tank sizes relative to town water make up for WesTrac to evaluate.

There is flexibility within the model to apportion rainwater tank overflows to the wetlands and the Hunter Water infiltration area. This is because the rainwater tank, at this stage, is located centrally under the pedestrian walkway spine. If WesTrac did decide to locate their tanks elsewhere, then some re evaluation in conjunction with the model could be used to ensure that the proportions remain the same as the results shown below in **Tables 8** and **9**.

Table 8 – Quantity of Runoff Discharging from Site to HWC Infiltration Area

Simulation	Quantity of Infiltration from Site - Existing (ML)*	Quantity of Runoff Discharging from Site - Post Development (ML)	Difference (%)
1979, Dry Year – 10th percentile	7.6	7.6	0
1984, Average Year	10.7	10.8	+1
1998, Wet Year – 90th percentile	15.0	15.7	+4.5
Full 30 year simulation	3,194	3,265	+2.2

* - quantity of infiltration from existing is conservatively estimated to be 100% of rainfall falling on the Special Area of 9.59 hectares.

Table 9 – Quantity of Runoff Discharging from Site to Wetlands Downstream

Simulation	Quantity of Runoff Discharging from Site - Existing (ML)	Quantity of Runoff Discharging from Site - Post Development (ML)	Difference (%)
1979, Dry Year – 10th percentile	65	62	-4
1984, Average Year –	91	93	+2
1998, Wet Year – 90th percentile	141	140	<1
Full 30 year simulation	2,800	2,780	<1

For the model results shown in **Tables 8** and **9**, the overflows of roof water runoff are apportioned at 35% to the infiltration area and 65% to the wetlands. This can be easily configured from the rainwater tank spine at the detailed stage of design by manipulation of the pipe outlets. It has been preferred to match the quantity of runoff for the full 30 year simulation, and average years. Values shown in **Table 9** are an inspection within the model for evaluation of wetting and drying cycles for discharge to the wetlands. The results from the model indicate that these quantities of discharge can be maintained within reasonable limits, post development.

The extent of water reuse for operations within the WesTrac facility has been documented in **Section 3.2.6**. Rainwater tank sizes in tandem with town water makeup to meet demand are being considered in a cost benefit analysis by WesTrac. The tank size to be adopted by WesTrac will be between 1 and 5 ML, as shown below in **Table 10**. **Table 10** also indicates the extreme cases of full town water supply and no town water supply.

Table 10 – Rainwater Tank Sizes versus Town Water Makeup

Tank Size (ML)	Town Water Supplement to Uses over 30 year analysis period (KL)*	Equivalent rate of town water supplement per year (KL)*
7.9	0	0
5.0	4,500	150
4.0	10,000	333
3.0	19,300	643
2.0	38,550	1,285
1.5	58,250	1,942
1.0	92,750	3,092
0.0	530,100	17,670

*-this does not include town water use for canteen and showers.

The water reuse, as a percentage of the townwater required for water uses, is shown below in **Table 11**.

Table 11 – Rainwater Tank Size vs Water Reuse

Tank Size (ML)	Water Reuse (%)*
7.9	100
5.0	99.2
4.0	98.1
3.0	96.4
2.0	92.7
1.5	89
1.0	82.5
0.0	0

*-this does not include town water use for canteen and showers.

Therefore the rainwater tank storage size of between 1 and 5ML being considered by WesTrac, will result in water reuse at a rate of between 82.5% and 99.2% respectively.

The total town water usage for operation of the site including canteen and showers, in an average rainfall year, will be between 2,595KL and 5,537KL per year depending on the rainwater tank size selected by WesTrac.

3.2.8 Model Sensitivity for Climate Change

From "Managing Urban Stormwater: an integrated approach" produced by DECC, the latest best-estimate predictions of the potential impacts of climate change in NSW by 2070 relevant to stormwater management include:

- Decreases in average annual rainfall by up to 10%;
- Increases in extreme storm rainfall intensity of up to 6%; and
- Increased evaporation of up to 8%.

The water balance already has some in built sensitivity since it includes the driest rainfall year on record in the analysis period. However, for further sensitivity analysis, the daily evaporation values were increased by 8% and the annual rainfall decreased by 10% over the 30 year simulation period. The results of this sensitivity are shown below in **Table 12**.

Table 12 – Sensitivity for Climate Change

Tank Size (ML)	Town Water Supplement to Uses over 30 year analysis period (KL)*	Sensitivity Result (increased evaporation, decreased rainfall)	Relative Water Reuse Change (%)
5.0	4,500	11,350	-1.3%
4.0	10,000	16,150	-1.2%
3.0	19,300	26,400	-1.3%
2.0	38,550	48,600	-1.9%
1.5	58,250	69,600	-2.1%
1.0	92,750	103,850	-2.1%

*-this does not include town water use for canteen and showers.

The results from **Table 12** indicate that the sensitivity result of climate change is that the percentage of water reuse will decline, as expected, and more town water will be required to supplement water uses for the equivalent tank size.

The increases in rainfall intensity are not anticipated to cause any long term issues with the water quantity. Changes to intensity are not part of the model, being more relevant to the sizing of conveyance structures. The open drainage around the perimeter of the facility has freeboard and capacity for these increases in intensity.

3.3 STORMWATER CONTROLS/SITE DESIGN

From **Section 3.2**, it has been shown that runoff from a large percentage of the site will discharge to the northern section of the site and recharge the aquifer/Tomago Sandbeds. Runoff from this northern section of the site will only discharge to the south and wetlands areas during extreme rainfall events. The remainder of the site however, will discharge runoff to the south. It has been demonstrated in **Section 3.2** that the runoff quantity discharging to the south post development, is equivalent to the runoff quantity pre development. This Section will address the issue of the quality of the runoff from the WesTrac operations, in particular, the treatment of discharge to the wetlands downstream.

A primary water quality control on site will be the Washpads. The purpose of these washing facilities is to clean heavy mechanical equipment prior to workshop activities. WesTrac has standardised control over these facilities country wide at its existing operations. This issue is addressed in **Section 3.3.1**.

The remainder of the site requires less specific design, for the treatment of finer dust and sediment in runoff after collecting on the hardstand areas between rainfall events. This issue is addressed in **Section 3.3.2**.

3.3.1 Washpads

There are two (2) washpads, WesTrac and B/Con, proposed on site for the purpose of cleaning heavy mechanical equipment prior to workshop activities. The process involves using a biodegradable detergent which releases free oil after addition of an emulsion breaker for efficient oil separation and collection, together with a detergent stripping stage using a foam fractionator. The resultant treated water is recycled through a filtration and sterilisation stage. A portion of treated water is removed from the circuit and sent for final treatment to the site sewage treatment plant.

Water for washpad operations is derived from three (3) sources:

- rainwater harvesting;
- town water; and
- recycled water.

All washpad solids are collected in a sump with capacity to be operated for a number of months prior to solids removal. Accumulated solids from the sump will be disposed of to NSW Class1 landfill by a licensed waste disposal contractor.

The resultant wastewater is pumped via a floating drawoff to a settling tank after dosing with a primary flocculant. The settled solids are returned to the solids sump for final disposal. The primary flocculant dose breaks all emulsions and presents free oil and wastewater to the skid mounted oil / water separator. Oil/Water separation is achieved using a heavy duty coalescing plate separator with waste oil being pumped to a double skinned storage tank before final disposal using a licensed contractor.

Wastewater produced by the separator is further treated by a foam fractionator (surfactant removal), with the surfactant waste collected and disposed of by a licensed contractor. The treated washpad wastewater is recycled after surfactant removal. Recycle water undergoes further treatment using chlorination and sand filtration. The recycled water feeds a low pressure wash unit with inline UV sterilisation. The spent wash water drains to the solids sump at the start of processing for reuse.

There is also a low volume high pressure wash unit proposed for the washpad which uses rainwater and/or town water. This water also drains to the solids sump after use.

The washing process utilises a number of chemicals most of which are classified as non hazardous. These include the following:

- Surfactants;
- Degreasers;
- Primary Alum Flocculant;
- Sodium Hypochlorite; and
- Hydrochloric Acid for pH control.

The main chemicals in use on the washpad will be for cleaning purposes and comprise the following:

- Emulsion Breaker Primary Flocculent /Polyelectrolyte based on poly aluminium chloride; and
- Non solvent alkaline cleaners and degreasers.

These products are designed to remove a broad spectrum of soils, grease and grime.

All the chemicals in use on the washpad have been selected by WesTrac for biodegradability and environmental acceptability. WesTrac has a standard policy on chemical purchase as part of its country wide environmental policy. The chemical selection policy takes account of the need to replace solvent based cleaners and degreasers such as Kerosene.

The chemical storage and use areas are bunded and the following safety equipment will be deployed in the washpad area:

- Eye Wash and Shower
- Fire Extinguisher
- First Aid Box
- Safety Signage

In addition to chemical standardisation, WesTrac has carefully selected a preferred washpad equipment manufacturer and installer who provides operation and maintenance backup on an all-round basis. The contractor/supplier is approved by Hunter Water for this type of process.

3.3.2 Water Quality Modelling – Discharge to Wetlands

Council has a range of water quality requirements for the improvement of runoff from the proposed development, prior to discharge from the site. From Table 8-3 of Council's document "Urban Stormwater and Rural Water Quality Management Plan", post construction targets have been set for the pollutants (Total Suspended Solids, Phosphorus and Nitrogen) in runoff. Council's document however, goes further to say that in sensitive catchments, these targets and objectives for stormwater treatment may need to be reassessed and upgraded. Similarly, "Managing urban stormwater: environmental targets" (Consultation Draft 2007) produced by DECC also provides targets for pollutant removal, with the opportunity to upgrade in the situation of sensitive receiving waters downstream.

It has been considered that this site should be classified as a sensitive catchment, and that a higher level of protection should be applied to the wetlands via a more extensive treatment of the stormwater runoff prior to discharge from the site.

DECC targets, to be *exceeded*, are as follows:

- *90% reduction in the average annual gross pollutant load*
- *85% reduction of average annual total suspended solids load;*
- *65% reduction in the average annual total phosphorus load;*
- *45% reduction in the average annual total nitrogen load.*

These targets are a higher level of protection for the downstream receiving waters than Councils general development objectives. The water quality objective for this site was to determine a solution of 'no impact' to the downstream receiving waters. Post development simulations were compared against existing, pre European settlement discharges to demonstrate 'no impact'. Meeting the objective of 'no impact' exceeds the DECC targets described above.

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) is the most appropriate and current water quality model available to demonstrate that all requirements have been met. Subsequently, a stormwater treatment train has been established to meet these requirements.

The source, catchment of pollutants, is the 'Hardstand Area 2' catchment, refer to **Figure 6**. Runoff from this catchment discharges to a swale which treats and conveys the runoff to a constructed wetland south of the south eastern corner of the site. As described in **Section 3.3**, the remainder of the catchment is designed to drain to the north.

A proportion of the overflows from the rainwater tank system will also enter this catchment to the constructed wetland, however, considering that rainwater tank storage is large and that we are using MUSIC to assess water quality, this flow, in times of higher rainfall, will not be considered. This is because water quality calculations are focused on regular runoff from smaller storm events. This runoff contains the majority of pollutants collected on the surface between storm events. Note that this stream of rainwater tank overflow was included for the overall runoff volumes to the wetlands downstream.

The treated discharge from the sewer treatment plant, as described in **Table 2** as being of very high quality and suitable for discharge as stormwater, will also enter the swale and constructed wetland. In reality it is considered that this stream will in effect act as a clean flushing and dilution stream to runoff from Hardstand Area 2, although not modelled in this manner. The anticipated rate of this stream is 35KL/day. The water balance model indicates that with the inclusion of this stream, flow quantities discharging to the wetlands downstream remain the same following development. This is partially controlled by the high evaporation rates from the large evaporative surface of the constructed wetland.

The following key parameters, generally in accordance with MUSIC user manual, were adopted:

- Rainfall/Evapotranspiration – 6min rainfall data for Williamtown BOM station was used for the simulation. The data was collected from 2004, closely equivalent to the average rainfall for Williamtown. Average monthly areal potential Evapotranspiration (PET) rates for the simulation were also sourced from the Bureau of Meteorology.

- The existing, pre development simulation adopted the 'forest' source node and the mean annual loads produced were noted as the target objectives for the post development simulation. Refer to **Figure 8**.

- The Hardstand Area 2 was modelled as 100% impervious in the post development simulation. The associated swale area within the catchment was modelled as pervious. Total catchment configuration was 8.063 hectares as 68% impervious. Refer to **Figures 6** and **9**.

- Storm flow pollutant generation parameters for the hardstand area were modified from default values to those described by "Fletcher et al (2004)" for Road Reserves. These values are slightly 'worse' than default parameters. Export of the pollutants was simulated in "stochastic generated" mode.

    - Log10 TSS Mean 2.38, Std Dev 0.4
    - Log10 TP Mean -0.6, Std Dev 0.5
    - Log10 TN Mean 0.42, Std Dev 0.19

- Treatment node parameters for the post development catchment consisted of a gross pollutant trap, swale and constructed wetland prior to discharge to the wetland. The discharge from the constructed wetland is also buffered by flowing over approximately 430 metres before discharge to the wetland boundary. There has been no representation of this flow length/buffer in the model. The point at which the quality has been measured is the discharge point of the constructed wetland, measured to meet the target water quality objectives.

A comparison of the pollutant modelling simulations for pre development and post development with controls (ie treatment train), is shown below in **Table 13**.

Table 13 – Water Quality Modelling Results from MUSIC

Pollutant	Existing Simulation – Pre European Settlement	Post Development Simulation with Controls	Treatment Train Effectiveness (%)
Total Suspended Solids (kg/year)	234	32.7	99.8
Total Phosphorus (kg/year)	0.34	0.328	98.7
Total Nitrogen (kg/year)	6.25	5.71	96.5

The modelling results in **Table 13** indicate that the post development simulation with mitigation controls in place, meets the target objective of 'no impact' by matching pollutant levels less than the levels from existing pre European settlement catchment. This level of stormwater treatment for water quality far exceeds the treatment levels outlined by DECC.

The outcomes of the water quality modelling indicate that a constructed wetland with a surface area of 11,000m^2 and volume of 7,150m^3 is required at the base of the proposed development. Concept design of the constructed wetland has been provided. Final detailed design of the constructed wetland for the configuration of the shallow water and deep water zones will be necessary at the detailed design phase of the development. Refer to **Figures 6** and **10**.

3.3.3 Drainage Flowpaths

Major drainage flowpaths around the WesTrac facility have been identified and sized for stormwater conveyance and control. These include box culverts under the perimeter road and secondary flowpaths for stormwater from the rainwater tanks and hardstand areas. Flowpaths are shown in **Figure 6**.

3.3.4 Off Site Hydraulic and HVOF Facility

The off site Hydraulic and HVOF facility occupies one lot in the proposed industrial subdivision. Individual stormwater treatment controls will be required for the development of this lot. These will include a rainwater tank for all roof water, gross pollutant traps as required, and a bio retention swale at the front, southern boundary. Stormwater will discharge to the swale, for further treatment, prior to discharging overland for approximately 800 metres and entering the wetland. This will act as a temporary buffer prior to the commencement of the industrial subdivision. The industrial subdivision has stormwater treatment controls designed to cater for development on this lot. The lot will be filled to an elevation of 2.3mAHD and of fill quality as described in **Section 3.3.6**. The associated swale and road will also be constructed. Refer to **Figure 6**.

3.3.5 Fill Elevation

The site will be filled to a minimum elevation of 2.3mAHD around the perimeter of the ring road of the WesTrac facility. This is closely equivalent to the peak 100 year recurrence regional flood level for the Hunter River. The bulk earthworks strategy, as described in Volume 2, will be to dome the middle of the site, with fall to the perimeter. Finished floor levels of all buildings will be 3.5m AHD, well clear of the 1:100 year peak flood level. There is no impoundment of stormwater runoff upstream of the site as a result of the fill. Refer to **Figure 11**. This is described further in **Volume 2 – Concept Engineering, Services and Earthworks Report - Overall**.

3.3.6 Fill Quality

Geotechnical approval will be required on the fill type and its properties prior to being used on the site. This is because there can be potential impacts of leachates emanating from the fill and migrating downstream with stormwater runoff. Geotechnical advice has been provided, directing that granular material with particles not greater than 100mm diameter is preferred for use on the site. In particular, no ash is to be used for filling; due to its leachate potential. The fill to be used must be pH neutral and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. This will mitigate any potential impacts of runoff from the fill to the wetlands. This is described further in **Volume 2 – Concept Engineering, Services and Earthworks Report - Overall**.

3.3.7 Groundwater – low lying plains

Groundwater in the Tomago Sandbeds has been described in **Section 3.1**. Groundwater levels over the remainder of the WesTrac facility site are variable, approximately RL (minus)0.5m AHD at the date of testing. The variability is due to the variable clay thicknesses, lenses and general subsurface conditions.

It is possible that the overflow of groundwater levels from the Tomago Sandbeds would pass into the surface water regime in the low lying plains during times of peak groundwater levels. Following development, the recharge to the HWC infiltration area has been maintained as described in **Section 3.1** and groundwater overflows will still pass through the sand fill layers beneath the hardstand areas during peak times.

Existing recharge of groundwater by infiltration through the clays is expected to be low, due to the heavy, saturated clays and presence of standing water over the surface. Therefore it is unlikely that the hardstand, impervious areas of the WesTrac facility would affect groundwater levels other than immediately beneath the facility. There are no other operations of the WesTrac facility that could impact on groundwater.

Any connection where surface water recharges groundwater downstream of the site can be determined as 'no impact'. This is because it has been demonstrated that the quality and quantity of stormwater discharge from the site will remain the same as existing, pre development levels.

It has been demonstrated that there is no significant change to the groundwater regime and therefore no impact to groundwater as a result of the WesTrac facility.

3.4 SOIL AND WATER MANAGEMENT PLAN

Erosion and sediment controls, described in a Soil and Water Management Plan (SWMP) are necessary during construction for the protection of receiving waters downstream. Erosion and sediment control measures are temporary, and are required until such time that building and construction areas are landscaped, revegetated and sealed.

Initially, the constructed wetland, south of the south eastern corner of the site will be established as a sediment dam. At this location, the sediment dam will be the final control treatment since it is likely that intermediate dams will be established over the site. Sediment fencing will also be installed along the southern boundary.

Although a significant quantity of the bulk earthworks to be completed will be cut to fill of the dunal sands on site, Type C soils, there is potential for Type F soils to be disturbed during construction. As a result the sediment basin has been designed for settlement of Type F soils. The volumetric coefficient of runoff has also been conservatively estimated, since the majority of soils to be disturbed will be sand.

To be conservative, a higher criteria level of protection has been adopted for the design sizing of the sediment basin(s), reflecting the sensitivity of the receiving waters downstream. "Managing Urban Stormwater: Mines and Quarries – Consultation Draft 2007" produced by DECC, was referenced due to the scale of the site works. The 90th percentile rainfall event is the standard for mines and quarries. It is also described that 2-5 day rainfall events are suitable criteria for well managed sites in which prompt action can be guaranteed. At this site the 95thpercentile, 5 day rainfall event has been selected, which is approximately 3 times the storage volume of that generated by using the 75th percentile, 5 day rainfall event typically used for development sites. This gives the basin an increased capacity, capturing runoff from a greater number of storm events. This minimises the potential risk of sediment laden water leaving the site and discharging to the wetlands downstream during construction.

An overall sediment basin for the full WesTrac site, sized in accordance with "*Managing Urban Stormwater Soils and Construction*" (Blue Book) 4th Edition, Volume 1, March 2004 produced by Landcom, has been sized to be approximately 9,835m^3, refer to **Appendix D**. This sediment basin quantity however would be apportioned between the constructed wetland and a number of smaller intermediate dams for greater control of runoff during construction. Further details of the layout of sediment dams will be determined during the detailed design phase, in conjunction with the bulk earthworks strategy. Refer to **Figures 12** and **13**.

3.4.1 Erosion and Sediment Control

Erosion and sediment control measures to be implemented during construction include:

1) Disturbance only of areas to be immediately worked on and regeneration of dust and erosion free surfaces – landscaping, concrete, bitumen sealing as soon as practical thereafter.

2) Provision of and continued maintenance of sediment fencing to low perimeter locations.

3) Provision of mesh and gravel or geotextile inlet filters.

4) Contract specifications requiring stabilised site access, low flow earth flow earth banks and wind erosion screens.

5) A construction programme that provides for the sediment basin to be constructed at the outset with all site runoff, where practical, piped or channelled to this basin for primary treatment/settlement before leaving the site via a mesh supported geotextile filter/riser before discharging to the wetlands. Refer to **Figure 10**.

6) Contract specifications requiring regular maintenance of all erosion and sediment control structures and devices for the full contract and maintenance period.

3.4.2 Land Disturbance Conditions

Where practicable the soil erosion hazard shall be kept as low as possible. Limitations to access are to be in accordance with **Table 14**.

Table 14 – Land Use Limitations

Land Use	**Limitation**
Access Areas	Access is to be limited to the designated all weather roads.
Truck Wash Down Bay	Any truck exiting out of the site shall be thoroughly cleaned and limit the exportation of clay and sediment on public roads.
Remaining Lands	Entry is prohibited to remaining land.

3.4.3 Construction Sequence

Works shall be undertaken in the following sequence prior to the commencement of bulk earthworks:

1) Install sediment fencing and cut drains to meet the requirements of the SWMP. Waste collection bins shall be installed adjacent to site office.

2) Construct stabilised site access in location nominated by the Contractor and in accordance with Port Stephens Council's requirements.

3) Construct sediment basins for disturbed areas in accordance with the rate per hectare provided in the SWMP. Install risers and two pegs in the floor of the basin and have them marked to show the top of the sediment storage zone. Ensure the basin is cleared of sediment once the design capacity is reached.

4) Redirect clean water around the construction site.

5) Install sediment control protection measures at all natural and man-made drainage structures. Maintain until all the disturbed areas are stabilised.

6) Clear and strip the work areas in accordance with the Geotechnical advice in **Appendix M** of the **Application**.

7) Any disturbed areas, other than lot grading areas, shall immediately be covered with site topsoil within 7 days of clearing. Lot re-graded shall be covered with bitumen emulsion as specified.

8) Apply permanent stabilisation to site (landscaping).

3.4.4 Sediment Control Conditions

1) Proprietary sediment fencing shall be installed by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent to contain sediment fractions as near as possible to their source.

2) Sediment removed from any trapping device shall be relocated where further pollution to downslope lands and waterways cannot occur.

3) Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days they shall be stabilised by covering with mulch or with temporary vegetation.

4) Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor's approved SWMP.

5) Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated.

6) Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas.

3.4.5 Site Maintenance Requirements

1) Waste bins are to be provided for all construction refuse. They are to be emptied at least weekly and refuse is to be disposed in accordance with the site manager's recommendations.

2) The site manager shall inspect the site at least weekly and shall:

   (a) Ensure that all drains are operating effectively and shall make any necessary repairs;

   (b) Remove any spilled material from area subject to runoff or concentrated flow;

   (c) Remove trapped sediment where the capacity of the trapping device falls below 60%;

   (d) Inspect the sediment basins after each rainfall event and/or weekly. Ensure that all sediment is removed once the sediment storage zone is full (refer to pegs installed in basins in accordance with the SWMP). Ensure that outlet and emergency spillway works are maintained in a fully operational condition at all times;

   (e) Ensure rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate;

   (f) Construct additional erosion or sediment control works as may be appropriate to ensure the protection of downslope lands and waterways;

   (g) Maintain erosion and sediment control measures in a fully functioning condition at all times until the site is rehabilitated;

   (h) Ensure that the revegetation scheme is adhered to and that the all grass covers are kept healthy, including watering and mowing;

   (i) Remove temporary soil conservation structures as the last activity in the rehabilitation program.

Section 4.0 Compliance Checklist

This report, Volume 3, was focused on the stormwater management WesTrac facility and associated road and trunk drainage infrastructure as well as the off site Hydraulic and HVOF facility.

It has been demonstrated in this report that the stormwater management system for the WesTrac facility has achieved the target objective of 'no impact', exceeding the requirements outlined in the most current DECC stormwater manuals and Council's development control plans. The stormwater management system also meets the requirements of DGRs and HWC correspondence to date.

Compliance of the stormwater management system is addressed in the report as follows:

- Simulations of water balance modelling have demonstrated water recycling and reuse, to levels of between 82.5% and 99.2%. This is described in detail in **Section 3.2**.

- The quality and volumes of stormwater runoff to the wetlands downstream will remain the same post development, demonstrated by modelling. This is described in detail in **Sections 3.2** and **3.3**.

- The quality and volumes of stormwater runoff to the Special Area have been demonstrated to have a slight positive impact, increasing HWC groundwater supply in the Tomago Sandbeds. This is described in detail in **Section 3.1**.

- A higher level of protection against runoff to the wetlands downstream has been designed in the Soil and Water Management Plan. This is described in detail in **Section 3.4**.

- Alternative sewer disposal arrangements have been made. Sewer will be treated on site and discharge to stormwater, monitored for water quality. Remote alarm systems will be installed for continuous on line monitoring. This is described in detail in **Section 3.1.2**.

Appendix A – Figures

Plan of WesTrac Facility
Tomago Road, Tomago

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0 100 200 300 500 1000 2000 3000

Bar Scale 1: 25000 (A1), 1: 50000 (A3)

- SITE BOUNDARY
- SURROUNDING BOUNDARIES
- PROPOSED WESTRAC SITE
- SEPP 14 WETLAND AREA
- RAMSAR WETLAND AREA

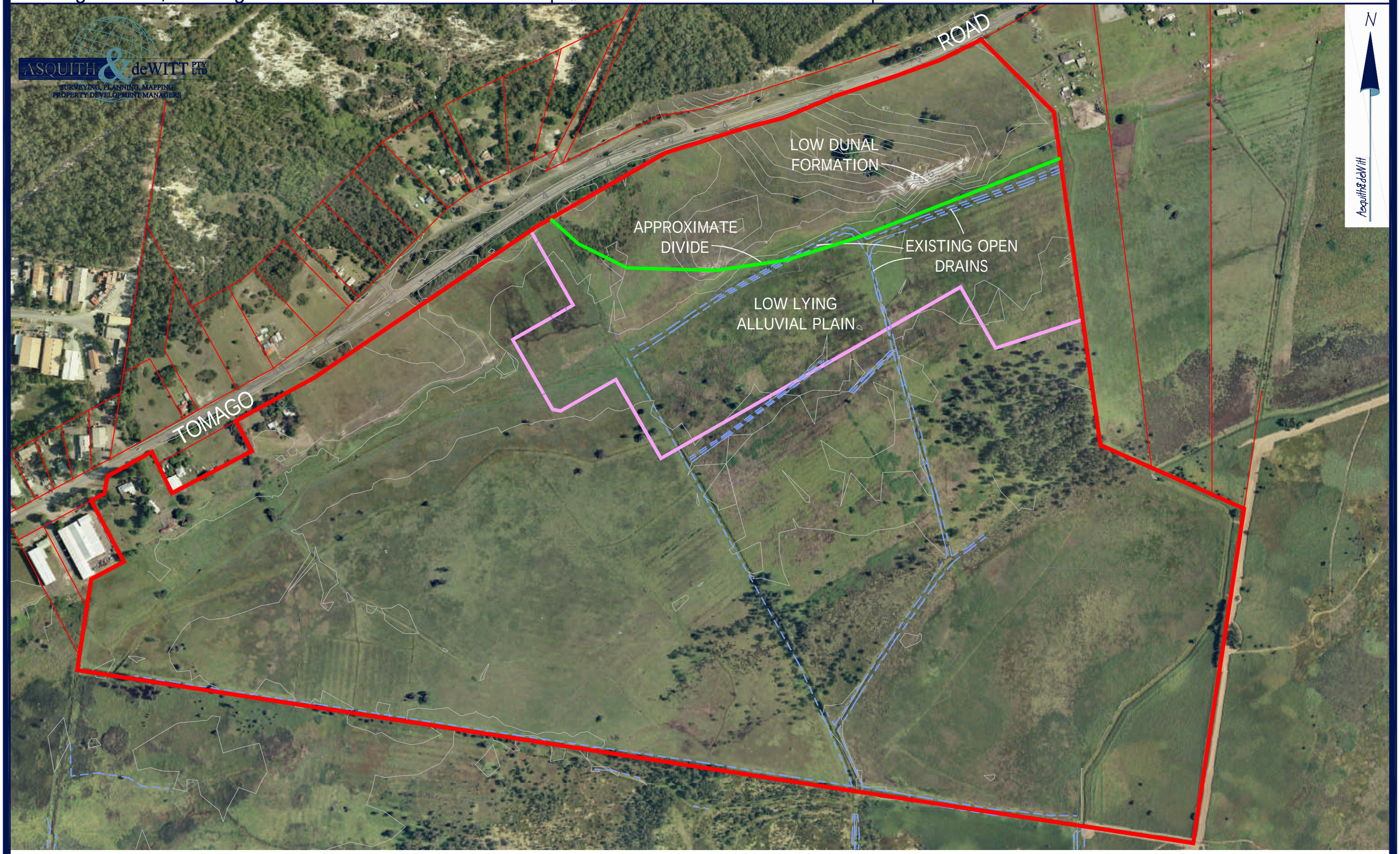
FIGURE 1
SITE LOCATION

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Tomago Road, Tomago

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- SITE BOUNDARY
- SURROUNDING BOUNDARIES
- OPEN DRAIN
- WESTRAC BOUNDARY

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Bar Scale 1: 5000 (A1), 1:10000 (A3)

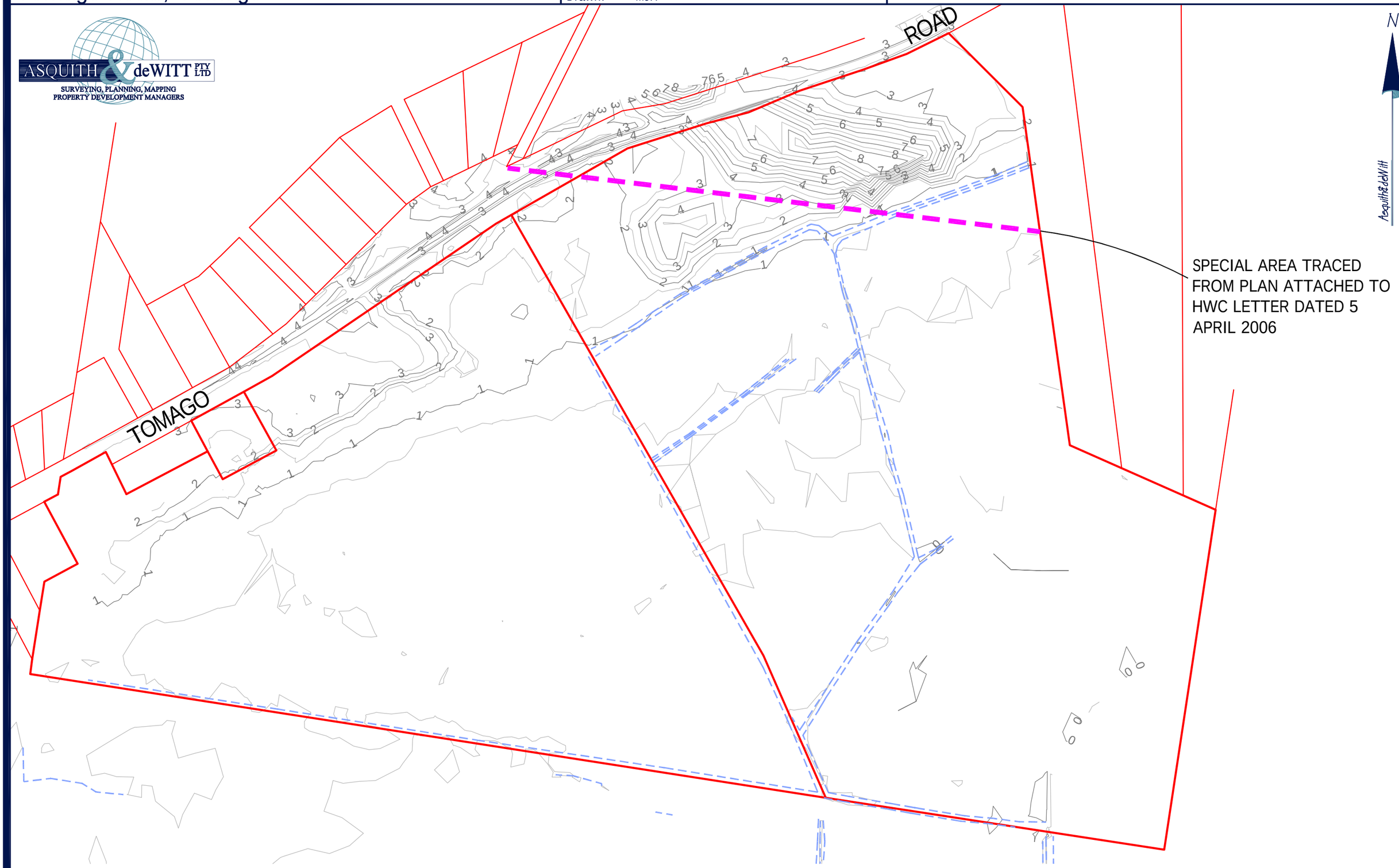
FIGURE 2
EXISTING SITE

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SITE BOUNDARY
OPEN DRAIN
SPECIAL AREA

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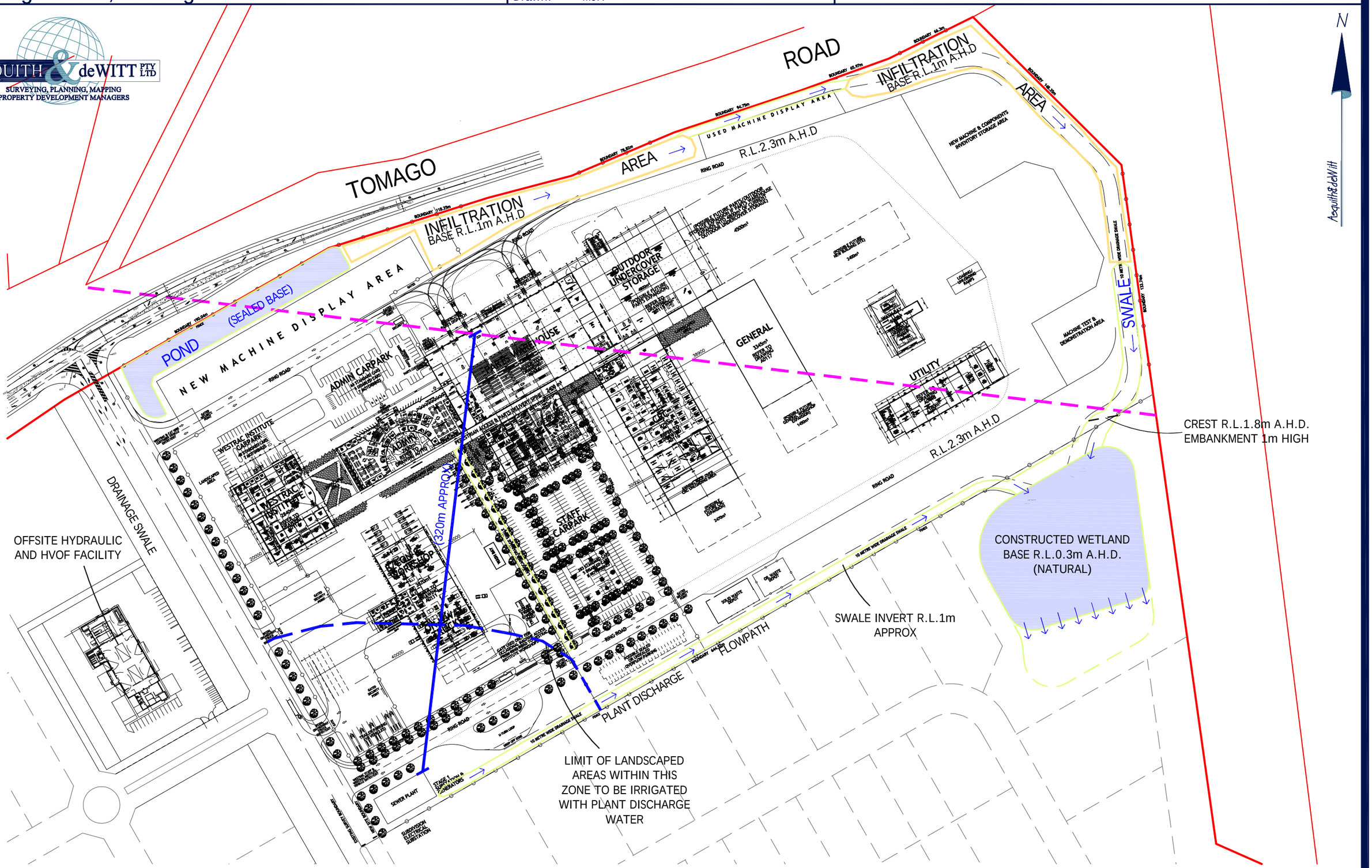
FIGURE 3
HWC PLAN - SPECIAL AREA

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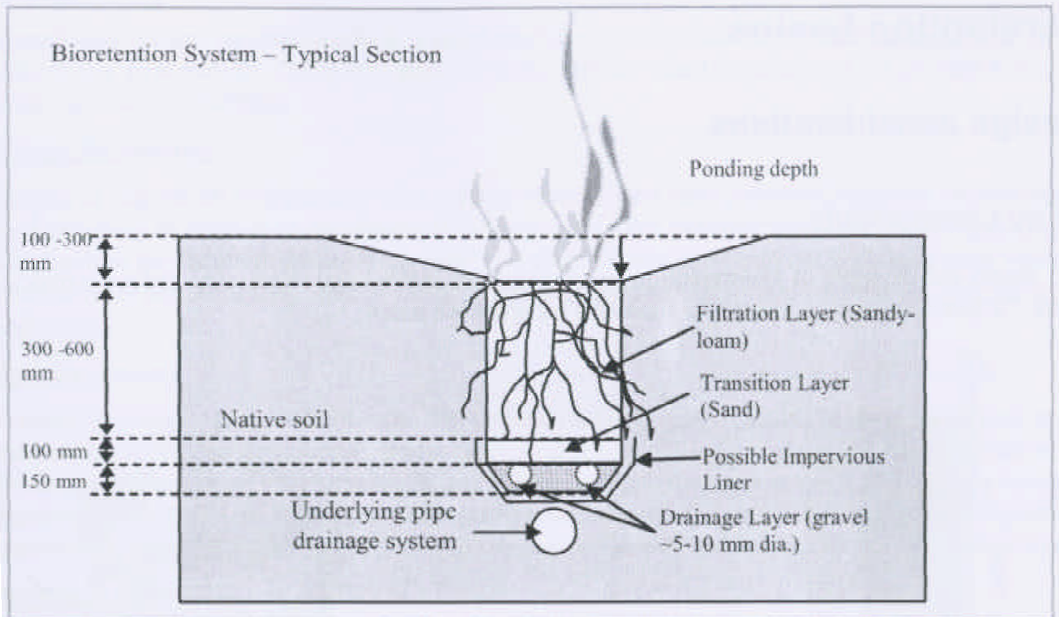
FIGURE 4
DEVELOPMENT LAYOUT

Plan of WesTrac Facility
Tomago Road, Tomago

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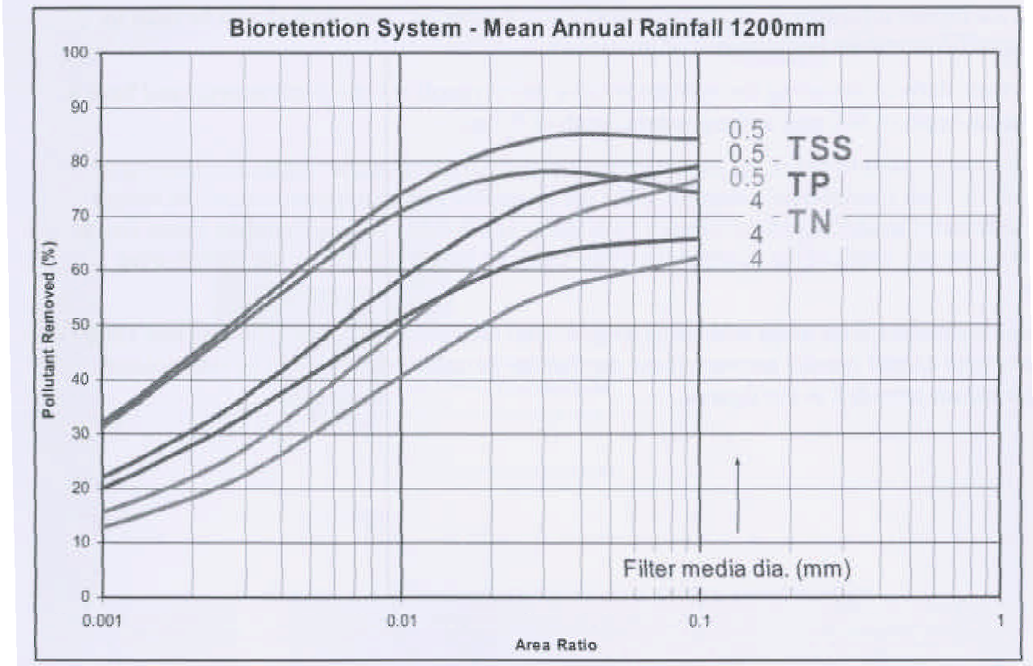
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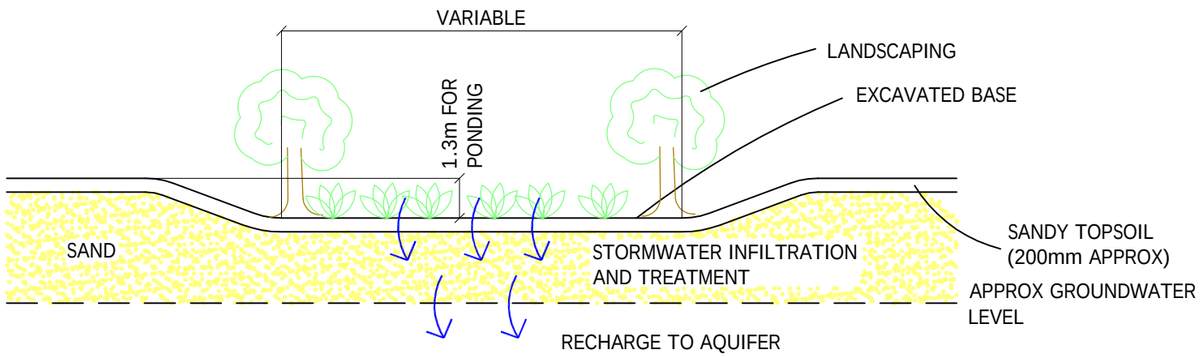
BIORETENTION SYSTEM - TYPICAL SECTION

REPRODUCED FROM MANAGING URBAN STORMWATER TREATMENT TECHNIQUES - CONSULTATION DRAFT 2007 (DECC)



POLLUTANT REMOVAL PERFORMANCE

REPRODUCED FROM MANAGING URBAN STORMWATER TREATMENT TECHNIQUES - CONSULTATION DRAFT 2007 (DECC)



HWC INFILTRATION AREA

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FIGURE 5
BIORETENTION SYSTEM

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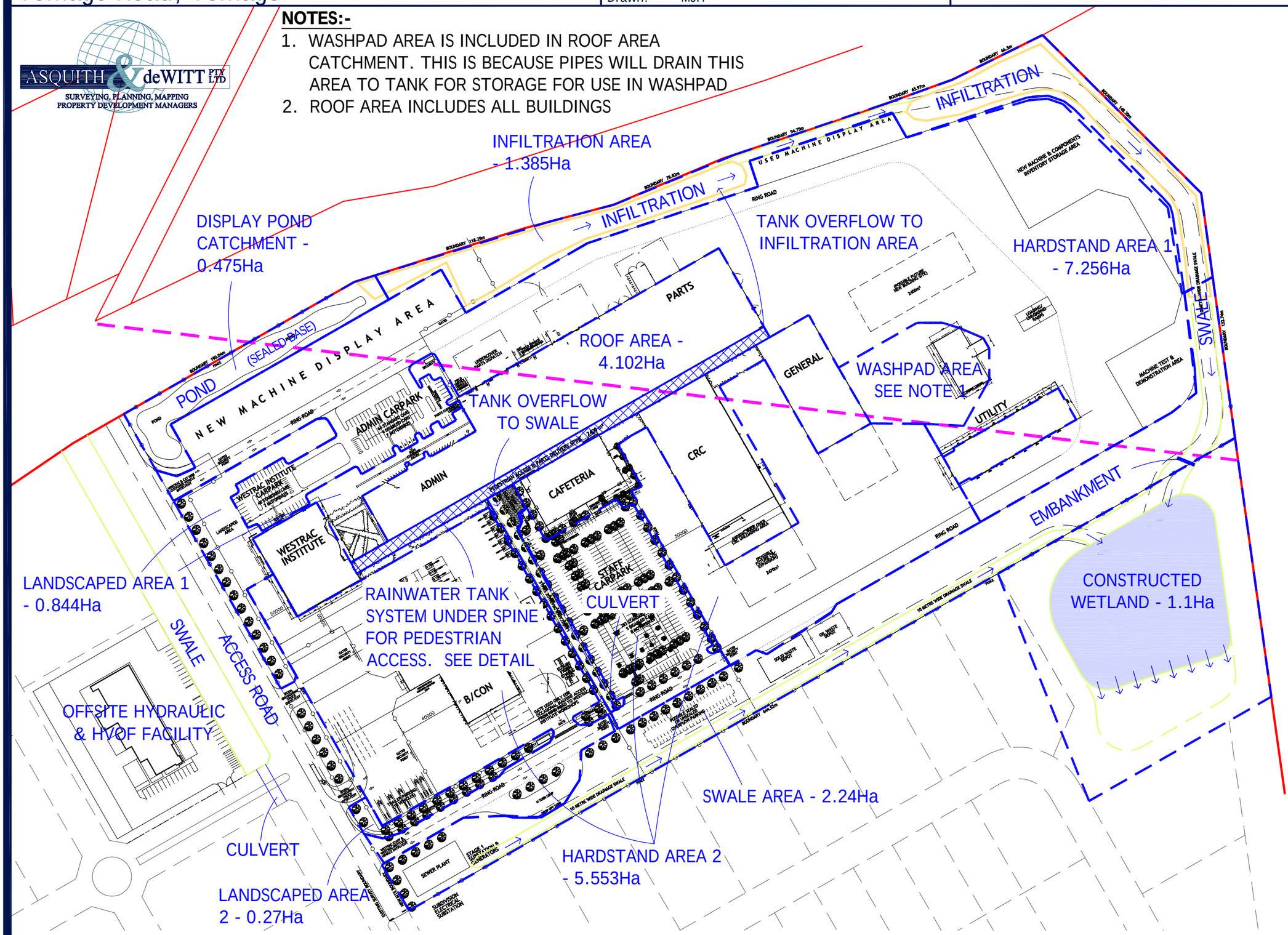
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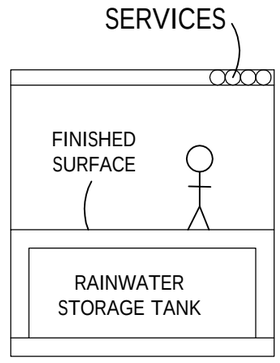
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NOTES:-

1. WASHPAD AREA IS INCLUDED IN ROOF AREA CATCHMENT. THIS IS BECAUSE PIPES WILL DRAIN THIS AREA TO TANK FOR STORAGE FOR USE IN WASHPAD
2. ROOF AREA INCLUDES ALL BUILDINGS





DETAIL OF SPINE FOR PEDESTRIAN ACCESS (CONCEPT) N.T.S.

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Bar Scale 1: 2500 (A1), 1: 5000 (A3)

FIGURE 6
STORMWATER MANAGEMENT

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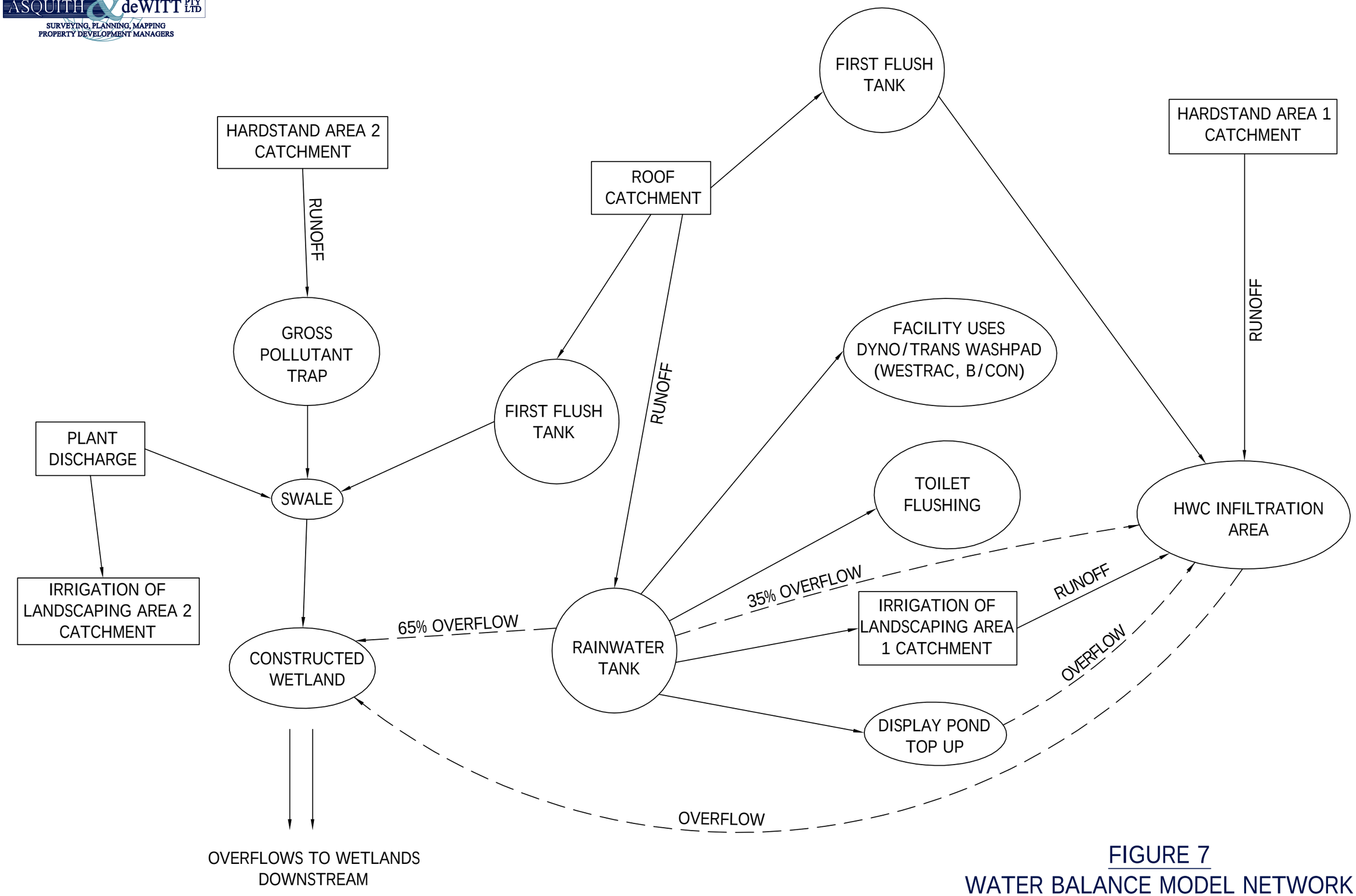


FIGURE 7
WATER BALANCE MODEL NETWORK

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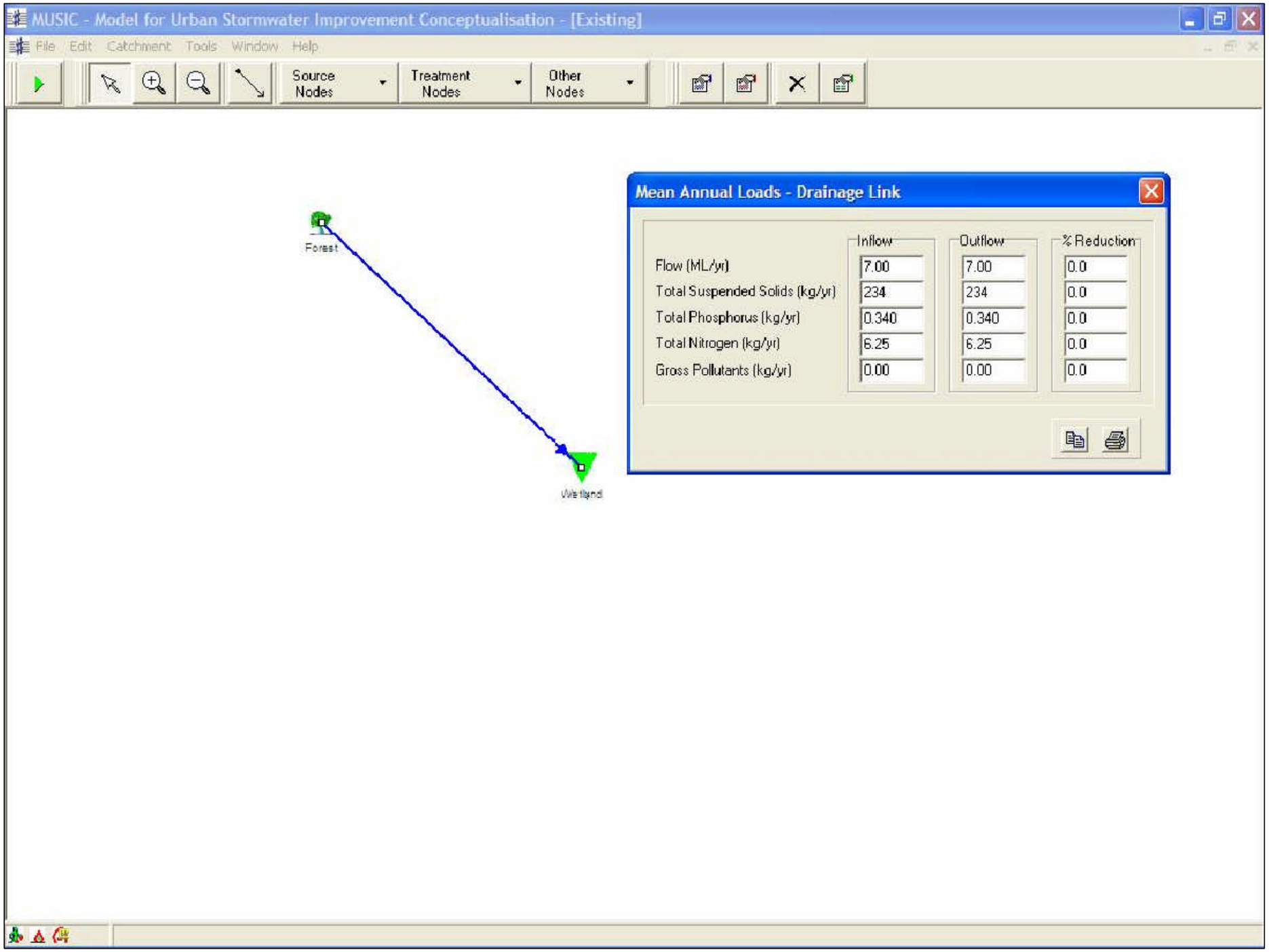


FIGURE 8
MUSIC LAYOUT
EXISTING

Plan of WesTrac Facility Tomago Road, Tomago	Date:	November 2007	AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 3\11886fig-9a
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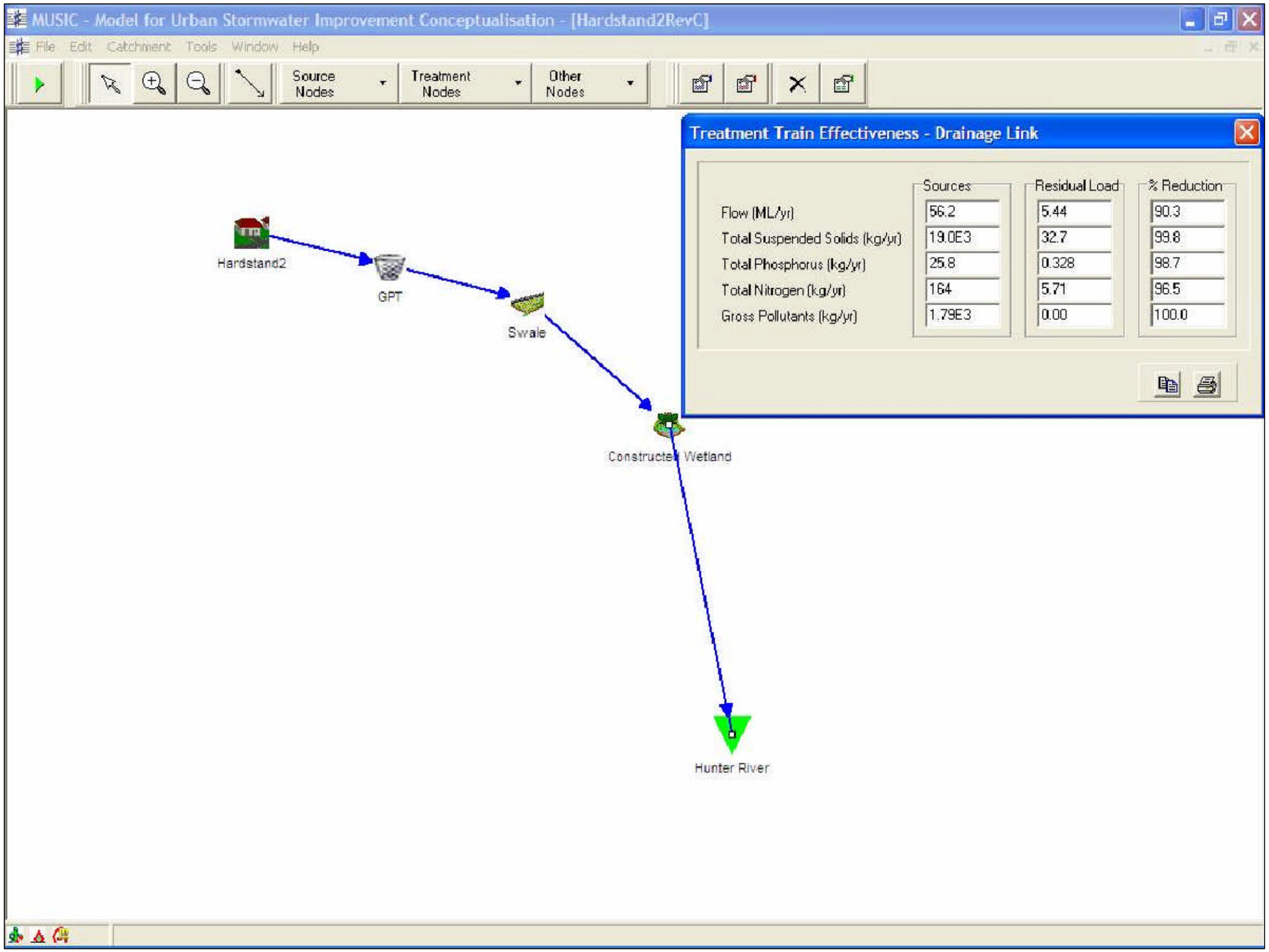


FIGURE 9
MUSIC LAYOUT
POST DEVELOPMENT

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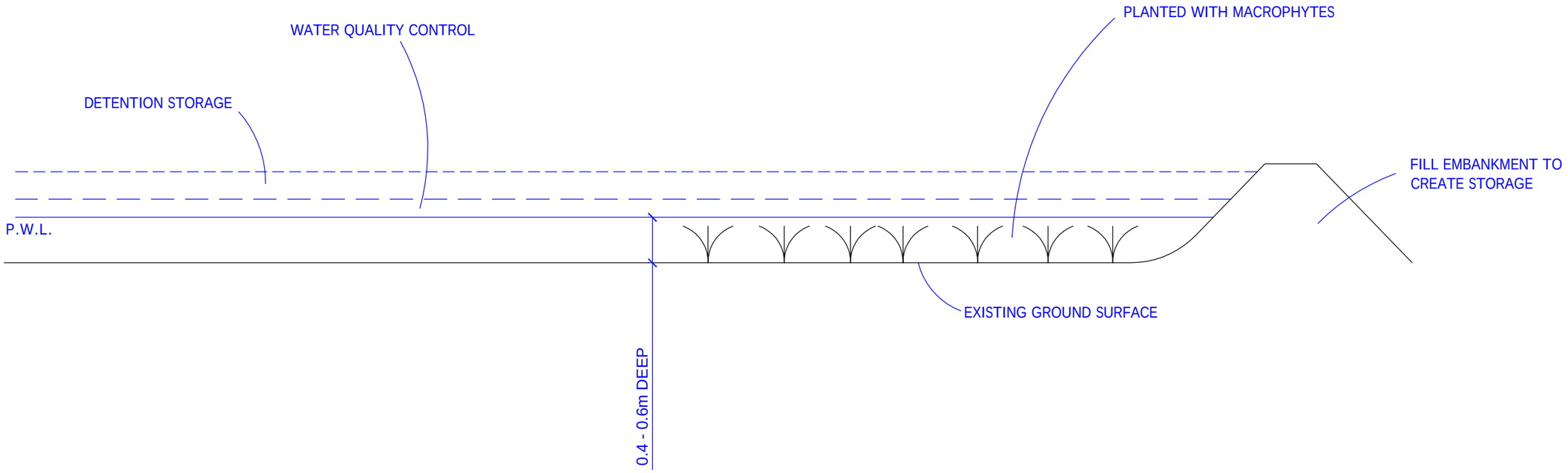


FIGURE 10
TYPICAL BASIN SECTION OF CONSTRUCTED WETLAND

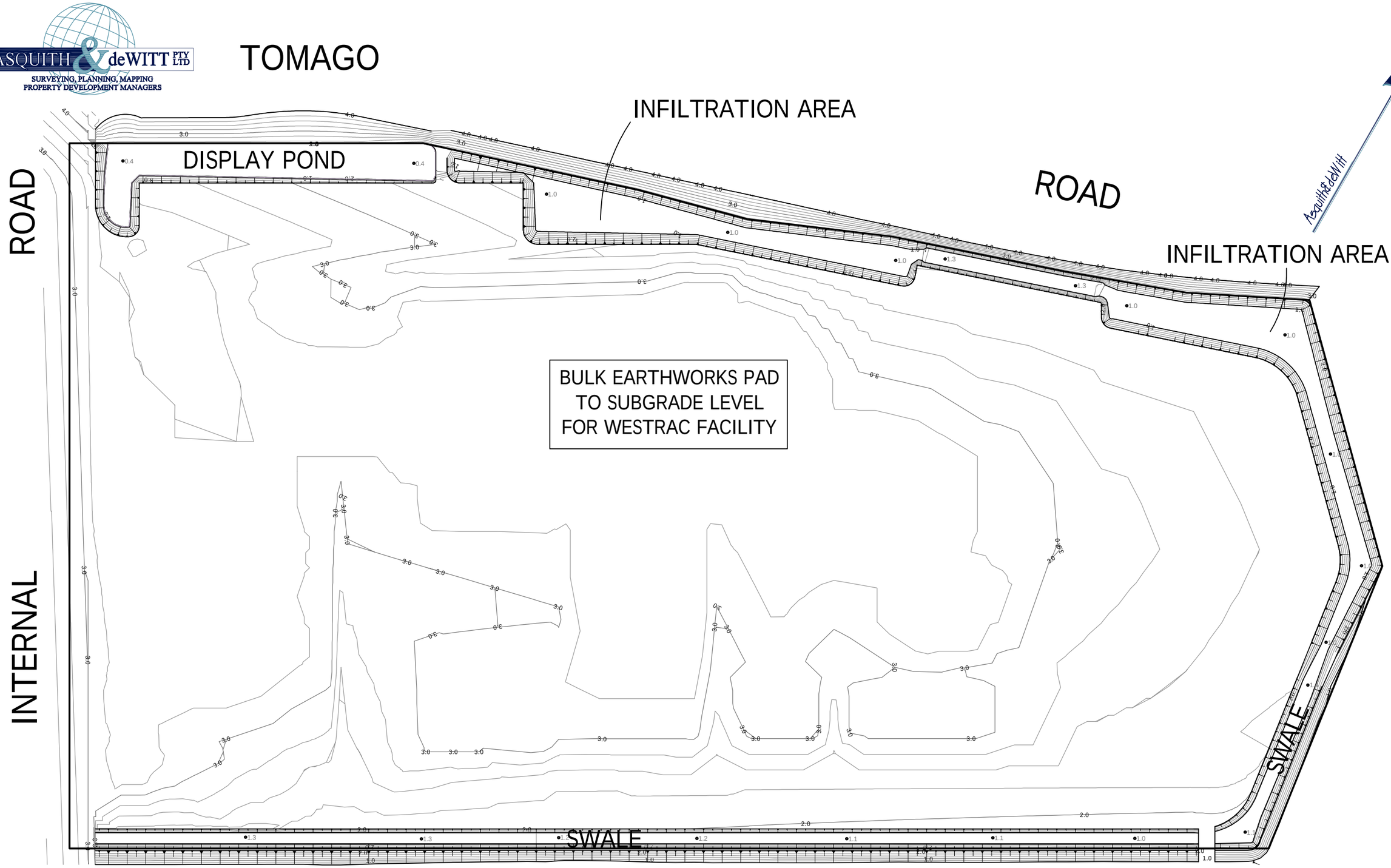
Plan of WesTrac Facility
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TOMAGO



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0 10 20 30 40 50 60 80 100 150 200

Bar Scale 1: 2000 (A3)

FIGURE 11
BULK EARTHWORKS

Plan of WesTrac Facility
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH

AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 3\11886fig-12a
Job No:	11886

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PROPERTY DEVELOPMENT MANAGERS

TEMPORARY CONSTRUCTION ACCESS. SEE FIGURE 13

SITE COMPOUND. SUGGESTED LOCATION ONLY

TOPSOIL STOCKPILE. SUGGESTED LOCATION ONLY

SEDIMENT FENCE. SEE FIGURE 13

TOPSOIL STOCKPILE. SUGGESTED LOCATION ONLY

POSSIBLE SEDIMENT BASIN LOCATION

SEDIMENT FENCE. SEE FIGURE 13

BLOCK EXISTING CHANNEL DURING CONSTRUCTION

FORM EMBANKMENT ABOVE GROUND, NO EXCAVATION

SEDIMENT BASIN

INSTALL BASIN RISER. SEE FIGURE 13

N

Asquith&deWitt

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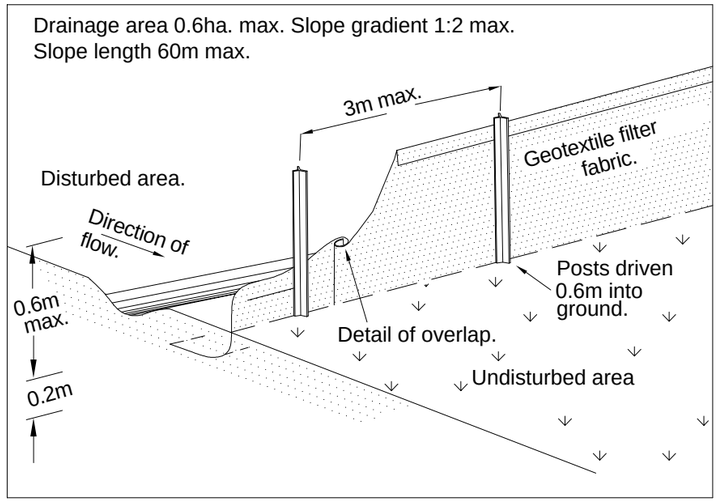
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FIGURE 12
SOIL AND WATER MANAGEMENT

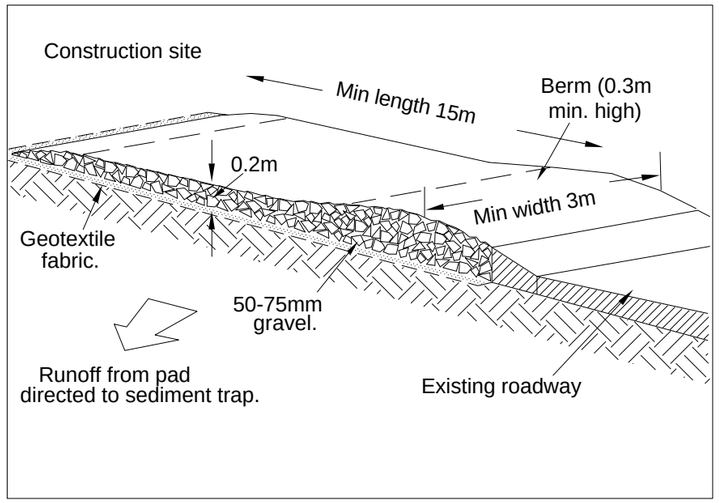
Plan of WesTrac Facility
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH
AutoCAD Ref:	N:\11886\Dwg\Eng\Report\Nov\Vol 4\11886fig-13a
Job No:	11886

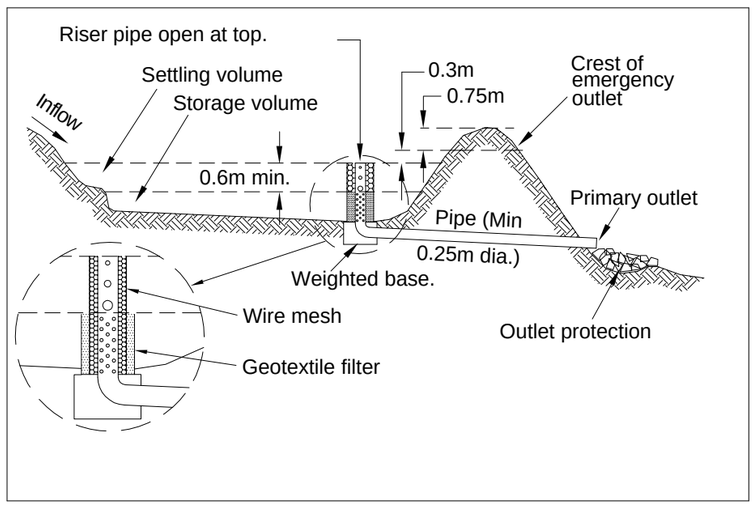
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PROPERTY DEVELOPMENT MANAGERS



SEDIMENT FENCE



TEMPORARY CONSTRUCTION ACCESS



BASIN RISER

NOTES

(a) Upon completion of final earthworks or after written direction of Council, immediate soil conservation treatments shall be applied so as to render areas that have been disturbed, erosion proof in 30 days.

(b) All perimeter and siltation control measures are to be the first step in clearing or earthworks.

(c) The area over all stormwater and sewer lines not within the roads are to be strip turfed on the contour as soon as possible but no later than 7 days after backfill. Max spacing of strip turf to be 4 metres

(d) No more than 150 metres of trench are to be open at any one time.

(e) Areas over electricity, telephone and gas supply trenches are to be seeded and mulched as soon as possible, but no later than, 7 days after backfill.

(f) All temporary earth berms, diversion and sediment basin embankments are to be track rolled and seeded or mulched for temporary vegetation cover as soon as they have been formed.

(g) All fills are to be left with a windrow at least 200mm high at the top of the slope at the end of each days earthworks, and all earthwork areas shall be rolled each evening to "seal" the earthworks.

(h) All final erosion prevention measures, including establishment of grassing, are to be completed prior to the subdivision final inspection.

(i) A strip of turf is to be placed immediately behind the kerb and gutter on all new roads and at any additional locations determined by Council's Supervising Officer.

(j) All topsoil is to be stockpiled on site for re-use (away from trees and drainage lines). Measures shall be applied to prevent erosion from the stockpiles.

(k) Establishment of fire breaks shall be carried out in consultation with the Fire Control Officer and Council's Environment Officer.

(l) Temporary sand bag sediment traps are to be placed at each drainage pit. Sand bags are to be used to construct temporary sediment traps at each kerb inlet.

(m) All disturbed areas are to be stabilised and/or revegetated within 14 days of earthworks completion, using turf or the following seed and fertilizer mixture:

	SPRING/SUMMER	AUTUMN/WINTER
Japanese Millet	10kg/Ha	
Ryecorn/Oats		15kg/Ha
Couch Grass	10kg/Ha	8kg/Ha
Perenial Grass	5kg/Ha	10kg/ha
Starter Fertilizer (Sowing)	300kg/Ha	300kg/Ha
Maintenance Fertilizer	100kg/Ha	100kg/Ha

FIGURE 13
STANDARD EROSION AND SEDIMENT CONTROLS

Appendix B – HWC Correspondence

HUNTER WATER CORPORATION . PO BOX 5171 HRMC NSW 2310 . TEL 1300 657 657
36 HONEYSUCKLE DRIVE NEWCASTLE . ABN 46 228 513 446 . HUNTERWATER.COM.AU

5 April 2006 Ref: 2006-126

Asquith & deWitt Pty Ltd
PO Box 179
CHARLESTOWN NSW 2290

Attention Craig Marler

Dear Sir

RE REDLAKE PROPOSAL TOMAGO ROAD TOMAGO
Lot 161 DP 774440; Lot 1 DP 1003492; Lot 1 DP 597373; Lot 513 DP 585256

I refer to your correspondence dated 13 March 2006 regarding part of your site being subject to the Hunter Water (Special Areas) Regulation 2003 and wish to advise the following.

As shown on the attached map the northern corner of the property lies within the special area boundary. For your information, the Tomago Sandbeds supply approximately 20 to 25% of drinking water to the Lower Hunter and also have an important strategic function in Hunter Water's Drought Management Plan and source substitution capabilities. In accordance with our role contained within the *Hunter Water (Special Area) Regulations* regarding Special Areas we would ask that the following issues be addressed in any environmental impact assessment for the development.

Sewerage Facilities – Hunter Water's approach for new developments within the special areas is that on-site disposal shall not be permitted. The environmental impact assessment should provide details on the proposed sewerage strategy. Given the sensitivity of the site with regard to the underlying aquifer Hunter Water would stipulate that any sewerage facilities within the special area boundary would need to be such that sewage will be either taken off site (ie pump-out system) or pumped to an existing Hunter Water sewerage system.

Aquifer Interference – Hunter Water would be concerned about any construction or operational activities that could interfere with the aquifer. Any such activities should be made clear as part of the development application and be assessed appropriately via an environmental impact assessment. The developer should also be reminded that any works that interfere with the groundwater would need to be approved by DNR under the provisions of the Water Management Act, 2000.

Safe Storage and Handling of Fuels/Chemicals - Any chemical spills during construction or operational activities could result in contamination of the groundwater and hence Hunter Water would stipulate that any storage and handling of chemicals and fuels must be done strictly in accordance with the appropriate Australian Standards (eg. AS 1940-1993 for *The storage and handling of flammable and combustible liquids*, AS/NZS 4452-1997 *for The storage and handling of toxic substances*). Contingency response plans that outline emergency procedures for chemical spills need to be incorporated into both the construction and operational aspects of the development.

Surface runoff – A Stormwater Management Plan should be prepared as part of the development application.

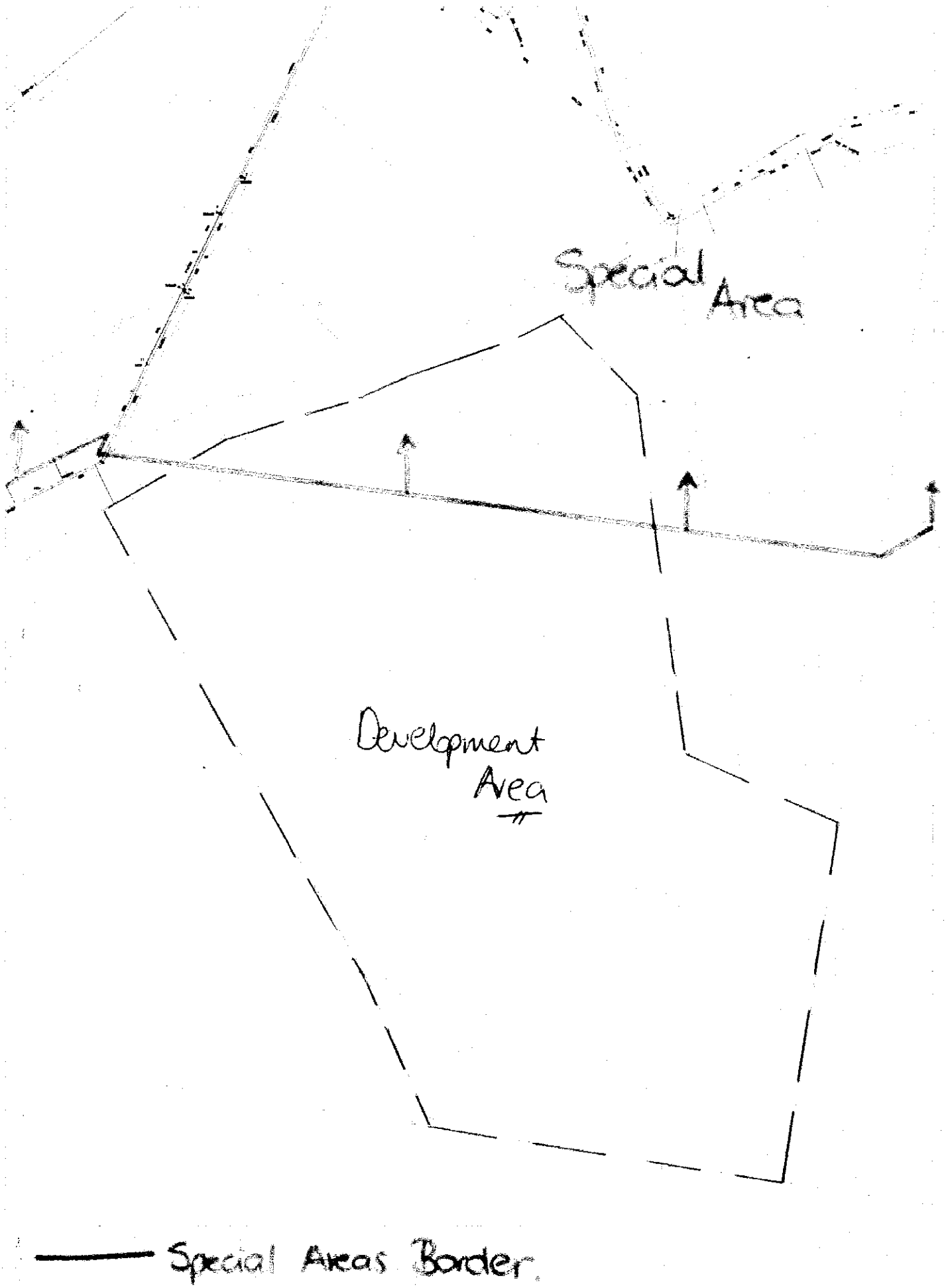
Appropriate planning of the above issues would minimise the potential for impacts in relation to clause 9 of the Regulation. Should you require any additional information please contact the writer on the enquiries officer nominated below.

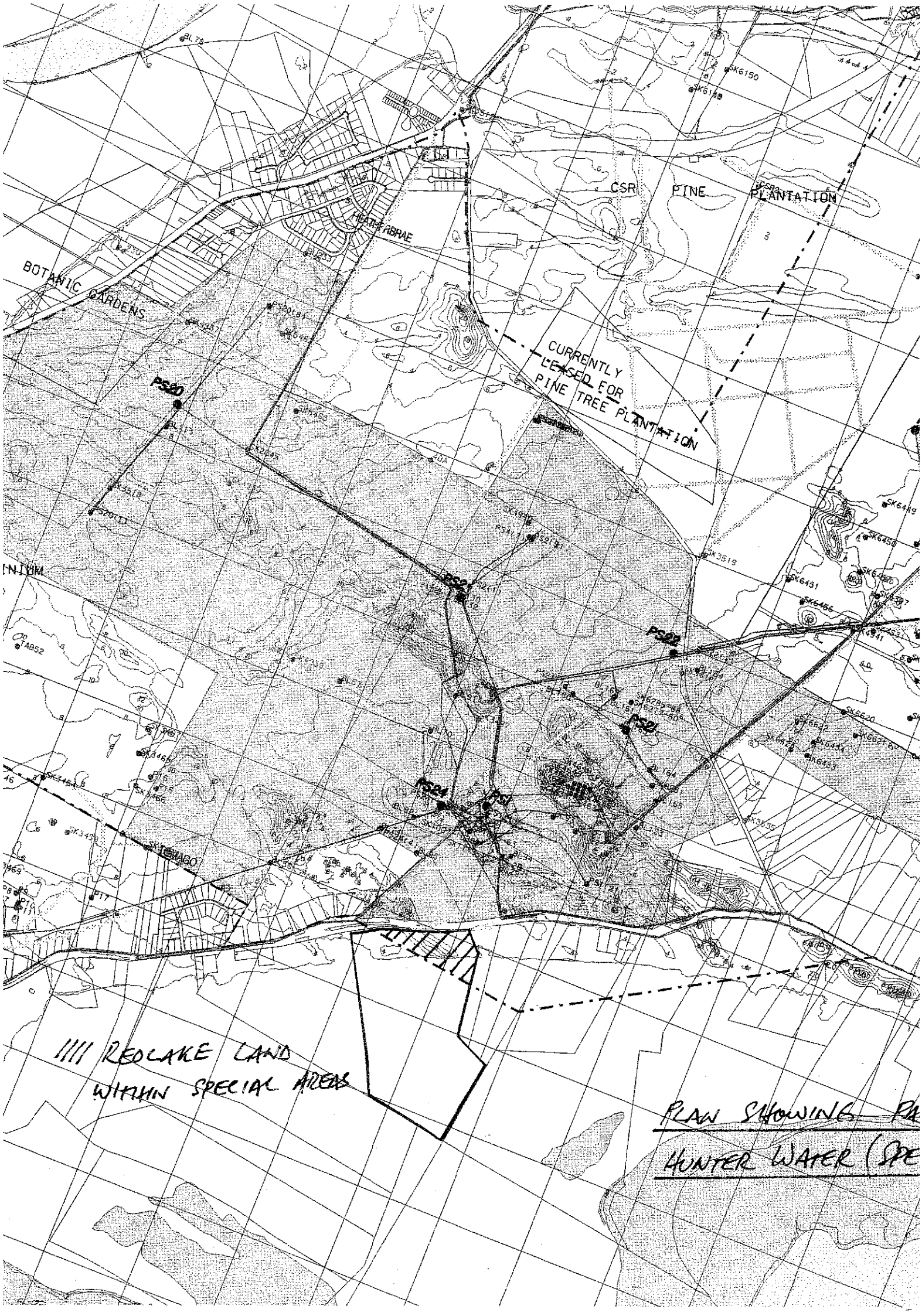
Yours faithfully



Brett Lewis
Developer Services & Trade Waste
Engineering Manager
Business & Urban Development

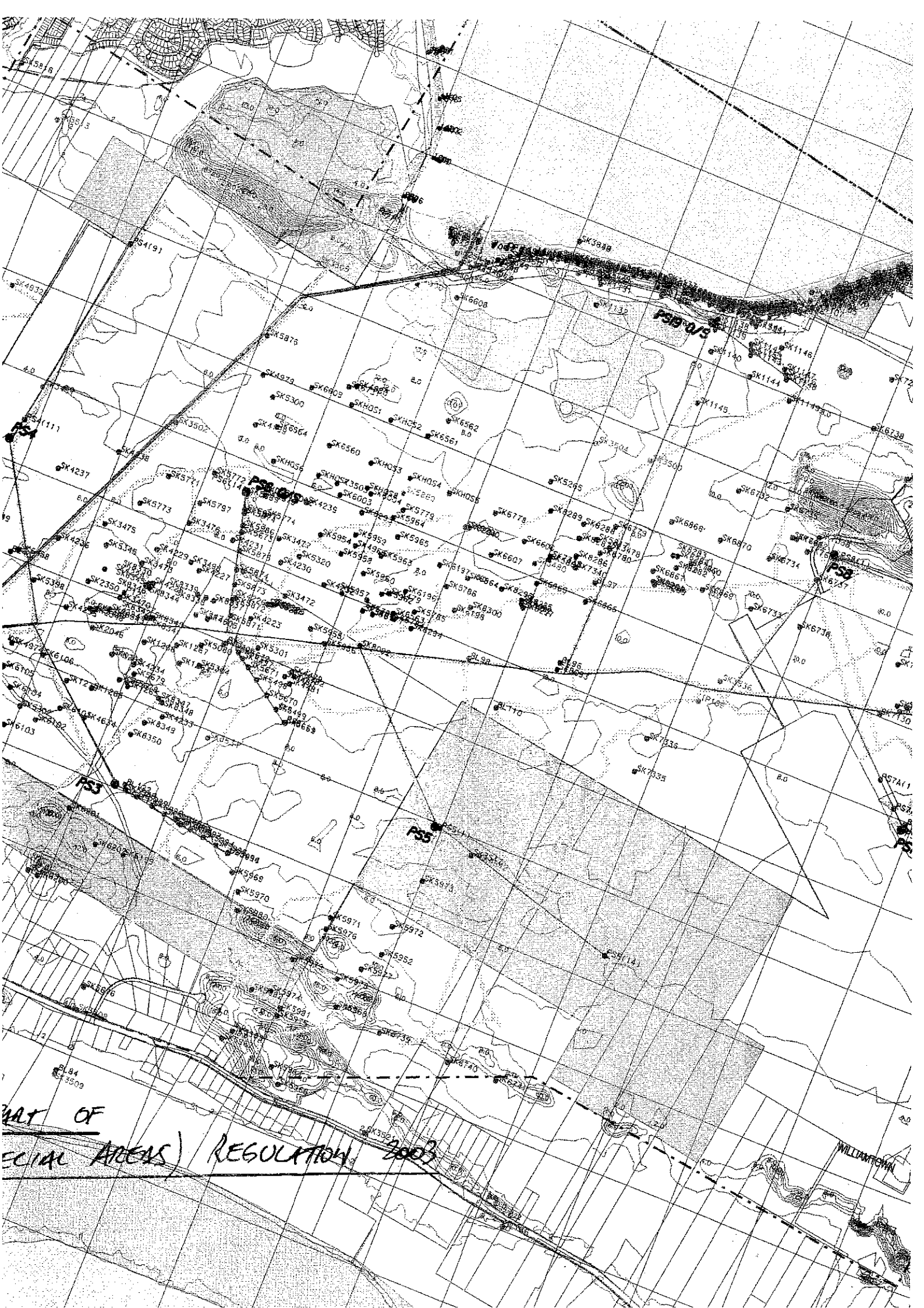
Enquiries: Bob Daniels
Tel: 02 4979 979723
Fax: 02 4979 9711


Special Area
Development Area
Special Areas Border



PLAN SHOWING PA

HUNTER WATER (SPE



AY OF

ECIAL AREAS) REGULATION 2003

HUNTER WATER CORPORATION . PO BOX 5171 HRMC NSW 2310 . TEL 1300 657 657
36 HONEYSUCKLE DRIVE NEWCASTLE . ABN 46 228 513 446 . HUNTERWATER.COM.AU

20 August 2007 Ref:2007-789

Geoffrey Graham & NSW Treasury - Crown Property Portfolio
C/- Johnson Partners P/L
P O Box 3717
Tuggerah NSW 2259

Dear Sir/Madam

RE NOTICE OF FORMAL REQUIREMENTS FOR PROPOSED DEVELOPMENT

Hunter Water's requirements for the provision of water and sewerage facilities to Stage 1 development of subdivision of 4 in to 2 lots at Lot 1 DP 597372, Lot 1 DP 1003492, Lot 161 DP 774440 & Lot 513 DP 585256, Tomago Road, Tomago with development of proposed lot 100 of an Industrial Commercial Facility (encompassing administration, machinery sales office, workshops, parts warehouse and machine storage – building area 54,800m^2) are as follows:

1 Payment of a **developer charge** of $212,160. (Refer page 5 of the attached guide).

If the developer charge and any other fee specified in this notice is not paid by 30 June 2008 the total will be adjusted for inflation from 1 July 2008. This adjustment will be based on the weighted average of the capital cities CPI for the 12 months to the end of March 2008;

The developer charge calculated has been based on information supplied by Johnson Partners – a total industrial/commercial building plan area of 54,800m^2. This value has been used by Hunter Water in the Equivalent Lot Methodology to derive a water and sewer loading in Equivalent Tenements (ET).

It is understood that the proposed development intends to utilize a range of water recycling and rainwater harvesting techniques that may impact the actual water consumed and wastewater discharged to the reticulated sewer systems of Hunter Water. It will be necessary, therefore, for the developer to evidence to Hunter Water a detailed water balance for the development that articulates the volumes of potable water to be consumed and proportion discharged to sewer.

This detailed commentary, stating assumptions, basis for outcomes, internal systems and any other supporting documentation will be required to be submitted and approved by Hunter Water prior to issue of a Section 50 Compliance Certificate for the development.

Any change in the development or development loading on our systems will result in a change to the developer charge payable.

2 Construct **Major Works**, (refer to page 7 of the attached guide) on behalf of Hunter Water, to connect each of the lots to the existing water and sewer systems of Hunter Water in accordance with approved servicing strategies.

It will be necessary for the developer to engage the services of an Accredited Design Consultant to complete local water and sewer servicing strategies for the ultimate development.

Prior to completing the servicing strategies it will be first necessary to clarify with Hunter Water the basis for water and sewer loadings derived from this (Westrak) and the surrounding development area. Please refer to the attached guideline for completion of servicing strategies.

The scope of the servicing strategies should be determined in consultation with Hunter Water's Development Services Unit prior to proceeding.

Water and Wastewater strategy review fees should to paid upon submission of the reports to Hunter Water.

The following connection advice is to be treated as tentative only as the yet to be agreed water and sewer loadings may impact the actual connection location(s).

Water Supply
The nominal points of connection point for water are the 200mm diameter watermain in Tomago Road and a cross connection with 500mm diameter watermain in Tomago Road. (Please refer to the attached plan).

Wastewater Transportation
Hunter Water is currently liaising with various parties in the Williamtown and Tomago areas regarding the possible design and construction of a Williamtown Wastewater Transfer Scheme taking flows from Williamtown to Raymond Terrace Wastewater Treatment Works (WWTW).

The preliminary strategy determined by Hunter Water proposes a wastewater pump station located at Williamtown pumping via a single rising main along Tomago Road and Masonite Roads to Raymond Terrace WWTW.

There may be scope for development in this servicing strategy area to connect to this Transfer Scheme at the intersection of Masonite and Cabbage Tree Road (forming a common rising main).

The local strategy will need to be prepared giving consideration to the outcomes of the broader strategy undertaken by Hunter Water.

Wastewater Treatment
Raymond Terrace WWTW is planned to be upgraded by Hunter Water in 2009. The design process has commenced. Continued liaison with the developer and respective design consultants will be welcomed as inputs into our design and construction process.

Major Works assessment/administration fees should be paid with water and sewer reticulation designs submitted. Further design assessment fees will become payable, depending on final infrastructure arrangement, for pumping stations involved in the scheme; and

3 Part of the site is within the Tomago Sandbeds Catchment Area and all wastewater should be disposed of 'off-site' ie on site treatment and disposal is not permitted. Hunter Water's letter dated 5 April 2006 remains valid and identifies issues that are relevant for development within the Special Area.

4 There may be some advantage for a joint arrangement between the various developers in the Williamtown and Tomago areas to share the costs for the Williamtown Wastewater Transfer Scheme.

Hunter Water is in the process of facilitating discussions between developers with the aim that an arrangement can be agreed in a timeframe that meets each developers needs.

Evidence of any commercial arrangements for cost sharing needs be revealed to Hunter Water for reimbursement purposes.

Alternatively, you may deliver the necessary works alone and rely on Hunter Water to collect reimbursements from other developments if and when they connect. Hunter Water will collect reimbursements for a period of 15 years from handover of assets to Hunter Water. Construction costs, when available, should be provided to Hunter Water to be used as the basis for the final calculation of reimbursements (Refer page 9 of the attached guide);

5 Prior to providing final approval of designs, Hunter Water will require a Review of Environmental Factors (REF) to be submitted (refer Section 1 of Hunter Water's Water and Sewer Design Manual). A REF considers the likely impacts a development may have on the environment. At all times, methods for preventing or reducing adverse environmental impacts should be considered and where appropriate, incorporated into the project design. Hunter Water, where appropriate, may make a determination in accordance with the EP& A Act 1979.

6 Your proposed development has been identified as having the potential to discharge trade waste into Hunter Water's sewerage system. You are therefore required to contact Hunter Water's Trade Waste Section on 4979 9596 and make the necessary application for a Trade Waste Permit and pay the prescribed fees. The discharge of trade waste to the sewer will not be permitted without a permit authorising that discharge; and

7 You will be required to submit internal water and sewer hydraulic designs for this development for our review. (Refer to page 7 of the attached guide).

8 Please note that Hunter Water requires 3 copies of the final plan of subdivision and a DXF file of the subdivision showing only lot numbers and boundaries directly on the MGA grid. The lot boundaries should be produced directly from your calculation software, should be all edge matched and unbroken, and should also match as near as possible the final deposited plan of the subdivision. This information should be emailed to plan.check@hunterwater.com.au .

The above requirements are valid for 12 months from the date of this letter and are specific to this development. Within this period Hunter Water's fees are subject to CPI adjustment. Please refer to the attached *Guide to Hunter Water's Notice of Requirements for Developers*, which details the conditions under which water and sewer facilities are available to new customers.

Hunter Water reserves the right to amend its requirements if an error has been made in their determination.

Yours faithfully



Brett Lewis
Manager Development Services

Enquiries: Robert Daniels
Tel: 1300 657 657
Fax: (02) 4979-9711
Your Ref: 50050

Attachments:
1. SWIMS Plan locating development relative to Raymond terrace WWTW
2. SWIMS Plan indicating water main connection location
3. Hunter Water Correspondence of 5 April 2006
4. Guidelines for Preparation of Servicing Strategies

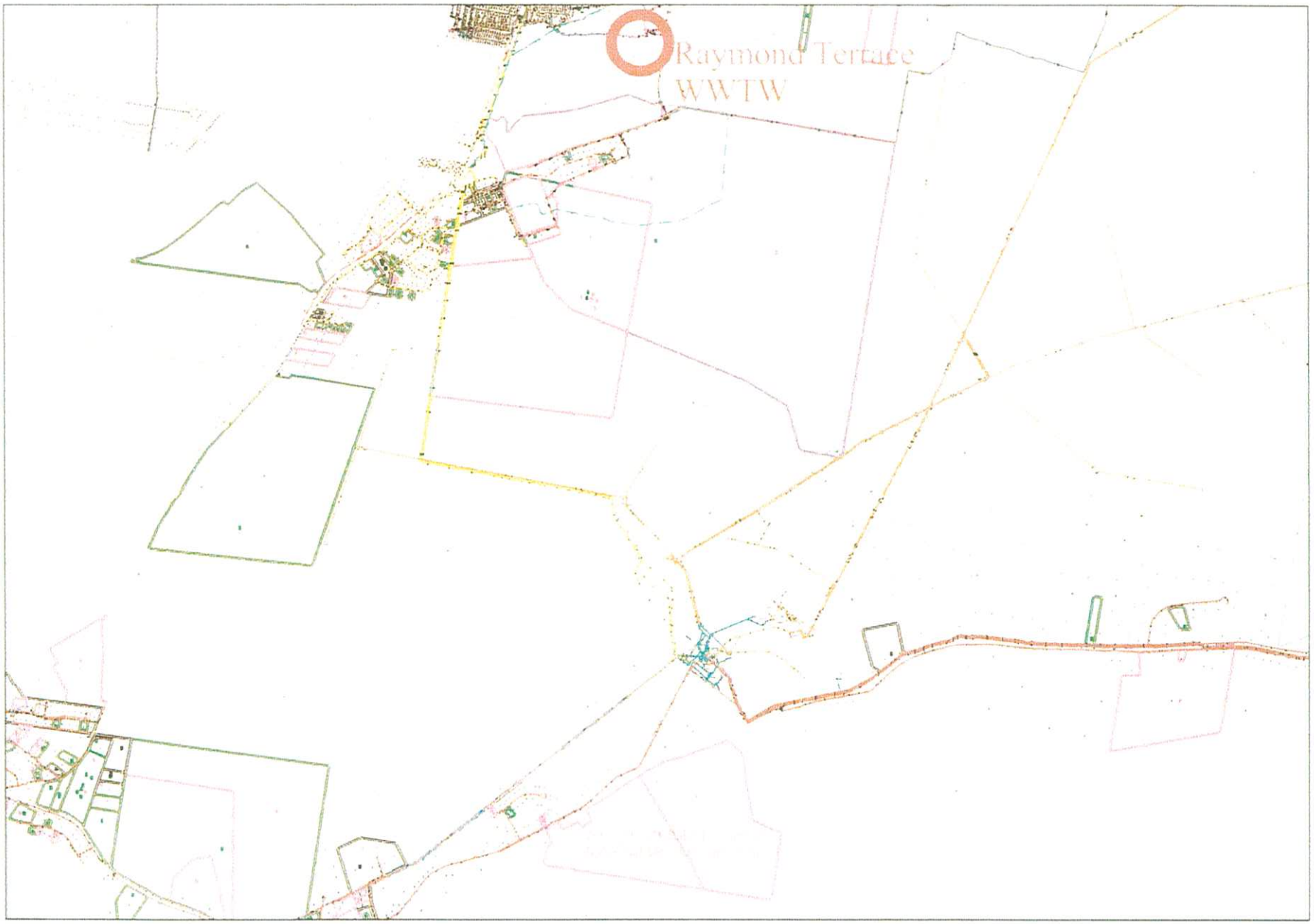
PAYMENT BY MAIL	Send the payment slip below with your cheque made payable to: Hunter Water Corporation Customer & Development Services Unit PO Box 5171 HRMC NSW 2310
PAY IN PERSON	Cash, cheque or credit card Present the slip below at any Hunter Water Corporation Customer Centre (Credit card limit of $5,000 per transaction per day) Present the slip below at Customer Service Centre Head Office 36 Honeysuckle Drive, Newcastle West (Credit card limit of $10,000 per transaction per day)
PAY BY PHONE	Credit card only Port Stephens & Newcastle Council Areas telephone (02) 4979 9725 OR (02) 4979 9716 Cessnock, Maitland & Lake Macquarie Council Areas telephone (02) 4979 9720 OR (02) 4979 9718 **QUOTE REFERENCE: 2007-789**

- **MINOR/MAJOR WORKS ASSESSMENT FEES AND/OR SUPERVISION FEES WILL NOT BE ACCEPTED UNLESS DESIGNS ARE SUBMITTED FOR REVIEW.**

Return this portion along with payment to Hunter Water

Our Ref: 2007-789
Customer Number: 15574 15573 15611

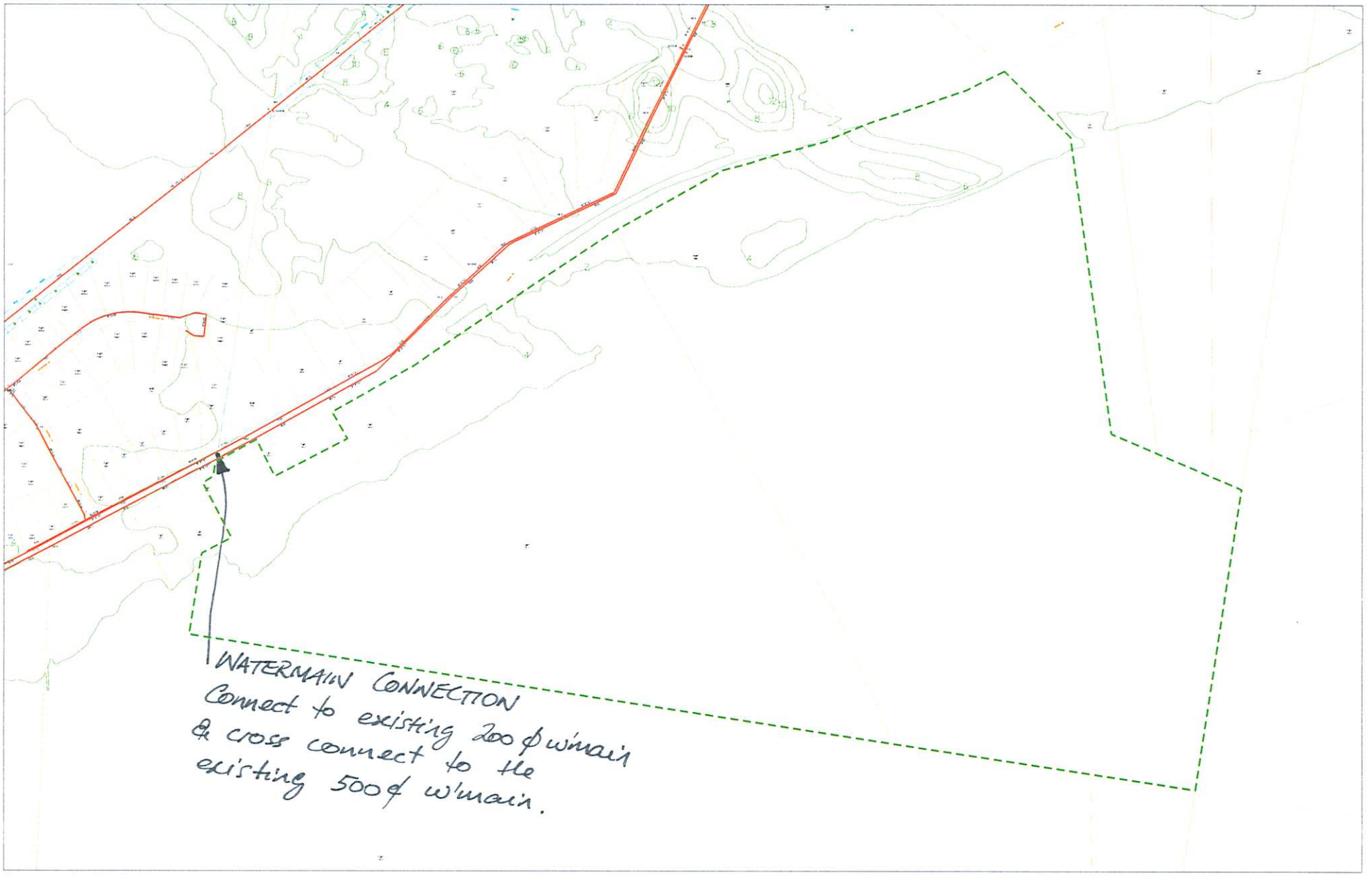
Re: Lot 1 DP 597372, Lot 1 DP 1003492, Lot 161 DP 774440 & Lot 513 DP 585256
Tomago Road
Tomago



Date: 10/07/2007 **Scale:** 1 : 37895.1

Notes: 2007-789 - SEWER - 5km to Raymond Terrace WWTW

HWC



Date: 25/06/2007 **Scale:** 1 : 8000

Notes: LOTS 1, 1, 161 & 513 TOMAGO ROAD, TOMAGO

HWC DOES NOT GUARANTEE THE ACCURACY OF THIS PLAN

Appendix C – Econova Details

NovaTainer™

STANDARD INDUSTRIES P/L
Since 1936

RE: NovaTainer Wastewater Recycling System

Standard Industries distributes the **EcoNova** wastewater recycling systems. The **NovaTainer** is a self contained waste-water recycling system housed in a container. It is perfect for larger building sites and development projects where connection to the sewer is either not immediately available or not economically viable to connect in the short term.

These systems are designed specifically for the situation where a transportable non-permanent wastewater treatment system is required. This **NovaTainer** system accepts all wastewater, treats the wastewater using the most advanced membrane technology available to commercial treatment plants, and outputs a water that is of **Class A+** quality which can be used for toilet flushing, laundry, vehicle washing, road watering and above ground irrigation in commercial projects.

The **NovaTainer** system is transported to a site on the rear of a truck and can be used as a treatment plant enabling the connection of many transportable buildings to the one plant. It could be connected to site sheds with showers and basins, transportable toilet facilities and site offices then after the project is completed the **NovaTainer** is removed and relocated to another project.

The **NovaTainer** can also be used as a more permanent solution, and used in applications such as mine sites, caravan Parks, holiday resorts and islands.

The system is odourless, silent, sludge free and does not require any pump outs. The final water quality is Class A+ and can be stored for use in toilet flushing, laundry vehicle washing, road watering and above ground irrigation.

The **NovaTainer** concept is ideally suited for Projects such as:

- Road works
- Remote area developments
- Defence facilities
- Military exercises
- Large scale developments
- Construction facilities
- Projects in Non-sewered areas
- Larger residential subdivisions
- Mines

The NovaTainer is a fully scaleable system that can be manufactured to treat from 4kl per day to 50kl per day and will be housed in either a 20 or 40ft container. In some situations it may require an additional external tank, though this is generally for the systems that treat over 25kl per day.

Head Office: 2B Carter St Cammeray NSW 2062,
Tel: (02) 9955 7071 **Fax:** (02) 9960 3180
lloyd@standardindustries.com.au

4/42 Victoria Ave Toukley NSW 2263,
Tel: (02) 4396 7750 **Fax:** (02) 4396 7787

22 Frith Street Mayfield Newcastle NSW, 2304
Tel: (02) 4962 4786 **Fax:** (02) 4396 7787
www.standardindustries.com.au

The technology used in this system relies on Microfiltration using **MembraneSafe™** technology then further sterilising the treated water with UV disinfection before a final chlorine disinfection. This results in safe water being 99.99999999% free of pathogens

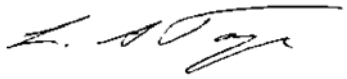
"Class A+ water is the highest quality rating recognised for recycled water. The manual for recycled water defines A+ water as no pathogens should be detectable. Safe for many uses other than those involving human consumption" QLD Environmental Protection Agency.

These systems are robust with low maintenance requirements and complete with PLC controlled quality monitoring with a guaranteed water quality.

Please find enclosed additional information on the **NovaTainer** together with technical specifications and case studies.

Should you require any further information, please do not hesitate to contact Lloyd Taylor.

Yours sincerely

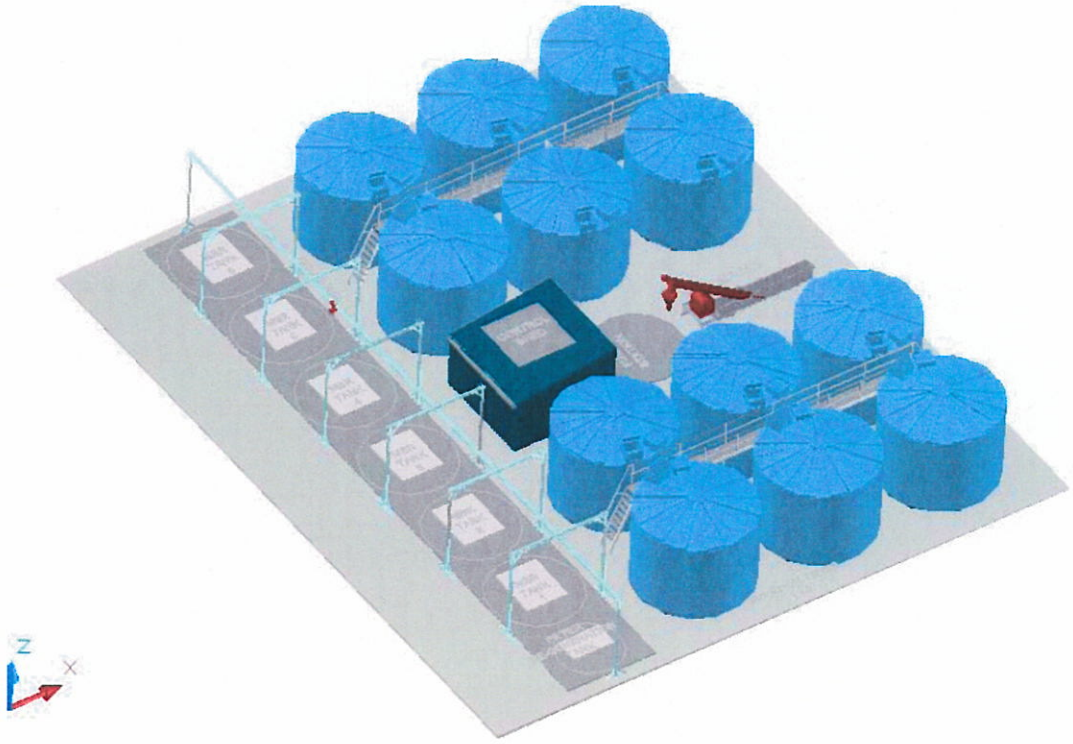


Lloyd Taylor
(Director of Operations)

Head Office: 2B Carter St Cammeray NSW 2062,
Tel: (02) 9955 7071 **Fax:** (02) 9960 3180
lloyd@standardindustries.com.au

4/42 Victoria Ave Toukley NSW 2263,
Tel: (02) 4396 7750 **Fax:** (02) 4396 7787

22 Frith Street Mayfield Newcastle NSW, 2304
Tel: (02) 4962 4786 **Fax:** (02) 4396 7787
www.standardindustries.com.au



WASTEWATER TREATMENT PLANT

Specification for MBR-500 kilolitre NovaProject

Standard Industries Pty Ltd

Revised: 23/4/07
Version 4.06

NOTICE Proprietary and Confidential

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1. Introduction

This proposal has been prepared for design, supply, installation and commissioning of a sewage treatment plant to cater for a 500 KL/day project.

The Water reclamation plant detailed within this specification utilises state of the art, flat plate membrane technology to produce Class A + effluent.

2. Standard Industries

The NovaClear MBR-500 is a state of the art Membrane Bio- Rector (MBR) which will provide Recycled water for internal and external reuse in toilets flushing, laundry facilities, vehicle washing, external hosing, garden irrigation etc, throughout the subdivision. This is not to be uses for human consumption

Credibility and Experience

NovaClear MBR-500 plants are considered to be Queensland's leading Project Specific Water Reclamation Plants and Urban Development systems. EcoNova has pioneered Queensland's first urban residential recycled water scheme in partnership with the EPA and various Local Authorities. The technical 'know how' developed by this team was instrumental in delivering the Gold Coast Recycled Water Plan and in the Pimpama-Coomera Scheme.

EcoNova then went on to manufacture and deliver as turn-key projects, 'state-of-the-art' Water Reclamation plants. These are now servicing some of Queensland's largest and most well known Residential Communities.

A number of Queensland Universities are partners in success and describe the technology as:

"superior to all other commercially available technologies and considered to be the most advanced of its kind known to exist any where in the World"

- Faculty of Engineering, Physical sciences and architecture 2005

3. Design Philosophy

The proposed designs have been suggested based on the following criteria:

- **Cost Effectiveness** - The most economical solutions whilst still delivering a robust and reliable system.
- **Current Best Practices** - Installation or upgrading of equipment in line with current best practices in sewage treatment processes.
- **Effluent Quality** - Utilisation of appropriate wastewater treatment technology to allow the highest quality effluent to be achieved, including nutrient removal.
- **Ease of Installation** - The proposal has allowed for the construction of a treatment plant that will not adversely affect the existing development or environment. The design of the proposal lends itself to a staged installation that can be carried out with minimal disruption to current operations.

A detailed description of our proposed plant, equipment and controls can be found in the attached specification. We have based our plant design on the following calculations:

Total daily wastewater flow 500 KL/day total

4. Proposed Technology

The medium sized range of Water Reclamation Plants (WRP's) are known as the NOVACLEAR Series. The NOVACLEAR MBR Range is a combination of sequential batch reactor and submerged membrane technology. It brings together the benefits of tried and tested SBR methods with the compactness, consistent reliability and extremely high quality effluent of membrane technology.

The batching arrangement provides buffering or balancing of incoming waste, whilst also creating short anaerobic conditions favourable to biological phosphorous removal. The batching arrangement allows for easy maintenance of modular aeration tanks and MBR modules.

The Membrane Bioreactor or MBR is based on the conventional wastewater process, but the separation of micro organisms is performed by submerged plate membranes.

The MBR has some distinctive advantages compared with conventional treatment systems:

Very stable process

The conventional biological system is sensitive to wastewater composition. Due to variations in wastewater composition and/or the presence of complex or toxic substances, high salt concentrations or low oxygen concentrations, the biomass floc formation is poor and the settling process will not perform well. This results in the discharge of the micro organisms and poor effluent quality. The membranes will, however, withhold all biomass and other suspended solids, ensuring a high effluent quality.

Very compact design

Due to the membrane separation the active micro organism population in the bioreactor can be maintained at a concentration 4-5 times higher than in conventional systems. This results in bioreactor tank volumes of only 20-25% of the size of conventional systems. A clarifier, which is a space-consuming tank, is not required.

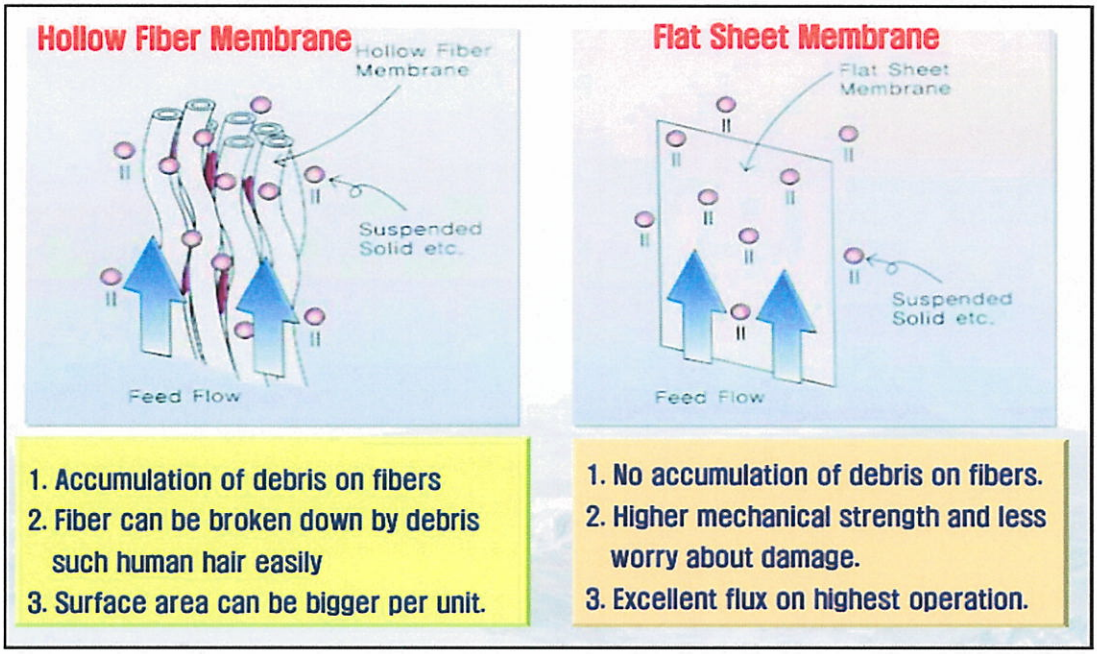
High effluent quality

The membranes withhold all micro organisms and most suspended solids, resulting in a clear and highly purified effluent. The effluent may be reused as low-grade process water.

Low sludge production

The MBR can operate at a low FIM ratio, i.e. the feed of organic substance per quantity of micro organisms per time unit. This results in a high mineralisation of the sludge. In conventional systems 1kg COD will result in about 0,3-0,4kg of biomass. With MBR systems 1kg COD is converted to 0 - 0.2kg biomass (zero biomass production can be obtained when operating at high temperatures). The discharge of biomass can have significant impact on the operational costs of the system.

Why Flat Sheet Membranes?



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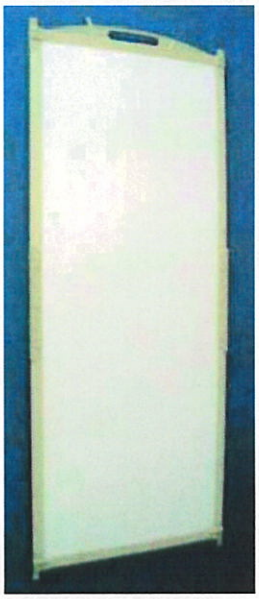
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STANDARD INDUSTRIES P/L
Since 1936

5. Membranes - Heart of the NOVACLEAR MBR

Resulting from intensive research in Asia, a range of low-head membrane modules has been developed for application in the water and wastewater industry. The modules utilise a PES membrane formed in a state-of the-art manner by welding two pieces of membrane to a plastic frame feeding a permeate collector.

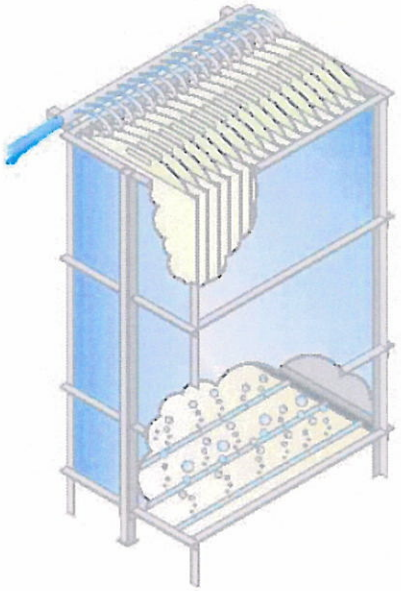


The plates are assembled in packs complete with framework/casing and immersed into the water or wastewater for direct filtration/sterilisation, or as membrane- bioreactors (MBR). Plate area, pack configuration and resulting dimensions are dependent on flux rates selected for design, sometimes after pilot confirmation.

In operation, a cross-membrane pressure results from a vacuum providing typical differential in the 50 millibar – 400 millibar range. Cleansing of the surface is provided by air scour from an air blower running on an intermittent basis.

The Quality Features

- very energy efficient due to optimized air scour.
- works with lowest chemical consumption.
- high packing density.
- no tendency for clogging with fibrous substances.
- CIP backwash possible.
- modular design enables easy adoption to the application.
- robust durable construction.



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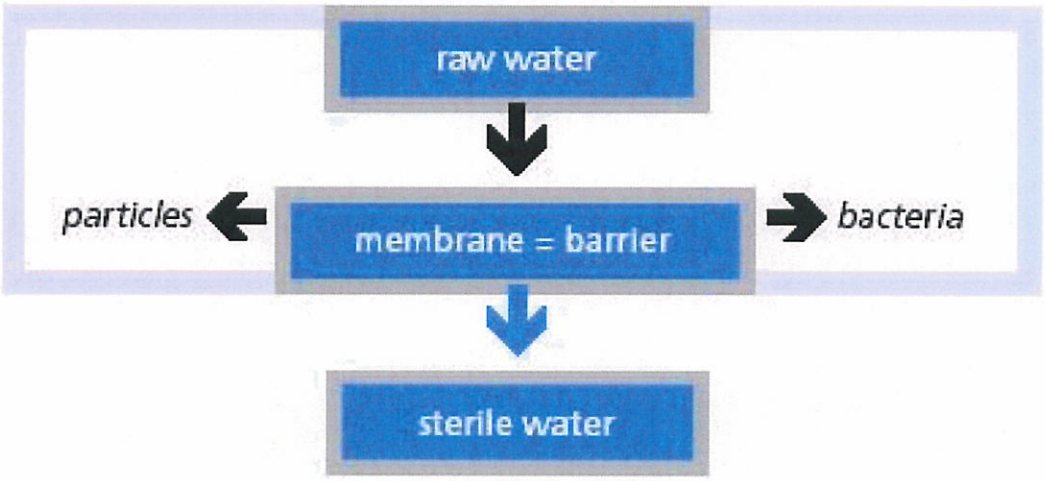
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6. The Function of Membranes

The membrane filter is a submerged ultra filtration system where the filter is directly mounted into the water. The filtrate is withdrawn using a suction pressure of 0,1 to 0,5 bar that is simply created by the submerging of the membranes.

A unique feature of the membrane filter is a cleaning mechanism that needs much less energy and still works more efficiently than existing cleaning Systems.

By the use of shearing forces that develop from periodically uprising air bubbles and interacting with the membrane through the water pushed away by the air bubbles, the dirt particles are constantly removed from the membrane. High cleaning forces occur via the "slug flow" regime within the membrane filter. This is the combined result of a specific bubble size acting between plates spaced only a few millimetres apart. Apart from a rough mechanical screening, no further pre-treatment of the water is necessary.



Compared to UV-based systems the main advantages are:

- The membrane acts like a barrier to all bacteria and virus, while UV can not affect all bacteria.
- Bacteria are removed from the water and are not just inactivated they are destroyed. This reduces the potential for regrowth of bacteria.

Safety does not depend on the turbidity of the water. UV-Systems lose efficiency, if the turbidity increases.

7. The NOVACLEAR MBR Treatment Process

The NOVACLEAR MBR process operates on a fill and draw batch system where incoming waste is first stored within the balance tank, then transferred to the aeration tanks and decanted via the final MBR process.

The batch is subject to biological treatment for a prescribed period of time with both anoxic and aerobic cycles possible. The sludge remains within the aeration and MBR tanks to provide the biological population for the subsequent cycle.

RAS pumps circulate the activated sludge between aeration tanks and between the MBR tanks and balance tanks for EBPR conditions. Excess biomass is pumped on a regular basis to a sludge holding tank for further digestion and disposal.

The various stages in the SBMBR sequence are:

Stage 1: Multi-Mode Filling

During this stage the SBR Tank is filled with the influent wastewater. The following three variations are used for the Fill step and any or all of them may be used depending on the operating strategy:

a) Static fill

b) Mixed fill

c) Aerated fill

During static fill, influent wastewater is added to the biomass already present in the SBR. Static fill is characterized by no mixing or aeration, meaning that there will be a high substrate (food) concentration when mixing begins. Static fill conditions favour organisms that produce internal storage products during high substrate conditions, a requirement for biological phosphorus removal.

Mixed fill is classified by mixing influent organics with the biomass, which initiates biological reactions. During mixed fill, bacteria biologically degrade the organics and use residual oxygen or alternative electron acceptors, such as nitrate nitrogen. In this environment, denitrification may occur during the anoxic conditions.

Aerated Fill is classified by aerating the contents of the reactor which begins the aerobic reactions that are completed in the React step. Aerated Fill can reduce the aeration time required in the React step.

Stage 2: Reaction

This stage involves the utilization of biochemical oxygen demand (BOD) and ammonia nitrogen, where applicable, by micro-organisms. The length of the aeration period and the sludge mass determines the degree of treatment. The length of the aeration period depends on the strength of the wastewater and the degree of nitrification (conversion of the ammonia to a less toxic form of nitrate or nitrite) provided for in the treatment.

Stage 3: Anoxic Periods

During this stage, aeration is stopped and anoxic conditions allowed to form. Anoxic cycles allow the denitrification process to occur. Along with the removal of nitrogen, the lower nitrate levels created by this process assists with the biological removal of phosphorous.

Stage 4: Decanting

Decanting of treated effluent occurs throughout the treatment cycle. The MBR tanks are subjected to both aerobic and anoxic conditions, however effluent is only filtered during the aeration periods. During peak flow or maintenance periods (where one or more MBR's are disabled) the filtration process may be operated continuously without any detrimental effects.

Stage 5: Idle

The SBR Tank waits idle until a batch accumulates and it is time to commence a new cycle with the filling stage.

Stage 6: Sludge Wasting

Excess activated sludge is wasted periodically during the SBMBR operation. Waste sludge is stored for further digestion and periodic removal.

8. Nutrient Removal

Phosphorous

In NOVACLEAR MBR Systems, removal of phosphorous is carried out via two separate processes - chemical precipitation and enhanced biological phosphorous removal (EBPR).

Chemical Precipitation

Chemical treatment for phosphorus removal involves the addition of metal salts (alum) that react with soluble phosphate and form solid precipitates that are removed by solids separation processes.

The NOVACLEAR MBR system utilizes single-point, co-precipitation methods, whereby the aluminium sulphate is dosed directly into the mixed liquor of the activated sludge process.

Enhanced Biological Phosphorous Removal (EBPR)

Removal of phosphorus from the wastewater by EBPR processes occurs through two major steps: uptake by phosphorus accumulating organisms (PAOs) and removal, processing, and disposal or reuse of the phosphorus-enriched bio-solids produced.

The following conditions are considered essential for excess biological phosphorus uptake and storage

- Exposing the activated sludge bacteria to influent wastewater in an anaerobic contacting zone, followed by an aerobic (or anoxic) zone;
- Minimizing the amount of nitrate or oxygen fed to the anaerobic zone; and
- Availability of volatile fatty acids (VFAs), such as acetate and propionate or a source of readily biodegradable organic substrate in the anaerobic zone that can be fermented to VFA.

The key process configuration proposed was originally termed the Phoredox process (or A/O Process) and involved the use of an anaerobic contact basin with a relatively short hydraulic retention time (45-60 minutes) prior to the aerobic treatment reactor.

A number of modified processes such as the UCT, MUCT or A^2 principles have been developed, however the NOVACLEAR MBR process uses a combination of the above.

NOVACLEAR EBPR Process

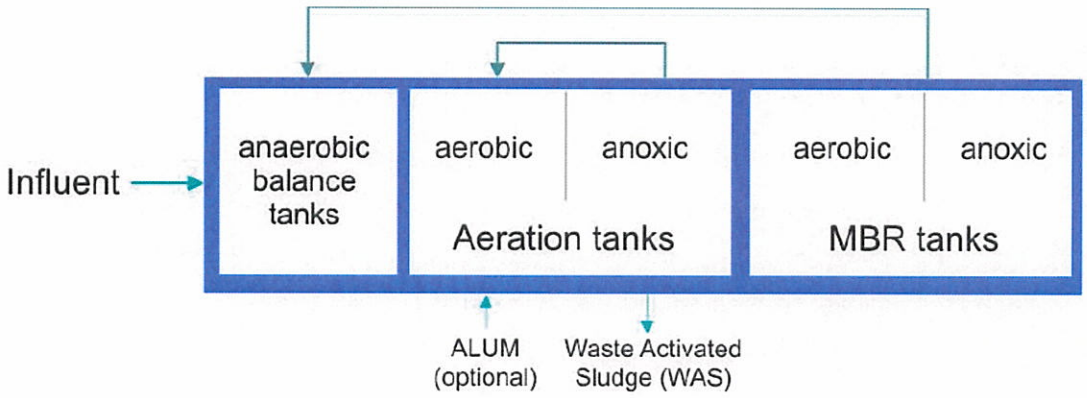
Influent wastewater and return activated sludge are mixed in anaerobic conditions (within balance tanks) prior to aeration.

Nitrate and oxygen input to the anaerobic reactor are minimalised through de-nitrification during anoxic periods, so that one of the main metabolic conditions for substrate utilization (anaerobic fermentation) is encouraged.

This process configuration promotes the selection of bacteria that are capable of removing and storing phosphorus at high levels in the aeration zone (referred to as phosphorus accumulating organisms - PAOs).

Phosphorus is removed from the system via excess sludge production, rich in stored phosphorus.

NOVACLEAR MBR Phosphorous Removal Process



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Nitrogen

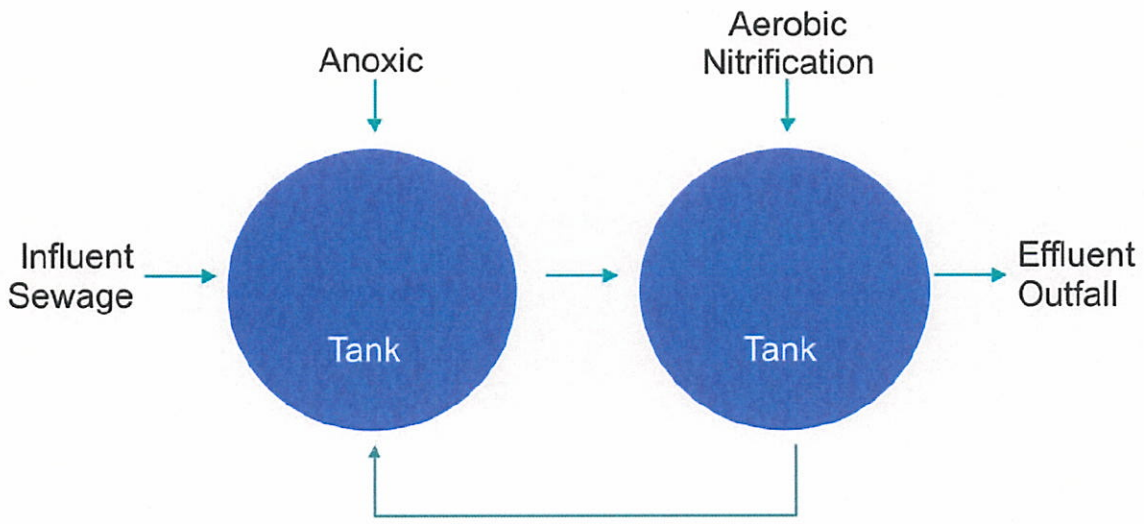
Oxidation of Ammonia is the initial process for Nitrification, which takes place in the aeration tank. For carbon removal and conversion of ammonia to nitrate, aerobic conditions with dissolved oxygen must be maintained.

Dissolved Oxygen conditions in the treatment plant must be controlled properly for biological removal of carbonaceous and nitrogenous wastes to occur. During Nitrification, portion of the biomass is circulated through the anoxic tank where it is mixed with the incoming sewage.

The carbon present in the raw sewage associated with endogenous respiration of the microbial sludge is to allow for Denitrification. The extent of Denitrification is determined mainly by the fraction of Mixed Liquor Suspended Solids that is recycled.

Conversion of nitrate to nitrogenous gases requires an established anoxic condition.

A simple diagram for the denitrification process is below:



9. Components of NOVACLEAR MBR

Inlet Works

It is proposed that the incoming waste water from a pump station be connected to a concrete channel inlet works at the head of the new plant. The primary section of the inlet works is to provide a manually cleaned grit trough. The channel will be appropriately sized to allow the velocity of the incoming waste to be sufficiently slowed to allow grit and similar heavy particles to settle out. The grit trough is to incorporate a tapered floor which finishes in a sump arrangement to allow easy removal of captured grit. Removal of the grit will be required periodically by the operators.

Bar Screen

Following the grit trough, the concrete channel will be fitted with a spiral sieve screen and manual overflow bar screens. The spiral sieve screen is designed to intercept and remove rags, plastics and debris which would impair the process or clog the treatment plant pumps.

Normal operation of the spiral sieve screen would include for the screen to become partially blocked and the channel level to rise. The rising channel level will activate an ultrasonic level sensor, which in turn activates the shaft-less auger within the screen. The screen auger clears the blocked debris from the screen and deposits the screenings into a sealed bin. The bin requires periodic emptying, however no direct contact with the screenings is required from the operators.

In the event of maintenance or failure of the spiral sieve screen, the channel level will continue to rise until the overflow weir level is reached. At the top of this weir (located either side of the spiral sieve) dual bar screens will be fitted, which will provide emergency screening of the incoming waste. Whilst the spiral sieve screen will provide 3mm screening, the emergency bypass bar screens will be fixed with a 5mm spacing. The bar screens will require manual cleaning by the operators, however these will only operate during maintenance or emergency situations.

Primary Influent Pump

Well Screened influent will be directed from the outlet of the inlet channel into the below ground primary pump well.

This pump well will be fitted with large submersible sewage pumps that will transfer the influent to the above ground Influent Equalisation Tank.

The pumps will be sized accordingly so as to cater for peak flows of the final design capacity and will operate in an alternating, duty/standby arrangement. The pumps will be installed on guide rails to allow for ease of removal and future maintenance. The pumps will be controlled via the plant PLC and SCADA system and will incorporate soft starters and motor overload protection. The pump well will be fitted with high level alarm indication.

Influent Equalisation (EQ) Tank(s)

Screened influent is transferred directly to the EQ tank via the primary pump well. The influent is stored as a batch" until the NOVACLEAR MBR is ready to receive waste (Fill Mode).

The Influent EQ Tank has been sized so as to provide additional capacity to cater for peak incoming flows. The primary EQ tank will be fitted with alternating duty/standby pumps that will supply batches of influent to the anoxic and aeration tanks. The submersible EQ Tank pumps will be installed on guide rails to allow for ease of removal and future maintenance. The pumps will be controlled via the plant PLC and SCADA system and will incorporate soft starters and motor overload protection. The EQ tank will be fitted with high level alarm indication to provide adequate notification prior to tank overflow.

Aeration Tanks (Reactors)

Filling of the aeration tanks occurs on a batch arrangement. Filling is controlled via PLC timers and float level switches within the tanks. Upon completion of the Filling Stage, no further influent will be transferred and the Reaction Stage begins.

The SBR Tanks are aerated by diffusers mounted near the bottom of the tank, and supplied by alternating duty/standby air blowers in the control building. The aeration tanks will be supplied by separate sets of air blowers, primarily to allow different zones to be created e.g. Aerobic/anoxic, however this also provides a high degree of redundancy and allows for ease of maintenance.

During the aeration stage the micro-organisms mix with the wastewater and through biological activity break down and consume the organics and nutrients within the wastewater.

A dedicated dissolved oxygen meter will be fitted within each reactor set. The dissolved oxygen meter will provide simple on/off control of the applicable air blower set allowing set oxygen levels to be maintained

within the plant. Typical D.O levels are set with a high and low range of between 1.0 mg/L and 1.5 mg/L to allow the oxidation of ammonia to occur, whilst still achieving some simultaneous de-nitrification.

Aeration System

Aeration is accomplished by fine bubble diffusers, which offer superior oxygen transfer capacity. Air blowers are to be dual stage side channel type for low energy consumption and low noise generation.

Membrane Filtration

The MBR tanks are kept filled from the main aeration tanks. The MBR tanks are aerated on a continuous basis. During the aeration cycle, the filtration process is activated and effluent is transferred to the intermediate effluent tank. The MBR processes the incoming waste until the aeration tank batch is completed.

Once the batch has been processed, the MBR will continue to cycle the aeration system, however no further filtration will occur (until the next batch commences).

Primary disinfection is provided via the MBR process. Submerged plate membranes are utilized allowing for removal of all bacteria and a high proportion of viruses.

Additional Secondary U.V Disinfection

U.V disinfection has been proposed if it is required to meet the double barrier disinfection requirement under Class A+ licensing conditions. The proposed UV system has been sized so as to provide a minimum dose level of 4Omw/cm^2 at peak STP flows.

The proposed UV system incorporates continuous intensity monitoring, lamp failure alarms and an auto-wiping mechanism.

Discharged effluent from the UV system will be directed to the irrigation storage tank.

Sludge Pumps

The population of micro-organisms may increase over time. In order to maintain an optimum population, some of the settled sludge must be removed from the SBR Tanks. A Sludge Waste Pump is provided in the final aeration tank to transfer some of the settled sludge into the Sludge Tank.

Additional sludge pumps will provide sludge balancing between aeration tanks, MBR tanks and the balance tank.

The submersible sludge pumps will be monitored via amp meters and current sensing devices. Operation of the pumps and sludge wasting/balancing will be controlled via adjustable pumping times and manually operated valving.

Sludge Management System

The Sludge Tank has an overflow at the normal operating water level which leads to a sump tank which returns waste back to the Influent EQ Tank. This maintains the level of this tank full under normal operating conditions. As waste sludge is pumped into the Sludge Tank, same volume of supernatant is displaced into the Influent EQ Tank and a thickening of the waste sludge occurs.

Accumulated sludge should be pumped out of the Sludge Tank on a periodic basis. By observation of the sludge blanket level with a "Sludge Judge" or a Secchi disk, the operator would arrange for the removal of the settled sludge as required.

Additional aeration may be provided for further aerobic degradation of the sludge prior to disposal.

Aluminium Sulphate Dosing

Phosphorous removal has been proposed by chemical precipitation. Aluminium Sulphate is to be dosed on a controlled basis into the aeration tanks. The precipitated phosphorous is then removed within the wasted sludge. Phosphorous removal is controlled via the Alum dosing rate and the sludge wasting rate.

The alum is to be pre-mixed within a dosing tank and transferred to the EQ tank via a diaphragm dosing pump. The alum dosing tank is to be installed within a concrete bunded enclosure. The tank will be fitted with low level alarms.

10. System Controls

The NOVACLEAR MBR process requires precise, automated and reliable control of various stages of the process. Recent developments in the programmable logic controller (PLC) and computer technology have made the precise control of the SBMBR process affordable and achievable.

The PLC program allows adjustments to the cycle durations to be made based on the flow rate through the plant. The number of cycles is variable (typically ranging from 4 to 8 cycles per day per SBR Tank), and as the number of cycles increases, the duration of the react stage decreases. The PLC program is capable of controlling actuated valves, blowers and pumps and other components essential to the production of high quality treated wastewater.

The plant can be operated by communication through a simple touch screen for most plants or via a computerised scada system for larger systems. Both program interfaces provide a point and click operation and value entry controls to keep the control simple.

The system incorporates the ability to manually operate all plant equipment in the event of automated control failure.

11. Effluent Quality

The NovaClear MBR process allows for a high quality effluent to be produced. Although some nitrogen removal will occur due to the cyclic nature of the process, additional features such as dissolved oxygen control and aluminium sulphate dosing will provide further nutrient removal. Typical effluent quality produced by the NovaClear MBR systems is as follows:

Class A+	
BOD 5	<10 mg/L
NFR (S/S)	<10 mg/L
E.Coli	<1 CFU/100 ml
TN	<10 mg/L
TP	<5 mg/L
NTU	<2
Residual $C1^2$	1.0 mg/L

12. Equipment Specification - per 5OOKLIday STP

System Controls

The SBR process utilizes PLC control linked with a SCADA style computer interface for precise, automated and reliable control of various stages of the treatment process.

The PLC program allows adjustments to the cycle durations to be made based on the flow rate through the plant. The number of cycles is variable (typically ranging from 4 to 8 cycles per day), and as the number of cycles increases, the duration of the react stage decreases. The PLC program is capable of controlling actuated valves, blowers and pumps and other components essential to the production of high quality treated wastewater.

The plant can be operated by communication through a computerised scada system, however all critical equipment can be manually operated via the main electrical control panel. The computer interface provides a point and click operation and value entry controls to keep the control simple.

Monitoring, Metering and Control Equipment

A number of items are proposed within the NovaClear plant that will aid in the operation of the system along with raising alarms and monitoring effluent quality.

These include:

- Influent flow meter between primary pump station and EQ tank.
- D.O meters for each cell to provide oxygen monitoring and blower control.

- Continuous NTU monitoring following tertiary filtration.
- Continuous UV intensity monitoring and lamp failure alarms.
- Continuous Cl^2 monitoring and set point failure alarms.
- High level alarms on all treatment tanks.
- Low level alarms on all dosing tanks.
- Final effluent flow meter following final irrigation pump.
- Motor overload protection with auxiliary alarm outputs on all pumps and air blowers where practical.
- Current sensing and amp meters on all submersible pumps where required.

All alarms will be locally activated on both the main electrical control panel and scada computer interface. All alarms will be presented as volt free contacts (or 4-2Oma outputs for metering) within a dedicated marshalling box.

The SCADA system will be linked via an independent telemetry system to a remote console. An auto dialler will alert remote operators of system alarms or equipment failure.

13. Staged Installation

As required within the tender specifications the proposed treatment plant has been designed to allow the staged installation in three sections.

Initial equipment such as inlet screening pump stations, UV disinfection etc. have all been sized appropriately to cater for the final system capacity. The modular design of the tanks, aeration equipment allow for simple up-grades whilst providing a high degree of redundancy.

14. Method Statement

Construction

The treatment plant proposed utilises the process described in the" Operation of Plant" section above. The final treatment plant design may be amended according to requirements and will be confirmed with the principal before the commencement of any works. Full construction drawings will be completed for all components along with proposed routes for underground services. Copies of all drawings will be submitted to the principal for approval if required.

The site will be prepared by the civil works sub-contractor and the tanks installed as per the designs. All underground services including electrical and control cable conduit along with aeration and plumbing pipe work will be installed as per the designs at appropriate depths.

Pre-assembled equipment will be delivered to site and installed appropriately. On completion of each item being installed run testing will be carried out to ensure correct operation.

Following the installation of all equipment pre-commissioning and testing will commence. The principal will be advised of all testing and may be available for witnessing if required. It is expected that the plant will be completed sufficiently within the time frame of the project (including initial equipment testing) to permit a minimum of 5 days actual run testing of all equipment prior to final commissioning on receipt of incoming waste.

All instruments shall be calibrated and tested. All alarms shall be tested.

A report on the commissioning and testing will be submitted to the principal on completion along with notification that the system is ready to receive waste.

15. Operator Training

A formal training course shall be carried out on site at the completion of the project.

16. Documentation

Three sets of detailed installation drawings and complete operating and maintenance manuals will be submitted on completion of the project. Prior to the final document issuing a draft set will be issued for to the Superintendent for approval. The documents shall include all necessary information and drawings pertaining to the design, operation and maintenance of the system.

17. Manufacture and Delivery

All treatment plant components are manufactured at the EcoNova factory in Queensland. The Plant will then be assembled on site by Standard Industries Pty Ltd.

18. Quality System

EcoNova Pty Ltd and Standard Industries Pty Ltd operate an internal Quality Management System.

19. Current Commitments

Standard Industries is the approved distributor installer and maintainer of the ECONOVA Systems. The Team is dedicated to the highest standard of workmanship with Quality Control Management. The building construction, engineering and site excavation is conducted with co-ordination with the Standard Industries pool of professional consultants. This assures successful installation, operation and maintenance of the Treatment Plant.

EcoNova maintains a continuously operating factory to produce domestic, commercial and marine sewage treatment plants and other water recycling systems. These systems are approved by local authorities throughout Australia to the relevant Federal and State Legislative requirements.

Standard Industries has been appointed to construct, install, maintain, service and report to the principal at regular intervals.

20. Environmental Management

Noise management

Definition

Noise is considered to be unwanted sound. It is a very powerful form of pollution which can have negative impacts on the environment. The air into which noise is emitted is a public amenity and noise can be an environmental nuisance.

Preventative Methods

The NOVACLEAR treatment plants are designed to produce low noise emissions with the majority of mechanical equipment housed within a brick control shed and are fitted with noise reduction equipment such as silencers on blower inlets where possible. Side channel blowers are utilised do to their low noise output (as opposed to roots type blowers) and are also located within the control shed. All equipment is fitted to mounting plates and securely fixed in place to reduce unnecessary noise from vibrations. Solid state controls are utilised for silent operation and all solenoid valves etc. are sealed units.

Noise emissions of individual equipment are detailed in the above specification. Noise modelling for the proposed treatment plant and all associated equipment can be provided for approval prior to construction if required.

Legislation, licenses, Standards

This system aims to address the following requirements as standard within all systems:

- Environmental Protection Act 7994, Section 319: general environmental duty.
- Environmental Protection (Noise) Policy 7997 Prescribes maximum permissible noise criteria for activities and premises during specified times.
- Environmental Nuisance Laws prescribe criteria associated with certain activities, including hours of operation of equipment and maximum acceptable noise levels.
- Specific license conditions set within Environmentally Relevant Activities.
- AS 1055.1-1997 Acoustics Description and measurement of environmental noise - general procedures
- AS 1055.2-1997 Acoustics Description and measurement of environmental noise - application to specific situations
- AS 1055.3-1997 Acoustics Description and measurement of environmental noise - acquisition of data pertinent to land use. These standards describe general and specific procedures for measurement and evaluation of environmental noise.

Visual Amenity

Definition

"Visual Amenity" is a measure of the visual quality of a site or area experienced by residents, workers or visitors. It is the collective impact of the visual components which make a site or an area pleasant to be in.

Preventative Methods

The NOVACLEAR treatment plants are designed to offer minimal visual effect on the surrounding environment. All tanks are proposed to be installed below ground with only the control shed visible. The control shed is available in a variety of colours and can be incorporate modern architectural designs. All platforms and equipment frame work is manufactured from aluminium incorporate curved designs where possible in keeping with the overall treatment plant design.

The NOVACLEAR treatment plants have been installed in a variety of locations including dense rainforest locations, beachfront installations, baron landscapes and mountainside installations.

Key Design Issues

Visual amenity issues are intrinsic to planning assessment of an individual proposal and the issues tend to be localised. Some amenity issues cannot be addressed purely on a local level, as they relate to a larger area or multiple legislative requirements. Nevertheless, individual proposals are specifically addressed and a dedicated strategy formed for each.

The following summarises the key issues forming the basis for a Visual Amenity Strategy. They include:

- The importance of water bodies, such as oceans, beaches, rivers and lakes, and the amenity created by the Treatment System;
- The significance of the sites vegetated character, particularly in forming backdrops to urban areas.
- The effect of the visual quality of the Treatment Plant and the scale and character of structures which create environmental elements relative to natural elements such as hills and vegetation and the way in which they are visually contained by the natural elements;
- The importance of "naturalness" to the perceived character of a Treatment system, particularly where it is challenged by large scale or tall development which is visible from a significant proportion of the region;
- The significance of strong architectural traditions which may need to be reflected within an Wastewater treatment System;

Odour Emissions

Definition

Odour is a parameter which cannot be measured physically or chemically. It only reflects the property of a certain substance or substance mixture. Odour perception is a sensoric reaction of the olfactory cells which are settled in the dome of the nasal cavity as olfactory epithelium, the human being having about 10 to 25 million.

Odour perception like the perception of tastes arise through a direct reciprocal effect between chemical compounds and the corresponding peripheral receptor system. Flavouring substances in an aqueous solution stimulate the sensory cells on the tongue. Odour substances which are exclusively transported in volatile compounds are conducted by breathing to the osmoceptors situated in the upper nose. Hereby the odour perception is generated over the sense of smell. The sense of smell consists of three main components [OHLOFF, 1990]

- the nose with its stimulus receptors, osmoceptors
- a nerve conductivity system for the transfer of the electrical pulses generated through the odour perception
- part of the brain(odour brain, rhinous cephalon) where the arriving pulses are worked up and transferred into an odour sensation.

Compared with the sense of taste which is limited to the four sensory perceptions sweet, sour, salty and bitter, which can even be realized in a relatively high concentration, the sense of smell can perceive a relatively unlimited number of chemical compounds at very low concentrations.

Preventative Methods

Odour emissions during normal operation of the treatment plant are extremely low due to the fully aerobic treatment process. In addition, all tanks are completely sealed. A low profile is proposed for the overall plant reducing the effects of any odours being carried by winds.

The incoming bar screen equipment is manufactured with high side walls to enclose the influent flow as much as possible. The screening equipment also incorporates a low profile design.

Fundamentals of odour measuring

Applied methods of odour measuring

Fundamentally two different methods of odour measuring can be mentioned:

- Sensory and
- Chemical-physical measuring methods

One distinguishes between wet-chemical methods within the chemical-physical methods and the capillary gas-chromatography. The wet-chemical method purposefully determines the search for single substances. This method, however, is of little importance for the odour measuring in biological waste treatment plants, as being a matter of very complex substance mixtures.

With the detection of material groups respectively individual substances, the capillary gaschromatography offers the possibility of a separation of complex substance mixtures. The mostly used detector for this test is the flame ionisation detector (FID). This measuring allows a continuous determination of the organic compound carbon. But even this method does not replace men as odour detector.

Following EITNER (1986) it is not possible to deduce in general a correlation between odour perception or carbon content. So, strongly smelling sulphur or nitrogen compounds are not collected during total carbon measuring, whereas the measuring instrument registers odourless methane.

Both observations show that for the time being the sensory measuring method of olfactometry, i.e. the odour perception by men, is still the better method in order to evaluate odours from biological waste treatment plants.

Odorant concentration

The determination of the odorant concentration is based on the idea that the odour intensity of the air to be tested is higher the more this air must be diluted in order to reach the odour threshold. The odorant concentration at the odour threshold is the dilution ratio between odourless air and the air to be tested, whereby 50 % of the panellists realize an odour impression and the other 50 % not. This concentration is defined as odour unit per cubic meter (1 OU/m3).

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Odour intensity

As the concentration at the perception of concentrations above the odour threshold is not a sufficient criteria for the assessment of an odour impact, among others the odour intensity is additionally determined. The intensity is theoretically calculable through the relation between odour intensity and odour concentration.

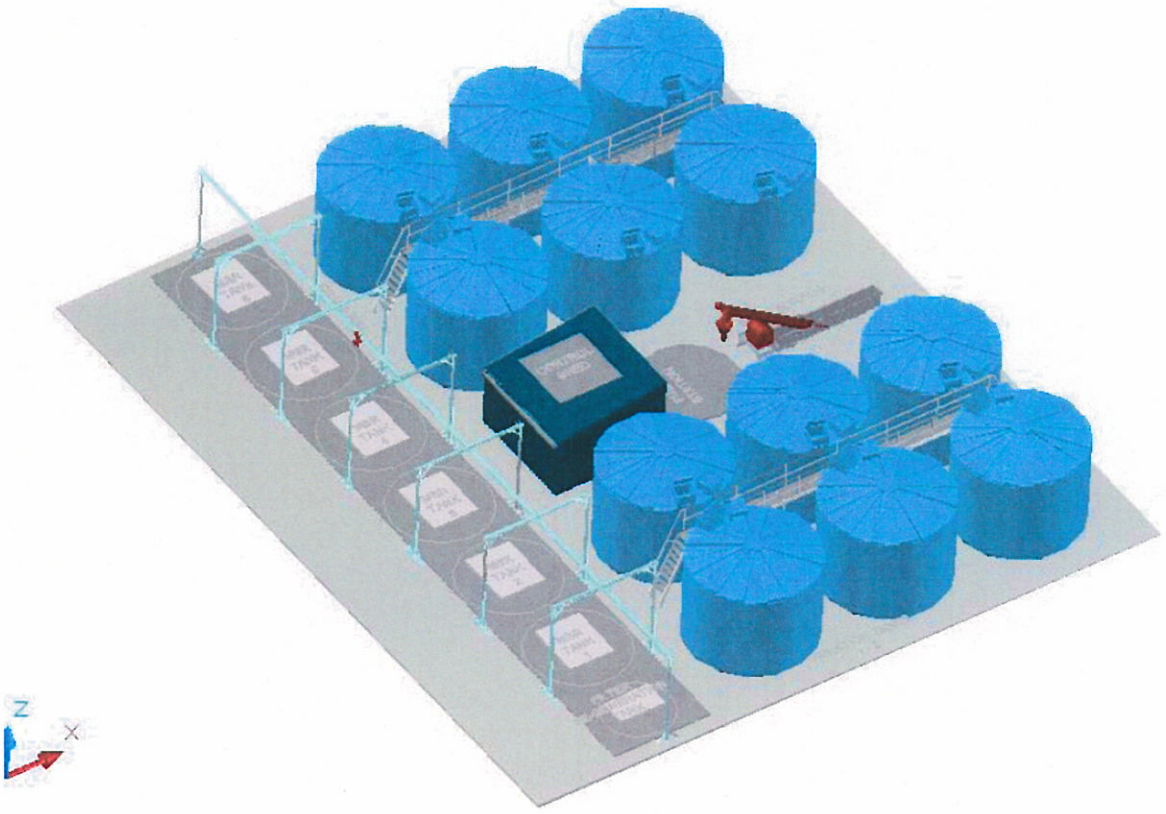
When emissions are tested in the field the odour intensity is determined by means of inspection. The determination by olfactometer is realized under the same conditions like those of the odour threshold determination.

Odour quality (hedonic tone)

In order to determine an odour annoyance the hedonic tone of an odour is quite of importance. Hereby the odour can be graduated from "very comfortable" over "neutral" to "very uncomfortable".

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Appendix A – STP Drawings

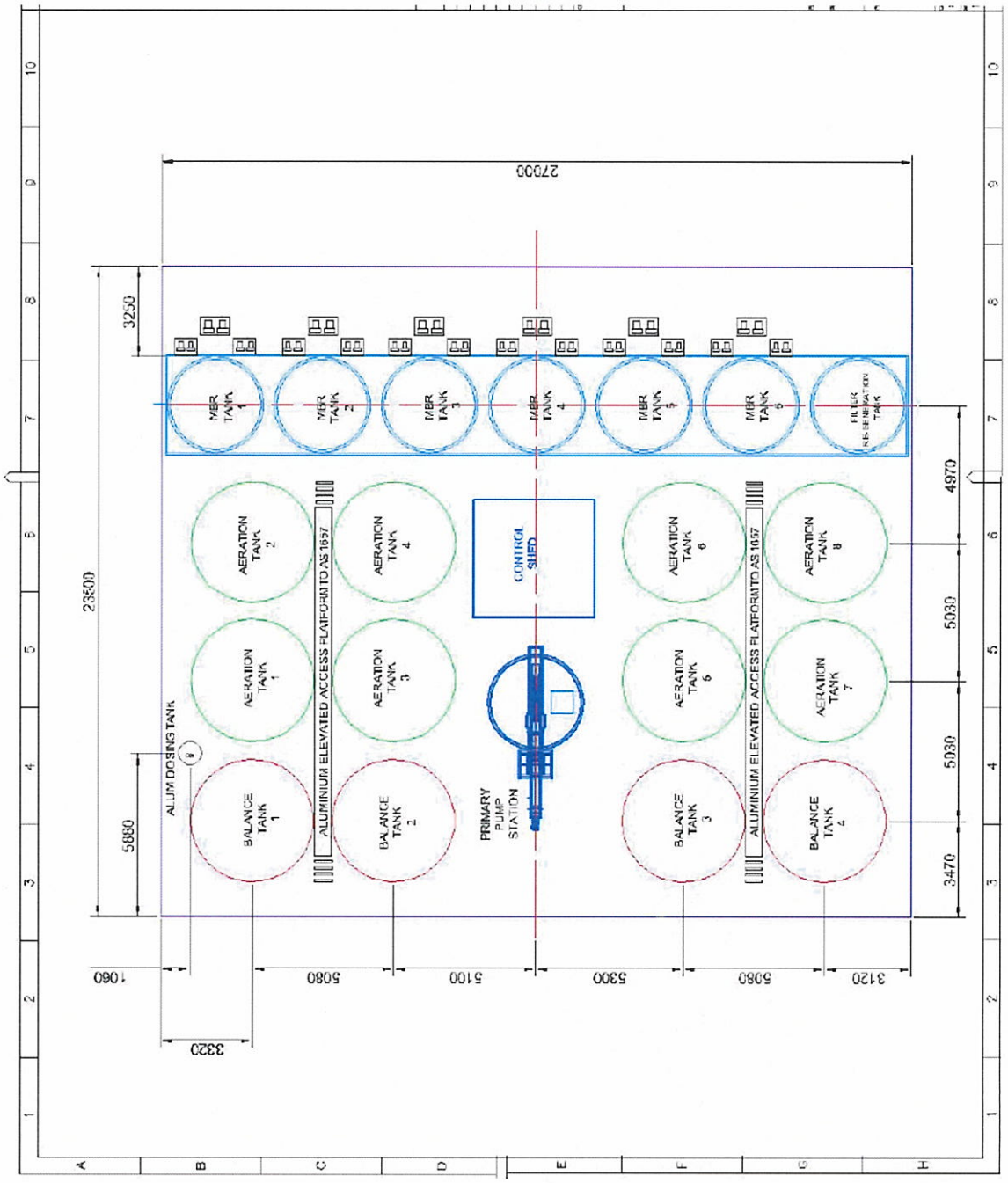


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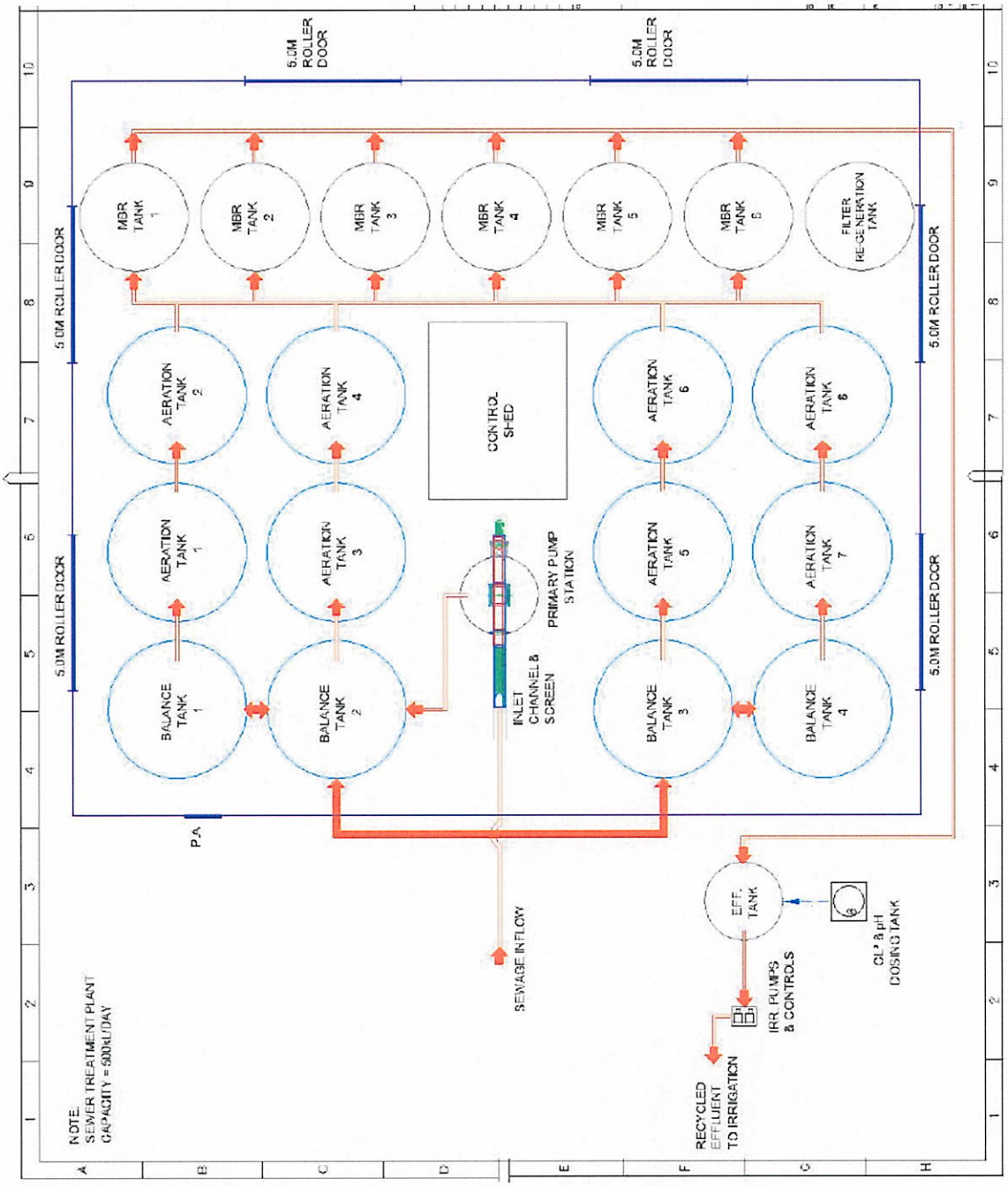


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Appendix B - Service and Maintenance

The maintenance plan for the project includes a comprehensive schedule and should the maintenance agreement be accepted, all major servicing requirements including basic weekly inspections or hose-downs will be provided and no additional man power or servicing will be required from the principal.

It is proposed that as part of any maintenance agreement, that daily summary reports recorded remotely would be either faxed or emailed to the principal on a daily or weekly basis.

In addition to this monitoring program, general maintenance inspections are categorised as follows:

In addition to EcoNova's standard remote monitoring program, general maintenance inspections are categorised as follows:

Weekly Maintenance Inspections	Weekly plant inspections are to include operational testing and monitoring of the plant. Although the plant is designed for Inspections automatic operation, monitoring and optimising of sludge levels, DO levels, dosing systems etc. will ensure that effluent quality standards are continuously met. Weekly plant inspections are expected to take approx. 1-2 hours total (15 – 20 mins/day).
Preventative/Operational Maintenance Inspections	Additional maintenance inspections will be required to provide Maintenance general preventative maintenance to plant and equipment. These are expected to average 3-4 hours per week (on-site) and will include items listed on the Planned Preventative

In addition to the regular scheduled maintenance inspections, the proposal includes for a minimum number of emergency call-outs during each 12 month period (1 per month). Emergency call-outs will be attended to within 4 hours during normal working hours and within 6 hours otherwise.

General maintenance consumables such as filters, lubricants, glue, tape etc. have been included for however plant operational consumables such as chlorine have not.

If the proposal is successful, a detailed maintenance schedule and available spare parts list held on site will be provided and agreed upon.

PPM Maintenance Items	

Typical preventative maintenance items within the proposal include but are not limited to:

Hose down and removal of sediment from primary grit trough	Weekly
Checking correct operation of spiral sieve screen and controls	Weekly
Cleaning emergency overflow bar screens	As required
Odour control of screenings	Weekly
Supervision of screenings removal by waste contractor - arranged as necessary	As required
Hose down and scum removal from primary pump well	Bi-Weekly
Periodic inspection and testing of influent pump well pumps and controls	Quarterly
Periodic inspection and testing of EQ tank pumps and controls	Quarterly
Periodic inspection of fine bubble diffusers within aeration tanks	Annually
Periodic inspection and testing of decant pumps and controls	Quarterly
Draining and cleaning of intermittent effluent tank	Weekly/Monthly
Periodic inspection and testing of dosing pumps and controls	Monthly
Periodic inspection and testing of filter pumps and controls	Quarterly
Periodic inspection and testing and cleaning/flushing of UV	Monthly
Hose down and scum removal from sump well	Weekly
Periodic inspection and testing of sump pump and controls	Monthly
Mixing and filling of Alum dosing tank, pump and controls	As required
Testing and calibration of metering equipment - DO meters, flow meters etc.	Monthly, quarterly

Mechanical maintenance to air blowers including filter replacement etc.	Monthly - as required
Sampling of effluent for EPA license testing	Daily, weekly, monthly
General site maintenance - fencing, weed control, signage etc.	As required
Calibration of meters and controls	Monthly or as required
Regeneration of membranes and cleaning of air scour equipment	Quarterly - Bi-annually

As mentioned above, operational consumables have not been included for within the current maintenance proposal. The excluded items include the following:

Operational Consumables not Included for: Estimated Cost	
Disposal of Waste Sludge NA	NA
Electricity	NA
Raw Water	NA
Chlorine	approx. $O.0306 / kL
Aluminium Sulphate	TBA
Removal of screenings from site (via normal garbage collection)	1 Wheelie Bin p Month

All maintenance work will be done so by qualified Mechanical Fitter Tradesmen, Certified Commercial Sewage Treatment Plant Operators or Licensed Plumbers/Drainers/irrigation Installer.

Appendix D – Sediment Basin Calculation

Site: Tomago			
WesTrac facility			
Description		**Typical Value**	
Catchment Site Area (hectares)	25.2		(minus const. wetland)
Type F/D			
Settling Zone			
Runoff Coefficient, Cv	0.5	0.5	
95th%ile, 5 day Rainfall Event	76.7		Table 6.3a, pg 6-24
Settling Zone Volume	**9664**		m3
Sediment Zone			
Disturbed site Area (hectares)	25.2		
Rainfall Erosivity Factor, R	2500		Appendix B, Newc B-11
Soil Erodibility Factor, K	0.059		Appendix A, Figure A3
Slope Length Gradient Factor, LS	0.27		Table A1, pg A-9
Erosion Control Practice Factor, P	1.3	1.3	Table A2, pg A-11
Cover Factor, C	1	1	Figure A5, pg A-12
Sediment Zone Volume	**171**		m3
Total Storage required			
Settling + Sediment	**9835**		m3

Volume 4 - Stormwater Management Report - Industrial Subdivision

Property:

Tomago Road, Tomago

Applicant:

Redlake Enterprises Pty Ltd

Version 1, November 2007



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This report has been prepared using the most up to date available survey information and current flooding analysis methods. No responsibility for loss occasioned to any person acting or refraining from action as a result of any material in this publication will be accepted by Asquith & deWitt.

Prepared by:

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Member No. 1465150 Civil and Environmental Colleges
Senior Environmental Engineer

Section 1.0 Introduction

Asquith & deWitt Pty Ltd has been engaged by Redlake Enterprises Pty Ltd, to complete reports on stormwater management and civil engineering requirements for the proposed development of a new WesTrac facility and industrial subdivision along Tomago Road, Tomago.

The focus of this report, Volume 4, is the stormwater management for the proposed industrial subdivision. Details of the servicing, infrastructure and sewerage treatment for the proposed subdivision are described in **Volume 2 - Concept Engineering, Servicing and Earthworks Report - Overall**.

The NSW Department of Planning issued Director General's Requirements (DGRs) on 18 September 2007. This report addresses the following DGRs for the development of the WesTrac facility as shown below in **Table 1**.

Table 1 - DGRs addressed in this Report – Volume 4

Issue	Section addressing Issue
a water balance for the site detailing water sources, water consumption, water recycling, the quantity and quality of waste water streams and the impact of any water release from the site on surface water and groundwater;	3.2
proposed erosion and sediment controls (during construction) and the proposed stormwater management system (during operations);	3.5
proposed management measures for containment of pollutants;	3.4

Whilst this report has been prepared for the Department of Planning, Port Stephens Council (Council) stormwater management objectives have been considered where applicable.

1.1 DEVELOPMENT DESCRIPTION

An industrial subdivision is proposed on land area of approximately 115 hectares. The land is zoned industrial, part of an industrial zone that includes a further 250 hectares (approx.) adjoining. The lands are yet to be developed, previously zoned for agricultural purposes. The subdivision will include a proposed WesTrac facility in the north eastern corner of the site. Refer to **Figure 1**.

1.2 SITE DESCRIPTION

The proposed subdivision will be created from the overall subject land to be developed, of Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256. The land is located on the northern floodplain of the Hunter River, on the southern side of Tomago Road, Tomago. Topographically, the site comprises a low dunal formation up to 8.5m AHD in the northern eastern corner of the site, and a flat, low lying alluvial plain at an elevation of 0.1-1.5mAHD over the remainder of the site. Refer to **Figure 2**.

The low-lying portion of the site is waterlogged, generally covered with standing water 0.1-0.3m deep along the southern boundary of the site. Open channel farm drains have previously been excavated into the site and drain toward the Hunter River. These drains have modified the existing hydrology. Vegetation is predominantly tall, thick grasses. Refer to **Figure 2**.

Land to the south, downstream of the site is SEPP14 and RAMSAR wetlands. The RAMSAR boundary, adjoining the south eastern corner of the site, is an existing boundary determined by RAMSAR. Refer to **Figure 1**.

Section 2.0 Background Information

The following documents have been used to complete the stormwater management requirements for the industrial subdivision:

- Asquith & deWitt subdivision layout plan.
- "*Managing Urban Stormwater: environmental targets*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: an integrated approach*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Urban design*" – Consultation draft – October 2007, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Harvesting and Reuse*" April 2006, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater: Treatment techniques*" – Consultation draft – October 2007, 2nd edition, Department of Environment & Climate Change NSW.
- "*Managing Urban Stormwater Soils and Construction*" 4th Edition, Volume 1, March 2004 produced by Landcom (Blue Book).
- "*Urban Stormwater and Rural Water Quality Management Plan*", Port Stephens Council.
- Water Industry Competition Bill 2006 – NSW Government
- "Proposed WesTrac Industrial Development – Tomago Geotechnical Assessment" GEOTSGTE20301AA-AI, 15 November 2007, Coffey Geotechnics, refer to **Appendix M**.
- "Proposed Industrial Development 197-325 Tomago Road, Tomago, NSW" Preliminary Geotechnical/Due Diligence Assessment" N09814/01-AD, 29 August 2006, Coffey Geotechnics, refer to **Appendix M**.
- "*Proposed Industrial Development at Tomago Road, Tomago flood Impact Assessment*" Issue No.2, October 2007, Patterson Britton & Partners.
- Daily and 6 minute Rainfall Data and Evaporation Data for Williamtown from Bureau of Meteorology.
- "The Influence of Urban Density and Drainage Infrastructure on the Concentrations and Loads of Pollutants in Small Streams" Fletcher et al 2004.

Section 3.0 Stormwater Management Requirements

The stormwater management system for the industrial subdivision has been designed to achieve a 'no impact' objective and to acknowledge and incorporate the requirements of DGRs, Hunter Water Corporation (HWC) requirements, the series of Department of Environment and Conservation NSW (DECC) stormwater manuals and Council's development control plans. Included in the development of the system were an assessment of water quality, quantity and volume of stormwater runoff discharging to the downstream receiving waters both pre and post development.

The low dunal formation described in **Section 1.2**, is part of the Tomago Sandbeds. During the Due Diligence assessment for the site, HWC were contacted in relation to their requirements. HWC identified that the WesTrac facility would overlap part of the Hunter Water (Special Areas) Regulation 2003. The Special Area is nominated over the Tomago Sandbeds, which is an aquifer containing groundwater reserves used for drinking water supply to Newcastle. This issue has been addressed in **Section 3.1**.

The key objectives of the stormwater management design for the proposed industrial subdivision are to achieve 'no impact' on water quality, quantity of runoff discharging downstream. Reuse of stormwater for toilet flushing, irrigation and site uses is required, to offset increased runoff from the creation of impervious areas assumed for the industrial subdivision. Impervious areas associated with the subdivision will be roads, buildings, carparking and hardstand areas within developed lots.

Initially, an 'holistic' approach to the stormwater management design has been undertaken for the proposed industrial subdivision. This includes assumptions of the anticipated level of development and design for runoff mitigation structures to achieve target objectives. Water quality and reuse is described in **Section 3.2**. Peak flow attenuation is described in **Section 3.3**.

Concept design of stormwater management controls is described in **Section 3.4**.

Soil and water management strategies are an important consideration during construction for the protection of downstream receiving waters. The temporary controls required and mitigation measures to be used at this site during construction are described in **Section 3.5**.

Stormwater management has been a key consideration in the iterative design process to prepare the development layout, refer to **Figure 3**.

3.1 HWC REQUIREMENTS - SPECIAL AREA

As described above in **Section 3.0**, HWC was contacted during the Due Diligence assessment process for the proposed development of the site. The Special Area, part of the Tomago Sandbeds, has been traced from plans provided by HWC, refer to **Figure 3**. The Special Area occupies approximately 9.59 hectares of the site proposed for development of the WesTrac facility.

Detailed analysis for the mitigation and treatment of stormwater runoff for the development in this area, is described in **Volume 3 – Stormwater Management Report - WesTrac Facility**.

3.2 WATER QUALITY AND REUSE MODELLING

Council has a range of water quality requirements for the improvement of runoff from the proposed development, prior to discharge from the site. From Table 8-3 of Council's document "Urban Stormwater and Rural Water Quality Management Plan", post construction targets have been set for the pollutants; Total Suspended Solids, Phosphorus and Nitrogen, in runoff. Council's document however, goes further to say that in sensitive catchments, these targets and objectives for stormwater treatment may need to be reassessed and upgraded. Similarly, "Managing urban stormwater: environmental targets - Consultation Draft 2007" produced by DECC also provides targets for pollutant removal, with the opportunity to upgrade in the situation of sensitive receiving waters downstream.

It has been considered that this site should be classified as a sensitive catchment, and that a higher level of protection should be applied to the wetlands via a more extensive treatment of the stormwater runoff prior to discharge from the site.

DECC targets, to be *exceeded*, are as follows:

- *90% reduction in the average annual gross pollutant load*
- *85% reduction of average annual total suspended solids load;*
- *65% reduction in the average annual total phosphorus load;*
- *45% reduction in the average annual total nitrogen load.*

These targets are a higher level of protection for the downstream receiving waters than Councils general development objectives. The water quality objective for this site was to determine a solution of 'no impact' to the downstream receiving waters. Post development simulations were compared against existing, pre European settlement discharges to demonstrate 'no impact'. Meeting the objective of 'no impact' exceeds the DECC targets described above.

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) is the most appropriate and current water quality model available to demonstrate that all requirements have been met. Subsequently, a stormwater treatment train has been established to meet these requirements.

The subdivision site has been divided into a series of subcatchments for the purposes of pollutant modelling. These subcatchments were further divided into pollutant source elements of Roof, Lot and Road areas. A stormwater treatment train will be used for removal of the pollutants from the stormwater runoff prior to discharging to the wetlands downstream.

The stormwater treatment train process has the following elements; rainwater tanks for the collection and reuse of roof water, gross pollutant traps, swales, three (3) constructed wetlands and a bio retention device prior to discharge. Each element has a specific role in the process of pollutant removal.

The following key parameters, generally in accordance with MUSIC user manual, were adopted:

- Rainfall/Evapotranspiration – 6min rainfall data for Williamtown BOM station was used for the simulation. The data was collected from 2004, closely equivalent to the average rainfall for Williamtown. Average monthly areal potential Evapotranspiration (PET) rates for the simulation were also sourced from the Bureau of Meteorology.

- The existing simulation adopted the 'forest' source node and the mean annual loads produced were noted as the target objectives for the post development simulation.

- The subcatchments of Roof, Lot and Road Reserves were modelled as different pollutant sources. The total lot area was modelled as 95% impervious, the remaining 5% is considered to be landscaping, setbacks, etc as pervious area. The Roof Area was assumed to be 75% of the lot area. Rainwater tank size was on the basis of 50L/m^2 and tank use was estimated to be 12KL/hectare of development area.

- Storm flow pollutant generation parameters for the Roof, Lot and Road Reserves were modified from default values to those determined by Fletcher et al (2004) for Roof Areas and Road Reserves. Lots were assumed to have the same pollutant generation potential as Road reserves due to the anticipation of hardstand, carparking areas being created on the lots within the industrial development. These values are slightly 'worse' than default parameters. Export of the pollutants was simulated in "stochastic generated" mode.

Lots and Road Reserves

- Log10 TSS Mean 2.38, Std Dev 0.4
- Log10 TP Mean -0.6, Std Dev 0.5
- Log10 TN Mean 0.42, Std Dev 0.19

Roof Areas

- Log10 TSS Mean 1.55, Std Dev 0.39
- Log10 TP Mean -0.92, Std Dev 0.29
- Log10 TN Mean 0.42, Std Dev 0.19

A comparison of the pollutant modelling simulations for pre development and post development with controls (ie treatment train), is shown below in **Table 2**.

Table 2 – Water Quality Modelling Results from MUSIC

Pollutant	Existing Simulation - Pre European Settlement	Post Development Simulation with Controls	Treatment Train Effectiveness (%)
Flow (ML/year)	49.5	42.4	93.8
Total Suspended Solids (kg/year)	1.95E3	198	99.8
Total Phosphorus (kg/year)	3.05	2.36	98.7
Total Nitrogen (kg/year)	40.6	35	98.3

The modelling results in **Table 2** indicate that the post development simulation with mitigation controls in place, meets the target objective of 'no impact' by matching pollutant levels equivalent to the levels from existing pre European settlement catchment. This level of stormwater treatment for water quality far exceeds the treatment levels outlined by DECC. Model links and results are represented in **Figures 4** and **5**.

Outcomes of the water quality modelling indicate that three (3) constructed wetlands, one of which is split by a road but connected with a combined surface area of 13 hectares are required at the base of the proposed development. Due to the uncertainty of the specifics of the operations on the industrial uses, assumptions have been made to determine land take for the stormwater treatment controls. There are several options for combining the treatment controls to meet the objective and no one unique solution. For example, a greater emphasis could be placed on the individual lot treatments for the reduction of the constructed wetland sizes, or vice versa. A typical section and concept design of the constructed wetlands have been provided. Final detailed design of the constructed wetland for configuration will be necessary at the detailed design phase of the development. Refer to **Figure 6**.

3.3 PEAK FLOW ATTENUATION MODELLING

The hydrological analyses for this study adopted the flood routing model XP-RAFTS (RAFTS). Parameters of catchment area, imperviousness, catchment slope and rainfall losses were used to simulate the catchment response to storm events, generating hydrographs for the estimate of peak discharge. The site was subdivided into a series of subcatchments for the pre development and proposed development simulations.

Catchment boundaries for both pre development and post development have been established for the contributing catchment and are shown in **Figures 7** and **8** respectively.

3.3.1 Rainfall Data

Design rainfall Intensity-Frequency-Duration (IFD) for the site was obtained using methods setout in Australian Rainfall and Runoff (ARR) 1987, which were checked against the published data in Port Stephens Council – "Subdivision Code". A summary of the rainfall intensities used in this study are shown in **Table 3**. Rainfall temporal patterns for the design storms are taken from ARR.

Table 3 – Rainfall Intensities for Tomago

Storm Duration (min)	Rainfall Intensity (mm/hr) Recurrence Interval						
	1	2	5	10	20	50	100
5	82	106	136	154	177	208	231
10	63	81	104	118	136	159	177
15	52	68	87	98	114	133	148
20	45.7	59	76	86	99	116	129
25	40.8	53	68	77	88	104	116
30	37.1	47.9	62	70	80	94	105
45	29.7	38.4	49.5	56	65	76	84
60	25.2	32.6	42	47.5	55	64	72
90	19.8	25.5	33	37.3	43.1	51	56
120	16.6	21.4	27.6	31.3	36.1	42.5	47.4
180	12.9	16.6	21.5	24.4	28.2	33.2	37
270	9.98	12.9	16.7	19	21.9	25.8	28.8
360	8.34	10.8	14	15.9	18.4	21.6	24.2
540	6.48	8.38	10.9	12.4	14.3	16.9	18.8
720	5.42	7.01	9.12	10.4	12	14.2	15.8
1440	3.54	4.61	6.1	6.99	8.14	9.68	10.9
2880	2.26	2.96	3.98	4.6	5.41	6.48	7.31

3.3.2 Calibration

RAFTS is most accurate for the prediction of peak flow estimation when calibrated to historical rainfall and stream flow data for the catchment being investigated. Since there is no historical stream flow data available for this catchment, the model was calibrated to the Probabilistic Rational Method (PRM). The PRM is widely accepted as a reliable estimate of peak discharge rates, in lieu of actual data.

A single nodal model was created for the proposed development site area and the peak flow estimated to be 13.75m^3/s by the PRM. This was derived from a time of concentration of 45 minutes. Using a default Storage Coefficient Multiplication Factor (Bx) of 1.0, the RAFTS model predicted a peak 100 year ARI discharge of 13.25m^3/s. The Bx was then adjusted until a close relationship was established. Adopting a Bx of 0.95, the RAFTS model predicted a peak 100 year ARI discharge of 13.95m^3/s. For further verification of the Bx value, a subcatchment of 6.5Ha within the model, PD4, was analysed. A close correlation of 1.41m^3/s from the RAFTS model compared to 1.38m^3/s by PRM was found. Therefore a Bx value of 0.95 was adopted.

3.3.3 RAFTS Modelling Parameters

Mannings 'n' is the subcatchment roughness factor; this value is adjusted to represent the different response of rural and urbanised catchments, impervious and pervious surfaces. The adopted 'n' values are shown below in **Table 4**.

Table 4 – RAFTS Mannings 'n' Values

Parameter	Catchment Condition	Value
Mannings 'n'	Impervious	0.015
	Pervious	0.035

RAFTS modelling was undertaken using the standard initial and continuing loss infiltration parameters. The existing, pre development site has two main soil material types, clay and sand. These types were represented with different initial and continuing loss parameters, modified to more closely match the site characteristics of waterlogging and saturation. The post development simulation was further differentiated by adopting more typical initial and continuing loss parameters due to the extent of imported fill material over the top of the clays. The initial and continuing losses adopted were as follows:

- Sand Pervious Catchment –
  - Initial Loss 15.0mm
  - Continuing Loss 5.0mm/hr

- Clay Pervious Catchment –
  - Initial Loss 5.0mm
  - Continuing Loss 1.0mm/hr

- Site Fill Pervious Catchment
  - Initial Loss 10.0mm
  - Continuing Loss 3.0mm/hr

- Impervious Catchment
  - Initial Loss 1.5mm
  - Continuing Loss 0.0mm/hr

For the existing, pre development simulation, the sand pervious catchment loss model was adopted for catchments corresponding with the sand dunal formation area (PD1, PD2 & PD3). The remaining catchments adopted the clay pervious catchment loss model.

For the post development simulation, the sand pervious catchment loss model was adopted as the Westrac facility (B1 West) catchment. It is noted that there is significant recharge of the aquifer in this catchment. This will result in significantly reduced flow quantities to the wetlands downstream, however to be conservative, modelling a worst case scenario, this catchment was included in the post development model. For instance, this representation could be associated with high groundwater table levels at the time of the peak storm occurring. The remaining catchments adopted the site fill pervious catchment loss parameters. To be conservative, the percentage of imperviousness assumed for the subdivision lots in the post development simulation was 95%.

Channel routing effects were modelled by RAFTS using a simple lag time approach. The lag times were estimated by velocity derived from the length and slope of channels. **Tables 5** and **6** presents the estimated lag times adopted for the existing predevelopment and post development simulations.

Table 5 – Estimated Lag Times for the Existing, Predevelopment Simulation

Linked Nodes	Length (m)	Lag Time Adopted (min)
PD1 - PD7	800	26
PD2 - PD7	725	24
PD3 - PD4	245	8
PD4 - PD6	760	25
PD5 - PD6	670	22

Table 6 – Estimated Lag Times for Post Development Simulation

Linked Nodes	Length (m)	Lag Time Adopted (min)
B2A – B2	500	8
B1 West – B1	350	6
B1 – SW1	330	6

3.3.4 Peak Discharge Estimates

Peak discharge from the overall site was estimated for three (3) simulations; existing, post development and post development with detention. Detention is required because the RAFTS model indicated an increase in peak discharge between the existing and post development simulations. Standard recurrence events of 1, 2, 5, 10, 20, 50 and 100 years were analysed as shown below in **Tables 7** and **8**. Storm durations ranged from 10 minutes to 72 hours to determine the critical storm for each subcatchment as shown below in **Table 9**.

Table 7 – Summary of Peak Discharges from RAFTS

ARI (years)	Peak Discharge (m^3/s)		
	Existing	Post Development	Post Development with Detention
1	3.47	13.30	3.35
2	4.83	17.43	4.30
5	6.74	22.84	6.74
10	7.97	25.73	7.64
20	9.89	29.91	8.78
50	12.01	33.41	10.61
100	13.95	37.30	13.86

Table 8 – Summary of Time to Peak from RAFTS

	Time to Peak (min)		
	Existing	Post Development	Post Development with Detention
1	340.00	30.00	74.00
2	336.00	30.00	80.00
5	333.00	30.00	68.00
10	78.00	25.00	67.00
20	76.00	25.00	75.00
50	74.00	25.00	74.00
100	74.00	25.00	55.00

Table 9 – Summary of Critical Storms from RAFTS

ARI (years)	Critical Storm Event (min)		
	Existing	Post Development	Post Development with Detention
1	540.00	90.00	120.00
2	540.00	90.00	120.00
5	540.00	90.00	120.00
10	120.00	60.00	120.00
20	120.00	60.00	120.00
50	120.00	60.00	120.00
100	120.00	60.00	120.00

The 'post development with detention' simulation was based on the configuration shown below in **Table 10**.

Table 10 – Detention Basin Outlet Configuration from RAFTS

Basin	Surface Area (m^2)	Depth (m)	Low Flow Control	High Flow Control	Extreme Control
B1	14545	1.1	2.7m x 0.3m Box Culvert	1.8m x 0.45m Box Culvert	Multi Staged Weir
B2	17115	1.1	2.7m x 0.3m Box Culvert	1.8m x 0.45m Box Culvert	Multi Staged Weir
B3	9000	1.1	1.2m x 0.3m Box Culvert	1.5m x 0.45m Box Culvert	Multi Staged Weir

Locations of the basins, B1, B2 and B3 are shown in **Figure 8**.

The performance of the detention basins during the 100 year ARI storm event is presented in **Table 11**.

Table 11 – Basin Performance during 100 year ARI Storm Event from RAFTS

Basin	Basin Capacity (m^3)	Peak Storage Used (m^3)	Stage Capacity (m)	Peak Stage Used (m)
B1	15032	14334	1.1	1.05
B2	18092	17362	1.1	1.05
B3	9652	8975	1.1	1.05

The RAFTS modelling undertaken shows that the inclusion of peak flow attenuation structures will reduce the peak discharge associated with the post development conditions to rates equivalent or below the existing, pre development peak levels for all standard design recurrence events. To be conservative, no allowance has been made for the excess stormwater capacity available in rainwater tank storages.

3.4 STORMWATER CONTROLS/SITE DESIGN

3.4.1 Gross Pollutant Traps

Gross Pollutant Traps will be installed at the entry to each of the constructed wetlands. This will most likely be a proprietary product for the screening of heavy sediment and litter.

3.4.2 Peak Flow Management

Due to the flat site grades of finished surface levels post development, a large open channel swale drain has been designed into the development layout. This swale will be used for street drainage, drainage of the intersection and secondary flows during major storm events. The end of line treatment basins have been spread over the site to reduce the distances drainable for stormwater runoff. It will also be used for services.

3.4.3 Discharge

From **Figure 2**, there are three (3) existing discharge points from the site along the southern boundary. These are open channel farm drains continuing downstream of the site toward the Hunter River. Basins have been suitably located to have discharge outlets to these existing discharge points from the site, post development. Refer to **Figure 6**.

3.4.4 Fill Level

The site will be filled for development of the subdivision. This fill level will be to a level that is flood free. There are several options available to achieve this including filling to the peak 100 year recurrence regional flood level for the Hunter River, filling to the peak 50 year recurrence regional flood level, creating a levee bank along the downstream, southern boundary. There will be no impoundment of stormwater runoff upstream of the site as a result of the fill. Refer to **Figure 8**. This is described further in **Volume 2 - Concept Engineering, Services and Earthworks Report - Overall**.

3.4.5 Fill Quality

Geotechnical approval will be required on the fill type and its properties prior to being used on the site. This is because there can be potential impacts of leachates emanating from the fill and migrating downstream with stormwater runoff. Geotechnical advice has been provided, directing that granular material with particles not greater than 100mm diameter is preferred for use on the site. In particular, no ash is to be used for filling; due to its leachate potential. The fill to be used must be pH neutral and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. This will mitigate any potential impacts of runoff from the fill to the wetlands. This is described further in **Volume 2 - Concept Engineering, Services and Earthworks Report - Overall**.

3.5 SOIL AND WATER MANAGEMENT PLAN

Erosion and sediment controls, described in a Soil and Water Management Plan (SWMP) are necessary during construction for the protection of receiving waters downstream. Erosion and sediment control measures are temporary, and are required until such time that building and construction areas are landscaped, revegetated and sealed.

It is likely that the subdivision will be constructed in a number of stages. For the sediment basin calculations, it has been assumed that development will be an area of approximately 25 hectares. The sediment basin has been designed for settlement of Type F soils. To be conservative, a higher criteria level of protection has been adopted for the design sizing of the sediment basin(s), reflecting the sensitivity of the receiving waters downstream. "Managing Urban Stormwater: Mines and Quarries – Consultation Draft 2007" produced by DECC was referenced due to the scale of the site works. The 90th percentile rainfall event is the standard for mines and quarries. It is also described that 2-5 day rainfall events are suitable criteria for well managed sites in which prompt action can be guaranteed. At this site the 95thpercentile, 5 day rainfall event has been selected, which is approximately 3 times the storage volume of that generated by using the 75th percentile, 5 day rainfall event typically used for development sites. This gives the basin an increased capacity, capturing runoff from a greater number of storm events. This minimises the potential risk of sediment laden water leaving the site and discharging to the wetlands downstream during construction.

For a 25 hectare stage of the site, a sediment basin sized in accordance with "*Managing Urban Stormwater Soils and Construction*" (Blue Book) 4th Edition, Volume 1, March 2004 produced by Landcom, will be approximately 9,757m^3, refer to **Appendix B**. This sediment basin quantity however would be apportioned between the constructed wetland and a number of smaller intermediate dams for greater control of runoff during construction. Further details of the layout of sediment dams will be determined during the detailed design phase, in conjunction with the bulk earthworks strategy. Refer to **Figures 9** and **10**.

3.5.1 Erosion and Sediment Control

Erosion and sediment control measures to be implemented during construction include:

1) Disturbance only of areas to be immediately worked on and regeneration of dust and erosion free surfaces – landscaping, concrete, bitumen sealing as soon as practical thereafter.

2) Provision of and continued maintenance of sediment fencing to low perimeter locations.

3) Provision of mesh and gravel or geotextile inlet filters.

4) Contract specifications requiring stabilised site access, low flow earth flow earth banks and wind erosion screens.

5) A construction programme that provides for the sediment basin to be constructed at the outset with all site runoff, where practical, piped or channelled to this basin for primary treatment/settlement before leaving the site via a mesh supported geotextile filter/riser before discharging to the wetlands. Refer to **Figure 10**.

6) Contract specifications requiring regular maintenance of all erosion and sediment control structures and devices for the full contract and maintenance period.

3.5.2 Land Disturbance Conditions

Where practicable the soil erosion hazard shall be kept as low as possible. Limitations to access are to be in accordance with **Table 14**.

Table 14 – Land Use Limitations

Land Use	**Limitation**
Access Areas	Access is to be limited to the designated all weather roads.
Truck Wash Down Bay	Any truck exiting out of the site shall be thoroughly cleaned and limit the exportation of clay and sediment on public roads.
Remaining Lands	Entry is prohibited to remaining land.

3.5.3 Construction Sequence

Works shall be undertaken in the following sequence prior to the commencement of bulk earthworks:

1) Install sediment fencing and cut drains to meet the requirements of the SWMP. Waste collection bins shall be installed adjacent to site office.

2) Construct stabilised site access in location nominated by the Contractor and in accordance with Port Stephens Council's requirements.

3) Construct sediment basins for disturbed areas in accordance with the rate per hectare provided in the SWMP. Install risers and two pegs in the floor of the basin and have them marked to show the top of the sediment storage zone. Ensure the basin is cleared of sediment once the design capacity is reached.

4) Redirect clean water around the construction site.

5) Install sediment control protection measures at all natural and man-made drainage structures. Maintain until all the disturbed areas are stabilised.

6) Clear and strip the work areas in accordance with the Geotechnical advice in **Appendix M** of the **Application**.

7) Any disturbed areas, other than lot grading areas, shall immediately be covered with site topsoil within 7 days of clearing. Lot re-graded shall be covered with bitumen emulsion as specified.

8) Apply permanent stabilisation to site (landscaping).

3.5.4 Sediment Control Conditions

1) Proprietary sediment fencing shall be installed by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent to contain sediment fractions as near as possible to their source.

2) Sediment removed from any trapping device shall be relocated where further pollution to downslope lands and waterways cannot occur.

3) Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days they shall be stabilised by covering with mulch or with temporary vegetation.

4) Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor's approved SWMP.

5) Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated.

6) Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas.

3.5.5 Site Maintenance Requirements

1) Waste bins are to be provided for all construction refuse. They are to be emptied at least weekly and refuse is to be disposed in accordance with the site manager's recommendations.

2) The site manager shall inspect the site at least weekly and shall:

   (a) Ensure that all drains are operating effectively and shall make any necessary repairs;

   (b) Remove any spilled material from area subject to runoff or concentrated flow;

   (c) Remove trapped sediment where the capacity of the trapping device falls below 60%;

   (d) Inspect the sediment basins after each rainfall event and/or weekly. Ensure that all sediment is removed once the sediment storage zone is full (refer to pegs installed in basins in accordance with the SWMP). Ensure that outlet and emergency spillway works are maintained in a fully operational condition at all times;

   (e) Ensure rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate;

   (f) Construct additional erosion or sediment control works as may be appropriate to ensure the protection of downslope lands and waterways;

   (g) Maintain erosion and sediment control measures in a fully functioning condition at all times until the site is rehabilitated;

   (h) Ensure that the revegetation scheme is adhered to and that the all grass covers are kept healthy, including watering and mowing;

Remove temporary soil conservation structures as the last activity in the rehabilitation program.

Section 4.0 Compliance Checklist

This report, Volume 4, was focused on the stormwater management for the industrial subdivision.

It has been demonstrated in this report that the stormwater management system for the industrial subdivision has achieved the target objective of 'no impact', exceeding the requirements outlined in the most current DECC stormwater manuals and Council's development control plans. The stormwater management system also meets the requirements of the DGRs.

Compliance of the stormwater management system is addressed in the report as follows:

- The quality and volumes of stormwater runoff post development, to the wetlands downstream have been matched to pre development levels. This was achieved and demonstrated by modelling with MUSIC. This is described in detail in **Sections 3.2**.

- The quantity, peak flows, of stormwater runoff to the wetlands downstream with peak flow attenuation. The targets for modelling was to design attenuation storage so that post development peak flows were limited to pre development peak flow levels. This was achieved and demonstrated by modelling with XP Rafts for all standard recurrence intervals. This is described in detail in **Section 3.3**.

- A higher level of protection against runoff to the wetlands downstream has been designed in the Soil and Water Management Plan. This is described in detail in **Section 3.5**.

The treatment train configuration described in **Section 3.2** is only one solution to demonstrate that the water quality objectives of 'no impact' can be achieved. There are several solutions that could also be used to achieve the same target objective. This would include different combinations of controls, for example varying the assumptions of water usage, tank sizes and the size of constructed wetlands. Redlake Enterprises Pty Ltd may choose to vary the water quality design in the future to suit different needs, provided that the objectives remain the same.

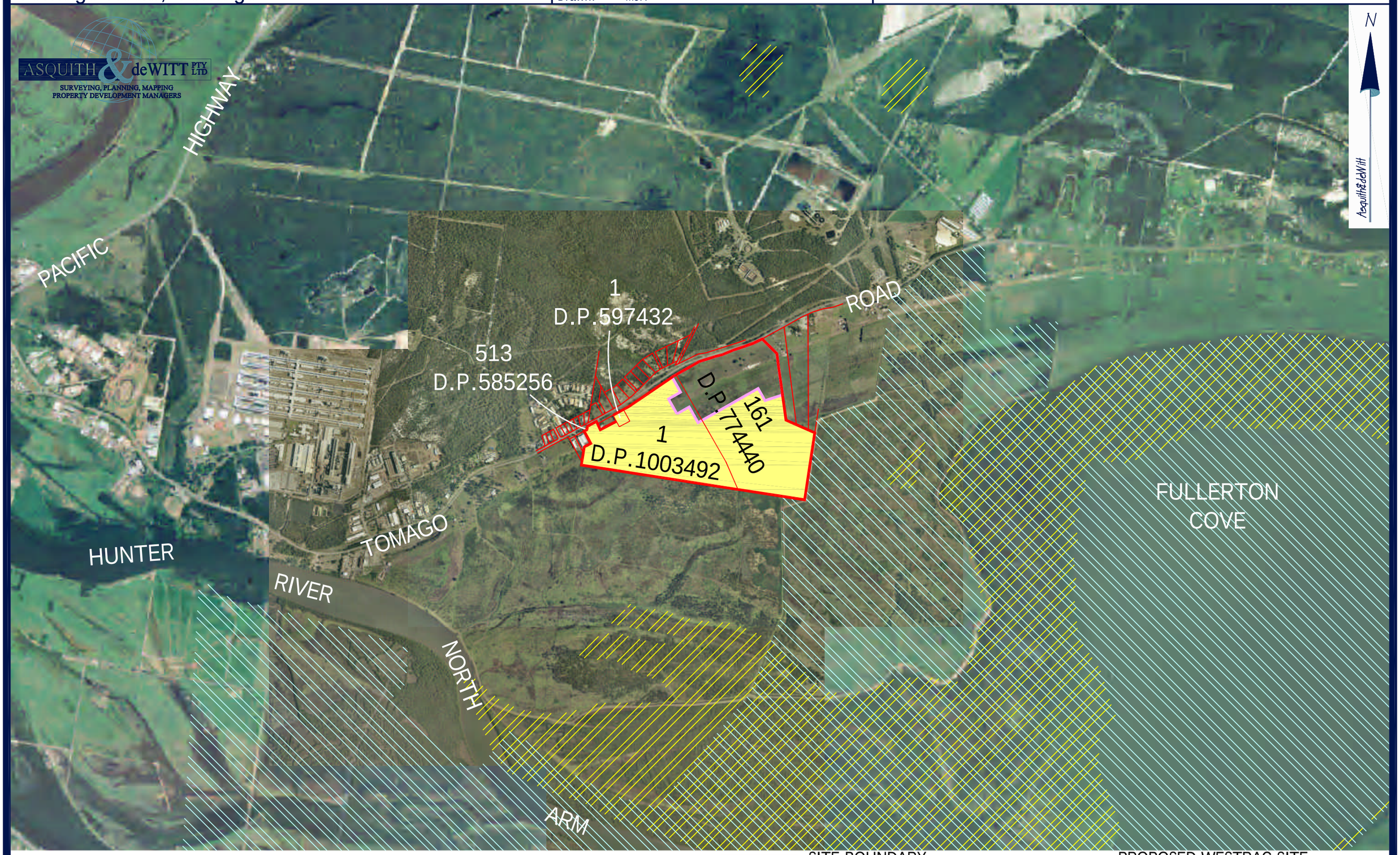
Appendix A – Figures

Plan of Industrial Subdivision
Tomago Road, Tomago

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0 100 200 300 500 1000 2000 3000

Bar Scale 1: 25000 (A1), 1: 50000 (A3)

SITE BOUNDARY
SURROUNDING BOUNDARIES
INDUSTRIAL SUBDIVISION
SEPP 14 WETLAND AREA
RAMSAR WETLAND AREA
PROPOSED WESTRAC SITE

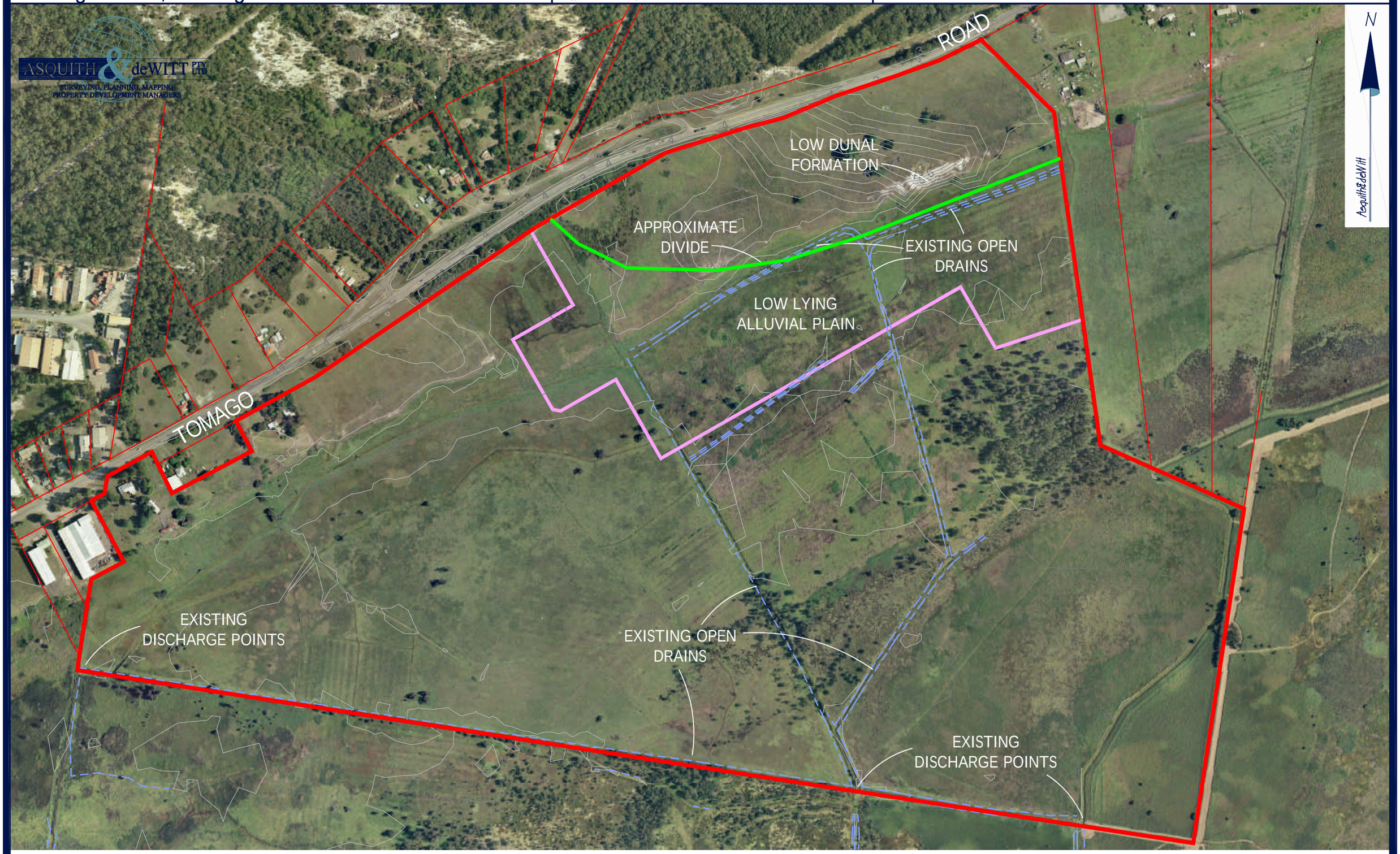
FIGURE 1
SITE LOCATION

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Tomago Road, Tomago

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- SITE BOUNDARY
- SURROUNDING BOUNDARIES
- OPEN DRAIN
- WESTRAC BOUNDARY

0 20 40 60 80 100 200 300 400 600

Bar Scale 1: 5000 (A1), 1:10000 (A3)

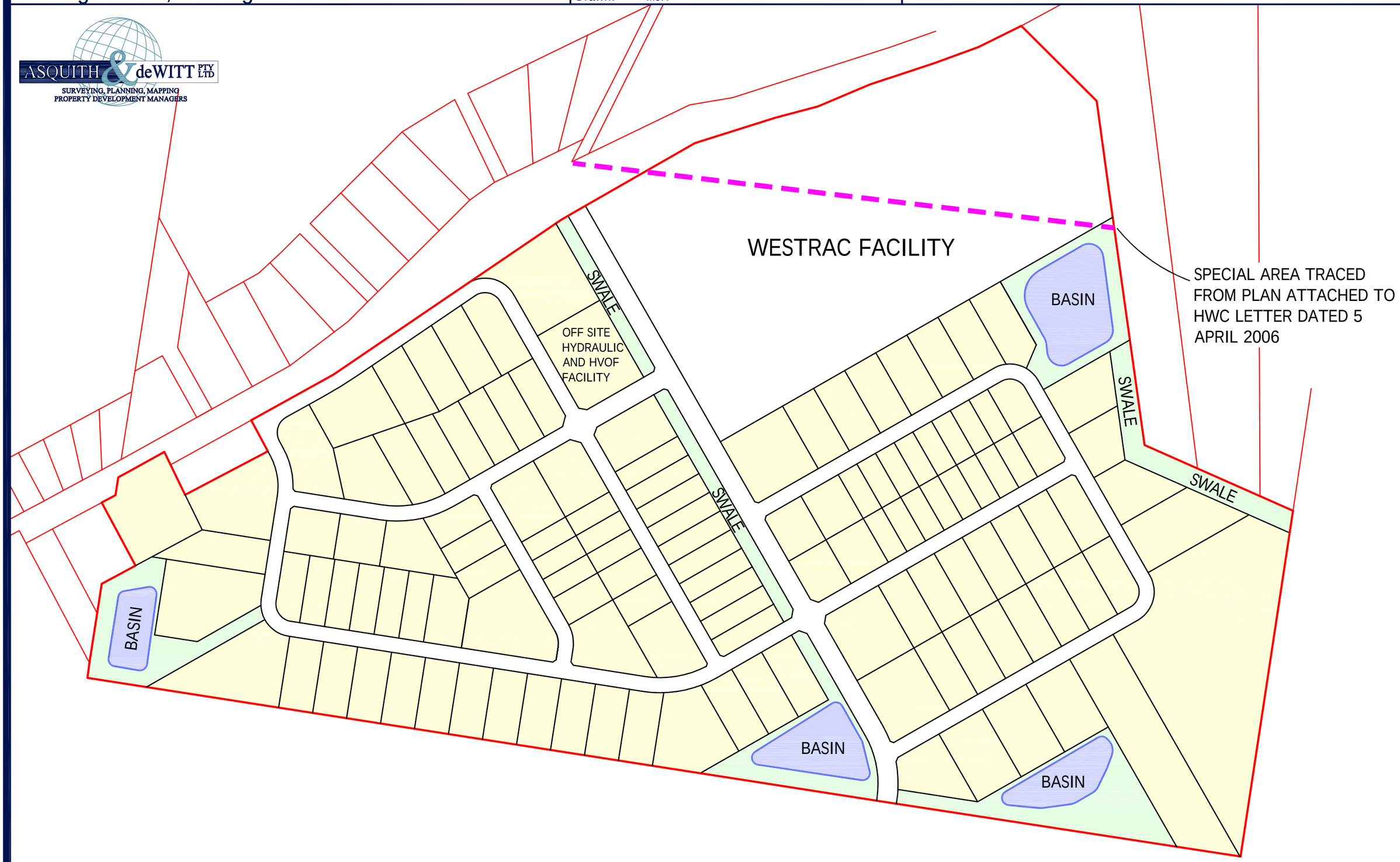
FIGURE 2
EXISTING SITE

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SITE BOUNDARY
PROPOSED BOUNDARIES
SPECIAL AREA

0m 50 100 200 500
Bar Scale 1: 5000 (A3)

FIGURE 3
DEVELOPMENT LAYOUT

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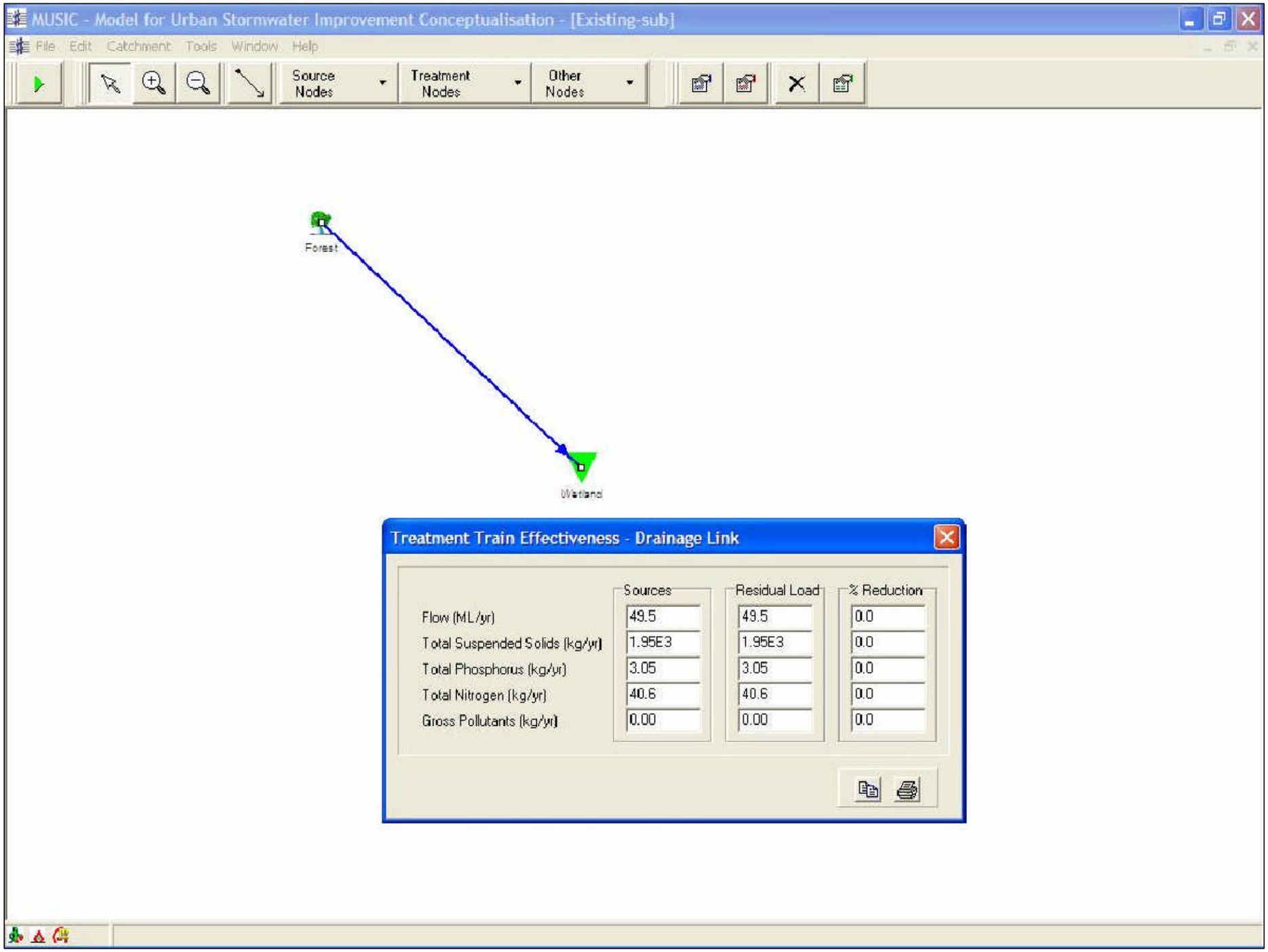


FIGURE 4
MUSIC LAYOUT
EXISTING

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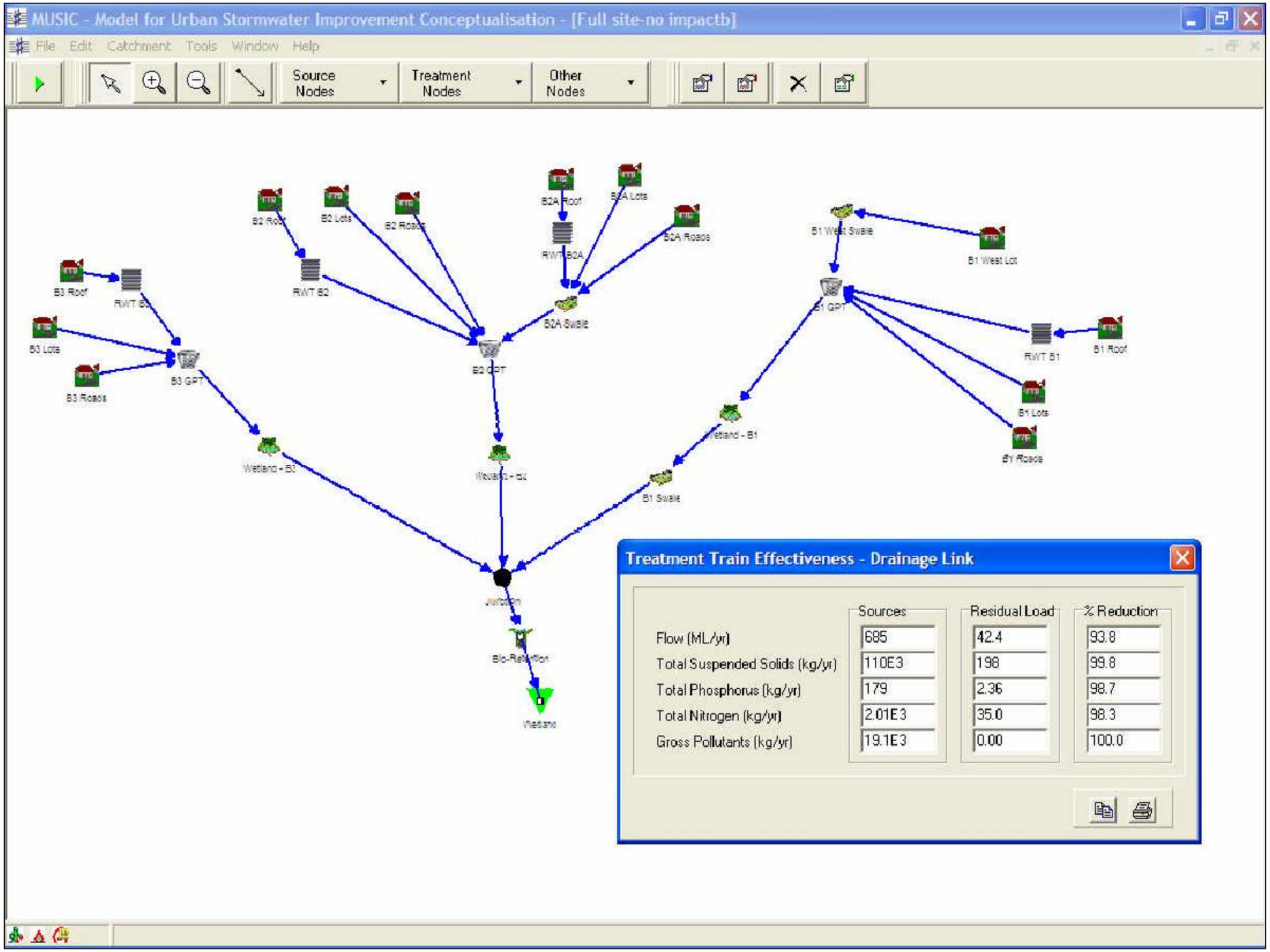


FIGURE 5
MUSIC LAYOUT
POST DEVELOPMENT

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N

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ROAD

TOMAGO

WESTRAC FACILITY

SWALE

SWALE

SWALE

SWALE

BASIN 1

OVERFLOW

BASIN 3

BASIN 2

BASIN 2

TOP

TOE

FILL

DISCHARGE POINT
(SAME AS EXISTING)

DISCHARGE POINT
(SAME AS EXISTING)

CULVERT CONNECTION
UNDER ROAD LINKING BASINS

DISCHARGE POINT
(SAME AS EXISTING)

BIORETENTION
GROSS POLLUTANT TRAP
'NO IMPACT' BASIN SIZE
CATCHMENT BOUNDARIES

0m 50 100 200 500

Bar Scale 1: 5000 (A3)

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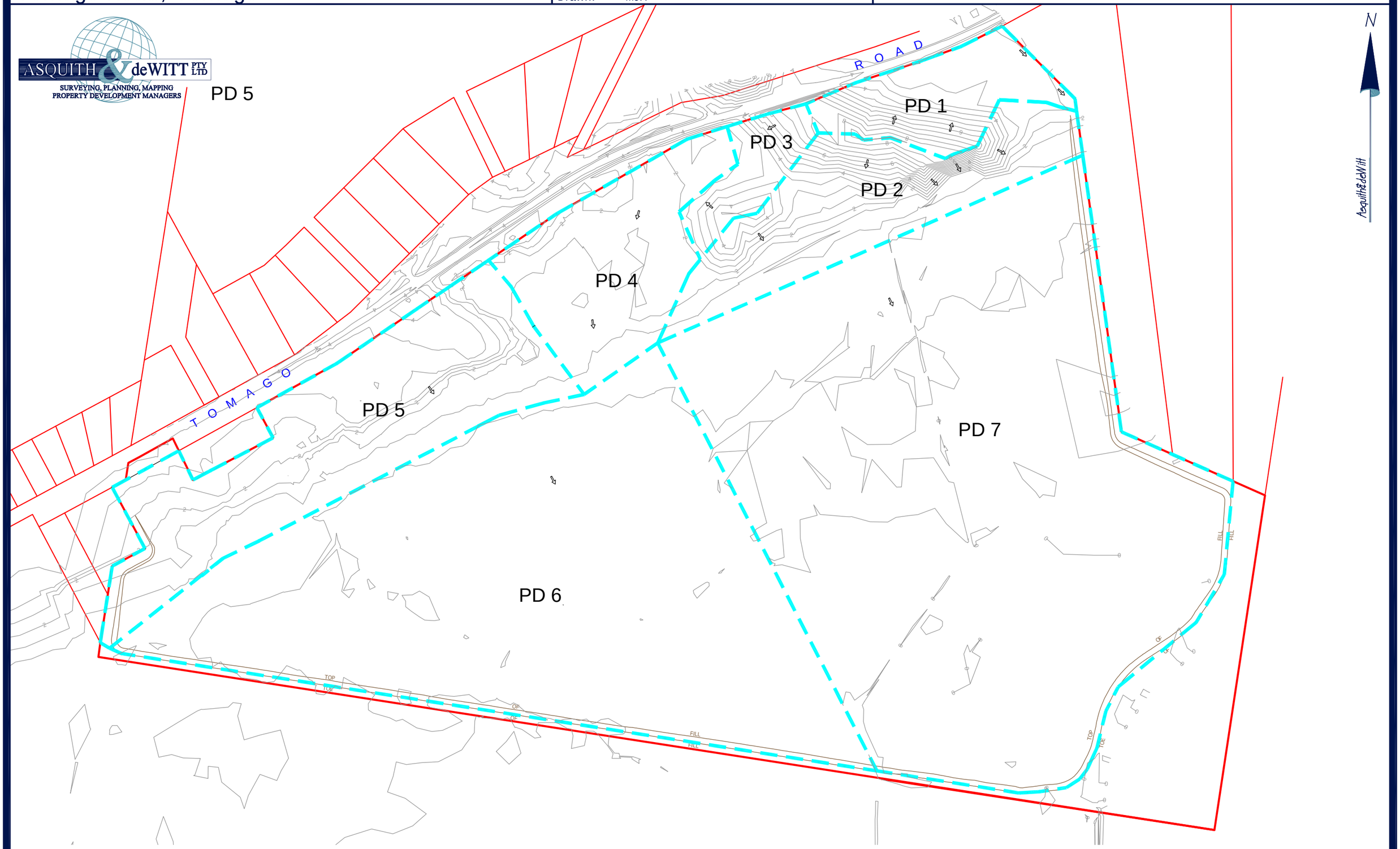
FIGURE 6
TREATMENT TRAIN LAYOUT

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CATCHMENT BOUNDARIES

0m 50 100 200 500

Bar Scale 1: 5000 (A3)

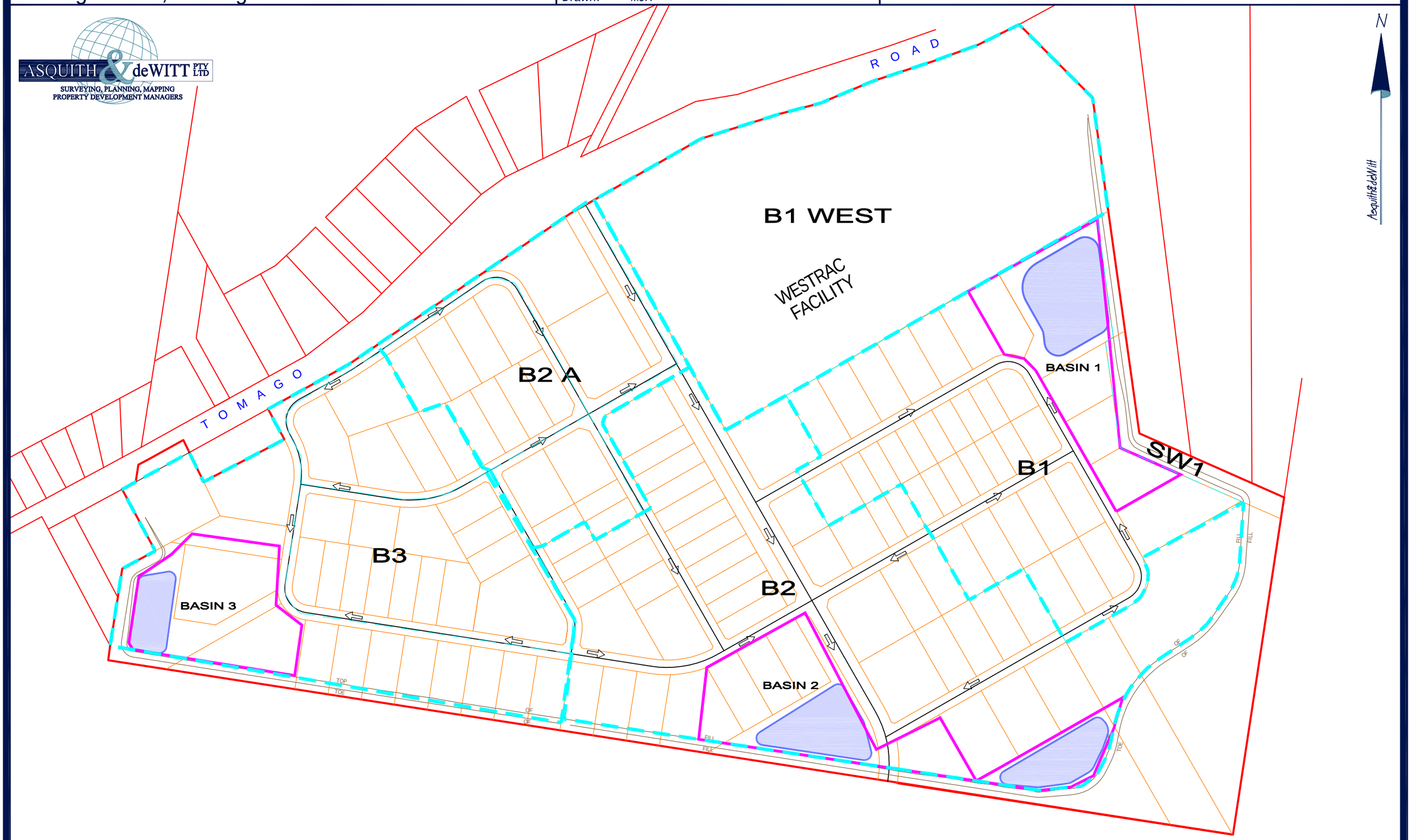
FIGURE 7
STORMWATER CATCHMENTS SITE PRE-DEVELOPMENT

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CATCHMENT BOUNDARIES
'NO IMPACT' BASIN SIZE

0m 50 100 200 500
Bar Scale 1: 5000 (A3)

FIGURE 8
STORMWATER CATCHMENTS SITE POST-DEVELOPMENT

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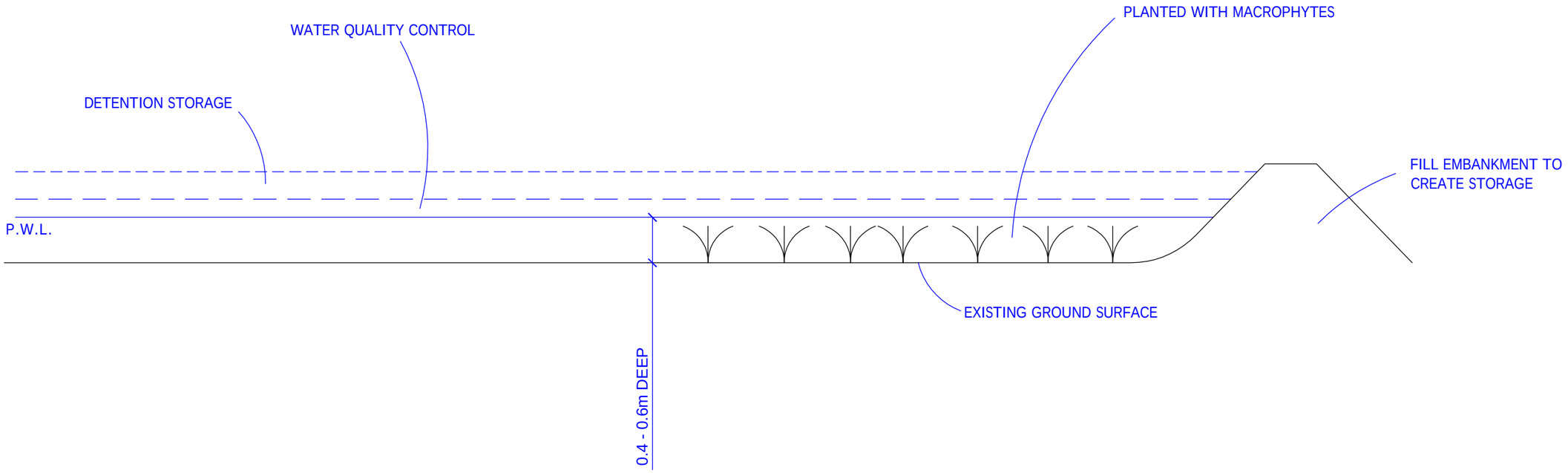


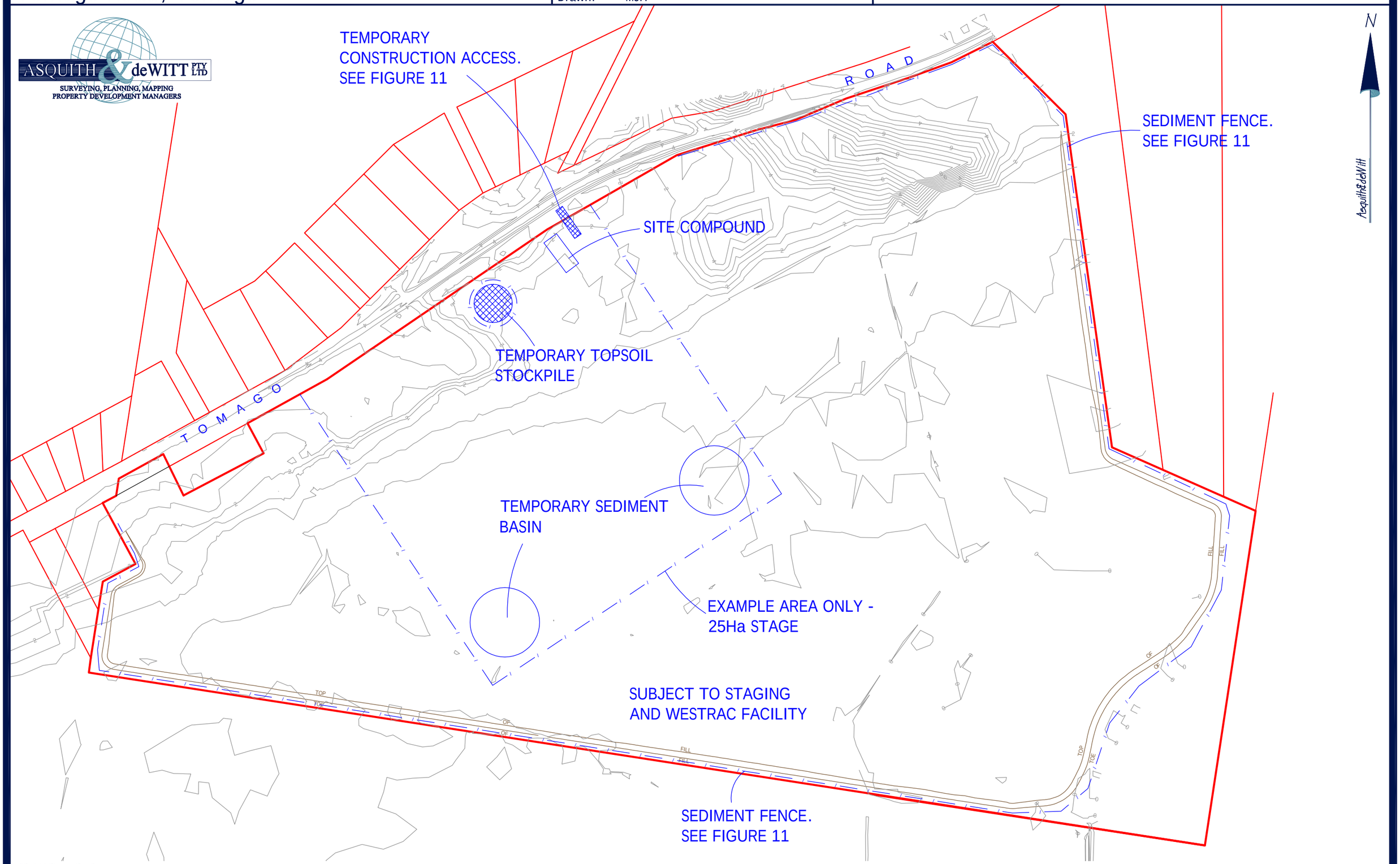
FIGURE 9
TYPICAL BASIN SECTION OF CONSTRUCTED WETLAND

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0m 50 100 200 500

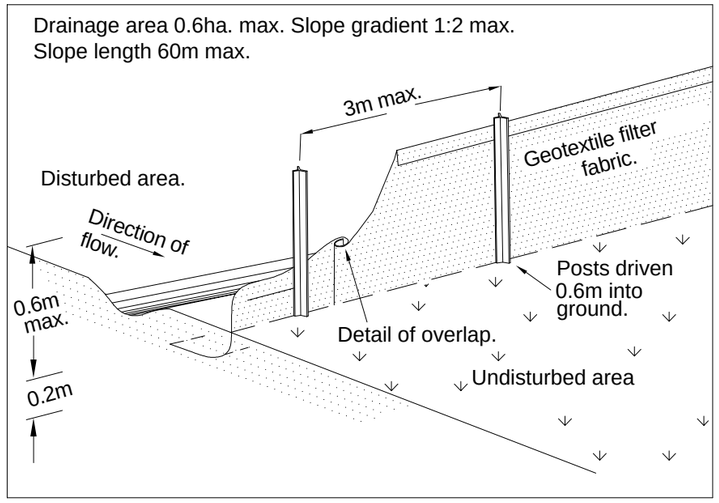
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FIGURE 10
SOIL AND WATER MANGEMENT

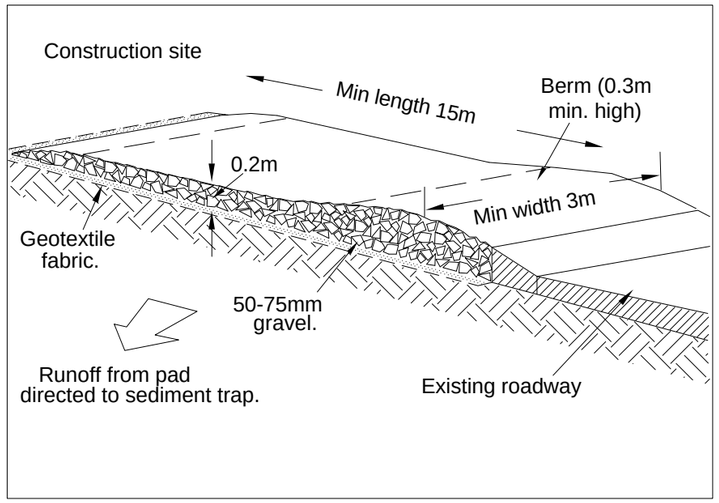
Plan of Industrial Subdivision
Tomago Road, Tomago

Date:	November 2007
Version:	A (November 2007)
Drawn:	MJH
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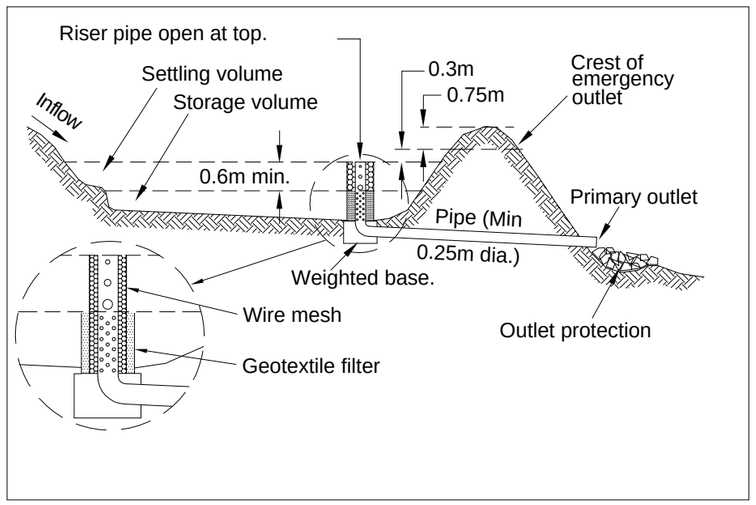
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SEDIMENT FENCE



TEMPORARY CONSTRUCTION ACCESS



BASIN RISER

NOTES

(a) Upon completion of final earthworks or after written direction of Council, immediate soil conservation treatments shall be applied so as to render areas that have been disturbed, erosion proof in 30 days.

(b) All perimeter and siltation control measures are to be the first step in clearing or earthworks.

(c) The area over all stormwater and sewer lines not within the roads are to be strip turfed on the contour as soon as possible but no later than 7 days after backfill. Max spacing of strip turf to be 4 metres

(d) No more than 150 metres of trench are to be open at any one time.

(e) Areas over electricity, telephone and gas supply trenches are to be seeded and mulched as soon as possible, but no later than, 7 days after backfill.

(f) All temporary earth berms, diversion and sediment basin embankments are to be track rolled and seeded or mulched for temporary vegetation cover as soon as they have been formed.

(g) All fills are to be left with a windrow at least 200mm high at the top of the slope at the end of each days earthworks, and all earthwork areas shall be rolled each evening to "seal" the earthworks.

(h) All final erosion prevention measures, including establishment of grassing, are to be completed prior to the subdivision final inspection.

(i) A strip of turf is to be placed immediately behind the kerb and gutter on all new roads and at any additional locations determined by Council's Supervising Officer.

(j) All topsoil is to be stockpiled on site for re-use (away from trees and drainage lines). Measures shall be applied to prevent erosion from the stockpiles.

(k) Establishment of fire breaks shall be carried out in consultation with the Fire Control Officer and Council's Environment Officer.

(l) Temporary sand bag sediment traps are to be placed at each drainage pit. Sand bags are to be used to construct temporary sediment traps at each kerb inlet.

(m) All disturbed areas are to be stabilised and/or revegetated within 14 days of earthworks completion, using turf or the following seed and fertilizer mixture:

	SPRING/SUMMER	AUTUMN/WINTER
Japanese Millet	10kg/Ha	
Ryecorn/Oats		15kg/Ha
Couch Grass	10kg/Ha	8kg/Ha
Perenial Grass	5kg/Ha	10kg/ha
Starter Fertilizer (Sowing)	300kg/Ha	300kg/Ha
Maintenance Fertilizer	100kg/Ha	100kg/Ha

FIGURE 11
STANDARD EROSION AND SEDIMENT CONTROLS

Appendix B – Sediment Basin Calculation

Site: Tomago			
Industrial Subdivision - Stage			
Description		Typical Value	
Catchment Site Area (hectares)	25		Sample Stage
Type F/D			
Settling Zone			
Runoff Coefficient, Cv	0.5	0.5	
95th%ile, 5 day Rainfall Event	76.7		Table 6.3a, pg 6-24
Settling Zone Volume	**9588**		m3
Sediment Zone			
Disturbed site Area (hectares)	25		
Rainfall Erosivity Factor, R	2500		Appendix B, Newc B-11
Soil Erodibility Factor, K	0.059		Appendix A, Figure A3
Slope Length Gradient Factor, LS	0.27		Table A1, pg A-9
Erosion Control Practice Factor, P	1.3	1.3	Table A2, pg A-11
Cover Factor, C	1	1	Figure A5, pg A-12
Sediment Zone Volume	**169**		m3
Total Storage required			
Settling + Sediment	**9757**		m3

Appendix G

TRAFFIC REPORT

Better Transport Futures

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering

Proposed Industrial Development Tomago, NSW

Redlake Enterprises Pty Ltd

Traffic Impact Statement

September 2007

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1. Executive Summary

Better Transport Futures was commissioned by Asquith & de Witt on behalf of Redlake Enterprises Pty Ltd to prepare a Traffic Impact Statement for a proposal to develop industrial land on Tomago Road at Tomago NSW. The proposal includes development of industrial uses and a heavy machinery equipment centre. The work is required as part of the approvals process for the site.

Site Location

The subject site is located on Tomago Road approximately 5 kilometres east of the Pacific Highway at Tomago NSW. Site access is available to Tomago Road, Main Road 302 in the RTA state road network. The site is adjacent to the existing Tomago industrial estate, which includes the Tomago Aluminium Smelter. Heavy vehicles are therefore part of the existing road traffic mix.

Existing Situation

Current road operations on the key road links, Tomago Road and Pacific Highway are within satisfactory operating levels for urban road conditions. The intersection of Tomago Road and Pacific Highway currently experiences significant queuing problems and plans are being developed now for an immediate upgrade by the RTA.

Road Network Planning

RTA has recently released its preferred option for a major bypass of the section of Pacific Highway at Tomago, as part of the proposed F3 extension to the Pacific Highway at Heatherbrae. This project has the potential to significantly change traffic flows in the area, to the extent that the nature of upgrading of the junction of Tomago Road and Pacific Highway may be simplified. The preferred route includes the potential for an interchange with Tomago Road.

The Development Proposal

A staged development is being considered for the site, in 3 parts. The separate parts of the stages are:

Stage1 – WesTrac Facility, Administration, Machinery Sales, Workshops, Parts Warehouse and Distribution, Machinery Storage

Stage1 – CAT Institute, Apprentice Training, WesTrac Universities and other educational facilities

Stage2 – Industrial Park, general industrial business activity, unrelated but possibly aligned.

Stage3 – Industrial Park, general industrial business activity, again unrelated but possibly aligned.

Potential Traffic Impacts

Forecast traffic flows based on standard RTA guidelines for traffic generating developments indicate that the proposed seagull priority controlled intersection has adequate capacity to cater for the future flows associated with the proposed development.

The procedures and issues associated with transport of oversize loads have been reviewed as part of the traffic assessment process. The site and its operations are able to utilise the existing arterial road system through application of the RTA procedures for transporting over dimension loads.

There are other development opportunities within the Tomago area and along Tomago Road and Cabbage Tree Road such as the Williamtown Airport and other development lands (such as held by RLMC) that will potentially contribute to any long term requirement for upgrading of this road corridor.

Conclusion

The conclusion from this investigation is that the proposed seagull priority controlled intersection has adequate capacity to cater for the future flows associated with the proposed development and that these flows can be accommodated on Tomago Road. It is recommended that the development be approved on traffic and access grounds.

2. Introduction

Better Transport Futures was commissioned by Asquith & de Witt on behalf of Redlake Enterprises Pty Ltd to prepare a Traffic Impact Statement as part of the approvals process for a proposal to develop industrial land on Tomago Road at Tomago NSW. The proposal includes development of industrial uses and a heavy machinery equipment centre.

This report presents the findings of the traffic investigations and assessment of the proposal. It is structured as follows:

- **Chapter 2** outlines the existing situation in the vicinity of the subject site, including discussion on the planned development growth within the vicinity and road network changes to support it.

- **Chapter 3** describes the traffic and parking features of the proposal, access arrangements and how these can meet Council's and road authority guidelines.

- **Chapter 4** details the assessment of traffic and road network operations related to the proposal

- **Chapter 5** summarises the findings of this investigation, outlining conclusions and recommendations for the traffic operations of the site to support the development application for the proposal.

3. Existing Situation

3.1 Background and Site Location

The subject site is located on a parcel of land to the south of Tomago Road in the general vicinity of Tomago. It is located approximately 5 km east of the intersection of the Pacific Highway and Tomago Road. The site has direct frontage to Tomago Road and is bounded by the wetlands area around Fullerton Cove to the east and the Hunter River to the south and west. The site is currently vacant and has been used for grazing land in the past.

The site location within its regional context is illustrated in **Figure 2.1** below.



Figure 2.1 – Site Location and Regional Context

3.2 Local Road System

3.2.1 Road Characteristics

Tomago Road is a classified main road, MR 302. In the vicinity of the site it is configured as a single lane of travel in both directions. While Port Stephens Council is the road authority under the Roads Act 1993, any works on or adjacent to the road will require consent from the Roads and Traffic Authority of NSW (RTA) in its role as the state government agency responsible for the state and main road network of NSW. Any new access required by the development or any impact upon the main road network will require the consent of the RTA.

Tomago Road corridor (which incorporates Cabbage Tree Road) provides an overall width in the order of 7.5 metres. For the majority of its length it provides a sealed shoulder to both sides, suitable for use by cyclists. Its alignment is varied, but generally it provides a good standard of road with a wide road reserve offering good visibility for the majority of its length. The road is mainly rural in its constructed form. There are no footpaths provided along the majority of its length and there are soft verges beyond the sealed shoulders along its entire length. The posted speed limit varies between 60 km/h at its eastern end and approach to the roundabout junction with Nelson Bay Road at Williamtown

to 80 km/h for the remainder of its length. Street lights are only provided in a number of limited areas, to illuminate intersections.

Tomago Road connects at its western end with the Pacific Highway via a seagull type T intersection. The road changes name to become Cabbage Tree Road at the intersection with Masonite Road, through to its junction at Nelson Bay Road. The Cabbage Tree Road / Nelson Bay Road intersection is controlled by a 4 way, 2 lane roundabout.



Photo 1 - View West along Tomago Road showing typical road alignment and characteristics.

There are a number of accesses to property along the length of the road, varying from simple driveways for individual residential lots to large intersections providing access to major industrial sites such as the Tomago Aluminium Smelter. The larger intersections provide sheltered right turn lanes as well as left turn deceleration lanes.

The Pacific Highway to the west of the site provides the major road link north and south along the east coast of Australia. At its intersection with Tomago Road, it provides two travel lanes in both directions with shoulders to both sides. There is a central median separating the opposing traffic streams with safety barrier located in a number of locations. It has a posted speed limit of 100 km/h at its intersection with Tomago Road and there are no footpaths provided. There are soft verges to both sides and wide kerb side shoulders that can be used by cyclists. The Pacific Highway is classified as a State Road (SH9) and as such any new works proposed along its length need approval from both the Council (as consent authority) and the RTA.

The Pacific Highway to the south of Tomago Road travels over the Hunter River. The southbound movements make use of the older steel truss bridge (built between 1945 and 1952) whilst the northbound traffic users the more recently concrete bridge. The southbound bridge has a height restriction of 5.2 metres. The northbound bridge is a reinforced concrete bridge providing high clearance over the river (built in 1987).



Photo 2 – View south showing the southbound steel truss bridge over the Hunter River.

To the east of the site, Tomago Road connects with Nelson Bay Road via Cabbage Tree Road. Nelson Bay Road provides an important connection between Newcastle to the south and the Port Stephens peninsula to the north. It also provides access to Williamtown Airport, a major Australian Defence Force Facility, and also Newcastle's commercial airport operations. It provides a combination of single and dual lanes in both directions, with a number of roundabouts located along its length. The speed limit varies form 60 km/h in the built up areas through to 80 km/h and 100 km/h in some sections. Nelson Bay Road is classified as a Main Road (MR108) and as such any new works proposed along its length need approval from both the Council (as consent authority) and the RTA.

Nelson Bay Road provides a connection to the major industrial centre of Newcastle on Kooragang Island and the banks of the Hunter River via Industrial Drive. It also provides a strategically important connection to greater Newcastle and the major road network for the Port Stephens area. Nelson Bay Road connects to the Tourle Street Bridge over the Hunter River south arm via cormorant Road and the Stockton Bridge over the Hunter River North arm. The south arm river crossing of the Hunter River is via a 2 lane steel truss bridge, providing a single lane of travel in each direction.



Photo 3 – View north over the bridge on Tourle Street over the Hunter River south channel.

The Tourle Street Bridge provides a narrow overall width in the order of 7.5 metres as well as a height restriction of 5.8 metres.

3.3 Traffic Volumes

3.3.1 Peak Hour Traffic Volumes

As discussed above, traffic volume data for the project has been collected during a survey of traffic movements along both the Pacific Highway and Tomago Road. The surveys were completed on Monday 13th February and Tuesday 14th February 2006.

The results from the traffic survey indicate that during the surveyed morning peak period (7.30 to 8.30 AM) the two-way traffic flows along the Pacific Highway to the south of Tomago Road were approximately 2,900 vehicles. The flows were reasonably evenly split, with 1440 vehicles northbound (49%) and 1,483 vehicles southbound. The majority of vehicles were light vehicles. There were in the order of 10% of the traffic flow observed as heavy goods vehicles during the survey period.

The corresponding afternoon traffic survey showed that the peak hour flow between 4.30 and 5.30 PM was approximately 3,100 vehicles per hour two way. Again, the vast majority of traffic was light traffic with a heavy goods vehicle content of close to 10%. The traffic flows were pretty evenly split between northbound and southbound, with 1,577 vehicles southbound (50.7%).

The two-way flows along Tomago Road were much lower. During the morning peak the two-way flow was 738 vehicles and the afternoon flow was 872 vehicles. During the morning peak, the dominant flow was eastbound, associated with the industrial users located along Tomago Road whilst the dominant flow during the afternoon period was westbound towards the Pacific Highway.

A traffic survey was also completed on Tomago Road to the east of McIntyre Road, to obtain the two-way traffic flow along Tomago Road to the east of the industrial users accessing Tomago Road. This survey was completed during both the morning and afternoon peak periods.

The results of the survey are summarised in **Table 2.1** below, with full details of the survey provided in **Appendix A** to this report.

Table 2.1 – Traffic Volumes

Road	Location	Direction	Mid-Block Road Capacity[2]	AM Peak hour Volumes[1]	PM Peak Hour Volumes[1]	Volume/ Capacity (AM)	Volume / Capacity (PM)
Pacific Highway	To south of Tomago Rd	Northbound	2800	1440	1531	0.51	0.55
Pacific Highway	To south of Tomago Rd	Southbound	2800	1483	1577	0.53	0.56
Tomago Road	To east of Pacific Hwy	Eastbound	1400	464	201	0.33	0.14
Tomago Road	To east of Pacific Hwy	Westbound	1400	274	671	0.20	0.48
Tomago Road	East of McIntyre Rd	Eastbound	1400	169	164	0.12	0.12
Tomago Road	East of McIntyre Rd	Westbound	1400	196	226	0.14	0.16

Notes: 1. Peak flow from September 2004 traffic survey results by Better Transport Futures
2. RTA 2002, Urban Road Conditions Level of Service E, from Table 4.4 of the RTA Guide to Traffic Generating Developments.

The application of Level of Service E for planning thresholds used in Table 2.1 has been applied recently in developments such as the Thornton North Release area as well as by the RTA in its evaluation of the replacement of the Tourle Street Bridge. This threshold is used to determine existing performance and the extent of potential upgrading required on the road network, both local and RTA

controlled roads. It takes into consideration the type of road, it's mid block capacity as defined by Austroads including the extent of access, intersection and flaring that represents a higher general lane capacity that quoted in the RTA guide for mid block capacity.

Table 2.1 demonstrates that the Pacific Highway and Tomago Road are currently operating within their technical and functional capacity levels based on the stated urban road flow conditions, with the volume to capacity ratio indicating spare capacity. The Tourle Street Bridge currently being replaced by the RTA with a new 2 lane bridge has been recently recorded with peak directional flows of around 1518 vehicles per hour (northbound PM peak).

2.1.1 RTA Traffic Data

The relevant traffic data provided by the RTA is for the station number 05.592, which is located on Tomago Road to the east of the Pacific Highway as well as station number 05.001 located on the Pacific Highway to the north of the Hunter River bridge and south of Tomago Road.

2.1.2 Pacific Highway Traffic flows

The traffic data from the RTA count station is shown in **Table 2.2** below.

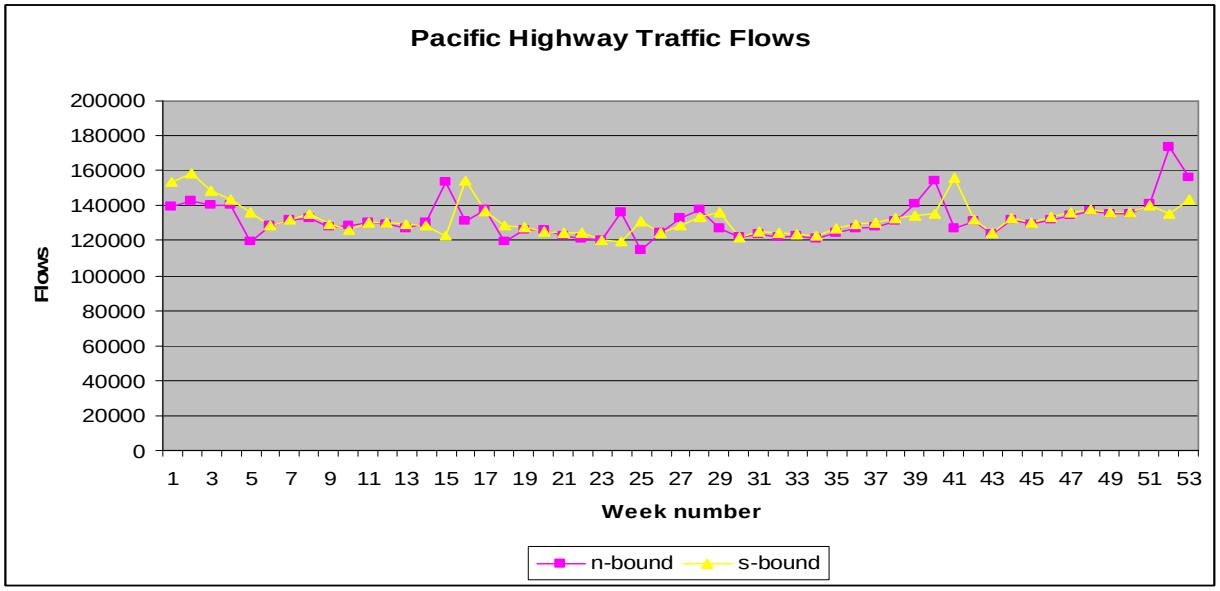
Table 2.2 – Traffic data for Pacific Highway (Station number 05.001)

Year	1984	1986	1988	1990	1992	1995	1998	2001	2004
AADT	18683	19227	21476	23762	25419	28104	31688	33275	37781
Growth		2.9%	11.7%	10.6%	7.0%	10.5%	12.7%	5.0%	13.5%

The above table shows that the traffic flows along the Pacific Highway continue to increase at a high rate. The average annual increase in flows is in the order of 5% per annum over the 20 year timeframe. The rate has been relatively steady, with the last 9 years of increase averaging just under the 5% level.

The RTA has also collected traffic flow data for Tomago Road. To the east of the Pacific Highway, the AADT for 2004 was 9343 vehicles. The traffic volumes along Tomago Road have doubled since 1984 (AADT 4770).

The weekly variation traffic data for flows along the Pacific Highway is presented in Graph 1 below.

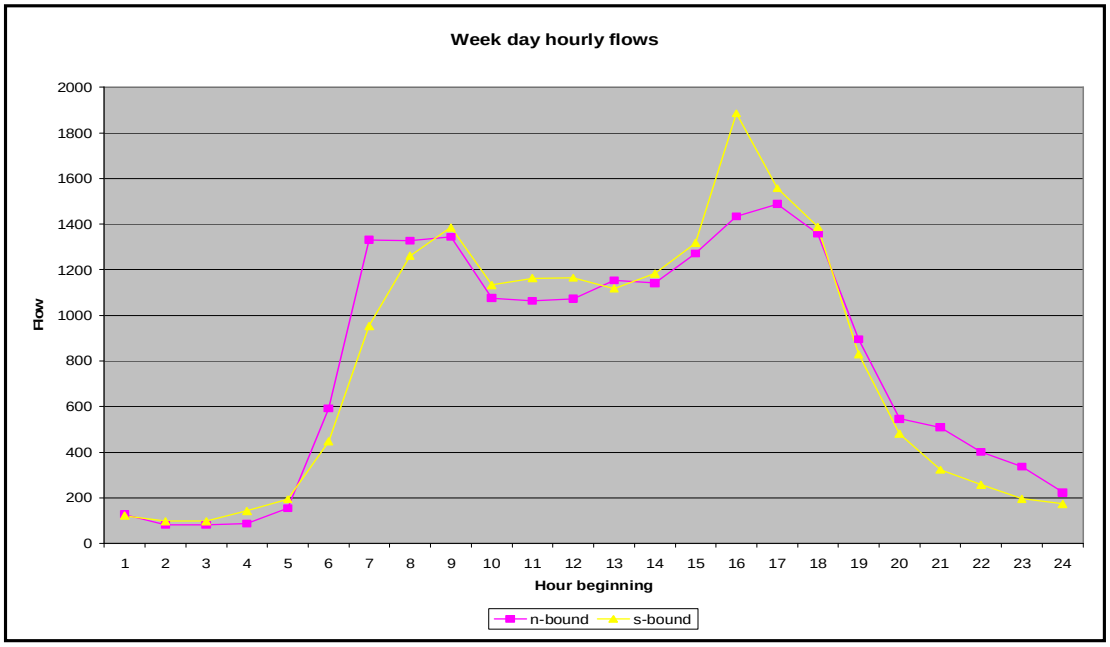


Graph 1 – Weekly variation in traffic flows on Pacific Highway

The graph above shows that there are a number of distinct peaks in traffic flows along the Pacific Highway during the course of a year, at the count station to the south of Tomago Road. These represent the peak demands during holiday periods when there are significant increases in traffic volumes along the Pacific Highway, for both northbound and southbound traffic flows.

2.1.3 Hourly variation in traffic flows along The Pacific Highway

The weekday hourly variation in traffic data for traffic flows along the Pacific Highway is presented in the Graph 2 below:



Graph 2 – Weekday hourly variation in traffic flows for Pacific Highway

From the graph above, it can be seen that there is a distinct peak in traffic flows during the afternoon peak, in particular the southbound traffic flow. This coincides with the survey periods completed as part of this project.

2.2 Intersection Controls

The intersection of the Pacific Highway and Tomago Road is controlled by a seagull type priority junction, with give way signs. Deceleration and acceleration lanes are provided in both directions for traffic entering and exiting Tomago Road. There is a wide central median with auxiliary lanes on the Pacific Highway that allows turning traffic to manoeuvre outside of the through lanes. The intersection provides good visibility in both directions and generally offers a safe and acceptable intersection control.

The RTA is currently completing an upgrade of the Pacific Highway and Tomago Road intersection having recently received funding approval from the Government. This is as a result of a history of significant queuing and a number of serious accidents associated with the speed limit at the intersection. The RTA have also highlighted that there are times currently when the right turn queue into Tomago Road extends beyond the existing length of the right turn bay on the Pacific Highway.

The intersection controls along Tomago Road are generally simple give way controlled intersections, with Tomago Road being the priority road. There is a roundabout serving access into the Tomago industrial estate, and the intersection of Cabbage Tree Road and Nelson Bay Road is controlled by a two lane circulating roundabout.

2.3 Road Network Improvements

2.3.1 F3 to Pacific Highway Link

One of the major road upgrades that could have an impact upon the subject development and in particular on the intersection of the Pacific Highway and Tomago Road is the proposed F3 to Pacific Highway at Raymond Terrace project. The RTA has recently published the preferred route from is investigations and consultation process as part of the planning for upgrading this link of the Pacific Highway. The options were on public display in late 2005. The next phase of the project is the preparation of an Environmental Impact Statement for the preferred route. Note that there is currently no date set for the construction of this road upgrade. The preferred route selected by the RTA is illustrated below.

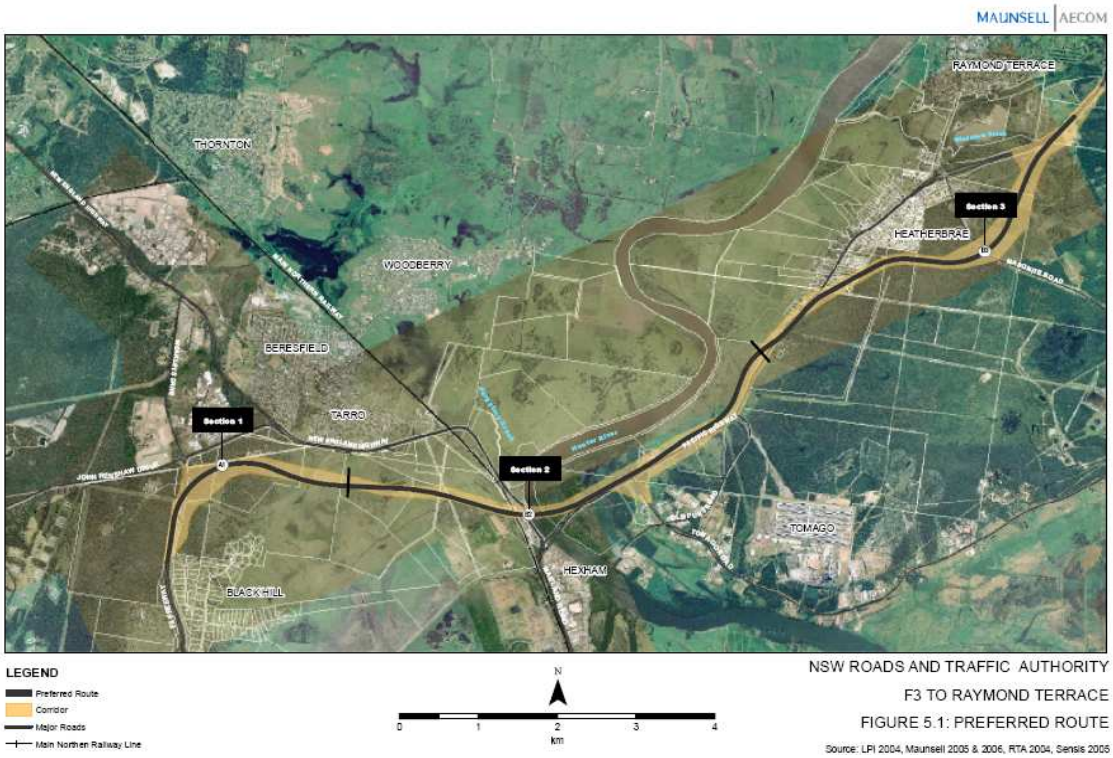


Figure 2.1 Proposed F3 to Raymond Terrace link
Source: Maunsell via www.RTA.com.au

It can be seen that this RTA project will have a significant impact on the longer term access arrangements to the Tomago locality. The route options for the have different local road connections to the bypass routes and consequently the extent of any road upgrading in the vicinity of the existing Pacific Highway / Tomago Road junction could vary significantly. This matter is discussed further in relation to the specific impacts of the subject site and current proposals under consideration.

2.3.2 Pacific Highway / Tomago Road Intersection

The RTA is currently upgrading the intersection of the Pacific Highway and Tomago Rd. Construction has been completed on the Old Punt Rd intersection with work underway at Tomago Rd.

The proposal, illustrated below, consist of installing traffic control signals and other traffic improvements at Tomago Road intersection with the Pacific Highway. The works will improve safety and traffic flow for road users.

The Tomago Road intersection upgrade includes following traffic:

- Installation of traffic control signals with provision for pedestrians.
- Provide paved area for cyclists.
- Provision of two right-turn lanes on the Pacific Highway for traffic turning into Tomago Road.
- Tomago Road widened to two lanes eastbound, near the highway
- Relocate bus stop facilities.
- Removal of the right-turn exit from Tomago Road to the Pacific Highway.

The Old Punt Road intersection upgraded has follows:

- Installation of traffic control signals.
- Provision of an improved left-turn lane from Old Punt Road to the Pacific Highway.
- Longer merge lane on the Pacific Highway from Old Punt Road.

The RTA has stated that these improvements will result in improved access to the Tomago industrial area and Newcastle airport, improved safety for vehicles/cyclists accessing the Pacific Highway and improved access for pedestrians and bus commuters on the Pacific Highway.

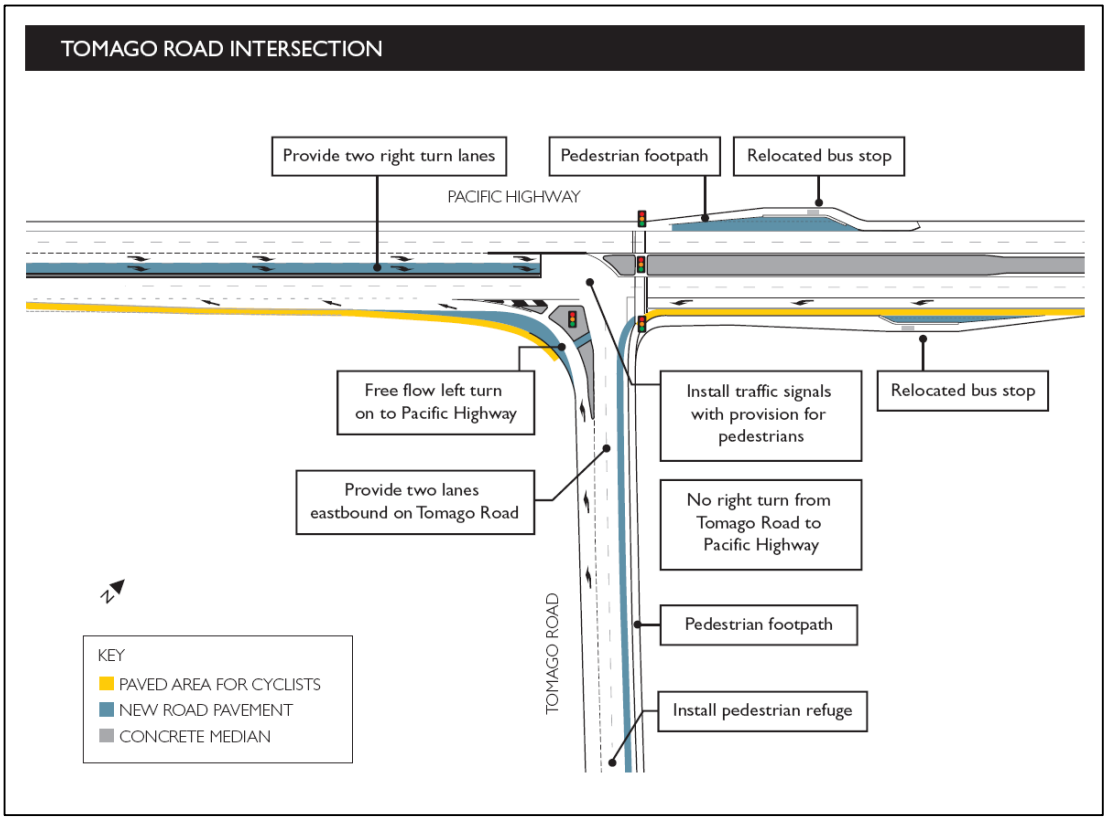


Figure 2.2 Pacific Highway Intersection Upgrades – Tomago Road intersection
Source: www.RTA.com.au

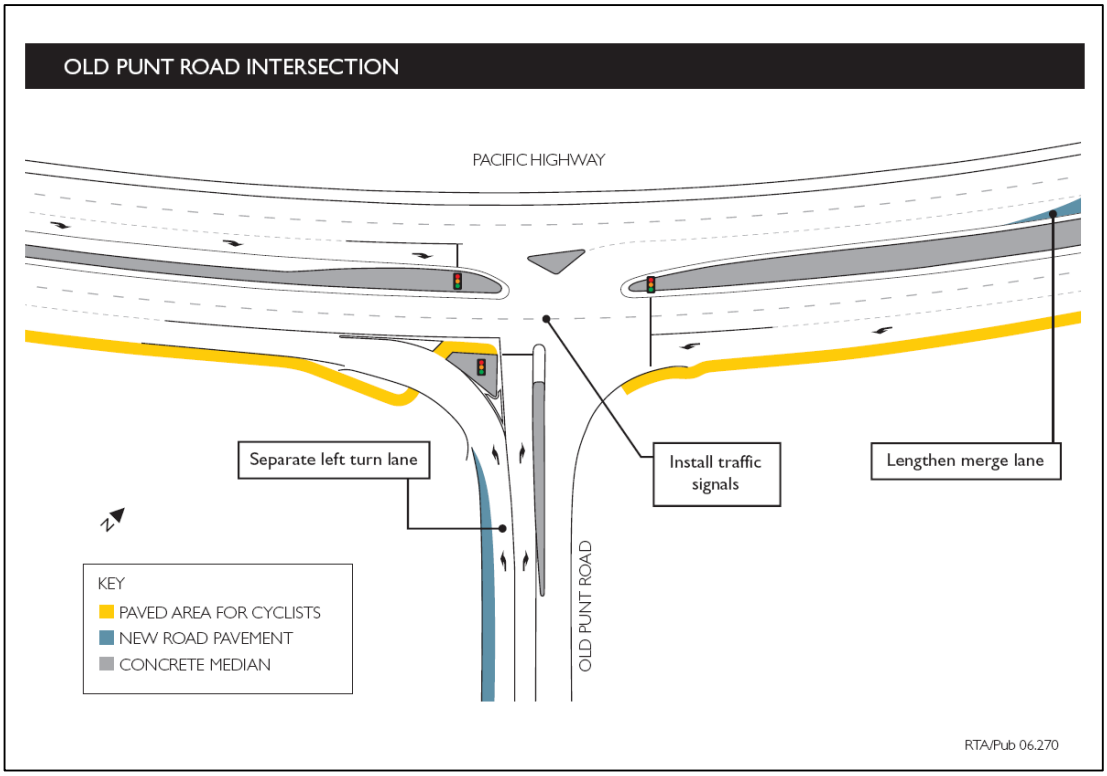


Figure 2.3 Pacific Highway Intersection Upgrades – Old Punt Road intersection
Source: www.RTA.com.au

It is understood there are no other major road network improvements planned in the vicinity of the subject site, apart from normal road maintenance performed by Council and the RTA.

2.4 Other known Development

The Tomago Industrial area has the potential to expand. There is potential for additional development in the area that will also have an impact on the existing operations of the road network. In addition to the Tomago area itself, there are plans for the Williamtown commercial airport to expand, with master planning currently underway. Whilst the particulars of individual development are not at hand at this time, it is important that these other activities are able to be considered so that any contributions towards improvements required to the road network are distributed in an equitable manner across all beneficiaries.

In recent times the RTA has required consideration of background growth in traffic flows representing a period of 10 years into the future. This figure can be variable depending on the extent of known or planned development. Where the level of development is not completely known (which is the case in most instances) the requirement is generally based on a projection of the historic growth rate for the part of the road network under investigation.

2.5 Public Transport, Pedestrians and Cyclists

Public transport in the vicinity of the site is limited. There are no known regular bus services to this location.

Cyclists are able to utilise the shoulders of the roadways in the vicinity of the site. During the survey period there was limited cyclists observed on both Tomago Road and the Pacific Highway.

During the survey period there were no pedestrian movements observed.

2.6 Approved B- double routes

The RTA has published a list of approved routes and roads for B-double access. All of the major roads in the vicinity of the site are approved for B-double use. These include the Pacific Highway, Tomago Road, Cabbage Tree Road and Nelson Bay Road.

The approved B-double routes in the general vicinity of the site are shown overleaf.

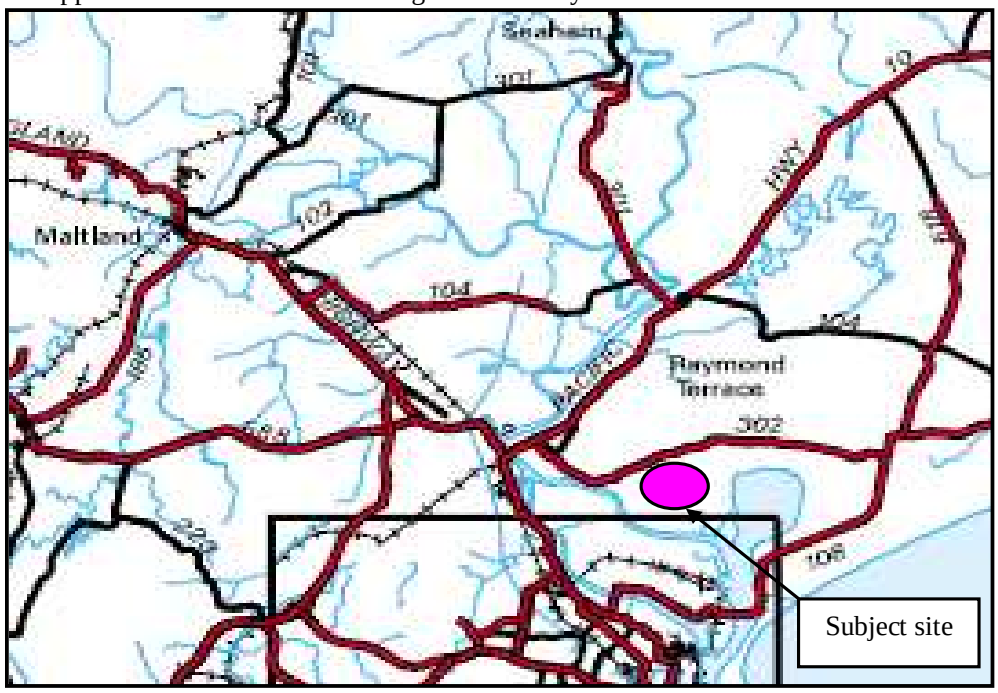


Figure 2.4 Approved B-double Routes
Source: RTA 2006

A B-double classified vehicle can have an overall length of 25 metres and has two trailers. The vehicles can have a maximum mass of 39 tonnes. It is also noted that the Tourle Street Bridge is restricted by the RTA to a single B-double at any time, although there are no signs indicating this on the approaches to the bridge.

2.7 Oversize and Over Mass Vehicle Restrictions

The RTA publishes material providing advice on overweight vehicles (Operators Guide to Oversize and over mass Vehicle Movements, dated October 2002). This guide provides advice on a wide range of issues with regard to over sized or over weight vehicles. In addition, general discussions were held with the RTA Hunter Region about road conditions and restrictions in relation to oversize and over mass vehicles.

From these general discussions with the RTA, the following points are noted:

1. There are NO specific weight limits imposed by RTA or Councils in the vicinity of the site. However, heavy loads defined as over 75 tonnes are required to sign an agreement to fix any road or structure broken due to the passage of a heavy load. This includes the road pavement, culverts, bridges etc. If the load is a wide load, this could also include power poles, signal poles, traffic signs etc.

2. For the Tourle Street Bridge, the absolute weight limit is 39 tonnes. As it is a steel truss bridge, this load cannot be exceeded under any circumstances as the bridge would fail. It also has a height limit of 5.8 metres and restricted width of approximately 7-8 metres due to the steel barriers to both sides of the bridge.

3. There is a similar weight limit of 39 tonnes on Hexham Bridge which cannot be exceeded due to possible bridge failure.

4. All southbound heavy loads exceeding 39 tonnes on the Pacific Highway at Hexham are diverted to the concrete northbound bridge. The maximum load ever carried by this bridge is 144 tonnes.

5. Southbound traffic movements over the northbound concrete bridge are controlled by the traffic signals installed by the RTA on the southern side of the bridge and there is a vehicle cross-over located in the central median of the Pacific Highway to the west of Tomago Road.

From the Operators Guide for oversize and over mass vehicles published by the RTA, the following points are made:

1. To move Oversize vehicle and/or Overweight vehicles a Permit must be obtained. An Oversize vehicle is defined as taller than 4.3 metres or wider than 2.5 metres. These forms are submitted to :

   Special Permits Unit
   P O Box 97
   Glen Innes
   NSW 2370

2. Permits can be for multiple use. I.e. by time period or as an annual permit and are route specific. This means that for a specific route that is used on a regular basis an annual permit can be obtained rather than applying for a permit each and every time an over size or over mass vehicle needs to be moved.

3. Whilst there are no weight limits on the road, there are a number of constraints on bridges in the area. Where an RTA bridge cannot be used, diversions must be used on the local road network. Where local roads are used, permission must be obtained from the relevant Council.

4. A road that passes over a railway via a bridge is owned by the railway owners, not RTA or Council. Approval is therefore required of the railway owners to drive over the bridge.

5. If the vehicle is over 75 tonnes, then maximum speed is 12 km/h. This is reduced to 6 km/h over bridges. Note that a load greater than 75 tonnes is NOT allowed to stop at any time on the road- they must move at all times, due to the possible damage to the road surface if the load is static.

6. For any route proposed, a specific survey needs to be completed by the applicant to determine suitability of the route. The proposed route and vehicle dimensions/weight are then submitted to the RTA for approval. In some cases the RTA may also complete their own survey, especially for very large loads (at the cost of the applicant).

7. Standard permit fees apply for administration purposes for loads up to 125 tonnes. For loads over 125 tonnes there is a standard fee plus 4 cents per journey km per Equivalent Standard Axle.

The purpose of reviewing the oversize and over mass procedures is to provide an understanding of the likely implications for that element of the proposed development that may require the transport of large machinery and transport equipment on the public road network.

What is apparent from the review, and observations of activity in the immediate area of the site is that with adjacent land uses such as the Tomago Aluminium Smelter, ship building, and Williamtown

airport, the road network has already been set up in the main to accommodate movement of large items to and from the Tomago area across the Hunter River to the State and National Highway network on the southern side of the river. This is achieved by utilising the newer bridge over the Hunter River which is the northbound river crossing. The bridge has been set up by the RTA to allow movement in both directions, with a signalised intersection at the base of the bridge approach to allow movements in either direction, back to the port of Newcastle along the Pacific Highway and Industrial Drive, or to the west on the New England Highway. In this way by utilising the northbound bridge crossing the only height issue becomes passing back under the northern river crossing bridge (which is well over RTA normal clearance levels.)

In terms of width, there is a minimum width of 2 travel lanes plus shoulders on all roads in the vicinity of the site whether by utilising the full width of single carriageway roads, or one carriageway on dual carriageway roads such as the Pacific and New England Highways.

For single carriageways the RTA operations restricts movements at night for safety reasons, unless the route has street lighting installed.

It is understood that large loads will be transported by component parts rather than fully assembled equipment. This will apply for both journeys from the port facility to the site warehousing facilities and then also on to customer sites to fulfil orders. The type of load movement is expected to be similar to that of existing movements on the Hunter Valley main road network resulting from the existing mine activities in the valley. For example dump truck trays are carried on the network from mine to off site maintenance facilities.

In all cases the RTA's requirements for oversize and overweight restrictions would apply where appropriate. It is expected that standard (or repeating) arrangements for multiple journeys would be available.

For the key section of Tomago Road, from 5km east of Pacific Highway back to the Highway the following observations were made in relation to the potential issues relating to operation of Oversize Loads:

1. There is currently no street lighting on Tomago Road. Only the roundabout with Old Punt Road has some street lighting. The RTA has advised that street lights will be required to move the oversized loads at night, particularly as this is the only times such loads will be allowed to cross over the Northbound Hunter River bridge counter flow.
2. The Tomago Road route is already used for the transport of oversize loads. For example Forgacs make use of Tomago Road for oversize loads, including dump truck trays, from the Old Punt Road intersection along Tomago Road to the Pacific Highway.
3. The roundabout at Old Punt road has an 8 metre approach lane width through the median islands, and a circulating lane width of 10.5 metres. Median island is 1.3 metres mountable, outside splitter island has removable signs (to improve clearance over the island)
4. The general road seal width along Tomago Road to the Tomago Aluminium Smelter entrance is more than 11 metres plus unsealed shoulder areas of about 1 metre each side
5. East of the smelter entrance the pavement is around 9 metres plus 1 metre unsealed shoulders either side of the carriageway
6. No significant drainage structures were observed on this stretch of Tomago Road
7. There is some overhead wiring crossing the route which can be lifted if required
8. The general pavement condition deteriorates noticeably east of the smelter entrance

As discussed above it is considered that use of the route for the transport of oversized loads is manageable and normal RTA procedures would apply. Under police control, opposing traffic would be waved down and directed to the shoulder until oversize loads pass as is normal practice.

3. Proposed Development

3.1 Development and Parking Arrangements

The development proposed for the subject site includes a warehouse facility, parts and specialist workshop for large earthmoving equipment and associated offices and amenities. There is also provision for an educational facility and administration offices on site. All parking for the development will be provided on site. This covers Stage 1, 2 and 3 of the development.

The total site area is in the order of 135 hectares and the site has a single road frontage to Tomago Road.

The separate parts of the stages are shown below:

Stage 1 – WesTrac -
- Administration
- Machinery Sales
- Workshops
- Parts Warehouse and Distribution
- Machinery Storage

Stage 1 – CAT Institute –
- Apprentice Training
- WesTrac
- Universities and other educational facilities

Stage 2 –Industrial Subdivision
- Associated business
- Unrelated but aligned business

Stage 3 – Industrial Subdivision -
- Associated business
- Unrelated but aligned business

The proposed lot layout is shown on the next page.



Figures 3.1 Proposed site layout

3.2 Traffic Generation

The level of traffic generation from the development proposal has been assessed using the rates available from the standard RTA guidelines for Traffic Generating Developments in the first instance with some qualifications supplied on specific activity by the client. The RTA Guidelines indicate a range of traffic generation rates depending on the type land use activity. Whilst the RTA guide provides advice on a wide range of developments, the proposed CAT institute does not have any specific guidelines due to the unique nature of the development. Consequently some analysis of the sensitivity of traffic forecasts has been applied in the investigations.

Normal practice is to determine the peak hour traffic volumes of a development to assess the impact of the development during the critical peak periods on the adjacent road network. The RTA guidelines indicate the critical movement periods as well as daily traffic volumes associated with various types of development. From the traffic surveys, it can be seen that the peak periods on the adjacent road network on 7.30 to 8.30 am and 4.30 to 5.30 pm. This is slightly earlier than a normal peak and is representative of the normal work practices associated with the industrial development along Tomago Road in the general vicinity of the site.

The future predicted traffic volumes associated with the various development scenarios are presented in **Table 3.1** below.

Table 3.1 – Predicted Future Traffic Volumes

Stage	Facility	Stage Area	Rate	Volume
Stage 1 - WesTrac	Administration	590 m^2	2 per 100 m^2	12
	Machinery Sales			
	Workshops	9780 m^2	-	Assumed 120
	Parts Warehouse and Distribution	6120 m^2	-	Assume 80
	Machinery Storage	-	-	-
Stage 1 – CAT Institute	Apprentice training	1500 m^2		Assumed 100
	WesTrac			
	Universities/other educational			
Stage 2	Industrial Subdivision	36 hectares	302 employees	**95 am** **109 pm**
Stage 3	Industrial Subdivision	48.49 hectares	450 employees	143 am 164 pm
			TOTAL	**550 am[1]** **585 pm[1]**

Notes:
1. All rates assumed from RTA Guide to Traffic Generating Developments unless specified otherwise.
2. Warehouse assumed to include a component of direct sales. That is traffic generation is based on both staff and customer movements
3. Warehouse rate based on planned staffing levels only assuming warehouse activity only for the facility.

Please note the following in relation to the above traffic generation data:

a) The machinery sales building will be located within the administration building on the site. The machinery itself will generally be stored outside rather than within a building.
b) The site has a large footprint and there is a large area available for storage of machinery. Again, this machinery will be stored outside on the site.
c) Total staff assumed for the workshop is 120 and all staff arrive/depart at same time.

d) Assumes 50 staff at the warehouse and distribution centre and all staff arrive/depart at same time. For the purposes of the traffic analysis this scenario has been assumed generation of 100 vehicle trips in the peak period based on staff only, or the alternate RTA rate for warehouse activity.
e) Assumed that typical training days could accommodate a maximum of 100 students.
f) The equipment and demonstration area supplements the development and allows for demonstrations from the sales area as well as use by the CAT Institute.
g) The industrial park generation has been derived from standard RTA guidelines, as set out overleaf.

Tables 3.2 presents RTA data on trip generation for industrial type estates. **Tables 3.3 and 3.4** adjust the rates to match the anticipated level of development for Stage 2 and 3 on the subject site.

Table 3.2- Traffic Generation rates and distribution for industrial estates - cars and commercial vehicles

Period	Cars/hr/1000 employees	CVs/hr/1000 employees	Total vehicles
7-8 am	100	1	101
8-9	307	11	318
9-10	206	28	234
10-11	108	33	141
11-12 pm	83	33	116
12-1	132	31	163
1-2	162	34	196
2-3	113	26	139
3-4	163	31	194
4-5	265	24	289
5-6	350	15	365
6-7	43	1	44
TOTAL	**2032**	**268**	**2300**

Source: RTA Guide to Traffic Generating Developments

Based on the future employment of 700 employees at the proposed industrial estate the daily traffic volumes associated with the development are presented overleaf in **Tables 3.3 & 3.4**.

Table 3.3- Forecast Traffic Generation for proposed Stage 2 Industrial Estate- cars and commercial vehicles

Period	Cars per hour	Commercial vehicles per hour	Total vehicles
7-8 am	30	0	30
8-9	93	4	97
9-10	62	9	71
10-11	33	11	44
11-12 pm	25	11	36
12-1	40	10	50
1-2	49	11	60
2-3	34	9	43
3-4	50	10	60
4-5	80	8	88
5-6	106	5	111
6-7	13	0	13
TOTAL	617	90	703

Note: Adopted from Table 3.2 applied to assumed Stage 2 development

Table 3.3indicates that for Stage 2 between 8.00 and 9.00 am, the predicted peak hour flows would be 97 vehicles two-way. The corresponding afternoon peak period is between 5.00 and 6.00 pm when the two-way flow is 111 vehicles per hour.

Table 3.4- Forecast Traffic Generation for proposed Stage 3 Industrial Estate- cars and commercial vehicles

Period	Cars per hour	Commercial vehicles per hour	Total vehicles
7-8 am	45	0	45
8-9	138	5	143
9-10	93	13	105
10-11	49	15	63
11-12 pm	37	15	52
12-1	59	14	73
1-2	73	15	88
2-3	51	12	63
3-4	73	14	87
4-5	119	11	130
5-6	158	7	164
6-7	19	0	20
TOTAL	914	121	1035

Note: Adopted from Table 3.2 applied to assumed Stage 3 development

Table 3.4 indicates that for Stage 3 between 8.00 and 9.00 am, the predicted peak hour flows would be 143 vehicles two-way. The corresponding afternoon peak period is between 5.00 and 6.00 pm when the two-way flow is 164 vehicles per hour.

Industrial Park Traffic Flows

Based on the total area of each stage, it has been assumed that the developed area would be 30% of the available area. This is consistent with other industrial estates in the region such as at Cardiff and Rutherford. A density of employment of 28 people per developed hectare was also assumed.
The 12 Ha of developable area for Stage 2 with 28 staff per hectare would represent 302 employees. The 16 Ha of developable area for Stage 3 with 28 staff per hectare would represent 450 employees. Again this factor could be variable depending on the ultimate type of industrial activity, and is considered in the sensitivity analysis reported in section 4 of this report.

Import Traffic Flows

Investigations into the likely point of unloading of product from import ships have confirmed The Basin at Carrington as the most practical and cost effective option. This means that there will be a small number of specialist traffic movements required between Carrington and Tomago. There are 2 land transport options that can be considered. Either route would be in the main operated on the arterial road network. From Carrington trucks delivering parts and equipment would use the designated Carrington Heavy Vehicle route along Darling Street and Elizabeth Street to access Industrial Drive, than follow Industrial Drive to Tourle Street. At this point the route could follow Tourle Street, Cormorant Road the Stockton Bridge and accessing Tomago via Nelson Bay Road and Cabbage Tree Road. The Tourle Street Bridge becomes the limiting factor along this route.

The alternate route would continue west along Industrial Drive to the New England Highway, then west along the New England Hwy to the Pacific Highway at Hexham. This route is less restricted than the Tourle Street Bridge.

Industrial Highway and New England Highway to Hexham are dual carriageway arterial roads with a minimum one way carriageway configuration of 2 lanes. This is increased at most intersections to

allow additional capacity for turning movements, which in this instance becomes available for turning manoeuvres for oversize loads. The northbound bridge over the Hunter River at Hexham is also 2 traffic lanes with shoulders, and does not have a physical height restriction (such as at the steel truss of the Tourle Street bridge.)

All roads that would be utilised for these specialist transport deliveries of product are already approved B-double routes and used for land transport access to the Port of Newcastle facilities . Where loads are outside the acceptable general dimensions for travel on the road network the normal RTA permit system would apply. This can be dealt with in terms of standard conditions, but the standard conditions in terms of notification etc would apply.

It should be noted that there will not be a large number of these specialist deliveries of product from the port to the site and as such capacity is not a concern. Preliminary investigations indicate that the road geometry as discussed above, being major arterial road is capable of accommodating the type of movements.

3.3 Traffic Distribution

General traffic to and from the development would in the main use a direction of travel to and from the west via the Pacific Highway. Some Newcastle based traffic could use Nelson Bay Road but this is a longer and more time consuming route. There would also be a small portion of the traffic travelling towards the Nelson Bay area. This distribution could vary by as much as 70/30 to 90/10 depending on the particular local conditions. For the purposes of this assessment it has been assumed that 85% of the traffic would be travelling in the peak direction. i.e. Towards the Pacific Highway in the PM peak.

3.4 Pedestrian Access

Pedestrian access to the site would be via existing facilities on Tomago Road. It is considered that due to the relatively remote location of the site there would be little if any pedestrian access to the proposed development.

3.5 Site Operations and Access Arrangements

The overall layout and internal road alignment needs to be designed in accordance with Council standards but must also take into account the specific requirements of the specialist plant that will be used on the site and accessing the workshop facilities. Overall access geometry would meet the requisite standards provided with the RTA Guide to Traffic Generating Developments.

The swept paths of the large vehicles accessing the site will need to be taken into account. This could affect the internal layout as well as the site access arrangements.

It is considered that a satisfactory design arrangement can be provide for safe entry and exit for the site to Tomago Road. The technical analysis of the site access operation is discussed further in **Section 4.**

3.6 Parking Requirements

Parking requirements for the development need to be assessed using the standard rates provided within the RTA Guide to Traffic Generating Developments as well as the specific requirements of the users on the site. The site provides a large area and it is considered that adequate parking will be able to provide on the site.

4. Assessment of Transport Operations

4.1 Site Access Operations

Access to the site is proposed via a single access on Tomago Road. It is proposed to provide a central spine road that will provide access to all three stages of the development, reducing the potential number of new intersections on Tomago Road.

The layout of the proposed main site access has been considered as a priority junction with auxiliary right turn lanes (Type CHR) and as a seagull intersection.

It can be seen that the relatively high traffic volumes associated with the full development, together with the significant number of large vehicles entering the site will generate the need for a sheltered right turn lane for vehicles entering the site. As the vast majority of traffic will have an origin/destination towards the west of the site the demand for the right turn movement out will be very low and a right turn acceleration lane is not considered necessary for the development access. The design of this intersection will need to be agreed in consultation with the RTA.

The sheltered right turn into the site option is shown below.

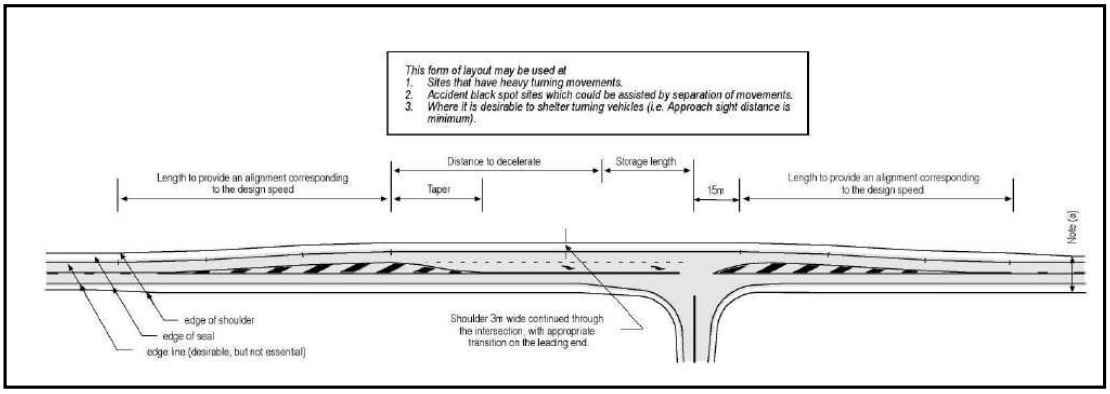


Figure 4.1 Type CHR Rural Intersection Layout General Details
Source: Austroads Pt5

For the above design, consideration needs to be given to the turning movements and in particular the right turn movement. The use of a raised central island to provide guidance to vehicles could block the movements for large vehicles. The layout may therefore need to be amended in consultation with the RTA to allow for the larger turning movements associated with large vehicles whilst retaining the safety benefits of the intersection design and layout.

The nature of industrial activity proposed on the site means that the road geometry at the entrance to the site should be generous, to cater for the oversize deliveries. This applies to entry movements (from the port) and also exit movements for delivery of final product.

In terms of the seagull intersection concept, the junction would provide a right turn auxiliary lane for movements to the east of the site,

The operation of this site access has been assessed using Sidra. The results from Sidra show that the proposed seagull controlled intersection has adequate capacity to cater for the future flows associated with the proposed development. This assessment has also been completed for the future design year of 2017,

allowing 20% growth in background traffic flows along Tomago Road. The results of the analysis are presented in **Appendix C** to this report.

A concept for this junction ahs been developed as illustrated overleaf.

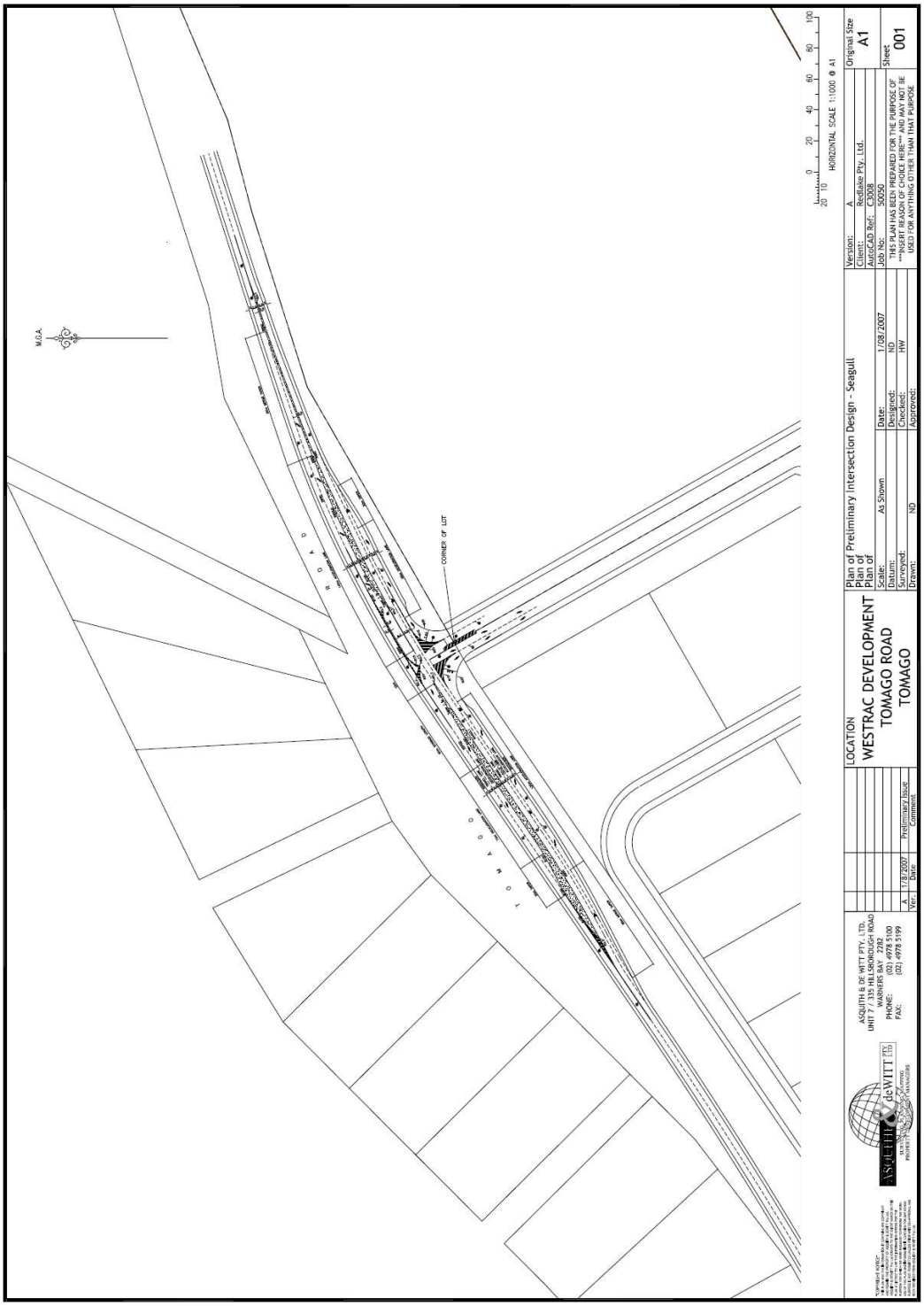


Figure 4.2 Site Access concept Design: Source Johnson Partners

4.2 Predicted Road Network Performance

The predicted traffic generation levels outlined in Section 3 have been added to the base traffic flows to assess the adequacy of the existing road network in terms of catering for the additional flows. The results by stage of the development are tabulated below.

Table 4.1 – Summary of Assumed Future Development Traffic Volumes

Stage	Volume[1]
Stage 1	312
Stage 2	95am 109 pm
Stage 3	143 am 164 pm
TOTAL	550 am 585 pm

Notes:
1. Base Generation rates assumed from RTA Guide to Traffic Generating Developments unless specified otherwise.

The traffic flow forecasts presented in **Tables 4.2 to 4.4** include the following assumptions:

- 10 year background traffic growth of 5 % per annum
- Road Lane Capacity of 1400 vehicles per lane per hour (Austroads LoS E)
- Directional split of 85/15 peak / non peak direction or travel
- Warehouse based on storage facility only, i.e. staff traffic generation only at peaks
- Industrial Park developed area would be 35% of site area, employee density of 28 / Ha giving staffing level of 700 employees

The effects of these assumptions in terms of infrastructure decisions are discussed in section 4.3 below.

Table 4.2 – Forecast Future Traffic Volumes @ Stage 1 development completion

Road	Location	Direction	Mid-Block Road Capacity[2]	AM peak hour Volumes[1]	PM Peak Hour Volumes[1]	Volume/ Capacity (AM)	Volume / Capacity (PM)
Pacific Highway	To south of Tomago Rd	Northbound	2800	2425	2343	0.87	0.84
Pacific Highway	To south of Tomago Rd	Southbound	2800	2271	2631	0.81	0.94
Tomago Road	To east of Pacific Hwy	Eastbound	1400	689	241	0.49	0.17
Tomago Road	To east of Pacific Hwy	Westbound	1400	314	896	0.22	0.64

Table 4.3 – Forecast Future Traffic Volumes @ Stage 2 development completion

Road	Location	Direction	Mid-Block Road Capacity[2]	AM peak hour Volumes[1]	PM Peak Hour Volumes[1]	Volume/ Capacity (AM)	Volume / Capacity (PM)
Pacific Highway	To south of Tomago Rd	Northbound	2800	2530	2360	0.903	0.843
Pacific Highway	To south of Tomago Rd	Southbound	2800	2289	2733	0.817	0.976
Tomago Road	To east of Pacific Hwy	Eastbound	1400	758	255	0.541	0.182
Tomago Road	To east of Pacific Hwy	Westbound	1400	325	977	0.232	0.698

Table 4.4 – Forecast Future Traffic Volumes @ Stage 3 development completion

Road	Location	Direction	Mid-Block Road Capacity[2]	AM peak hour Volumes[1]	PM Peak Hour Volumes[1]	Volume/ Capacity (AM)	Volume / Capacity (PM)
Pacific Highway	To south of Tomago Rd	Northbound	2800	2744	2399	0.980	0.857
Pacific Highway	To south of Tomago Rd	Southbound	2800	2326	2950	0.831	1.053
Tomago Road	To east of Pacific Hwy	Eastbound	1400	861	270	0.615	0.193
Tomago Road	To east of Pacific Hwy	Westbound	1400	343	1006	0.245	0.718

Notes:
1. Source: base traffic volume counts adjusted for 10yr growth and development flows
2. Source: RTA Guide to Traffic Generating Developments, Urban Road Level of Service 'E"

The above results indicate that Tomago Road has sufficient capacity to cater for the subject development.

4.3 Potential Traffic Impacts

The impacts on the Pacific Highway and Tomago Road sections of the road network based on the assumed scenario in Section 4.2 above are discussed below.

4.3.1 Pacific Highway

From the base data presented in **Section 2.3** and the above summary of future flows it can be seen that the forecast hourly traffic flows along the Pacific Highway including the Stage 3 development can be accommodated. This assessment has been based on application of the Level of Service 'E' threshold for urban flow conditions (1400 vphpl), and assuming 85% outbound on Tomago Road and heading south along the Pacific Highway.

With an assumed urban peak hour limit for planning purposes of 2,800 vehicles per hour, this would give a volume to capacity ratio approaching 1.0 under the Stage 3 development indicating the traffic flows along the Pacific Highway in this location would operate within the technical capacity limits. Note though that this does not take into consideration changes in traffic flow on this section of the Pacific Highway resulting from the planned bypass that will connect the F3 at John Renshaw Drive to the Pacific Highway at Heatherbrae. This is an important point to note as the likely future operation of this section of highway once the proposed bypass connecting the F3 to the Pacific Highway at Heatherbrae is in place it will completely change the flow dynamics at this location, with background flows being significantly lower than those quoted above.

4.3.2 Tomago Road

The base flows from recent traffic surveys were added to the forecast flows for the proposed development and assessed against existing capacity levels. It can be seen from Tables 4.1 to 4.4 that Tomago Road will remain within its nominal capacity at completion of the Stage 3 of the proposed development.

4.3.3 Background Traffic Growth

The RTA has for some time been applying a requirement for all developments to be assessed against a 10 year future forecast of flows, with an agreed growth factor applied to represent this period of growth of background flows.

Whilst it is considered that this approach is not able to be substantiated against the strict rules of traffic impact assessment to meet the requirements of the E P & A Act, it has been consistently applied now for some years.

The recorded historical growth rate for the Pacific Highway for some time has been in the order of 5% per annum. This would imply a 10 year growth rate of 50%. This level of growth is well beyond the requirement of consideration for a single development proposal, and in fact it can be argued it is part of the substantiation for the RTA's current examination of alternate connections of the F3 Freeway to the Pacific Highway at Heatherbrae

In the case of Tomago Road the level of background traffic growth is expected to be much lower and in line with a growth rate of around 2% over the past 20 years.

If this level of background growth is factored into a development staging of 5 and 10 years for stages 1 and 2, and up to 20 years for stage 3, then it can be seen that the development can be accommodated on the existing Tomago Road.

4.3.4 Intersection of Tomago Road and Pacific Highway

The RTA is currently upgrading the intersection of the Pacific Highway and Tomago Road, Tomago. Construction has been completed on the Old Punt Road intersection with work underway at Tomago Road. The proposal consists of installing traffic control signal and other traffic improvements at Tomago Road where it intersections with the Pacific Highway. The work will improve safety and traffic flow for road users.

It is also important to take into account the future bypass of this length of the Pacific Highway in connecting the F3 Freeway to the Pacific Highway at Raymond Terrace. Upgrading of this connection will aim to reduce the number of intersections as well as provide grade separation at some key locations. The development of the preferred route will also identify key intersections and these could become grade separated.

It is possible that under one of the bypass route options the intersection of Tomago Road and the Pacific Highway could become grade separated, if the route option B2 is adopted. This route runs adjacent to the current alignment of the Pacific Highway at Tomago Road and will therefore affect the layout of this key intersection.

It is recognised that there is a large amount of existing industrial area along Tomago Road and that further land will be developed for industrial use along this road, thereby increasing traffic flows through this intersection of Tomago Road and the Pacific Highway.

4.4 Site Layout and Operational Issues

No detailed analysis of site layout or parking requirements has been conducted at this stage. The site footprint provides a large area and indicative parking arrangements have been provided. Given the size of the site, it is considered that there will be adequate space to design appropriate facilities to cater for all on-site access, circulation and parking demands.

Observations of activity in the immediate area of the site indicate that adjacent land uses such as the Tomago Aluminium Smelter, ship building, and Williamtown airport, results in the road network already being utilised for movement of large items to and from the Tomago area across the Hunter River to the State and National Highway network. This is achieved by utilising the newer bridge over the Hunter River which is the northbound river crossing. The bridge has been set up by the RTA to allow movement in both directions, with a signalised intersection at the base of the bridge approach to allow movements in either direction, back to the port of Newcastle along the Pacific Highway and Industrial Drive, or to the west on the New England Highway. In this way by utilising the northbound bridge crossing the only height issue becomes passing back under the northern river crossing bridge (which is well over RTA normal clearance levels.)

In terms of width, there is a minimum width of 2 travel lanes plus shoulders on all roads in the vicinity of the site whether by utilising the full width of single carriageway roads, or one carriageway on dual carriageway roads such as the Pacific and New England Highways.

For single carriageways the RTA operations restricts movements at night for safety reasons, unless the route has street lighting installed.

It is understood that large loads will be transported by component parts rather than fully assembled equipment. This will apply for both journeys from the port facility to the site warehousing facilities and then also on to customer sites to fulfil orders. The type of load movement is expected to be similar to that of existing movements on the Hunter Valley main road network resulting from the existing mine activities in the valley. For example dump truck trays are carried on the network from mine to off site maintenance facilities.

For the key section of Tomago Road, from 5km east of Pacific Highway back to the Highway the following observations were made in relation to the potential issues relating to operation of Oversize Loads:

1. There is no route street lighting on Tomago Road. Only the roundabout with Old Punt Road has some street lighting. The RTA has advised that street lights will be required to move the oversized loads at night, particularly as this is the only times such loads will be allowed to cross over the Northbound Hunter River bridge counter flow.
2. The roundabout at Old Punt road has an 8 metre approach lane width through the median islands, and a circulating lane width of 10.5 metres. Median island is 1.3 metres mountable, outside splitter island has removable signs (to improve clearance over the island)
3. General road seal width to Tomago smelter entrance is > 11 metres plus unsealed shoulder areas of about 1 metre each side
4. East of the smelter entrance the pavement is around 9 metres plus 1 metre unsealed shoulders either side
5. There were no significant drainage structures observed on this section of road.
6. There is some overhead wiring crossing route (which can be lifted.)
7. There are power lines present along the route for lighting (if required.)
8. The general pavement condition deteriorates noticeably east of smelter entrance

The conclusion is that use of the route for oversize loads is manageable and normal RTA procedures would apply. It is noted that the lighting option for the single carriageway would not appear to be applied at the moment for the current Forgacs operation.

6. Conclusions and Recommendation

The following conclusions are drawn from the investigations into the proposed industrial development off Tomago Road, Tomago NSW:

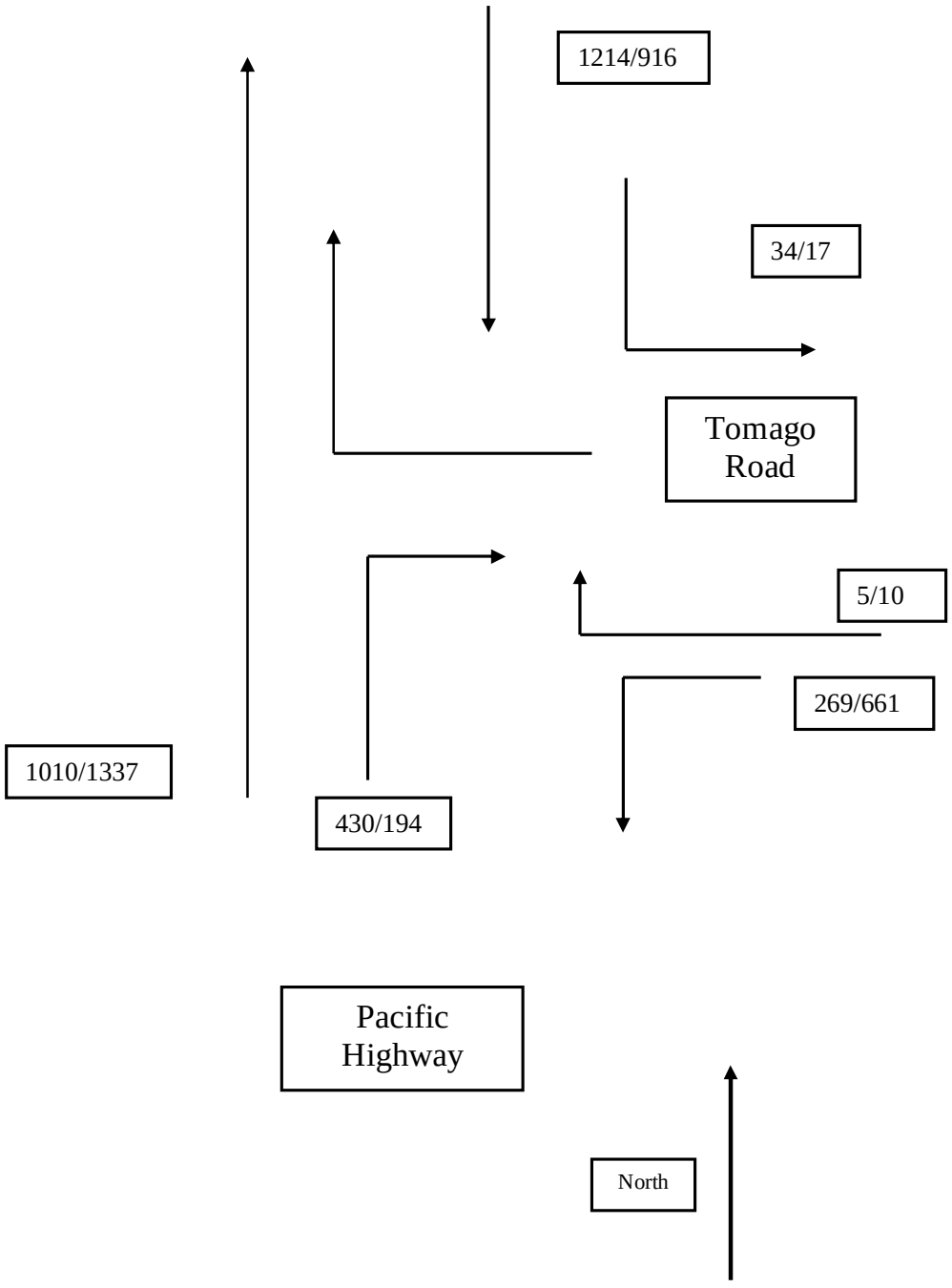
1. The subject site is located on Tomago Road approximately 5 km east of the Pacific Highway at Tomago NSW
2. Site access is available to Tomago Road, Main Road 302 in the RTA state road network
3. The site is adjacent to the existing Tomago industrial estate, which includes the Tomago Aluminium Smelter. Heavy vehicles are therefore part of the existing road traffic mix.
4. Current road operations on the key road links, Tomago Road and Pacific Highway are within satisfactory operating levels for urban road conditions.
5. The intersection of Tomago Road and Pacific Highway currently experiences significant queuing problems and the NSW RTA are currently completing an upgrade of this junction with a set of traffic signals to control all movements.
6. A 3 staged development is being considered for the site, with a mixture of industrial and specialist use proposed. All parking for the development can be accommodated on site.
7. Forecast traffic flows based on standard RTA guidelines for traffic generating developments indicate that the proposed development are able to be accommodated on the existing road network.
8. The sensitivity of the traffic forecasts to the level of background growth assumed as required by the RTA in considering future flow conditions can affect the timing of possible upgrading being required.
9. RTA has recently released its preferred option for a major bypass of the section of Pacific Highway at Tomago, as part of the proposed F3 extension to the Pacific Highway at Heatherbrae. This project has the potential to significantly change traffic flows in the area, to the extent that the nature of upgrading of the junction of Tomago Road and Pacific Highway may be simplified. The preferred route includes the potential for an interchange with Tomago Road.
10. The procedures and issues associated with transport of oversize loads have been reviewed. The site and its operations are able to utilise the existing arterial road system through application of the RTA procedures for transporting over dimension loads. This includes possibly the necessity to light sections of Tomago Road to allow oversize transport at night along the single carriageway to the Pacific Highway
11. Forecast traffic flows based on standard RTA guidelines for traffic generating developments indicate that the proposed seagull priority controlled intersection has adequate capacity to cater for the future flows associated with the proposed development.

Conclusion

The conclusion from this investigation is that the proposed seagull priority controlled intersection has adequate capacity to cater for the future flows associated with the proposed development and that these flows can be accommodated on Tomago Road. It is recommended that the development be approved on traffic and access grounds.

Appendix A Traffic Survey Results

Results of traffic survey completed on Monday 13th February 2006.
AM Peak 7.30 to 8.30
PM peak 4.30 to 5.30 PM.



Appendix B RTA Traffic Volume Data

DAILY TRAFFIC VOLUMES Year 2004
PACIFIC HWY,SH10 1KM N OF HUNTER RIVER BR Station No. 05.001.N

Week	Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total	Percent
1	29/12/03	21881	21025	19483	14420p	23245	23148	16418	139620	2.0376
2	5/01/04	21624	19750	19486	20285	23637	22452	15918	143152	2.0891
3	12/01/04	21095	19446	19929	20638	23605	20165	15608	140486	2.0502
4	19/01/04	20340	19250	19570	20725	25934	21041	13440	140300	2.0475
5	26/01/04	11266p	18687	18344	18704	22789	16613	13308	119711	1.7471
6	2/02/04	18719	17970	18070	19029	24214	16986	13480	128468	1.8748
7	9/02/04	19760	18169	18316	19297	24558	17333	14166	131599	1.9205
8	16/02/04	19690	18710	18937	19642	25231	16607	14159	132976	1.9406
9	23/02/04	19066	17986	17219	18899	24318	16594	13942	128024	1.8684
10	1/03/04	18779	18283	18546	19811	24381	15439	13393	128632	1.8772
11	8/03/04	19286	18257	18367	19459	24434	16518	13808	130129	1.8991
12	15/03/04	19078	18398	18653	19301	24575	16423	13326	129754	1.8936
13	22/03/04	18125	17658	18356	19411	23184	15971	13995	126700	1.8490
14	29/03/04	19028	18332	19337	20014	23364	16573	13627	130275	1.9012
15	5/04/04	19100	19524	23320	35129	25727p	16835	13554	153189	2.2356
16	12/04/04	13545p	19993	19826	20555	23608	18017	15214	130758	1.9083
17	19/04/04	20453	19340	19488	20548	25541	19447	12591	137408	2.0053
18	26/04/04	11821p	18992	18466	18976	22541	16004	12707	119507	1.7441
19	3/05/04	18844	18038	18155	19077	22187	16180	14034	126515	1.8463
20	10/05/04	19000	18059	18438	19102	23075	15396	13006	126076	1.8399
21	17/05/04	18171	17837	18106	18947	22138	14894	12490	122583	1.7890
22	24/05/04	18221	17116	17735	18901	21986	14855	12739	121553	1.7739
23	31/05/04	18285	17558	17686	18135	21365	15034	12391	120454	1.7579
24	7/06/04	18280	17833	18658	20521	28431	20013	12284	136020	1.9851
25	14/06/04	11653p	18263	18032	18828	21382	14438	12155	114751	1.6747
26	21/06/04	18121	17761	18331	19079	22162	15508	13301	124263	1.8135
27	28/06/04	18686	18279	18641	20048	23202	18749	15209	132814	1.9383
28	5/07/04	20775	19157	19369	20994	24858	18012	14679	137844	2.0117
29	12/07/04	19933	18708	19169	19880	22369	15733	11205	126997	1.8534
30	19/07/04	17874	17508	18113	19709	22228	14480	12132	122044	1.7811
31	26/07/04	17978	16846	17768	19068	22220	15439	13945	123264	1.7989
32	2/08/04	18238	17906	18039	18663	21495	15017	12994	122352	1.7856
33	9/08/04	18377	17539	18344	19159	22013	14726	12697	122855	1.7929
34	16/08/04	17883	17452	17103	18449	22218	15020	12894	121019	1.7661
35	23/08/04	18021	17544	18013	19136	22733	15866	13301	124614	1.8186
36	30/08/04	18401	17843	18186	19149	23048	16221	13888	126736	1.8496
37	6/09/04	19043	18068	18551	19397	23318	16111	13204	127692	1.8635
38	13/09/04	19242	17358	18789	19641	24508	17114	14338	130990	1.9117
39	20/09/04	19639	18633	19237	20594	26017	20031	16817	140968	2.0573
40	27/09/04	22348	20253	20888	23424	29270	23469	14349	154001	2.2475
41	4/10/04	14674p	20147	19932	20414	22761	16085	13303	127316	1.8580
42	11/10/04	20446	18927	18681	19725	23439	15999	13641	130858	1.9097
43	18/10/04	18888	17119	17443	18437	23028	15923	12812	123650	1.8045
44	25/10/04	18914	18529	18432	20160	25159	16693	13872	131759	1.9229
45	1/11/04	19265	17209	19071	20389	23952	16255	13693	129834	1.8948
46	8/11/04	19200	17887	18711	19973	25002	16787	14472	132032	1.9269
47	15/11/04	19875	19027	19027	20342	25187	16466	14276	134200	1.9585
48	22/11/04	20162	18904	19267	20674	25560	17756	14374	136697	1.9949
49	29/11/04	20036	18804	19150	20940	24500	17502	14672	135604	1.9790
50	6/12/04	20228	19132	19415	20616	23556	17583	14339	134869	1.9683
51	13/12/04	20629	19714	20306	21329	24087	19009	15755	140829	2.0552
52	20/12/04	22080	21649	24521	27934	27111	22458	27786	173539	2.5326
53	27/12/04	30165p	21932p	21889	22316	21903	16355	21111	155671	2.2718
Annual Averages:		19385	18507	18961	20261	23781	17157	14166	131773	

AADT	AAWT	AAWE	AAPH
18825	20190	15662	17245

p indicates Public Holiday

DAILY TRAFFIC VOLUMES Year 2004
PACIFIC HWY,SH10 1KM N OF HUNTER RIVER BR Station No. 05.001.S

Week	Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total	Percent
1	29/12/03	20225	22196	18923	15660p	25591	27505	23694	153794	2.2289
2	5/01/04	23050	21263	21257	22529	25945	23348	20884	158276	2.2938
3	12/01/04	21835	20178	20936	22098	24651	19918	19095	148711	2.1552
4	19/01/04	20949	19743	20862	21688	23650	19238	17785	143915	2.0857
5	26/01/04	21844p	22634	19386	19035	20980	15238	17099	136216	1.9741
6	2/02/04	18705	18100	18405	19148	20949	15216	18045	128568	1.8633
7	9/02/04	19346	18507	18421	19324	21622	15790	19237	132247	1.9166
8	16/02/04	20659	18918	19226	19879	22043	15130	19648	135503	1.9638
9	23/02/04	19673	17841	18600	19557	21291	14704	17984	129650	1.8790
10	1/03/04	18827	17890	17797	18688	19815	14557	18393	125967	1.8256
11	8/03/04	19566	18363	18641	19374	21225	14828	18456	130453	1.8906
12	15/03/04	19440	18421	19027	19283	21354	14991	18009	130525	1.8917
13	22/03/04	18711	18336	18865	19423	21012	14810	18348	129505	1.8769
14	29/03/04	19116	18532	19007	19411	20992	14565	17157	128780	1.8664
15	5/04/04	19844	19859	20425	21519	11640p	12778	17072	123137	1.7846
16	12/04/04	25080p	25313	21675	21628	23371	18148	18926	154141	2.2339
17	19/04/04	20305	19726	20463	21383	23723	16992	14345	136937	1.9846
18	26/04/04	19411p	20658	18744	19022	20460	14429	16281	129005	1.8696
19	3/05/04	18545	17753	18703	19165	21087	15333	17028	127614	1.8495
20	10/05/04	18437	17967	18485	18918	20807	13948	16648	125210	1.8146
21	17/05/04	18434	17939	18259	19137	20422	13927	15986	124104	1.7986
22	24/05/04	18669	17977	18562	18936	20662	14668	15379	124853	1.8095
23	31/05/04	18467	17740	17632	18346	19879	13648	14704	120416	1.7452
24	7/06/04	18011	17719	18421	19023	20592	12889	13189	119844	1.7369
25	14/06/04	22744p	21506	18540	19124	20243	13969	14735	130861	1.8965
26	21/06/04	18079	17989	18366	19073	20708	14271	16132	124618	1.8061
27	28/06/04	18662	18538	18853	19230	21190	15520	16527	128520	1.8626
28	5/07/04	19218	18936	19543	20154	22326	15850	18034	133961	1.9415
29	12/07/04	20283	19579	20106	21038	23117	16967	14904	135994	1.9709
30	19/07/04	18334	17857	18028	19136	20265	13691	14862	122173	1.7706
31	26/07/04	19121	18024	18116	18996	20376	13968	16817	125418	1.8176
32	2/08/04	18800	18117	18066	18813	20393	14584	15421	124194	1.7999
33	9/08/04	18345	17914	18421	19179	20453	13728	15389	123429	1.7888
34	16/08/04	18155	17736	17288	18451	20866	14323	16199	123018	1.7829
35	23/08/04	18440	18117	18530	19590	20732	14490	17387	127286	1.8447
36	30/08/04	18742	18451	18655	19467	20794	14953	18037	129099	1.8710
37	6/09/04	19295	18698	18873	19926	20860	14911	18083	130646	1.8934
38	13/09/04	19027	18444	19166	19558	21746	15754	18708	132403	1.9189
39	20/09/04	19941	19164	19620	20271	22554	15560	16985	134095	1.9434
40	27/09/04	20058	19782	20337	21690	22543	16113	15155	135678	1.9663
41	4/10/04	24914p	24880	21342	22216	24859	19567	18139	155917	2.2597
42	11/10/04	20095	19062	18895	19597	21837	14749	17663	131898	1.9116
43	18/10/04	19260	17674	17778	18436	20762	14086	16509	124505	1.8044
44	25/10/04	19623	19201	19222	20135	21801	14733	18456	133171	1.9300
45	1/11/04	19820	17652	19006	20019	20980	14555	18265	130297	1.8884
46	8/11/04	19696	18506	18974	19782	21939	15142	19225	133264	1.9314
47	15/11/04	19813	19375	19668	20611	22423	15236	18591	135717	1.9669
48	22/11/04	20103	19597	19855	20982	21940	15630	19429	137536	1.9933
49	29/11/04	20526	19450	19313	20685	22545	15617	18288	136424	1.9772
50	6/12/04	20662	19860	20008	20790	21939	15714	16887	135860	1.9690
51	13/12/04	20367	20165	20649	21712	23103	17305	16683	139984	2.0287
52	20/12/04	21018	21436	23124	24172	20034	11960	13889	135633	1.9657
53	27/12/04	17667p	19991p	21174	24097	19980	15665	25167	143741	2.0832
Annual Averages:		19496	19215	19250	20066	21643	15570	17433	132693	

AADT	AAWT	AAWE	AAPH
18956	19940	16502	19883

p indicates Public Holiday

HOURLY TRAFFIC VOLUMES for Week commencing MON 9/08/04 Station No. 05.001.N

PACIFIC HWY,SH10 18M N OF HUNTER RIVER BR

HOUR	MON	TUE	WED	THU	FRI	SAT	SUN	WEEKDAYS			WEEKEND (+HOLIDAYS)			WHOLE WEEK		
comm.	9/08	10/08	11/08	12/08	13/08	14/08	15/08	TOTAL	MEAN	%	TOTAL	MEAN	%	TOTAL	MEAN	%
0	91	132	115	149	149	217	153	636	127	0.67	370	185	1.35	1006	144	0.82
1	61	82	85	78	99	110	77	405	81	0.42	187	94	0.68	592	85	0.48
2	66	86	74	87	90	89	80	403	81	0.42	169	85	0.62	572	82	0.47
3	64	85	93	93	94	84	55	429	86	0.45	139	70	0.51	568	81	0.46
4	135	156	140	177	164	133	93	772	154	0.81	226	113	0.82	998	143	0.81
5	580	576	573	609	622	356	124	2960	592	3.10	480	240	1.75	3440	491	2.80
6	1386	1262	1327	1370	1310	481	222	6855	1331	6.97	703	352	2.56	7358	1051	5.99
7	1400	1357	1309	1314	1257	631	351	6637	1327	6.95	982	491	3.58	7619	1088	6.20
8	1382	1303	1348	1312	1377	882	533	6722	1344	7.04	1415	708	5.16	8137	1162	6.62
9	1063	1002	1073	1115	1122	1123	810	5375	1075	5.63	1933	967	7.05	7308	1044	5.95
10	1085	967	1023	1052	1184	1258	974	5311	1062	5.57	2232	1116	8.14	7543	1078	6.14
11	1054	1003	944	1116	1241	1203	1009	5358	1072	5.61	2212	1106	8.07	7570	1081	6.16
12	1252	975	1074	1130	1334	1261	1055	5765	1153	6.04	2316	1158	8.45	8081	1154	6.58
13	1141	1042	1083	1073	1367	1114	1070	5706	1141	5.98	2184	1092	7.96	7890	1127	6.42
14	1200	1144	1212	1269	1531	1090	1090	6356	1271	6.66	2180	1090	7.95	8536	1219	6.95
15	1353	1325	1425	1386	1674	1051	1061	7163	1433	7.51	2112	1056	7.70	9275	1325	7.55
16	1384	1319	1434	1520	1785	902	1007	7442	1488	7.80	1909	955	6.96	9351	1336	7.61
17	1263	1252	1288	1335	1654	874	918	6782	1358	7.12	1792	896	6.53	8584	1226	6.99
18	781	803	846	843	1197	598	694	4470	894	4.68	1292	646	4.71	5762	823	4.69
19	422	432	506	567	801	358	430	2728	546	2.86	788	394	2.87	3516	502	2.86
20	393	418	445	527	762	264	334	2545	509	2.67	598	299	2.18	3143	449	2.56
21	319	338	399	450	500	247	267	2006	401	2.10	514	257	1.87	2520	360	2.05
22	317	288	304	363	410	217	161	1682	336	1.76	378	189	1.38	2060	294	1.68
23	185	192	224	224	289	183	129	1114	223	1.17	312	156	1.14	1426	204	1.16
DAY TOT	18377	17539	18344	19159	22013	14726	12697	95432	19086	100.00	27423	13712	100.00	122855	17551	100.00
MAX	1400	1357	1434	1520	1785	1261	1090	AWT =	19086		AWE =	13712		ADT =	17551	

HOURLY TRAFFIC VOLUMES for Week commencing MON 9/08/04 Station No. 05.001.S

PACIFIC HWY,SH10 18M N OF HUNTER RIVER BR

HOUR	MON	TUE	WED	THU	FRI	SAT	SUN	WEEKDAYS			WEEKEND (+HOLIDAYS)			WHOLE WEEK		
comm.	9/08	10/08	11/08	12/08	13/08	14/08	15/08	TOTAL	MEAN	%	TOTAL	MEAN	%	TOTAL	MEAN	%
0	108	112	122	113	148	109	102	603	121	0.64	211	106	0.72	814	116	0.66
1	92	94	95	91	112	87	67	484	97	0.51	154	77	0.53	638	91	0.52
2	76	107	102	107	95	52	46	487	97	0.52	98	49	0.34	585	84	0.47
3	117	147	161	137	148	76	59	710	142	0.75	135	68	0.46	845	121	0.68
4	190	199	210	155	218	96	56	972	194	1.03	152	76	0.52	1124	161	0.91
5	470	438	455	446	427	241	143	2236	447	2.37	384	192	1.32	2620	374	2.12
6	938	968	957	939	981	408	253	4763	953	5.05	661	331	2.27	5424	775	4.39
7	1332	1287	1202	1233	1251	474	297	6305	1261	6.69	771	386	2.65	7076	1011	5.73
8	1378	1319	1439	1428	1360	883	509	6924	1385	7.34	1392	696	4.78	8316	1188	6.74
9	1087	1070	1128	1138	1236	1092	851	5859	1132	6.00	1943	972	6.67	7602	1086	6.16
10	1160	1125	1156	1159	1217	1213	1079	5817	1163	6.17	2292	1146	7.87	8109	1158	6.57
11	1124	1062	1079	1202	1354	1259	1246	5821	1164	6.17	2505	1253	8.60	8326	1189	6.75
12	1136	981	1015	1140	1317	1205	1371	5589	1118	5.93	2576	1288	8.85	8165	1166	6.62
13	1169	1005	1169	1174	1400	1086	1339	5917	1183	6.27	2425	1213	8.33	8342	1192	6.76
14	1235	1221	1249	1332	1546	1032	1351	6583	1317	6.98	2383	1192	8.18	8966	1281	7.26
15	1825	1844	1841	1998	1922	910	1474	9430	1886	10.00	2384	1192	8.19	11814	1688	9.57
16	1582	1477	1512	1602	1613	901	1459	7786	1557	8.26	2360	1180	8.11	10146	1449	8.22
17	1339	1366	1389	1452	1393	810	1163	6939	1388	7.36	1973	987	6.78	8912	1273	7.22
18	727	761	783	837	1035	629	884	4143	829	4.39	1513	757	5.20	5656	808	4.58
19	420	443	438	491	608	354	584	2400	480	2.54	938	469	3.22	3338	477	2.70
20	272	300	296	336	412	235	399	1616	323	1.71	634	317	2.18	2250	321	1.82
21	245	237	245	252	306	255	333	1285	257	1.36	588	294	2.02	1873	268	1.52
22	180	181	203	225	187	193	192	976	195	1.03	385	193	1.32	1361	194	1.10
23	143	170	175	192	187	128	132	867	173	0.92	260	130	0.89	1127	161	0.91
DAY TOT	18345	17914	18421	19179	20453	13728	15389	94312	18862	100.00	29117	14559	100.00	123429	17633	100.00
MAX	1825	1844	1841	1998	1922	1259	1474	AWT =	18862		AWE =	14559		ADT =	17633	

Appendix C Sidra Analysis results

Intersection Summary
Tomago Rd and site entry
Seagull base+dev AM peak stage 3 550 total flows (6/7/07)

Performance Measure	Vehicles	Persons
Demand Flows - Total	964 veh/h	1446 pers/h
Percent Heavy Vehicles	16.4 %	
Degree of Saturation	0.480	
Effective Intersection Capacity	2009 veh/h	
95% Back of Queue (m)	37 m	
95% Back of Queue (veh)	4.4 veh	
Control Delay (Total)	1.96 veh-h/h	2.94 pers-h/h
Control Delay (Average)	7.3 s/veh	7.3 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	469 veh/h	704 pers/h
Effective Stop Rate	0.49 per veh	0.49 per pers
Proportion Queued	0.28	0.28
Travel Distance (Total)	582.6 veh-km/h	874.0 pers-km/h
Travel Distance (Average)	604 m	604 m
Travel Time (Total)	11.6 veh-h/h	17.3 pers-h/h
Travel Time (Average)	43.2 secs	43.2 secs
Travel Speed	50.4 km/h	50.4 km/h
Operating Cost (Total)	450 $/h	450 $/h
Fuel Consumption (Total)	83.0 L/h	
Carbon Dioxide (Total)	209.0 kg/h	
Hydrocarbons (Total)	0.284 kg/h	
Carbon Monoxide (Total)	14.49 kg/h	
NOX (Total)	0.470 kg/h	

Movement Summary

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Site entry point										
1	L	74	5.4	0.082	9.8	LOS A	3	0.36	0.67	47.4
3	R	13	7.7	0.077	28.8	LOS C	2	0.82	0.94	33.5
Approach		**87**	**5.7**	**0.082**	**12.6**	**LOS A**	**3**	**0.43**	**0.71**	**44.6**
Tomago Rd westbound										
4	L	74	4.1	0.038	8.3	LOS A	0	0.00	0.67	49.0
5	T	206	15.0	0.106	0.0	LOS A	0	0.00	0.00	60.0
Approach		**280**	**12.1**	**0.106**	**2.2**	**LOS A**		**0.00**	**0.18**	**56.6**
Tomago Rd eastbound										
11	T	178	15.2	0.091	0.0	LOS A	0	0.00	0.00	60.0
12	R	419	22.0	0.480	12.7	LOS A	37	0.56	0.85	45.2
Approach		**597**	**19.9**	**0.480**	**8.9**	**LOS A**	**37**	**0.40**	**0.60**	**48.8**
All Vehicles		**964**	**16.4**	**0.480**	**7.3**	**Not Applicable**	**37**	**0.28**	**0.49**	**50.4**

Intersection Summary
Tomago Rd and site entry
Seagull base+dev PM peak Stage 3 550 flows (6/7/07)

Performance Measure	Vehicles	Persons
Demand Flows - Total	975 veh/h	1463 pers/h
Percent Heavy Vehicles	16.9 %	
Degree of Saturation	0.604	
Effective Intersection Capacity	1614 veh/h	
95% Back of Queue (m)	56 m	
95% Back of Queue (veh)	6.7 veh	
Control Delay (Total)	2.21 veh-h/h	3.32 pers-h/h
Control Delay (Average)	8.2 s/veh	8.2 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	518 veh/h	776 pers/h
Effective Stop Rate	0.53 per veh	0.53 per pers
Proportion Queued	0.34	0.34
Travel Distance (Total)	589.9 veh-km/h	884.9 pers-km/h
Travel Distance (Average)	605 m	605 m
Travel Time (Total)	11.9 veh-h/h	17.9 pers-h/h
Travel Time (Average)	44.1 secs	44.1 secs
Travel Speed	49.4 km/h	49.4 km/h
Operating Cost (Total)	465 $/h	465 $/h
Fuel Consumption (Total)	85.2 L/h	
Carbon Dioxide (Total)	214.5 kg/h	
Hydrocarbons (Total)	0.290 kg/h	
Carbon Monoxide (Total)	14.77 kg/h	
NOX (Total)	0.481 kg/h	

Movement Summary
Tomago Rd and site entry
Seagull base+dev PM peak Stage 3 550 flows (6/7/07)
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Site entry point										
1	L	444	22.1	0.604	14.4	LOS A	56	0.62	0.95	43.6
3	R	79	3.8	0.186	15.0	LOS B	7	0.59	0.87	42.5
Approach		**523**	**19.3**	**0.604**	**14.5**	**LOS B**	**56**	**0.62**	**0.94**	**43.5**
Tomago Rd westbound										
4	L	14	6.7	0.008	8.2	LOS A	0	0.00	0.67	49.0
5	T	238	15.1	0.122	0.0	LOS A	0	0.00	0.00	60.0
Approach		**253**	**14.6**	**0.122**	**0.5**	**LOS A**		**0.00**	**0.04**	**59.2**
Tomago Rd eastbound										
11	T	173	15.0	0.089	0.0	LOS A	0	0.00	0.00	60.0
12	R	26	3.8	0.024	9.6	LOS A	1	0.35	0.65	47.3
Approach		**199**	**13.6**	**0.089**	**1.2**	**LOS A**	**1**	**0.05**	**0.08**	**58.0**
All Vehicles		**975**	**16.9**	**0.604**	**8.2**	**Not Applicable**	**56**	**0.34**	**0.53**	**49.4**

Intersection Summary
Tomago Rd and site entry
2017 Seagull base+dev AM peak stage 3 550 total flows (6/7/07)

Performance Measure	Vehicles	Persons
Demand Flows - Total	1041 veh/h	1562 pers/h
Percent Heavy Vehicles	16.2 %	
Degree of Saturation	0.507	
Effective Intersection Capacity	2052 veh/h	
95% Back of Queue (m)	40 m	
95% Back of Queue (veh)	4.8 veh	
Control Delay (Total)	2.08 veh-h/h	3.11 pers-h/h
Control Delay (Average)	7.2 s/veh	7.2 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	498 veh/h	747 pers/h
Effective Stop Rate	0.48 per veh	0.48 per pers
Proportion Queued	0.28	0.28
Travel Distance (Total)	629.3 veh-km/h	944.0 pers-km/h
Travel Distance (Average)	605 m	605 m
Travel Time (Total)	12.5 veh-h/h	18.7 pers-h/h
Travel Time (Average)	43.1 secs	43.1 secs
Travel Speed	50.5 km/h	50.5 km/h
Operating Cost (Total)	482 $/h	482 $/h
Fuel Consumption (Total)	87.9 L/h	
Carbon Dioxide (Total)	221.2 kg/h	
Hydrocarbons (Total)	0.298 kg/h	
Carbon Monoxide (Total)	14.84 kg/h	
NOX (Total)	0.488 kg/h	

Movement Summary
Tomago Rd and site entry
2017 Seagull base+dev AM peak stage 3 550 total flows (6/7/07)
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Site entry point										
1	L	74	5.4	0.086	10.0	LOS A	3	0.39	0.69	47.2
3	R	13	7.7	0.092	33.2	LOS C	3	0.85	0.95	31.3
Approach		**87**	**5.7**	**0.092**	**13.5**	**LOS A**	**3**	**0.46**	**0.73**	**43.9**
Tomago Rd westbound										
4	L	74	4.1	0.038	8.3	LOS A	0	0.00	0.67	49.0
5	T	247	15.0	0.127	0.0	LOS A	0	0.00	0.00	60.0
Approach		**321**	**12.5**	**0.127**	**1.9**	**LOS A**		**0.00**	**0.15**	**57.0**
Tomago Rd eastbound										
11	T	214	15.0	0.110	0.0	LOS A	0	0.00	0.00	60.0
12	R	419	22.0	0.507	13.6	LOS A	40	0.61	0.92	44.4
Approach		**633**	**19.6**	**0.507**	**9.0**	**LOS A**	**40**	**0.40**	**0.61**	**48.7**
All Vehicles		**1041**	**16.2**	**0.507**	**7.2**	**Not Applicable**	**40**	**0.28**	**0.48**	**50.5**

Intersection Summary
Tomago Rd and site entry
2017 Seagull base+dev PM peak Stage 3 550 flows (6/7/07)

Performance Measure	Vehicles	Persons
Demand Flows - Total	1056 veh/h	1584 pers/h
Percent Heavy Vehicles	16.8 %	
Degree of Saturation	0.647	
Effective Intersection Capacity	1632 veh/h	
95% Back of Queue (m)	63 m	
95% Back of Queue (veh)	7.5 veh	
Control Delay (Total)	2.45 veh-h/h	3.68 pers-h/h
Control Delay (Average)	8.4 s/veh	8.4 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	569 veh/h	854 pers/h
Effective Stop Rate	0.54 per veh	0.54 per pers
Proportion Queued	0.35	0.35
Travel Distance (Total)	639.0 veh-km/h	958.5 pers-km/h
Travel Distance (Average)	605 m	605 m
Travel Time (Total)	13.0 veh-h/h	19.5 pers-h/h
Travel Time (Average)	44.3 secs	44.3 secs
Travel Speed	49.2 km/h	49.2 km/h
Operating Cost (Total)	502 $/h	502 $/h
Fuel Consumption (Total)	90.6 L/h	
Carbon Dioxide (Total)	228.2 kg/h	
Hydrocarbons (Total)	0.307 kg/h	
Carbon Monoxide (Total)	15.22 kg/h	
NOX (Total)	0.502 kg/h	

Movement Summary
Tomago Rd and site entry
2017 Seagull base+dev PM peak Stage 3 550 flows (6/7/07)
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Site entry point										
1	L	444	22.1	0.647	16.0	LOS B	63	0.68	1.06	42.3
3	R	79	3.8	0.216	17.0	LOS B	8	0.65	0.90	40.9
Approach		**523**	**19.3**	**0.647**	**16.2**	**LOS B**	**63**	**0.68**	**1.04**	**42.1**
Tomago Rd westbound										
4	L	14	6.7	0.008	8.2	LOS A	0	0.00	0.67	49.0
5	T	285	15.1	0.146	0.0	LOS A	0	0.00	0.00	60.0
Approach		**300**	**14.7**	**0.146**	**0.4**	**LOS A**		**0.00**	**0.03**	**59.3**
Tomago Rd eastbound										
11	T	207	15.0	0.106	0.0	LOS A	0	0.00	0.00	60.0
12	R	26	3.8	0.025	9.8	LOS A	1	0.39	0.66	47.2
Approach		**233**	**13.7**	**0.106**	**1.1**	**LOS A**	**1**	**0.04**	**0.07**	**58.2**
All Vehicles		**1056**	**16.8**	**0.647**	**8.4**	**Not Applicable**	**63**	**0.35**	**0.54**	**49.2**

Better Transport Futures

Mark Waugh Pty Limited
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Transport Planning & Engineering

Traffic Management Plan, Import of Fill Material, Tomago Rd, Tomago NSW



Traffic Management Plan – FULL Import Operations

March 2008

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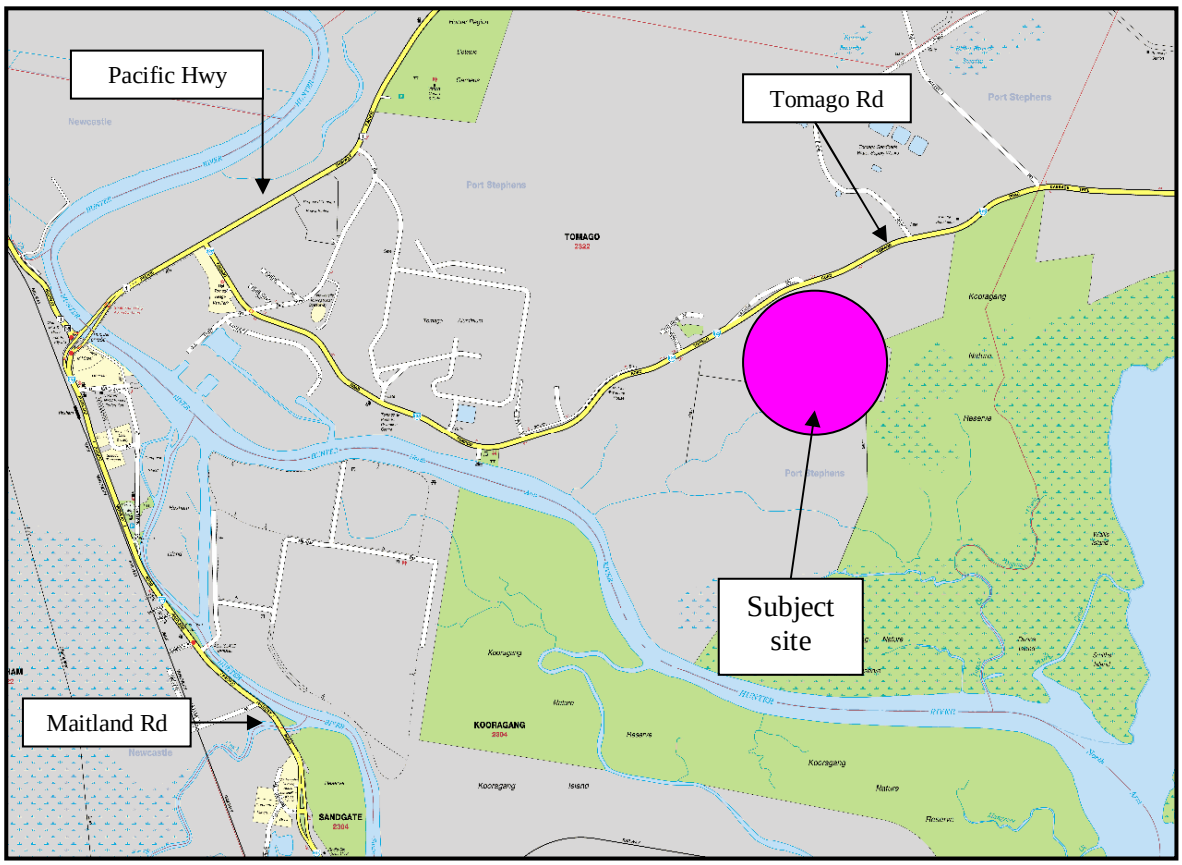
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1. Introduction

Better Transport Futures was commissioned by Asquith and de Witt to prepare a Traffic Management Plan (TMP) to manage the traffic operations during the fill operation for the land at Tomago, NSW. It is proposed to develop the site for future industrial use over a number of years. An initial Traffic Management Plan has been prepared and submitted for the initial fill operations on site and this report is for the balance of the import of fill material only as part of the on-going works for the site. This report and accompanying plans are required as part of the development consent from Port Stephens Council.

The project consists of importing fill to the site from various locations in the general locality of Newcastle and the Lower Hunter. The fill is required as part of the site establishment before the construction of the future development on the site. The land fill will be imported over a number of years, with the volume of fill being dependent upon the future uptake of land on the site. Advice from the study team indicates that the construction work on site will take place over a 10 year timeframe, and correspondingly the fill operation could take place over a similar timeframe.

The subject site is located to the west of south of Tomago Road in the general locality of Tomago and is shown in Figure 1 below. It is currently vacant land.



Source: Mark Waugh Pty Ltd. Map reproduced with permission of UBD. Copyright Universal Publishers Pty. Ltd. DG 11/05

Tomago Road is classified as a main road (number 302) and provides an important link between the Nelson Bay Peninsula to the east and the Pacific Highway to the west. It provides a single lane of travel for the majority of its length, with occasional widening at key locations to improve capacity. Adjacent to the subject site, it provides a single lane in each direction.

The posted speed limit along its length varies between 70 and 90 km/h. Within the built up areas, the speed limit reduces further to 60 and 70 km/h. Adjacent to the subject site the posted speed limit is 90 km/h. Along the frontage of the site there are no footpaths provided nor streetlights.

The intersection controls along the length of the road are simple priority controlled intersections (Stop or Give Way) as well as roundabout control. The majority of the adjacent land is used for light and heavy industrial use, with some residential use. It carries significant traffic volumes when the adjacent industrial development starts and finishes the work day, which creates significant peaks in the daily traffic flows between the subject site area and the Pacific Highway.

The RTA has been monitoring the local traffic conditions and has recently constructed a new signal controlled intersection at the intersection of the Pacific Highway and Old Punt Road. The RTA has also provided new traffic signal control at the intersection of the Pacific Highway and Tomago Road. These upgrades have been provided to improve road safety and also to increase capacity for the critical right turn movements.

1.1 Traffic Volumes

1.1.1 Intersection Survey

A traffic survey has been completed at the signal controlled intersection of the Pacific Highway and Tomago Road during both the morning and afternoon peak hour periods to determine the traffic flows at this location. These surveys were completed on Monday 13th February and Tuesday 14th February 2006.

The results from the traffic survey indicate that during the surveyed morning peak period (7.30 to 8.30 AM) the two-way traffic flows along the Pacific Highway to the south of Tomago Road were approximately 2,900 vehicles. The flows were reasonably evenly split, with 1440 vehicles northbound (49%) and 1,483 vehicles southbound. The majority of vehicles were light vehicles. There were in the order of 10% of the traffic flow observed as heavy goods vehicles during the survey period.

The corresponding afternoon traffic survey showed that the peak hour flow between 4.30 and 5.30 PM was approximately 3,100 vehicles per hour two-way. Again, the vast majority of traffic was light traffic with a heavy goods vehicle content of close to 10%. The traffic flows were pretty evenly split between northbound and southbound, with 1,577 vehicles southbound (50.7%).

The two-way flows along Tomago Road were much lower. During the morning peak the two-way flow was 738 vehicles and the afternoon flow was 872 vehicles. During the morning peak, the dominant flow was eastbound, associated with the industrial users located along Tomago Road whilst the dominant flow during the afternoon period was westbound towards the Pacific Highway.

A traffic survey was also completed on Tomago Road to the east of McIntyre Road, to obtain the two-way traffic flow along Tomago Road to the east of the industrial zone currently accessing Tomago Road. This survey was completed during both the morning and afternoon peak periods.

The results of the surveys are summarised in **Table 2.1** below.

Table 2.1 – Traffic Volumes

Road	Location	Direction	Mid-Block Road Capacity[2]	AM Peak hour Volumes[1]	PM Peak Hour Volumes[1]	Volume/ Capacity (AM)	Volume / Capacity (PM)
Pacific Highway	To south of Tomago Rd	Northbound	2800	1440	1531	0.51	0.55
Pacific Highway	To south of Tomago Rd	Southbound	2800	1483	1577	0.53	0.56
Tomago Road	To east of Pacific Hwy	Eastbound	1400	464	201	0.33	0.14
Tomago Road	To east of Pacific Hwy	Westbound	1400	274	671	0.20	0.48
Tomago Road	East of McIntyre Rd	Eastbound	1400	169	164	0.12	0.12
Tomago Road	East of McIntyre Rd	Westbound	1400	196	226	0.14	0.16

Notes: 1. Peak flow from September 2004 traffic survey results by Mark Waugh Pty Ltd
2. RTA 2002, Urban Road Conditions Level of Service E, from Table 4.4 of the RTA Guide to Traffic Generating Developments.

Tomago Road is a classified regional road and is under the control of the Roads and Traffic Authority for NSW (RTA). All vehicle access for the works, delivery of material for fill and construction workers etc will be via Tomago Road.

3. Fill Import Activities

2.1 Methodology

All material will be imported to the site from external sites. Advice from the client indicates that there is a total of 1.8 million cubic metres of fill to be imported to the site for the full development of the site (subject to authority DA approval). All material will be imported using truck and dog combination, to reduce the number of loads required. With a typical load of 40 tonnes it can be seen that there will be in the order of 58,500 truck loads entering the site over the duration of the works. This assumes a cubic metre of fill is in the order of 1.3 tonnes.

Whilst the fill source is not known at this stage, it is considered that the material will all be sourced from the south, north and west of the site from the Newcastle and Lower Hunter area. There will be little if any fill imported from the east of the site. The material will be sourced over a number of years, replicating the release of land for development.

Advice from the study team indicates that there could be in the order of 30 to 50 truck loads entering the site per day. This would give some 1200 to 1500 tonnes of fill per day or 1560 to 1950 cubic metres.

It is considered that the upper limit for the import of fill would be 50 trucks per day. Given the location of the site and the volume of fill required, it can be seen that sourcing the material will involve using a number of sites around the Lower Hunter region and it will be difficult to obtain more fill per day than the 50 truck loads.

The importing of fill will take place over a timeframe in the order of 10 years. The importation of fill will be completed in stages, to suit the construction work on site. The fill operations will also occur over concise stages, with works occurring over a number of weeks at a time with gaps in between when no fill material will be delivered to the site. During the periods of fill activity, there will be up to 50 inbound truck loads per day, with a corresponding outbound number of empty trucks.

As part of the fill operations, a large excavator will be required on site. This would be delivered to site before commencement of the fill operation and would remain on site for the full duration of the works. This excavator may be removed from site at the end of each stage and then returned to the site at the beginning of the next stage of fill operations. A petrol tanker will be required to access the site on a regular basis to service the excavator. Staff numbers on site for the fill operations would be relatively low, in the order of 5 maximum during fill operations.

3.1 Timing

The initial stages of the importing of fill have begun on site, and it is expected that each stage of the importing of fill would take in the order of 6 months or less to complete.

3.2 Working Hours

Normal working hours would be between 7:00am and 6:00pm Monday to Friday, and 7:00am to 1:00pm Saturdays. No construction work is scheduled for Night time, Sundays or Public Holidays.

Work may be undertaken outside these hours where:

- The delivery of fill may occur outside these hours if required by the Police or other authorities.
- Council providing permission for working out of hours
- It is required in an emergency to avoid loss of life, damage to property and / or to prevent environmental harm
- The work is approved from the Construction Noise and Vibration Management Plan
- Residents likely to be affected by the works are notified of the timing and duration of these works at least 48 hours prior to the commencement of the works.

4. Traffic Control Plan

4.1 General

This TCP has been prepared to meet the requirements of the RTA Traffic Control at Work Sites Manual 2003 Edition. The plan covers the access requirements to the site and the safe passage of vehicles in and out of the subject site during the fill operations.

At all times the Roads and Traffic Authority's Traffic Control at Work Sites guidelines must be adhered to. Please refer to the RTA guidelines for traffic control matters not listed in this report.

4.2 Existing traffic conditions on Nelson Bay Road

- 90km/hr Speed limit;
- Peak AM traffic approximately 370 vehicles per hour two-way adjacent to site
- Peak PM traffic approximately 390 vehicles per hour two-way adjacent to site
- Work Site on the southern side of Tomago Road to the east of the Tomago Smelter site Tomago, NSW and
- No restrictions to access to adjacent properties are created by the works.

4.3 Cyclists and Pedestrians

There are limited pedestrian and cyclist movements along Tomago Road. There are no existing pedestrian footpaths in the vicinity of the site.

There are no existing cyclist facilities along Tomago Road. All cyclist movement will remain as per the current situation with cyclists using the road carriageway.

4.4 General Traffic Control Considerations

The factors that have been considered in preparing this TCP are:

- All parking associated with employees on the site can be contained within the site with no requirement to park on Tomago Road
- All deliveries will approach the site from the west, turning right into the site and then departing by turning left onto Tomago Road.
- No loading/delivery to be completed along the Tomago Road frontage.
- No delivery vehicles will be permitted to stand on the roadway. All vehicles are to be unloaded within the site.
- NO alteration to the existing speed zone will need to be applied
- Pedestrian and cyclist considerations;
- Location of machines/personnel on-site relative to roadway;
- Access to/from Work Site;
- Timing of works, and
- Safety of road users and site personnel.

The RTA Traffic Control at Worksites 2003 manual recommends safety barriers are considered if:

- The location will continue to be a work area for longer than two weeks. (Applicable)
- Traffic speeds are likely to be greater than 80 km/hr. (Applicable)
- ADT exceeds 5000 vehicles for traffic lane nearest the works. (Applicable)
- The work area is less than 3 metres clear of traffic on straights (less on tight curves) (Not Applicable)
- Personnel do not have other protection, such as operating plant. (Not Applicable)

Each stage of the filling operation is expected to take around 6 months or less to complete.

The location and nature of the work does not require any safety barrier to be installed. At its closest point the work will be at least 7 metres from the closest traffic lane.

The local speed zone limits of 90 km/h are considered adequate for the environment adjacent to the construction site.

4.5 Traffic Control – Signage and Line Marking

The TCP provides Work Site definition and sets out the extent of the Work Zone adjacent to the worksite. General signage and line marking are included due to the nature of the passing traffic and the location and nature of the works.

All signs shall be permanently mounted and shall be covered outside working hours. The signs shall be uncovered at the beginning of the working day before any trucks access the site.

A copy of this TCP must be on site at all times.

4.6 Daily Checklist

In accordance with the Roads and Traffic Authority of New South Wales 'Traffic Control at Worksites' guidelines, the site ganger should complete a daily traffic control checklist and this checklist should be filed for future reference. A copy of the RTA's Proforma Checklist from the guidelines is included in **Appendix B.**

4.7 Traffic Impact

Due to the nature of the work, the frequency of delivery trucks will be relatively low. Over the typical 8 hour working day there would be in the order of 4 to 7 trucks entering and exiting the site per hour and traffic along Tomago Road may experience minor delays due to this additional traffic.

The proposed works will have little if any impacts upon pedestrians.

The existing roadway width should allow a cyclist to safely pass the site at this time.

4.8 Contractors Contact Details

Project Manager:
Telephone:
Fax:
Mobile:
E-mail .

4.9 Road Occupancy

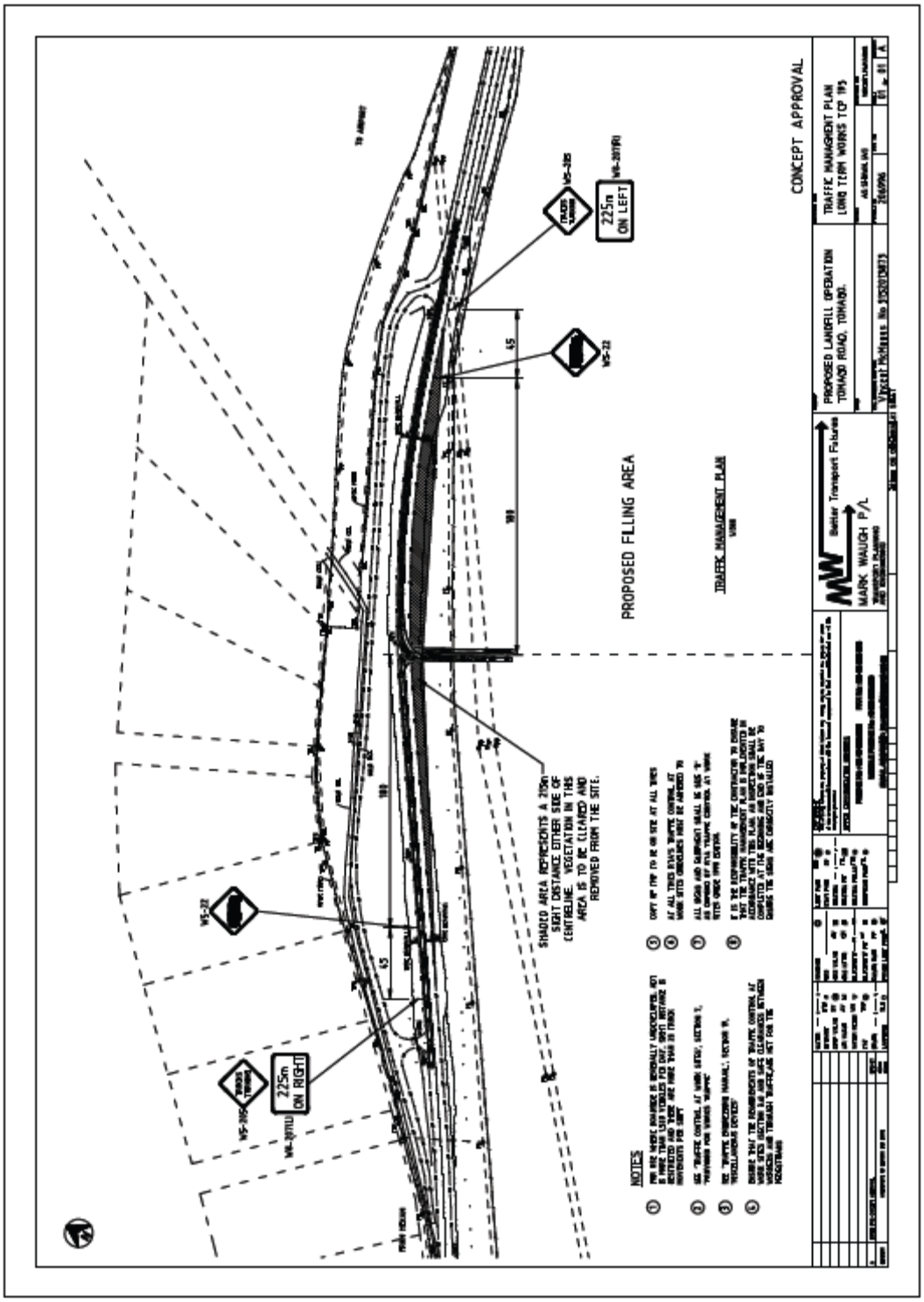
An 'Application for Road Occupancy Licence on State Roads' form is attached in **Appendix C.** This will be completed once full details of the construction personnel awarded the contract for the works is known. Details for lodging the form and plan with the RTA are:

- TCP and Application required to be completed and faxed to Bruce Kimber at the Roads and Traffic Authority, Newcastle, at least 2 weeks prior to the commencement of Works for each and every stage.
- RTA fax number **02 4924 0347.**

This Traffic Control Plan has been prepared and reviewed by suitable qualified professionals in accordance with the RTA Traffic Control at Work Sites Manual 2003 edition.

Sean Morgan 6th March 2008

Appendix A Traffic Control Plans



Appendix B RTA Check Lists (Appendix E of RTA Traffic Control at Works Site Manual)

Appendix E Audit and checklist forms

This Appendix contains examples of audit and checklist forms to be used at traffic control sites. The forms may be modified to suit local requirements provided that the basic information is retained.

AUDIT CHECKLIST

Date.....Time.....Auditor.....

RTA Office/Contractor.....Site Supervisor.....

Location.....TCP No.....

Type of work.....

Duration of work.....

Road configuration.....

Rate in the following manner:

✓ Acceptable X Not Acceptable N/A Not Applicable

No	Conditions	TCAWSM Section	Rating
1	**TCP**		
1.1	Is an approved TCP on site ?	4.3.1 & 4.3.2	
1.2	Is the TCP relevant for the works in progress ?	4.3.2	
1.3	Is the TCP correctly implemented (i.e. all signs and devices in place and at correct spacing) ?	4.3.2	
2	**Roadwork Speed Limits**		
2.1	Is a roadwork speed limit in place ?	8.2	
2.2	Is the limit the correct one ?	8.2.3	
2.3	Are all signs installed and at the correct spacings ?	8.2.4	
2.4	Is the speed limit authorised ?	8.2.5	

COMMENTS

3	**Traffic Controllers**		
3.1	Are Traffic Controllers being used ?	8.1	
3.2	Have their Traffic Control Certificates been sighted ?	8.1.1a	
3.3	Are they wearing high visibility clothing ?	8.1.1b	
	Are they correctly authorised ?	8.1.1b	
	Are they positioned to be visible to approaching traffic ?	8.1.1d	
4	**Portable Traffic Signals (PTS)**		
4.1	Are portable traffic signals being used ?	10	
4.2	Is the approach speed limit 80 km/h or less ?	10.7.2	
4.3	Is minimum sight distance provided ?	10.7.3	
4.4	Have the signals been approved for use ?	T 10.7	
4.5	Are the signal Type Approved ?	10.5	
5	**Flashing Arrow Sign (FAS)**		
5.1	Is a flashing arrow sign being used ?	11	
5.2	Is it the correct Type ?	3.2.2	
5.3	Is it located correctly ?	11.4.4	
5.4	Is it Type Approved ?	11.2	
6	**Variable Message Sign (VMS)**		
6.1	Is a variable message sign being used ?	3.2.8	
6.2	Is the message relevant ?	3.2.8	
6.3	Is the sign located in a safe position ?		
7	**Safety Barriers**		
7.1	Are safety barriers installed correctly ?	9.6	
7.2	Have the correct barriers been installed ?	9.6 & 3.3.7	
COMMENTS			

8	**Signs and Devices**		
8.1	Are signs and devices in good condition ?	4.3.2	
8.2	Are the signs clearly visible and not affected by other signs. Plant items, vegetation, shade, light glare etc ?	3.1.1	
8.3	Are the correct sign sizes being used ?	3.2.2	
8.4	Are signs duplicated ?	3.2.4	
8.5	Are signs erected at the correct height and position ?	3.2.7	
8.6	Are the signs erected to give the correct sight distance ?		
8.7	Are there any contradictory or superfluous signs, devices or markings ?	4.3.2	
8.8	Have the needs of pedestrians been provided for ?	9.3	
8.9	Have the needs of cyclists been provided for ?	9.4	
8.10	Are all property accesses to the site controlled ?	9.7	
8.11	Are all cones and bollards installed at the correct spacing ?	5.2.2	
8.12	Has the potential for end of queue accidents been considered and action taken ?	3.5.7	

COMMENTS

RECOMMENDATIONS/CORRECTIVE ACTION

Auditor.....**Site Supervisor**.....

DAILY CHECKLIST – TRAFFIC CONTROL AT SHORT TERM WORK SITES

SITE SUPERVISOR:_____ **DATE:**_____

REPORTING OFFICE/COMPANY:_____

SITE:	1		2		3		4	
TCP No:								
INSPECTION:	Pre-Start	Pre-Close	Pre-Start	Pre-Close	Pre-Close	Pre-Start	Pre-Close	Pre-Start
TIME: (24 hrs)								
All signs used during the work are to be recorded below, using the following codes: *Y – signs and devices are in place during pre-start check and between shifts.* *N – signs and devices are no longer required at pre-close down check.* *X – signs and devices are damaged, vandalised or missing.*								
Signs and devices:								
Traffic Signals – time operational	To		To		To		To	
Appr No								
Temp Speed – time operational	To		To		To		To	
Appr No								
Speed (km/h)								
Supervisor's Initials:								

SITE 1

SITE 2

SITE 3

SITE 4

WEEKLY CHECKLIST – TRAFFIC CONTROL AT LONG TERM WORK SITES

NATURE OF WORK_____ **TCP No**_____

LOCATION_____

REPORTING OFFICE/COMPANY_____

DATE								
INSPECTION	Pre-Start	Pre-Close	Pre-Start	Pre-Close	Pre-Close	Pre-Start	Pre-Close	Pre-Start
TIME: (24 hrs)								
All signs used during the work are to be recorded below, using the following codes: ***Y – signs and devices are in place during pre-start check and between shifts.*** ***N – signs and devices are no longer required at pre-close down check.*** ***X – signs and devices are damaged, vandalised or missing.***								
Signs and devices								
Traffic Signals – time operational	To		To		To		To	
Appr No								
Temp Speed – time operational	To		To		To		To	
Appr No								
Speed (km/h)								
Supervisor's Initials:								

COMMENTS:

Appendix C Application for Road Occupancy Licence

Roads and Traffic Authority of NSW
Hunter Region / Central Coast

Application for Road Occupancy Licence on State Roads

Name of road: **Tomago Road**

Location & Suburb: **Tomago NSW**

Site contact Name and Phone Number

Type of work: **Import of fill material to development site**

Hours of work: **7:00 am to 6:00pm Monday to Friday, 7:00am to 1:00pm Saturdays.**
No construction work is scheduled for Night time, Sundays or Public Holidays.

Dates and days: August 2007 for up to December 2017 (typically maximum 6 month duration per year)

Est. completion: December 2017

NB: Works < or =7 days Duration 1 Wk Notice Required. Works > 7 days Duration 2 Wks Min Notice Required

Will there be any lanes closed? (Tick boxes)	Yes	☐	How many normally? One lane	☐	How many closed?	0
	No	X				

Circle closed lanes : N/B S/B E/B W/B

Existing speed zoning - 9**0 kph** Work speed zoning: - 9**0kph**

**** Private Contractors Have You Received RTA Approval (Sect 138) To Alter The Asset? Yes / No → NO – NOT REQUIRED**

TCP No. to be used …… Altered Yes / No (Attach if Altered) → Not Applicable

Will there be any delays? (Tick boxes)	Yes	X	Extent of delays?	< 5 mins	X
	No	☐		< 10 mins	☐
NO DELAYS PERMITTED ON F3 4AM to 8PM				> 10 mins	☐ (attach further information)

Procedures to minimise traffic delays (eg. Nightwork, detours):

……

Emergency procedures (if unplanned long delays occur. ie. over 10 minutes):

……

……

Do the roadworks impose a restriction on the passage of over dimension or overweight vehicles? **→NO**

Details of weight/height etc……

Concurrence/Approvals	Yes	No	Concurrence and Comments
Project Manager			
Traffic Commander			
Traffic / Network Line Manager			

PROPONENT DECLARATION

-: Our TCP complies with the RTA TCP Manual Requirements, Traffic at the site will be controlled as described in the plan. In the event of Lane Closures, the proponent or representative WILL notify the RTA Transport Management Centre (TMC) at the start and end of each shift/days work on 131700.

Signed: _____ Name /Company: _____ Contact: _____
Title_____
Address/ Section:
Date_____
Proponents Fax Number _____ Proponents Telephone Number _____

Appendix H

DEVELOPMENT PLANS



LOCATION PLAN

Scale 1:50,000 APPROX.

DRAWING SCHEDULE

A0100	LOCATION PLAN, DRAWING SCHEDULE
A0101	MASTERPLAN - ALL STAGES
A0102	STAGE 1 SITE PLAN
A0105	STAGE 1 SITE ELEVATIONS
A0110	ADMINISTRATION BUILDING FLOOR PLAN
A0111	B'CON & ON-HIGHWAY TRUCKS BUILDING FLOOR PLAN
A0112	WESTRAC INSTITUTE FLOOR PLAN
A0113	CHANGE ROOM, CAFETERIA BUILDING FLOOR PLAN
A0114	PARTS WAREHOUSE BUILDING FLOOR PLAN
A0115	PARTS OUTDOOR STORAGE AREA PLAN
A0116	CRC BUILDING FLOOR PLAN
A0117	GENERAL WORKSHOP FLOOR PLAN
A0118	UTILITY BUILDINGS FLOOR PLAN
A0119	HYDRAULIC & HVOF BUILDING FLOOR PLAN

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A	24.09.07	ISSUE FOR CLIENT APPROVAL	JPC	KMG
B	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
C	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

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ARCHITECT:	EJE ARCHITECTURE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
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LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
L3, 30 KINGS PARK ROAD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

DRAWING :
- LOCATION PLAN
- DRAWING SCHEDULE

EJE architecture

WORK IN FIGURED DIMENSIONS IN PREFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMPLETION OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

DRAWN :	DATE :	SCALES :
JPC	SEPT 2007	NTS

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0100	C



SUBDIVISION MASTERPLAN - ALL STAGES

Scale 1:2500

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REV	DATE	COMMENTS	DRN	CHKD
A	12.12.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
B	18.12.07	ISSUE FOR INCLUSION IN OVERVIEW DESIGN DOCUMENT	JPC	BJC
C	14.01.08	ISSUE FOR CLIENT CO-ORDINATION	JPC	BJC
D	07.03.08	ISSUE FOR CLIENT SIGN-OFF	JPC	BJC

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HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

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WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

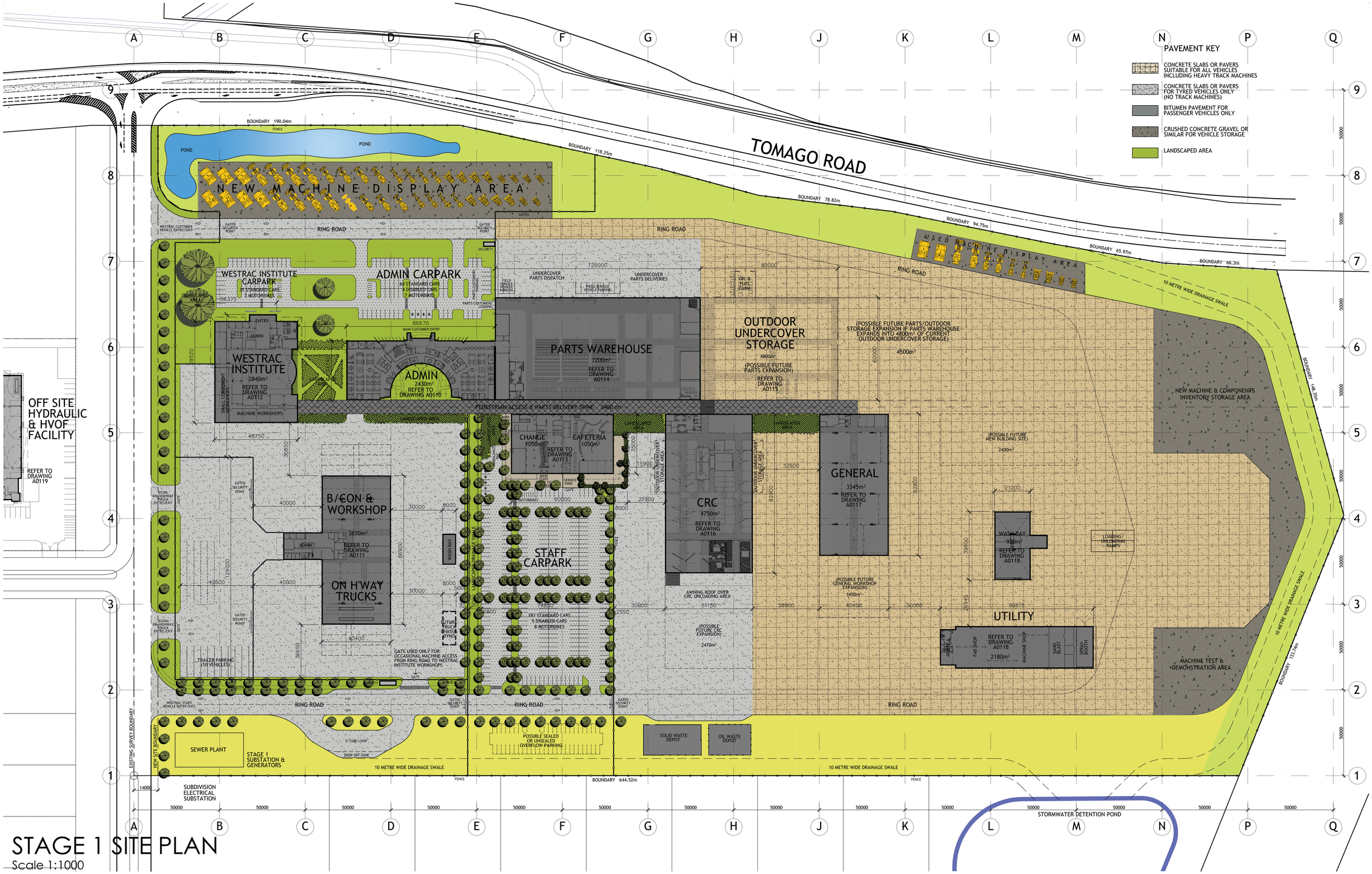
DRAWING :
SUBDIVISION MASTERPLAN - ALL STAGES

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JPC	DEC 07	1:2500

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	CC	A1001	D



STAGE 1 SITE PLAN

Scale 1:1000

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REV	DATE	COMMENTS	DRN	CHKD
B	13.08.07	UPDATED MASTERPLAN FOR CLIENT COMMENT	RJD	BJC
C	21.08.07	UPDATED MASTERPLAN FOR CLIENT COMMENT	GCS	BJC
D	21.08.07	UPDATED MASTERPLAN FOR CLIENT COMMENT	GCS	BJC
E	06.09.07	GENERAL REVISION FOR REVIEW	JPC	KMG
F	24.09.07	ISSUE FOR CLIENT APPROVAL	JPC	KMG
G	06.11.07	GENERAL REVISION FOR REVIEW	JPC	KMG
H	13.11.07	ISSUE FOR CO-ORDINATION	JPC	BJC
J	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
K	19.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
L	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
M	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

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LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

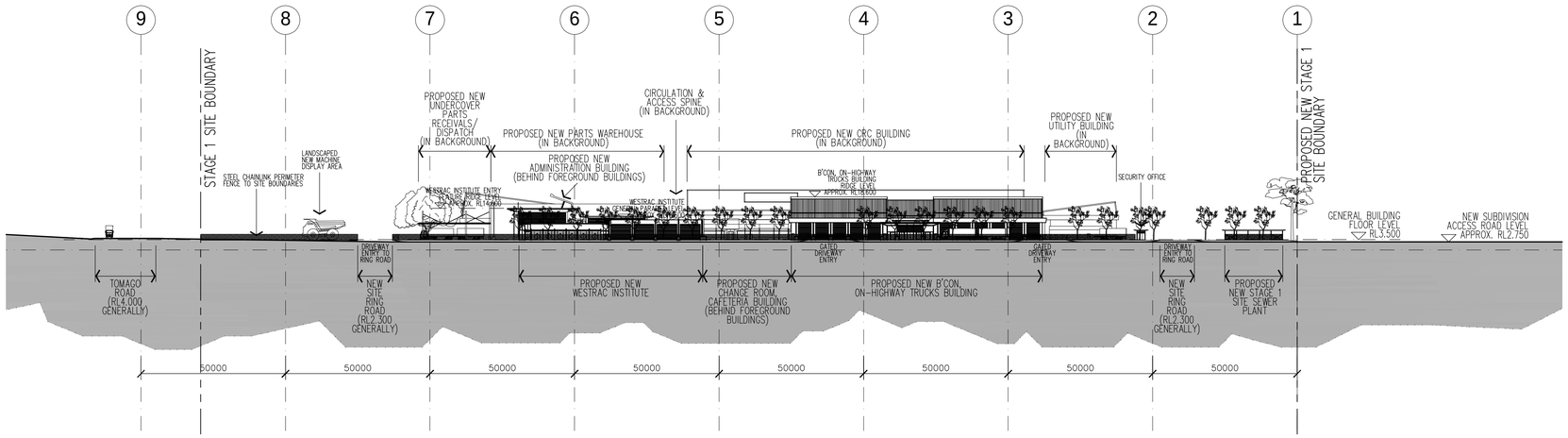
DRAWING :
STAGE 1
SITE PLAN

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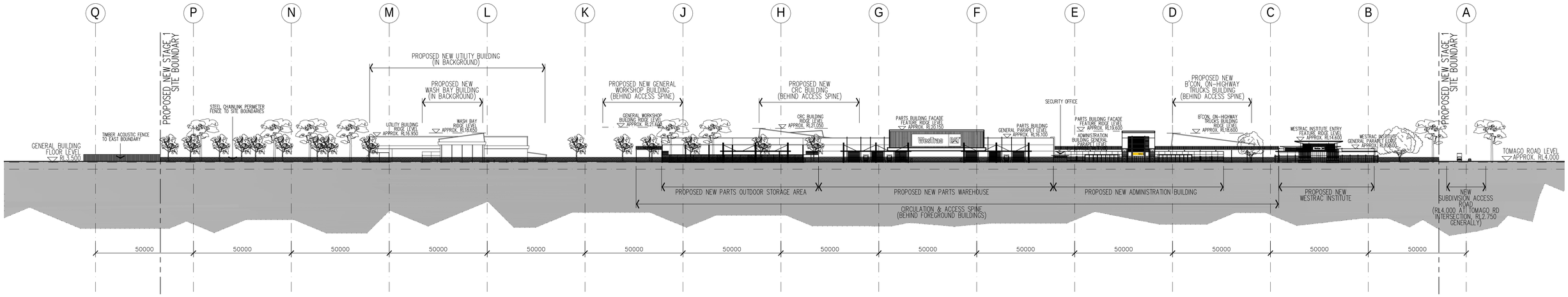
DRAWN :	DATE :	SCALES :
JPC	AUG 07	1:1000

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0102	M



STAGE 1 SITE ELEVATIONS
- WEST ELEVATION (VIEW FROM NEW SUBDIVISION ACCESS ROAD)

Scale 1:1000



STAGE 1 SITE ELEVATIONS
- NORTH ELEVATION (VIEW FROM TOMAGO ROAD)

Scale 1:1000

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REV	DATE	COMMENTS	DRN	CHKD
A	22.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
B	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

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MECHANICAL:	
ELECTRICAL:	
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SITE :
TOMAGO ROAD
TOMAGO

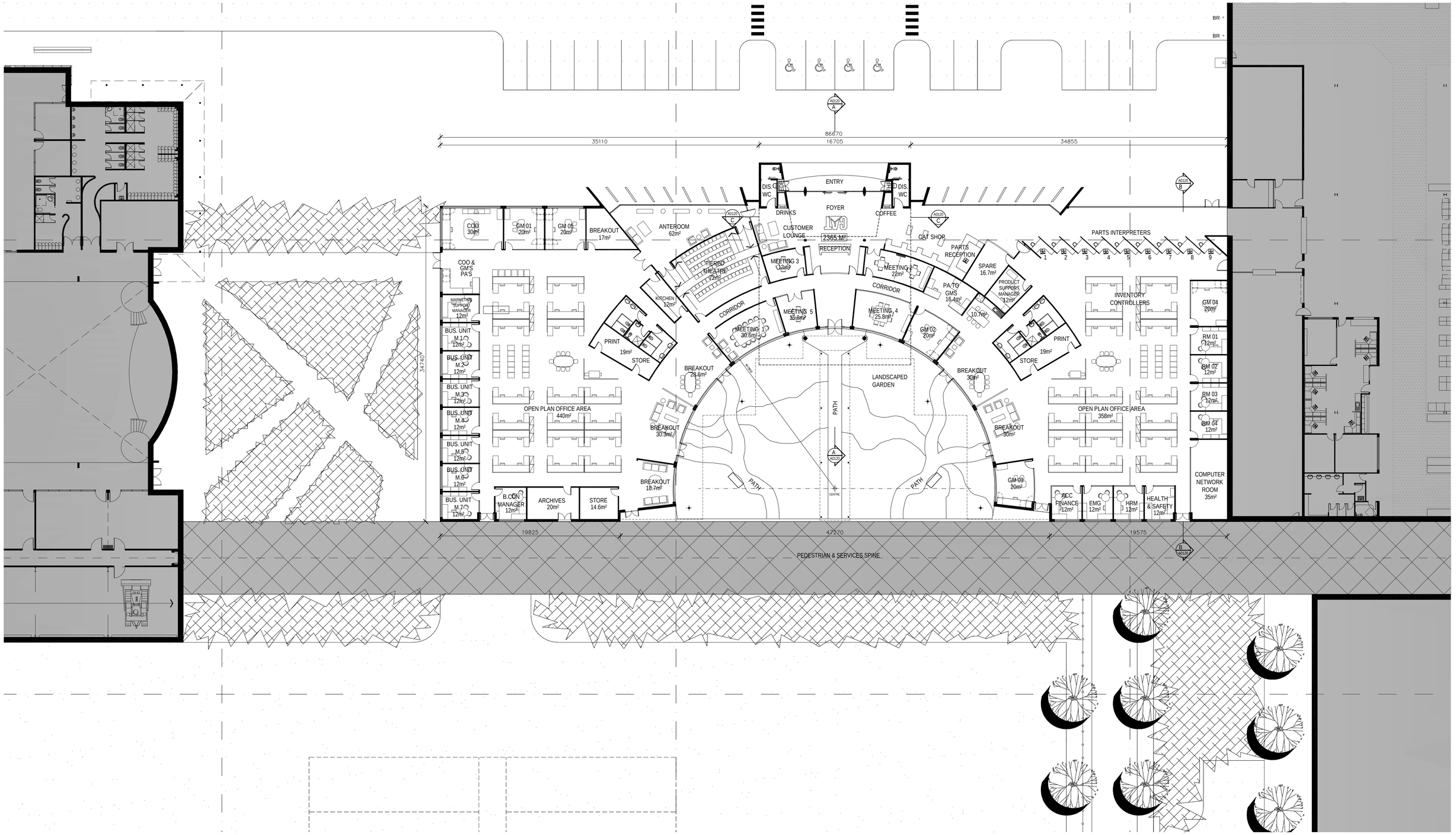
DRAWING :
STAGE 1
SITE ELEVATIONS

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JPC	NOV 07	1:1000

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0105	B



ADMINISTRATION BUILDING FLOOR PLAN

Scale 1:200

REV	DATE	COMMENTS	DRN	CHKD
B	13.08.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
C	20.08.07	ROOM AREA'S ISSUED FOR CLIENT REVIEW	JPC	BJC
D	24.09.07	ISSUE FOR CLIENT APPROVAL	JPC	KMG
E	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
F	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
G	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

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mail@eje.com.au http://www.eje.com.au

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CIVIL: ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
STRUCTURAL:
LANDSCAPE: TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
HYDRAULIC:
MECHANICAL:
ELECTRICAL:
FIRE:

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

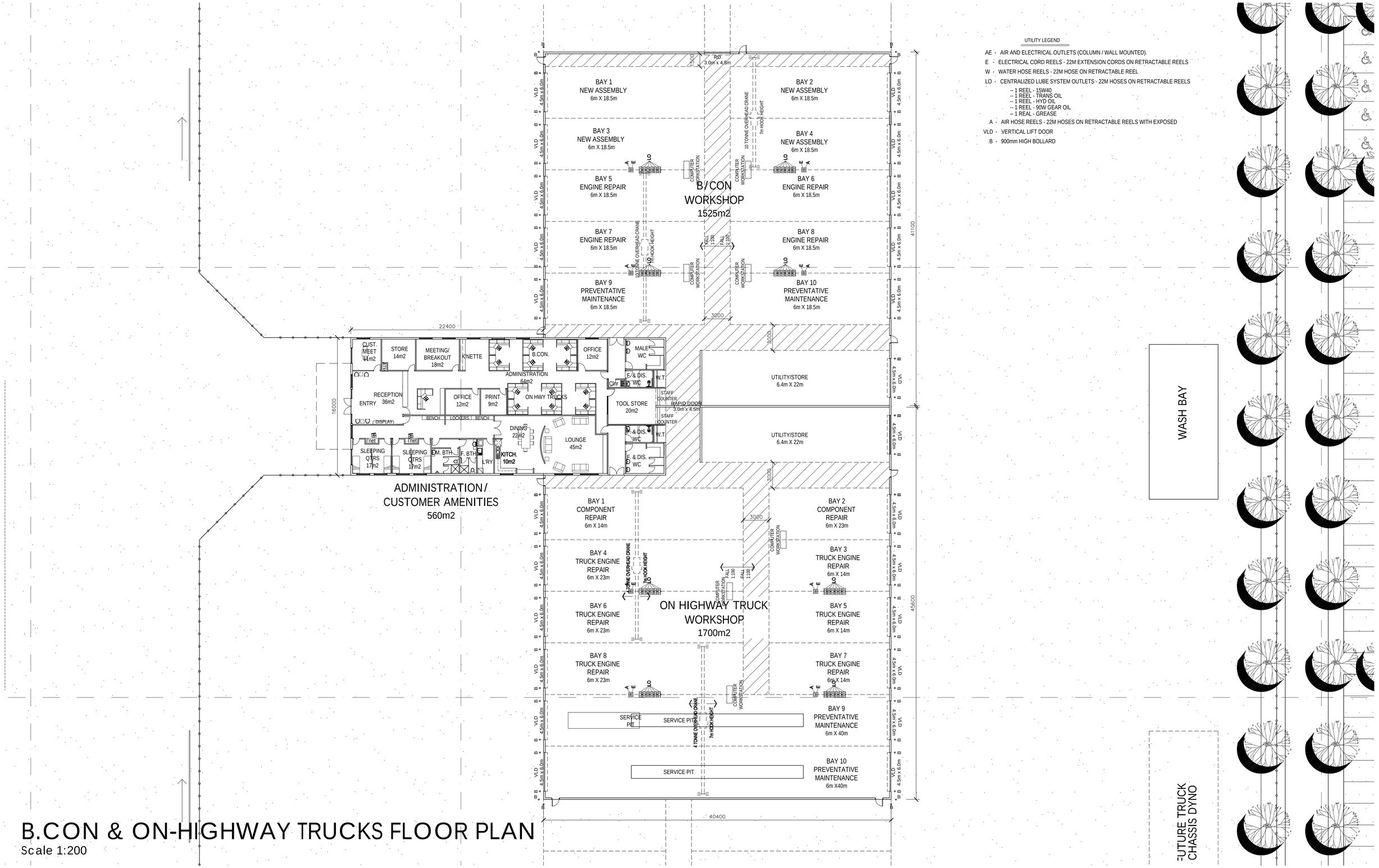
DRAWING :
ADMINISTRATION BUILDING FLOOR PLAN

EJE architecture

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JPC	AUG 07	1:200

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0110	G



B.CON & ON-HIGHWAY TRUCKS FLOOR PLAN

Scale 1:200

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REV	DATE	COMMENTS	DRN	CHKD
A	-.08.07	ISSUE FOR CLIENT REVIEW	GCS	KG
B	10.09.07	ISSUE FOR CLIENT REVIEW	GCS	KG
C	19.09.07	ISSUE FOR CLIENT REVIEW	GCS	KG
D	24.09.07	ISSUE FOR CLIENT APPROVAL	GCS	KG
E	22.10.07	ISSUE FOR CLIENT APPROVAL	GCS	KG
F	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
G	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
H	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

CLIENT:	REDLAKE ENTERPRISES, LVL 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
ARCHITECT:	EJE ARCHITECTURE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
STRUCTURAL:	
LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

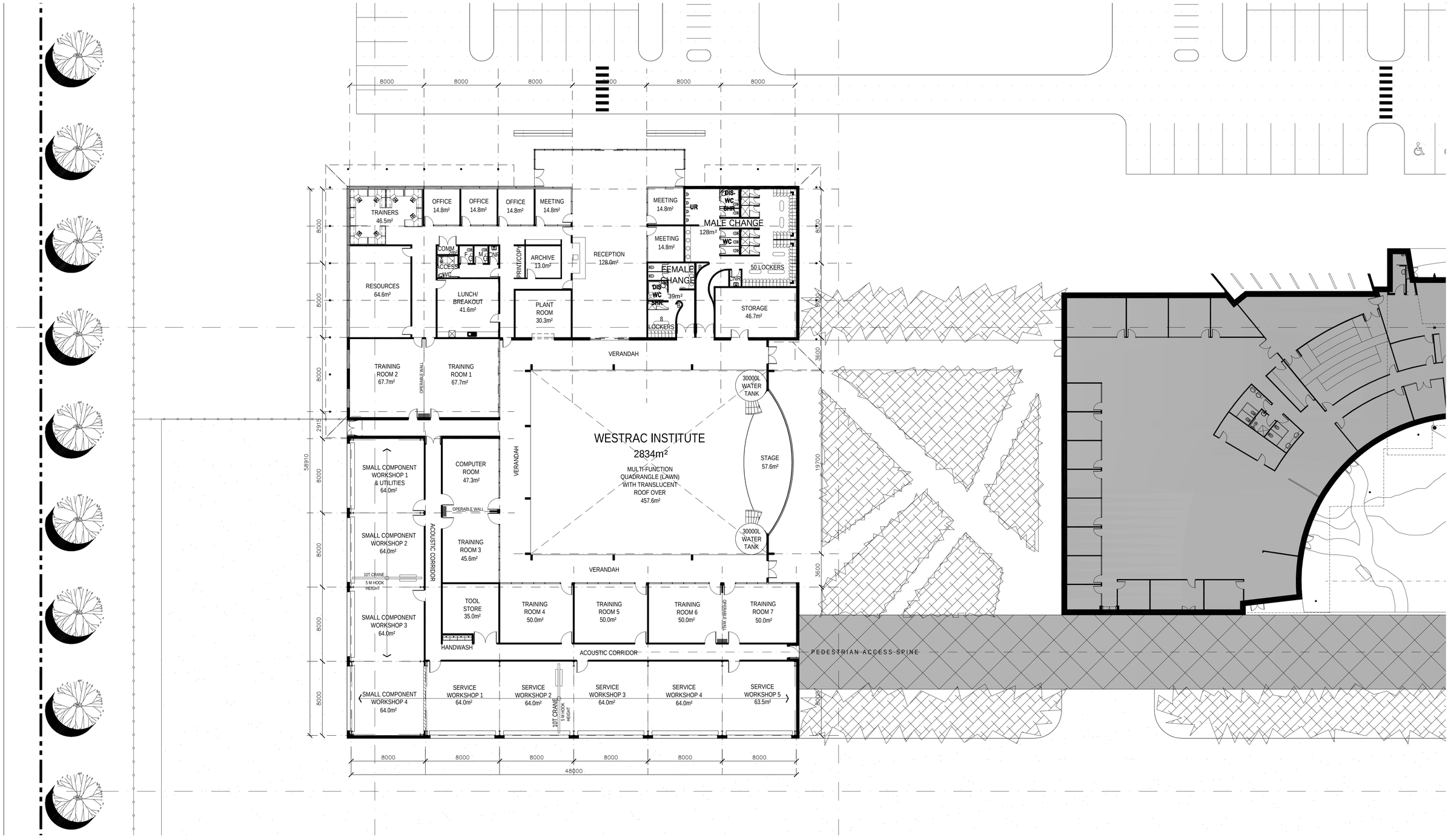
DRAWING :
B'CON & ON-HIGHWAY TRUCKS FLOOR PLAN

EJE architecture

WORK IN FIGURED DIMENSIONS IN PREFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMPLETION OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

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GCS	AUG 07	1:200

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0111	H



WESTRAC INSTITUTE FLOOR PLAN

Scale 1:200

AMENITIES SCHEDULE

	FEMALE CHANGE	MALE CHANGE
WC	3 (1 Dis)	6 (1 Dis)
BASIN	3	4
SHOWERS	2 (1 Dis)	7 (1 Dis)
LOCKERS	8	50
URINAL	-	4

COMPLETION OF THE QUALITY A"

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REV	DATE	COMMENTS	DRN	CHKD
B	13.08.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
C	24.09.07	ISSUE FOR CLIENT APPROVAL	RJD	KG
D	12.11.07	ISSUE FOR CLIENT APPROVAL	RJD	KG
E	15.11.07	ISSUE FOR CLIENT APPROVAL	RJD	KG
F	19.11.07	ISSUE FOR CLIENT REVIEW	RJD	KG
G	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
H	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

CLIENT:	REDLAKE ENTERPRISES, LVL. 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
ARCHITECT:	EJE ARCHITECTURE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
STRUCTURAL:	
LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
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ELECTRICAL:	
FIRE:	

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REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

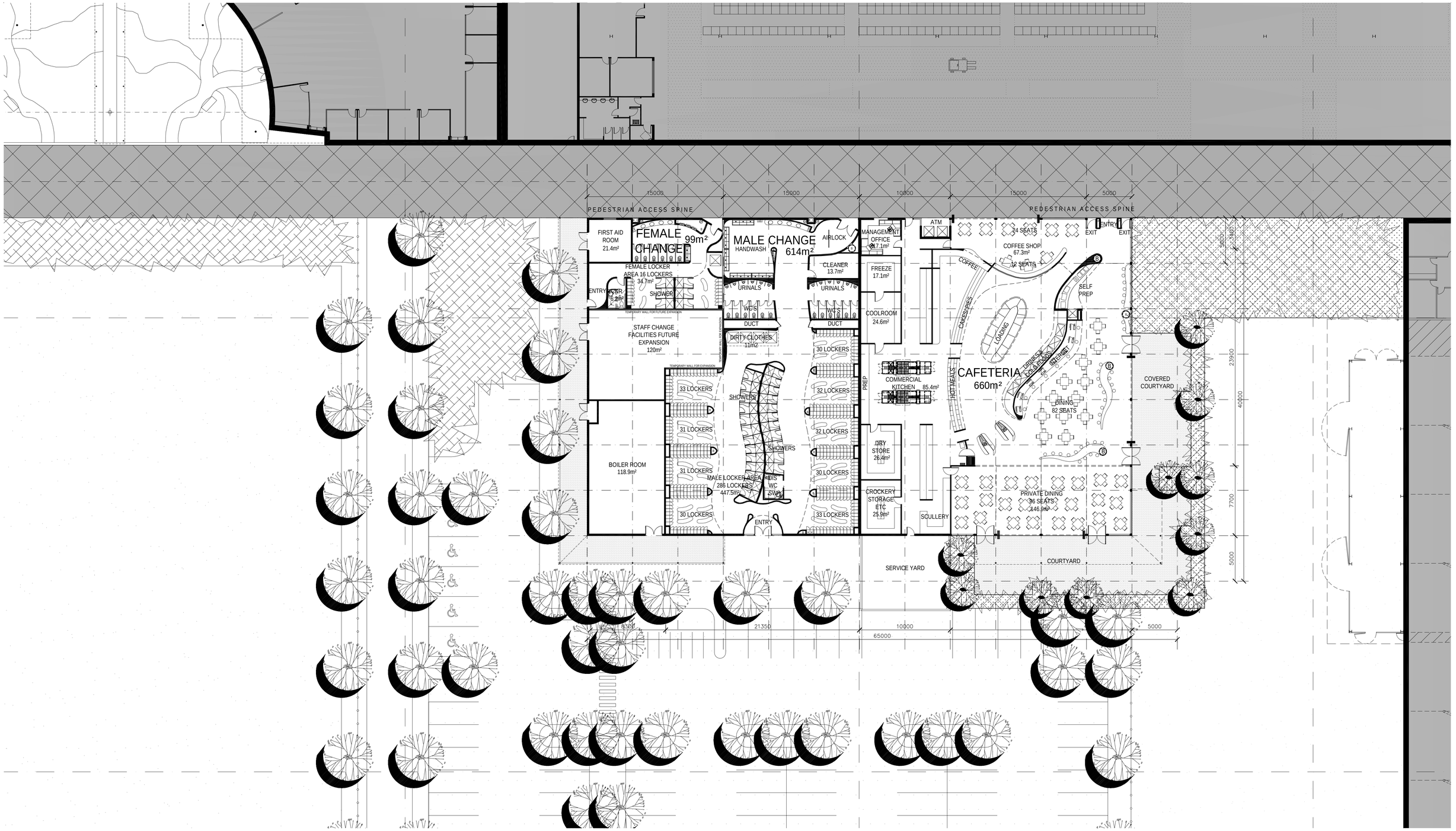
DRAWING :
WESTRAC INSTITUTE FLOOR PLAN

EJE architecture

WORK IN FIGURED DIMENSIONS IN PREFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMPLETION OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

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RJD	AUG 07	1:200

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0112	H



CHANGE ROOM & CAFETERIA FLOOR PLAN

Scale 1:200

AMENITIES SCHEDULE		
	FEMALE CHANGE	MALE CHANGE
WC	6	13 (1 Dis)
BASIN	4	4
SHOWERS	6	25 (1 Dis)
LOCKERS	16	286
URINAL	-	12
H'WASH TUB	2	15

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REV	DATE	COMMENTS	DRN	CHKD
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C	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
D	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
E	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

CLIENT:	REDLAKE ENTERPRISES, Lvl. 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
ARCHITECT:	EJE ARCHITECTURE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
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ACN 068 121 317

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PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
L3, 30 KINGS PARK ROAD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

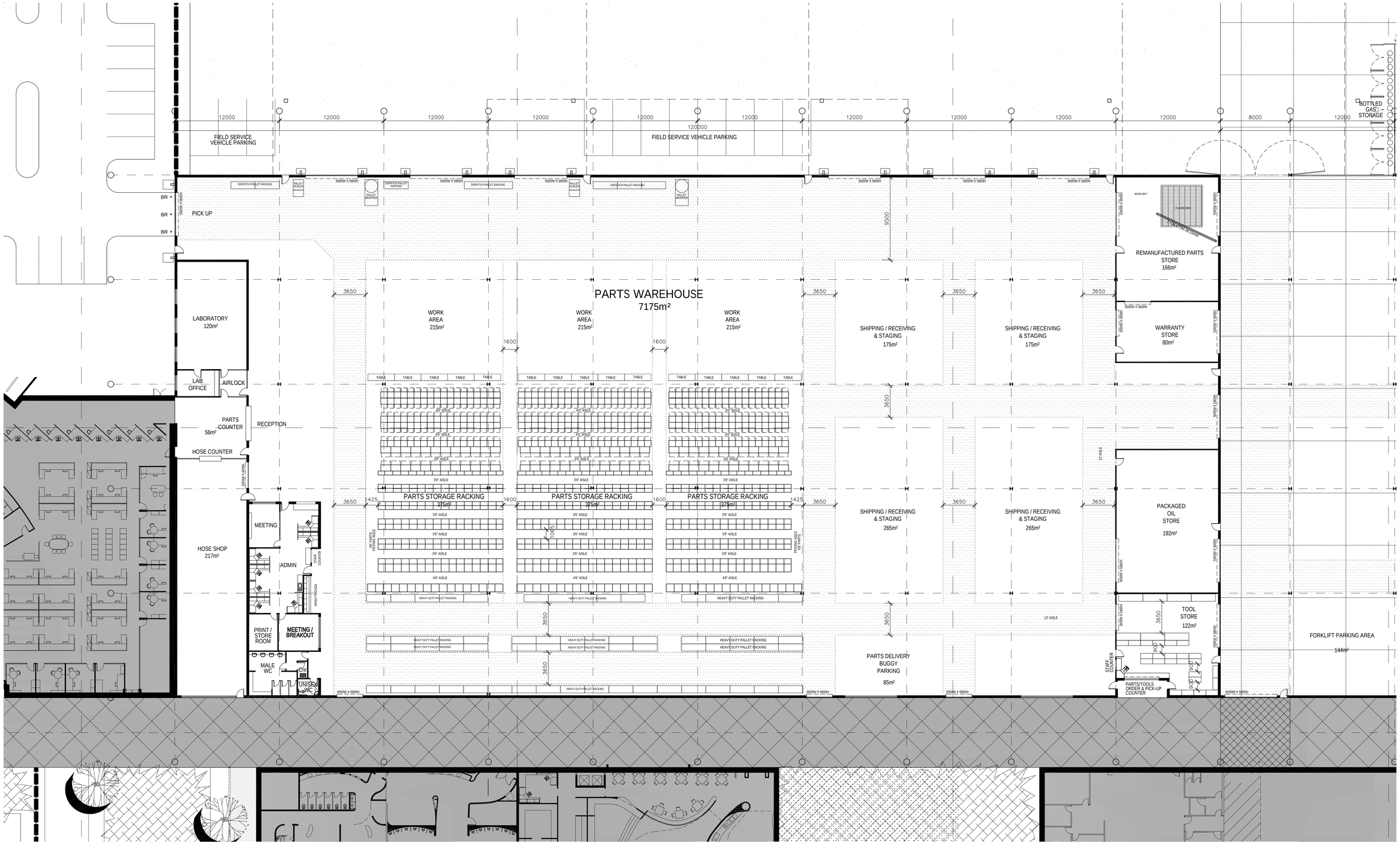
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CHANGE ROOMS & CAFETERIA FLOOR PLANS

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PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0113	E



PARTS WAREHOUSE FLOOR PLAN

Scale 1:200

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REV	DATE	COMMENTS	DRN	CHKD
A	24.09.07	ISSUE FOR CLIENT APPROVAL	JPC	KMG
B	10.10.07	DUPLICATE STAND STORE ROOM LABEL CHANGED	JPC	KMG
C	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
D	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
E	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

CLIENT:	REDLAKE ENTERPRISES, LVL 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
ARCHITECT:	EJE ARCHITECTURE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
STRUCTURAL:	
LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

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REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

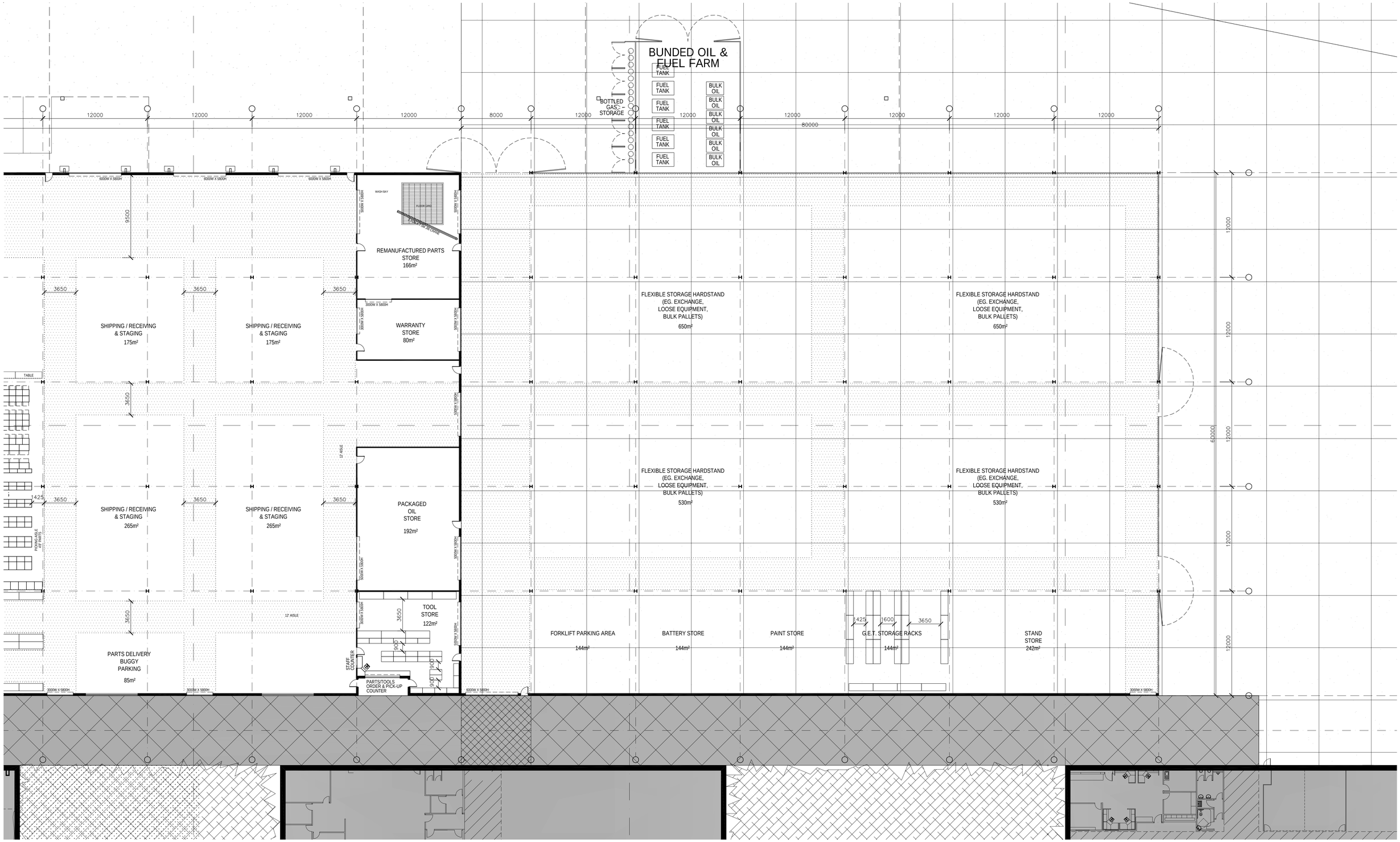
DRAWING :
PARTS WAREHOUSE BUILDING FLOOR PLAN

EJE architecture

WORK IN FIGURED DIMENSIONS IN PREFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMPLETION OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

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PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0114	E



PARTS OUTDOOR STORAGE FLOOR PLAN

Scale 1:200

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CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
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FIRE:	

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ACN 068 121 317

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PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

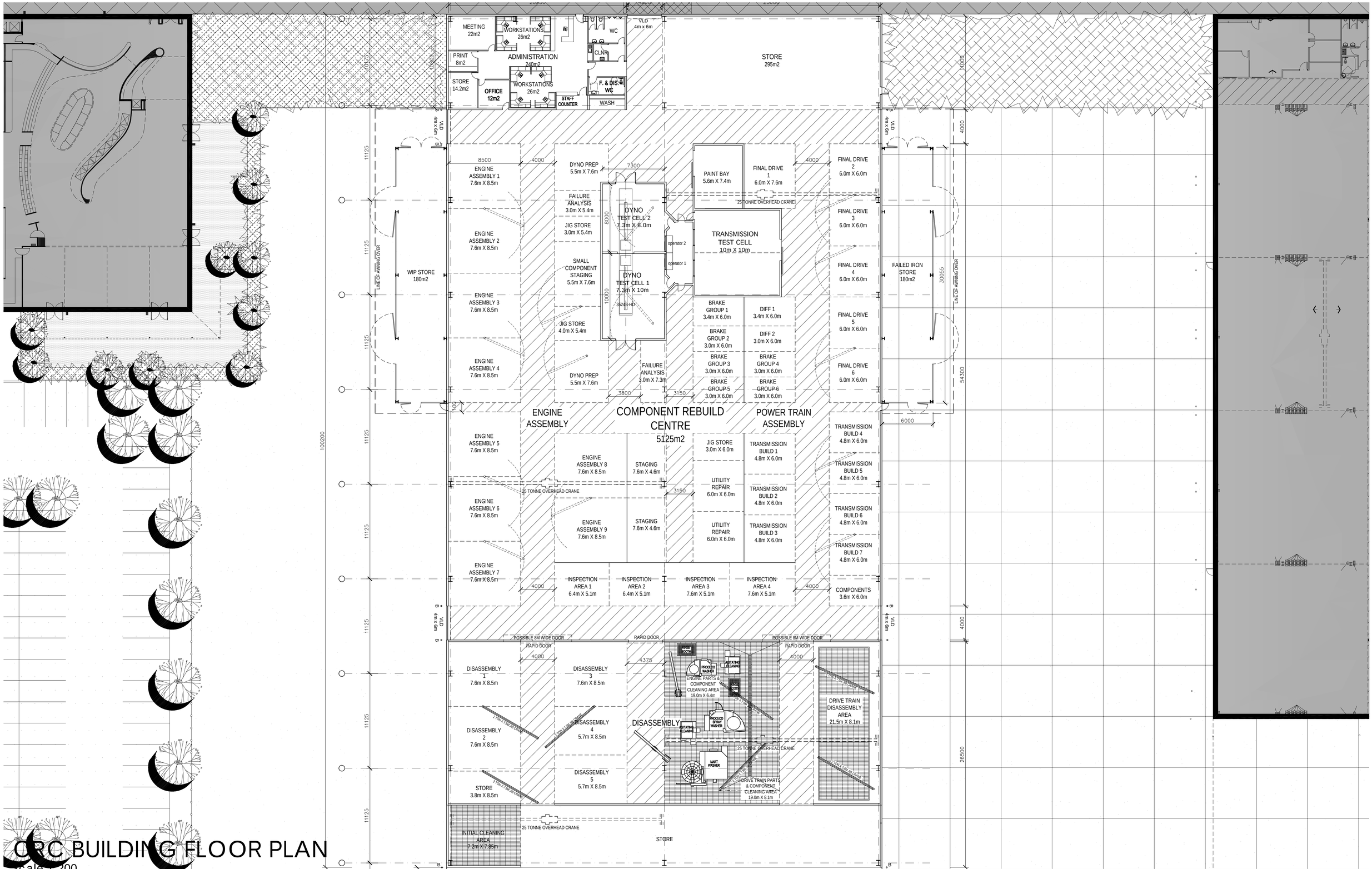
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PARTS OUTDOOR STORAGE FLOOR PLAN

EJE architecture

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CRC BUILDING FLOOR PLAN

Scale 1:200

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B	07.09.07	ISSUE FOR CLIENT REVIEW	GCS	KG
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CLIENT:	REDLAKE ENTERPRISES, LVL 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
ARCHITECT:	EJE ARCHITECTURE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
CIVIL:	ASQUITH & DE WITT, 7/335 HILLSBOROUGH RD, WARNERS BAY 2282, ph 02.49785100
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LANDSCAPE:	TERRAS LANDSCAPE, 412 KING ST, NEWCASTLE 2300, ph 02.49292353
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MECHANICAL:	
ELECTRICAL:	
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REDLAKE ENTERPRISES PTY. LIMITED
ACN 088 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

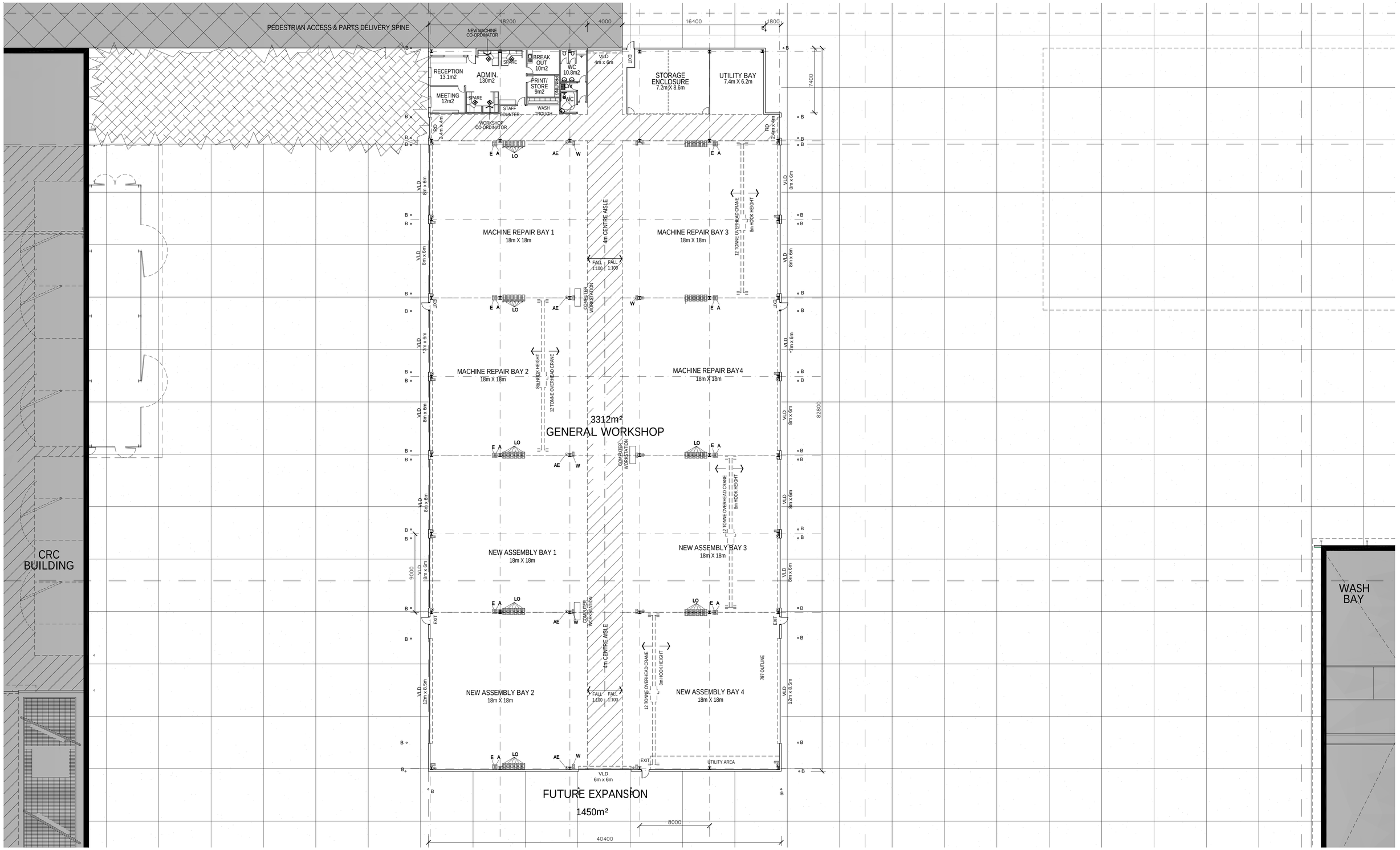
DRAWING :
CRC BUILDING FLOOR PLAN

EJE architecture

WORK IN FIGURED DIMENSIONS IN PREFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMPLETION OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

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7254	DA	A0116	F



GENERAL WORKSHOP FLOOR PLAN

Scale 1:200

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REV	DATE	COMMENTS	DRN	CHKD
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C	24.08.07	ISSUE FOR CLIENT APPROVAL	GCS/RJD	KG
D	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
E	20.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC
F	29.11.07	ISSUE FOR DEPT OF PLANNING PROJECT APPLICATION	JPC	BJC

CLIENT: REDLAKE ENTERPRISES, LVL 3, 30 KINGS PARK RD, WEST PERTH 6005, ph 08.92158888
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STRUCTURAL:
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HYDRAULIC:
MECHANICAL:
ELECTRICAL:
FIRE:

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
LEVEL 3, 30 KINGS PARK RD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

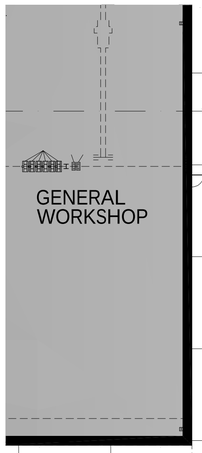
DRAWING :
GENERAL WORKSHOP BUILDING FLOOR PLAN

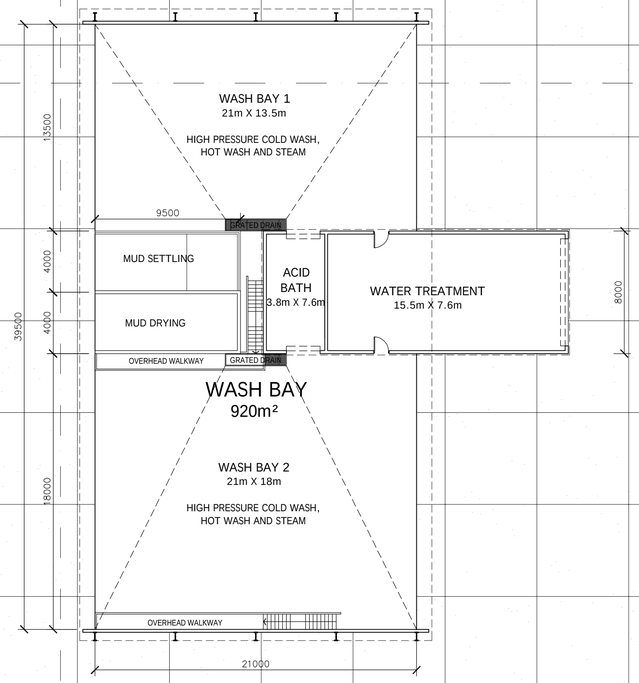
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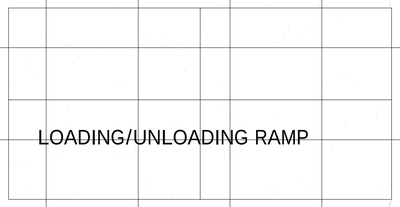
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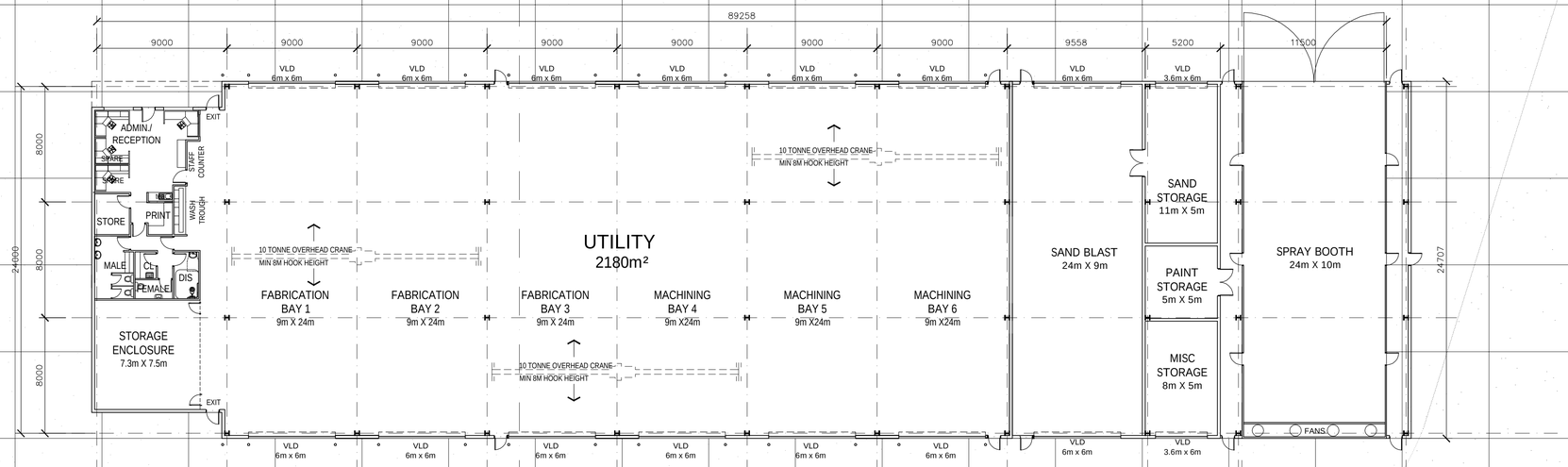
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JPC	AUG 07	1:200

PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0117	F









UTILITY & WASH BAY BUILDING FLOOR PLANS

Scale 1:200

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REV	DATE	COMMENTS	DRN	CHKD
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B	15.11.07	ISSUE FOR CLIENT REVIEW	JPC	BJC
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HYDRAULIC:	
MECHANICAL:	
ELECTRICAL:	
FIRE:	

REDLAKE ENTERPRISES PTY. LIMITED
ACN 068 121 317

WesTrac CAT

PROJECT :
PROPOSED NEW WESTRAC FACILITY, TOMAGO

CLIENT :
REDLAKE ENTERPRISES
L3, 30 KINGS PARK ROAD
WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

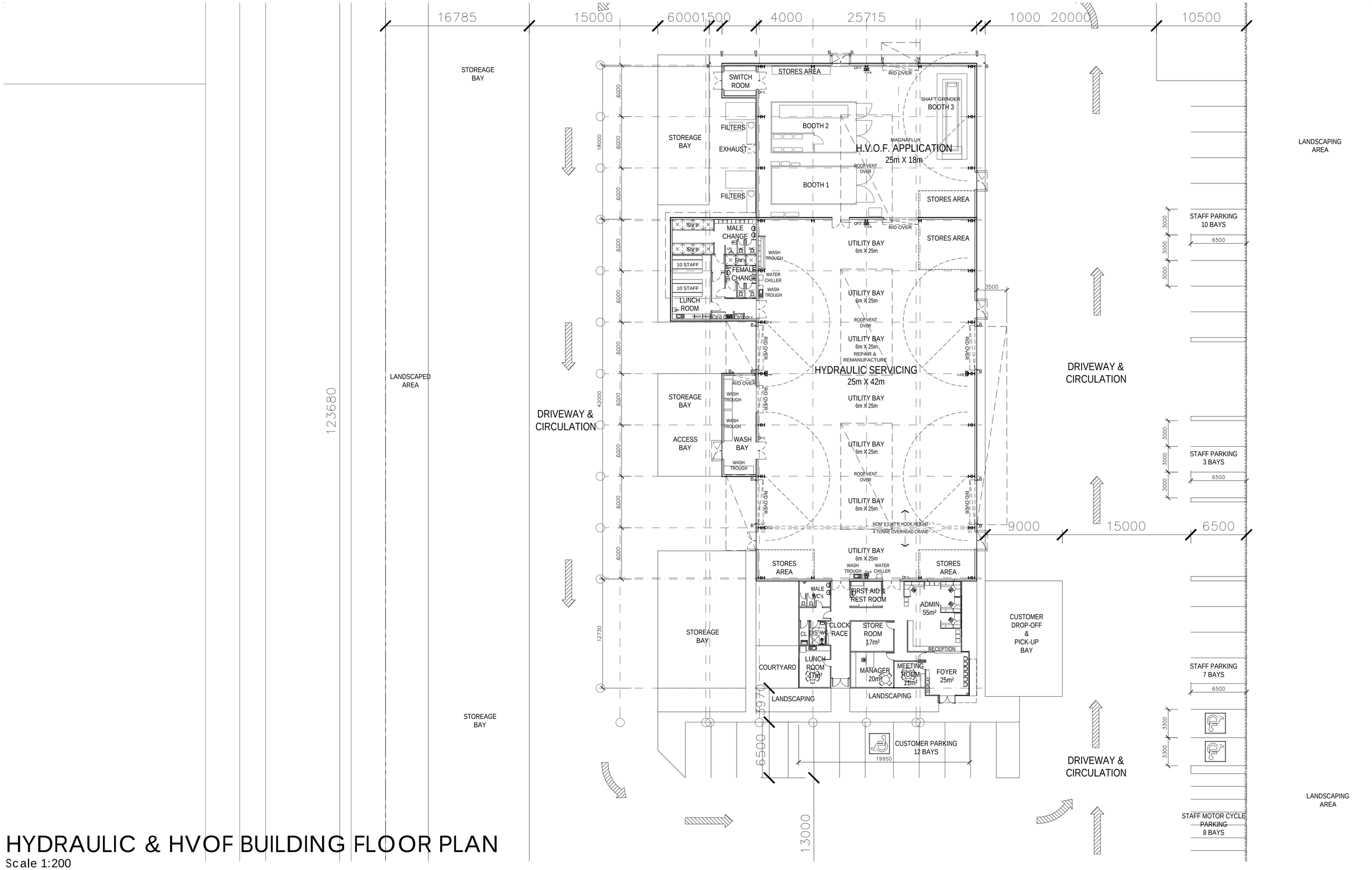
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UTILITY & WASH BAY BUILDING FLOOR PLANS

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WesTrac CAT

PROJECT :
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WEST PERTH WA 6005

SITE :
TOMAGO ROAD
TOMAGO

DRAWING :
HYDRAULIC & HVOF BUILDING FLOOR PLAN

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PROJECT No :	PHASE :	DRAWING No :	REV :
7254	DA	A0119	D

Appendix I

EPBC ASSESSMENT

Prepared by:

ASQUITH & deWITT PTY LTD

EPBC ASSESSMENT

Location:

TOMAGO ROAD, TOMAGO

Owner:

REDLAKE ENTERPRISES PTY LTD



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Section 1
Introduction

The proposed development for the establishment of WesTrac operations and industrial subdivision is a controlled action under the EPBC Act and is subject to assessment under the Bilateral Agreement between the Commonwealth and NSW governments. The assessment process will be under Part 3A of the Environmental Planning & Assessment Act, which is an accredited process. Relevant controlling provisions are:

- Wetlands of international importance (sections 16 and 17B);
- Listed threatened species and communities (sections 18 and 18A) and
- Listed migratory species (sections 20 and 20A).

Under the Bilateral Agreement the matters specified in Schedule 4 of the EPBC Regulations should be considered. This document has been prepared to address these matters and should be read in conjunction with the Environmental Assessment Report and submitted plans (This document and the Environmental Assessment Report form the environmental impact statement).

This report has been prepared in accordance with the NSW DOP Commonwealth Environment Protection and Biodiversity Conservation Act Guidelines, May 2007. The information provided meets the requirements specified in the Guidelines and Schedule 4 of the EPBC Regulation.

The format of the following report follows the outline prescribed in Schedule 4 of the EPBC Act. To this structure a conclusion has been added that addresses matters identified in the Commonwealth EPBC Guidelines.

Section 2
General Information

2.1 BACKGROUND OF THE ACTION

2.1.1 The Title of the Action

Proposed WesTrac operations facility and industrial subdivision.

2.1.2 The Full Name and Postal Address of the Designated Proponent

Person responsible for preparing assessment documentation:

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Senior Planner
Asquith & de Witt Pty Ltd
7/335 Hillsborough Road Warners Bay NSW 2282

Responsible Party:

David Aspinall
Redlake Enterprises Pty Ltd
C/- Asquith de Witt Pty Ltd
7/335 Hillsborough Road Warners Bay

2.1.3 A Clear Outline of the Objective of the Action

The objective of the action is to establish WesTrac operational facilities and industrial subdivision for future development.

2.1.4 The Location of the Action

The subject site of the proposed action comprises Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256, including the adjoining road reserve, Tomago Road, Tomago, NSW.

2.1.5 The Background to the Development of the Action

The proposal includes an industrial development to facilitate the assembly, sale, maintenance and repair of heavy earthmoving equipment, warehousing and distribution of parts, associated uses and subdivision, and required land filling.

The proposed development is a Major Project to be determined under Part 3A of the Environmental Planning & Assessment Act.

Of particular note is the conservation outcomes achieved as part of the rezoning of this site and those adjoining to General Industrial. Some 241.3 hectares of land was set aside for conservation as part of the Memorandum Of Understanding between the Minister for the Environment, the Minister for Planning and the then owner of the subject land (and current owner of adjoining lands) the Regional Land Management Corporation Pty Ltd. Attached is a copy of that MOU as **Appendix A** to this document.

2.1.6 How the Action Relates to any Other Actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action

The action is not known to relate to any other action or proposed action.

2.1.7 The Current Status of the Action

The action is currently seeking approval under Part 3A of the Act.

2.1.8 The Consequences of Not Proceeding with the Action

Not proceeding with the action will compromise regional strategic planning development outcomes envisaged by the Lower Hunter Regional Strategy (detailed in the Environmental Assessment Report), particularly as an area for provision of employment. The site classification as a State Significant Site and industrial zoning under the Major Projects State Environmental Planning Policy reflects this strategic importance.

In addition, not proceeding with the action will have a significant impact on the current operations of WesTrac and will inhibit future growth and employment opportunities and have a material impact on the ability to service customer needs and in particular the mining industry in NSW which relies heavily on Caterpillar equipment supplied, serviced and maintained by WesTrac.

Section 3
Description

A description of the action, including:

3.1 THE COMPONENTS OF THE ACTION

The proposed development is broken up into stages and involves the following actions:

- The majority of the subject site will be filled to the 1:100 year flood level (fill area approximately 107 hectares);

- Stage 1 development of approximately 23 hectares for the purpose of an integrated WesTrac facility for the following:

    - Manufacture/assembly, display, sale, maintenance and servicing of predominantly large earth moving and mining machinery but also smaller machinery;

    - Warehouse and distribution of associated parts;

    - Servicing of on highway trucks;

    - WesTrac Rental Agency for the rental of Machinery and other equipment associated with the construction industry on long or short term basis;

    - WesTrac/Institute for WesTrac NSW/ACT apprentices and general training in new technologies and procedures; and

    - Construct an intersection off Tomago Road.

- Stage 2 filling of the balance of the land and subdivision for sale to related and unrelated land users in a number of sub stages.

The EAR contains plans showing the proposed layout of all components of the proposed development.

3.2 THE LOCATION OF WORKS TO BE UNDERTAKEN

The subject site is approximately 116 hectares in size, and is situated in Tomago (NSW), off Tomago Road. The subject site is bound by Tomago Road to the north with rural residential land and naturally forested areas beyond, rural residential land and wetland including part of Kooragang Nature Reserve (listed as a Ramsar

wetland of international importance) to the east, rural land and some wetland including a small portion of Kooragang Nature Reserve to the south and rural residential land to the west but also zoned for Industrial development.

The EAR contains site plans and aerial showing the location of the site.

3.3 HOW THE WORKS ARE TO BE UNDER TAKEN

The Environmental Assessment Report in conjunction with the provided plans details how the proposed works will be undertaken. The following summarises how the works will be undertaken.

Stage 1 will involve earthworks to level the existing sand ridge adjacent Tomago Road and importation by truck of some 30,000 m^3 of fill. The purpose of these works will be to create a levelled area to ensure buildings are above the 1:100 year flood level. As part of these works an intersection will be constructed off Tomago Road to cater for this stage and for the future industrial subdivision.

Stage 2 of the proposed development is likely to be constructed in a number of sub stages. It will involve the importation of approximately 1.8 million cubic metres by truck. Again the purpose is to allow future buildings to be located above the 1:100 year flood level.

The work method will involve preloading for consolidation.

3.4 THE RELEVANT IMPACTS OF THE ACTION INCLUDING THE EFFECT ON LISTED EPBC SPECIES

RELEVANT IMPACTS OF THE ACTION

The subject site is defined as the area directly affected by the proposal and the study area is defined as the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. In this case, the subject site is Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256, including the adjoining road reserve, Tomago Road, Tomago. The study area for the purposes of the Threatened Species Assessment (**Appendix J** of the EAR) comprised the subject site and a 200m buffer area along the western, southern and eastern boundaries as well as a 100m buffer area either side of the drainage line flowing south into the Ramsar wetland for approximately 800m.

In defining the study area (area of potential impact) for environmental investigation all impacts, both direct and indirect, must be considered. Three such impacts; changes in hydrology, noise disturbance and lighting could potentially impact on the adjoining wetland reserves thereby requiring the need to extend the study area (area of consideration) into these areas.

EFFECT ON LISTED EPBC WETLAND OF INTERNATIONAL IMPORTANCE

Reports have been prepared addressing flooding hydrology and water quality issues (Patterson Britton, 2007 & Asquith de Witt, 2007) and noise issues (Spectrum Acoustics, 2008) and these have been considered by EcoBiological when preparing their Threatened Species Assessment.

A Flood Impact Assessment was prepared by Patterson Britton Pty Ltd which models the potential impacts on hydrology and flooding as a result of the proposed development based on worse case scenario. This report shows that:

- The flooding hydrology will remain unaltered post development;
- There will be no impact on the discharge rate of flood flows;
- The magnitude in change of flow regime is insignificant;
- There will be insignificant effect on flood pattern; and
- There will be no significant change to flood velocity.

In addition the report by Asquith & de Witt's Environmental Engineer establishes through a water balance model that the flow of water to the wetland will not be adversely impacted by an increase or decrease. In addition the quality of water flow to the wetland is likely to be improved with removal of agriculture from the site and implementation of substantial water quality measures. Soil erosion and sedimentation measures are also proposed.

Accordingly it is considered that there will be no significant hydrological and water quality impacts on the adjoining wetland reserve.

An assessment of potential noise impacts on surrounding lands was prepared by Spectrum Acoustics Pty Ltd. This assessment shows that noise generated by Stage 1 of the WesTrac facility is forecast to be around 59dB(a) at the rear of the Stage 1 WesTrac boundary and that by the time the noise reaches the wetland at the rear of the site the noise level is below background level. Environmental noise such as crickets and cicadas would be far greater. It is considered that no impact will occur on the adjoining wetland reserve due to noise generated by this stage of the proposal.

It is uncertain as to the exact level of future noise impact generated by industry moving into the proposed industrial subdivision planned for Stage 2 of the proposal although assumptions could be made. If the assumption was made that noise generated at the boundaries adjoining the wetlands was similar to that of the WesTrac development (i.e. 59dB(a)) then it remains unlikely that this would cause disturbance to migratory birds based on the report by Spectrum Pty Ltd, particularly when taking into account that environmental noise from invertebrates such as crickets would be greater than this. In addition it is considered that opportunity exists to manage noise impacts from future users

through mitigation and management measures if deemed necessary at the time. It is also noted that any future proposed development will be subject to individual assessment as part of the development application process.

Excessive direct lighting could cause disturbance to Migratory birds. In relation to Stage 1 incorporating the proposed WesTrac facility, given the distance from the development to the rear boundary with the wetland of some 500m to 800m it is unlikely that lighting will cause undue disturbance. However to ensure that there is no lighting directed to the Wetland a lighting management plan will be prepared to ensure lights are appropriately positioned, directed and shielded to avoid direct lighting.

Future development within the proposed industrial subdivision could be managed in the same way. Future development will be subjected to the development application/project application process and so will be subject to separate assessment of this issue also.

EFFECT ON LISTED EPBC THREATENED SPECIES

Three flora species (*Eucalyptus parramatensis subsp. decadens*, *Eucalyptus camfieldii* and *Rulingia prostrata*) and two fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*) and the Green and Golden Bell Frog (*Litoria aurea*) which have previously been recorded within a 5 kilometre radius of the subject site are listed under the EPBC Act.

The three flora species were not detected during field surveys of the subject site and it was considered that suitable habitat for each of these species does not occur on the subject site. The proposed development was assessed as unlikely to have any significant effect on the survival of these species in the locality.

The subject site was assessed as having some suitable habitat for the Green and Golden Bell Frog. The subject site was targeted for the Green and Golden Bell Frog on four occasions. However, no Green and Golden Bell Frogs were detected on or near to the subject site. From this survey it is concluded unlikely that any Green and Golden Bell Frogs inhabit any areas on or near the subject site. The proposed action will remove a small portion of potential habitat however no Green and Golden Bell Frogs were located within the study area and the amount of habitat to be removed will not likely cause the species to decline. The habitat being removed is approximately 22 hectares and of the 241 hectares of land provided as an offset zone 130 hectares constitutes suitable green and golden bell frog habitat.

The Grey-headed Flying-fox was detected foraging in the few suitable feed trees (<20) present on the subject site. This species would use the subject site as an opportunistic foraging source when desired tree species are in flower. It is unlikely that the removal of a small number of feed trees would adversely affect the lifecycle of this species. Full EPBC Impact Assessments are provided in Appendix J of the EAR (Threatened Species Assessment).

EFFECT ON LISTED EPBC MIGRATORY SPECIES

Appendix B: Table 1 details EPBC listed threatened and migratory species previously recorded within a 5-kilometre radius of the subject site as well as additional species recorded to occur on nearby Kooragang and Ash Island from 1980-2006. **Appendix B**: Table 2 assesses the likelihood of EPBC listed threatened and migratory species occurring within the subject site or study area and the likelihood of these species being affected either directly or indirectly by the proposed action.

One EPBC-listed migratory species, the Cattle Egret (*Ardea ibis*), was recorded on the subject site during field surveys. The proposed development will result in loss of a relatively small amount of habitat for this species and it is considered unlikely that the proposed development would have any significant impact on the long-term survival of this species in the locality. The remaining EPBC-listed migratory species were assessed as having unsuitable habitat on the subject site or study area and provided mitigation measures relating to hydrological impacts, noise and lighting are implemented it is considered unlikely that there would be any significant impact on these species which are known to inhabit the adjoining RAMSAR wetland and Kooragang Nature Reserve.

3.5 PROPOSED SAFEGUARDS AND MITIGATION MEASURES TO DEAL WITH RELEVANT IMPACTS OF THE ACTION

The ameliorative measures for this proposal fall into the following categories:

- Compensatory Strategies (Environmental Offsets);
- Avoiding the use of potentially harmful chemicals (biocides);
- Pre-clearing surveys;
- Management and monitoring plans;
- Recommendations for future development; and
- Buffer to RAMSAR wetland provided in the south east corner.

Relevant proposed mitigation measures relating to EPBC matters are as follows:

LONG TERM MANAGEMENT STRATEGIES

<u>Flora and Fauna management and monitoring plans</u>

It is envisaged that the proposed management and monitoring plans be incorporated into conditions of consent and that these plans be approved by DECC prior to construction.

Management plans

Prior to the commencement of construction detailed management plans should be prepared to cover the following:

- A management and monitoring plan for the adjacent Ramsar wetland (Kooragang Nature Reserve). A thorough and intensive program should be put in place to protect the adjoining wetland against weed invasion, significant alterations to hydrology, and surface and underground run-off that may occur from land filling both during and after the construction phase of the proposed development. Some points that should be considered and addressed when constructing the management plan include:

    - The nature and control of sediment run-off during the construction phase particularly as a result of an exceptional storm event;

    - The chemical content of the fill and of the groundwater seepage from that fill that would disperse into the wetlands over the long term;

    - The volume, path and content of stormwater discharging from the site during and after development;

    - The handling of hydrocarbon waste from the site during construction and operation stages;

    - Existing flow regime of surface and groundwater flow from the subject site into the wetlands;

    - At times of peak rainfall, sub-surface drainage through the fill is likely to discharge into the wetland - what will be the impact of the development on the quality of this water;

    - The current ecological character (as defined by the Ramsar Convention) of the wetland in the immediate vicinity of the potential impact area;

    - The impact of weed invasion during and after the construction phase. Weed invasion is very obvious around Kooragang and along the edges of the Hunter estuary where edges of fill are dominated by weeds; and

    - It is recommended that a lighting management plan be prepared to ensure no direct light impacts on the adjacent wetlands. This may be achieved by ensuring any lighting to be installed on the subject site either faces away from the wetland area or has a shade attached to prevent an excess of light entering the

wetland area of a night time. These measures will insure that no impact occurs as a result of light pollution.

COMPENSATORY (ENVIRONMENTAL OFFSET) STRATEGIES

As part of the rezoning of the subject site and those adjoining via the Major Projects State Environmental Planning Policy, and in anticipation of this development and others, some 240 hectares of land previously zoned for rural activities has been rezoned for conservation purposes as outlined in the Memorandum of Understanding (MOU) between the Minister for the Environment, the Minister for Planning and the Regional Land Management Corporation. This environmental offset will protect the rezoned 241.3ha of land into the future, which currently contains ecologically sensitive wetlands of national importance and habitat for several endangered ecological communities and threatened species including the Green and Golden Bell Frog, Grass Owl, Australasian Bittern, Black Bittern and both endangered ecological communities considered in this report.

ONGOING MONITORING

A monitoring plan should be prepared to document the ongoing status of the protected Ramsar Wetland to the south of the subject site. This plan should commence with a baseline report which describes the status and condition of the wetland prior to the commencement of construction.

This plan should describe thresholds at which management actions are required to arrest any documented deterioration in the condition of the wetland, its associated habitats, and the populations that are reliant on these habitats.

FUTURE DEVELOPMENT

Future development within the proposed Stage 2 industrial estate is unknown at this time. Such development will be subjected to assessment as part of a development application or project application to be dealt with under either Part 3A or Part 4 of the Environmental Planning & Assessment Act.

3.6 REQUIREMENTS FOR APPROVAL AND CONDITIONS WILL BE SPECIFIED AS PART OF ANY APPROVAL RECEIVED FOR THE CONCEPT PLAN

The proponent will be bound by the conditions of approval that are likely to reflect the Statement of Commitments provided as part of the approval documentation.

3.7 FEASIBLE ALTERNATIVES

Alternatives and justification for site selection are addressed as part of the Environmental Assessment Report.

(i) The no action alternative

The no action alternative would be of limited environmental benefit, particularly with the likely continued use of the subject land for grazing. It is considered that the no action alternative is not a justified course of action in this instance as it will not achieve the strategic planning objectives of the Lower Hunter Regional Strategy which is consistent with the industrial zoning of the site. In particular the land has been identified as an employment zone and zoned accordingly for industrial use.

(ii) Comparative description of the impacts of each alternative

There are potentially 2 options:

No action, or

The outcome proposed as detailed in the EAR and consistent with the MOU **(Appendix A)** and industrial zoning of the land.

OPTIONS COMPARISON TABLE

IMPACT	NO ACTION	PROPOSED ACTION
Swamp Oak Loss (Disturbed/Grazed)	Nil – however likely to be degraded over time due grazing	Approx. 5.35 ha loss
Saltmarsh Loss (Disturbed Grazed) (Incorporates Phragmites)	Nil – however likely to be degraded over time due grazing	Approx 22 ha loss
Habitat loss for six threatened species	Nil – but subject to impacts of grazing	Varies depending on species (see report by Ecobiological contained in the EAR).
Impact on Wetland	Likely long term impacts from grazing	Likely reduced impacts from proper management of water quality.
Provision of Employment	Significant loss of employment opportunity 400 for WesTrac site significantly more for the industrial subdivision	Significant employment.
Economic Benefits	NIL	$130m now and substantially more as the industrial subdivision is established.

(iii) Preferred Alternatives

The preferred option is development in accordance with the strategic plans for the locality, the industrial zoning of the land and identified in the project application submission. It being noted that as part of the process of the site being zoned industrial some 241.3 hectares of land zoned agriculture has been rezoned for conservation.

The development will occur over what is mostly grazing land drained to the existing wetland. It is expected that water quality draining to the wetland will be improved with the removal of grazing and with the implementation of the proposed water quality measures outlined in the Environmental Assessment Report.

3.8 ANY CONSULTATION ABOUT THE ACTION

(i) Any consultation that has already taken place.

Stakeholder consultation is outlined in the Environmental Assessment Report.

(ii) Further consultation

The action will be further consulted on via exhibition of the Project Application as part of the Part 3A process. The public and NSW Authorities will have the opportunity for further comment.

(iii) Response to prior consultation

The matter was referred under the EPBC Act and found to be a controlled action. Relevant controlling provisions are:

- Wetlands of international importance (sections 16 and 17B);
- Listed threatened species and communities (sections 18 & 18A);
- Listed migratory species (sections 20 and 20A).

The Bilateral Agreement applies and the matter is assessed under Part 3A of the EPA Act by the NSW Minister of Planning.

(iv) Identification of affected parties including any affected communities and their views.

No community will be directly affected by the proposed development.

Section 4
Relevant Impacts

4.1 DESCRIPTION OF THE RELEVANT IMPACTS OF THE ACTION

EFFECT ON LISTED EPBC WETLAND OF INTERNATIONAL IMPORTANCE

There will be no significant hydrological or water quality impacts on the adjoining wetland reserve.

EFFECT ON LISTED EPBC THREATENED SPECIES

EcoBiological concluded that there would be no significant impact on the Grey-headed Flying-fox or Green and Golden Bell Frog from the proposed action.

EFFECT ON LISTED EPBC MIGRATORY SPECIES

The proposed development will result in the loss of a relatively small amount of habitat for the Cattle Egret (*Ardea ibis*), a commonly occurring migratory species in the Hunter Valley. EcoBiological concludes that the proposed development will have no significant impact on the long term survival of this species in the locality.

4.2 (B) & (C) SHORT AND LONG TERM IMPACTS

The proposed impacts as described above are irreversible and so they may all be regarded as long term impacts.

4.3 SIGNIFICANCE OF RELEVANT IMPACTS

The report by EcoBiological included as an Appendix to the Environmental Assessment Report indicates that the impacts are not significant.

The likely impacts have been anticipated and hence the MOU between the Minister for the Environment, The Minister for Planning and previous land owner with some 241.3 hectares of land previously zoned for rural now set aside for conservation.

4.4 DATA USED TO ASSESS IMPACTS

The effects on threatened species have been assessed on the basis of detailed field surveys and investigations carried out by EcoBiological. A copy of their report is included as **Appendix J** to the Environmental Assessment. Data used to

assess the likelihood of listed threatened and migratory species occurring on the subject site and study area has been drawn from habitat assessment during field surveys and from the following sources:

- 5km radius data from NSW NPWS Wildlife Atlas;
- Hunter Bird Observers bird list from Kooragang Island/Ash Island for the period 1980 – 2006;
- Flegg, J. (2002). Photographic Field Guide, Birds of Australia, Second Edition. Reed New Holland Publishers, Sydney;
- Pizzey, G. & Knight, F. (2007). The Field Guide to the Birds of Australia, Eighth Edition. Harper Collins Publishers, Sydney; and,
- Department of the Environment, Water, Heritage and the Arts (2008). SPRAT EPBC Migratory Lists in Species Profile and Threat Database, Department of the Environment, Water, Heritage and the Arts, Canberra.

Section 5
Proposed Safeguards and Mitigation Measures

5.1 THE PROPOSED MITIGATION MEASURES

The effects on threatened species, whilst being relatively insignificant are considered to be mitigated through the MOU that has previously been referenced. The MOU provides for some 241.3 hectares of land previously zoned rural to be set aside for conservation and this has been reflected in the recent rezoning of the land via the Major Projects State Environmental Planning Policy. This zoning has been outlined as part of the Environmental Assessment Report.

No offsite impacts to the wetlands adjoining the site will occur due to the proposed water quality and flow regime controls proposed. In addition it is proposed to monitor water quality as outlined in the reports addressing water quality and flora fauna contained as appendices to the Environmental Assessment Report.

5.2 STATUTORY OR POLICY BASIS FOR THE MITIGATION MEASURE

The 241.3 hectares for conservation, is consistent with the Lower Hunter Conservation Strategy and the MOU to which the NSW Ministers for Planning and Environment are signatories.

Water quality and flow to ensure no impact on wetlands at the rear of the site (including RAMSAR wetlands) is addressed in detail as part of the Environmental Assessment Report.

5.3 COST OF THE MITIGATION MEASURES

The land to be set aside for conservation has already been zoned for conservation. Ongoing management costs of this land will depend on the efforts of the NSW National Parks and Wildlife Services.

The proposed mitigation measures associated with water quality treatment will be borne by the developer.

5.4 CONTINUING MANAGEMENT

Ongoing management of the offset area will be by NSW National Parks. Ongoing

maintenance of the water quality from site to wetlands will be the responsibility of the developer.

5.5 RESPONSIBLE AGENCY

Responsibility for the land already zoned for conservation will be the NSW National Parks and Wildlife Service.

5.6 LIST OF MITIGATION MEASURES

- Rural land to be set aside for conservation has already occurred as part of the zoning of the subject site and those nearby for industrial development.

- Water quality and flow controls to ensure no adverse impacts on wetlands as detailed in the Environmental Assessment Report.

Section 6
Other Approvals

6.1 THE ACTION IS SUBJECT TO APPROVAL UNDER PART 3A OF THE NSW EPA ACT 1979.

(i) Assessment of the action is being carried out via the provisions of Part 3A of the NSW Environmental Planning & Assessment Act which requires the preparation of an Environmental Assessment Report to the specification provided in "Director Generals Requirements".

(ii) Part 3A provides for management of impacts by applying legally enforceable conditions of approval. Under Part 3A proponents must prepare a draft Statement of Commitments that is binding on the action and its proponents.

6.2 (B) & (C) OTHER APPROVALS

No other approvals have been sought or granted in respect of the proposed action.

6.3 MONITORING ENFORCEMENT AND REVIEW PROCEDURES

Any monitoring or review procedures applied by the NSW Department of Planning as conditions of approval would be enforceable under the NSW EP&A Act.

Section 7
Environmental record of person proposing to take the action

The proponent, Redlake Enterprises and its constituent companies, have not been subject to proceedings on the basis of protection of the environment or the conservation and use of natural resources.

Redlake Enterprises by way of policy take serious the consideration of environmental impacts. Water quality has been determined in this instance to be the most likely source of potential environmental impact and so detailed mitigation measures are proposed to ensure that such impact does not occur. These details can be found in the Environmental Assessment Report.

Section 8
Information Sources

8.1 (A) & (B) SOURCE AND CURRENCY OF INFORMATION

This report is based on a series of flora and fauna assessments undertaken over the land on which the action is proposed as well as the Environmental Assessment Report as a whole. All information is current and the dates for field studies can be found within the EcoBiological report included as an Appendix to the Environmental Assessment Report.

8.2 (C) HOW THE RELIABILITY OF THE INFORMATION WAS TESTED

The flora and fauna surveys have been conducted in accordance with established guidelines.

The Environmental Assessment Report has been completed in accordance with the requirements of the Act and Director General Requirements.

8.3 (D) UNCERTAINTIES IN THE INFORMATION

No specific uncertainties in the information have been identified.

Section 9
Summary and Conclusion

In summary, threatened species survey work has been conducted in accordance with appropriate standards, the information can be considered reliable.

The majority of the site is grazed pasture and the reports have identified that the proposed impacts of the action are not significant.

The proposed action is considered to be adequately mitigated through both the zoning of land for conservation that was previously zoned for rural (in accordance with the MOU between the Minister for the Environment and the Minister for Planning) and having regard to the proposed water quality and flow regime controls proposed likely improving quality of the adjoining wetlands.

The significance of the likely impacts in accordance with EPBC Act policy statement 1.1 is as follows.

9.1 SENSITIVITY OF THE IMPACTED ENVIRONMENT

The impacted development area is not considered to be particularly sensitive having regard to its use for grazing. The important wetlands at the rear of the site are regarded as a sensitive receiving environment, however, will not be adversely impacted by the proposed development. Indeed an improvement can be expected through the introduction of water quality controls.

9.2 TIMING DURATION AND FREQUENCY OF IMPACTS

The effect will be a one off loss of habitat and vegetation on the development area.

9.3 ALL ON SITE AND OFFSITE IMPACTS

The on site impacts are loss of habitat, some off site impacts may occur as a result of the overall decrease in threatened species habitat (all regarded as not being significant). The impacts are unlikely to be significant particularly when balanced against the offsite area of land provided for conservation and the potential benefit from the likely improved water quality flow to the wetlands by removal of grazing.

9.4 ALL DIRECT AND INDIRECT IMPACTS

The direct impacts are loss of habitat which whilst negative can still be regarded as not significant. Indirect and positive effects are likely from increased conservation and improved water quality.

9.5 TOTAL IMPACT OVER TIME OVER THE ENTIRE GEOGRAPHIC AREA AFFECTED

Generally the total impact over time and the region is expected to be positive given the conservation gains through larger conservation areas.

9.6 EXISTING LEVELS OF IMPACT FROM OTHER SOURCES

There are no known significant levels of impact from other sources.

9.7 THE DEGREE OF CONFIDENCE WITH WHICH THE IMPACTS ARE KNOWN AND UNDERSTOOD

There is a high degree of confidence in the known impacts given the extent of reporting outlined in the Environmental Assessment Report.

Confidence in the mitigation measures is high given that the land for offset has already been zoned for conservation and the details regarding water quality and flow outlined in the Environmental Assessment Report.

Appendix A

MOU

MEMORANDUM OF UNDERSTANDING

THIS MOU is made on _____ of _____ 2006.

Between

1. **THE MINISTER FOR THE ENVIRONMENT** of Level 36, Governor Macquarie Tower, 1 Farrer Place, Sydney in the State of New South Wales; and

2. **THE MINISTER FOR PLANNING** of Level 34, Governor Macquarie Tower, 1 Farrer Place, Sydney in the State of New South Wales

   (together, the "Government"); and

3. **THE REGIONAL LAND MANAGEMENT CORPORATION PTY LTD ACN 103 702 530** (the "Land Manager").

Background

A. The New South Wales Government intends to implement an Environmental Land Offset Scheme for the Lower Hunter region to complement and support the Lower Hunter Regional Strategy and the Lower Hunter Regional Conservation Plan.

B. The Environmental Land Offset Scheme aims to:

   (i) increase public ownership of certain land in the Lower Hunter region for dedication as a conservation reserve; and

   (ii) recognise the development potential of certain other land in the Lower Hunter region.

C. The purpose of this MOU is to set out the parties' intentions with respect to the implementation of the Environmental Land Offset Scheme, insofar as it concerns the Schedule 1 Land and the Schedule 2 Land.

1. Definitions and interpretation

1.1 In this MOU, unless the context otherwise requires:

"Conservation reserve" means any land intended to be reserved or dedicated under the *NPW Act* and includes references to a national park, nature reserve, state conservation area or regional park, as those terms are defined under that Act

"Development potential of Schedule 1 land" means the development potential specified in Schedule 1 for each parcel of Schedule 1 land.

"**Environmental Land Offset Scheme**" insofar as it concerns the Schedule 1 Land and Schedule 2 Land means the Environmental Land Offset Scheme described in clause 3 of this MOU.

"**EP&A Act**" means the *Environmental Planning and Assessment Act 1979*, as amended from time to time.

"**Lower Hunter Regional Conservation Plan**" means the Lower Hunter Regional Conservation plan released by the NSW Department of Environment and Conservation, published on that Department's website and as amended from time to time.

"**Lower Hunter Regional Strategy**" means the Lower Hunter Regional Strategy released by the NSW Department of Planning, published on that Department's website and as amended from time to time.

"**Map**" means the maps titled "*Concept Development Plan*" (Figure 6.1 Landcom LHRS Submissions West Wallsend) and "*Employment/Conservation Plan: RLMC Tomago*" that are incorporated into this MOU by reference.

"**MOU**" means this Memorandum of Understanding which includes the Schedules and maps that are incorporated into this MOU by reference

"**NPW Act**" means the *National Parks and Wildlife Act 1974* as amended from time to time.

"**Rezoning**" means the mechanism of changing the landuse zone for a parcel of land contained in a environmental planning instrument (as defined by the the EP&A Act), noting that this change in landuse zone may be effected by the gazettal of a State Environmental Planning Policy or a local environmental plan.

"**Schedule 1 land**" means the parcels of land currently managed by the Land Manager, referred to in the Lower Hunter Regional Strategy and identified in Schedule 1, or part thereof.

"**Schedule 2 land**" means the parcels of land currently managed by the Land Manager and identified in Schedule 2, or part thereof.

"**TSC Act**" means the *Threatened Species Conservation Act 1995* as amended from time to time.

"**Transferred Schedule 2 land**" means Schedule 2 land, or part thereof, transferred to the Minister for the Environment in accordance with clause 3.2.

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2. Implementation

2.1 The parties are committed to using their best endeavours to implement this MOU.

2.2 The parties acknowledge and agree that:

(a) this MOU is intended to express the parties' objectives and firm intentions with regard to those matters with which it deals, but is not intended to create enforceable or binding legal obligations between them;

(b) nothing in this MOU shall be taken to fetter the discretion of the Minister for Planning in exercising functions under the *EP&A Act* or the Minister for the Environment in exercising functions under the NPW Act or the TSC Act; and

(c) nothing in this MOU is intended to constitute a representation, warranty or guarantee by or on behalf of the Government, the Minister for Planning, the Minister for the Environment, or the Land Manager.

2.3 All parties acknowledge and agree that they have not relied or acted or forborne from acting in any way as a result of any statement made by any of the parties in this MOU or in discussions leading up to this MOU.

3. The Environmental Land Offset Scheme

3.1 The Land Manager intends to develop the Schedule 1 Land identified in the Lower Hunter Regional Strategy by preparing a Rezoning application as soon as practicable and at least within 5 years that is consistent with the development potential of Schedule 1 land.

3.2 The Minister for Planning intends to use reasonable endeavours to allow the Land Manager to achieve the development potential of Schedule 1 land by either:

(a) Rezoning the land through an amendment to State Environmental Planning Policy 2005 (Major Projects) and approval of any concept plan submitted under Part 3A of the EP&A Act; and/or

(b) Facilitating the rezoning of the land through the gazettal of a Local Environmental Plan prepared by the relevant local government authority and made by the Minister for Planning and approval of any concept plan submitted under Part 3A of the EP&A Act; and/or

(c) Any other means that achieves or encourages the more intensive use of the land;

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in accordance with the Lower Hunter Regional Strategy, the Lower Hunter Regional Conservation Plan and subject to the requirements of the *EP&A Act*.

3.3 The Land Manager intends to recommend to the owner of the Schedule 1 Land, the transfer ownership of Schedule 2 land to the Minister for the Environment upon the rezoning of Schedule 1 land.

3.4 The Minister for the Environment intends to ensure Transferred Schedule 2 land is dedicated as part of the national park estate or as a conservation reserve.

3.5 The Land Manager does not currently intend to undertake any action or activity, pending transfer of Schedule 2 land or rezoning of Schedule 1 land that will have detrimental effect on the conservation or Aboriginal heritage values of Schedule 2 lands except where the Landholder is

(a) directed to undertake such an action or activity by another Government agency or instrumentality (such as the Rural Fire Service), or

(b) is otherwise required by law to undertake such an action or activity.

4. Agreement

4.1 Notwithstanding clause 3, the details of the Environmental Land Offset Scheme described in clause 3 are the subject of ongoing negotiation by the parties, which they propose will form part of a legally enforceable agreement to be entered into by the Government and the owner of the Schedule 1 Land and Schedule 2 Land.

4.2 All parties are to use their best endeavours to enter into such an agreement referred to in clause 4.1 as soon as possible noting a target date of three months for this to occur.

4.3 The parties acknowledge that the proposed agreement referred to in clause 4.1 will include a schedule of commitments that set out the sequencing and staging of Schedule 1 land and the dedication for conservation of Schedule 2 lands.

4.4 The parties acknowledge that:

(a) If there is any reduction in Schedule 2 Land to be transferred then a proportional reduction will result for the development potential of Schedule 1 Land

(b) If the development potential of Schedule 1 Land in relation to the number of dwellings or lots to be achieved is reduced then a

proportional reduction will occur in the amount of Schedule 2 Land to be transferred to the Minister for the Environment

5. Term

5.1 This MOU starts on the date it is signed by both parties and continues until the parties enter into an agreement of the type referred to in clause 4, or 5 years, whichever is the later..

6. Change in Position

A party will promptly notify all the other parties to this MOU if its intentions as started in this MOU change.

7. Assignment

The Land Manager may assign this MOU to:

(a) the owner of the Schedule 1 Land and/or the Schedule 2 Land; or

(b) any other entity which manages the Schedule 1 Land and/or the Schedule 2 Land if the Land Manager ceases to manage the Land

without the consent of either of the other parties.

This Memorandum of Understanding is signed on 16 October **2006.**

The Honourable Bob Debus MP
The Minister for the Environment

The Honourable Frank Sartor MP
The Minister for Planning

Brad Foot, General Manager Operations
Regional Land Management Corporation Pty Ltd
ACN 103 702 530

SCHEDULE 1 – POTENTIAL DEVELOPMENT LAND

This Schedule forms part of the MOU.

Schedule 1 Land

Property description	Map reference	Development potential
	West Wallsend – "Potential Development Areas" as shown on the map "*Concept Development Plan*" (Figure 6.1 Landcom LHRS Submissions West Wallsend)	Development covering up to 876.9 hectares predominately for the purpose of employment lands that will be identified by a detailed structure planning process, but recognising that the structure planning may also identify a number of other complementary uses (including residential where appropriate), subject to these complementary uses satisfying sustainability criteria.
	Tomago – "Employment Lands" as shown on the map "*Employment/ Conservation Plan: RLMC Tomago*"	Employment lands development covering up to 351.6 hectares subject to detailed structure planning

SCHEDULE 2 – ENVIRONMENTAL LAND OFFSETS

This Schedule forms part of the MOU.

Schedule 2 Land

Property description	Map reference	Area
	West Wallsend – "Conservation Areas" as shown on the map "*Concept Development Plan*" (Figure 6.1 Landcom LHRS Submissions West Wallsend)	791.5 hectares
	Tomago – "Conservation Lands" as shown on the map "*Employment/ Conservation Plan: RLMC Tomago*"	241.3 hectares
		Total 1032.8 hectares

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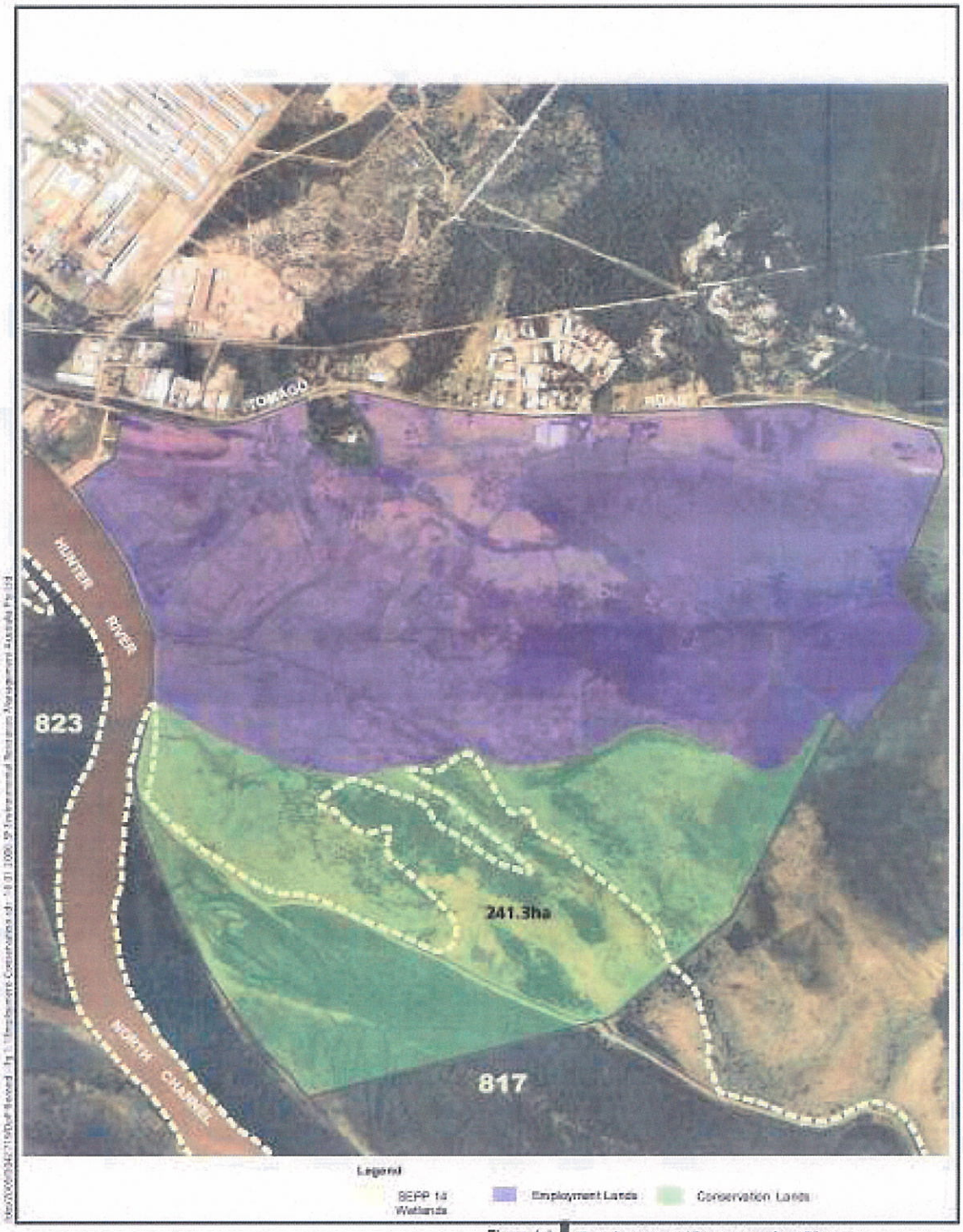


Figure 1.1 **Employment/Conservation Plan**

RLMC - Tomago

Appendix B

EPBC LISTED THREATENED AND MIGRATORY SPECIES

Table 1: EPBC listed threatened and migratory species previously recorded within a 5-kilometre radius of the subject site and additional species recorded to occur on nearby Kooragang and Ash Island from 1980-2006.

Scientific Name	Common Name	Listed within a ^5km radius of the subject site and from * HBOC surveys	EPBC Act		Listed (International treaties)			
			Marine	Listed (threatened species)	JAMBA	CAMBA	ROKAMBA	Bonn Convention
Actitis hypoleucos	Common Sandpiper	*	+	-	+	+	+	A2H
Anas clypeata	Northern Shoveler	*	+	-	+	+	+	-
Apus pacificus	Fork-tailed Swift	*	+	-	+	+	+	-
Ardea alba (Egretta alba)	Great Egret	*	+	-	+	+	-	-
Ardea ibis	Cattle Egret	*	+	-	+	+	-	-
Arenaria interpres	Ruddy Turnstone	*	+	-	+	+	+	A2H
Calidris acuminata	Sharp-tailed Sandpiper	*	+	-	+	+	+	A2H
Calidris alba	Sanderling	*	+	-	+	+	+	A2H
Calidris canutus	Red Knot	*	+	-	+	+	+	A2H
Calidris ferruginea	Curlew Sandpiper	*	+	-	+	+	+	A2H
Calidris melanotos	Pectoral Sandpiper	*	+	-	+	-	+	A2H
Calidris ruficollis	Red-necked Stint	*	+	-	+	+	+	A2H
Calidris tenuirostris	Great Knot	^ *	+	-	+	+	+	A2H
Charadrius leschenaultii	Greater Sand Plover	^ *	+	-	+	+	+	A2H
Charadrius mongolus	Lesser Sand Plover	^ *	+	-	+	+	+	A2H
Chlidonias leucopterus	White-winged Black Tern	*	+	-	+	+	+	-
Gallinago hardwickii	Latham's Snipe	*	+	-	+	+	+	A2H
Haliaeetus leucogaster	White-bellied Sea-Eagle	*	+	-	-	+	-	-
Heteroscelus brevipes	Grey-tailed Tattler	*	+	-	+	+	+	A2H
Heteroscelus incanus	Wandering Tattler	*	+	-	+	-	-	A2H
Hirundapus caudacutus	White-throated Needletail	*	+	-	+	+	+	-
Limicola falcinellus	Broad-billed Sandpiper	^ *	+	-	+	+	+	A2H
Limnodromus semipalmatus	Asian Dowitcher	*	+	-	+	+	+	A2H
Limosa lapponica	Bar-tailed Godwit	*	+	-	+	+	+	A2H
Limosa limosa	Black-tailed Godwit	^ *	+	-	+	+	+	A2H
Monarcha melanopsis	Black-faced Monarch	*	+	-	-	-	-	A2H
Motacilla flava	Yellow Wagtail	*	+	-	+	+	+	-
Numenius madagascariensis	Eastern Curlew	*	+	-	+	+	+	A2H
Numenius minutus	Little Curlew	*	+	-	+	+	+	A2H
Numenius phaeopus	Whimbrel	*	+	-	+	+	+	A2H
Philomachus pugnax	Ruff	*	+	-	+	+	+	A2H
Pluvialis fulva	Pacific Golden Plover	*	+	-	+	-	+	A2H
Pluvialis squatarola	Grey Plover	*	+	-	+	+	+	A2H
Rhipidura rufifrons	Rufous Fantail	*	+	-	-	-	-	A2H
Rostratula australis	Australian Painted Snipe	*	+	V	-	+	-	-
Sterna albifrons	Little Tern	^ *	+	-	+	+	+	A2S
Hydroprogne caspia	Caspian Tern	*	+	-	+	+	-	-
Tringa glareola	Wood Sandpiper	*	+	-	+	+	+	A2H
Tringa nebularia	Common Greenshank	*	+	-	+	+	+	A2H
Tringa stagnatilis	Marsh Sandpiper	*	+	-	+	+	+	A2H
Tryngites subruficollis	Buff-breasted Sandpiper	*	+	-	+	-	+	-
Xenus cinereus	Terek Sandpiper	^ *	+	-	+	+	+	A2H

+ = Listed, - = not listed
^ = Species has been recorded to occur within a 5-kilometre radius from NSW NPWS Wildlife Atlas
* = Species recorded from Ash Island and Kooragang Island between 1980-2006 (Hunter Bird Observers Club)
A2H = Species is a member of a family listed in Appendix 2
A2S = Species listed as a result of a recent taxonomic revision of a species listed explicitly in Appendix 2
V = listed as Vulnerable under EPBC Act 1999

Table 2: Likelihood of EPBC listed threatened and migratory species occurring within subject site or study area and the likelihood of these species being affected either directly or indirectly by the proposed action.

Scientific Name	Common Name	Likelihood of occurring within subject site or study area	Likely to be affected by proposed action
Actitis hypoleucos	Common Sandpiper	Unsuitable habitat Fresh and salt marshes; beside lakes, dams, streams, sheltered coasts. **Not recorded**	No
Anas clypeata	Northern Shoveler	Unsuitable habitat Breeds in open, shallow wetlands. In winter, inhabits both freshwater and saline marshes. **Not recorded**	No
Apus pacificus	Fork-tailed Swift	May occur on occasion. Aerial, over many habitats. **Not recorded**	No
Ardea alba (Egretta alba)	Great Egret	Unsuitable habitat Larger shallow fresh waters of most types, estuaries and lagoons. **Not recorded**	No
Ardea ibis	Cattle Egret	Suitable habitat Swamps, open grazing land, often distant from water. **Recorded on site**	Yes
Arenaria interpres	Ruddy Turnstone	Unsuitable habitat Rocky coasts, rare inland. **Not recorded**	No
Calidris acuminata	Sharp-tailed Sandpiper	Unsuitable habitat Wetlands of all types, coastal and inland. **Not recorded**	No
Calidris alba	Sanderling	Unsuitable habitat Sandy bays and beaches, reefs. **Not recorded**	No
Calidris canutus	Red Knot	Unsuitable habitat Mostly on sand and mudflats of sheltered coastal bays and estuaries. **Not recorded.**	No
Calidris ferruginea	Curlew Sandpiper	Unsuitable habitat Sheltered bays and estuaries, lagoons, freshwater marshes. **Not recorded**	No
Calidris melanotos	Pectoral Sandpiper	Unsuitable habitat Shallow fresh waters, usually within grassy margins, floods, sewage farms. **Not recorded**	No
Calidris ruficollis	Red-necked Stint	Unsuitable habitat Tidal mudflats, lagoons, freshwaters marshes, lakes. **Not recorded**	No
Calidris tenuirostris	Great Knot	Unsuitable habitat Inhabits tidal mudflats, sandy ocean and bay shores, estuaries, shallow saline and freshwater wetlands. **Not recorded**	No
Charadrius leschenaultii	Greater Sand Plover	Unsuitable habitat Prefers coastal wide sandy or shelly beaches, sandspits, tidal mudflats, reefs, sand cays and mangroves. **Not recorded**	No
Charadrius mongolus	Lesser Sand Plover	Unsuitable habitat Prefers intertidal sand and mudflats in estuaries and roosts on sandy beaches or rocky shores at high tide. **Not recorded**	No
Chlidonias leucopterus	White-winged Black Tern	Unsuitable habitat Over both coastal and inland waters. **Not recorded**	No
Gallinago hardwickii	Latham's Snipe	Unsuitable habitat Muddy freshwater shallows. **Not recorded**	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	May occur on occasion. Close to larger waters of most types, fresh or saline, coastal. **Not recorded**	No
Heteroscelus brevipes	Grey-tailed Tattler	Unsuitable habitat Rocky shores, mangroves, mudflats and beaches. **Not recorded**	No
Heteroscelus incanus	Wandering Tattler	Unsuitable habitat Predominantly reefs and beaches, less often mudflats. **Not recorded**	No
Hirundapus caudacutus	White-throated Needletail	May occur on occasion. Almost inevitably in the air, over most habitats except desert, but most often over hillsides. **Not recorded**	No

Scientific Name	Common Name	Likelihood of occurring within subject site or study area	Likely to be affected by proposed action
Limicola falcinellus	Broad-billed Sandpiper	Unsuitable habitat Prefers sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, lagoons, saltmarshes and reefs. **Not recorded**	No
Limnodromus semipalmatus	Asian Dowitcher	Unsuitable habitat Tidal mudflats, lagoons, muddy lake edges. **Not recorded**	No
Limosa lapponica	Bar-tailed Godwit	Unsuitable habitat. Muddy or sandy estuaries, sheltered coastal bays, inland or shallow lakes, sewage farms. **Not recorded**	No
Limosa limosa	Black-tailed Godwit	Unsuitable habitat Prefers sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. **Not recorded**	No
Monarcha melanopsis	Black-faced Monarch	Unsuitable habitat Forests and woodlands, often damp. **Not recorded**	No
Motacilla flava	Yellow Wagtail	Unlikely due to grazing disturbance. Damp meadows and marsh, short grass and bare ground. **Not recorded**	No
Numenius madagascariensis	Eastern Curlew	Unsuitable habitat Coastal mudflats, mangroves, estuaries. **Not recorded**	No
Numenius minutus	Little Curlew	Unlikely due to grazing disturbance. Open short grasslands, not necessarily close to water, tidal mudflats. **Not recorded**	No
Numenius phaeopus	Whimbrel	Unsuitable habitat Usually on coastal marshes. **Not recorded**	No
Philomachus pugnax	Ruff	Unsuitable habitat Coastal lagoons and inland muddy pools. **Not recorded**	No
Pluvialis fulva	Pacific Golden Plover	Unsuitable habitat Estuaries, muddy bays, reefs, occasionally mangroves. **Not recorded**	No
Pluvialis squatarola	Grey Plover	Unsuitable habitat Sheltered coastal bays and estuaries. **Not recorded**	No
Rhipidura rufifrons	Rufous Fantail	Unsuitable habitat Dense undergrowth in woodland or forest, usually damp or beside rivers, occasionally mangroves. **Not recorded**	No
Rostratula australis	Australian Painted Snipe	Unsuitable habitat Densely vegetated wetland margins, sewage farms. **Not recorded**	No
Sterna albifrons	Little Tern	Unsuitable habitat Inhabits coastal waters, bays, inlets, saline or brackish lakes, saltfields, and sewage ponds near the coast. **Not recorded**	No
Hydroprogne caspia	Caspian Tern	Unsuitable habitat Over lagoons, coastal waters and occasionally but erratically inland. **Not recorded**	No
Tringa glareola	Wood Sandpiper	Unsuitable habitat Inland and coastal marshes and pools. **Not recorded**	No
Tringa nebularia	Common Greenshank	Unsuitable habitat Coastal lagoons and sheltered sandy or muddy estuaries and bays on fresh marshes and beside streams, dams and sewage farms. **Not recorded**	No
Tringa stagnatilis	Marsh Sandpiper	Unsuitable habitat Usually on freshwater marshes, dams, sewage farms, lagoons and saltpans, occasionally on muddy coasts. **Not recorded**	No
Tryngites subruficollis	Buff-breasted Sandpiper	Unsuitable habitat Open grassy or lightly vegetated areas, usually near water. **Not recorded**	No
Xenus cinereus	Terek Sandpiper	Unsuitable habitat Estuaries, muddy bays, reefs, lagoons and saltpans. **Not recorded**	No

Appendix J

FLORA & FAUNA REPORT

October 2007

THREATENED SPECIES ASSESSMENT:
Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256 Tomago Road, Tomago.

Report prepared for Redlake Enterprises Pty Ltd.

This report was prepared for the sole use of the proponents, their agents and any regulatory agencies involved in the development application approval process. It should not be otherwise referenced without permission.

Prepared By:
EcoBiological



Simon Clulow
Ecologist
NPWS Scientific Licence S10565

Reviewed By:
EcoBiological



Adam Blundell
Senior Environmental Scientist
NPWS Scientific Licence S10565

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CERTIFICATION

I certify that this Threatened Species Assessment, prepared by EcoBiological Survey & Assessment has been produced in accordance with the requirements of Part 3A of the Environmental Planning & Assessment Act 1979 and the Draft Guidelines for Threatened Species Assessment, and with regard to the requirements notified by the Director General of the Department of Environment and Climate Change.

Simon Clulow (B.Sc. /B. Teach.)

Ecologist

EcoBiological Survey and Assessment

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Tunnel forged by the Grass Owl (*Tyto capensis*) in thick grass to the south east of the subject site.

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EXECUTIVE SUMMARY

EcoBiological was commissioned by Redlake Enterprises Pty Limited to prepare an assessment of fauna, flora and threatened species for Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256, including the adjoining road reserve, Tomago Road, Tomago. Redlake Enterprises Pty Limited proposes to undertake an industrial development on the subject site to facilitate the assembly, sale, maintenance and repair of heavy earthmoving equipment, warehousing and distribution of parts, associated uses and subdivision. Filling of the site will be required.

A list of threatened flora and fauna reported from the local area was compiled from data obtained from the National Parks and Wildlife Service (NPWS) database, the Atlas of NSW Wildlife. In particular, this data comprised all threatened flora and fauna species recorded within a 5-kilometre radius of the subject site. A field survey was conducted using the list of threatened species as a guide to species potentially likely to occur on the subject site. Searches were carried out for any species listed on Schedules 1 and 2 of the NSW Threatened Species Conservation Act 1995 that were considered likely to occur in the type of vegetative habitat present on the subject site. The field surveys were conducted between January 2006 and July 2007.

Four threatened plant species and twenty five threatened fauna species had been recorded within a 5-kilometre radius of the subject site. Subsequent assessment revealed that habitat present on the subject site was suitable for ten of these species. These species included the threatened plant Zannichellia palustris, Green and Golden Bell Frog, Australasian Bittern, Black Bittern, Masked Owl, Grey-headed Flying-fox, Eastern Free-tail Bat, Greater Broad-nosed Bat, Large-footed Myotis and Little Bent-wing Bat.

Results of the field surveys showed that the subject site supported 101 plant species within three plant communities, two of which form Endangered Ecological Communities. An estimated 102 trees supported potential fauna habitat hollows; one Koala feed tree was present; 99 species of fauna were recorded, including six threatened species (Eastern Freetail Bat, Greater Broad-nosed Bat, Little Bentwing Bat, Grey-headed Flying Fox, Grass Owl and Wallum Froglet). The Threatened Species Assessment revealed that minimal impact on any threatened species would occur as a result of the proposed development.

Both endangered ecological communities present on the subject site will be removed; however an impact assessment revealed that it is unlikely that this would have any long-term impact on the endangered ecological communities within their known regional distribution.

DEFINITIONS

Abundance – a quantification of the population of the species or community.

Affected species – subject species likely to be affected by the proposal.

Allopatric – species of the same genus occupying different areas. As opposed to *sympatric*.

Arboreal – living in a tree or trees. Contrasted with *terrestrial*, living on the ground; *aquatic*, living in water; *amphibious*, living on land and in the water.

Aquatic – living in the water.

Amphibious – having two distinct life phases, one of which involves living on land and one of which involves living in water.

Benthic – bottom dwelling. In reference to *aquatic* organisms.

Browse – to feed on the leaves and twigs of trees and shrubs, not grasses. Compare with *Graze*.

Carnivorous – feeding on other animals. In practice, a distinction is often made between *carnivores* (flesh eaters) and *insectivores* (eaters of insects and other arthropods).

Conservation status – regarded as the degree of representation of a species or community in formal conservation reserves.

Conspecifics – members of the same species.

Cryptic – hidden. A cryptic species is one that is difficult to detect in the natural environment.

DECC – Department of Environmnent and Climate Change.

Development – has the same meaning as in the EP&A Act.

Direct impacts – impacts that directly affect habitat and individuals and include but are not limited to acute death through predation, trampling, poisoning of the organism itself and the removal of suitable habitat.

Director-General – the Director-General of DECC.

Distribution – the overall area in which a species is known to occur. It is not implied, and is very rarely the case, that a species occurs in all parts of the area defined by its distribution.

Diurnal – pertaining to the day. An animal that is active by day is said to be diurnal.

Drey – the nest of an arboreal mammal.

Epiphyte – a plant that grows upon another plant (usually a tree) and does not have roots reaching into the soil

Exudate – a substance that has been exuded. Used here mainly to refer to the gums of certain trees and the nutritious excreta of some sap sucking insects.

Folivorous – feeding on the leaves of trees.

Frugivorous – fruit eating.

Graze – to eat grass or herbs.

Habitat – an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community and includes any biotic or abiotic component. The habitat of a species is usually far less in extent than distribution indicated on a map.

Herbivorous – feeding on plants. Herbivores may be further divided into *frugivores* (fruit eaters), *folivores* (eaters of the leaves of trees), and into *browsers* and *grazers*.

Home range – the area habitually traversed by an individual animal. It may be exclusive or overlap with the home ranges of other individuals of the same species.

Indirect impacts – occur when project-related activities affect resources in a manner other than a direct loss of the resource. A broad range of impacts need to be considered and include, but are not limited to, killing a species through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious changes in the water table, increased soil salinity, promotion of erosion, inhibition of nitrogen fixation, provision of a suitable seed bed for exotic weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.

Insectivorous – feeding on insects and other arthropods.

Jaw sheaths – used here in reference to the hard, black sheath of keratin (similar to fingernails or horn) over the upper and lower jaw cartilage in tadpole mouthparts.

Lentic – living in still water.

Life cycle – the series or stages of reproduction, growth, development, aging and death of an organism.

Local population – the population that occurs in the study area.

Locality – means the area within a 5km radius of the study area.

Lotic – living in flowing water.

Nocturnal – pertaining to the night. An animal that is active by night is said to be nocturnal.

Opportunistic – used, in reference to diet, to denote the eating of any of a wide variety of foods, depending upon their availability. In respect of reproduction, it refers to a pattern of

breeding that is linked with irregular favourable conditions (particularly unpredictable rainfall in arid areas) rather than to season.

Papillae – small, nipple-like, fleshy projections around a tadpole's oral disk.

Patagium – an expanse of skin between the fore- and hind limbs used in gliding.

Range – this term has the same meaning as *distribution*, which is a better term.

Region – means, for the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes. If the bioregion occurs partly within and partly outside of New South Wales, the region consists only of so much of the bioregion as occurs within New South Wales.

Relict – surviving from the past. A relict species is one, or one of a few, surviving from a group that was once more numerous and/or widespread.

Riparian – pertaining to the banks of a river.

Risk of extinction – the likelihood that the local population will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the viability of that population.

Sclerophyll – pertaining to plants with tough leaves. Here used mainly to distinguish between two major types of eucalypt forest: *dry sclerophyll* forest which is open and *wet sclerophyll* forest which has a closed canopy. The two types intergrade.

Significant species – means species not listed in the TSC Act but considered to be of regional or local significance.

Speciation – the evolutionary processes by which new species arise.

Spiracle – referred to here as the external tube which expels water used for respiration from the gills of tadpoles.

Study area – the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly.

Subject site – the area which is proposed for development/activity.

Subject species – those threatened and significant species, populations or ecological communities which are known or considered likely to occur in the study area.

Subspecies – an interbreeding population within a species, differing measurably from one or more other populations and usually geographically separate from these.

Sympatric – living in the same area. Here used in respect of species of the same genus. Usually these occupy different areas and are then said to be *allopatric*.

Taxon – the scientific name of a category of animals. The practice and study of naming organisms is known as *taxonomy*.

Terrestrial – living on the ground.

Territory – an area occupied by one or more individuals and defended against other members of the species. A territory is usually centred on a more or less permanent nest, burrow, den or resting place.

Threatening process – a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. The defintion is not limited to key threatening processes.

Type locality- the location from which the first specimen, or *type holotype*, of a new species is formally described for the first time.

Type specimen – when a species is formally described for the first time, one of the specimens described is lodged in a museum to provide a permanent reference. It is known as the *type specimen* or *type holotype*. Other specimens of the species lodged at the same time as the holotype are referred to as *paratypes*.

Viable – the capacity to successfully complete each stage of the life cycle under normal conditions.

ABBREVIATIONS

DECC Department of Environment and Climate Change

DGR Director General's Requirements for this EA

EA Environmental Assessment

EEC Endangered Ecological Community

EP&A Act *Environmental Planning and Assessment Act* 1979

EPBC Act *Environment Protection and Biodiversity Conservation Act* 1999

FMA Fuel Management Area

GIS Geographic Information System

GPS Global Positioning System

ha hectares

km kilometres

KTP Key Threatening Process

LGA Local Government Authority

NPWS National Parks and Wildlife Service

PSCC Port Stephens City Council

ROTAP Rare or Threatened Australian Plants

SEE Statement of Environmental Effects

SEPP State Environmental Planning Policy

sp. Species (singular)

spp. Species (plural)

subsp. subspecies

TSC Act *Threatened Species Conservation Act* 1995

var. variety



Swamp Oak Floodplain Forest forming an Endangered Ecological Community on the subject site.

1. INTRODUCTION

1.1. SCOPE

EcoBiological was commissioned by Redlake Enterprises Pty Limited to prepare an assessment of fauna, flora and threatened species for Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256, including the adjoining road reserve, Tomago Road, Tomago. The location of the subject site is shown in Figure 1. This report is an assessment of the flora and fauna that were recorded to occur, or were considered likely to occur based on the habitat characteristics of the subject site, as well as threatened flora and fauna that have been recorded within a 5-kilometre radius of the subject site. Redlake Enterprises Pty Limited proposes to undertake an industrial development on the subject site to facilitate the assembly, sale, maintenance and repair of heavy earthmoving equipment, warehousing and distribution of parts, associated uses and subdivision. Filling of the site and roadwork will be required.

1.2. LOCAL CONTEXT

The subject site is approximately 116 hectares in size, and is situated in Tomago (NSW), off Tomago Road. The subject site is bound by Tomago Road to the north with rural residential land and naturally forested areas beyond, rural residential land and wetland including part of Kooragang Nature Reserve (listed as a Ramsar wetland of international importance) to the east, rural land and some wetland including a small portion of Kooragang Nature Reserve to the south and rural residential land to the west. The extent of vegetation and infrastructure that adjoins the subject site is shown in Figure 2. Zoning of the lots is IN1 - General Industrial as defined by the Department of Planning.



Figure 1. Map of the Tomago region with the subject site shown.

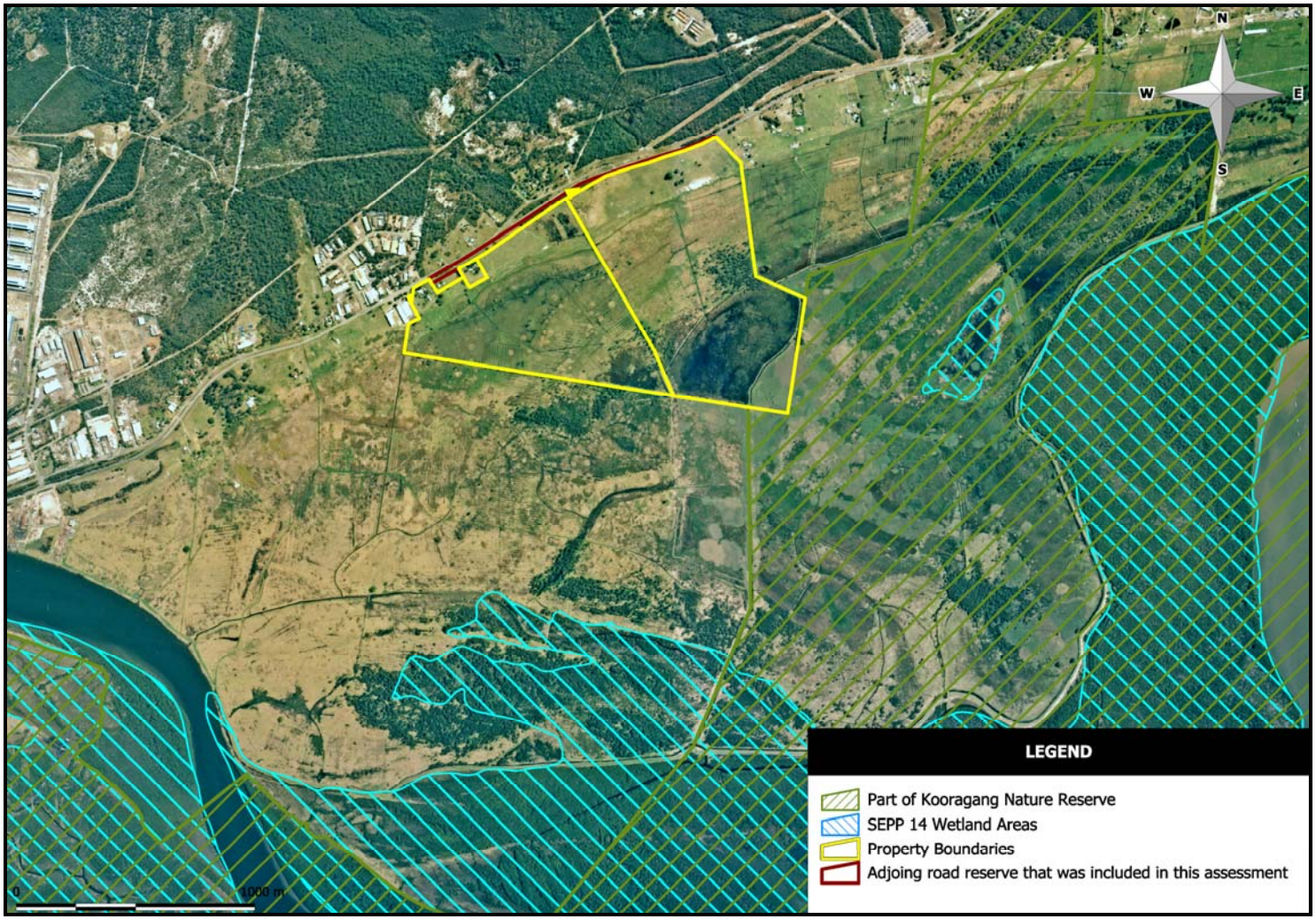


Figure 2. Aerial photograph of the subject site showing the extent of vegetation and infrastructure that adjoins the site.

1.3. DESCRIPTION OF THE PROPOSAL

The proposal includes an industrial development to facilitate the assembly, sale, maintenance and repair of heavy earthmoving equipment, warehousing and distribution of parts, associated uses and subdivision, and required land filling. The proposed development is broken up into stages and involves the following actions:

- The majority of the subject site will be filled to the 1:100 year flood level (fill area approximately 107 hectares).
- Stage 1 development of approximately 23 hectares for the purpose of an integrated WesTrac facility for the following:
    - Manufacture/assembly, display, sale, maintenance and servicing of predominantly large earth moving and mining machinery but also smaller machinery;
    - Warehouse and distribution of associated parts;
    - Servicing of on highway trucks;
    - WesTrac Rental Agency for the rental of Machinery and other equipment associated with the construction industry on long or short term basis; and
    - WesTrac/Institute for WesTrac NSW/ACT apprentices and general training in new technologies and procedures.
- Subdivision of the balance of the land for sale to related and unrelated land users in a number of stages.
- An intersection off Tomago Road will be built.

1.4. CONSIDERATION OF OTHER REPORTS IN THE DETERMINATION OF POTENTIAL IMPACTS

In defining the study area (area of potential impact) for environmental investigation all impacts, both direct and indirect, must be considered. Two such impacts; changes in hydrology and noise disturbance could potentially impact on the adjoining wetland reserves thereby requiring the need to extend the study area (area of consideration) into these areas. Reports have been prepared addressing flooding and hydrology issues (Patterson Britton, 2007) and noise issues (Spectrum Acoustics, 2008) and these have been considered by EcoBiological.

1.4.1. Flooding and Hydrology Issues

A Flood Impact Assessment was prepared by Patterson Britton Pty Ltd which models the potential impacts on hydrology and flooding as a result of the proposed development based on worse case scenario. This report shows that:

- The flooding hydrology will remain unaltered post development;
- There will be no impact on the discharge rate of flood flows;
- The magnitude in change of flow regime is insignificant;
- There will be insignificant effect on flood pattern; and
- There will be no significant change to flood velocity.

It is considered by EcoBiological that providing the measures to avoid hydrological change are put in place (as modelled in the Flood Impact Assessment) there will be no significant hydrological impacts on the adjoining wetland reserve.

1.4.2. Noise issues

An assessment of potential noise impacts on surrounding lands was prepared by Spectrum Acoustics Pty Ltd. This assessment shows that noise generated by Stage 1 of the WesTrac facility is forecast to be around 59dB(a) at the rear of the stage 1 WesTrac boundary and that by the time the noise reaches the wetland at the rear of the site the noise level is below background level. Environmental noise such as crickets and cicadas would be far greater. It is considered likely by EcoBiological that no impact will occur on the adjoining wetland reserve due to noise generated by this stage of the proposal.

It is uncertain as to the level of future noise impact generated by industry moving into the proposed industrial subdivision planned for Stage 2 of the proposal. If the assumption was made that noise generated at the boundaries adjoining the wetlands was similar to that of the WesTrac development (i.e. 59dB(a)) then it remains unlikely that this would cause disturbance to migratory birds based on the report by Spectrum Pty Ltd, particularly when taking into account that environmental noise from invertebrates such as crickets would be greater than this. In addition it is considered that opportunity exists to manage noise impacts from future users through mitigation and management measures if deemed necessary at the time. It is also noted that any future proposed development will be subject to individual assessment as part of the development application process. Recommendations have been made in regard to this in Section 5.4 of this report.

1.5. HISTORICAL DISTURBANCE

Aerial photographs were obtained for the subject site and surrounds for 1954 and 2000. These images were orthorectified and the subject site boundary overlaid in a GIS (Figures 3 & 4). The lots have not changed significantly in the past 53 years with all lots being almost entirely cleared some time before 1954. The two small swamp oak forest fragments forming part of an Endangered Ecological Community on the subject site were present in 1954 and have since undergone some regrowth, expanding slightly in area. Two small dwellings have been built to the immediate west of the subject site and several dwellings have been built to the north of Tomago Road since 1954, somewhat fragmenting the landscape.

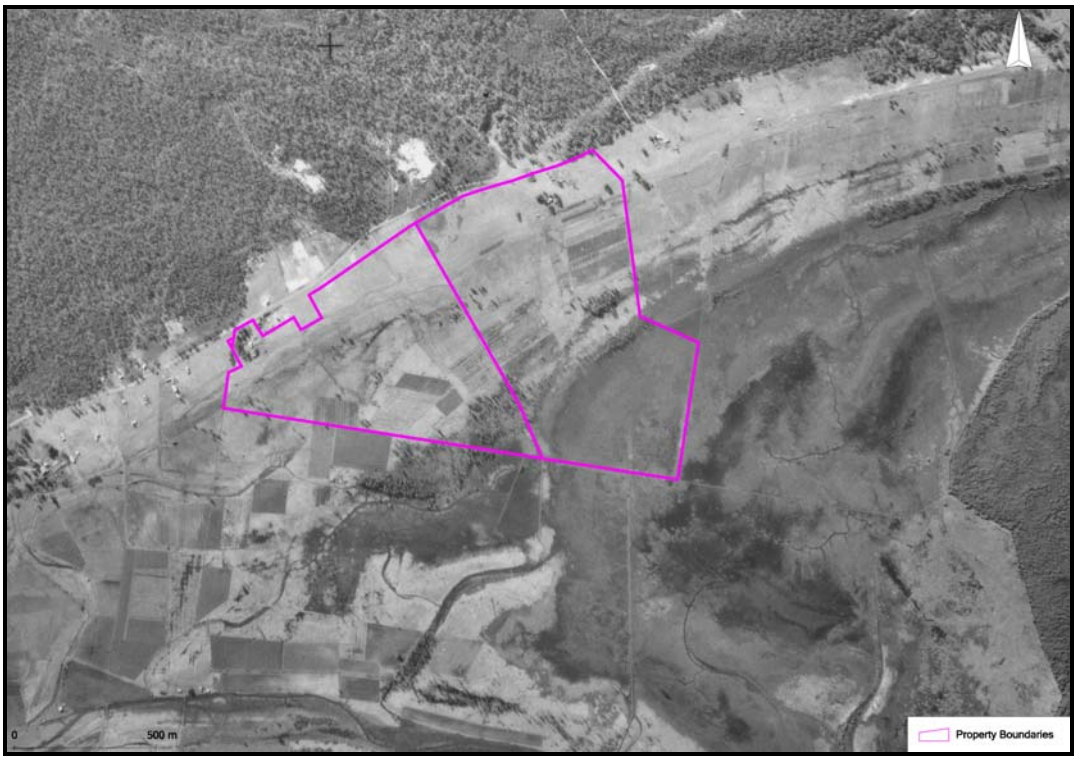


Figure 3. Aerial photograph showing the subject site and surrounds in 1954.

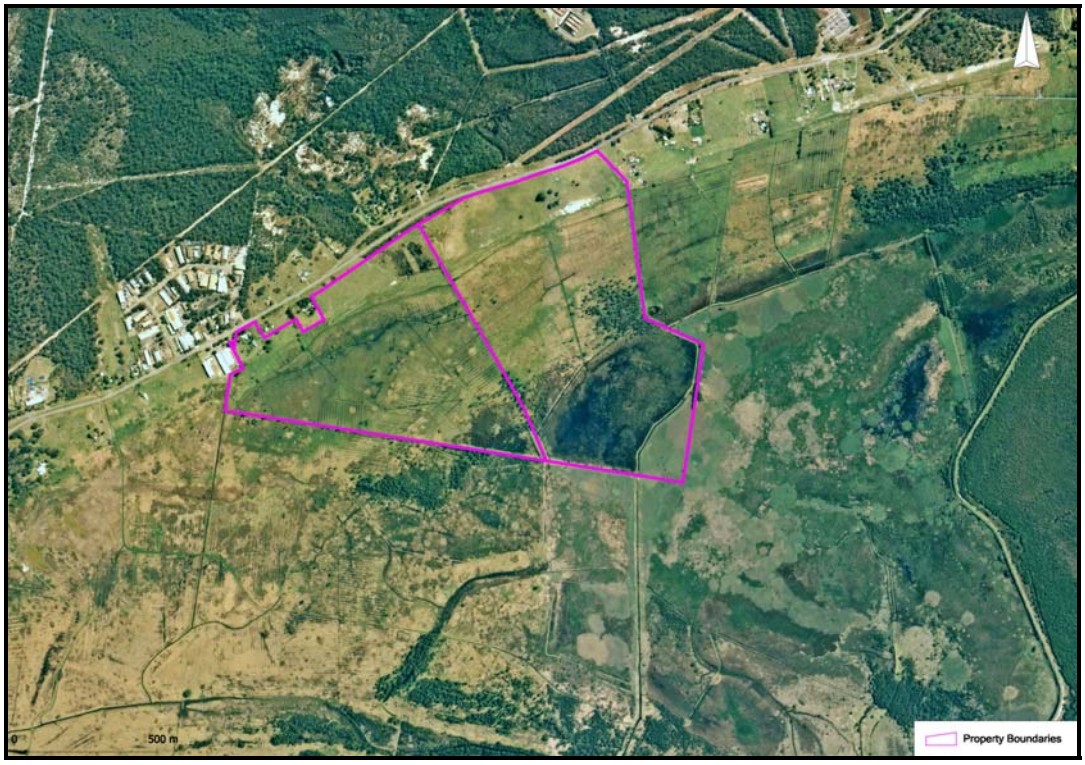


Figure 4. Aerial photograph showing the subject site and surrounds in 2000.

1.6. GEOLOGY AND SOILS

The subject site is comprised of two soil types including Bobs Farm and Tea Gardens landscapes.

The Bobs Farm landscape is broad, flat, swampy Holocene estuarine plain with slope gradients <1% and an elevation of 1-3m ASL. The estuarine plain is often bounded to the north and south by Pleistocene transgressive dune fields and to the east by Holocene sand plains and dunes. The soils consist generally of up to 30cm of black strongly pedal organic-rich loam which overlies 20 to >80cm of grey saturated plastic clay which in turn may occasionally overlie >50cm of saturated greyish yellow brown massive sandy clay loam. Total soil depths exceed 300cm.

The Tea Gardens landscape is characterised by Pleistocene beach ridges and swales on the Tomago Coastal Plain consisting of marine and Aeolian quartz sands. Local relief of the ridges rarely exceeds 1m and has slope gradients of <5%. Elevation is generally 5-8m but near the inner barrier depression elevations are as low as 2m ASL. The ridges are generally well drained but the swales are

often waterlogged for periods of the year and the watertable is generally <100cm below the surface. The soils consist of deep (often >300cm) imperfectly drained Humus Podzols on the ridges with poorly drained Peaty Humus Podzols in the swales (Murphy, 1995).

1.7. LEGISLATION

This project was undertaken in accordance with the following Acts and Policies:

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *NSW Threatened Species Conservation Act 1995* (TSC Act);
- *NSW Threatened Species Conservation Amendment Act 2002*;
- *National Parks and Wildlife Act 1974* (NP&W Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *Draft Guidelines for Threatened Species Assessment;*
- *Native Vegetation Act 2003* (NV Act);
- Port Stephens Comprehensive Koala Plan of Management 2002*;*
- State Environment Planning Policy 44 (SEPP44) Koala Habitat Assessment;
- State Environment Planning Policy 14 (SEPP 14) Coastal Wetlands;
- State Environment Planning Policy 71 (SEPP 71) Coastal Protection;
- LHCCREMS (2002a) – 'Flora and Fauna Survey Guidelines Volume 1'; and
- LHCCREMS (2002b) – 'Flora and Fauna Survey Guidelines Volume 2'.

1.7.1. Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

Under the EPBC Act assessment an approval is required for actions that are likely to have a significant impact on matters of national environmental significance. An action includes a project, development, undertaking, activity, or series of activities. When a person proposes to take an action they believe may need approval under the EPBC Act, they must refer the proposal to the Australian Government Minister for the Environment, Water, Heritage and the Arts. The Act identifies seven matters of national environmental significance:

1) World Heritage properties;
2) National heritage places;
3) Wetlands of international importance (Ramsar);
4) Listed threatened species and communities;
5) Migratory species listed under international agreements;
6) Commonwealth marine areas; and
7) Nuclear actions.

This report assesses points 3 and 4. However, further information and an assessment of impacts on migratory species are provided in Appendix I (EPBC Assessment).

1.7.2. NSW Threatened Species Act 1995 (TSC Act)

Schedules 1 and 2 of the TSC Act contain lists of flora and fauna species and communities, which have been determined by the NSW Scientific Committee as being under threat of serious decline that could ultimately lead to extinction. The TSC Act, pursuant to section 5A of the EP& A Act provides for a seven-part test of significance and impact to be applied to any of these listed species or communities that are found in an area subject to proposed development. Schedule 3 of the TSC Act contains a list of 'key threatening processes' deemed to be processes that have a negative impact on threatened species, populations or communities.

1.7.3. Port Stephens Comprehensive Koala Plan of Management

The lots are located within the Port Stephens Local Government Area. The Port Stephens Comprehensive Koala Plan of Management (CKPoM) applies to all development applications on land within the LGA of Port Stephens. It aims to ensure the long-term sustainability of any local Koala populations. Compliance with the provisions of the CKPoM will constitute compliance with the provisions of SEPP 44 Koala Habitat Protection.

1.7.4. SEPP 14 Coastal Wetlands

The Department of Environment and Conservation (DEC) refer to a recommendation by a State Government Inter Agency Working Group (IAWG) that a minimum buffer for riparian zones and wetlands be 50m. The eastern boundary of Lot 161 DP 774440 is the closest portion of the subject site to SEPP 14 wetlands (Figure 2). EcoBiological estimate that

any proposed development would be approximately 550 metres from the SEPP 14 wetland boundary. Therefore no further consideration is given to SEPP 14 for this proposal.

1.7.5. SEPP 71 Coastal Protection

SEPP 71 aims to protect sensitive coastal zones. The objectives of SEPP 71 can be summarised as follows:

- Manage the coastal zone in accordance with ecologically sustainable development principles;
- Ensure that coastal cities, towns, centres, villages, hamlets, and their communities thrive by protecting the natural and cultural attributes that attract people to the coast to live, work, and recreate;
- Protect and manage the coast in a coordinated manner so the community and future generations can enjoy its natural, scenic and cultural beauty;
- Ensure that existing public access to the coastal foreshore is retained — and new opportunities for public access are provided — in accordance with the natural and cultural attributes of the area; and,
- Ensure that development is appropriate for the coastal environment.

The definition of a sensitive coastal location under SEPP 71 include:

- land within 100m of any of the following:
    - a declared Ramsar wetland within the meaning of the Environment Protection and Biodiversity Conservation Act 1999 of the Commonwealth,
    - land reserved or dedicated under the National Parks and Wildlife Act 1974,
    - land to which State Environmental Planning Policy No 14 - Coastal Wetlands applies.

As already highlighted, the closest SEPP 14 wetland is approximately 550 metres from the subject site, well outside the 100 metre buffer for SEPP 71. However, the eastern boundary of Lot 161 DP 774440 adjoins the Kooragang Nature Reserve, which is managed by NSW National Parks and Wildlife and forms part of the Hunter Estuary Wetlands RAMSAR site. Measures to reduce impacts on and conserve animals, plants and their habitats, particularly within the adjoining Ramsar Wetland, are addressed in section 5 of this report.

1.7.6. Ramsar Wetlands

Under the EPBC Act (1999) a Ramsar wetland (considered of international importance) is either an Australian wetland on the list of Wetlands of International Importance kept under the Ramsar Convention (Ramsar, Iran, 1971), or a wetland declared to be a Ramsar wetland by the Commonwealth Environment Minister. Ramsar wetlands are recognised as a matter of national environmental significance under the EPBC Act's assessment and approval provisions.

A Ramsar wetland of international importance (forming part of Kooragang Nature Reserve) is located adjacent to the south-eastern corner of the subject site where there is about 750 metres of common boundary between the Ramsar declared wetland and the proposed disturbance area on the subject site.

Under Chapter 2, Part 3, Division 1, Section 16 of the EPBC Act it is stated that
"A person must not take an action that:

a) has or will have a significant impact on the ecological character of a declared Ramsar wetland; or

b) *is likely to have a significant impact on the ecological character of a declared Ramsar wetland."*

Where a significant impact is likely to occur as a consequence of a proposed action or development a referral to Environment Australia (EA) may be required in which case the Environment Minister would make a decision as to whether or not the level of impact is properly defined and is or is not tolerable. An extract from the EPBC Act Administrative Guidelines on Significance, July 2000 with respect to wetlands is shown below:

Wetlands of international importance

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on the ecological character of a declared Ramsar wetland.

Criteria

An action has, will have, or is likely to have a significant impact on the ecological character of a declared Ramsar wetland if it does, will, or is likely to result in:

- areas of the wetland being destroyed or substantially modified, or
- a substantial and measurable change in the hydrological regime of the wetland for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland, or
- the habitat or life cycle of native species dependant upon the wetland being seriously affected, or
- a substantial and measurable change in the physico-chemical status of the wetland for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or
- an invasive species that is harmful to the ecological character of the wetland being established in the wetland.

Considering the nature of the proposal and the immediate proximity of the subject site and proposed disturbance area to the Ramsar wetland it is considered likely that an impact will occur on the Ramsar wetland in the form of altered hydrology, weed invasion and run-off leading to siltation, excess nutrient, chemical and acid sulphate pollution if the project is not managed to address these issues. A number of recommendations as outlined under sections 5.1 & 5.3 of this report have been made in regard to this. It is noted that a report prepared by Patterson Britton Pty Ltd has shown that the measures proposed by Redlake Pty Ltd to avoid hydrological impact on the wetlands will result in no alteration or impact on the hydrological and flood regimes in the neighboring wetlands.

2. METHODS

A list of threatened flora and fauna reported from the local area was obtained from the NPWS database, the Atlas of NSW Wildlife. In particular, this assessment included a list of all threatened flora and fauna species recorded within a 5-kilometre radius of the subject site. Based on information available concerning habitat requirements of these species, an assessment was made as to the likelihood of any of the reported threatened species occurring on the subject site or using the habitat of the subject site as an essential part of a foraging range.

A field survey was then conducted using the list of threatened species as a guide to species potentially likely to occur on the subject site. The survey was however, not limited to the species reported on the database extract. Searches were carried out for any species listed on Schedules 1 and 2 of the TSC Act that were considered likely to occur in the type of vegetative habitat present on the subject site. The likelihood of any 'key threatening processes' occurring on the subject site was also assessed. The subject site was inspected on numerous occasions throughout the period from January 2006 to July 2007.

2.1. FLORA

Plant species that occurred across the subject site were identified using a process of systematic searches conducted in accordance with the Lower Hunter Central Coast Regional Environmental Management Strategy guidelines (Murray *et al*. 2002). Floristic identification and nomenclature was based on Harden (1992, 1993, 2000, 2002) with subsequent revisions as published on PlantNet (http://plantnet.rbgsyd.nsw.gov.au). Targeted searches were conducted for those threatened plant species that were identified during the preliminary assessment as likely to occur on the subject site. Plants listed under the ROTAP scheme (Briggs & Leigh 1996) were also considered in this assessment along with species and vegetation deemed to be of local conservation significance. A map of the subject site with the location of flora survey transects and plots are shown in Figure 5.

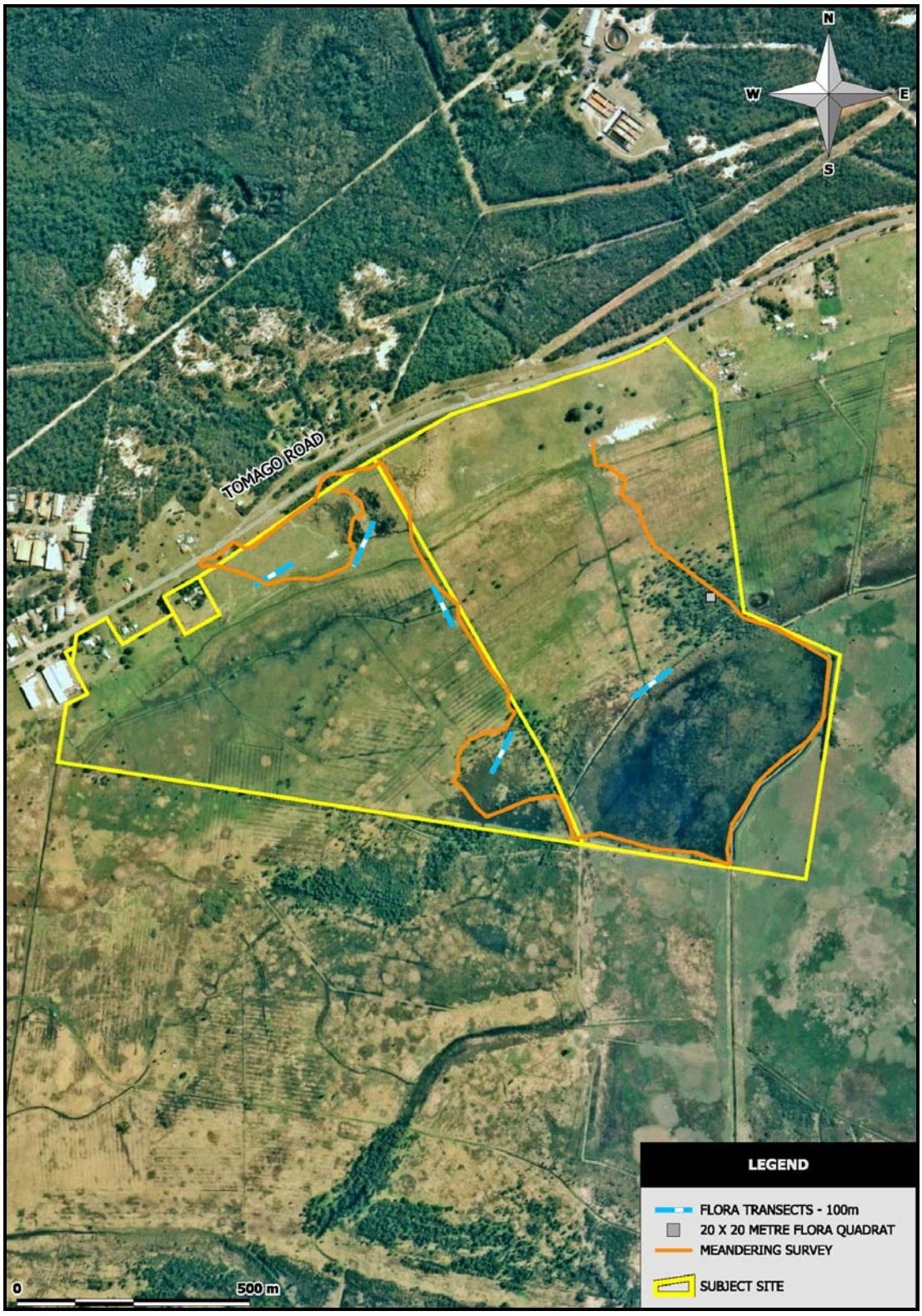


Figure 5. Aerial photograph of the subject site with the location of flora surveys shown.

2.2. VEGETATIVE COMMUNITY TYPE DETERMINATION

The combination of plant species found on the subject site and the surrounding area was assessed against the vegetative community descriptions from the LHCCREMS regional model (NPWS 2000) and a determination was made as to the dominant vegetation community present.

2.3. PORT STEPHENS COMPREHENSIVE KOALA PLAN OF MANAGEMENT

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) applies to all development applications on land within the LGA of Port Stephens. It aims to ensure the long-term sustainability of any local Koala populations. The CKPoM Guidelines for Koala Habitat Assessment have been used to determine the impact that the proposed development will have on the subject property and surrounding potential koala habitat and/or populations. Compliance with the provisions of the CKPoM will constitute compliance with the provisions of SEPP 44. The Koala Habitat Assessment is undertaken in 4 major parts:

1) **Preliminary Assessment** – refer to the Koala Habitat Planning Map of the Port Stephens LGA to determine the mapped Koala Habitat and undertake an inspection of the subject site to determine whether the subject site contains individuals of preferred koala feed trees (Table 1) outside areas mapped as Preferred Koala Habitat.

Table 1. List of Preferred Koala Feed Trees in the Port Stephens LGA

Preferred Koala Feed Trees	
Common Name	**Scientific Name**
Swamp Mahogany	*Eucalyptus robusta*
Forest Red Gum	*Eucalyptus tereticornis*
Parramatta Red Gum	*Eucalyptus parramattensis*

2) **Vegetation Mapping** – of the subject site and surrounding area using aerial photography and detailed ground-truthing. Floristic and structural characteristics of each vegetation community was determined using both transect and quadrat based survey methods.

3) **Koala Habitat Identification** – If the LGA-wide vegetation map produced by Port Stephens Council is inaccurate for the subject site, a revised Koala Habitat Planning Map in accordance with the vegetation communities definitions of the CKPoM must be produced. If it is identified that the subject site contains either Preferred or Supplementary Koala habitat, Habitat Buffers or Habitat linking areas then proceed to Step 4.

4) **Assessment of Proposal** – At this point a map needs to be produced showing information gathered in Steps 1, 2 and 3 and showing the proposed development. The appropriateness of the proposal is assessed using performance criteria from Appendix 4 of the CKPoM. If the applicant requests that council waive provisions listed in Appendix 4, additional work is required. The additional work involves an assessment of koala habitat utilisation of the subject site using the Spot Assessment Technique (SAT). This method locates potential habitat and signs of the presence of the Koala (such as faecal pellets and claw marks) and determines the activity level and the significance of the Koala habitat. The activity level for the SAT is expressed as the percentage equivalent of the quotient derived by dividing the number of trees that had one or more Koala faecal pellets recorded beneath them, by the total number of trees sampled.

2.4. FAUNA

The assessment of fauna occurred across the entire subject site and the following fauna groups were surveyed in accordance with the Lower Hunter Central Coast Regional Environmental Management Strategy Fauna Survey Guidelines (Murray *et al*, 2002). Four 250m trapping transects were positioned over the subject site. Each transect was located in a representative tract of the different vegetation types and structures present on the subject site including in thick *Phragmites*, *Casuarina* forest, thick grass paddock and along a grass edge running along a track in the paddock (Figure 6). Each transect was set out

on two occasions in May and October 2006 and left for a total of four consecutive trap nights on each occasion. The total trap night count is shown in Table 2. A map of the subject site with the location of fauna survey transects and plots are shown in Figure 6. Spotlighting for arboreal and terrestrial mammals and amphibians as well as bat surveys (using Anabat) were conducted over three nights.

Table 2. Trapping Statistics for the Property

Trap type	Traps	Nights	Trap nights
Hair Tubes	15	4	60
Elliot A	40	8	320

2.4.1. Arboreal Mammals

Hair tubes were placed in trees at heights between 1m and 3m or above, set in a grid across the two patches of *Casuarina* forest present on the subject site. Hair tubes were baited with a mixture of rolled oats, honey, peanut butter and treacle. The trunks of trees with the traps were sprayed with a honey and water mixture. Wafers from the hair tubes were collected after the four-night period and checked for the presence of hair samples. Hair identification methods followed those of Brunner *et al.* (2002). If any hair sample was from a vulnerable or endangered species, the sample was sent to Barbara Triggs, an expert in the field of hair identification for a second opinion.

Spotlighting was undertaken from dusk for a 3-hour period on three separate nights to identify the presence of any arboreal mammals. Trees were inspected (during daylight hours) for the presence of habitat hollows and if present these were watched at dusk to see if any nocturnal birds or mammals emerged.

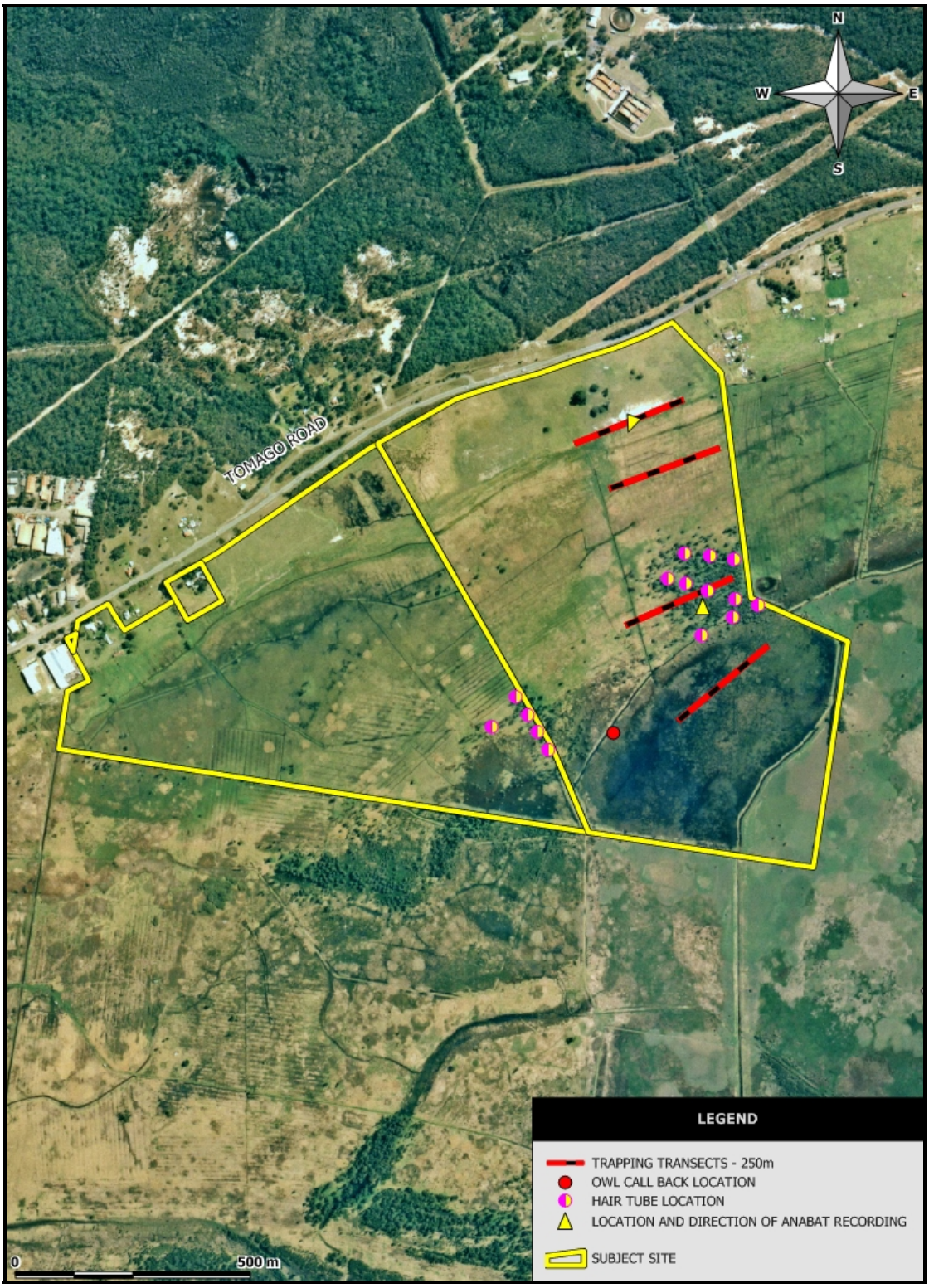


Figure 6. Aerial photograph of the subject site with the location of fauna surveys shown.

2.4.2. Terrestrial Mammals

A combination of spotlighting and Elliott A traps were used to sample terrestrial mammals at the subject site. Elliott traps were placed along four transects at regular intervals and baited with a mixture of rolled oats, honey, peanut butter, treacle and aniseed. These traps were set in position for four consecutive nights and checked each morning for captures. Each trapping transect was set out on two occasions in 2006; once in May and once in October. Spotlighting from dusk for a 3-hour period on three nights was undertaken to identify the presence of any terrestrial mammals. Careful daytime searches were also conducted for the presence of fauna activity such as diggings, droppings or scratch marks.

2.4.3. Bats

An Anabat II bat-call recorder (Titley Electronics, Ballina) was used to record the calls of any Microchiropteran bats feeding in the area. Two units were set up at dusk and recording occurred for 2 hours continuous on one night. Spotlighting searches of blossoming trees were undertaken to identify any Megachiropteran bat species.

2.4.4. Birds

An area search of vegetation on the subject site was carried out to survey for diurnal birds which included a meandering survey for 40 minute periods in each of the two broad habitat types i.e. grassland and *Casuarina* forest (LHCCREMS, 2002) Birds were identified either visually, with the aid of binoculars, or by call interpretation. Surveys were conducted in the morning when bird activity is maximised (Bibby *et al*. 2000). Opportunistic sightings were also recorded and listed separately to actual survey results (Appendix 1).

Diurnal visual and nocturnal searches for the Australasian Bittern and Black Bittern were conducted within the determined potential foraging area on the subject site. A diurnal search within the Casuarina forest was undertaken in March 2007 to locate any individuals or their characteristic nests.

A second diurnal visual and nocturnal search in July 2007 was undertaken for a minimum distance of 200m along the drainage line through the Casuarina forest on dusk, followed by 30 minutes of quiet listening, call playback and spotlighting searches.

Diurnal visual inspections for the Black-necked Stork were conducted in areas of suitable habitat, such as the open paddocks to the south of the subject site which are subject to inundation during heavy or prolonged rainfall events.

After dark, the calls of threatened owl species were broadcast over a megaphone in an attempt to encourage a response. The subject site was also searched to locate any regurgitated owl pellets. If any pellets were found, their size, shape and content was analysed to determine the species of owl from which the pellet originated as well as the prey species the owl had been feeding on. Analysis methods followed those of Brunner *et al*. (2002) and Triggs (1996). Analysis was carried out by Barbara Triggs, an expert in the field of hair and pellet analysis.

Additionally to standard bird surveys EcoBiological was commissioned by Redlake Enterprises Pty Ltd to undertake a detailed research project on the Grass Owl (*Tyto capensis*) after it was detected on the subject site. This was due to little information being known on the species in the region. The study was conducted both on the subject site and in the locality. Aspects of the Grass Owl's ecology that was investigated included:

1) Prey species (Dietary analysis);
2) Movements and home range size;
3) Seasonality;
4) Potential habitat mapping;
5) Behavioural ecology;
6) Local population size;
7) Residency; and
8) Importance of subject site to the Grass Owls.

1) <u>Prey Species (Dietary Analysis)</u>

Two complimentary methods were used in the determination of the Grass Owl's dietary intake and feeding behaviour. Small mammal trapping was conducted across the foraging range of the target population of Grass Owl to determine the availability of terrestrial mammals that could potentially form prey species, and ejecta pellets were collected in order to determine the actual composition of the Grass Owl's diet.

Four 250m trapping transects were positioned across the differing vegetation structures and communities on the subject site in order to identify the presence and abundance of small terrestrial mammals present in the foraging range of the target Grass Owl population. Each transect consisted of ten *Elliott A* traps that were positioned across a

representative tract of the different vegetation types and structures present on the subject site including in thick *Phragmites*, *Casuarina* forest, thick grass paddock and along a grass edge running along a track in the paddock. Each transect was set out on two occasions in May and October 2006 and left for a total of four consecutive trap nights on each occasion.

Collection of Grass Owl ejecta pellets was undertaken from various roost sites across the local population's observed home range in order to determine the composition of the Grass Owl's diet in the local area. Data collected from the ejecta pellets was analysed as the proportion of each prey taxon (identified to class, family, genus or species level) per overall dietary intake. This data was used to try and determine whether the Grass Owl has a localised/specialised dietary intake or is an itinerant opportunistic feeder. Ejecta pellets were analysed by Barbara Triggs, an expert in the field of remains detection, who confirmed the presence of any identifiable remains in the pellets.

2) Movements and Home Range Size

EcoBiological's original proposal was to determine the Grass Owl's home range through capture and radio-tracking, a method never attempted with this species in Australia. In order to give this proposal the best chance of success, one of Australia's leading owl experts and pioneer of the capture and radio tracking method for owls, Dr Rod Kavanagh was asked to be part of the project. Dr Rod Kavanagh has had long-term experience over the past 16 years in the capture and radio tracking of the Masked, Powerful, Sooty and Barking Owls.

Several known methods for catching large forest owls were used in an attempt to catch the Grass Owl. These methods were however unsuccessful. This was largely attributed to the differences in behaviour between the Grass Owl and large forest owls, particularly the natural cautious flight and ground-roosting nature of the Grass Owl. Therefore the complete home range of the Grass Owl was not determined; rather a foraging area was identified through observation of suitable habitat in the area.

Grass Owl movements and foraging area were identified using observational techniques and monitoring. Grass Owl roost sites were identified using triangulation and then

regularly monitored to determine movement patterns. Survey methods for the initial detection of Grass Owls and the location of roost sites are described below:

- Owl Call Playback

  Initial surveys to detect the presence of Grass Owls were carried out on dusk or early evening using call playback to attract any owls present. At each call playback site, an initial listening period of 10 to 15 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animal in the immediate vicinity. The calls of the Grass Owl were then played intermittently for 5 minutes, followed by a 10-minute listening period. A further 10 minutes of spotlighting and listening was conducted in the vicinity to check for birds that were attracted by the calls but were not vocalising.

- Roost Site Searches

  Surveys were carried out to detect owl roost sites using human proximity to flush owls out their roosts in the grass. Suitable survey locations were selected based on the type, length, and amount of grass present. Flushings were conducted by establishing an "emu line" of between 3 – 5 people and walking through the grass, observing where the owls would fly up from. Searches were then targeted in these areas to locate current roost sites.

Methods used to attempt to catch the owls are described below:

- Suspended Netting

  A large fish net 14 x 10m was strung between two aluminium poles, thirteen metres off the ground and placed in probable owl flight paths, determined from observations of the owls foraging at night. The net was rigged with a pulley system to enable the net to be lowered upon an owl colliding with the net. Call playback was used to attract the owls into the area and to further try and attract them to fly into the net.

- Drag Netting

  Two different types of net were trialled for this capture method (one 14 x 2m mist net and one 14 x 10m fish net). The nets were suspended horizontally between four people and dragged over the grass where a recently occupied Grass Owl roost site

was known to be located in the hope that the owl would be flushed out and fly up into the net. The site was then inspected to ensure that no owls remained in the roost.

- Bal-chatri Traps

  This small trap was comprised of 1-inch chicken wire formed into a cage with numerous small (3 - 4cm diameter) nylon nooses attached to the wire on top of the cage. Bait was placed in the cage, and the nylon nooses set to entangle the birds' feet upon landing on the cage. Traps were placed on the ground on tracks through the grass paddocks at the subject site on three occasions. Live rats were used as bait and a tape recording of rat calls was played to lure Grass Owls to the trap. Owl call playback was also used on one occasion to try to attract the owls into the area.

- Opportunistic Noose Traps

  Small opportunistic noose traps were attached to strategically placed perch sites in the front paddock as it was noted during behavioural studies that the Grass Owls liked to perch on stumps. These perch sites were constructed by attaching a small length of plywood horizontally to a metal star picket. The length of wood was wrapped in a piece of carpet which had many small nylon nooses attached to it, to entangle the birds' feet upon landing on the perch. Two people positioned themselves nearby and out of sight and spent nights observing the traps both with and without the use of call playback to attract the owls into the area.

3) Seasonality

The investigation involved the observation and monitoring of the local Grass Owl population for a nine-month period from mid-January 2006 to the end of November 2006. This time period was chosen to see if the Grass Owls were present in all seasons of the year.

4) Potential Habitat Mapping

Areas of known or potential Grass Owl habitat within the study area were mapped to determine the quantitative significance of habitat loss associated with the proposal. The methods used to map known and potential Grass Owl habitat are the same as section 2.1 above.

5) Behavioural Ecology

Methods used to record observations of the Grass Owls' ecology are described below:

- Observational Surveys

  Observational surveys were carried out in the general roosting area, in the front paddock of the subject site, and in one of the roosts itself to examine aspects of the owl's behaviour. The observational surveys of the general roosting area were carried out systematically by having two people positioned at set points where they would sit quietly and observe the owls' behaviour. This behaviour was recorded under categories of flight behaviour and call behaviour and included patterns of flying, flight time, interactions with other birds, landing/taking off sequences, calling behaviours, calling times and time spent on the ground. For each noted activity a bearing of direction was recorded and the data was plotted using GPS to establish a conservative foraging range and possible roosting locations.

- Spotlighting Surveys

  Observational spotlighting surveys were carried out in the front paddock of the subject site to detect owl presence. This data was used to determine the regularity of foraging over the subject site.

- Surveillance

  An infrared surveillance camera was set up at one of the roost sites to make remote observations of roost activity.

6) Local Population Size

A determination of local population size was hindered by the absence of Grass Owl records from the NSW Wildlife Atlas within a 5-kilometre radius of the subject site. One confirmed sighting to the southwest of the subject site within Kooragang Nature Reserve (L. Penman pers. comm.) was known of prior to this study. A roadkill specimen was also collected in 1997 from the Nelson Bay Road just north of Williamtown (HBOC Unusual Record Report #111).

As an alternative to determining local population size, survey work focussed on finding other populations of Grass Owls in the wider region to provide an overall population spread.

The spread of Grass Owl populations in the surrounding region was determined through two (2) surveys at six (6) observation points, playing owl call play back simultaneously to recording the time and number of owls that responded. The six locations were chosen from anecdotal evidence of Grass Owl sightings, the confirmed record of a Grass Owl road kill near Williamtown, records from the NPWS Wildlife Atlas and the identification of potential habitat in the surrounding region.

Two regional surveys were conducted (the first on the 23.11.06 and the second on the 28.11.06), with 6 observation stations on each night.

7) Residency

The investigation involved the observation and monitoring of the local Grass Owl population for a nine-month period from mid-January 2006 to the end of November 2006. The range of survey methods employed and the length of the investigation were designed to determine whether the Grass Owl could be observed at the subject site or within the locality in all seasons.

8) Importance of the Subject Site to Local Grass Owl Population

A combination of survey methods (described above) were employed to gauge the importance of the subject site to the local population. The question of importance was measured against a combination of factors such as availability of prey in the local area, suitability as roosting and foraging habitat, residency in the area and the role of the subject site as a corridor for the movement of this species.

The subject site was visited on a minimum of forty-two (42) occasions with approximately 206 survey hours spent conducting the activities described above. Table 3 provides details of trapping and survey effort used during the investigation of the local Grass Owl population recorded at the subject site.

Table 3. Details of Grass Owl investigation methods

Trap or survey type	No. of Trap Attempts / Survey nights
Owl call playback	5
Roost site searches	4
Suspended mist netting	4
Drag netting	3
Bal-chatri traps	6
Opportunistic noose traps	4
Observational surveys	26
Spotlighting surveys	5
Surveillance	1

2.4.5. Amphibians

Standardised survey techniques for amphibians were employed throughout the survey period and included diurnal habitat searches, nocturnal spotlight surveys, call playback and dip netting for tadpoles. During diurnal surveys, dip netting and visual searches were carried out to locate any tadpoles present in any water bodies. During nocturnal surveys, spotlight searches were carried out by walking lengths of suitable habitat and using head torches to search for frogs by eye shine or by physical sightings.

Adult frogs encountered were identified by visual confirmation or by their distinct advertisement calls. Tadpoles were keyed out using diagnostic features including mouthparts (tooth rows, jaw sheaths and papillae), pigmentation, body size, tail structure (musculature, fin depth, fin shape, tip shape), eye direction and spacing, pupil pigmentation, nare shape and spacing, spiracle height and direction, vent length and direction, and tadpole behaviour according to Anstis (2002).

Additionally to standard amphibian surveys EcoBiological was commissioned by Redlake Enterprises Pty Ltd to undertake target surveys for the Green and Golden Bell Frog (*Litoria aurea*) on the subject site. These surveys were conducted on four occasions during mid September and late November. Two diurnal surveys and three nocturnal surveys were completed with a total of fourteen survey hours undertaken. Surveys were timed to coincide with suitable conditions for finding the target species, either during or shortly after significant rain events (September survey) or during the species' breeding

season when they are known to be highly active (November surveys). A known nearby population of Green and Golden Bell Frog (Kooragang Island, <4km away) was also surveyed on each survey night as a reference site to determine the suitability of climatic conditions for the detection of the species during each of the survey periods.

2.4.6. Reptiles

Targeted reptile searches were carried out by inspecting suitable habitat on site to detect the presence of any reptile species by way of occupancy, scats or other detectable traces. Suitable habitat included rock outcrops and crevices, any fallen hollow logs and limbs, burrows, underneath bark on trees and the ground and suitable rubbish items such as sheets of tin. In addition, where possible any reptiles seen during other routine fauna survey work at the subject site were captured and identified.

2.5. SURVEY EFFORT

Tables 4 & 5 below list the dates of the investigation periods. Table 6 lists dates of fieldwork activities conducted during the nine-month Grass Owl investigation. The time invested in each survey method applied is summarised in Table 7.

Table 4. Dates of fieldwork for the flora investigation.

Activity	Date
Floristic searches	20 January 2006
Vegetation Community Mapping	20 January 2006
Floristic searches and Vegetation Community Mapping	13 February 2006
Floristic searches	14 February 2006
Floristic searches	13 June 2007
Floristic searches	19 June 2007

Table 5. Dates of fieldwork for the fauna investigation.

Activity	Date
Spotlighting	January, February & March 2006
Anabat Call Recording	January 2006
Habitat Search	January to November 2006 June 2007
Bird Survey	January 2006
Amphibian Survey	January, September & November 2006 June 2007
Targeted Green and Golden Bell Frog Survey	September & November 2006
Small mammal trapping	May 2006 & October 2006
Owl call playback	January, February & March 2006
Targeted Waterbird Survey	March & July 2007

Table 6. Dates of fieldwork for the Grass Owl investigation

Activity	Date
Small mammal trapping	May 2006 & October 2006
Owl call playback	January, February & March 2006
Roost site searches	February, March, September & October 2006
Suspended mist net	February & March 2006
Drag netting	February, June & September 2006
Bal-Chatri traps	March 2006
Opportunistic noose traps	May & June 2006
Observational surveys	January, April, May, June & September 2006
Spotlighting surveys	April & July 2006
Surveillance	February 2006

Table 7. Time invested in each survey method applied during the investigation.

Activity	Sampling Effort
Spotlighting	10 pers hrs
Anabat Call Recording	4 hrs
Bird Survey	1.33 pers hrs
Amphibian Survey	6 pers hrs
Targeted Green and Golden Bell Frog Survey	14 pers hrs
Owl call playback	2 hrs
Targeted Waterbird Survey	3 pers hrs
Targeted Grass Owl Survey	206 pers hrs

3. RESULTS

3.1. THREATENED SPECIES PRELIMINARY ASSESSMENT

The records of threatened species, listed in the Atlas of NSW Wildlife, previously recorded within a 5-kilometre radius of the subject site are detailed in the following sections.

3.1.1. Flora

Four threatened flora species were previously recorded within a 5-kilometre radius of the subject site (Table 8).

Table 8. Threatened flora species recorded within a 5-kilometre radius of the subject site.

Class/Scientific Name	Common Name	Legal Status EPBC Act	Legal Status TSC Act	Last Date Recorded
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	17/04/2001
Eucalyptus parramattensis decadens		V	V	20/11/1996
Rulingia prostrata		E	E	11/01/2000
Zannichellia palustris		-	E	21/05/1971

E = Endangered; V = Vulnerable (NSW TSC Act 1995 and EPBC Act 1999)

3.1.2. Fauna

A total of 25 threatened fauna species, including 17 birds, 1 amphibian and 7 mammals were previously recorded within a 5-kilometre radius of the subject site (Table 9, Figure 7).

Table 9. Threatened fauna species recorded within a 5-kilometre radius of the subject site.

Class/Scientific Name	Common Name	Legal Status EPBC Act	Legal Status TSC Act	Last Date Recorded
Amphibia				
Litoria aurea	Green and Golden Bell Frog	V	E	4/03/2002
Mammalia				
Phascogale tapoatafa	Brush-tailed Phascogale	-	V	30/06/1992
Phascolarctos cinereus	Koala	-	V	22/11/2000
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	1/03/1999
Mormopterus norfolkensis	Eastern Freetail-bat	-	V	22/11/2000
Miniopterus australis	Little Bentwing-bat	-	V	22/11/2000
Myotis adversus	Large-footed Myotis	-	V	22/11/2000
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	22/11/2000
Aves				
Stictonetta naevosa	Freckled Duck	-	V	12/05/1985
Botaurus poiciloptilus	Australasian Bittern	-	V	2/07/2002
Ixobrychus flavicollis	Black Bittern	-	V	7/02/1999
Lophoictinia isura	Square-tailed Kite	-	V	6/07/1985
Pandion haliaetus	Osprey	-	V	25/02/2005
Calidris tenuirostris	Great Knot	-	V	3/01/1987
Limicola falcinellus	Broad-billed Sandpiper	-	V	25/02/1990
Limosa limosa	Black-tailed Godwit	-	V	17/03/1991
Xenus cinereus	Terek Sandpiper	-	V	6/02/1999
Irediparra gallinacea	Comb-crested Jacana	-	V	30/11/1984
Charadrius leschenaultii	Greater Sand Plover	-	V	22/01/1984
Charadrius mongolus	Lesser Sand Plover	-	V	17/03/1991
Sterna albifrons	Little Tern	-	E	6/02/1999
Ptilinopus magnificus	Wompoo Fruit-Dove	-	V	26/07/1996
Neophema pulchella	Turquoise Parrot	-	V	30/06/1991
Ninox strenua	Powerful Owl	-	V	24/04/1995
Tyto novaehollandiae	Masked Owl	-	V	22/11/2000

E = Endangered; V = Vulnerable (NSW TSC Act 1995 and EPBC Act 1999)

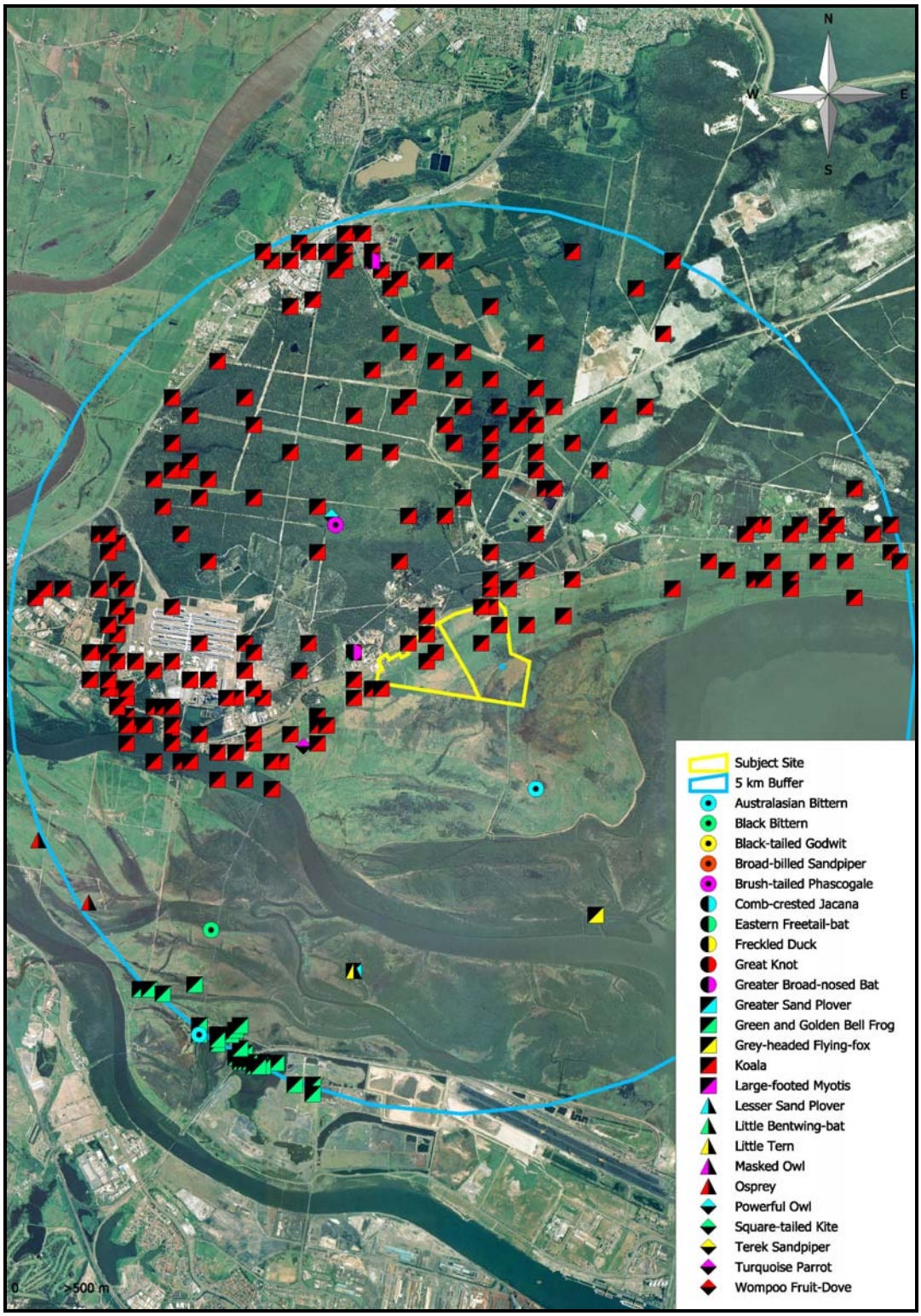


Figure 7. Threatened fauna species records within the locality as listed on the DECC Atlas of NSW Wildlife.

3.2. THREATENED SPECIES PROFILES AND DETERMINATION

The following section provides summary information on the habitat requirements and distribution of threatened flora and fauna that were listed in the Atlas of NSW Wildlife preliminary assessment.

3.2.1. Eucalyptus camfieldii

This is a member of the stringybark group of eucalypts and a distinctive characteristic is the heart shape of the juvenile leaves. It can be found from Tomago to the Royal National Park and in this range it is found in scattered, small, clustered populations. Preferred soil types are sandy coastal or sandstone soils (Hill 2002).

3.2.2. Eucalyptus parramattensis subsp. decadens

A small smooth-barked tree to 15m tall (although generally around 7m) with white or grey bark that does not shed cleanly. Leaves are 7-20cm long and 4-3.5cm wide; discolorous (Hill 2002). The species is distributed in two main disjunct locations being the Tomago sandbeds and the Cessnock-Kurri area. Bell (2006) estimates that there are 2500 - >8000 plants in each area. The species grows on Permian sediments in the Cessnock-Kurri area and on Pleistocene Sands in the Tomago area (Bell 2006). Small portions of the Cessnock-Kurri population is conserved in the Werakata National Park (Bell 2004).

3.2.3. Rulingia prostrata

Rulingia prostrata or Dwarf Kerrawang, as it name indicates, is prostrate shrub forming dense mats to 1m across and only 5 cm high. Stems and branches are sparsely covered with stellate hairs. Leaves are ovate to lanceolate, mostly 2-6 cm long, 5-20 mm wide with margins irregularly crenate or lobed. Upper leaf surfaces are green and glabrescent, lower surface sparsely tomentose. Flowering is mainly between October and November. Initially white, the petals turn pink with age. Petals are 2-3mm long and cymes can have 3-12 flowers. Capsule are between 8-10 mm diameter, having stellate hairs on short and dense bristles. Fruits can be found during spring to summer (Harden, G. 2000).

Dwarf Kerrawang occurs on the Southern Tablelands (one plant at Penrose State Forest, one plant at Rowes Lagoon and one plant at Tallong) and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). It is also found in Victoria.

Habitat occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland at Rose Lagoon; Blue leaved Stringybark (*Eucalyptus agglomerata)* Open Forest at Tallong; and in Brittle Gum (*Eucalyptus mannifera*) Low Open Woodland at Penrose; Scribbly Gum (*Eucalyptus haemostoma*)/ Swamp Mahogany (*Eucalyptus robusta*) Ecotonal Forest at Tomago (DEC 2005).

3.2.4. Zannichellia palustris

Zannichellia palustris is a submerged monoecious weakly rhizomatous aquatic annual or perennial plant (Harden, 1993). It is considered to be indigenous in NSW and is recognized as rare nationally (Briggs, J.D. and Leigh, J.H. 1995) by which it is given a coding 3R+. *Zannichellia palustris* occurs in fresh to brackish, still to slowly moving waters. Recent collections of *Zannichellia palustris* in NSW are from Ironbark Creek and tributaries at Shortland and Wallsend, in Black Creek at Cessnock and in ponds on Kooragang Island. It has also been recorded from near Belmont.

In NSW, populations of *Zannichellia palustris* behave as annuals, completely dying back each summer. The individual patches of *Zannichellia palustris* range from about 5m2 to 100m2, and can vary from year to year.

None of the known sites of *Zannichellia palustris* in NSW are formally protected, or managed in any way for the conservation of this species. Known sites are in areas where considerable changes have, and are continuing, to take place in their catchments. These changes in catchment land use may result in changes in hydrological conditions and water quality, which may affect the ability of the species to persist in areas where it is known to occur.

3.2.5. Freckled Duck *(Stictonetta naevosa)*

The adult Freckled Duck is a dark duck with a large and pointed head. The feathers of the adult are dark brownish-black uniformly freckled with white or buff (Frith 1982). The preferred habitat for this large bodied duck includes larger open brackish or fresh lakes, creeks, farm dams and floodwaters (Marchant & Higgins 1990). They feed on algae, seeds and plants and macro-invertebrates at wetland edges and productive shallow waters at dusk. Preferred breeding habitat is beside heavily vegetated fresh waters (Frith 1982). The Freckled Duck is endemic to south-eastern and south-western Australia, occurring as a vagrant elsewhere e.g. coastal districts in drought years (Marchant & Higgins 1990). The Murray-Darling Basin, Lake Eyre and south-western Queensland forms the eastern breeding stronghold for the species (Pizzey 1991).

Threats to the Freckled Duck are loss of habitat and potential breeding sites, hydrological changes through altered river flow, irrigation and conservation schemes and illegal hunting. Management plans include habitat protection zones, river and wetland management and education programs for landholders and hunters (Ayres et al.. 1996).

3.2.6. Australasian Bittern *(Botaurus poiciloptilis)*

The Australasian Bittern is a medium to large-sized (66-76cm) heron with mottled buff, brown and dark brown plumage (Marchant & Higgins 1990). Adults produce loud booming calls, typically four quick gasps followed immediately by loud booming usually repeated 2-3 times. The Australasian Bittern occurs in reeds and marshes in terrestrial freshwater wetlands and, occasionally estuarine habitats feeding mainly at night on small mammals, birds, amphibians, eels, crustaceans and insects. The species breeds from October through to February and nests in stands of Phragmites, Typha, and rushes (Juncus, Baumea spp.). The nest is usually comprised of a well-constructed flat platform of rushes or reeds (Marchant & Higgins 1990).

The Australasian Bittern is distributed across south-eastern Australia, including south-eastern South Australia, Victoria, eastern Murray-Darling Basin in NSW to south-east Queensland (Marchant & Higgins 1990; Garnett & Crowley 2000; Barrett et al.. 2003). The Australasian Bittern is listed as vulnerable under the NSW Threatened Species Conservation Act 1995. The main threats to the species include the diversion of water for irrigation (Kingsford 2000); salinisation or drainage of permanent swamps; clearing of riparian vegetation; degradation of drought refuges; grazing and trampling of vegetation by livestock and; poor representation of habitat in conservation areas (NPWS 1999).

3.2.7. Black Bittern *(Ixobrychus flavicollis)*

The Black Bittern is a medium-sized, dark grey-black bittern with a buff-streaked throat and foreneck and distinct yellow streaks on sides of its head and neck. The species has a characteristic booming call, not unlike, but much louder than the call of a pigeon. The species usually occurs singly or in pairs in thick vegetation in terrestrial wetlands, watercourses, swamps,

billabongs, mudflats and mangroves, also streamside vegetation in shrubland or low forest (Marchant & Higgins 1990).

The Black Bittern is widely distributed in Australia, occurring from north-eastern Victoria, NSW, Queensland, to the Kimberley area in north Western Australia with a separate occurrence in the south-western corner of WA (Schodde & Tidemann 1986, Barrett et al.. 2003). In NSW, the species occurs in the coastal regions of the north and mid-north coast, Sydney Basin Bioregion and scattered records for the south coast. The species is not well represented in reserves and is listed as vulnerable under the NSW Threatened Species Conservation Act 1995. The Black Bittern is threatened by grazing and trampling of vegetation by cattle; predation by feral cats on eggs and juveniles; clearing of riparian vegetation for agriculture; drainage, salinisation, siltation and pollution of wetlands and waterbodies (NPWS 1999).

3.2.8. Powerful Owl *(Ninox strenua)*

The Powerful Owl is a large (60cm) forest owl that inhabits forest and woodlands of the coastal, escarpment, tablelands and western slopes in NSW (Kavanagh 2002b). Habitat for the Powerful Owl comprises tall, moist productive eucalypt forests and a mosaic of wet and dry sclerophyll occurring on undulating, gentles terrain near the coast. Optimal habitat includes a tall, shrub layer and abundant hollows supporting high densities of arboreal mammals (DEC 2005). The Powerful Owl preys on arboreal mammals, particularly the Common Ringtail Possum in the lowlands and the Greater Glider in the highlands. These two species comprise more than 80% of the species' diet. Other prey species include the Sugar Glider, the Common Brushtail Possum, Grey-headed Flying Fox as well as some diurnal bird species such as the Pied Currawong (DEC 2005).

The Powerful Owl roosts in dense mid-canopy trees or tall shrubs in sheltered gullies, while nesting occurs in hollows of old eucalypts in unlogged, unburnt gullies and lower slopes within 100m of streams or minor drainage lines (DEC 2005). The species is faithful to nesting hollows (Kavanagh 1997; Higgins 1999; Kavanagh 2002b). The home range of the Powerful Owl is variable, depending on habitat productivity, however, is generally between 300 and 1500ha (Kavanagh 1997). The species systematically 'farms' this territory rather than regularly hunting across the entire home range. The breeding season of the Powerful Owl is from mid-May to mid-July (Kavanagh 1997; Kavanagh 1998; Kavanagh 2002a, 2000b; Kavanagh & Stanton 2002).

3.2.9. Square-tailed Kite *(Lophoictinia isura)*

The Square-tailed Kite is a large raptor that occurs in temperate and tropical forest and woodlands including the coastal regions across Australia. The bird has been recorded in most parts of Australia with the exception of the extremely arid centre (Barrett et al.. 2003). The species prefers ridge and gully forests dominated by Eucalyptus, Angophora and Acacia scrub and patches of low open eucalypt woodland and coastal heath. The Square-tailed Kite usually nests along or near watercourses or in forest gullies. Nests are large platforms of sticks usually situated in the fork or limb of a large tree. The species prefers to hunt singly in Eucalypt open forest and woodland (Debus and Czechura 1989), where it feeds on small birds, foliage insects and sometimes on small mammals and lizards.

In NSW, records for the Square-tailed Kite occur across a wide area of the state with most of the records in the coastal zones of the south (i.e. south of Wollongong) and north coast (north of Taree). Scattered records occur west of the divide on the northern tablelands, north-west slopes and plains as well as in the far west mainly along major watercourses. In the Sydney Basin Bioregion the species is rare with only eight records during the second Birds Australia Atlas (Garnett et al.. 2001). Similarly, in the Hunter region, the Square-tailed Kite has previously been reported well north of Newcastle at Cundletown, Purfleet and Crowdy Head NP (HBOC 1997,1998) and only two records in the lower Hunter.

3.2.10. Osprey *(Pandion halieatus)*

The Osprey, also known as the Fish-Hawk or White-headed Osprey, is a long-lived, sedentary and cosmopolitan species (Marchant & Higgins 1993). Its core habitat includes bays, estuaries, mangrove swamps, beaches, dunes, cliffs, inshore waters of mainland and islands, and coral and rocky reefs (Roberts & Ingram 1976; Gosper 1981, 1983; Ekert & Brady 2004). In Australia, the Osprey mainly occurs in the coastal zone, covering approximately 75% of the mainland coastline. There are thought to be three disjunct populations: the northern and eastern population occurring from Broome, WA to the south coast of NSW; the southern population from Kangaroo Island to the Great Australian Bight and; the western population from Esperance to Cape Keraudren (Marchant & Higgins 1993).

In NSW, the Osprey occurs from the Queensland/NSW border to the south coast, with a number of inland records. The breeding season for the Osprey occurs from June to October. The Osprey is monogamous and very faithful to the nest-site and nesting territory, and returns to the same nest in successive years (Olsen 1995; Ekert & Brady 2004). The Osprey constructs a large nest, predominantly composed of dead sticks, branches, driftwood, seaweed, bark and woodchips. The nests are constructed on a variety of sites but most commonly in a fork or broken trunk in the upper part of a dead tree or dead crown of a live tree (Clancy 1993; Rose 2000). The diet of the Osprey mainly consists of fish, although small terrestrial vertebrates, seabirds and crustaceans have also been recorded (Marchant & Higgins 1993).

3.2.11. Great Knot *(Calidris tenuirostris)*

The habitat of the Great Knot is tidal mudflats, sandy ocean and bay shores, estuaries, shallow saline and freshwater wetlands. The species breeds in northeast Siberia and migrates to India, south and southeast Asia, Indonesia and Papua New Guinea and New Zealand. The bird is a regular summer migrant (Sept – March) to coastal Australia. It is most common in the Northern Territory to coastal northwest Western Australia (Pizzey & Night, 2003).

3.2.12. Broad-billed Sandpiper *(Limicola falcinellus)*

The Broad-billed Sandpiper is an uncommon, small, stint-like sandpiper which breeds in northern Siberia before migrating southwards in winter to Australia, arriving in September and departing in March. The species overwinters in Australia along the northern coast, particularly in the northwest, with occasional birds seen on the south coast, and very few records inland (Smith 1991). In NSW, the majority of records are from the Hunter River estuary, with some birds occasionally reaching the Shoalhaven estuary (Rogers 1973; Smith 1991). Favoured habitat of the Broad-billed Sandpiper includes sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, lagoons, saltmarshes and reefs. There have also been some records of individuals in sewage farms or within shallow freshwater lagoons (Higgins & Davies 1996).

This species roosts on banks on sheltered sand, shell or shingle beaches. Large flocks are rarely recorded and birds are often either encountered alone or feeding with other waders such as Red-necked Stints or Curlew Sandpipers (NPWS 2000). Broad-billed Sandpipers forage by rapidly and repeatedly jabbing their bills into soft wet mud (Smith 1991). Their diet includes insects, crustaceans, worms, seeds and molluscs (Cramp 1983). Threats to this species include hydrological changes to estuaries and similar water bodies which may modify or remove important areas of habitat and clearance of coastal habitat for residential, agricultural and tourism developments (NPWS 1999).

3.2.13. Black-tailed Godwit *(Limosa limosa)*

The Black-tailed Godwit is a migratory wading bird that breeds in the Palaearctic (Siberia and Mongolia) and visits Australia during the summer, arriving in August and departing in March (Kingsford 1991; Higgins & Davies 1996). Most NSW records of this species come from Kooragang Island (Hunter River estuary), with scattered sightings from both coastal and inland

areas (Higgins & Davies 1996). Black-tailed Godwits are often recorded in mixed flocks with the more common Bar-tailed Godwit. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed (Pizzey 1991). The primary habitat for the Black-tailed Godwit is along the coast in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, the Black-tailed Godwit can be found on mudflats and in water less than 10cm deep around muddy lakes and swamps (Pizzey 1991; Higgins & Davies 1996). Individuals have also been recorded in wet fields and sewerage treatment works (Kingsford 1991).

The diet of this wader includes insects, crustaceans, worms, molluscs, fish eggs, spiders, larvae and the spawn and tadpoles of frogs (Schodde & Tidemann 1986; Higgins & Davies 1996). Threats to the species include hydrological changes to inland lakes which modify or remove important areas of suitable habitat for those individuals that remain in Australia over winter and tourism or agricultural developments reducing coastal and inland habitat areas (NPWS 1999).

3.2.14. Terek Sandpiper *(Xenus cinereus)*

The Terek Sandpiper is a medium-sized migratory wading bird that breeds from southern Finland to north-eastern Siberia and visits Australia from August to April. When in Australia, the Terek Sandpiper ranges along the west, north and east coasts. Individuals have also been irregularly recorded on the southern Australian coast and inland (Higgins & Davies 1996). Most NSW records of this species come from the Richmond estuary (Smith 1991) and the Hunter River estuary. The latter has been identified as nationally and internationally important for this species (Watkins 1993).

Within Australia, this species is recorded on coastal mudflats, lagoons, creeks and estuaries. Records indicate that the species favours muddy beaches near mangroves but has also been observed on rocky pools and corals reefs and occasionally up to 10km inland around brackish pools (Smith 1991; Higgins & Davies 1996). Terek Sandpipers generally roost communally among mangroves, often with related wader species such as Marsh Sandpipers, Godwits and Lapwings (Pringle 1987).

The diet of this wader includes crustaceans, worms, small shellfish and the adults and larvae of various flies, beetles and water bugs (Higgins & Davies 1996). Foraging is undertaken by moving rapidly and randomly over soft, wet mud, pecking or probing at the surface (Smith 1991). Threats to the species include hydrological changes to estuaries and similar waterbodies which modify or remove important areas of suitable habitat, tourism or agricultural developments reducing coastal and inland habitat areas and disturbance to foraging and roosting sites (NPWS 1999).

3.2.15. Comb-crested Jacana *(Irediparra gallinacea)*

The Comb-crested Jacana, also known as the 'Lotusbird', is an obligate freshwater species (Garnett et al. 2001) that occupies permanent territories all year round. The species inhabits freshwater wetlands on coastal floodplains, particularly those with abundant vegetation, such as waterlilies (Nymphaea spp.) and the introduced Water Hyacinth (Eichhornia crassipes). The species requires this floating vegetation as a means of walking over it while foraging for food and for breeding in which they construct a small floating platform supported by aquatic vegetation. The species breeds as solitary pairs, which vigorously defend their nesting territory (Smith 1991). Comb-crested Jacanas eat a wide variety of invertebrate and plant material with seeds of waterlilies and aquatic moth larvae being particularly important (Dostine & Morton 2000).

Within Australia the Comb-crested Jacana is confined to the coastal and sub-coastal fringes of the north and north-east of the continent (Blakers et al.. 1984; Marchant & Higgins 1993). The species is most abundant and widespread in NSW in the floodplain wetlands along the Richmond and Clarence Rivers (Smith 1991). The Comb-crested Jacana is listed as vulnerable in the NSW

Threatened Species Act 1995. Threats include the loss of wetland habitat through clearing and draining for flood mitigation and agriculture (Marchant & Higgins 1993).

3.2.16. Greater Sand Plover *(Charadrius leschenaultii)*

The habitat of the Greater Sand Plover is coastal wide sandy or shelly beaches, sandspits, tidal mudflats, reefs, sand cays, mangroves, saltmarsh, dune wilderness, and bare paddocks. It is rarely found far from the coast. The bird is a regular summer (Aug – May) migrant to Australia. It is most common in northwest Western Australia where flocks of thousands occur (Pizzey & Knight, 2003).

3.2.17. Lesser Sand Plover *(Charadrius mongolus)*

The Lesser Sand-plover is a small (18-21cm) migratory shorebird that breeds in the Northern Hemisphere (i.e. eastern Siberia, southern Mongolia, western China and Himalayas). In Australia, the species occurs during the spring and summer migration period and occurs mainly along the east coast of Queensland and northern NSW (Marchant & Higgins 1993), with occasional records in the Hunter River Estuary (Ekert 2005).

The Lesser Sand-plover is found on intertidal sand and mudflats in estuaries or roosting on sandy beaches or rocky shores at high tide (Smith 1991; Marchant & Higgins 1993; Ekert 2005). The species is threatened by habitat modification and removal in estuaries.

3.2.18. Little Tern *(Sterna albifrons)*

The habitat of the Little Tern is coastal waters, bays, inlets, saline or brackish lakes, saltfields, and sewage ponds near the coast. The bird can be found within suitable habitat along the north west, northern, eastern and southeast coastline of Australia from about Shark Bay (W.A) to eastern Tasmania and west to Yorke Pensinsula (S.A). Breeding occurs mostly from September to January with typically 1-2 eggs laid in scrapes in sand or shell debris. The species has suffered serious decline in southeast and eastern Australia due to beachgoers, dogs and vehicles intruding on beach nest sites (Pizzey & Knight, 2003).

3.2.19. Wompoo Fruit Dove *(Ptilinopus magnificus)*

This species occurs in much of the lowlands of New Guinea and adjacent islands and in Torres Strait. Within Australia, the species historically occurs from the Illawarra district of New South Wales, north to the tip of Cape York Peninsula. There are consistent although limited numbers of reports of the Wompoo Fruit-dove from the southern parts of its range (Garnett et al.. 2000). The preferred habitat of this species is sub-tropical and tropical rainforest; however, the species has also been reported in low elevation moist eucalypt forest and brush box forests (Frith 1982). Wompoo Fruit-doves feed on a diverse range of tree and vine fruits and are locally nomadic, following ripening fruits. Threats to this species include: Clearing, fragmentation and weed invasion of low to mid-elevation rainforest due to coastal development and grazing; Logging and roading in moist eucalypt forest with well-developed rainforest understorey, and; Burning, which reduces remnant rainforest habitat patches (NPWS 2000, 2002).

3.2.20. Turquoise Parrot *(Neophema pulchella)*

The Turquoise Parrot is a small (20cm) temperate woodland species that occurs from south-east Queensland through NSW to east and north-east Victoria. Generally, the distribution of the Turquoise Parrot is patchy, determined by areas of suitable habitat. Such habitat is usually steep, rocky ridges and gullies, rolling hills, valleys and river-flats comprised of eucalypt woodland and open forests with a ground cover of grasses and low understorey of shrubs. The Turquoise Parrot is an obligate granivore feeding on the seeds of grasses, herbaceous plants and shrubs and requires a reliable supply of water (Higgins 1999). Breeding occurs from August to January,

usually nesting less than two metres above the ground. Nests are located in the hollows of small trees, dead eucalypts or in holes or stumps.

The Turquoise Parrot is a resident or partially nomadic species with movements usually a result of seasonal fluctuations in the distribution and availability of food. The species mostly occurs as pairs or small parties of 6-8 birds. In NSW, the species mainly occurs on or at the foothills of the Great Divide from Moree south to Dubbo, Griffith and Wagga Wagga. The species is listed as vulnerable under the NSW Threatened Species Conservation Act 1995 (Blakers et al.. 1984; Barrett et al.. 2003). Threats to the Turquoise Parrot include loss of habitat through clearing, intensive logging, burning and grazing; the destruction of nest sites; and, inappropriate fire regimes which remove nesting and feeding resources (Garnet and Crowley 2000).

3.2.21. Masked Owl *(Tyto novaehollandiae)*

The Masked Owl is a medium to large sized (40-50cm) owl that inhabits eucalypt forests and woodlands from the coast, where it is most abundant, to the western plains (Kavanagh 2002b). The preferred habitat is open woodland and forest with an open understorey and sparse ground cover (Kavanagh 2002a, 2002b; Kavanagh & Stanton 2002). Potential habitat for the species is mostly in conservation areas and state forests, although the species is often found in large tracts of forest or woodland on public and private lands, including suburban bushland (DEC 2005).

The diet of the Masked Owl consists almost entirely of small terrestrial mammals and some birds (Higgins 1999). The species roosts in hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or cliffs. Hollows can be located in a variety of topographic positions from gully to upper slope. The Masked Owl is a sedentary (resident) species that occupies a large home range, estimated as 400-1000ha. The estimated population size in NSW is 1,500 pairs (Debus 1994; Kavanagh 1997). Threats to the Masked Owl include habitat clearing and fragmentation, logging, fire, and predation, human hazards (e.g. road kills, fences, wires etc) (DEC 2005).

3.2.22. Brush-tailed Phascogale *(Phascogale tapoatafa)*

The Brush-tailed Phascogale is a rat-sized marsupial of the Dasyurid group that also contains the Antechinus, Spotted Quoll and Tasmanian Devil. As its name implies the Brush-tailed Phascogale has a flamboyant ‘bottle-brush’ style black tail which is attached to a grey body. It also has the distinction of being the largest of the Dasyurids where the male only lives for one year, dying shortly after mating. The males are also prone to stress induced stomach ulcers that weaken them so that they fall prey to other forest predators. This species is found in patches around the forested edge of Australia where it generally occupies very large home ranges for such a small animal with females occupying about 40 hectares and males about 100 hectares. Their food is anything that moves from spiders and centipedes to baby birds in nests along with the nectar and pollen of flowering eucalypts (van der Ree et al. 2001, Soderquist 1995).

3.2.23. Koala *(Phascolarctus cinereus)*

The Koala generally occurs from the Townsville district in northern Queensland, south along the coast and ranges into Victoria and part of South Australia. Within New South Wales and Queensland, this distribution extends into the western slopes and plains. The Koala lives entirely on a diet of leaves of both eucalypt and non-eucalypt trees and it has been shown that within its range there are local and regional preferences for the tree species used for feeding. Examples of eucalypts used as feed trees are E. camuldulensis; E. viminalis; E. ovata; E. teretecornis; E. microcorys; E. punctata. Non-eucalypts recorded have been Allocasuarina torulosa; Melaleuca quinquenervia; and Lophostemon confertus. Throughout its range the Koala suffers from either a lack of numbers or severe over-population where problems such as eye disease and reproductive tract bacterial disease caused by Chlamydia psittaci become prevalent (Martin & Handasyde 1995; Moore & Foley 2000; Phillips & Callaghan 2000; Phillips et al. 2000).

3.2.24. Eastern Freetail Bat *(Mormopterus norfolkensis)*

While this bat is regarded as a separate species, the taxonomy is yet to be resolved. It can be found along the eastern seaboard from central Victoria to north Queensland and can only be found in Australia. The bat can be found in a wide range of forest and woodland habitats where it forages for insects. It prefers tree and limb hollows for denning (Churchill 1998; Allison & Hoye 1995).

3.2.25. Little Bentwing Bat *(Miniopterus australis)*

This species is widely distributed on the coast and ranges of eastern Australia, from Cape York Peninsula, south to Victoria and eastern South Australia. The species is also present in northern Western Australia and the Northern Territory. Within New South Wales, it extends from the coast to the western slopes of the Great Dividing Range. These bats roost in caves and man-made structures such as culverts, mine shafts and farm sheds. They are territorial, moving within a 300 km radius of a maternity cave. They forage for insects in generally well-wooded habitat of a variety of forms from swamp forest, dry forest to rain forest (Churchill 1998, Dwyer 1995).

3.2.26. Myotis adversus *(Large-footed Myotis)*

Also known as the Fishing Bat, this bat is the only confirmed Australian representative of the most widely spread genus of Microchiropteran bat worldwide. It can be found within 100 km of the coast from the Kimberly in Western Australia to southeastern South Australia. Foraging is commonly over water with the bats skimming the surface and using their large hind feet to scoop aquatic insects and even small fish. They can be found roosting in a variety of locations that include caves, bridges, tree hollows, and even dense foliage (Churchill 1998, Richards 1995).

3.2.27. Greater Broad-nosed Bat *(Scoteanax rueppellii)*

This species occurs along the coast and ranges of eastern Australia, from northern Queensland to the New South Wales/Victorian border. This bat appears to be most frequent in the river systems draining the Great Dividing Range. Tree-lined creeks, and the junctions of woodland and cleared paddocks, are favoured hunting areas for the Greater Broad-nosed Bat, although it may also forage in rainforest environments, flying as low as one metre above the surface of a creek. The species normally roosts in tree hollows, but roosting records in the ceilings of old buildings also exist (Churchill 1998; Hoye & Richards 1995).

3.2.28. Grey-headed Flying-fox *(Pteropus poliocephalus)*

This species occurs along the eastern seaboard of Australia roosting in communal colony sites, which are used permanently, annually, or occasionally depending on food availability (Tidemann 2000). Colonies can vary considerably in size from hundreds to many thousands of individuals, and fluctuate according to food resources (Parry-Jones & Augee 1991; Tidemann 2000). Fruits from numerous rainforest trees and other myrtaceous species form a large component of their diet, and consequently mass nomadic movements occur throughout their range in response to fruit availability. Large colonies are very vocal even during the day, and can significantly damage roost trees by their sheer weight of numbers.

"The Grey-headed flying fox must be acknowledged as being highly significant to the health and maintenance of many ecosystems in eastern Australia. The species performs the ecosystem services of pollination and seed dispersal for a wide range of native trees, including commercially important hardwood and rainforest species. It thus contributes directly to reproduction, regeneration and the evolutionary processes of forest ecosystems. Flying-foxes are unique in the large distances they disperse pollen and seeds. The population of Grey-headed flying fox must be of sufficient size

for this to continue. If numbers were reduced to small or localised groups, then rainforest seed dispersal and hardwood pollination processes would be severely curtailed (Eby 2000)".

3.3. SUMMARY OF THREATENED SPECIES DETERMINATION

The following table is an assessment of the likelihood of threatened flora and fauna species recorded within 5 kilometres of the property, occurring on the subject site. A total of ten threatened species; comprising one plant, three birds, five mammals and one frog were assessed as having potential habitat on the subject site.

Table 10. An assessment of the likelihood of selected threatened flora and fauna species occurring on the subject site.

Class/Scientific Name	Common Name	Likelihood of being found on the subject site	Impact assessment applied
Flora			
Eucalyptus camfieldii	Heart-leaved Stringybark	Unlikely – unsuitable habitat	No
Eucalyptus parramattensis decadens		Unlikely – unsuitable habitat	No
Rulingia prostrata		Unlikely – unsuitable habitat	No
Zannichellia palustris		Possible – suitable habitat present	Yes
Amphibia			
Litoria aurea	Green and Golden Bell Frog	Possible – suitable habitat present	Yes
Mammalia			
Phascogale tapoatafa	Brush-tailed Phascogale	Unlikely – unsuitable habitat	No
Phascolarctos cinereus	Koala	Unlikely – unsuitable habitat	No
Pteropus poliocephalus	Grey-headed Flying-fox	Present on subject site	Yes
Mormopterus norfolkensis	Eastern Freetail-bat	Present on subject site	Yes
Miniopterus australis	Little Bentwing-bat	Present on subject site	Yes
Myotis adversus	Large-footed Myotis	Likely – suitable roosting and foraging habitat present	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	Present on subject site	Yes

Class/Scientific Name	Common Name	Likelihood of being found on the subject site	Impact assessment applied
Aves			
Stictonetta naevosa	Freckled Duck	Unlikely – unsuitable habitat	No
Botaurus poiciloptilus	Australasian Bittern	Possible – some marginal habitat present	Yes
Ixobrychus flavicollis	Black Bittern	Possible – some marginal habitat present	Yes
Lophoictinia isura	Square-tailed Kite	Unlikely – unsuitable habitat	No
Pandion haliaetus	Osprey	Unlikely – unsuitable habitat	No
Calidris tenuirostris	Great Knot	Unlikely – unsuitable habitat	No
Limicola falcinellus	Broad-billed Sandpiper	Unlikely – unsuitable habitat	No
Limosa limosa	Black-tailed Godwit	Unlikely – unsuitable habitat	No
Xenus cinereus	Terek Sandpiper	Unlikely – unsuitable habitat	No
Irediparra gallinacea	Comb-crested Jacana	Unlikely – unsuitable habitat	No
Charadrius leschenaultii	Greater Sand Plover	Unlikely – unsuitable habitat	No
Charadrius mongolus	Lesser Sand Plover	Unlikely – unsuitable habitat	No
Sterna albifrons	Little Tern	Unlikely – unsuitable habitat	No
Ptilinopus magnificus	Wompoo Fruit-Dove	Unlikely – unsuitable habitat	No
Neophema pulchella	Turquoise Parrot	Unlikely – unsuitable habitat	No
Ninox strenua	Powerful Owl	Unlikely – unsuitable habitat	No
Tyto novaehollandiae	Masked Owl	Possible – may form part of a foraging range	Yes

3.4. FIELD SURVEY RESULTS

This section provides details of the results of the field surveys that were undertaken.

3.4.1. Flora

A comprehensive flora species list for the proposed development area was compiled from data collected from line transects (Figure 7) and a considerable amount of careful searching. In total 101 species of plant were found growing on the subject site, 26.7% (n=27) of which were weed species. A full list of flora species found on the subject site is provided in Appendix 2. No threatened plant species were detected at the subject site.

3.4.2. Vegetative Community Type and Mapping

Vegetation across the subject site has been historically cleared and altered and used for agricultural purposes. A network of drainage lines has been constructed across the site which has contributed to the vegetation communities on the subject site becoming altered from their natural form. The prevention of the natural flow regime of tidal waters from the Hunter River has also contributed to the alteration of vegetation communities on the subject site. The vegetation changes across the subject site, with pasture located on relic sand dunes and across drained swamps, and stands of *Casuarina glauca* forest located centrally on the subject site. A *Phragmites* dominated swamp complex extends to the southern boundary. No threatened flora species were found to occur on the subject site. Figure 8 shows the three vegetation community types found on the subject site which are described below.

Pasture

The higher elevated dunes on the northern portion of the subject site have improved pasture and pasture weed species (Plate 1). Low lying land adjoining the dunes had been drained to allow for improved pasture (Kikuyu, Couch, Paspalum, Clover) with wetland and swamp species becoming more frequent in poorly drained areas (ephemeral swamps and man-made drainage lines). The drainage lines are channeled toward the swamp area located to the south of the subject site.

Swamp Oak - Rushland Forest (MU40)

Two areas at the southern fringes of the pastureland were vegetated with mature *Casuarina glauca* forests to approximately 15m high with scattered *Parsonsia straminea* vines and a sparse groundcover (Plate 2). Any mid storey was absent at both mapped *Casuarina glauca* stands. The shrub layer in the eastern-most forest was dominated by *Carex appressa, Persicaria decipens, Persicaria strigosa* and scattered *Hypolepis Muelleri* to approximately 50cm high. The ground layer was dominated by pasture grasses (Couch, Kikuyu, Paspalum), *Isachne globosa* and *Commelina cyanea* and salt tolerant species at the southern fringes, including *Sporobolus virginicus, Sarcocornia quinqueflora* and *Juncus kraussii*. This vegetation shows signs of previous disturbance and is currently used for cattle grazing and shelter.

The Swamp Oak Forest vegetation indicates a potential *Swamp Oak Floodplain Forest* on the NSW North Coast, Sydney Basin and South East Corner bioregions, which is listed as an Endangered Ecological Community (EEC) under the *TSC Act 1995* and is briefly summarised below.

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.

*Swamp Oak Floodplain Forest o*f the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Elevation is generally below 20m and rarely above 10m.

The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Typically these forests, woodlands, scrubs and reedlands form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

Swamp Oak Floodplain Forest may adjoin or intergrade with Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner bioregions. The

boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston et al. 2003). Alteration of tidal flows may have led to decreased soil salinity and localised expansion of *Casuarina glauca* into areas that previously supported Coastal Saltmarsh or mangroves (Stevenson 2003).

Saltmarsh (MU47a)

The *Casuarina* stand to the west had sparse trees with a groundcover dominated by salt tolerant species *Sporobolus virginicus* and *Juncus kraussii* (Plate 3). The portion of land located centrally between both Casuarina stands resembled a transition between Swamp Oak - Rushland Forest (MU40) and Saltmarsh (MU47a) with *Sacocornia quinqueflora* and *Sporobolus virginicus* indicating more salty or brackish soils. It is likely that the drainage and levy bank constructions over the property, and the long-term stock grazing has substantially changed the vegetation composition and structure; however the key species indicating a saltmarsh community remain.

The mapped Saltmarsh areas are indicative of *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*, which is listed as an Endangered Ecological Community (EEC) under the *TSC Act 1995* and is briefly summarised below.

Saltmarsh (Phragmites variant)

The southern portion of the subject site was dominated by *Phragmites australis* to approximately 2-3m high with large connecting clumps of *Bolboshoenus caldwellii* and *Sporobolus virginicus* present within (Plate 4). *Juncus kraussii* was common at the northern fringes of this area.

The Phragmites at this location is associated with the saltmarsh and should be considered as forming a part of the larger saltmarsh area. The NSW Scientific determination states that *'in brackish areas dense stands of tall reeds (Phragmites australis, Bulboschoenus spp., Schoenoplectus spp., Typha spp.) may occur as part of the Saltmarsh community*'. It also states that where patterns of tidal flow have been restricted by artificial structures and the

discharge of storm water, the resulting alteration of the natural salinity regimes increases nutrient levels and facilitates the spread of Phragmites and weeds.

The Phragmites area to the south of the subject site displayed a similar species composition with obvious saltmarsh areas assorted with similar stands of tall reeds. It has been determined that the mapped *Phragmites* area on the subject site is indicative of *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*, which is listed as an Endangered Ecological Community (EEC) under the *TSC Act 1995* and is briefly summarised below.

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is the name given to the ecological community occurring in the intertidal zone on the shores of estuaries and lagoons including when they are intermittently closed along the NSW coast. Coastal Saltmarsh is frequently found as a zone landward of mangrove stands. Occasional scattered mature *Avicennia marina* trees can occur through saltmarsh at some sites, and *Avicennia* (and less frequently *Aegiceras corniculatum*) seedlings may occur throughout saltmarsh, although this was not apparent at the subject site. However, in brackish areas dense stands of tall reeds (*Phragmites australis, Bulboschoenus spp., Schoenoplectus spp., Typha spp.*) may occur as part of the community.

The estimated total area of coastal saltmarsh in NSW was approximately 5700 hectares distributed in fragmented patches mostly less than 100 hectares. Since this estimate, further reduction and fragmentation have occurred (West et al. 1985).

Saltmarshes are globally threatened, and many of the identified threatening processes operate in NSW and at this location, including infilling, modified tidal flow, weed invasion, damage by domestic and feral animals, human disturbance, altered fire regimes and climate change.

Patterns of tidal flow have been restricted by artificial structures in many NSW saltmarshes including this subject site. The discharge of storm water also alters salinity regimes, increases nutrient levels and facilitates the spread of Phragmites and weeds. This is the likely factor affecting the subject site and the lands to the south.

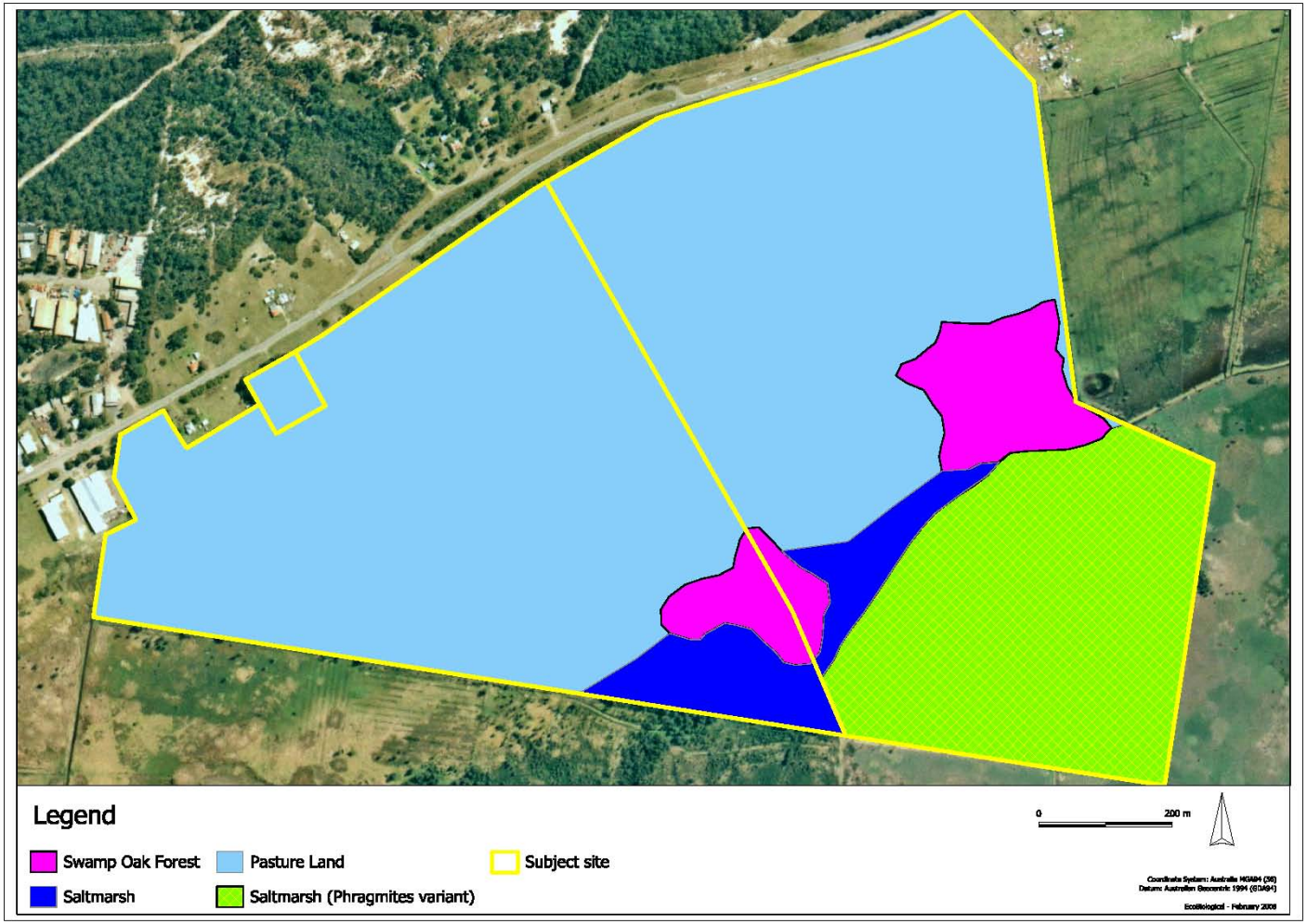


Figure 8. Vegetation communities present on the subject site. Both the Swamp Oak Forest and Coastal Saltmarsh form Endangered Ecological Communities.



Plate 1. Pasture present on the northern portion of the subject site that is used for grazing purposes and forms the majority of the subject site.



Plate 2. Swamp oak forest with sparse understorey present on the subject site.



Plate 3. Saltmarsh present on the subject site.



Plate 4. *Phragmites* dominated area on the southern portion of the subject site.

3.4.3. Habitat Hollows

Hollows are an important resource utilised by a variety of forest fauna. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, thermoregulation and to facilitate ranging behaviour and dispersal (Gibbons & Lindenmayer 2002). Approximately 400 Australian species potentially use hollows either on a permanent or opportunistic basis. Many threatened species are obligate users, requiring the presence of hollows to survive in the landscape (Gibbons & Lindenmayer 2002).

A hollow survey was conducted in the proposed disturbance area to provide an assessment of the number and size of habitat hollows present. All of the trees containing hollows in the eastern forested area were mapped (Figures 9 & 10). The density of habitat hollows per hectare in this area was then calculated from the data by dividing the number of hollows by the area surveyed (mean = 7.6 hollow bearing trees/hectare; 18.1 hollows/hectare). This average was applied as an estimate of the density of habitat hollows in the western forested area (Figure 10). Sixty two trees in the eastern forested area on the subject site were found to contain habitat hollows with 147 hollows identified in total. A further 40 trees containing 96 hollows are estimated to exist in the western forested area forming an estimated total of 102 trees containing 243 potential habitat hollows over the entire subject site. The majority of the hollows detected in the eastern forested area were small (70%; n=103). Twenty five medium-sized hollows (17%; n=25) and nineteen large sized hollows (13%; n=19) were also detected.

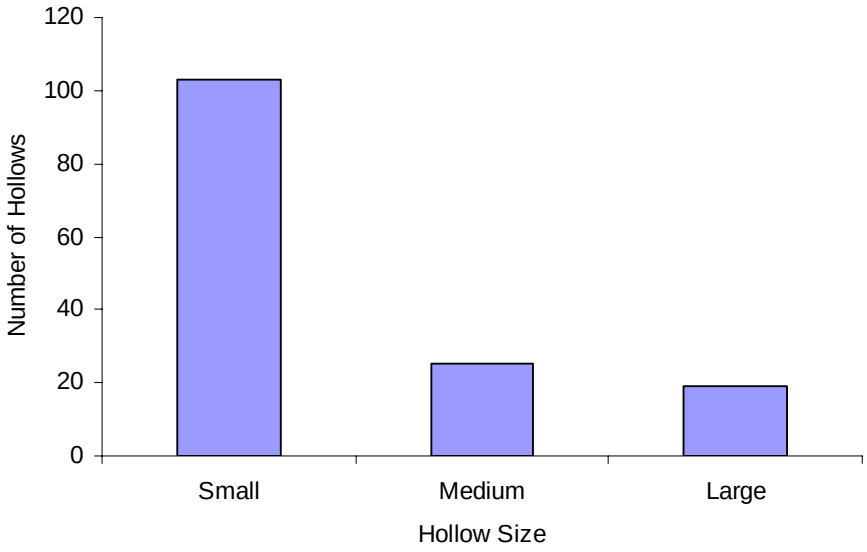


Figure 9. Hollow size frequency in the eastern forested area at the subject site. Small < 8 cm, medium = 8 – 20 cm and large < 20 cm.

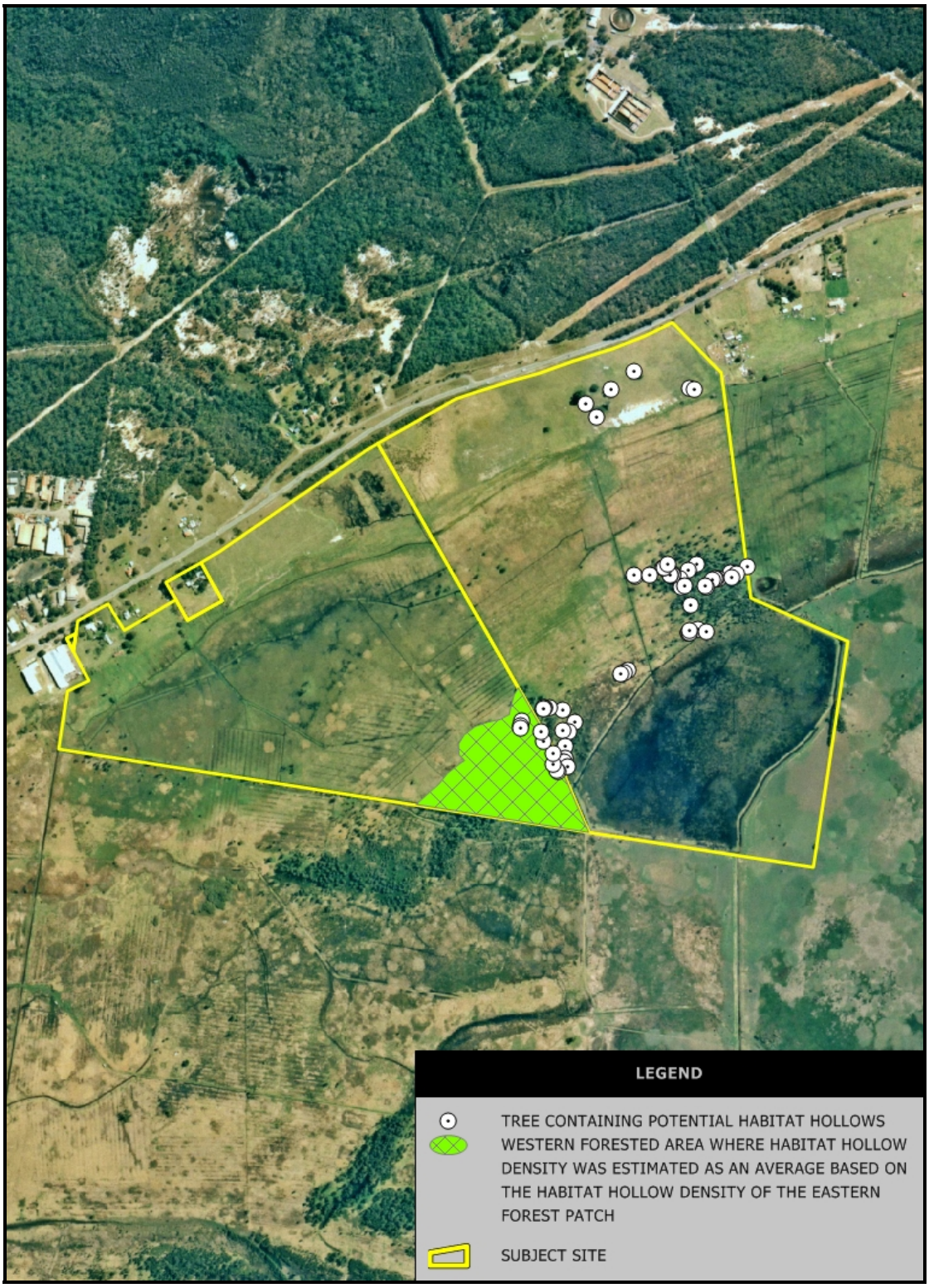


Figure 10. Location of trees containing habitat hollows on the subject site.

3.4.4. Port Stephens Comprehensive Koala Plan of Management

The CKPoM Guidelines for Koala Habitat Assessments were used to determine the impact that the proposed development will have on the subject property and surrounding potential koala habitat and/or populations. Compliance with the provisions of the CKPoM will constitute compliance with the provisions of SEPP 44. The Koala Habitat Assessment is undertaken in 4 major parts as indicated in section 2.3 of the Methods. Part 1 requires the current Koala habitat map to be referred to in order to determine previously mapped Koala Habitat (Appendix 3). Part 2 requires that the vegetation communities present on the subject site be mapped (Figure 8). If the vegetation mapped on the subject site does not relate to the vegetation communities mapped in the Koala habitat map (Appendix 3) then Part 3 of the CKPoM requires that a new map should be produced (Appendix 4). The results of mapping undertaken to produce revised Koala habitat mapped shows that no preferred or supplementary Koala habitat, Habitat Buffers or Habitat linking are located on or directly adjacent to the subject site. Therefore it is not necessary to move to part 4 of the CKPoM and no further assessment is required. No impact upon Koala populations or Koala habitat is expected to occur.

3.4.5. Fauna

A total of 99 fauna species were recorded on the subject site. A list of these species is shown in Appendix 1. These species comprised: 1 fish, 11 frogs, 69 birds, 9 bats, 2 reptiles, 1 arboreal mammal and 6 terrestrial mammals. Of these, 6 species are listed as significant (Vulnerable) under the TSC Act with one species also listed as significant (Vulnerable) under the EPBC Act (Table 11).

Three species of threatened insectivorous (Microchiropteran) bat were found on the subject site: Eastern Freetail Bat (*Mormopterus norfolkensis*); Little Bent-wing Bat (*Miniopterus australis*); and Greater Broad-nosed Bat (*Scoteanax rueppellii*). The Eastern Freetail Bat and Little Bent-wing Bat were detected in both the *Casuarina* forest and open pasture while the Greater Broad-nosed Bat was detected in the *Casuarina* forest only. One threatened species of Megachiropteran bat, Grey-headed Flying Fox (*Pteropus poliocephalus*), was detected feeding in three Fig trees (*Ficus spp.*) located in open pasture toward the northern boundary of the subject site.

One species of threatened frog was found on the subject site, Wallum Froglet (*Crinia tinnula*). Only one individual of this species was detected on the subject site (Figure 11) in an area of flooded paddock that is considered to be highly disturbed wallum habitat (marginal habitat for the Wallum Froglet when in close proximity to undisturbed wallum or wallum equivalent habitat). A population of Wallum Froglet was found to reside north of Tomago Road (approximately 80m from the subject site) in an ephemeral acid paperbark swamp and several Wallum Froglets were located in a thin strip of disturbed wallum habitat between Tomago Road and Graham Drive (Figure 11). It is considered likely that individual Wallum Froglets (such as the individual observed on the subject site) would at times disperse back and forth between the northern edge of the subject site and the core habitat supporting the Wallum Froglet population to the north of Tomago Road during times of water inundation following heavy rain.

One species of threatened bird was found on the subject site: Grass Owl (*Tyto capensis*). This species was found to utilize the subject site for foraging. Several roosts for the population were located off the subject site to the east, south and west.

Table 11. Threatened fauna species recorded on the subject site.

Scientific Name	Common Name	Method	Legal Status
Mormopterus norfolkensis	Eastern Freetail Bat	Anabat call recording	Vulnerable*
Miniopterus australis	Little Bentwing Bat	Anabat call recording	Vulnerable*
Scoteanax rueppellii	Greater Broad-nosed Bat	Anabat call recording	Vulnerable*
Pteropus poliocephalus	Grey-headed Flying Fox	Spotlighting	Vulnerable*^
Tyto capensis	Grass Owl	Call play-back	Vulnerable*
Crinia tinnula	Wallum Froglet	Nocturnal amphibian survey (call ID)	Vulnerable

* Listed under the TSC Act, ^ Listed under the EPBC Act

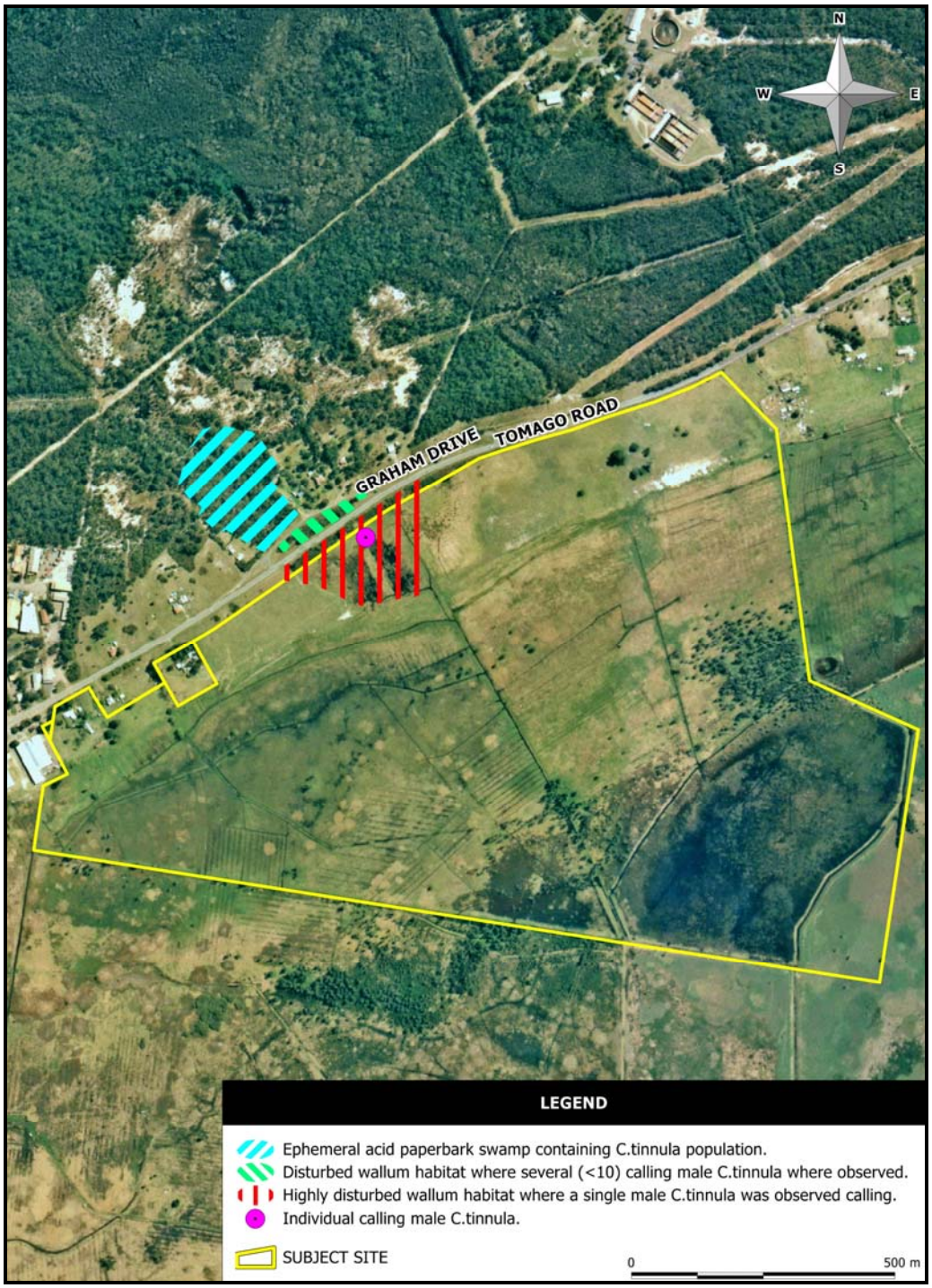


Figure 11. Aerial photograph showing the location of the acid paperbark swamp where a population of Wallum Froglet was located; a thin strip of disturbed wallum habitat between Graham Drive and Tomago Road that contained several calling male Wallum Froglets; and the cleared, highly disturbed wallum habitat present on the subject site that becomes inundated with water only after heavy rain. One individual calling male Wallum Froglet was recorded in this highly disturbed area on the subject site.

3.4.6. Targeted Grass Owl Study

1) Prey Species (Dietary Analysis)

The Common House Mouse (*Mus musculus*) was captured on 23 occasions across the subject site during the May trapping survey with no other terrestrial mammals caught. One Common House Mouse was caught during the October trapping survey.

One hundred and twenty one ejecta pellets were collected during the ejecta pellet survey. Figure 12 shows the results from the pellet analysis. Small terrestrial mammals such as the House Mouse, *Mus musculus*, (present in 76.86% of pellets) and *Rattus* spp. (present in 28.93% of pellets) were found in the majority of pellets analysed and formed the bulk of the Grass Owl's diet at this locality. Non terrestrial vertebrates (insects and birds) were also present in a significant proportion of pellets analysed (17.36%) while plant material was found in 4.13% of pellets (presumed to be inadvertently ingested whilst consuming other prey). Rabbit, reptile, native *Melomys sp.* and eggs were also found to form part of the Grass Owl diet. The high proportion of House Mouse consumed by the local population (forming the majority of the diet) when compared to the prey species availability in the area (100% House Mouse trapped) is suggestive of the Grass Owl being a localised, and not an itinerant feeder. The data also supports the hypothesis that while consuming mostly terrestrial mammals the Grass Owl is an opportunistic feeder, consuming a wide variety of prey items across its foraging range. The discrepancy in results between the trapping surveys and pellet analysis (observed lack of *Rattus spp.* trapped compared to the proportion of *Rattus spp.* found in the analysed pellets) is believed to be due to a lack of power in trapping survey effort and the possibility of microhabitats favouring *Rattus spp.* being left unsurveyed.

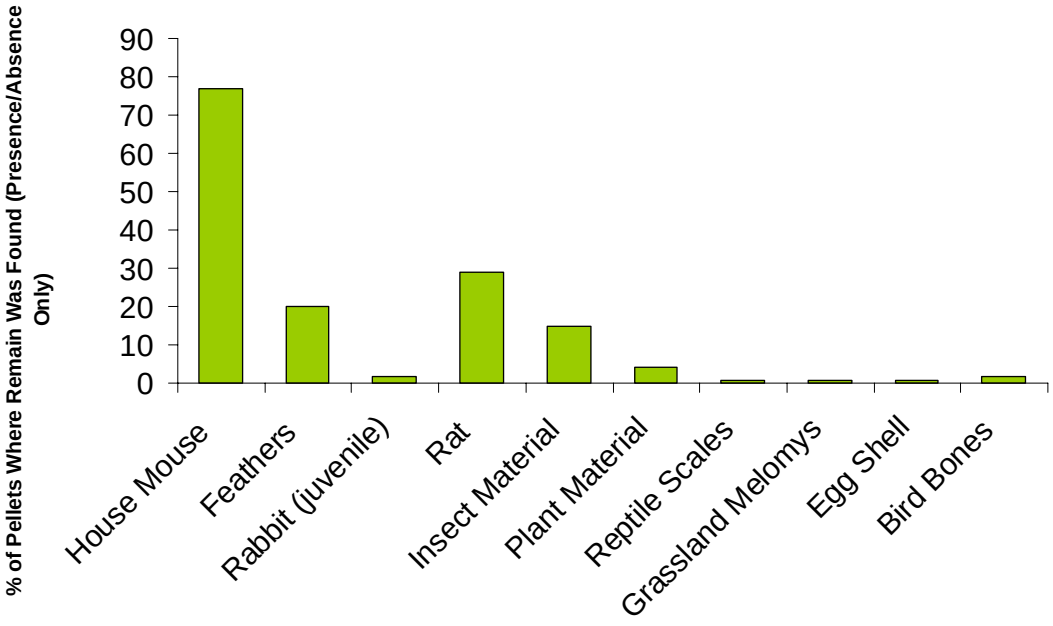


Figure 12. Grass Owl dietary analysis of regurgitated pellets.

2) Movements and Home Range Size

Two Grass Owl roost sites were located within the study area (Figure 13). The primary roost site to the southeast of the subject site within the Ramsar wetland was used by the owls for a 7-month period. The secondary roost to the southwest of the subject site was used for a 2-month period when the Ramsar wetland was inundated with water during heavy rainfall periods in late August 2006. Once the water had receded from the wetlands, the Grass Owls returned to the primary roost site.

Grass Owls presumed to be those resident to the Ramsar wetland roost site, were observed to utilise a minimum of 785 hectares of surrounding land for foraging, with a maximum of 6 individuals recorded using the primary roost site at one time. At least three nests within the primary roost site were observed to be utilised by the Grass Owls at any given time with >7 nests (utilised and unutilised) being observed within the primary roost area.

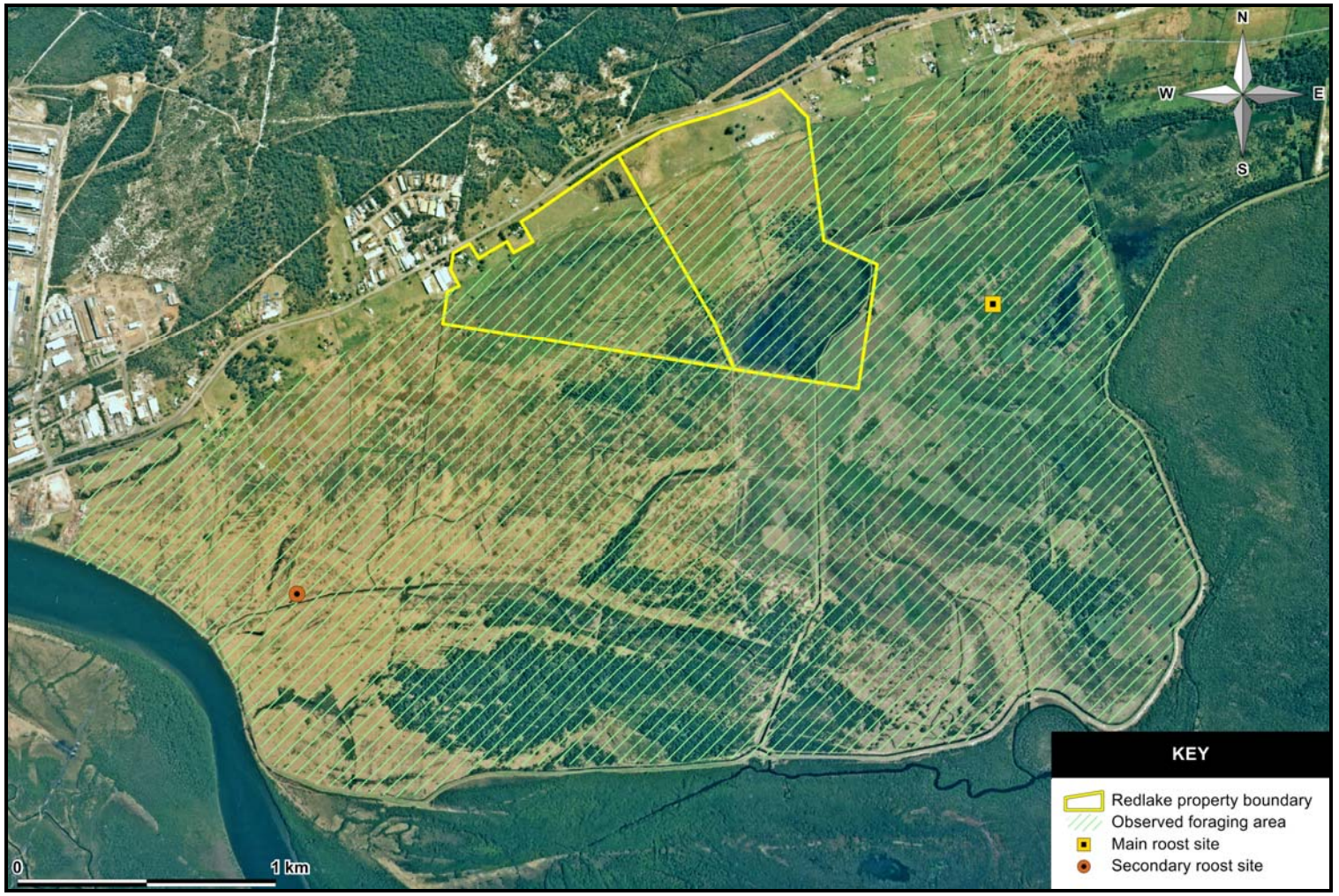


Figure 13. Grass Owl main and secondary roost sites and observed foraging area in the locality of the subject site.

3) Seasonality

Grass Owls from the local population were observed and recorded throughout the survey period from January to November 2006 indicating that the Grass Owls inhabit the site and are active throughout the year.

4) Potential Habitat Mapping

The local Grass Owl population is estimated to use approximately 785ha area for foraging, 97ha of which occurs on the subject site (representing 12% of the observed foraging area). A small area of Juncus/Saltmarsh vegetation in the south-eastern corner of the subject site was also considered to provide suitable roosting and nesting habitat. A thorough inspection of the vegetation on the subject site showed no evidence that the Grass Owl was using any of the more densely vegetated areas for daytime roosting.

5) Behavioural Ecology

Observational surveys of the local Grass Owl population revealed that between 2-3 individuals regularly left the main roost site on or just after dusk. The most commonly observed flight behaviour was low straight flight after leaving the roost site and circular (believed to be investigative) flight around the observer. The birds were also observed aerially foraging and hovering over the paddocks before diving into the grass presumably in pursuit of prey.

Owls were recorded vocalising during 12 of the 26 observational survey nights, with calls most often recorded on or just after dusk before the birds left their roost for the first time. The most common call behaviour recorded was a raspy hissing call from the ground followed by a cricket-like call also from the ground. On several occasions, birds foraging or roosting in the same vicinity were heard to communicate with one another. While not as common, owls were also heard to emit both the hissing and cricket call while flying. No observations of breeding attempts or behaviour at the roost sites were recorded during the surveillance attempts with the infrared camera.

During times of water inundation around the main roost site following heavy or extended rain periods the Grass Owls were observed to utilise the secondary roost site and not the primary roost site (Figure 12). It was also observed that after a roost site was disturbed (from collecting regurge pellets or setting up a camera nearby) the Grass Owl did not

return to it. It is speculated that the Grass Owl possesses the ability to move and create new roosts readily when climatic conditions change or when there is a perceived threat from potential predators.

6) Local Population Size

Recordings of between two and three individual Grass Owls was the norm during surveys of the subject site and the two roost locations. However, a maximum of 6 individuals were recorded using the main roost site to the southeast of the subject site on one occasion.

The two regional surveys resulted in a number of other local family groups of Grass Owls being discovered in the area.

- On 23.11.06 four Grass Owls were sighted at three different locations:
  - One individual on Ash Island to the south west of the main roost;
  - One individual at the main roost; and
  - Two individuals along Lavis Lane to the east of the main roost.
- On 28.11.06 three Grass Owls were sighted, at two different locations:
  - One individual on Ash Island to the south west of the main roost; and
  - Two individuals along Lavis Lane to the east of the main roost.

Figure 14 shows the locations of Grass Owl sightings from the various survey periods as well as other Grass Owl records in the area obtained from various sources as outlined in this report.

The discovery of the Ash Island, RAMSAR Wetland and Lavis Lane Owls is considered to be highly significant being the most southerly resident population in Australia (pers. comm. R. Kavanagh).

Grass Owls are generally seen singly, but occasionally in pairs or family groups of adult pair and young (Higgins 1999). This species has also been observed on a few occasions foraging in small loose groups e.g. in north-east Queensland, 40 – 50 breeding pairs in 40ha of fallow rice fields (Schodde & Mason 1981); and up to 30 birds recorded in <100ha.

Four distinct family groups were recorded during the regional survey and from opportunistic records – 1) subject site, 2) Ash Island, 3) Lavis Lane, and 4) Fletcher. The family group of up to 6 individuals on the subject site had a conservative foraging area of 785ha and utilised two roost sites – one main roost to the southeast and a secondary roost to the southwest used during periods of wet weather. The area of suitable foraging habitat on the subject site represents a maximum of 12% of the observed foraging range of this family group.

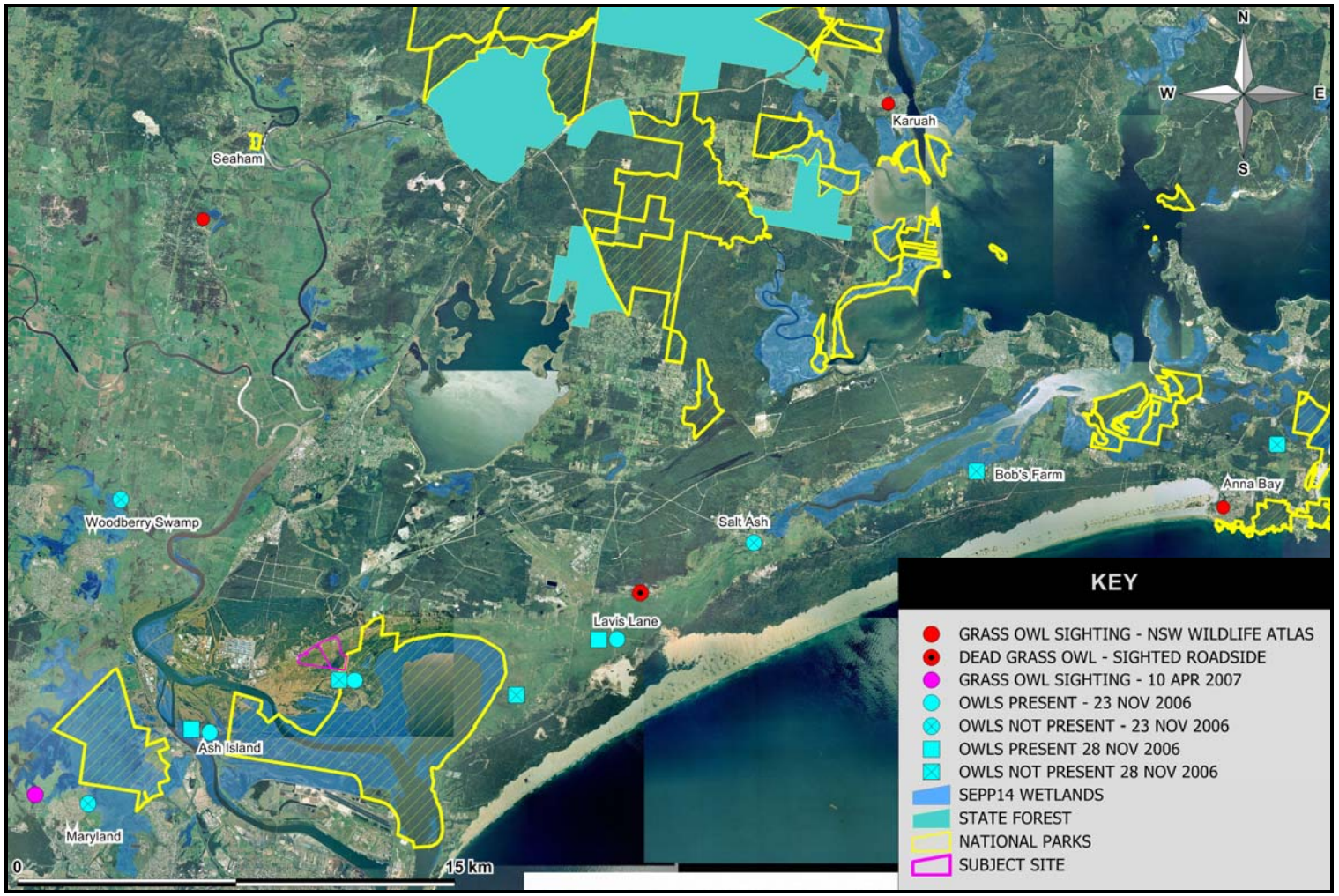


Figure 14. Regional Grass Owl survey locations and recorded sightings.

7) Residency

The Grass Owls were recorded foraging on the subject site in all seasons suggesting that they are resident to the subject site.

8) Importance of the Subject Site to Local Grass Owl Population

The family group of Grass Owls recorded on the subject site was observed foraging over approximately 84% of the subject site, with a conservative estimate of a 785ha foraging range in the surrounding area. This estimate is consistent with the recorded home ranges of other Large Forest Owls that have home ranges from between 300 – 1500ha dependant on habitat productivity (Kavanagh 1997). The Grass Owl is a highly mobile species and is known to regularly shift roosts due to inclement conditions, disturbance, prey availability and predators.

The subject site was used only for foraging and supported high densities of the Grass Owl's main prey item, the House Mouse (*Mus musculus*). However, the House Mouse would be well populated through grazing paddocks along Tomago Road and in Kooragang Nature Reserve. Therefore, while the subject site represents approximately 12% of the recorded foraging area for the local population, the loss of this habitat would be unlikely to affect the life cycle of the Grass Owl such that a local population would be placed at risk of extinction.

3.4.7. Targeted Green and Golden Bell Frog Survey

The subject site was targeted for the Green and Golden Bell Frog on four occasions. A known local population (Kooragang Island, <4km away) was also surveyed during these periods as a reference site to indicate the suitability of the climatic conditions. No Green and Golden Bell Frogs were detected on or near to the subject site while natural (non-stimulated) calling behaviour was observed at the Kooragang Island population (Table 12). From this survey it is concluded unlikely that any Green and Golden Bell Frogs inhabit any areas on or near the subject site.

Table 12. Results of the four targeted Green and Golden Bell Frog surveys at both the subject site and known local population at Kooragang Island.

Date	Site	Climatic Conditions	Species Present		Method of Detection
			Scientific Name	Common Name	
14/9/06	Subject Site (nocturnal)	Rained heavily in prior 24 hour period. Site very swamped.	*Litoria dentata*	Bleating Tree Frog	Heard
			Litoria fallax	Dwarf Green Tree Frog	Heard, sighted
			Litoria jervisiensis	Jervis Bay Tree Frog	Heard
			Litoria peronii	Emerald Spotted Tree Frog	Heard
			Litoria latopalmata	Broad-palmed Frog	Heard, sighted
			Limnodynastes peronii	Striped Marsh Frog	Heard, sighted
			Crinia signifera	Common Eastern Froglet	Heard, sighted
14/9/06	Kooragang Island	Rained heavily in prior 24 hour period.	*Litoria aurea*	Green and Golden Bell Frog (>5 males calling)	Heard
24/11/06	Subject Site (diurnal)	Dried up considerably but still some pools of water present. Little cloud cover. No wind.	No Detection		
28/11/06	Subject Site (diurnal)	Little cloud cover. Slight breeze.	No Detection		
28/11/06	Subject Site (nocturnal)	Warm night. No wind.	*Litoria dentata*	Bleating Tree Frog	Heard
			Litoria fallax	Dwarf Green Tree Frog	Sighted
			Limnodynastes peronii	Striped Marsh Frog	Heard
28/11/06	Kooragang Island	Warm night. Slight breeze.	No Detection of Target Species		
29/11/06	Subject Site (nocturnal)	Warm night. Moderate breeze.	*Litoria fallax*	Dwarf Green Tree Frog	Sighted
			Limnodynastes peronii	Striped Marsh Frog	Heard, sighted
29/11/06	Kooragang Island	Warm night. Moderate breeze.	No Detection of Target Species		

4. IMPACT EVALUATION

Part 3A of the EP&A Act and the Draft Guidelines for Threatened Species Assessment provides for the application of an impact assessment the level of impact of any proposed activity on threatened species, populations or habitats. A review of the threatened species profiles shows that there were threatened species that could be found on the subject site under different conditions to those prevailing at the time of this investigation or that could be found in similar habitat in the immediate region. An assessment of the impact of the proposed action on these species along with the threatened species, populations and communities recorded on the subject site during the investigation period is provided below.

4.1. ENDANGERED ECOLOGICAL COMMUNITY ASSESSMENT

There were two Endangered Ecological Community (EEC) present on the subject site which is discussed below.

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

Not applicable for EEC.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The proposed action to clear and fill the land within the subject site would involve clearing all existing vegetation within the property boundaries. The amount of vegetation comprising the *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* Endangered Ecological Community on the subject site is 5.35ha. This area represents approximately 3.1% of the 170ha of this vegetation type found and mapped by EcoBiological within the locality (Figure 15). Approximately 86.5ha of this vegetation type mapped in the locality falls within the 241.3ha environmental offset that forms part of the rezoning process.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

The *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* on the subject site is not at the limit of its known distribution.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. **How is the proposal likely to affect habitat connectivity?**

While a small portion of *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* will be removed, no areas would become isolated or fragmented by the proposed activity.

6. **How is the proposal likely to affect critical habitat?**

No critical habitat occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this Endangered Ecological Community in the locality or in the region.

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

Not applicable for EEC.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The proposed action to clear and fill the land within the subject site would involve clearing all existing vegetation within the property boundaries. The amount of vegetation comprising the *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions* Endangered Ecological Community on the subject site is approximately 22ha. This area represents approximately 7.1% of the estimated 300ha of saltmarsh vegetation type found and mapped by EcoBiological within the locality (Figure 16). Approximately 45.9ha of this vegetation type mapped in the locality falls within the 241.3ha environmental offset that forms part of the rezoning process.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

The *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions* on the subject site is not at the limit of its known distribution.

4. How is the proposal likely to affect current disturbance regimes?

The majority of natural tidal and hydrological flow regimes on the subject site have been modified since pre 1954 with the construction of levy banks to the south and drainage lines and associated clearing to the north. The modification of flow is likely to have altered the salinity regimes, increased nutrient levels and facilitated the spread of *Phragmites* and weeds, such that the potential fuel loading has increased and the occurrence of 'grassfire' in saltmarsh areas becomes more frequent. The amount of clearing that will take place for the proposed development is within a previously modified area and would be confined by the levy bank in the south. It is unlikely the proposed development will significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the saltmarsh. Filling of the land will alter the flow regimes within the subject site; however objectives for stormwater management will be to maintain existing flow regime and discharge to the saltmarsh wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

The saltmarsh area is known to link east and west around the subject site. While a portion of *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions* will be removed, no areas would become isolated or fragmented by the proposed activity.

6. How is the proposal likely to affect critical habitat?

No critical habitat occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this Endangered Ecological Community in the locality or in the region.



Figure 15. The extent of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion (an endangered ecological community) in the locality.

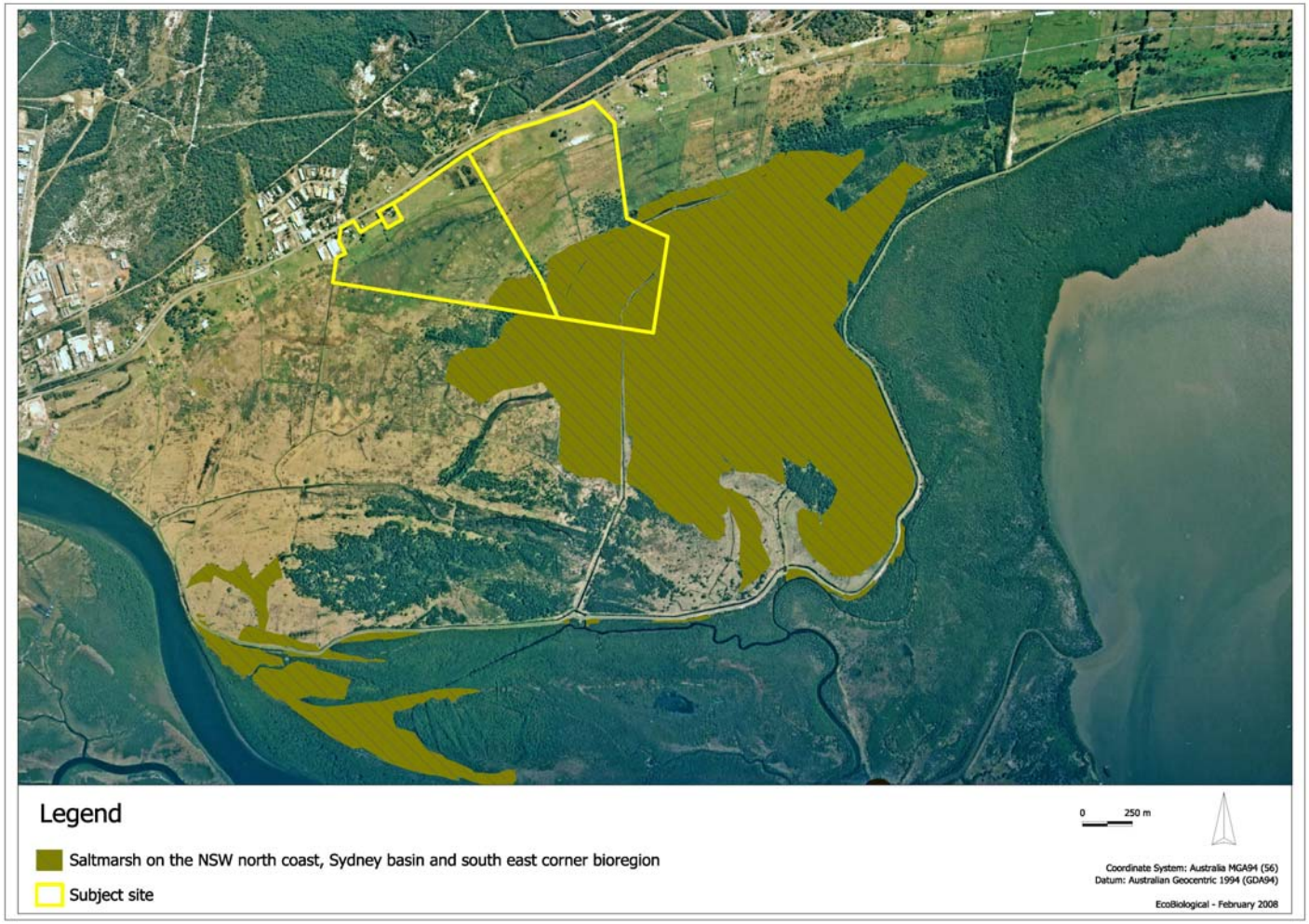


Figure 16. The extent of Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner Bioregion (an endangered ecological community) in the locality.

4.2. FLORA THREATENED SPECIES ASSESSMENT

While no threatened flora species were recorded on the subject site one threatened flora species (*Zannichellia palustris)* was considered as having suitable habitat present on the subject site. Therefore an impact assessment was conducted for this species.

Zannichellia palustris

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

Zannichellia palustris occurs in fresh to brackish, still to slowly moving waters. Recent collections of *Zannichellia palustris* in NSW are from Ironbark Creek and tributaries at Shortland and Wallsend, in Black Creek at Cessnock and in ponds on Kooragang Island. In NSW, populations of *Zannichellia palustris* behave as annuals, completely dying back each summer.

The proposed development would involve removal of potential *Zannichellia palustris* habitat. Targeted surveys for this species were conducted during the growth season and after a significant rainfall event in June 2007. No plants were recorded on or nearby to the subject site.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

Significant rainfall events or prolonged wet weather cause the drainage lines on the property to fill and form ephemeral wetlands, swamps and drainage lines within constructed channels on the subject site.

The proposed development would involve removal of this aquatic landscape formation and ultimately any potential habitat. Targeted surveys for this species were conducted during the growth season and after a significant rainfall event in June 2007. No plants were recorded on or nearby to the subject site.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

This species has a cosmopolitan distribution known only from the Murray River estuary in South Australia and the lower Hunter region in NSW.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the

flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

Although the proposed clearing and filling associated with the proposed development would remove a small portion of potential habitat, it would not isolate or fragment any areas of habitat for the species.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

4.3. FAUNA THREATENED SPECIES ASSESSMENT

Six threatened fauna species (Grass Owl, *Tyto capensis*; Grey-headed Flying Fox, *Pteropus poliocephalus*; Eastern Freetail Bat, *Mormopterus norfolkensis*; Little Bentwing Bat, *Miniopterus australis;* Greater Broad-nosed Bat, *Scoteanax rueppellii*; Wallum Froglet *Crinia tinnula*) were detected on the subject site. A further five species (Green and Golden Bell Frog, *Litoria aurea*; Australasian Bittern, *Botaurus poiciloptilus*; Black Bittern, *Ixobrychus flavicollis*; Masked Owl, *Tyto novaehollandiae*; Large-footed Myotis, *Myotis adversus*) were considered to have suitable habitat present on the subject site. Threatened fauna that were present or considered as possibly occurring in the type of habitat represented both on and in the locality of the subject site are discussed below.

Australasian Bittern (*Botaurus poiciloptilus*)

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Australasian Bittern occurs in reeds and marshes in terrestrial freshwater wetlands and, occasionally estuarine habitats, generally where there is permanent water. The Australasian Bittern is a cryptic bird, roosting during the day on the ground amongst dense reeds (Marchant & Higgins 1990). Foraging occurs mainly at night with typical prey consisting of small mammals, birds, amphibians, eels, crustaceans and insects. The breeding season is from October through to February with nests being built in stands of Phragmites, Typha, and rushes (*Juncus*, *Baumea* spp.). The nest is usually comprised of a well-constructed flat platform of rushes or reeds. The species may occur singly, in pairs or in groups of up to 12 individuals (Marchant & Higgins 1990). The Australasian Bittern is generally sedentary but sometimes moves in response to flooding and drought (Smith *et al*. 1995).

Significant rainfall events or prolonged wet weather cause the drainage lines on the property to fill and form ephemeral wetlands and swamps on the southern portion of the subject site. Targeted surveys for this species were conducted both during the breeding season and after a significant rainfall event in June 2007. No individuals or evidence of nesting was recorded.

The Swamp Oak Rushland Forest, Saltmarsh and Phragmites Rushland vegetation communities in the southeast corner of the subject site may provide opportunistic foraging habitat for this species during wet periods. However, as the Australasian Bittern prefers permanent water bodies, it is unlikely that the subject site supports optimal foraging habitat for this species. Cattle grazing and sheltering within the Casuarina forests on the subject site also make it unlikely that any permanent nesting habitat occurs on the property. Therefore, it is unlikely that the proposed action would have an adverse effect on the life cycle of this species.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The subject site contains potential foraging habitat for this species following long periods of rain and runoff within the Swamp Oak Rushland Forest, Saltmarsh and Phragmites Rushland. Approximately 35ha of marginal foraging habitat will be removed as a result of the proposed development.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Australasian Bittern is not at the known limit of its distribution at this location.

4. How is the proposal likely to affect current disturbance regimes?

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

The clearing associated with the proposed development would not create fragmentation or isolation that would threaten the long-term survival of the species in the locality.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Black Bittern (*Ixobrychus flavicollis*)

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

The Black Bittern usually occurs singly or in pairs in thick vegetation in terrestrial wetlands, watercourses, swamps, billabongs, mudflats and mangroves, and also streamside vegetation in shrubland or low forest (Marchant & Higgins 1990). However, it is most often encountered in permanent wetlands fringed by dense vegetation and rarely in open habitats (McKilligan 2005). Foraging generally occurs at dusk and at night along the edges of still and running water. Typical prey items consist of reptiles, fish, crayfish, mussels and invertebrates (McKilligan 2005). During the day, the species roosts in trees or amongst dense reeds on the ground.

Significant rainfall events or prolonged wet weather cause the drainage lines on the property to fill and form ephemeral wetlands and swamps on the southern portion of the subject site. The Swamp Oak Forest and Saltmarsh (including *Phragmites*) vegetation communities in the southeast corner of the subject site may provide opportunistic foraging habitat for this species during wet periods. However, as the Black Bittern prefers permanent water bodies, it is unlikely that the subject site supports optimal foraging habitat for this species. Cattle grazing and sheltering within the *Casuarina* forests on the subject site also make it unlikely that any permanent nesting habitat occurs on the property. Therefore, it is unlikely that the proposed action would have an adverse effect on the life cycle of this species.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The subject site contains potential foraging habitat for this species following long periods of rain and runoff within the Swamp Oak Rushland Forest and Saltmarsh. Approximately 35ha of marginal foraging habitat will be removed as a result of the proposed development.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

The Black Bittern is not at the known limit of its distribution at this location.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. **How is the proposal likely to affect habitat connectivity?**

The clearing associated with the proposed development would not create fragmentation or isolation that would threaten the long-term survival of the species in the locality.

6. **How is the proposal likely to affect critical habitat?**

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Masked Owl (*Tyto novaehollandiae*)

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

The Masked Owl forages for ground dwelling mammals such as native rats and prefers a habitat of relatively open woodland. The small mammal trapping indicated very low numbers of potential prey species for the Masked Owl, however, fluctuating House Mouse (*Mus musculus*) populations may provide an opportunistic prey source. No evidence was found of the Masked Owl being present on the property and the habitat, due to its openness, would be marginal for this species. The loss of approximately 94ha of marginal foraging area in the home range of this bird (400 – 1000ha) would be unlikely to affect the lifecycle of this species.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The subject site contains potential foraging habitat for this species within the open pasture, Swamp Oak Rushland Forest and Saltmarsh. Approximately 94ha of marginal foraging habitat will be removed as a result of the proposed development.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

The Masked Owl is not at the known limit of its distribution at this location.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. **How is the proposal likely to affect habitat connectivity?**

The clearing associated with the proposed development would not create fragmentation or isolation that would threaten the long-term survival of the species in the locality.

6. **How is the proposal likely to affect critical habitat?**

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Grass Owl (*Tyto capensis*)

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

The local Grass Owl population appears to use an approximately 785ha area for foraging, 97ha of which occurs on the subject site. A small area in the south-eastern corner of the subject site was also considered to provide suitable roosting and nesting habitat. However, a thorough inspection of the vegetation on the subject site showed no evidence that the Grass Owl was using any of the more densely vegetated areas for daytime roosting. Evidence of roost sites to the southeast and southwest of the subject site was found by way of numerous owl ejecta pellets in characteristic Grass Owl roosts.

The proposed development would remove or substantially modify the entire 97ha of Grass Owl habitat on the subject site. However the loss of a maximum 12% of the observed foraging area of the local population would be unlikely to significantly affect the lifecycle of this species in the locality.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The proposal which involves the construction of a warehouse, associated office buildings and access roads would likely remove the entire 97ha of observed Grass Owl foraging habitat on site. This would reduce the currently observed foraging habitat in the local area from 785ha to 688ha. It is likely that habitat on the subject site represents a maximum of 12% of the foraging range of the local Grass Owl population. The species has not been recorded roosting on the proposed development site. The subject site itself is not of high importance to the survival of the local Grass Owl population, as the family group has been observed foraging over a much larger area and its main prey species is widely available in the surrounding pastureland and wetlands.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The discovery of the Ash Island, RAMSAR Wetland and Lavis Lane Grass Owls is considered to be highly significant being the most southerly resident population on the NSW coast (pers. comm. R. Kavanagh).

4. How is the proposal likely to affect current disturbance regimes?

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

Other areas of potential Grass Owl habitat exist to the east, west and south of the proposed development site within Kooragang Nature Reserve, on Ash Island and in surrounding farmland. The proposed development will remove a 97ha portion of this habitat from the northern section of a continuous patch, thereby fragmenting the eastern and western habitat along Tomago Road.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

***Green and Golden Bell Frog* (*Litoria aurea*)**

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Once one of the most common frog species on the east coast of Australia the Green and Golden Bell Frog has undergone a widespread and unexplained range contraction since the mid 1970's. Its distribution today is restricted to isolated pockets along the coast at various scattered locations throughout its former range with only one known remaining highland population at Queenbeyan.

The habitat preference and requirements of the Green and Golden Bell Frog are not well understood and difficult to define (Mahony 1999) resulting in some disagreement and confusion

between biologists studying the species. Some of the differing views on Green and Golden Bell Frog ecology between biologists may be due to a failure to take into account the role of disease (a pathogenic fungus) that is probably primarily responsible for changes in its distribution and abundance in the last two decades. The species uses different habitat components throughout the various stages of its life cycle including different breeding, foraging and refuge habitats and has been known to disperse distances of up to several kilometres between these various habitats. Generally large, permanent water bodies containing high levels of emergent vegetation such as *Typha*, *Baumea* and the introduced *Juncus acutus* are favourable for the detection of the Green and Golden Bell Frog, however it has been observed utilising a wide range of natural and man-made water bodies including coastal swamps, marshes, dune swales, lagoons, lakes, estuary wetlands, riverine floodplain wetlands, billabongs, storm water retention basins, farm dams, bunded areas, storage tanks, water troughs, drains, ditches and other excavation areas capable of capturing water such as quarries and brick pits (DEC, 2005). Terrestrial habitat attributes that appear to favour the species include large grassy areas associated with adjacent cover from logs, rocks or tussock forming vegetation that provide shelter. There also appears to be a preference shown to habitat containing a complexity of terrestrial and aquatic vegetation structure (Hamer *et al*., 2002). The introduced mosquito fish, *Gambusia holbrooki*, is believed to feed on small tadpoles and habitat free of these fish is preferred (White & Pike 1996).

A population of Green and Golden Bell Frogs exists on Kooragang Island to the south of the subject site and is one of the largest remaining known populations in NSW. This population is less that 4km from the subject site and is separated only by an arm of the Hunter River. Suitable connectivity in the form of drainage lines and wetlands connects the subject site to this arm of the Hunter River, and from the other side of the river to the current site of the existing population.

Suitable habitat for the Green and Golden Bell Frog exists in the south-eastern corner of the subject site. This portion of the site consists of wetland that is largely semipermanent with areas that dry out completely and become inundated with water during and after heavy rain. The water bodies that form in the wetland are large and the wetland contains a good complexity of terrestrial and aquatic vegetation structure with preferred plant species present including *Typha orientalis*, *Juncus krausii* and the introduced *Juncus acutus.* This portion of wetland borders the wetlands that form part of the Kooragang Nature Reserve.

Taking into consideration the suitable nature of portions of the subject site to form Green and Golden Bell Frog habitat, and that a known population occurs less than 4km away with a suitable movement corridor present between the existing population and the subject site, it must be considered a possibility that the Green and Golden Bell Frog could potentially utilise portions of the subject site during periods of water inundation. It is considered likely that the habitat on the subject site would primarily be secondary habitat where movement onto the subject site would occur only during inundation from heavy rain. Extensive surveys for the Green and Golden Bell Frog were undertaken during favourable conditions and no Green and Golden Bell Frogs were detected on, or adjacent to, the subject site. It is considered therefore unlikely that the Green and Golden Bell Frog inhabits the subject site. The wetland present on the south-eastern corner of the subject site forms only a small fraction of the wetlands present in the area which consist in part of the adjoining Kooragang Nature Reserve and SEPP 14 wetlands approximately 550m away. Additionally, a large portion of the wetland that forms potential habitat for the Green and Golden Bell Frog will be protected into the future through the 241.3ha environmental offset that will take place as part of the rezoning process. While it is a possibility that the Green and Golden Bell Frog could potentially utilise the south eastern corner of the subject site during water inundation it is considered likely that the small fraction of wetland that would be filled in due to the proposed development would have no significant impact on the life cycle of the species in the locality or the region.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The proposed development would result in a loss of approximately 27.6 ha of semi-permanent and permanent wetland that could form potential Green and Golden Bell Frog habitat. However this wetland area forms only around 2% of the adjoining wetland area present between the northern arm of the Hunter River to the south and Fullerton Cove to the east. Additionally more than 240ha of land, much of which forms potential habitat for the species, will be protected into the future through an environmental offset that will take place as part of the rezoning process.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

The Green and Golden Bell Frog is not at the known limit of its distribution at this location.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. **How is the proposal likely to affect habitat connectivity?**

The filling in of the wetland on site that would be involved in this proposal would remove a small portion of a larger contiguous patch of potential Green and Golden Bell Frog habitat in the locality however no habitat would be isolated or fragmented by the proposal.

6. **How is the proposal likely to affect critical habitat?**

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Wallum Froglet (*Crinia tinnula*)

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

The Wallum Froglet is one of a group of wallum-dependent frog species of coastal south-east Queensland and eastern New South Wales. All of the species in this group are wholly or largely restricted to Wallum or Wallum-equivalent habitat (Meyer *et al*, 2006). Dependence on this specific habitat type makes it difficult for the species to persist when it is removed. The fragmentation and destruction of this habitat on which the Wallum Froglet depends as a result of urban land clearing has caused decline in the species and continues to be the main threat to its survival.

The Wallum is a system of silicious sand plains and dunes that support varying vegetation types including eucalypt forests and woodland, rainforest and heathland (Coaldrake, 1961). Tanin-stained water collects above organic hardpan layers forming swamps and lakes within the Wallum. Often these water bodies are acidic (pH <5.5) and oligotrophic (nutrient poor). While commonly occupying wallum habitat, the Wallum froglet may also be found in wallum-equivalent habitat (sub-coastal wet heath in areas of sandy soil) outside of the wallum (Stewart, 1995) and is more commonly associated with ephemeral swamps and soaks than lakes. The Wallum Froglet is most likely to be encountered in wet heath, *Melaleuca* swamps and sedge swamps in areas of sandy soil although it has been found to breed in disturbed wallum habitat including pine plantations and drainage ditches more readily than other species of Wallum-dependent frogs. The species has also been recorded in habitat well away from water during dry periods (Meyer *et al*, 2006). Its range extends along the coast from south-east Queensland to areas around Sydney. It has suffered significant habitat loss largely due to its distribution along the coast in mainland areas subject to exotic afforestation and urban development.

An individual male Wallum Froglet was detected calling on the subject site near the northern boundary in an area inundated with water considered to be highly disturbed wallum habitat (currently cleared paddock that receives water from an adjoining roadside drainage line that can become inundated with water to form a soak [see Figure 11 above]). The drainage line along the roadside easement that adjoins the subject site is vegetated with regrowth shrubs and grasses. Several (<10) male Wallum Froglets were also detected calling along the northern edge of Tomago Road, between Tomago Road and Graham Drive, where a small patch of disturbed wallum habitat exists (see Figure 11 above). A moderate population of Wallum Froglets (>50 calling males observed) was detected approximately 80 metres north of Tomago Road (and the subject site) in a naturally forested, ephemeral acid paperbark (*Melaleuca*) swamp. Acid paperbark swamp is commonly considered preferred *Crinia tinnula* habitat. Conditions were suitable for surveying for *C. tinnula* (based on heavy rainfall for the 3 weeks prior to the survey period and suitable seasonality) and it is considered that the calling behaviour, habitat use and spatial movements observed during the survey period would likely be typical of this local population. In other words it is considered highly likely that the majority of the population would utilise the naturally occurring acid paperbark swamp (considered preferred habitat) while individuals would on occasion disperse back and forth into the nearby disturbed and highly disturbed wallum habitats (considered marginal habitat in this instance) during heavy rain including into the drainage line or flooded paddock present on the subject site. It is considered likely that only a small number of individuals would occupy the highly disturbed habitat on the subject site at any given time and that this habitat is not essential to the persistence of the population. The proposed development is not likely to have a significant impact on the lifecycle of the species such that the local population would be at threat of extinction or the species would suffer further decline in the locality or region.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Land filling the subject site will occur as a result of the proposal. It is likely therefore that all of the areas on the subject site that become inundated with water and form highly disturbed wallum habitat will no longer form temporary soaks suitable for the species. The inundated area after heavy rain on the subject site observed during the amphibian survey (see Figure 11 above) is approximately 4 ha in size. This habitat will be removed or heavily modified by the proposal. Other areas of paddock may also become inundated with water after heavy rain. These areas will also be removed or modified by the proposal. The likelihood of an individual Wallum Froglet moving into other areas of flooded paddock significantly decreases as these areas move away from the core

population situated in the preferred acid paperbark swamp habitat to the north. Only one individual Wallum Froglet was observed anywhere in the highly disturbed wallum habitat on the subject site.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

The Wallum Froglet is not at the known limit of its distribution at this location.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. **How is the proposal likely to affect habitat connectivity?**

The clearing and filling associated with the proposed development would remove a small portion of marginal habitat however it would not isolate or fragment any areas of habitat for the species.

6. **How is the proposal likely to affect critical habitat?**

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

Grey-headed Flying Foxes exhibit a high site fidelity to their roosting locations and will travel up to 50 km from their roosting camp to forage. Roosting camps may be occupied by tens of thousands of individuals and generally occur within 20 km of a regular food source, in densely vegetated gullies close to permanent water (Hall & Richards, 2000).

There was no indication of a roosting camp occurring at the subject site, however individual Grey-headed Flying Foxes were detected foraging in the few suitable feed trees (<20) present on the subject site. Given their ability to traverse unsuitable habitat to reach foraging grounds is

considerably greater than the size of the area to be removed under the proposed development, it is unlikely the development would affect the life cycle of the Grey-headed Flying Fox.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The vegetation on the subject site consists predominately of improved pasture used for stock grazing with some *Casuarina* forest that does not form foraging habitat. There are less than twenty trees on the subject site that would provide ideal foraging for the Grey-headed Flying Fox. The proposed activity will result in the loss of these trees.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Grey-headed Flying Fox is not at the known limit of its distribution at this location.

4. How is the proposal likely to affect current disturbance regimes?

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

The clearing associated with the proposed development would remove a small number of potential feed trees for the species however it would not isolate or fragment any areas of habitat.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Tree Roosting Microchiropteran Bats

- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Although the two species listed above differ in their size, breeding biology and foraging habits, both occur in forested habitats and roost primarily in tree hollows and under loose bark on trees (Churchill 1998). Hence their forest habitats provide for their daily and seasonal foraging, roosting and breeding requirements. Consequently both of these threatened species is reliant on a sufficient area of their preferred forest habitats to persist in the landscape.

While it is acknowledged that habitat loss has contributed to the decline of these species from parts of their distributions, removal of the proposed 7.4 ha of forested area and 107.88ha of other vegetation used for foraging is unlikely to have an adverse effect on the lifecycle of these species such that they are put at risk of extinction.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposed development would result in a net total loss of approximately 7.4 ha of swamp oak forest habitat potentially utilised for roosting and foraging and 107.88ha of other vegetation used for foraging. An environmental offset of 241.3ha of land, some of which provides suitable foraging habitat for these species, will occur as part of the rezoning process.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

These species are not at the known limit of their distribution at this location.

4. How is the proposal likely to affect current disturbance regimes?

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

The subject site and surrounding area to the south of Tomago Road is already heavily fragmented due to clearing for grazing purposes with only small remnant patches of forest remaining. The

proposed activity will remove two small patches of Casuarina forest, further fragmenting habitat for these species.

6. **How is the proposal likely to affect critical habitat?**

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on these species in the locality or the region.

Cave Roosting Microchiropteran Bats

- Little Bentwing-bat (*Miniopterus australis*)
- Large-footed Myotis (*Myotis adversus*)

1. **How is the proposal likely to affect the lifecycle of a threatened species and/or population?**

Both species use caves for roosting, but *Miniopterus australis* will occasionally use tree hollows and *Myotis adversus* regularly uses them for roosting (pers. comm. G. Hoye). Both species also forage in forested habitats but their niches differ. *Miniopterus australis* uses the canopy for foraging, while *Myotis adversus* skims the surface of streams and ponds catching insects and small fish (Richards 2000; Dwyer 2001a, 2001b).

Research on the home ranges of these species is limited but suggests that *Miniopterus* australis exhibits a high fidelity to a particular foraging area that may change seasonally, and that *Myotis adversus* is capable of travelling long linear distances along riparian zones to exploit hunting areas (pers. comm. G. Hoye). The proposed action would remove foraging habitat from the home ranges of both of these species and potential current and future roosting habitat. However, the area of clearing involved in the proposed development would not likely have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk of extinction.

2. **How is the proposal likely to affect the habitat of a threatened species, population or ecological community?**

The proposed development would result in a net total loss of approximately 7.4 ha of swamp oak forest habitat and 107.88ha of other vegetation used for foraging. An environmental offset of 241.3ha of land, some of which provides suitable foraging habitat for these species, will occur as part of the rezoning process.

3. **Does the proposal affect any threatened species or populations that are at the limit of its known distribution?**

These species are not at the known limit of their distribution at this location.

4. **How is the proposal likely to affect current disturbance regimes?**

The majority of vegetation on the subject site has been cleared since pre 1954 with the land being predominately utilised for stock grazing since this time. The lack of vegetation on the subject site has restricted the ability for fires to naturally occur across the subject site and the small amount of further clearing that will take place for the proposed development will not significantly modify the intensity or frequency of fires that currently take place.

Farm drains have been previously excavated across the subject site. It is believed that these drains were associated with stock grazing activities but the time of excavation of the drains is unknown. These drains have modified previous flow regimes to the wetland. Filling of the land will alter the flow regimes within the subject site, however objectives for stormwater management will be to maintain existing flow regime and discharge to the wetlands downstream, post development.

5. How is the proposal likely to affect habitat connectivity?

The subject site and surrounding area to the south of Tomago Road is already heavily fragmented due to clearing for grazing purposes with only small remnant patches of forest remaining. The proposed activity will remove two small patches of swamp oak forest, further fragmenting habitat for these species.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

4.3.1. EPBC Act Impact Assessments

An action will require the approval of the Federal Minister for the Environment (in addition to any State or Local Government approval or determination) if that action will have, or is likely to have, a significant impact on a matter of national environmental significance. Threatened species and communities listed in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are considered to be a matter of national environmental significance. It was assessed that the subject site contained no suitable habitat for the three threatened flora species previously recorded within a 5-kilometre radius from the NSW Wildlife Atlas. These species were not detected during field surveys of the subject site and the subject site was assessed as not containing suitable habitat for these flora species. Both EEC's mapped as occurring on the subject site are not listed as threatened under the EPBC Act 1999.

The EPBC Act test of significance is applied to those species listed as threatened under the act that were considered likely to occur on the subject site or were recorded during field surveys.

Grey Headed Flying Fox (*Pteropus poliocephalus*)

The Grey-headed Flying Fox is listed as a Vulnerable species under the EPBC Act. The 7-Part Test for the Grey-headed Flying Fox concluded that the proposal is not likely to have a significant impact on the species.

Is the action likely to lead to a long-term decrease in the size of a population of a species?

The action will lead to the removal of a small number of potential feed trees (<20) which will not lead to a long-term decrease in the size of the population.

Will the action reduce the area of occupancy of the species?

Due to the small number of potential feed trees to be removed and the abundance of other potential feed trees in the area it is considered unlikely that the area of occupancy will be reduced for the species.

Will the action fragment an existing population into two or more populations?

The proposal will not fragment any existing populations of Grey-headed Flying Fox.

Will the action adversely affect habitat critical to the survival of a species?

The action will not remove habitat critical to the survival of the species. Less than 20 potential feed trees will be removed.

Will the action disrupt the breeding cycle of a population?

The proposed development will not likely disrupt the breeding cycle of the population.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The removal of less than 20 potential feed trees will not lead to any significant decline in the species.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?

The proposed action will not lead to any invasive species becoming established that are known to be harmful to the Grey-headed Flying Fox.

Will the action interfere substantially with the recovery of the species?

The proposed action is unlikely to interfere substantially with the recovery of the Grey-headed Flying Fox.

Conclusion

Based on the above assessment it is considered unlikely that the Grey-headed Flying Fox will be significantly impacted by the proposal.

Green and Golden Bell Frog (*Litoria aurea*)

The Green and Golden Bell Frog is listed as a Vulnerable species under the EPBC Act. The 7-Part Test for the Green and Golden Bell Frog concluded that the proposal is not likely to have a significant impact on the species.

Is the action likely to lead to a long-term decrease in the size of a population of a species?

No Green and Golden Bell Frogs were located in the study area and it is considered unlikely that any Green and Golden Bell Frogs inhabit the study area. The proposed action will not likely lead to a long-term decrease in the size of any population of Green and Golden Bell Frog.

Will the action reduce the area of occupancy of the species?

Green and Golden Bell Frogs were not found to occupy the study area and it is considered that the proposed action will not reduce the area of occupancy of the species.

Will the action fragment an existing population into two or more populations?

The proposal will not fragment any existing populations of Green and Golden Bell Frogs.

Will the action adversely affect habitat critical to the survival of a species?

The action will not remove habitat critical to the survival of the species.

Will the action disrupt the breeding cycle of a population?

No populations were located within the study area. The proposed action will not likely disrupt the breeding cycle of any populations of Green and Golden Bell Frogs.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposed action will remove a small portion of potential habitat however no Green and Golden Bell Frogs were located within the study area and the amount of habitat to be removed will not likely cause the species to decline.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?

The proposed action will not lead to any additional invasive species becoming established that are known to be harmful to the Green and Golden Bell Frog.

Will the action interfere substantially with the recovery of the species?

The proposed action is unlikely to interfere substantially with the recovery of the Green and Golden Bell Frog.

Conclusion

Based on the above assessment it is considered unlikely that the Green and Golden Bell Frog will be significantly impacted by the proposal.

5. MITIGATION

The ameliorative measures for this proposal fall into the following categories:

- Compensatory Strategies (Environmental Offsets)
- Avoiding the use of potentially harmful chemicals (biocides);
- Preclearing surveys;
- Management and monitoring plans; and,
- Recommendations for future development.

5.1. LONG TERM MANAGEMENT STRATEGIES

5.1.1. Retaining integrity of habitat and minimizing harm.

The use of insecticides and herbicides in the study area should be avoided where possible to retain the integrity of the habitat for insectivorous Microchiropteran bats utilizing the surrounding area for foraging and to prevent deformities or death to Wallum Froglets in the area. The use of pesticides affects insect availability and is known to bioaccumulate in the body fat of individuals of various Microchiropteran bat species. The use of biocides in the control of weeds and mosquitoes has been shown to be toxic to frogs causing deformities, hermaphroditism and death and has been listed as a potential threat to the Wallum Froglet in the National Recovery Plan for the Wallum Sedgefrog and Other Wallum Dependant Frog Species.

5.1.2. Flora and Fauna management and monitoring plans.

It is envisaged that the proposed management and monitoring plans be incorporated into conditions of consent and that these plans be approved by DECC prior to construction.

Pre-clearing surveys

Approximately 1 week prior to any vegetation clearing a survey of habitat trees should be conducted in the planned clearing area. These trees should be watched at dusk to determine whether any of the hollows are in use by fauna. The actual felling of any habitat trees should be attended by a suitably experienced fauna ecologist in order to ensure the safety of any fauna found to be in the hollows. On all occasions, trees having potential

habitat hollows should be 'soft felled' by an experienced machine operator. It is noted that, although not a threatened species, a population of Common Green Tree Frog (*Litoria caerulea*) exists in the two swamp oak stands on the subject site that will be removed by the proposal. This species utilises and relies on trees and their hollows for protection and overwintering and is not usually located in areas without trees and branches. Due to heavy fragmentation of forest in the area the stands of swamp oak on the subject site are isolated. The population of Common Green Tree Frog appears to exist almost entirely in the larger of these two stands and when they are removed it is likely that the population at this locality may be placed at risk of extinction. It is recommended therefore that consideration be given to incorporating an amphibian translocation plan into the management plan governing pre-clearing survey protocols (discussed below) in order to relocate individuals from this population to the nearest suitable remaining forest patch. This plan should include appropriate hygiene protocols to prevent the spread of amphibian diseases, particularly *Batrachochytrium dendrobatidis* (Amphibian Chytrid fungus). Similarly a population of the common Bleating Tree Frog has been observed to exist largely in this stand of swamp oak. The Bleating Tree Frog is also a tree frog that utilises trees to a large extent. Where possible individuals of this species should also be relocated to the nearest suitable stand of forest habitat.

Management plans

Prior to the commencement of construction detailed management plans should be prepared to cover the following:

- Pre-clearing survey protocols including measures to be taken where fauna are found to be occupying habitat hollows, are captured during felling or where fauna are injured; and
- A management and monitoring plan for the adjacent Ramsar wetland (Kooragang Nature Reserve). A thorough and intensive program should be put in place to protect the adjoining wetland against weed invasion, significant alterations to hydrology, and surface and underground run-off that may occur from land filling both during and after the construction phase of the proposed development. Some points that should be considered and addressed when constructing the management plan include:
    - The nature and control of sediment run-off during the construction phase particularly as a result of an exceptional storm event;

- The chemical content of the fill and of the groundwater seepage from that fill that would disperse into the wetlands over the long term;
- The volume, path and content of stormwater discharging from the site during and after development;
- The handling of hydrocarbon waste from the site during construction and operation stages;
- Existing flow regime of surface and groundwater flow from the subject site into the wetlands;
- At times of peak rainfall, sub-surface drainage through the fill is likely to discharge into the wetland - what will be the impact of the development on the quality of this water;
- The current ecological character (as defined by the Ramsar Convention) of the wetland in the immediate vicinity of the potential impact area;
- The impact of weed invasion during and after the construction phase. Weed invasion is very obvious around Kooragang and along the edges of the Hunter estuary where edges of fill are dominated by weeds.

It is also recommended that consideration be given to providing a 100m buffer where possible in the SE corner of the subject site against the Ramsar site boundary and that ongoing monitoring is in place to ensure that there is no invasion of the wetlands by exotic species.

- It is recommended that a lighting management plan be prepared to ensure no direct light impacts on the adjacent wetlands. This may be achieved by ensuring any lighting to be installed on the subject site either faces away from the wetland area or has a shade attached to prevent an excess of light entering the wetland area of a night time. These measures will insure that no impact occurs as a result of light pollution.

5.2. COMPENSATORY (ENVIRONMENTAL OFFSET) STRATEGIES

As part of the rezoning of the subject site and those adjoining via the Major Projects State Environmental Planning Policy, and in anticipation of this development and others, some 240 hectares of land previously zoned for rural activities has been rezoned for conservation purposes as outlined in the Memorandum of Understanding (MOU) between the Minister for the Environment, the Minister for Planning and the Regional Land

Management Corporation. This environmental offset will protect the rezoned 241.3ha of land into the future, which currently contains ecologically sensitive wetlands of national importance and habitat for several endangered ecological communities and threatened species including the Green and Golden Bell Frog, Grass Owl, Australasian Bittern, Black Bittern and both endangered ecological communities considered in this report.

5.3. ONGOING MONITORING

A monitoring plan should be prepared to document the ongoing status of the protected Ramsar Wetland to the south of the subject site. This plan should commence with a baseline report which describes the status and condition of the wetland prior to the commencement of construction.

This plan should describe thresholds at which management actions are required to arrest any documented deterioration in the condition of the wetland, its associated habitats, and the populations that are reliant on these habitats.

5.4. RECOMMENDATIONS FOR FUTURE DEVELOPMENT

It is recommended that any future development proposed for the industrial subdivision is subject to a noise impact assessment to ensure that noise levels are not too great that they may impact on the nearby wetlands.

6. CONCLUSION

A Threatened Species Assessment has been prepared in accordance with the requirements of the Director General of DECC for a proposed industrial development to facilitate the assembly, sale, maintenance and repair of heavy earthmoving equipment, warehousing and distribution of parts, associated uses and subdivision and required land filling on the subject site, Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256 Tomago Road, Tomago including the road reserve along the northern property boundary.

The assessment of flora and fauna within a five-kilometre radius of Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256 Tomago Road, Tomago revealed that:

- Four threatened flora species have previously been recorded within a five-kilometre radius of the subject site;
- Twenty five threatened fauna species have previously been recorded within a five-kilometre radius of the subject site; and
- Ten of these species including one plant and nine animals were assessed as having suitable habitat present on the subject site.

The field surveys conducted between January and November 2006 at Lot 1 DP597372, Lot 1 DP1003492, Lot 161 DP774440 and Lot 513 DP585256 Tomago Road, Tomago revealed that:

- One hundred and one plant species were recorded on the subject site;
- Three plant communities were present on the subject site;
- Two Endangered Ecological Communities were present;
- An estimated 102 trees supported 243 potential fauna habitat hollows;
- One Koala feed tree was present on the subject site;
- Ninety nine species of fauna were recorded during field surveys; and
- Six threatened species (Eastern Freetail Bat, Greater Broad-nosed Bat, Little Bentwing Bat, Grey-headed Flying Fox, Grass Owl and Wallum Froglet) were recorded on the subject site.

Flora Species

No threatened flora species were recorded during the investigation period and it was determined unlikely that any threatened species would be affected by the proposal.

Endangered Ecological Communities

Historical aerial photograph analysis shows that the subject site has been cleared and pasture improved since at least 1954 and appears to have been regularly grazed. The result has been that the native flora of the determined communities is depleted at all stratum. Two ecological communities listed as endangered in the NSW TSC Act (*Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* and *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions*) were identified on the subject site occupying areas of approximately 5.35ha and 22.0ha respectively. These communities would be removed for their entirety on the subject site. The assessment of significance determined the removal of vegetation from these communities on the subject site is not likely to have a significant impact on the EECs in the locality or the region.

Fauna Species

Several threatened fauna species including the Grass Owl, Wallum Froglet, Grey-headed Flying Fox, Eastern Freetail Bat, Little Bent-wing Bat and Greater Broad-nosed Bat were recorded on the subject site. While approximately 116ha of potential habitat will be modified or destroyed under the proposal it is concluded that there would not be a significant impact on any of these species.

Ramsar Wetlands

While it has been determined that an impact on the Ramsar Wetland adjoining the subject site is likely if not properly managed it is considered that this impact will be reduced to an acceptable level providing that the ameliorative measures outlined in sections 5.1 & 5.3 above are put in place. It is noted that the storm water and flood reports show that no impact on hydrology will occur in the nearby Ramsar wetland as a result of the proposed development.

Management and Monitoring Plans

Management plans for the clearing of vegetation and for the protection of the adjoining Ramsar wetland against weed invasion, significant alterations to hydrology, and surface

and underground run-off are proposed. A monitoring plan to document the ongoing status of the protected Ramsar Wetland is also proposed.

Key Thresholds

While the application of the impact assessment revealed that for all threatened species considered the proposed action represents an acceptable threat to the viability of local populations a potential threat was identified on the adjoining Ramsar wetland. This wetland contains habitat for a large number of fauna and flora species and holds a high biodiversity value. It is considered however that this threat will be significantly reduced to a point where biodiversity values will be protected and maintained providing the ameliorative measures outlined in sections 5.1 & 5.3 above are put in place. Taking into account the actions to mitigate impacts the proposal will maintain biodiversity values in the locality and the region.

The impact assessment revealed that the proposed activity is unlikely to reduce the long-term viability of any threatened species, population or ecological community. It is also considered that the proposed activity is unlikely to accelerate the extinction of any threatened species, population or ecological community.

No critical habitat was identified on the subject site and the proposal will not adversely affect any critical habitat.

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Appendix 1 - Fauna species recorded on the subject site

Scientific Name	Common Name
Fish	
*Gambusia holbrooki**	Plague Minnow
Amphibians	
Litoria caerulea	Common Green Tree Frog
Litoria dentata	Bleating Tree Frog
Litoria fallax	Sedge Frog
Litoria jervisiensis	Jervis Bay Tree Frog
Litoria latopalmata	Broad-palmed Frog
Litoria peronii	Emerald-spotted Tree Frog
Crinia signifera	Common Eastern Froglet
Crinia tinnula #	Wallum Froglet
Limnodynastes peronii	Striped Marsh Frog
Limnodynastes tasmaniensis	Spotted Grass Frog
Pseudophryne bibroni	Brown Brood Frog
Reptiles	
Pseudechis porphyriacus	Red-bellied Black Snake
Demansia psammophis	Yellow-faced Whip Snake
Arboreal mammals	
Trichosurus vulpecula	Brushtail Possum
Terrestrial mammals	
*Oryctolagus cuniculus**	Rabbit
*Vulpes vulpes**	Fox
Macropus giganteus	Eastern Grey Kangaroo
*Mus musculus**	House Mouse
*Rattus rattus**	Black Rat
*Rattus norvegicus**	Brown Rat
Bats	
Pteropus poliocephalus #	Grey-headed Flying-fox
Tadarida australis	White-striped Mastiff Bat
Mormopterus norfolkensis #	East Coast Freetail Bat
Mormopterus sp. 2	Eastern Freetail Bat
Chalinolobus morio	Chocolate Wattled Bat
Miniopterus australis #	Little Bent-wing Bat

Scientific Name	Common Name
Bats cont.	
Scoteanax rueppellii #	Greater Broad-nosed Bat
Scotorepens orion	Eastern Broad-nosed Bat
Vespadelus vulturnus	Little Forest Bat
Birds	
Gymnorhina tibicen	Australian Magpie
Corvus coronoides	Australian Raven
Geopelia humeralis	Bar-shouldered Dove
Coracina novaehollandiae	Black-faced Cuckoo Shrike
Acanthiza pusilla	Brown Thornbill
Melithreptus brevirostris	Brown-headed Honeyeater
Scythrops novaehollandiae	Channel-billed Cuckoo
Coracina tenuirostris	Cicadabird
Eudynamys scolopacea	Common Koel
*Acridotheres tristis **	Common Myna
Platycercus eximius	Eastern Rosella
Acanthorhynchus tenuirostris	Eastern Spinebill
Psophodes olivaceus	Eastern Whipbird
Eopsaltria australis	Eastern Yellow Robin
Sphecotheres viridis	Figbird
Cacatua roseicapilla	Galah
Pachycephala pectoralis	Golden Whistler
Colluricincla harmonica	Grey Shrike-thrush
Cracticus torquatus	Grey Butcherbird
Rhipidura fuliginosa	Grey Fantail
Accipiter novaehollandiae	Grey Goshawk
Dacelo novaeguineae	Laughing Kookaburra
Myiagra rubecula	Leaden Flycatcher
Meliphaga lewinii	Lewin's Honeyeater
Glossopsitta pusilla	Little Lorikeet
Anthochaera chrysoptera	Little Wattlebird
Grallina cyanoleuca	Magpie-lark
Dicaeum hirundinaceum	Mistletoebird
Philemon corniculatus	Noisy Friarbird
Manorina melanocephala	Noisy Miner

Scientific Name	Common Name
Birds cont.	
Oriolus sagittatus	Olive-backed Oriole
Cracticus nigrogularis	Pied Butcherbird
Strepera graculina	Pied Currawong
Porphyrio porphyrio	Purple Swamphen
Trichoglossus haematodus	Rainbow Lorikeet
Neochmia temporalis	Red-browed Finch
Anthochaera carnunculata	Red Wattlebird
Pachycephala rufiventris	Rufous Whistler
Todiramphus sanctus	Sacred Kingfisher
Ptilonorhynchus violaceus	Satin Bowerbird
Zosterops lateralis	Silvereye
Streptopelia chinensis *	Spotted Turtle-Dove
Plectorhyncha lanceolata	Striped Honeyeater
Malurus cyaneus	Superb-fairy Wren
Malurus lamberti	Variegated Fairy-wren
Sericornis frontalis	White-browed Scrubwren
Phylidonyris nigra	White-cheeked Honeyeater
Gerygone olivacea	White-throated Gerygone
Lichenostomus chrysops	Yellow-faced Honeyeater
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo
Opportunistic sightings of bird species on the subject site	
Falco longipennis	Australian Hobby
Threskiornis molucca	Australian White Ibis
Chenonetta jubata	Australian Wood Duck
Elanus axillaris	Black-shouldered Kite
Ninox novaeseelandiae	Boobook Owl
Ardea ibis	Cattle Egret
Anas castanea	Chestnut Teal
Sturnus vulgaris *	Common Starling
Tyto capensis #	Grass Owl
Coturnix chinensis	King Quail
Vanellus miles	Masked Lapwing
Anas superciliosa	Pacific Black Duck
Centropus phasianinus	Pheasant Coucal

Scientific Name	Common Name
Opportunistic sightings of bird species on the subject site (cont.)	
Falco cenchroides	Nankeen Kestrel
Threskiornis spinicollis	Straw-necked Ibis
Podargus strigoides	Tawny Frogmouth
Hirundo neoxena	Welcome Swallow
Haliastur sphenurus	Whistling Kite
Rhipidura leucophrys	Willie Wagtail

* - Introduced species

- Listed as threatened (vulnerable) under the TSC Act

Appendix 2 - Flora species recorded on the subject site

Family	Species	Common Name
Adiantaceae	*Cheilanthes sieberi*	Mulga Fern
Amaranthaceae	**Gomphrena celosioides*	Gomphrena
Anthericaceae	*Tricoryne simplex*	Yellow Rush Lily
Apiaceae	*Centella asiatica*	Indian
Apiaceae	**Hydrocotyle bonariensis*	Pennywort
Apocynaceae	*Parsonsia straminea straminea*	Monkey Rope
Asteraceae	**Ambrosia psilostachya*	Perennial
Asteraceae	**Cirsium vulgare*	Black thistle
Asteraceae	**Conyza bonariensis*	
Asteraceae	**Cotula coronopifolia*	Water Buttons
Asteraceae	**Heterotheca grandiflora*	
Asteraceae	**Hypochoeris radicata*	Catsear
Azollaceae	*Azolla pinnata*	Ferny Azolla
Bignoniaceae	*Pandorea pandorana pandorana*	Wonga Wonga
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Chenopodiaceae	*Sarcocornia quinqueflora*	Samphire
Chenopodiaceae	*Einadia trigonos stellutata*	Fishweed
Commelinaceae	*Commelina cyanea*	Scurvy Weed
Cyperaceae	*Bolboschoenus caldwellii*	
Cyperaceae	*Baumea rubiginosa*	Soft Twig-rush
Cyperaceae	*Carex gaudichaudiana*	Tufted Sedge
Cyperaceae	**Cyperus brevifolius*	
Cyperaceae	*Carex appressa*	Tall Sedge
Cyperaceae	*Cyperus difformis*	
Cyperaceae	*Cyperus exaltatus*	
Cyperaceae	*Cyperus inversa*	
Cyperaceae	*Cyperus odoratus*	
Cyperaceae	*Eleocharis cylindrostachys*	
Cyperaceae	*Gahnia clarkei*	Swordgrass
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground-
Dennstaedtiaceae	*Pteridium esculentum*	Bracken Fern
Droseraceae	*Drosera binata*	Forked Sundew
Ericaceae	*Monotoca elliptica*	
Fabaceae	**Trifolium repens*	White Clover
Fabaceae	*Kennedia rubicunda*	Red Kennedy
Fabaceae	*Acacia longifolia*	Sydney Golden
Fabaceae	*Acacia terminalis longiaxialis*	Sunshine Wattle
Gleicheniaceae	*Gleichenia dicarpa*	Coral Fern
Goodeniaceae	*Goodenia paniculata*	
Juncaceae	**Juncus acutus*	Sharp Rush

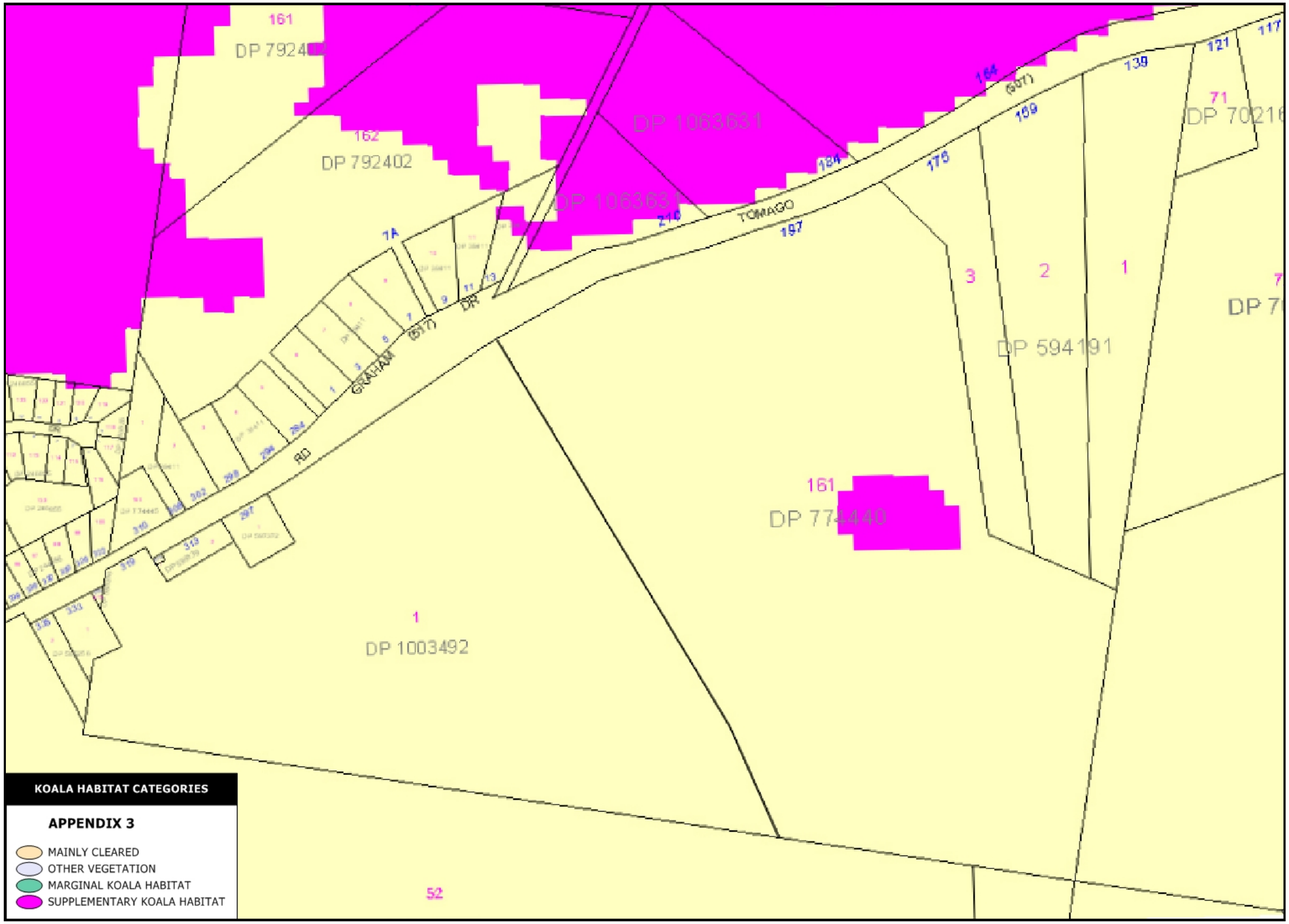
Family	Species	Common Name
Juncaceae	*Juncus continuus*	
Juncaceae	*Juncus kraussii*	Sea Rush
Juncaceae	*Juncus prismatocarpus*	
Juncaceae	*Juncus usitatus*	Common Rush
Juncaginaceae	*Maundia triglochinoides*	
Lobeliaceae	*Lobelia alata*	Angled Lobelia
Lomandraceae	*Lomandra longifolia*	Mat Rush
Malvaceae	**Sida rhombifolia*	Paddy's Lucerne
Moraceae	*Ficus macrophylla*	Moreton Bay Fig
Moraceae	*Ficus rubiginosa*	Port Jackson Fig
Myrtaceae	*Angophora costata*	Smooth-barked
Myrtaceae	*Callistemon salignus*	White
Myrtaceae	*Eucalyptus robusta*	Swamp
Myrtaceae	*Eucalyptus tereticornis*	Red Gum
Myrtaceae	*Leptospermum juniperinum*	Prickly Teatree
Myrtaceae	*Leptospermum laevigatum*	Coast Teatree
Myrtaceae	*Melaleuca styphelioides*	
Myrtaceae	*Melaleuca quinquinervia*	Broad-leaf
Orchidaceae	*Dendrobium teretifolium*	Rats Tail Orchid
Philydraceae	*Philydrum lanuginosum*	Woolly
Phormiaceae	*Dianella caerulea caerulea*	Paroo Lily
Pittosporaceae	*Pittosporum undulatum*	Sweet
Plantaginaceae	**Plantago lanceolata*	Lambs Tongue
Poaceae	**Andropogon virginicus*	Whiskey Grass
Poaceae	**Axonopus fissifolius*	Narrow-leafed
Poaceae	**Chloris gayana*	Rhodes Grass
Poaceae	**Melinis repens*	Red Natal Grass
Poaceae	**Paspalum dilatatum*	Paspalum
Poaceae	**Pennisetum cclandestinum*	Kikuyu
Poaceae	**Sporobolus africanus*	Parramatta
Poaceae	**Stenotaphrum secundatum*	Buffalo Grass
Poaceae	*Cymbopogon refractus*	Barbed Wire
Poaceae	*Cynodon dactylon*	Couch
Poaceae	*Deyeuxia quadriseta*	Reed Bent-grass
Poaceae	*Digitaria didactyla*	Queensland
Poaceae	*Imperata cylindrical major*	Bladey Grass
Poaceae	*Isachne globosa*	Swamp Millet
Poaceae	*Oplismenus aemulus*	Basket Grass
Poaceae	*Ottochloa gracillima*	
Poaceae	*Panicum simile*	Two Colour
Poaceae	*Paspalum distichum*	Water Couch
Poaceae	*Paspalum vaginatum*	Salt Water

Family	Species	Common Name
Poaceae	*Poa labillardieri*	Tussock Grass
Poaceae	*Sporobolus virginicus var. minor*	Sand Couch
Poaceae	*Themeda australis*	Kangaroo grass
Proteaceae	*Banksia serrata*	Old Man
Polygonaceae	** Rumex crispus*	Dock
Polygonaceae	*Persicaria decipiens*	Slender
Polygonaceae	*Persicaria hydropiper*	Water Pepper
Polygonaceae	*Persicaria strigosa*	
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn
Ranunculaceae	*Ranunculus inundatus*	Water Buttercup
Ranunculaceae	*Ranunculus plebius*	Water Buttercup
Restionaceae	*Baloskion tetraphyllum*	
Rosaceae	**Rubus fruticosus*	Blackberry
Selaginellaceae	*Selaginella uliginosa*	Swamp
Solanaceae	**Solanum mauritianum*	Wild Tobacco
Typhaceae	*Typha orientalis*	Broadleaf
Verbenaceae	**Verbena bonariensis*	Purple Top
Verbenaceae	**Lantana camara*	
Violaceae	*Viola hederacea*	

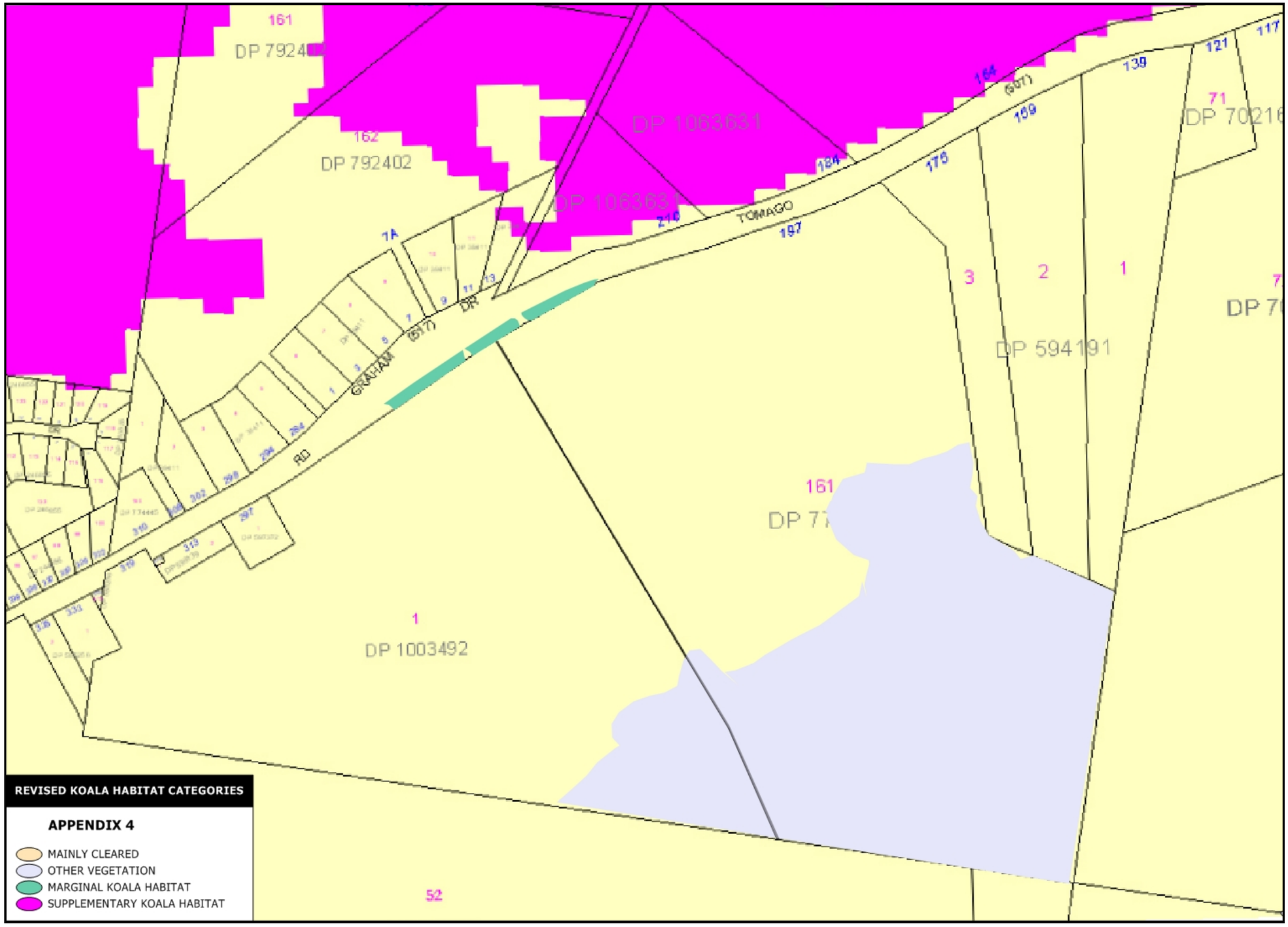
* - Introduced species

- Listed as threatened (vulnerable) under the TSC Act

Appendix 3 – Comprehensive Koala Plan of Management Koala Habitat Categories.



Appendix 4 – Comprehensive Koala Plan of Management Revised Koala Habitat Categories.



Appendix 5 – Contributions and qualifications of EcoBiological Staff.

Name	Qualifications	Experience	Role
Simon Clulow	B. Sc. B. Teach.	4 years Herpetologist and Environmental Scientist. Research in evolutionary biology, ecology, reproductive physiology and conservation biology.	Project management and Threatened Species Assessment preparation. Reptile and amphibian surveys. Targeted Green and Golden Bell Frog survey. Research into the ecology and distribution of the Grass Owl. Trapping design and mammal trap checking. Owl & mammal call playback. Spotlighting.
Colin Driscoll	B. Sc. PhD candidate	30 years Bird identification, Botany, Vegetation classification and mapping.	Research into the ecology and distribution of the Grass Owl. Vegetation classification review.
Adam Blundell	B. Env. Sc. (Hons)	7 years Large forest owls research. Trained by Barbara Triggs in hair and scat analysis	Hair sample analysis. Research into the ecology and distribution of the Grass Owl. Trapping design and mammal trap checking. Owl & mammal call playback. Spotlighting. Report review.
Dan Pederson	B. Sc. Grad.Dip.DBPA	4 years Botany, vegetation classification and mapping. Bushfire consultant.	Flora & vegetation community survey. Research into the ecology and distribution of the Grass Owl.
Kristy Peters	B. ParkMgt.	1.5 years Bird identification.	Targeted Waterbird survey. Research into the ecology and distribution of the Grass Owl.
Peter Ekert	B. App. Sc.	9 years Bird identification and research.	Bird surveys.
Rod Kavanagh	Dip. Appl. Sc Dip. Nat. Res. MSc PhD	30 years Research into the ecology of Arboreal Marsupials and large Forest Owls.	Research into the ecology and distribution of the Grass Owl.
Matthew Stanton	B. Sc.		Research into the ecology and distribution of the Grass Owl.
Glen Hoye	B. Sc.	20 years Research into Insectivorous Bat ecology.	Bat call identification.
Barbara Triggs		26 years Expert in hair, scat and regurge pellet analysis.	Owl regurge pellet analysis.

Appendix 6 - Licensing Matters Relating to the Survey

EcoBiological and employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act* 1974 (License Number: S10565, Expiry: 31 August 2007) and the *Animal Research Act* 1985 to harm/trap/pick/hold/study protected fauna and native flora and to undertake fauna surveys.

Additional licensing and ethics approvals to capture and radio track the Grass Owl in the Hunter estuary were also granted under this scientific license in order to carry out the Grass Owl research project

Appendix K

FLOOD REPORT

REDLAKE ENTERPRISES PTY LTD

PROPOSED INDUSTRIAL DEVELOPMENT AT TOMAGO ROAD, TOMAGO

FLOOD IMPACT ASSESSMENT



Issue No. 2
OCTOBER 2007

REDLAKE ENTERPRISES PTY LTD

PROPOSED INDUSTRIAL DEVELOPMENT AT TOMAGO ROAD, TOMAGO

FLOOD IMPACT ASSESSMENT

Issue No. 2
OCTOBER 2007

Document Amendment and Approval Record

Issue	Description of Amendment	**Prepared by** [date]	**Verified by** [date]	**Approved by** [date]
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1 INTRODUCTION

Redlake Enterprises Pty Ltd (*Redlake*) is planning to develop an area of land at Tomago for industrial purposes. The land fronts Tomago Road and comprises the following parcels:

- Lot 161 DP 774440;
- Lot 1 DP 1003492;
- Lot 1 DP 597372; and,
- Lot 513 DP 585256.

Collectively, these lots have a combined area of about 115 hectares (*refer* **Figure 1**).

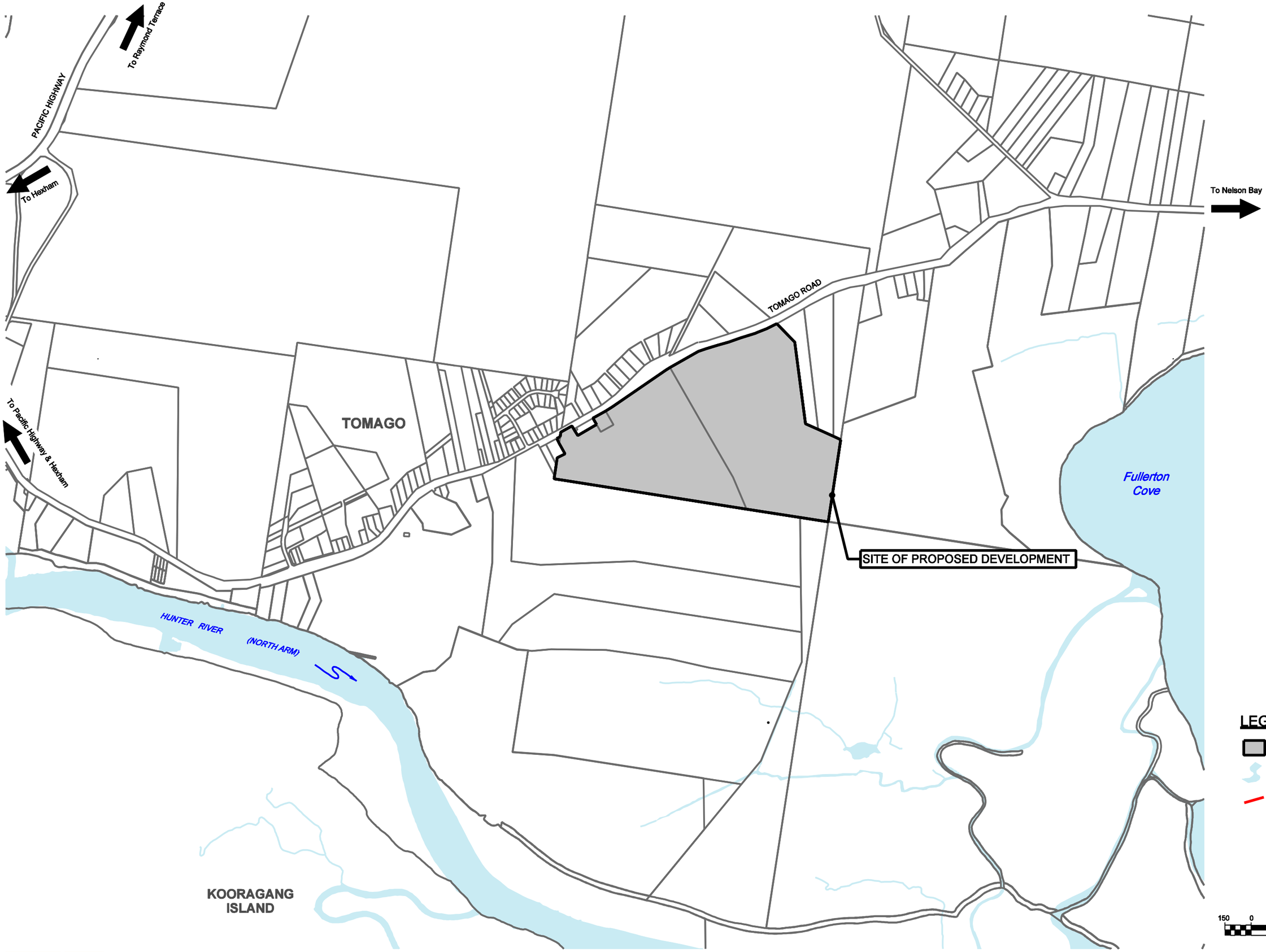
As shown in **Figures 1** and **2**, the land is located on the northern floodplain of the Hunter River. **Figure 2** also shows that the majority of the development site is located below an elevation of 1 mAHD. Predicted peak flood level data indicates that these low lying areas of the site will be inundated during large Hunter River floods. Only a relatively narrow strip of the land located immediately adjacent to Tomago Road would remain 'flood free' in floods of the magnitude of the 100 year recurrence event.

Development on flood affected land typically requires the floor levels of buildings and infrastructure to be constructed at or above the peak level of the design 100 year recurrence flood. Therefore, Redlake plans to undertake filling across the site so that buildings, roads and associated infrastructure can be constructed on a platform that is above the peak 100 year recurrence flood level. However, any filling that is undertaken across the site has the potential to alter local flood behaviour and to remove the flood storage that is currently afforded by the site. This in turn could adversely impact adjoining properties.

Accordingly, Asquith & deWitt Pty Ltd, acting on behalf of Redlake, engaged Patterson Britton & Partners to undertake a Flood Impact Assessment for the proposed development.

This report documents the findings from those investigations, including predicted peak flood levels across the land and the likely extent and depth of inundation during the 100 year recurrence flood. The report also outlines the change in flood behaviour that is predicted as a consequence of the filling that is proposed for the land. This includes a quantitative assessment of the predicted increase in peak flood level, peak flow velocity and provisional flood hazard across the Hunter River floodplain in the vicinity of Tomago.

FIGURE 1

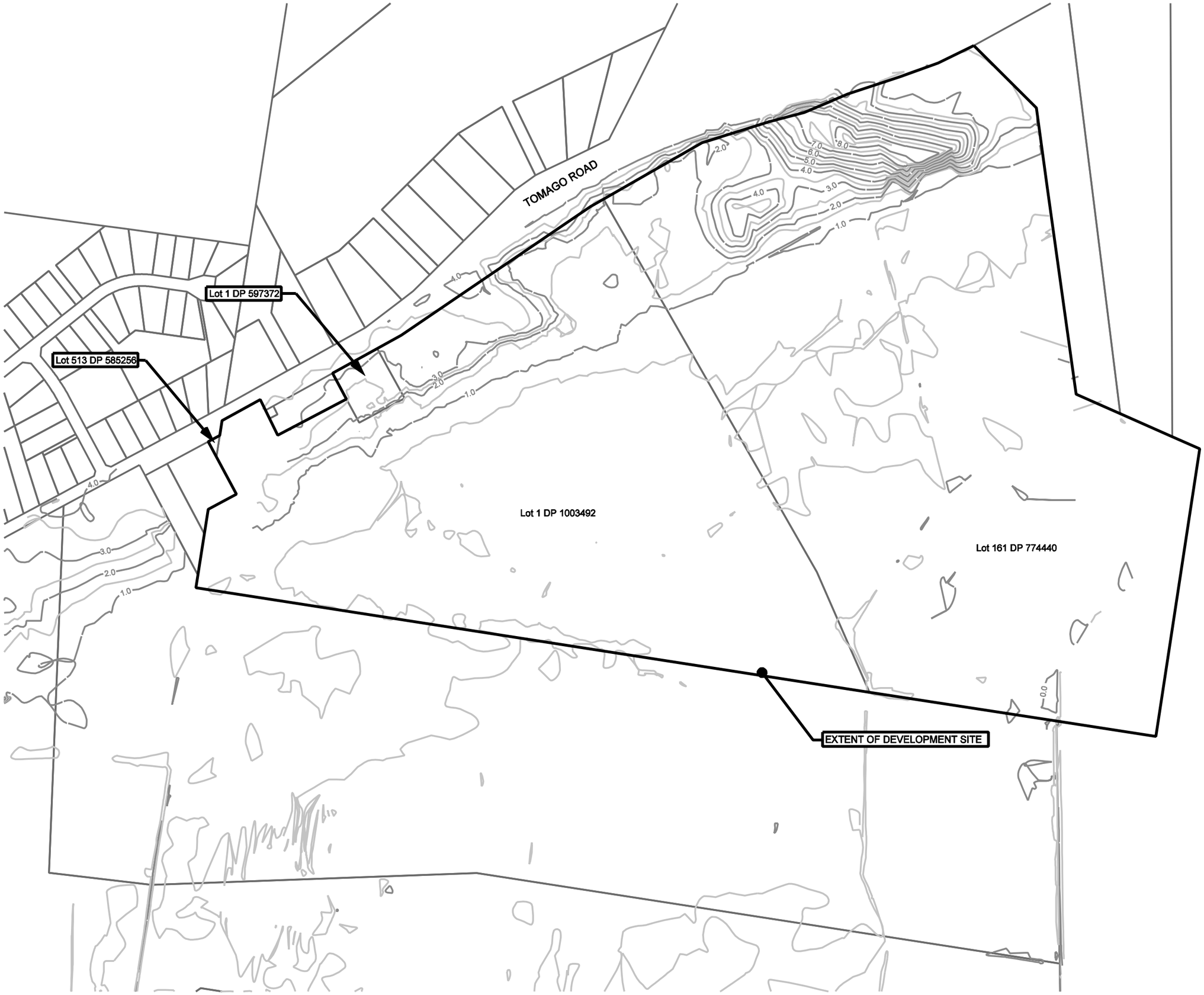


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LOCATION OF DEVELOPMENT SITE

FIGURE 2



LEGEND

4.0 Contour of existing ground surface elevation relative to mAHD

N

Scale

50 0 50 100 150 200 250

Metres

EXISTING TOPOGRAPHY IN THE VICINITY OF THE LAND

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2 BACKGROUND

2.1 PREVIOUS FLOOD INVESTIGATIONS

2.1.1 Lower Hunter River Flood Study

The Lower Hunter River has a long history of flooding with many reported instances of floodwaters overtopping the natural banks of the river and inundating the adjoining floodplain. This was particularly evident during the flood that occurred in 1955 which caused extensive damage along the lower reaches of the Hunter River (*Hawke, 1958*).

In recognition of the severe impact that flooding can have on communities in the Lower Hunter catchment, Newcastle City and Port Stephens Councils undertook a Flood Study for the Lower Hunter River and its floodplain. The Flood Study was completed in 1994 and involved the development of a computer model of the Hunter River system that extends from Green Rocks near Hinton, to the mouth of the Hunter River at Newcastle.

The computer model was developed using the MIKE-11 software. MIKE-11 is a one-dimensional branched network unsteady flow model. The model is based on well established hydraulic principles and was calibrated to reproduce past floods such as the 1955 event.

The calibrated model was subsequently used to simulate a range of design floods and define peak water levels and flow velocities at discrete locations across the floodplain of the Hunter River for topographic conditions that existed at that time. This included peak flood level and velocity estimates in the vicinity of Tomago for the 100 year recurrence flood. The results of the Flood Study are documented in a report titled, *'Lower Hunter River Flood Study: Green Rocks to Newcastle'* (*1994*).

2.1.2 Lower Hunter River Floodplain Management Study

Following publication of the Flood Study, Newcastle City and Port Stephens Council's proceeded with the preparation of a floodplain risk management study for the region. The results from the floodplain risk management study process are documented in the following reports:

- *'Lower Hunter Valley Floodplain Management Study – Volume A: Assessment of Strategic Options for Community Consultation'* (*October, 1996*); prepared by Patterson Britton & Partners Pty Ltd
- *'Lower Hunter Valley Floodplain Management Study – Volume A: Assessment of Strategic Options for Community Consultation – Summary Report'* (*April, 1997*); prepared by Patterson Britton & Partners Pty Ltd
- *'Lower Hunter Valley Floodplain Management Study – Volume B: Planning Implementation Strategy'* (*November, 2001, in draft*); prepared by Patterson Britton & Partners Pty Ltd

- *'Lower Hunter Valley Floodplain Management Study – Volume B: Planning Implementation Strategy – Summary Report'* (*November, 2001, in draft*); prepared by Patterson Britton & Partners Pty Ltd.
- *'Lower Hunter Valley Floodplain Management Study – Volume B Report: Exhibition Results and Recommendations'* (*March 2003*); prepared by Patterson Britton & Partners Pty Ltd.

The floodplain management study was prepared to identify and assess appropriate measures for managing the potential flood hazard along the Lower Hunter River.

Volume A Report

An assessment of the existing and future flooding problems was undertaken and is documented in a report titled, *'Lower Hunter Floodplain Management Study: Volume A – Assessment of Strategic Options for Community Consultation'* (*October, 1996*). The report is referred to as the Volume A Report and documents the flood related benefits of implementing a range of flood mitigation works to reduce existing flood damages. It also details the hydraulic or flood related impacts of a range of broad scale development options that were considered for the floodplain. The report also introduced issues associated with the future flooding problem, which relates to potential development pressures that may arise across the floodplain within each of the Newcastle and Port Stephens Local Government Areas.

The Volume A Report included an assessment of the impact of filling of the floodplain east of the existing Tomago Industrial Area. This includes the land that Redlake plans to develop.

The assessment that was undertaken for the Volume A Report established that filling of the floodplain east of the existing Tomago Industrial Area would increase peak 100 year recurrence flood levels by up to 120 mm in areas upstream of Hexham. Peak Probable Maximum Flood levels would increase by as much as 200 mm. However, increases in peak flood level were found to be negligible in events smaller or more frequent that the 50 year recurrence flood.

The Volume A Report concluded that filling could be undertaken along a 1 kilometre wide strip of land running parallel to Tomago Road without causing adverse flood impacts, provided flow paths were preserved to allow floodwaters to spill out of the Hunter system, through Tilligerry Creek and into Port Stephens in events rarer than the 50 year recurrence flood.

Volume B Report

The residual or continuing flood problem was addressed in the *'Lower Hunter Floodplain Management Study: Volume B – Planning Implementation Strategy'* (*November, 2001*). The Volume B Report was concerned with the management of flood affected properties in those areas of the floodplain where residential, commercial and industrial buildings are likely to remain for some time into the future, and where the hazard will largely remain unchanged despite the implementation of strategies recommended in the floodplain management plan (*which is yet to be prepared*).

The Volume B Report documents recommendations for minimum floor level requirements for residential, commercial and industrial land uses across the Newcastle and Port Stephens Local Government Areas. The report suggests that the following controls be applied to industrial developments that are proposed for land located west of Fullerton Cove:

- that the minimum floor level for industrial developments be at least 300 mm above the peak level of the 20 year recurrence flood;
- that all industrial developments have access to higher ground that is above the level of the 50 year recurrence flood;
- that all industrial developments have access routes for staff and transport of stock/equipment that is at least at the level of the 50 year recurrence flood; and
- where the industrial complex is located below the peak level of the PMF, an 'internal' flood management plan should be prepared and submitted as part of the Development Application. This should include:
  - how inventory and equipment housed on the proposed development site is to be transferred to higher ground during a flood; and,
  - procedures for evacuation of staff during a major flood, including the minimum warning time before all staff are evacuated.

Notwithstanding, it should be recognised that the recommendations outlined above have not been formally adopted by Port Stephens Council.

2.2 RELEVANCE OF PREVIOUS INVESTIGATIONS AND PLANNING INSTRUMENTS

As outlined above, the recommendations outlined in the *Lower Hunter Valley Floodplain Management Study* have not been formally adopted and implemented by Port Stephens Council. Accordingly, there is no existing planning instrument that embodies the floor level recommendations outlined above cannot necessarily be applied for the development that is proposed for the Redlake site.

In most circumstances, the development of land within the Port Stephens LGA would need to comply with the requirements of Port Stephens Council's LEP and Council's *Flood Policy*. These documents typically require the nature and extent of the existing flood hazard to be determined. They also require determination of the potential for development, including filling, to adversely impact on existing flood hazard across adjoining properties. Where adverse impacts are identified, measures need to be incorporated into the development to mitigate these impacts or to establish that the impacts will not manifest as an increased risk to life and property.

In this instance, the development proposal will be assessed as a Major Project in accordance with Part 3A of the Environmental Planning & Assessment Act 1979. Notwithstanding, in accordance with the principles of responsible floodplain management, the typical protocols for assessment of development on flood prone lands has been applied.

Accordingly, the following sections of this report quantify the potential impacts that development of the land may have on existing flood behaviour in accordance with the typical requirements of the NSW Government's *Flood Prone Land Policy* and the guidelines outlined in the *'Floodplain Development Manual'*.

3 ASSESSMENT OF EXISTING FLOOD BEHAVIOUR

3.1 DESCRIPTION OF THE DEVELOPMENT SITE

The development site is located on the northern floodplain of the Hunter River at Tomago. It covers a total area of about 115 hectares and has a 1.5 kilometre frontage to Tomago Road (*refer* **Figure 1**).

Detailed topographic survey was gathered in the vicinity of the site and is presented in **Figure 2**. The survey was gathered by Asquith & de Witt Pty Ltd and was combined with additional survey data provided by Hunter Water Corporation.

Figure 2 shows that the topography across the land varies between 0 and 8 mAHD. Tomago Road and the north-western sections of the site that adjoin it are generally above the 3 metre contour. However, the elevation of the land grades down steeply to an elevation of 1 mAHD within 200 metres of the frontage to Tomago Road. The remainder of the site extending south-east toward the Hunter River is typically at an elevation of about 0.5 mAHD (*refer* **Figure 2**).

The land is generally flat and sparsely vegetated, having been previously cleared and drained for grazing purposes. A low level levee also extends across the floodplain of the Hunter River to the south of the land and is understood to afford protection during floods up to and including the 10 year recurrence event (*Newcastle City Council & Port Stephens Council, 1996*).

A number of drainage channels extend across the southern sections of the land. The channels drain surface runoff from the land into a Ramsar Wetland which adjoins the south-eastern boundary of the site. The wetland, in turn, drains to the Hunter River and Fullerton Cove.

The land is currently zoned *IN1 – General Industrial* via SEPP Major Projects. Adjoining land on the northern side of Tomago Road is currently zoned 1(a) Rural Agriculture, 4(a) General Industrial and 7(c) Environmental Protection – Water Catchment.

3.2 FLOOD CHARACTERISTICS IN VICINITY OF THE DEVELOPMENT SITE

3.2.1 Hydraulic Model Development

As discussed, flood behaviour along the Lower Hunter River is currently defined using the results generated by a one-dimensional MIKE-11 branched network model. The MIKE-11 model was originally developed as part of the *'Lower Hunter River Flood Study: Green Rocks to Newcastle'* (*1994*).

However, since publication of the Flood Study, hydraulic modelling tools have improved considerably. Moreover, work undertaken for the *Lower Hunter Valley Floodplain Management Study* (*refer Volume B*) recognised that the MIKE-11 model does not have sufficient discretisation to model the complex two-dimensional nature of flooding along some sections of the Lower Hunter River.

Furthermore, the broad-scale nature of the MIKE-11 model does not allow reliable assessment of the potential for individual developments to impact on local flood behaviour.

In recognition of the limitations of the existing MIKE-11 model and the advances in hydraulic modelling techniques over the past decade, a fully two-dimensional hydrodynamic computer model was developed and used to define local flood behaviour in the vicinity of Tomago.

The computer model was developed using the RMA-2 software package (*King, 2001*). RMA-2 is a two-dimensional finite element software package that employs a 'mesh' of geometric shapes (*i.e., triangles and rectangles*) to represent the topographic features of the river and floodplain. The mesh can also include road and railway embankments as well as isolated sections of filling that has or could occur across the floodplain (*like that which is proposed for the Redlake Development site*).

The RMA-2 model that was developed extends from the Hunter River entrance at Newcastle upstream to Green Rocks near Hinton and along the Williams River to Irrawang Swamp. It was developed using are range of data including:

- river and floodplain cross-section data extracted from the existing MIKE-11 model of the Lower Hunter River;
- 2 metre contours derived from 1:4000 series orthophoto mapping of the area;
- detailed topographic data gathered by aerial laser scanning for the strip of industrial land between the Pacific Highway and the Chichester Dam Water Supply, from Tarro to Ironbark Creek; and,
- bathymetric data for the Lower Hunter River extending from the mouth of the river upstream to Raymond Terrace.

In order to ensure that local flood behaviour in the vicinity of the development site was reliably represented, the detailed topographic survey of the site presented in **Figure 2** was also incorporated into the RMA-2 model.

The RMA-2 finite element mesh was delineated into eight different "element types" to simulate the different hydraulic roughness characteristics of the main river channel and floodplain areas. The adopted roughness parameter values for each element type are listed in **Table 1**. All of the values listed are within acceptable limits.

3.2.2 Hydraulic Model Boundary Conditions

Upstream Boundary Conditions

Hydrodynamic model inflows for the 100 year recurrence flood were defined using discharge hydrographs extracted from the existing MIKE-11 model. Model inflow hydrographs were specified for the Hunter and Williams Rivers at the upstream boundary of the RMA-2 model as well as at major points of inflow into Hexham Swamp.

Table 1 ADOPTED RMA-2 MODEL ELEMENT PARAMETERS

ELEMENT TYPE	DESCRIPTION	ROUGHNESS PARAMETER
1	River Channel	0.020
2	Marsh/Mangroves	0.080
3	Roadways	0.015
4	Railways	0.018
5	Urban/Industrial Areas	0.025
6	Swamp	0.040
7	Floodplain with Medium to Dense Trees	0.070
8	Floodplain with Short Grass	0.030

Downstream Boundary Conditions

Computer models that simulate sub-critical flow behaviour (*such as RMA-2*) require the adoption of a suitable downstream boundary condition in order to reliably define flood behaviour throughout the area of interest. The downstream boundary condition is typically specified as a known water surface elevation.

The downstream boundary condition for the RMA-2 model was specified as a stage hydrograph at the Hunter River entrance at Newcastle. The peak stage for the downstream boundary for the 100 year recurrence flood was specified as 1.34 mAHD which corresponds to the current peak 100 year recurrence flood level estimate at the Hunter River entrance, as documented in the *'Lower Hunter River Flood Study: Green Rocks to Newcastle'* (*1994*).

3.2.3 Hydraulic Model Verification

In order to ensure that the RMA-2 model was reliably representing flood behaviour in the vicinity of Tomago for the 100 year recurrence flood, the model was verified by comparing RMA-2 model results with those generated by the existing MIKE-11 model. The verification process involved comparing peak flood level estimates generated by the RMA-2 model in the vicinity of Tomago with peak flood levels documented in the *'Lower Hunter River Flood Study: Green Rocks to Newcastle'* (*1994*).

A comparison between peak flood level estimates at selected MIKE-11 model cross-sections is presented in **Table 2**.

Table 2 indicates that the RMA-2 model generates peak flood level estimates that are generally within 30 mm of those documented in the *'Lower Hunter River Flood Study: Green Rocks to Newcastle'* (*1994*). Accordingly, it can be concluded that the RMA-2 model generates realistic peak flood level estimates and is a reliable tool for the definition of flood behaviour in the vicinity of Tomago.

Table 2 COMPARISON BETWEEN PREDICTED PEAK FLOOD LEVELS GENERATED BY RMA-2 AND MIKE-11 HYDRAULIC MODELS

DESCRIPTION OF LOCATION OF MIKE-11 CROSS-SECTION	MIKE-11 MODEL CROSS-SECTION REFERENCE	PEAK 100 YEAR RECURRENCE FLOOD LEVEL (*mAHD*)	
		MIKE-11 MODEL	RMA-2 MODEL
Approximately 300 metres west of the development site	TMGO-6.00	2.24	2.30
Near western boundary of the development site	TMGO-6.50	2.24	2.25
Midway along Lot 1 DP1003492	TMGO-7.00	2.24	2.21
Approximately halfway along development site	TMGO-7.50	2.18	2.18
Near eastern boundary of the development site	TMGO-8.00	2.13	2.12
Approximately 700 metres east of the development site	TMGO-8.50	2.00	2.03

3.2.4 Hydraulic Modelling Results

The verified RMA-2 model was used to simulate the 100 year recurrence flood for existing topographic conditions using the roughness parameter values listed in **Table 1** and the boundary conditions described in **Section 3.2.2**. The results of the modelling are presented in the following sections.

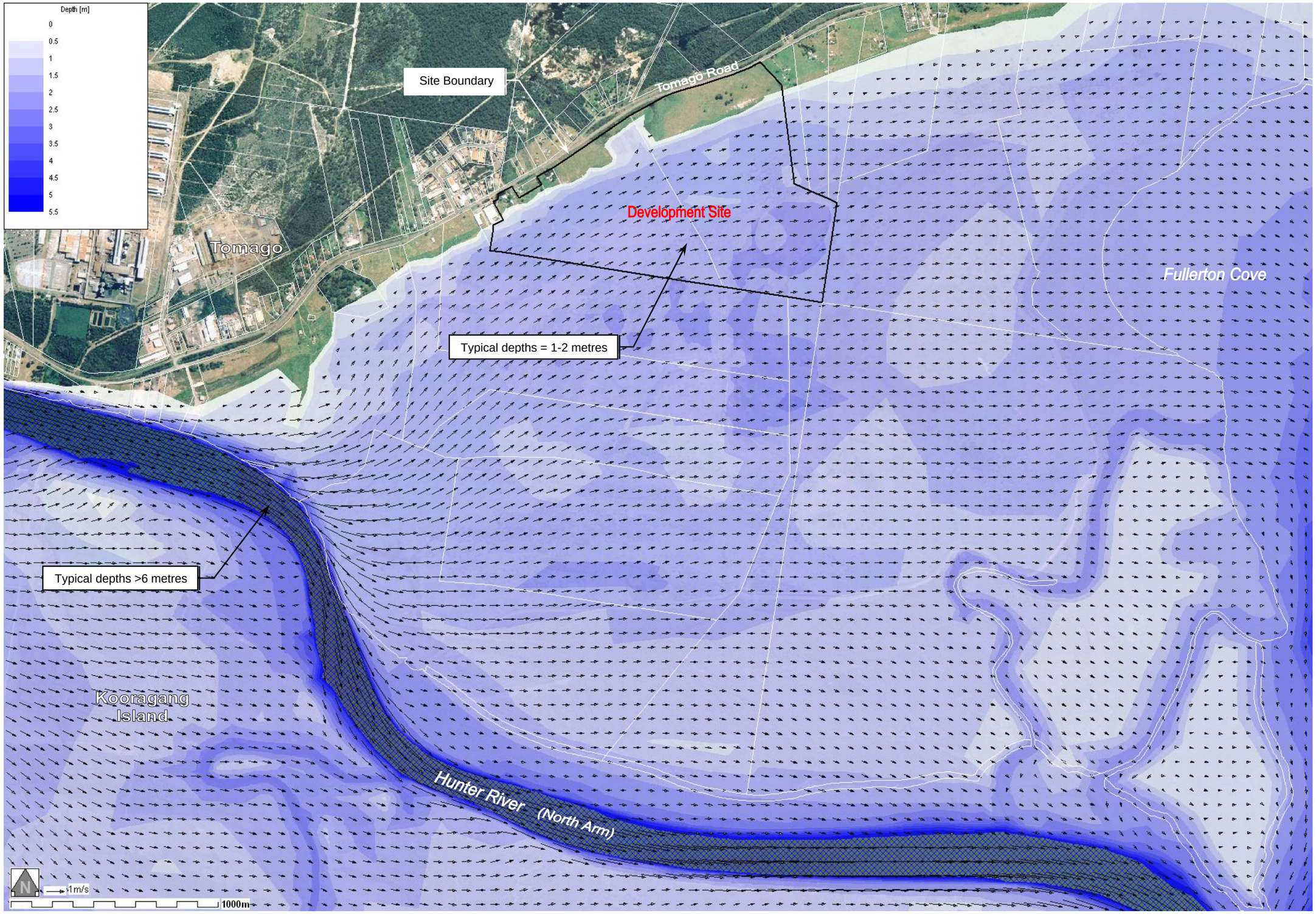
Predicted Peak Flood Levels and Depths

The results of the modelling show that the peak 100 year recurrence flood level in the vicinity of the development site is predicted to vary between 2.29 mAHD at the western boundary of the site and 2.14 mAHD near the eastern boundary of the site.

As discussed, the ground surface elevation across the development site varies between 0 and 8 mAHD (*refer* **Figure 2**). However, the majority of the site is located below 1 mAHD. Accordingly, the majority of the site would be inundated at the peak of the design 100 year recurrence flood.

Peak floodwater depths in the vicinity of the site were extracted from the results of the modelling and are reproduced in **Figure 3** for the 100 year recurrence event. As shown in **Figure 3**, with the exception of a strip of high ground fronting Tomago Road, floodwaters are predicted to extend across the majority of the land. The maximum floodwater depth is predicted to be about 2 metres.

Floodwater depths are predicted to exceed 1 metre across most of the land at the peak of the 100 year recurrence flood.



LEGEND

Development site

NOTES *Aerial photography dated 2005*

Cadastre dated 2001

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fig-Existing Depths.doc

PREDICTED FLOODWATER DEPTHS AND VELOCITIES AT THE PEAK OF THE 100 YEAR RECURRENCE FLOOD FOR EXISTING CONDITIONS

Peak Flow Velocities

Peak flow velocities for the 100 year recurrence flood were also extracted from the results of the modelling and are superimposed on the floodwater depth contours shown in **Figure 3**. The velocity vectors give an indication of the magnitude and direction of flow at the peak of the flood.

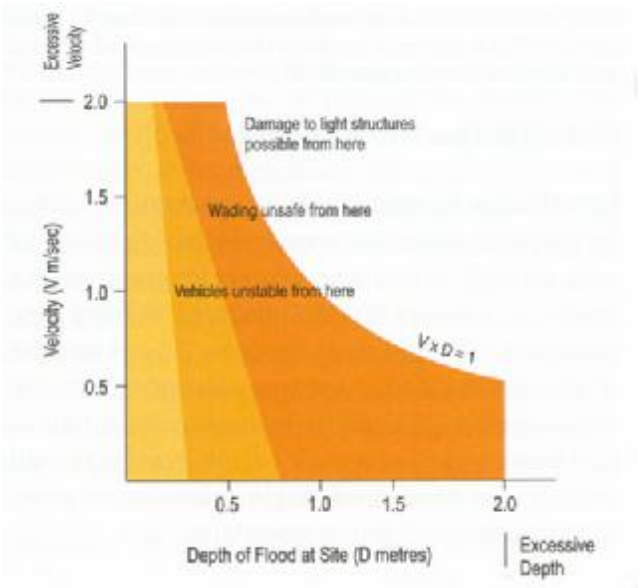
As shown in **Figure 3**, peak flow velocities across the site are predicted to vary between 0.2 and 0.5 m/s. The higher flow velocities are predicted to be concentrated across the southern sections of the development site.

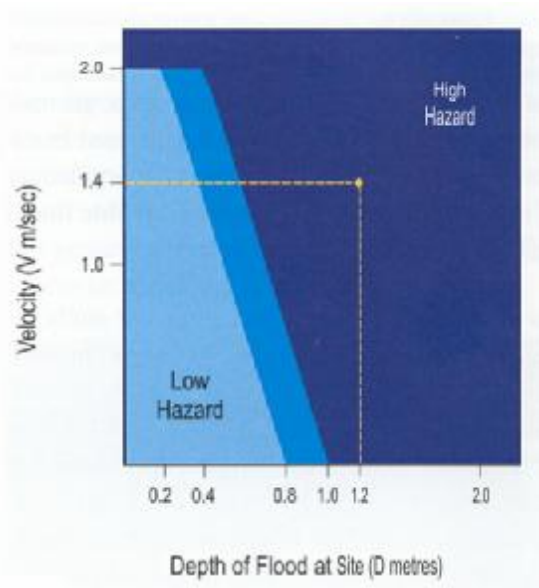
Provisional Flood Hazard

Flood hazard is a measure of the degree of difficulty that pedestrians, cars and other vehicles will have in egressing flooded areas, and the likely damage to property and infrastructure. The provisional flood hazard in a particular area is defined by the static and dynamic energy of floodwaters at that location. The static energy is defined by the depth of floodwaters, while the dynamic energy is defined by the rate of movement of the floodwaters (*i.e., flow velocity*).

The *'Floodplain Development Manual'* (*2005*) effectively divides hazard into two categories, namely high and low. An interpretation of the hazard at a particular site can be established from the graphs below, which have been taken directly from the manual.

The graph on the left shows approximate relationships between the depth and velocity of floodwaters and the resulting hazard. This relationship has been used to define the provisional low and high hazard categories represented in the graph on the right.





As discussed, during the 100 year recurrence flood, peak floodwater depths are generally predicted to exceed 1 metre. This indicates that the majority of the land would be considered **High Hazard** at the peak of the 100 year recurrence flood based on definitions provided in Appendix L of the NSW Government's *'Floodplain Development Manual'* (*2005*).

The high hazard categorisation indicates that at the peak of the 100 year recurrence flood:

- there is possible danger to personal safety;
- evacuation by trucks would be difficult;
- able-bodied adults would have difficulty wading to safety; and,
- there is potential for significant structural damage to buildings.

It should be noted that this provisional flood hazard classification is depth dominated, not velocity dominated. Therefore, the provisional hazard classification of the land could be reduced by reducing the depth of floodwaters across the land; that is by filling the land.

Provisional Hydraulic Category

The NSW Government's *'Floodplain Development Manual'* (*2005*) also characterises flood prone areas according to the hydraulic categories presented in **Table 3**. The hydraulic categories provide an indication of the potential for development across different sections of the floodplain to impact on existing flood behaviour (*NSW Government, 2005*).

Table 3 DEFINITIONS FOR HYDRAULIC CATEGORIES

HYDRAULIC CATEGORY	DESCRIPTION
FLOODWAY	• those areas where a significant volume of water flows during floods • often aligned with obvious natural channels • they are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas • they are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.
FLOOD STORAGE	• those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood • if the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. • substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.
FLOOD FRINGE	• the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. • development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

As indicated in **Table 3**, even partial blockage of floodway areas is considered unacceptable. Due to its location within the floodplain, it was considered that some of the Redlake site may be classified as "floodway".

Unfortunately, no definition of the extent of floodways has been determined for the Lower Hunter River. Therefore, an independent assessment of the potential extent of floodway areas in the vicinity of the development site was completed.

Unlike provisional hazard categories, the *'Floodplain Development Manual'* (*2005*) does not provide explicit quantitative criteria for defining hydraulic categories. This is because the extent of floodway, flood storage and flood fringe areas is site specific.

Nevertheless, it is possible to provide an initial assessment of the likely extent of floodway areas by considering design floodwater depths, flow velocities and the velocity-depth product. For example, the 1986 edition of the *'Floodplain Development Manual'* indicates that floodway areas could be defined as those areas subject to a velocity-depth product of greater than one.

Although the quantitative floodway definition provided in the 1986 edition of the Manual is now superseded, it was considered that this criteria would provide a reasonable indication of the likely extent of floodway areas in the vicinity of the site.

Accordingly, peak velocity-depth product values for the 100 year recurrence flood were extracted from the results of the modelling. Those sections of the river and floodplain exposed to a velocity-depth product of greater than one were delineated and are shown in red on **Figure 4**.

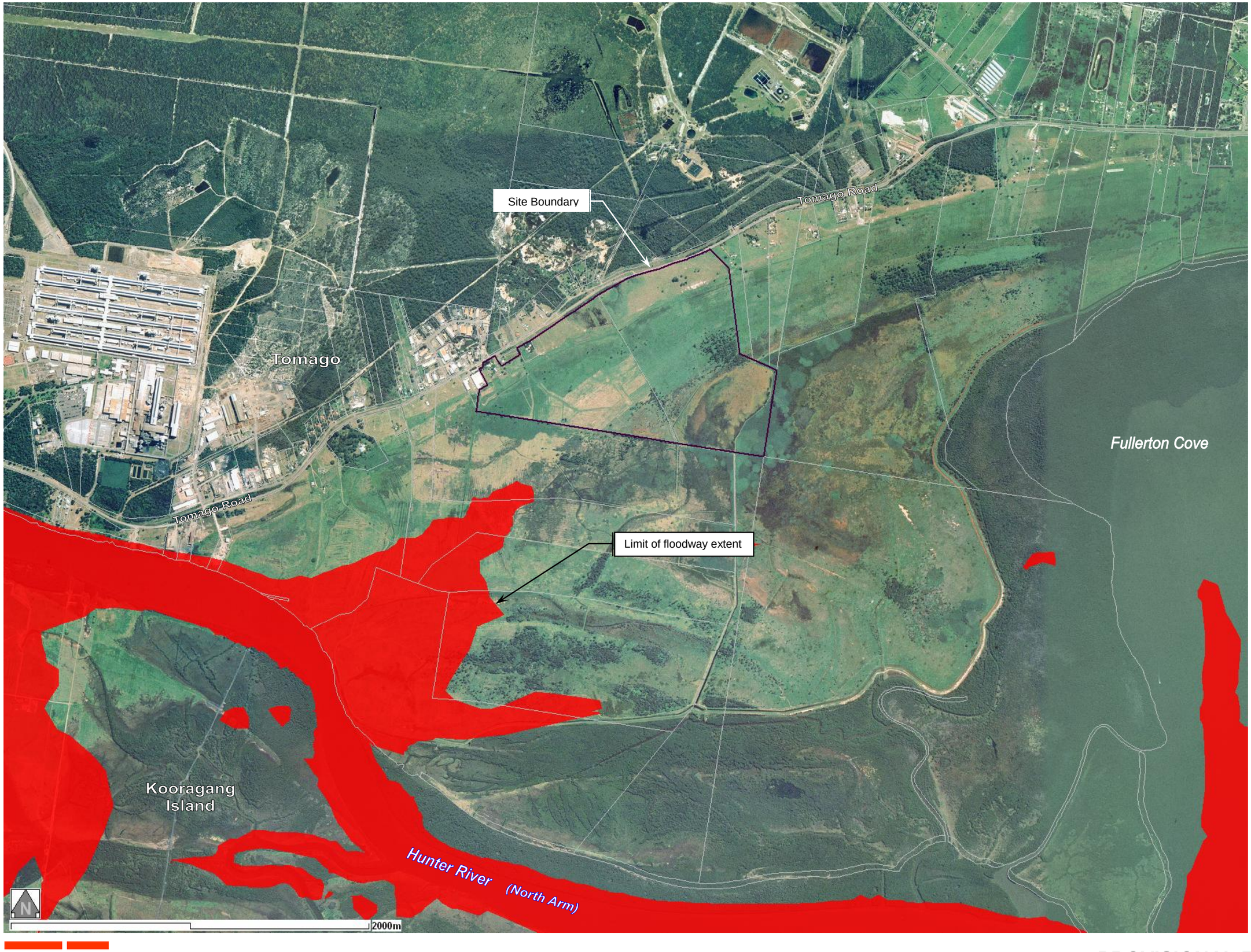
As shown in **Figure 4**, no section of the development site is predicted to be located in a floodway. Those sections of the floodplain likely to be classified as floodway are generally contained in close proximity to the North Arm of the Hunter River. An area of the Hunter River floodplain located immediately south-west of the site may also be considered a floodway. However, this area is located at least 350 metres south of the southern site boundary.

The results of the 100 year recurrence flood simulations indicate that peak VxD values across the development site are generally less than 0.8 m^2/s. Accordingly, previous experience indicates that the existing development site would not be classified as a floodway at the peak of the 100 year recurrence event.

However, the significant depths of inundation across the site do indicate that the land would contribute to the temporary storage of floodwater during large floods. As such, it is likely that the majority of the land would be classified as a **flood storage** area at the peak of the 100 year recurrence flood.

The *'Floodplain Development Manual'* (*2005*) indicates that if the capacity of a flood storage area is significantly reduced, for example, by filling, flood levels in nearby areas may rise and the peak downstream discharges may be increased. It may also cause a significant redistribution of flood flows.

FIGURE 4



LEGEND

Floodway extent (*based on VxD = 1 m^2/s*)

NOTES

Floodway extent is provisional and is based on consideration of flood hydraulics only.

Aerial photography dated 2005

Cadastre dated 2001

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fig-Floodway.doc

PROVISIONAL FLOODWAY EXTENT AT THE PEAK OF THE 100 YEAR RECURRENCE FLOOD

Accordingly, there is potential for any filling that is undertaken across the Redlake site to adversely impact on existing flood behaviour. Therefore, it was considered necessary to undertake further hydraulic investigations aimed at quantifying the potential for any filling to impact on existing flood behaviour. The outcomes of these investigations are presented in the following section.

4 FLOOD IMPACT ASSESSMENT

4.1 DESCRIPTION OF THE PROPOSED DEVELOPMENT

Redlake plans to develop its Tomago site for industrial purposes. Specifically, the land will be used for the following:

- assembly, maintenance and repair of heavy earthmoving equipment;
- warehousing and distribution of parts;
- earthmoving and machinery operator training;
- ancillary office and administration; and,
- industrial subdivision for related and unrelated uses.

As discussed in **Section 3.2.4**, the majority of the existing site is predicted to be inundated during the 100 year recurrence flood. Accordingly, if development of the land is to proceed, it will be necessary to fill a substantial proportion of the site so that buildings, roads, car parks and associated infrastructure can be located above the peak level of the 100 year recurrence flood.

The extent of filling that is proposed to accommodate the development is shown in **Figure 5**. As shown in **Figure 5**, the proposed filling will extend across the majority of the site and will involve filling to depths of up to 2 metres.

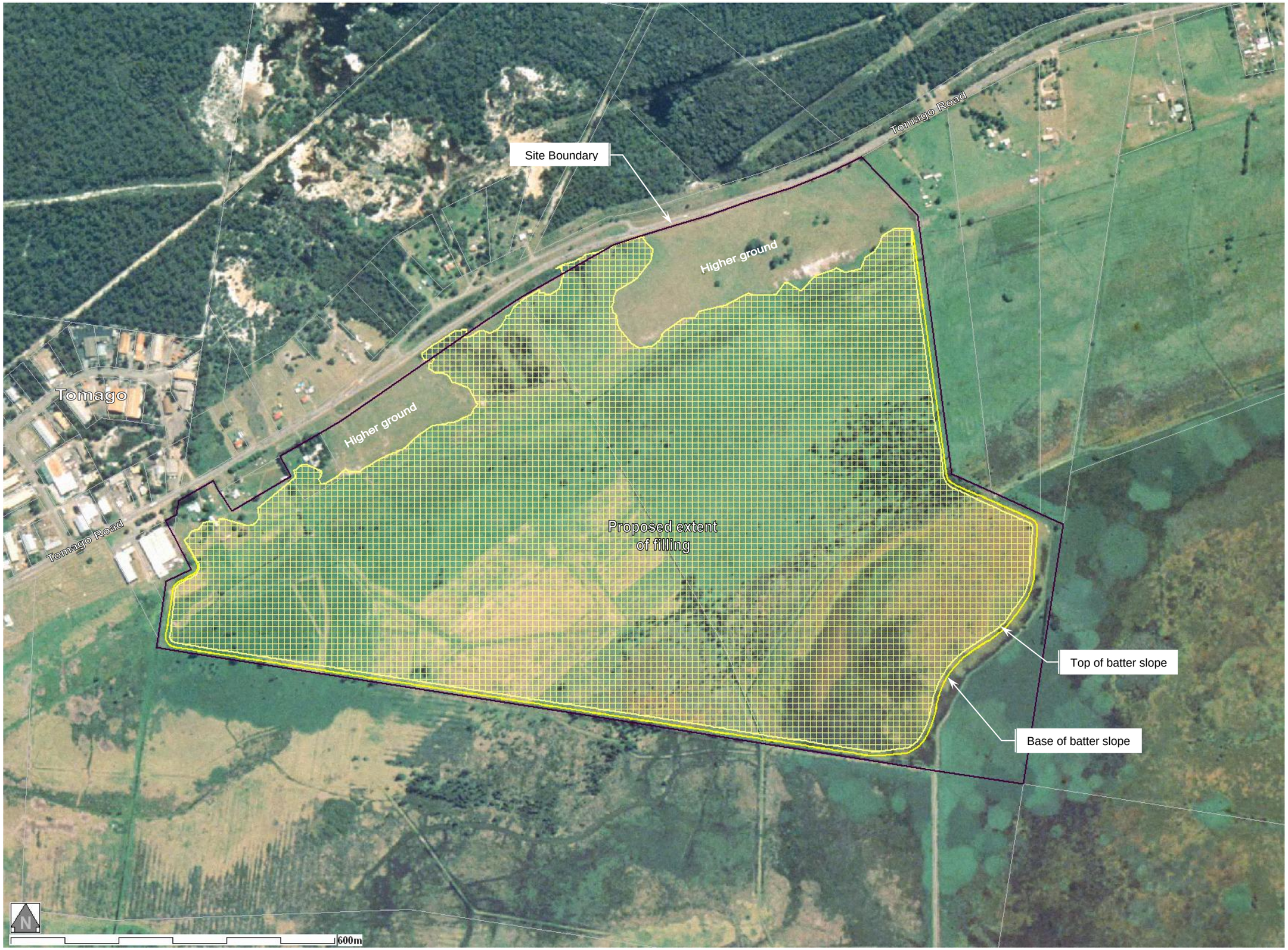
4.2 IMPACTS OF FILLING ON FLOOD BEHAVIOUR

4.2.1 Model Modifications to Reflect Proposed Development

The proposed development will incorporate modification to the existing natural surface of the land in order to provide a platform for the construction of industrial buildings, roadways and car parking areas. As shown in **Figure 5**, the fill proposal will incorporate significant filling that will be concentrated across Lot 1 DP 1003 and Lot 161 DP 774440.

The fill will "batter up" from the existing ground surface near the site boundaries to an elevation above the peak level of the 100 year recurrence flood (*i.e., between 2.14 and 2.29 mAHD*) at a grade of 1V:4H. No filling is proposed in the south-eastern corner of the site immediately adjoining the Ramsar Wetland.

The hydraulic model that was developed to define existing flood behaviour in the vicinity of the development site was modified to reflect the fill proposal shown in **Figure 5**. The modifications involved increasing the model node elevations within those sections of the site where filling is proposed. The elevations of nodes outside the area proposed for filling were not altered.



LEGEND

Proposed fill extent

NOTES

Extent of fill based on fill plan provided by Asquith & deWitt dated 29 June 2007

Aerial photography dated 2005

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fig-Fill_extent.doc

EXTENT OF PROPOSED FILLING

4.2.2 Flood Modelling Results

The modified model was used to simulate the design 100 year recurrence flood under post-development conditions (*i.e., with the fill proposal in place*). The magnitude of any changes in flood behaviour arising from the proposed filling was then established by comparing model results (*e.g., peak flood levels, flow velocities and velocity depth product*) at each hydrodynamic model node for pre-development (*refer* **Section 3**) and post-development conditions.

Impact on Flood Extent

Peak post-development (*after filling*) floodwater depths were extracted from the results of the modelling and are presented in **Figure 6**. The predicted flood extent for existing (*i.e., pre-development*) conditions is also superimposed for comparison (*refer blue line superimposed on* **Figure 6**).

As shown in **Figure 6**, the proposed filling will effectively prevent inundation across the majority of land where industrial development is proposed, in all floods up to and including the 100 year recurrence event.

Figure 6 also shows that the proposed filling will result in minor alterations to the flood extent in areas outside of the development site. As shown in **Figure 6**, the filling is predicted to generate a small increase in the peak 100 year recurrence flood extent in areas upstream of the filling and decrease the extent of inundation in areas downstream of the site.

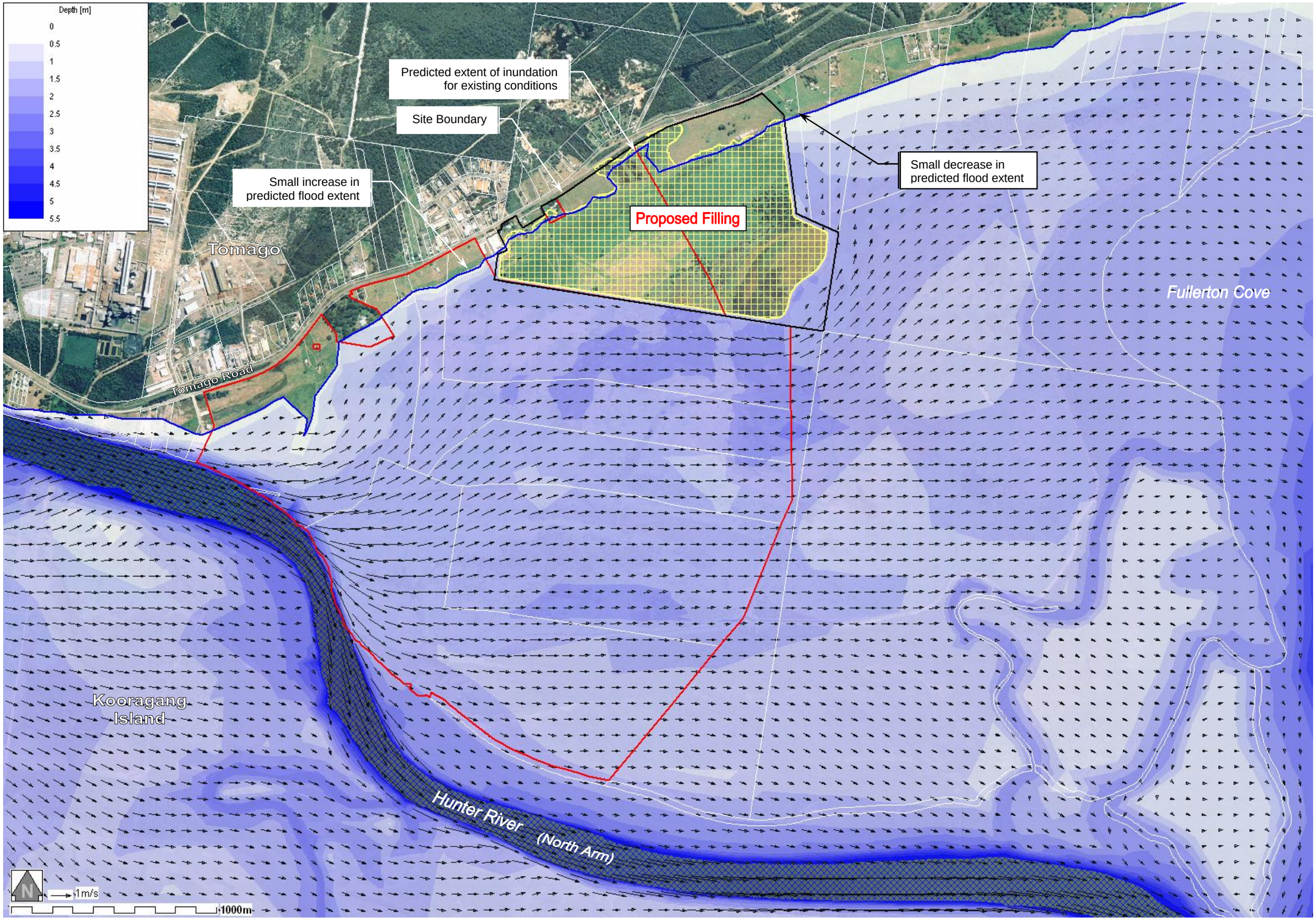
Impact on Peak Flood Level

The proposed filling is predicted to slightly alter the extent of flood liable land outside of the development site. The filling also has the potential to cause localised increases in peak flood levels elsewhere across the floodplain. Accordingly, flood level difference mapping was developed to quantify the location and magnitude of changes in peak flood levels associated with the proposed filling.

Difference maps are created by comparing peak flood level estimates at each node in the hydrodynamic model from simulations undertaken for both pre and post-development scenarios. This effectively creates a contour map of predicted changes in peak flood levels and allows easy determination of the impact of the proposed filling on existing flood behaviour.

Flood level difference mapping was developed for the 100 year recurrence flood and is presented in **Figure 7**. Increases in peak flood level are represented as different shades of red and decreases in peak flood level are represented as shades of blue. The white areas indicate changes in peak flood level of less than 20 mm.

The difference mapping presented in **Figure 7** indicates that the proposed filling will generate changes in peak 100 year recurrence flood levels across the floodplain of the Hunter River.



LEGEND

- Proposed fill extent
- Predicted 100 year recurrence flood extent for existing conditions

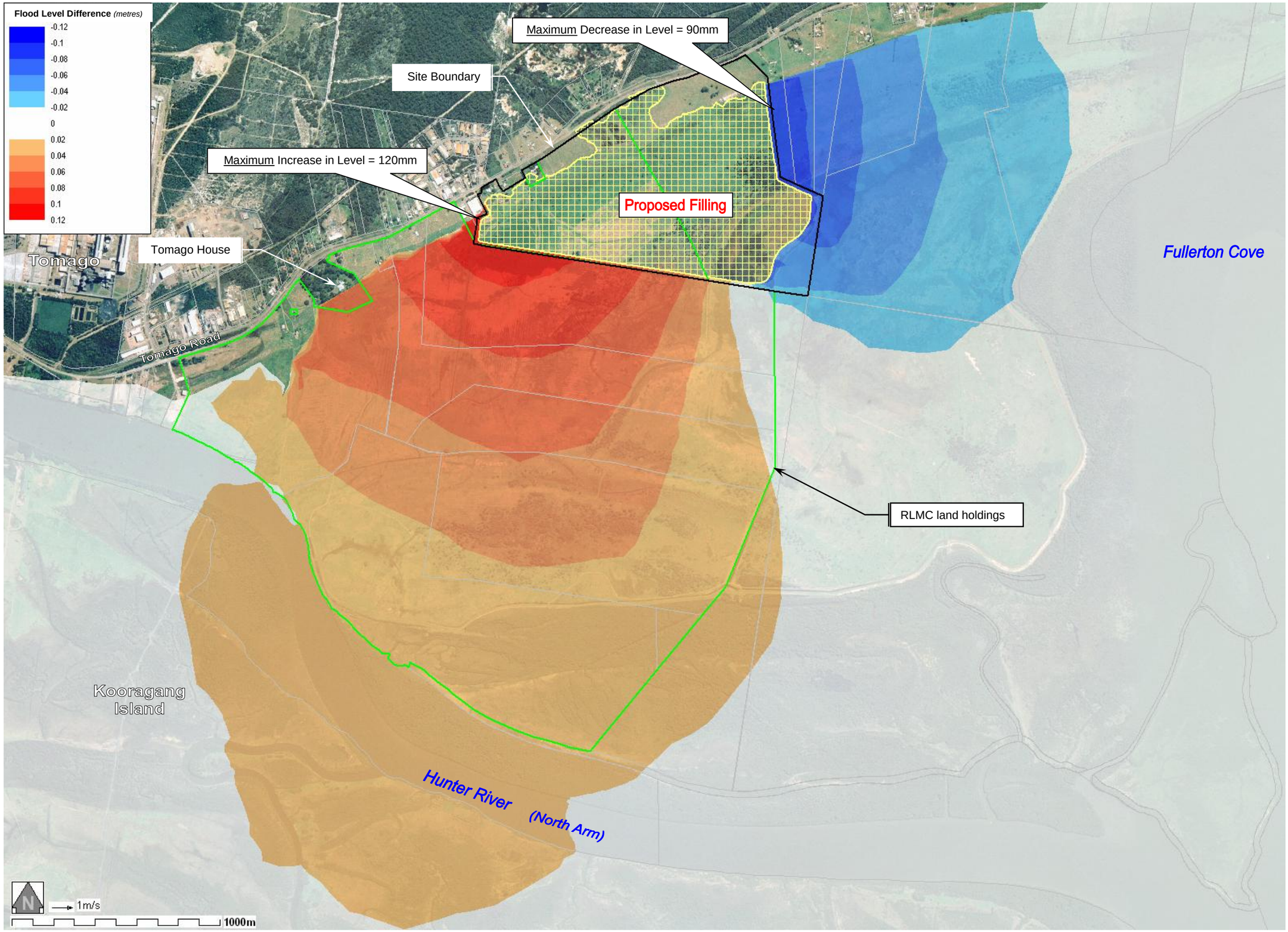
NOTES *Aerial photography dated 2005*

Cadastre dated 2001

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fig-Post Depths.doc

PREDICTED FLOODWATER DEPTHS AND VELOCITIES AT THE PEAK OF THE 100 YEAR RECURRENCE FLOOD FOR POST-DEVELOPMENT CONDITIONS



LEGEND

- Proposed fill extent
- Extent of RLMC land holdings

NOTES *Aerial photography dated 2005*

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Fig-Level difference.doc

PREDICTED CHANGE IN PEAK 100 YEAR RECURRENCE FLOOD LEVELS AFTER FILLING

The maximum increase in peak flood level is predicted to be about 120 mm and occurs near the western boundary of Lot 1 DP 1003492. The increase in peak level at this location is associated with the "build up" of floodwater against the western edge of the filling. This maximum increase is predicted to be contained within 15 metres of the site boundary. Although there is an increase, provision has been made along the western boundary for a flow path within the site so as not to 'impound' floodwaters behind the filling.

As shown in **Figure 7**, the increases in peak flood level are predicted to extend south and west of the development site. The majority of the land over which the larger flood level increases are predicted to occur is currently owned by the Regional Land Management Council (*RLMC*) (*refer green line shown on* **Figure 7**). Increases in peak flood level across this land range from 80 to 20 mm, typically decreasing with proximity to the river.

Increases in peak flood level are predicted to extend across some areas of land that are not owned by RLMC. For example, increases in the order of 70 mm are predicted across the southern third of the grounds of Tomago House. However, the majority of the grounds and Tomago House itself are at an elevation of 4 mAHD, which is about 1.5 metres above the predicted peak 100 year recurrence flood level.

Increases in peak level are also predicted to extend south from the RLMC lands and across the North Arm of the Hunter River to Kooragang Island. However, the predicted increase in peak flood level across this area is typically less than 20 mm.

Furthermore, it should be recognised that the majority of the areas where increases in peak flood level are predicted to occur are currently undeveloped. This includes environmentally sensitive low-lying wetlands where significant development is unlikely to be considered acceptable.

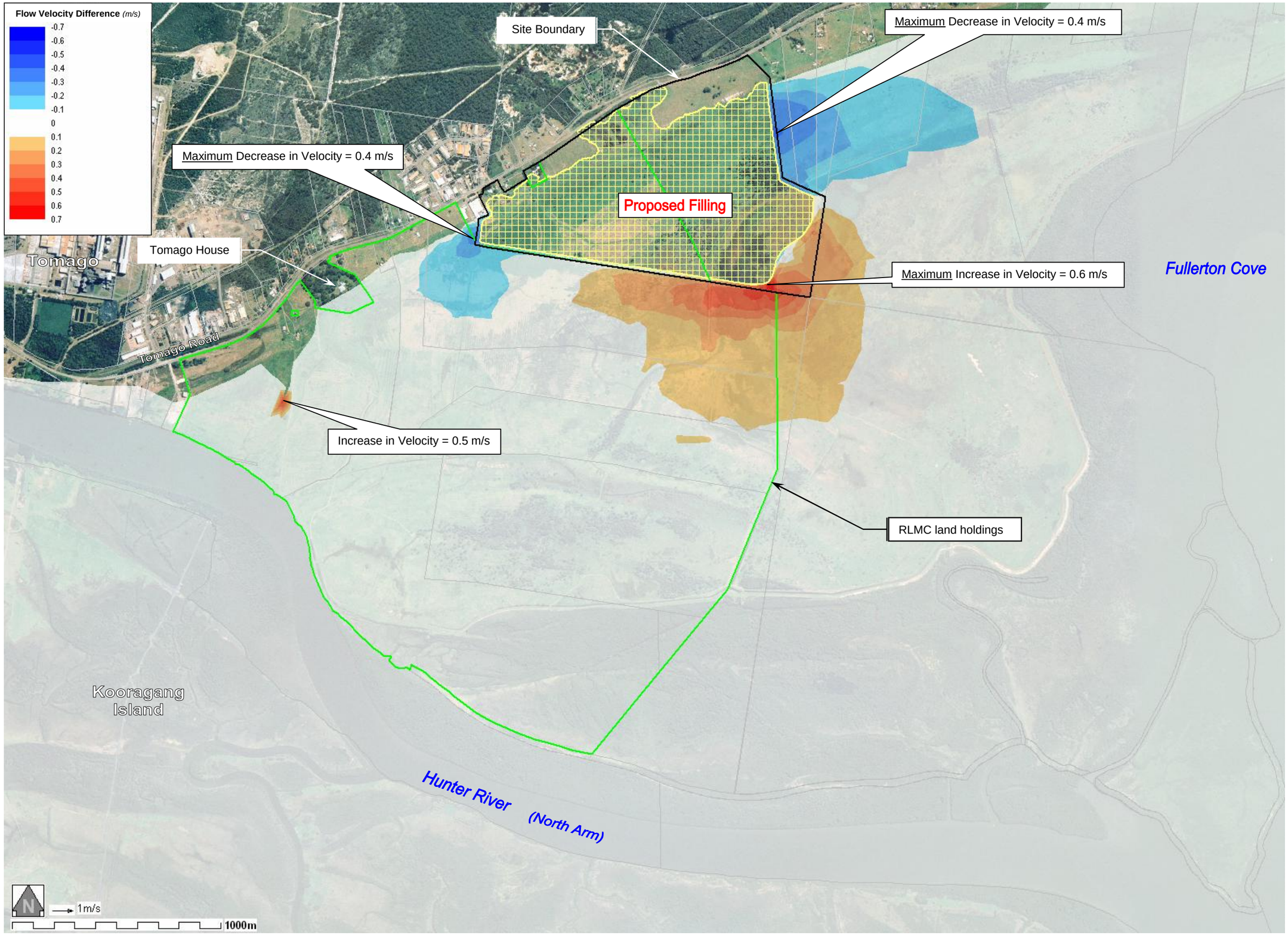
Figure 7 also shows that the proposed filling is predicted to reduce peak 100 year recurrence flood levels downstream of the site by up to 90 mm. The decreases in peak flood level are predicted to extend from the eastern edge of the development site to the western fringes of Fullerton Cove.

Impact on Peak Flow Velocity

A difference map was also created to quantify any changes in the peak flow velocity associated with the proposed filling. The velocity difference mapping that was developed for the 100 year recurrence flood is presented in **Figure 8**.

Figure 8 shows that the proposed filling is also predicted to cause changes in peak flow velocity during the 100 year recurrence event. The maximum increase in peak flow velocity is predicted to be about 0.6 m/s and occurs around the south-eastern corner of the filling and within Lot 161 DP 774440 (*refer* **Figure 8**).

In general, the increases in peak flow velocity are concentrated around the south-eastern corner of the fill platform. This section of the floodplain is currently undeveloped and includes a Ramsar Wetland that will likely remain undeveloped. In addition, increases in flow velocity of this magnitude are not predicted to damage existing vegetation across this wetland as the overall flow velocities are still relatively low; typically less than 1 m/s.



LEGEND

- Proposed fill extent
- Extent of RLMC land holdings

NOTES *Aerial photography dated 2005*

Cadastre dated 2001

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Fig-Velocity difference.doc

PREDICTED CHANGE IN PEAK 100 YEAR RECURRENCE FLOW VELOCITY AFTER FILLING

A small increase in peak flow velocity is also predicted in an area south-west of the site. This is associated with the increase in peak flood level at this location which allows floodwaters to discharge across a ridge that was previously predicted to remain "flood free". The increase in flood velocity at this location is contained to a small, localised area and is not predicted to extend across any existing development.

Figure 8 also shows that the proposed filling is predicted to reduce peak flow velocities immediately upstream and downstream of the site. A reduction in peak flow velocity of 0.4 m/s is predicted upstream of the site and is associated with the impediment to overland flow that will be created by the fill platform.

A reduction in peak flow velocity of about 0.4 m/s is also predicted downstream of the proposed filling. This is associated with the "sheltering" effect provided by the fill at this location.

Impact on Flood Hazard

As discussed, the proposed filling is predicted to produce increases in peak flood level (*and therefore depths*) as well as flow velocity. Accordingly, there is potential for the fill to increase the velocity-depth product and therefore, increase the provisional flood hazard classification of land located outside of the boundaries of the development site.

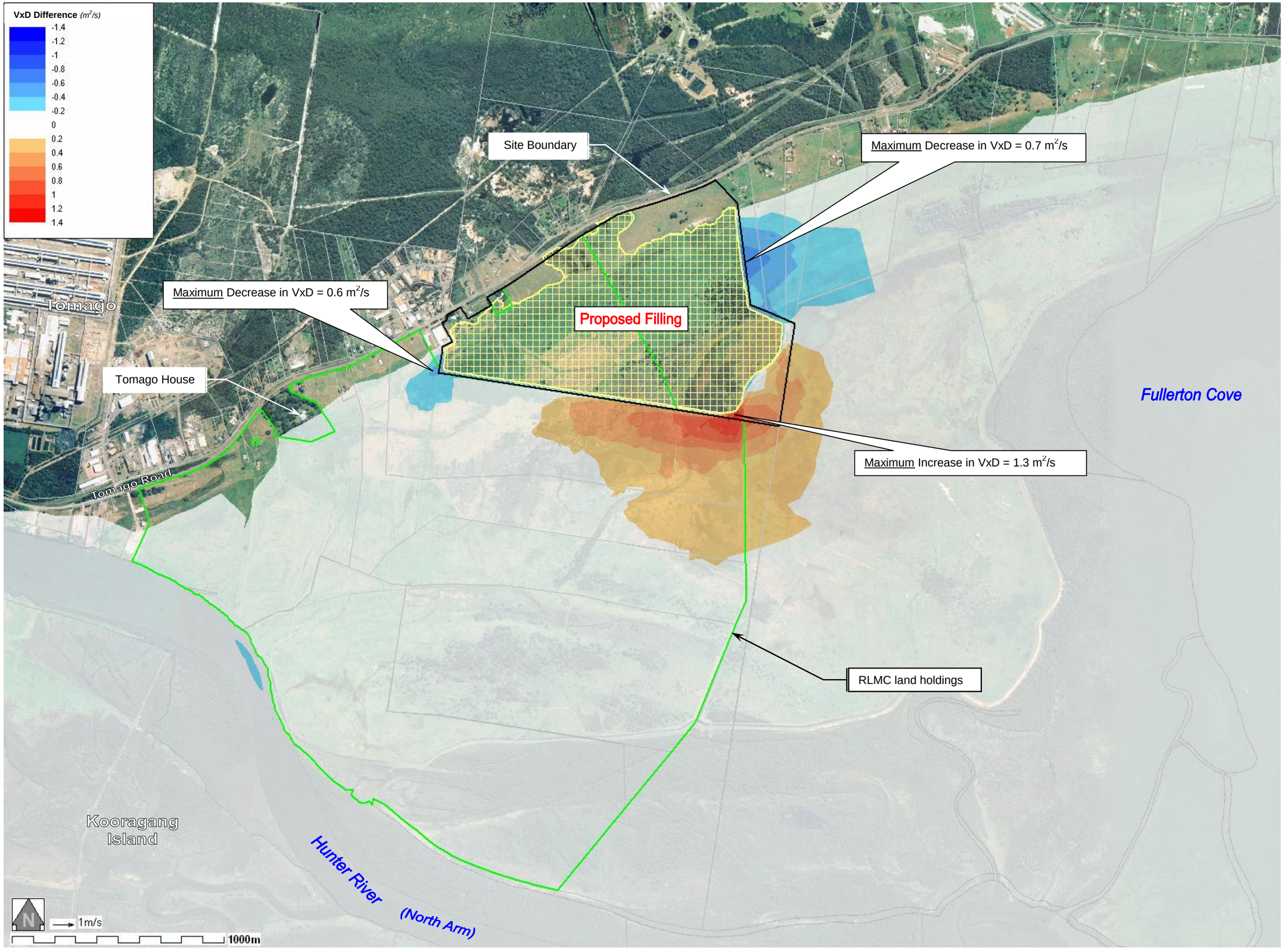
In recognition of this, velocity-depth product different mapping was developed to quantify any changes in peak velocity-depth product due to the proposed filling. The velocity-depth product difference map that was generated for the 100 year recurrence flood is presented in **Figure 9**.

As shown in **Figure 9**, the proposed filling is predicted to increase the velocity-depth product across the northern floodplain of the Hunter River. The maximum increase in velocity-depth product is predicted to be about 1.3 m^2/s. This maximum increase occurs around the south-eastern corner of the filling within Lot 161 DP 774440 and is fully contained within the development site (*refer* **Figure 9**).

Figure 9 also shows that the increases are predicted to extend outside of the site across undeveloped land located south from the site. As discussed, this land is unlikely to be developed in the future due to its environmental sensitivity and close proximity to the Hunter River.

More importantly, **Figure 9** shows that no increases in velocity-depth product are predicted across any adjoining development located upstream or downstream of the site. That is, the proposed development is not predicted to detrimentally impact on flood hazard across any existing development fronting Tomago Road.

FIGURE 9



LEGEND

- Proposed fill extent
- Extent of RLMC land holdings

NOTES *Aerial photography dated 2005*

Cadastre dated 2001

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& Partners Pty Ltd

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Fig-Velocity difference.doc

PREDICTED CHANGE IN PEAK 100 YEAR RECURRENCE VELOCITY DEPTH PRODUCT AFTER FILLING

5 CONCLUSIONS

Redlake Enterprises Pty Ltd plans to develop a 115 hectare parcel of land at Tomago for industrial purposes (*refer* **Figure 1**). It is proposed to undertake filling across the development site so that construction of buildings, car parking areas, roads and associated infrastructure can occur on a platform that is above the peak level of the 100 year recurrence flood. The extent of filling that is proposed is shown in **Figure 5**.

Investigations completed for this report have assessed the potential for development of the site to adversely impact on existing flood behaviour. The assessment has been based on the results of computer modelling undertaken using a two-dimensional hydrodynamic model of the Hunter River and its floodplain. The model has been used to assess flood behaviour for both existing and post-development conditions (*i.e., incorporating the proposed filling*), and the results have been compared to establish whether any change in peak flood level, flow velocity or velocity depth product can be expected at any location across the floodplain of the Hunter River.

Specifically, the following conclusions can be drawn from the results of the modelling:

- The peak 100 year recurrence flood level across the existing site is estimated to vary from 2.29 mAHD at the western boundary of the site to 2.14 mAHD at the eastern site boundary.
- The majority of the development site would currently be inundated during a design 100 year recurrence flood (*or a flood of similar magnitude to the 1955 Flood*). As shown in **Figure 3**, peak floodwater depths across the site would vary between 1 and 2 metres.
- Under existing conditions, peak flow velocities across the site are predicted to vary between 0.3 and 0.5 m/s during the design 100 year recurrence flood (*refer* **Figure 3**).
- The results of the modelling indicate that floodwaters will be relatively deep and slow moving at the peak of the 100 year recurrence flood. As a result, the site is likely to be considered a high hazard flood storage area.
- The fill proposal for the development is predicted to generate increases in peak flood level across the floodplain of the Hunter River (*refer* **Figure 7**). The increases are predicted to extend west and south of the site. The increases in peak level are predicted to extend as far south as Kooragang Island.

  The maximum increase in peak level is predicted to be about 120 mm and will occur immediately west of the proposed filling. Most of the land where flood level increases are predicted is owned by RLMC and adjoins the southern boundary of the site. Flood level increases across this area are predicted to range from 120 to 20 mm, with the flood level increases diminishing with increasing proximity to the Hunter River.

  Notably, increases in peak flood level in areas outside the RLMC land holding are less than 20 mm.

- The proposed filling is also predicted to generate some increases in peak flow velocity (*refer* **Figure 8**). However, the increases are predicted to be largely contained to an area near the south-eastern corner of the development site.

Some increases in peak flow velocity are predicted to extend south of the development site. However, this area generally comprises low lying wetlands and is currently undeveloped.

§ The fill proposal is also predicted to generate an increase in the velocity depth product and, therefore, the provisional flood hazard across the northern floodplain of the Hunter River (*refer* **Figure 9**). However, the increases are predicted to extend across areas that are currently undeveloped and which are unlikely to be developed due to environmental constraints. That is, the proposed filling is not predicted to increase the provisional flood hazard across any areas where residential or industrial development currently exists.

In summary, the proposed filling is predicted to generate increases in peak flood level, flow velocity and velocity-depth product (*i.e., hazard*) in areas immediately south and west of the development site. However, increase in peak flood level and flow velocity are restricted to areas of land that are currently undeveloped (*predominantly owned by RLMC*) or which could not be developed due to environmental constraints. Furthermore, the proposed filling is not predicted to increase the provisional flood hazard across land where residential or industrial development currently exists.

Therefore, it is considered that the potential flood impacts associated with the proposed development of the land are acceptable and will not manifest as significant adverse impacts on adjoining properties.

6 REFERENCES

(1) King, I (*2001*), *'RMA2 – A Two Dimensional Finite Element Model for Flow in Estuaries and Streams'*, developed by Resource Modelling Associates, Sydney, Australia.

(2) Newcastle City & Port Stephens Councils (*August, 1994*), *'Lower Hunter River Flood Study (Green Rocks to Newcastle)'*; PWD Report No. 91077 ISBN 07305 86472; prepared by Lawson & Treloar Pty Ltd.

(3) Newcastle City & Port Stephens Councils (*October, 1996*), *'Lower Hunter Valley Floodplain Management Study – Volume A: Assessment of Strategic Options for Community Consultation'*; prepared by Patterson Britton & Partners Pty Ltd.

(4) Newcastle City & Port Stephens Councils (*April, 1997*), *'Lower Hunter Valley Floodplain Management Study – Volume A: Assessment of Strategic Options for Community Consultation – Summary Report'*; prepared by Patterson Britton & Partners Pty Ltd.

(5) Newcastle City & Port Stephens Councils (*November 2001, in draft*), *'Lower Hunter Valley Floodplain Management Study – Volume B: Planning Implementation Strategy'*; prepared by Patterson Britton & Partners Pty Ltd.

(6) Newcastle City & Port Stephens Councils (*March 2003*), *'Lower Hunter Valley Floodplain Management Study – Volume B Report: Exhibition Results and Recommendations'*; prepared by Patterson Britton & Partners Pty Ltd.

(7) NSW Government (*2005*), *'Floodplain Development Manual: the Management of Flood Liable Land'*; ISBN 07313 0370 9.

(8) Redlake Enterprises Pty Ltd (*2006*), *'Due Diligence Assessment for Land at Tomago Road, Tomago – Flood Impact Assessment'*; prepared by Patterson Britton & Partners Pty Ltd.

(9) Port Stephens Council (*2000*), *'Port Stephens Local Environmental Plan'*.

Appendix L

VISUAL & LANDSCAPE REPORT

VISUAL IMPACT ASSESSMENT

for the

Westrac Facility - Tomago

prepared by:
Terras Landscape Architects

on behalf of:
Redlake Enterprises

Revision B - November 2007

© TERRAS LANDSCAPE ARCHITECTS -

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REFERENCES 18

PROJECT: **Westrac Facility**
LOCATION: **Tomago**
CLIENT: **Redlake Enterprises**
COUNCIL: **Port Stephens**
PROPOSAL: **Industrial Development**

1.0 INTRODUCTION

This document was commissioned by Redlake Enterprises. The VIA is for the industrial development with an associated training facility proposed on land along the southern side of Tomago Road. This VIA forms part of the project application documentation.

Fieldwork for this VIA was undertaken during November 2007.

1.1 Objectives

The objectives of this report are as follows:

- To identify and describe the existing visual environment and to evaluate its current qualities.
- To portray the proposal in contextual settings from selected viewpoints.
- To determine the likely impacts this development will have on the scenic quality of the area.
- To propose methods, as required, to reduce the scenic impact of the proposed development or methods to increase the existing scenic quality, where possible.

1.2 Terminology

- The *subject site (*referred to as *the site)* is defined as the land area directly affected by the proposal within defined boundaries;
- The *study area* consists of the subject site plus the immediate surrounding land potentially affected by the proposal during its construction and operation phase;
- The *study locality* is the area of land within the regional visual catchments whereby the proposal can be readily recognised. Generally this is confined to a six-kilometre radius beyond which individual buildings for a project this size are difficult to discern especially amongst other development where contrast is low. Further, visual sensitivity generally declines significantly beyond this distance due to the broad viewing range that can be had from vantage points.

  Figure 1.1 indicates the area defined as the site, the study area and the study locality for the purposes of this report.

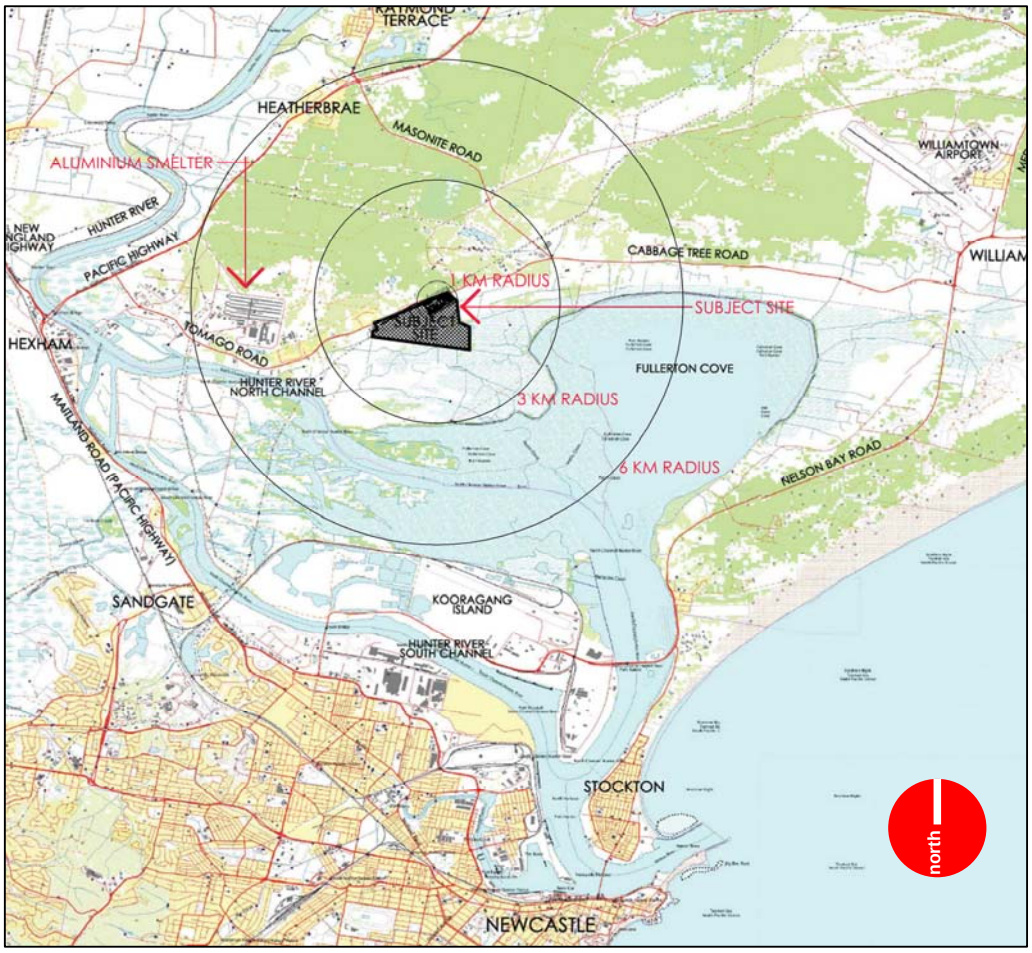


FIGURE 1.1 SITE LOCATION AND STUDY AREA

1.3 Visual Assessment Principles

An assessment of the visual impact of a proposed development involves consideration of the proposal in relation to three key issues:

- Visual or scenic quality,
- Visual sensitivity,
- Visual effect.

Visual or Scenic Quality

Visual quality of an area is determined by assessing how viewers may respond to designated scenery. Scenes of high visual quality are those that are valued by a community for the enjoyment and improved amenity that they can create. Conversely, scenes of low visual quality are of little scenic value to the community with a preference that they be changed and improved, often through the introduction of landscape treatments (e.g. screen planting).

As visual quality relates to aesthetics, its assessment is largely subjective. There is evidence to suggest that certain landscapes are continually preferred over others with preferences related to the presence or absence of certain elements.

The rating of visual quality of this study has been based on the following generally accepted conclusions arising from scientific research (DOP, 1988).

- Visual quality increases as relative relief and topographic ruggedness increases.
- Visual quality increases as vegetation pattern variations increase.
- Visual quality increases due to the presence of natural and/or agricultural landscapes.
- Visual quality increases owing to the presence of waterforms (without becoming common) and related to water quality and associated activity.
- Visual quality increases with increases in land use compatibility.

Appendix A contains a visual quality preference table that has a more detailed breakdown of the above elements and their impact on visual quality.

Visual Sensitivity

Another aspect affecting visual assessments is visual sensitivity. This is the estimate of the significance that a change will have on a landscape and to those viewing it. For example, a significant change that is not frequently seen may result in a low visual sensitivity although its impact on a landscape may be high. Visual sensitivity is assessed using a number of variables such as the number of people affected, viewer location including distance from the source, viewer position (i.e. inferior, neutral, superior), the surrounding land use and degree of change. Generally the following principles apply:

- Visual sensitivity decreases as the viewer distance increases.
- Visual sensitivity decreases as the viewing time decreases.
- Visual sensitivity is related to viewer activity (e.g. a person viewing an affected site whilst engaged in recreational activities will be more strongly affected by change than someone passing a scene in a car travelling to a desired destination).

The table below is a general guide to visual sensitivity based on the above criteria (EDAW, 2000); it generally describes general ratings, however, consideration must also be given to particular conditions that may modify the results for particular sites.

VISUAL SENSITIVITY TABLE			
	DISTANCE ZONES		
LAND USE	**Foreground (0-1km)**	**Middleground (1-6km)**	**Background (>6km)**
Residential: Rural or Urban	High Sensitivity	High Sensitivity	Moderate Sensitivity
Tourist or Passive Recreation	High Sensitivity	High Sensitivity	Moderate Sensitivity
Commercial/Retail Centre	Moderate Sensitivity	Low Sensitivity	Low Sensitivity
Major Travel Corridors	Moderate Sensitivity	Moderate Sensitivity	Low Sensitivity
Tourist Roads	High Sensitivity	Moderate Sensitivity	Low Sensitivity
Minor Roads	Moderate Sensitivity	Low Sensitivity	Low Sensitivity
Agricultural Areas	Moderate Sensitivity	Low Sensitivity	Low Sensitivity
Industrial Areas	Low Sensitivity	Low Sensitivity	Low Sensitivity

Visual Effect

Visual effect is the interaction between a proposal and the existing visual environment. It is often expressed as the level of visual contrast of a proposal against its setting or background in which it is viewed. This is a particularly important consideration when a development, such as the proposed Westrac development, is taller or of strong contrast to the surrounding structures and landcapes. Visual effect is rated as follows:

- **Low Visual** effect occurs when a proposal blends in with its existing viewed landscape due to a high level of integration of one or several of the following: form, shape, pattern, line, texture or colour. It can also result from the use of effective screening often using a combination of landform and landscaping.

- **Moderate Visual** effect results where a proposal noticeably contrasts with its viewed landscape, however, there exists some degree of integration (e.g. good siting principles employed, retention of significant existing vegetation, provision of screen landscaping, careful colour selection and/or appropriately scaled development.)

- **High Visual** effect results when a proposal presents itself with high Visual contrast to its viewed landscape with little or no integration and/or screening.

Visual Impact

The following table illustrates how visual effect and visual sensitivity levels combine to produce varying degrees of visual impact.

VISUAL IMPACTS TABLE				
		VISUAL EFFECT LEVELS		
VISUAL SENSITIVITY LEVELS		HIGH	MODERATE	LOW
	HIGH	High Impact	High Impact	Moderate Impact
	MODERATE	High Impact	Moderate Impact	Low Impact
	LOW	Moderate Impact	Low Impact	Low Impact

It should be noted that a high visual impact does not necessarily equate with a reduction in scenic quality, and the degree of visual impact has to be understood and assessed in relation to both the existing scenic quality of an area and the design merits of the proposal itself. For example, a well-designed proposal with a high visual impact may help to improve the visual environment of an area with low scenic quality.

1.4 Assessment Methodology

The methodology used in this report for assessing visual impact involves systematically evaluating the existing visual environment pertaining to the site and assessing the proposed development according the principles of visual assessment outlined above. Local planning documents relating to urban and landscape design were also consulted to provide a set of considerations with which to assess the visual impacts of the proposed development (Refer to Section 5.0 Viewpoint Analysis).

The assessment was undertaken in five stages as noted below:

I. A written description (with accompanying images) of the existing visual environment to provide an appreciation of the development's local context, including vegetation, topography and surrounding development.

II. A description of the proposal in relation to its height, scale, materials, roofline and landscape treatment.

III. A viewpoint analysis to identify locations where scenic quality is likely to be affected by the proposed development and to provide a visual indication of the development's impact on those views. Viewpoints were chosen that represent those locations where impacts will affect significant groups within the population (e.g. major traffic corridors, community gathering places, settlements etc.) as scenic features and significant viewing points in relation to the proposed development.

IV. An assessment of visual impacts.

V. The purpose of the above methodology is to reduce the amount of subjectivity entering into the impact assessment and to provide sufficient data to allow for third party verification of results.

2.0 EXISTING VISUAL ENVIRONMENT

2.1 Site Location, Zoning & Description (Refer Figure 1.1)

The subject site is located on the southern side of Tomago Road approximately 7km east of the Pacific Highway and approximately 10km west of Williamtown.

The site adjoins small rural allotments to the east, vacant land zoned Industrial to the west, south Tomago Road and bushland to the north and large residential lots to the northwest. The land is owned by Redlake Enterprises.

The subject land is approximately 24 hectares in size and has recently been rezoned to Industrial – under SEPP Major Projects. The site is generally flat with the exception of a central knoll upon which the trees are located. The land slopes gently away from the high point down to level ground. Areas located towards the southern boundary show signs of impeded drainage resulting in boggy conditions.

The site is cleared of native bushland and has been modified significantly with drainage lines excavated through the centre of the site. Existing vegetation consists of a small tract of native wetland species in the north-western corner and on southern boundary.

A group of exotic and native trees are located towards the western part of the site. A grouping consists of two *Ficus macrophylla* (Moreton Bay Figs) approximately 25m high, two *Ficus rubiginosa* (Port Jackson Figs) approximately 10 and15m metres tall and several stunted or dead conifer species. It would seem likely that these trees would have been associated with a former farm house that has subsequently been demolished. A heritage assessment has been undertaken and found that the site including the remnant trees does not have heritage significance.

The remainder of the site is covered in pasture grasses currently used for cattle grazing. Attempts to drain the land can be seen on the southern half of the site where open drainage channels have been formed conducting water south and away from the site.

2.2 Visual Environment of the Study Area

The site is located in a local visual catchment that is contained to the north by native vegetation and extends south to the Hunter River, east to Nelson Bay Road and west to the Pacific Highway.

The local visual catchment contains five broad land types; bushland to the north, pockets of residential, rural and industrial development to the west, residential and rural to the east and swampland associated with the Hunter River and Fullerton Cove to the south.

The bushland to the north encompasses the Tomago Sandbeds: a water resource of 100sq kilometres owned by The Hunter Water Corporation. The bushland is in a relatively healthy state due to restricted access into the sandbed area.

The residential, rural and industrial areas to the west are intermingled particularly on the northern side of Tomago Road. The residential blocks are generally of a large nature with houses built of varied materials with no common setback.

Industrial sites vary in size from small metal-clad workshop-style sheds to large-scale processing plants (e.g. Tomago Alumimium). A part from Tomago Aluminium and some of the more recent industrial development, the other industrial development is ill-conceived and presents badly in terms of visual quality to Tomago Road. These developments have a localised negative impact of the visual quality on the broader area. This impact is greatest for people travelling along Tomago Road.



FIGURE 2.1 LOOKING WEST INTO SITE ACROSS THE ROAD FROM THE NORTH-EASTERN BOUNDARY SHOWING A BROADSCALE RURAL LANDSCAPE.



FIGURE 2.2 LOOKING SOUTH-EAST INTO SITE ONCE AGAIN INDICATING A BROADSCALE RURAL LANDSCAPE.

2.3 Visual Assessment

The visual quality of the locality generally can be rated as moderate primarily due to the presence of a broad rural landscape, native vegetation with the occurrence of scattered, small scale development (not including Tomago Aluminium that is well screened from general view). Topographic variation is low with variations in land use and patterning moderate. Where clusters of industrial development occur west along Tomago Road, generally executed with little regard to aesthetics or landscaping, the visual quality drops to moderately low. To the east, houses tend to be located at varying intervals facing Tomago Road, which tend to separate the viewer from the more visually desirable rural landscape.

3.0 THE PROPOSAL

The proposal consists of an assembly plant, sales, storage and training facilities for heavy and other machinery. Buildings vary in height between 6 to 18 metres.

Generally the administration and institute buildings are two storeys high with architectural features rising above to accentuate their locations and to signify their position in the hierarchy of buildings;

- administrative centre
- Westrac Institute (associated training facility)
- assembly workshops
- outdoor display areas
- parts warehouse
- outdoor hardstand storage areas
- undercover storage areas
- cafeteria and staff change rooms
- service workshops
- car parks
- sewer plant

Proposed landscaping consists of;

- well-maintained, landscaped areas around the entry including the use of large scale trees and feature planting at the entry and along approach roads.
- screening to northern boundary east of the display area.
- attractive courtyard areas for visual relief and worker comfort.
- revegetation with indigenous species along north-eastern, eastern and southern boundaries.
- shade trees to car park areas
- internal screen plantings to break views across the site.
- timber acoustic fencing

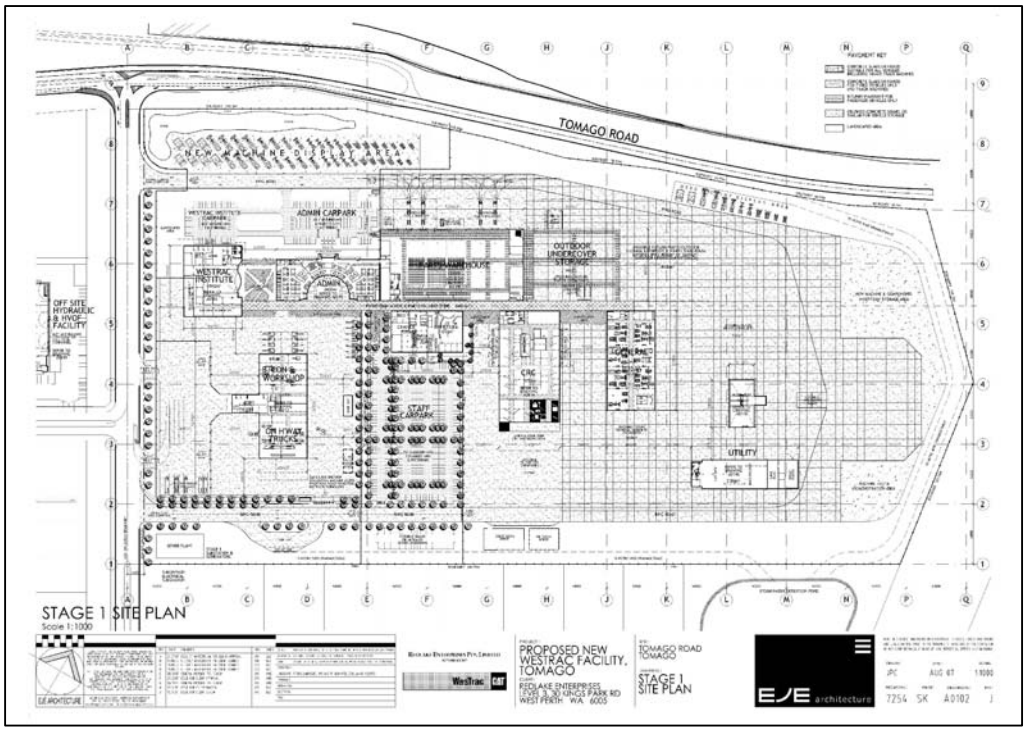


FIGURE 3.1 SITE LAYOUT. EJE ARCHITECTURE

The proposed development is the first to be initiated in the recently rezoned industrial area. Its construction will unavoidably produce a change to the area's landscape character bringing a shift from the rural landscape to a more highly developed industrial landscape.

The landscape treatment of the site is seen as important element of the development to ensure that it presents well to the community (including Westrac staff and customers) and especially users of Tomago Road who would make up the largest viewing group likely to be affected.

The landscape masterplan includes the installation of well-vegetated drainage swales that will assist in the recharging of groundwater as well as providing attractive screening.

The screening of large warehouse buildings and hardstand areas will be achieved with the use of large, indigenous Eucalypts and densely foliaged C*asuarina glauca* along north-eastern, eastern and southern boundaries.

4.0 VIEWPOINT ANALYSIS

This section of the VIA considers the likely impact that the proposed development may have on the local visual environment. This is done by selecting particular sites, referred to as viewpoints, conducting inspections and determining how the development will appear from these viewpoints. Many areas in the study locality were visited to gain an appreciation of views and sightlines back to the development.

4.1 Viewpoint Selection

Many viewpoints were considered when undertaking fieldwork for the VIA. The only significant public viewpoints, however, are located on Tomago Road travelling east or west of the site. All of the other possible viewpoints are highly localised and occur within a radius of 600m from either end of the site. Viewpoints were attempted to no avail further to the east and south along Masonite Road, Fullerton Cove Road and from the northern end of Ash Island. Viewpoints were attempted further to the west as far as Tomago House to no avail.

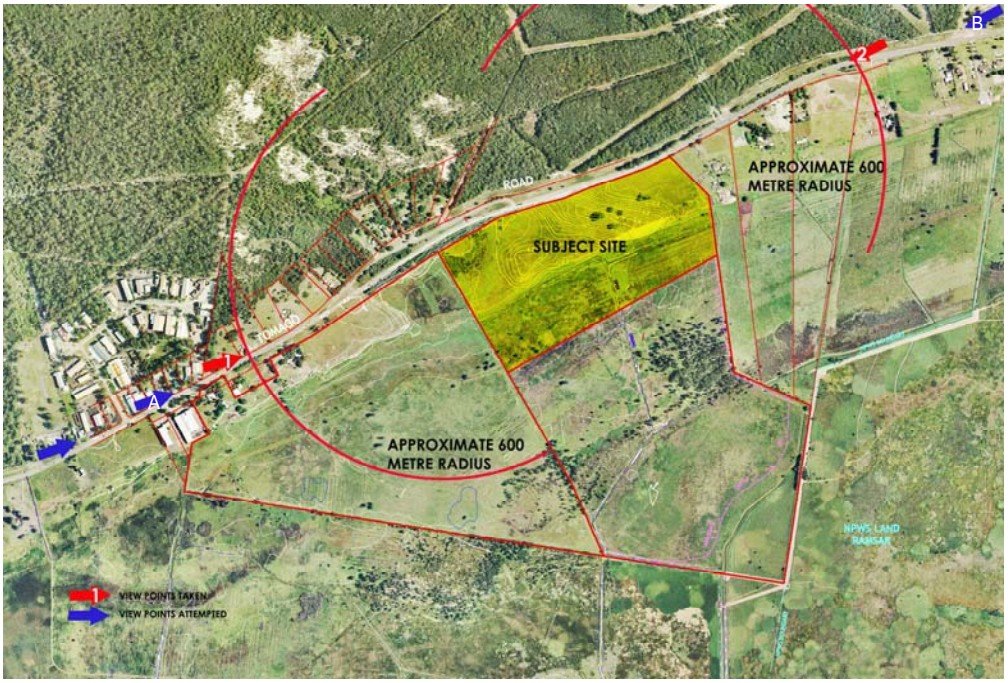


FIGURE 4.1 VIEWPOINT LOCATION

4.2 Viewpoint Data Sheets

The most relevant viewpoints are those close to the subject site which can be viewed by passing traffic. These points are located beside Tomago Road.

The data sheets include descriptive details and brief comments regarding likely impacts. A summary assessment of visual impact has also been included with five options. In some instances, two options have been ticked. This indicates that the rating of visual impact occurs between the two (e.g. ☑ **Low Impact** ☑ **Moderate Impact** equals ☑ **Low - Moderate Impact**).



Viewpoint Location:	Tomago Road				**Distance from Site:**	600m west	
Location of Site:	☐Foreground ☐ Middleground ☑ **Background**	**Viewer Position:**	☐ Inferior ☑ **Neutral** ☐ Superior		**Viewer Access:**	☐ V. Low ☐Low ☐Med. ☑**High**	
Description:	It is from this position travelling east along Tomago Road that the site first comes into view. Prior to this section of road the site is screened by pockets of vegetation and industrial development. Visual access to the site is considered high from this point on due to the bend in the road, the flat terrain and lack of vegetation to the left.						
Visual Sensitivity:	☐ Low ☑ **Mod.** ☐ High	**Visual Effect:**	☐ Low ☑ **Mod.** ☑ **High**	**Visual Impact:**	☑ **Low Impact** ☑ **Moderate Impact** ☐High Impact		
Comments:	The visual sensitivity of the site is moderate and the visual effect is moderate to high considering the contrast with the existing environment and the proposed development. While the site can be identified from this postion the impact rating is considered low to moderate for a number of reasons. Firstly existing industrial development is approximately 100 metres back to the west on both sides of the road. Secondly, this combination of industrial development, rural scenery and bushland continues to the west right back to the Pacific Highway. Finally, the proposal recommends planting of indigenous trees on the northern boundary once past the machinery display area. This will provide screening and integration with the bushland to the northern side of Tomago Road.						





Viewpoint Location:	Tomago Road			**Distance from Site:**	600m east
Location of Site:	☐Foreground ☐ Middleground ☑ **Background**	**Viewer Position:**	☐ Inferior ☑ **Neutral** ☐ Superior	**Viewer Access:**	☐ V. Low ☐Low ☑**Med**. ☐High
Description:	It is from this position travelling west along Tomago Road that the site first comes into view. Previous sections of road to the east are screened by vegetation and the natural topography. Visual access to the site is considered moderate from this point due to the bushland screening the western portion of the site.				
Visual Sensitivity:	☐ Low ☑ **Mod.** ☐ High	**Visual Effect:**	☐ Low ☑ **Mod.** ☑ **High**	**Visual Impact:**	☑ **Low Impact** ☑ **Moderate Impact** ☐High Impact
Comments:	The visual sensitivity of the location is moderate and the visual effect is moderate to high, due to this being the first glimpse of industrial development when travelling west along Tomago Road from Williamtown and its contrast to the preceding rural and bushland landscape. Visual impact is considered low to moderate due to partial screening from bushland, the proposed revegetation screening the northeastern perimeter of the site and the existance of industrial development further on to the west.				



FIGURE 4.2 ATTEMPTED VIEWPOINT A: LOCATION IN EXISTING INDUSTRIAL AREA.



FIGURE 4.3 ATTEMPTED VIEWPOINT B: LOCATION ON THE EASTERN APPROACH

5.0 IMPACT ASSESSMENT

Generally conclusions derived from the assessment of the existing visual environment (Section 2) reveal the site is located within an area of moderate scenic quality arising mainly from large areas of exposed and slightly undulating rural land. The presence of areas of bushland and other natural vegetation including swamp vegetation which persists to the Hunter River further enhances the locality's scenic quality. Small pockets of ill-considered industrial development to the west detract from the overall scenic quality of the area and have low to moderate scenic quality. The site's rural character will be altered to industrial which is in line with the land's zoning. The proposed vegetation however will contribute greatly to the scenic quality of the area.

Visual access to the site is surprisingly small despite much of the area being largely cleared for rural activities. The highest visual access is afforded to people using Tomago Road, although, once again, opportunities to view the site are relatively limited to a small section of the road. In addition, it is estimated that 10-15 dwellings also have some visual access to the subject site.

The most prominent views to the site were those identified from the western approach along Tomago Road. The ground is relatively flat and cleared of vegetation allowing for uninhibited views into the site. These views occur from approximately 600m back from the western boundary of the site. The use of landscaping to screen this view will be important to lessen any potential impacts.

The eastern approach is the most sensitive visually due to rural landscapes that stretch back to Nelson Bay Road. The site is well screened on this approach, by a combination of pockets of vegetation and bends in the road. Once again views can be had approximately 600m back from the site's eastern boundary, but are limited due to bushland on the northern side of Tomago Road screening the western portion of the site from view. The proposed screen planting located along the eastern boundary will lessen any potential impacts.

Integrating the proposed site into the surrounding landscape is a moderately sensitive issue. The site is located in a mix of rural and industrial surrounds, an industrial subdivision is located approximately 800m to the west and further again to the west are larger industrial developments which includes Tomago Aluminium. Development on the subject site will expand this existing commercial/industrial typology and will represent a shift in the landscape character of the area.

As noted above, the subject site will be visible from a number of private dwellings. These areas are located beyond the eastern and northern boundaries and require planning to minimise visual impact during and after construction. Two dwellings sited at the north eastern corner are within close proximity of the site. Dense stands of *Casuarina glauca* and taller *Eucalypt* species combined with a 3.5 metre tall timber acoustic fence behind, will screen out the development. In addition houses located across Tomago and Grahame Roads will have some visual access but the stands of *Casuarina and Eucalyptus* will screen views into the site. Consideration also needs to be given to the fact that the buildings have been designed by architects who have a regard for aesthetics and so the proposed development will not be a repeat of the other industrial developments that down grade their local visual environments.

6.0 CONCLUSION

This visual impact assessment has found that the proposal is in keeping with the permitted zoning that will result in a change to the visual character of the area.

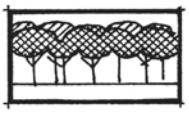
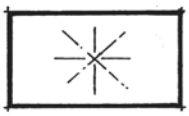
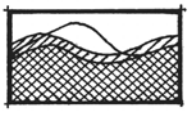
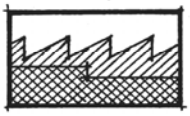
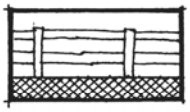
It is considered that the proposed landscape treatments will effectively screen the more visually sensitive parts of development whilst allowing desirable views into selected areas of the site that are important to providing visual identification for the site's operator.

The proposed scheme is an extension of and improvement to the existing industrial typology that lays to the west of the subject site. With the land directly to the west and south now zoned Industrial, it is inevitable that industrial development will occur. This industrial development is to be one of quality with architecturally designed buildings and an extensive associated landscape that will ameliorate concerns related to visual impact.

Therefore, refusal of this proposal based on visual considerations would not be warranted on this occasion having regard to the existing visual quality of the area being moderate and the low level of visual access. The proposed architectural treatment of the buildings and the accompanying landscaping should ensure that the site is appropriately treated to properly address the visual aspects of the development.

APPENDIX A: VISUAL QUALITY REFERENCE TABLE

APPENDIX A: VISUAL QUALITY REFERNCE TABLE[1]

	LOW	*MEDIUM*	*HIGH*
RELIEF/LANDFORM Diversity & Contrast 	Flat terrain dominant. Ridgelines not often seen.	Undulating terrain dominant. Little contrast or ruggedness. Ridgelines prominent in only half or less of landscape unit.	High hills in foreground and middleground. Presence of cliffs, rocks and other geological features. High relief (eg steep slopes rising from water or plain). Ridgelines prominent in most of landscape unit.
VEGETATION Diversity & Contrast 	One or two vegetation types present in foreground. Uniformity along skyline.	Patterning in only one or two areas. 3 or 4 vegetation types in foreground. Few emergent or feature trees.	High degree of patterning in vegetation. 4 or more distinct vegetation types. Emergent trees prominent and distinctive to region. Stands of specimen or accent vegetation (eg palms, pines etc.)
NATURALNESS 	Dominence of development within many parts of a landscape unit.	Some evidence of development but not dominant. Traditional built character. Development in background and/or partially concealed.	Absence of development or minimal dominance within landscape unit. Presence of parkland or other open space including beach, lakeside etc.
WATER Presence, Extent & Character 	Little or no view of water. Water in background without prominence. Presence of polluted water or stagnant water.	Moderate extent of water. Presence of calm water. No islands, channels meandering water. Intermittent streams, lakes, rivers etc.	Dominance of water in foreground and middleground. Presence of flowing water, turbulence and permanent water. Intricate shapes and river edges.
DEVELOPMENT Form & Identity 	Presence of commercial and industrial structures. Presence of large scale devlopment (eg mining, infrastructure etc.) Newer residential development prominent.	Presence of established residential development. Small scale industrial etc in middleground. Presence of sports and recreational facilities.	Presence of rural structures (eg farm buildings, fences etc.) Heritage buildings and other structures apparent. Isolated domestic scale structures.
CULTURAL 	No evidence present. Area free of cultural landmarks. Presence of new development.	Presence of established, well-landscaped development esp. in middleground and background.	Presence of established, maintained landscapes (eg farmlands, forests, gardens etc), old towns and buildings etc.

[1] After Clouston and Brouwer, 1995.

REFERENCES

Publications and Reports

EDAW (Australia) "Section 12, Visual Assessment", *The Mount Arthur North Coal Project: Environmental Impact Statement,* URS Australia Pty Ltd, prepared for Coal Operations Australia Limited, 2000.

Port Stephens Council *Local Environment Plan 2000.* Port Stephens Council December 2000

Maps

NSW Land and Property Information, 1977, Raymond Terrace Topographic Map

http://maps.google.com.au/maps?ll=-24.044223,131.79087&z=3&hl=en&t=h

LANDSCAPE DESIGN REPORT

for the

Westrac Facility
Tomago Road, Tomago

prepared by:
Terras Landscape Architects

on behalf of:
Redlake Enterprises

Revision A - November 2007

PROJECT: **Westrac Facility**
LOCATION: **Tomago Road, Tomago**
CLIENT: **Redlake Enterprises**
COUNCIL: **Port Stephens**
PROPOSAL: **Industrial Development**

1.0 The Site

The site is located on the southern side of Tomago Road, Tomago. Approximately halfway between the Pacific Highway to the west and Nelson Bay Road to the east. The site is currently utilised for cattle grazing.

The majority of the site is relatively flat, with the exception of a central knoll. Located on the knoll are four large figs and a couple of stunted and dead conifers. The rest of the site is covered in pasture grasses.

To the north of the site is across Tomago Road is bushland and the Tomago Sandbeds, a facility owned by Hunter Water. Also to the north are several residences.
Land to the south of the site is low laying swampy ground which runs all the way down to the northern bank of the Hunter River and Fullerton Cove. Land immediately to the south of the subject site is zoned 4a Industrial-general.
Two residences lay immediately to the east of the subject site. These are located on large rural blocks.
Land to the west is currently cleared grazing land much the same as the subject site, it is also zoned 4a Industrial-General.

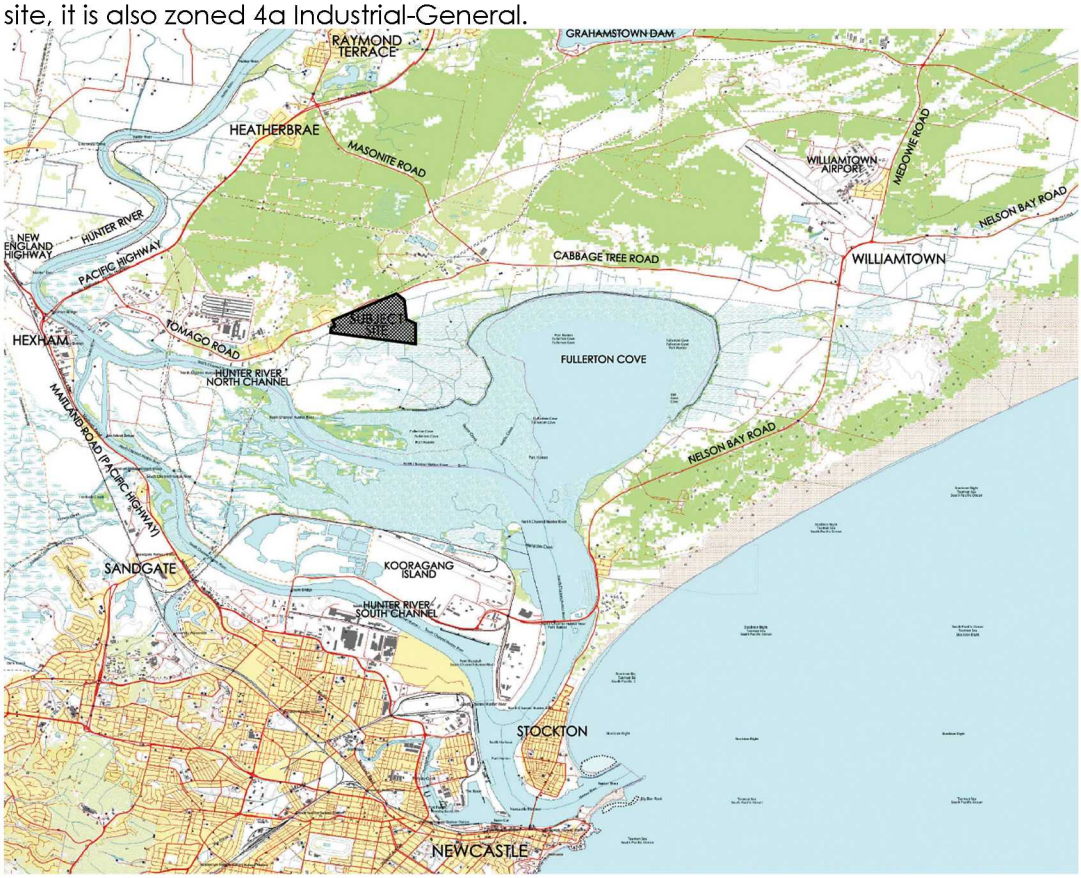


Fig 1. Site Location

2.0 The Soils

Soils on this site are made up of the Shoal Bay soil type. These are typically loose sandy soils with high permeability, low in fertility, strongly acidic with low water holding capacity.
It is proposed to import premium and general soil blends to maximise plant growth.

3.0 Vegetation

All of the natural vegetation from this site has been cleared. Existing vegetation is made up of pasture grasses with some native grasses in swampy areas such as *Gahnia sp.* As mentioned previously there are four figs two *Ficus Macrophylla* and two *Ficus Rubiginosa.* Although these trees are endemic to the area it is likely that they were planted to provide shelter for livestock.
The natural vegetation type that originally occurred on the subject site would have been the same as that located to the north of the site across Tomago Road. This is made up of *Eucalyptus pilularis* (Blackbutt), *Eucalyptus gummifera* (Red Bloodwood), *Angophora costata* (Smooth Barked Apple), *Melaleuca quinquenervia* (Paperbark) and understorey plants such as *Macrozamia communis* (Burrawang), *Acacia longifolia* (Golden Wattle), *Banksia serrata* (Old Man Banksia).
Revegetation with endemic species is proposed along the eastern and southern boundaries.

4.0 Existing Landscape Character

The landscape character consists is a mixture of natural bushland, rural residential, industrial and commercial landscapes. Land to the east is rural residential particularly on the southern side of Tomago Road. Land to the north is relatively uncleared with occasional residential buildings on large blocks. To the east are pockets of residential and industrial development, the largest of these being Tomago Aluminium Smelter.



Fig 2. Bushland to the north of the site across Tomago Road



Fig 3.Industrial development to the east of the subject site



Fig 4. Residential development to the east of the subject site.

5.0 Proposed Development

The proposed development is to be used as a Caterpillar Machinery Depot. This will include administration buildings, training facilities, spare parts storage, and equipment servicing buildings, outdoor machinery sales area, carparking and outdoor storage areas.

To supplement the proposed development, the primary objectives for landscaping shall be to

- Create a landscape buffer to the east and south of the site. This will be done using endemic plant species. Trees have been selected for their high and low canopies which will provide a dense vegetative screen between the development and neighbouring properties.

- Front entry, front carpark and landscaping around Administration and Westrac Institute buildings will be well manicured with large specimen trees formal avenues of tall Eucalypts, lawn areas and mass planted gardens.

- Staff carparks will be planted with a mixture of native evergreen trees and exotic deciduous trees to provide plentiful shade. Hedging plants along the perimeters will break views into surrounding areas of hardstand.

- Landscaping on the western boundary along the entry road will consist of an avenue of tall Eucalypts, screen planting along the fence line of *Casuarina glauca* and tall shrub species.

- A 3.5 metre acoustic fence made of timber will be constructed in the northeastern corner of the site to alleviate noise concerns.

- Attractive outdoor areas for staff and visitors that will be utilised for dining, relaxation and passive recreation.

With these landscape treatments in place it is felt that an attractive and functional landscape will be produced, a landscape that addresses screening issues while allowing for corporate identity, provides attractive outdoor areas for staff and visitors to enjoy, shading to carparks and enhances the proposed buildings

6.0 References

Matthei L.E, (1995). *Soil Landscapes of the Newcastle 1:100 000 Sheet* Report, Department of Land and Water Conservation, Sydney

Port Stephens Council *Port Stephens Development Control Plan,* 2007

Eucalyptus citriodora PROVIDE UPRIGHT HABIT WITH HIGH CANOPY WHICH WILL ALLOW FOR LARGE MACHINERY MOVEMENTS.

LOW MACROPHYTE PLANTING AND TURF AROUND EDGE OF DECORATIVE POND PROVIDES AN ATTRACTIVE ENTRY FEATURE WHILE ALLOWING FOR UNINHIBITED VIEWS TO DISPLAY AREA.

citriodora CONTINUES INTO SITE AND ALIGN TO FRAME BUILDINGS.

LARGE FEATURE TREES TO ENHANCE BUILDING ENTRY AND SCALE LANDSCAPE WITH THE PROPOSED DEVELOPMENT.

FRONT LANDSCAPE TO HAVE AN APPEALING MANICURED LOOK AND PROVIDE FOR A CORPORATE IDENTITY.

SCATTERED TREES IN TURF ALLOW PARTIAL VIEWING INTO SITE AND INTERFACE BETWEEN CLEAR AREA AROUND POND AND DENSELY SCREENED REVEGETATION ZONE.

LOW NATIVE GRASSES TO FORM ATTRACTIVE FOREGROUND PLANTING TO DISPLAY AREA.

10 METRE WIDE DRAINAGE SWALE TO HOLD SITE RUN OFF AND ALLOW FOR PERCOLATION BACK INTO GROUND WATER RESERVES.

- AVENUE PLANTINGS
- FEATURE TREES
- INFORMAL AND REGENERATIVE PLANTING
- REGENERATIVE PLANTING
- CAR PARK AND COURTYARDS
- AREA OF NATIVE REVEGETATION
- AMENITY PLANTING
- TURF AREAS
- 3.5M HIGH ACOUSTIC FENCE

3.5 METRE HIGH TIMBER ACOUSTIC FENCE. TIMBER TO BE LEFT TO AGE GREY AND BLEND WITH VEGETATION IN FOREGROUND.

TOMAGO ROAD

NEW MACHINE DISPLAY AREA

USED MACHINE DISPLAY AREA

BOUNDARY 190.04m

BOUNDARY 418.25m

BOUNDARY 94.75m

BOUNDARY 65.97m

BOUNDARY 66.3m

BOUNDARY 418.35m

BOUNDARY 133.74m

POND

FENCE

RING ROAD

GATED SECURITY POINT

WESTRAC CUSTOMER VEHICLE ENTRY/EXIT

LANDSCAPED AREA

UNDERCOVER PARTS DISPATCH

UNDERCOVER PARTS DELIVERIES

FIELD SERVICE VEHICLE PARKING

OIL & FUEL FARM

A-A L02

B-B L02

D-D L02

ENTRY

ADMIN

WESTRAC INSTITUTE
2840m²
REFER TO DRAWING A0112

SMALL COMPONENT WORKSHOPS

MACHINE WORKSHOPS

MAIN CUSTOMER ENTRY

ADMIN
2430m²

PARTS WAREHOUSE
7200m²
REFER TO DRAWING A0114

OUTDOOR UNDERCOVER STORAGE
4800m²
(POSSIBLE FUTURE PARTS EXPANSION)
REFER TO DRAWING A0115

(POSSIBLE FUTURE PARTS/OUTDOOR STORAGE EXPANSION IF PARTS WAREHOUSE EXPANDS INTO 4800m² OF CURRENT OUTDOOR UNDERCOVER STORAGE)
4500m²

NEW MACHINE & COMPONENTS INVENTORY STORAGE AREA

PEDESTRIAN ACCESS & PARTS DELIVERY SPINE 2400 m²

OFF SITE HYDRAULIC & HVOF FACILITY

REFER TO DRAWING A0119

CHANGE 1050m²
CAFETERIA 1050m²
REFER TO DRAWING A0113

B/CON & WORKSHOP
3870m²
REFER TO DRAWING A0111

ADMIN

ON H'WAY TRUCKS

WASH BAY

OUTDOOR UNDERCOVER STORAGE AREA

CRC
4750m²
REFER TO DRAWING A0116

GENERAL
3345m²
REFER TO DRAWING A0117

(POSSIBLE FUTURE NEW BUILDING SITE)
2400m²

WASH BAY
920m²
REFER TO DRAWING A0118

LOADING/ UNLOADING RAMPS

AWNING ROOF OVER CRC UNLOADING AREA

(POSSIBLE FUTURE GENERAL WORKSHOP EXPANSION)
1450m²

(POSSIBLE FUTURE CRC EXPANSION)
2470m²

UTILITY

ADMIN | FAB SHOP | MACHINE SHOP | SAND BLAST | SPRAY BOOTH
REFER TO DRAWING A0118
2180m²

MACHINE TEST & DEMONSTRATION AREA

283 STANDARD CARS
5 DISABLED CARS
8 MOTORBIKES

FUTURE TRUCK CHASSIS BYPASS

GATE USED ONLY FOR OCCASIONAL MACHINE ACCESS FROM RING ROAD TO WESTRAC INSTITUTE WORKSHOPS

GATE

TRAILER PARKING (10 VEHICLES)

WESTRAC STAFF VEHICLE ENTRY/EXIT

U-TURN LOOP

DROP OFF ZONE

POSSIBLE SEALED OR UNSEALED OVERFLOW PARKING

SEWER PLANT

SUBDIVISION ELECTRICAL SUBSTATION

SOLID WASTE DEPOT

OIL WASTE DEPOT

EXISTING SURVEY BOUNDARY

NEW SITE BOUNDARY

BOUNDARY 644.52m

STORMWATER DETENTION POND

DENSE PLANTING OF TREES AROUND EASTERN AND SOUTHERN BOUNDARIES WILL SCREEN DEVELOPMENT FROM EXISTING AND FUTURE NEIGHBOURING PROPERTIES. *Casuarina glauca* TO PROVIDE DENSE LOWER SCREEN. *Eucalyptus species* TO PROVIDE HIGH CANOPY SCREENING. NATIVE GRASSES AND SHRUBS TO PROVIDE UNDERSTOREY.

HEDGE AND TREE PLANTING WILL PROVIDE A VISUAL BREAK TO LARGE AREA OF HARDSTAND.

STAFF CARPARK PLANTED IN A MIXTURE OF EVERGREEN NATIVE AND EXOTIC DECIDUOUS TREES.

LANDSCAPE AREAS BETWEEN BUILDINGS PROVIDE OPPORTUNITY FOR OUTDOOR DINING AND RELAXATION AREAS.

DRAINAGE SWALE PLANTED WITH NATIVE TREES AND GRASSES.

DENSE SCREEN PLANTING OF *Casuarina glauca* ALONG FENCE LINE WILL SCREEN HARDSTAND AREAS FROM ENTRY ROAD.

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PROJECT: PROPOSED WESTRAC FACILITY

SITE: TOMAGO ROAD, TOMAGO

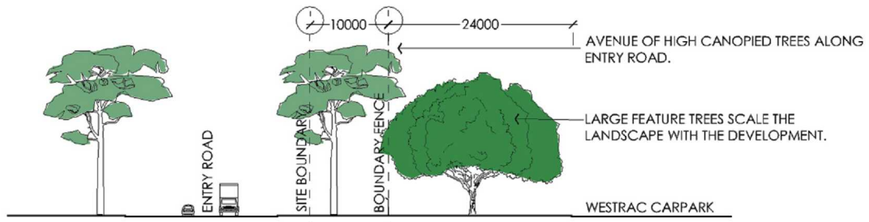
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DRAWING: LANDSCAPE PLAN

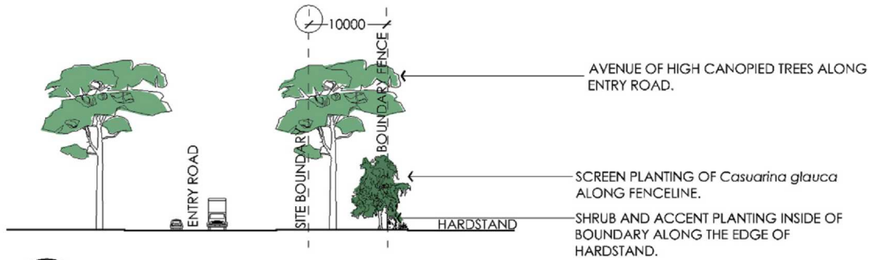
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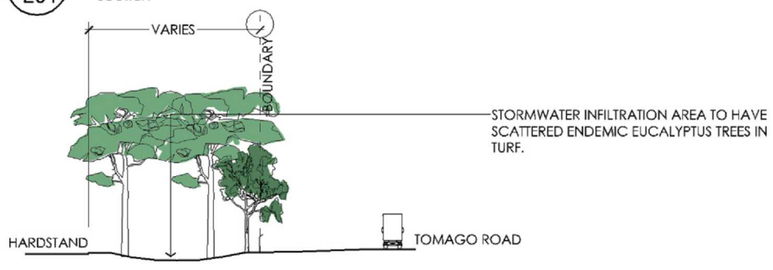
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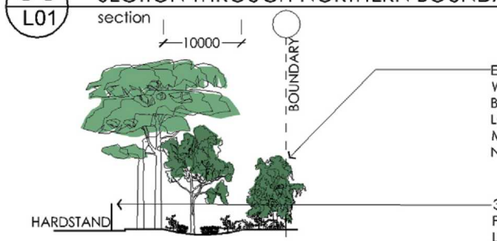
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B-B L01 SECTION THROUGH WESTERN BOUNDARY
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C-C L01 SECTION THROUGH NORTHERN BOUNDARY
section



D-D L01 SECTION THROUGH EASTERN BOUNDARY
section



F-F L01 SECTION THROUGH SOUTHERNBOUNDARY
section

PLANT SCHEDULE NO.1

ABV	BOTANICAL NAME	COMMON NAME	POT SIZE
	ENTRY & STREET TREES		
	Corymbia citriodora	Lemon Scented Gum	100 litre
	WESTRAC INSTITUTE AND ADMINISTRATION PLANTING		
	CARPARK, BUILDING FRONTAGE & COURTYARDS		
	TREES		
	Alphitonia excelsa	Red Ash	100 litre
	Angophora costata	Smooth Barked Apple	
	Banksia integrifolia	Coastal Banksia	45 litre
	Banksia serrata	Old Man Banksia	45 litre
	Corymbia citriodora	Lemon Scented Gum	100 litre
	Cupaniopsis anacardioides	Tuckeroo	100 litre
	Eucalyptus haemastoma	Scribbly Gum	100 litre
	Ficus rubiginosa	Port Jackson Fig	400 litre
	Ficus macrophylla	Moreton Bay Fig	400 litre
	Nyssa sylvatica	Tupelo	45 litre
	Oreocallis wickhamii	Tree Waratah	45 litre
	Pyrus calleryana 'Chanticleer'	Ornamental Pear	45 litre
	Toona ciliata	Australian Red Cedar	100 litre
	SHRUBS		
	Acacia cognata 'Limelight'	Bower Wattle	5 litre
	Acmena smithii cvs	Lilly Pilly cultivars	5 litre
	Callistemon 'White Anzac'	Bottlebrush	2.5 litre
	Gardenia augusta	Gardenia	2.5 litre
	Nerium oleander cvs	Dwarf Oleander	5 litre
	Philotheca myporoides	Wax Flower	2.5 litre
	Syzygium cvs	Lilly Pilly cultivars	5 litre
	PERENNIALS AND GROUND COVERS		
	Anigozanthos cvs	Kangaroo Paw cultivars	2.5 litre
	Asplenium australasicum	Birdsnest Fern	5 litre
	Cordyline stricta	Palm Lily	5 litre
	Crinum pendunculatum	Swamp Lily	5 litre
	Dianella cvs	Blue Flax Lilly cultivars	Viro-tube
	Doryanthe excelsa	Gymea Lily	5 litre
	Grevillea 'Poorinda Royal Mantle'	Prostrate Grevillea	2.5 litre
	Hibbertia scandens	Snake Vine	2.5 litre
	Liriope cvs	Lily Turf cultivars	2.5 litre
	Lomandra cvs	Matt Rush cultivars	Viro-tube
	Macrozamia communis	Burrawang	5 litre
	Trachelospermum asiaticum	Star Jasmine	2.5 litre
	STAFF CARPARK & DRAINAGE SWALE		
	TREES		
	Cupaniopsis anacardioides	Tuckeroo	100 litre
	Fraxinus 'Raywoodii'	Claret Ash	100 litre
	Melaleuca quinquenervia	Paperbark	45 litre
	Platanus digitalis	Plane Tree	100 litre
	Waterhousia floribunda	Weeping Lilly Pilly	100 litre
	PERENNIALS AND GROUNDCOVERS		
	Crinum pendunculatum	Swamp Lily	5 litre
	Dianella cvs	Blue Flax Lilly cultivars	Viro-tube
	Grevillea 'Poorinda Royal Mantle'	Prostrate Grevillea	2.5 litre
	Hibbertia scandens	Snake Vine	2.5 litre
	Isolepsis nodosa	Knobby Club Rush	Viro-tube
	Juncus usitatus	Common Rush	Viro-tube
	Liriope cvs	Lily Turf cultivars	2.5 litre
	Lomandra cvs	Matt Rush cultivars	Viro-tube
	Themeda australis	Kangaroo Grass	Viro-tube
	Trachelospermum asiaticum	Star Jasmine	2.5 litre
	BOUNDARY & SWALE PLANTING		
	TREES		
	Casuarina glauca	Swamp She-Oak	2.5 litre
	Eucalyptus gummifera	Red Bloodwood	2.5 litre
	Eucalyptus pilularis	Blackbutt	2.5 litre
	Melaleuca quinquenervia	Paperbark	2.5 litre
	SHRUBS		
	Acacia longifolia	Golden Wattle	Viro-tube
	Banksia robur	Swamp Banksia	
	Breynia oblongifolia	Coffee Bush	
	Dillwynia retorta	Bacon and Eggs	Viro-tube
	Leptospermum laevigatum	Coastal Tea Tree	
	Melaleuca ericifolia	Swamp Paper Bark	
	Pimelea linifolia	Rice Flower	
	PERENNIALS AND GROUNDCOVERS		
	Dianella cvs	Blue Flax Lilly cultivars	Viro-tube
	Dryarna fluvius	Dryarna	Rolls
	Gahnia aspera	Rough Saw Sedge	Viro-tube
	Hardenbergia violaceae	Natibve Sarsparilla	Viro-tube
	Isolepsis nodosa	Knobby Club Rush	Viro-tube
	Juncus usitatus	Common Rush	Viro-tube
	Lomandra cvs	Matt Rush cultivars	Viro-tube
	Themeda australis	Kangaroo Grass	Viro-tube
	POND MACROPHYTE PLANTING		
	Baumea articulata	Twig Rush	
	Isolepsis nodosa	Knobby Club Rush	Viro-tube
	Juncus usitatus	Common Rush	Viro-tube
	Lomandra cvs	Matt Rush cultivars	Viro-tube

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PROJECT: PROPOSED WESTRAC FACILITY
SITE: TOMAGO ROAD, TOMAGO
CLIENT: REDLAKE ENTERPRISES
DRAWING: SECTIONS & PLANT SCHEDULE

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Appendix M

GEOTECHNICAL REPORTS

REDLAKE ENTERPRISES PTY LTD

C/- ASQUITH & DEWITT PTY LTD

PROPOSED INDUSTRIAL DEVELOPMENT

197-325 TOMAGO ROAD, TOMAGO, NSW

PRELIMINARY GEOTECHNICAL / DUE DILIGENCE ASSESSMENT

N09814/01-AD

29 August 2006

N09814/01-AD DMR
29 August 2006

Redlake Enterprises Pty Ltd
C/- Asquith & deWitt Pty Ltd
6 Canberra Street
CHARLESTOWN NSW 2290

Attention: Craig Marler

Dear Sir

RE: PROPOSED INDUSTRIAL DEVELOPMENT
197-325 TOMAGO ROAD, TOMAGO, NSW
PRELIMINARY GEOTECHNICAL / DUE DILIGENCE ASSESSMENT

As requested, Coffey Geosciences Pty Ltd (Coffey) has conducted an appraisal of the geotechnical conditions at the proposed industrial development site at Tomago, in the form of a preliminary geotechnical assessment. The findings of the assessment are summarised in the enclosed report, which also discusses the engineering implications of the site conditions identified, and provides possible engineering solutions to the potential risks and associated geotechnical constraints on development.

The report is aimed at a feasibility level, for the purposes of a pre-purchase due diligence assessment, and the conclusions and recommendations contained within this report should be regarded as preliminary only. Further geotechnical investigations will be required for detailed design of the structures forming the development, in addition to detailed settlement and stability analyses for fill embankments.

Further discussion on the uses and limitations of this report are presented in the attached sheet '*Important Information about your Coffey Report*'.

If you have any questions regarding this report, or should you require further assistance on this project, please do not hesitate to contact the undersigned.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD



ARTHUR LOVE

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N09814/01-AD
29 August 2006

EXECUTIVE SUMMARY

Coffey Geosciences Pty Ltd (Coffey) has conducted an appraisal of geotechnical conditions at the site of a proposed large-scale industrial development, which is situated on the low lying Hunter River flood plain at Tomago, NSW.

The geotechnical report is based on limited geotechnical information from past investigations on part of the subject site and immediate surrounding area, and additional limited investigations undertaken during the current assessment. The scope of work for the current assessment was aimed at increasing our understanding of the geotechnical model by supplementing existing data and filling in gaps in existing information, to identify potential geotechnical constraints and issues associated with development of the site. The geotechnical information obtained has been compiled into a preliminary geotechnical model, as outlined below.

The subject of this assessment, herein referred to as the 'site', occupies a plan area of approximately 115 hectares on the southern side of Tomago Road, and is bounded by a Ramsar Wetland and Fullerton Cove, an estuary of the Hunter River, to the east and south east. The site is underlain by stratigraphic sequences comprising soft alluvial and estuarine sediments and alluvial sands of variable density, overlying deep Pleistocene clay deposits, in turn overlying an irregular bedrock surface. These profiles are typical of the Alluvial / Estuarine environment in which the site is situated, and subsurface profiles can vary dramatically over short horizontal distances.

The report is aimed at a feasibility level, for the purposes of a pre-purchase due diligence assessment, and the conclusions and recommendations contained within this report should be regarded as preliminary only. The objective of the report was to draw attention to the site conditions, potential risks and associated issues and geotechnical constraints on development, and to provide possible solutions to those constraints. Further geotechnical investigations will be required for detailed design of the structures forming the development, in addition to detailed settlement and stability analyses for fill embankments.

The enclosed geotechnical report identifies possible geotechnical hazards associated with the proposed industrial development in the format of a Geotechnical Hazard Register. Guidance is given as to how this register could be developed into a Risk Register by the stakeholders of the development in consultation with Geotechnical Engineers. Some suggested geotechnical solutions are also presented which could be used to reduce the level of geotechnical risk.

Based on the information obtained during the desk top study, the following potential hazards have been identified that may affect the feasibility of the proposed development:

- Presence of soft ground and suitable founding conditions;
- Sources of available fill material;
- Magnitudes and rates of expected total and potential differential settlements;
- Embankment foundation strength and likely impacts on batters and slope stability;
- Potential disturbance of acid sulfate soils or contaminated soil.

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1. INTRODUCTION

This report presents the results of a preliminary geotechnical investigation and appraisal of geotechnical conditions carried out by Coffey Geosciences Pty Ltd (Coffey) for the proposed development of a large parcel of land located at 197-325 Tomago Road, Tomago, NSW.

The subject of this assessment, herein referred to as the 'site', comprises Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256, encompassing an irregularly shaped plan area of approximately 115 hectares. The approximate location and boundary of the site is shown on Figures 1 and 2.

The report was commissioned by Craig Marler of Asquith & deWitt Pty Ltd on 22 December 2005, on behalf of Redlake Enterprises Pty Ltd (Redlake). Redlake intend to purchase and develop the above mentioned parcel of land for industrial purposes.

We understand that Asquith & deWitt Pty Ltd have been engaged by Redlake to complete a due diligence assessment to determine the suitability of the land for its intended purpose. The objective of this preliminary geotechnical assessment is to draw the purchasers attention to the geotechnical aspects of the site conditions encountered, identify associated constraints and / or risks associated with development of the site and provide possible solutions to those constraints.

The assessment collates available geotechnical site information, summarises the conditions encountered during previous and current investigations across the site and immediate surrounding area, and provides an appraisal of the likely implications of such conditions on the proposed development. The detail of the available geotechnical information is not considered sufficient for detailed design, and is aimed only at providing preliminary advice on the suitability of the land for its intended purpose, to assist the project team in future decision making processes.

Based on the information obtained during the assessment, the following potential hazards have been identified that may affect the feasibility of the proposed development:

- Presence of soft ground and suitable founding conditions;
- Sources of available fill material;
- Magnitudes and rates of expected total and potential differential settlements;
- Embankment foundation strength and likely impacts on batters and slope stability;
- Potential disturbance of acid sulfate soils or contaminated soil.

The enclosed report provides recommendations and preliminary advice on the likely requirements for pre-loading / surcharging / ground improvement of the site to reduce these risks prior to construction. Preliminary settlement and stability analyses have been conducted to assess the likely impacts of the encountered geotechnical conditions on the critical elements of the proposed development. Preliminary design heights for preload embankments and anticipated post construction settlements have also been provided based on the limited available data.

The work has been conducted in general accordance with Coffey proposal N09814/01-AB dated 12 December 2005 and revised proposal N09814/01-AC dated 16 December 2005, in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than Redlake Enterprises Pty Ltd and their respective consultants. This report may not contain sufficient information for the purposes of other parties or for other uses. Further specific geotechnical investigations will be required for each of the detailed design phases of the proposed development.

2. BRIEF DESCRIPTION OF PROPOSED DEVELOPMENT

Redlake Enterprises Pty Ltd (Redlake) intend to purchase and develop a large parcel of land on the southern side of Tomago Road at Tomago, NSW, for purposes of an industrial nature. The area proposed for development encompasses approximately 115 hectares in a low-lying alluvial plain and swamp environment. On the basis of our understanding of the project, the proposed development will be divided into three stages, as outlined below.

Development of Stage 1 (Westrac and CAT Institute) will include the following:

- Administration and machinery sales;
- Assembly, storage, maintenance and repair of heavy earthmoving equipment;
- Workshops, warehousing and distribution of parts;
- Apprentice Training.

Development of Stage 2 (Proposed Caterpillar Parts & Distribution Centre) will include the following:

- Ancillary office and administration;
- Two 50,000m^2 parts warehouses;
- Earthmoving machinery operator training and equipment demonstration area.

The proposed development layout for Stages 1 and 2 is illustrated on Figure 3. We understand that development of Stage 3 is intended for related, but presently unspecified, purposes of a light industrial nature in the form of an Industrial Business Park.

The majority of the site presently lies below the 1 in 100 year flood level, with surface elevations typically below RL 0.5.m AHD. Site levels will be therefore need to be raised to a safe level above the estimated 1 in 100 year flood level (to be determined by others). At the time of writing this report, it is understood that the proposed development will have a finished surface elevation of approximately RL 3.4m AHD, which will require substantial filling in the order of about 2.5 to 3 million cubic metres across the entire site.

3. AVAILABLE GEOTECHNICAL INFORMATION

3.1 References and Previous Reports

The following information was supplied by Asquith & deWitt Pty Ltd:

- Plans showing the general site locality, approximate site boundaries and indicative layout of the proposed development;
- Plan indicating existing site contours, superimposed over a colour aerial photograph of the subject site (1: 8000 scale);
- Compact disc containing powerpoint presentation on proposed stages of development.

Coffey has extensive information on conditions in the immediate surrounding area from work undertaken by Soil and Rock Engineering Pty Ltd in 2001, including deep boreholes to rock, friction probes and piezocones. Data from the following reports has been referred to and / or incorporated into the current assessment:

- Soil & Rock Engineering Pty Ltd Report, '*Preliminary Geotechnical Investigation – Proposed Steel Mill and Port Development – Tomago, NSW, Australia*', 20 July 2001 (Ref: dcb5264_1_01rep.doc);
- Soil & Rock Engineering Pty Ltd Report, '*Stage 2 Geotechnical Investigation – Proposed Steel Mill – Tomago, NSW, Australia'*, 28 December 2001 (Ref: dcb5264_3_01rep.doc).

The following reports and papers have also been referred to for the current assessment:

- Coffey Partners International Pty Ltd, Sinclair Knight Merz and Ansto, '*Report No.1 – Data Review and Assessment of Hydrogeological and Hydrochemical Impacts of Heavy Mineral Mining on the Tomago Sandbeds, Newcastle, NSW*', 22 February 1996 (Ref: G419/3-BP);
- Summerell, S.J. and McNally, G.H. (1998), '*Engineering and Quaternary Geology of a Lightweight Fill Site at Lenaghans Swamp, Near Minmi NSW*', published by the Australian Geomechanics Society in 'Geotechnical Engineering in the Hunter Valley', 11-13 July 1998 Conference Proceedings, University of Newcastle (pp.98-107).

3.2 Data from Previous Investigations

In 2001, Soil and Rock Engineering Pty Ltd carried out preliminary and detailed geotechnical investigations for the proposed steel mill and port development to be located on a large parcel of land that bounds the southern margin of the subject site for the current investigation.

During the preliminary investigation conducted in early 2001, limited subsurface investigations including nine electric friction cone penetrometer (CPT) tests and four test pits were carried out on Lot 161 DP 774440, encompassing an area 64.25 hectares within the 115 hectare site currently being assessed by Coffey.

The CPT data obtained during the previous investigation on Lot 161 has been included in the preliminary geotechnical model and analyses contained in this report. Additional geotechnical information obtained from the neighbouring Austeel land, not within the current site, has also been compiled into the geotechnical model where it was deemed to provide useful information. CPT logs from previous investigations that have been included in this assessment are presented in Appendix C and are summarised in Section 7.

4. SITE DESCRIPTION

4.1 Site Location, Identification and Geographic Setting

The site comprises an area of approximately 115 hectares located on the southern side of Tomago Road, Tomago, and comprises Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256.

The terrain of the study area includes large sections of the Hunter River floodplain and also incorporates the Tomago Sandbeds along the northern boundary. The predominant current land use is understood to be grazing land in the low lying floodplain areas, with some residential dwellings along Tomago Road.

The site is bounded to the north by Tomago Road, to the south by low lying swamp adjoining the north arm of the Hunter River, and to the east by the Kooragang Nature Reserve. The majority of the site encompasses a relatively flat low lying alluvial plain, with surface elevations typically less than RL 1.0m AHD. A small portion of the property adjacent to Tomago Road is higher in elevation than the remainder of the site, which represents the remnants of a Pleistocene dunal formation. The elevated area is approximately 100m to 200m wide (from west to east) and is roughly parallel with the northern boundary of the site. In this area, ground surface elevations are typically RL 1m to 2m AHD within the north western portion of Lot 1 DP 1003492, rising to approximately RL 2.5m to 8.5m AHD in the northern portion of Lot 161 DP 774440.

The site will require substantial filling as most of it lies below the 1:100 year flood level. The site is bisected by numerous open drainage channels typically running in a southwest to northeast orientation. There are also two open drains on Lot 161 that run in a north northeast to south southwest orientation, with lengths of approximately 500m and 900m, draining into the wetland area to the south of the site. The drainage channels are typically 1.5m to 3m wide, and are obscured by reeds. It is estimated that the drains are in excess of 1m deep.

At the time of the previous and current field investigations, shallow groundwater, the presence of channels bisecting the site and poor drainage / waterlogging of the surface soils made the majority of the site wet and boggy, with very poor trafficability. A 16 tonne excavator was required to tow both the truck mounted cone rig and drilling rig around the site. In some areas, the cone rig became bogged up to its axles in the very soft Unit 1A surface soils (estuarine clays / peat). Trafficability on foot was also limited in some areas, with evidence that cattle presently grazing on the site have sunk up to about 0.3m depth in the very soft surface soils, typically encountered adjacent to the drainage channels and in the central portion of Lot 1 DP 1003492.

Vegetation across the majority of the site typically comprised thick grass cover and reeds, up to about 1.5m in height, with some scattered stands of mature trees. An area of dense trees is located in the central portion of Lot 161 DP 774440, as indicated on Figure 2. The south eastern corner of Lot 161, on the south eastern side of the large open drainage channel which runs in a northeast to south west orientation between CPT-10 and CPT-11, was vegetated with long swamp grass and reeds, and could not be accessed for this assessment. Reference to the 1: 25,000 scale Williamtown Topographic and Orthophoto Map 9232-2N (2001) indicates that this low lying area is subject to inundation, and borders the Kooragang Nature Reserve. CPT testing was previously undertaken in this portion of the site in 2001 using portable equipment, with some areas under approximately 100mm to 200mm of water.

4.2 Surrounding Land Use

At the time of the current assessment (January 2006), the surrounding landuse comprised:

- Kooragang Nature Reserve (including Ramsar and SEPP 14 wetlands) immediately to the south west, south and south east. Fullerton Cove is located approximately 1km to 1.5km to the east and south east, and the North Channel of the Hunter River approximately 2.5km to the south and 1.6km to the south west;
- Agricultural/residential properties to the north east and west and residential properties to the north;
- Commercial/industrial properties immediately west of the north western portion of Lot 1 DP 1003492 as well as to the north west across Tomago Road;
- The Tomago Aluminium Smelter is located approximately 1.6km to the west of the site;
- The Tomago Sand Beds water supply works is located approximately 500m to the north of the site and the Grahamstown Water Treatment Works are located approximately 1km to the north of the site.

4.3 Local Geology and Hydrogeology

The topography generally comprises a broad, flat alluvial flood plain, with the elevation of the ground surface over the majority of the study area typically lower than RL 1.0m AHD. A small sand ridge occupies the northern margin of Lot 161 DP 774440, adjacent to Tomago Road, with a maximum elevation of approximately RL 8.5m AHD.

The site is located in the Quaternary aged alluvial and fluvial deposits associated with the meandering river valley of the Hunter River, defined by the geology maps as Quaternary Alluvium. As such, the site is underlain by sedimentary deposits comprising mixtures of sands, silts, clays and gravels.

Soil conditions can vary considerably over relatively short distances in a meandering river valley setting. Coffey's experience in the alluvium within the Hexham, Tomago and Raymond Terrace area is that lenses of barrier sand and channel deposits that exist within the profile are erratically distributed, and both vertically and laterally discontinuous.

Broadly, units within the Quaternary Alluvium comprise (from oldest to youngest) Pleistocene clay, Pleistocene barrier sands, Holocene estuarine clay and recent floodplain deposits. Beneath these sediments, the bedrock comprises interbedded sandstone, siltstone, mudstone and coal of the Permian aged Tomago Coal Measures.

The Pleistocene clay is typically stiff to hard, and forms the basal surface for the younger deposits. The depth to the Pleistocene clay may be typically of the order of 10m to 15m, but can be as deep as 30m to 50m within paleochannels. The Pleistocene barrier sands are typically quartz sands, ranging from 5m to 35m in thickness. Within the sand deposits are cemented 'Coffee Rock' deposits. The Holocene clay and recent floodplain deposits are typically soft to very soft. Deep deposits of the Holocene clay are founded within the paleochannels cut through the Pleistocene clay.

Data from the weather station at Williamtown RAAF base indicates that the site would have an average annual rainfall of 1087.6mm and annual evaporation of 1674.3mm. Based on the data obtained from the Bureau of Meteorology website, it is understood that evaporation exceeds rainfall for 9 months of the year.

Reference to the report prepared by Coffey Partners International (Reference 1) indicates that regional groundwater flows from the northeast and northwest converge at Tomago Road and then flow beneath the site to the south east, towards Fullerton Cove.

Reference to the Acid Sulfate Soil Risk Map for Williamtown, published by the Soil Conservation of NSW, indicates that there is a high probability of occurrence of Acid Sulfate Soils (ASS) at shallow depth (between 1m and 3m depth) over the low-lying flood plains (elevation less than RL 2m AHD). The map also indicates that there is a low probability of occurrence of ASS at a depth of greater than 3m below the existing surface in the elevated area of the site adjacent to Tomago Road (above RL 2m AHD). This elevated area is described by the Risk Map as a Pleistocene Aeolian Sandplain and, if present, ASS within this area are expected to be sporadic and buried by alluvium and Aeolian (windblown) sediments.

5. SCOPE OF WORK

5.1 Desk Top Study

The first phase of the work included a desk top study, backed by on-site reconnaissance mapping to provide a preliminary geotechnical model and consideration of geotechnical issues. The desk top study included a review of the following geological, geotechnical and hydrogeological information:

- A review of the 1:100,000 scale Geological Series Sheet 9231 'Newcastle Coalfield Regional Geology', published by the Department of Mineral Resources (1995);
- A review of the 1:25000 scale Topographic and Orthophoto Maps for Beresfield and Williamtown (2001);
- A review of the 1:100,000 scale Soil Landscape Sheet 9232 for Newcastle, published by the Department of Conservation and Land Management (1995);
- A review of the 1:25,000 scale Acid Sulfate Soil Risk Map for Williamtown, published by the Soil Conservation Service of NSW (1995);
- A review of historical aerial photographs of the study area for terrain evaluation and identification of past potentially contaminating activities in the area (Refer Coffey Report N09814/02-AF);
- Review of geotechnical reports on previous nearby investigations held in Coffey archives and reports prepared by Soil and Rock Engineering Pty Ltd;
- A review of other relevant information, including reports on nearby sites held within Coffey archives, and the references listed in Section 3.1.

To assist with the appreciation of existing site conditions and assessment of potential geotechnical constraints associated with the proposed development, a site walkover was then conducted by an Engineering Geologist, and site visits were made by both a Principal Engineer and Principal Engineering Geologist from Coffey.

5.2 Geotechnical Investigations & Testing

The information obtained during the desk top study was used to form the basis of the current geotechnical assessment and model of the study area. The scope of work for the current assessment was based on a limited field investigation program designed to increase our understanding of the geotechnical model, to fill in gaps in existing information and to increase our certainty of data obtained during previous investigations. Field investigation methods comprised a combination of piezocone cone penetrometer tests, piezocone dissipation tests, and boreholes to assess the geotechnical conditions across the site.

The scope of the additional work for the due diligence assessment is summarised below.

Boreholes

Five boreholes were drilled across the proposed development area to depths ranging between 18.0m and 19.55m. The boreholes were drilled using a truck-mounted rig equipped with continuous spiral flight augers, and were wash bored below a depth of about 2m to 3m due to the collapse of sands below the water table. Thin walled tube samples were taken in the upper clay layer (Unit 1A) at approximately 1m to 1.5m intervals. Standard penetration tests (SPT's) were carried out at approximately 1m to 1.5m intervals in the underlying sand and gravel deposits.

The field investigations were carried out in the full time presence of an Engineer from Coffey who located the boreholes, nominated sampling and testing depths and produced engineering field logs. The engineering logs are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation. Borehole locations are indicated on Figure 2. Ground surface levels at the borehole locations are shown on the logs and are summarised in Tables 1.1 and 1.2.

Electric Friction Cone Penetrometer Testing

The electric friction cone penetrometer (CPT) tests undertaken for the current assessment included measurement of pore water immediately behind the cone tip using a Piezocone. Five piezocones were conducted across the site, at the locations indicated on Figure 2 (TOM-01 to TOM-05). These tests also included dissipation tests at selected locations and depths, whereby the probe is stopped and the excess pore pressure generated during testing is allowed to dissipate back towards the expected insitu hydrostatic water pressure. These tests enable an assessment of the time related consolidation characteristics of the material to be made.

The testing was carried out by NEWSYD Geotechnical Testing, a specialist subcontractor based out of the University of Newcastle, using conventional truck mounted equipment which supplies a thrust of approximately 20 tonne. CPT tests at locations TOM-01, TOM-02 and TOM-03 were terminated due to refusal caused by high tip, sleeve or overall resistance, at depths in excess of 31m. The tests conducted at locations TOM-04 and TOM-05 were terminated due to refusal within dense sand / gravel layers at 18.0m and 15.58m depth respectively. The CPT locations are indicated on Figure 2.

The CPT is described in AS 1289-1999.6.5.1 and the results of the tests of relevance to this assessment are presented in Appendices B and C in the form of plots of Cone Resistance (q_c) Sleeve Friction (f_s) and Friction Ratio.

Coffey has conducted an interpretation of the relevant test data from the previous and current assessments. Reduced plots of the CPT data, including an interpretation of the density ratio and shear strength of the soil profile, is presented in Appendix D. An interpretation of the dissipation test results is also presented in Appendix D.

Survey data

The boreholes and CPT's for the current assessment were located in the field by an Engineering Geologist from Coffey, using GPS coordinates, and were marked with flagged and numbered wooden pegs. Ground surface levels at the borehole and CPT locations were interpolated relative to contours and spot heights shown on a detailed survey plan provided by Asquith & deWitt Pty Ltd. It should be noted that satellite (GPS) derived values may be in error by up to 20m to the Map Grid Australia (MGA) coordinate system.

The CPT's from the previous investigations were surveyed using International Survey Grid (ISG) coordinates. These coordinates have been converted to MGA values using the program 'Geodetic Transformations V03.42' which uses high accuracy survey data, to within approximately +/- 0.1m. Ground surface elevations were surveyed to the Australian Height Datum (AHD).

A summary of the coordinates (MGA) and surface elevation (AHD) of each of the borehole and CPT locations used in this assessment are presented in Tables 1.1 and 1.2.

TABLE 1.1 – BOREHOLE & CPT LOCATIONS (CURRENT INVESTIGATIONS)

CPT / BOREHOLE LOCATION		EASTING (MGA)	NORTHING (MGA)	ELEVATION (m) AHD
CPT	TOM-01	56 382 697	6367 479	1.1
	TOM-02	56 382 668	6367 230	0.46
	TOM-03	56 383 175	6367 160	0.25
	TOM-04	56 383 030	6367 389	0.47
	TOM-05	56 383 390	6367 798	0.9
Borehole	CBH1	56 382 507	6367 352	0.85
	CBH2	56 382 942	6367 169	0.41
	CBH3	56 382 893	6367 558	0.8
	CBH4	56 383 456	6367 558	0.5
	CBH5	56 383 640	6367 720	0.5

TABLE 1.2 – CPT LOCATIONS (PREVIOUS INVESTIGATIONS)

CPT LOCATION	EASTING (MGA)	NORTHING (MGA)	ELEVATION (m) AHD
CPT-01	56 383 185.30	6367 837.56	1.7
CPT-02	56 383 251.21	6367 841.70	3
CPT-03	56 383 432.74	6367 813.13	0.9
CPT-04	56 383 598.67	6367 869.27	1.1
CPT-10	56 383 643.20	6367 418.14	0.2
CPT-11	56 383 401.20	6367 207.57	0.2
CPT-12	56 383 646.12	6367 211.21	0.4
CPT-14A	56 383 395.06	6367 003.47	0.4
CPT-15	56 383 654.79	6367 017.38	0.3
CPT-18	56 382 103.16	6367 213.01	2.7
CPT-25	56 382 091.33	6366 939.80	0.7
CPT-26	56 382 269.08	6367 058.16	0.4
CPT-27A	56 382 460.86	6367 016.79	0.4
CPT-28	56 382 643.18	6366 999.24	0.7
CPT-29	56 382 888.91	6366 959.89	0.2
CPT-30	56 383 087.48	6366 929.65	0.2
CPT-31	56 383 396.75	6366 861.51	0.2
PZP-32	56 383 692.33	6366 830.10	0.5
CPT-39A	56 382 106.70	6366 762.10	0.6
CPT-40	56 382 411.29	6366 835.86	0.5
CPT-41	56 382 658.09	6366 792.53	0.2
CPT-42	56 382 902.79	6366 755.16	0.3
CPT-43	56 383 152.54	6366 714.89	0.2
CPT-44	56 383 351.10	6366 684.65	0.3
CPT-45	56 383 694.17	6366 627.15	0.6

6. RESULTS OF LABORATORY TESTING

6.1 Oedometer Consolidation Testing

The consolidation characteristics of the very soft clay (Unit 1A) and soft / loose clayey sand (Unit 1B) materials has been assessed from the results of oedometer consolidation testing conducted on two thin walled samples taken from boreholes CBH2 and CBH4 during the current assessment, and correlation of the results with data obtained from previous investigations undertaken on the adjacent site.

The consolidation testing for the current assessment was carried out by Coffey's NATA accredited Sydney laboratory. Results of the consolidation testing are presented in Appendix E and are summarised in Table 2.

TABLE 2 – CONSOLIDATION TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (m)	INFERRED GEOTECHNICAL UNIT	C_c	C_v (m^2/year)	C_α	MOISTURE CONTENT (%)
CBH2	2.5 – 2.8	1A	0.35	0.1	0.02	76.7
CBH4	2.0 – 2.3	1A	0.34	0.2	0.03	39.0
BH38*	2.0 – 2.4	1A	0.16	1.4	0.018	35.3
BH110*	2.1 – 2.45	1A	0.12	1.4	0.018	32.8
BH110*	3.5 – 3.6	1A	0.145	0.37	0.0005	31.5
BH111*	2.1 – 2.45	1B	0.055		0.0016	10.7
BH111*	3.6 – 3.9	1B	0.048	1.55	0.0011	26.6
PB156*	3.0 – 3.4	1B	0.072	2.4		26.2
PB167*	3.0 – 3.4	1A	0.62	0.3		79.3

NOTES:

** Results incorporated from reports prepared by Soil and Rock Engineering, 2001 (References 2 & 3)*

C_c = compression index of clay

C_v = coefficient of consolidation

C_α = coefficient of secondary consolidation

6.2 Vane Shear Testing

Vane shear testing of soft clay thin walled (U50) soil samples was conducted using a 33mm Pilcon hand vane shear apparatus to provide in situ strength profiles, to assist in preliminary embankment stability analyses. The results of the vane shear tests are summarised in Table 3.

The results of the vane shear testing indicate that the Unit 1A soils have a measured insitu undrained shear strength of about 11kPa to 24kPa in the upper 1m, reducing to 6kPa to 10kPa at about 1.5m to 1.8m depth. When adjusted by a correction factor of 1.33 for sampling stress relief, the Pilcon vane shear tests indicate that the soils have an undrained shear strength of about 14.63kPa to 31.92kPa in the upper 1m, reducing to 7.98kPa to 13.3kPa at about 1.5m to 1.8m depth. These results are consistent with results obtained during the previous investigations undertaken by Soil & Rock Engineering in 2001.

TABLE 3 – VANE SHEAR TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (m)	MATERIAL TYPE	PEAK SHEAR STRENGTH (kPa)		RESIDUAL SHEAR STRENGTH (kPa)	MOISTURE CONTENT (%)
			Measured	Adjusted*		
CBH1	0.6 – 0.7	CLAY	17	22.61	7	-
CBH1	0.7 – 0.8	Sandy CLAY	20	26.6	7	43.75
CBH1	1.55 – 1.65	Sandy CLAY / Clayey SAND	10	13.3	3	24.77
CBH2	1.0 – 1.3	CLAY	24	31.92	4	44.71
CBH3	0.5 – 0.65	Sandy CLAY	11	14.63	5	-
CBH3	0.7 – 0.8	Sandy CLAY	12	15.96	1	29.05
CBH4	0.5 – 0.6	CLAY	19	25.27	6	41.06
CBH4	0.7 – 0.8	CLAY	23	30.59	5	41.06
CBH5	1.7 – 1.8	Clayey SAND	6	7.98	1	34.01

*NOTE: * A correction factor of 1.33 has been applied for the Pilcon hand vane shear tests conducted on U50 samples to account for disturbance and sampling stress relief.*

7. PRELIMINARY GEOTECHNICAL MODEL

A preliminary geotechnical model has been prepared based on the available subsurface data. The geotechnical model represents a simplified and approximate version of the true ground conditions. Relevant static friction cone penetrometer test (CPT) data from previous studies at the site have been used to supplement information from the current investigations where applicable. Subsurface conditions between borehole and CPT locations have been interpolated and, as such, the accuracy of the model is highest near borehole and CPT locations and diminishes with increasing distance from these locations.

The model is divided into seven stratigraphic units presented in Table 4. These units represent layers or zones of the soil or rock that possess significantly different engineering properties than the adjacent units. The distribution, depths and thicknesses of the units have been estimated from the available subsurface data. Interpreted stratigraphic sections are presented as Sections A-A' to F-F' (Figures 4 to 9 respectively).

A summary of borehole and static friction cone data from the current investigations is presented in Tables 5.1, and 5.2. A summary of the CPT data from the previous investigation is presented in Table 5.3. Copies of the boreholes logs and piezocone plots from the current investigation are presented in Appendices A and B respectively. Copies of CPT results from the previous investigation are presented in Appendix C.

The groundwater table was noted on the borehole logs at depths ranging between 0.2m and 1.2m below the existing ground surface, which corresponds to Reduced Levels (RL m AHD) of -0.05m, -0.21m, 0.6m, -0.4m and -0.3m in boreholes CBH1 to CBH5 respectively.

TABLE 4 – INFERRED STRATIGRAPHIC / GEOTECHNICAL UNITS

INFERRED GEOTECHNICAL UNIT	PROBABLE ORIGIN	MATERIAL DESCRIPTION	COMMENTS
1A	Estuarine	CLAY (topsoil), medium plasticity, brown to red/brown, with some organic matter and root fibres, overlying CLAY / Sandy CLAY, high plasticity, grey, very soft to soft consistency, with some organics.	Compressible soils and possible Acid Sulfate Soils
1B	Alluvial	Silty SAND and Clayey SAND, fine to medium grained, light brown to grey, very loose to loose, clay medium plasticity, with some organics, trace shell fragments (<5mm).	Loose / compressible soils and possible Acid Sulfate Soils (Sensitive fine grained material)
2A	Alluvial	SAND (SP), fine to medium grained, light brown to grey, medium dense to dense, some loose lenses and gravelly clayey sand lenses have been noted, lenses of shell material throughout.	Possible founding material for driven piles
2B	Alluvial	SAND (SP), fine to medium grained, light brown to grey, trace clay medium plasticity, with lenses of coarse sand and fine grained gravel (subrounded), typically dense to very dense, occasional medium dense lenses have been noted.	Possible founding material for piles, provided pile toe is three pile diameters above Unit 3 soils
3	Estuarine / Alluvial	Interbedded layers / lenses of Silty SAND / Clayey SAND and Sandy CLAY, grey, sand fine to medium grained, clay medium plasticity. Layers of variable density with loose zones of clayey sand, and medium dense to dense gravelly bands, trace carbonaceous material, gravel fine grained (subrounded)	Variable in extent / soil type / thickness / density, some compressible layers expected.
4	Alluvial	Sandy GRAVEL / Gravelly SAND, gravel fine to medium grained, sand fine to coarse grained, grey, variable density (typically dense to very dense but loose to medium dense Clayey SAND layer often encountered immediately overlying the Unit 5 CLAY).	Variable lenses across site, absent in some areas, significant water loss during drilling
5	Alluvial	Silty CLAY / CLAY, medium to high plasticity, grey, with lenses containing shell material, stiff consistency, slightly overconsolidated	

TABLE 5.1 - SUMMARY OF INFERRED GEOTECHNICAL UNITS ENCOUNTERED AT EACH BOREHOLE LOCATION (CURRENT INVESTIGATION)

BOREHOLE LOCATION	ELEVATION (m) AHD	INFERRED GEOTECHNICAL UNIT							WATER TABLE
		UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 3	UNIT 4	UNIT 5	
		DEPTH IN METRES							
CBH1	0.85	0.0 – 3.4	3.4 – 5.25	5.25 – 6.9	6.9 – 10.1	10.1 – 15.5	15.5 – 18.4	18.4 – 19.05	0.9
CBH2	0.41	0.0 – 3.4	3.4 – 5.5	5.5 – 8.0	8.0 – 12.75	12.75 – 17.15	17.15 – 18.95	-	1.2
CBH3	0.80	0.0 – 1.7	-	3.8 – 8.0	1.7 – 3.8, 8.0 – 12.9	12.9 – 17.7	17.7 – 18.5	-	0.2
CBH4	0.50	0.0 – 2.2	2.2 – 3.3	3.3 – 7.15	7.15 – 11.2	11.2 – 14.8	14.8 – 18.6	18.6 – 19.55	1.1
CBH5	0.50	0.0 – 1.7	1.7 – 3.4	3.4 – 9.8	9.8 – 13.6	13.6 – 15.0	15.0 – 18.0	-	1.2

TABLE 5.2 - SUMMARY OF INFERRED GEOTECHNICAL UNITS ENCOUNTERED AT EACH CPT LOCATION (CURRENT INVESTIGATION)

CPT LOCATION	ELEVATION (m) AHD	INFERRED GEOTECHNICAL UNIT							CPT REFUSAL
		UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 3	UNIT 4	UNIT 5	
		DEPTH IN METRES							
TOM-01	1.10	0.0 – 2.7	2.7 – 5.3	5.3 – 8.0	8.0 – 12.7	12.7 – 18.4	18.4 – 22.90	22.90 – 32.78	32.78
TOM-02	0.46	0.0 – 2.1	2.1 - 3.9	3.9 – 7.9	7.9– 12.8	12.8 – 17.6	17.6 – 22.25	22.25 – 35.50	35.50
TOM-03	0.25	0.0 – 3.0	3.0 – 6.75	6.75 – 11.65	11.65 – 15.65	15.65 – 17.8	-	17.8 – 31.22	31.22
TOM-04	0.47	0.0 – 2.1	2.1 – 3.75	3.75 – 9.4	9.4 – 12.9	12.9 – 17.15	17.15 – 18.0	-	18.00
TOM-05	0.90	0.0 – 3.65	3.65 – 4.9	4.9 – 8.8	8.8 – 13.95	13.95 – 15.25	15.25 – 15.58	-	15.58

TABLE 5.3 - SUMMARY OF INFERRED GEOTECHNICAL UNITS ENCOUNTERED AT EACH CPT LOCATION (PREVIOUS INVESTIGATIONS)

CPT LOCATION	ELEVATION (m) AHD	INFERRED GEOTECHNICAL UNIT							CPT REFUSAL
		UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 3	UNIT 4	UNIT 5	
		DEPTH IN METRES							
CPT-01	1.7	0.0 – 0.25	0.25 – 1.0	1.0 – 11.4	11.4 – 13.5	13.5 – 15.1	15.1 – 15.36	-	15.36
CPT-02	3.0	0.0 – 0.15	0.15 – 1.25	1.25 – 11.7	11.7 – 15.5	15.5 – 17.45	17.45 – 19.9	-	19.9
CPT-03	0.9	0.0 – 0.15	0.15 – 1.0	1.0 – 9.6	9.6 – 14.65	14.65 – 15.65	15.65 – 16.26	-	16.26
CPT-04	1.1	0.0 – 0.7	0.7 - 3.5	3.5 – 9.4	9.4 - 10.1	10.1 - 15.55	15.55 – 23.18	-	23.18
CPT-10	0.2	0.0 – 3.95	3.95 – 6.3	6.3 – 7.0	7.0 – 7.35	-	-	-	7.35
CPT-11	0.2	0.0 – 4.4	4.4 – 7.3	7.3 – 8.85	-	--	-	-	8.85
CPT-12	0.4	0.0 – 6.15	6.15 – 9.4	9.4 – 10.85	-	-	-	-	10.85
CPT-14A	0.4	0.0 – 6.2	6.20 – 9.55	9.55 – 15.0	-	15.0 – 18.5	18.5 – 25.5	25.5 – 37.96	37.96
CPT-15	0.3	0.0 – 6.05	6.05 – 9.8	9.8 – 11.75	-	-	-	-	11.75
CPT-18	2.7	0.0 – 0.1	0.1 – 1.85	1.85 - 7.6	7.6 – 13.3	13.3 – 14.6	-	-	14.6
CPT-25	0.7	0.0 – 2.55	2.55 – 4.5	4.5 – 6.95	6.95 – 7.4	-	-	-	7.4
CPT-26	0.4	0.0 – 1.8	1.8 – 3.95	3.95 – 5.4	5.4 – 5.65	-	-	-	5.65
CPT-27A	0.4	0.0 – 3.4	3.4 – 5.6	5.6 – 7.5	7.5 – 13.4	13.4 – 18.9	-	18.9 – 20.46	20.46

TABLE 5.3 - SUMMARY OF INFERRED GEOTECHNICAL UNITS ENCOUNTERED AT EACH CPT LOCATION (PREVIOUS INVESTIGATIONS) (CONTINUED)

CPT LOCATION	ELEVATION (m) AHD	INFERRED GEOTECHNICAL UNIT							CPT REFUSAL
		UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 3	UNIT 4	UNIT 5	
		DEPTH IN METRES							
CPT-28	0.7	0.0 – 3.6	3.6 – 5.8	5.8 – 13.5	-	13.5 - 17.95	17.95 – 19.05	19.05 – 24.34	24.34
CPT-29	0.2	0.0 – 4.5	4.5 – 7.2	7.2 – 10.6	10.6 – 16.5	16.5 – 17.55	17.55 – 19.35	19.35 – 45.06	45.06
CPT-30	0.2	0.0 – 5.2	5.2 – 8.95	8.95 – 10.1	-	-	-	-	10.1
CPT-31	0.2	0.0 – 8.15	8.15 – 8.65	8.65 – 14.1	14.1 – 15.9	15.9 – 18.5	-	18.5 – 36.54	36.54
PZP-32	0.5	0.0 – 7.7	7.7 – 10.9	10.9 – 13.4	-	13.4 – 17.0	17.0 – 17.1	-	17.1

8. DISCUSSION OF GEOTECHNICAL CONDITIONS

It should be noted that soil conditions can vary considerably over relatively short distances in a meandering river valley / alluvial setting. Coffey's experience within the local area is that lenses of barrier sand and channel deposits that exist within the profile are erratically distributed, and both vertically and laterally discontinuous. The boreholes and cone penetrometer test results used as the basis for the preliminary geotechnical model and recommendations contained within this report represent a very small proportion of the site to be developed, and variations in ground conditions can occur between such locations. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. Allowance should therefore be made for variability in design and construction budgets, and the potential for lateral discontinuity of both the soft upper soil layers (Unit 1A and 1B) and suitable founding stratum (Units 2A and 2B) should be further investigated. In particular, the presence and depth of potential compressible or low / variable density layers at greater depth (Unit 3) should be identified to assess their potential impact on each of the proposed development areas. Generally, piles should not be founded within 3 piles diameters of these weaker zones.

9. POSSIBLE GEOTECHNICAL ISSUES / HAZARDS

9.1 General

Geotechnical issues / hazards constitute potentially high risks for the project and management of these risks and development of solutions will be a prominent determining factor in assessing the feasibility of the project. Based on an appraisal of the subsurface conditions encountered during the previous and current geotechnical investigations conducted at the site and in the immediate surrounding area, the main issues that might affect the feasibility of the proposed development of the site include:

- Presence of soft ground and suitable founding conditions;
- Both short and long term settlement rates and magnitudes under embankments over alluvial soils, and how these may affect design levels;
- Magnitudes and rates of expected total and potential differential settlement under embankments in both the short and long term;
- Embankment foundation strength and likely impacts on batters and stability of embankments constructed over alluvial soils;
- Control of differential settlement between rigid structures and embankments;
- Resource requirements, including the need for large amounts of imported material required to fill to design levels on soft ground, and the availability of resource materials from sources within the general area;
- The presence of Acid Sulfate Soils, and the need to reduce the potential for disturbance by excavation within these soils;
- The presence of contaminated land from past land uses.

The potential geotechnical issues / hazards presented above are discussed in the following sub-sections, in relation to the proposed development. Possible solutions to these hazards are discussed in Section 10 and Section 11 of this report.

9.2 Consolidation of Soft Clays and Loose Sands

The investigated ground conditions over the majority of the site are currently unsuitable for support of shallow foundations. In addition, the ground surface elevation is below the 1 in 100 year flood level, and the site will therefore require significant filling to a design height of about RL 3.4m AHD. The previous and current site investigations within the site and immediate surrounding area have identified the presence of very soft to soft and very loose to loose sediments within the upper 4m to 10m of the soil profile (Units 1A and 1B), that will undergo significant primary and long term secondary consolidation settlements as a result of the site filling, even without the addition of building loads.

The Unit 1A and 1B and to a lesser extent Unit 3 soils present a geotechnical hazard in that large loads applied to these units are likely to result in consolidation and settlement. The variability of the thickness of these units would result in varying amount of consolidation that may result in significant differential settlements. The hazard lessens where the soils are non-cohesive (sand) as these soils consolidate less and more rapidly. In contrast, cohesive fine grained soils such as silts and clays are less permeable and take longer to consolidate when loaded. The presence of organic material within some of the soils of Units 1A and 1B adds to the potential for settlement as such material can continue to consolidate over long periods of time and result in on-going long term (creep) settlements.

The severity of this hazard depends on how much settlement can be tolerated by the surface features and the design requirements for pavements and structures to cope with these settlements. To minimise the impact of these settlements on future developments, ground improvement works will need to be carried out. As discussed further in Section 11, feasible means of ground improvement for the site include:

i. Surcharge preloading to complete a minimum 90% of primary consolidation before removal of the preload & commencement of building and construction. This is achieved by mounding up an appropriate height of sand fill over the site and leaving it in place until the appropriate amount of settlement has occurred, then cutting the mound back to design level for construction. The amount of settlement achieved using this method is dependent upon the drainage properties of the soils within the weaker layers. Such properties can be enhanced using wick drains or vertical sand drains.

ii. Ground reinforcement which transfers the weight of the fill through the soft layers and into the underlying dense sands. This process may involve the construction of piles or columns on a grid pattern, founded with the medium dense to dense sand layers (Unit 2A/2B) beneath all soft or loose zones. A geogrid is then installed to transfer the uniformly distributed load of the sand fill to the pile heads.

9.3 Dewatering Induced Consolidation

Dewatering for construction below the groundwater table requires the drawdown of the groundwater table in an area surrounding the proposed excavation. Such drawdown leads to an increase in effective stress experienced by the soil which could lead to consolidation of soils within Units 1A and 1B. Structures surrounding the dewatering site can be affected within a radius of several hundred metres. Dewatering may also require management of contaminated groundwater, not considered in this report. From the current plans for the project, it appears that extensive dewatering will not be required.

9.4 Sources of Available Fill Material

It is understood that the quantity of bulk fill required to raise the general site level to about RL 3.4m AHD is about 2.5×10^6 m^3 plus any extra to cope with the settlement and preloading program. The sourcing of suitable material at a suitable cost is important to the viability of the project. Some details of potential suppliers and their products are included in Table 6.

TABLE 6 – ADVANTAGES AND DISADVANTAGES OF AVAILABLE FILL MATERIALS

FILL TYPE	POTENTIAL SUPPLIERS	CHARACTERISTICS	ADVANTAGES	DISADVANTAGES
DUNE SAND	• TOLL BULK SANDS • Other sand quarries near Stockton Dune Area	SAND, fine to medium grained, non-reactive, high CBR strength reducing pavement requirements	• Short haul, large quantity available. Easily transportable • Low erosion or dust potential • Easily compacted into a free draining, stable engineered fill • Non reactive • Provides good drainage and infiltration capacity	• Limited suppliers • Poor trafficability, particularly when dry • Subject to wind erosion • Require working platform of sub base gravel to provide trafficable surface
DREDGED SAND	• Hunter Ports Corp, from dredging of harbour and river	SAND, fine to coarse grained, with some shells, non-reactive but with variable fines content	• Similar to Dune SAND but slightly coarser • May contain some fines that will reduce free draining characteristics	• Only available during dredging programs, otherwise long and costly process to obtain regulatory approval to instigate own dredging program • Haul or transport distances could be large, costs probably greater than that of Dune Sand
QUARRY OR MINE OVERBURDEN	• Daracon Quarries, Blackhill • Bloomfield Collieries, East Maitland	Mixture of GRAVEL, SAND and CLAY produced during the removal of soils and weathered rock to expose coal. Requires selection and processing to remove oversize prior to transport.	• Large quantities available within reasonable haul distances • Provides reasonably trafficable surface after compaction • Requires erosion protection	• Requires pre-processing prior to transport • Requires more compactive effort than sand • Not free draining • Increased surface runoff / erosion of soils • Increased detention facilities • Increased pavement requirements due to lower CBR

TABLE 6 – ADVANTAGES AND DISADVANTAGES OF AVAILABLE FILL MATERIALS (continued)

FILL TYPE	POTENTIAL SUPPLIERS	CHARACTERISTICS	ADVANTAGES	DISADVANTAGES
COARSE WASHERY REJECT (CWR) OR CHITTER	• Bloomfield Collieries, East Maitland • Teralba Colliery	Clayey Sandy GRAVEL which breaks down to Gravelly Clayey SAND on compaction, produced during the processing of coal. Some coal content and may contain pyrite which can generate acidic runoff / soils.	• Large quantity available within reasonable distance • Provides trafficable surface	• Requires more compactive effort than SAND • Not free draining • Increased runoff erosion of soils • Increased runoff detention facilities required • Slightly increased pavement requirements • May contain excessive levels of pyrite • Will require site to be declared a Waste Disposal Facility if >20,000 tonnes used in one year
POWER STATION BOTTON ASH / FLY ASH	• Bayswater Power Station • Liddell Power Station • Eraring Power Station • Mannering Park Power Station • Trueways Pty Ltd	Bottom Ash: SAND, fine to coarse grained, grey, non-plastic, low density (1.4 t/m^3 cf 2.0 t/m^3 for normal fill). Fly Ash: Sandy SILT, grey, sand fine to medium grained, non-plastic fines. May be supplied as various mixtures of Bottom Ash / Fly Ash	• Large quantities available • May be available at minimal supply cost and / or transportation cost (backloading) • Low density provides 50% more volume for same mass • Lightweight fill reduces settlement of soft soils • Preloading stages can be increased	• Haulage distances greater than other materials • Reasonably trafficable but requires a gravel surfacing to make it trafficable to all vehicles

9.5 Acid Sulfate Soils

Reference to the Acid Sulfate Soil Risk Map for Williamtown, published by the Soil Conservation Service of NSW (1995), indicates that the lower-lying central portion of the site described as an alluvial swamp has a high probability of occurrence of acid sulfate soils within 1m below the natural ground surface. There is no known occurrence of acid sulfate soils in the elevated areas of the site (above RL 2m AHD).

Acid Sulfate Soils (ASS) are soils that contain significant concentrations of pyrite, which when exposed to oxygen and in the presence of sufficient moisture oxidises, resulting in the generation of sulfuric acid. Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed the oxidation of pyrite occurs and sulfuric acids are generated, and the soils are said to be actual ASS.

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 2m AHD. They can also form as bottom sediments in coastal rivers and creeks. Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period (that is 10,000 years ago to present day), predominantly in the 7,000 years since the last rise in sea level.

Disturbance or poorly managed development or use of acid sulfate soils can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity. The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works. Generation of acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters can have detrimental effect on aquatic ecosystems.

As part of the current investigation methodology, no specific sampling or laboratory analysis was undertaken to determine the presence and / or significance of acid sulfate soils across the site. It is expected that if ASS were present at the site they would most likely occur within Unit 1A soils below the groundwater table. It is noted that the area lies within an area identified to be a high risk of acid sulphate soils, however as it is understood that the proposed redevelopment of the site will not involve major excavations and inversely will most likely comprise significant filling, it is considered unlikely that the presence of potential acid sulphate soils will pose a constraint to the development.

9.6 Groundwater Aggresivity to Buried Concrete and Steel

The aggressivity of the groundwater to buried elements can be directly affected by the presence of acid sulfate soils. In addition, other chemical characteristics of the groundwater such as pH and chlorides, can lead to attack and degradation of buried elements.

During previous investigations on the adjacent site, conducted by Soil & Rock Engineering in 2001, a limited amount of chemical testing was undertaken on samples of the soil and groundwater recovered from the site. The test results indicate that a mildly aggressive to non-aggressive exposure classification for steel and concrete piles would apply in accordance with AS2159-1995, however it is recommended that some further testing be conducted on representative samples from the current site.

9.7 Contaminated Soil

A factual report presenting the findings of a preliminary site contamination assessment has been forwarded under separate cover, (Coffey Ref: N09814/02-AF, 17 February 2006).

The site history review for the preliminary contamination assessment revealed that contamination could potentially have been introduced to the site through:

- Atmospheric fallout of contamination from nearby Tomago Aluminium Smelter;
- Importation of contaminated fill material;
- Leaching or weathering of zinc, lead or asbestos from current/former buildings and structures;
- Application of pesticides during use for agricultural purposes.

Limited sampling and laboratory analysis were undertaken to make a preliminary assessment of the presence of soil contamination associated with the above potential contaminating sources.

A review of the laboratory data indicates that PAHs, BTEX, OCPs and PCBs were not detected above the laboratory limit of reporting in the samples analysed. Heavy metals were detected as some locations at concentrations considered to be elevated with respect to anticipated natural background levels however were not detected above the NSW EPA (1998) health based investigation levels for commercial/industrial use. TPH was not detected above the NSW EPA (1994) soil investigation level for sensitive sites in samples collected across the site and was generally below laboratory detection limits. TPH was detected at elevated concentrations below the NSW EPA (1994) soil investigation level for sensitive sites in sampling locations across the paddock areas, however these TPH detections are considered to most likely represent natural organic material rather than petroleum hydrocarbon related contamination. Asbestos cement fragments were detected at two locations in the vicinity of a former building and an abandoned building. Asbestos fibres were not detected in surface soils surrounding these areas.

Based on the findings of the results of the site history review and the limited sampling and laboratory analysis, the following conclusions regarding potential site contamination can be made:

- The potential for widespread soil contamination associated with atmospheric fallout from the nearby Tomago Aluminium Smelter to be present at the site is low;
- The potential for widespread gross contamination to be present in fill material at the site is low. However, it is noted that the number of samples collected relative to the volume of fill observed to be present at the site is low and as such the potential for contaminated fill material to be present at the site cannot be precluded;
- Fragments of asbestos cement material were found in surface soils in the vicinity of an abandoned shed located in the north western portion of Lot 1 DP1003492 (numerous fragments) as well as in the vicinity of a former building located upon the peak of the dune in the northern portion of Lot 161 DP 774440 (one fragment). Asbestos fibres were not detected in soils samples collected near where asbestos cement fragments were found. With the exception of the identified asbestos contamination, the potential for widespread contamination associated with the weathering of building materials to be present at the site is low;
- The potential for widespread soil contamination associated with the application of pesticides to be present at the site is low.

Based on the above, subject to the adequate assessment and management/remediation of the identified asbestos contamination, it is considered that the site is likely to be suitable for the proposed industrial development.

It should be noted that the assessment has not included an assessment of groundwater contamination beneath the site. Based on the findings of the preliminary contamination assessment, it is considered that the potential for site originated groundwater contamination to be present at the site is low. It is noted there is some potential for offsite originated groundwater contamination from the nearby Tomago Aluminium Smelter (if present) to have migrated to beneath the site, although as the site is approximately 1.5-2km from the smelter this is considered to be unlikely.

9.8 Mine Subsidence

The Mine Subsidence Board was contacted on your behalf to ascertain whether the site is affected by mine subsidence. The Board indicated that the site is not located within a proclaimed mine subsidence district and is not subject to any building restrictions or controls imposed by the Mine Subsidence Board. A formal reply from the Mine Subsidence Board, received on 1 March 2006, has been included at the end of this report.

It is well established that no coal mining has occurred beneath the site. The Board's records indicate that the site is not undermined and is not likely to be affected by any future mining. Thus, there is no potential hazard associated with abandoned mine workings or associated mine subsidence related issues.

9.9 Seismicity

Earthquake induced liquefaction requires consideration on this site, as there are deep deposits of soft alluvial and estuarine sediments that are susceptible to liquefaction.

It would be reasonable to use a design earthquake with a Richter magnitude of 6 or even 6.5 for the site. Liquefaction of loose sand layers is likely to occur under seismic events of the above magnitude. This could lead to failure of foundations and/or settlement of structures founded on these sediments. The risk of liquefaction could be reduced by deep ground improvement techniques.

Based on the Australian Standard Earthquake Code AS1170.4-1993, an acceleration coefficient of 0.11 would apply to the Newcastle area and a Site Factor of 2 would apply for the depth of rock at this site, giving a surface acceleration of 0.22 (or 22%g).

Deep pile foundations and fully suspended structures may provide the best earthquake resistant foundations. Analysis of the effect of seismic activity on piled foundations should be carried out at the design phase. The following two aspects must be considered:

- Additional lateral load on the pile head due to ground surface acceleration;
- Interaction effects on the pile shaft due to lateral movement of the ground profile.

The effect of seismic activity on pile design will be additional bending moment and shear, and probably a reduced axial structural capacity due to movement interaction.

9.10 Ground Vibrations

Driving piles will induce vibrations in the sands that may cause concern to occupiers of existing nearby buildings that are supported on high-level footings and / or unacceptable levels of noise to nearby commercial and residential establishments. Apart from pile driving, other sources of construction related ground vibrations such as the use of vibrating compaction equipment have the potential to damage nearby structures. It is recommended that ground vibration monitoring be conducted when there is a risk of structural damage to neighbouring property.

The monitoring should comprise dilapidation surveys conducted on surrounding buildings before and after piling and that ground vibration monitoring be carried out during piling and / or compaction, as well as pre-defined ground vibration alarm levels and associated reaction measures. Coffey are able to provide vibration monitoring services.

10. GEOTECHNICAL RISK REGISTER

The geotechnical issues or hazards presented in Section 9 are similar across the entire site, however the possible consequences of these hazards may vary depending on the nature of the proposed development. For example, the consolidation of soil in Units 1A and 1B is a geotechnical hazard that applies to almost the entire site. The associated possible consequence for a heavy duty pavement is loss of shape or subgrade failure, whereas for buildings an associated possible consequence would be settlement, failure of piles and loss of serviceability, and for fill embankments a possible consequence may be settlement leading to embankment instability and shear failure.

The likelihood and severity of the hazards also vary with the nature of the proposed development. For example, an amenities building, parts warehouse, local access roads and heavy duty pavement / equipment demonstration areas are all at risk of settlement due to the consolidation of the Unit 1A clays and / or peats. The likelihood of this happening is greater for the heavy duty pavement areas as the loads are expected to be much higher. The likelihood is also higher for the warehouses as the structures cover a significantly larger area, with higher loads, and will therefore be more sensitive to differential settlements within the underlying strata. The severity is also higher for the parts warehouse as the consequences of loss of service is much greater than loss of service to an amenities building.

It may be feasible to reduce the geotechnical hazard by ground improvement, or be more cost effective to design for the hazard and thus reduce the likelihood. For example, the warehouses could be supported by piles that are founded in the medium dense to dense sands (Unit 2A/2B) below the Unit 1A and 1B soils.

The geotechnical hazard register presented in Table 7 summaries possible consequences and solutions for the geotechnical hazards identified by the assessment. Further discussion on the possible engineering solutions is presented in Section 11.

At this stage, general comments only are provided on potential consequences if the identified hazards occur. For each of the design phases, a full geotechnical risk register would need to be developed involving the following steps:

i. Stakeholders of the project will need to determine the severity scale in consultation with the geotechnical consultant.

ii. Determine the degree of risk by multiplying the likelihood shown in Table 7 with the severity scale assessed in step (i) above.

iii. Assess whether or not the resulting degree of risk is acceptable.

iv. Determine the necessary controls to reduce risks (See suggestions in Table 7).

v. Repeat the above process to assess the residual risks assuming the controls in step (iv) are implemented, such that the residual risks will be at tolerable levels.

The risk register is an iterative process and should be reviewed and developed regularly to reflect increased understanding of proposed developments and subsurface conditions as it becomes available.

The definitions of likelihood, severity and risk adopted in Table 7 are as follows:

LIKELIHOOD

Scale	Likelihood	Definition
4	Probable	Almost certain to occur
3	Likely	Expected to occur
2	Unlikely	Possible, but not expected to occur
1	Negligible	Almost inconceivable

SEVERITY

Scale	Severity	Increase of cost or time (% of cost or time)
4	Very high	> 10%
3	High	4 to 10%
2	Low	1 to 4%
1	Very Low	< 1%
Severity can be categorised in terms of cost implication or loss of service of structure. The categories should be developed by consultation between all parties involved		

Degree of risk = likelihood x severity

Degree of risk	Risk Level	Action Required
1 – 4	Trivial	*The action required should be developed by consultation between all parties involved in managing or accepting risk*
5 – 8	Significant	
9 – 12	Substantial	
13 - 16	Intolerable	

TABLE 7 – GEOTECHNICAL RISK / HAZARD REGISTER

LIKELY STRUCTURES / DEVELOPMENT	GEOTECHNICAL RISK / HAZARD	POSSIBLE CONSEQUENCE	LIKELIHOOD	SEVERITY	POSSIBLE CONTROLS TO REDUCE RISK
Building foundations on soft ground	Excessive consolidation, differential settlement of very soft to soft estuarine sandy clay and silt (Unit 1A & 1B soils)	Settlement, loss of serviceability	3	3	Preloading, reduce bearing pressures, deep foundations, design for higher settlements, geogrids
	Low or variable bearing capacity of footing and / or low pile capacity	Excessive settlement of footings or failure of piles	2	3	Piezocone testing for continuous strength profile, reduce bearing pressures, design for higher settlements
	Potential lateral discontinuity of foundation materials and layers causing large differential post construction settlement	Excessive settlement / failure of piles, Loss of serviceability	3	3	Adequately identify all loads and conditions to properly design and construct piles. Design should take into account the nature of layers beneath the toe of the pile. Detailed investigations required to assess potential for depth variability of geotechnical units across the site, and the engineering parameters and characteristics that apply to each.
Site Filling - Availability of suitable material	Insufficient material available to adequately fill and preload site within construction program	Inability to access site for construction activities, Delays to construction program	2	4	Negotiate fill procurement contracts with several alternate suppliers prior to purchase
Entire Site	Potentially contaminating activities from past land use or nearby land use impacting on proposed development of the land.	Delays to approval process. Delays while evaluating extent of problem and remediation measures. Excessive cost of clean up / containment	2	4	Carry out full contamination assessment over the entire site including the previously developed areas near Tomago Road

TABLE 7 – GEOTECHNICAL RISK / HAZARD REGISTER (continued)

LIKELY STRUCTURES / DEVELOPMENT	GEOTECHNICAL RISK / HAZARD	POSSIBLE CONSEQUENCE	LIKELIHOOD	SEVERITY	POSSIBLE CONTROLS TO REDUCE RISK
Placement of filling over soft ground	Potential slope stability failures of embankment due to weight of fill	Displacement of acid sulfate soils. Delays to construction program. Environmental damage and remedial costs	3	3	Conduct detailed investigation of soil strength parameters
	Magnitude and rate of total and differential settlements in excess of predictions	Delays to construction program	3	4	Conduct detailed investigation to asses soil parameters including a fully instrumented trial preload. Install wick drains to increase rate of settlement. Construct stabilising berms and flatten slope
	Excess time required to achieve strength gain in underlying soils	Delays to construction program due to inability to place full preload	3	2	Carry out trial preload to assess soil consolidation / strength gain characteristics, Install wick drains to increase rate of consolidation
Fill Embankments	Embankment instability	Loss of serviceability. Delays to construction program	3	2	Conduct detailed geotechnical investigation to establish soil parameters and construct trial preload
	Embankment erosion	Could lead to embankment instability	3	1	Protect against erosion, rip-rap, sheet piles, containment

TABLE 7 – GEOTECHNICAL RISK / HAZARD REGISTER (continued)

LIKELY STRUCTURES / DEVELOPMENT	GEOTECHNICAL RISK / HAZARD	POSSIBLE CONSEQUENCE	LIKELIHOOD	SEVERITY	POSSIBLE CONTROLS TO REDUCE RISK
Roads / Heavy Duty Pavements / Equipment Demonstration Areas	High watertable / poor drainage	Subgrade failure, pavement damage	2	2	Raise subgrade level, provide adequate surface and subsurface drainage, install geotextile filters
	Excessive post construction consolidation of Unit 1A & 1B soils	Poor pavement performance due to differential settlement and loss of shape and poor surface drainage	3	2	Increase effectiveness of preloading. Allow for placement of correction layers. Increase design surface grades to cope with differential settlement
	Insufficient cover over Unit 1A soils in subgrade	Pavement failure due to poor subgrade	2	3	Raise subgrade level, design for poor subgrade, improve subgrade, reinforce with geogrid raft
	Excessive post construction consolidation of Unit 3 or Unit 5 soils	Settlement and loss of shape	2	2	Increase effectiveness of preloading. Allow for placement of correction layers. Increase design surface grades to cope with differential settlement
Acid Sulfate Soils (ASS) in low–lying areas (below RL 2m AHD)	Excavation of potential ASS from bored piles	Aggressivity to buried elements	2	2	Use driven piles, treat spoil with lime, protect buried elements
	Adverse environmental impacts of disturbance of potential ASS	Damage to aquatic ecosystems	2	2	Use driven piles, treat spoil with lime, reduce excavation quantities by using minimal displacement piles
	Groundwater aggressivity	Loss of durability of buried elements	3	2	Protect buried elements. Increase corrosion resistance of buried elements

TABLE 7 – GEOTECHNICAL RISK / HAZARD REGISTER (continued)

LIKELY STRUCTURES / DEVELOPMENT	GEOTECHNICAL RISK / HAZARD	POSSIBLE CONSEQUENCE	LIKELIHOOD	SEVERITY	POSSIBLE CONTROLS TO REDUCE RISK
General amenities / warehouses	Excessive post construction consolidation of Unit 1A & 1B soils	Settlement issues for flexible structures, storage areas, etc, loss of serviceability	3	2	Increase effectiveness of preload, reduce bearing pressures, support on deep foundations, design for higher settlements. Use of a piled slab with piles acting as settlement reducers rather than full load carrying elements ("soft pile" or "piled raft slab"). Timber piles with gravel layer above and tensile geofabric within gravel to distribute loads
Buried services / utilities	Inadequate support provided by Unit 1A & 1B soils	Poor ground support conditions	2	3	Raise services, deep foundations, raft foundations, geogrids
	High watertable preventing installation of services	Excavation difficulties, support, need for dewatering	2	3	Raise level of services, provide support for excavations, install effective dewatering system
	Excavation of potential ASS causing acidic soils	Soil aggressivity reducing the effective life of buried elements	2	3	Treat spoil with lime, protect buried elements
		Damage to aquatic ecosystems	2	3	Effective containment and treatment of spoil and runoff water with lime, reduce excavation quantities
	Groundwater aggressivity in excess of design values	Loss of durability of buried elements	3	2	Increase protection of buried elements
	Dewatering induced settlements	Settlements of surrounding structures, damage to pavements	2	3	Increase preload in area. Reduce drawdown amount, use recharge areas

11. GEOTECHNICAL SOLUTIONS

11.1 Soft Ground Treatment Options

Based on the subsurface profiles and geotechnical conditions encountered at the site, major geotechnical issues presented by this terrain with respect to embankments include:

- The potential for significant post construction settlement or bearing capacity failure of embankments constructed over soft alluvial soils;
- Lateral and vertical loading on piles due to ground movement;
- The potential for cut and fill batter slope instability.

The use of light weight fill, as for the Five Islands Road Project, will be beneficial in reducing post-construction settlement, however the reduction in post-construction settlement is only marginal unless it is used in combination with other ground treatment strategies.

An assessment of options available for ground improvement techniques for the proposed embankments has been carried out. Possible options include improving soil conditions and / or transferring loads to more resistant layers (Ground Reinforcement). The ground improvement options are presented below:

Improving Poor Soil Conditions

- Pre-loading/surcharging;
- Berm combined with preloading;
- Vertical drainage systems (eg, wick drains), including possible use of these in conjunction with dewatering or vacuum consolidation methods;
- Pre-loading/surcharging in conjunction with vertical wick drains at close centres.

Ground Reinforcement

- Granular piles or columns of sand or stone;
- Concrete or treated timber piles.

The above possible development solutions are discussed in the following sub-sections. Some additional soft ground engineering solutions and means of reducing geotechnical risk are listed below. The suitability of these solutions would need to be further investigated by a geotechnical consultant once details of the proposed development and additional subsurface information are available.

Improving Poor Soil Conditions

- Soil reinforcement with geotextiles or geogrids;
- Lime or cement/soil mixed columns;
- Electro-chemical injection;
- Dynamic or vibro-consolidation;
- Thermal stabilisation.

Reducing or Balancing Loads

- Stability berms;
- Light weight fill materials.

11.1.1 Improving Poor Soil Conditions

a) Pre-Loading

The consolidation of Unit 1A, 1B and Unit 3 soils under increased loads could lead to significant settlements. Differential settlements caused by variations in subsurface conditions and loading may be more problematic than the magnitude of total settlements. One possible method to reduce this settlement is to pre-load the area with a load at least equal to the proposed load. The soils are then able to consolidate and reach equilibrium with the increased load and settlements allowed to occur. Once consolidation has satisfactorily occurred, the pre-load is removed and the proposed structure built. As the underlying soils have already been subjected to this load, the amount of post-construction settlement is significantly reduced, usually to acceptable limits.

The principal of pre-loading is simple and the results reliable in comparison to most other options. The major disadvantage is the time taken for satisfactory consolidation and the need for large quantities of pre-load material. Monitoring of the progress of consolidation is critical as is the assessment of soil parameters to allow prediction of the consolidation rate and expected pre-load time.

The rate of consolidation can be increased by increasing the load and also by providing enhanced drainage of fine grained soils. Wick drains and gravel columns are often used for this purpose. At the proposed site, the rate of consolidation is expected to be reasonably rapid due to the limited thickness of Units 1A, 1B and 3. Other methods of management include allowing some differential settlement to occur and supporting containers on blocks or pad footings that can be replaced or adjusted as settlement occurs.

b) Berm Combined With Preloading

Preloading is generally the most cost effective ground improvement technique provided sufficient time is available in the construction programming and sufficient space exists for the preloading to occur. In addition to the obvious benefit of reducing post-construction settlement, the process of preloading enables more monitoring data to be collected during the loading and unloading stages. This will enable better review of the design assumptions and provide better confidence on the post-construction settlement estimates.

Problems associated with preloading at this site include:

- Time required for preloading to achieve designed settlement;
- Additional space required and possible encroachment into the wetland area;
- Importing large volumes of fill which then need to be removed at the completion of the preload period.

11.1.2 Ground Reinforcement

a) Stone Columns / Vibro-Replacement

This method of ground improvement (also known as Vibro-Replacement) consists of forming vertical holes in the ground, which are filled with compacted gravel to form ‘columns’ or ‘piles’ confined by the soil. The holes are created and gravel compacted using a vibrating probe with water used as a cutting jet and medium to bring the soft soil out of the holes. Because of the relatively high ‘column to soil’ modulus ratio, the columns attract a high proportion of the applied surface loading, providing greater load carrying capacity and reducing settlement. Furthermore, they act as vertical drains to facilitate consolidation of the foundation soil.

The following comments are made with respect to the use of the stone column option:

- The normal ‘wet’ method of Vibro-Replacement involves bringing large quantities of fine slurry out of the ground and is environmentally unfriendly in sensitive wet lands environments. Acid sulfate soil issue is a particular concern;

- Specialist equipment is available to enable 'dry' Vibro-Replacement construction, but the cost of this method could be over 50% higher compared to the conventional 'wet' method of construction;
- Relatively closely spaced stone columns will be required. For example, to reduce settlement to 25% of those for an untreated ground at this site, a stone column diameter of about 1m at 2m spacing is anticipated to be required;
- Good quality gravel with strong aggregate strength is required;
- The area of treatment is usually required to extend beyond the footprint of the embankment in order to improve stability, as the zone beyond the toe of the embankment is a critical zone in terms of resistance to the slip circle failure mechanism in soft grounds;
- Preloading or other forms of ground stiffening solution may still be required to limit post construction settlements due to the residual settlement indicated above;
- The cost of the stone column option will depend strongly on the source of gravel available locally and the method (ie 'wet' or 'dry') of construction as discussed above.

The stone column option is likely to be the least cost effective ground improvement technique and will also require the use of a separate ground treatment option to limit the issue of adverse impact on the existing bridge abutment piles.

b) Pile Embankment Foundations

Piled embankments provide a possible solution for construction of the embankment over soft soils to limit post construction settlement. They have the advantage of being relatively rapid to construct and do not require the extended time periods which many conventional forms of ground improvement (eg preloading) demand.

With the recent introduction of very high strength geosynthetic tensile fabrics (ultimate strengths over 600kN/m width), the use of a piled embankment with a basal layer of tensile fabric to distribute the load to the piles becomes even more cost effective compared to piled reinforced concrete slabs.

The design of piled embankments require the following aspects to be addressed:

- Design fabric strength;
- Axial load capacity of the piles;
- Group settlement;
- Downdrag effect on piles.

A piled embankment foundation option would provide stability for the embankment, avoid the need to preload the embankment and could be designed to limit post-construction settlements and differential settlement to acceptable values that are consistent with normal pavement maintenance programs.

The piled embankment option appears to be the least cost-effective of the two options assessed. It is also the most time-efficient compared to the other options as preloading at the approach embankments to reduce differential settlement relative to the structures will not be required.

A number of important design principles for piled embankments are outlined below:

- The effects of ground settlements can be very important and can lead to considerable settlement of the piles;
- Differential settlement in transition areas can be controlled by designing the embankment piles to have settlements which satisfy the specified differential settlement criteria. This can be achieved by selecting appropriate combinations of pile size, length and spacing;
- Pile driving penetrations / sets should be reviewed for the last two sets of piles at the interface between piled embankment and preload areas to limit differential settlement and reduce the effect of differential settlement over the transition zone;
- To avoid excessive effects of lateral ground movements on the piles, the piling platform fill should extend well beyond the edges of the embankment;
- To avoid excessive bending moments, shears and deflections arising from fill-inducing lateral soil movements, the fill platform should extend well beyond the last pile and the pile heads should not be fixed rigidly to the supporting slab or mattress;
- Provided the piles are designed to cope with the anticipated structural action effects, piles may be installed without delay once the embankments are constructed. The construction sequence should allow for casing / sleeves to be installed at the pile locations prior to embankment construction. Subject to satisfactory embankment settlement monitoring, the piles may be constructed. Once the piles are subsequently driven, the space between the pile and casing should be backfilled with grout or weak sand / cement mix.

11.2 Piled Foundations

For a piled footing system, some suitable options may include driven displacement Hardwood piles, or cast insitu piles founded in medium dense to dense sands (Units 2A/2B). Cast insitu piles may be either Grout Injected CFA piles or conventional bored piles. Conventional bored piers would be difficult to install on this site and the use of mud drilling and casing would be essential due to the potential for collapse of the sands below the water table. Bored non-displacement piles should be closely supervised by experienced persons to ensure adequate construction practices are followed.

To maximise the allowable bearing capacity, the piles should not be founded too deep within the Unit 2A/2B sands. This depth limitation is to avoid the zone of influence of the pile toe from being within the Unit 3 soils (interbedded clays and sands of low / variable density) that have a lower ultimate bearing capacity. The extent of the zone of influence can be taken as being to three maximum pile diameters below the pile toe for a single pile. For pile groups, this zone of influence becomes larger. Hence, for a 0.3m diameter pile, the zone of influence can be taken as say 1m. The toe of such a pile should not therefore be any deeper than 1m above the base of Unit 2B. For a 1m diameter pile, the zone of influence would extend about 3m below the toe of the pile.

Driven Piles

Driven piles provide resistance to load by both end bearing and shaft friction. The shaft friction developed along the pile length would be used to resist both axial compression and tension loads. The piles would be driven to a design refusal set in medium dense to dense sands. Depths to the required design refusal set will be dependent on the required capacity and size of piles and would be best evaluated by driving test piles. The capacity of piles driven to refusal set will be controlled by the structural capacity of the pile and the limitations of readily available pile driving equipment. For practical reasons it is generally advisable to limit pile working loads to about 500kN, although larger capacities are possible with larger pile driving equipment.

The ultimate bearing capacity of the pile may be determined from Hiley pile driving formulae or wave equation analysis once the hammer type and size, and pile size and lengths are known.

Driven displacement piles carry the risk of causing vibration induced damage to adjacent buildings or structures. Dilapidation surveys and vibration monitoring would be required on all structures within 100m of the site. Driven piles may require pre-drilling through the upper indurated sand layer encountered along the northern boundary of the site.

Grout Injected CFA Piles

Grout injected piles are installed with a rig that screws in a continuous flight auger (CFA) to the design depth (a function of the pile size and subsurface condition). The auger is then withdrawn whilst grout is pumped through the auger to the hole below. A steel reinforcing cage is then inserted into the wet grout mix. A pile integrity test is recommended for each pile after installation to confirm the continuity of the section.

Table 8 summarises the advantages and disadvantages of various pile types.

TABLE 8 – ADVANTAGES / DISADVANTAGES OF VARIOUS PILE TYPES

PILE TYPE	ADVANTAGES	DISADVANTAGES
Precast Concrete Driven Piles	• Cost; • Can cope with variable ground conditions by varying penetration depth; • Can drive to a design set; • No spoil removal required.	• Possible construction vibrations on adjacent properties; • Greater number of piles required.
Driven Timber Piles	• Cost; • Can cope with variable ground conditions by varying penetration depth; • Can drive to a design set; • No spoil removal required.	• Possible construction vibrations on adjacent properties; • Greater number of piles required.
Driven Steel Tube Piles	• High capacity with larger diameters; • Can cope with variable ground conditions by varying penetration depth; • Can drive to a design set; • No spoil removal required.	• Cost; • Possible construction vibrations on adjacent properties; • Durability Issues.
Grout Injected CFA Piles	• Cost	• Lower shaft capacity due to smear; • Limit depth to reinforcement; • Spoil removal / acid sulfate soil issues.

TABLE 8 – ADVANTAGES / DISADVANTAGES OF VARIOUS PILE TYPES (continued)

PILE TYPE	ADVANTAGES	DISADVANTAGES
Bored Piles		• Cost; • Requires casing and drilling with mud (polymer, bentonite); Spoil removal / disturbance of acid sulfate soils.

Piles founded in the medium dense to dense sands (Unit 2A or 2B) may be proportioned for the ultimate capacities presented in Table 9.

TABLE 9 - ULTIMATE GEOTECHNICAL STRENGTH PARAMETERS

PILE TYPE	FOUNDING UNIT	ULTIMATE END BEARING (f_b) (MPa)	ULTIMATE SIDE ADHESION (f_s) (kPa)
Non Displacement Piles - Grout Injected (CFA) Piles	UNIT 2A	3.0 MPa	25 kPa
	UNIT2B	5.5 MPa	45 kPa
Displacement Piles - Driven Piles*	UNIT 2A	5.0 MPa	50 kPa
	UNIT 2B	10 MPa	85 kPa
* *Parameters to be proved by pile load tests*			

These recommendations do not preclude the use of established correlations for specific pile types and may be upgraded by carrying out pile load testing. Settlement of piles should be assessed once pile loads are known.

Ultimate skin friction and end bearing pressure for the above pile types are given in Table 9. However, the following points should be borne in mind in the design process:

- Where the founding stratum is underlain by a weaker layer, the pile toe should be located at least three pile diameters above the top of the weaker layer as previously discussed;
- Settlement criteria may govern for structures sensitive to total and/or differential settlement;
- The effects of earthquakes on lateral capacity and structural capacity of piles foundations must also be taken into account as discussed in Section 9.9;
- Piles should be no closer than 2.5 pile diameters apart. If closer than this, interaction effects between piles should be taken into account and pile group settlement assessed;
- Pile design should be in accordance with Australian Standard AS 2159-1995, *Piling – Design and Installation.* Appropriate geotechnical reduction factors should be applied to the ultimate parameters provided in Table 9;
- More accurate ultimate bearing capacities and settlement estimates can be obtained by undertaking static load tests on trial piles;
- Where uplift is critical, it is recommended that uplift load tests be conducted.

11.3 Preliminary Preload Design

The extent of preload in any area of the development will depend on the depth of soft soil in that area and the level of post construction settlement that would be acceptable. The depth of the soft clay and loose clayey sand layers varies over the site, as shown on Figures 10 and 11.

Significant soft clays and clayey sands (sensitive fine grained material) exist over the majority of the site and placement of the regrading fill to about RL 3.4m AHD will result in significant settlement. The settlement will consist of relatively short term settlement due to primary consolidation of the clay layers and long term settlement due to secondary (creep) consolidation. These settlements can be reduced by preloading, by the placement of additional fill for a period and then removing the fill back down to the required level. The longer the preload is in place and the higher the preload for a particular depth of clay, the lower will be the expected post construction settlement.

Over the majority of the site the depth of the Unit 1A Clay is only about 2m, with the underlying Unit 1B Clayey Sand also about 2m, but there are some areas of the site where the depth of these clay layers increase to a total of 9m or 10m.

The anticipated post construction settlement associated with filling of the site with various depths of clay and preload heights are shown in Table 10. The anticipated rates of settlement are based on 95% consolidation over 20years, aiming for a minimum 90% consolidation prior to the preload fill being removed.

TABLE 10 – SUMMARY OF ANTICIPATED POST CONSTRUCTION SETTLEMENTS FOR VARIOUS PRELOAD HEIGHTS AND THICKNESSES OF COMPRESSIBLE SOIL LAYERS

ESTIMATED THICKNESS OF COMPRESSIBLE SOIL LAYERS	SETTLEMENT WITHOUT PRELOAD (2.8m OF FILL)	SETTLEMENT WITH 2m OF PRELOAD FILL	SETTLEMENT WITH 3m OF PRELOAD FILL	ESTIMATED PRELOAD TIME FOR 90% PRIMARY CONSOLIDATION
CASE 1 2m UNIT 1A 2m UNIT 1B	112	30	9	0.2 to 0.4 years
CASE 2 4m UNIT 1A 2m Unit 1B	196	56	18	0.6 to 1.2 years
CASE 3 6m UNIT 1A 4m UNIT 1B	324	110	46	1.1 to 2.2 years

NOTES:

1. *The settlement is designed to cope with a surface load of 10kPa over a 15m width.*
2. *The preload remains in place for a sufficient time to obtain at least 90% primary consolidation of the clay layers prior to removal of the preload.*
3. *Settlement of the sand layers occurs during preload and does not contribute to post construction settlement.*
4. *The preload is placed as single stage preload.*
5. *Normal density fill is used for the bulk fill and preload fill.*

The above table indicates that the majority of the low lying portion of the site will require preloading to control post construction settlements to a reasonable level. Where the clay is not thick (less than about 1m to 1.5m thick), the preload times are relatively short and a rolling preload could be adopted to progressively preload the areas required. Preload fill could be reused to fill or preload other areas in the staged development as required.

Where filling takes place directly over soft ground areas the contractor should apply construction methodology to minimise the risk of shear failure occurring in the clay layer from plant equipment movements. This may include the use of tensile fabric, a bridging layer of fill to provide a construction platform and the use of specifically nominated equipment.

It is difficult to quantify differential settlement as distinct from absolute settlement, but by designing total post-construction settlement to less than 50mm in twenty years by preloading, then differential settlement should be manageable. Preloading will need to be instrumented and monitored, with adjustment of timing and placement of additional preload if required. Monitoring during preloading will be able to provide better indication of possible differential settlement at the top of the embankment in relation to total settlement.

The results indicate that, assuming there are no stability problems, surcharges of at least 3m high could be required in order to build out the majority of settlement under the design loading in a reasonable time frame. More likely, it is considered that wick drains or other means of accelerating the groundwater drainage from the consolidating layer will probably be required if a time period for consolidation of shorter than 6 months is required.

Owing to the importance of the consolidation issues for the overall project, in terms of the volumes of sand fill required and the construction timing, construction of a monitored trial embankment should be considered for this site at the earliest opportunity.

11.4 Stability of Embankments

The low shear strength and depth of the Soft Clay (UNIT 1A) materials will limit the height to which embankments can be constructed, together with the rate at which embankments can be constructed. Shear failure at the edge of the filled areas can be controlled by either:

1. Staged placement of the fill, with placement of the subsequent layers following consolidation of the clays with increased shear strengths; or
2. Placement of the fill on a flat batter of say 1V:4H.

Specific fill placement will require analysis using slope stability programs such as “SLOPE/W” for the specific conditions at a site.

11.5 Heavy Duty Pavements

The effectiveness of heavy duty pavements is obviously dependent of the quality of the materials used as well as the proper thickness design and quality of construction. These are relatively easy to control compared to the existing sub grade conditions. An effective pavement would have to allow for poor sub grade conditions by additional pavement thickness or some modification of the sub grade.

11.6 Acid Sulfate Soil Management

As dewatering is not expected to be required and the volume of excavated material is expected to be minimal, the effective treatment of Acid Sulfate Soils is expected to be achievable by mixing with lime which, with the right dosing and mixing, neutralises the sulfuric acid produced.

11.7 Buried Concrete and Steel Protection

The Australian Standard AS 2159–1995, '*Piling Design and Installation'* is often used to provide exposure classifications for steel and concrete piles for a variety of environments as well as guidance on the design for durability of steel, concrete and timber piles. In most situations, the aggressivity of groundwater can be combated by proper concrete mix design and allowance for concrete cover thickness of steel thickness.

12. LIMITATIONS OF ASSESSMENT

This report has not been prepared for use by parties other than Redlake Enterprises Pty Ltd and their respective consultants. This report may not contain sufficient information for the purposes of other parties or for other uses.

This assessment of geotechnical conditions should be considered as preliminary as it is based on very limited subsurface information. The report has been prepared in accordance with generally accepted consulting practice and is intended to alert interested parties to the geotechnical conditions, associated hazards, and possible solutions for the proposed development. As such the document is provided for use in preliminary planning and to provide direction to further investigations. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The extent of testing associated with this assessment is limited to borehole and CPT data at discrete locations. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. The boreholes and CPT's used as the basis for the preliminary geotechnical model represent a very small proportion of the site to be developed, and it should be noted that significant variations in ground conditions can occur between such locations in the alluvial / estuarine environment. Specific, detailed geotechnical investigations should be undertaken prior to developing concept or detailed design.

The key geotechnical issues that need to be investigated in further detail before detailed design of the foundations and excavations can proceed include the following:

(i) Variation in depth of the dense sand layer across the site;

(ii) Strength and deformation properties of the dense sand layer for piled foundation design;

(iii) Soil dynamic properties for vibrating machinery;

(iv) Soil permeabilities and groundwater flow rates for dewatering design and analysis of consolidation;

(v) Shear strength properties of the soft layers for excavation support and stability assessment;

(vi) Variation in consolidation properties of the soft layers;

(vii) Acid Sulfate Soil potential in the materials to be excavated.

Coffey would be pleased to assist in such investigations, management of geotechnical risk, and geotechnical design work.

If you have any questions regarding this report, or require further assistance with this project, please do not hesitate to contact the undersigned.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD



ARTHUR LOVE

REFERENCES:

1. Coffey Partners International Pty Ltd, Sinclair Knight Merz and Ansto, '*Report No.1 – Data Review and Assessment of Hydrogeological and Hydrochemical Impacts of Heavy Mineral Mining on the Tomago Sandbeds, Newcastle, NSW*', 22 February 1996 (Ref: G419/3-BP).
2. Soil & Rock Engineering Pty Ltd Report, '*Preliminary Geotechnical Investigation – Proposed Steel Mill and Port Development – Tomago, NSW, Australia*', 20 July 2001 (Ref: dcb5264_1_01rep.doc).
3. Soil & Rock Engineering Pty Ltd Report, '*Stage 2 Geotechnical Investigation – Proposed Steel Mill – Tomago, NSW, Australia'*, 28 December 2001 (Ref: dcb5264_3_01rep.doc).
4. Summerell, S.J. and McNally, G.H. (1998), '*Engineering and Quaternary Geology of a Lightweight Fill Site at Lenaghans Swamp, Near Minmi NSW*', published by the Australian Geomechanics Society in 'Geotechnical Engineering in the Hunter Valley', Conference Proceedings, University of Newcastle, 11-13 July 1998 (pp.98-107).
5. Bureau of Meteorology website (www.bom.gov.au).

Information

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Coffey Geosciences Pty Ltd ABN 057 056 335 516

Coffey

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design toward construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

** For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, National Headquarters, Canberra, 1987.*

In reply please send to: Newcastle District Office

Our reference:

Your reference:

Contact: Phil Alexander (02) 4908 4352

Coffey Geosciences Pty Ltd
Fax No 4967 5402

ATTENTION: ARTHUR LOVE

1 March 2006

Dear Sir

ENQUIRY NO. TENQ06-00481O1
LOT 161 DP 774440, LOT 1 DP 1003492, LOT 1 DP 597372 AND
LOT 513 DP 585256 TOMAGO RD TOMAGO

Thank you for your letter dated 1st March 2006. The abovementioned properties **are not** located within a proclaimed Mine Subsidence District and **are not** subject to any controls imposed by the Mine Subsidence Board.

The Board's records indicate the subject properties are not undermined and are not likely to be affected by any future mining.

Yours faithfully

Phil Alexander
Acting District Manager

COFFEY GEOSCIENCES PTY LTD NEWCASTLE
- 2 MAR 2006

MINE SUBSIDENCE BOARD

HEAD OFFICE:
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APPENDIX A

Results of Current Field Investigations (Borehole Logs)

Soil Description

Explanation Sheet

Coffey

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil.

Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (USC) as shown in the table on the following page.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200mm
Cobbles		63mm to 200mm
Gravel	coarse	20mm to 63mm
	medium	6mm to 20mm
	fine	2.36mm to 6mm
Sand	coarse	600μm to 2.36mm
	medium	200μm to 600μm
	fine	75μm to 200μm

MOISTURE CONDITION

Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH su (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	-	Crumbles or powders when scraped by thumb nail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very Loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:	
		Coarse grained	Fine grained
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	<5%	<15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	5% - 12%	15% - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample	Weakly cemented	Easily broken up by hand in air or water
Lenses	Discontinuous layers of lenticular shape	Moderately cemented	Effort is required to break up the soil by hand in air or water
Pockets	Irregular inclusions of differential material		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible
Residual soil	Structure and fabric of parent rock not visible

TRANSPORTED SOILS

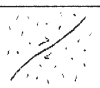
Aeolian soil	Deposited by wind
Alluvial soil	Deposited by stream and rivers
Colluvial soil	Deposited on slopes (transported downslope by gravity)
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes
Marine soil	Deposited in ocean basins, bays, beaches and estuaries

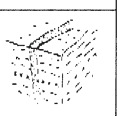
SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60mm and basing fractions on estimated mass)						USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of material less than 63mm is larger than 0.075mm	(A 0.075mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.		GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)		GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below).		GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing.		SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).		SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63mm is smaller than 0.075mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2mm				
			DRY STRENGTH	DILATANCY	TOUGHNESS		
		SILTS AND CLAYS Liquid limit less than 50	None to Low	Quick to slow	None	ML	SILT
			Medium to high	None	Medium	CL	CLAY
			Low to medium	Slow to very slow	Low	OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to none	Low to medium	MH	SILT
			High	None	High	CH	CLAY
			Medium to high	None	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture			Pt	PEAT

* Low plasticity - Liquid Limit W_L less than 35%. Medium plasticity - W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2m in length	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter.	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planer to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 1**

Engineering Log - Borehole

Sheet 1 of 3

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **27.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **27.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382507 | slope: -90° | R.L. Surface: 0.85

hole diameter: 100 mm | Northing 6367352 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		C						CI	**CLAY:** medium plasticity, brown, with organic material and rootlets.	M	VS-S		TOPSOIL
								CH	**Sandy CLAY:** high plasticity, grey, sand fine to medium grained.	M>Wp			ESTUARINE
				U_{50}	0	1							Vane Shear Test 0.6-0.8m, Peak 20kPa, Residual 7kPa.
											VS	x x	
				U_{50}	-1	2						x	Vane Shear Test 1.55-1.65m, Peak 10kPa, Residual 3kPa.
W		W			-2	3							
				SPT 0,1,1 N*=2	-3	4		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity.	W	L		ALLUVIUM
					-4	5		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity, trace sand coarse grained and subrounded gravel fine grained.				
				SPT 5,7,19 N*=26				SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity.		MD-D		
					-5	6		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity, trace sand coarse grained and subrounded gravel fine grained.				
				SPT 2,13,>20 N*=R	-6	7		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity.		D-VD		SPT bouncing after 0.4m.
					-7	8							

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

Form GEO 5.3 Issue 3 Rev.2

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 1**

Sheet 2 of 3

Office Job No.: **N09814/01**

Engineering Log - Borehole

Client: ***ASQUITH & DE WITT PTY LTD***

Date started: ***27.1.2006***

Principal: ***REDLAKE ENTERPRISES PTY LTD***

Date completed: ***27.1.2006***

Project: ***DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO***

Logged by: ***KM***

Borehole Location: ***REFER TO DRAWING N09814/01-1***

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382507 | slope: -90° | R.L. Surface: 0.85

hole diameter: 100 mm | Northing 6367352 | bearing: | datum: AHD

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
W		W		SPT 14,>20,- N*=R	-8	9		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity. *(continued)* Layer (<50mm) with carbonaceous material (<3m) and subrounded gravel fine grained.	W	D-VD		
				SPT 15,>20,- N*=R	-9	10							
					-10	11		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity.		MD-D		
				SPT 8,11,15 N*=26				SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity.				
					-11	12		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity.		MD		
				SPT 4,11,11 N*=22	-12	13			Trace carbonaceous material (<1mm) and subrounded gravel fine grained. Increased clay content. Possibly clay based on lack of cuttings and poor penetration (no clay on bit).				
					-13	14							
				U_{50}	-14	15		SP	**SAND:** fine to coarse grained, dark grey, trace clay medium plasticity.				U50 refused after 100mm - had to push through approximately 0.5m of backfill before reaching target depth - U50 tube empty replace rock roller bit.
				SPT 7,17,21 N*=38	-15	16		GP	**Sandy GRAVEL:** fine to medium grained, grey, sand fine to coarse grained.		D		

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 1**

Engineering Log - Borehole

Sheet 3 of 3

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **27.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **27.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382507 | slope: -90° | R.L. Surface: 0.85

hole diameter: 100 mm | Northing 6367352 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		W						SP SP	**SAND:** fine to coarse grained, dark grey, trace clay medium plasticity. *(continued)*	W	D		
					-16	17							
				SPT 5,10,11 N*=21							MD		
					-17	18		SC	**Clayey SAND:** fine to medium grained, dark grey, clay medium plasticity, with some subrounded gravel fine grained. With shell material (<3mm).				
								CH	**CLAY:** high plasticity, grey, with lenses containing shell material (<20mm).	M<Wp	St	×	
				SPT 2,4,4 N*=8	-18	19							
									Borehole CBH 1 terminated at 19.05m			×	
					-19	20							
					-20	21							
					-21	22							
					-22	23							
					-23	24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix e.g.	ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 2**

Sheet 1 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **23.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **23.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **DMR/KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382942 | slope: -90° | R.L. Surface: 0.41

hole diameter: 100 mm | Northing 6367169 | bearing: | datum: AHD

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		C			0	1		CH	**TOPSOIL:** CLAY, medium plasticity, brown-red/brown with some organic matter and root fibres.	M=Wp			TOPSOIL
								CH	**CLAY:** high plasticity, grey.	M>>Wp	S-VS		ESTUARINE
			▼	U_{50}	-1	2							Vane Shear Test 1.0-1.3m, Peak 24kPa, Residual 4kPa.
W				U_{50}	-2								
					-3	3							
				SPT 1,1,0 N=1	-4	4		SP-SC	**SAND:** fine to medium grained, grey, some clay medium plasticity, trace shell fragments (<5mm).	W	L		ALLUVIUM
						5		SP	**SAND:** fine to medium grained, grey, some shell fragments (<5mm).		L-MD		
				SPT 3,3,4 N*=7	-5								
		M			-6	6		SP	**SAND:** fine to medium grained, grey/pale brown, some lenses with shell material throughout (<5mm).		MD		
				SPT 4,6,8 N*=14	-7	7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

▼ 10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 2**

Sheet 2 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **23.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **23.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **DMR/KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382942 | slope: -90° | R.L. Surface: 0.41

hole diameter: 100 mm | Northing 6367169 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		M		SPT 5,13,16 N*=29	-8	9		SP	**SAND:** fine to medium grained, grey/pale brown, some lenses with shell material throughout (<5mm). *(continued)*	W	MD-D		
					-9								
				SPT 6,10,14 N*=24		10							
					-10			SC	**Clayey SAND:** fine to medium grained, grey/brown, clay low plasticity, with shell material (<5mm).				
						11							
				SPT 6,12,19 N*=31	-11			SP	**SAND:** fine grained, grey, trace clay low plasticity.		D		
						12							
					-12				Carbonaceous fragments (3mm to 5mm)				
				SPT 5,9,14 N*=23		13		SC	**Clayey SAND:** fine to medium grained, grey, clay low plasticity.		MD		
					-13								
						14		SP	**SAND:** coarse grained, grey/black/orange/blue, some clay low plasticity.				
				SPT 7,2,2 N*=4	-14			GP	**Sandy GRAVEL:** fine grained, white/black/grey/red, subangular, sand fine to medium grained.		L		
						15							
					-15				Possible clay lense based on cuttings/drill head (<100mm). Penetration alternating every 100mm between 15.1m and 15.4m (2-3).				
				SPT 4,11,24		16					MD-D		

BOREHOLE N09814-01.GPJ COFFEY.GDT 23.02.06

Form GEO 5.3 Issue 3 Rev.2

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 2**

Sheet 3 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **23.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **23.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **DMR/KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382942 | slope: -90° | R.L. Surface: 0.41

hole diameter: 100 mm | Northing 6367169 | bearing: | datum: AHD

drilling information

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres
W		M		N*=35	-16	17
				SPT 10,24,- N*=R	-17	18
					-18	
				SPT 12,30,- N*=R		19
					-19	20
					-20	21
					-21	22
					-22	23
					-23	24

material substance

graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
	SP	**SAND:** medium to coarse grained, grey/brown, some clay low plasticity.	W	MD-D		
		Possible carbonaceous lenses (<50mm) 16.5m to 17m.				
	SP	**Gravelly SAND:** medium to coarse grained, grey, gravel fine grained. Some medium (15mm - 20mm), subrounded gravels. SPT finished at 17.45m, SPT bouncing. Water loss.		VD-D		
		Carbonaceous lense. SPT finished at 18.95m, SPT bouncing.				
		Borehole CBH 2 terminated at 18.95m				

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE N09814-01.GPJ COFFEY.GDT 23.02.06

Form GEO 5.3 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 3**

Sheet 1 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **27.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **27.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382893 | slope: -90° | R.L. Surface: 0.8

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres
ADV		C	▼			
				U_{50}	0	1
				U_{50}	-1	
W				SPT 4,9,14 N*=23	-2	2
		W				3
				SPT 7,11,13 N*=24	-3	
					-4	4
				SPT 6,11,15 N*=26		5
					-5	6
				SPT 3,6,7 N*=13	-6	
					-7	7
						8

material substance

graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
	CI	**CLAY:** medium plasticity, brown.	M	S	×	TOPSOIL
	CI	**Sandy CLAY:** medium plasticity, grey, sand fine grained.	W>Wp	S/VS	×	ESTUARINE
					×	Vane Shear Test 0.7-0.8m, Peak 12kPa, Residual 1kPa.
	SP	**SAND:** fine to medium grained, brown, some silt.	W	D-VD		INDURATED SAND
	SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity.				ALLUVIUM
	SP	**SAND:** fine to medium grained, brown, some silt.				INDURATED SAND
				D		
		Trace sand coarse grained and carbonaceous material (<3mm).				
		Trace subrounded gravel fine grained and carbonaceous material (<3mm).		MD		
	SP					ALLUVIUM

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

▼ 10/1/98 water level on date shown

► water inflow

◄ water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 3**

Sheet 2 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **27.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **27.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

Coffey

drill model and mounting: Atkins Truck Rig | Easting: 56382893 | slope: -90° | R.L. Surface: 0.8

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		W		SPT 9,15,20 N*=35	-8	9		SP	**SAND:** fine to medium grained, brown/grey, trace clay medium plasticity. *(continued)*	W	D		
				SPT 9,>20,- N*=R	-9	10		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity.		D-VD		
				SPT 11,20,>20 N*=R	-10	11							
					-11	12							
				SPT 12,>20,- N*=R	-12	13		Cl	**CLAY:** medium plasticity, grey (physical characteristics unable to be determined - observation from cuttings).	M>Wp	S		
								Cl	**CLAY:** medium plasticity, light brown (as above).				
					-13			Cl	**CLAY:** medium plasticity, grey (as above).				
				SPT 0,2,2 N*=4		14		Cl	**Sandy CLAY:** medium plasticity, grey, sand fine to medium grained, trace carbonaceous material (<5mm).		VS		
					-14			SP	**SAND:** fine to coarse grained, grey.	M	L/MD		
						15		GP	**Sandy GRAVEL:** fine to coarse grained, grey/black, sand fine to coarse grained.				
				SPT 4,4,3 N*=7	-15			Cl	**Sandy CLAY:** medium plasticity, grey, sand fine to medium grained.	M>Wp	VS		
						16							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 3**

Sheet 3 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **27.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **27.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56382893 | slope: -90° | R.L. Surface: 0.8

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		W						CI	**Sandy CLAY:** medium plasticity, grey, sand fine to medium grained. *(continued)*	M>Wp	VS		
					-16	17		CH	**CLAY:** high plasticity, grey, some sand fine to medium grained. Rock roller wheels filling with clay - near refusal. U50 refusal at 17.2m - U50 full with gravels which have most likely fall in from higher in the profile.		S		
				U_{50}	-17	18		GP	**Sandy GRAVEL:** fine to coarse grained, grey/black, sand fine to coarse grained.	W	MD		
					-18	19			Unable to do SPT, hole backfilled to approximately 17.5m. Borehole CBH 3 terminated at 18.5m				
					-19	20							
					-20	21							
					-21	22							
					-22	23							
					-23	24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE N09814-01.GPJ COFFEY.GDT 23.02.06

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Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 4**

Sheet 1 of 3

Office Job No.: **N09814/01**

Engineering Log - Borehole

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **24.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **24.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56383456 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres
ADV		C			0	1
				U_{50}	-1	2
				U_{50}	-2	3
W					-3	4
				SPT 3,4,4 N*=8	-4	5
		M		SPT 7,11,12 N*=23	-5	6
					-6	7
				SPT 6,7,9 N*=16	-7	8
				SPT 6,13,15 N*=28		

material substance

graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
	CH	**TOPSOIL:** CLAY, medium plasticity, brown/red-brown, white, organic matter and rootlets.	D/M	VS		TOPSOIL
	CH	**CLAY:** high plasticity, grey/brown mottled, some sand fine to medium grained.	M>Wp		× ×	ESTUARINE Vane Shear Test 0.7-0.8m, Peak 23kPa, Residual 5kPa.
	SP-SC	**SAND:** fine grained, grey, some clay medium plasticity, trace sand coarse grained.	W	L		ALLUVIUM
	SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity, brown, clayey sand lense <100mm thick with shell material (<3mm) throughout. Fine subrounded gravel in Clayey Sand lense.		MD		
		Penetration varying - apparent medium dense to dense layers <200mm, thickness of layers.		MD-D		
				D		

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

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Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 4**

Sheet 2 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **24.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **24.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56383456 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information							material substance					
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		M			-8	9		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity, brown, clayey sand lense <100mm thick with shell material (<3mm) throughout. *(continued)*	W	D		
					-9								
				SPT 8,14,20 N*=34		10			Trace fine subrounded gravels in clayey sand layer at 9.7m. Carbonaceous material (<2mm) through grey sand layers from approximately 9.7m.				
					-10								
						11							
				SPT 7,10,10 N*=20	-11						MD/D		
						12							
					-12								
				SPT 6,9,12 N*=21		13		SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity, trace fine subrounded gravels, trace carbonaceous material (3mm).		L-MD		
					-13								
						14							
				SPT 1,2,1 N*=3	-14						L		
						15		SP	**Gravelly SAND:** fine to coarse grained, grey, trace shell material (<2mm). Water loss occurring.		MD/D		
					-15								
				SPT R N*=R		16		GP	**Sandy GRAVEL:** fine grained, grey, sand coarse grained. SPT refusal prior to first 150mm.				

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

Form GEO 5.3 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 4**

Sheet 3 of 3

Office Job No.: **N09814/01**

Engineering Log - Borehole

Client: ***ASQUITH & DE WITT PTY LTD***

Date started: ***24.1.2006***

Principal: ***REDLAKE ENTERPRISES PTY LTD***

Date completed: ***24.1.2006***

Project: ***DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO***

Logged by: ***KM***

Borehole Location: ***REFER TO DRAWING N09814/01-1***

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56383456 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
W		M			-16	17		GP	**Sandy GRAVEL:** fine grained, grey, sand coarse grained. *(continued)*	W	MD/D		
					-17	18							
					-18	19		CH	**Silty CLAY:** high plasticity, grey, low liquid limit, silt.	M>Wp	S/VS		
					-19				Sample collected from rock roller at 19.55m.			x	
				SPT 10,6,10 N*=16	-20	20			SPT full of gravel most likely from higher in profile. Borehole CBH 4 terminated at 19.55m				
					-21	21							
					-22	22							
					-23	23							
						24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 5**

Sheet 1 of 3

Engineering Log - Borehole

Office Job No.: ***N09814/01***

Client: ***ASQUITH & DE WITT PTY LTD*** Date started: ***25.1.2006***

Principal: ***REDLAKE ENTERPRISES PTY LTD*** Date completed: ***25.1.2006***

Project: ***DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*** Logged by: ***KM***

Borehole Location: ***REFER TO DRAWING N09814/01-1*** Checked by:

Coffey

drill model and mounting: Atkins Truck Rig | Easting: 56383640 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367720 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADV		C			0	1		CI	**TOPSOIL:** CLAY, low to medium plasticity, brown, with organics and rootlets.	D/M	S	×	TOPSOIL
								CH	**CLAY:** high plasticity, grey.	W>Wp	S/VS		ESTUARINE
			▼	U_{50}	-1	2						×	
				U_{50}				SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity.	W	L/VL		ALLUVIUM
W					-2	3							
					-3	4		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity. Occasional brown clayey sand layers containing shell material (<3mm).		MD		
				SPT 4,5,7 N*=12	-4	5							
				SPT 5,9,11 N*=20	-5	6			No evidence of clayey sand layers containing shell material between 5.1m and 6.1m.		MD-D		
					-6	7		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity. Contains layers of carbonaceous material (<3mm) and layers containing trace sand coarse grained/gravel fine grained (SR) - layers generally <50mm (obs from SPT).		D-VD		
				SPT 19,20,22 N*=42	-7	8					MD-D		

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

▼ 10/1/98 water level on date shown

► water inflow

◄ water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 5**

Sheet 2 of 3

Engineering Log - Borehole

Office Job No.: ***N09814/01***

Client: ***ASQUITH & DE WITT PTY LTD*** Date started: ***25.1.2006***

Principal: ***REDLAKE ENTERPRISES PTY LTD*** Date completed: ***25.1.2006***

Project: ***DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*** Logged by: ***KM***

Borehole Location: ***REFER TO DRAWING N09814/01-1*** Checked by:

Coffey

drill model and mounting: Atkins Truck Rig | Easting: 56383640 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367720 | bearing: | datum: AHD

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
W		C		SPT 7,8,12 N*=20	-8	9		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity. *(continued)*	W	MD-D		
					-9								
				SPT 6,11,13 N*=24		10		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity. Containing layers with carbonaceous material (<5mm) and brown clayey sand layers with some fine gravelly layers (< 100mm thick, subrounded gravel).		D		
					-10								
						11			Possible clay layers based on cuttings.				
				SPT 6,11,15 N*=26	-11								
						12							
					-12						D-VD		
				SPT 10,23,35 N*=58		13							
					-13								
								SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity, some fine subrounded gravels.		VL/L		
						14							
				SPT 0,1,- N*=R	-14				SPT refusal after 400mm.				
								GP	**Sandy GRAVEL:** fine grained, subrounded gravels, grey/orange/black, sand fine to coarse grained.		D		
						15			**CLAY:** (physical characteristics unable to be determined from washbore cuttings).				
								GP	**Sandy GRAVEL:** fine grained, subrounded gravels, grey/orange/black, sand fine to coarse grained.				
					-15								
						16							

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

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method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 5**

Sheet 3 of 3

Engineering Log - Borehole

Office Job No.: **N09814/01**

Client: **ASQUITH & DE WITT PTY LTD**

Date started: **25.1.2006**

Principal: **REDLAKE ENTERPRISES PTY LTD**

Date completed: **25.1.2006**

Project: **DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO**

Logged by: **KM**

Borehole Location: **REFER TO DRAWING N09814/01-1**

Checked by:

drill model and mounting: Atkins Truck Rig | Easting: 56383640 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367720 | bearing: | datum: AHD

drilling information

material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C			-16	17		GP	**Sandy GRAVEL:** fine grained, subrounded gravels, grey/orange/black, sand fine to coarse grained. *(continued)* Water loss.	W	D		
					-17	18							
					-18	19			Cant manage water loss, hole collapsing when lifting rods to introduce more water. Borehole CBH 5 terminated at 18m				
					-19	20							
					-20	21							
					-21	22							
					-22	23							
					-23	24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

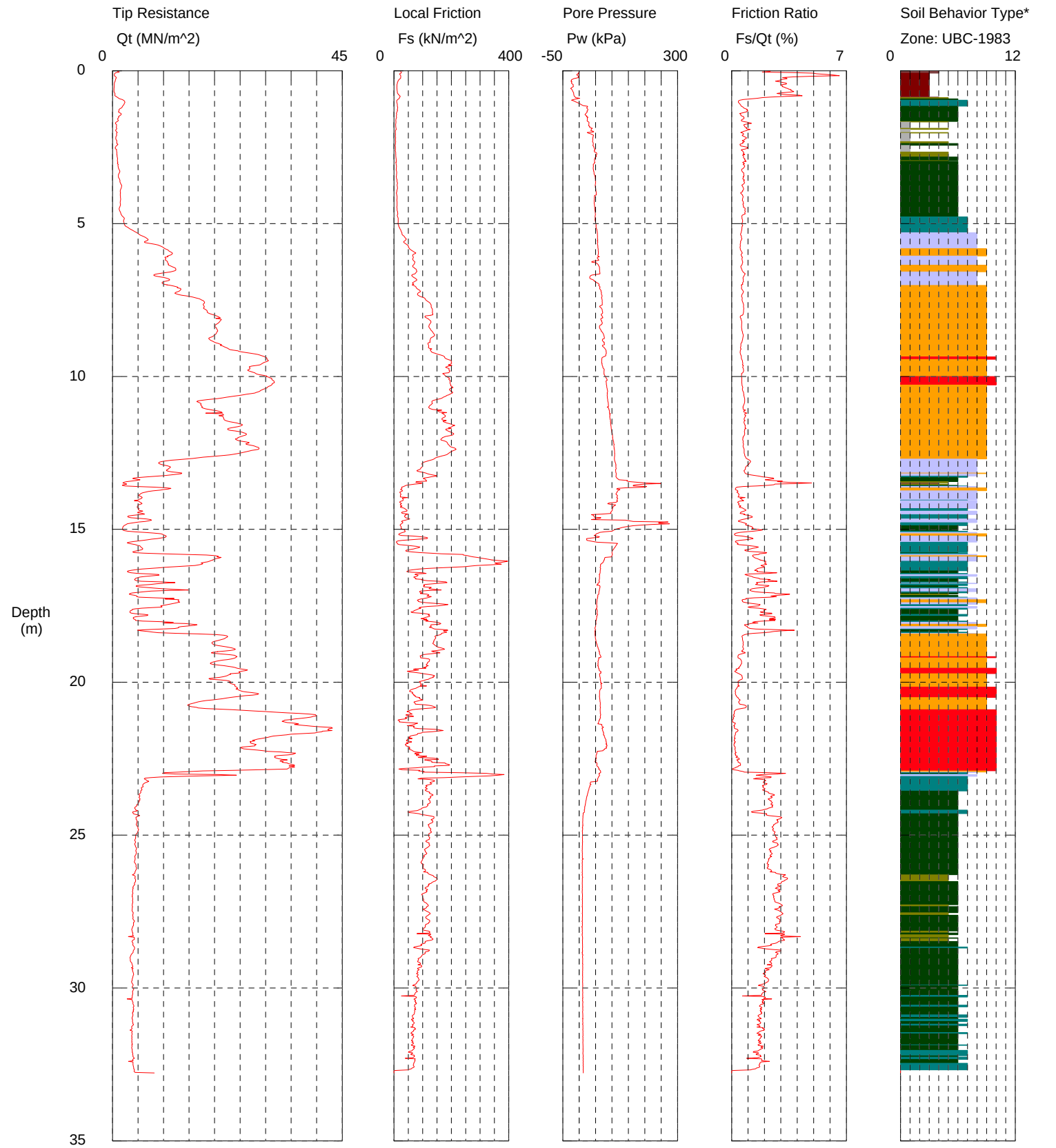
APPENDIX B

Results of Current Field Investigations (CPT (Piezocone) Test Results)

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Tom-01
Cone Used: 5T4CH

CPT Date/Time: 01-19-06 21:09
Location: Tomago
Job Number: 249



Maximum Depth = 32.78 meters

Depth Increment = 0.020 meters

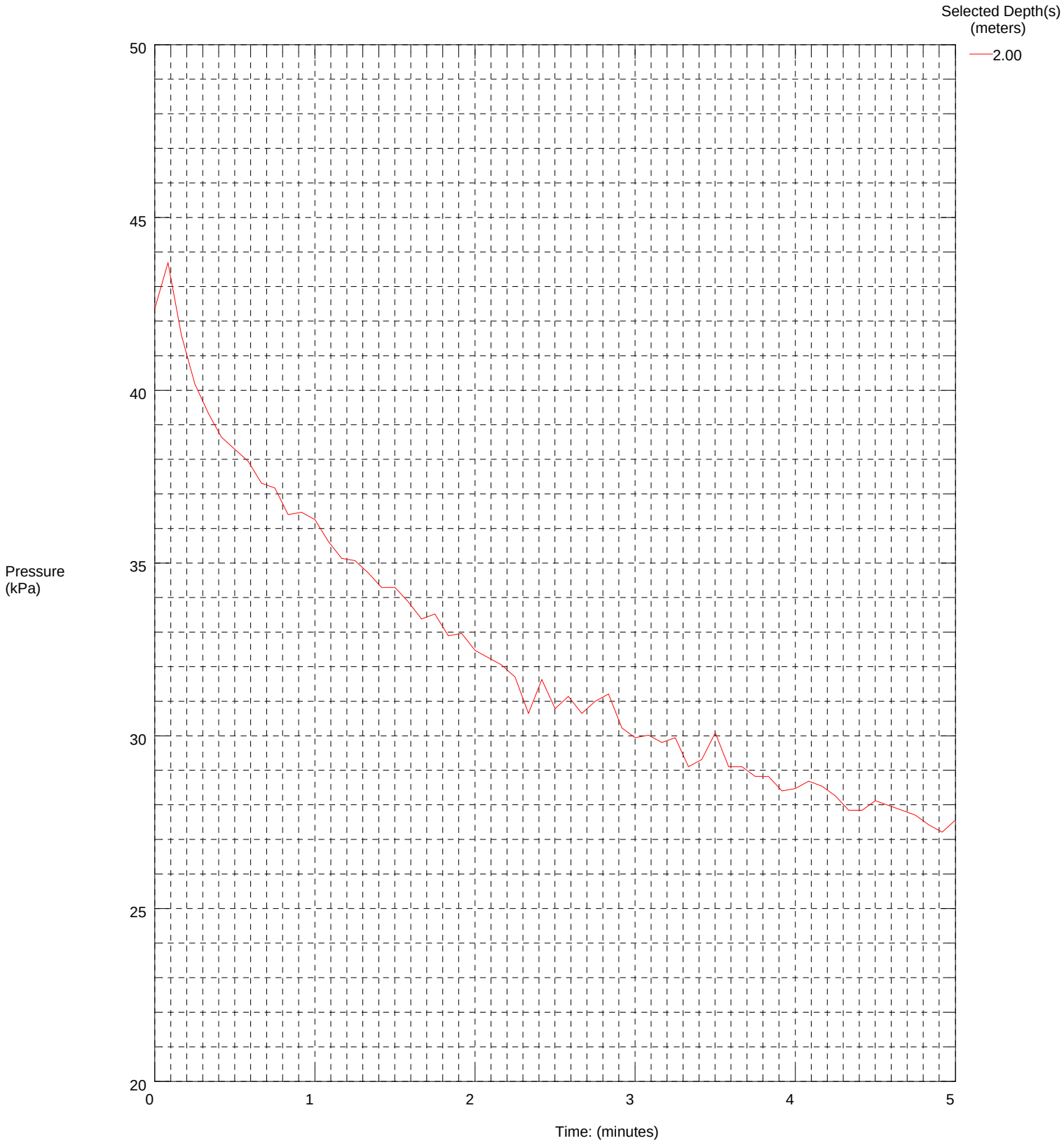
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-01
Cone Used: 5T4CH

CPT Date/Time: 01-19-06 21:09
Location: Tomago
Job Number: 249

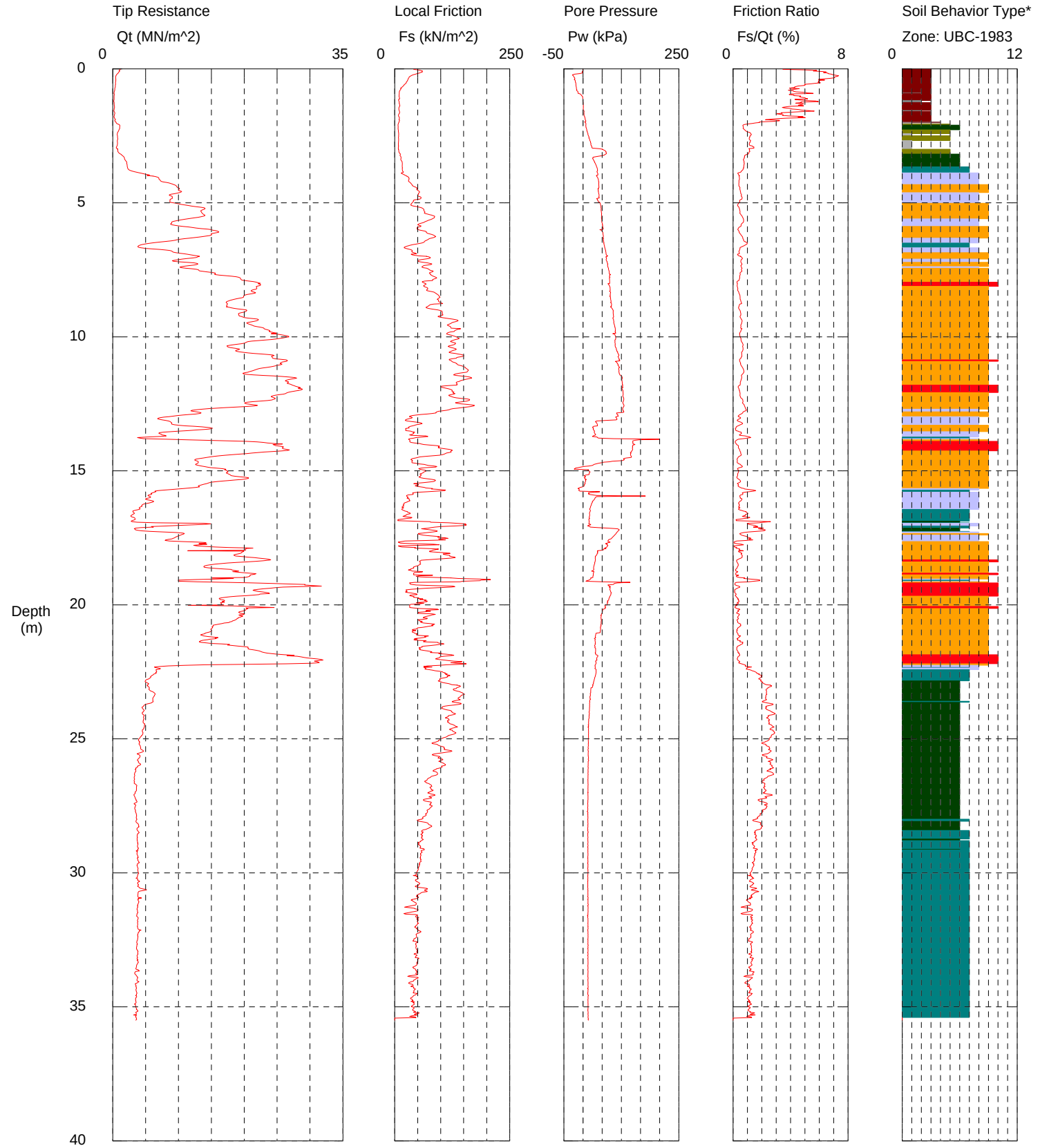


Maximum Pressure = 43.694 kPa
Hydrostatic Pressure = 12.763 kPa

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Tom-02
Cone Used: 5T4CH

CPT Date/Time: 01-19-06 22:53
Location: Tomago
Job Number: 249



Maximum Depth = 35.50 meters

Depth Increment = 0.020 meters

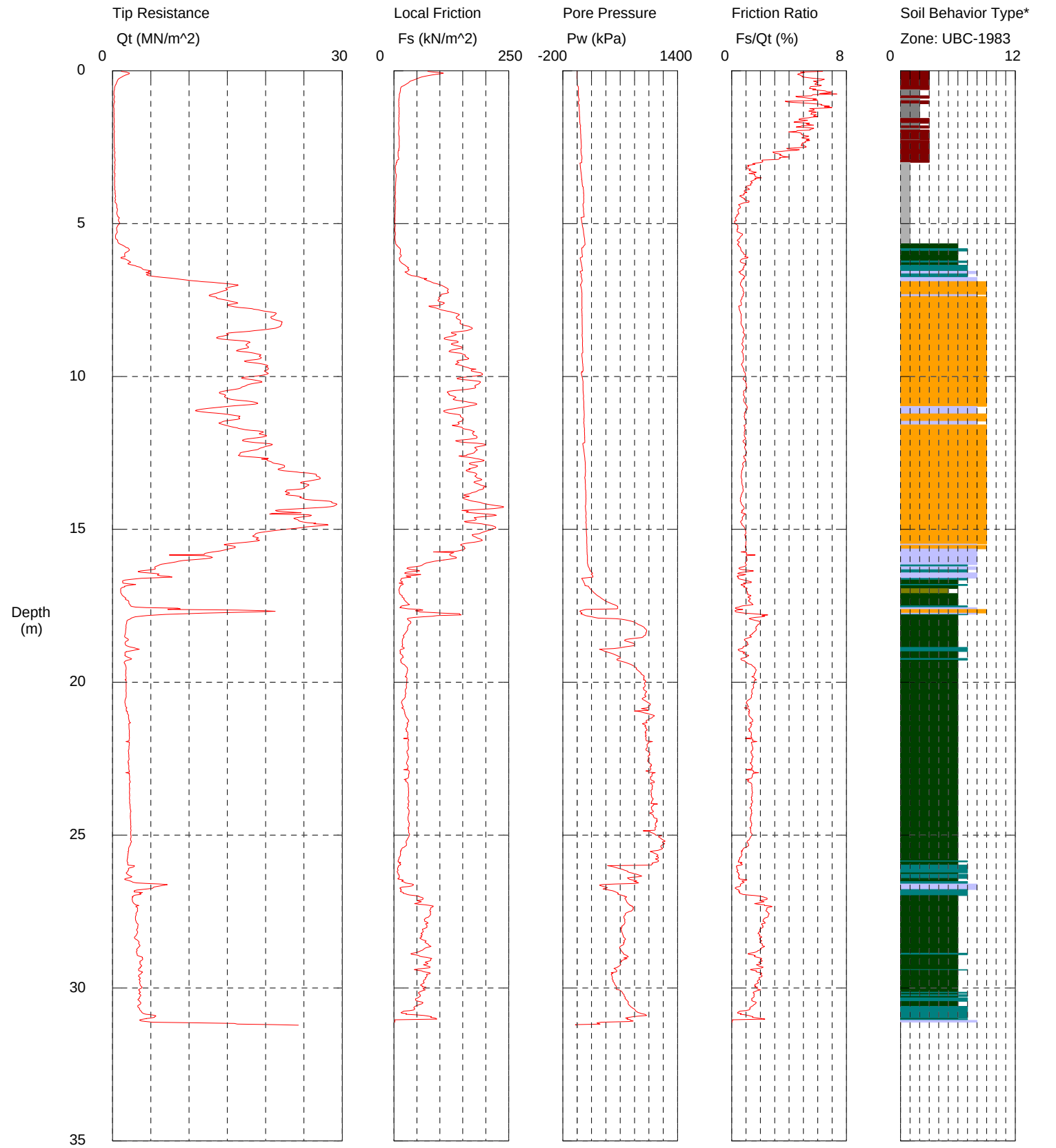
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Tom-03
Cone Used: 5T4CH

CPT Date/Time: 01-20-06 00:59
Location: Tomago
Job Number: 249



Maximum Depth = 31.22 meters

Depth Increment = 0.020 meters

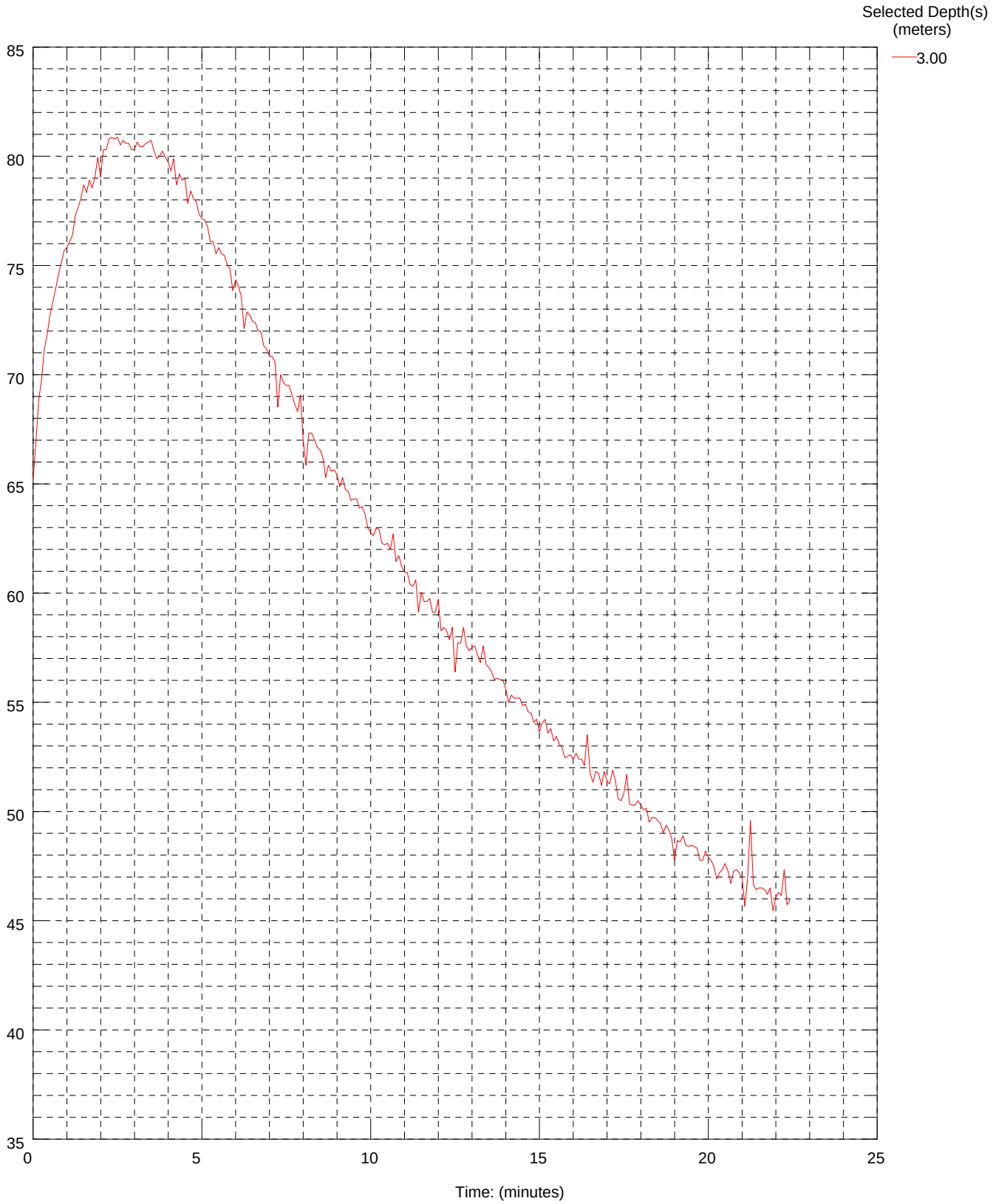
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-03
Cone Used: 5T4CH

CPT Date/Time: 01-20-06 00:59
Location: Tomago
Job Number: 249

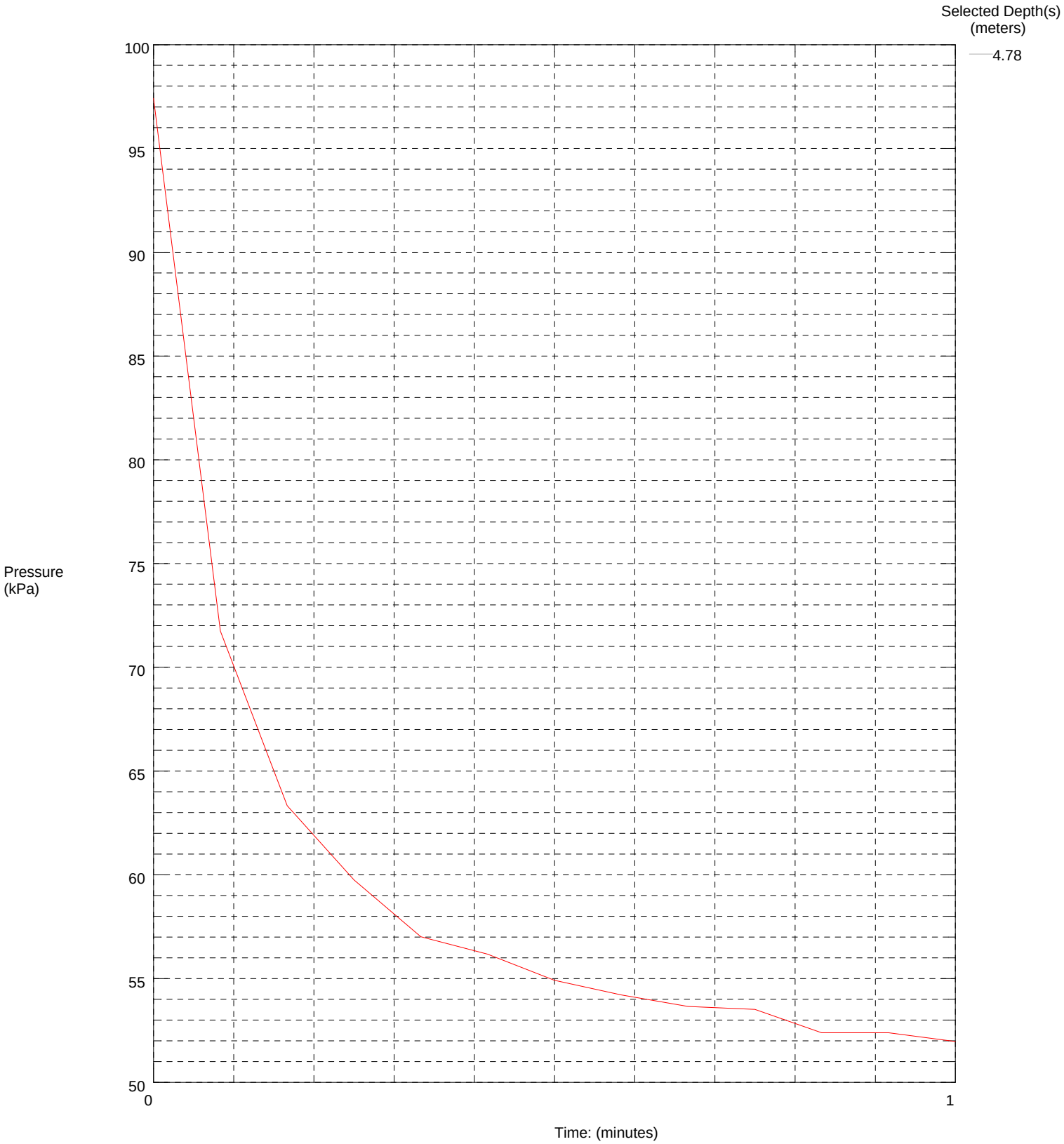


Maximum Pressure = 80.866 kPa
Hydrostatic Pressure = 22.581 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-03
Cone Used: 5T4CH

CPT Date/Time: 01-20-06 00:59
Location: Tomago
Job Number: 249

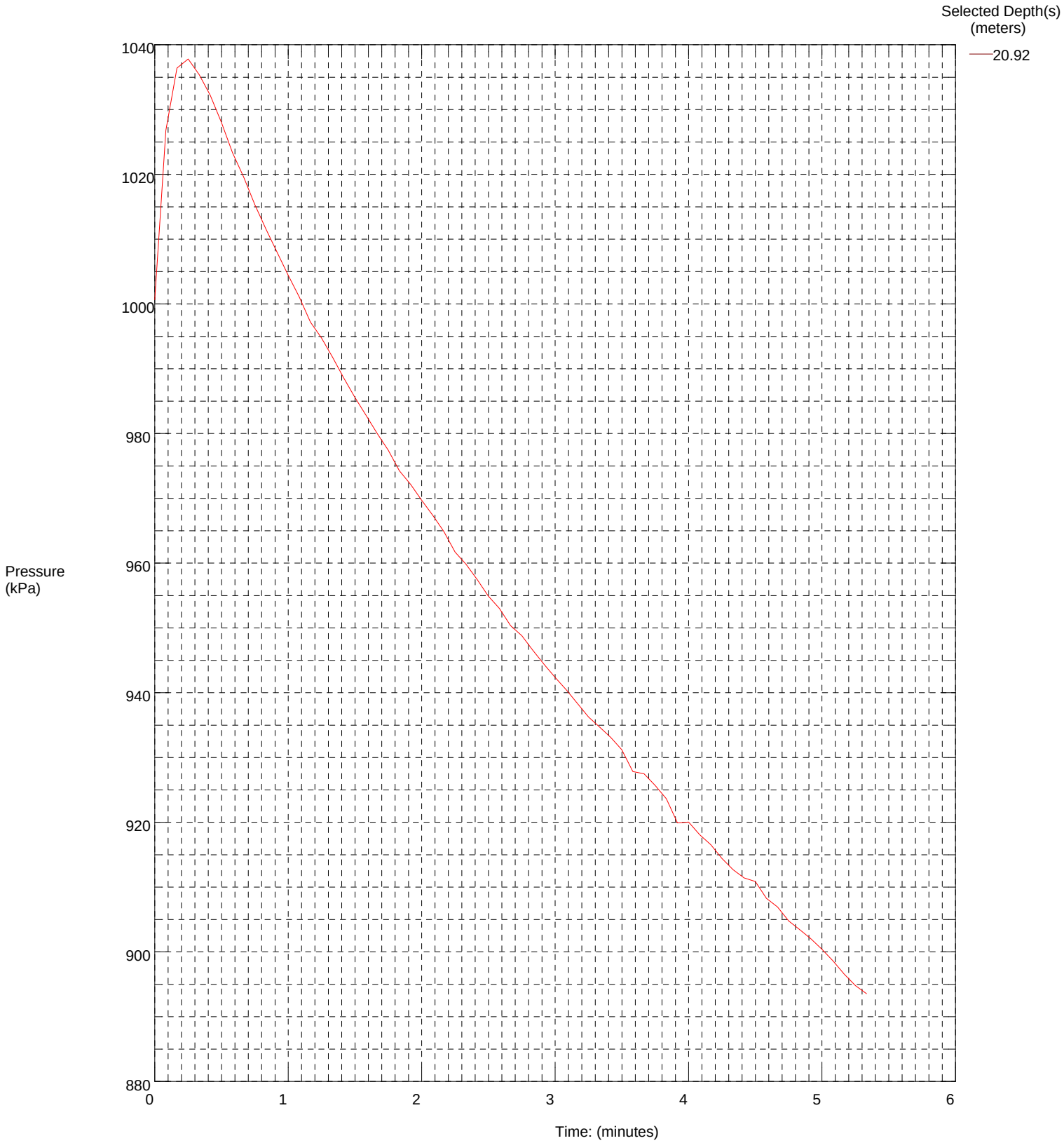


Maximum Pressure = 97.418 kPa
Hydrostatic Pressure = 40.056 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-03
Cone Used: 5T4CH

CPT Date/Time: 01-20-06 00:59
Location: Tomago
Job Number: 249

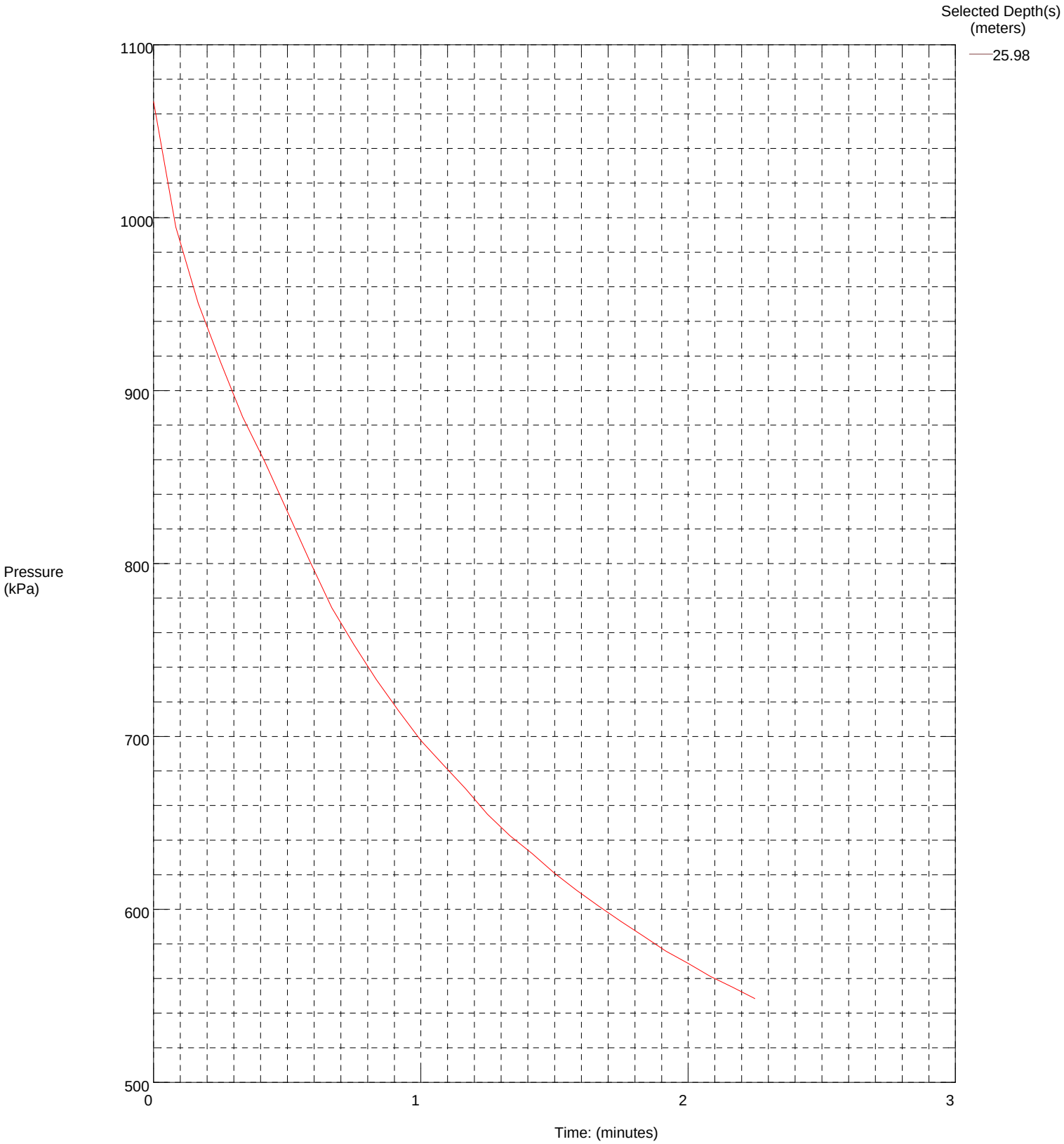


Maximum Pressure = 1037.795 kPa
Hydrostatic Pressure = 198.514 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-03
Cone Used: 5T4CH

CPT Date/Time: 01-20-06 00:59
Location: Tomago
Job Number: 249

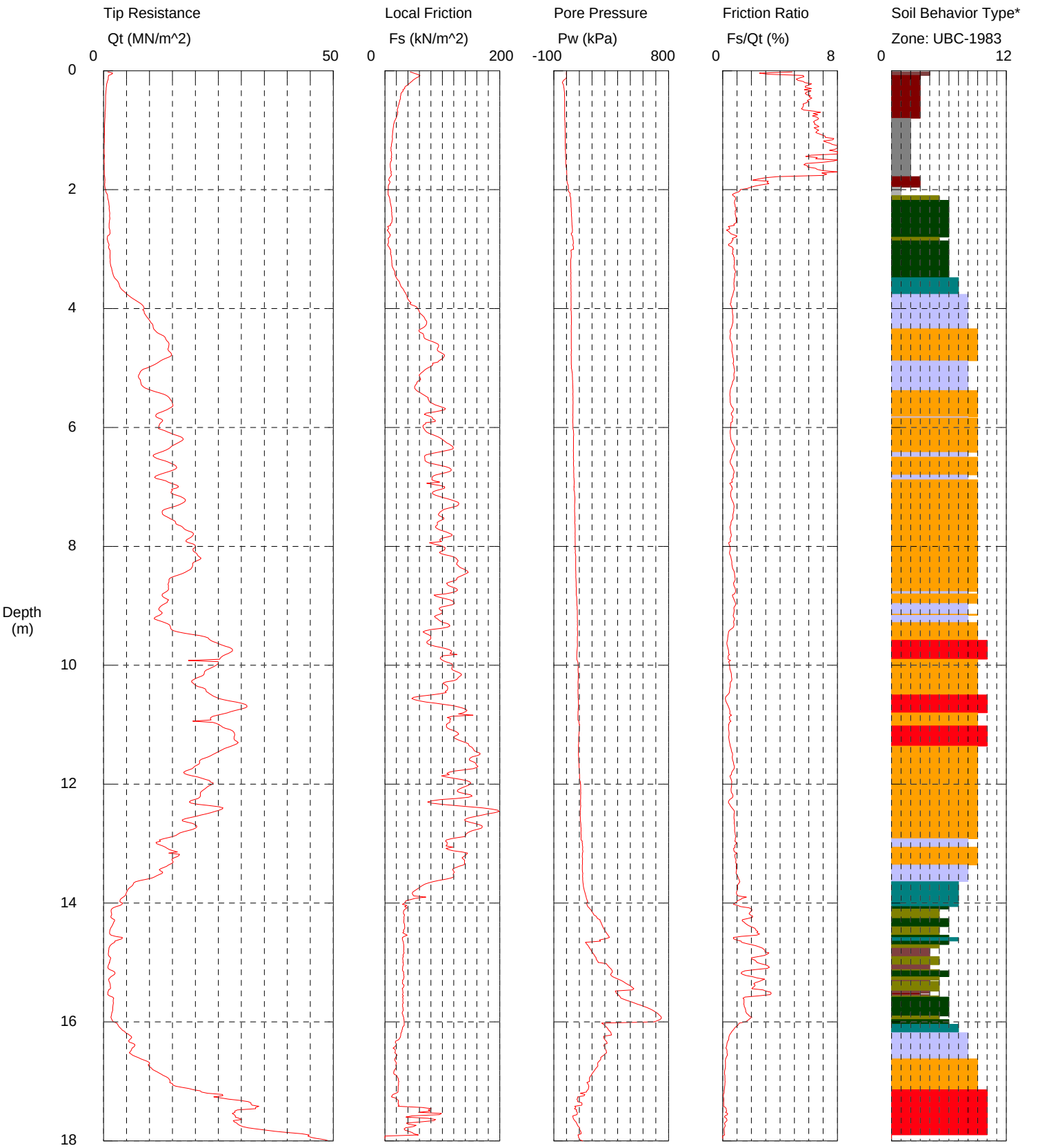


Maximum Pressure = 1067.112 kPa
Hydrostatic Pressure = 248.191 kPa

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Tom-04
Cone Used: 5T4CH

CPT Date/Time: 01-23-06 10:25
Location: Tomago
Job Number: 249



Maximum Depth = 18.00 meters

Depth Increment = 0.020 meters

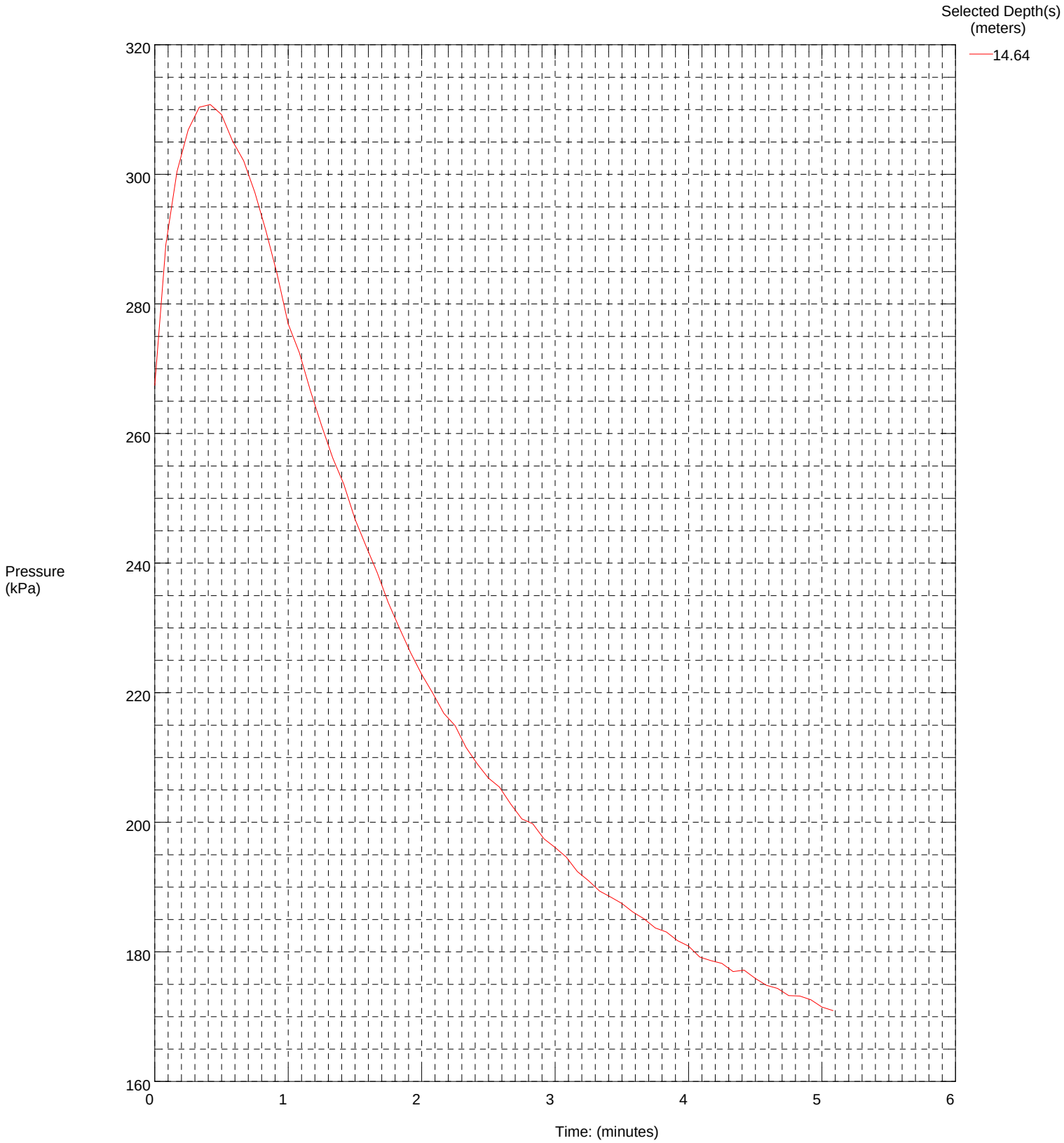
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-04
Cone Used: 5T4CH

CPT Date/Time: 01-23-06 10:25
Location: Tomago
Job Number: 249

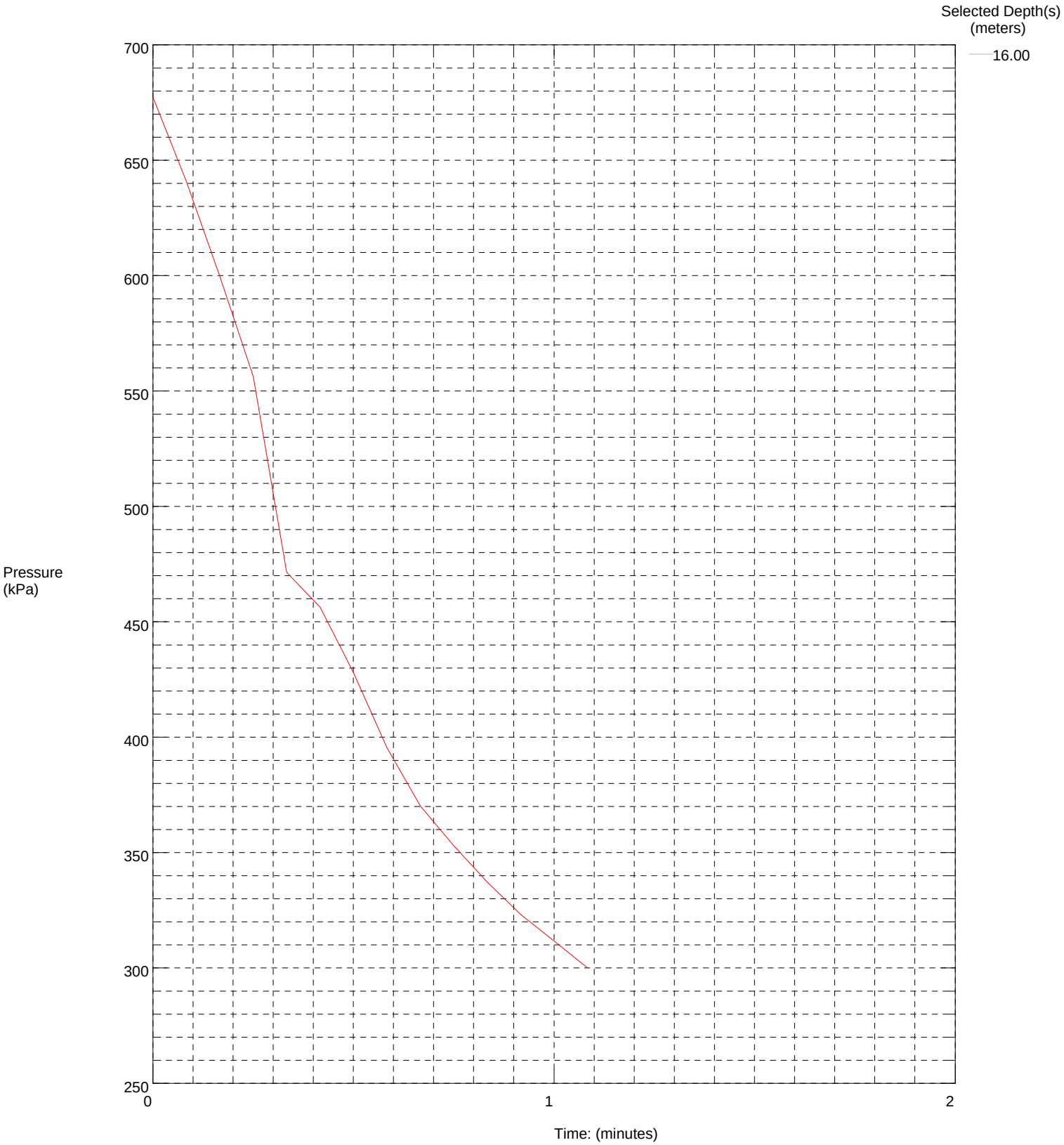


Maximum Pressure = 310.77 kPa
Hydrostatic Pressure = 136.859 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: Tom-04
Cone Used: 5T4CH

CPT Date/Time: 01-23-06 10:25
Location: Tomago
Job Number: 249

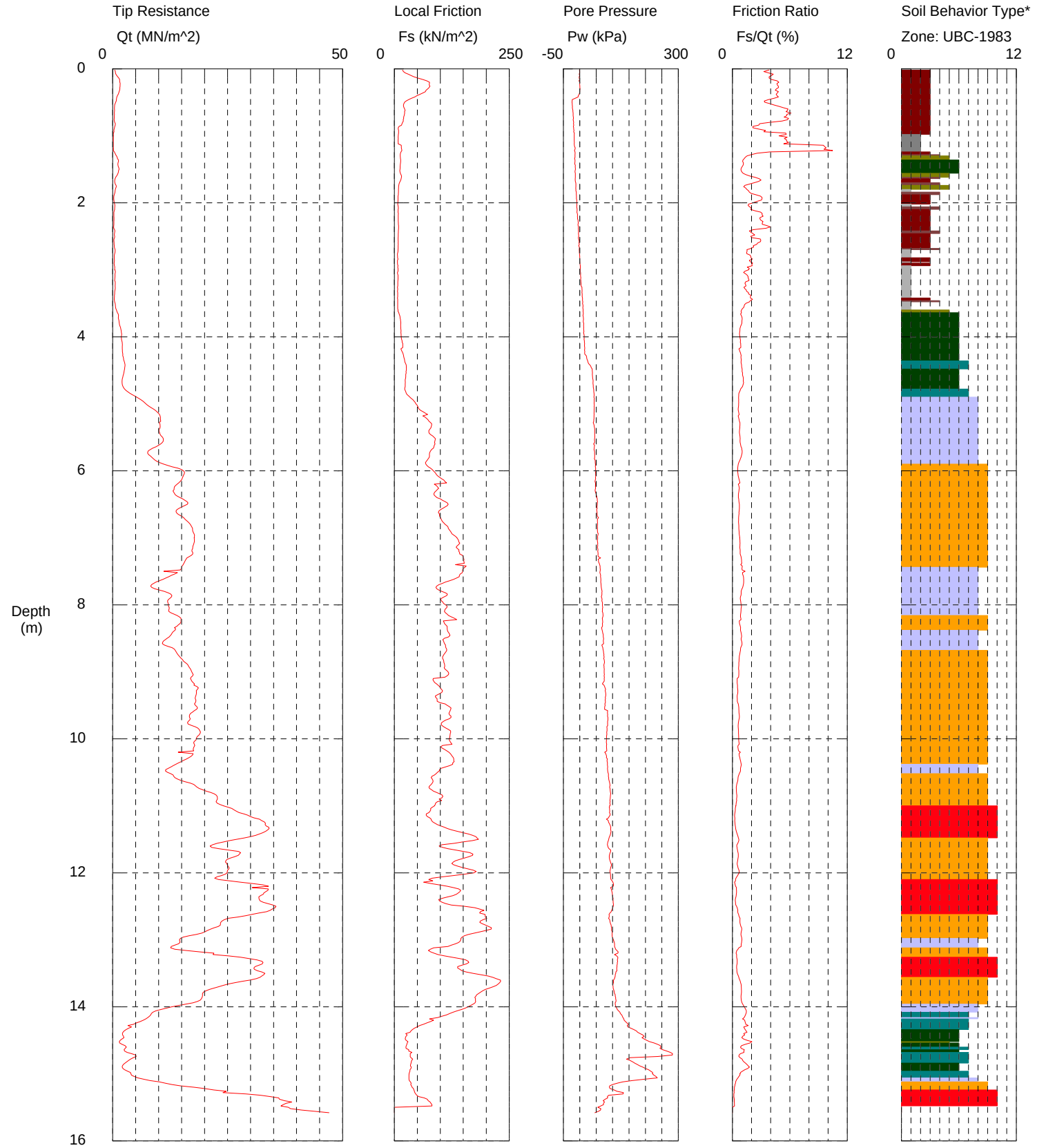


Maximum Pressure = 677.299 kPa
Hydrostatic Pressure = 150.211 kPa

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Tom-05
Cone Used: 5T4CH

CPT Date/Time: 01-23-06 12:08
Location: Tomago
Job Number: 249



Maximum Depth = 15.58 meters

Depth Increment = 0.020 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

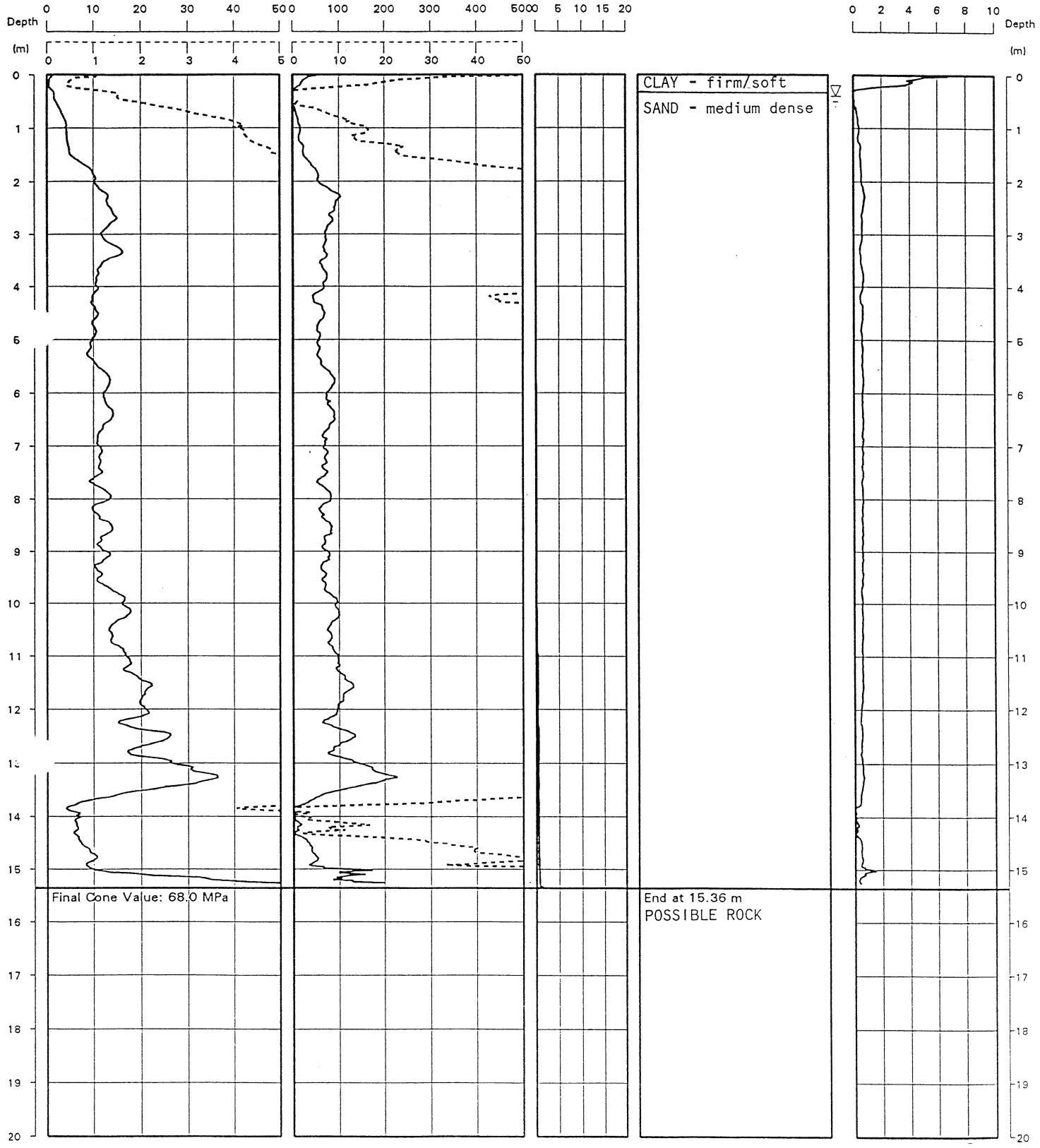
*Soil behavior type and SPT based on data from UBC-1983

APPENDIX C

Field Data From Previous Investigations (CPT Test Results)

CONE PENETRATION TEST

LIENT SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL	01 Page 1 of 1
	LOCATION	TOMAGO ROAD, TOMAGO	DATE 24/04/01
	PROJECT No	31299	SURFACE RL



REMARKS:

Date	4·5·01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-01.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 0.4m depth

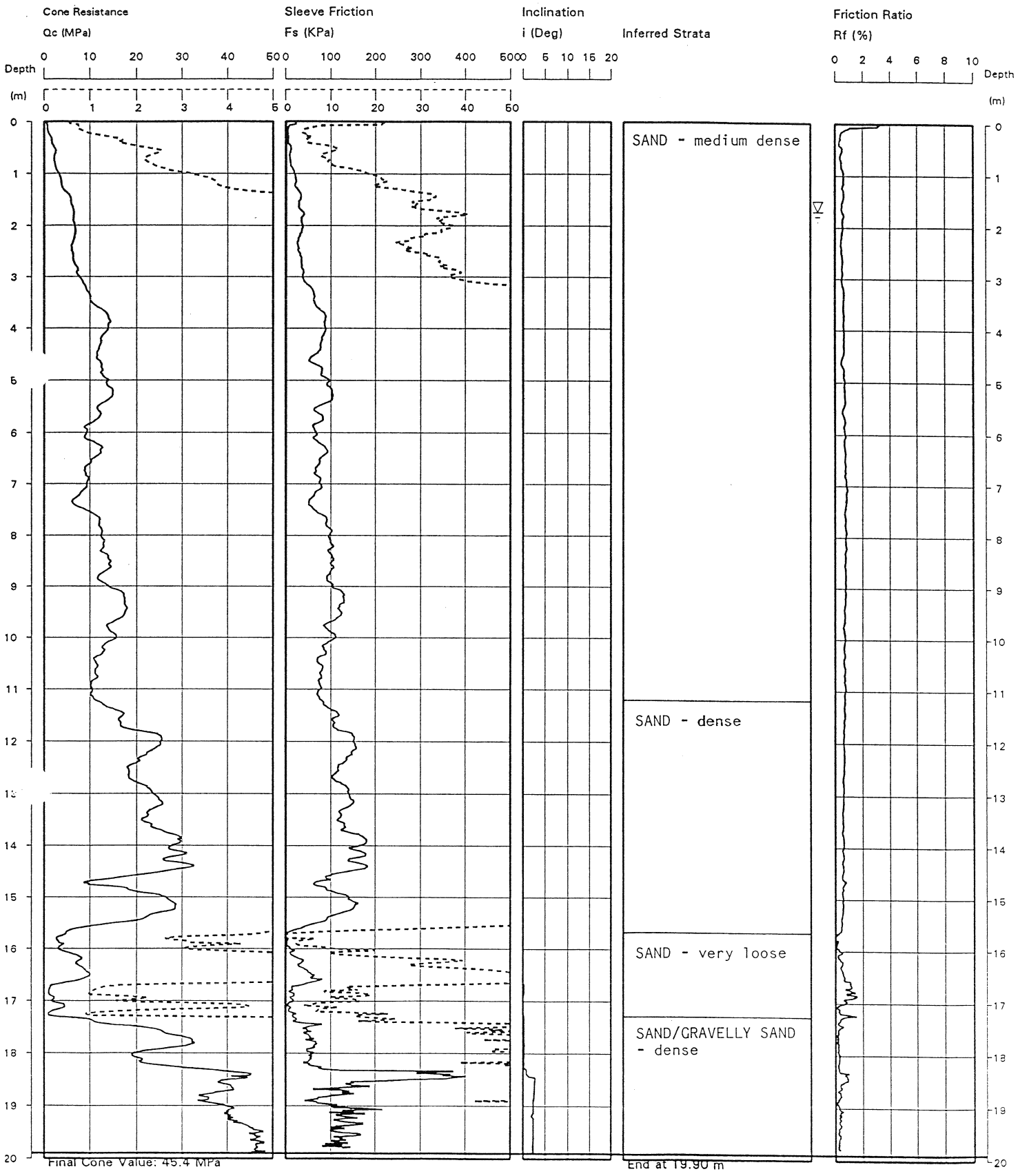
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CONE PENETRATION TEST

PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

02
Page 1 of 1
DATE 24/04/01
SURFACE RL

LIENT SOIL & ROCK ENGINEERING PTY LTD
PREMIER'S DEPARTMENT NSW



Final Cone Value: 45.4 MPa

End at 19.90 m

REMARKS:

Date	4.5.01
Plotted	
Checked	

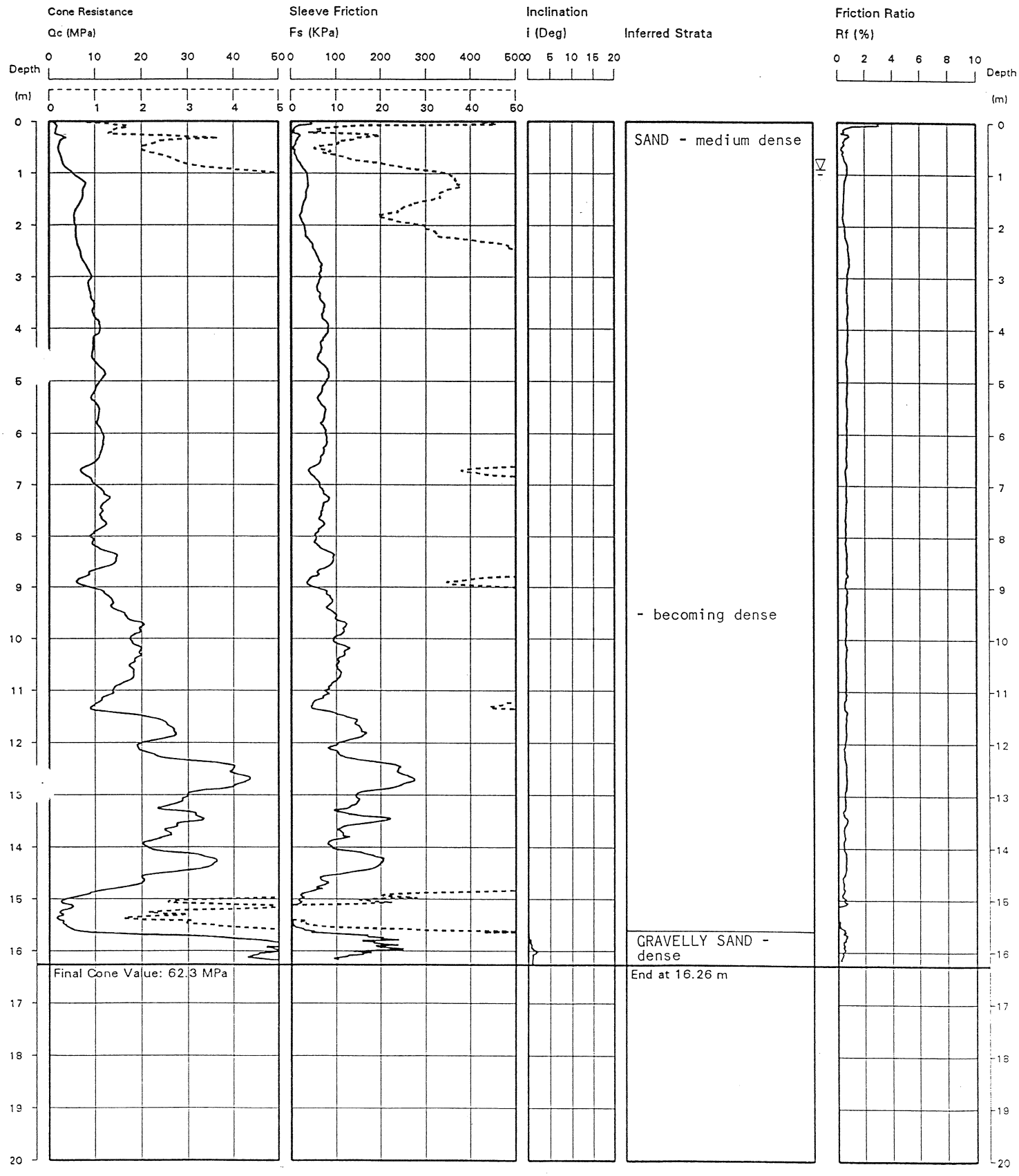
File: N:\CONEFILE\31299\31299-02.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 1.7m depth

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CONE PENETRATION TEST

LIENT SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT PROPOSED STEEL MILL LOCATION TOMAGO ROAD, TOMAGO PROJECT No 31299	03 Page 1 of 1 DATE 24/04/01 SURFACE RL



REMARKS:

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-03.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 0.9m depth

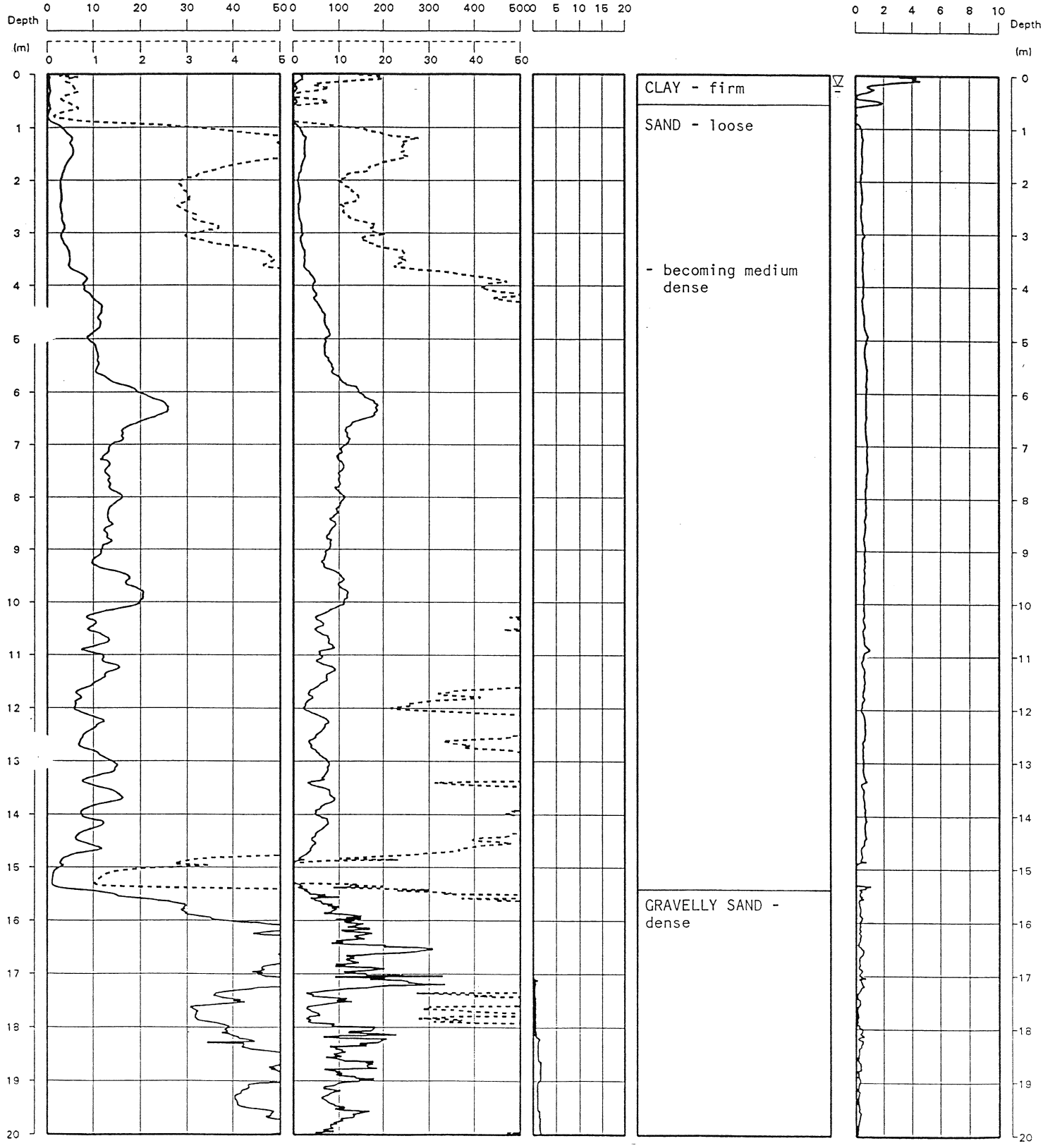
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CONE PENETRATION TEST

PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

04
Page 1 of 2
DATE 24/04/01
SURFACE RL

CLIENT SOIL & ROCK ENGINEERING PTY LTD
PREMIER'S DEPARTMENT NSW



REMARKS:

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-04.CPT
Cone ID: CONE-906 Type: Standard

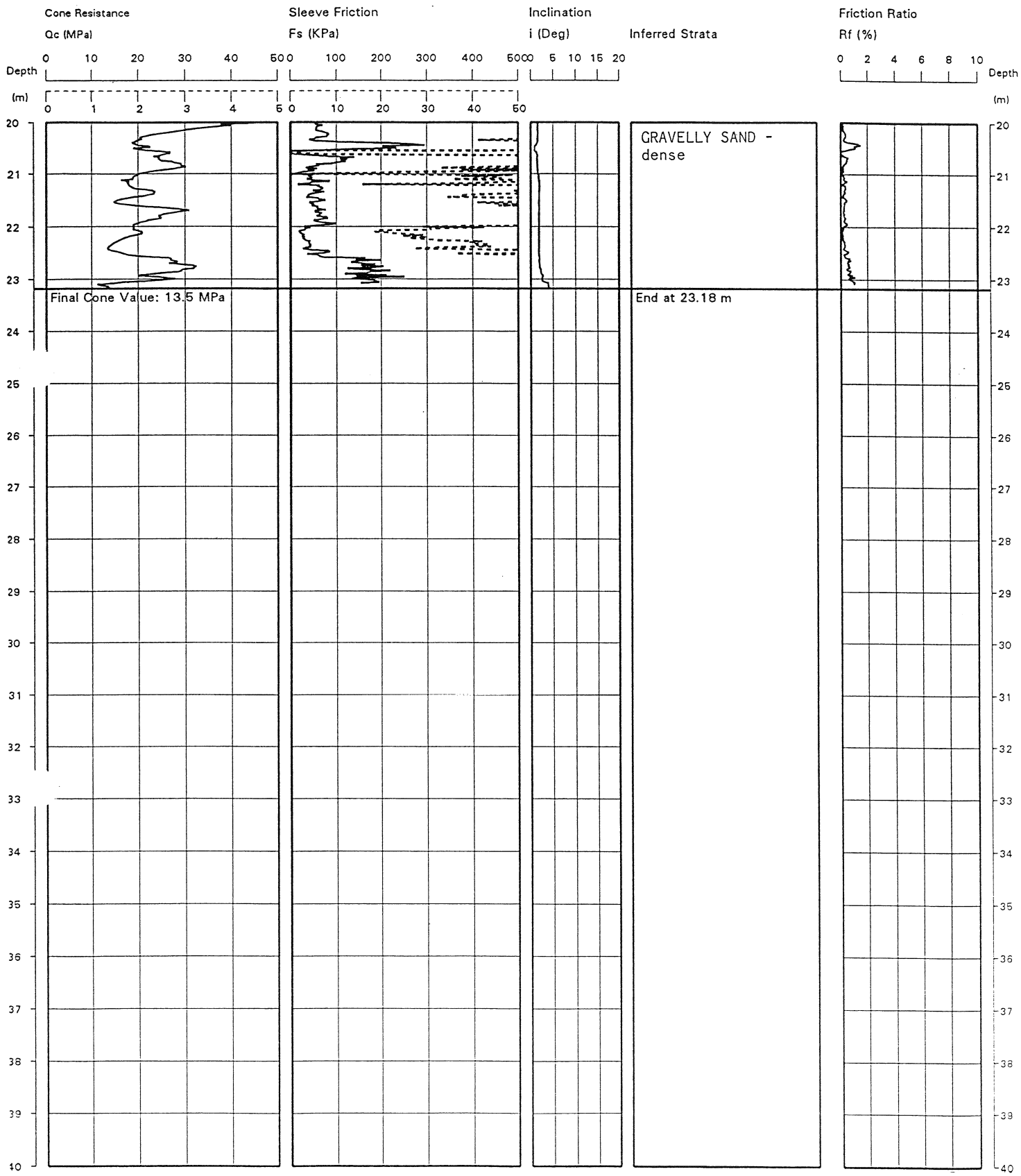
▽ Water Level after test: 0.2m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

04
Page 2 of 2
DATE 24/04/01
SURFACE RL



REMARKS:

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-04.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 0.2m depth

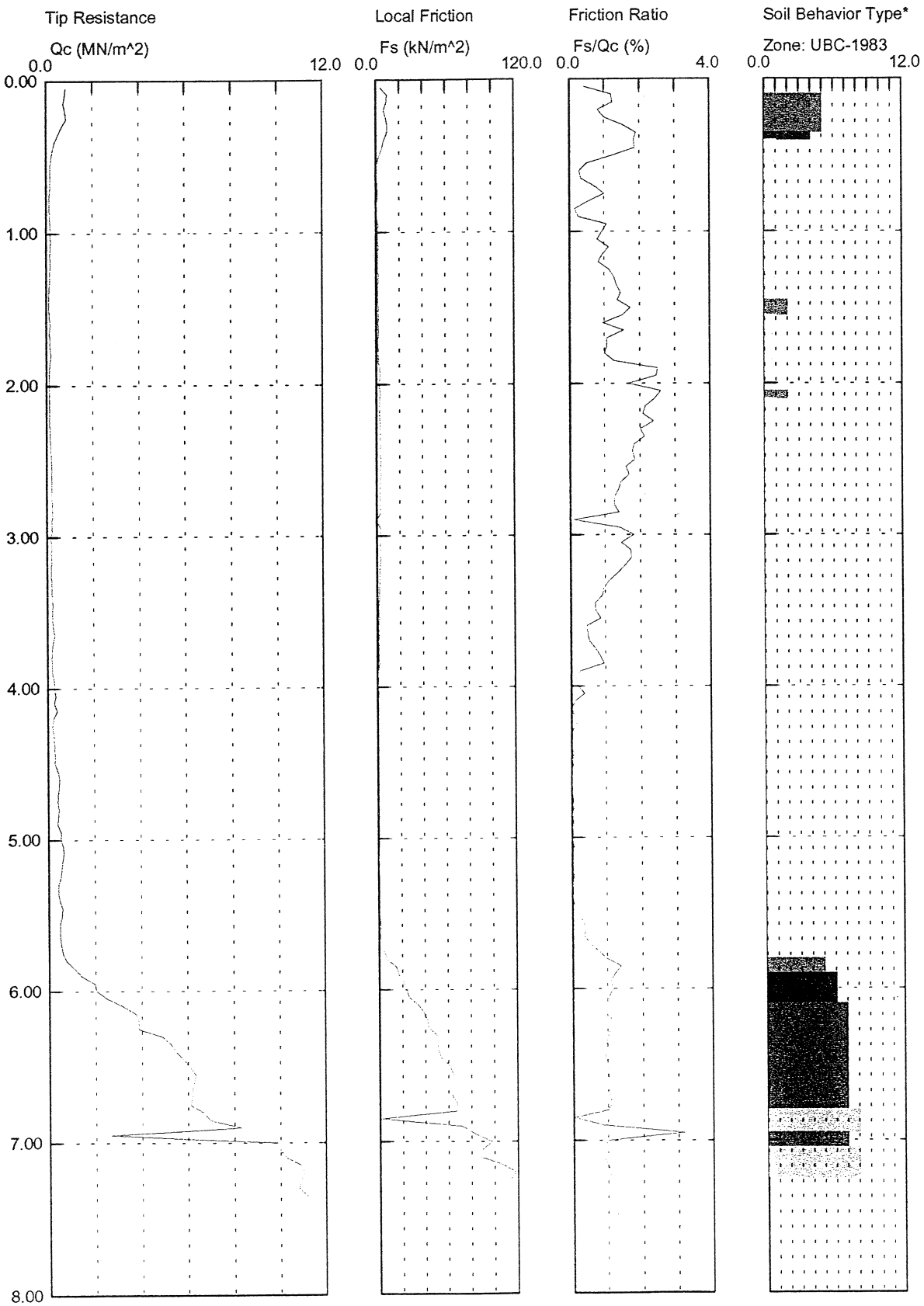
Douglas Partners
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*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-10
Cone Used: 5T 3CH

CPT Date/Time: 04-26-01 11:16
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 7.35 meters

Depth Increment = 0.05 meters

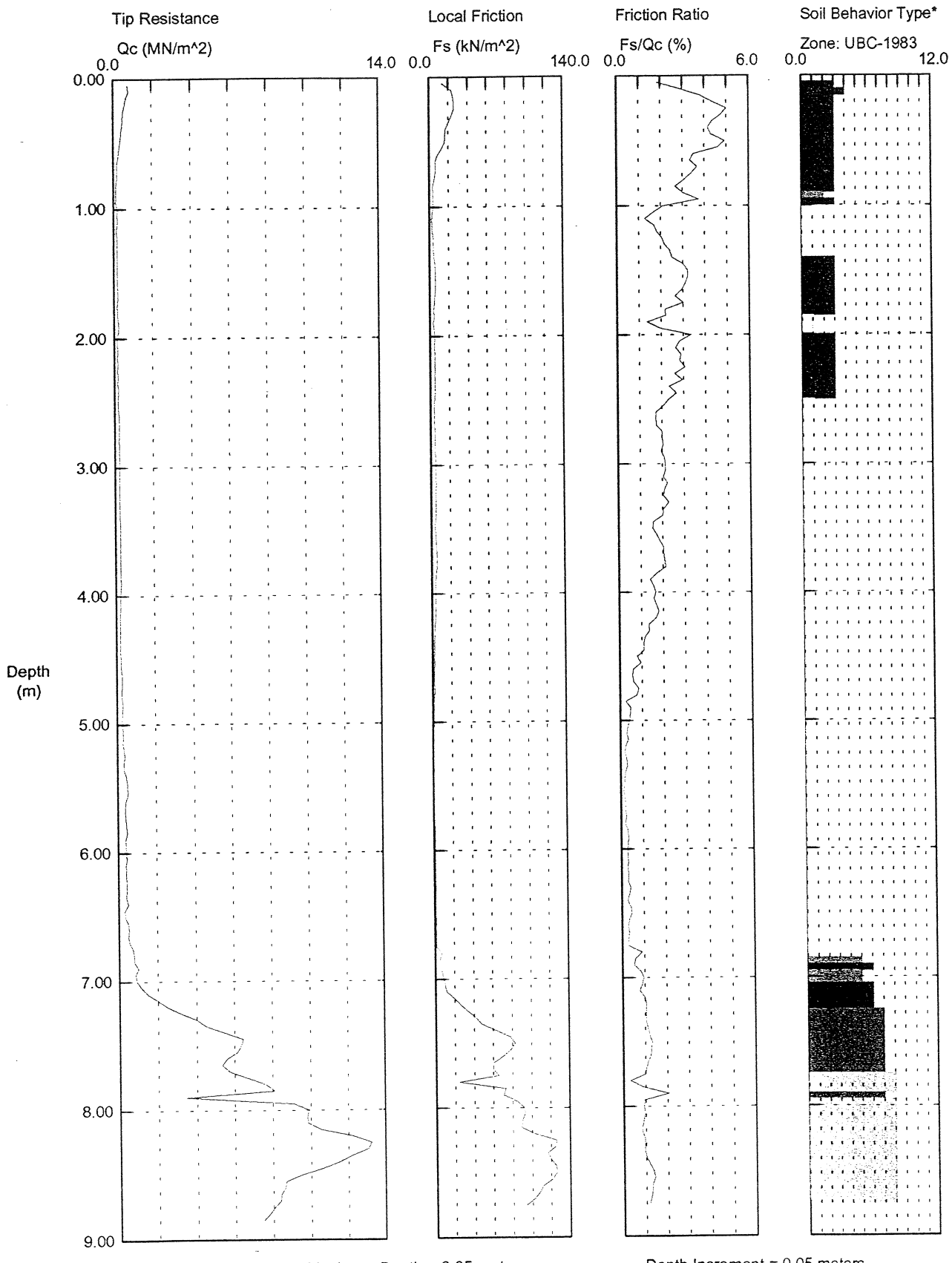
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-11
Cone Used: 5T 3CH

CPT Date/Time: 04-26-01 14:45
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 8.85 meters

Depth Increment = 0.05 meters

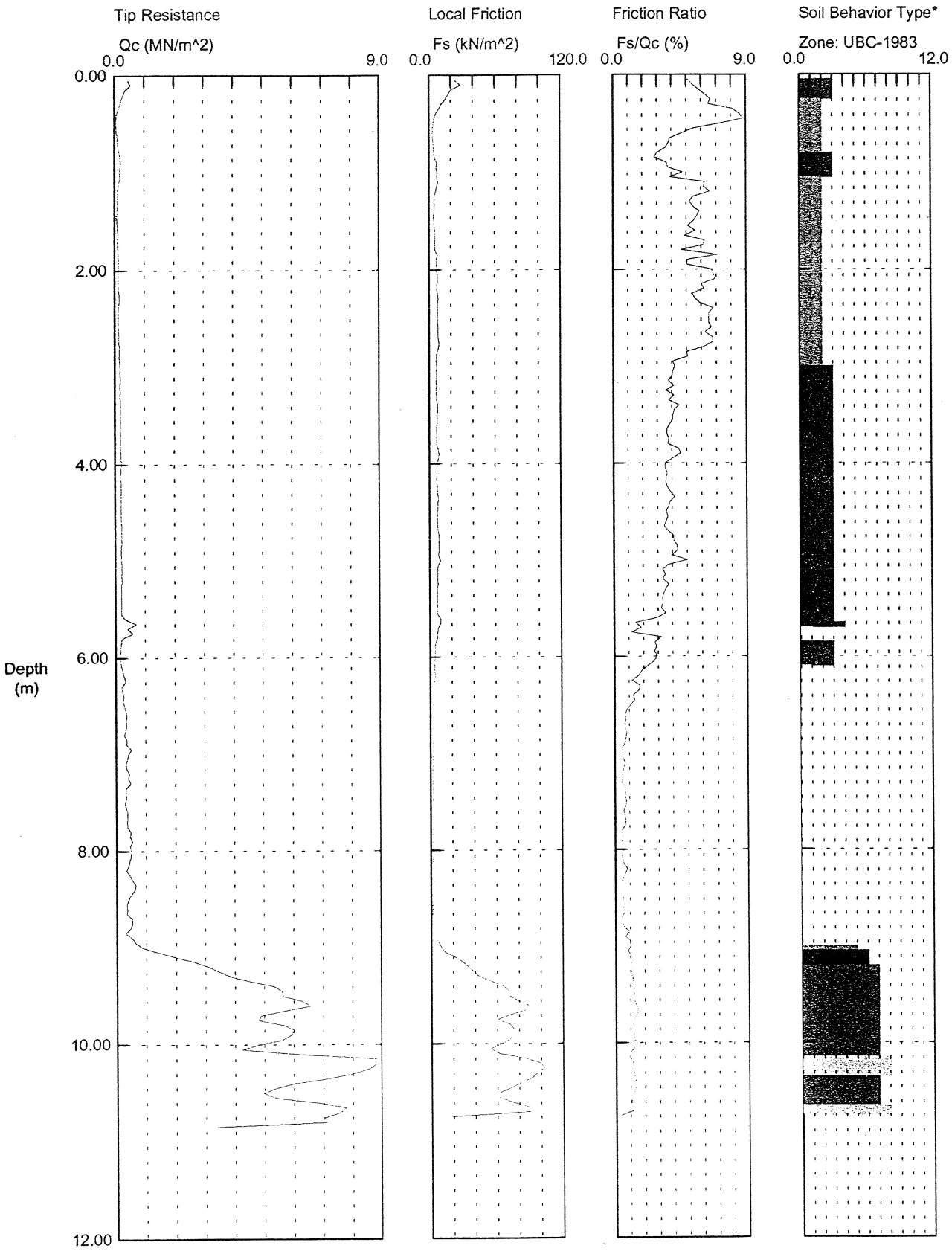
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-12
Cone Used: 5T 3CH

CPT Date/Time: 04-26-01 12:53
Location: P.S.M TOMAGO
Job Number: 013



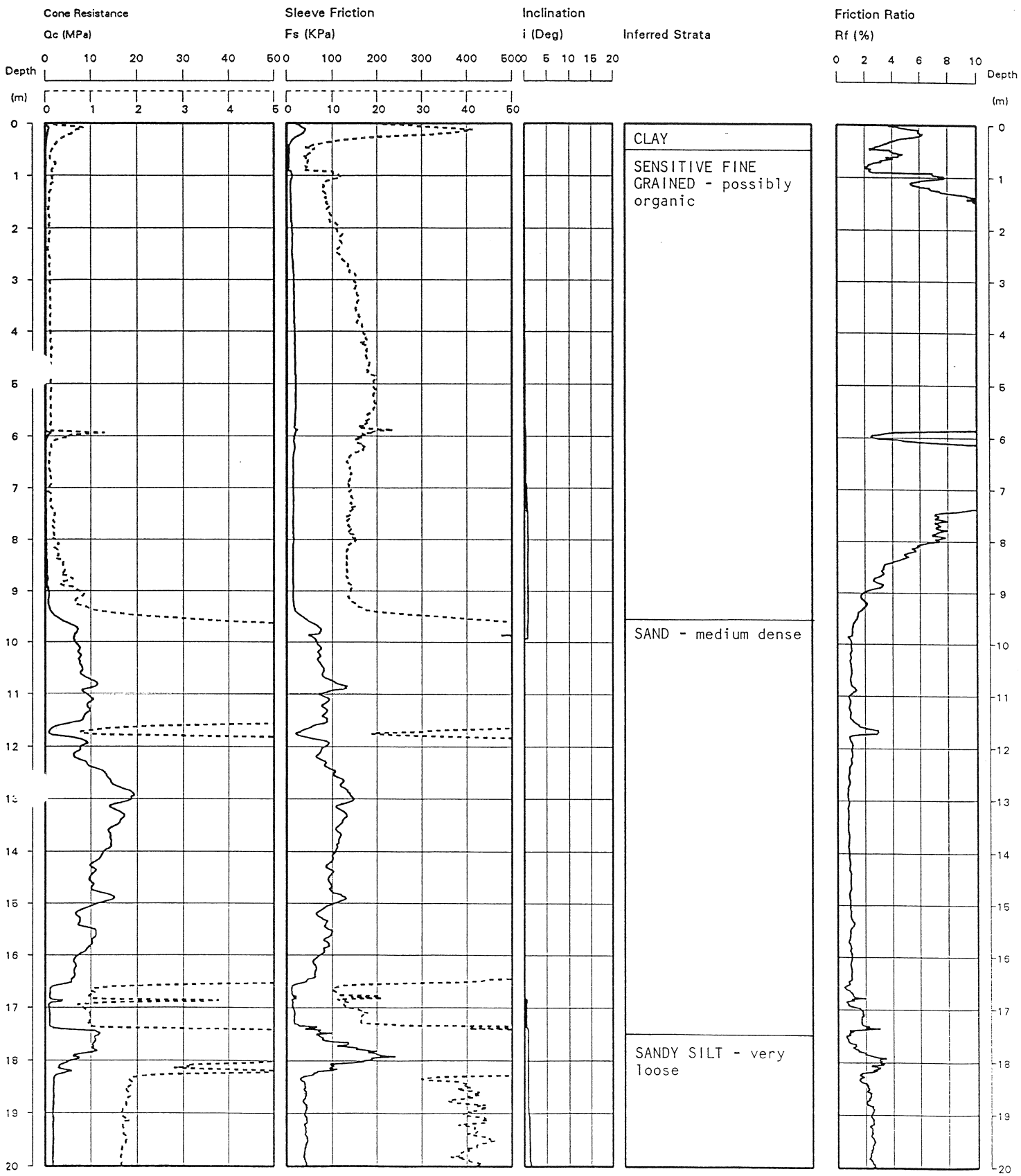
Maximum Depth = 10.85 meters

Depth Increment = 0.05 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

CONE PENETRATION TEST

CLIENT: SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT: PROPOSED STEEL MILL LOCATION: TOMAGO ROAD, TOMAGO PROJECT No: 31299	14A Page 1 of 2 DATE: 20/04/01 SURFACE RL:	



REMARKS: Test located 60m west of 14A peg.

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\3129914A.CPT
Cone ID: CONE-906 Type: Standard

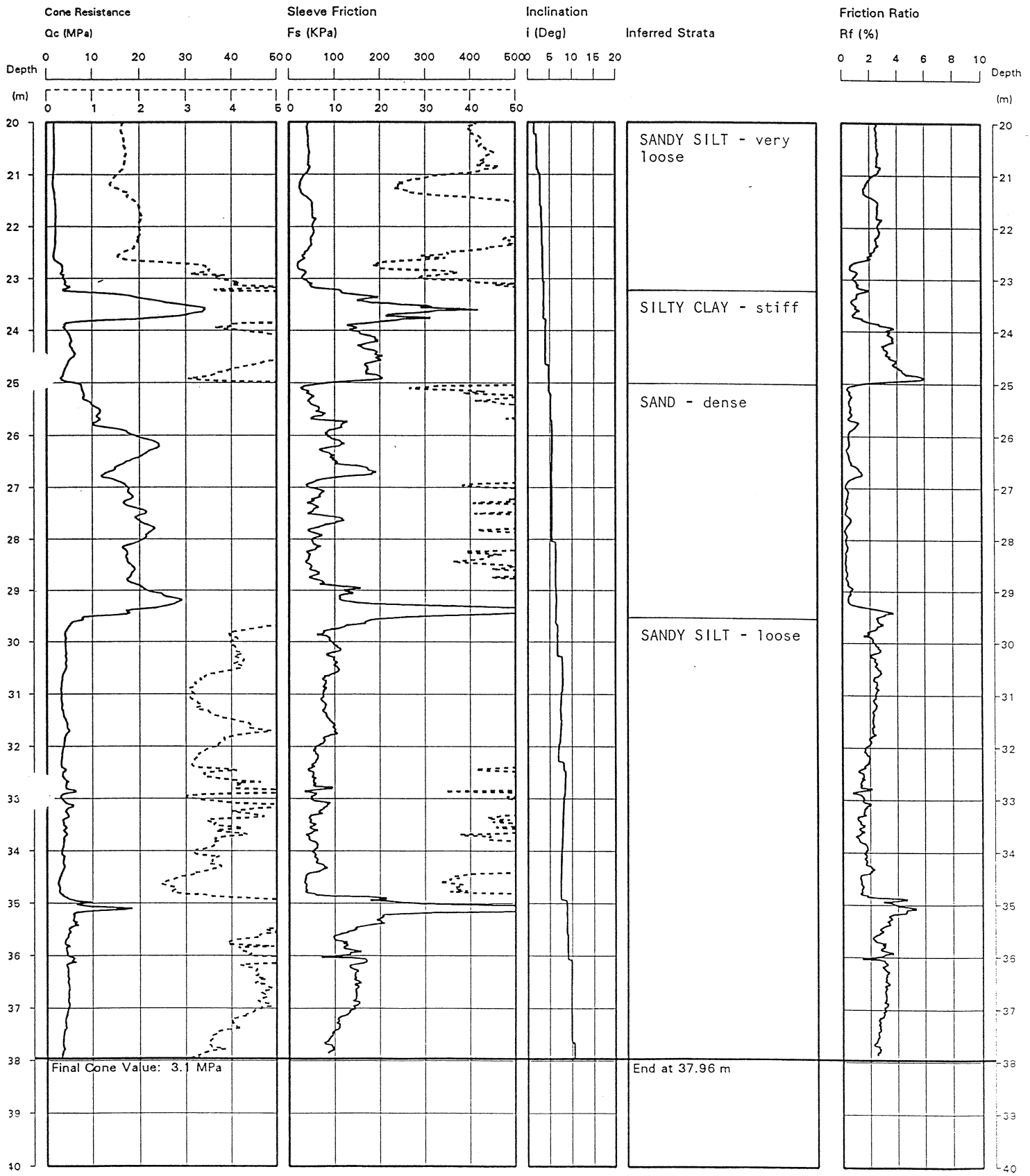
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CONE PENETRATION TEST

PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

14A
Page 2 of 2
DATE 20/04/01
SURFACE RL

CLIENT SOIL & ROCK ENGINEERING PTY LTD
PREMIER'S DEPARTMENT NSW



REMARKS: Test located 50m west of 14A peg.

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\3129914A.CPT
Cone ID: CONE-906 Type: Standard

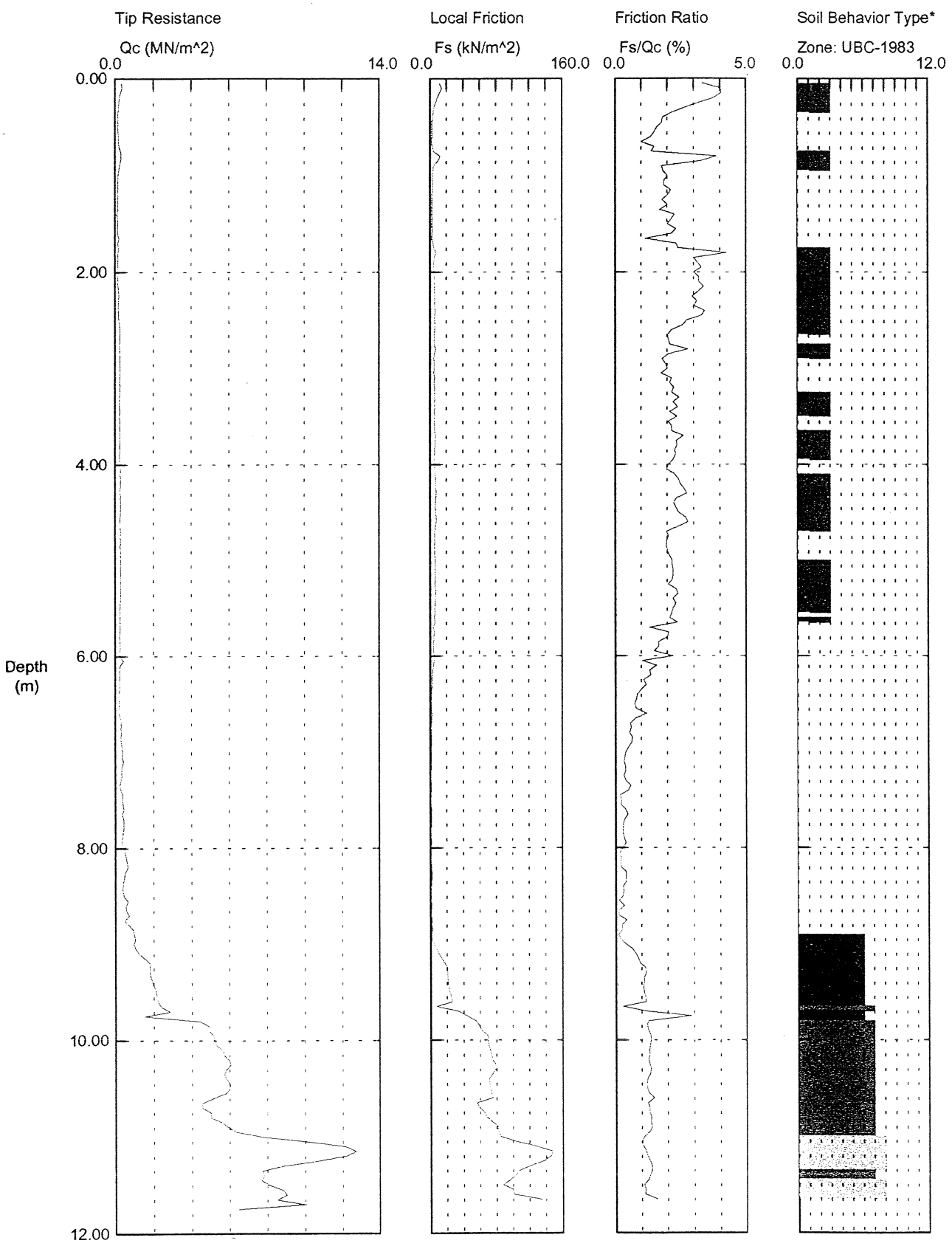
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*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-15
Cone Used: 5T 3CH

CPT Date/Time: 04-26-01 16:37
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 11.75 meters

Depth Increment = 0.05 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

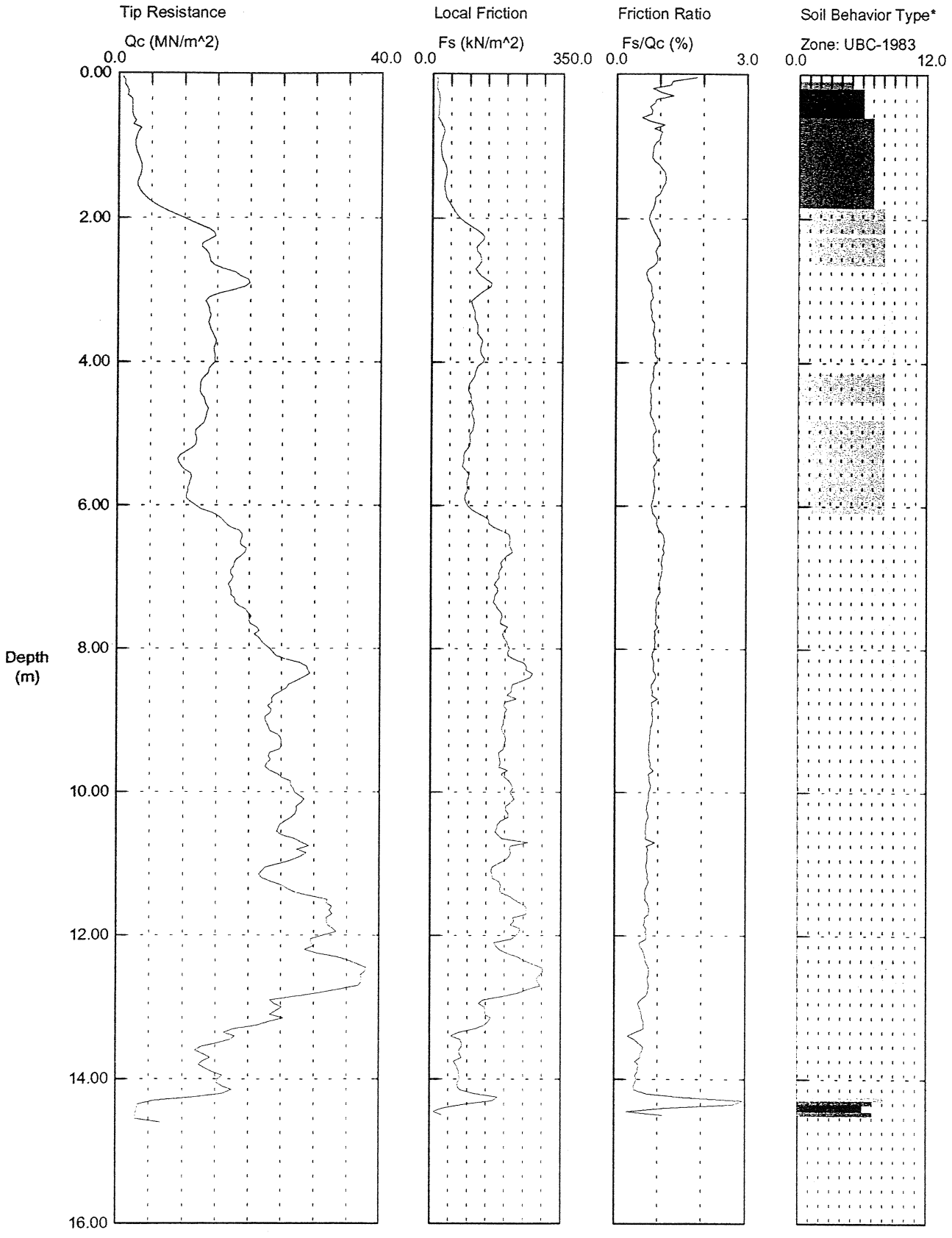
Pushing Refusal at 11.75m

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-18
Cone Used: 10T 3CH

CPT Date/Time: 04-11-01 11:49
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 14.60 meters

Depth Increment = 0.05 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

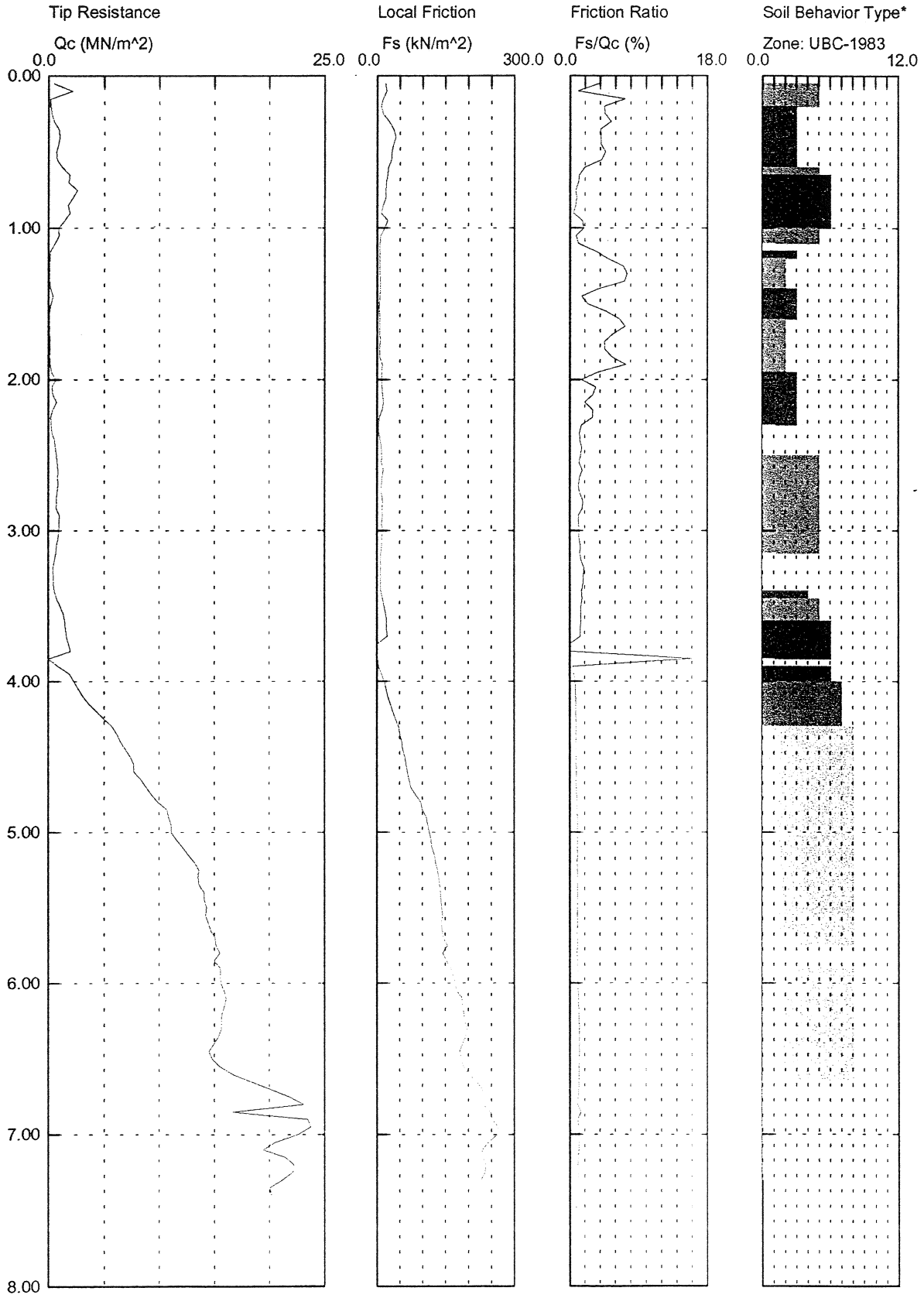
Tip Resistance > 50MPa at 14.60m

Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-25
Cone Used: 5T 3CH

CPT Date/Time: 04-24-01 13:17
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 7.40 meters

Depth Increment = 0.05 meters

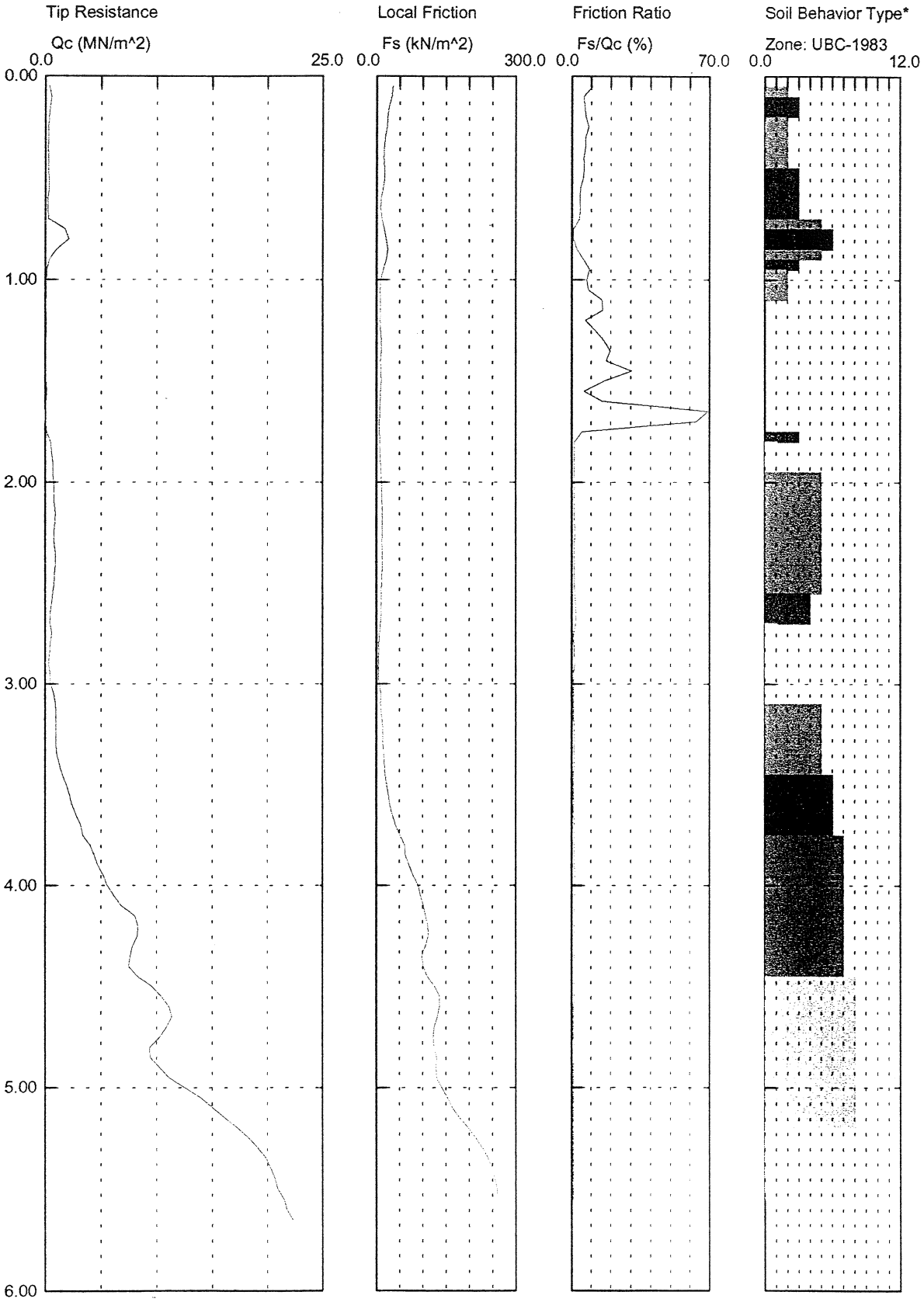
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-26
Cone Used: 5T 3CH

CPT Date/Time: 04-24-01 16:00
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 5.65 meters

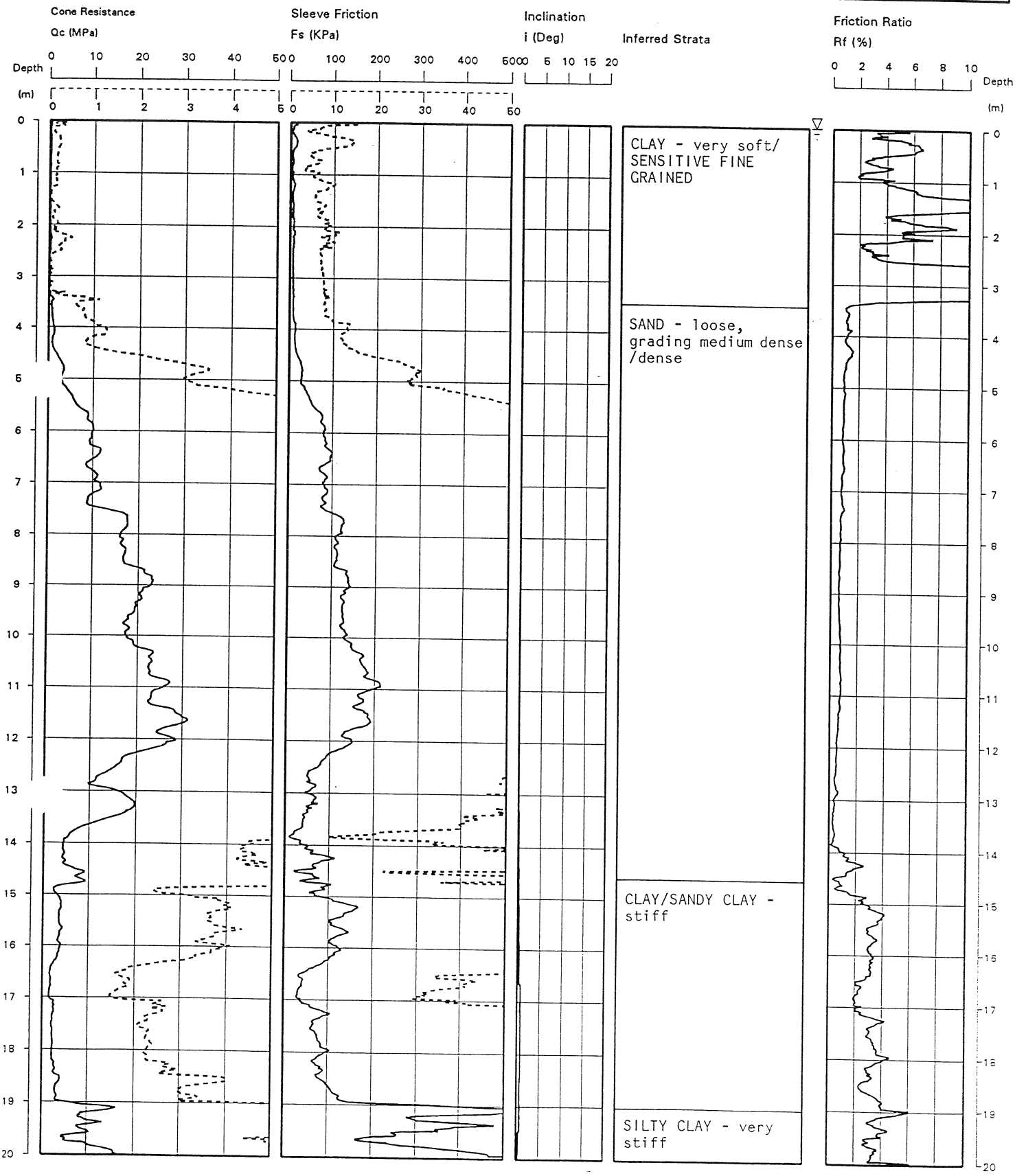
Depth Increment = 0.05 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

27A
Page 1 of 2
DATE 23/04/01
SURFACE RL



REMARKS:

Date 4-5-01
Plotted
Checked

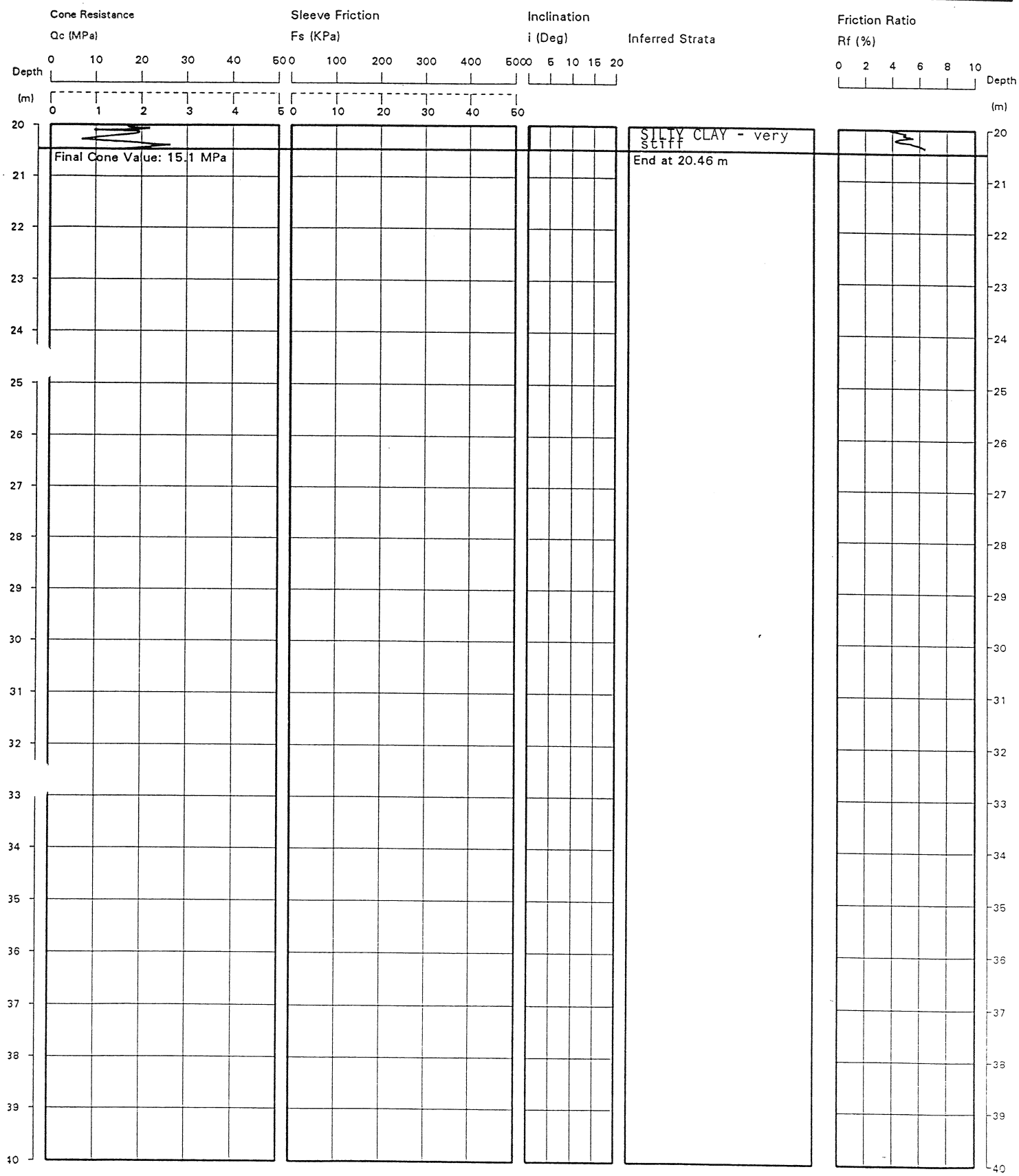
File: N:\CONEFILE\31299\3129927A.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 0.0m depth

Douglas Partners
Geotechnics · Environment · Groundwater

CONE PENETRATION TEST

CLIENT: SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT: PROPOSED STEEL MILL LOCATION: TOMAGO ROAD, TOMAGO PROJECT No: 31299	27A Page 2 of 2 DATE: 23/04/01 SURFACE RL	



REMARKS:

Date	4-5-01
Plotted	
Checked	

File: N:\CONEFILE\31299\3129927A.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 0.0m depth

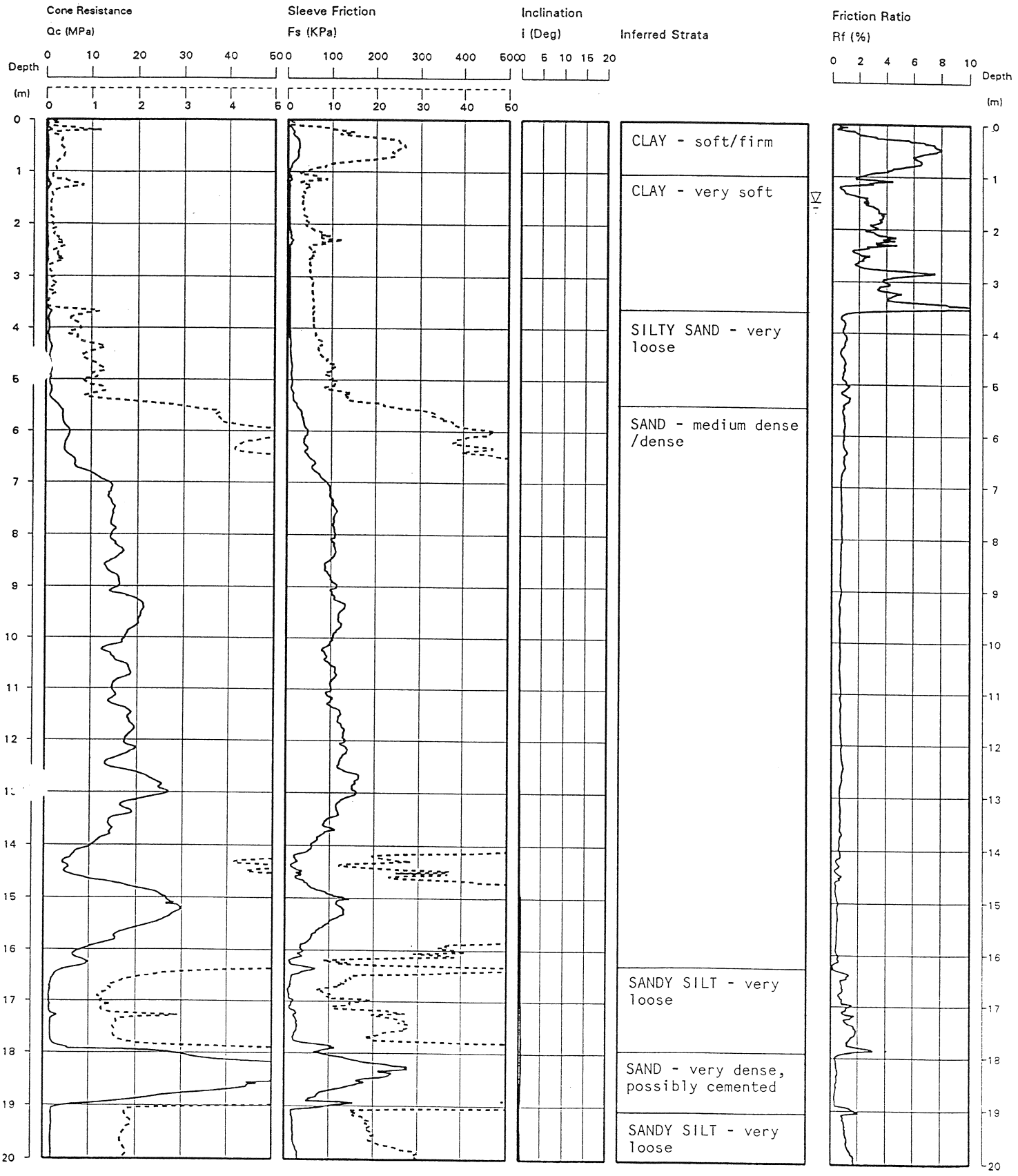
Douglas Partners
Geotechnics · Environment · Groundwater

CONE PENETRATION TEST

PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

28
Page 1 of 2
DATE 23/04/01
SURFACE RL

LIENT SOIL & ROCK ENGINEERING PTY LTD
PREMIER'S DEPARTMENT NSW



REMARKS:

Date	4-5-01
Plotted	
Checked	

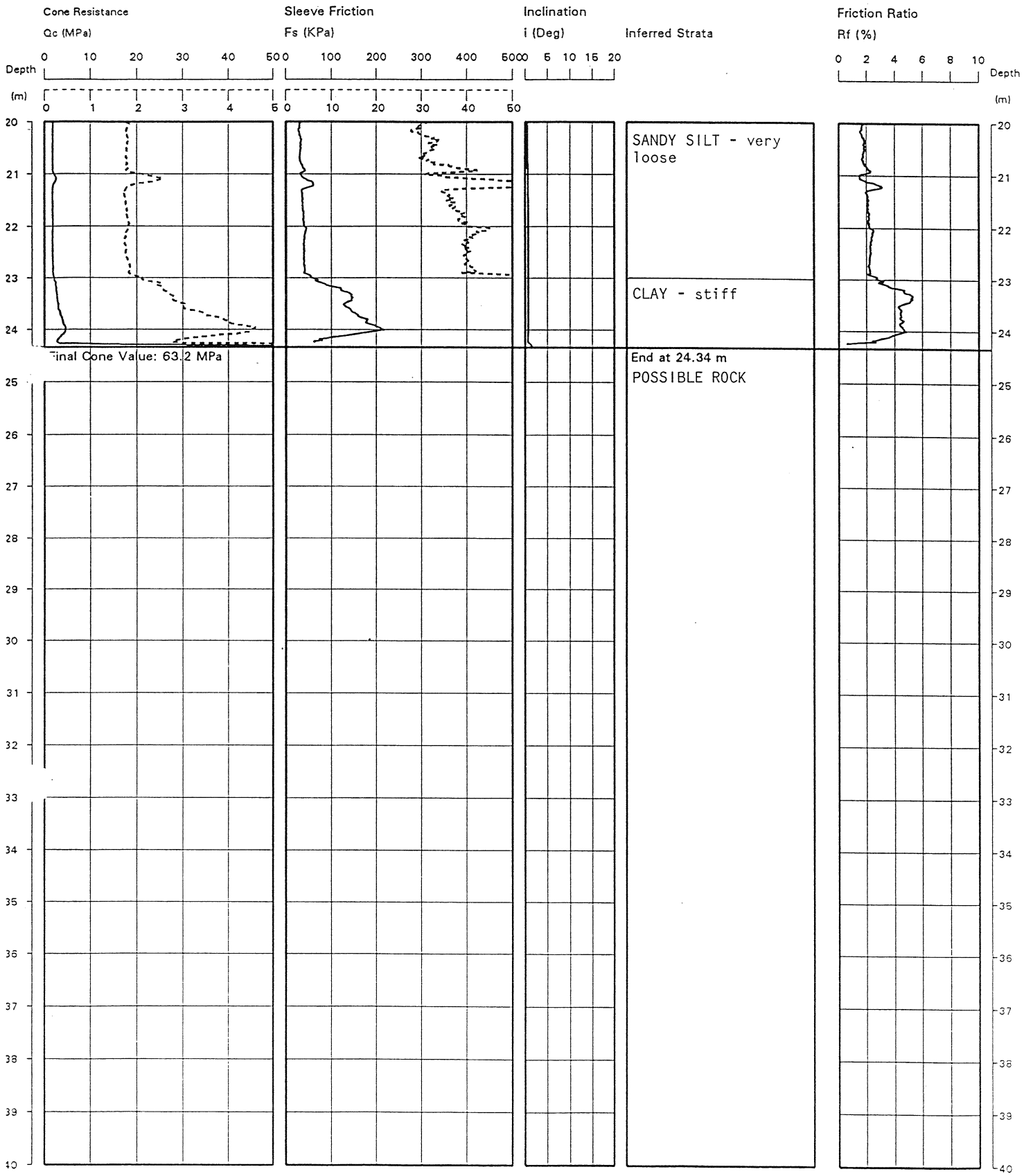
File: N:\CONEFILE\31299\31299-28.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 1.5m depth

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CONE PENETRATION TEST

	PROJECT: PROPOSED STEEL MILL		28
	LOCATION: TOMAGO ROAD, TOMAGO		Page 2 of 2
CLIENT: SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW		PROJECT No: 31299	DATE: 23/04/01
			SURFACE RL:



REMARKS:

Date	45-01
Plotted	
Checked	

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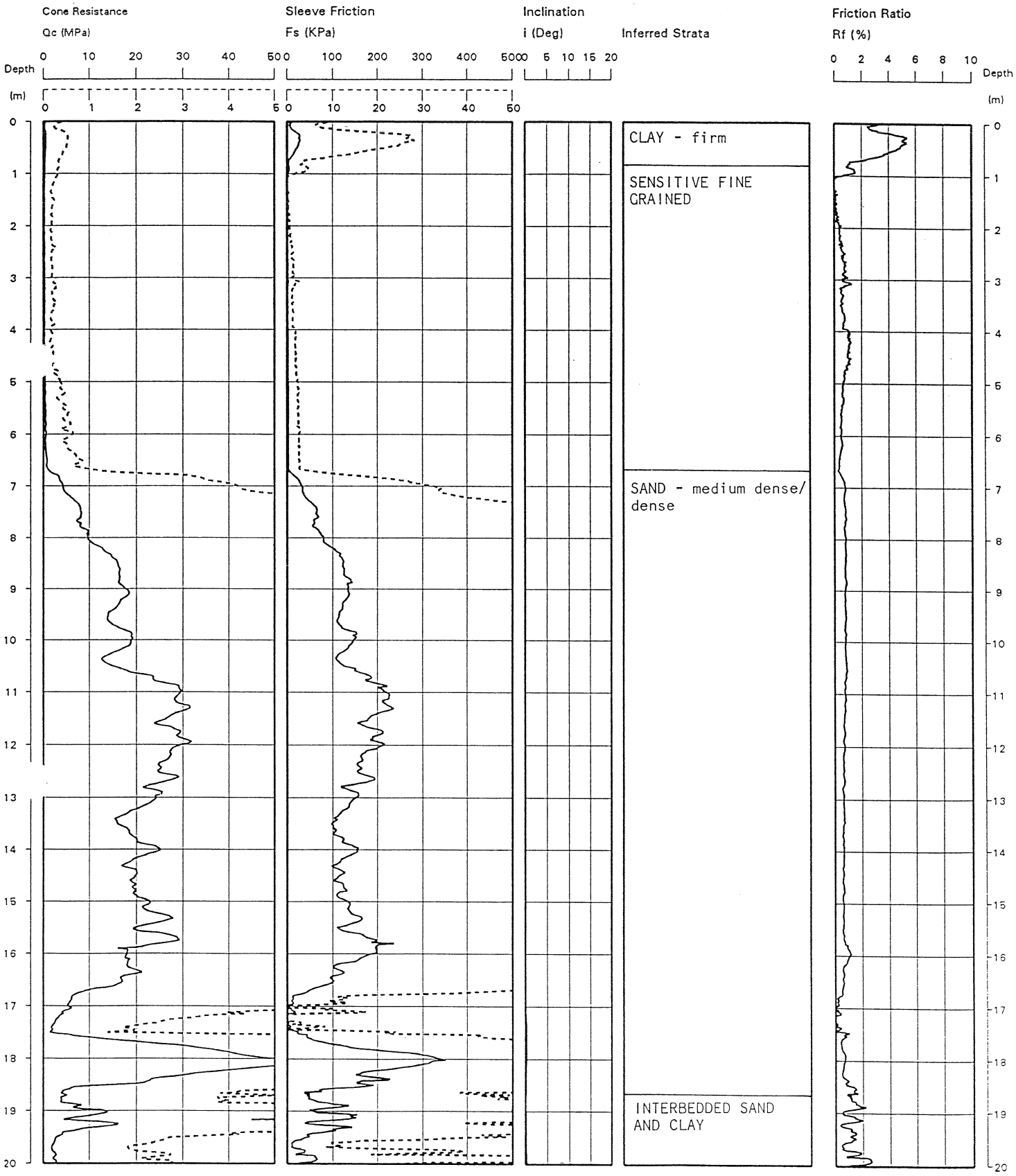
▽ Water Level after test: 1.5m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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DATE 23/04/01
SURFACE RL



REMARKS:

Date	4-5-01
Plotted	
Checked	

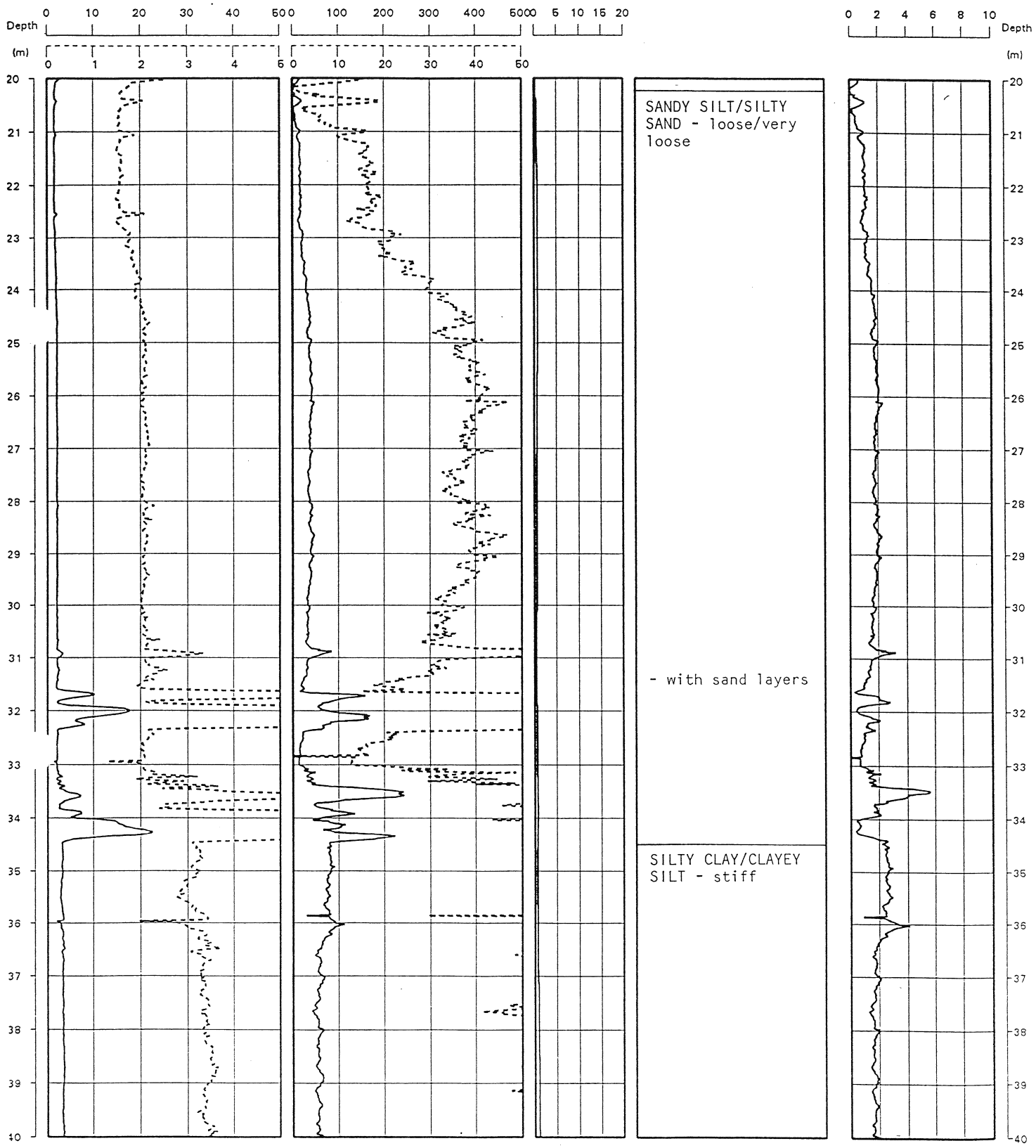
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Cone ID: CONE-906 Type: Standard

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CONE PENETRATION TEST

LIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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DATE 23/04/01
SURFACE RL



REMARKS:

Date	4-5-01
Plotted	
Checked	

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Cone ID: CONE-906 Type: Standard

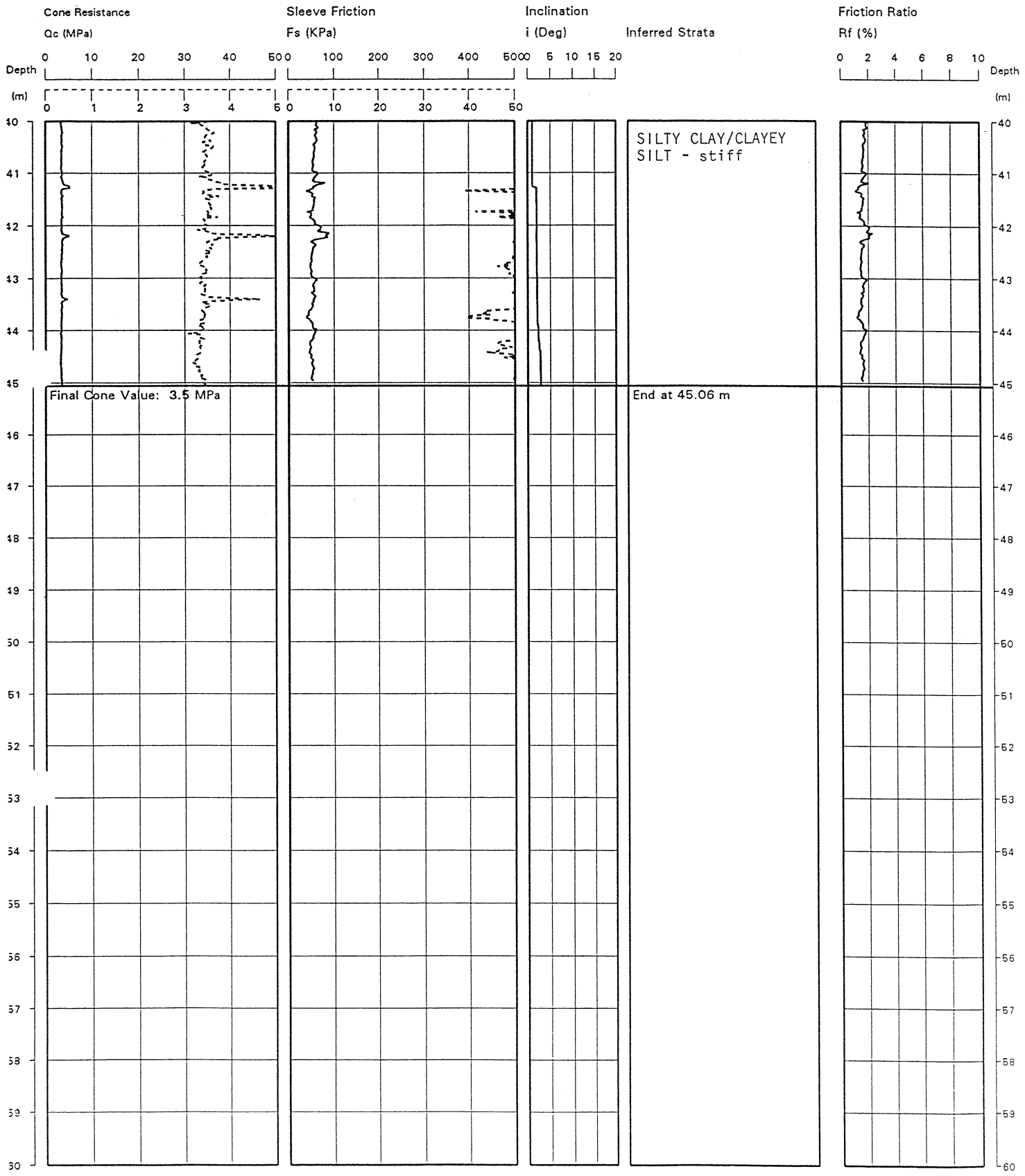
Douglas Partners
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CONE PENETRATION TEST

PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

29
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DATE 23/04/01
SURFACE RL

.IENT SOIL & ROCK ENGINEERING PTY LTD
PREMIER'S DEPARTMENT NSW



REMARKS:

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-29.CPT
Cone ID: CONE-906 Type: Standard

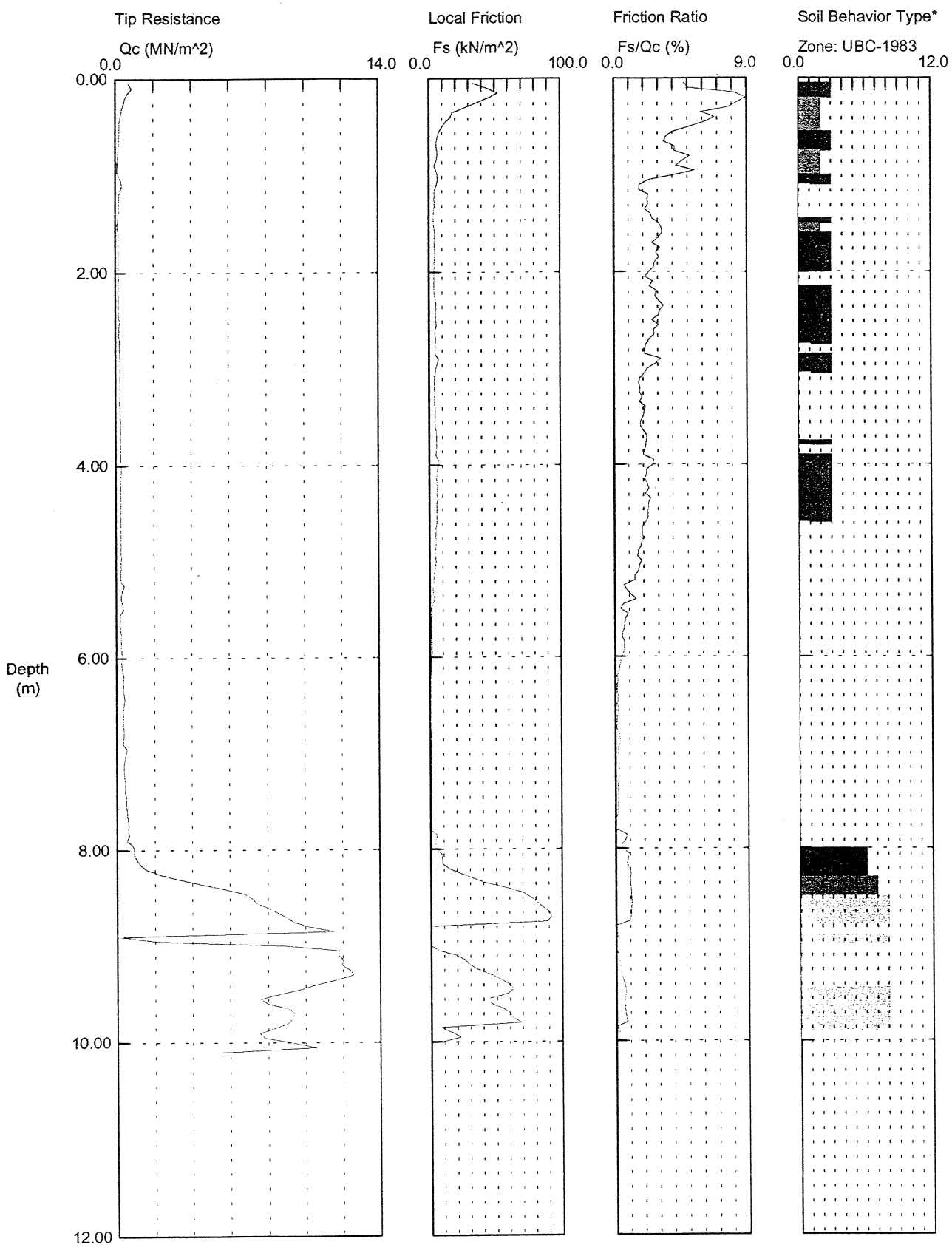
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Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-30
Cone Used: 5T 3CH

CPT Date/Time: 04-26-01 08:57
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 10.10 meters

Depth Increment = 0.05 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

CONE PENETRATION TEST

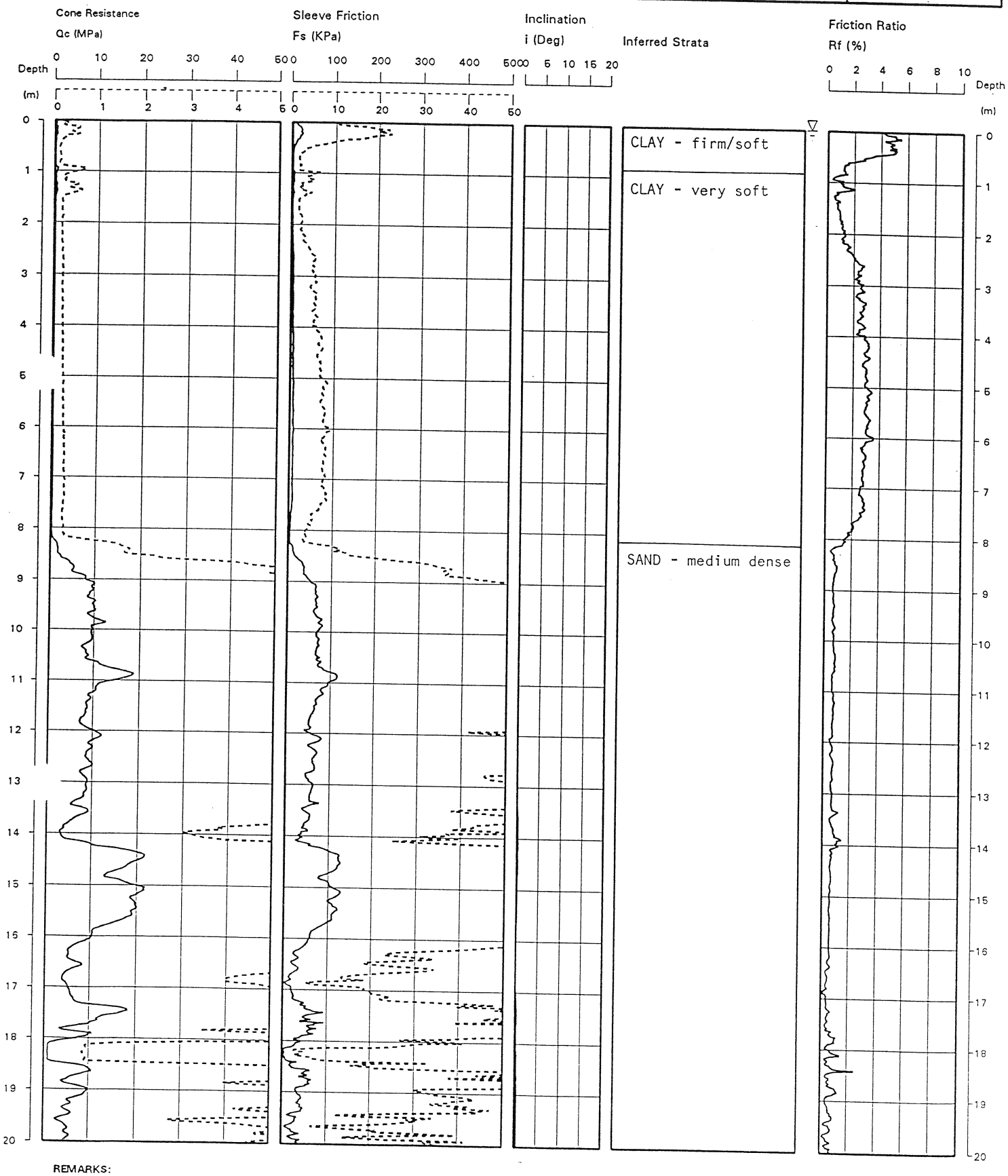
CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW
PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

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DATE 23/04/01

SURFACE RL



REMARKS:

Date	4·5·01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-31.CPT
Cone ID: CONE-906 Type: Standard

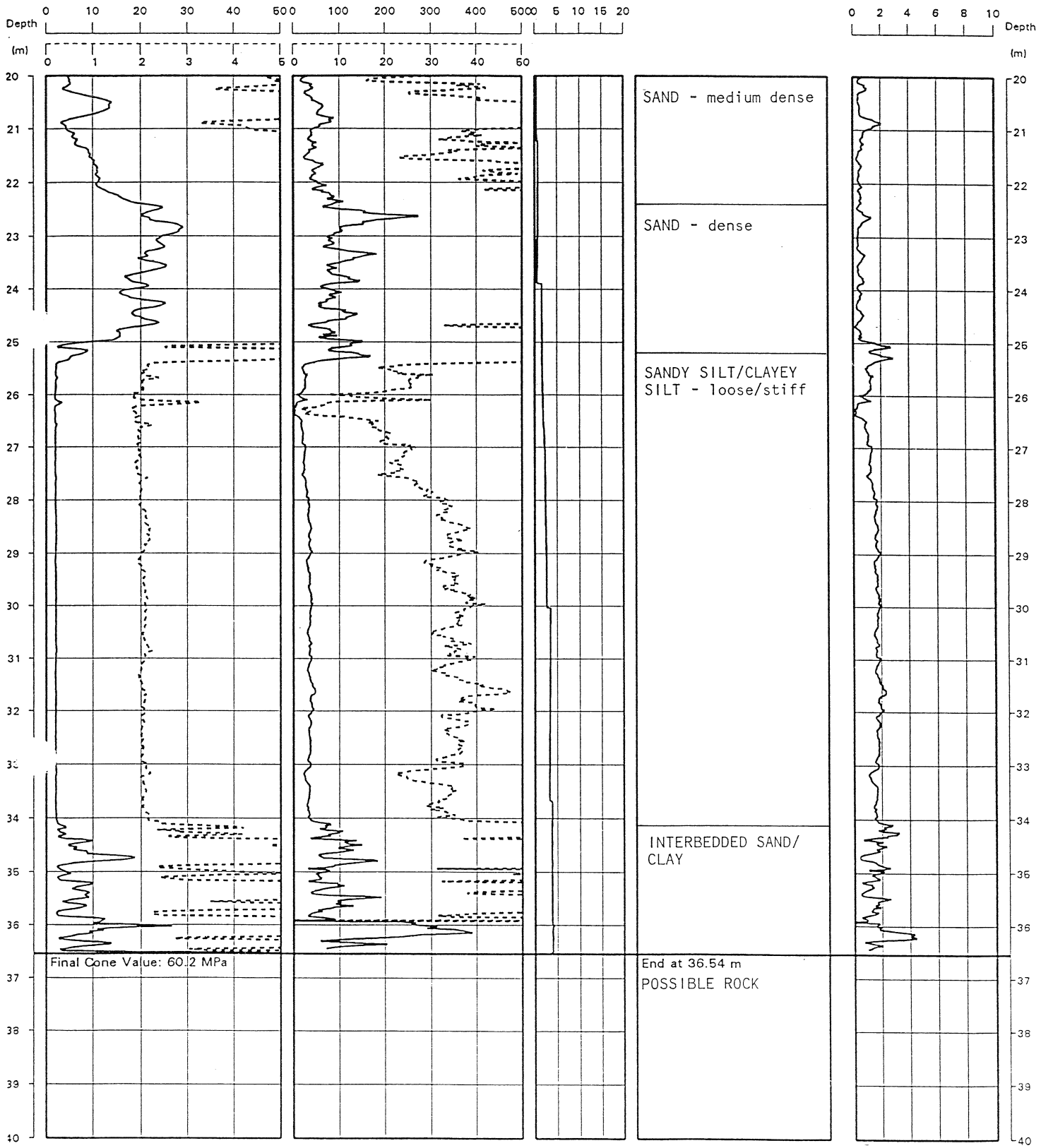
▽ Water Level after test: 0.0m depth

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CONE PENETRATION TEST

LIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

31
Page 2 of 2
DATE 23/04/01
SURFACE RL



REMARKS:

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-31.CPT
Cone ID: CONE-906 Type: Standard

▽ Water Level after test: 0.0m depth

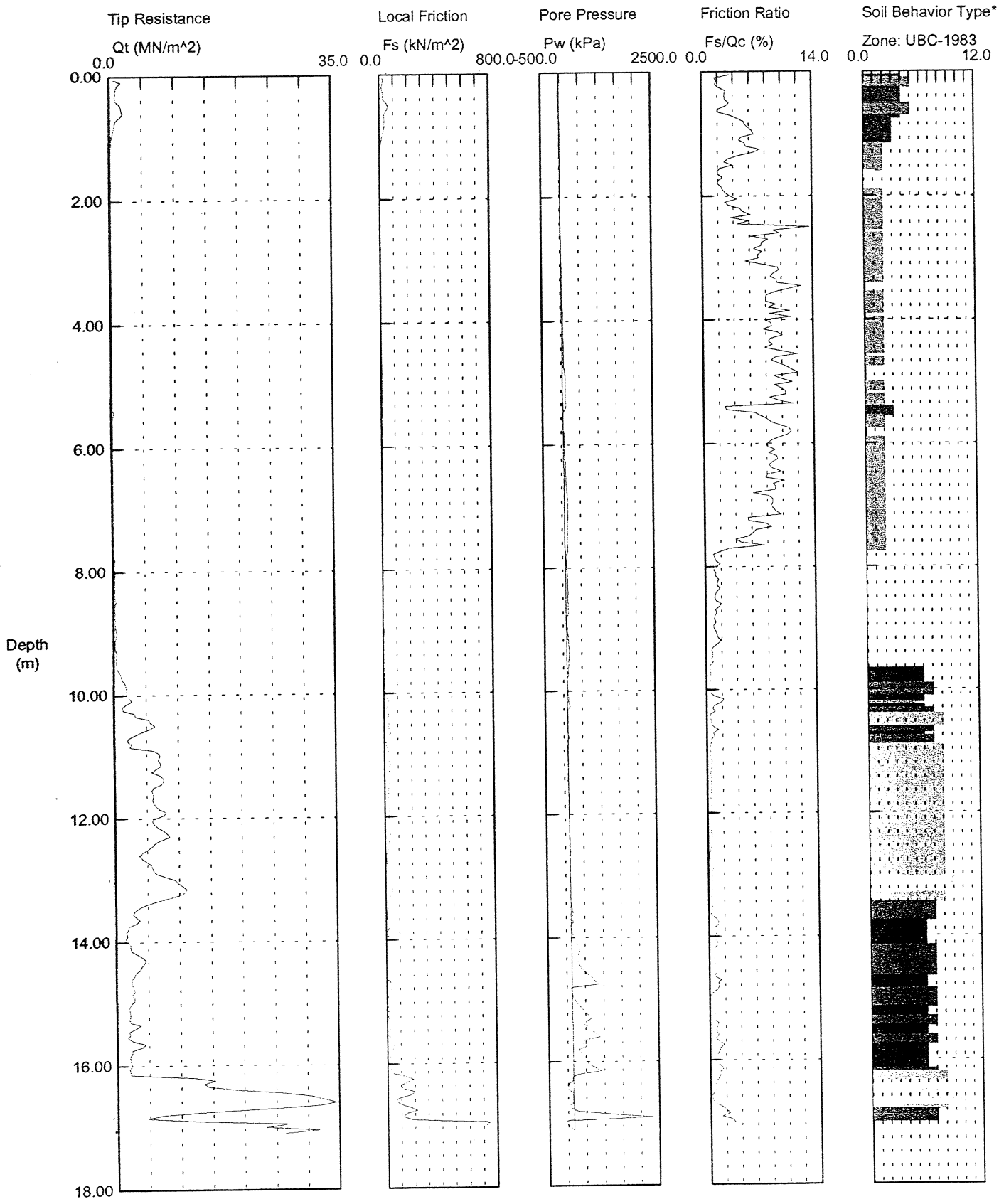
Douglas Partners
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Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: PZP-32
Cone Used: 10T 4CH

CPT Date/Time: 04-20-01 12:46
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 17.10 meters

Depth Increment = 0.05 meters

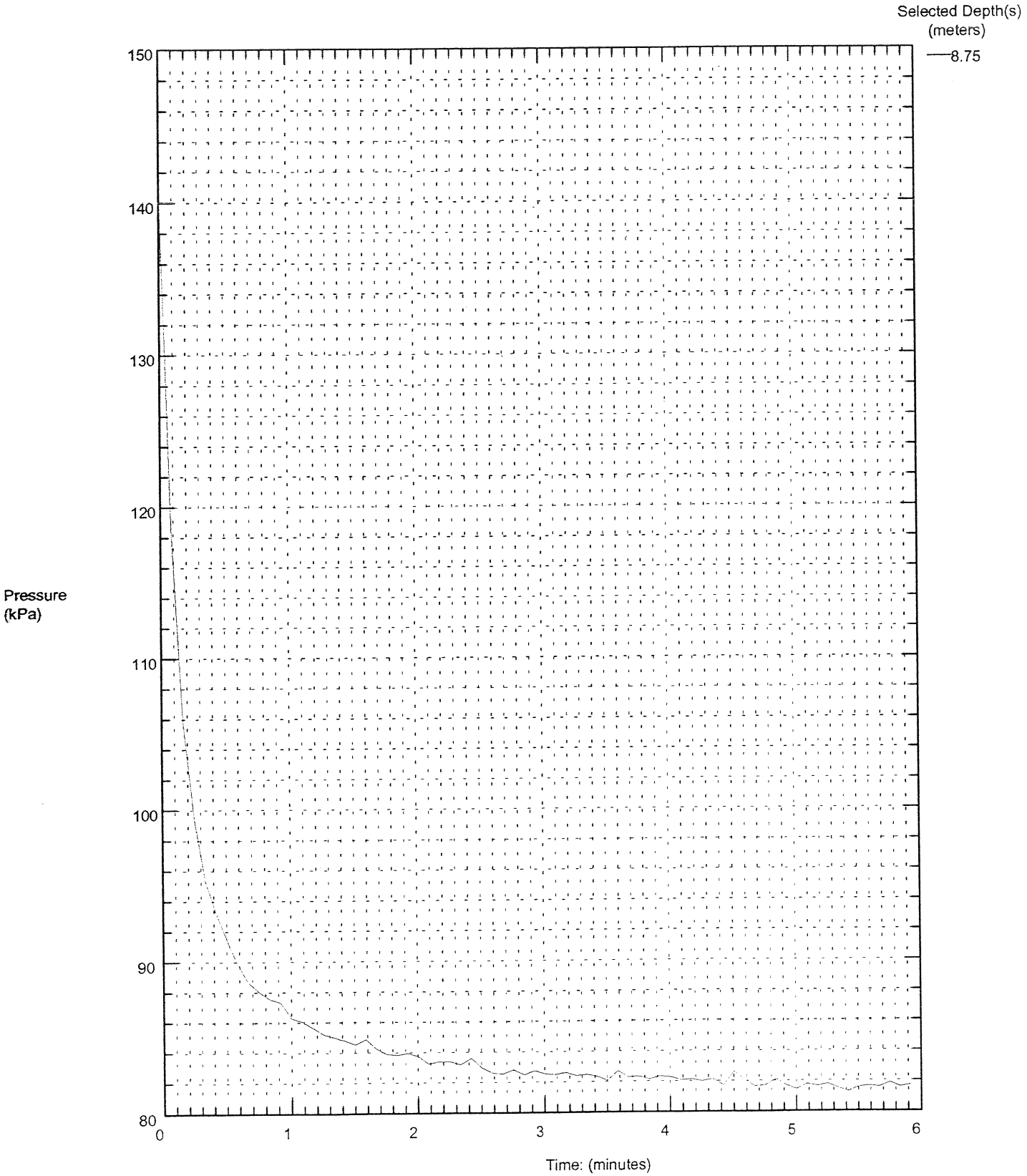
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Sleeve Resistance > 1 MPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: PZP-32
Cone Used: 10T 4CH

CPT Date/Time: 04-20-01 12:46
Location: P.S.M TOMAGO
Job Number: 013



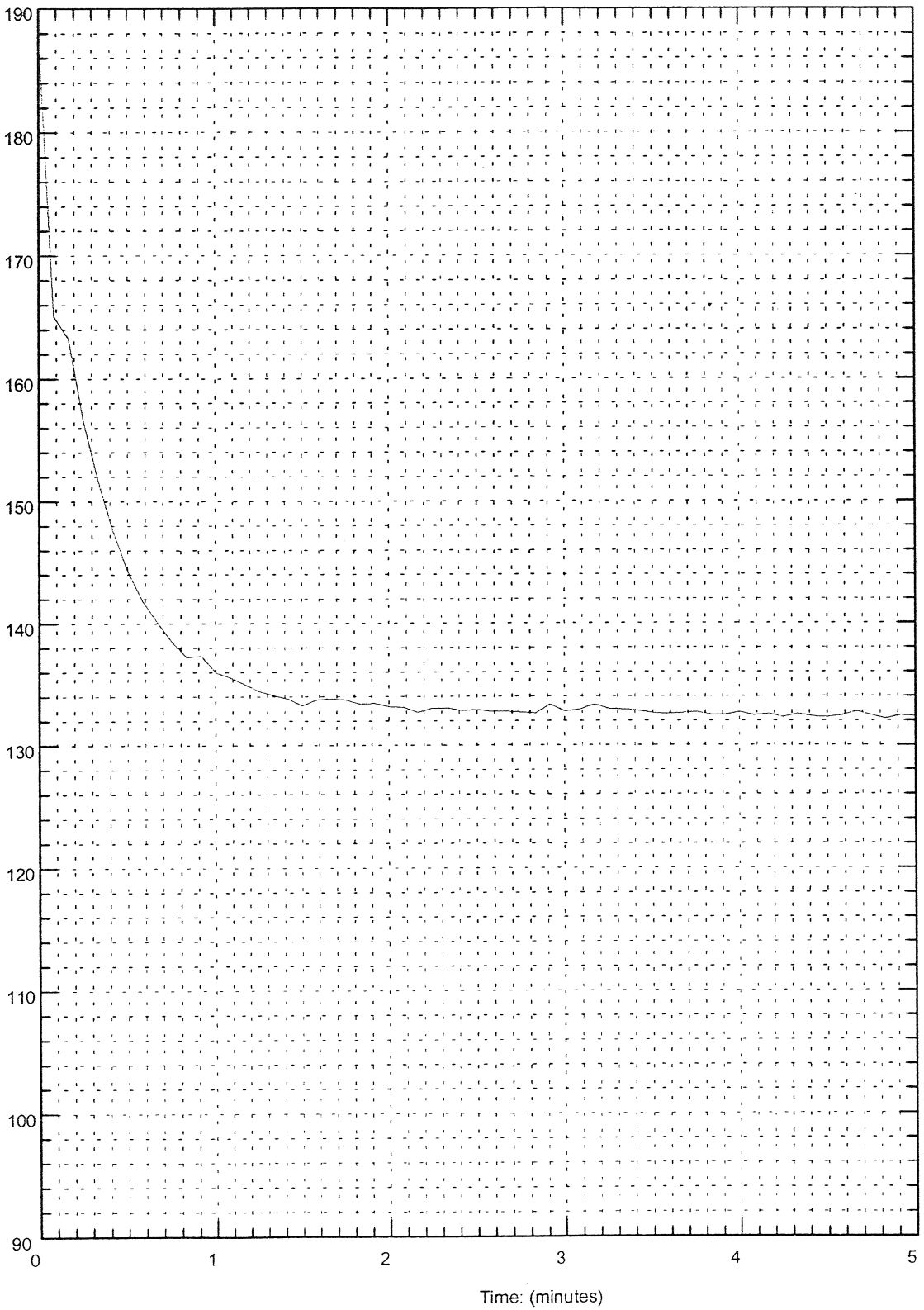
Maximum Pressure = 140.622 kPa
Hydrostatic Pressure = 79.032 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: PZP-32
Cone Used: 10T 4CH

CPT Date/Time: 04-20-01 12:46
Location: P.S.M TOMAGO
Job Number: 013

Selected Depth(s)
(meters)
13.75

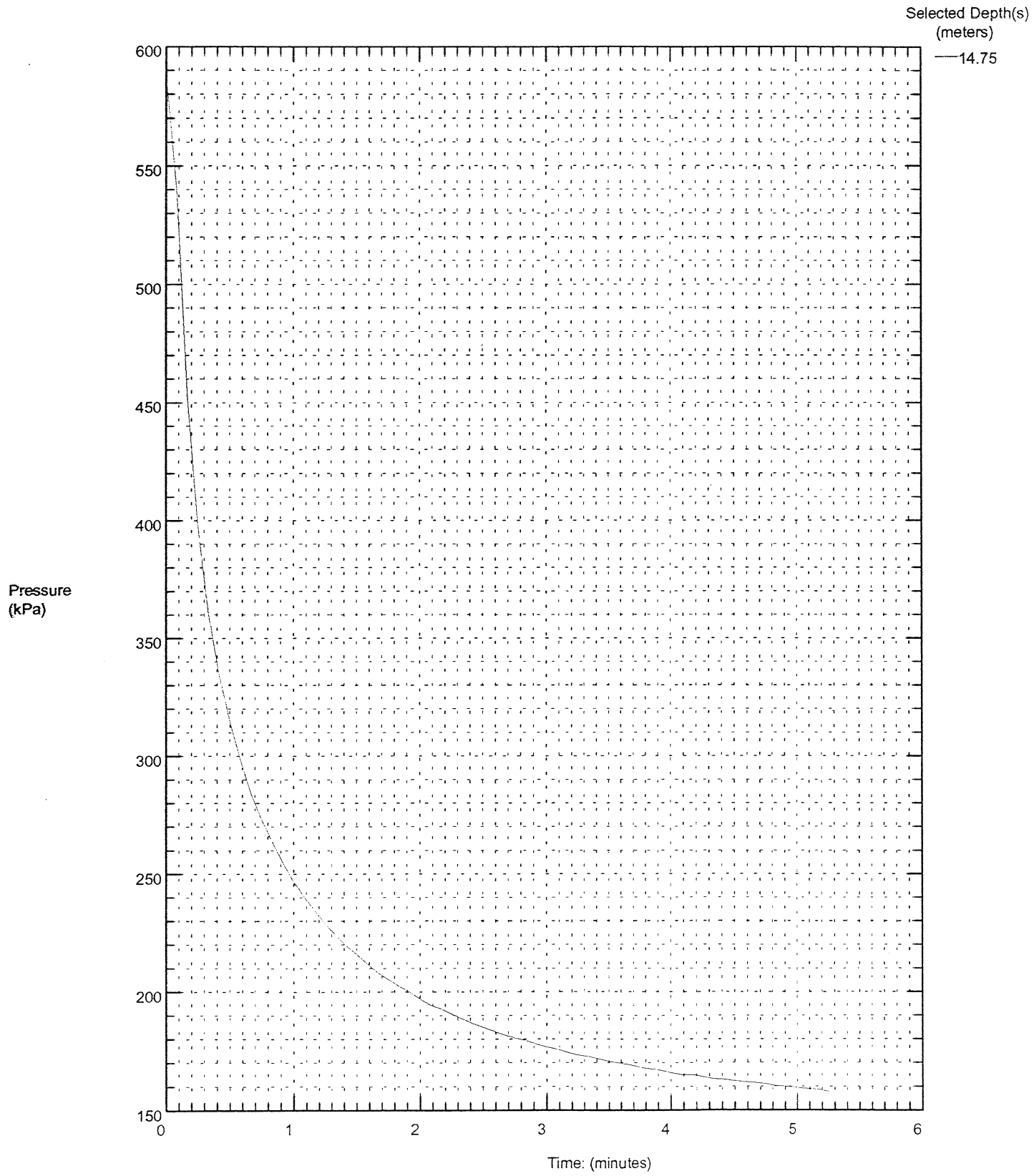


Maximum Pressure = 187.753 kPa
Hydrostatic Pressure = 128.121 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: PZP-32
Cone Used: 10T 4CH

CPT Date/Time: 04-20-01 12:46
Location: P.S.M TOMAGO
Job Number: 013

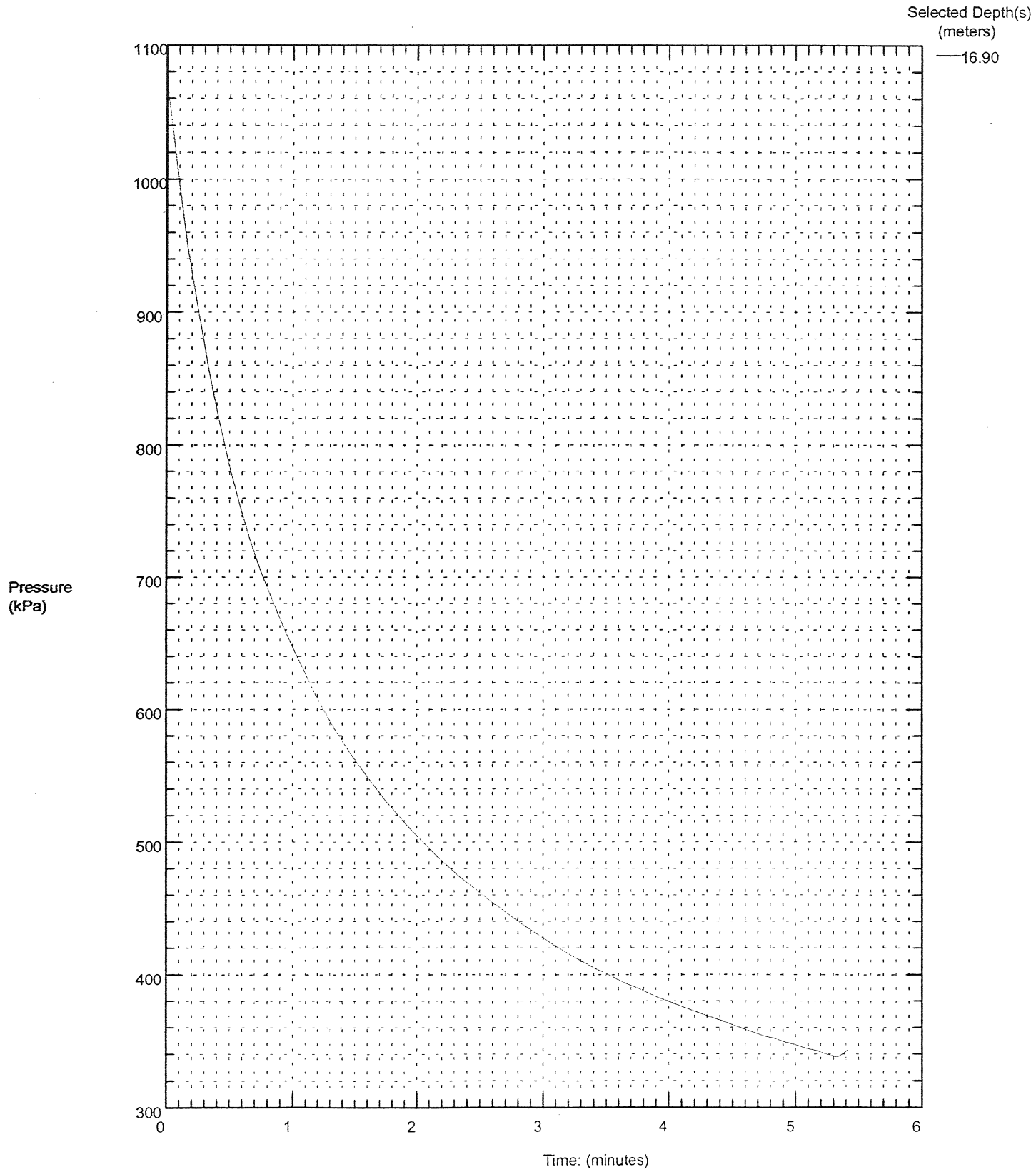


Maximum Pressure = 586.894 kPa
Hydrostatic Pressure = 137.939 kPa

NEWSYD Geotechnical Testing

Operator LJB
Sounding: PZP-32
Cone Used: 10T 4CH

CPT Date/Time: 04-20-01 12:46
Location: P.S.M TOMAGO
Job Number: 013

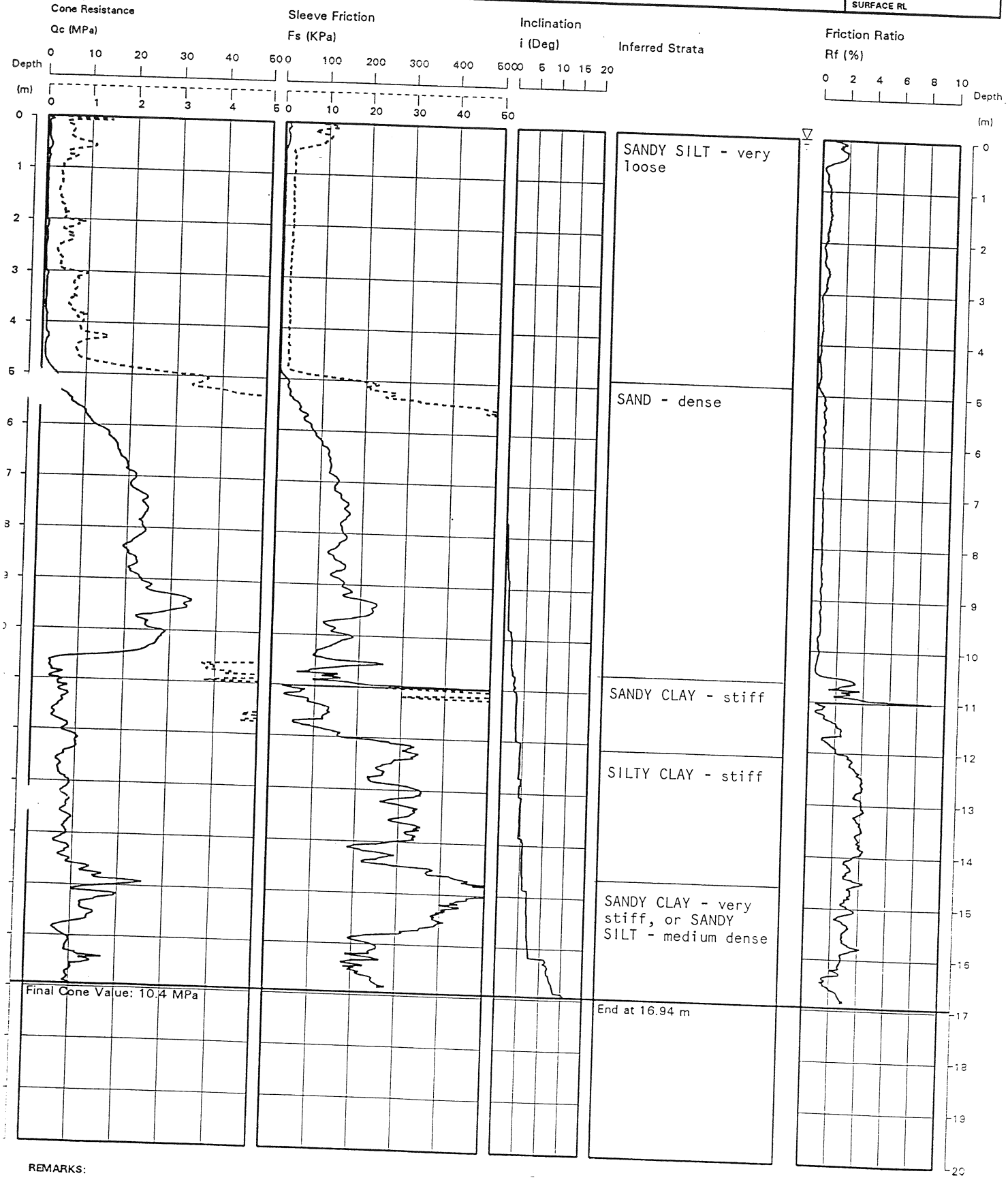


Maximum Pressure = 1071.46 kPa
Hydrostatic Pressure = 159.047 kPa

CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

39A
Page 1 of 1
DATE 10/04/01
SURFACE RL



REMARKS:

Plotted 4.5.01
Checked

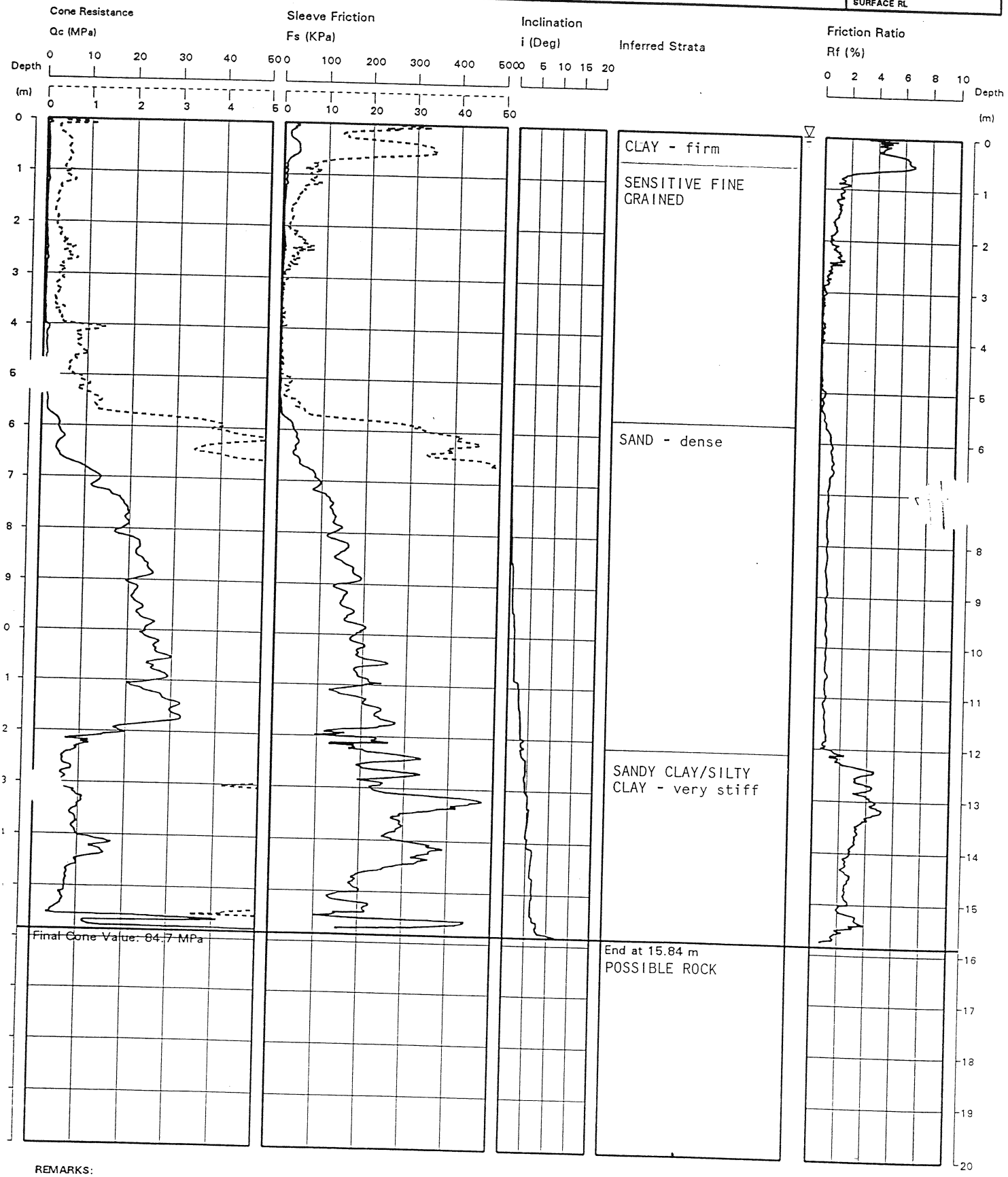
File: N:\CONEFILE\31299\3129939A.CPT
Cone ID: CONE-901 Type: Standard

▽ Water Level after test: 0.0m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299
			40
			Page 1 of 1
		DATE	10/04/01
		SURFACE RL	



REMARKS:

Date 4-5-01
Plotted
Checked

File: N:\CONEFILE\31299\31299-40.CPT
Cone ID: CONE-901 Type: Standard

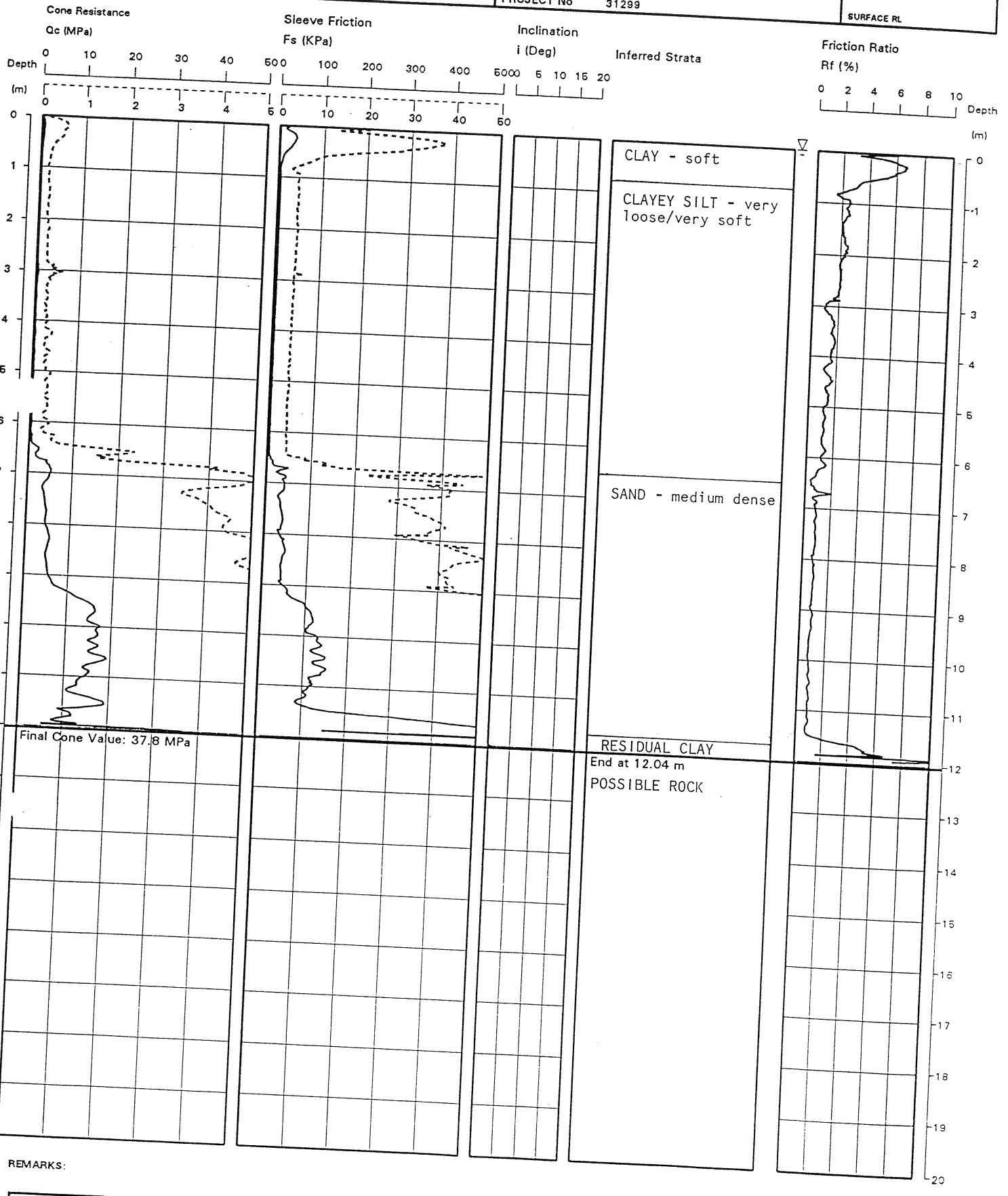
▽ Water Level after test: 0.0m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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Page 1 of 1
DATE 10/04/01
SURFACE RL



REMARKS:

4-5-01
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Checked

File: N:\CONEFILE\31299\31299-41.CPT
Cone ID: CONE-901 Type: Standard

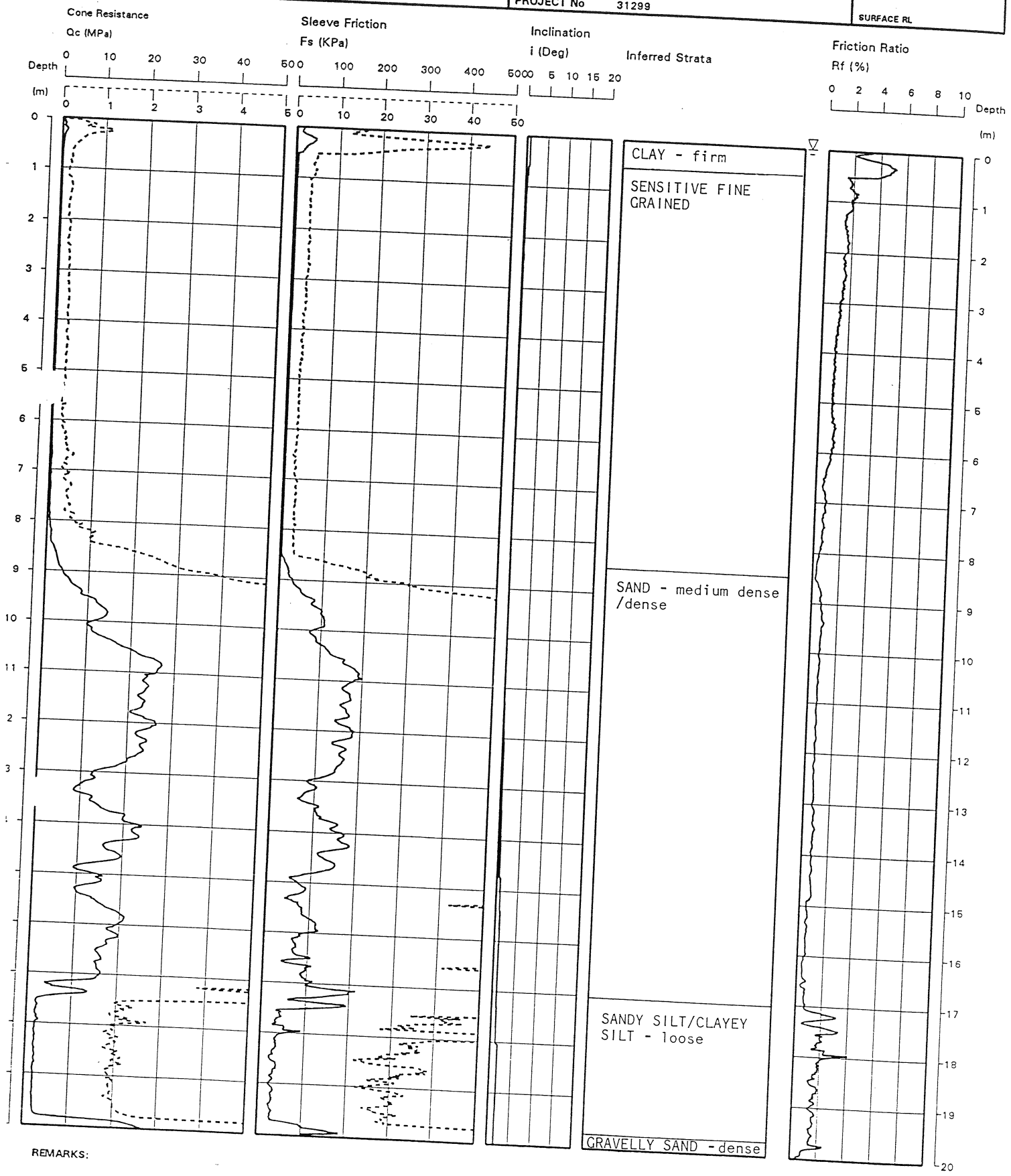
▽ Water Level after test: 0.0m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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DATE 9/04/01
SURFACE RL



REMARKS:

Checked 4.5.01

File: N:\CONEFILE\31299\31299-42.CPT
Cone ID: CONE-901 Type: Standard

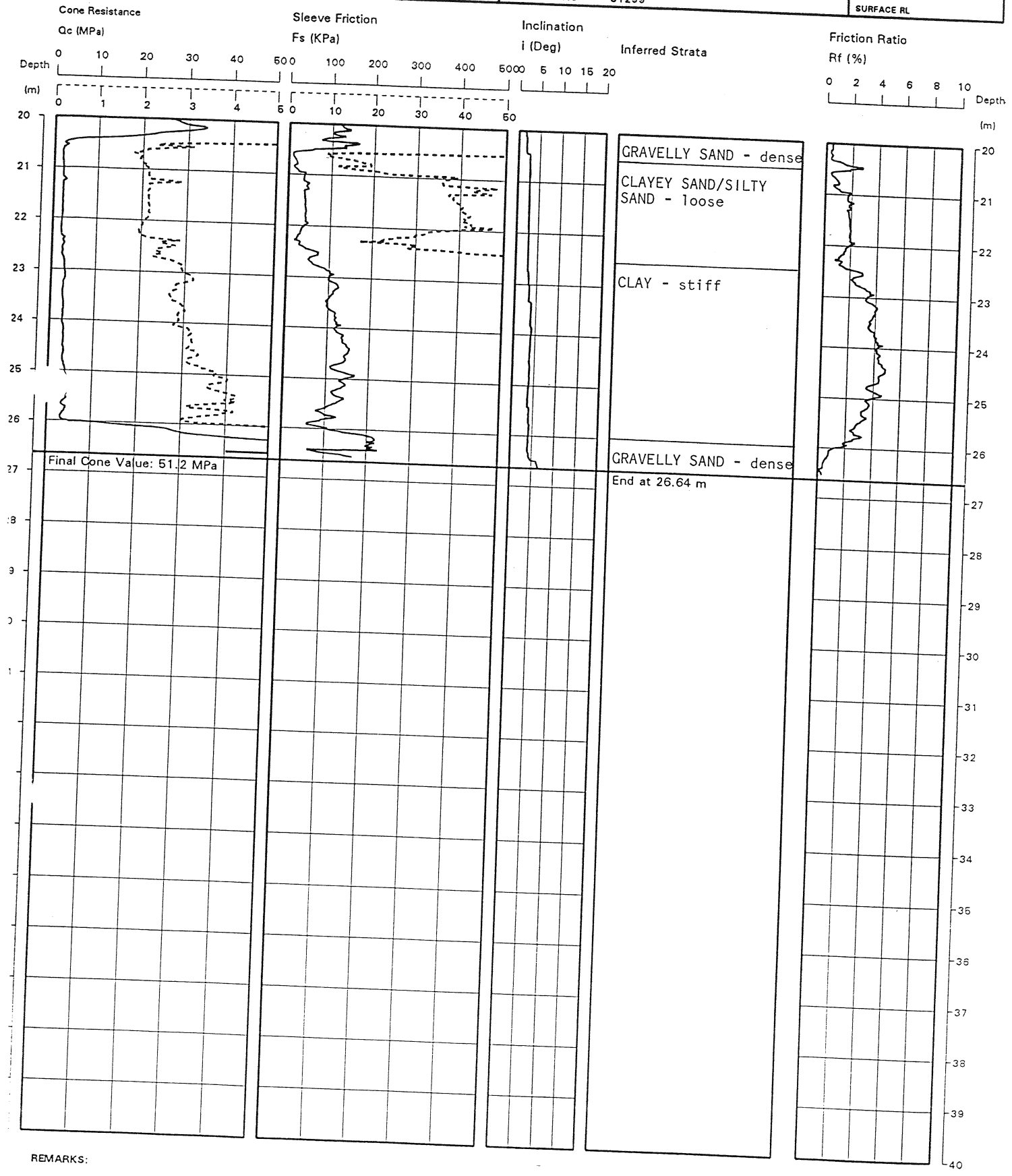
▽ Water Level after test: 0.0m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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Page 2 of 2
DATE 9/04/01
SURFACE RL



REMARKS:

4.5.01
Plotted
Checked

File: N:\CONEFILE\31299\31299-42.CPT
Cone ID: CONE-901 Type: Standard

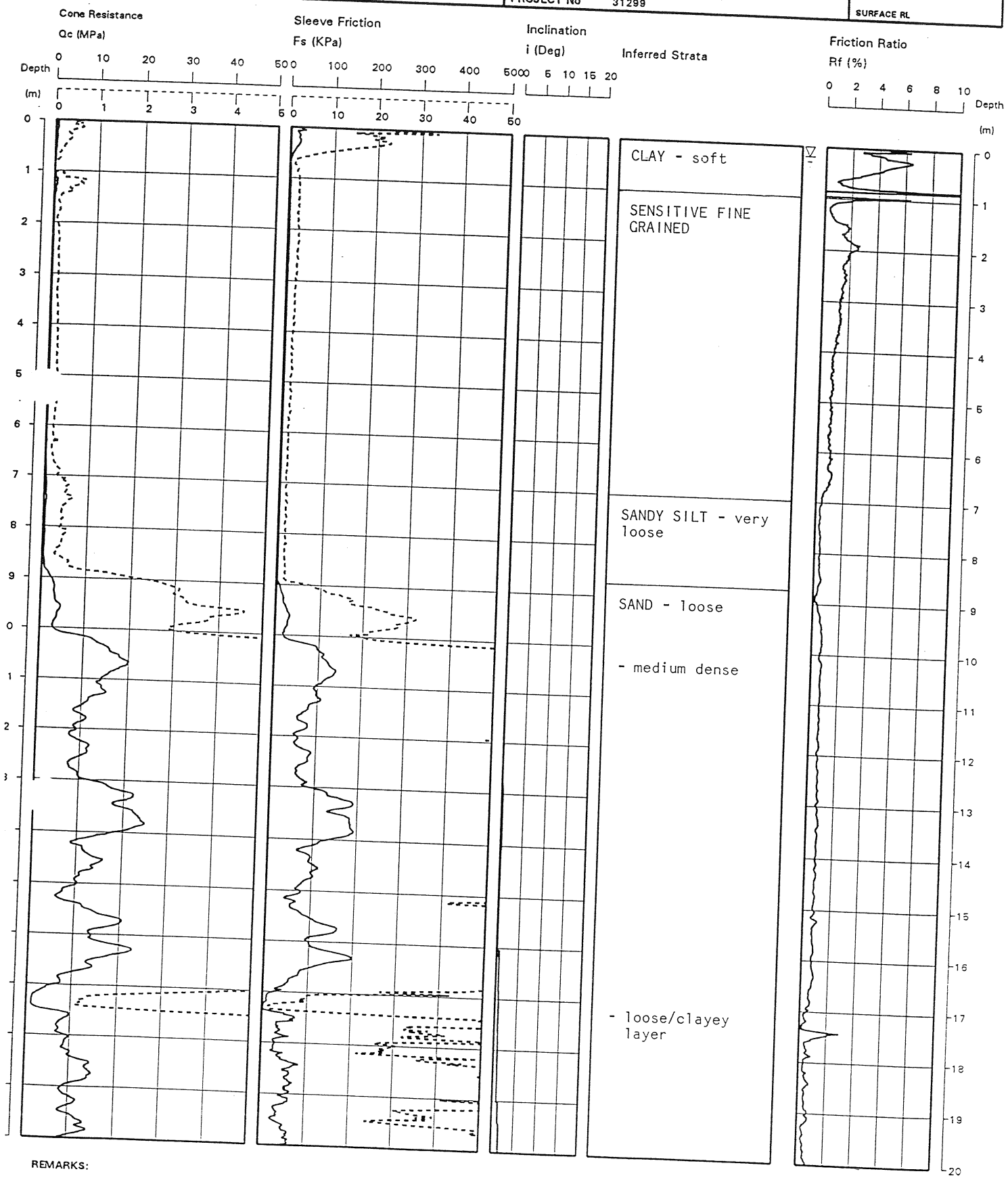
▽ Water Level after test: 0.0m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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Page 1 of 3
DATE 9/04/01
SURFACE RL



REMARKS:

e 4.50
riotted
Checked

File: N:\CONEFILE\31299\31299-43.CPT
Cone ID: CONE-901 Type: Standard

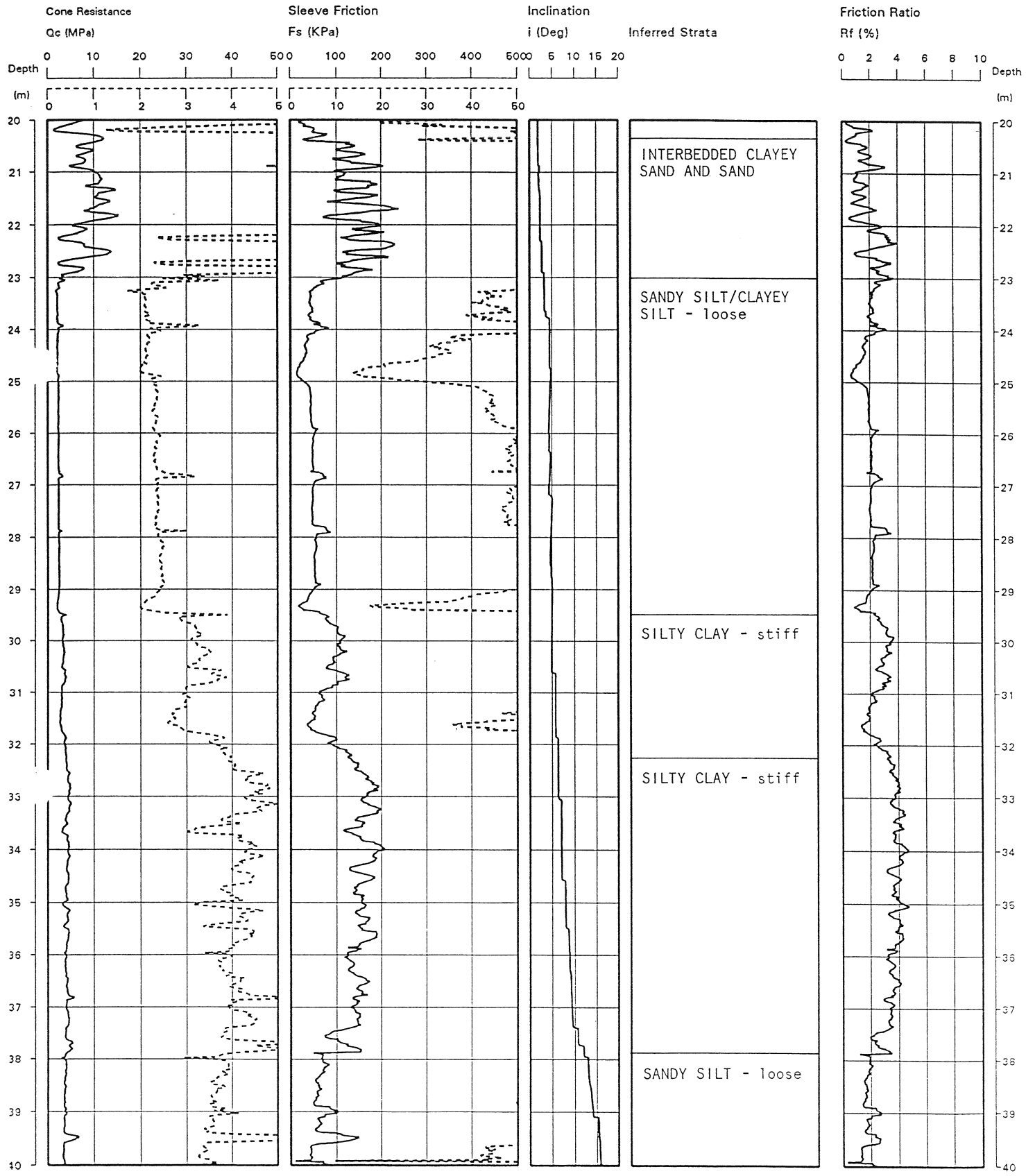
▽ Water Level after test: 0.2m depth

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CONE PENETRATION TEST

CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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Page 2 of 3
DATE 9/04/01
SURFACE RL



REMARKS:

Date	4.5.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-43.CPT
Cone ID: CONE-901 Type: Standard

▽ Water Level after test: 0.2m depth

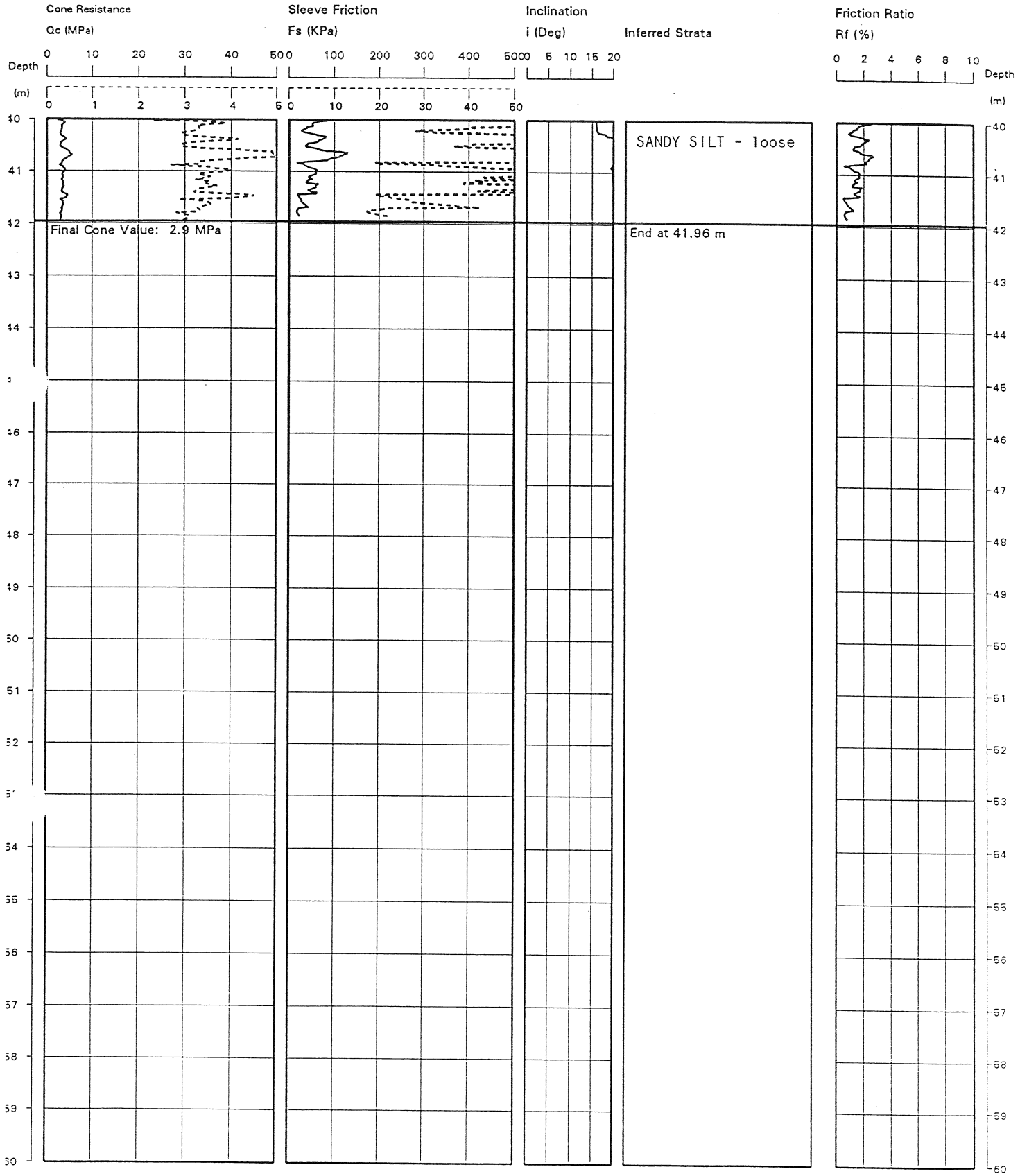
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CONE PENETRATION TEST

PROJECT	PROPOSED STEEL MILL
LOCATION	TOMAGO ROAD, TOMAGO
PROJECT No	31299

CLIENT SOIL & ROCK ENGINEERING PTY LTD
PREMIER'S DEPARTMENT NSW

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Page 3 of 3
DATE 9/04/01
SURFACE RL



REMARKS:

Date	4-5-01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-43.CPT
Cone ID: CONE-901 Type: Standard

Water Level after test: 0.2m depth

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CONE PENETRATION TEST

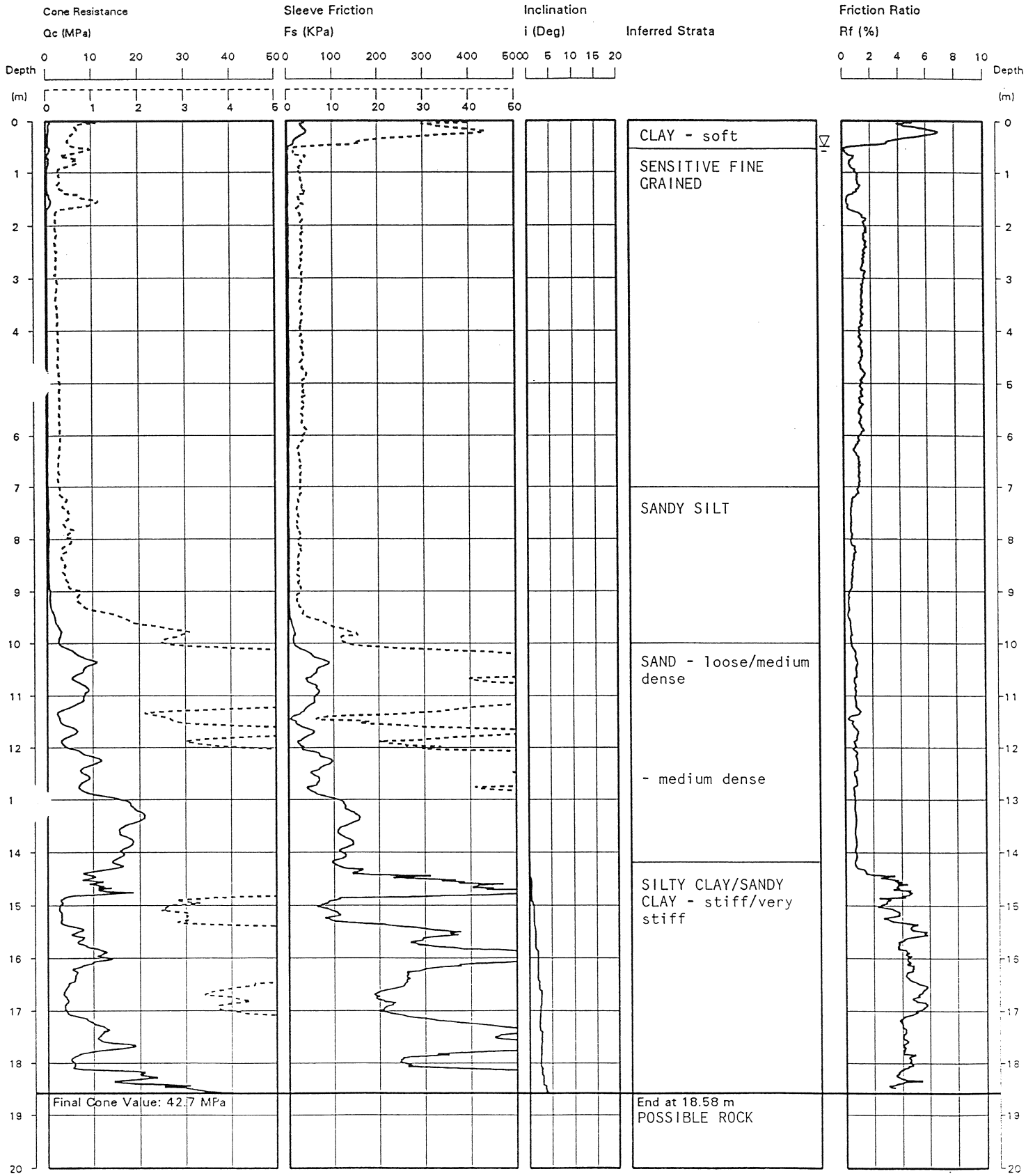
CLIENT	SOIL & ROCK ENGINEERING PTY LTD PREMIER'S DEPARTMENT NSW	PROJECT	PROPOSED STEEL MILL
		LOCATION	TOMAGO ROAD, TOMAGO
		PROJECT No	31299

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DATE 7/04/01

SURFACE RL



REMARKS:

Date	45.01
Plotted	
Checked	

File: N:\CONEFILE\31299\31299-44.CPT
Cone ID: CONE-901 Type: Standard

▽ Water Level after test: 0.5m depth

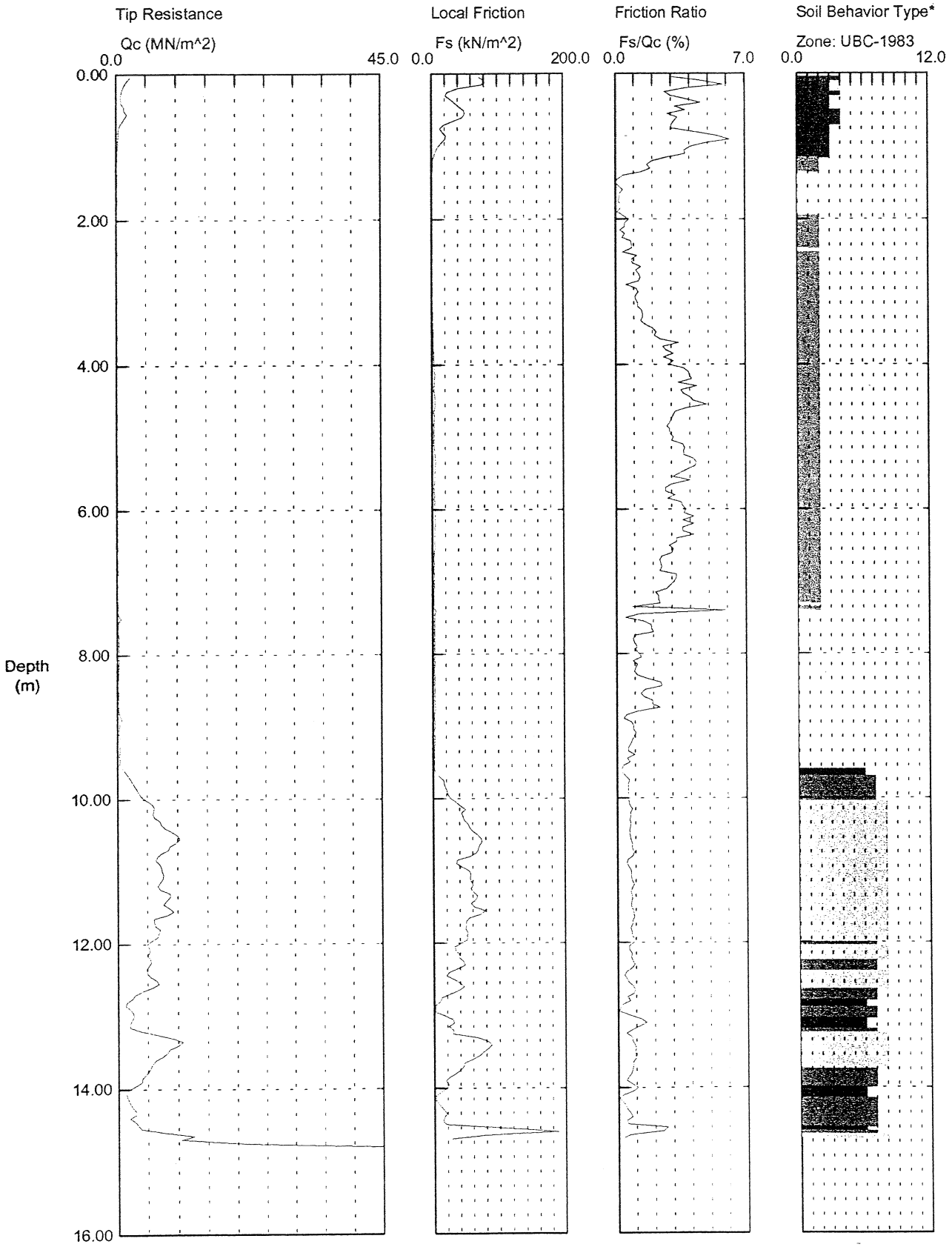
Douglas Partners
Geotechnics · Environment · Groundwater

*Soil behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: CPT-45
Cone Used: 10T 3CH

CPT Date/Time: 04-20-01 14:26
Location: P.S.M TOMAGO
Job Number: 013



Maximum Depth = 14.80 meters

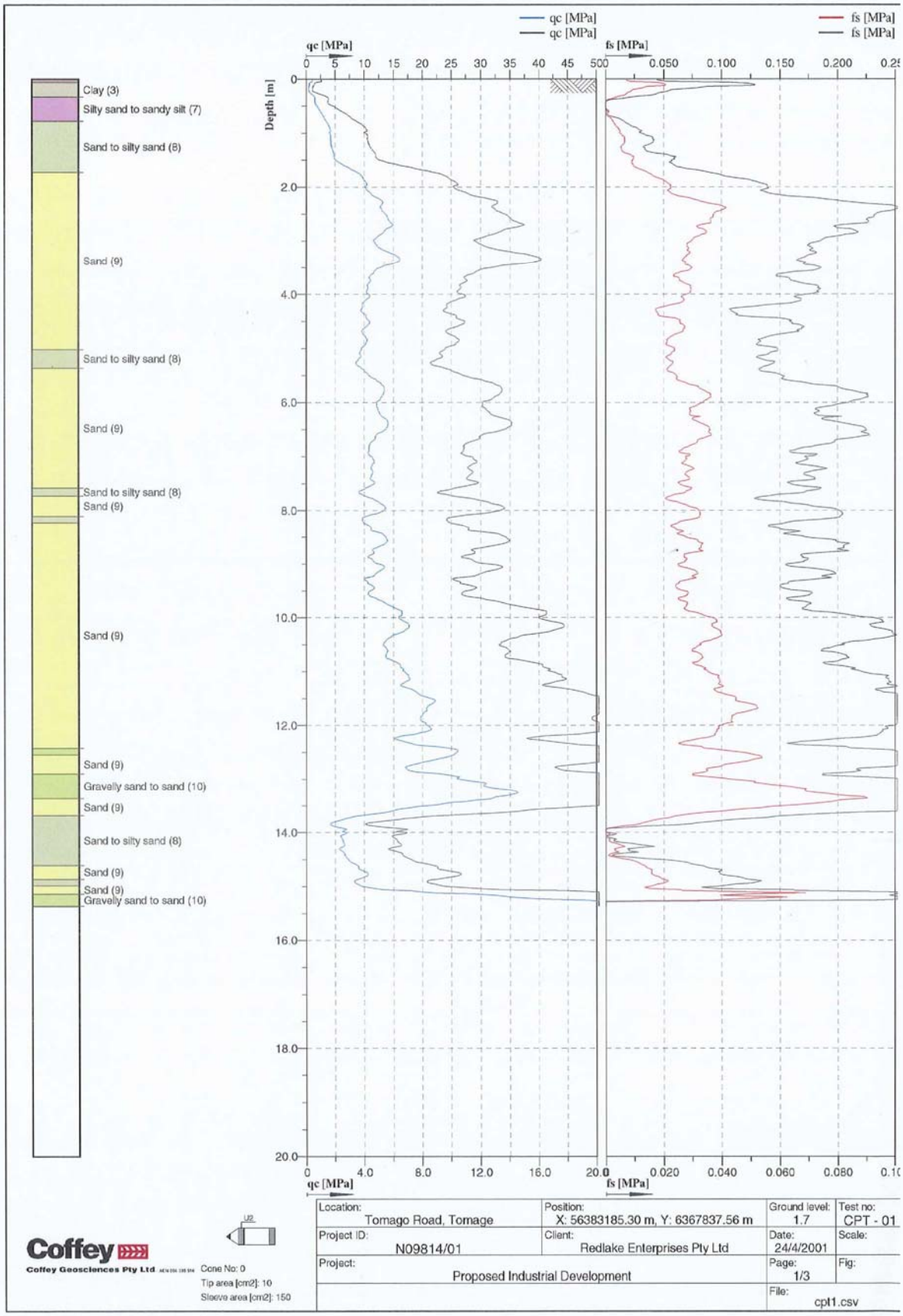
Depth Increment = 0.05 meters

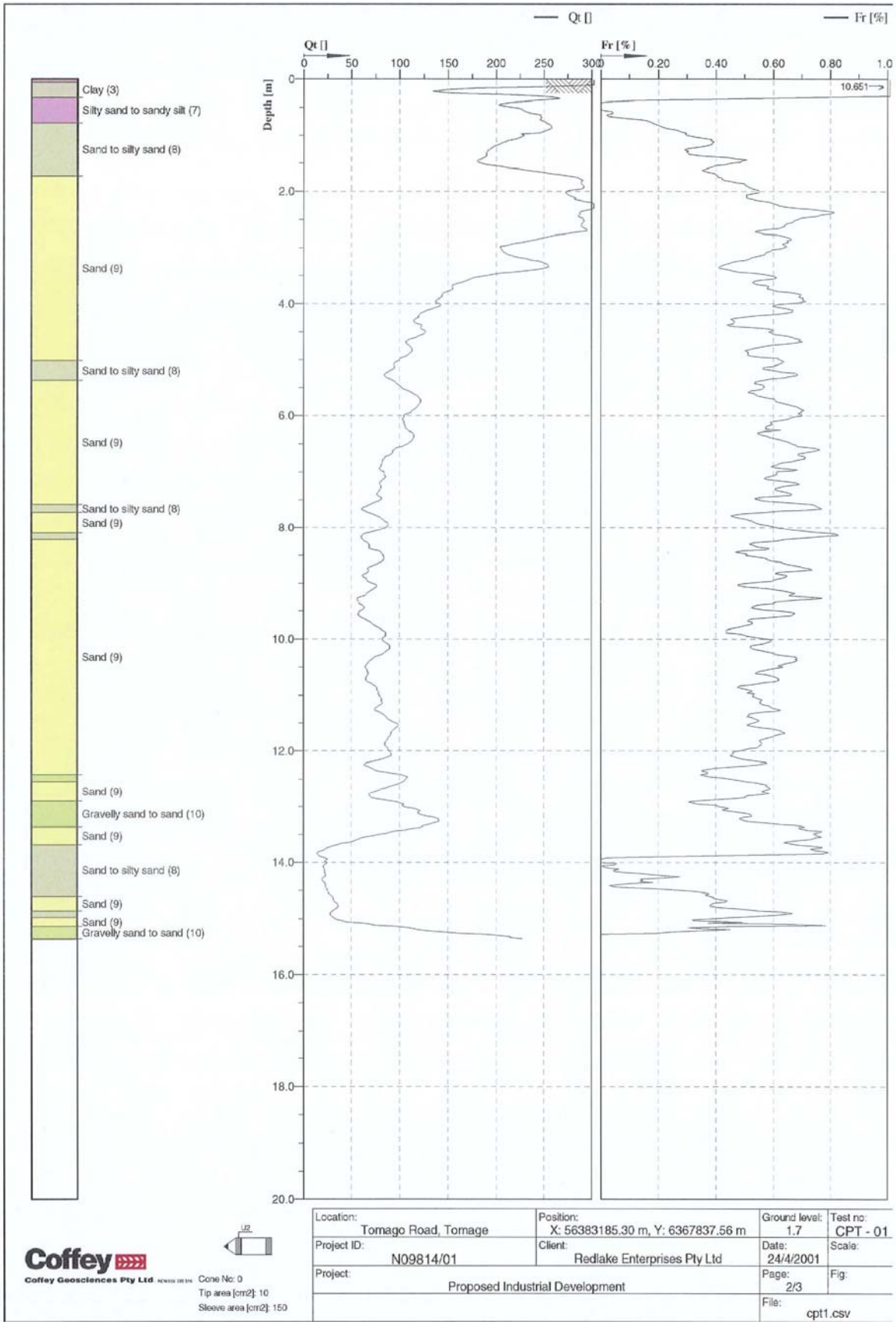
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Tip Resistance > 60 MPa at 14.8m

APPENDIX D

Converted CPT and Dissipation Test Results


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Location: Tomago Road, Tomago
Position: X: 56383185.30 m, Y: 6367837.56 m
Ground level: 1.7
Test no: CPT - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/3
Fig:
File: cpt1.csv
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

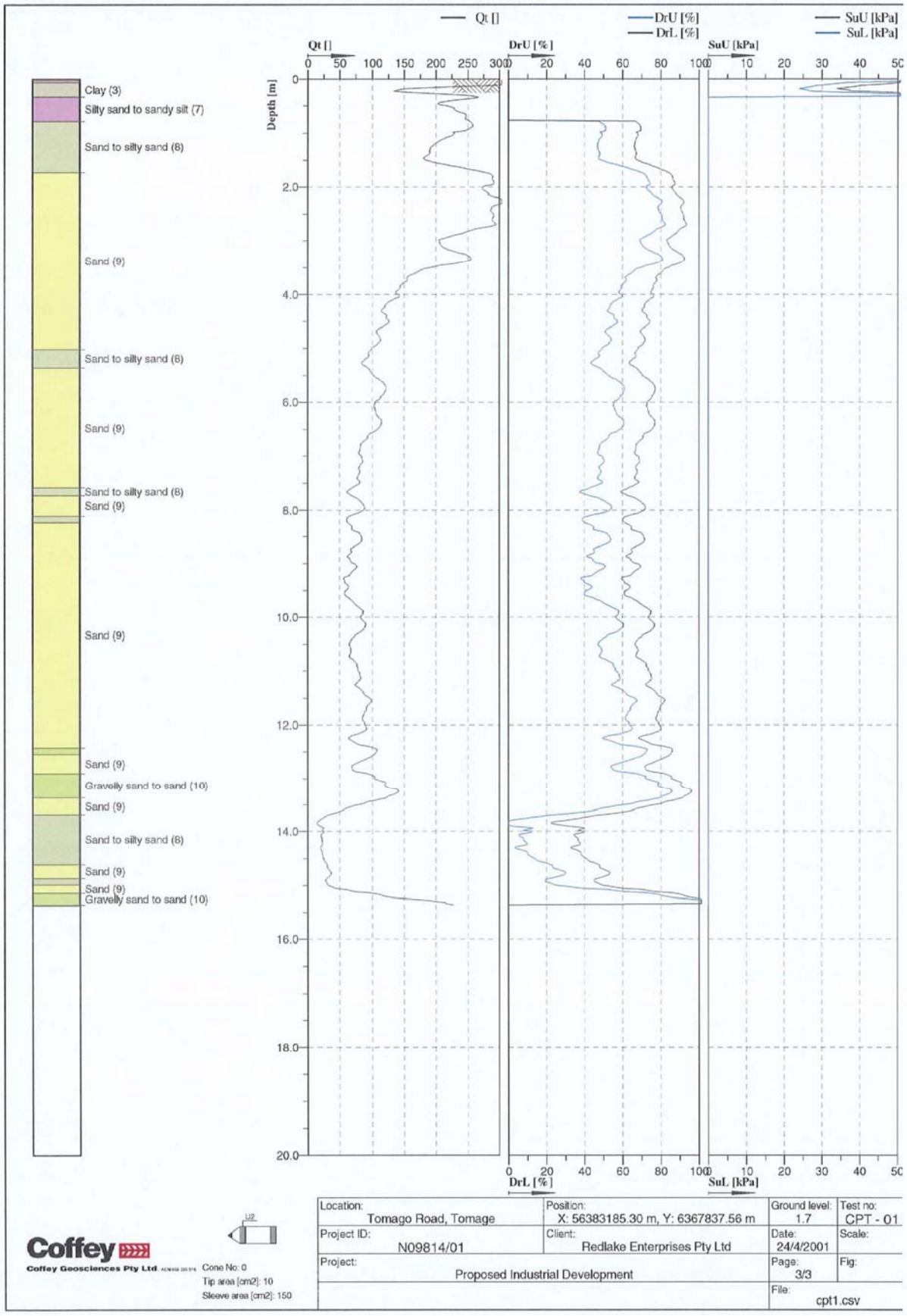


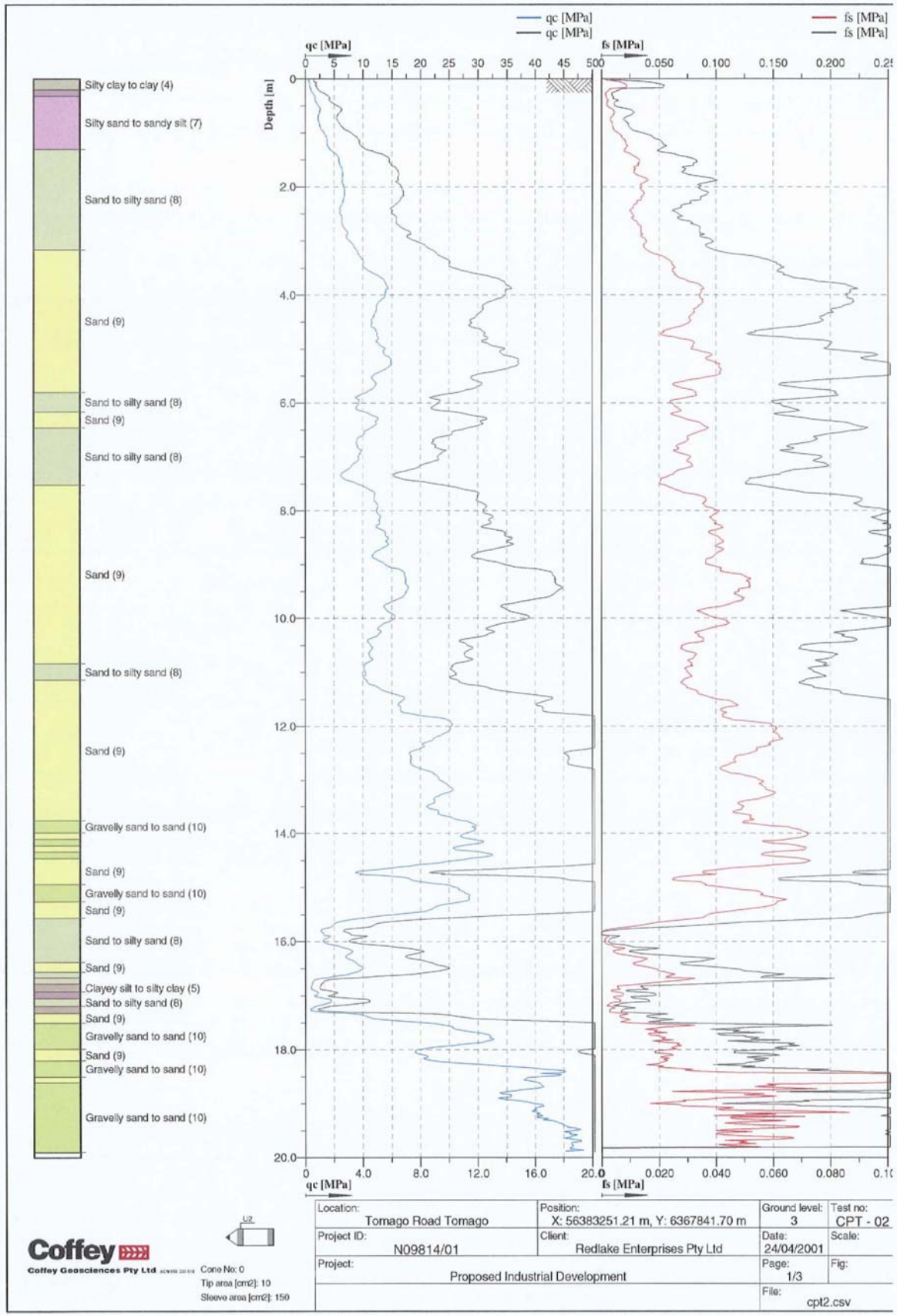
Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383185.30 m, Y: 6367837.56 m	Ground level: 1.7	Test no: CPT - 01
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 2/3	Fig:
		File: cpt1.csv	


Qt []
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Clay (3)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomage
Position: X: 56383185.30 m, Y: 6367837.56 m
Ground level: 1.7
Test no: CPT - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 3/3
Fig:
File: cpt1.csv

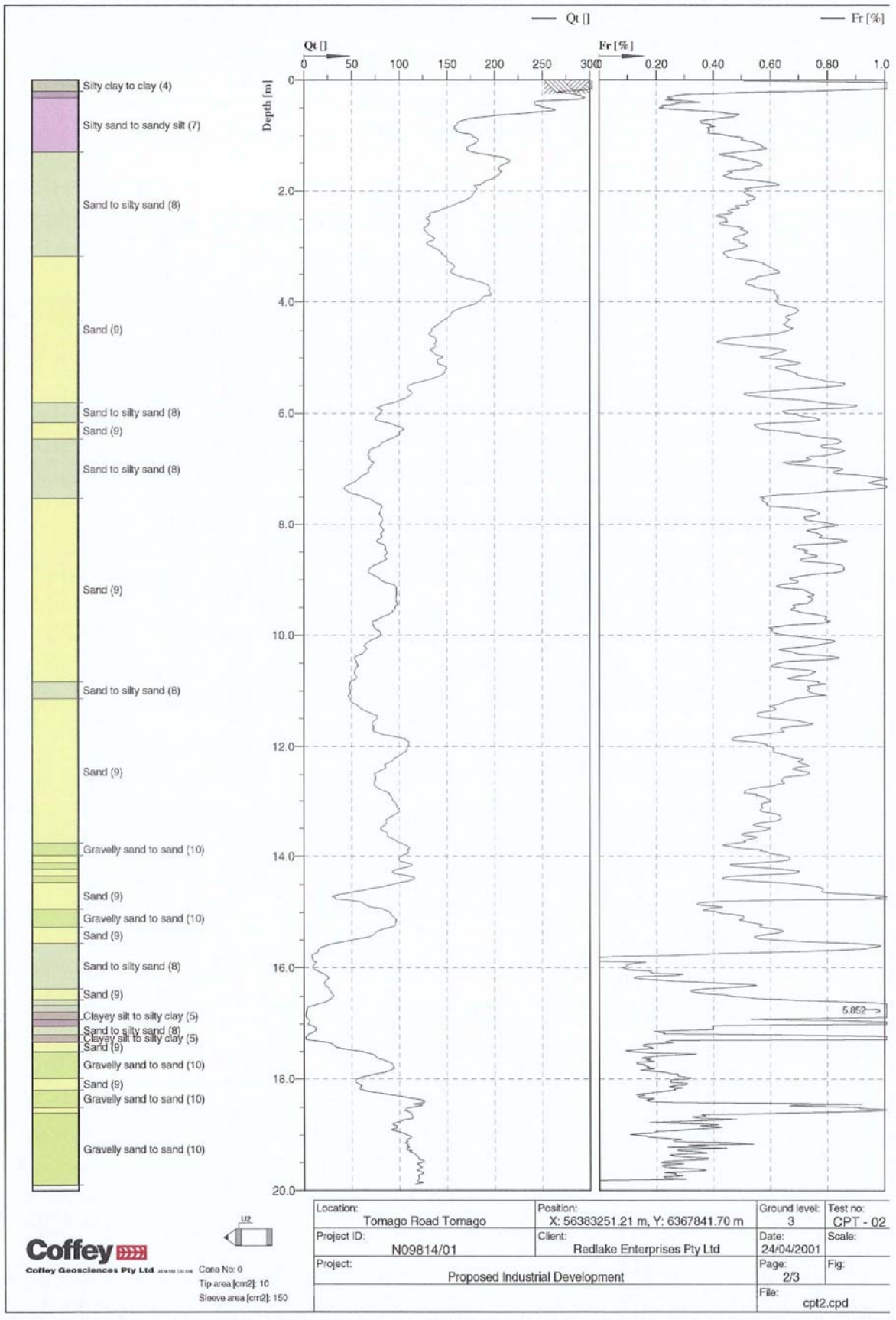


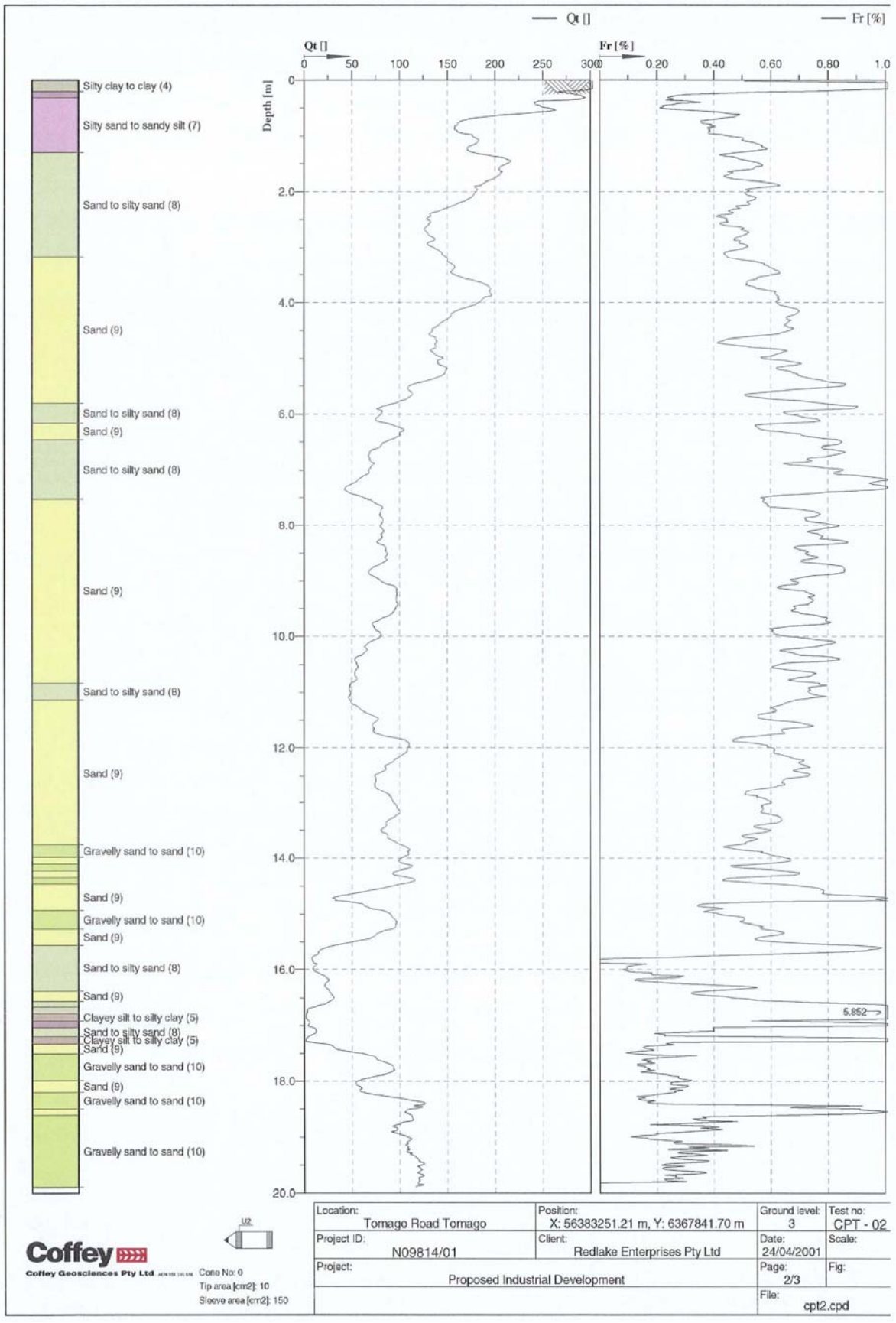
Coffey

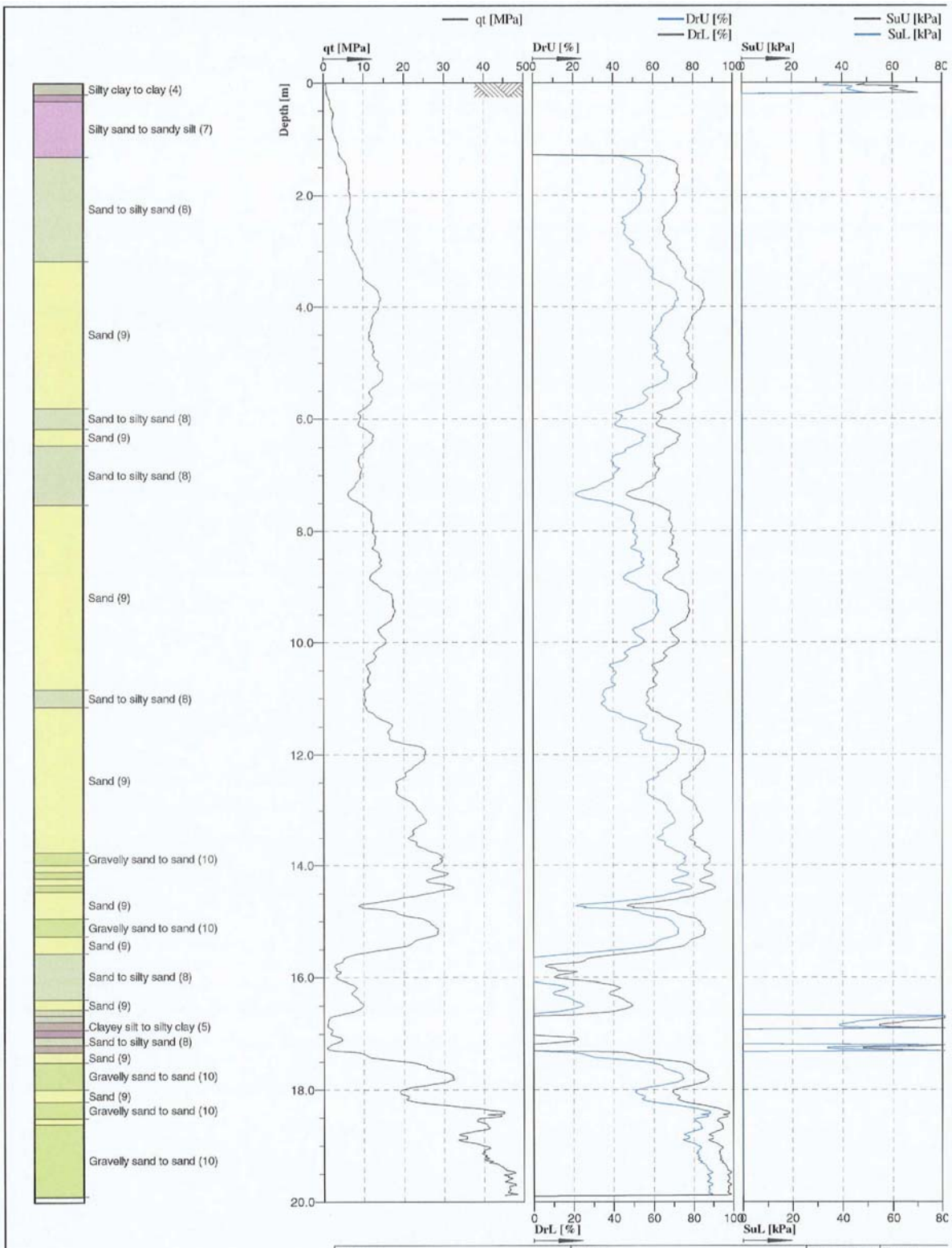
Coffey Geosciences Pty Ltd

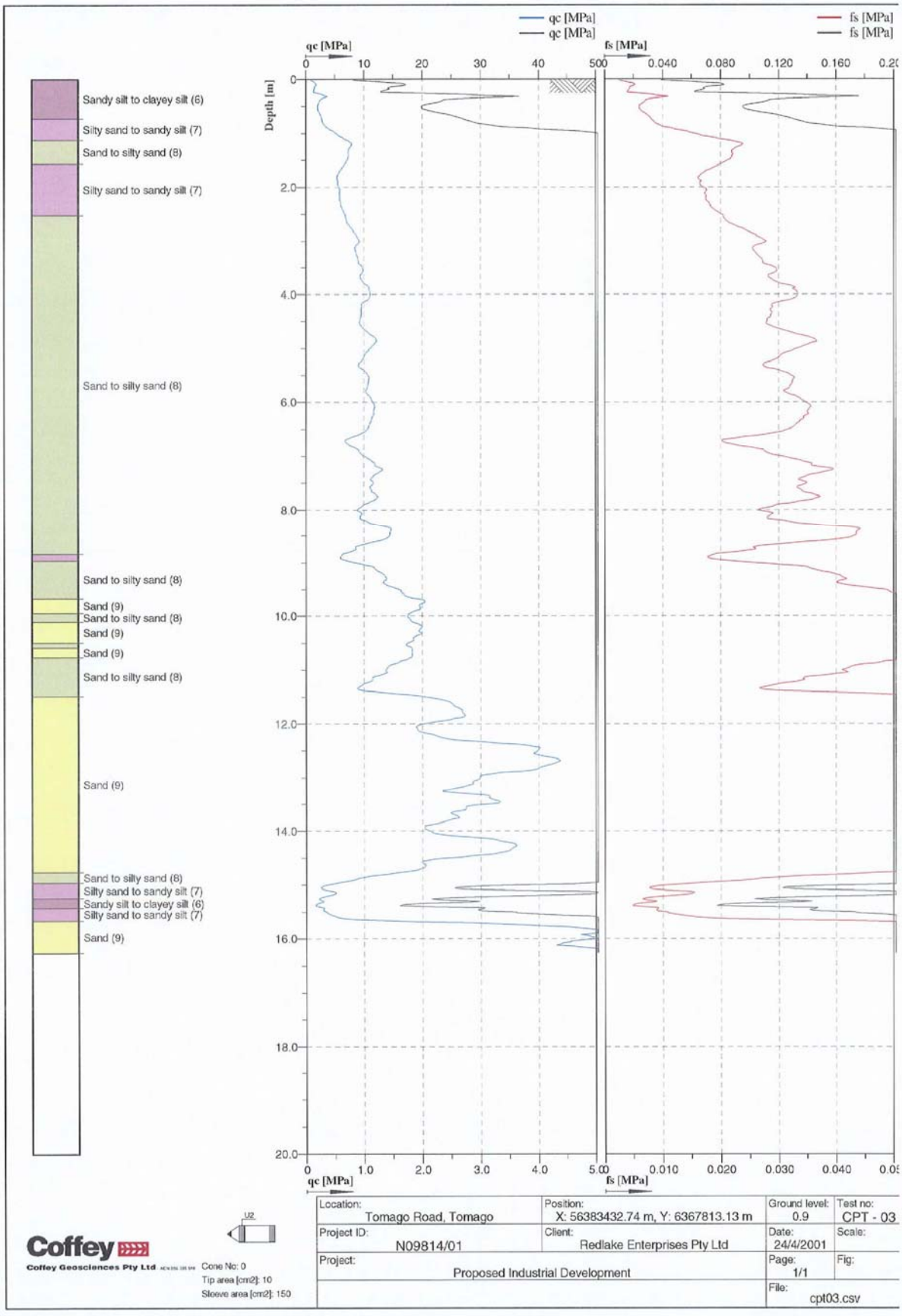
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

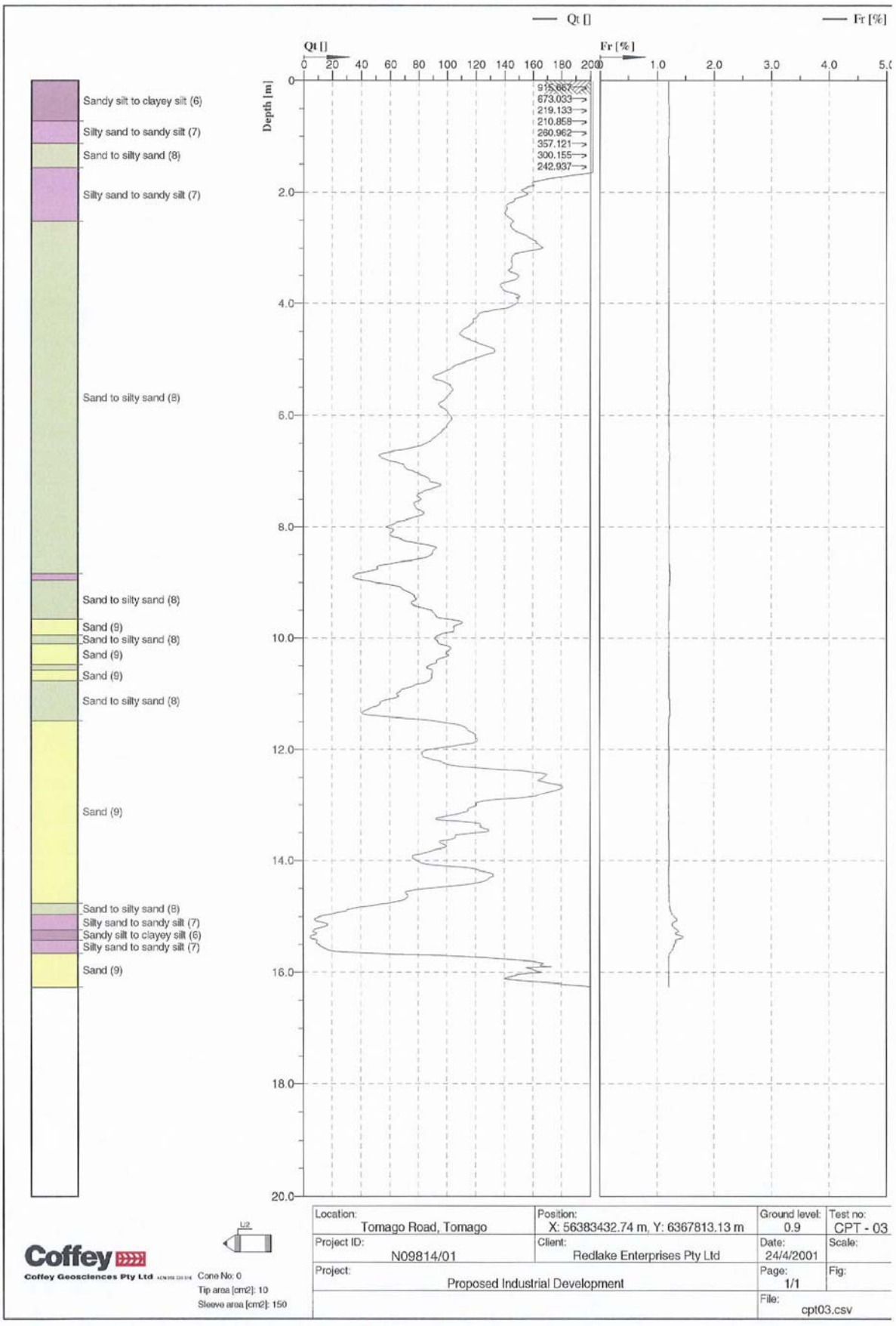
Location: Tomago Road Tomago	Position: X: 56383251.21 m, Y: 6367841.70 m	Ground level: 3	Test no: CPT - 02
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/04/2001	Scale:
Project: Proposed Industrial Development		Page: 1/3	Fig:
		File: cpt2.csv	


Qt []
Fr [%]
Qt []
Fr [%]
Depth [m]
0
50
100
150
200
250
300
0.00
0.20
0.40
0.60
0.80
1.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Clayey silt to silty clay (5)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Gravelly sand to sand (10)
5.852
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road Tomago
Position: X: 56383251.21 m, Y: 6367841.70 m
Ground level: 3
Test no: CPT - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt2.cpd


Qt []
Fr [%]
Depth [m]
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Clayey silt to silty clay (5)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Gravelly sand to sand (10)
5.852
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road Tomago
Position: X: 56383251.21 m, Y: 6367841.70 m
Ground level: 3
Test no: CPT - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt2.cpd


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Gravelly sand to sand (10)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road Tomago
Position: X: 56383251.21 m, Y: 6367841.70 m
Ground level: 3
Test no: CPT - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 3/3
Fig:
File: cpt2.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand (9)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383432.74 m, Y: 6367813.13 m
Ground level: 0.9
Test no: CPT - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt03.csv

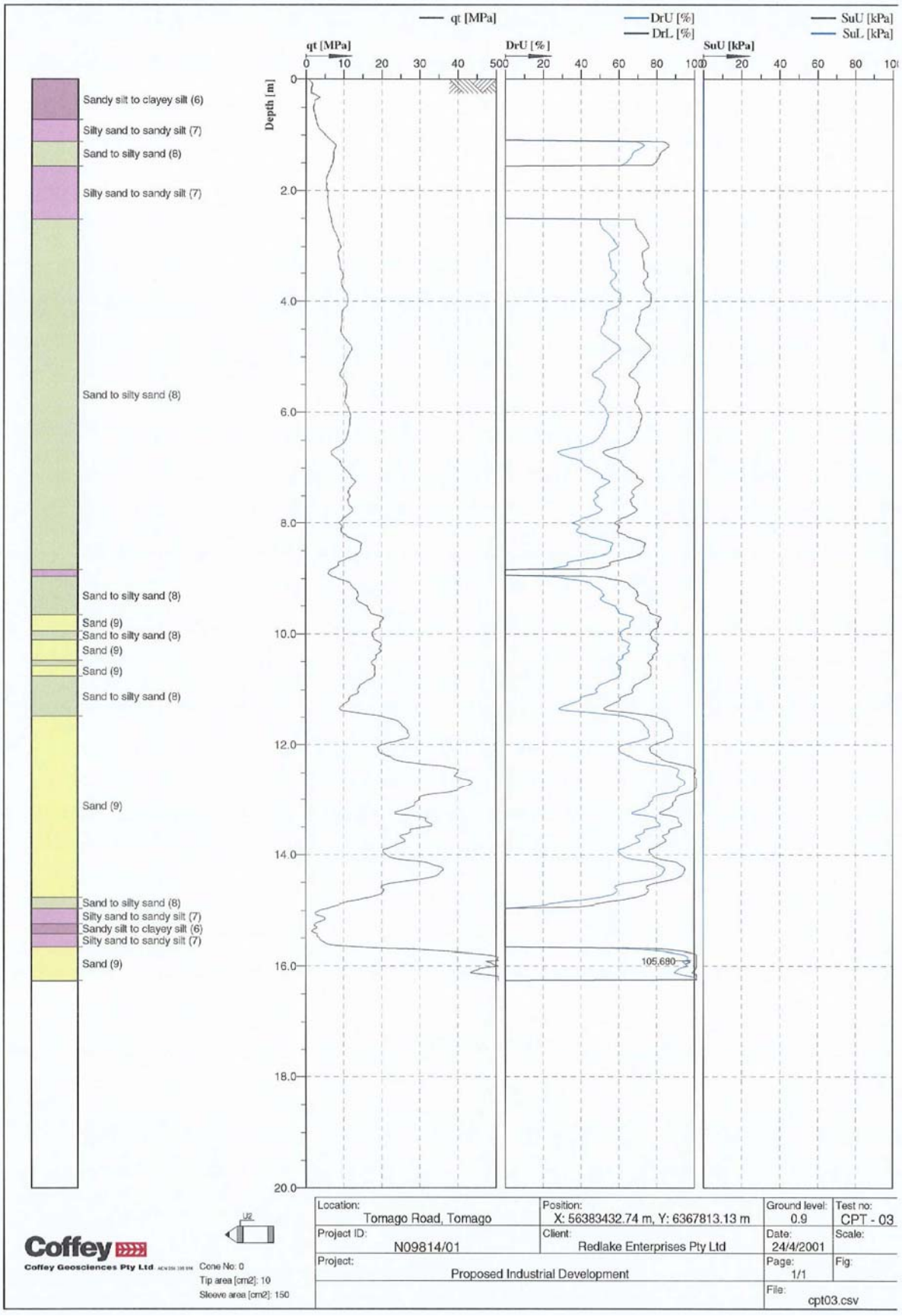


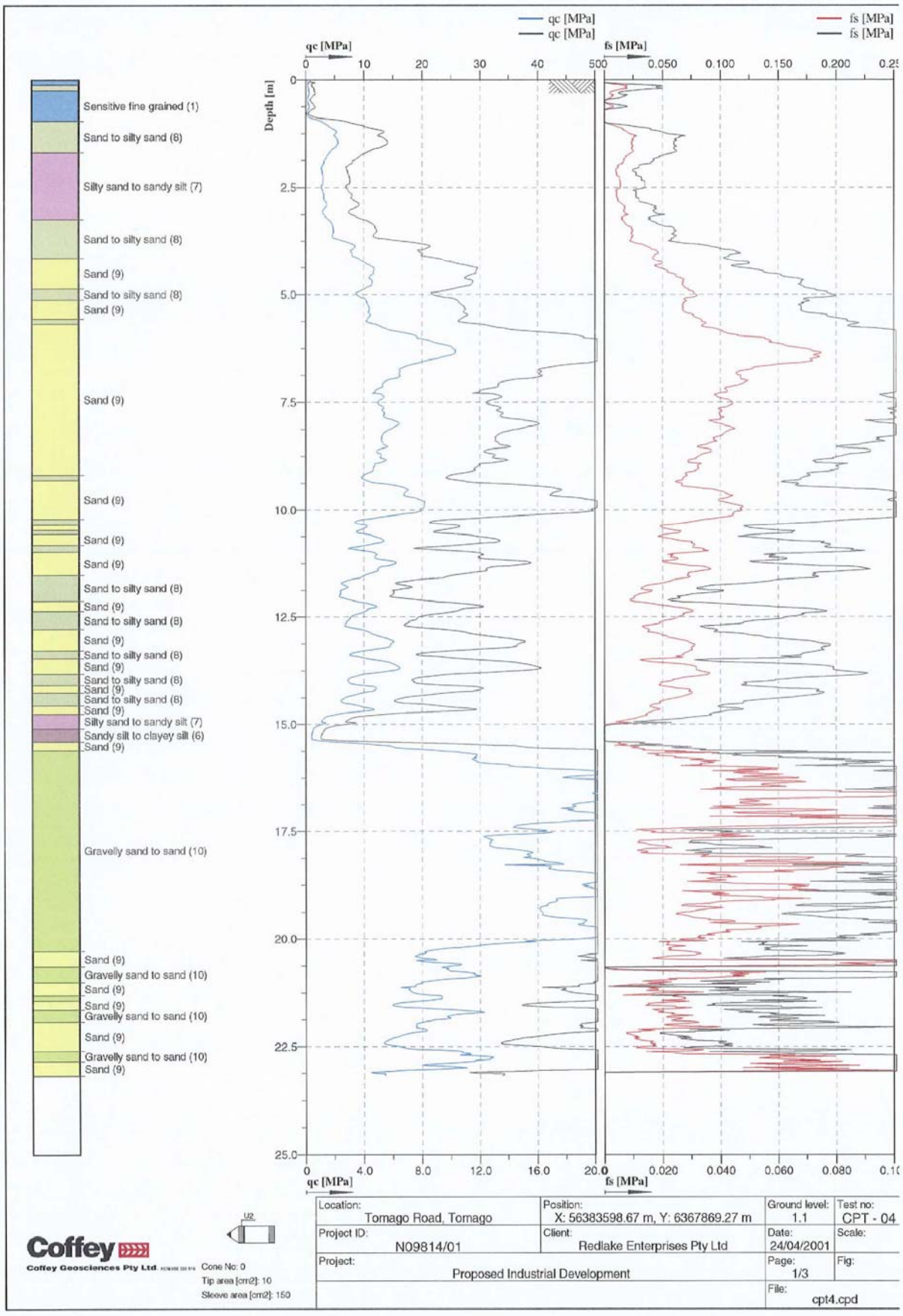
Coffey

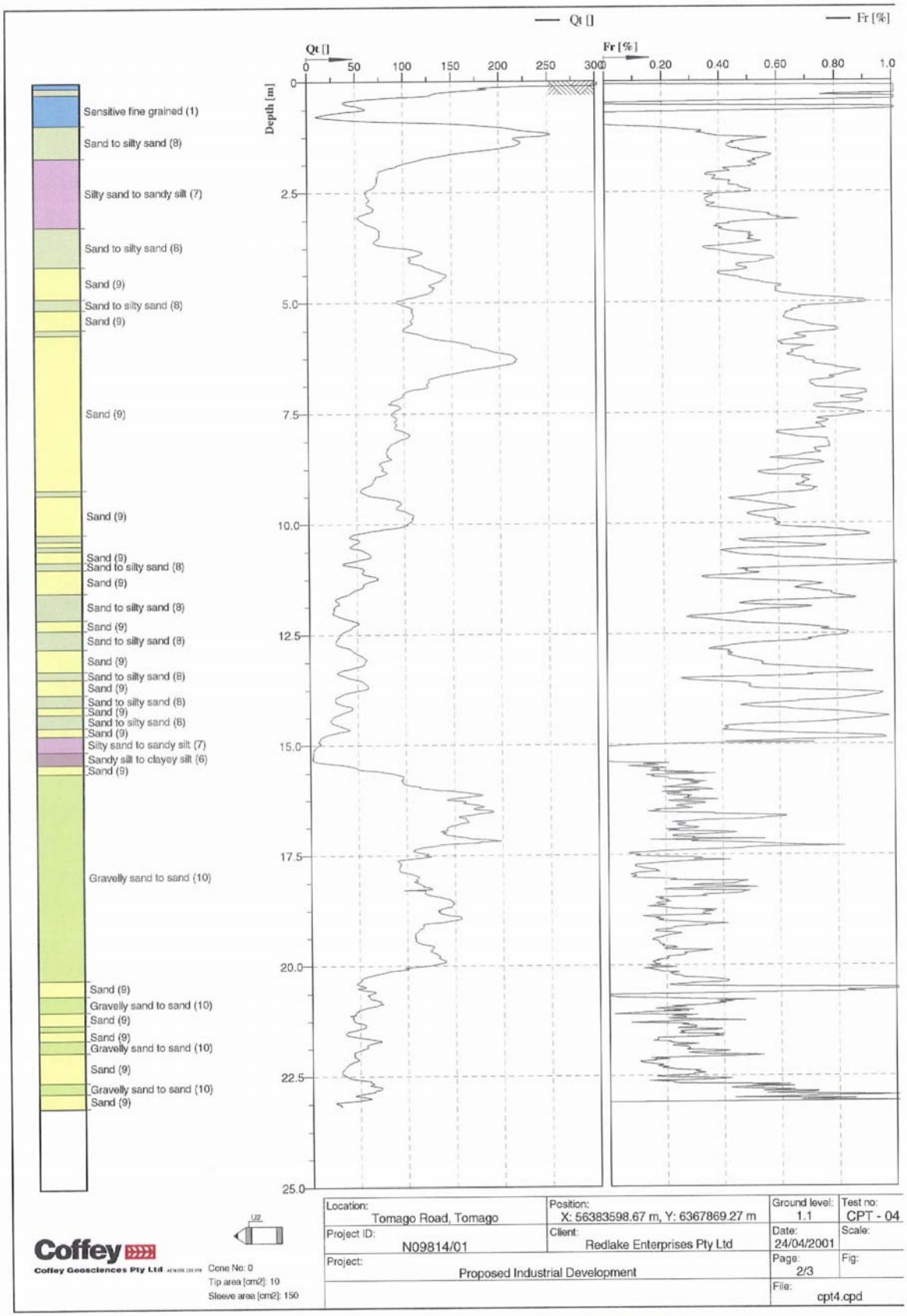
Coffey Geosciences Pty Ltd

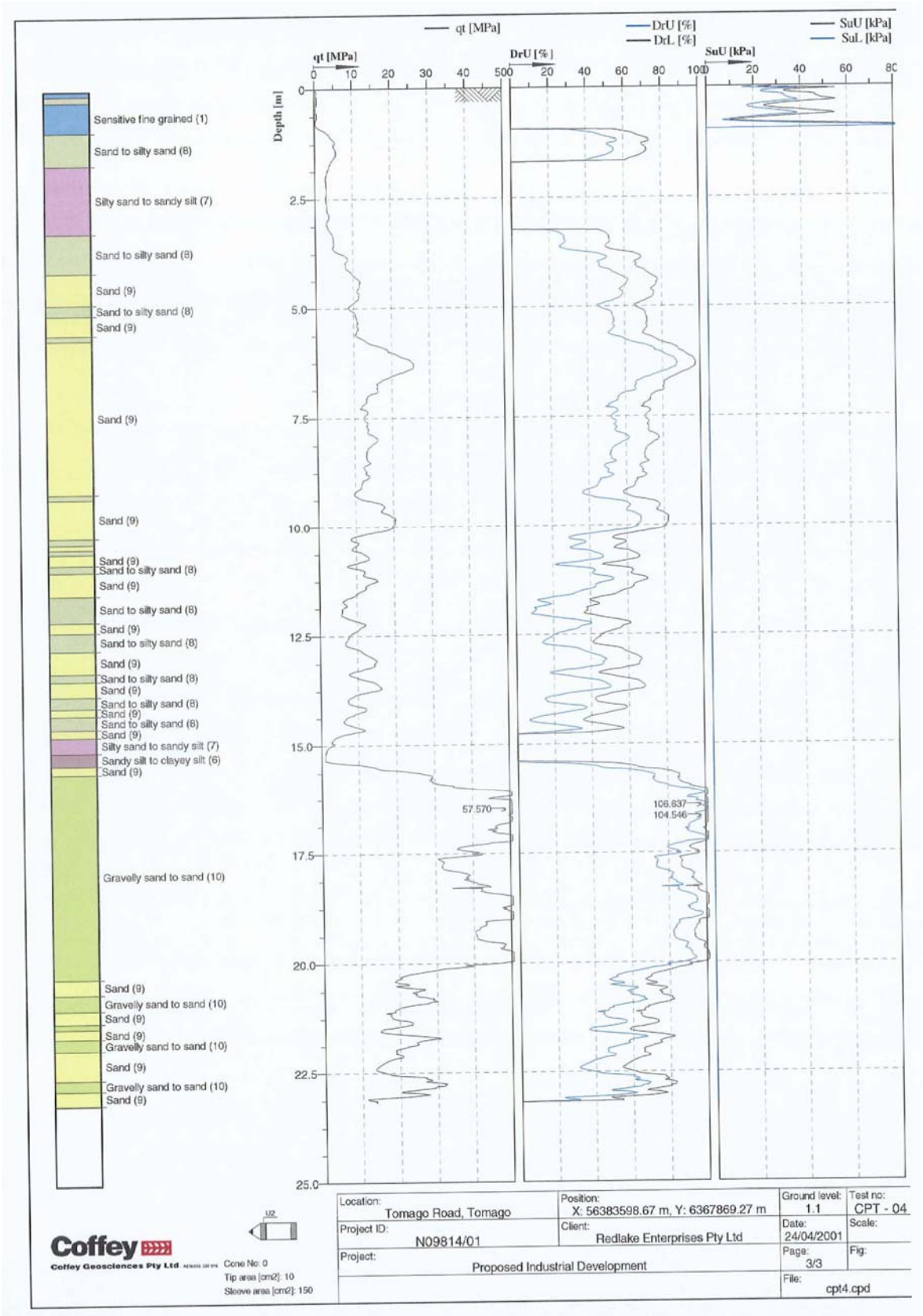
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

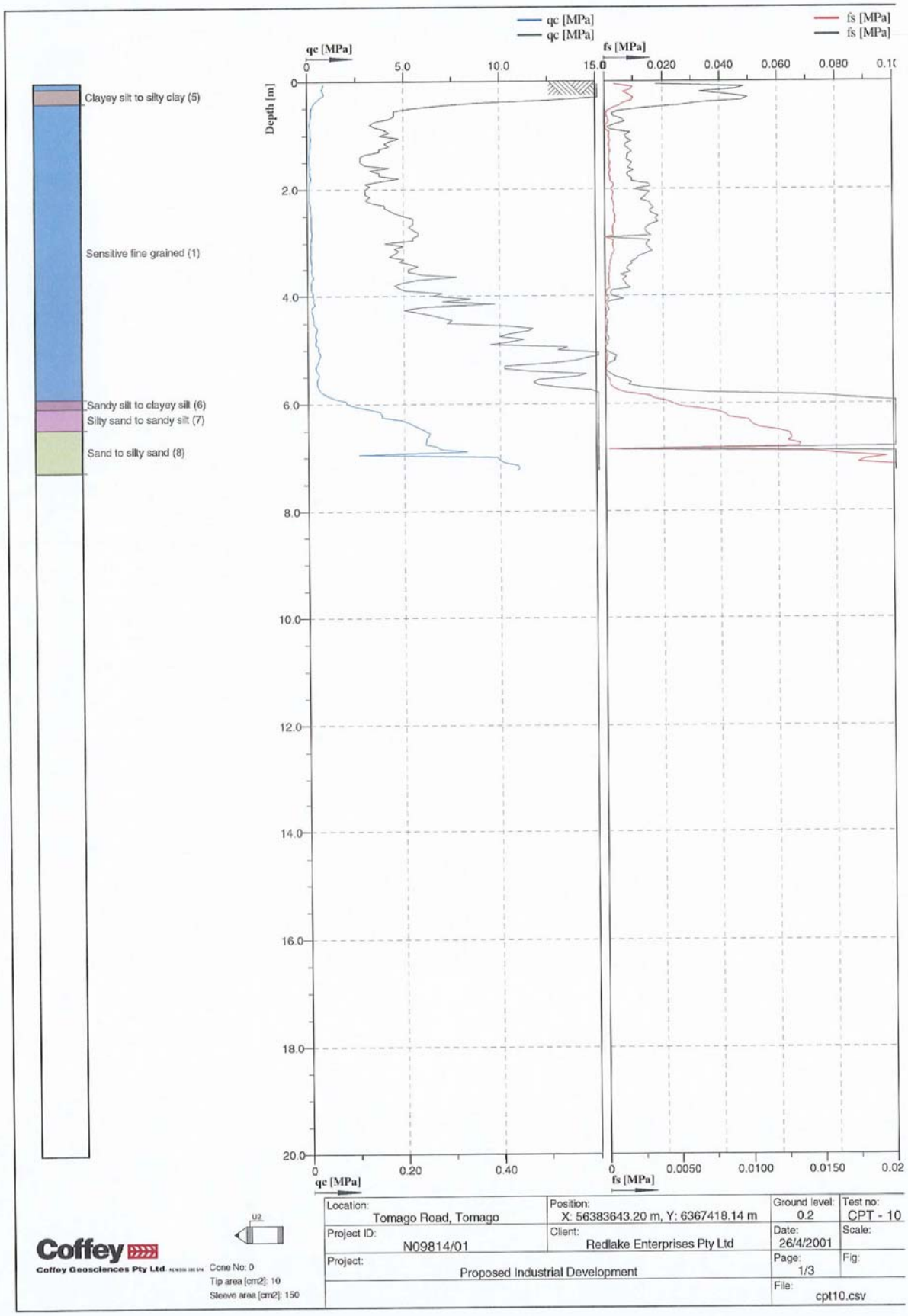
Location: Tomago Road, Tomago	Position: X: 56383432.74 m, Y: 6367813.13 m	Ground level: 0.9	Test no: CPT - 03
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt03.csv	


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand (9)
105,680
Location: Tomago Road, Tomago
Position: X: 56383432.74 m, Y: 6367813.13 m
Ground level: 0.9
Test no: CPT - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt03.csv
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sensitive fine grained (1)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
0
10
20
30
40
500
0.050
0.100
0.150
0.200
0.25
0
4.0
8.0
12.0
16.0
20.0
0.020
0.040
0.060
0.080
0.1
qc [MPa]
fs [MPa]
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383598.67 m, Y: 6367869.27 m
Ground level: 1.1
Test no: CPT - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 1/3
Fig:
File: cpt4.cpd


Qt []
Fr [%]
Depth [m]
Sensitive fine grained (1)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383598.67 m, Y: 6367869.27 m
Ground level: 1.1
Test no: CPT - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt4.cpd


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Sensitive fine grained (1)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
57.570
106.637
104.546
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383598.67 m, Y: 6367869.27 m
Ground level: 1.1
Test no: CPT - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 3/3
Fig:
File: cpt4.cpd

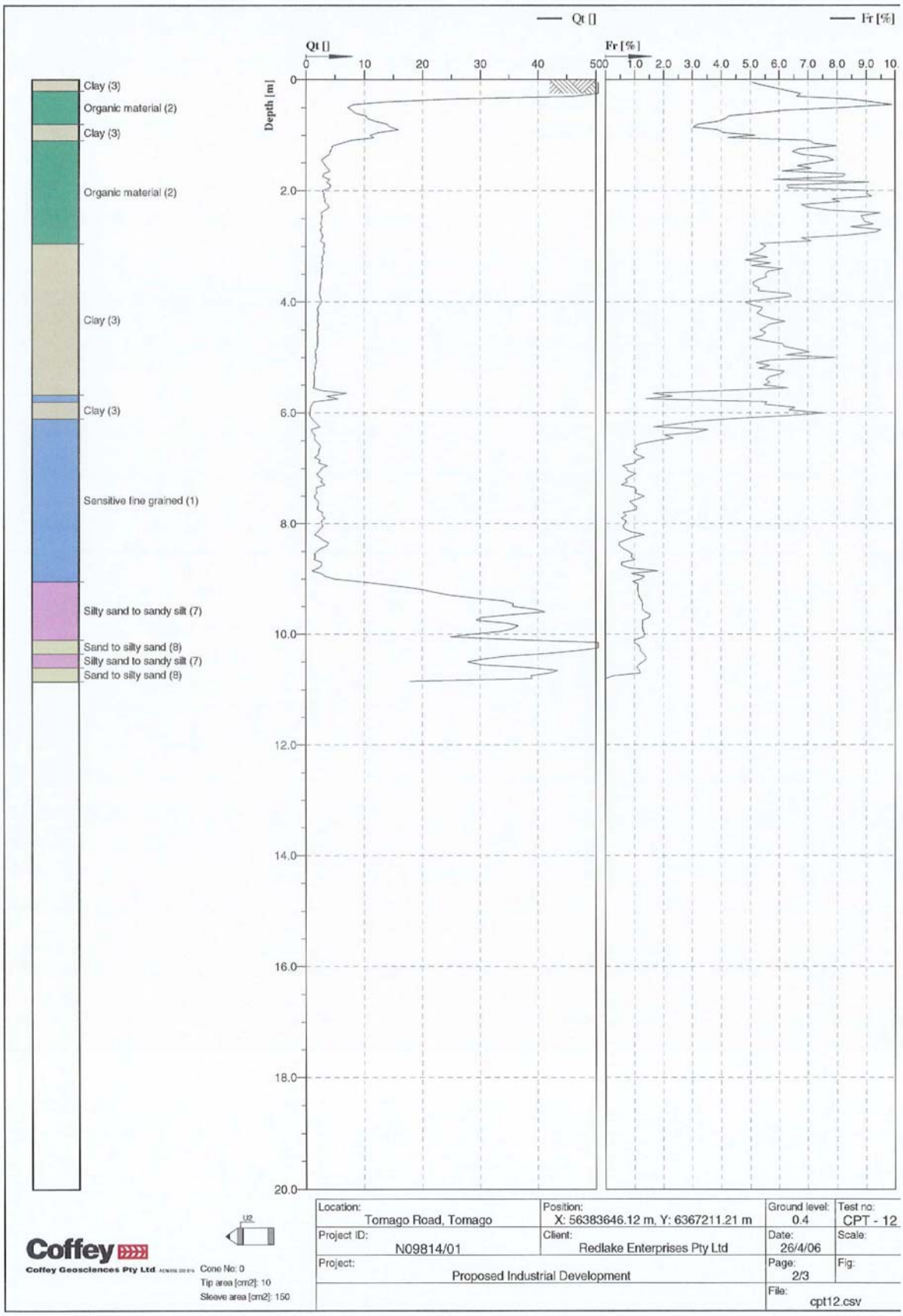


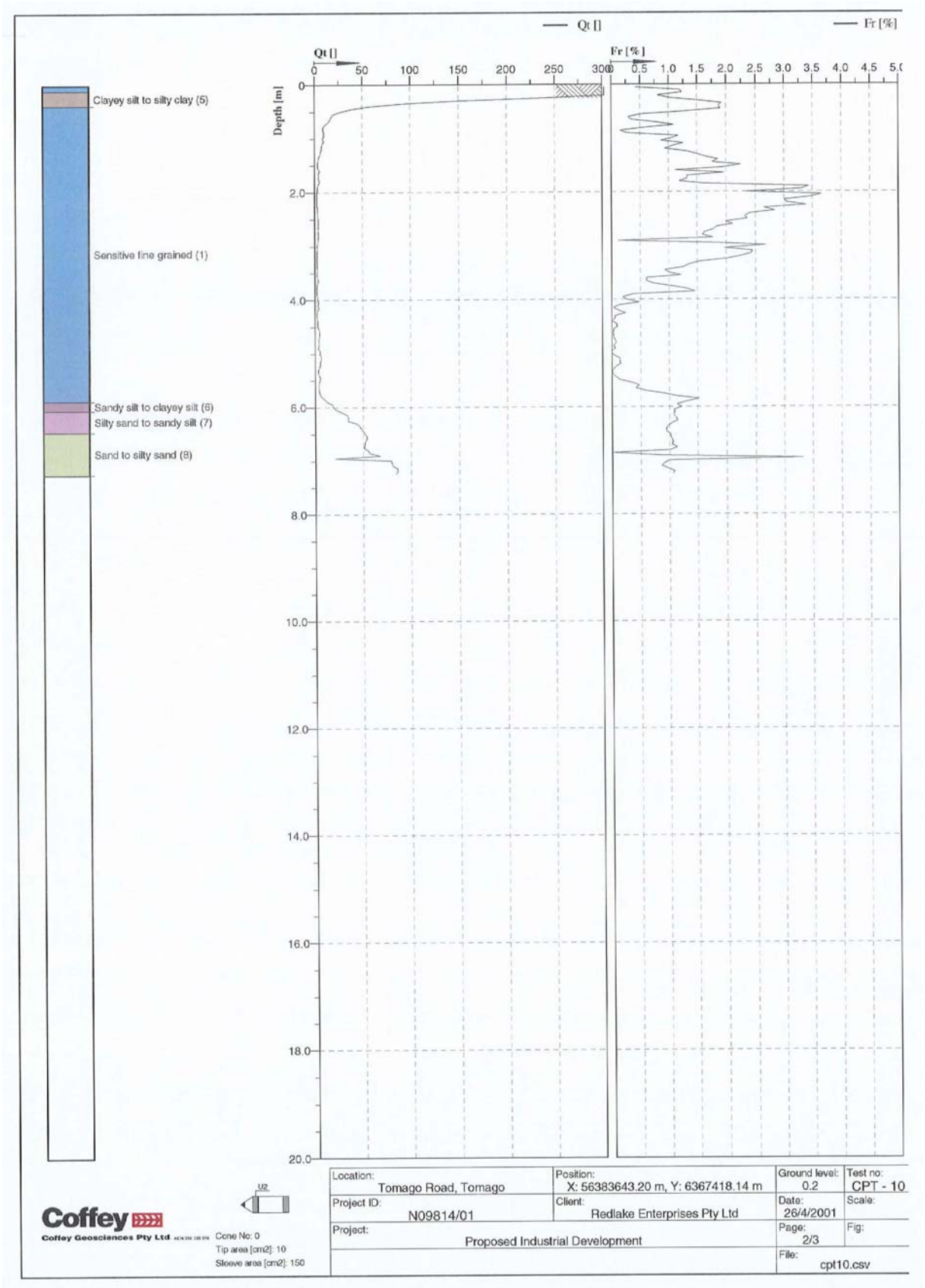
Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383643.20 m, Y: 6367418.14 m	Ground level: 0.2	Test no: CPT - 10
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/3	Fig:
		File: cpt10.csv	


Qt []
Fr [%]
Depth [m]
Clay (3)
Organic material (2)
Clay (3)
Organic material (2)
Clay (3)
Clay (3)
Sensitive fine grained (1)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383646.12 m, Y: 6367211.21 m
Ground level: 0.4
Test no: CPT - 12
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 26/4/06
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt12.csv

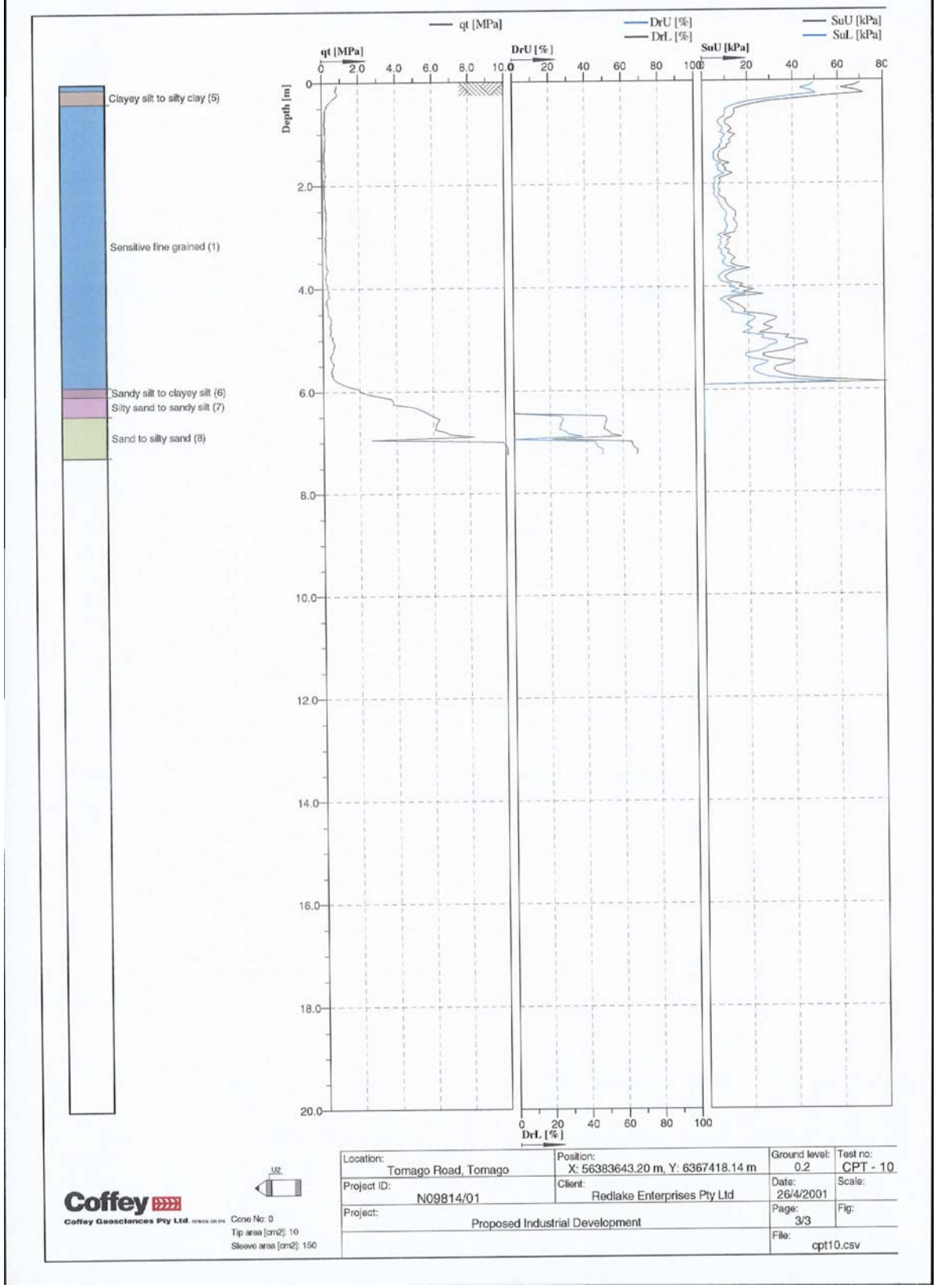


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

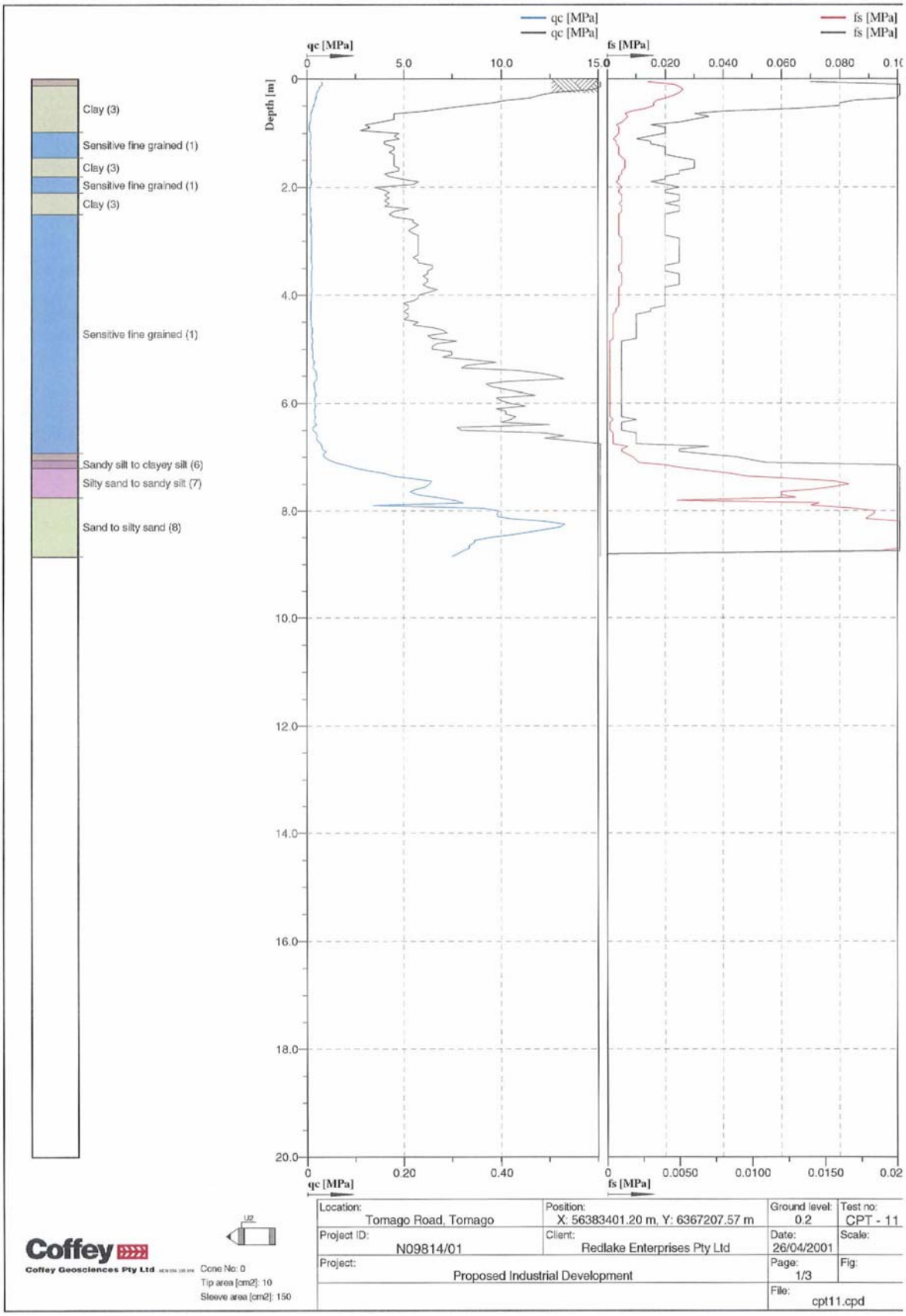
Location: Tomago Road, Tomago	Position: X: 56383643.20 m, Y: 6367418.14 m	Ground level: 0.2	Test no: CPT - 10
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/4/2001	Scale:
Project: Proposed Industrial Development		Page: 2/3	Fig:
		File: cpt10.csv	



Location: Tomago Road, Tomago	Position: X: 56383643.20 m, Y: 6367418.14 m	Ground level: 0.2	Test no: CPT - 10
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/4/2001	Scale:
Project: Proposed Industrial Development		Page: 3/3	Fig:
		File: cpt10.csv	

Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

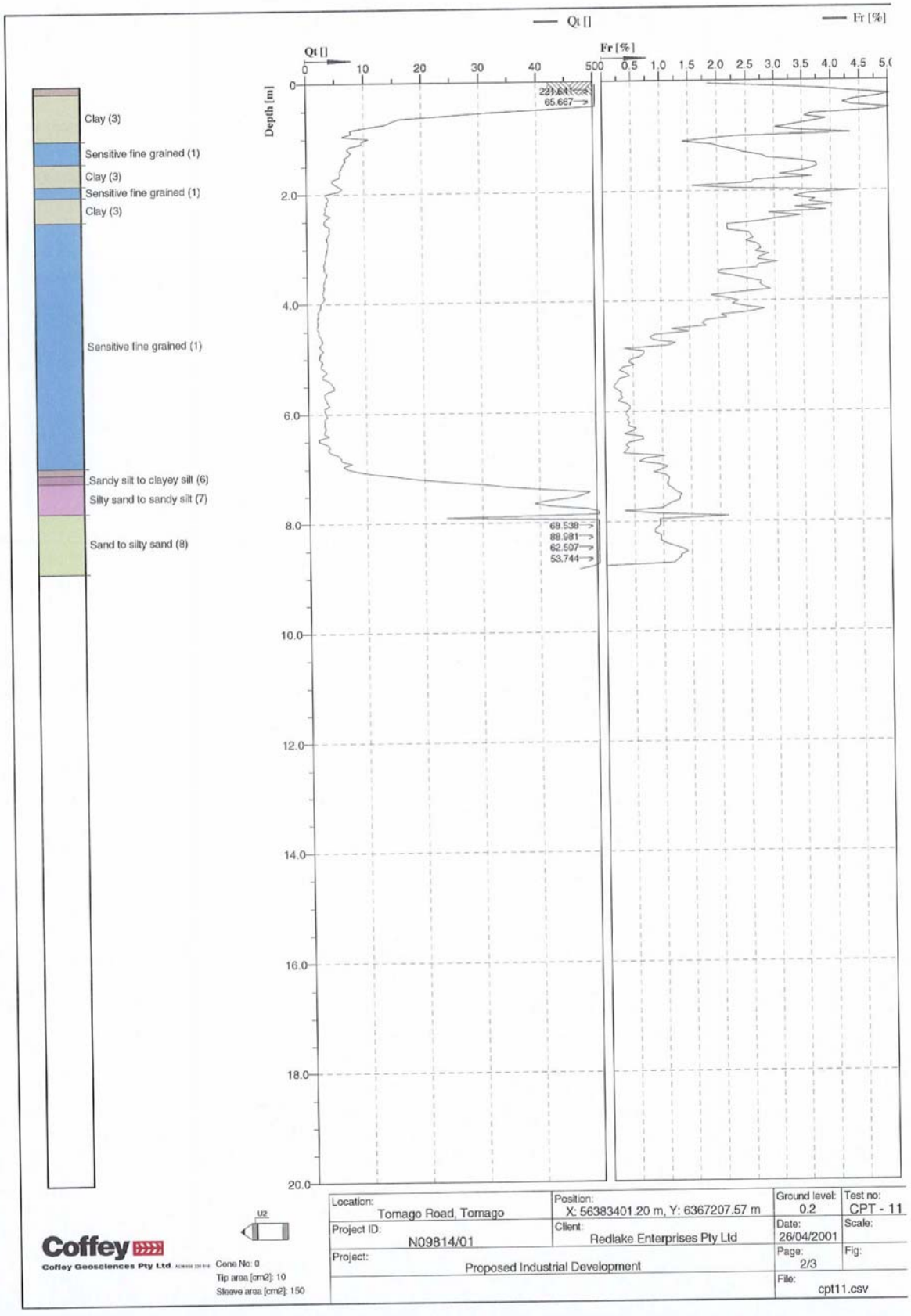


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383401.20 m, Y: 6367207.57 m	Ground level: 0.2	Test no: CPT - 11
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/04/2001	Scale:
Project: Proposed Industrial Development		Page: 1/3	Fig:
		File: cpt11.cpd	

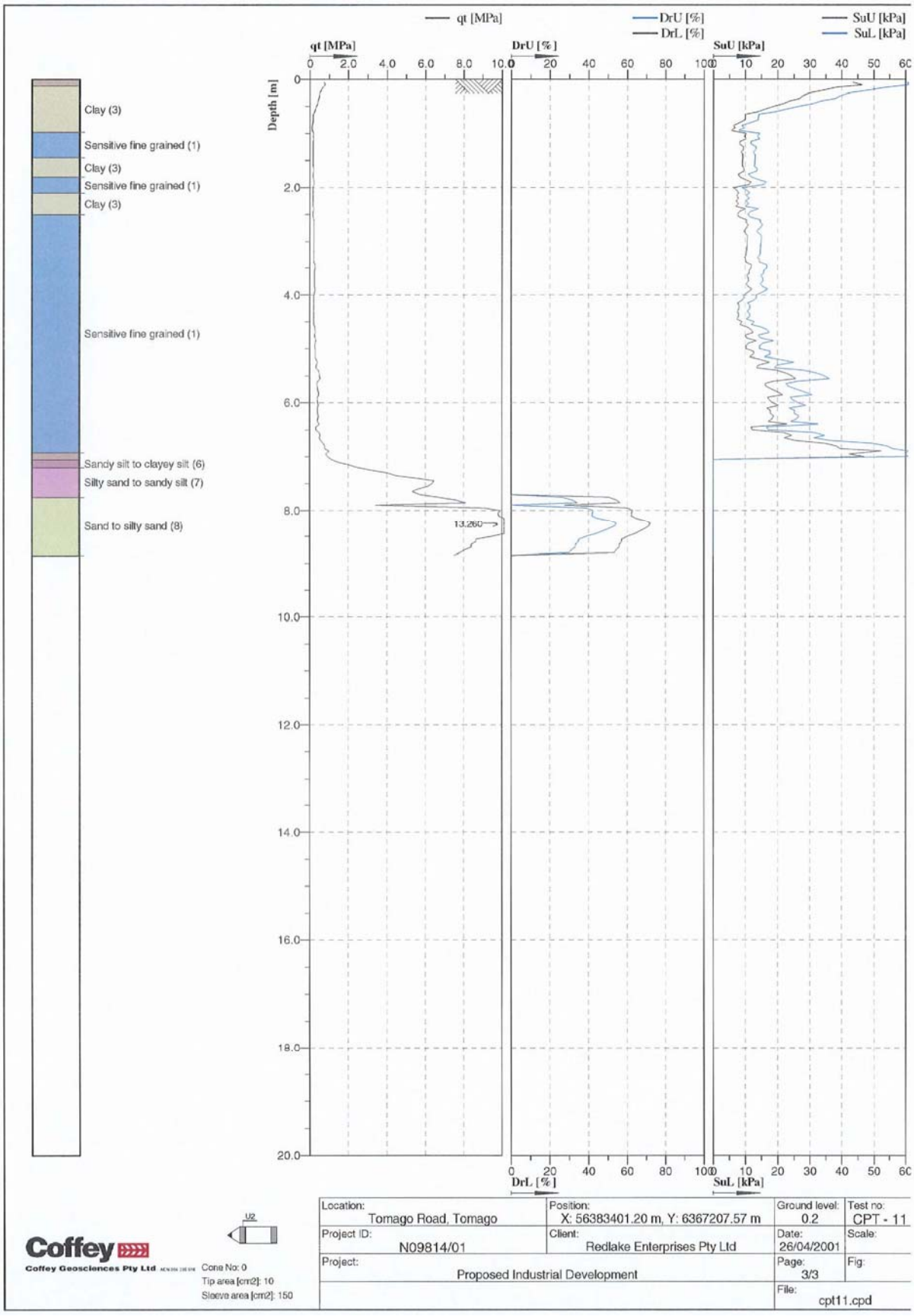


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

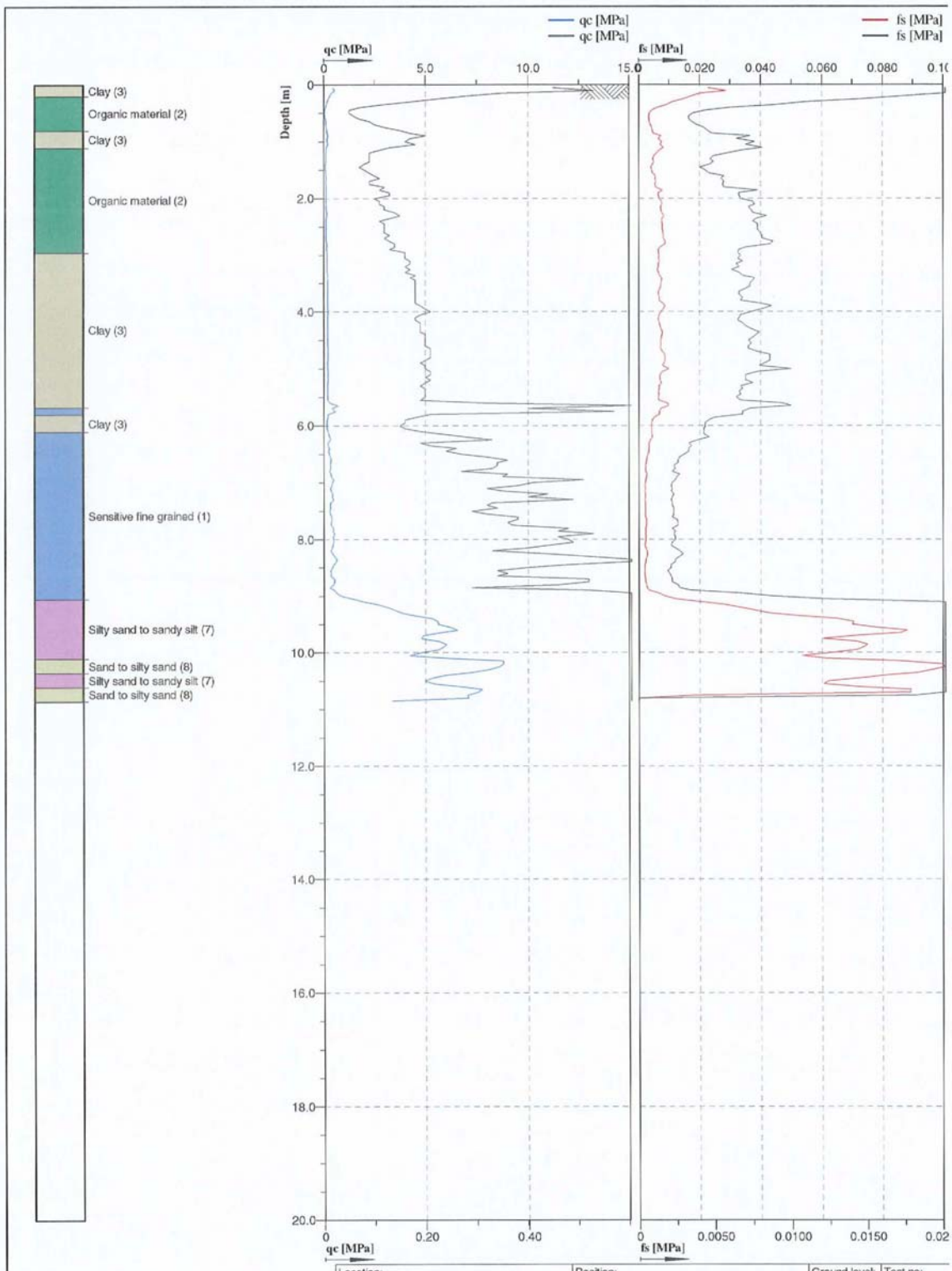
Location: Tomago Road, Tomago	Position: X: 56383401.20 m, Y: 6367207.57 m	Ground level: 0.2	Test no: CPT - 11
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/04/2001	Scale:
Project: Proposed Industrial Development		Page: 2/3	Fig:
		File: cpt11.csv	



Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383401.20 m, Y: 6367207.57 m	Ground level: 0.2	Test no: CPT - 11
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/04/2001	Scale:
Project: Proposed Industrial Development		Page: 3/3	Fig:
		File: cpt11.cpd	

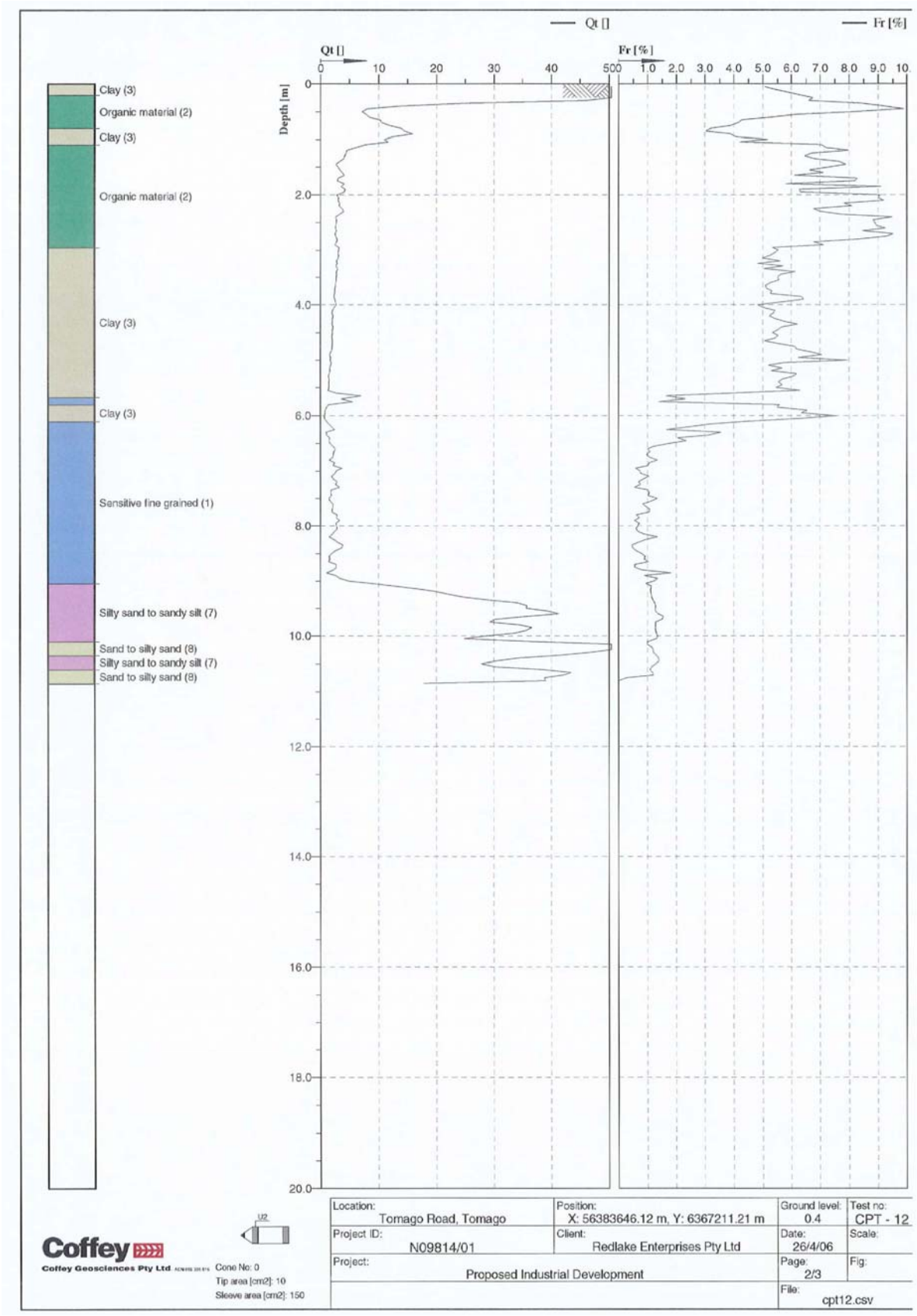


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383646.12 m, Y: 6367211.21 m		Ground level: 0.4	Test no: CPT - 12
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd		Date: 26/4/06	Scale:
Project: Proposed Industrial Development			Page: 1/3	Fig:
			File: cpt12.csv	

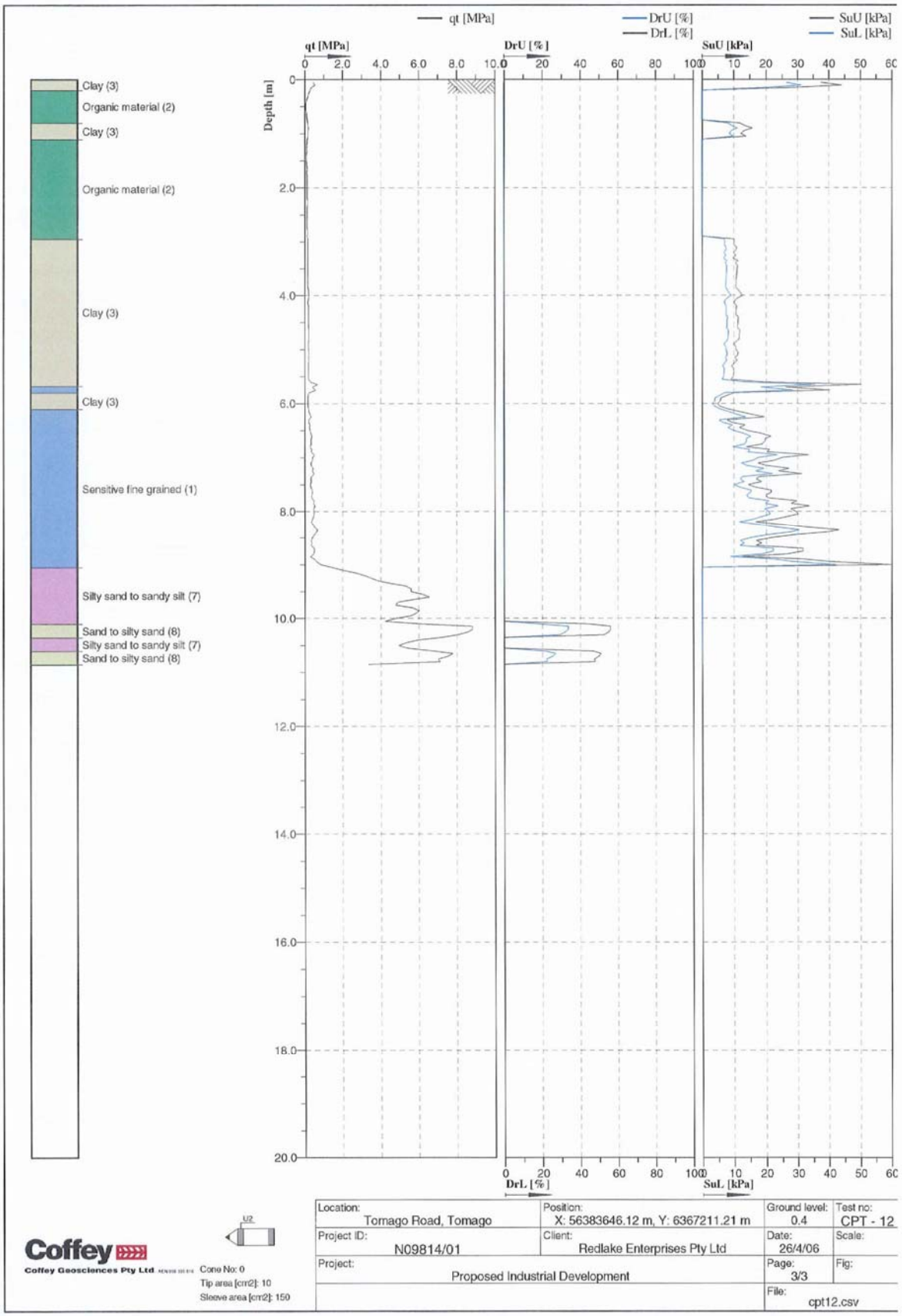


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383646.12 m, Y: 6367211.21 m	Ground level: 0.4	Test no: CPT - 12
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/4/06	Scale:
Project: Proposed Industrial Development		Page: 2/3	Fig:
		File: cpt12.csv	

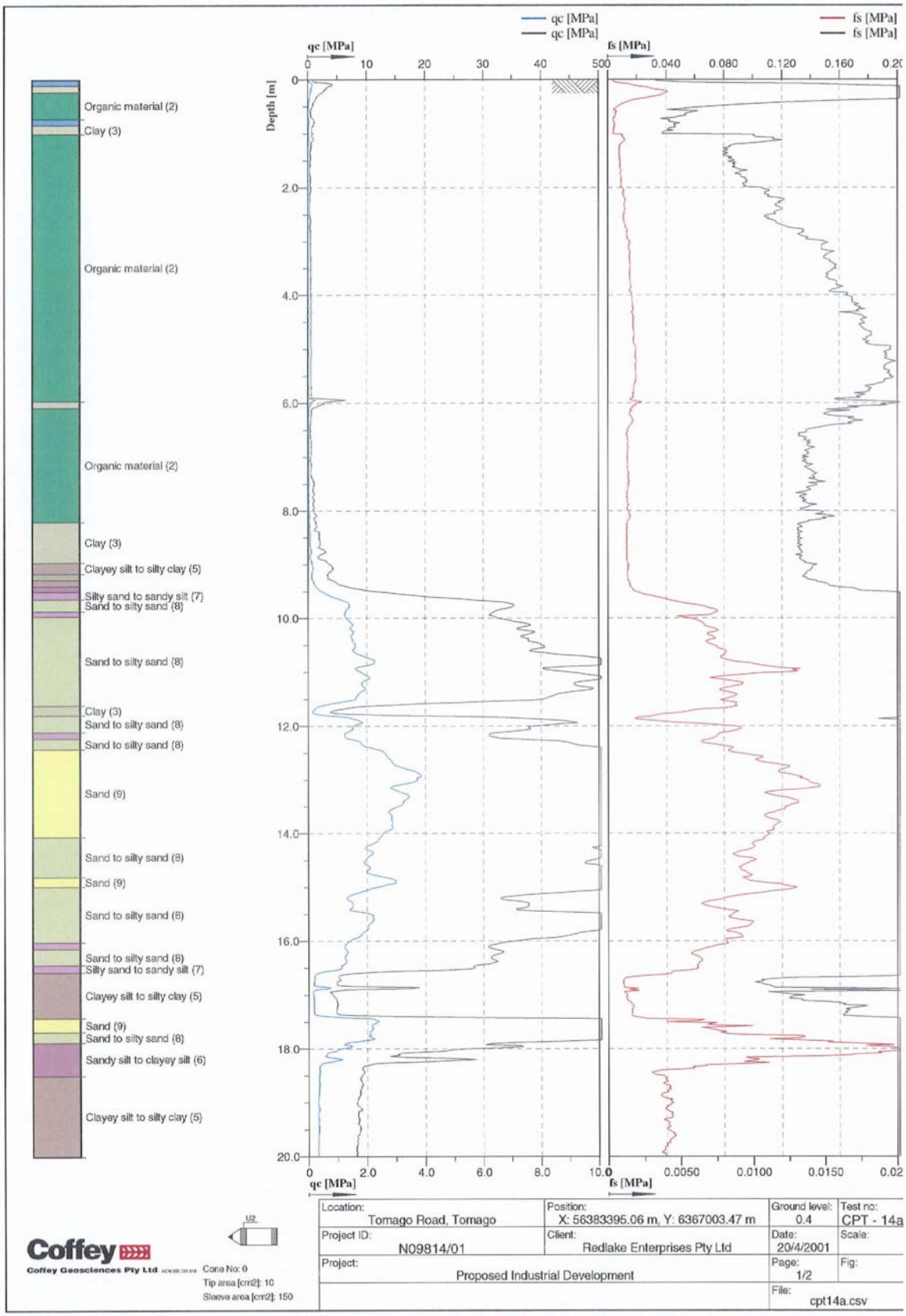


Location: Tomago Road, Tomago	Position: X: 56383646.12 m, Y: 6367211.21 m	Ground level: 0.4	Test no: CPT - 12
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 26/4/06	Scale:
Project: Proposed Industrial Development		Page: 3/3	Fig:
		File: cpt12.csv	

Coffey
Coffey Geosciences Pty Ltd

U2

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

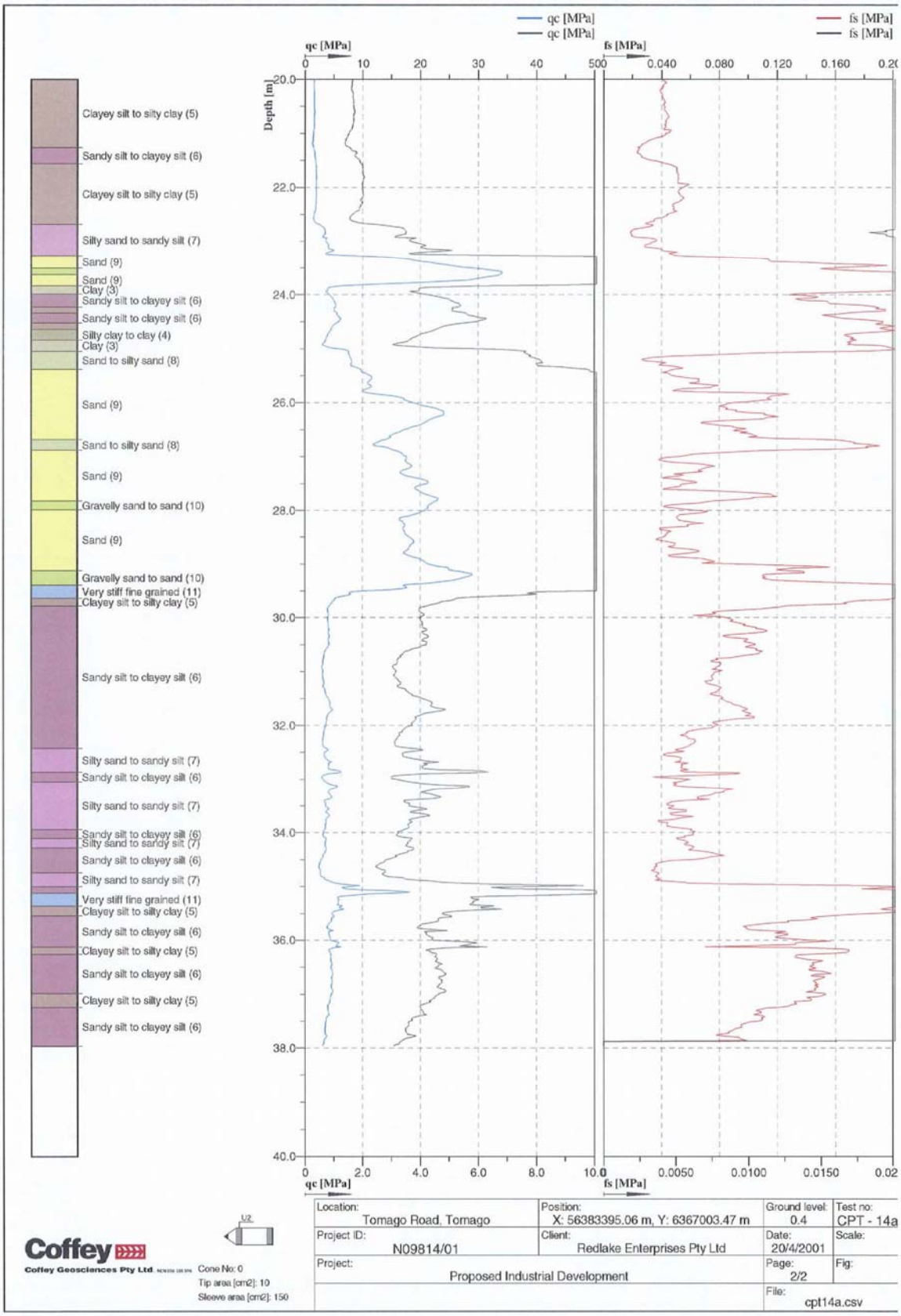


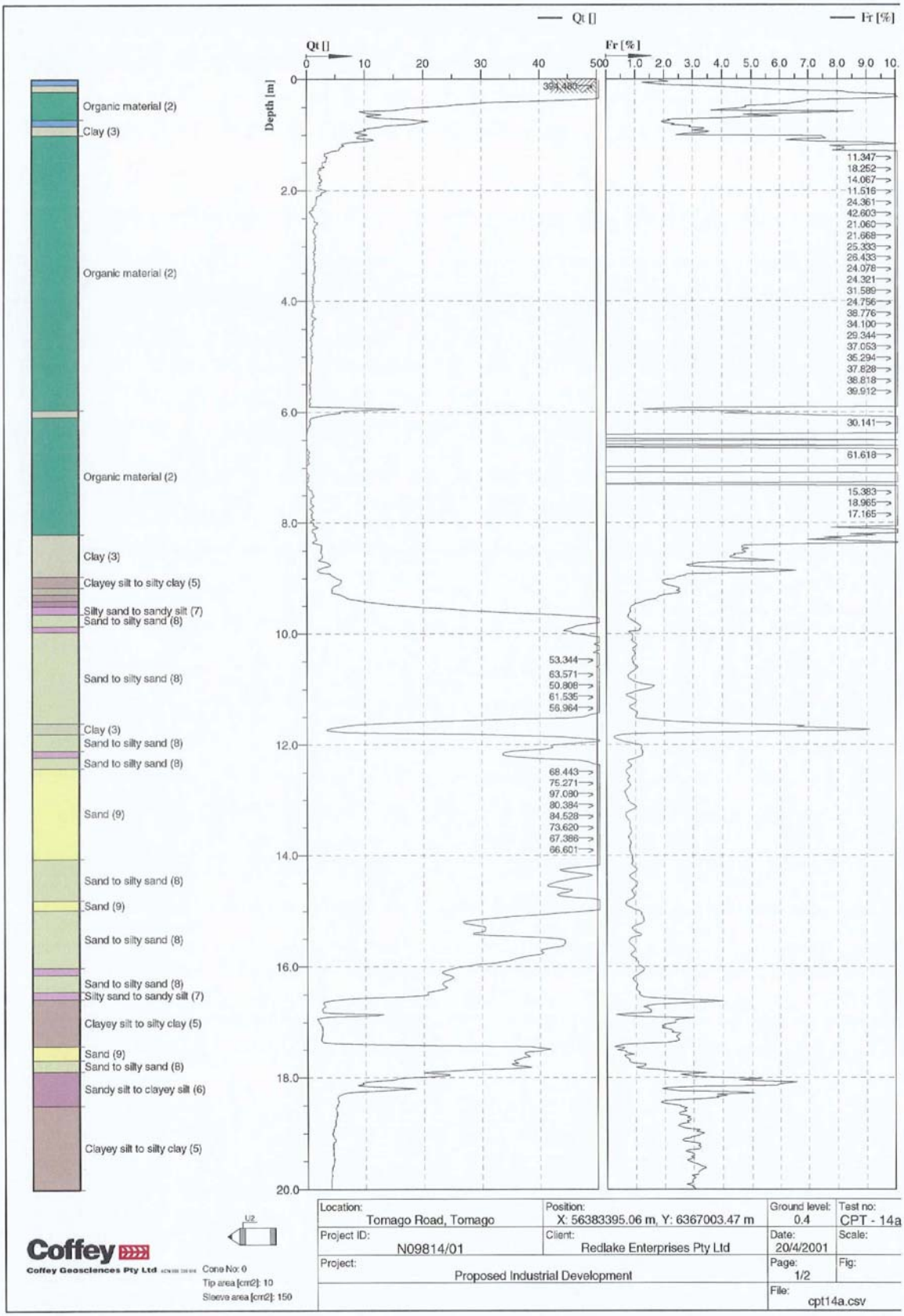
Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383395.06 m, Y: 6367003.47 m	Ground level: 0.4	Test no: CPT - 14a
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: cpt14a.csv	

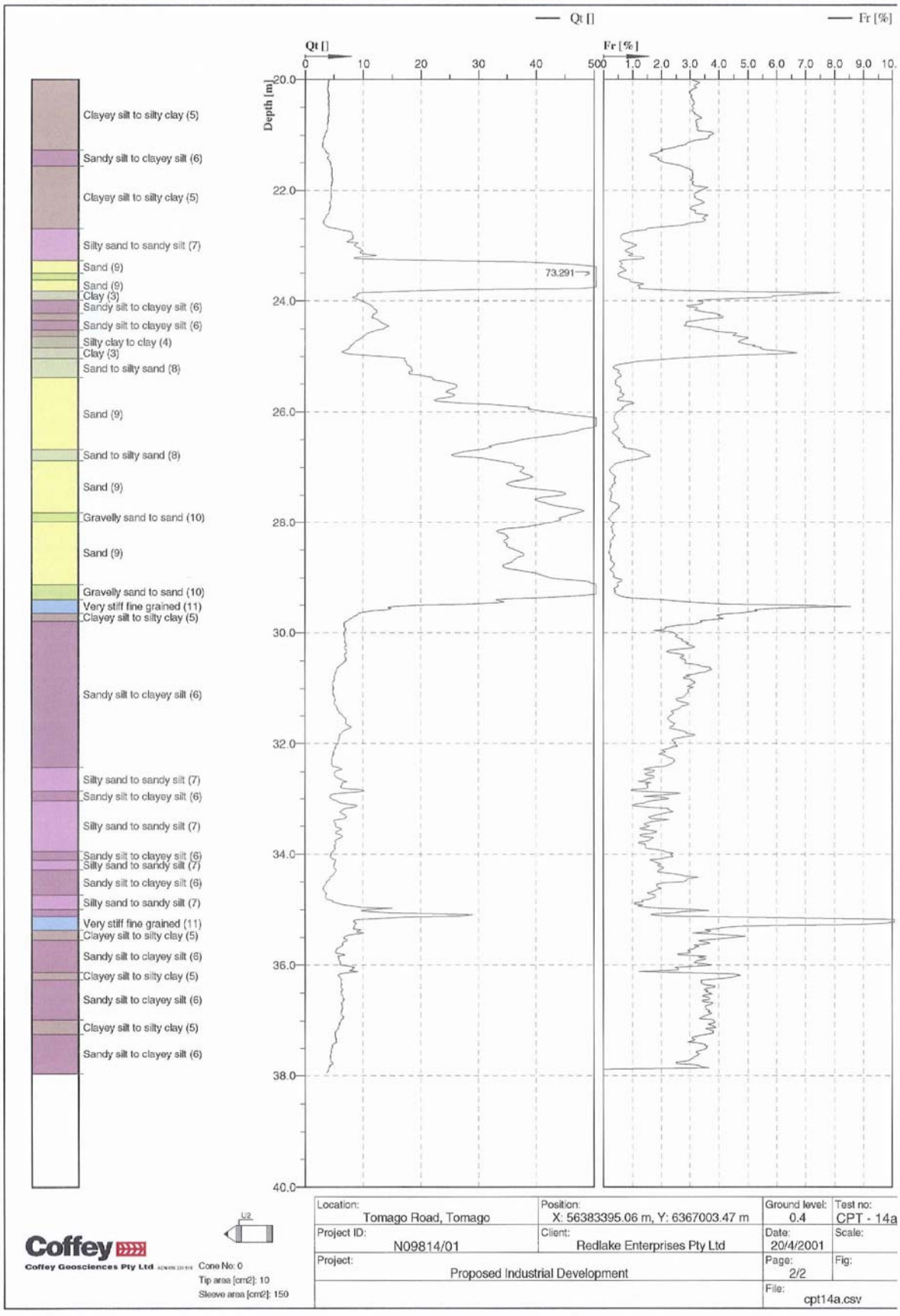

qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Sand (9)
Sand (9)
Clay (3)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty clay to clay (4)
Clay (3)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Very stiff fine grained (11)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Very stiff fine grained (11)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
qc [MPa]
fs [MPa]
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383395.06 m, Y: 6367003.47 m
Ground level: 0.4
Test no: CPT - 14a
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/4/2001
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: cpt14a.csv



Location: Tomago Road, Tomago	Position: X: 56383395.06 m, Y: 6367003.47 m	Ground level: 0.4	Test no: CPT - 14a
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: cpt14a.csv	

Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

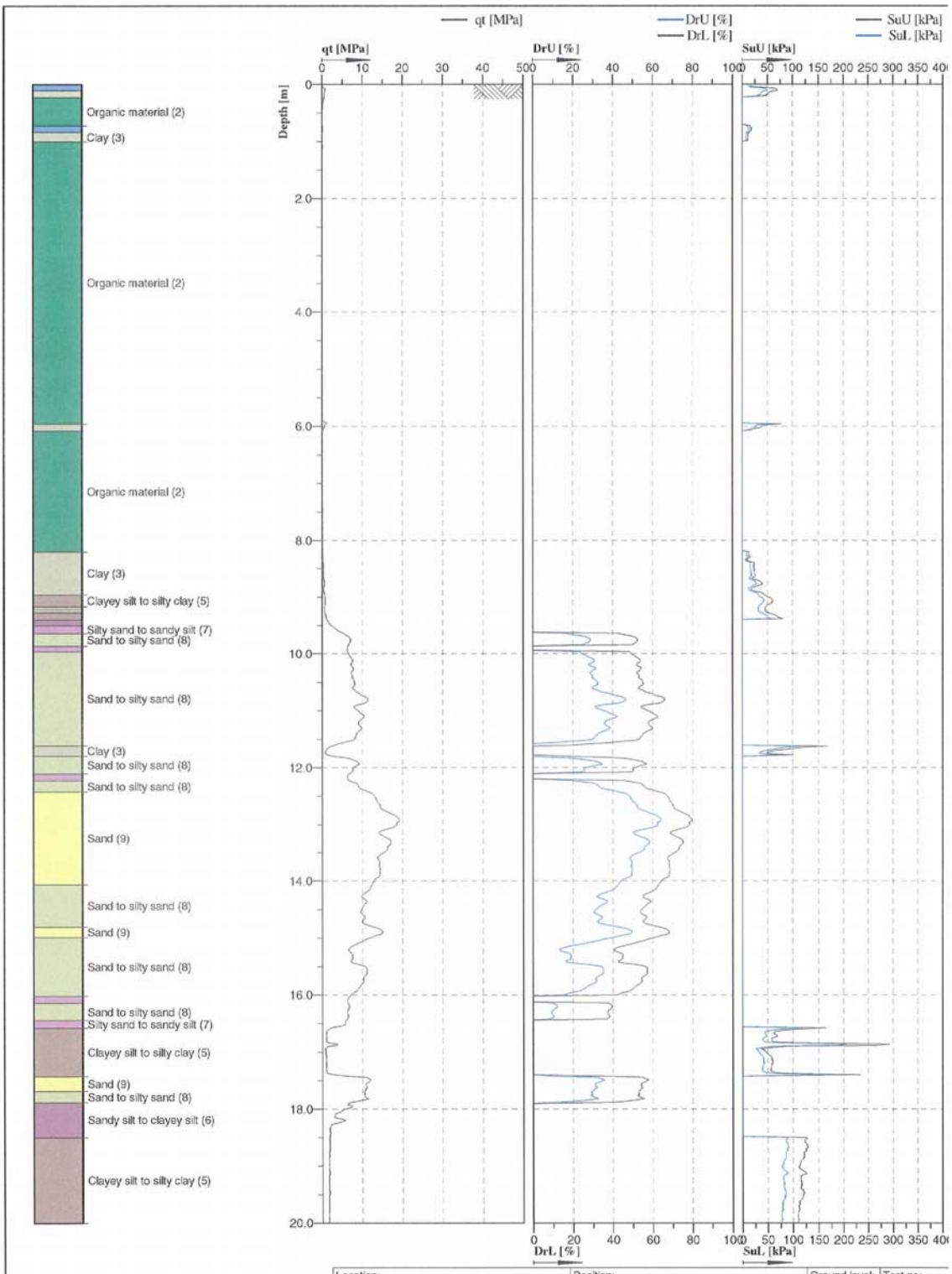


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383395.06 m, Y: 6367003.47 m	Ground level: 0.4	Test no: CPT - 14a
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/4/2001	Scale:
Project: Proposed Industrial Development		Page: 2/2	Fig:
		File: cpt14a.csv	

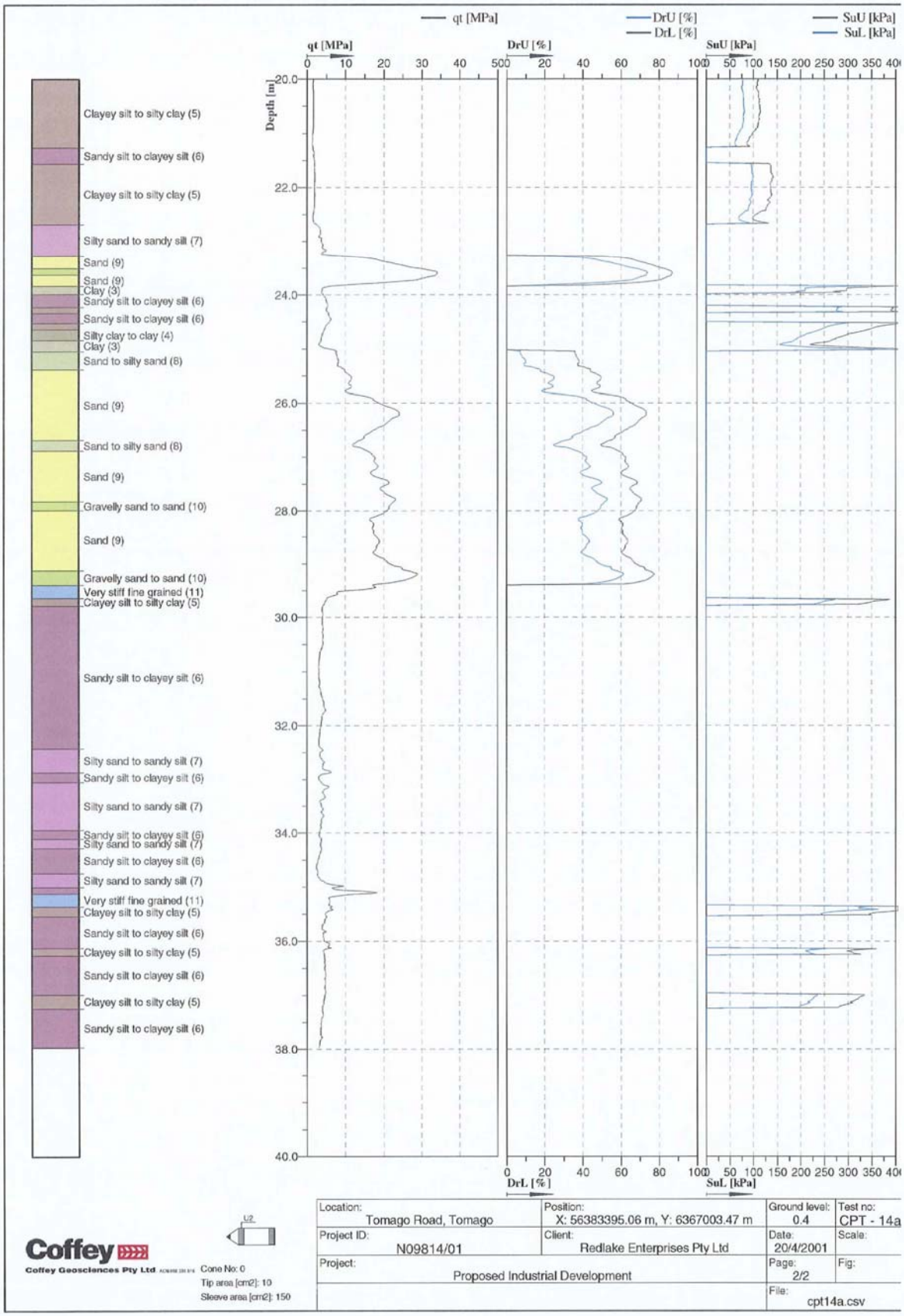


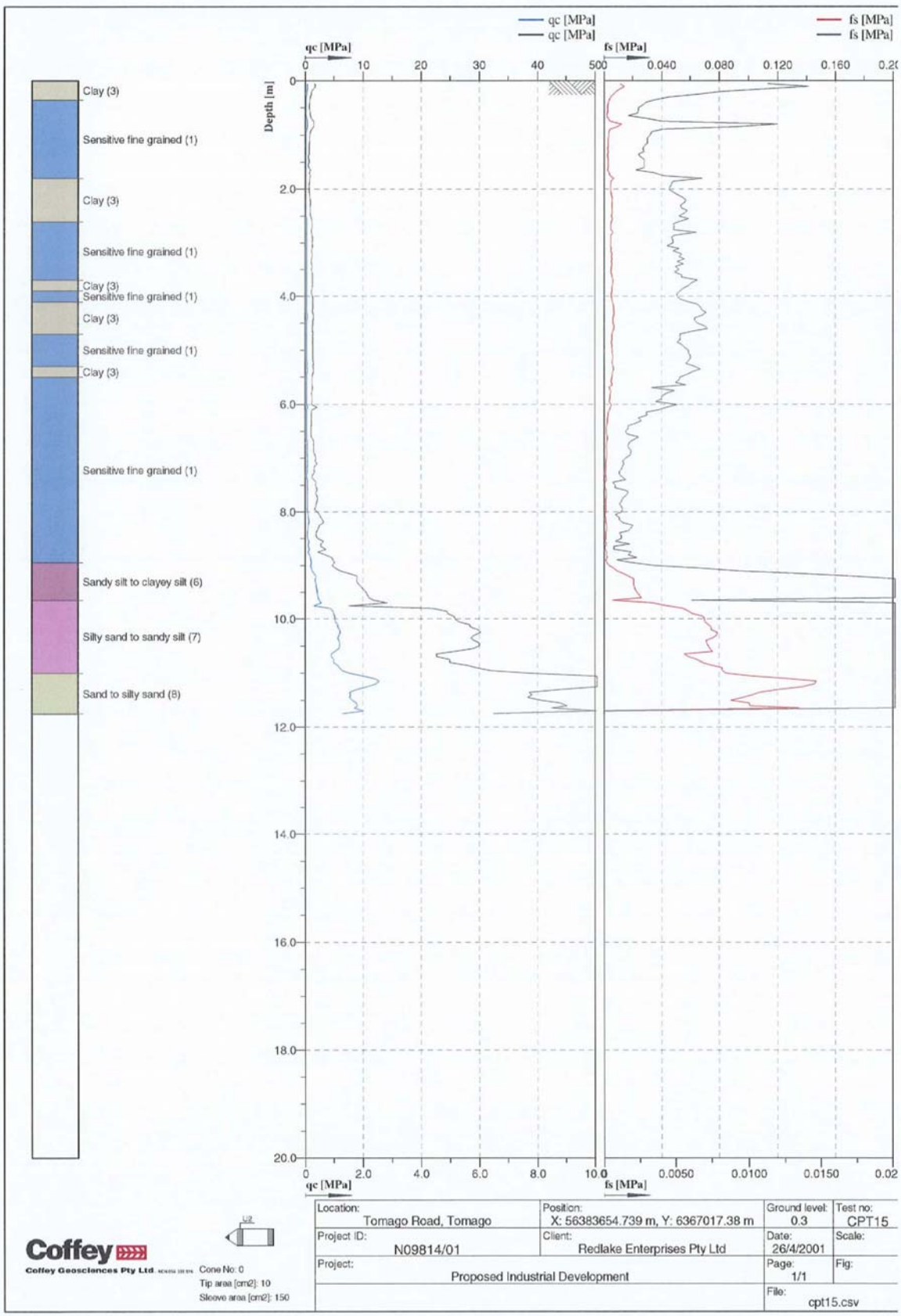
Coffey

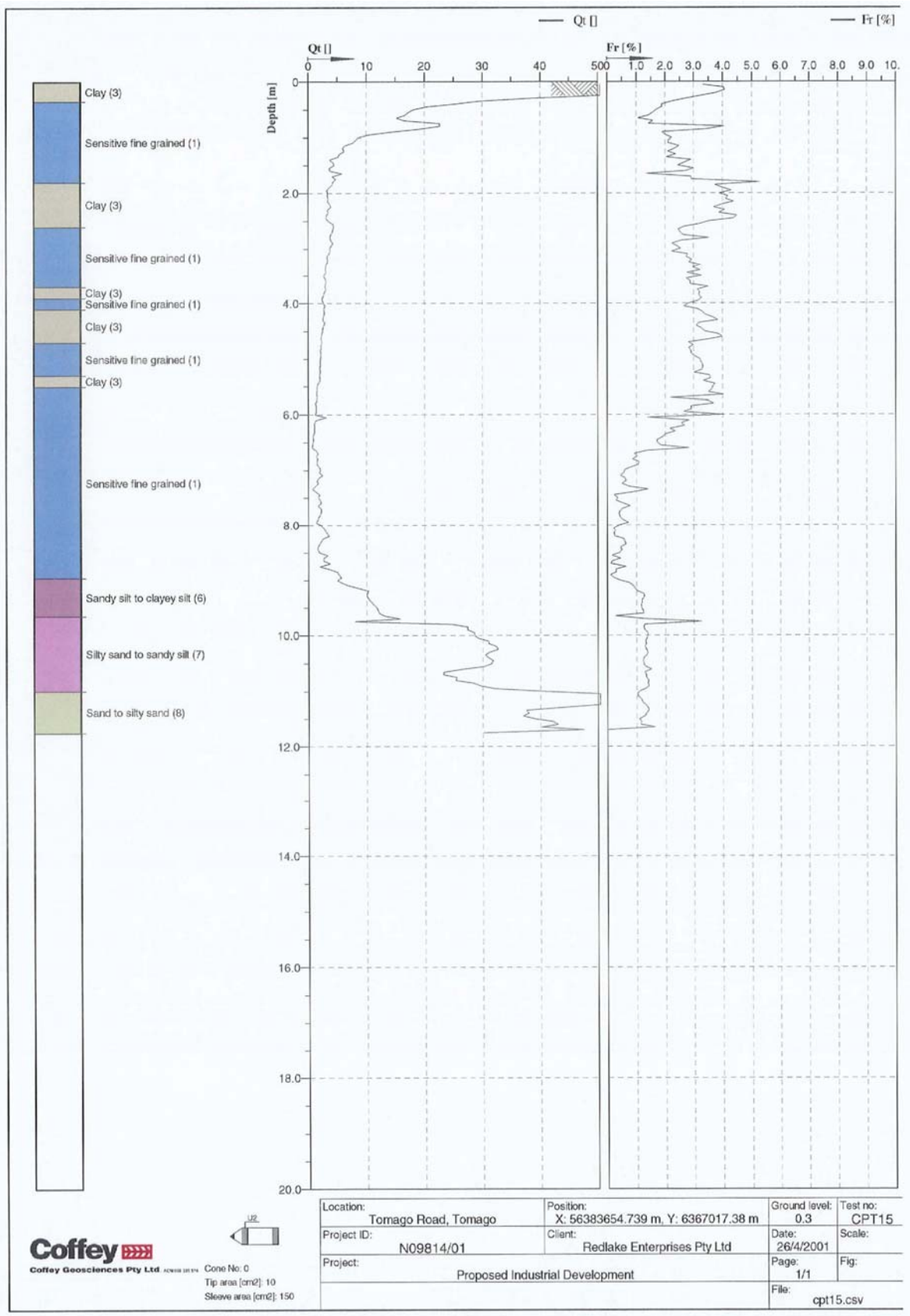
Coffey Geosciences Pty Ltd

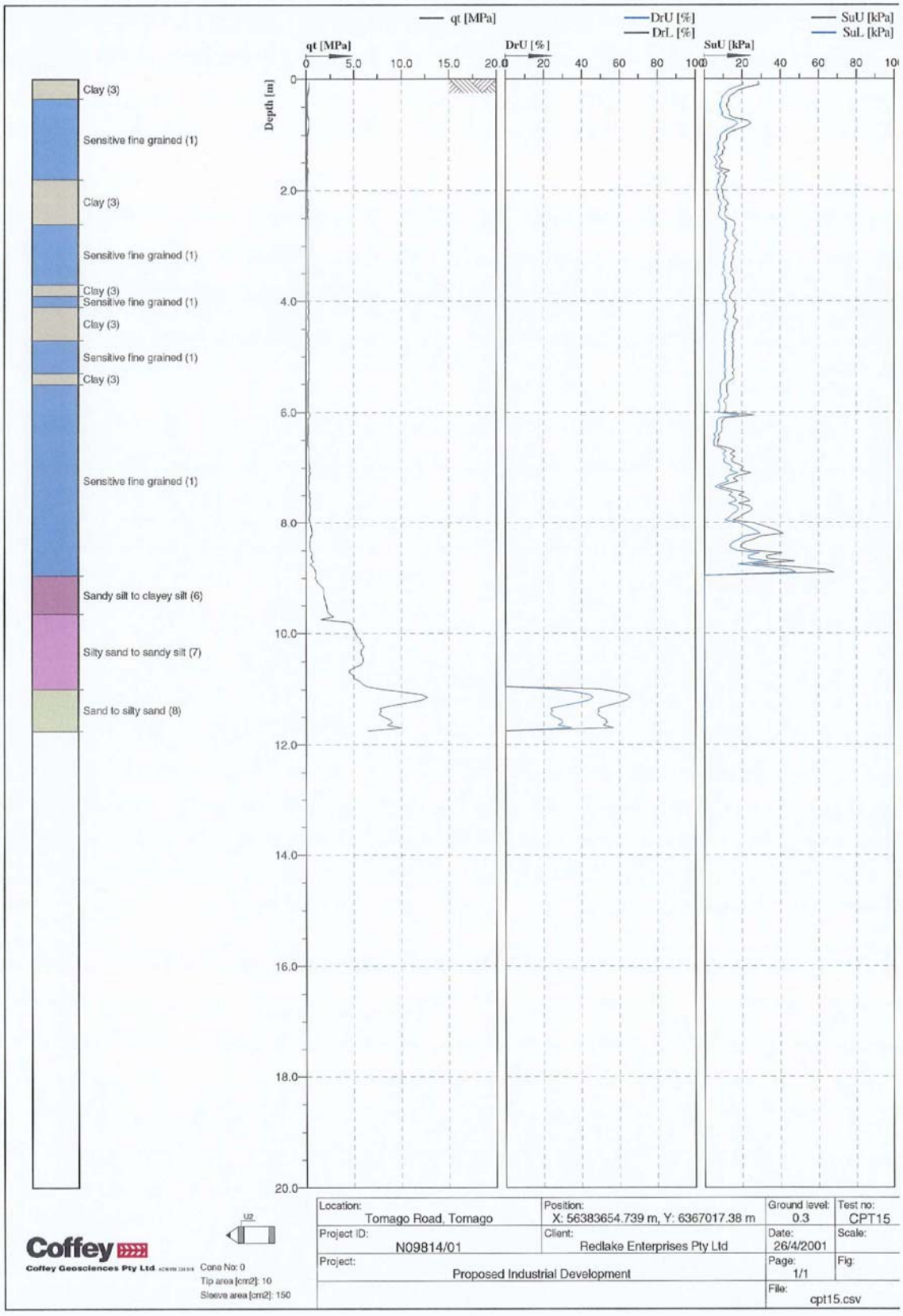
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

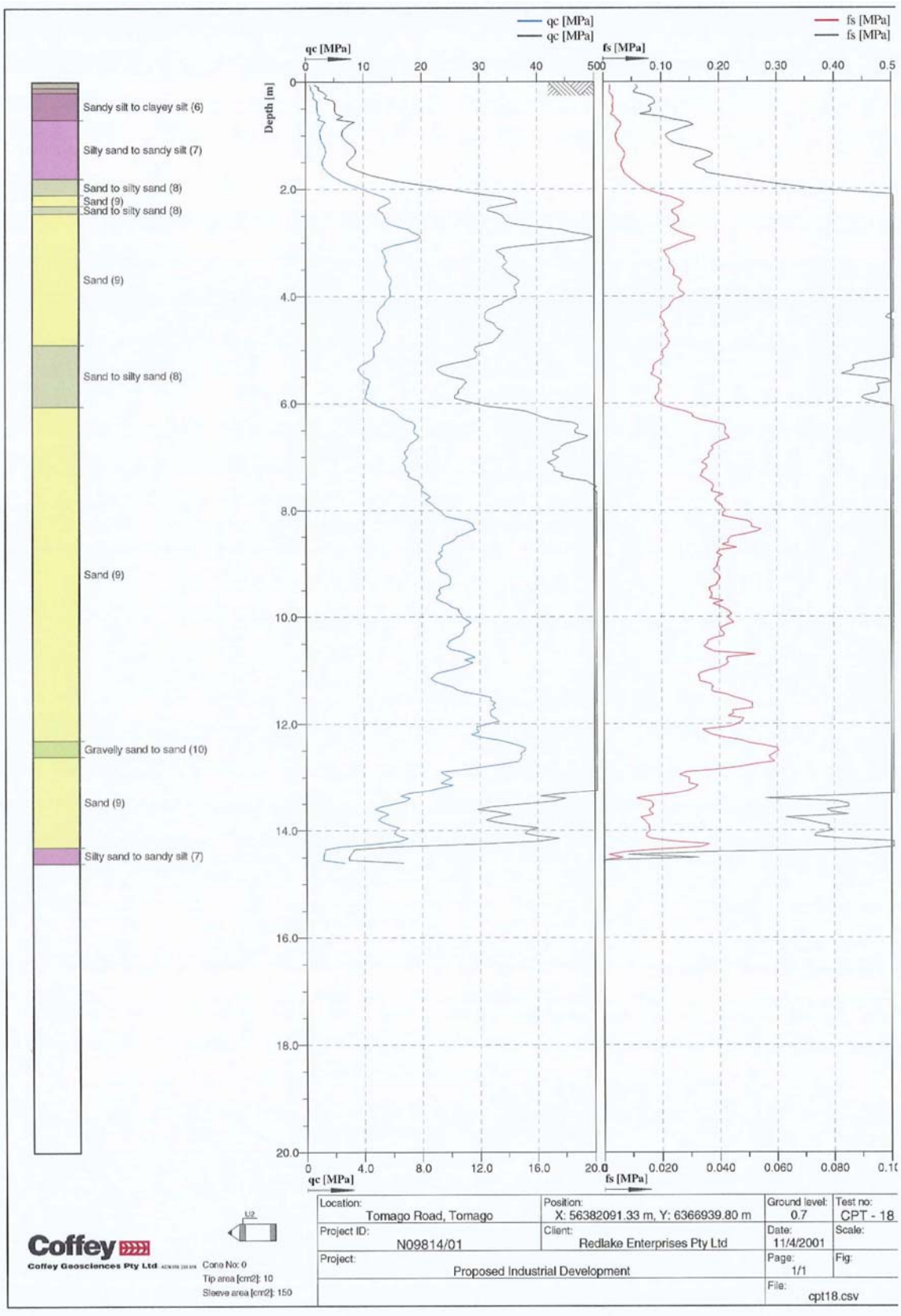
Location: Tomago Road, Tomago	Position: X: 56383395.06 m, Y: 6367003.47 m	Ground level: 0.4	Test no: CPT - 14a
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: cpt14a.csv	

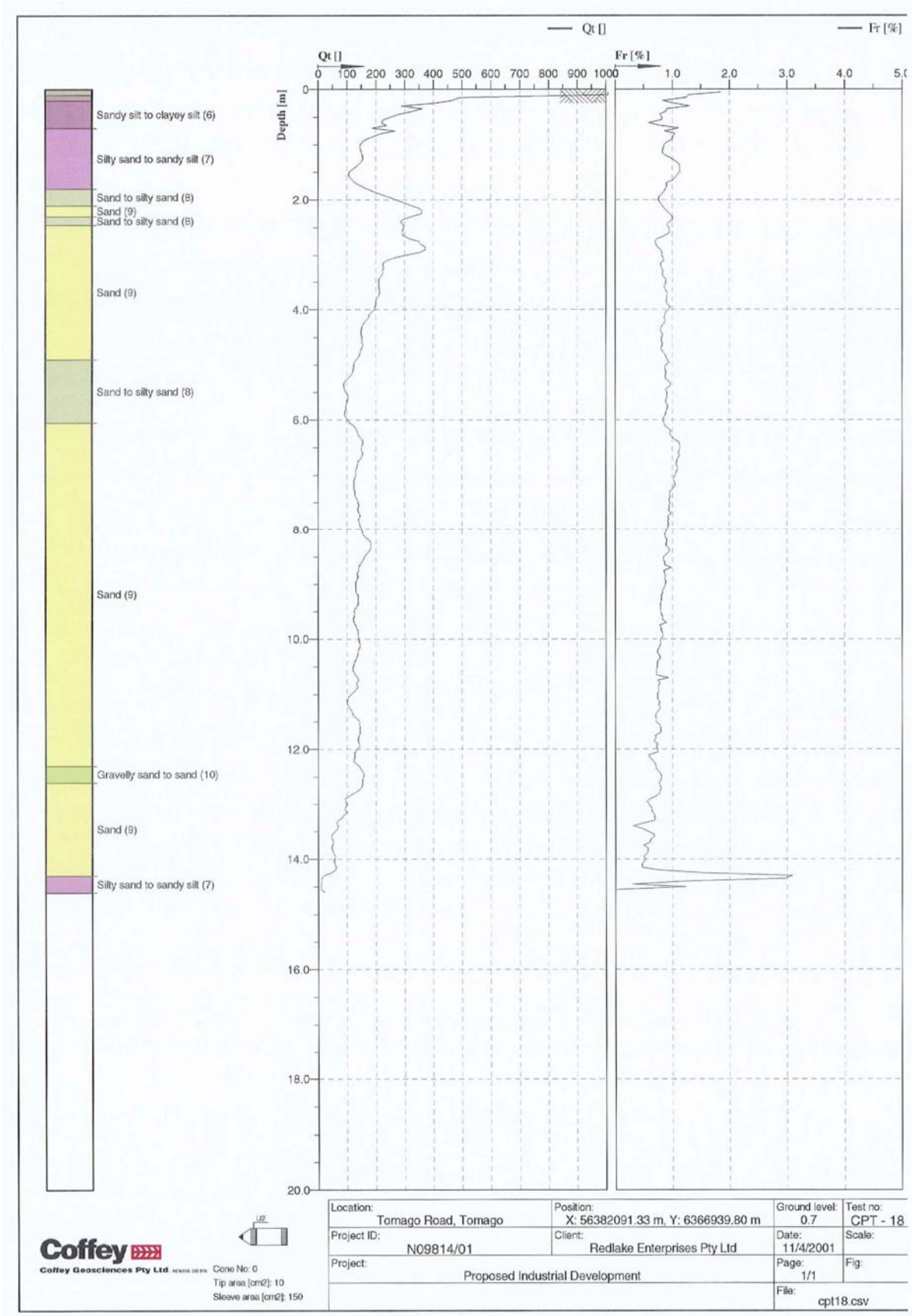

qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Sand (9)
Sand (9)
Clay (3)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty clay to clay (4)
Clay (3)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Very stiff fine grained (11)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Very stiff fine grained (11)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383395.06 m, Y: 6367003.47 m
Ground level: 0.4
Test no: CPT - 14a
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/4/2001
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: cpt14a.csv

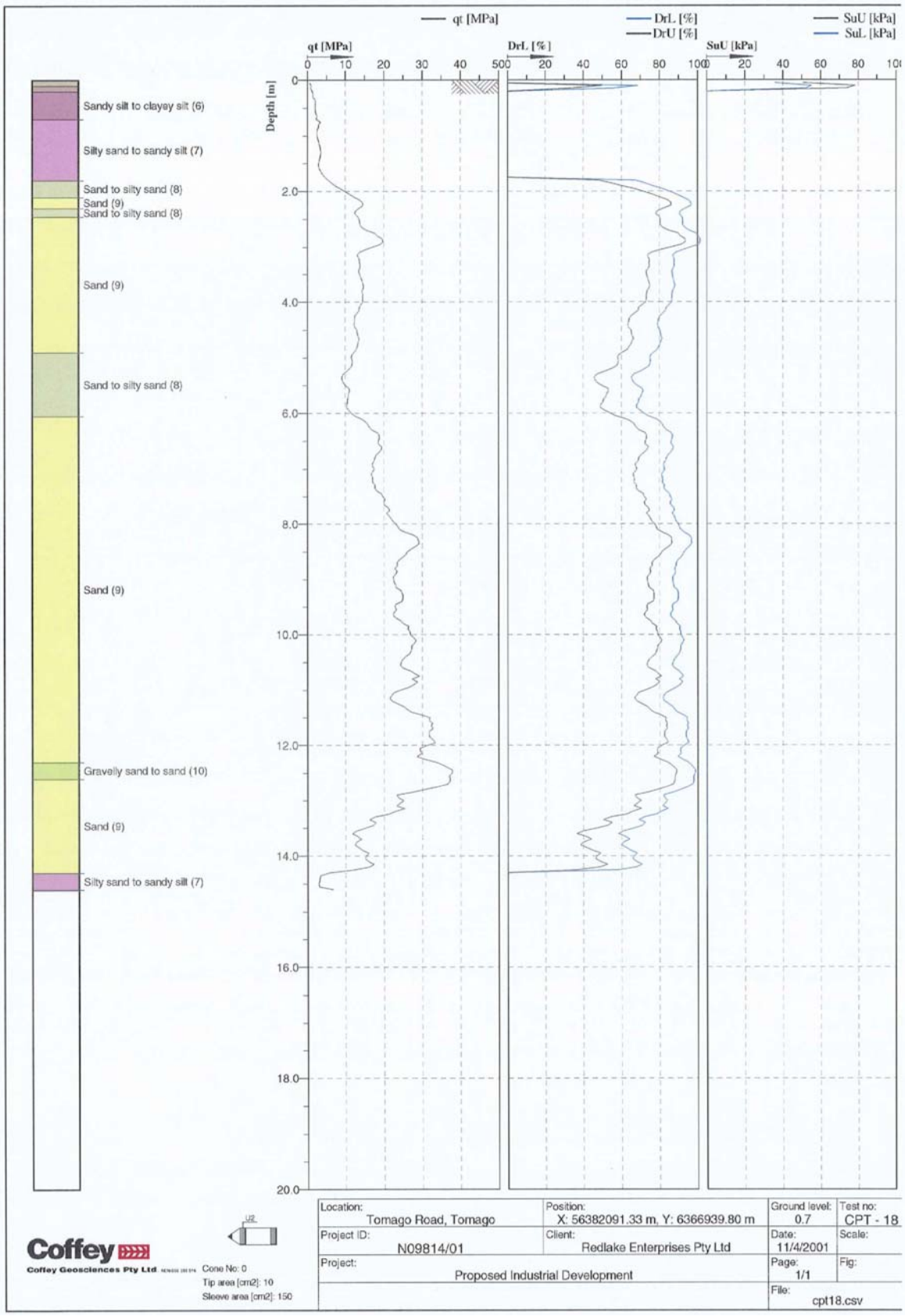

qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383654.739 m, Y: 6367017.38 m
Ground level: 0.3
Test no: CPT15
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 26/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt15.csv


Qt []
Fr [%]
Qt []
Fr [%]
Depth [m]
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383654.739 m, Y: 6367017.38 m
Ground level: 0.3
Test no: CPT15
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 26/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt15.csv


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383654.739 m, Y: 6367017.38 m
Ground level: 0.3
Test no: CPT15
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 26/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt15.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382091.33 m, Y: 6366939.80 m
Ground level: 0.7
Test no: CPT - 18
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 11/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt18.csv


Qt []
Fr [%]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
0 100 200 300 400 500 600 700 800 900 1000
1.0 2.0 3.0 4.0
0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382091.33 m, Y: 6366939.80 m
Ground level: 0.7
Test no: CPT - 18
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 11/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt18.csv

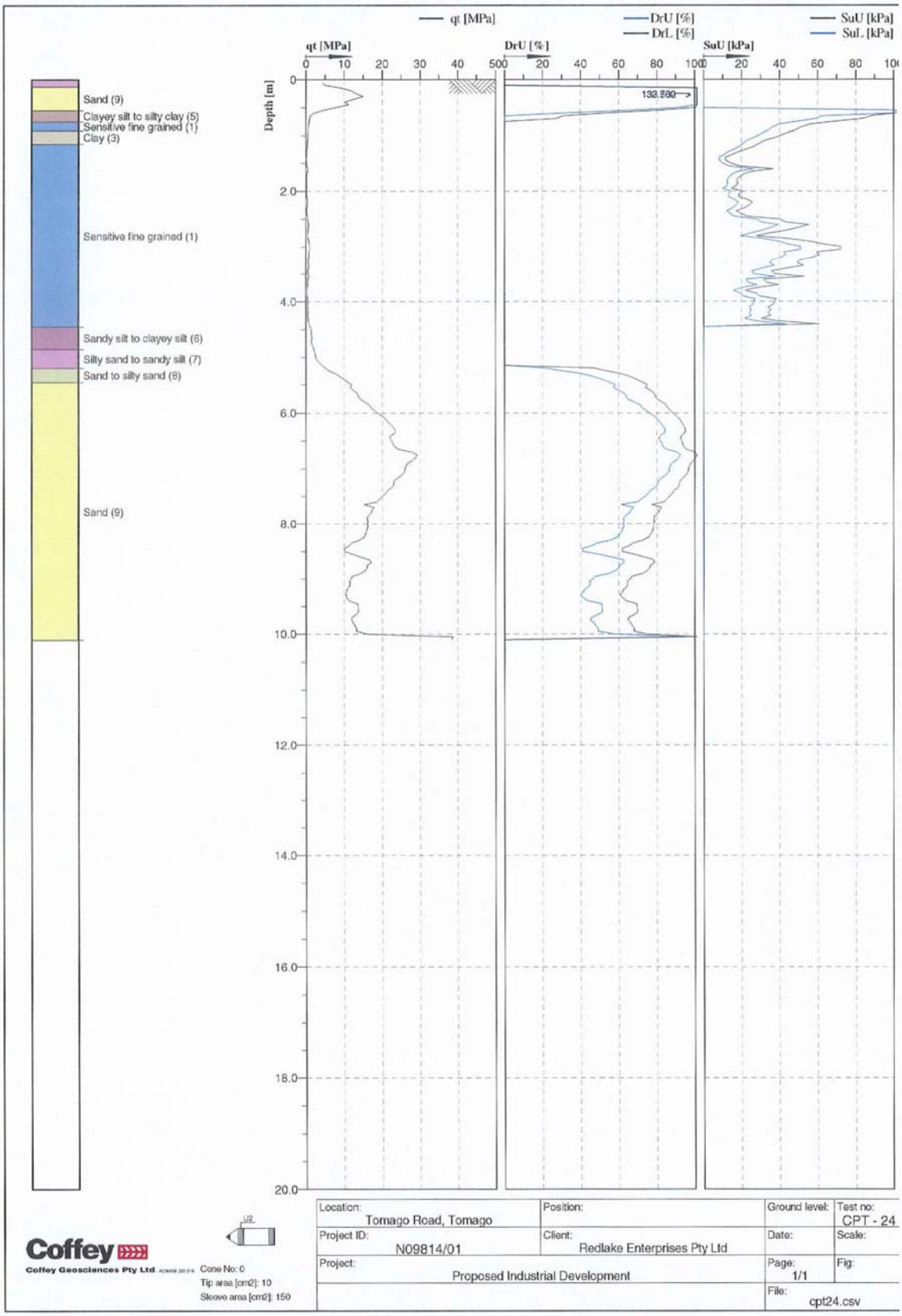


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

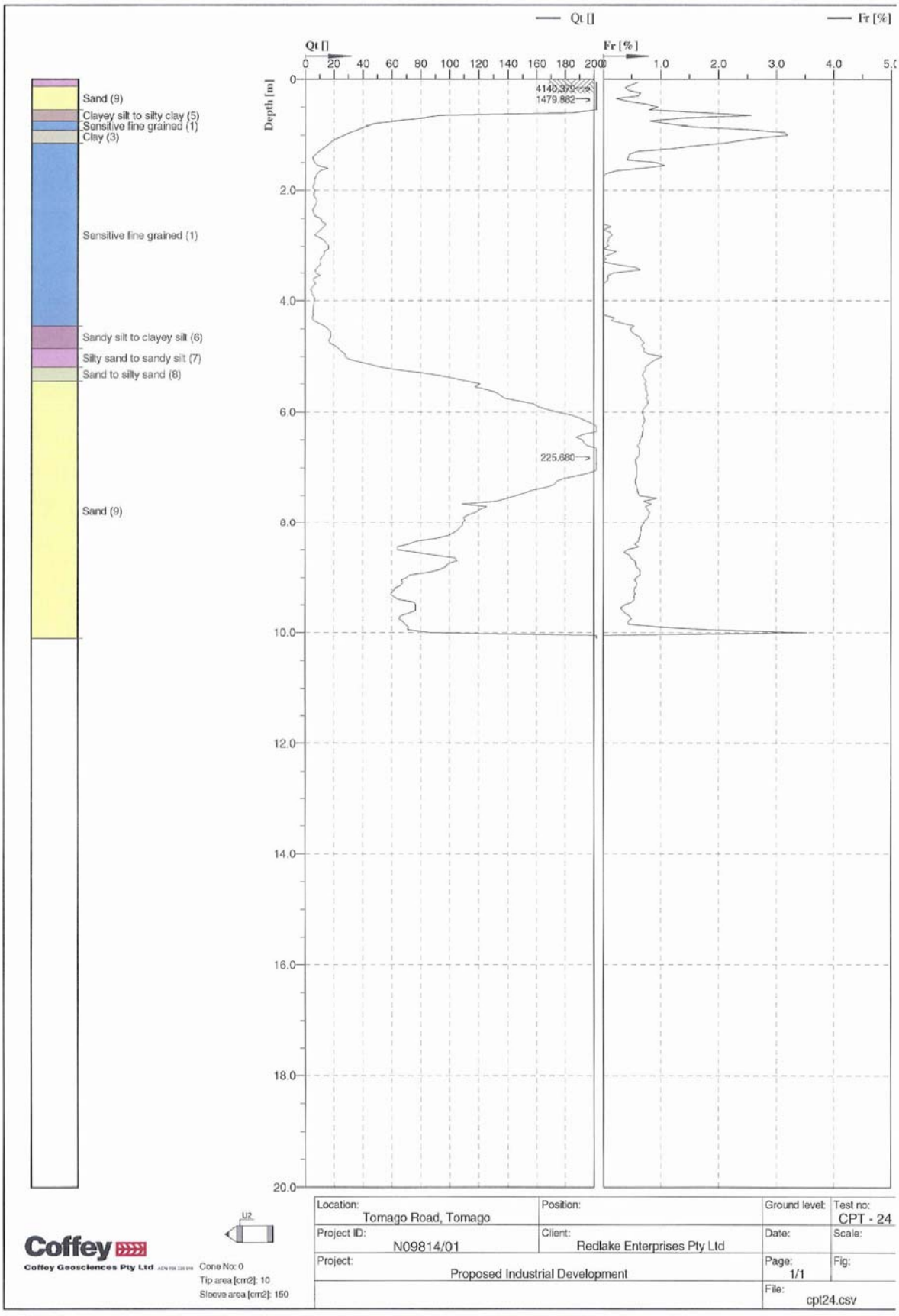
Location: Tomago Road, Tomago	Position: X: 56382091.33 m, Y: 6366939.80 m	Ground level: 0.7	Test no: CPT - 18
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 11/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt18.csv	



Location: Tomago Road, Tomago	Position:	Ground level:	Test no: CPT - 24
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date:	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt24.csv	

Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

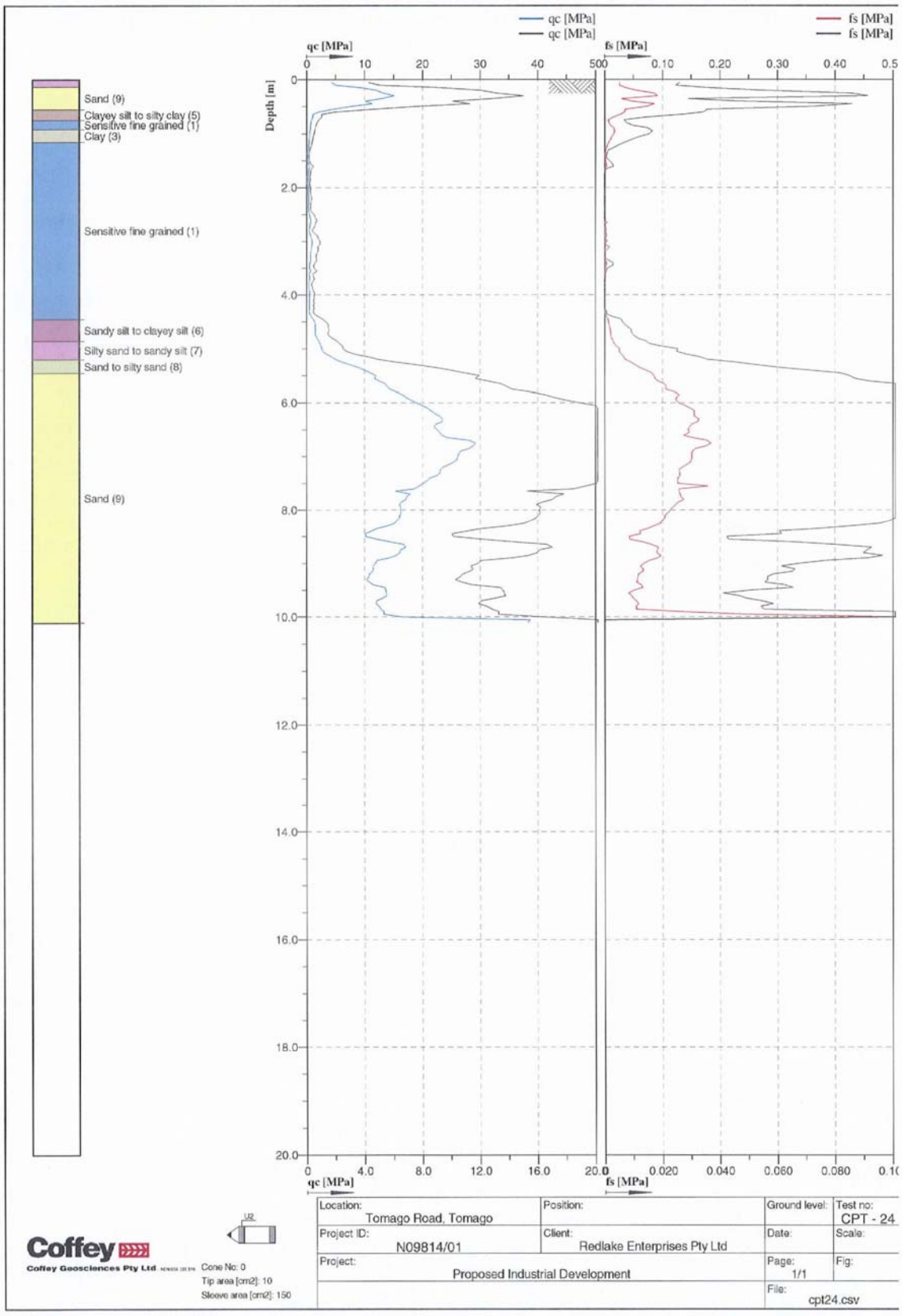


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position:	Ground level:	Test no: CPT - 24
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date:	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt24.csv	



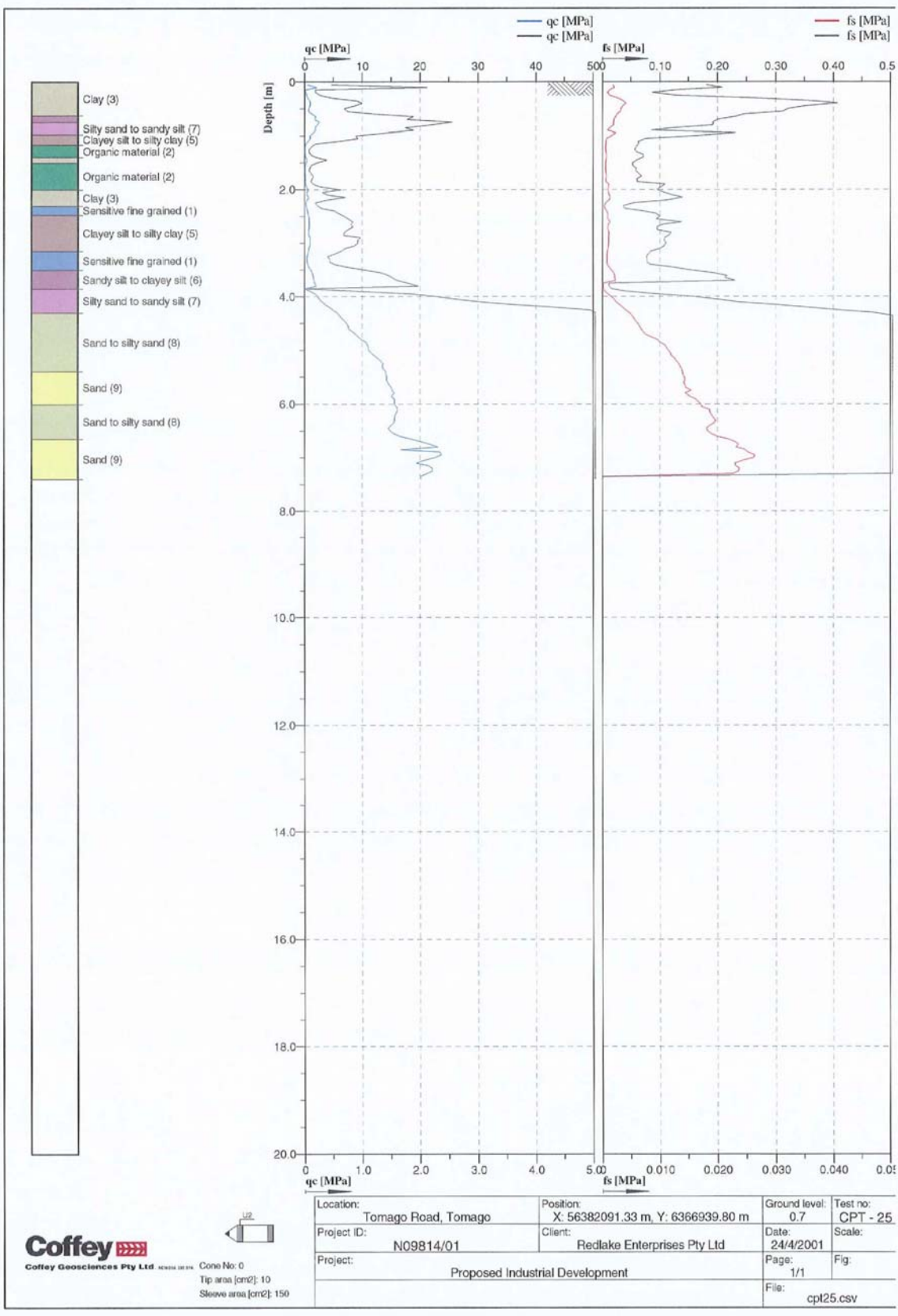
U2

Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

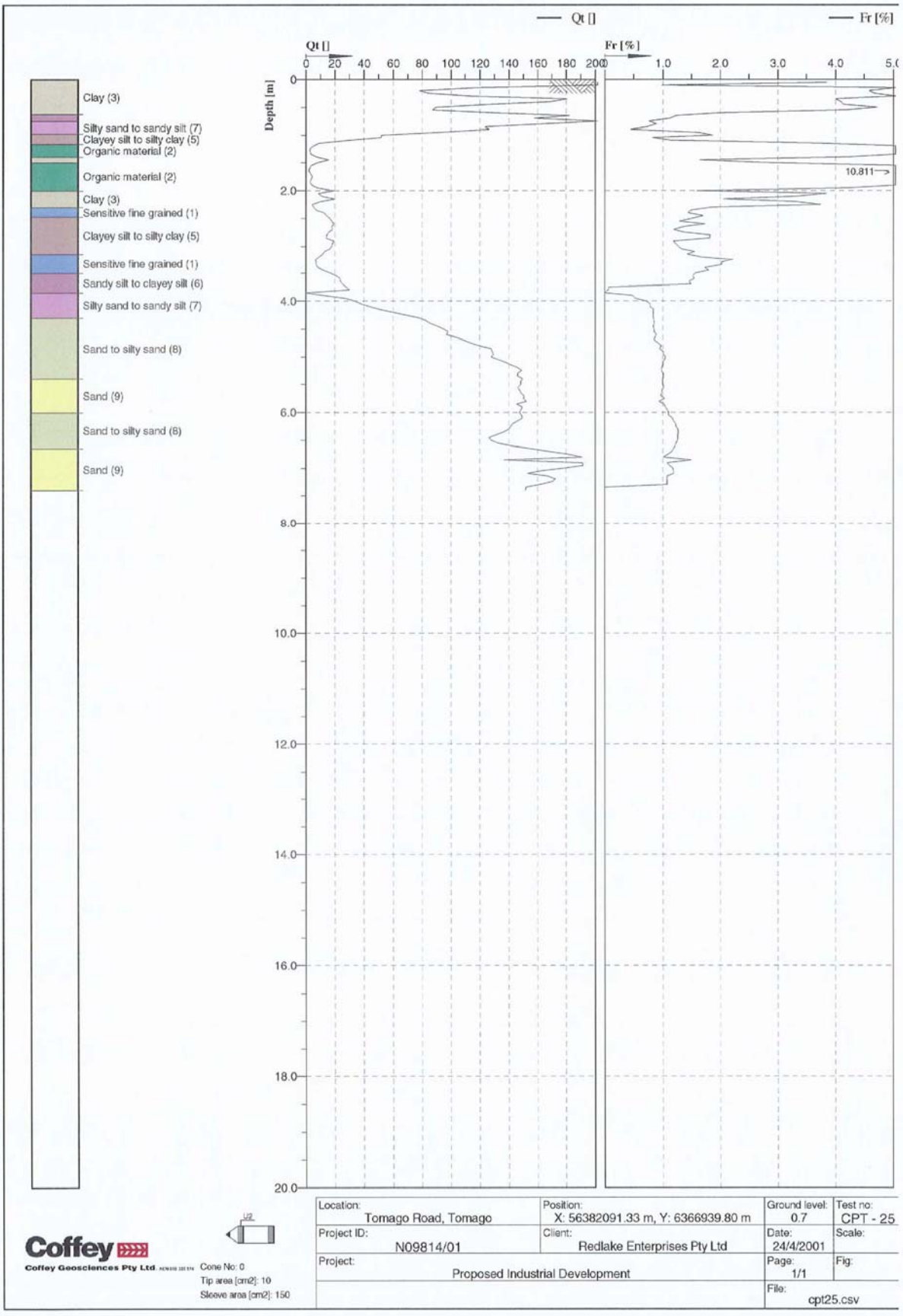
Location: Tomago Road, Tomago	Position:	Ground level:	Test no: CPT - 24
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date:	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt24.csv	



Location: Tomago Road, Tomago	Position: X: 56382091.33 m, Y: 6366939.80 m	Ground level: 0.7	Test no: CPT - 25
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt25.csv	

Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

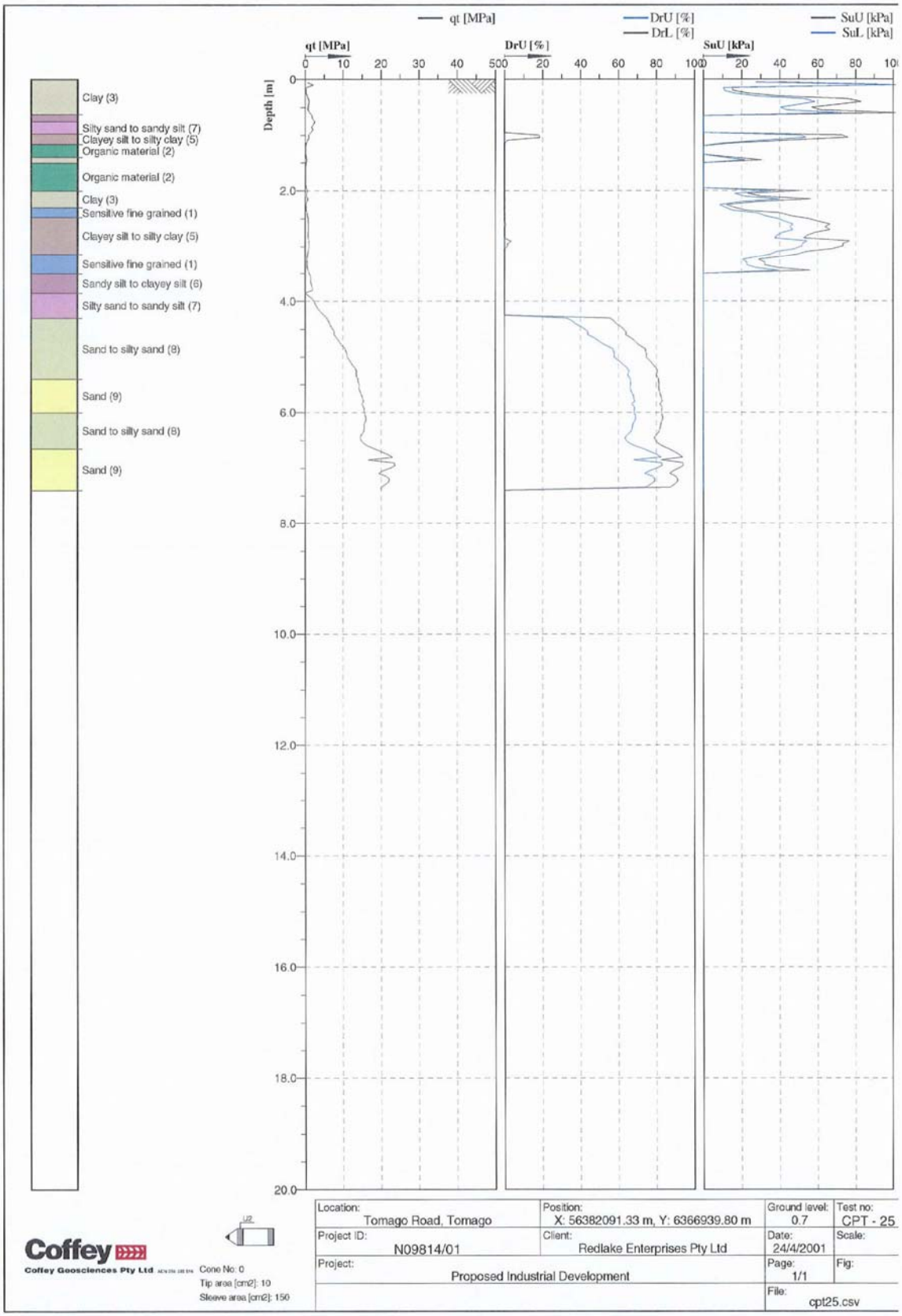


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56382091.33 m, Y: 6366939.80 m		Ground level: 0.7	Test no: CPT - 25
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd		Date: 24/4/2001	Scale:
Project: Proposed Industrial Development			Page: 1/1	Fig:
			File: cpt25.csv	

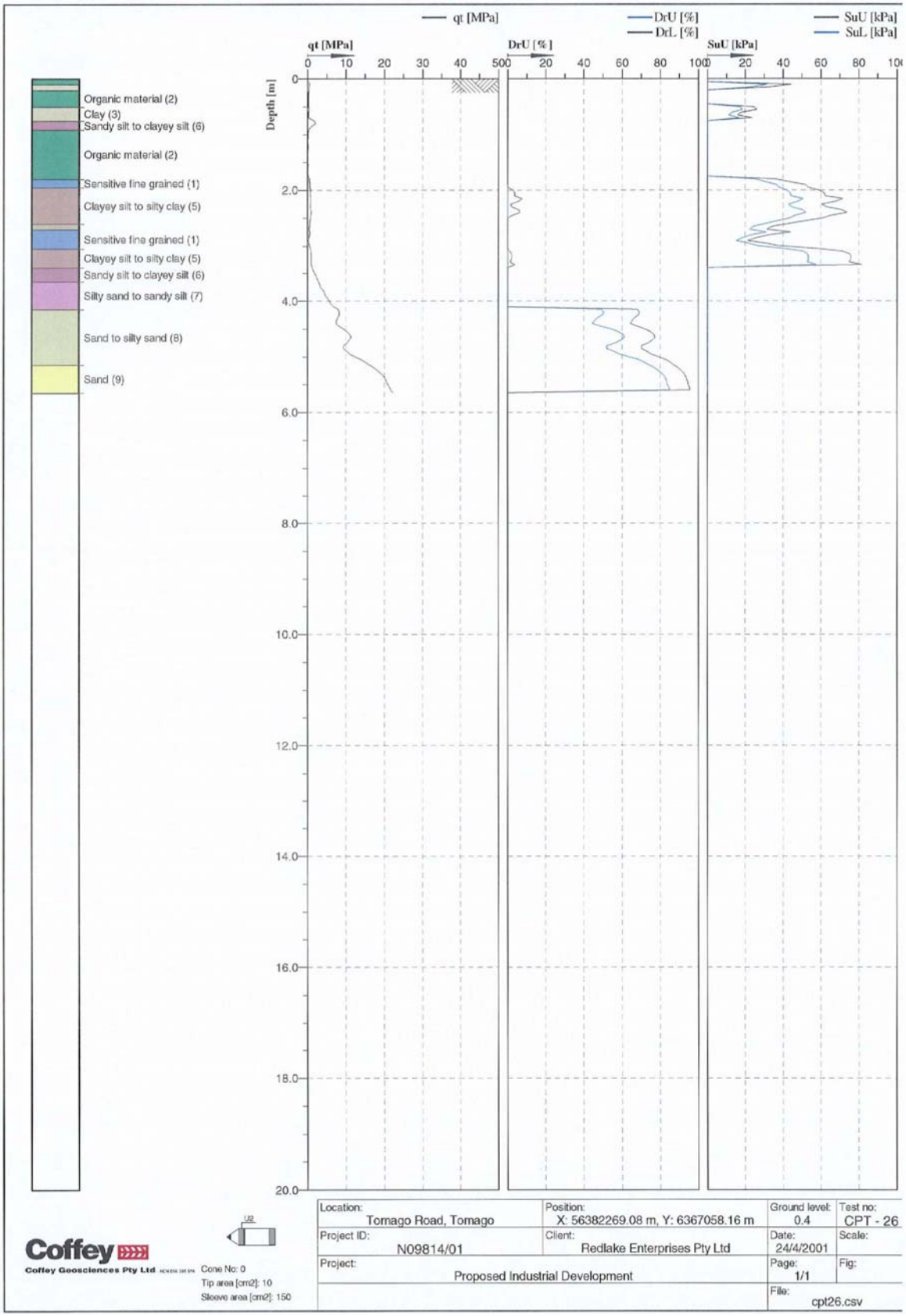


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56382091.33 m, Y: 6366939.80 m		Ground level: 0.7	Test no: CPT - 25
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd		Date: 24/4/2001	Scale:
Project: Proposed Industrial Development			Page: 1/1	Fig:
			File: cpt25.csv	

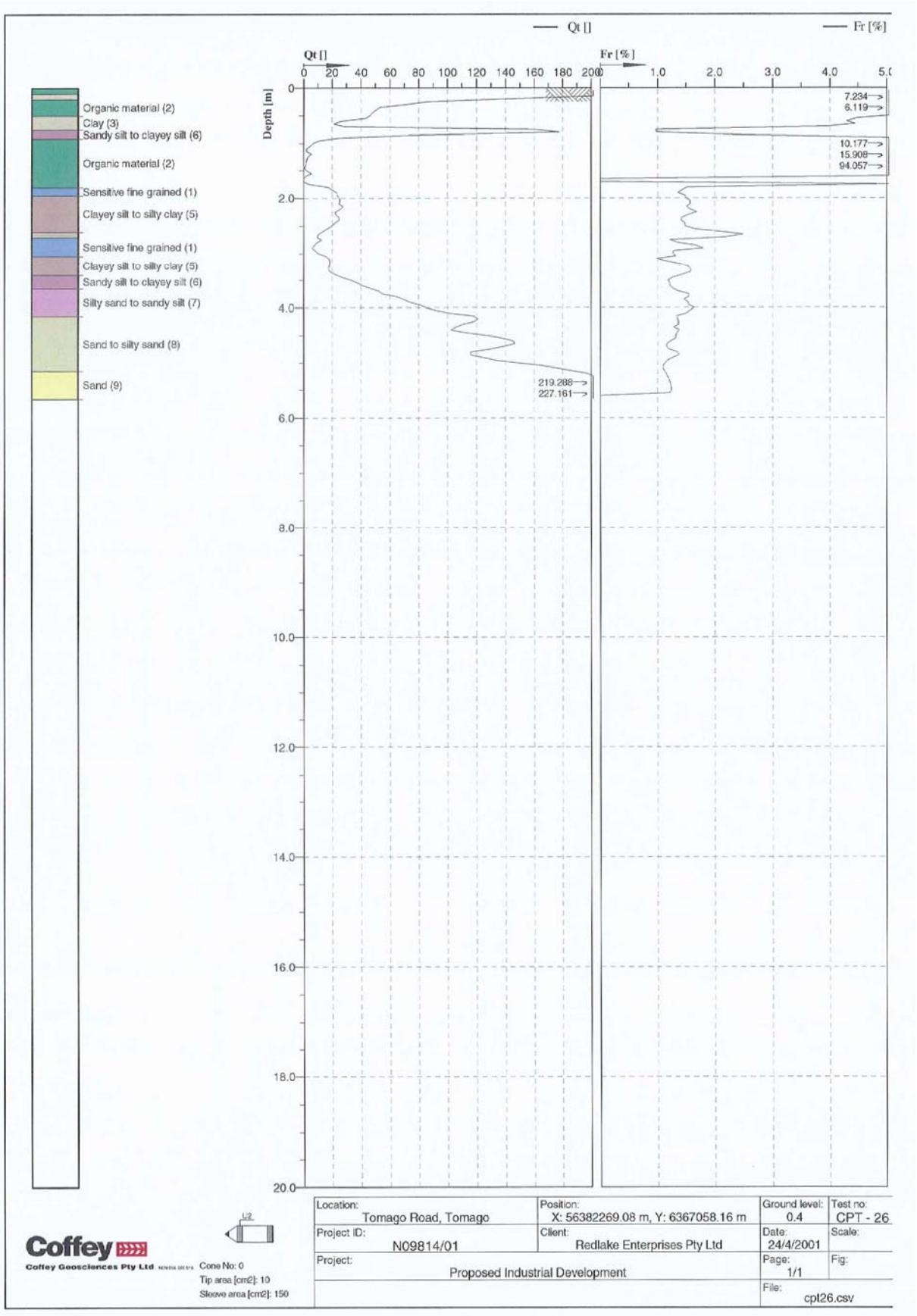


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56382269.08 m, Y: 6367058.16 m	Ground level: 0.4	Test no: CPT - 26
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt26.csv	

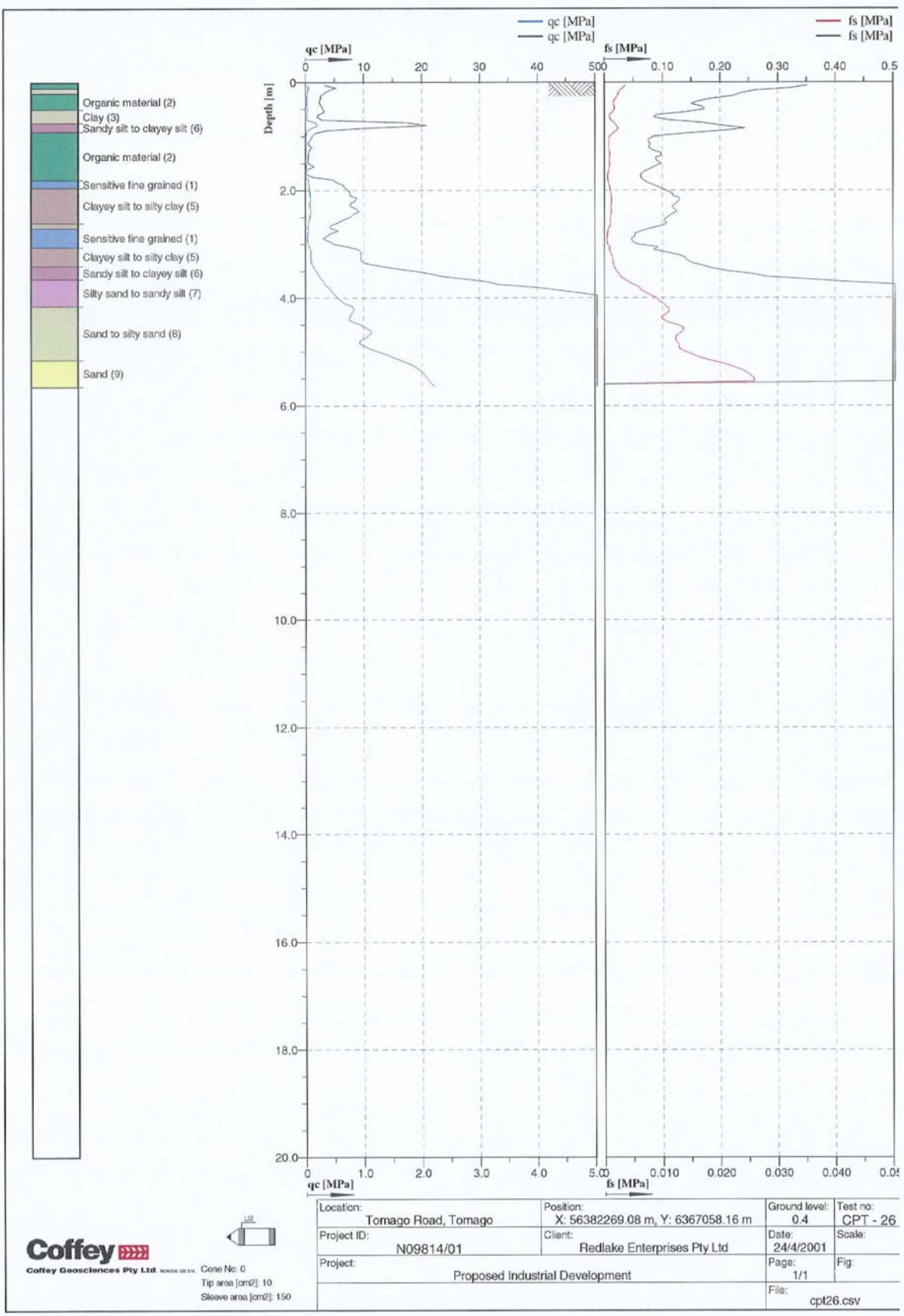


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

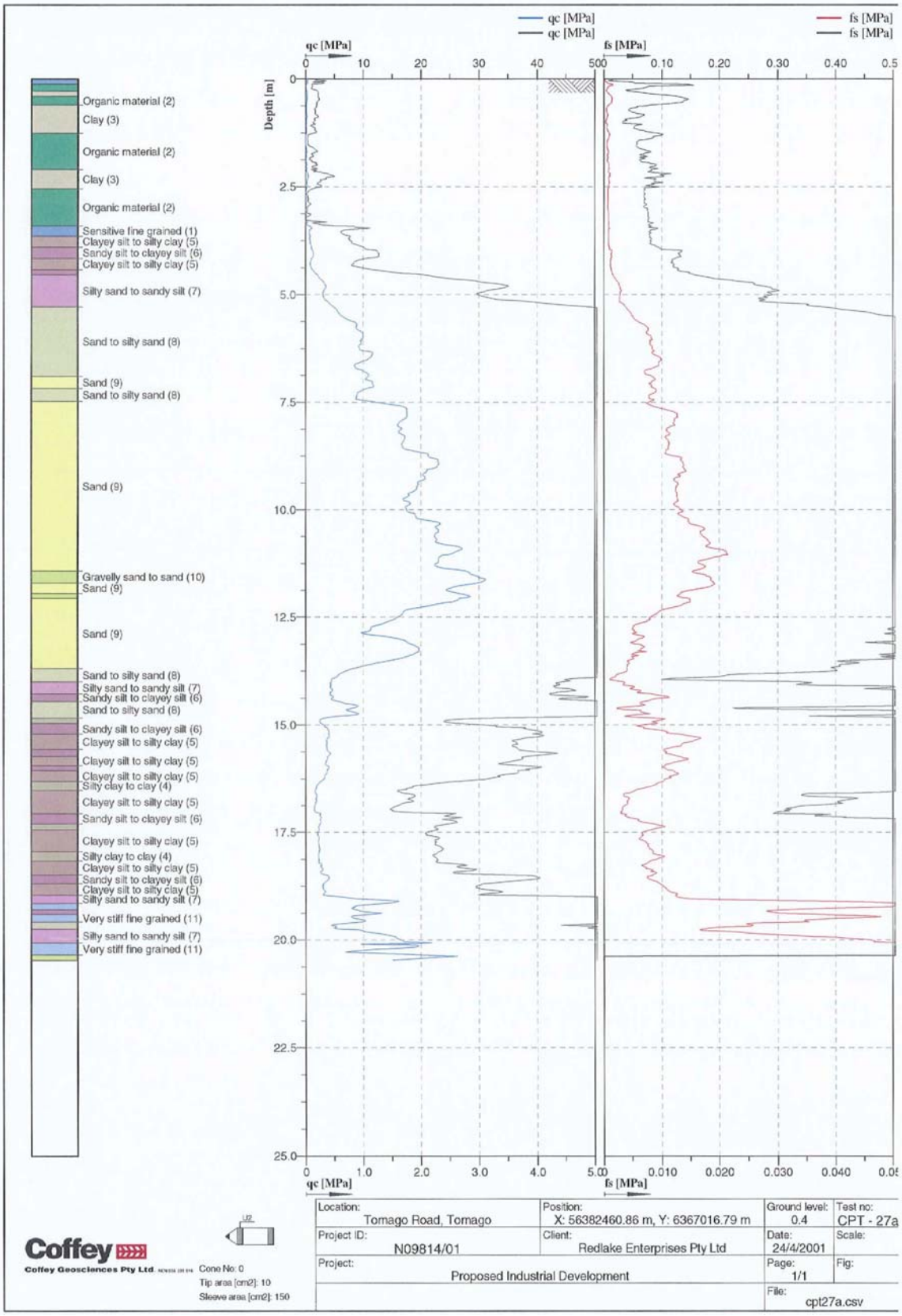
Location: Tomago Road, Tomago	Position: X: 56382269.08 m, Y: 6367058.16 m	Ground level: 0.4	Test no: CPT - 26	
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:	
Project: Proposed Industrial Development		Page: 1/1	Fig:	
		File: cpt26.csv		

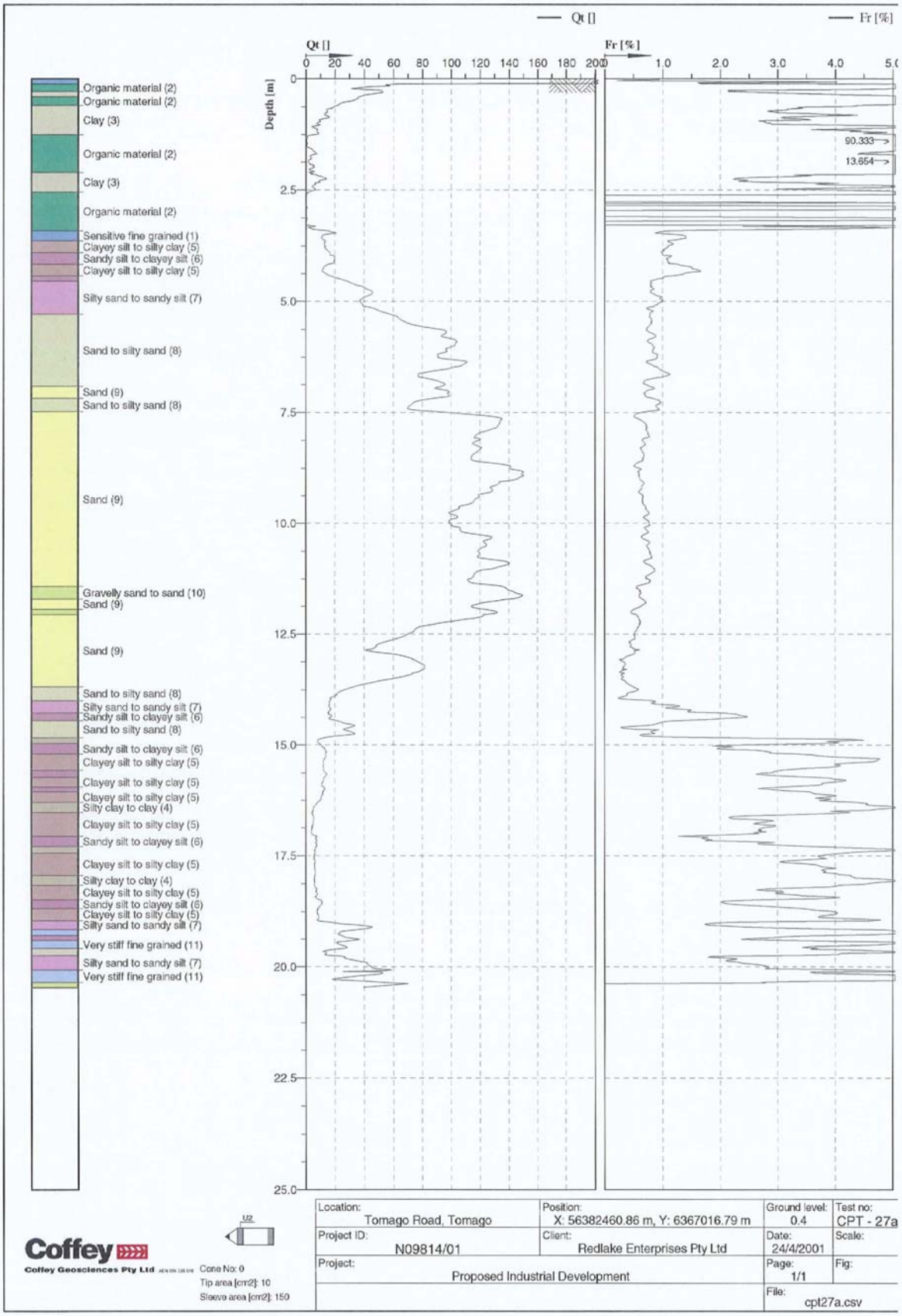


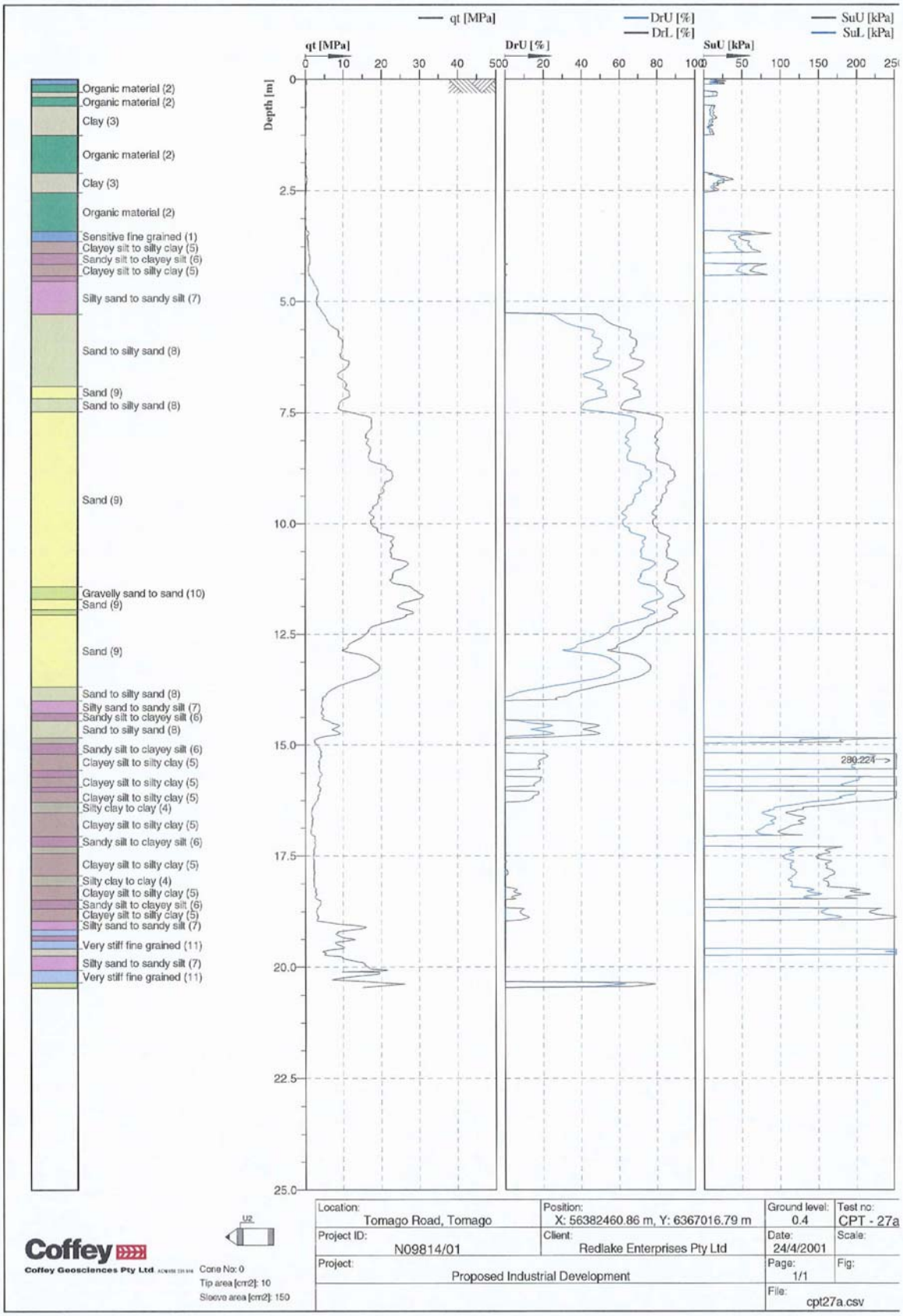
Location: Tomago Road, Tomago	Position: X: 56382269.08 m, Y: 6367058.16 m	Ground level: 0.4	Test no: CPT - 26
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt26.csv	

Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150


qc [MPa]
fs [MPa]
Depth [m]
Organic material (2)
Clay (3)
Organic material (2)
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clayey silt to silty clay (5)
Clayey silt to silty clay (5)
Silty clay to clay (4)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty clay to clay (4)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Very stiff fine grained (11)
Silty sand to sandy silt (7)
Very stiff fine grained (11)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382460.86 m, Y: 6367016.79 m
Ground level: 0.4
Test no: CPT - 27a
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt27a.csv


Qt []
Fr [%]
Qt []
0 20 40 60 80 100 120 140 160 180 200
Fr [%]
1.0 2.0 3.0 4.0 5.0
Depth [m]
0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0
90.333
13.654
Organic material (2)
Organic material (2)
Clay (3)
Organic material (2)
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clayey silt to silty clay (5)
Clayey silt to silty clay (5)
Silty clay to clay (4)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty clay to clay (4)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Very stiff fine grained (11)
Silty sand to sandy silt (7)
Very stiff fine grained (11)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382460.86 m, Y: 6367016.79 m
Ground level: 0.4
Test no: CPT - 27a
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt27a.csv



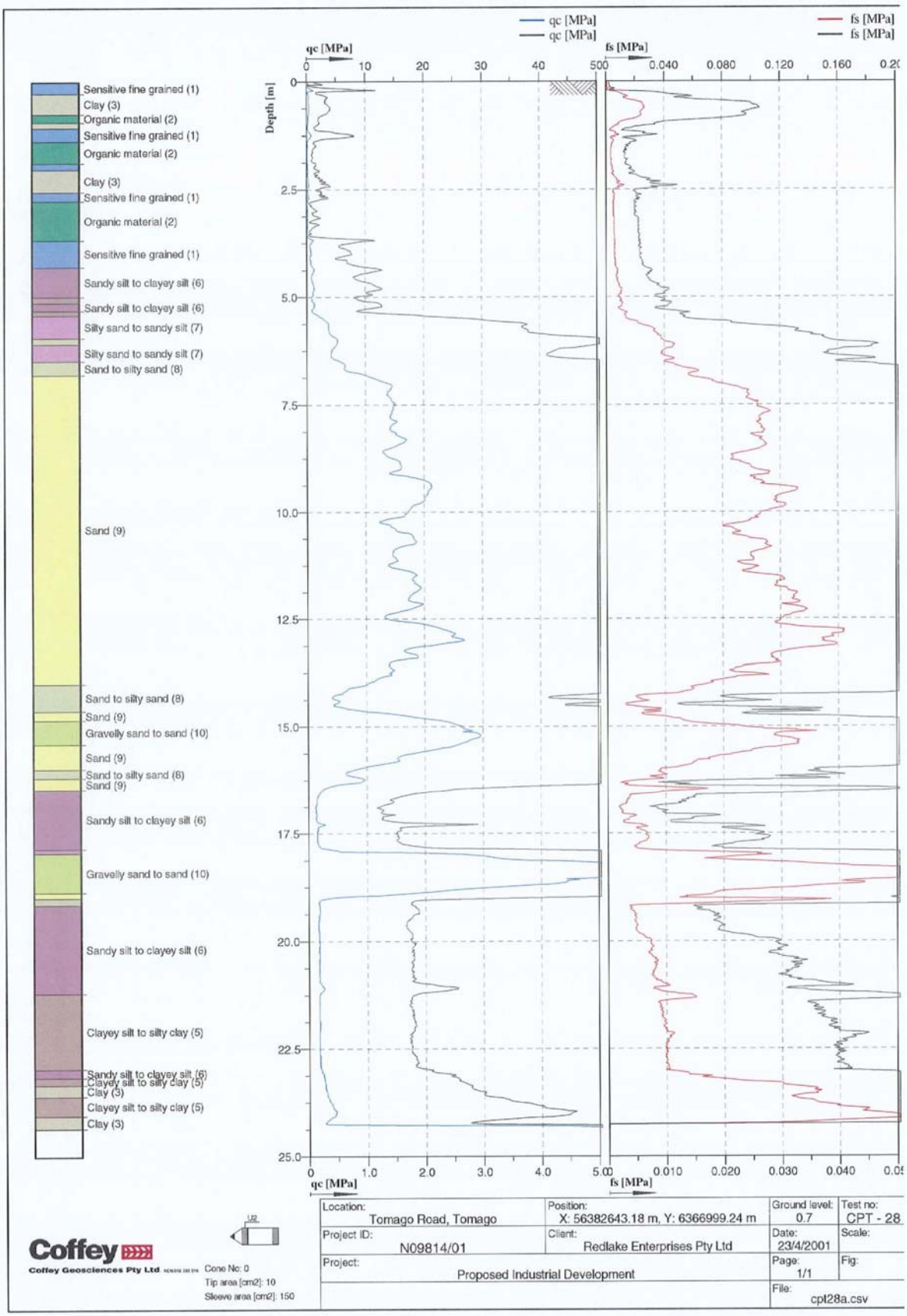
Coffey

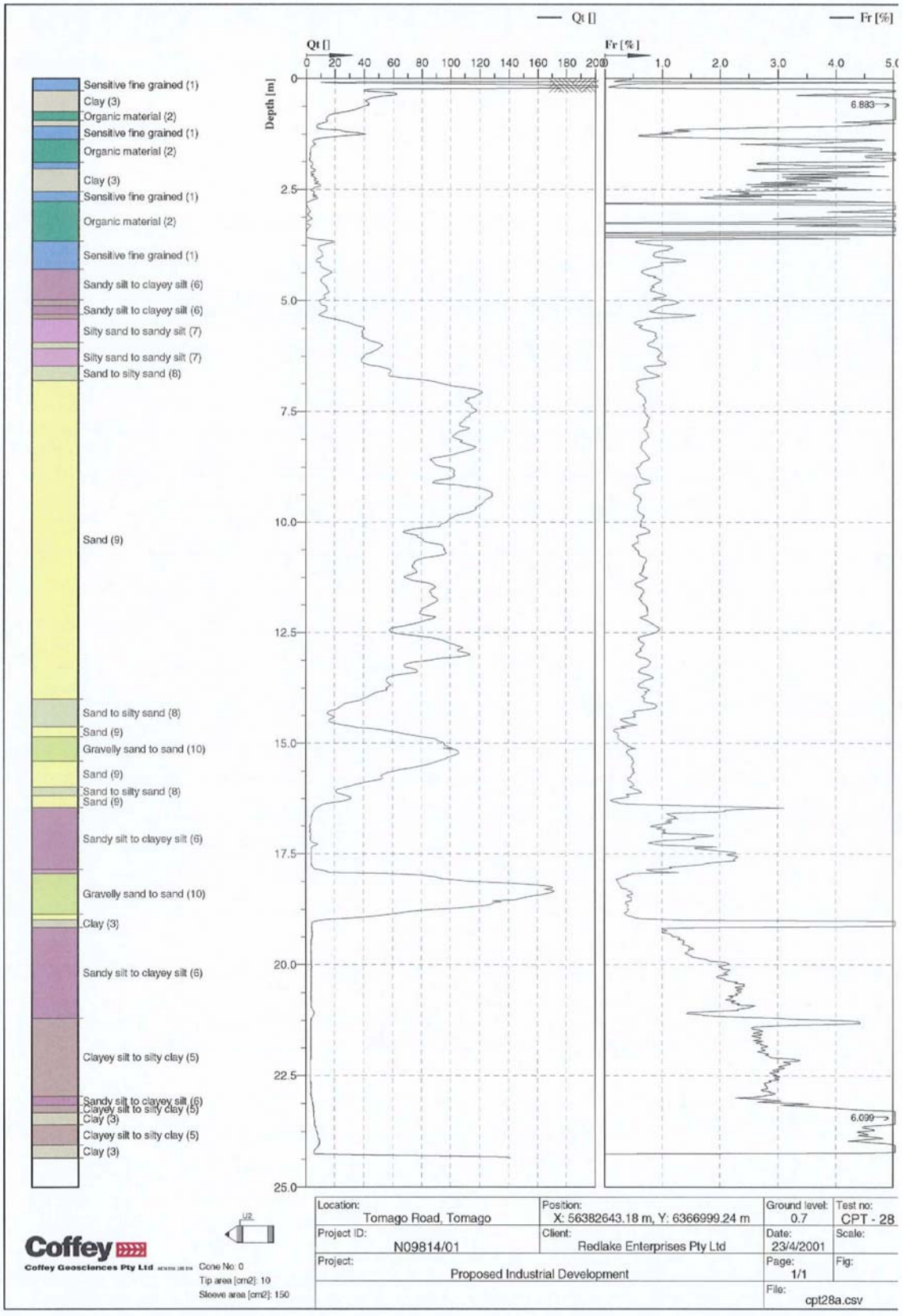
Coffey Geosciences Pty Ltd

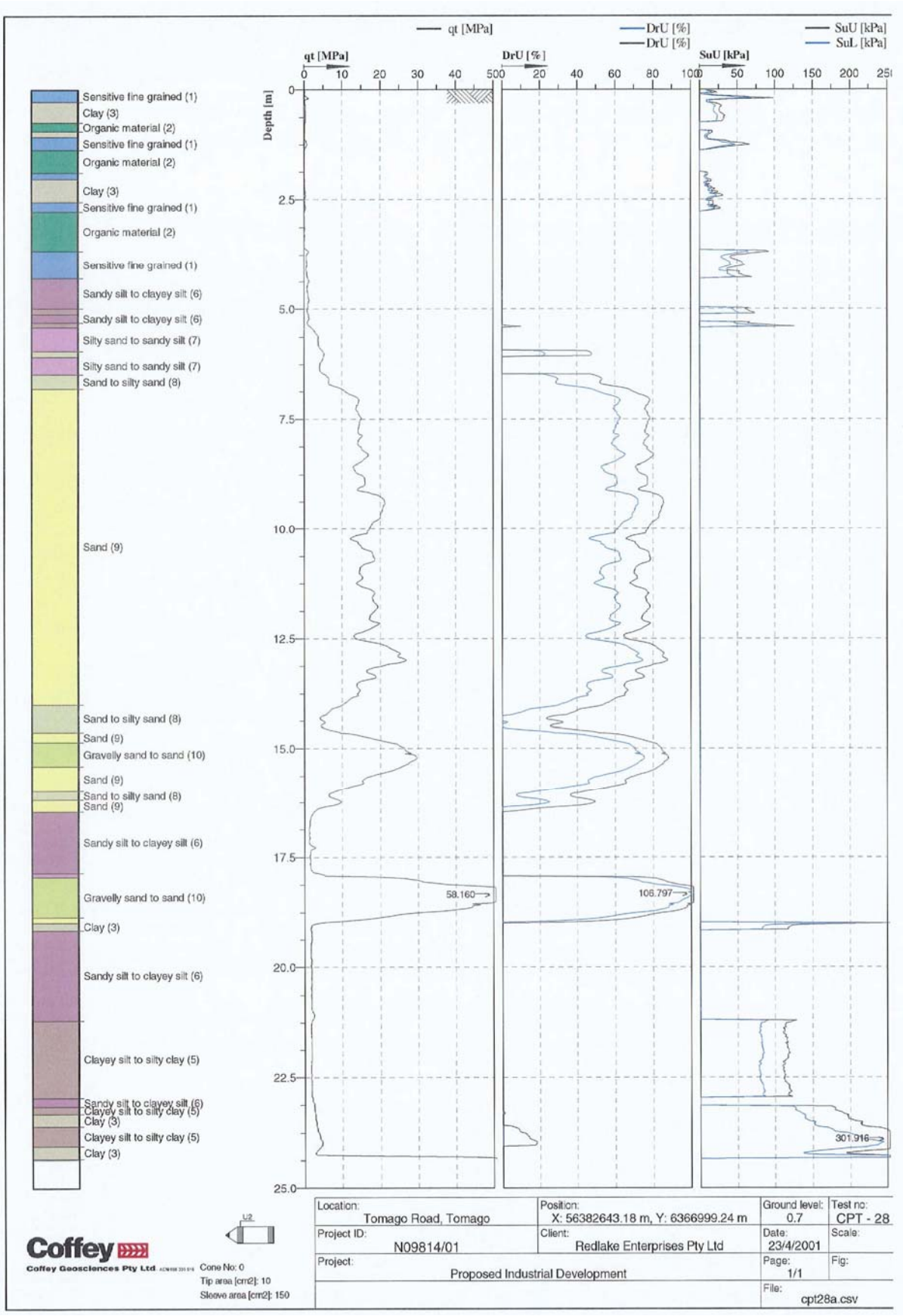
U2

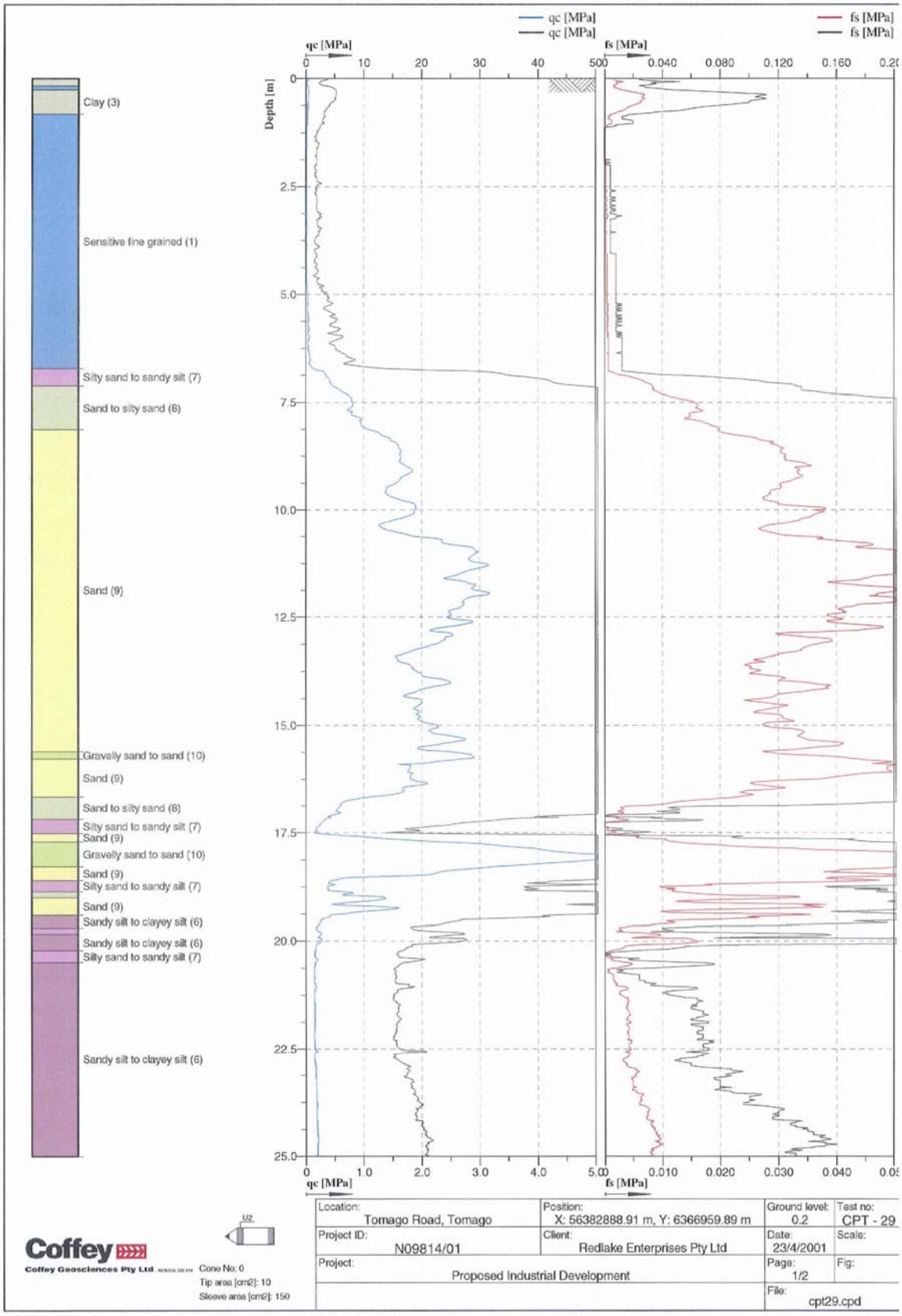
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

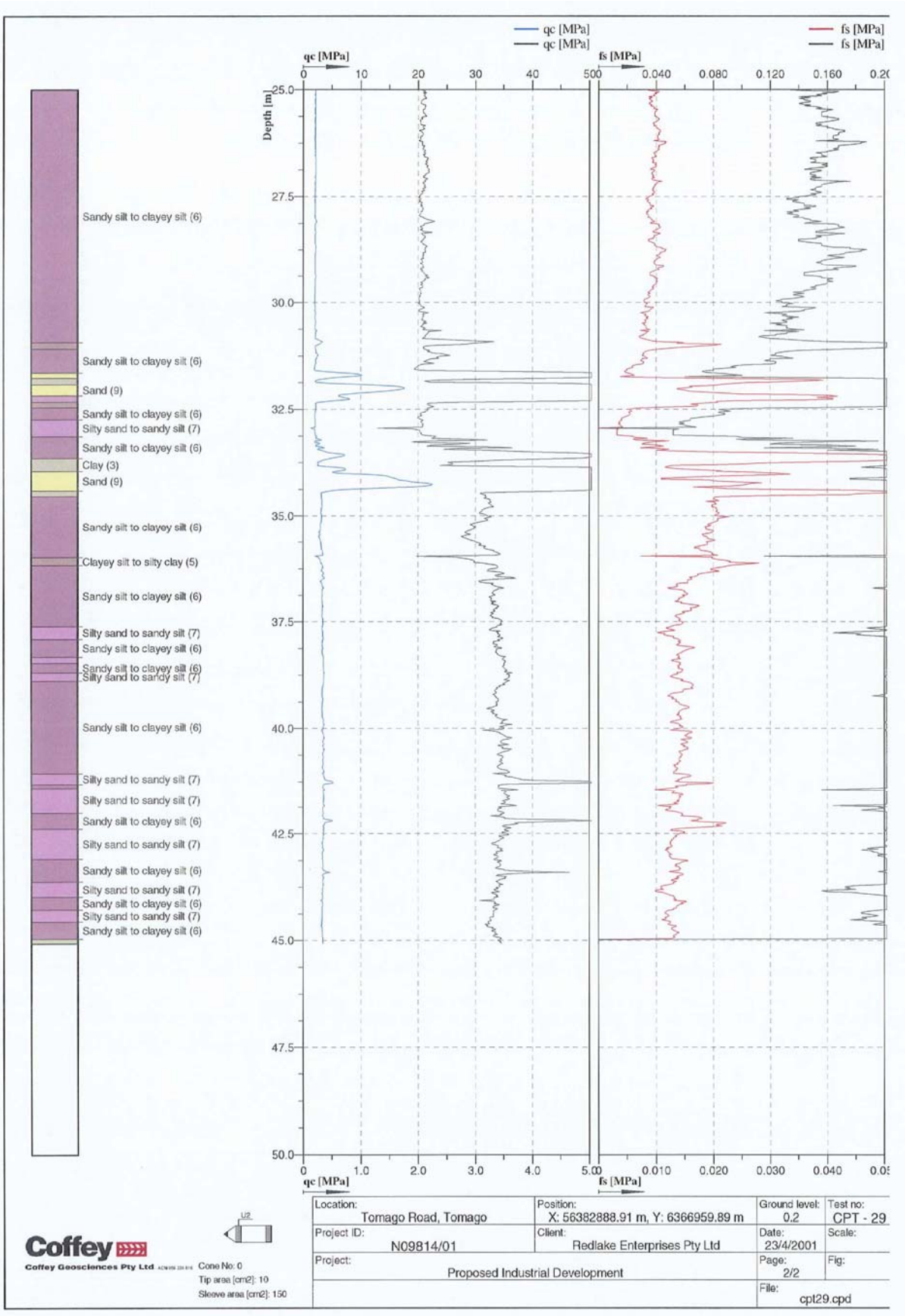
Location: Tomago Road, Tomago	Position: X: 56382460.86 m, Y: 6367016.79 m	Ground level: 0.4	Test no: CPT - 27a
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt27a.csv	

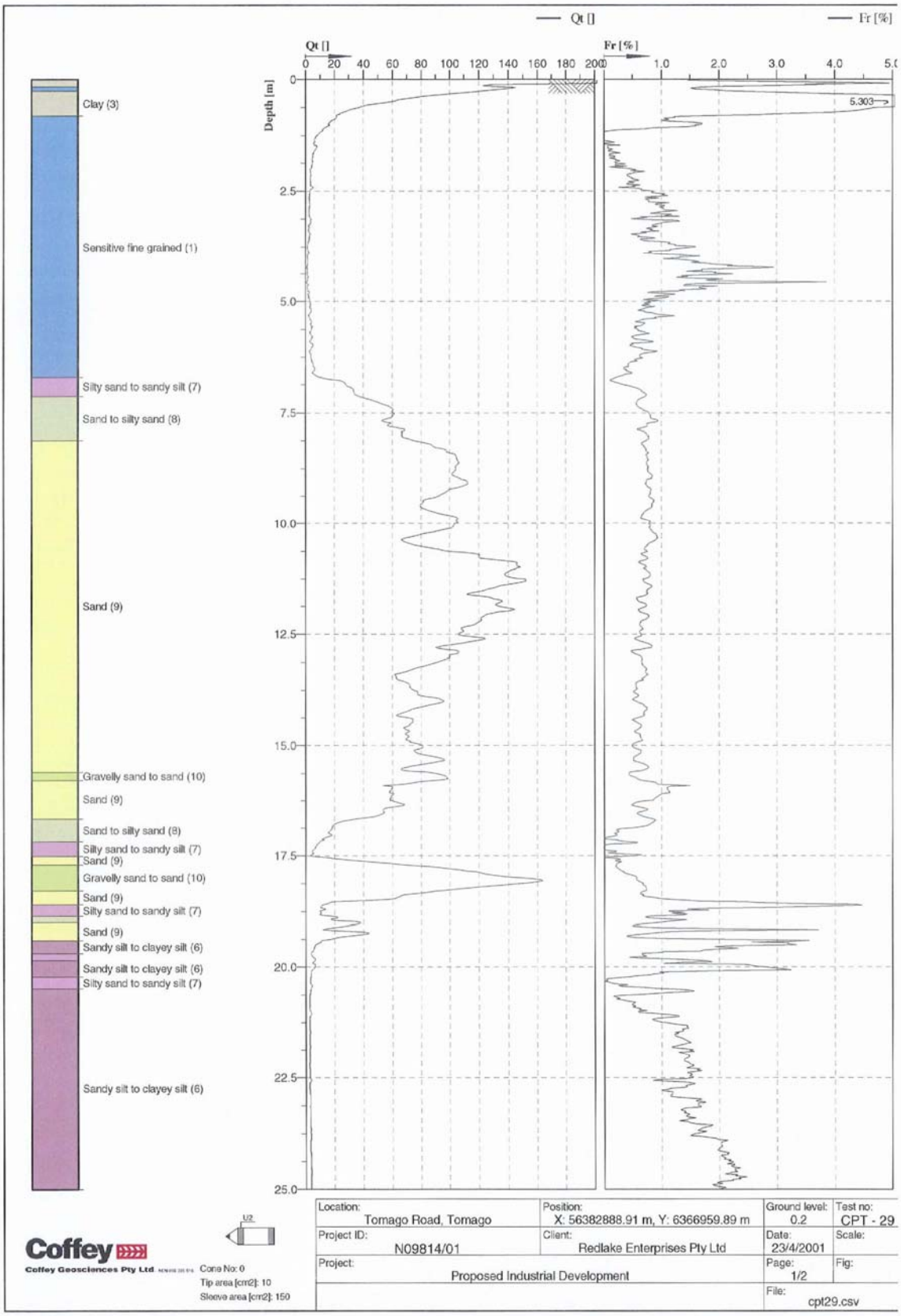

qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sensitive fine grained (1)
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Organic material (2)
Clay (3)
Sensitive fine grained (1)
Organic material (2)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Gravelly sand to sand (10)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clay (3)
Clayey silt to silty clay (5)
Clay (3)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382643.18 m, Y: 6366999.24 m
Ground level: 0.7
Test no: CPT - 28
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt28a.csv

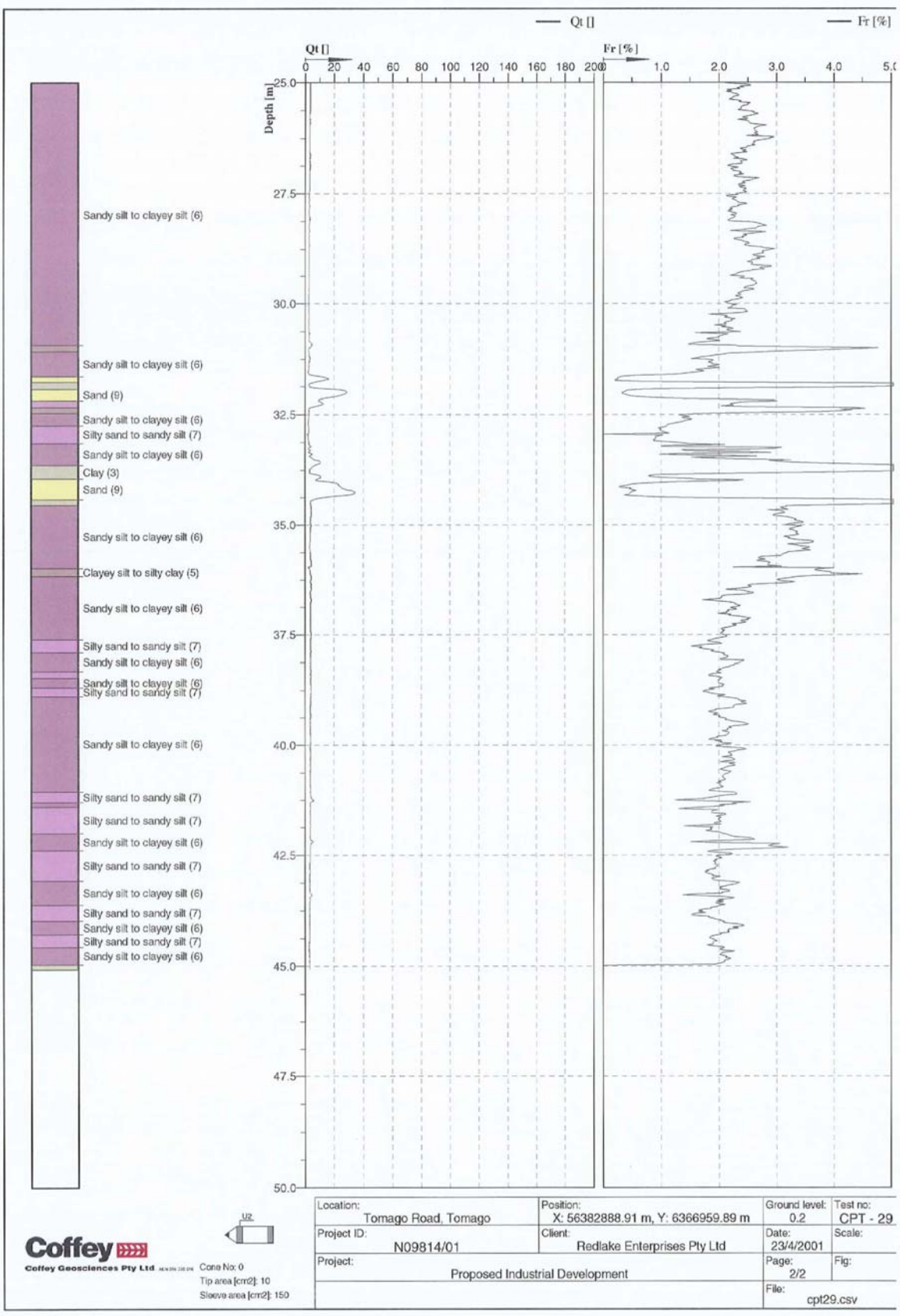

Qt []
Fr [%]
Depth [m]
Sensitive fine grained (1)
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Organic material (2)
Clay (3)
Sensitive fine grained (1)
Organic material (2)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Gravelly sand to sand (10)
Clay (3)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clay (3)
Clayey silt to silty clay (5)
Clay (3)
6.883
6.099
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382643.18 m, Y: 6366999.24 m
Ground level: 0.7
Test no: CPT - 28
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt28a.csv

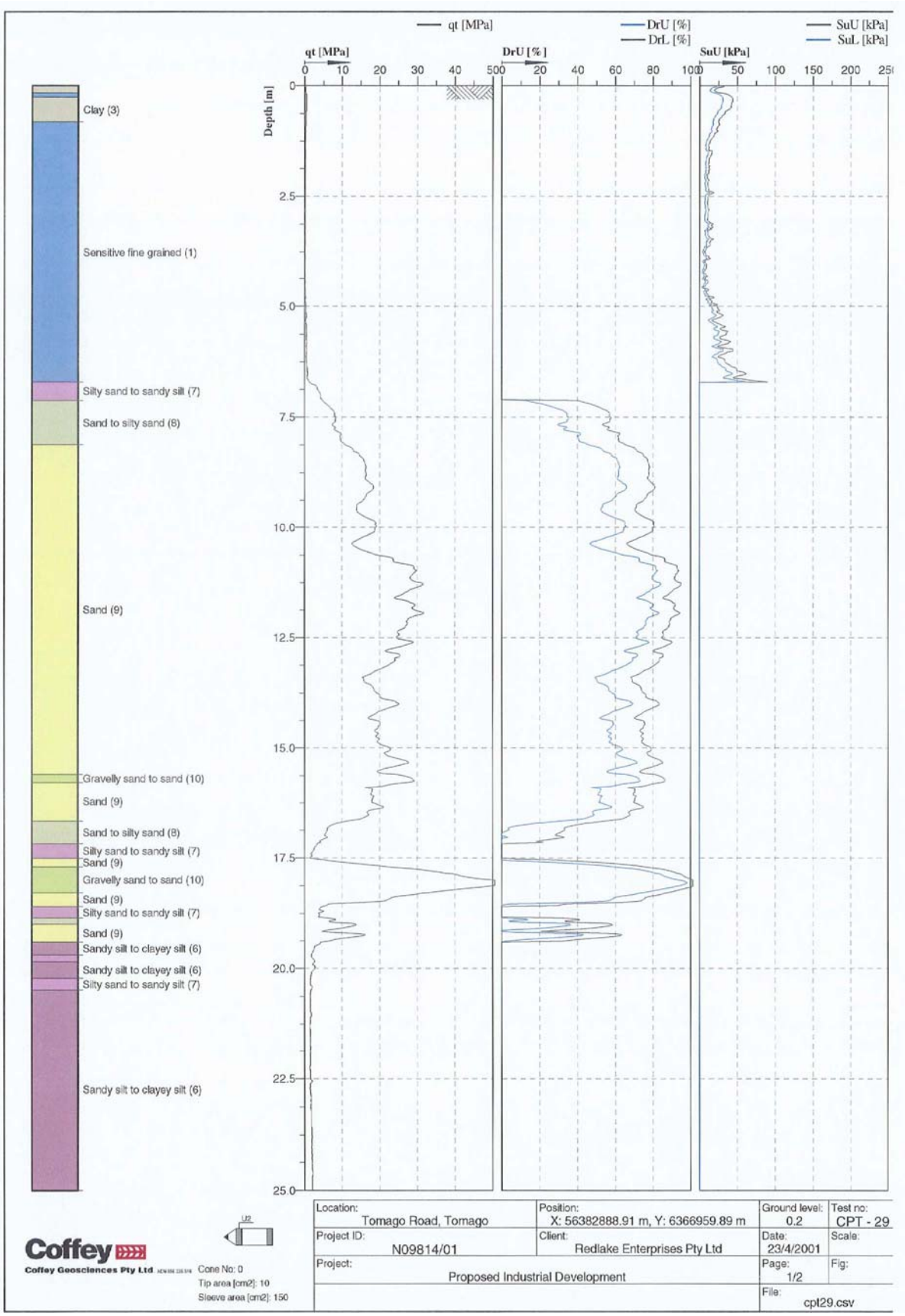

qt [MPa]
DrU [%]
DrU [%]
SuU [kPa]
SuL [kPa]
qt [MPa]
DrU [%]
SuU [kPa]
Depth [m]
Sensitive fine grained (1)
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Organic material (2)
Clay (3)
Sensitive fine grained (1)
Organic material (2)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Gravelly sand to sand (10)
Clay (3)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clay (3)
Clayey silt to silty clay (5)
Clay (3)
58.160
106.797
301.916
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382643.18 m, Y: 6366999.24 m
Ground level: 0.7
Test no: CPT - 28
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt28a.csv


qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Sensitive fine grained (1)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
Sand (9)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382888.91 m, Y: 6366959.89 m
Ground level: 0.2
Test no: CPT - 29
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: cpt29.cpd


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Sand (9)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Clay (3)
Sand (9)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Location: Tomago Road, Tomago
Position: X: 56382888.91 m, Y: 6366959.89 m
Ground level: 0.2
Test no: CPT - 29
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: cpt29.cpd
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150


Qt []
Fr [%]
Depth [m]
Clay (3)
Sensitive fine grained (1)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
Sand (9)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
5.303
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382888.91 m, Y: 6366959.89 m
Ground level: 0.2
Test no: CPT - 29
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: cpt29.csv


Qt []
Fr [%]
Depth [m]
0 20 40 60 80 100 120 140 160 180 200
0 1.0 2.0 3.0 4.0
25.0
27.5
30.0
32.5
35.0
37.5
40.0
42.5
45.0
47.5
50.0
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Sand (9)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Clay (3)
Sand (9)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382888.91 m, Y: 6366959.89 m
Ground level: 0.2
Test no: CPT - 29
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/4/2001
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: cpt29.csv

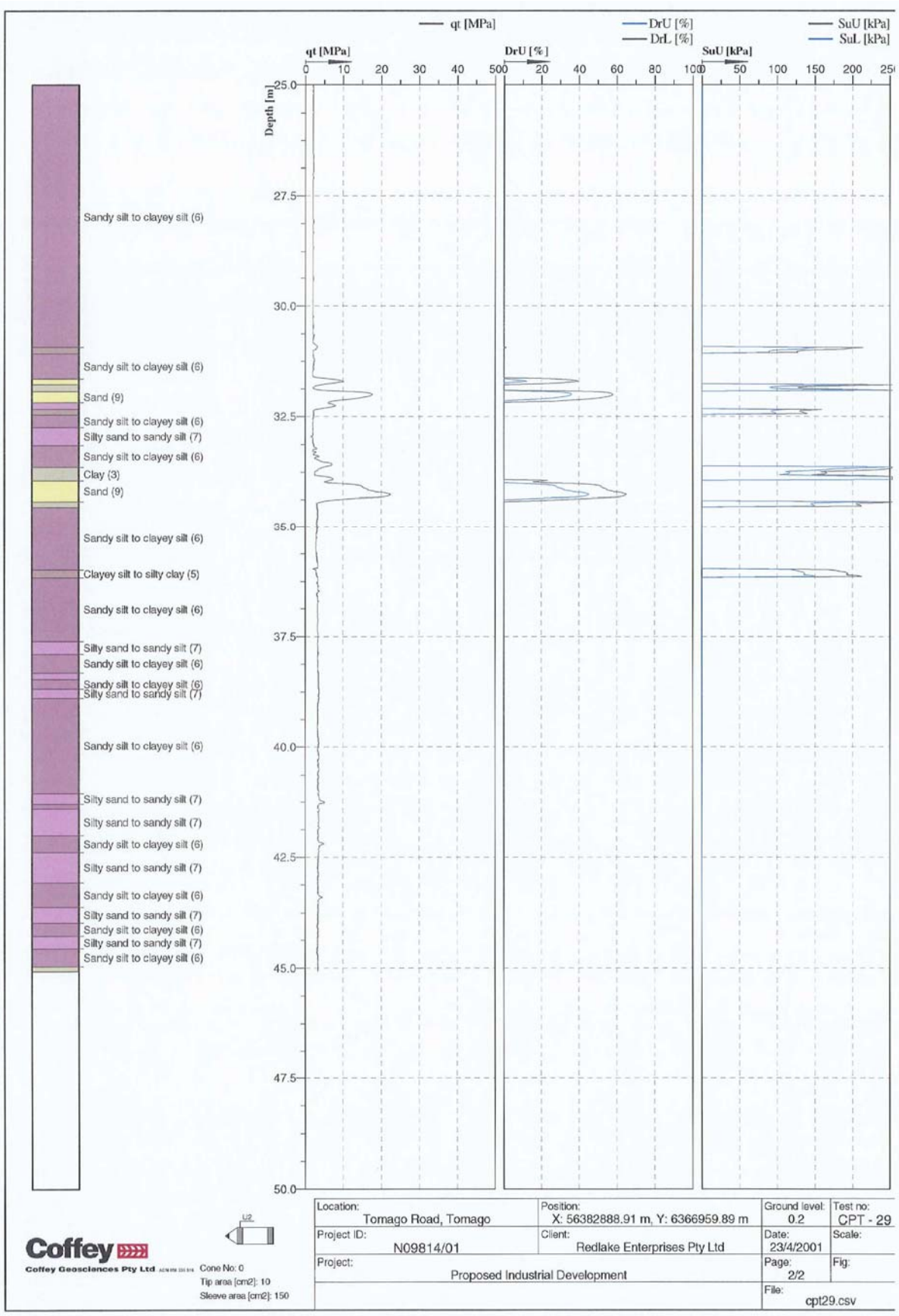


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56382888.91 m, Y: 6366959.89 m	Ground level: 0.2	Test no: CPT - 29
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 23/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: cpt29.csv	

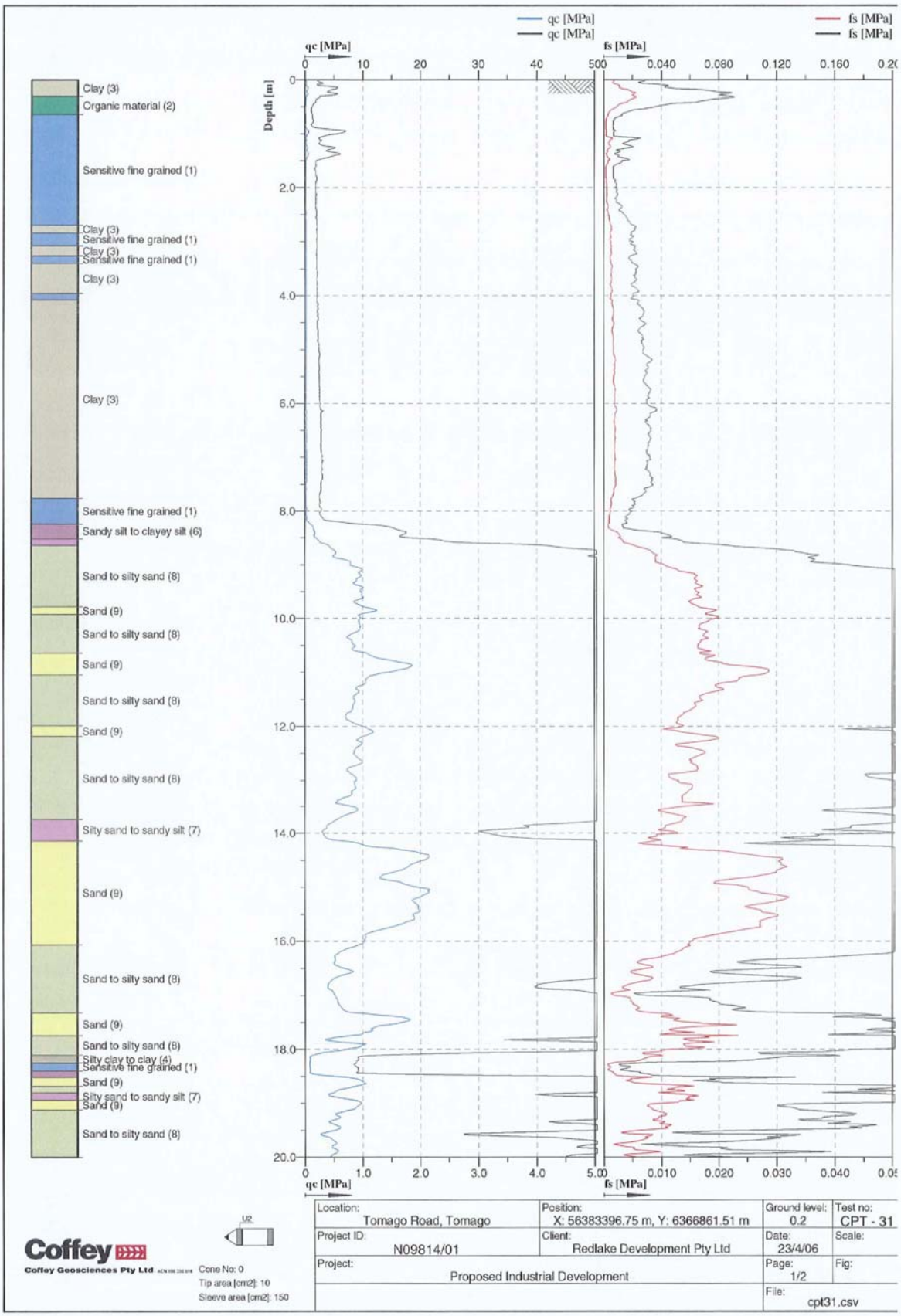


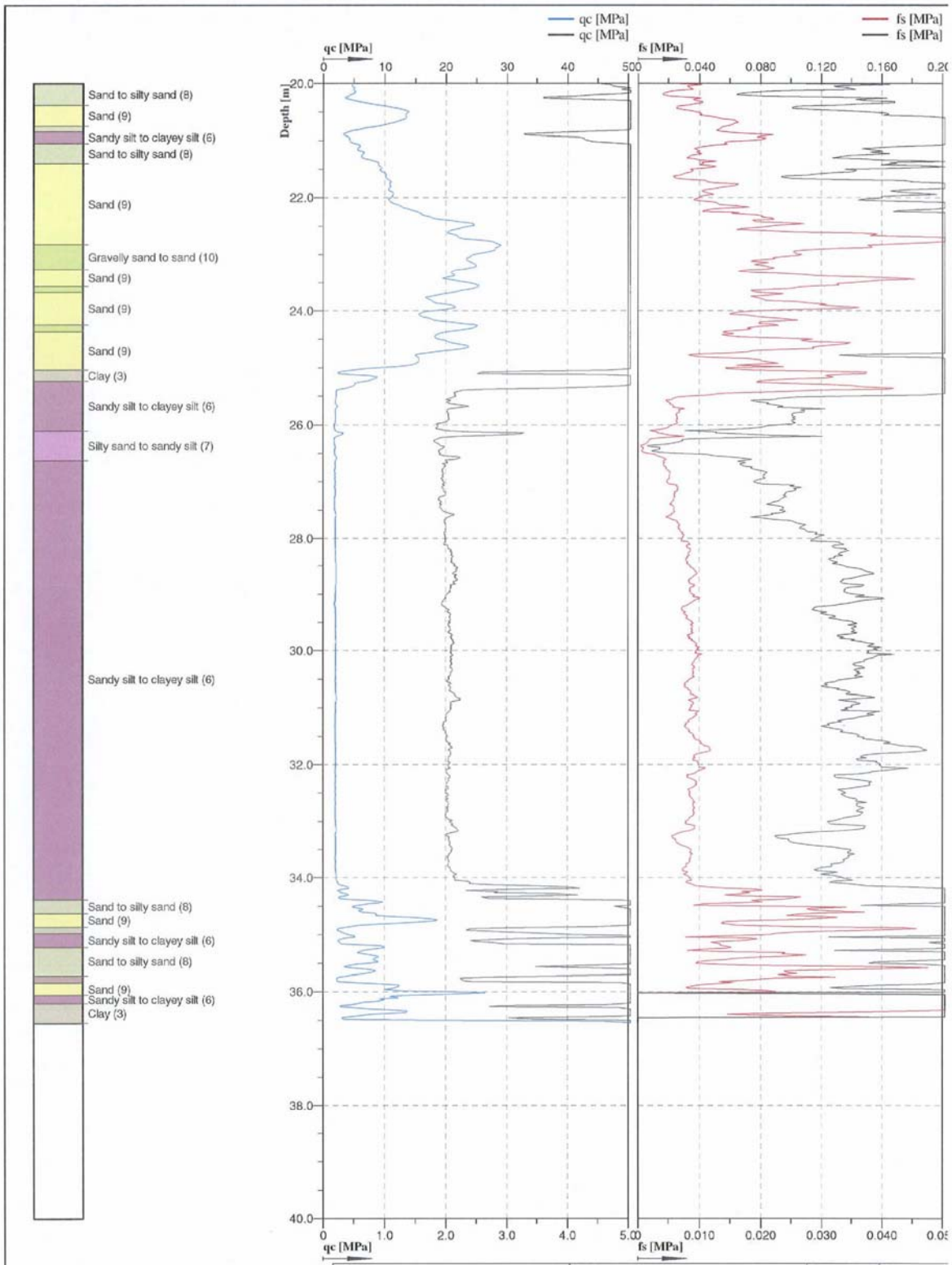
Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56382888.91 m, Y: 6366959.89 m	Ground level: 0.2	Test no: CPT - 29
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 23/4/2001	Scale:
Project: Proposed Industrial Development		Page: 2/2	Fig:
		File: cpt29.csv	


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty clay to clay (4)
Sensitive fine grained (1)
Sand (9)
Silty sand to sandy silt (7)
Sand (9)
Sand to silty sand (8)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383396.75 m, Y: 6366861.51 m
Ground level: 0.2
Test no: CPT - 31
Project ID: N09814/01
Client: Redlake Development Pty Ltd
Date: 23/4/06
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: cpt31.csv

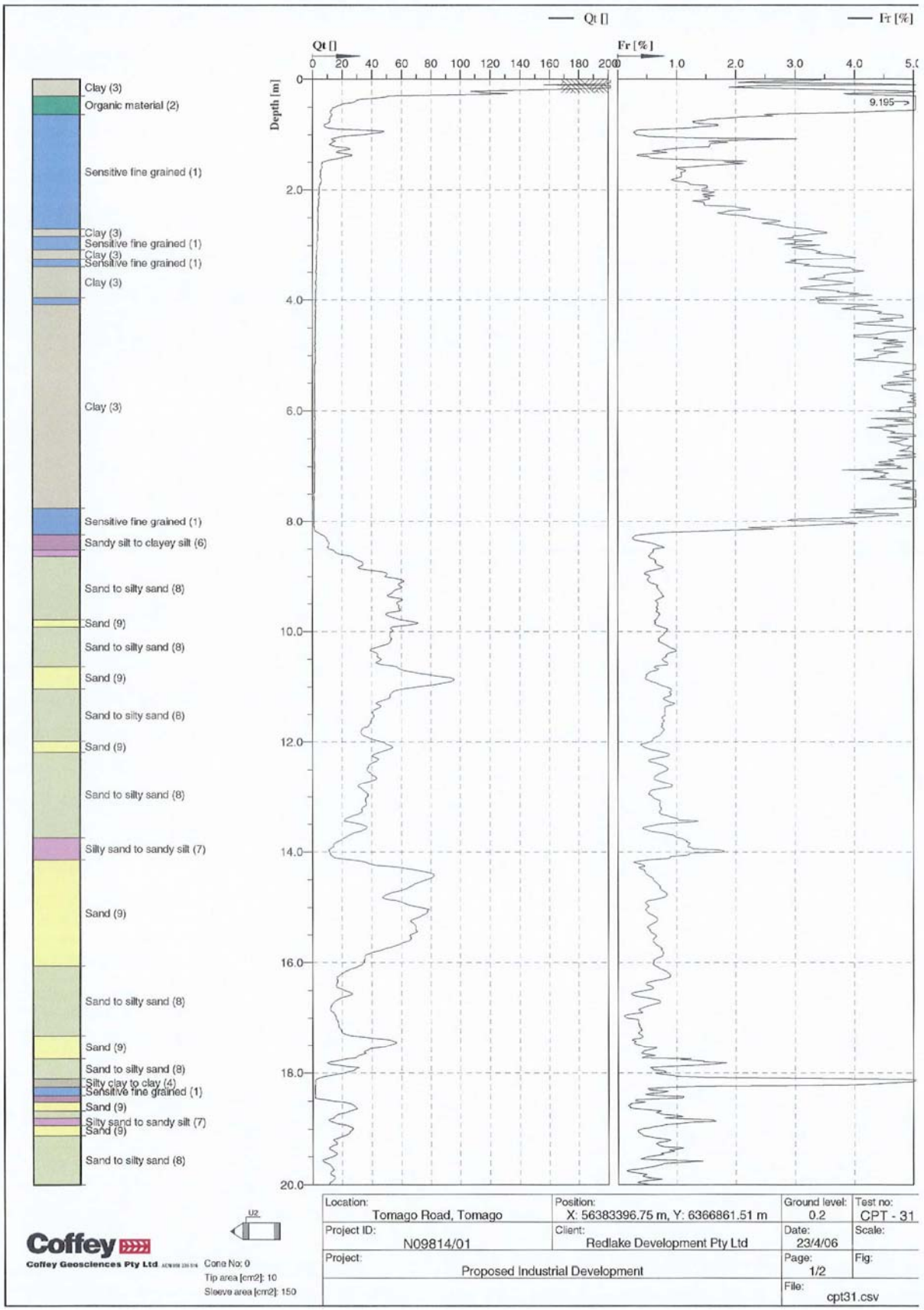


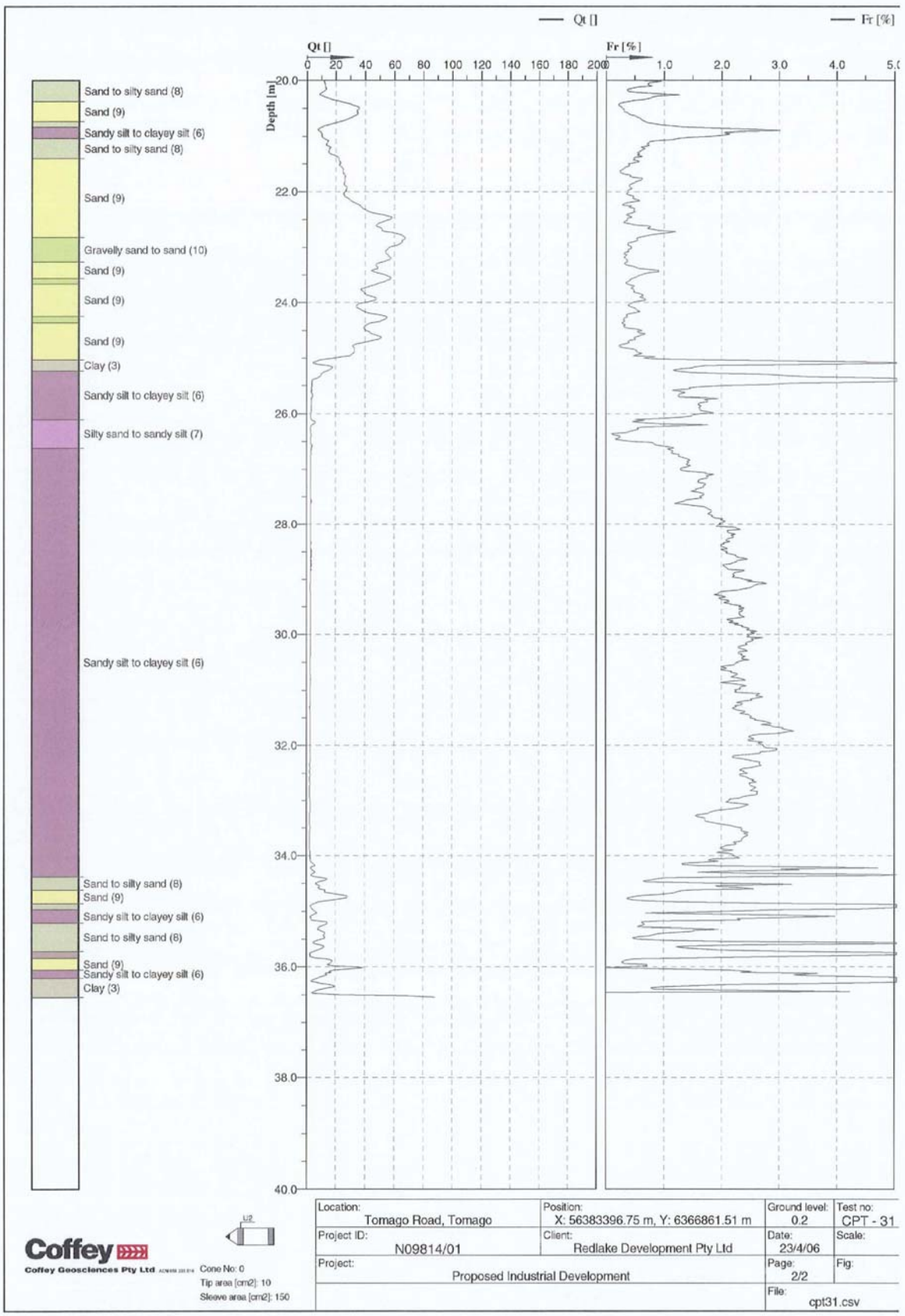
Coffey

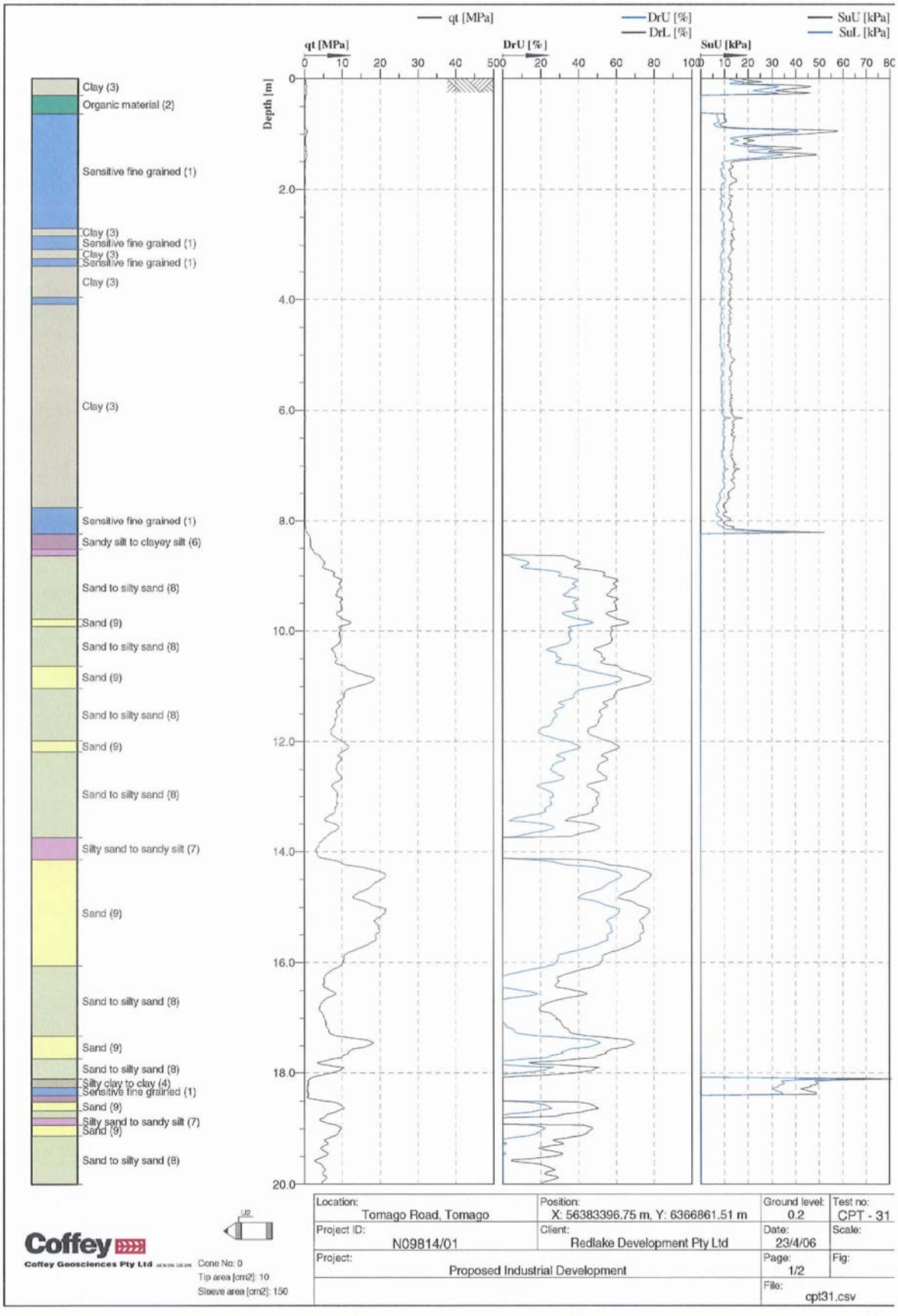
Coffey Geosciences Pty Ltd

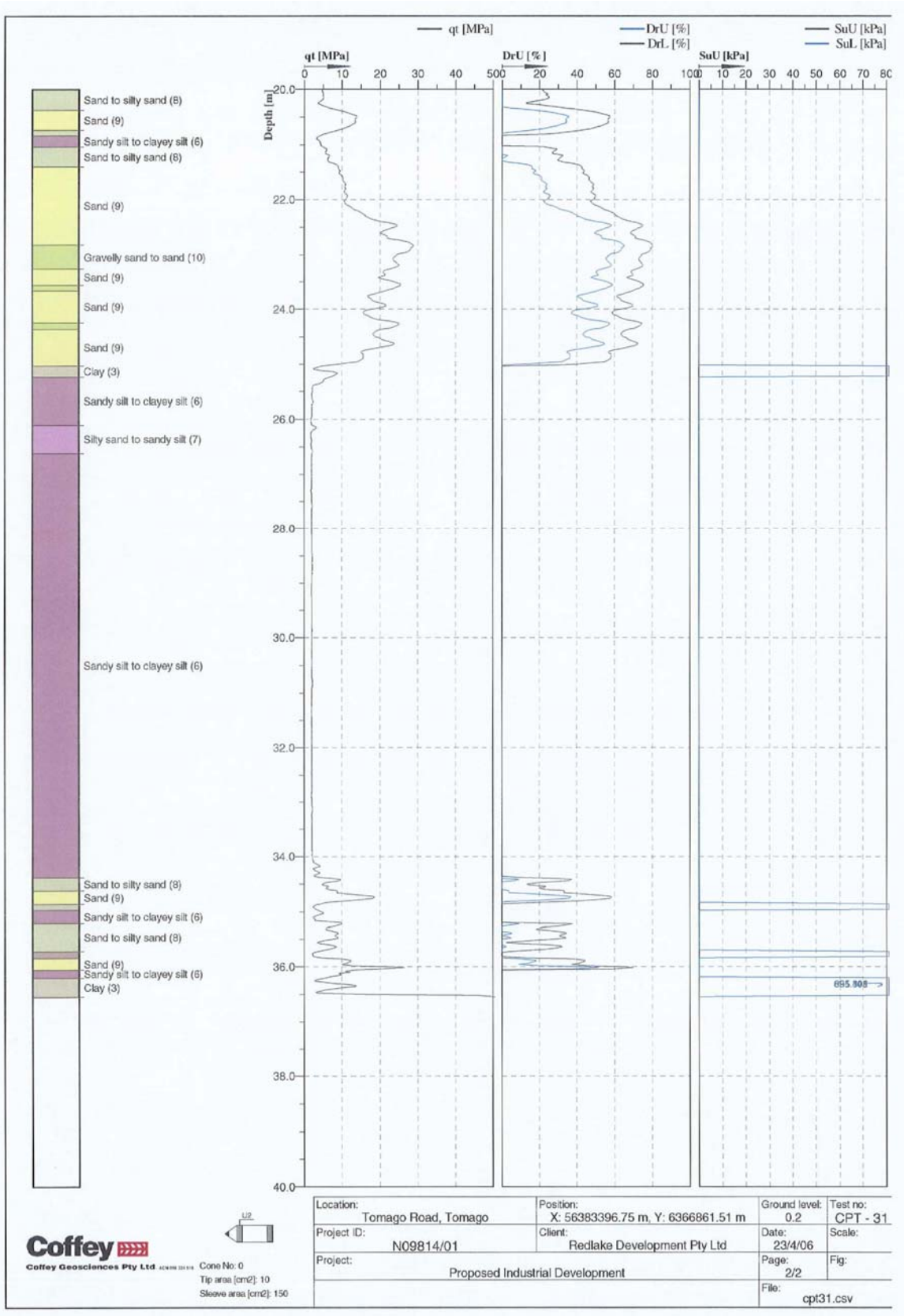
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

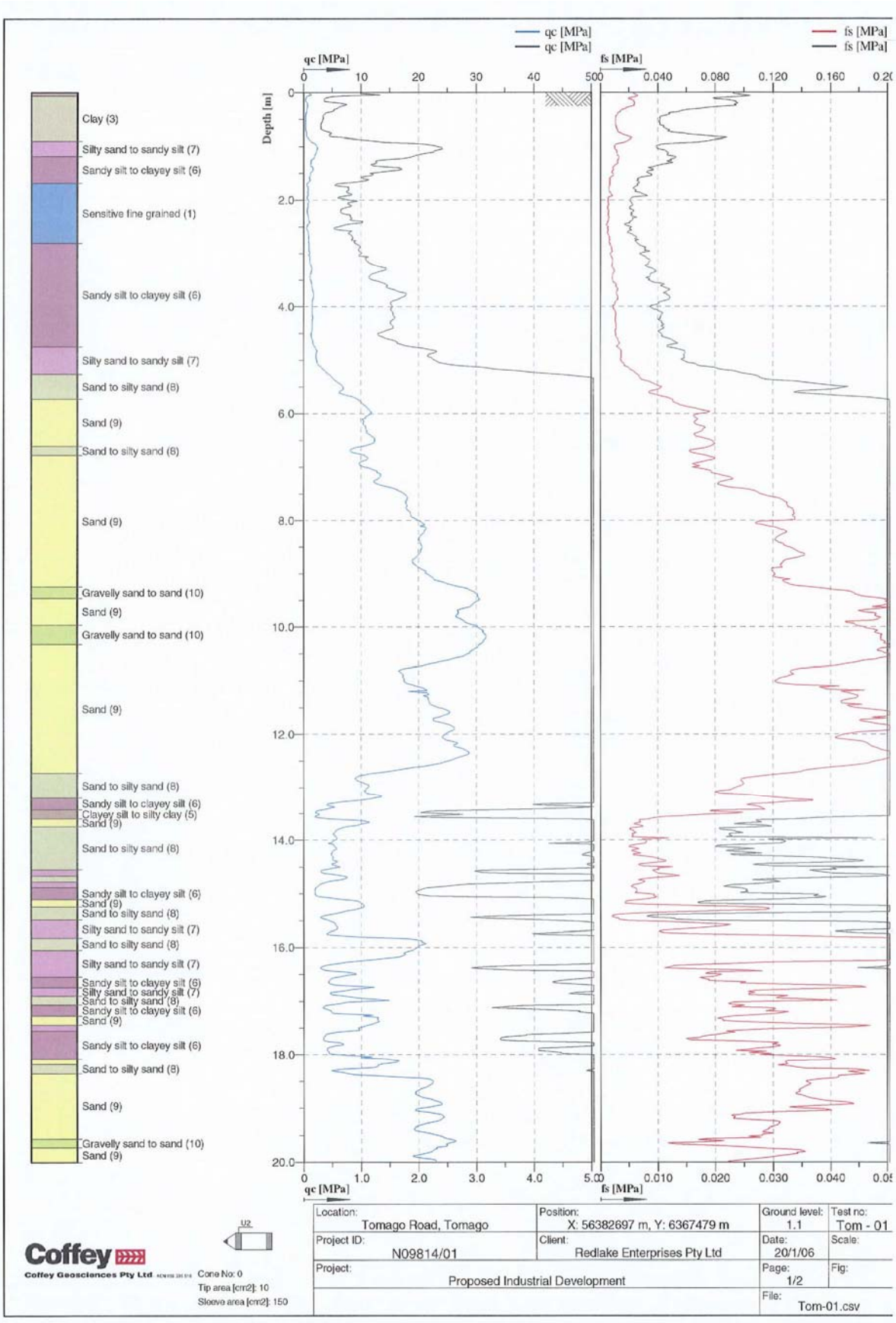
Location: Tomago Road, Tomago	Position: X: 56383396.75 m, Y: 6366861.51 m	Ground level: 0.2	Test no: CPT - 31
Project ID: N09814/01	Client: Redlake Development Pty Ltd	Date: 23/4/06	Scale:
Project: Proposed Industrial Development		Page: 2/2	Fig:
		File: cpt31.csv	

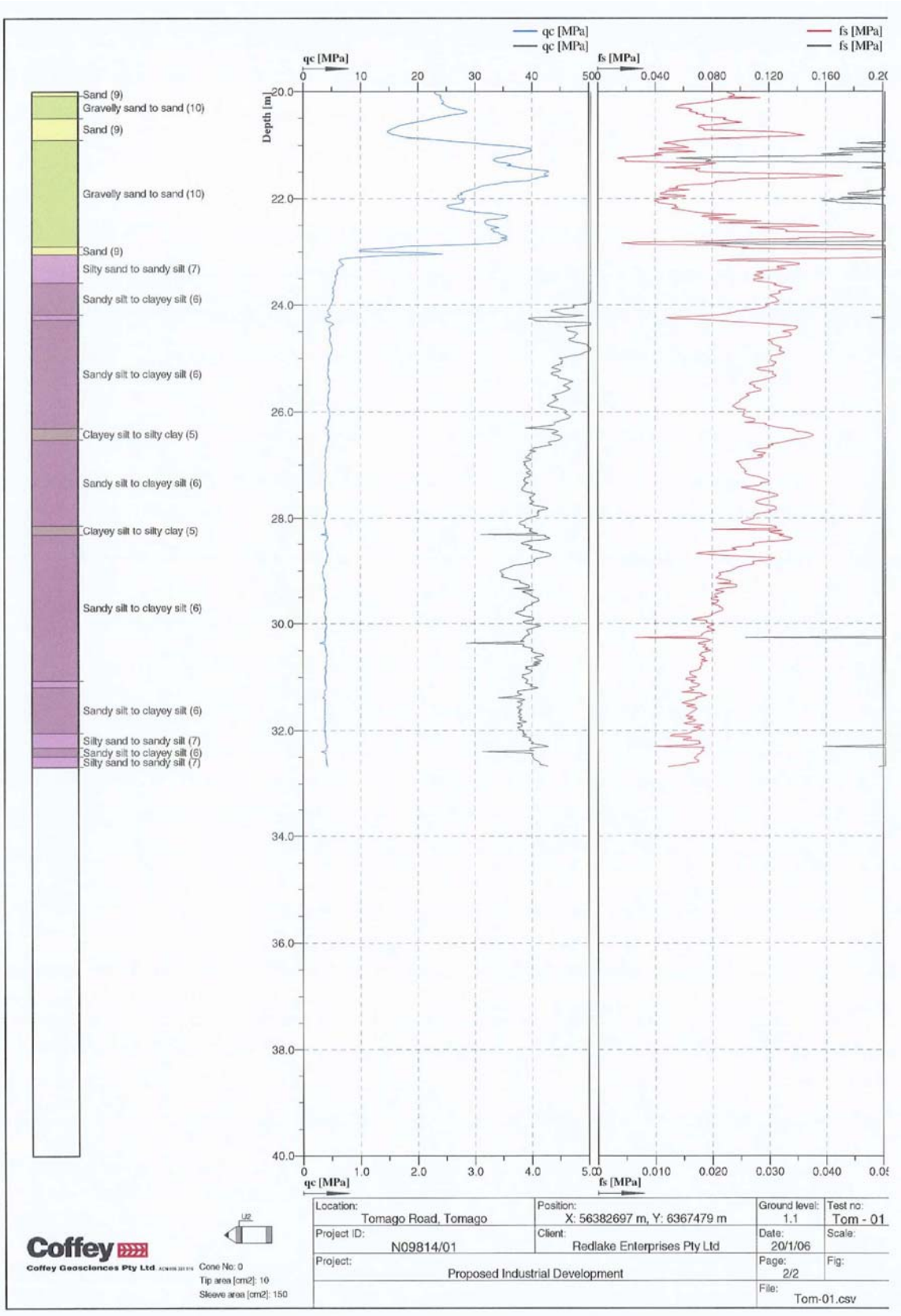

Qt []
Fr [%]
Depth [m]
9.195
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty clay to clay (4)
Sensitive fine grained (1)
Sand (9)
Silty sand to sandy silt (7)
Sand (9)
Sand to silty sand (8)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383396.75 m, Y: 6366861.51 m
Ground level: 0.2
Test no: CPT - 31
Project ID: N09814/01
Client: Redlake Development Pty Ltd
Date: 23/4/06
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: cpt31.csv

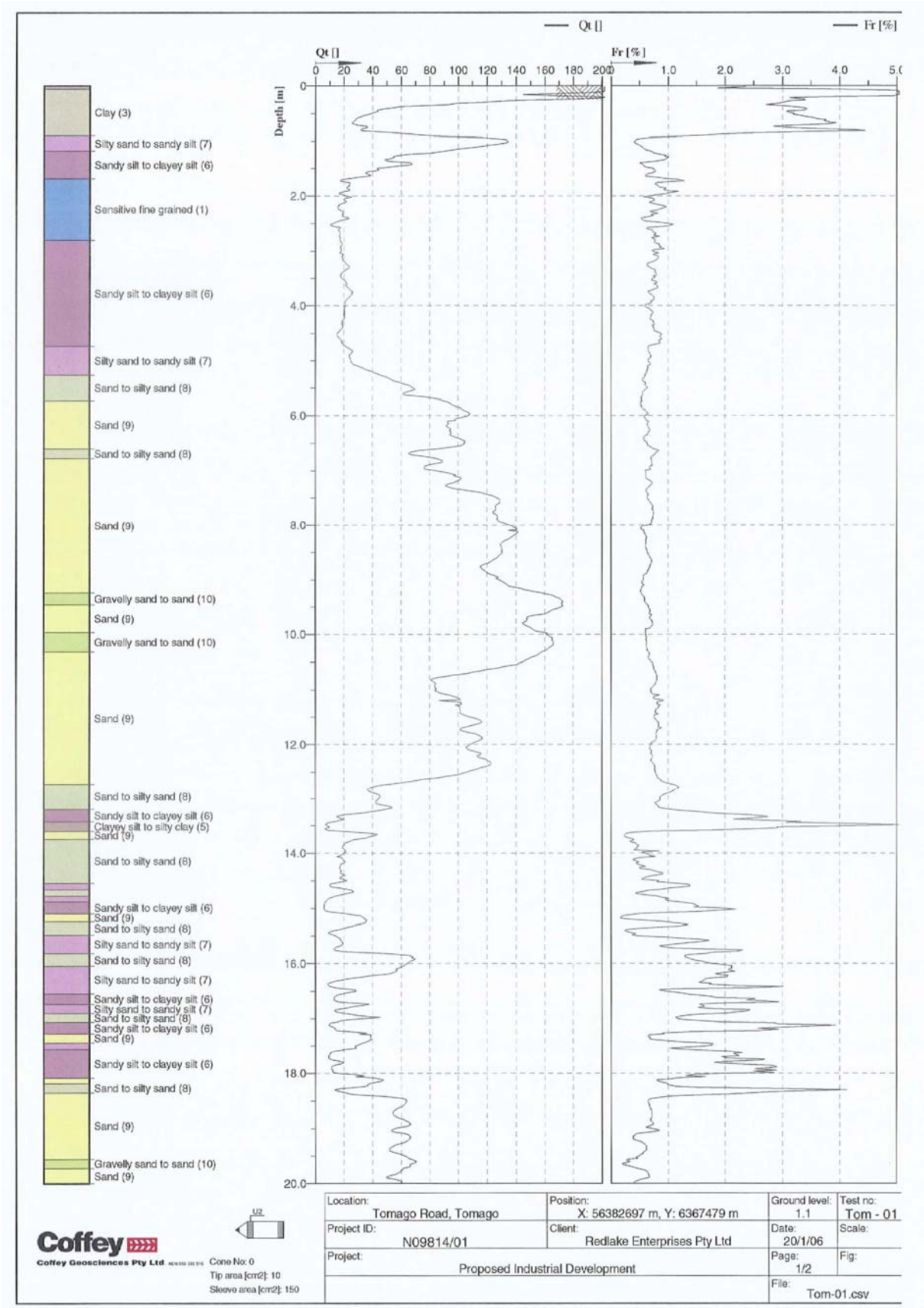

Qt []
Fr [%]
Depth [m]
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Sand (9)
Clay (3)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Clay (3)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383396.75 m, Y: 6366861.51 m
Ground level: 0.2
Test no: CPT - 31
Project ID: N09814/01
Client: Redlake Development Pty Ltd
Date: 23/4/06
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: cpt31.csv

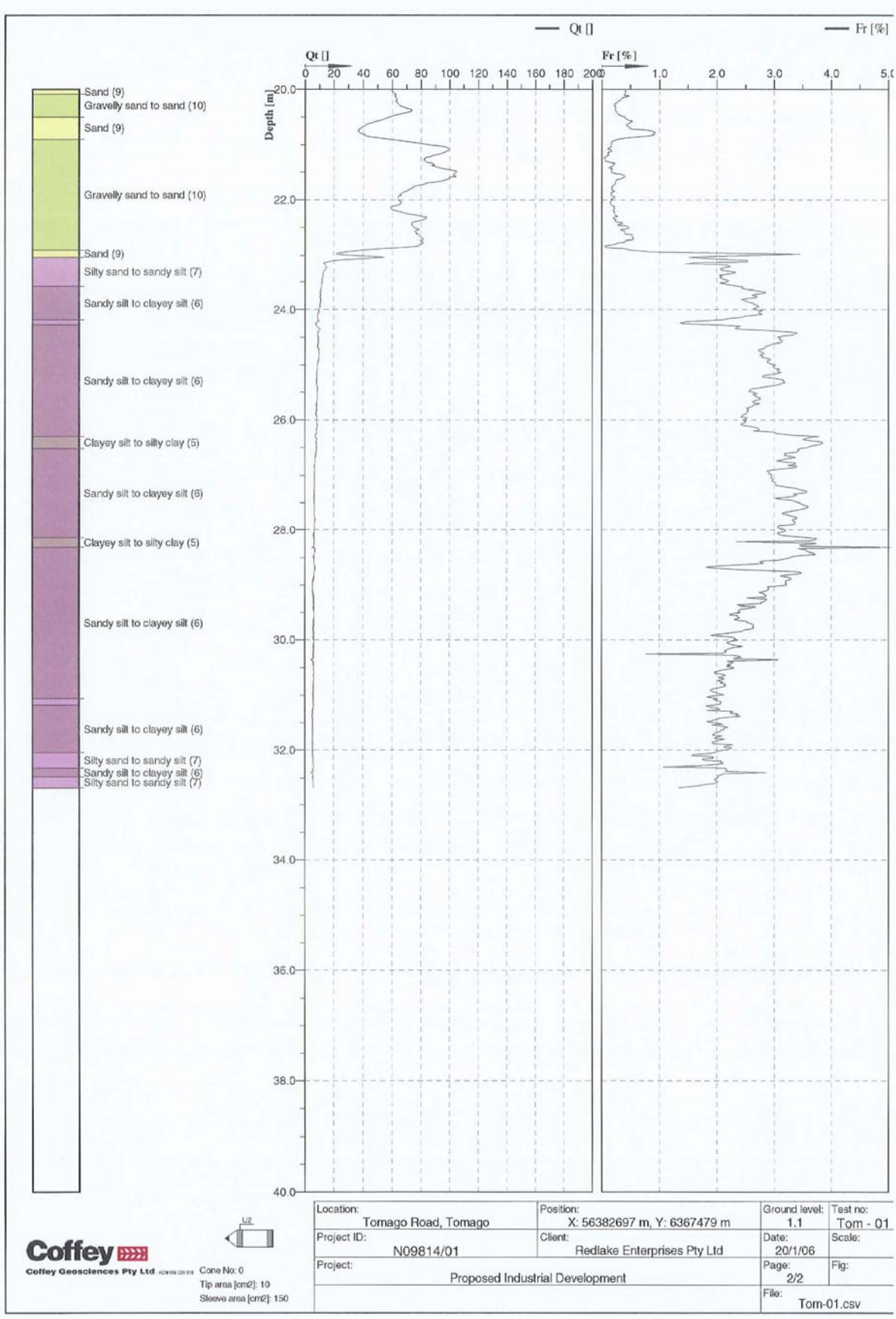

qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Clay (3)
Organic material (2)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Sensitive fine grained (1)
Clay (3)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty clay to clay (4)
Sensitive fine grained (1)
Sand (9)
Silty sand to sandy silt (7)
Sand (9)
Sand to silty sand (8)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383396.75 m, Y: 6366861.51 m
Ground level: 0.2
Test no: CPT - 31
Project ID: N09814/01
Client: Redlake Development Pty Ltd
Date: 23/4/06
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: cpt31.csv

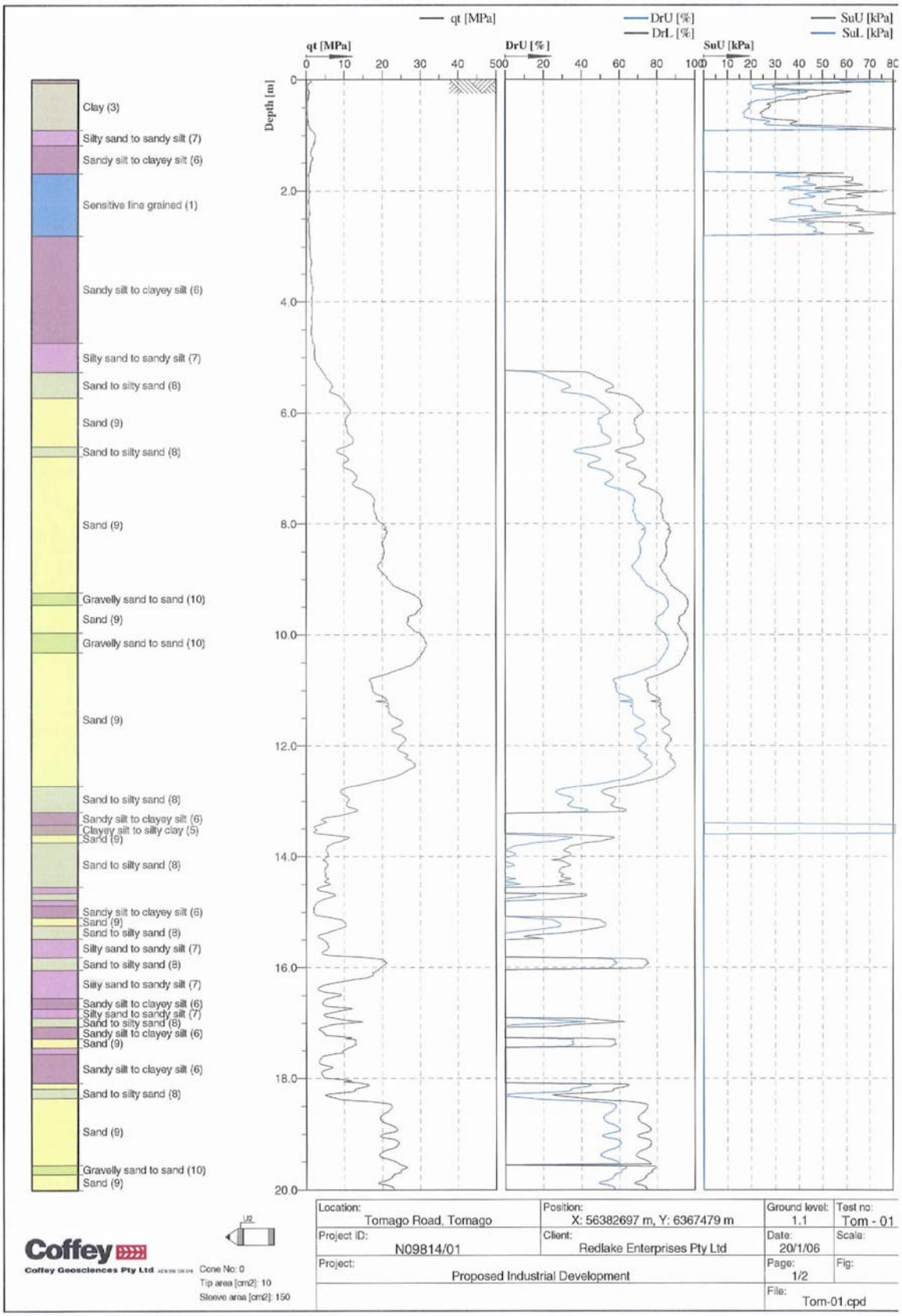

qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Sand (9)
Clay (3)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sandy silt to clayey silt (6)
Clay (3)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383396.75 m, Y: 6366861.51 m
Ground level: 0.2
Test no: CPT - 31
Project ID: N09814/01
Client: Redlake Development Pty Ltd
Date: 23/4/06
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: cpt31.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sand (9)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Sand (9)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382697 m, Y: 6367479 m
Ground level: 1.1
Test no: Tom - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/06
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: Tom-01.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382697 m, Y: 6367479 m
Ground level: 1.1
Test no: Tom - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/06
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: Tom-01.csv


Qt []
Fr [%]
Depth [m]
Clay (3)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sand (9)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Sand (9)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382697 m, Y: 6367479 m
Ground level: 1.1
Test no: Tom - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/06
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: Tom-01.csv


Qt []
Fr [%]
Depth [m]
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382697 m, Y: 6367479 m
Ground level: 1.1
Test no: Tom - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/06
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: Tom-01.csv

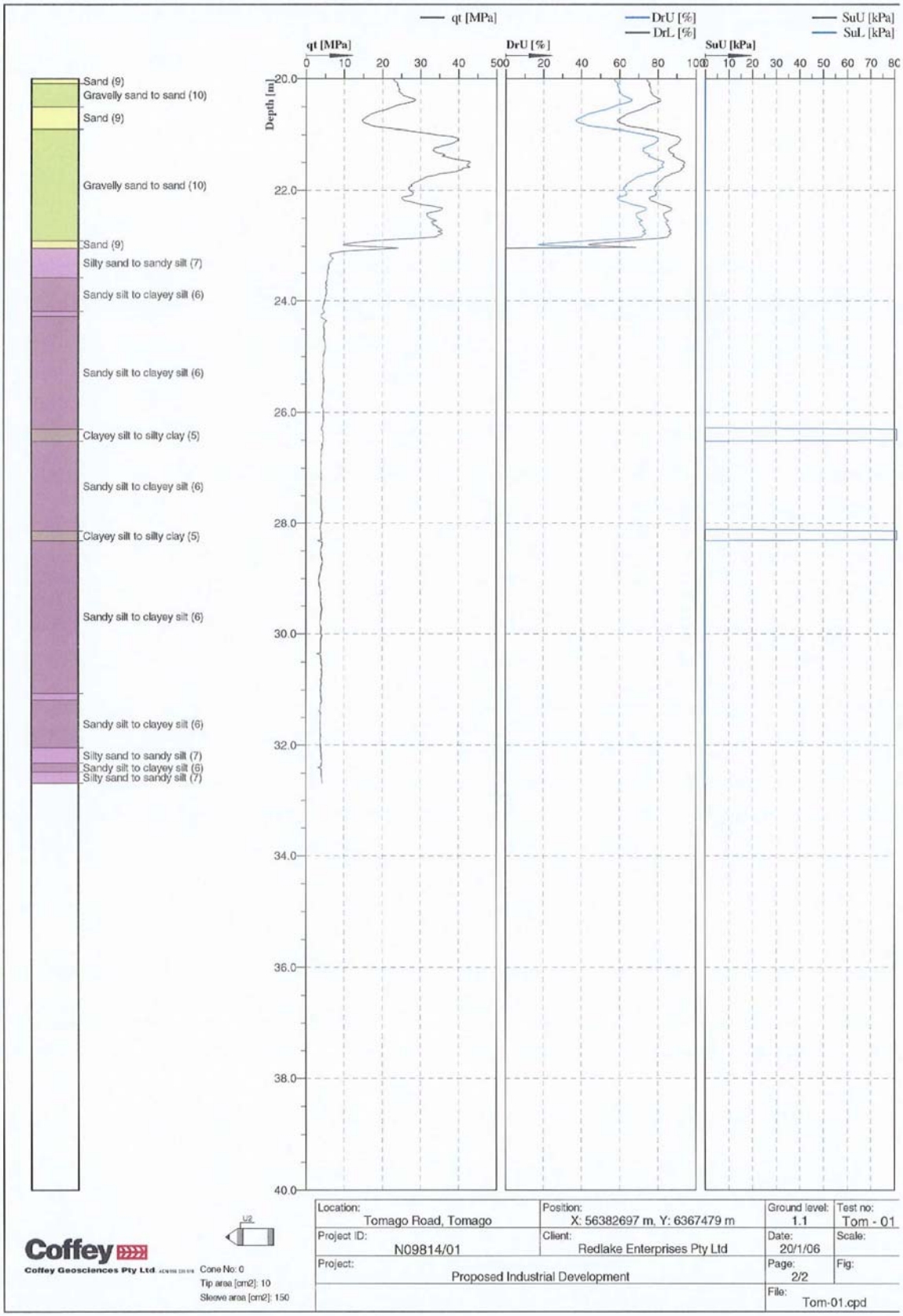


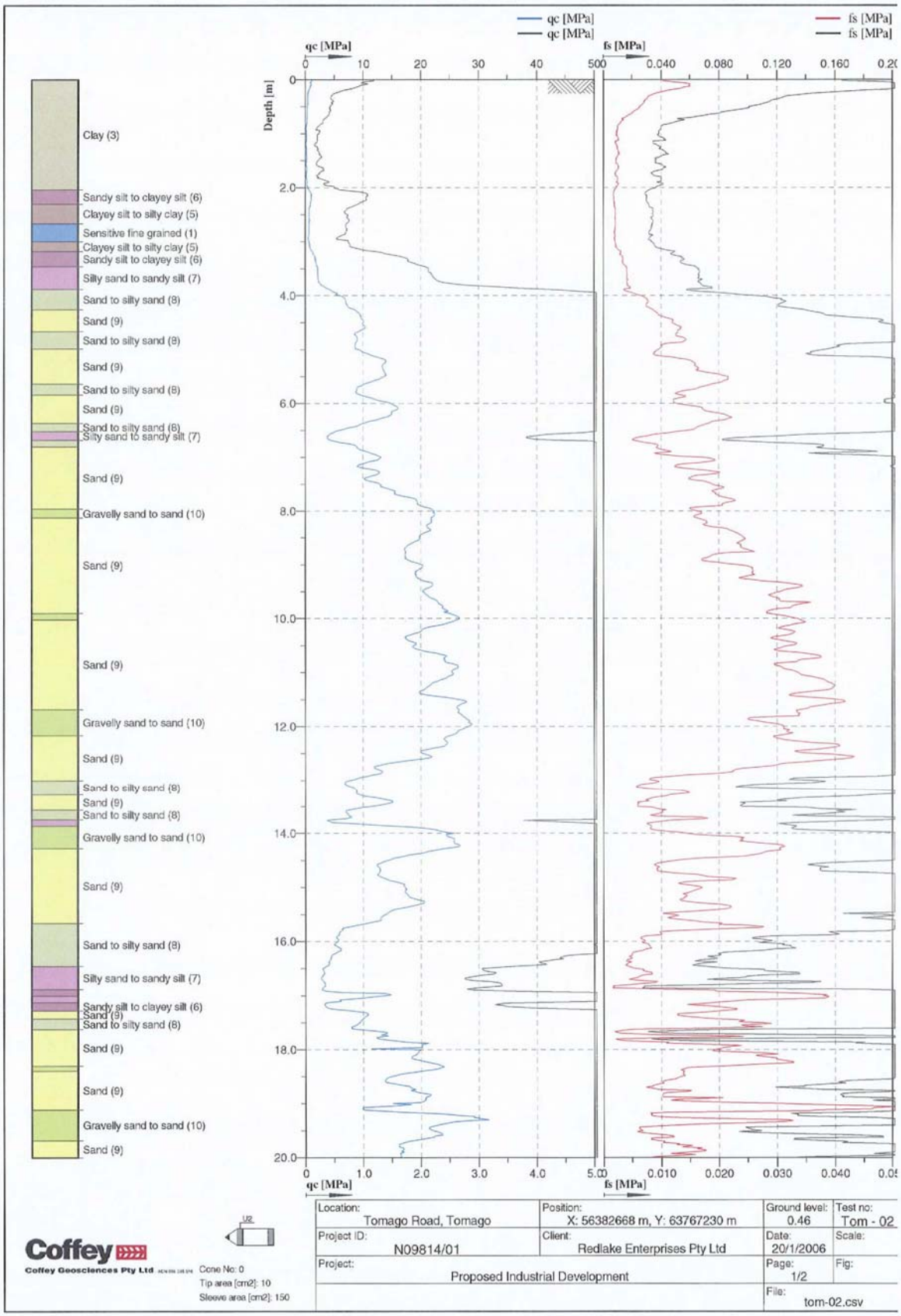
Location: Tomago Road, Tomago	Position: X: 56382697 m, Y: 6367479 m	Ground level: 1.1	Test no: Tom - 01
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/1/06	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: Tom-01.cpd	

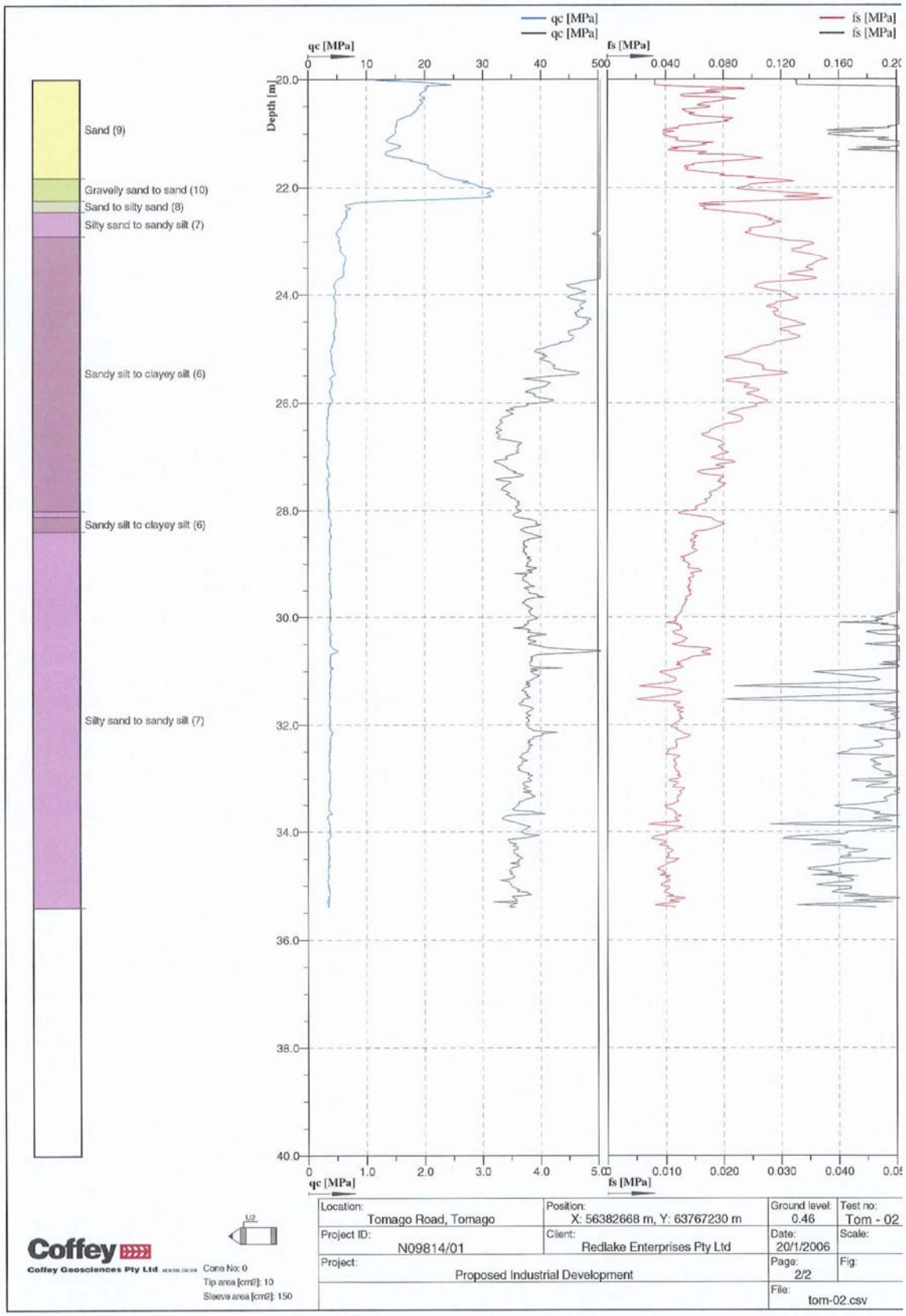
Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382697 m, Y: 6367479 m
Ground level: 1.1
Test no: Tom - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/06
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: Tom-01.cpd


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sensitive fine grained (1)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Location: Tomago Road, Tomago
Position: X: 56382668 m, Y: 63767230 m
Ground level: 0.46
Test no: Tom - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: tom-02.csv
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

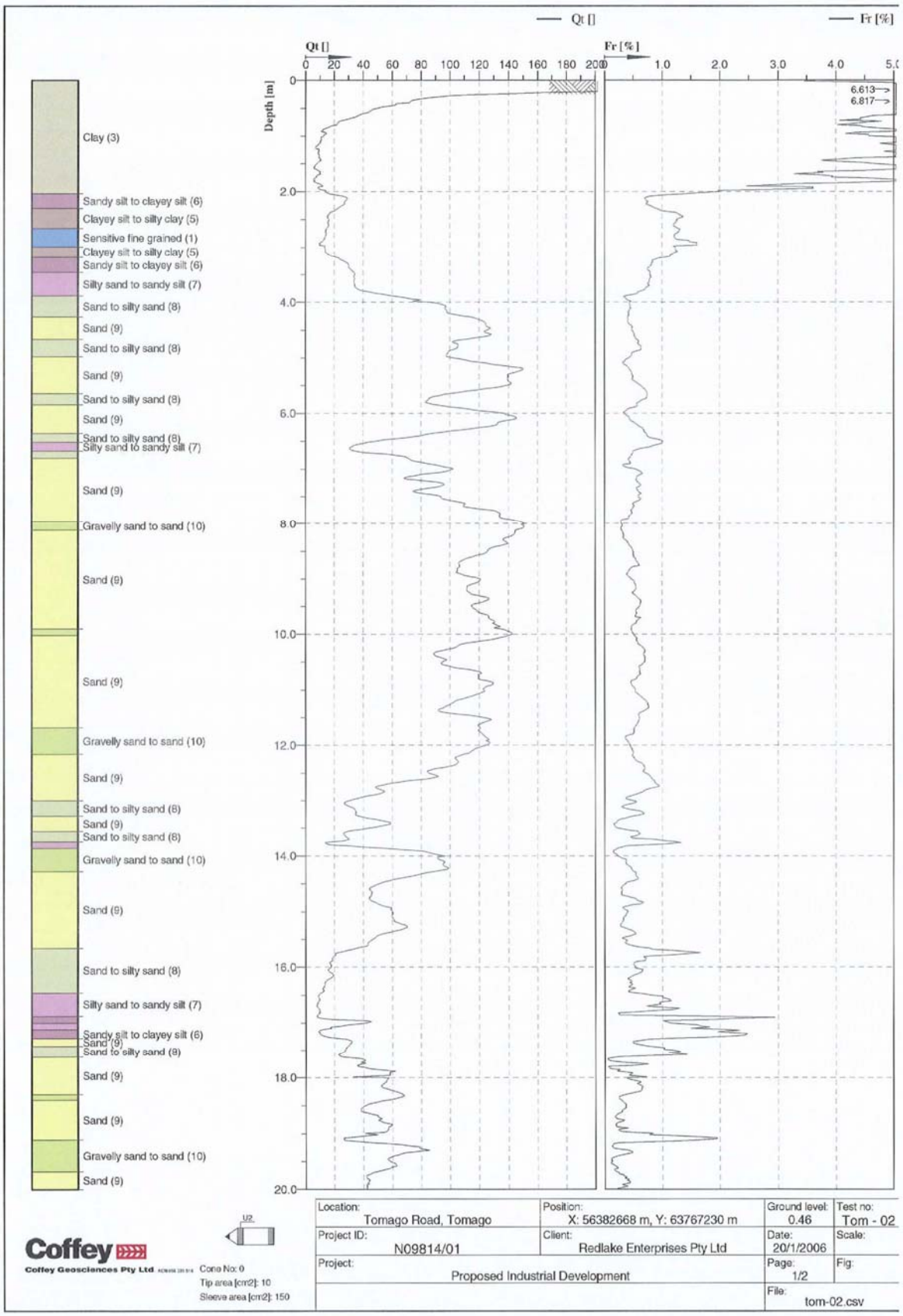


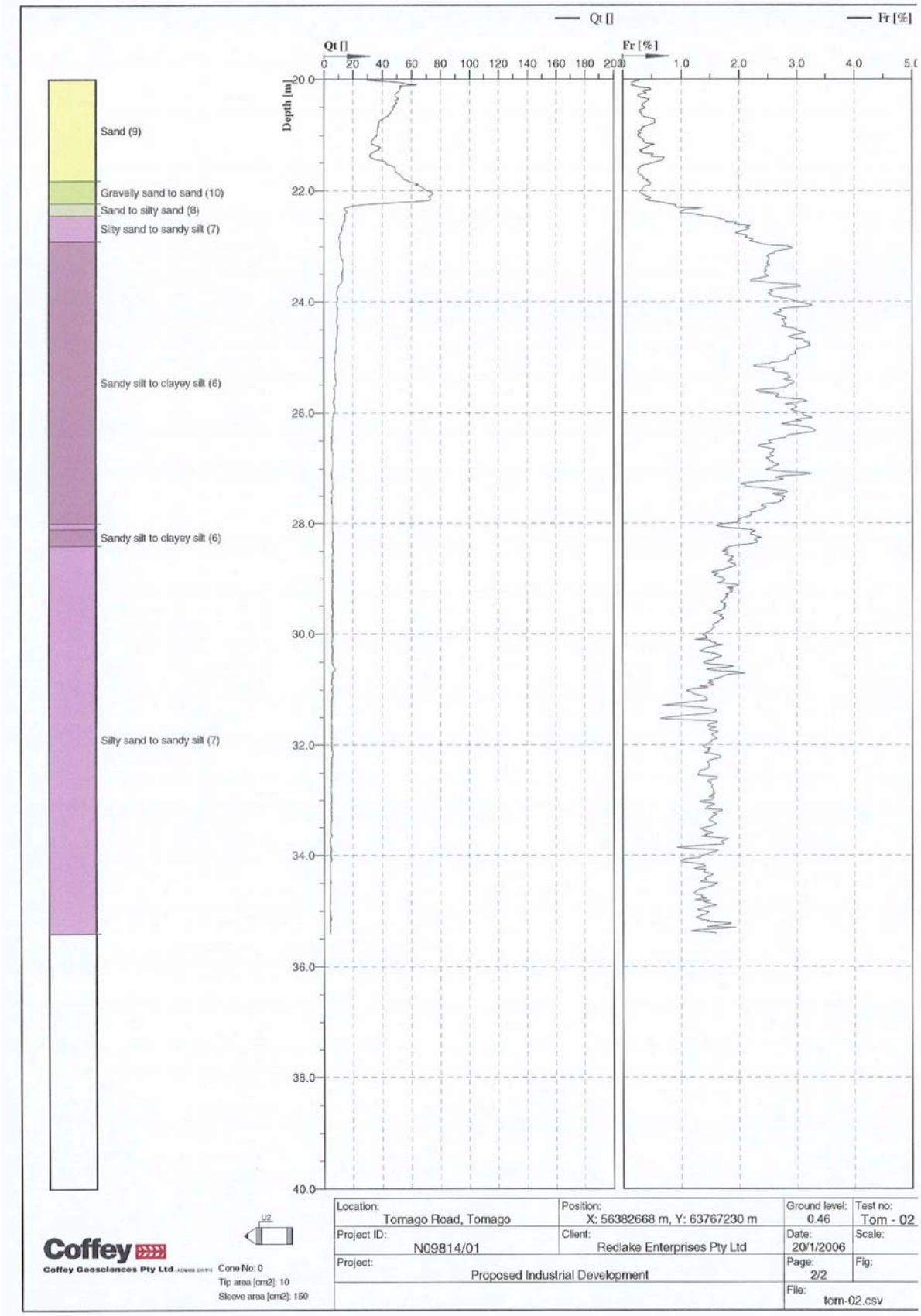
Location: Tomago Road, Tomago	Position: X: 56382668 m, Y: 63767230 m	Ground level: 0.46	Test no: Tom - 02
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/1/2006	Scale:
Project: Proposed Industrial Development		Page: 2/2	Fig:
		File: tom-02.csv	

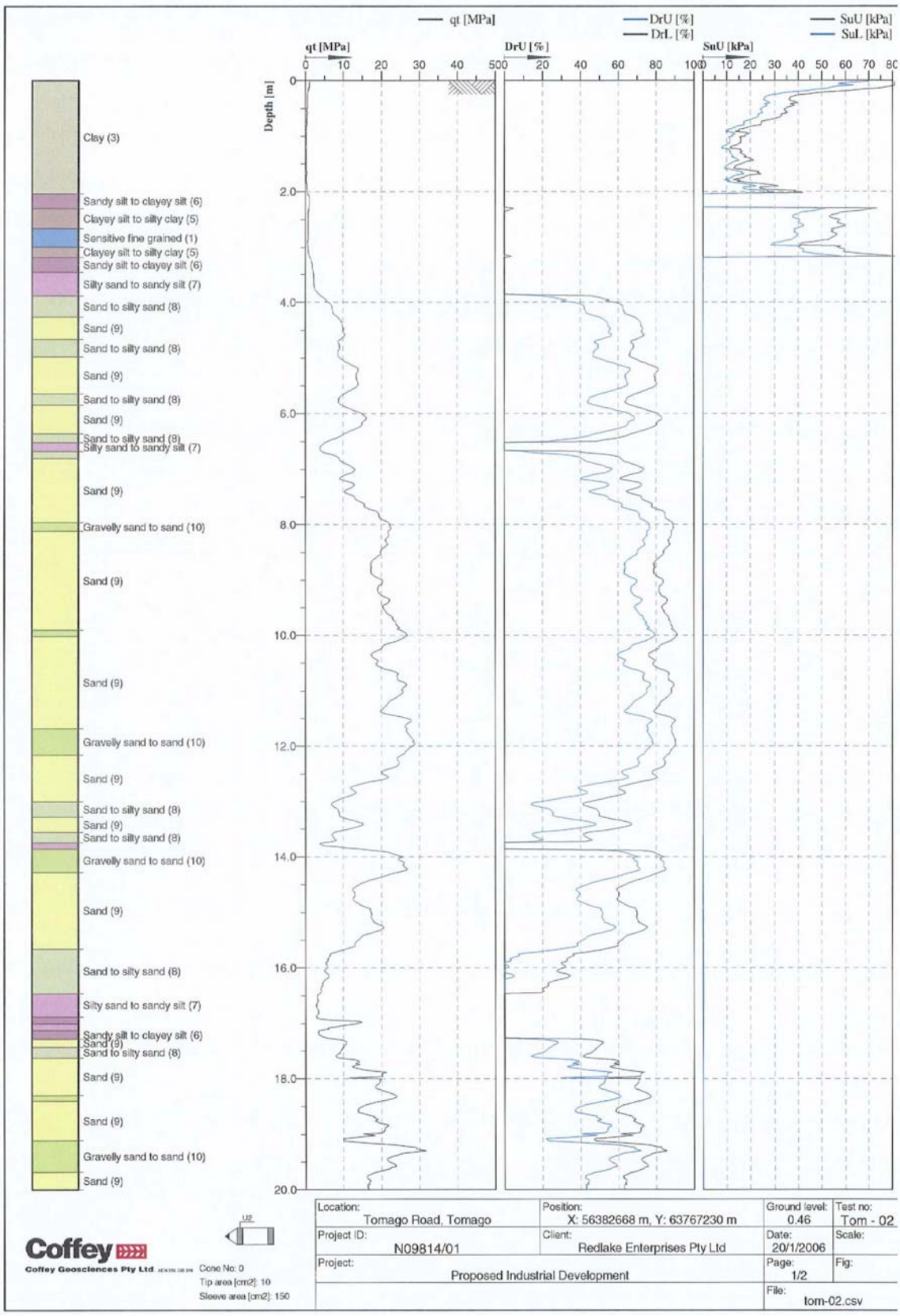
Coffey

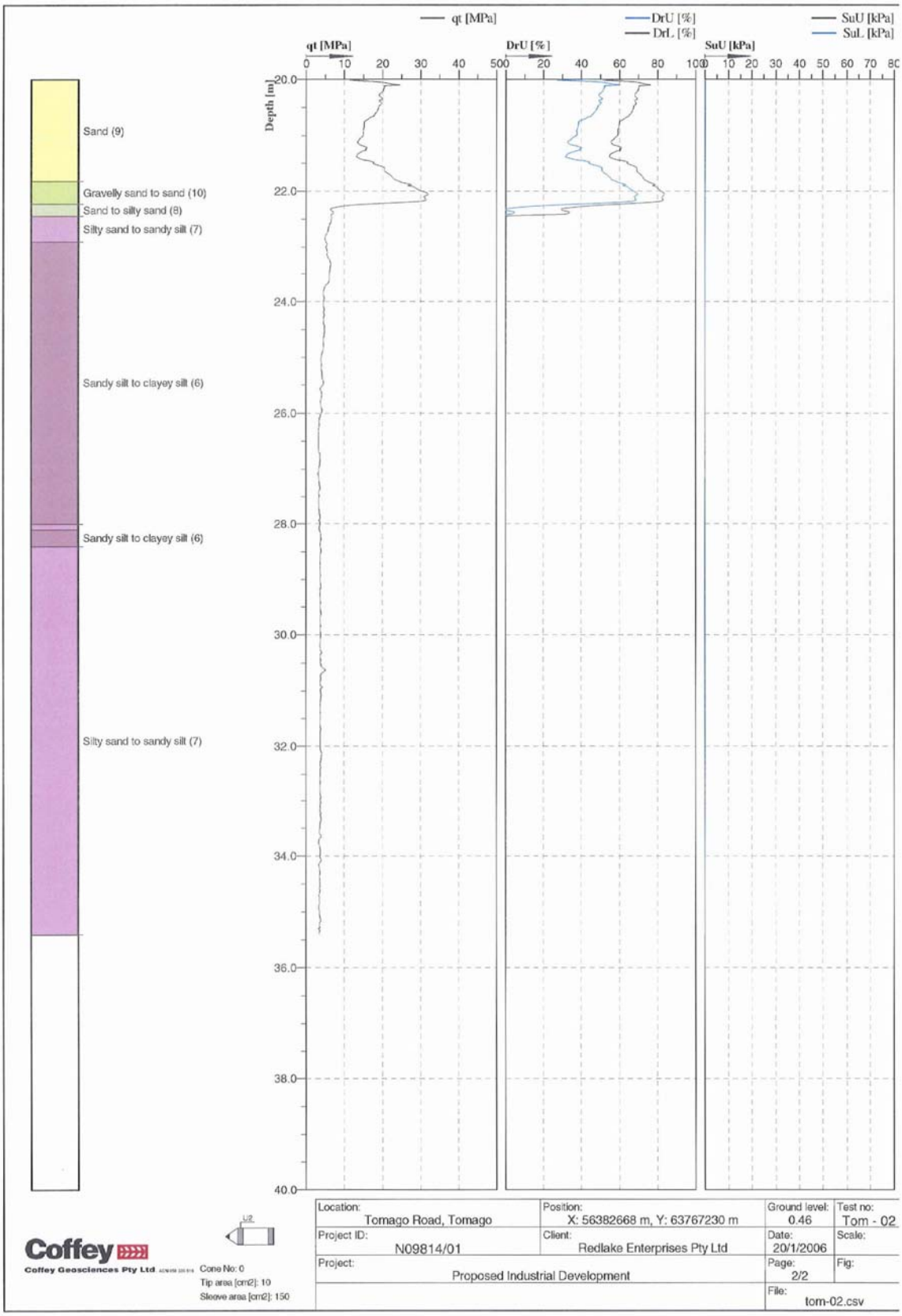
Coffey Geosciences Pty Ltd

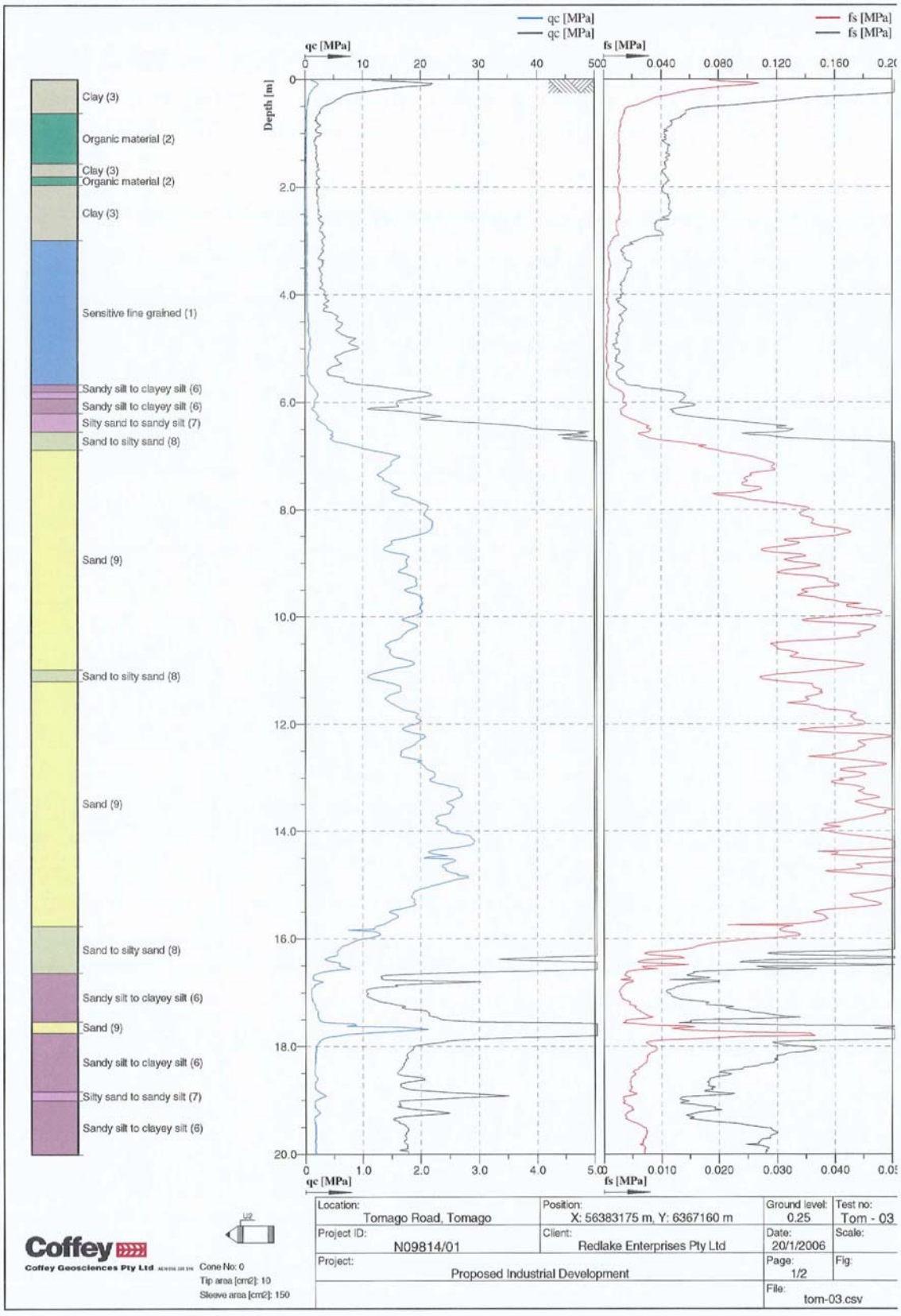
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

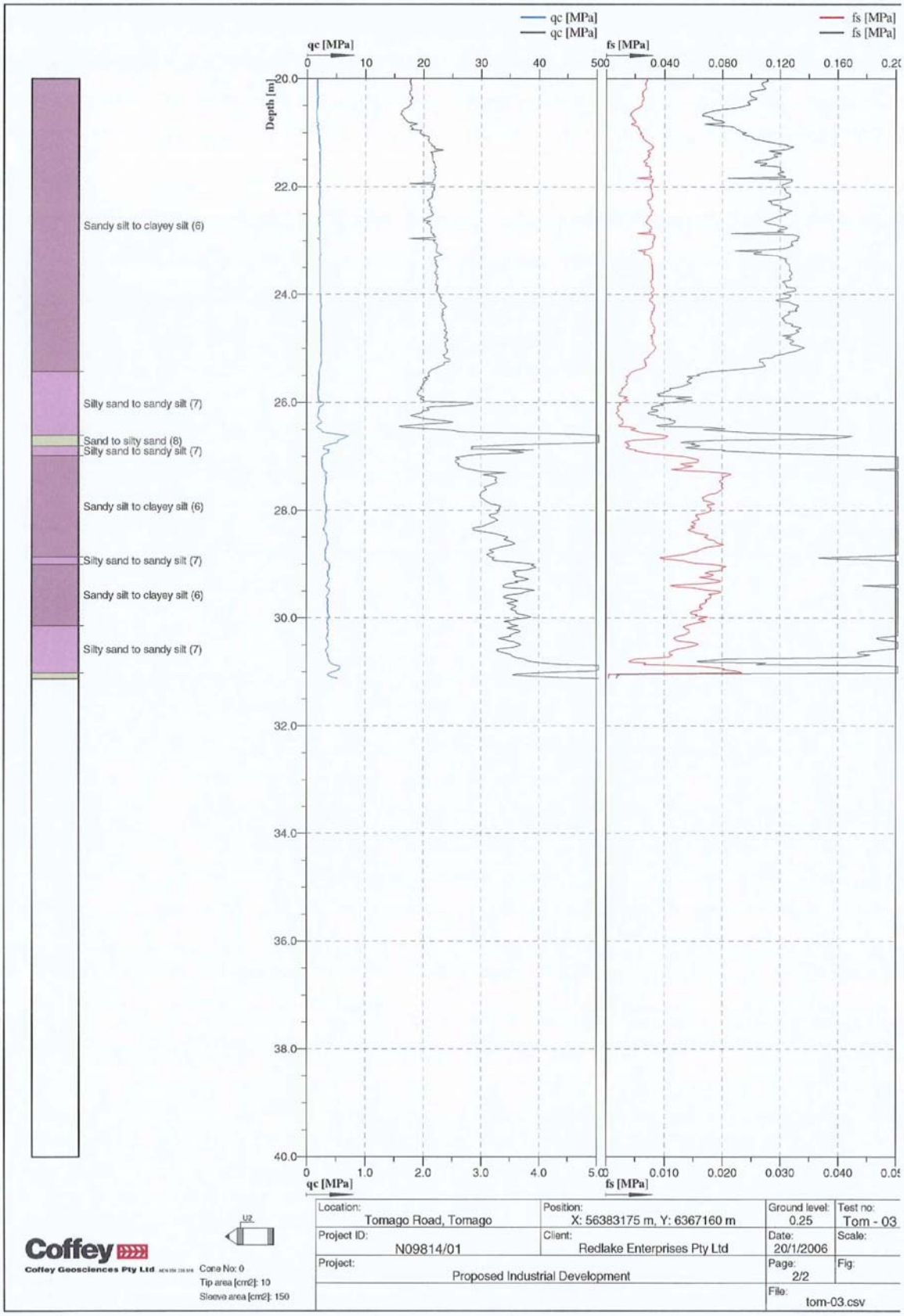

Qt []
Fr [%]
Qt []
Fr [%]
Depth [m]
6.613
6.817
Clay (3)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sensitive fine grained (1)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382668 m, Y: 63767230 m
Ground level: 0.46
Test no: Tom - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: tom-02.csv

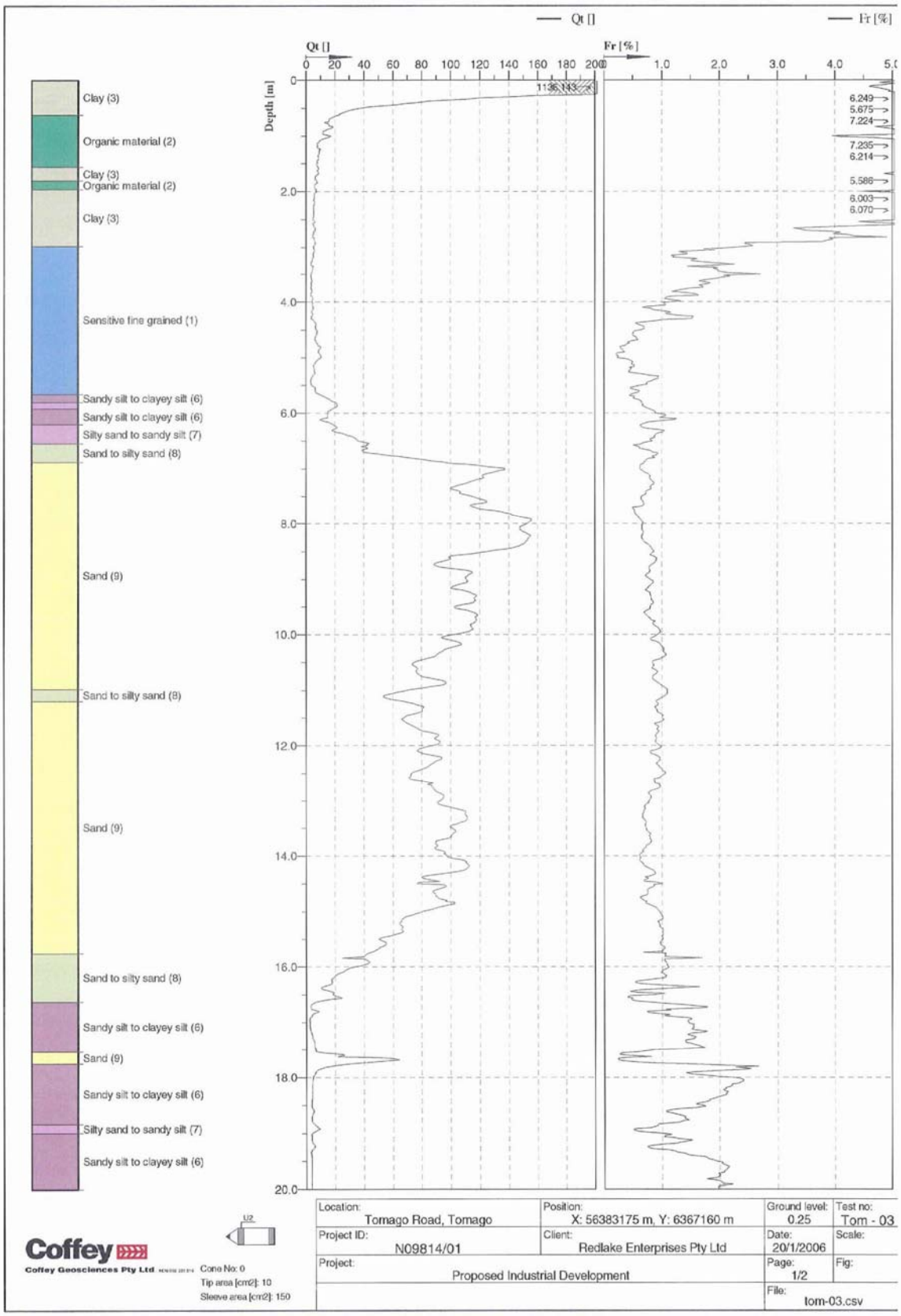

Qt []
Fr [%]
Depth [m]
Sand (9)
Gravelly sand to sand (10)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Location: Tomago Road, Tomago
Position: X: 56382668 m, Y: 63767230 m
Ground level: 0.46
Test no: Tom - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: tom-02.csv
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
qt [MPa]
DrU [%]
SuU [kPa]
Depth [m]
Clay (3)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sensitive fine grained (1)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382668 m, Y: 63767230 m
Ground level: 0.46
Test no: Tom - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: tom-02.csv


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
qt [MPa]
DrU [%]
SuU [kPa]
Depth [m]
Sand (9)
Gravelly sand to sand (10)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56382668 m, Y: 63767230 m
Ground level: 0.46
Test no: Tom - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: tom-02.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Organic material (2)
Clay (3)
Organic material (2)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Sand (9)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383175 m, Y: 6367160 m
Ground level: 0.25
Test no: Tom - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/2
Fig:
File: tom-03.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383175 m, Y: 6367160 m
Ground level: 0.25
Test no: Tom - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: tom-03.csv



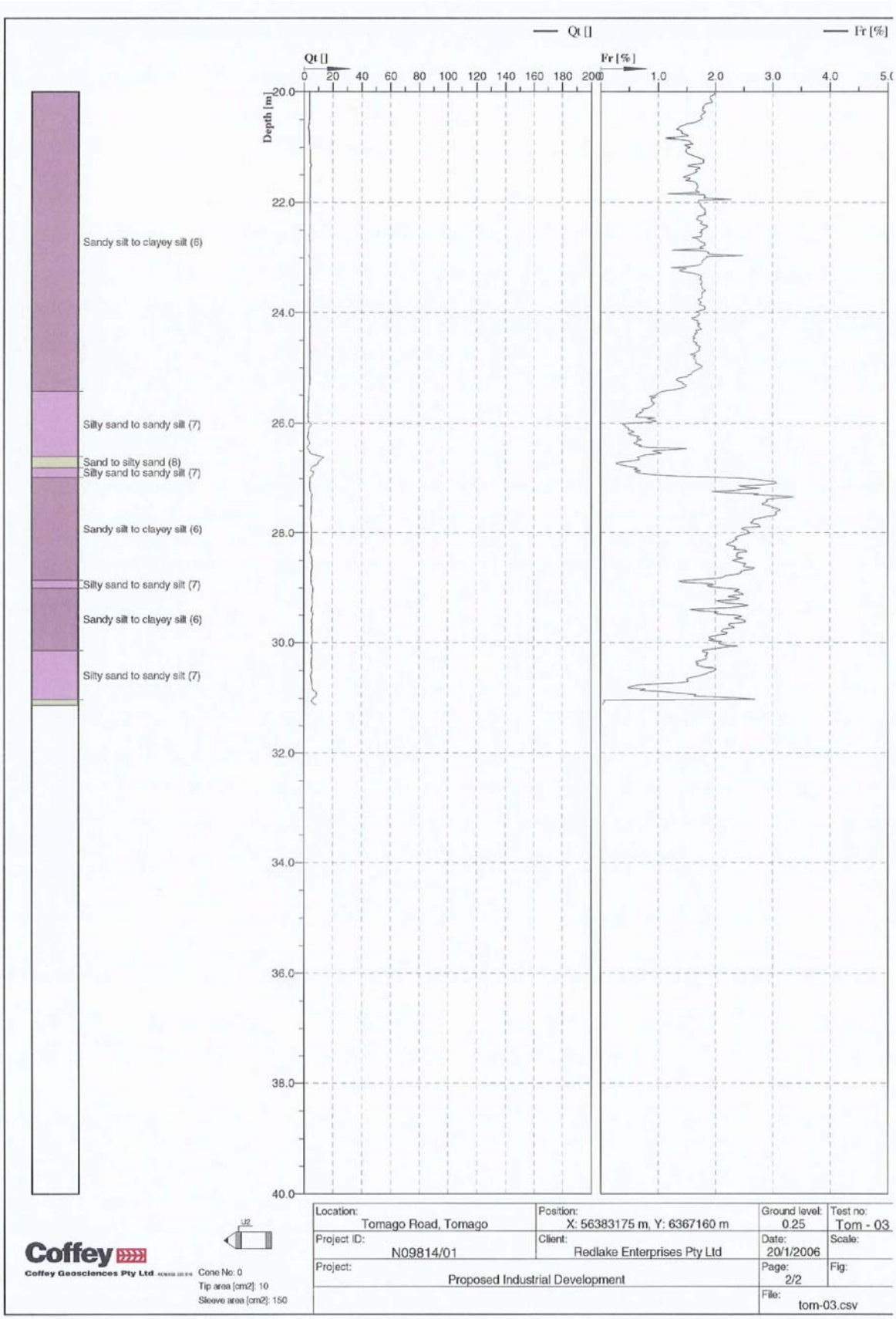
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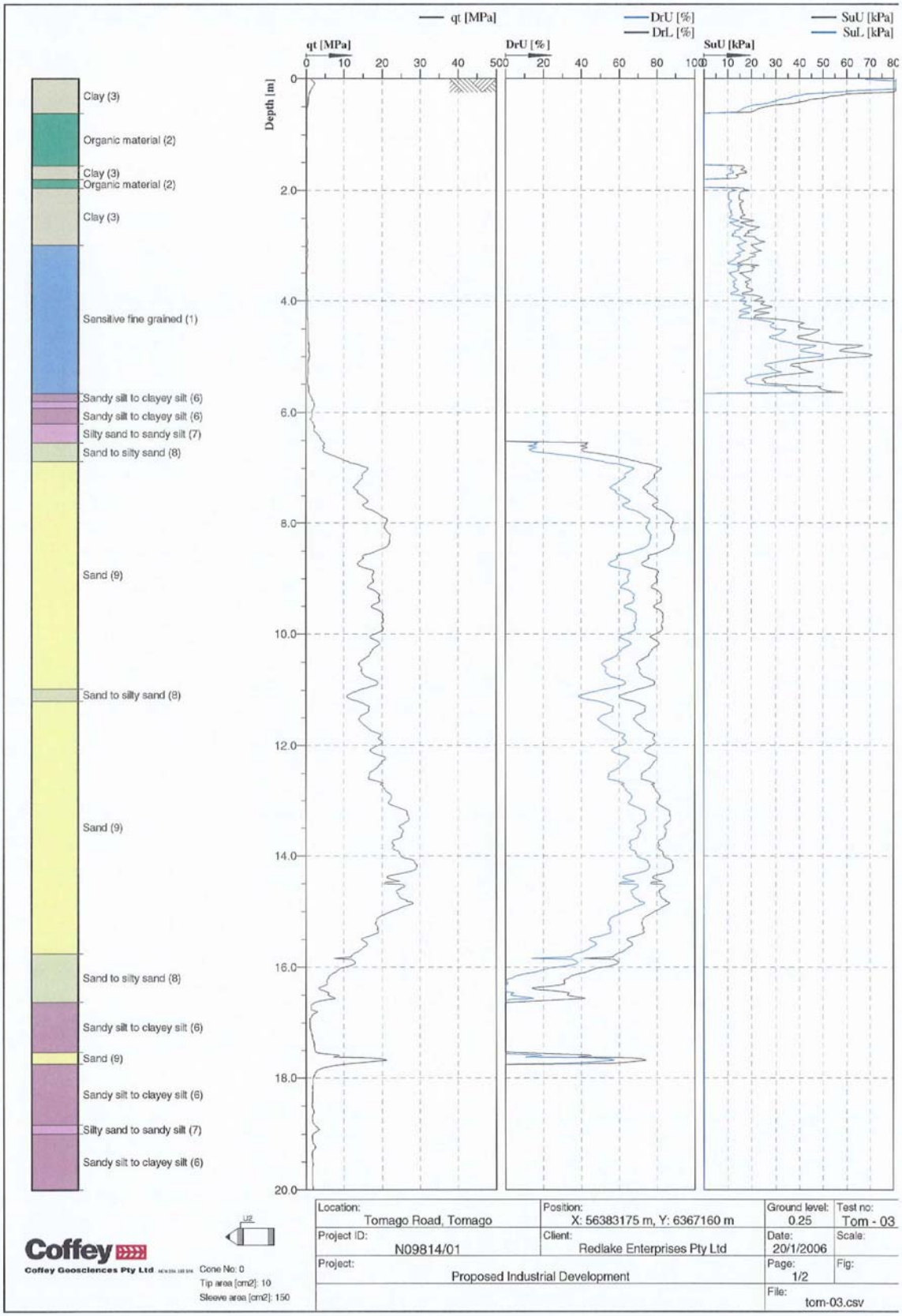
Coffey Geosciences Pty Ltd

U2

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383175 m, Y: 6367160 m	Ground level: 0.25	Test no: Tom - 03
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/1/2006	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: tom-03.csv	

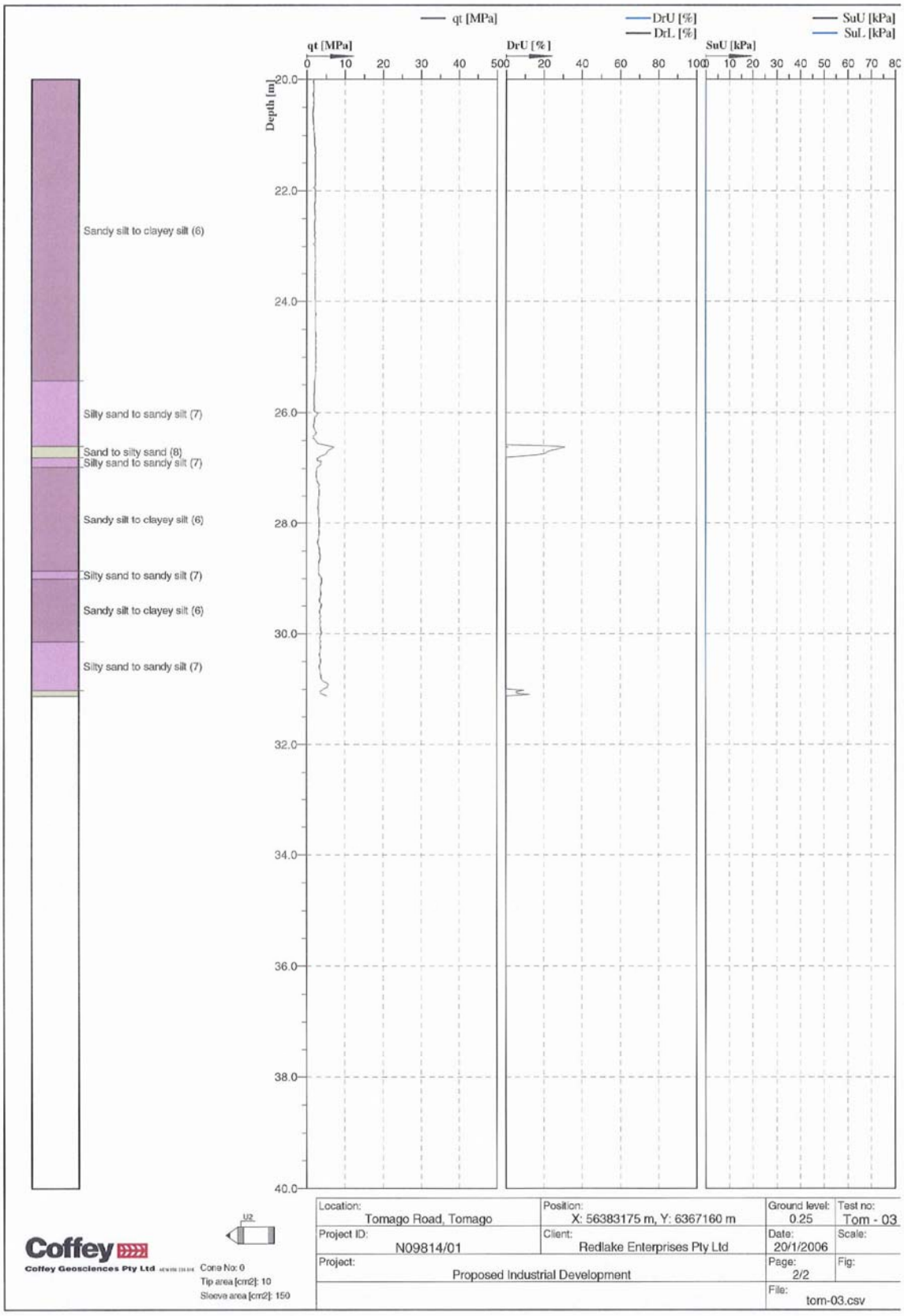

Qt []
Fr [%]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383175 m, Y: 6367160 m
Ground level: 0.25
Test no: Tom - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 20/1/2006
Scale:
Project: Proposed Industrial Development
Page: 2/2
Fig:
File: tom-03.csv



Location: Tomago Road, Tomago	Position: X: 56383175 m, Y: 6367160 m	Ground level: 0.25	Test no: Tom - 03
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 20/1/2006	Scale:
Project: Proposed Industrial Development		Page: 1/2	Fig:
		File: tom-03.csv	

Coffey
Coffey Geosciences Pty Ltd

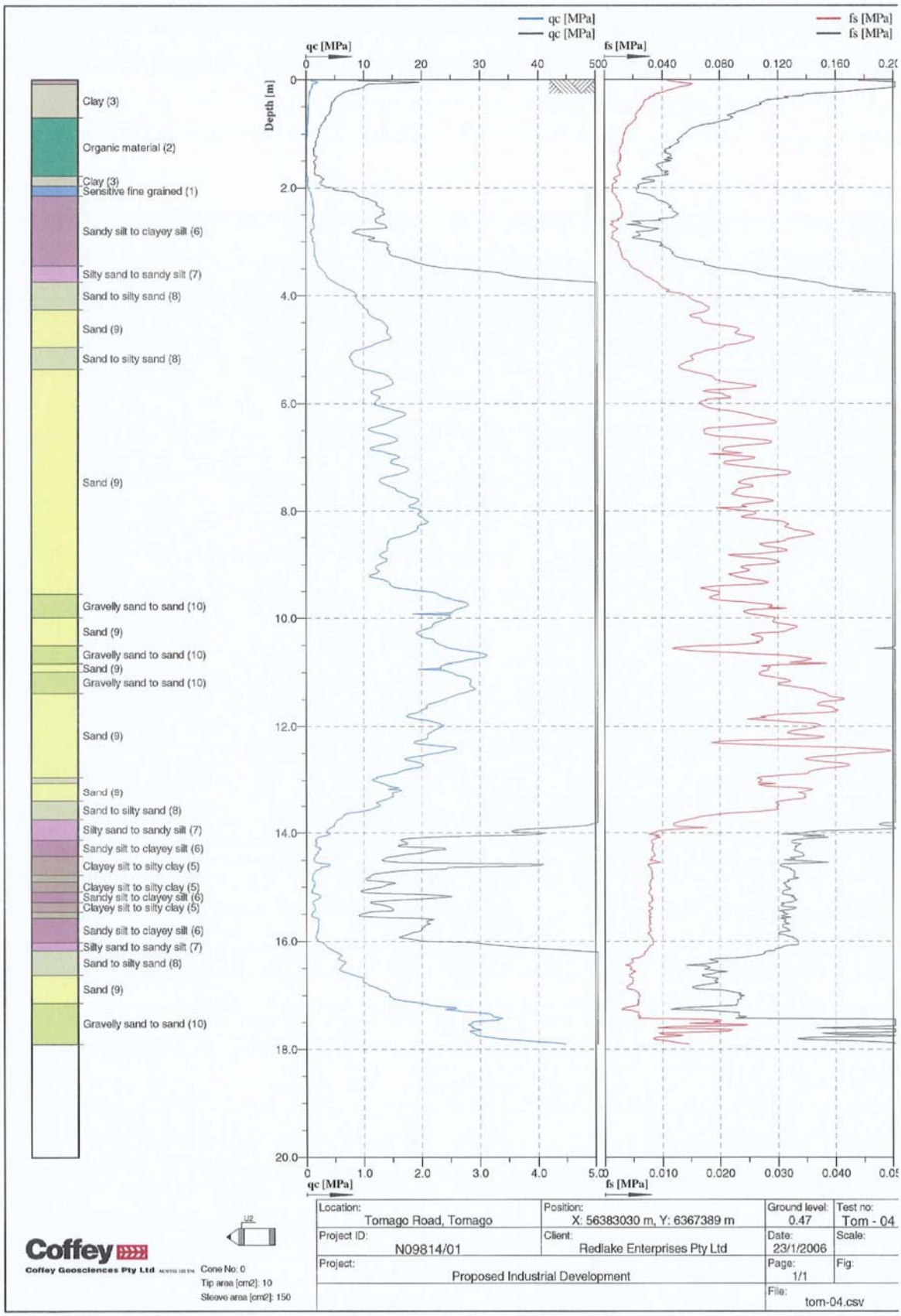
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

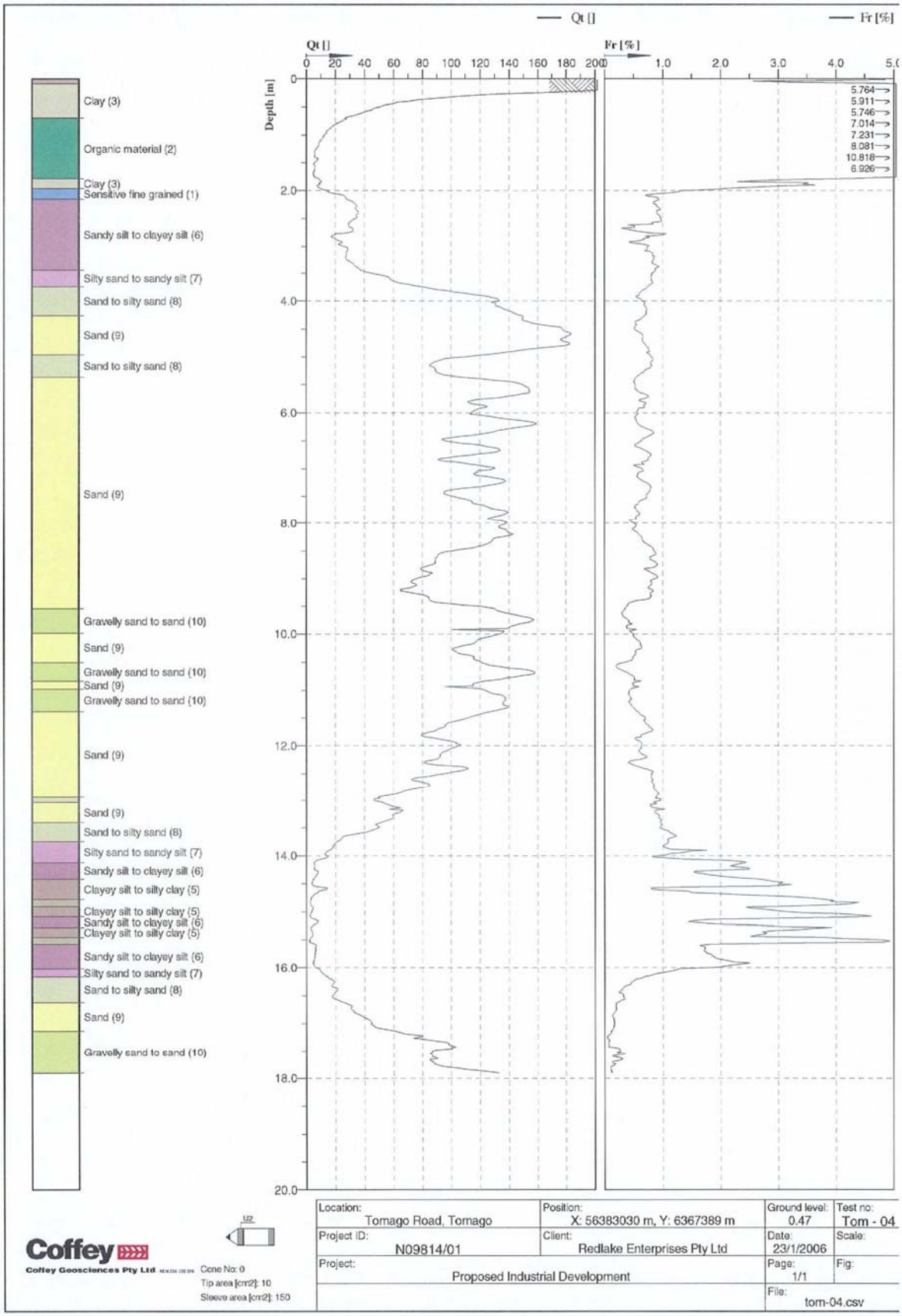


Location: Tomago Road, Tomago	Position: X: 56383175 m, Y: 6367160 m		Ground level: 0.25	Test no: Tom - 03
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd		Date: 20/1/2006	Scale:
Project: Proposed Industrial Development			Page: 2/2	Fig:
			File: tom-03.csv	

Coffey
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150


qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Organic material (2)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Location: Tomago Road, Tomago
Position: X: 56383030 m, Y: 6367389 m
Ground level: 0.47
Test no: Tom - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: tom-04.csv
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

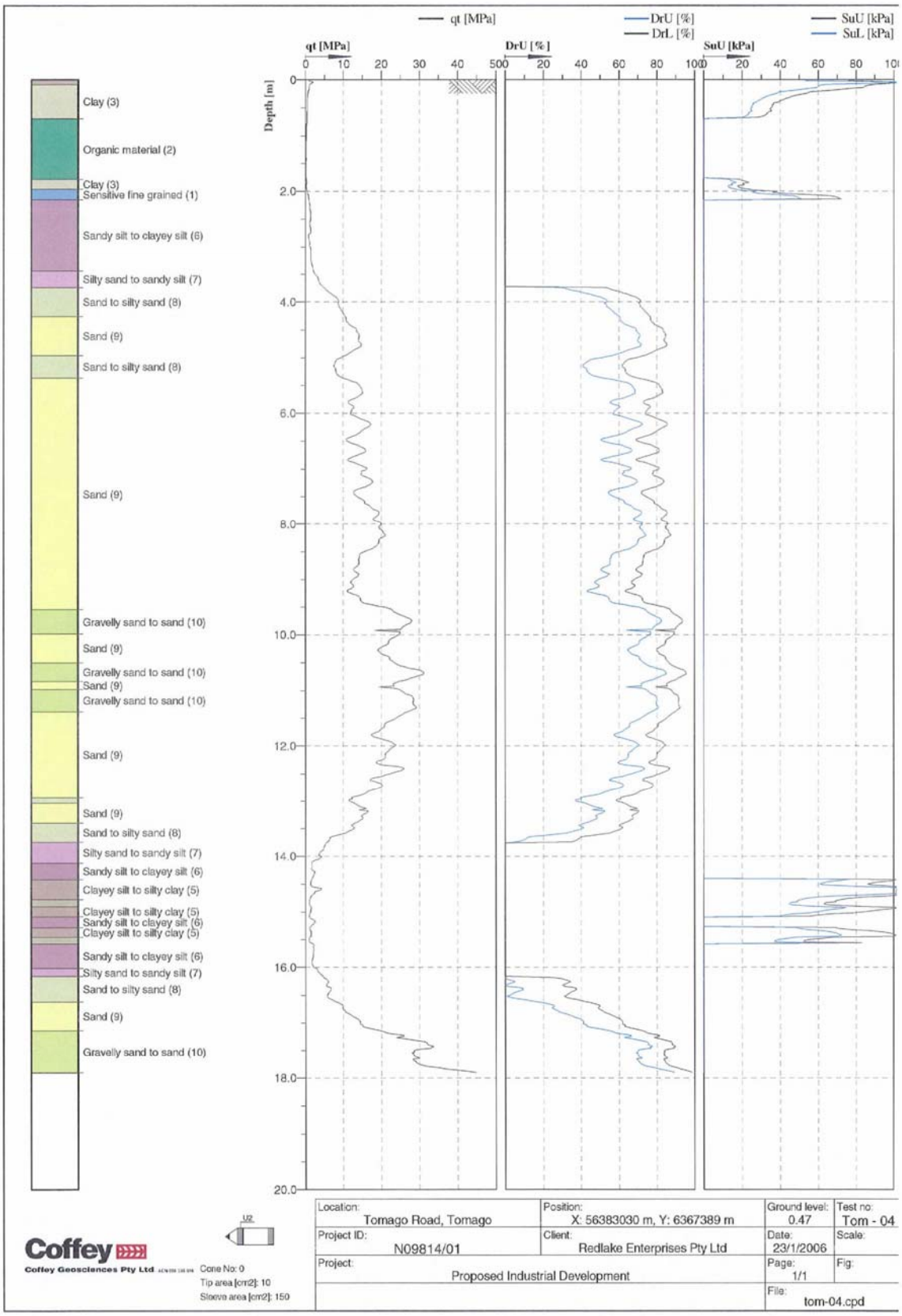


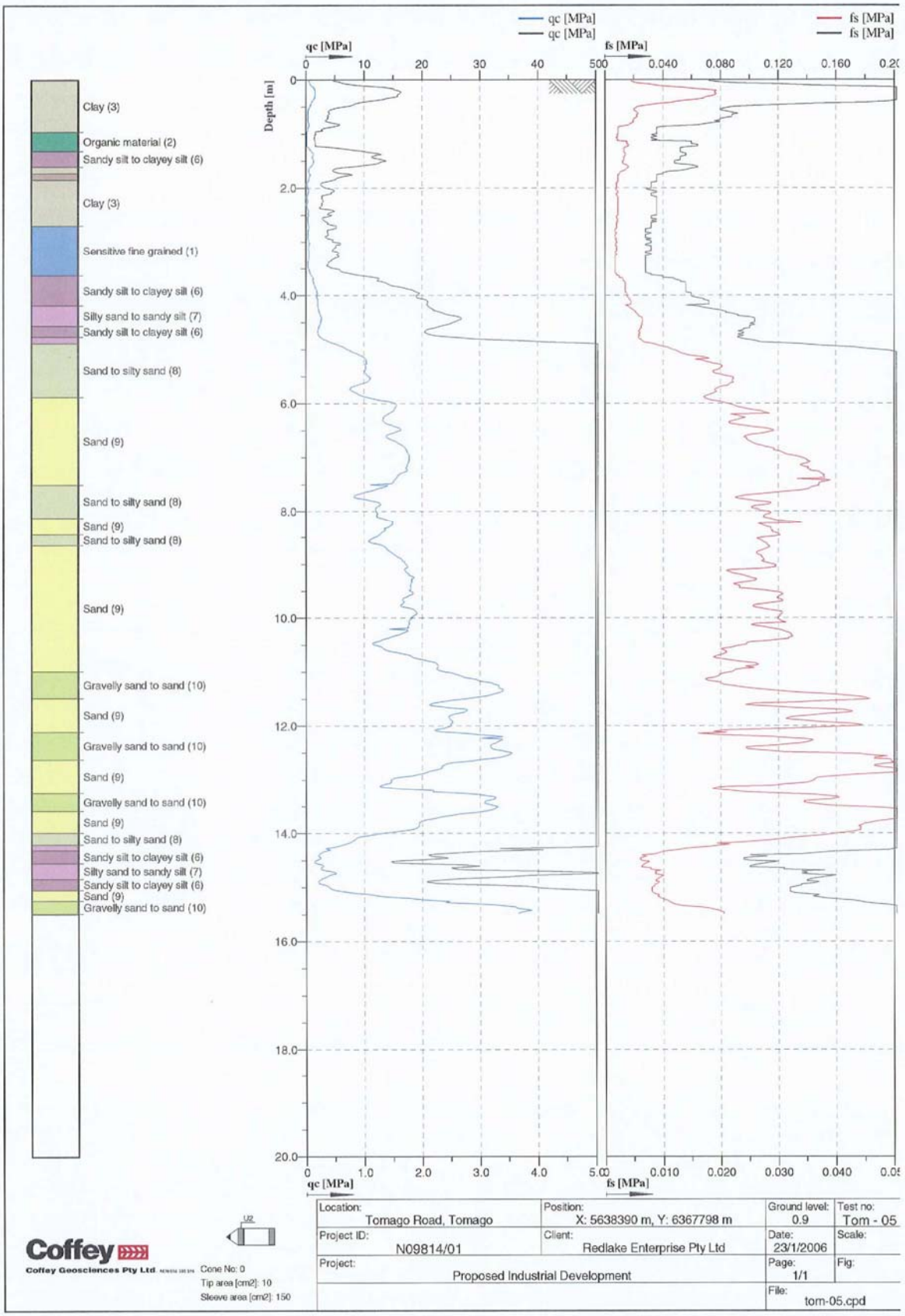
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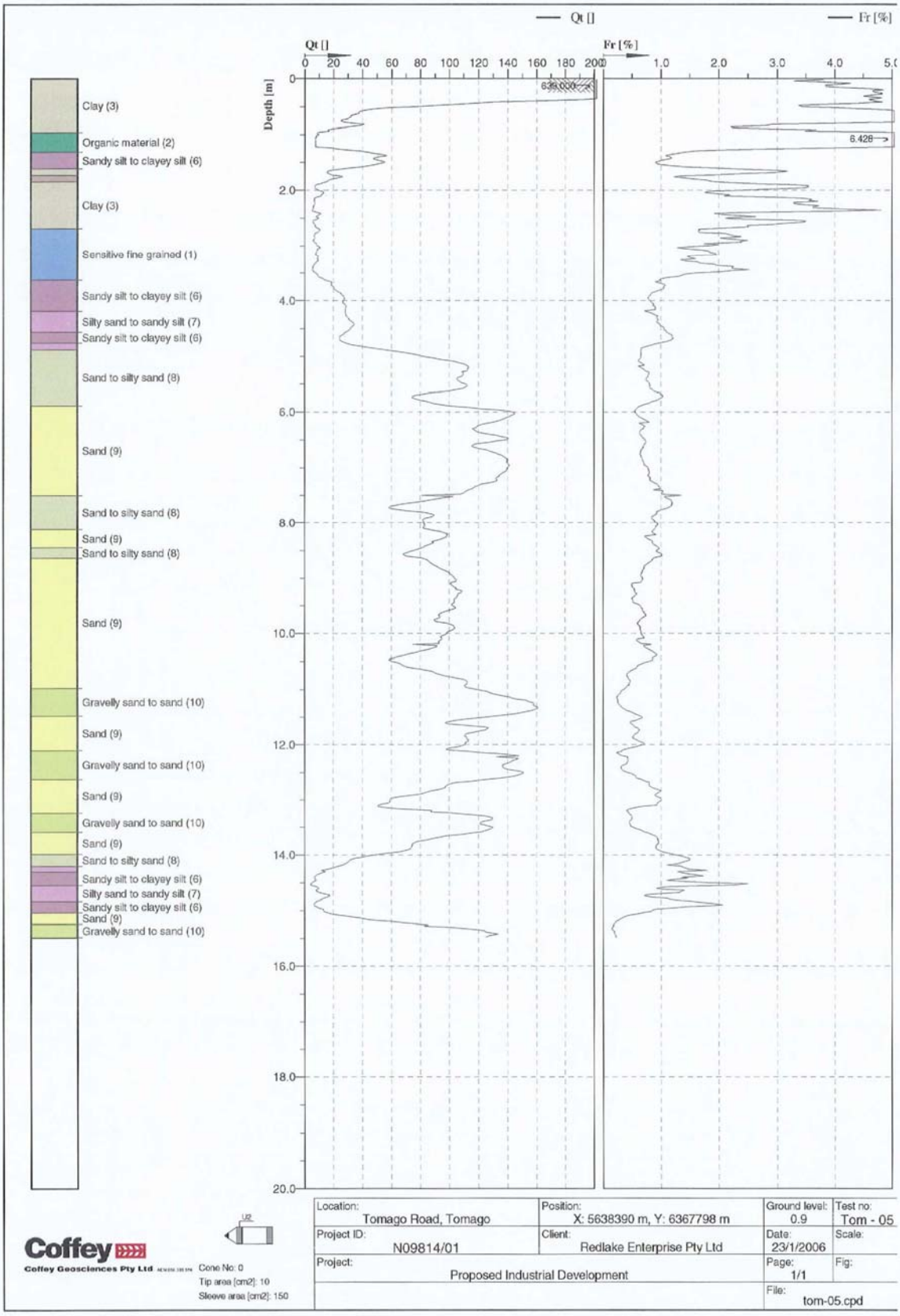
Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383030 m, Y: 6367389 m	Ground level: 0.47	Test no: Tom - 04
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 23/1/2006	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: tom-04.csv	


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Clay (3)
Organic material (2)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383030 m, Y: 6367389 m
Ground level: 0.47
Test no: Tom - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 23/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: tom-04.cpd


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Clay (3)
Organic material (2)
Sandy silt to clayey silt (6)
Clay (3)
Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 5638390 m, Y: 6367798 m
Ground level: 0.9
Test no: Tom - 05
Project ID: N09814/01
Client: Redlake Enterprise Pty Ltd
Date: 23/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: tom-05.cpd

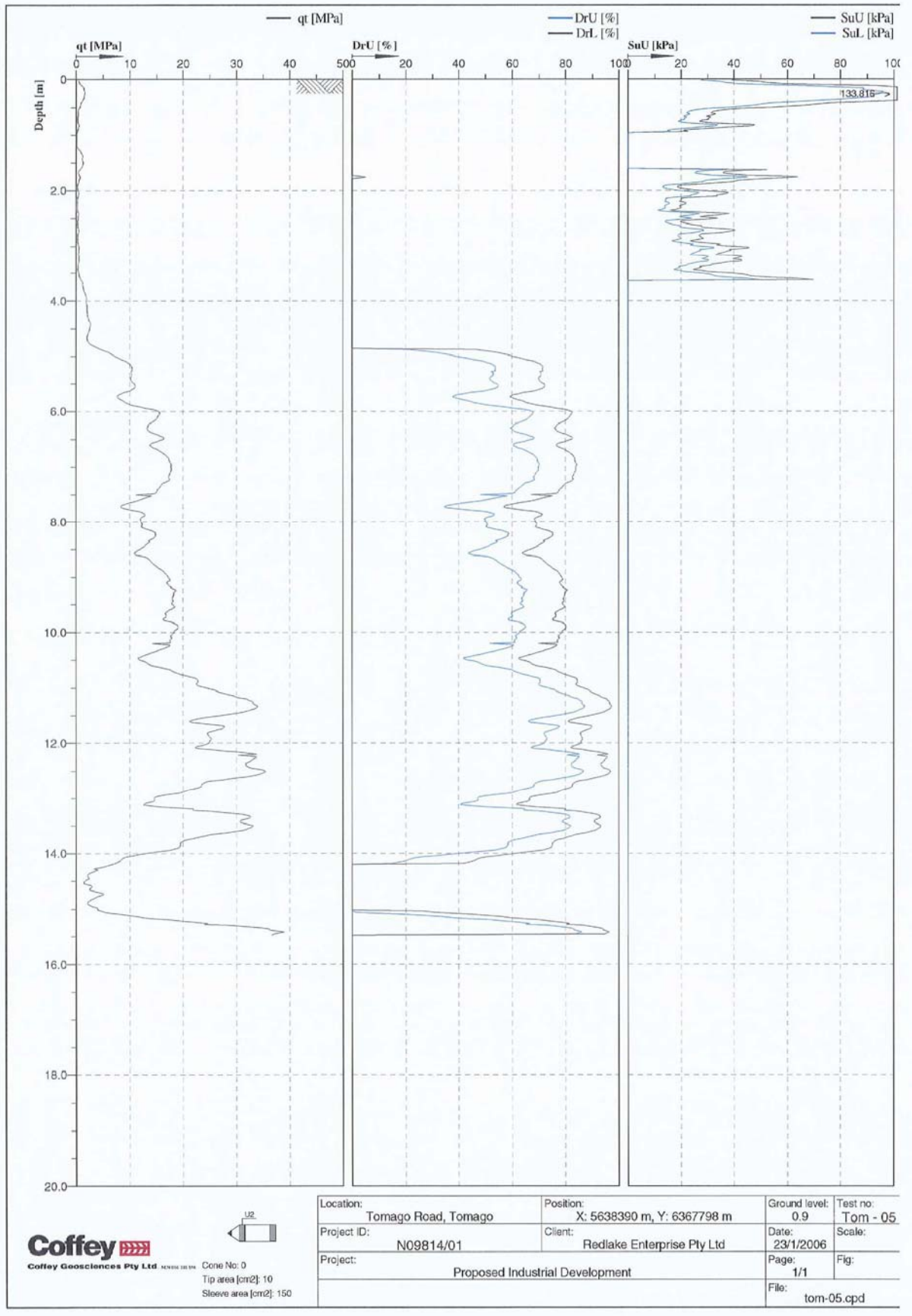


Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 5638390 m, Y: 6367798 m	Ground level: 0.9	Test no: Tom - 05
Project ID: N09814/01	Client: Redlake Enterprise Pty Ltd	Date: 23/1/2006	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: tom-05.cpd	


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
qt [MPa]
DrU [%]
SuU [kPa]
Depth [m]
133.815
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 5638390 m, Y: 6367798 m
Ground level: 0.9
Test no: Tom - 05
Project ID: N09814/01
Client: Redlake Enterprise Pty Ltd
Date: 23/1/2006
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: tom-05.cpd

APPENDIX E

Results of Laboratory Testing

Coffey Geosciences Pty Ltd A.C.N. 056 335 516
Unit 8, 12 Mars Road, Lane Cove West, NSW, 2066
Ph: (61 2) 9911 1000, Fax: (61 2) 9911 1003

COFFEY

case no: CBH2
sheet 1 of 1

consolidation test

client:	ASQUITH & DEWITT PTY LTD.	office job no:	N09814/01 SYDNEY
principal:	REDLAKE ENTERPRISES PTY LTD.	date:	30/01/06
project:	PRE-PURCHASE ASSESSMENT	carried out by:	GC
location:	TOMAGO ROAD, TOMAGO	checked by:	GC

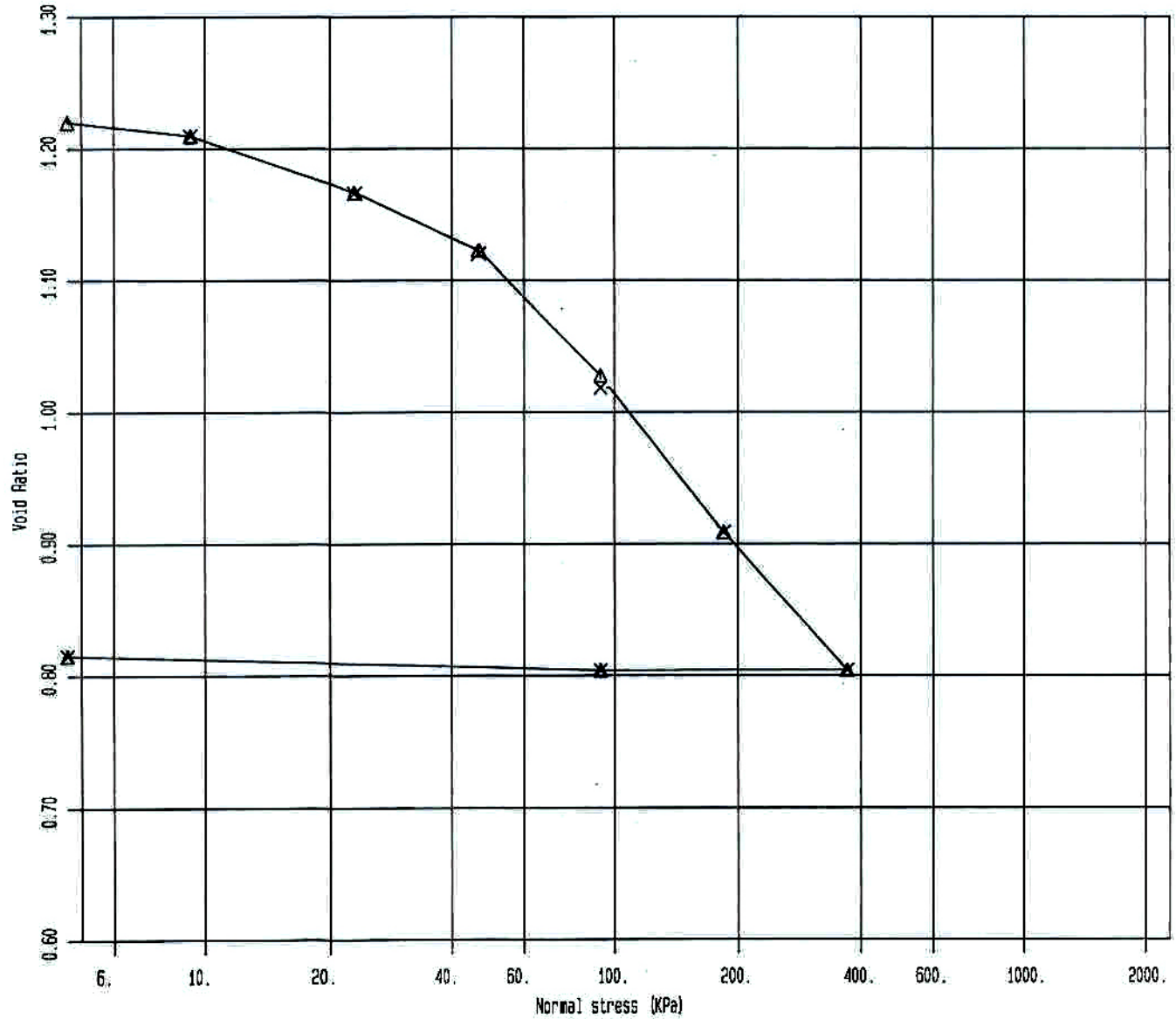
MATERIAL CLASSIFICATION : (CH) GRAVELLY SANDY SILTY CLAY - high plasticity, mottled grey, shells and shell fragments.

DEPTH: 2.50 2.80

TEST METHOD: AS1289.6.6.1

INITIAL D.D.	1.37	t/m3	INITIAL M.C.	29.6	%	SAMPLE HEIGHT 17.32 mm
SOIL PART.D.D.	2.65	g/m3	FINAL M.C.	32.7	%	SAMPLE DIAMETER 45.99 mm

NORMAL STRESS	5.	9.	23.	46.	92.	185.	370.	92.
RANGE (kPa)	9.	23.	46.	92.	185.	370.	92.	5.
Cc	0.0346	0.1075	0.1452	0.3192	0.3935	0.3479		
Mv (m2/kN)	.102E-02	.139E-02	.870E-03	.978E-03	.633E-03	.297E-03		
Cv (m2/year)	0.05	0.08	0.13	0.10	0.06	0.15		
K (m/year)	.463E-03	.116E-02	.114E-02	.102E-02	.430E-03	.459E-03		



The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements, which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced except in full.

G.K. COLLINS 12 / 09 / 2006
Authorised Signature
Laboratory Manager

CONSOLID VERSION A1 SYD03 13 / 9 A06 11 : 5 43
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Coffey Geosciences Pty Ltd A.C.N. 056 335 516
Unit 8, 12 Mars Road, Lane Cove West, NSW, 2066
Ph: (61 2) 9911 1000, Fax: (61 2) 9911 1003

COFFEY

case no: CBH4
sheet 1 of 1

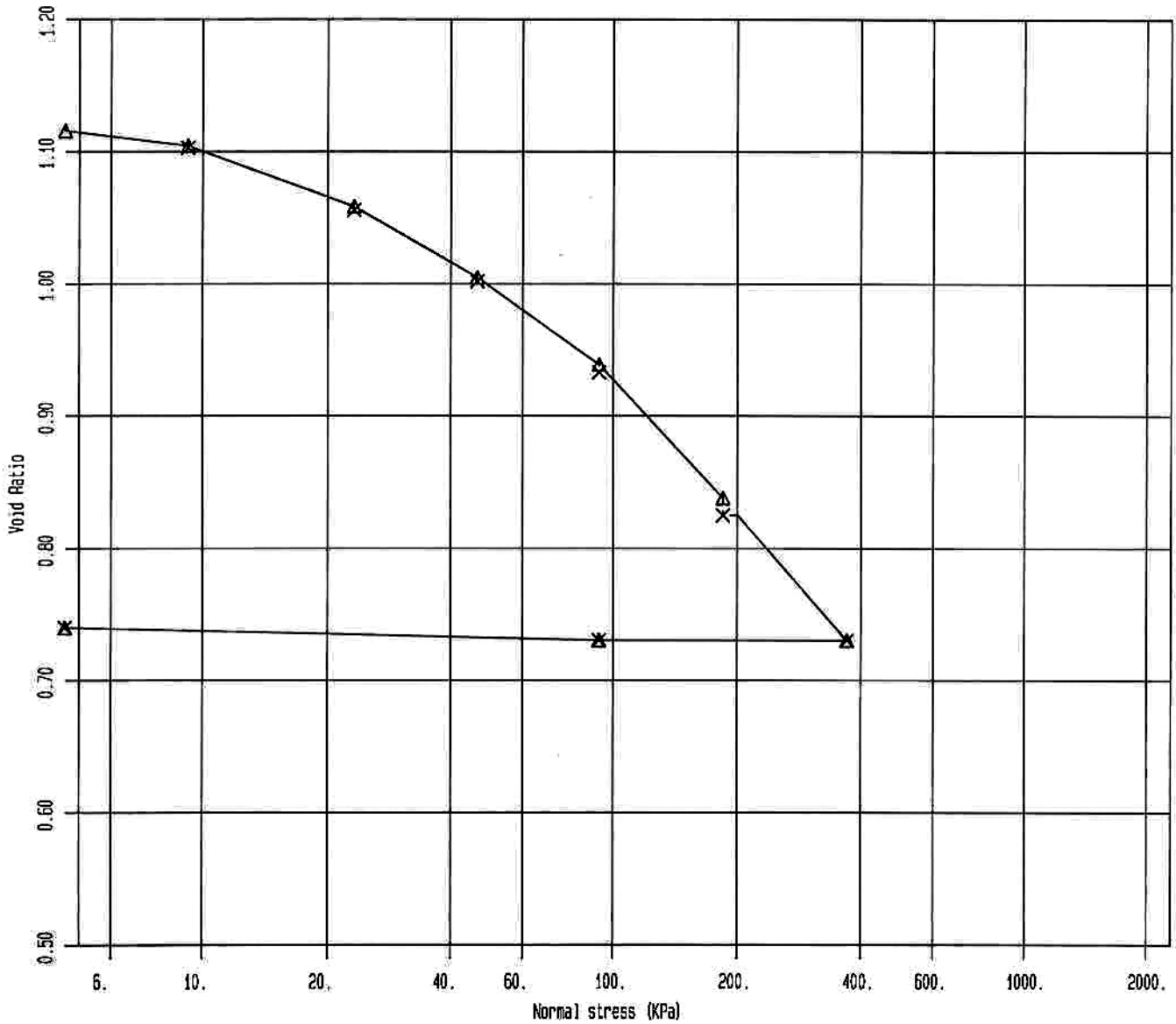
consolidation test

client:	ASQUITH & DEWITT PTY LTD.	office job no:	N09814/01 SYDNEY
principal:	REDLAKE ENTERPRISES PTY LTD.	date:	30/01/06
project:	PRE-PURCHASE ASSESSMENT	carried out by:	GC
location:	TOMAGO ROAD, TOMAGO	checked by:	GC

MATERIAL CLASSIFICATION: (CH) GRAVELLY SANDY SILTY CLAY - high plasticity, mottled grey, shells and shell fragments.
DEPTH: 2.00 2.30
TEST METHOD: AS1289.6.6.1

INITIAL D.D.	1.27	t/m3	INITIAL M.C.	39.0	%	SAMPLE HEIGHT 17.19 mm
SOIL PART.D.D.	2.65	g/m3	FINAL M.C.	27.6	%	SAMPLE DIAMETER 46.17 mm

NORMAL STRESS	5.	9.	23.	46.	92.	185.	370.	92.
RANGE (kPa)	9.	23.	46.	92.	185.	370.	92.	5.
Cc	0.0377	0.1142	0.1787	0.2212	0.3344	0.3568		
Mv (m2/kN)	.116E-02	.156E-02	.113E-02	.718E-03	.562E-03	.316E-03		
Cv (m2/year)	0.14	0.09	0.13	0.24	0.32	0.14		
K (m/year)	.164E-02	.147E-02	.151E-02	.176E-02	.190E-02	.455E-03		



The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements, which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced except in full.

G.K. COLLINS 13/09/2006
Authorised Signature
Laboratory Manager

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Coffey Geosciences Pty Ltd A.C.N. 056 335 516 FEB14-12

Geotechnical | **Resources** | Environmental | **Technical** | Project Management

13 Mangrove Road, Sandgate, NSW, 2304
Ph: (02) 4967 6377 Fax (02) 4967 5402

test results

client : *ASQUITH & DEWITT PTY LTD*
PO BOX 179, CHARLESTOWN NSW 2290

principal : *REDLAKE ENTERPRISES PTY LTD*

project : *PROPOSED INDUSTRIAL DEVELOPMENT*

location : *TOMAGO ROAD, TOMAGO*

job no : *N09814/01*

laboratory : *NEWCASTLE*

report date : *February 14, 2006*

test report : *FEB14-12*

test procedure : *AS1289 1.2, 2.1, 3.1 and 4.1*

test date : *02-02-06*

LABORATORY REFERENCE			CBH1 18.60 - 19.05m
Material Source			*On-Site*
Liquid Limit	*Wl*	%	*83.0*
Plastic Limit	*Wp*	%	*28.0*
Plasticity Index	*Ip*	%	*55.0*
Linear Shrinkage	*LS*	%	*17.5*
Sample History			*Air Dried and Dry Sieved*

remarks :
Silty CLAY, dark grey.

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced except in full.

NATA Accredited Laboratory No. 431

Date : *14 February 2006*

Authorised Signature:

Alan Cullen

Form Number 1.08R1 Version 5.2

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Coffey Geosciences Pty Ltd A.C.N. 056 335 516 FEB14-13

Geotechnical | **Resources** | Environmental | **Technical** | Project Management

13 Mangrove Road, Sandgate, NSW, 2304
Ph: (02) 4967 6377 Fax (02) 4967 5402

test results

client : *ASQUITH & DEWITT PTY LTD*
PO BOX 179, CHARLESTOWN NSW 2290

job no : *N09814/01*

principal : *REDLAKE ENTERPRISES PTY LTD*

laboratory : *NEWCASTLE*

project : *PROPOSED INDUSTRIAL DEVELOPMENT*

report date : *February 14, 2006*

location : *TOMAGO ROAD, TOMAGO*

test report : *FEB14-13*

test procedure : *AS1289 2.1.1*

test date : *31-01-06*

LABORATORY REFERENCE	NE06/419
CLIENT REFERENCE	CBH1 18.6 - 19.05m
MOISTURE CONTENT	*45.6*

remarks :

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced except in full.

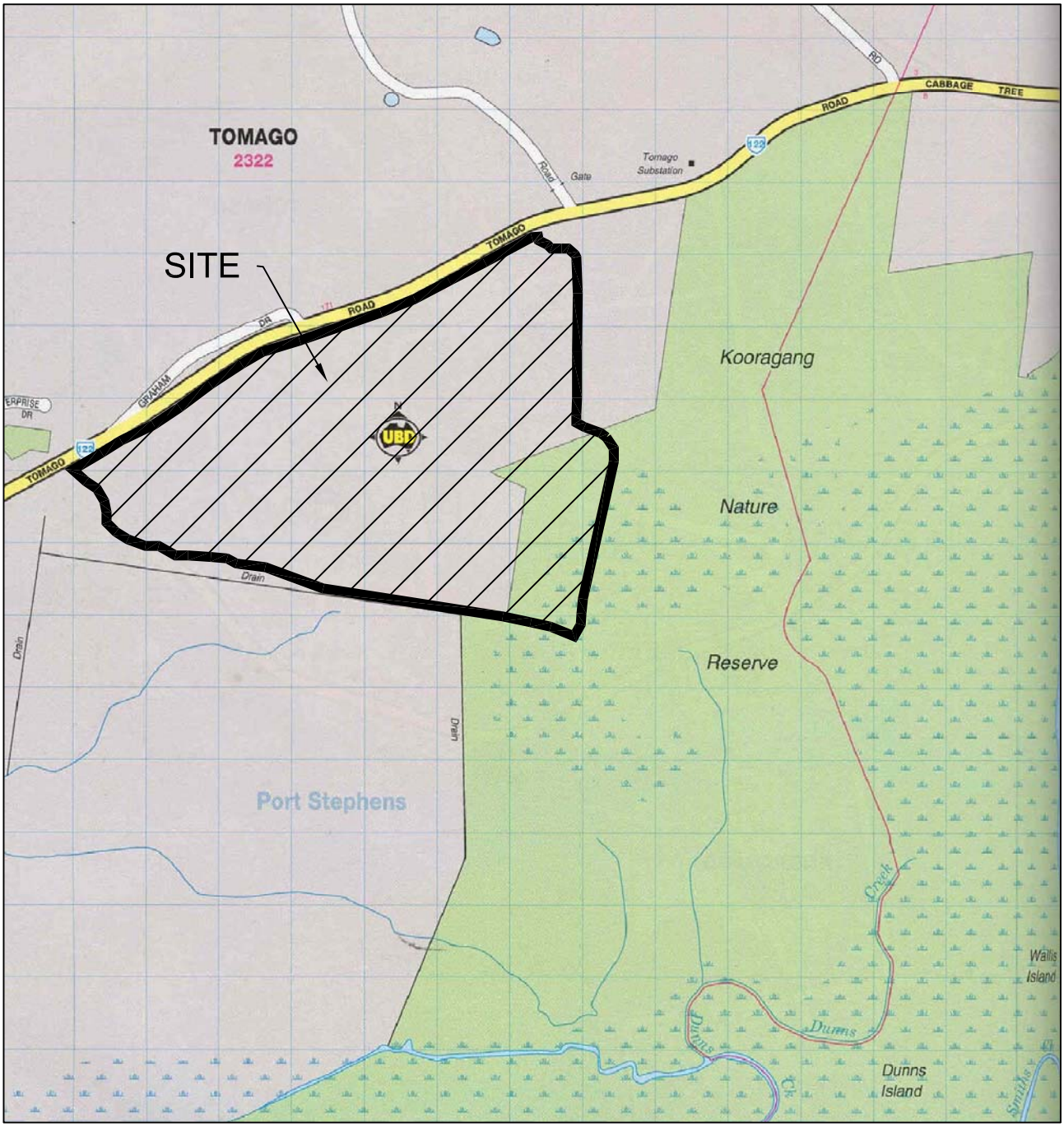
NATA Accredited Laboratory No. 431

Authorised Signature: *Alan Cullen*

Date : *14 February 2006*

Form Number 1.1.0R1 Version 5.2

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Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical | **Resources** | Environmental | **Technical** | Project Management		
	Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH AND DEWITT DUE DILIGENCE/PRELIMINARY GEOTECHNICAL ASSESSMENT 197 - 325 TOMAGO ROAD, TOMAGO SITE LOCATION PLAN	Drawing No: **FIGURE 1**
	Approved			
	Date	06–03–06		
	Scale	NTS		Job no: **N09814/01-AD**

382000
383000
384000N
6368000N
6367000N
TO WILLIAMSTOWN ROAD
1
D.P.597372
513
D.P.585256
161
D.P. 774440
1
D.P. 1003492
CAMPBELL STREET
TOMAGO
OPEN DRAINAGE CHANNEL
Ramsar Wetland
A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
CPT-01
CPT-02
CPT-03
CPT-04
CPT-10
CPT-11
CPT-12
CPT-14A
CPT-15
CPT-18
CPT-25
CPT-26
CPT-27A
CPT-28
CPT-29
CPT-30
CPT-31
PZP-32
CPT-39A
CPT-40
CPT-41
CPT-42
CPT-43
CPT-44
CPT-45
TOM-01
TOM-02
TOM-03
TOM-04
TOM-05
CBH1
CBH2
CBH3
CBH4
CBH5
LEGEND
BOREHOLE / CPT LOCATION
SECTIONS

Coffey Geosciences Pty Ltd ACN 056 335 516

Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Revision	Description	Drawn	Approved	Date

Drawn	NLS
Approved	
Date	06–03–06
Scale	1: 8000

REDLAKE ENTERPRISES C/- ASQUITH AND DEWITT
DUE DILIGENCE ASSESSMENT / GEOTECHNICAL ASSESSMENT
197 - 325 TOMAGO ROAD, TOMAGO
BOREHOLE / CPT LOCATION PLAN

Drawing No:
FIGURE 2
Job no: **N09814/01-AD**



N

Coffey

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Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Revision	Description	Drawn	Approved	Date

Drawn	NLS
Approved	
Date	06–03–06
Scale	1: 8000

REDLAKE ENTERPRISES C/- ASQUITH AND DEWITT
DUE DILIGENCE ASSESSMENT / GEOTECHNICAL ASSESSMENT
197 - 325 TOMAGO ROAD, TOMAGO
PROPOSED DEVELOPMENT LAYOUT

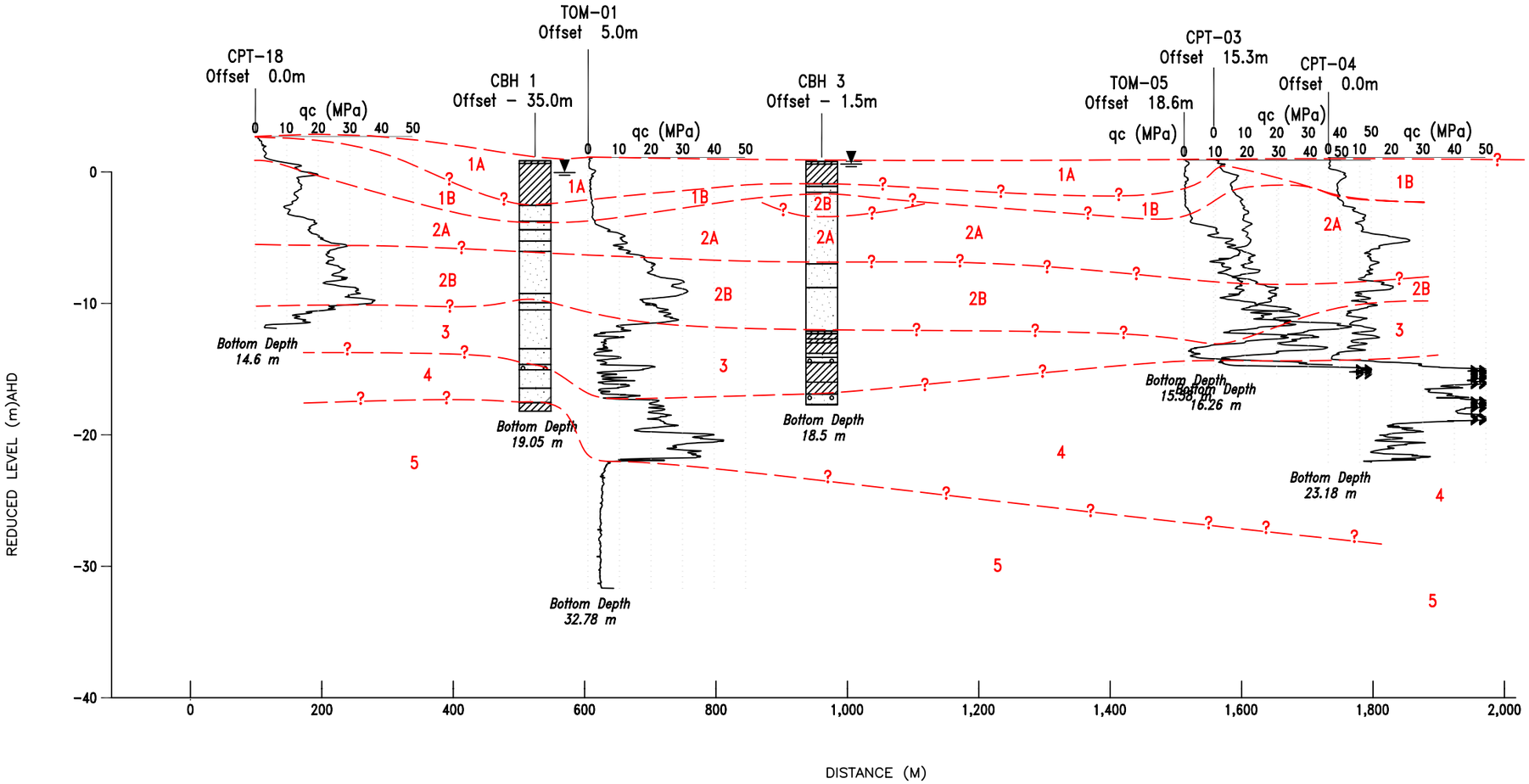
Drawing No:

FIGURE 3

Job no: **N09814/01-AD**

WEST
A

EAST
A'



LEGEND

- CLAY
- SANDY CLAY
- SAND
- SANDY GRAVEL
- CLAYEY SAND
- WATER LEVEL
- INFERRED BOUNDARY BETWEEN GEOTECHNICAL UNITS
- CPT CONE RESISTANCE (Qc MPa)

SCALE

VERTICAL SCALE 1:400
HORIZONTAL SCALE 1:8000
V/H RATIO = 20

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Revision	Description	Drawn	Approved	Date

Drawn	SW/NLS
Checked	
Date	06-03-06

REDLAKE ENTERPRISES PTY LTD C/- ASQUITH & DEWITT PTY LTD
DUE DILIGENCE / PRELIMINARY GEOTECHNICAL ASSESSMENT
197-325 TOMAGO ROAD, TOMAGO
INFERRED STRATIGRAPHIC SECTION A-A'

Drawing No.
FIGURE 4

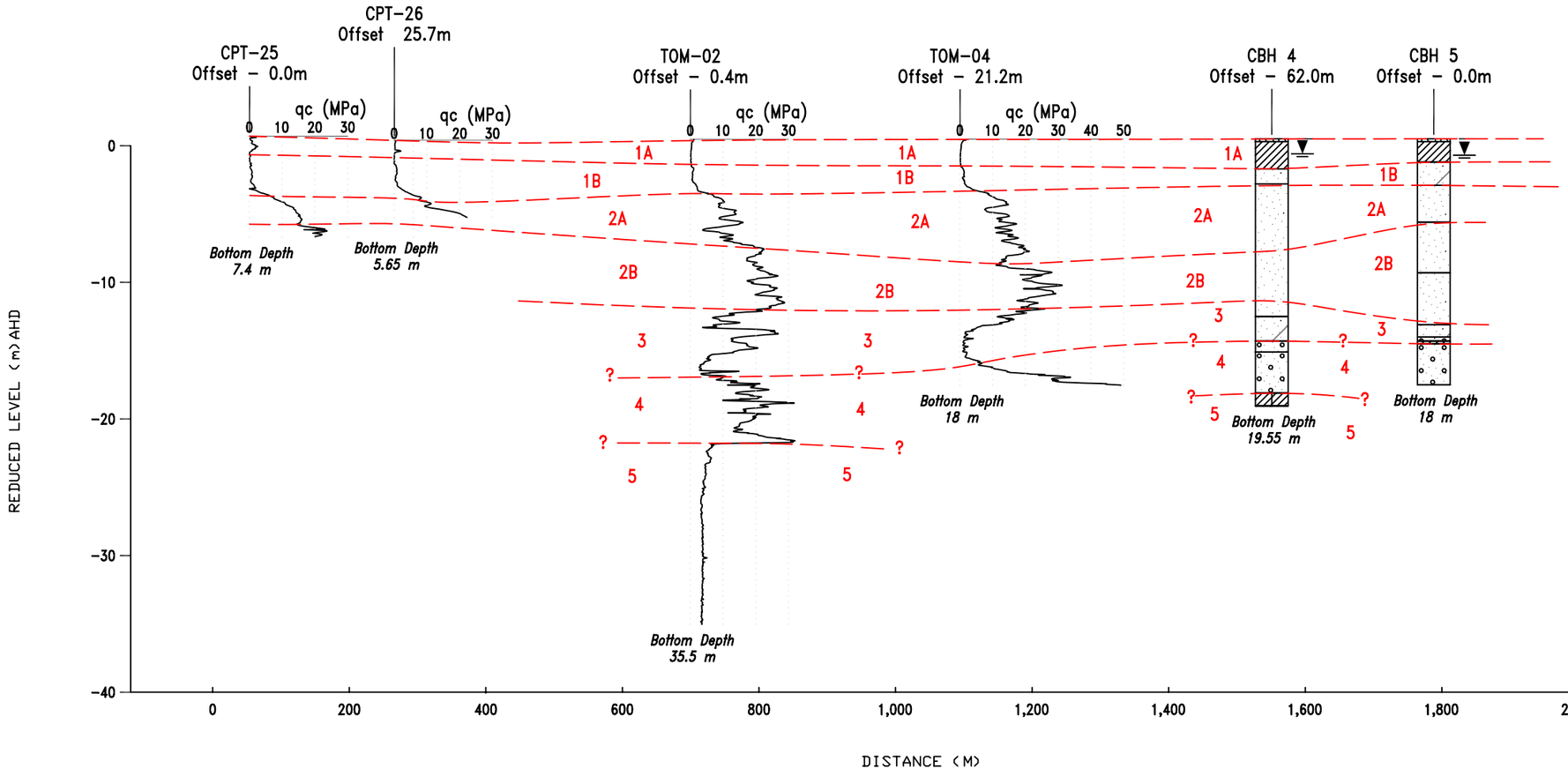
Job No.
N09814/01-AD

A3LANDSCAPE N09814-01.GPJ COFFEY.GDT 01.03.06

Revision A

WEST
B

EAST
B'



LEGEND

- TOPSOIL
- CLAY
- SAND
- CLAYEY SAND
- GRAVELLY SAND
- SANDY GRAVEL
- SILTY CLAY
- WATER LEVEL
- INFERRED BOUNDARY BETWEEN GEOTECHNICAL UNITS
- CPT CONE RESISTANCE (Qc MPa)

SCALE

VERTICAL SCALE 1:400
HORIZONTAL SCALE 1:8000
V/H RATIO = 20

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Revision	Description	Drawn	Approved	Date

Drawn	SW/NLS
Checked	
Date	06-03-06

REDLAKE ENTERPRISES PTY LTD C/- ASQUITH & DEWITT PTY LTD
DUE DILIGENCE / PRELIMINARY GEOTECHNICAL ASSESSMENT
197-325 TOMAGO ROAD, TOMAGO
INFERRED STRATIGRAPHIC SECTION B-B'

Drawing No. FIGURE 5

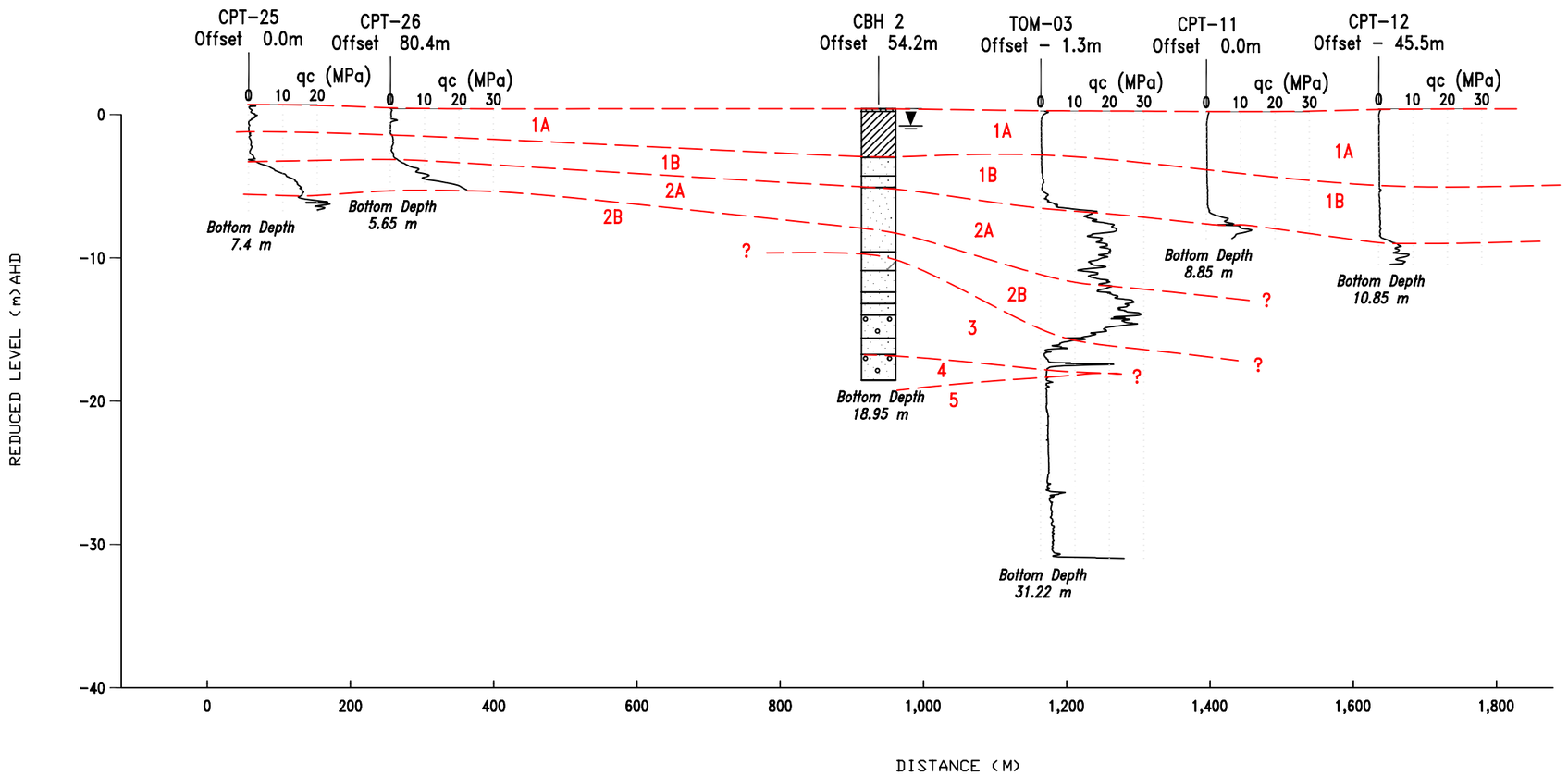
Job No. N09814/01-AD

A3LANDSCAPE N09814-01.GPJ COFFEY.GDT 01.03.06

Revision A

WEST
C

EAST
C'



LEGEND

- TOPSOIL
- CLAY
- SAND
- CLAYEY SAND
- SANDY GRAVEL
- GRAVELLY SAND
- WATER LEVEL
- INFERRED BOUNDARY BETWEEN GEOTECHNICAL UNITS
- CPT CONE RESISTANCE (Qc MPa)

SCALE

VERTICAL SCALE 1:400
HORIZONTAL SCALE 1:8000
V/H RATIO = 20

A3LANDSCAPE N09814-01.GPJ COFFEY.GDT 01.03.06

Revision A

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | **Resources** | Environmental | **Technical** | Project Management

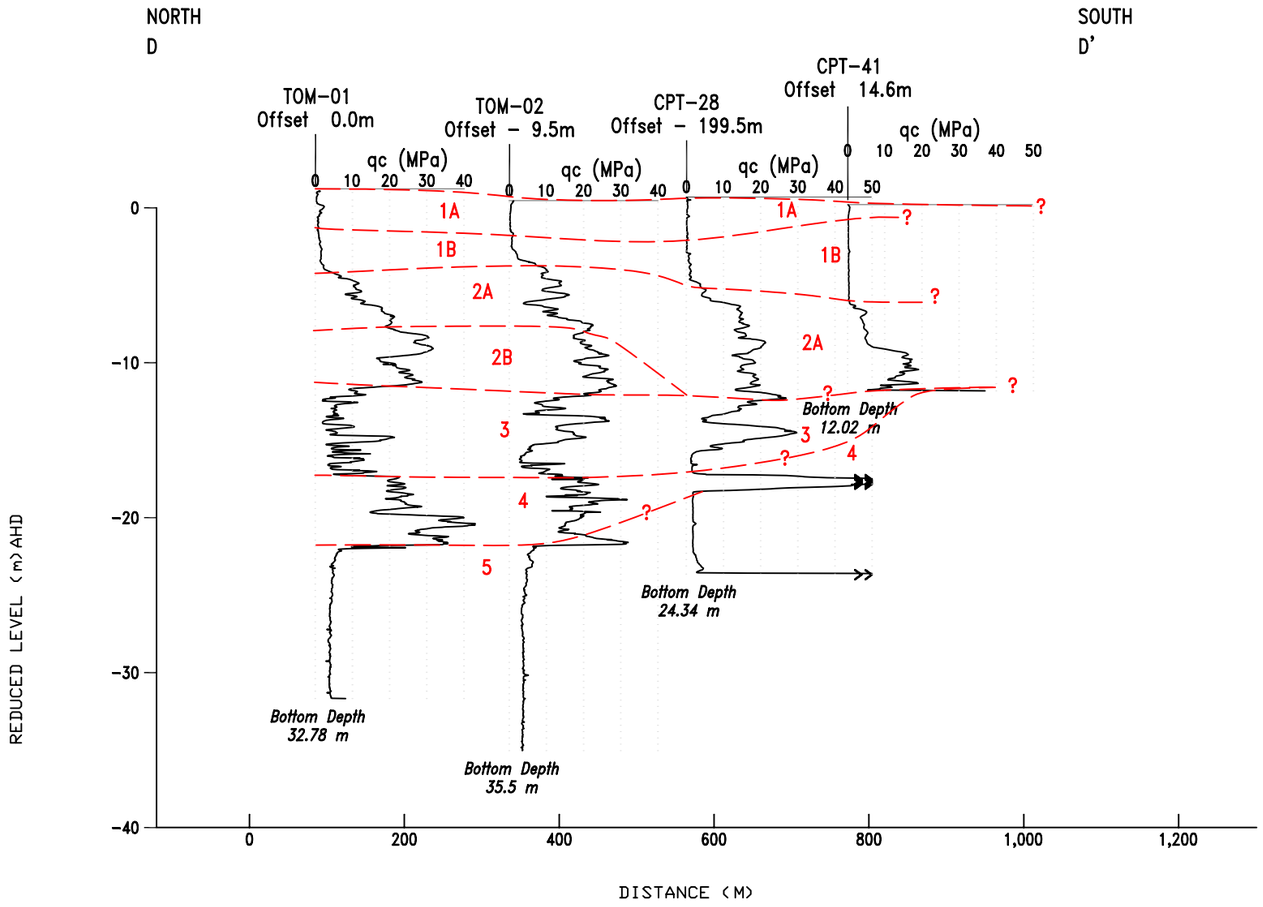
Revision	Description	Drawn	Approved	Date

Drawn	SW/NLS
Checked	
Date	06-03-06

REDLAKE ENTERPRISES PTY LTD C/- ASQUITH & DEWITT PTY LTD
DUE DILIGENCE / PRELIMINARY GEOTECHNICAL ASSESSMENT
197-325 TOMAGO ROAD, TOMAGO
INFERRED STRATIGRAPHIC SECTION C-C'

Drawing No.
FIGURE 6

Job No.
N09814/01-AD



LEGEND

INFERRED BOUNDARY BETWEEN GEOTECHNICAL UNITS

CPT CONE RESISTANCE (Qc MPa)

SCALE

VERTICAL SCALE 1:400

HORIZONTAL SCALE 1:8000

V/H RATIO = 20

Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | **Resources** | Environmental | **Technical** | Project Management

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Drawn	SW/NLS
Checked	
Date	06-03-06

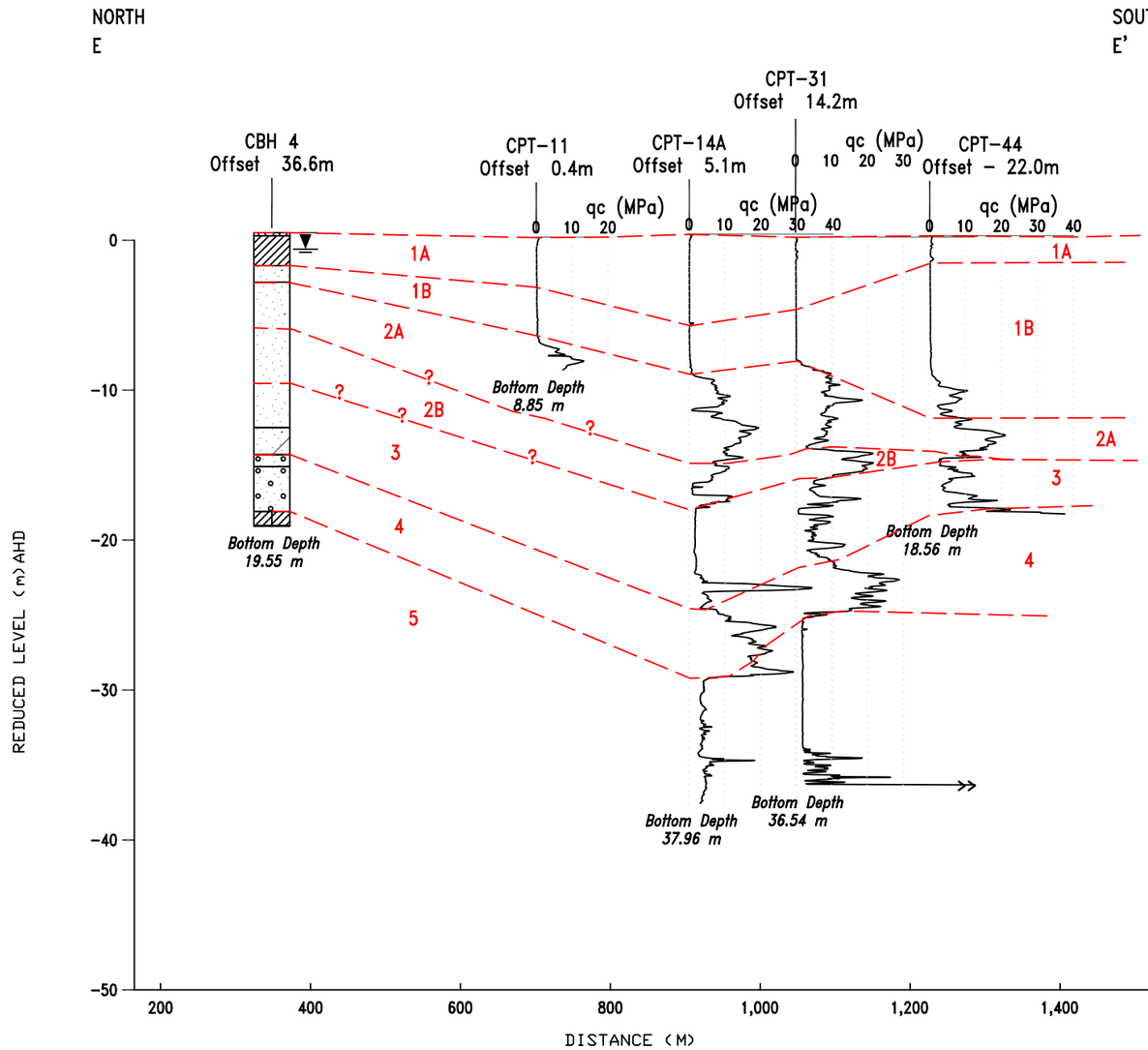
REDLAKE ENTERPRISES PTY LTD C/- ASQUITH & DEWITT PTY LTD
DUE DILIGENCE / PRELIMINARY GEOTECHNICAL ASSESSMENT
197-325 TOMAGO ROAD, TOMAGO
INFERRED STRATIGRAPHIC SECTION D-D'

Drawing No. FIGURE 7

Job No. N09814/01-AD

A3LANDSCAPE N09814-01.GPJ COFFEY.GDT 03.03.06

Revision A



LEGEND

- TOPSOIL
- CLAY
- SAND
- CLAYEY SAND
- GRAVELLY SAND
- SANDY GRAVEL
- SILTY CLAY
- WATER LEVEL
- INFERRED BOUNDARY BETWEEN GEOTECHNICAL UNITS
- CPT CONE RESISTANCE (Qc MPa)

SCALE

VERTICAL SCALE 1:400
HORIZONTAL SCALE 1:8000
V/H RATIO = 20

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Revision	Description	Drawn	Approved	Date

Drawn	SW/NLS
Checked	
Date	06-03-06

REDLAKE ENTERPRISES PTY LTD C/- ASQUITH & DEWITT PTY LTD
DUE DILIGENCE / PRELIMINARY GEOTECHNICAL ASSESSMENT
197-325 TOMAGO ROAD, TOMAGO
INFERRED STRATIGRAPHIC SECTION E-E'

Drawing No. FIGURE 8

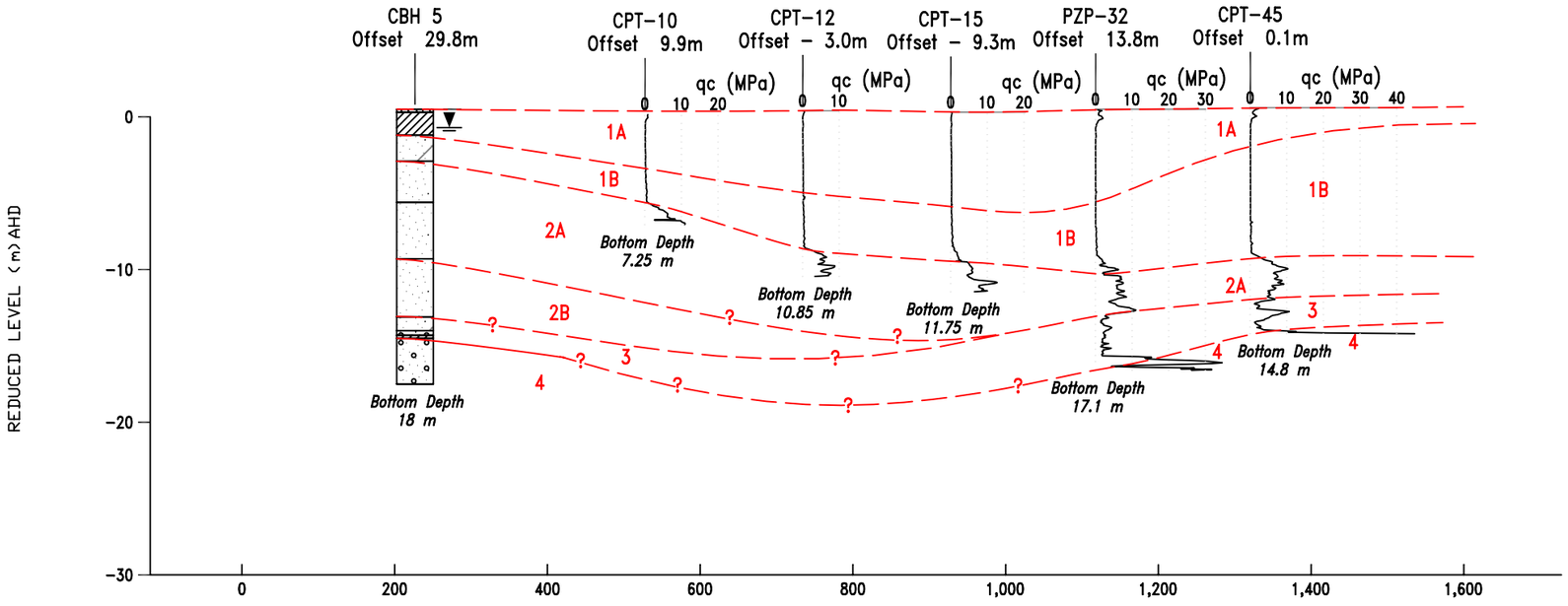
Job No. N09814/01-AD

A3LANDSCAPE N09814-01.GPJ COFFEY.GDT 03.03.06

Revision A

NORTH
F

SOUTH
F'



LEGEND

- TOPSOIL
- CLAY
- CLAYEY SAND
- SAND
- SANDY GRAVEL
- WATER LEVEL
- INFERRED BOUNDARY BETWEEN GEOTECHNICAL UNITS
- CPT CONE RESISTANCE (Qc MPa)

SCALE

VERTICAL SCALE 1:400
HORIZONTAL SCALE 1:8000
V/H RATIO = 20

Coffey

A3LANDSCAPE N09814-01.GPJ COFFEY.GDT 03.03.06

Revision A

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | **Resources** | Environmental | **Technical** | Project Management

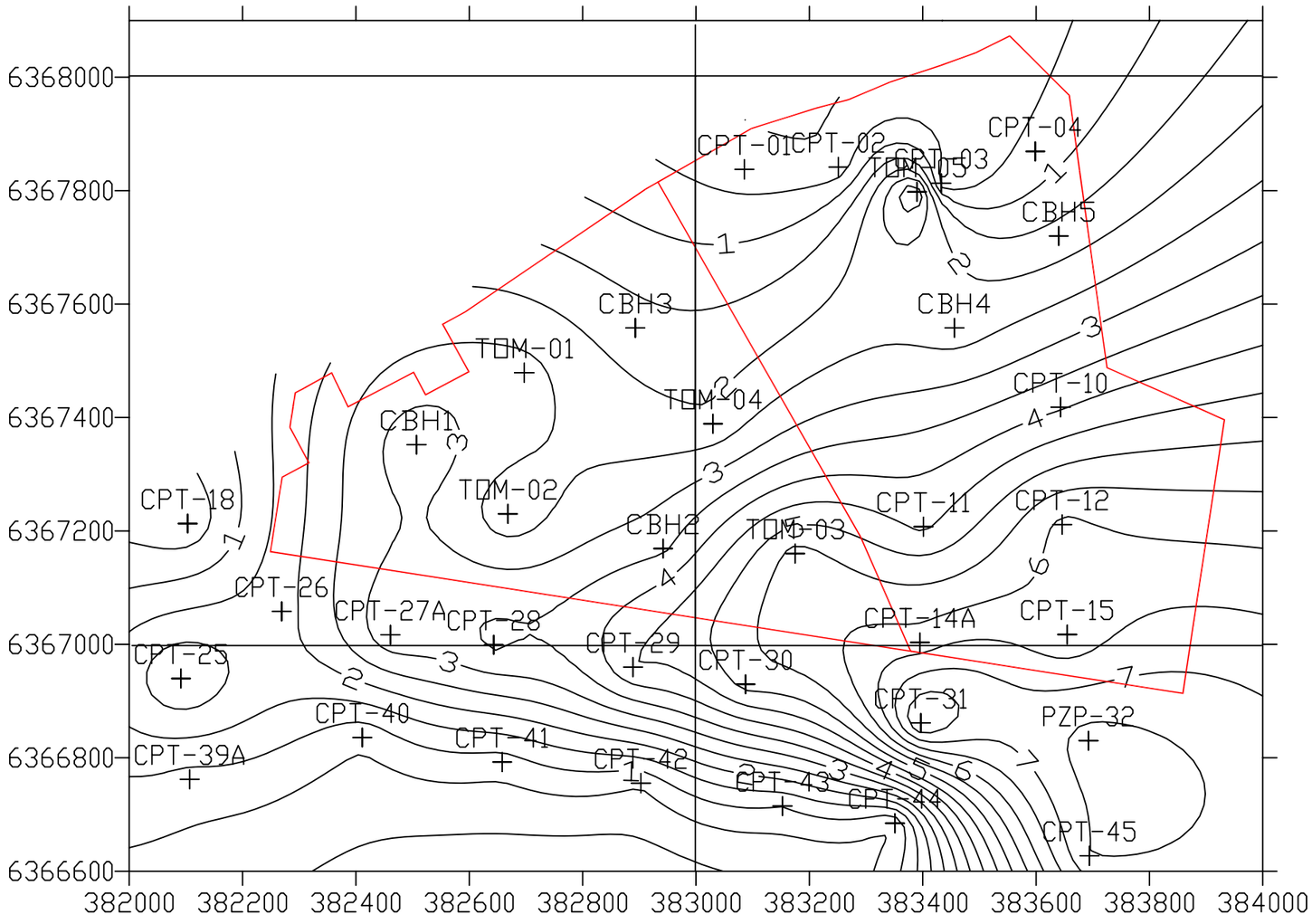
Revision	Description	Drawn	Approved	Date

Drawn	SW/NLS
Checked	
Date	06-03-06

REDLAKE ENTERPRISES PTY LTD C/- ASQUITH & DEWITT PTY LTD
DUE DILIGENCE / PRELIMINARY GEOTECHNICAL ASSESSMENT
197-325 TOMAGO ROAD, TOMAGO
INFERRED STRATIGRAPHIC SECTION F-F'

Drawing No.
FIGURE 9

Job No.
N09814/01-AD



LEGEND

2 — INFERRED THICKNESS/DEPTH (M) OF UNIT 1A CLAY BASED ON BOREHOLE LOGS AND CPT PLOTS.

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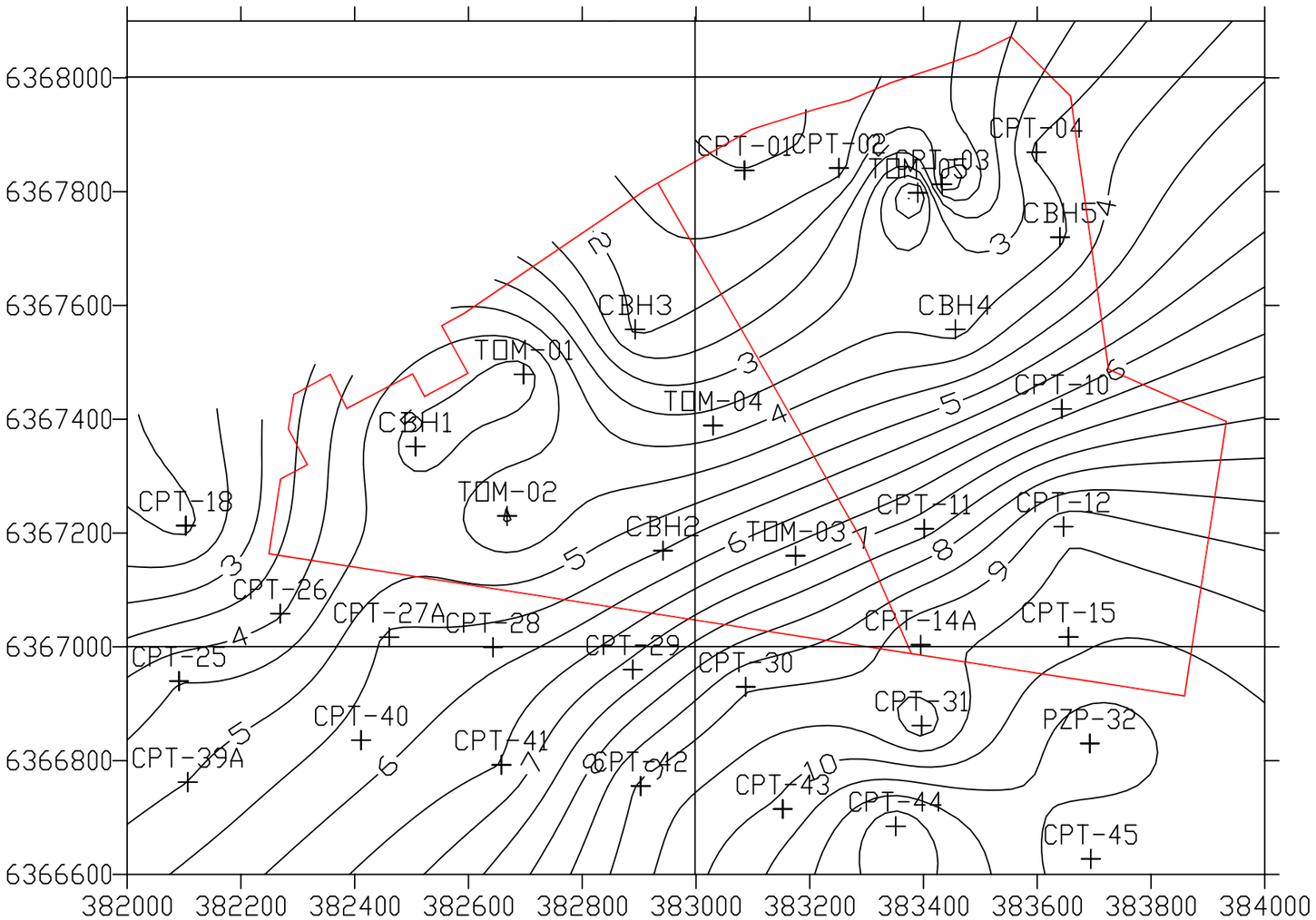
Revision	Description	Drawn	Approved	Date

Drawn	NLS
Approved	
Date	08–03–06
Scale	1:10000

REDLAKE ENTERPRISES C/- ASQUITH AND DEWITT
DUE DILIGENCE/PRELIMINARY GEOTECHNICAL ASSESSMENT
197 - 325 TOMAGO ROAD, TOMAGO
INFERRED THICKNESS OF UNIT 1A CLAY
CONTOUR PLAN - UNIT 1A/1B INTERFACE

Drawing No: **FIGURE 10**

Job no: **N09814/01-AD**



LEGEND

2 — INFERRED THICKNESS/DEPTH (M) OF UNIT 1A & 1B SOILS BASED ON BOREHOLE LOGS AND CPT PLOTS.

Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516

Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Revision	Description	Drawn	Approved	Date

Drawn	NLS
Approved	
Date	08–03–06
Scale	1:10000

REDLAKE ENTERPRISES C/- ASQUITH AND DEWITT
DUE DILIGENCE/PRELIMINARY GEOTECHNICAL ASSESSMENT
197 - 325 TOMAGO ROAD, TOMAGO
INFERRED THICKNESS OF SOFT/LOOSE UNIT 1A & 1B SOILS
CONTOUR PLAN - UNIT 1B/2A INTERFACE

Drawing No:

FIGURE 11

Job no: **N09814/01-AD**

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT - TOMAGO GEOTECHNICAL ASSESSMENT

Asquith & de Witt Pty Ltd

GEOTSGTE20301AA-AI
15 November 2007

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
19 Warabrook Boulevard Warabrook NSW 2304 Australia

15 November 2007

Asquith & de Witt Pty Ltd
PO Box 179
CHARLESTOWN NSW 2290

Attention: Scott Day

Dear Scott

RE: PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT

TOMAGO ROAD, TOMAGO

GEOTECHNICAL ASSESSMENT

Please find enclosed a report describing geotechnical studies carried out at the above site.

Further advice on the uses and limitations of this report is presented in the attached document, *'Important Information about your Coffey Report'.*

If you have any questions regarding this matter please contact Robert Pearce or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd.



Arthur Love

Principal Geotechnical Engineer

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Figure 1A: Test Pit and Borehole Location Plan

Figure 1B: CPT Location Plan

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Appendices

Appendix A: Results of Field Investigations

Appendix B: Results of CPT Testing

Appendix C: Results of Relevant Previous Investigations

Appendix D: Results of Laboratory Testing

Appendix E: Results of Acid Sulfate Soils Testing

1 INTRODUCTION

This report presents the results of a geotechnical assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) on behalf of Asquith & de Witt Pty Ltd for Stage 1 of the proposed Westrac Industrial development, Tomago.

The work was commissioned by David Aspinall of Redlake Enterprises Pty Ltd in an email dated 25 April 2007 and subsequent Authorisation to Proceed form. A plan of the site overlayed with a 50m by 50m square grid and grid point coordinates were provided by the client.

The proposed development is understood to involve cutting and filling the site to about RL 2.5m AHD finished level and construction of the following:

- An access road off Tomago Road;
- Workshop and service buildings for heavy earthmoving equipment;
- A parts warehouse building;
- Administration offices;
- Associated car parking areas.

The scope of work for the geotechnical assessment included providing recommendations on:

- Ground improvement measures;
- Site preparation;
- Special requirements for construction procedures and/or site drainage;
- The suitability of site soils for use as fill and fill construction procedures;
- Stability and settlement of embankments;
- Suitable footing types, founding depths and foundation design parameters;
- Pavement design and construction;
- Acid sulfate soil conditions and requirements for an acid sulfate soil management plan.

The following report presents the results of field investigations and laboratory testing and provides discussion and recommendations relevant to the above scope of work.

2 BACKGROUND

Coffey previously carried out a preliminary geotechnical assessment of the larger 115 hectare site comprising Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256 (ref: Coffey Report No. N09814/01-AD, dated 29 August 2006).

Soil & Rock Engineering Pty Ltd also carried out preliminary and detailed geotechnical investigations for a proposed 150 hectare steel mill site within a larger 450 hectare site offered for development (ref: Soil & Rock Engineering Pty Ltd Report No. dcb5264_3_01rep.doc, dated 28 December 2001 and Report No. dcb5264_1_01rep.doc, dated 20 July 2001).

Testing carried out on the Stage 1 site as part of these previous investigations comprised four electric friction cone penetrometer tests and one electric friction piezocone test. Two boreholes were also drilled near the southern boundary of the Stage 1 site as part of Coffey's previous investigation.

Results of previous investigations carried out across the larger Westrac site and proposed steel mill site have been used to help develop a geotechnical model for the Stage 1 site. Results of previous investigations relevant to the Stage 1 site are presented in Appendix C.

3 FIELD WORK

- Field work for the current investigation was carried out between on 9 May and 15 August 2007 and consisted of:
- Excavation of 15 test pits (TP1 to TP15) across the site using a 17 tonne excavator to depths of up to 3.6m. Disturbed samples of representative materials were taken for moisture content and acid sulfate soils testing;
- Piezocone Penetrometer Testing (CPT) at 40 locations (CPT1 to CPT40) in a grid pattern across the site by a specialist subcontractor using a purpose built all terrain CPT rig. CPT tests were terminated at depths of between 11.59m to 18.23m (and 5.65m at CPT113) due to sleeve friction or cone tip refusal or if gravel was encountered. Dissipation testing was carried out at selected locations and depths during CPT testing to assess the time related consolidation characteristics of site soils. Plots of all piezocone probes and interpretation of soils encountered are presented in Appendix B. Interpretations of dissipation test results are also presented in Appendix B;
- Drilling of 10 boreholes using a 4WD mounted rig and a track mounted all terrain rig at selected CPT locations to depths of between 9.4m to 19.95m. Standard penetration tests (SPT) or undisturbed (U50) tube sampling was carried out at regular intervals within boreholes.

All field work was carried out in the full time presence of an Engineering Geologist who located the test locations by GPS using the grid point coordinates provided by the client, carried out the sampling and testing and produced engineering logs of the test pits and boreholes. Engineering logs of the test pits and boreholes are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation.

Test pit and borehole locations are shown on Figure 1A. CPT test locations are shown on Figure 1B.

4 SITE CONDITIONS

4.1 Surface Conditions

The Stage 1 site comprises an area of approximately 23 hectares and is located in the north eastern corner of the larger site on the southern side of Tomago Road, Tomago. The Stage 1 site is bounded by Tomago Road to the north, private property to the east and future stages of the proposed development to the south and west.

Topographically the site comprises a low dunal formation across the northern portion and a relatively flat low lying alluvial plain across the southern portion. Surface elevations are typically less than RL 1.0m AHD across the southern portion of the site and range from about RL 1.5m AHD to RL 8.5m AHD across the northern portion of the site.

The low lying southern portion of the site is poorly drained and was waterlogged. Trafficability across this area was poor during the previous and current field investigations. One open drain extends across the full width of the site and another extends across about the western half of the site within this area, both are orientated roughly parallel to the southern Stage 1 site boundary. Another drain is located along the southern two thirds of the western Stage 1 site boundary.

Vegetation across the northern portion of the site comprises predominantly tall grasses and vegetation across the southern portion of the site comprises predominantly thick grasses. Some large trees were also observed across the north eastern and south western portions of the site.

4.2 Subsurface Conditions

Reference to the 1:100,000 scale Newcastle Coalfield Regional Geology sheet indicates the site is underlain by Quaternary aged deposits comprising gravel, sand, silt and clay.

The typical soil types encountered at test pit and borehole locations during the field investigations have been divided into geotechnical units as summarised in Table 1.

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES AT TEST PIT AND BOREHOLE LOCATIONS

GEOTECHNICAL UNIT	SOIL TYPE	DESCRIPTION
1A	Alluvial / Estuarine Clay	Silty CLAY, of low to medium plasticity, brown and dark brown (Topsoil), CLAY, Sandy CLAY and Silty CLAY, of medium to high plasticity and very soft to stiff consistency, grey, pale grey, brown, pale brown and grey – dark grey, with some shelly bands.
1B	Alluvial / Estuarine Clayey Sand	Clayey SAND, fine to course grained, very loose to medium dense, pale grey, grey, pale brown and grey – dark grey, with some shelly bands.
2	Alluvial / Aeolian Sand	Silty SAND and SAND, fine to course grained, medium dense to very dense with some loose bands, brown, pale brown, dark brown, grey and pale grey, some indurated and some with a trace to some gravel.
3	Alluvial / Estuarine Clayey Sand	CLAY, of medium to high plasticity, firm to stiff consistency, grey – dark grey and Clayey SAND, fine to coarse grained, very loose and grey.

Table 2 provides a summary of the distribution of the above geotechnical units at each test location.

TABLE 2 – SUMMARY OF DISTRIBUTION OF GEOTECHNICAL UNITS AT TEST PIT AND BOREHOLE LOCATIONS

TEST LOCATION	UNIT 1A	UNIT 1B	UNIT 2	UNIT 3	WATER INFLOW / WATER TABLE
	DEPTH BELOW EXISTING GROUND SURFACE (m)				
TP1	0.0 - >3.60	-	-	-	1.10
TP2	0.0 – 0.40	0.40 – 1.40	1.40 - >3.20	-	1.40
TP3	0.0 – 1.60	1.60 - >3.20	-	-	1.10
TP4	0.0 – 0.30	0.30 – 1.70	1.70 - >3.60	-	1.10
TP5	0.0 - >2.20	-	-	-	0.00
TP6	0.0 – 1.60	-	1.60 - >3.00	-	
TP7	0.0 – 1.70	1.70 - >2.20	-	-	1.40
TP8	-	-	0.0 - >3.20	-	3.20
TP9	-	-	0.0 - >3.00	-	1.40
TP10	-	-	0.0 - >3.00	-	-
TP11	-	-	0.0 - >3.10	-	-
TP12	-	-	0.0 - >2.20	-	-
TP13	-	-	0.0 - >2.60	-	1.70
TP14	-	-	0.0 - >3.00	-	1.50
TP15	0.0 – 0.50	-	0.50 - >2.50	-	0.50
BH101	-	-	0.0 – 18.00	18.00 - >19.95	1.25
BH104	0.0 – 1.50	1.50 – 6.50	6.00 – 15.00 17.00 - >17.15	15.00 – 17.00	1.25

TEST LOCATION	UNIT 1A	UNIT 1B	UNIT 2	UNIT 3	WATER INFLOW / WATER TABLE
	DEPTH BELOW EXISTING GROUND SURFACE (m)				
BH106	-	-	0.0 - >9.45	-	2.90
BH113	-	-	0.0 - >9.45	-	5.00
BH116	0.0 – 6.00	-	6.00 - >14.90	-	0.00
BH119	0.0 – 4.50	4.50 – 7.50	7.50 – >9.40	-	0.95
BH121	-	-	0.0 - >9.45	-	0.10
BH128	0.0 – 6.00	-	6.00 - >9.45	-	0.00
BH134	-	-	0.0 - >9.45	-	
BH137	-	0.0 – 1.50 6.40 – 9.00	1.50 – 6.40 9.00 - >15.45	-	0.40

The inferred soil types encountered based on CPT data have been divided into inferred geotechnical units as summarised in Table 3.

TABLE 3 – SUMMARY OF INFERRED GEOTECHNICAL UNITS BASED ON CPT DATA

INFERRED GEOTECHNICAL UNIT	INFERRED SOIL TYPE	CLASSIFICATION
1A	Alluvial / Estuarine Clay	Sensitive fine grained; Organic material; Clay; Silty Clay to Clay; Clayey Silt to Silty Clay, typically of very soft to firm consistency.
1B	Alluvial / Estuarine Clayey Sand	Sandy Silt to Clayey Silt; Silty Sand to Sandy Silt; Sand to Silty Sand, very loose to medium dense.
2A	Alluvial / Aeolian Sand	Sandy Silt to Clayey Silt; Silty Sand to Sandy Silt; Sand to Silty Sand; Sand, medium dense with some loose bands.
2B	Alluvial / Aeolian Sand	Sand to Silty Sand; Sand; Gravelly Sand to Sand, dense to very dense with some medium dense bands.

INFERRED GEOTECHNICAL UNIT	INFERRED SOIL TYPE	CLASSIFICATION
2C	Alluvial / Aeolian Sand	Sandy Silt to Clayey Silt; Silty Sand to Sandy Silt; Sand to Silty Sand; Sand, medium dense with some loose bands.
3	Alluvial / Estuarine Clayey Sand	Interbedded Sandy Silty to Clayey Silt; Silty Sand to Sandy Silt; Sand to Silty Sand and some Sensitive fine grained and Clay, typically very loose to medium dense and of stiff to hard consistency.

Table 4 provides a summary of the distribution of the above inferred geotechnical units at each CPT test location.

TABLE 4 – SUMMARY OF DISTRIBUTION OF INFERRED GEOTECHNICAL UNITS AT CPT TEST LOCATIONS

INFERRED UNIT	UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 2C	UNIT 3
TEST LOCATION	**DEPTH BELOW EXISTING GROUND SURFACE (m)**					
CPT101	-	-	0.0 – 2.20	2.20 – 14.75	14.75 – 15.55	15.55 – 16.92
CPT102	-	-	0.0 – 3.20	3.20 – 13.75	13.75 – 17.00	17.00 – 18.23
CPT103	**0.0 – 0.75**	-	0.75 – 4.90	4.90 – 10.70 15.35 – 15.80	10.70 – 14.40	14.40 – 15.35
CPT104	**0.0 – 4.40**	4.40 – 5.75	-	5.75 – 11.00	11.00 – 13.75	13.75 – 14.96
CPT105	-	-	0.0 – 0.65	0.65 – 13.35	-	-
CPT106	-	-	0.0 – 2.90	2.90 – 16.30	-	-
CPT107	**0.0 – 0.90** **2.15 – 3.20**	0.90 – 2.15 3.20 – 4.50	4.50 – 5.55	5.55 – 9.65 14.80 – 15.35	9.65 – 14.80	-
CPT108	**0.0 – 4.60**	4.60 – 5.50	-	5.50 – 10.45 14.90 – 15.13	10.45 – 14.15	14.15 – 14.90
CPT109	-	-	0.0 – 2.80	2.80 – 13.94	-	-

INFERRED UNIT	UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 2C	UNIT 3
TEST LOCATION	**DEPTH BELOW EXISTING GROUND SURFACE (m)**					
CPT110	-	-	0.0 – 2.00	2.00 – 3.80 5.60 – 17.74	3.80 – 5.60	-
CPT111	**0.0 – 1.05** **1.65 – 3.50**	1.05 – 1.65 3.50 – 4.50	4.50 – 5.30	5.30 – 14.10 14.55 – 14.74	-	14.10 – 14.55
CPT112	**0.0 – 5.20**	5.20 – 5.70	5.70 – 7.00	7.00 – 10.45 11.30 – 13.25	10.45 – 11.30 13.25 – 14.10	14.10 – 14.63
CPT113	-	-	0.0 – 1.90	1.90 – 5.65	-	-
CPT114	-	-	0.0 – 2.50	2.50 – 15.60 16.80 – 17.40	-	15.60 – 16.80
CPT115	**0.0 – 1.40** **2.30 – 3.30**	3.30 – 4.90	1.40 – 2.30	4.90 – 13.30 14.55 – 14.78	13.30 – 13.75	13.75 – 14.55
CPT116	**0.0 – 4.60**	4.60 – 5.85	12.45 – 13.90	5.85 – 12.45 14.70 – 14.92	-	13.90 – 14.70
CPT117	-	-	0.0 – 0.90	0.90 – 13.17	-	-
CPT118	-	-	0.0 – 2.20	2.20 – 13.96	-	-
CPT119	**0.0 – 1.40** **2.80 – 3.90**	1.40 – 3.90 3.90 – 5.25	-	5.25 – 13.60 14.50 – 14.89	-	13.60 – 14.50
CPT120	**0.0 – 4.15**	4.15 – 5.30	-	5.30 – 13.05	13.05 – 13.70	13.70 – 14.67
CPT121	-	-	0.0 – 0.55	0.55 – 13.33	-	-
CPT122	-	-	0.0 – 2.90	2.90 – 14.75	-	-
CPT123	**0.0 – 0.70**	0.70 – 2.20	2.20 – 4.70	4.70 – 11.64	-	-
CPT124	**0.0 – 2.10**	4.55 – 5.70	2.10 – 2.60	5.70 – 12.45	-	-

INFERRED UNIT	UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 2C	UNIT 3
TEST LOCATION	**DEPTH BELOW EXISTING GROUND SURFACE (m)**					
	2.60 – 4.55					
CPT125	-	-	0.0 – 1.00	1.00 – 13.90	-	-
CPT126	-	-	0.0 – 1.85	1.85 – 13.12	-	-
CPT127	**0.0 – 1.20** **2.40 – 3.95**	1.20 – 2.40	3.95 – 5.35	5.35 – 13.35 15.00 – 15.89	-	13.35 – 15.00
CPT128	**0.0 – 3.80**	3.80 – 4.60	-	4.60 – 12.80 14.50 – 14.99	12.80 – 13.45	13.45 – 14.50
CPT129	**0.0 – 0.35**	-	-	0.35 – 12.59	-	-
CPT130	**0.0 – 0.30** **1.05 – 1.50**	0.30 – 1.05	-	1.50 – 12.58	-	-
CPT131	**0.0 – 0.90**	0.90 – 1.65	-	1.65 – 13.50	-	13.50 – 14.90
CPT132	**0.0 – 4.40**	4.40 – 5.45	-	5.45 – 13.25 14.55 – 15.68	-	13.25 – 14.55
CPT133	**0.0 – 0.65**	0.65 – 1.85	-	1.85 – 11.59	-	-
CPT134	-	-	0.0 – 0.95	0.95 – 11.99	-	-
CPT135	**0.0 – 4.80**	4.80 – 5.85	5.85 – 7.45	7.45 – 12.11	-	-
CPT136	**0.0 – 2.25**	2.25 – 4.45	-	4.45 – 13.40 14.70 – 14.80	-	13.40 – 14.70
CPT137	**0.0 – 0.60**	-	-	0.60 – 6.30 10.90 – 11.90	9.00 – 10.90	6.30 – 9.00
CPT138	**0.0 – 0.30**	-	0.30 – 1.50	1.50 – 12.79	-	-
CPT139	**0.0 – 0.70**	0.70 – 2.45	4.70 – 7.10	7.10 – 12.12	-	-

INFERRED UNIT	UNIT 1A	UNIT 1B	UNIT 2A	UNIT 2B	UNIT 2C	UNIT 3
TEST LOCATION	**DEPTH BELOW EXISTING GROUND SURFACE (m)**					
	2.45 – 3.05	3.05 – 4.70				
CPT140	**0.0 – 4.85**	4.85 – 5.90	5.90 – 7.10	7.10 – 13.20 15.05 – 16.11	14.50 – 15.05	13.20 – 14.50

5 LABORATORY TESTING

5.1 General

The extent of testing carried out on samples recovered from test pits and boreholes during the current field investigation comprised of:

- Moisture Content (6 no.);
- Atterberg Limits (4 no.);
- Oedometer Test (4 no.);
- Laboratory compaction and ten day soaked CBR (4 no.).

The results of the laboratory testing are presented in Appendix D and are summarised below.

5.2 Moisture Content and Atterberg Limits

The results of the moisture content and Atterberg Limits testing are presented in Tables 5 and 6.

TABLE 5 – SUMMARY OF RESULTS OF MOISTURE CONTENT TESTING

LOCATION	SAMPLE DEPTH (m)	MOISTURE CONTENT (%)
TP1	0.5 – 0.6	53.9
TP3	0.5 – 0.6	42.4
TP3	1.6 – 1.7	35.4
TP5	0.5 – 0.6	38.1
TP6	0.5 – 0.6	43.8
TP7	0.5 – 0.6	47.5

TABLE 6 – SUMMARY OF RESULTS OF ATTERBERG LIMITS TESTING

LOCATION	SAMPLE DEPTH (m)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX
BH104	0.6 – 1.05	36	15	21
BH116	1.5 – 1.95	26	15	11
BH119	0.95 – 1.40	25	16	9
BH128	1.5 – 1.95	29	16	13

Based on the results of Atterberg Limits testing, Unit 1A soils could be given a Unified Classification Symbol of CL to CI.

5.3 Oedometer Testing

Oedometer testing for the current investigation was carried out by Australian Geomechanical Laboratories Pty Ltd. The results of Oedometer testing carried out on four samples as part of the current investigation and on one sample taken from a borehole drilled near the southern boundary of the Stage 1 site as part of Coffey's previous investigation are summarised in Table 7.

TABLE 7 – SUMMARY OF RESULTS OF OEDOMETER TESTING

LOCATION	SAMPLE DEPTH (m)	INFERRED GEOTECH. UNIT	C_C	C_V (m2/yr)	MOISTURE CONTENT (%)
BH104	0.2 – 0.5	1A	0.50	0.8	59.1
BH116	0.5 – 0.76	1A	0.47	0.45	53.8
BH119	0.1 – 0.5	1A	0.42	1.3	24.5
BH128	0.5 – 0.86	1A	0.26	1.5	47.0
CBH4*	2.0 – 2.3	1A	0.34	0.2	39.0

NOTES:

C_C – compression index of clay

C_V – coefficient of consolidation

* - Sample tested as part of Coffey's previous investigation (ref: Coffey Report No. N09814/01-AD, dated 29 August 2006).

5.4 Vane Shear Testing

The results of Vane Shear testing of three samples of undisturbed (U50 tube) samples taken from two boreholes drilled near the southern boundary of the Stage 1 site as part of Coffey's previous investigation of the larger site are summarised in Table 8.

TABLE 8 – SUMMARY OF RESULST OF VANE SHEAR TESTING

LOCATION	SAMPLE DEPTH (m)	MATERIAL TYPE	PEAK SHEAR STRENGTH (kPa)		RESIDUAL SHEAR STRENGTH (kPa)	MOISTURE CONTENT (%)
			Measured	Adjusted*		
CBH4	0.5 – 0.6	CLAY	19	25.3	6	41.1
CBH4	0.7 – 0.8	CLAY	23	30.6	5	41.1
CBH5	1.7 – 1.8	Clayey SAND	6	8.0	1	34.0
* - A correction factor of 1.33 has been applied to the Pilcon hand vane shear test results to account for disturbance and sampling stress relief.						

5.5 CBR Testing

The results of the laboratory CBR testing are summarised in Table 9.

TABLE 9 – SUMMARY OF RESULTS OF CBR TESTING

LOCATION	SAMPLE DEPTH (m)	FIELD MOISTURE CONTENT (%)	OPTIMUM MOISTURE CONTENT (OMC) (%)	RELATIONSHIP OF FIELD MC TO OMC (%)	CBR (%)
TP10	2.5 – 3.0	5.4	19.3	13.9 dry	16
TP11	1.5 – 2.0	4.4	20.0	15.6 dry	18
BH3*	0.6 – 1.0	6.1	9.7	3.6 dry	50
BH5*	0.4 – 0.9	3.8	12.7	8.9 dry	40
* - Sample tested as part of Coffey's previous investigation (ref: Coffey Report No. GEOTSGTE20301AA-AG, dated).					

6 DISCUSSION AND RECOMMENDATIONS

6.1 General

It should be noted that subsurface conditions can vary considerably over relatively short distances in a meandering river valley / alluvial setting such as is the location of this site. Coffey's experience in the local area is that lenses of barrier sand and channel deposits that exist within the profile are erratically distributed and both vertically and laterally discontinuous. The CPT and borehole data used as the basis for the recommendations contained in this report is relatively sparse and variations in ground conditions can occur between test locations. To the best of our knowledge, they represent a reasonable interpretation of the general conditions at the site. Under no circumstances however can it be considered that these findings represent the actual state of the site at all points. Allowance should therefore be made for variability in design and construction budgets and the potential for lateral discontinuity of both the upper Unit 1 and suitable founding Unit 2 materials.

6.2 Geotechnical Issues for Site Development

The proposed development is understood to involve cutting and filling the site to about RL 2.5m AHD finished level. This will involve raising the level of the low lying southern and north western portions of the site by up to about 2.2m. The previous and current field investigations encountered very soft to soft and very loose to loose sediments within these lower lying areas that will undergo significant primary and secondary consolidation settlements as a result of site filling.

To minimise the impact of these settlements on the proposed development, ground improvement works will need to be carried out. Feasible means of ground improvement for the affected portions of the site include:

- Surcharge preloading to complete the majority of settlements as rapidly as possible before development commences. This is achieved by mounding up an appropriate height of fill and leaving it in place until an appropriate amount of settlement has occurred, then cutting the mound back to design level. The amount of settlement achieved is dependant on the drainage properties of the soils within the weak layers. Such properties can be enhanced using wick drains or vertical sand drains;
- Ground reinforcement which transfers the weight of the fill through the weak layers and into the underlying suitable founding materials. This would probably involve the construction of piles or columns on a grid pattern and a geogrid reinforced granular mattress to transfer the uniformly distributed load of the fill to the pile head.
- Surcharge preloading is considered the most suitable ground improvement option for the Stage 1 site and is discussed in detail in the following sections.
- Once the ground improvement works are completed, access roads, hardstands, car parks and lighter or settlement tolerant structures could be founded on top of the fill, however heavier or settlement sensitive elements will require support on deep piled foundations.

6.3 Site Preparation

6.3.1 Stripping Requirements

Stripping requirements for the low lying southern portion of the site which is underlain by weak layers should consist of:

- Removal of all shrubs and trees, including the major root bulb;
- Slashing and removal of slashings by raking;

Stripping of grasses and topsoil from this portion of the site is not recommended because this matted layer will help bridge the underlying saturated soils.

6.3.2 Requirement for Geotextile Layer

Following slashing and raking or stripping there may be a requirement to place a geotextile separating layer prior to placement of fill. A geotextile separating layer is likely to be required in the following areas:

- Within existing drainage channels;
- Over areas that have no grass root mat or have become boggy during stripping.

6.3.3 Fill Embankment Construction

It is understood that filling used in the lower layers at least will comprise aeolian sands (Unit 2) won from the elevated northern portion of the site.

Based on the results of the field investigations, these sands are generally considered to be suitable for reuse as bulk fill on the site provided all vegetation and root affected sands are removed. Removal of the upper 0.15m to 0.3m depth of sands to spoil should be expected.

Imported fill for bulk earthworks should comprise either a well graded granular material of 100mm maximum particle size, clean sand. Placement of fill should be carried out in such a way as to minimise the amount of compaction effort required and should consider among other things slope stability of the fill batter on soft soils.

Sand fill placed in the lower layers of embankments should be compacted to a minimum density index of 70%. Well graded granular fill used in the upper layers should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum density ratio of 98% Standard Compaction in accordance with AS1289 5.1.1 or equivalent.

6.2 Embankment Stability

Calculations have been carried out to estimate safe batter slope angles for placement of fill that could initially be constructed across the low lying southern portion of the site without causing a bearing capacity or stability failure of the underlying materials. Calculations have been made using the slope stability analysis package SLOPE/W.

In situ soil properties used for the calculations have been based on Vane Shear test results from previous investigations, which indicate an insitu undrained shear strength of between 12kPa to 24kPa in the upper 1m depth, reducing to between 8kPa to 12kPa below 1m depth to the base of the weaker layer.

Insitu properties adopted for the analyses are summarised in Table 10.

TABLE 10 – SUMMARY OF INSITU SOIL PROPOERTIES ADOPTED FOR STABILITY ANALYSES

LAYER / DEPTH (m)	UNIT WEIGHT (kN/m^3)	UNDRAINED SHEAR STRENGTH (kPa)	EFFECTIVE COHESION (kPa)	EFFECTIVE FRICTION ANGLE (deg.)
PRELOAD FILL (4.0m max.)	18.0	0	0	30
EMBANKMENT FILL (2.2m max.)	20.0	0	0	33
0.0 – 1.0	16.5	20	5	25
1.0 – 5.2	16.5	12	0	20
>5.2	20.0	0	0	30

Potential circular slip type failures were evaluated for the maximum preload and embankment depths to determine the maximum temporary batter slope minimum stability berm configuration to achieve a Factor of Safety of 1.3 during construction. Preliminary analysis indicates a 20m wide by 2m high stability berm will achieve a FOS of 1.3.

6.3 Embankment Settlement

6.3.1 Basis for Settlement Assessment

Assessments of total settlement have been performed using a Coffey in-house spreadsheet, which considers one-dimensional consolidation under various applied pressures. The analyses incorporate the assessed over-consolidation of the soil as well as appropriate compression and recompression ratios as a function of the assessed pre-consolidation pressures and in-situ vertical stress. The analyses also incorporate an allowance for buoyancy effects due to settlement of the in-situ soil and embankment fill below the ground water table.

Settlement is highly dependent on the thickness of the weak (Unit 1) layer. Based on CPT profiles, the thickness of Unit 1A soils varies between 0.7m to 5.2m across the low lying southern portion of the site (south of grid row 5/6) and is less than 1.5m thick across the slightly more elevated north western portion of the site (north of grid row 5). The thickness of Unit 1B soils is typically less than about 1.5m thick.

For preliminary assessment purposes, settlement analyses have been performed for embankments constructed on Unit 1A thicknesses of 1.5m, 3.0m and 5.2m and a Unit 1B thickness of 1.5m.

Estimates of the consolidation properties of Unit 1A soils have been made based on analysis of piezocone and laboratory testing carried out during the current and previous investigations.

Design parameters adopted for the analyses are presented in Table 11.

TABLE 11 – SUMMARY OF ADOPTED DESIGN PARAMETERS FOR SETTLEMENT ANALYSES

UNIT	DEPTH BELOW GROUND SURFACE (m)	UNIT WEIGHT (kN/m^3)	$C_c/(1+e_0)$	$C_R/(1+e_0)$	$C_v/(1+e_0)$	OCR
1A	0.0 – 1.0	16.5	0.20	0.04	0.008	20
1A	1.0 – 3.0	16.5	0.20	0.04	0.008	3
1A	>3.0	16.5	0.20	0.04	0.008	1.5

6.3.2 Estimated Total Settlement

A summary of the total settlement (primary + one log cycle in time of creep) for three Unit 1A layer thicknesses and two embankment heights is presented in Table 12. The embankment heights chosen are the maximum embankment heights for the two fill areas, being south of grid row 5/6 and the north western portion of the site, north of grid row 5. Settlement of Unit 1A soils is likely to occur rapidly and for the purpose of this assessment, the contribution of settlement from this layer is assumed to occur immediately.

TABLE 12 – SUMMARY OF TOTAL SETTLEMENT FOR VARIOUS UNIT 1A THICKNESSES

UNIT 1A THICKNESS (m)	TOTAL SETTLEMENT (mm)	
	FILL AREA	
	SOUTH OF GRID ROW 5	NW PORTION, NORTH GRID ROW 5
	2.2m Max. Embankment	1.5m Max. Embankment
1.5	-	120
3.0	245	-
5.2	410	-
NOTE - Settlements are for the embankment heights shown plus a 10kPa surcharge loading.		

6.3.3 Rate of Settlement without Ground Improvement

The rates of settlement without ground improvement can be estimated using one-dimensional consolidation theory.

For estimation of vertical Coefficient of Consolidation, C_v, from piezocone dissipation tests carried out during previous investigations, a ratio of $C_h/C_v = 3.0$ was adopted based on the results of groundwater pumping trials which were also carried out as part of previous investigations and which indicated that the ratio of horizontal permeability to vertical permeability of site soils was likely to be of the order of 3.0.

A chart showing the variation of C_v with depth from Soil & Rock Engineering Pty Ltd Report No. dcb5264_3_01rep.doc, dated 28 December 2001 is presented in Appendix C. It is noted that C_v values estimated from dissipation testing are considerably higher than the laboratory values, which probably represents a difference between the laboratory results and the true field values. The design value of C_v adopted for analysis of $7m^2/yr$ corresponds to the lower bound C_v estimated from dissipation testing.

Assuming two way drainage, the predicted time for 90% primary consolidation of various thicknesses of Unit 1A are summarised in Table 13.

TABLE 13 – SUMMARY OF TIME FOR 90% PRIMARY CONSOLIDATION

UNIT 1A THICKNESS (m)	**TIME FOR 90% PRIMARY CONSOLIDATION (Yr)**	
	FILL AREA	
	SOUTH OF GRID ROW 5	**NW PORTION, NORTH GRID ROW 5**
1.5	-	0.1
3.0	0.3	-
5.2	0.9	-

6.3.4 Rate of Settlement for Ground Incorporating Wick Drains

Analyses have been performed using a Coffey in-house spreadsheet to determine the rates of settlement for the Unit 1A soils if prefabricated wick drains having an equivalent effective diameter of 50mm were installed. For wick drains spaced in triangular patterns at 1.5m intervals, 90% consolidation of the Unit 1A layer would occur in approximately 0.2 year for Unit 1A thicknesses of 3.0m and 5.2m. However, the performance of wick drains is dependant on drain capacity, resistance to ‘kinking’ under high settlement, susceptibility to clogging and installation techniques such as degree of smearing. Assessment of the time rate of settlement using wick drains should therefore be regarded as indicative and field trials are required to be carried out to gather more accurate data.

6.3.5 Surcharge Preloading Requirements

Preloading is the placement of a fill load equivalent to the development load, and the ground is allowed to consolidate and thereby remove the majority of the expected settlement under the development load. Surcharging is the placement of extra fill load above the preload amount to either remove the same magnitude of settlement but at a shorter time period, and/or to reduce creep settlement.

Surcharging is a common method of practically removing consolidation settlement and reducing post-construction creep settlement to acceptable limits.

A summary of the thickness of surcharge preloading required to reduce creep settlements to 50mm over a 40 year design life, total settlement under preload and time for 90% primary consolidation under preload for Unit 1A layer thicknesses of 3.0m and 5.2m is presented in Table 14.

TABLE 14: SUMMARY OF SURCHARGE PRELOADING REQUIREMENTS

UNIT 1A THICKNESS (m)	**3.0**	**5.2**
MAX. EMBANKMENT HEIGHT (m)	2.2	2.2
MAX. TOTAL FILL HEIGHT (INCLUDING PRELOAD) (m)	3.0	4.0
SETTLEMENT UNDER PRELOAD (mm)	220	505
TIME FOR 90% CONSOLIDATION (ASSUMING WICK DRAINS AT 1.5m INTERVALS) (Yr)	0.5	0.5

Due to the observed variability in material parameters and layer thicknesses over the site, it is extremely difficult to accurately predict settlement magnitudes or times. The values given in Tables 12 to 14 are shown to the nearest 5mm for illustrative purposes only and are not intended to represent a level of confidence in the estimation. The settlement estimates are likely to be far less accurate and may only be within +/- 50% of the actual values.

6.4 Foundations

6.4.1 General

The proposed development is understood to involve cutting and filling the site to about RL 2.5m AHD finished level. This will involve excavations up to at least 6m depth across the central northern and north eastern portions of the site and filling up to a maximum depth of about 2.2m across the low lying southern and north western portions of the site. Soils at foundation level across the site will therefore comprise typically medium dense to very dense sands across the central northern and north eastern portions of the site and fill to varying depths overlying very soft to soft and very loose to loose sediments to varying depths across the remainder of the site.

It is recommended that heavier or settlement sensitive elements constructed over filled areas or over cut to fill transition zones be founded on pile footings founded into Units 2A, 2B or 2C. Lighter or more settlement tolerant structures could be founded on top of the fill provided the pressure exerted beneath such structures is limited to 10kPa.

6.4.2 Deep Footings

Suitable pile options for this site include driven piles or grout injected CFA piles. Conventional bored piles are not considered feasible for this site because of the shallow water table and likelihood of sediments below the water table to collapse.

Piles founded into Units 2A/2C and 2B materials may be proportioned for the geotechnical strength parameters provided in Table 15.

TABLE 15 – ULTIMATE GEOTECHNICAL STRENGTH PARAMETRS FOR PILE FOOTINGS

PILE TYPE	FOUNDING MATERIAL	ULTIMATE END BEARING PRESSURE (MPa)	ULTIMATE SHAFT ADHESION (kPa)
Non displacement piles – Grout Injected CFA Piles	Unit 2A/2C	3.0	25
	Unit 2B	5.5	45
Displacement piles – Driven Piles*	Unit 2A/2C	5.0	50
	Unit 2B	10	85
* - Parameters to be proved by pile load testing.			

The above parameters assume that piles are founded at greater than 3 pile diameters above weaker underlying layers (Units 2C and 3).

A geotechnical reduction factor of 0.45 should be applied to ultimate capacities to obtain limit state design parameters.

The capacity of piles driven to a refusal set may be evaluated by the Hiley pile driving formulae or wave equation once the pile capacity and hammer size and type are known. Depth to the required set will be dependant on required capacity and size of piles and would be best evaluated by driving test piles.

6.4.3 Negative Skin Friction

Negative skin friction should be accounted for in the design of piles to meet serviceability criteria within areas to be filled that are underlain by Unit 1 materials. The negative skin friction will be excerted by the long term consolidation of the Unit 1A materials and subsequent settlement of the fill embankment.

The magnitude of the negative skin friction is difficult to predict and depends on the pile type and degree of consolidation / densification achieved by the initial preloading of the site. It is recommended that further work should be carried out during the detailed design phase to assess the negative skin friction including a set of pile pull out tests.

6.4.4 Shallow Footings

Structures founded entirely in cut and outside of or below the zone of influence of adjoining Unit 1 materials could be supported on shallow footings comprising stiffened raft slabs or strip and pad footings. Stiffened raft slabs may be cast directly onto the prepared alluvial / aeolian sands (Units 2A and 2B), following stripping and rolling with a heavy smooth drum roller.

A maximum allowable bearing pressure of 100kPa is recommended for shallow footings founded as described above.

6.5 Pavement Design

6.5.1 General

It is understood a segmental concrete block pavement is proposed for heavily trafficked operational areas of the site and an asphaltic concrete surfaced pavement is proposed for lightly trafficked car park areas of the site.

6.5.2 Design Traffic Loading

The following traffic information was supplied by the client for heavily trafficked operational areas of the site:

- Daily Use - Forklifts with a maximum load capacity of 20 tonne;
- Less Frequent Use - Low loader heavy vehicle transporters;
- Infrequent Use - Mobile cranes with a maximum load capacity of 200 tonne.

A design traffic loading of 5×10^5 ESAs has been adopted for proposed lightly trafficked car park areas.

6.5.3 Design CBR

Based on a proposed finished level of RL 2.5m AHD and assuming fill embankments will be constructed using clean sand in the lower layers and a well graded granular material in the upper layers, a design subgrade CBR value of 10% has been adopted for the proposed pavements.

6.5.4 Flexible Pavement Design

Mechanistic analysis using 'LOCKPAVE' was carried out for the proposed segmental concrete block pavement for the design traffic loading and subgrade conditions outlined above. A flexible pavement thickness design for proposed lightly trafficked car park areas has been prepared with reference to APRG Report No. 21.

The recommended material, construction specification and pavement make-ups for the two pavement types are presented on the attached Pavement Thickness Design Summaries (PTDS).

Subgrade materials are expected to comprise a well graded granular fill overlying aeolian sand and sand fill.

6.5.5 Drainage

The enclosed pavement design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. It is recommended that subsoil drains be installed around all landscaped areas.

6.5.6 Site Preparation and Pavement Construction

Low lying areas should be prepared as described in section 6.3.1. Site preparation for other areas and pavement construction for all areas should consist of:

- Prior to construction of the pavement and placement of any fill, the proposed fill areas should be stripped to remove all vegetation, topsoil, root affected or other potentially deleterious material. Stripping across elevated areas of the site is generally expected to be required to depths of between about 0.15m to 0.3m;
- Following stripping, the exposed subgrade materials should be proof rolled to identify any wet or excessively deflecting material. Any such areas should be over excavated and backfilled with an approved select material;
- Approved sand fill beneath pavements should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum density index of 70% (AS1289 5.6.1);
- The top 300mm of natural sand subgrade below pavements should be compacted to a minimum density index of 80%;
- Approved well graded granular fill beneath pavements should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum density ratio of 98% Standard Compaction in accordance with AS1289 5.1.1 or equivalent;
- The top 300mm of approved well graded granular fill beneath pavements should be compacted to a minimum density ratio of 100% Standard Compaction or equivalent.
- Subbase and basecourse layers should be compacted to minimum density ratios of 95% and 98% Modified Compaction respectively in accordance with AS1289 5.2.1.

Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007 *'Guidelines for Earthworks for Commercial and Residential Developments'*.

6.6 Acid Sulfate Soils (ASS) Assessment

6.6.1 Formation of Acid Sulfate Soils

Acid Sulfate Soils (ASS) are soils which contain significant concentrations of pyrite which, in the presence of sufficient moisture, oxidises when exposed to oxygen, resulting in the generation of sulfuric acid.

Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed, the oxidation of pyrite occurs and sulfuric acids are generated, the soils are said to be actual ASS.

Pyritic soils typically form as waterlogged, saline sediments rich in iron and sulfate. Typically, the environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (ie: 10,000 years ago) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (ie: >10,000 years ago) would already have oxidised and leached during periods of low sea level during ice ages, which exposed pyritic coastal sediments to oxygen.

6.6.2 Significance of Acid Sulfate Soils

Disturbance or poorly managed development and use of acid sulfate soils can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters can have a detrimental effect on aquatic ecosystems.

6.6.3 Acid Sulfate Soils Risk Map

Reference to the Acid Sulfate Soils Risk Map for Beresfield / Williamtown indicates that the site is located near the boundary between an area where there is a low probability of occurrence of acid sulfate soil materials greater than 3m below the ground surface and an area where there is a high probability of acid sulfate soil materials between 1m and 3m below the ground surface.

6.6.4 Screening Tests

Samples obtained during the field investigation were screened for the presence of actual and potential acid sulfate soils using methods 21Af and 21Bf of the 1998 ASSMAC Guidelines. The results of screening tests are presented in Appendix E and are summarised below:

- pH values in 1:5 soil to distilled water mix ranged from 3.45 to 7.45. A pH of <4 in this test can indicate the presence of actual ASS;
- pH values of soil in 30% H_2O_2 were between 1.49 to 5.85. A pH of <3 in this test can indicate the presence of potential ASS;
- A maximum pH change of 5.15 after oxidation with H_2O_2 was recorded. Significant pH changes (>2) after oxidation with H_2O_2 can indicate potential ASS. pH changes >2 were recorded in 57 of the 135 samples screened for ASS;
- Vigorous effervescence reactions were observed in 19 of the 135 samples tested. Vigorous effervescent reactions with oxidation in 30% H2O2 can indicate potential ASS;
- An odour was released upon oxidation with H2O2 in 19 of the 135 samples tested. A sulphurous odour is often associated with oxidising potential ASS;
- Temperatures of greater than 60° were recorded in 20 of the 135 H_2O_2 oxidation screening tests. Generally the oxidation of significant quantities of pyrite in this test will generate temperatures to >60°C.

6.6.5 Laboratory Analysis

Laboratory test results for samples sent for SCR Suite analysis are summarised in Table 16.

TABLE 16 – SUMMARY OF ASS TEST RESULTS

LOCATION	SAMPLE DEPTH (m)	SCREENING TEST RESULT		S_{CR} (%)	NET ACIDITY (mol H+ / tonne)	LIMING RATE (kg / tonne)
		pH_F	pH_{FOX}			
TP1	3.4 – 3.5	3.95	2.22	**0.508**	**361**	**31**
TP2	1.4 – 1.5	3.78	2.99	0.013	**59**	**6**
TP3	1.6 – 1.7	7.39	2.48	**0.550**	**343**	**38**
TP4	3.5 – 3.6	6.12	1.78	**0.115**	**73**	**8**
TP5	2.1 – 2.2	7.26	2.58	**0.670**	**418**	**41**
TP6	1.5 – 1.6	5.96	2.93	0.002	7	1
TP7	2.0 – 2.1	7.43	2.43	**0.595**	**371**	**30**
TP14	2.5 – 2.6	4.81	1.55	**0.192**	**135**	**16**
ASSMAC Action Criteria	-	-	-	0.1* 0.03**	62* 18**	-
Levels of Concern for Screening Test	-	4	3	-	-	-

* Action criteria shown are those for fine textured soils (ie clays) and management of excavations involving disturbance of less than 1000 tonnes of soil.

** Action criteria shown are those for course textured soils (ie sands) and management of excavations involving disturbance of more than 1000 tonnes of soil.

S_{CR} – Percentage of chromium reducible Sulfur

Results of SCR Suite analysis indicate that seven out of the eight samples tested exceeded the Acid Sulfate Soil Management Advisory Committee (ASSMAC) action criteria. Works involving disturbance of soils that exceed these action criteria must prepare an Acid Sulfate Soils Management Plan.

6.6.6 Interpretation of Results

Based on the results of screening tests and SCR Suite analysis presented in Appendix B, it is considered that the majority of alluvial soils encountered below about RL 1.5m AHD are potential acid sulfate soils and aeolian sands encountered above the proposed site finished level of about RL 2.5m AHD are not actual or potential ASS.

7 CONSTRUCTION RISK

The extent of testing associated with this assessment is limited to discrete test locations and variations in ground conditions can occur between and away from such locations. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

Further advice on the uses and limitations of this report is presented in the attached document, '*Important Information about your Coffey Report*'.

For and on behalf of Coffey Geotechnics Pty Ltd



Arthur Love

Principal Geotechnical Engineer

OCT25-02

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19 Warabrook Boulevard, Warabrook, NSW, 2304
Ph: (02) 4016 2300 Fax (02) 4016 2380

pavement thickness design summary

client : *ASQUITH & DE WITT PTY LTD*
job no : *GEOTSGTE20301AA*

principal :
laboratory : *NEWCASTLE*

project : *PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT*
report date : *October 25, 2007*

location : *TOMAGO ROAD, TOMAGO*
test report no.: *OCT25-02/1*

council : *PORT STEPHENS COUNCIL*
designed by : *RJP* checked by :

road name or type :		*Concrete Segmental Pavement*			
chainage interval :	(m)	*Based on 20t capacity forklift*			
design traffic loading:		*5 x 10^6*			
paving unit thickness :	(mm)	*80*			
basecourse thickness:	(mm)	*525*			
sub-base thickness:	(mm)	*150*			
select thickness:	(mm)	-			
total thickness :	(mm)	*755**			
CBR used for design :	(%)	*10*			

design traffic loading : Design traffic loading is the number of equivalent standard axles (E.S.A.) in the design lane during the design period. For definitions, refer Appendix 1.1 "Pavement Design" AUSTROADS. Refer covering letter/report.

Material Quality

paving unit : *Shape Type A laid in herringbone pattern*

basecourse : *Conforming to RN73*

sub-base: *Conforming to ARRB Special Report No 41*

select : ** - Thickness does not include 25mm compacted thickness bedding course.*

Note : Recommended material types may vary from those of job specification or statutory authority. Refer covering letter/report.

Compaction Requirements

wearing course : *N/A*

basecourse : upper : *98% Modified*

lower :

sub-base : *95% Modified*

select : -

subgrade : *80% Density Index*

fill below : *70% Density Index*

Modified: Minimum required dry density ratio, AS1289 5.4.1-1993, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent, and the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.

Standard: As above, but maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.

Density Index: Minimum required Density Index AS1289 5.6.1-1998, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent, and laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent.

Note: Recommendations for compaction may vary from those of job specification or statutory authority. Refer covering letter/report.

Drainage: The design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. Refer covering letter/report.

Form Number LZ.TUR1 Version 0.0
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Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

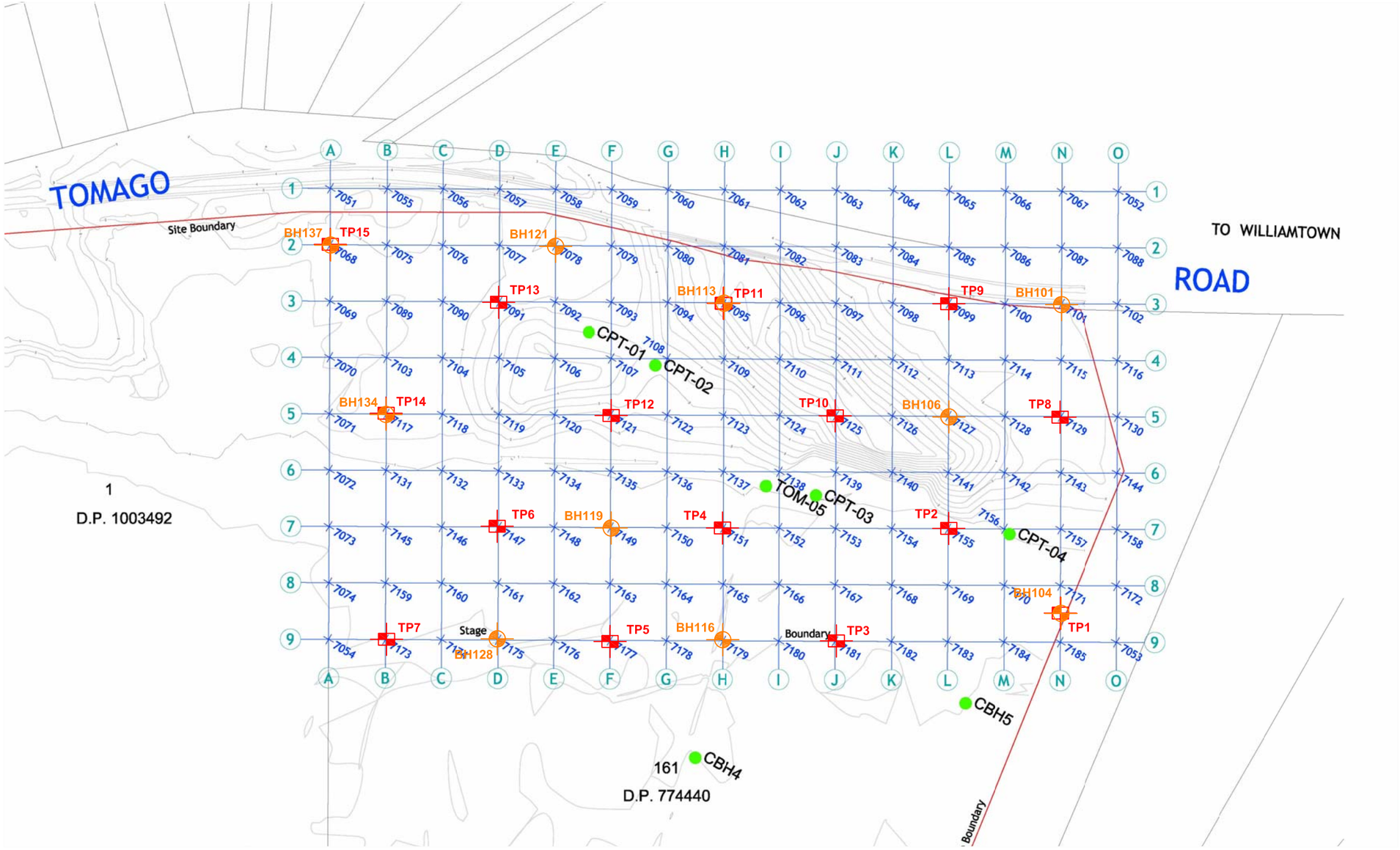
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures



LEGEND

- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE BOREHOLE LOCATION

revision	description	drawn	approved	date

0 40 80 160 240

Scale (metres)

drawn	CW/NLS
approved	RJP
date	08-07-06
scale	1:4000
original size	A3

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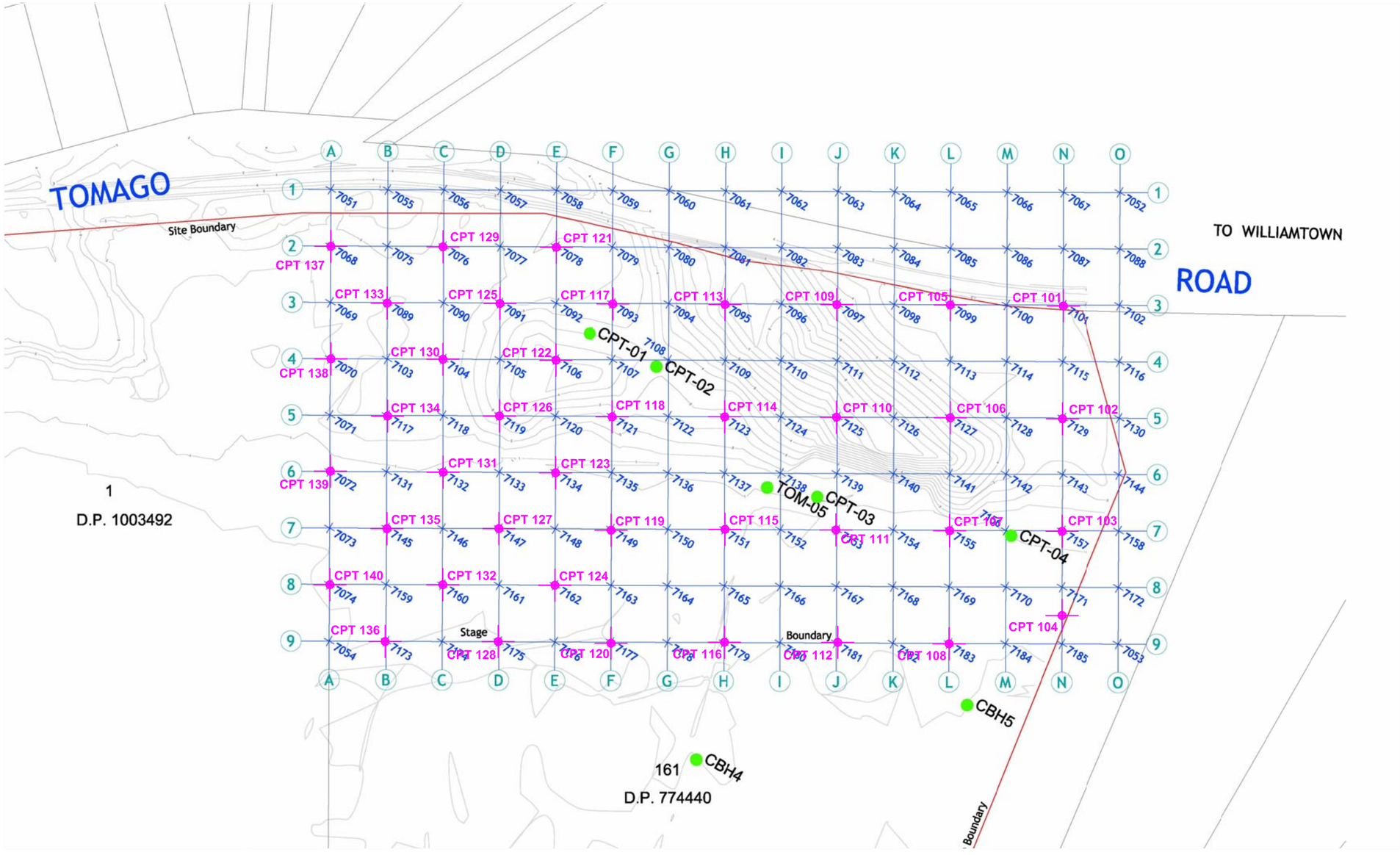
client: ASQUITH & de WITT PTY LTD

project: PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO

title: APPROXIMATE TEST LOCATION PLAN

project no: GEOTSGTE20301AA

figure no: FIGURE 1A



LEGEND

APPROXIMATE CPT LOCATION

revision	description	drawn	approved	date

0 40 80 160 240

Scale (metres)

drawn	CW/NLS
approved	RJP
date	08-07-06
scale	1:4000
original size	A3

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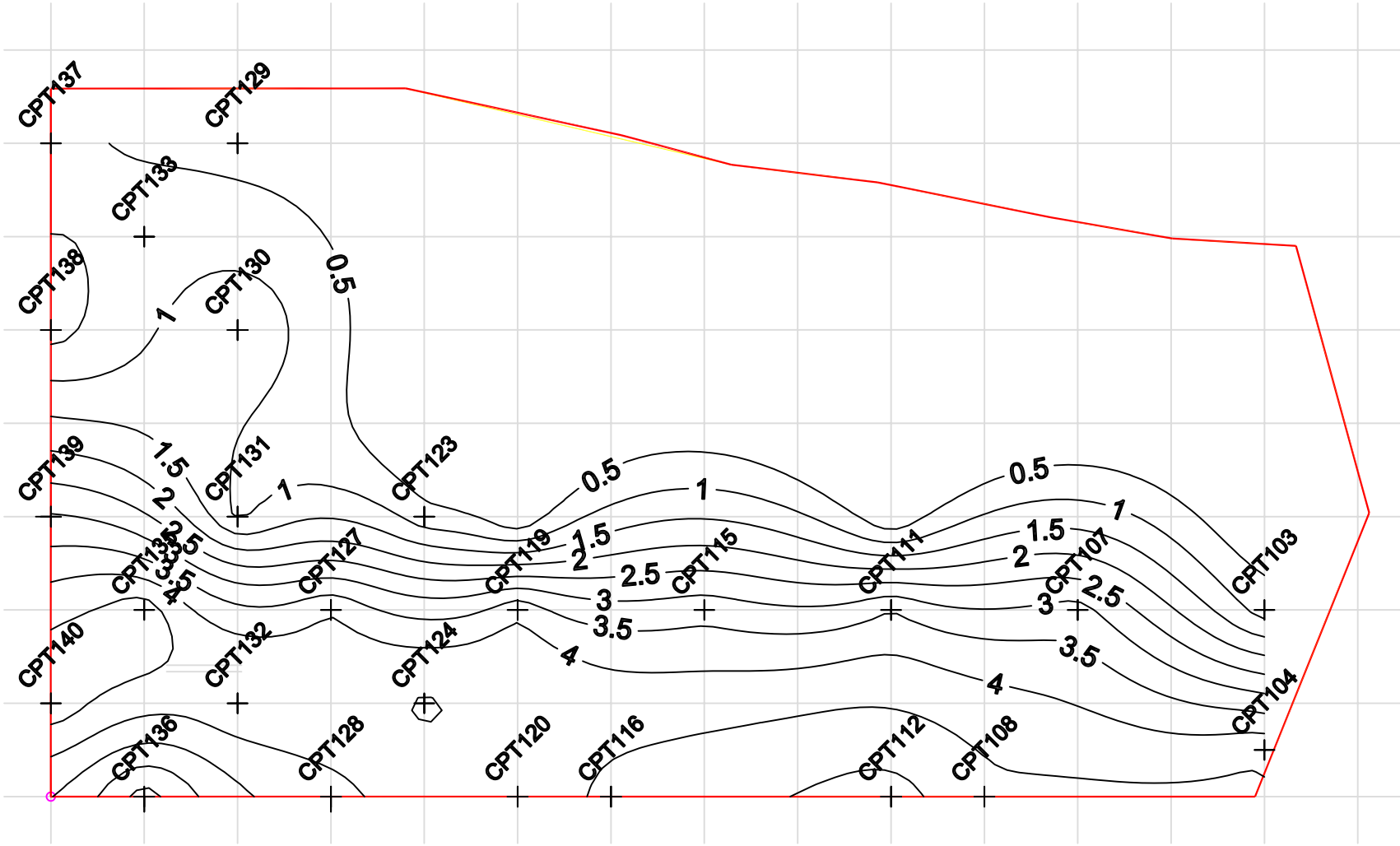
client: ASQUITH & de WITT PTY LTD

project: PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO

title: APPROXIMATE TEST LOCATION PLAN

project no: GEOTSGTE20301AA

figure no: FIGURE 1B



LEGEND

1.5 SOIL THICKNESS

drawn	NLS
approved	ABL
date	15-11-07
scale	1:4000
original size	A4

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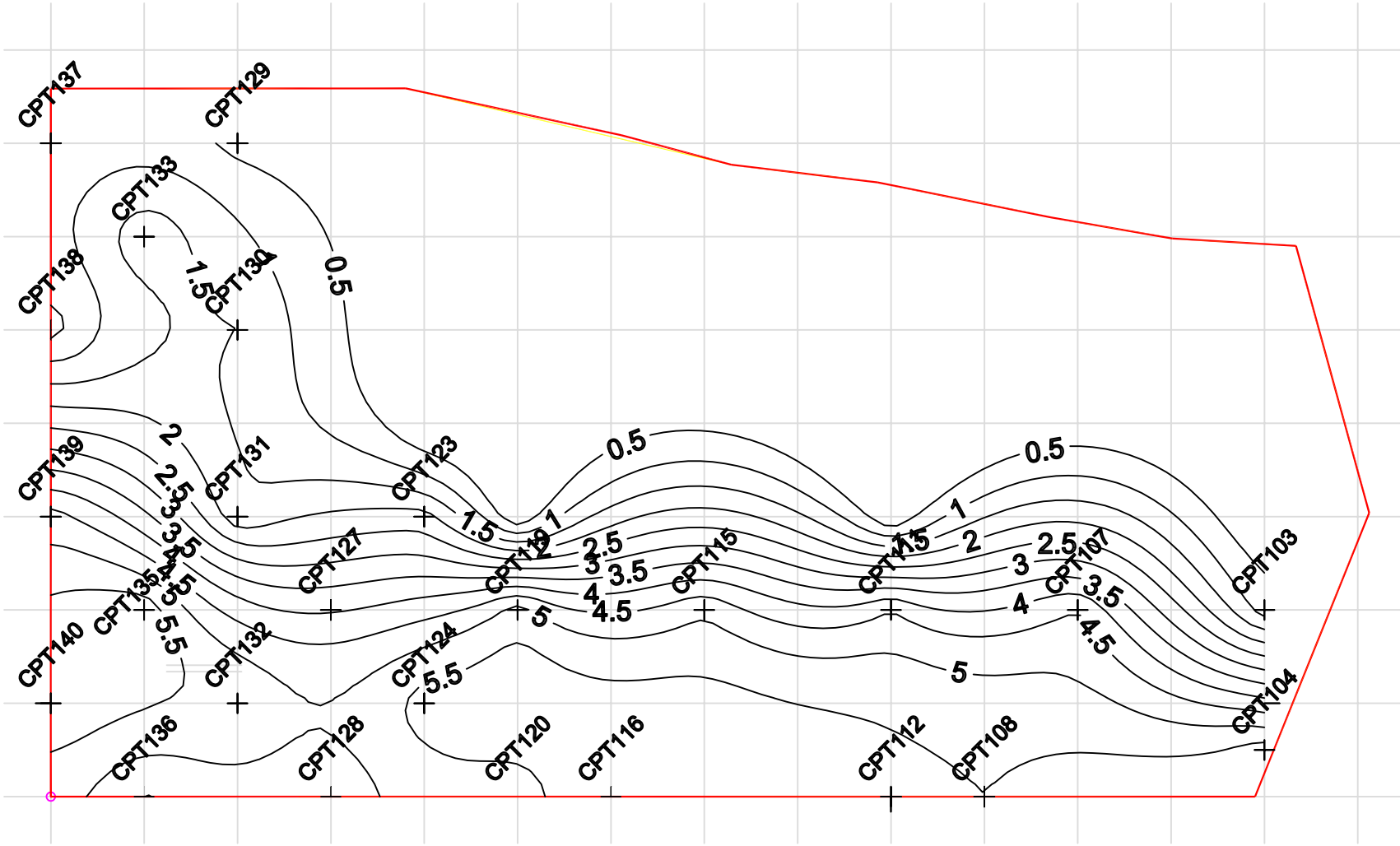
client: ASQUITH & de WITT PTY LTD

project: PROPOSED WESTRAC INDUSTRIAL DEVLEOPMENT TOMAGO ROAD, TOMAGO

title: UNIT 1A SOIL THICKNESSES

project no: GEOTSGTE20301AA

figure no: FIGURE 1C



LEGEND

1.5 SOIL THICKNESS

drawn	NLS
approved	ABL
date	15-11-07
scale	1:4000
original size	A4

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SPECIALISTS MANAGING THE EARTH

client: ASQUITH & de WITT PTY LTD

project: PROPOSED WESTRAC INDUSTRIAL DEVLEOPMENT TOMAGO ROAD, TOMAGO

title: UNIT 1A AND 1B SOIL THICKNESSES

project no: GEOTSGTE20301AA

figure no: FIGURE 1D

Appendix A

Results of Field Investigations

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

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Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	PEAT

• Low plasticity – Liquid Limit W_L less than 35%. • Modium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

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Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance	In engineering terms roch substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**SW**	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:

1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
2. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbrev-iation	Point Load Index, I_S50 (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

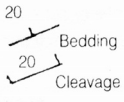
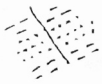
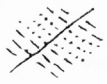
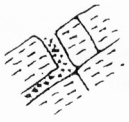
Notes on Rock Substance Strength:

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
3. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index (Is50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

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Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS

Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greate than cross section

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Engineering Log - Excavation

Excavation No. **TP 1**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383580.84 m | R.L. Surface: 0.57

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367619.67 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
E		N			0.5	0.5			**TOPSOIL:** Silty CLAY, low to medium plasticity, brown, 150-200mm of rootlets.	M			TOPSOIL
				D	0.0			CI	**CLAY:** medium plasticity, grey mottled orange.	M>Wp	St		ALLUVIAL
						1.0		CH	**CLAY:** high plasticity, grey.				
			9:14am ▼	D	-0.5			CH	**Sandy CLAY:** high plasticity, grey, white / grey, sand fine to coarse grained.				Pit collapsing from sides water ponding.
					-1.0	1.5							
					-1.5	2.0							
				D	-2.0	2.5							
					-2.5	3.0			Becoming sandier with depth less fines.				Excavator slowly sinking in tracks, sunk 0.3m-0.4m.
				D	-3.0	3.5							
						4.0			Test pit TP 1 terminated at 3.6m				

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP 2**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383444.38 m | R.L. Surface: 0.83

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367656.8 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
E		N			0.5	0.5			**TOPSOIL:** Silty CLAY, medium plasticity, dark brown with rootlets.	M			TOPSOIL
				D	0.0	1.0		SC	**Silty Clayey SAND:** fine to medium grained, pale grey / brown, medium plasticity fines, trace of rootlets.		MD		ALLUVIAL
					-0.5			SC	**Clayey SAND:** fine to medium grained, grey, trace of roots.				
			►	D	-1.0	1.5		SP	**SAND:** fine to coarse grained, grey-pale grey, with small traces of fines.	M/W	MD/D		
				D	-1.5	2.5							
				D	-2.0	3.0							
					-2.5	3.5			Pit collapsing from sides. Test pit TP 2 terminated at 3.2m				
					-3.0	4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP 3**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383407.25 m | R.L. Surface: 0.56

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367520.34 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
EI		N							**TOPSOIL:** Silty CLAY, high plasticity, dark brown, with rootlets to approximately 400mm.	M			TOPSOIL
				D	0.0	0.5		CI	**CLAY:** medium plasticity, grey mottled orange, trace of rootlets, trace of fine sand.	M>Wp	F	x	ALLUVIAL
								CH	**CLAY:** medium to high plasticity, pale grey.			x	
			▶		-0.5	1.0		CH	**CLAY:** high plasticity, grey, trace of fine sand.	M/W >Wp			
				D	-1.0	1.5							
				D				SC	**Clayey SAND / Sandy CLAY:** fine to medium grained, dark grey / grey, with band of shells, approximately 20cm size.	W	MD		ESTUARINE
					-1.5	2.0							
					-2.0	2.5							
				D									
				D	-2.5	3.0							
					-3.0	3.5			Pit collapsing from sides. Excavator sinking. Test pit TP 3 terminated at 3.2m				
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP 4**

Sheet 1 of 2

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383270.79 m | R.L. Surface: 0.75

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367557.48 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N			0.5	0.5			**TOPSOIL:** Silty CLAY, low to medium plasticity, dark brown-black, with rootlets to approximately 200mm.	M			TOPSOIL
				Bs	0.0			SC	**Clayey SAND:** fine to medium grained, pale brown, low plasticity fines.		MD		ALLUVIAL
			rapid inflow		-0.5	1.0		SC	**Clayey SAND:** fine to coarse grained, grey, low to medium plasticity fines.		D		
				Bs	-1.0	1.5		SP	**SAND:** fine to coarse grained, grey-dark grey, trace of fines.	M/W			
				Bs	-1.5	2.0							
					-2.0	2.5							
				Bs	-2.5	3.0							
					-3.0	3.5		SP	**SAND:** fine to coarse grained, grey-dark grey, trace of medium grained gravel pieces, less than 1cm size rounded to subrounded. Pit collapsing from sides. Pit widened to get 1m	W			
						4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP 4**

Sheet 2 of 2

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383270.79 m | R.L. Surface: 0.75

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367557.48 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
					-3.5	4.5			deeper. Test pit TP 4 terminated at 3.6m				
					-4.0	5.0							
					-4.5	5.5							
					-5.0	6.0							
					-5.5	6.5							
					-6.0	7.0							
					-6.5	7.5							
					-7.0	8.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP 5**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383233.65 m | R.L. Surface: 0.85

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367421.02 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N	Water ponding		0.5	0.5			**TOPSOIL:** Silty CLAY, high plasticity, dark brown, with rootlets.	W>Wp			TOPSOIL
				D				CH	**Sandy CLAY:** medium plasticity, brown, with some rootlets.		F		ALLUVIAL
					0.0	1.0		CH	**Sandy CLAY:** high plasticity, grey, with some rootlets.		St		
				D	-0.5	1.5		CH	**Sandy CLAY:** high plasticity, dark grey / grey, sand fine to medium grained, traces of rootlets.	W			
				D	-1.0	2.0		CH	**Sandy CLAY:** high plasticity, dark grey / grey, shelly layer.				ESTUARINE
					-1.5	2.5			Pit collapsing from both sides. Hole water logged, filled about 0.3m to 0.5m. Test pit TP 5 terminated at 2.2m				
					-2.0	3.0							
					-2.5	3.5							
					-3.0	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP 6**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383097.2 m | R.L. Surface: 0.65

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367458.15 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N	Not measured - water ponding in bottom of pit.		0.5				**TOPSOIL:** Silty CLAY, low plasticity, dark brown-black, with some rootlets.	M			TOPSOIL
				D	0.0	0.5		CH	**CLAY:** medium to high plasticity, with some rootlets, brown mottled orange.		F		ALLUVIAL
					-0.5	1.0							
				D	-1.0	1.5		SC	**Clayey SAND:** fine to coarse grained, pale brown mottled orange, low plasticity fines.	W	MD		
								SP	**SAND:** fine to coarse grained, grey, with small percentage of fines, colour mottling to pale brown.				
				D	-1.5	2.0							
					-2.0	2.5							
				D	-2.5	3.0			Pit collapsing from sides water infilling and ponding at bottom of pit. Test pit TP 6 terminated at 3m				
					-3.0	3.5							
						4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Engineering Log - Excavation

Excavation No. **TP 7**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383060.06 m | R.L. Surface: 0.50

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367321.7 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N	▼						**TOPSOIL:** Silty CLAY, low to medium plasticity, brown-dark brown, with some rootlets.	M			TOPSOIL Water ponding on surface.
								CH	**CLAY:** medium to high plasticity, brown / grey.	M/W >Wp	F/St		ALLUVIAL
				D	0.0	0.5							
					-0.5	1.0							
			▼	D	-1.0	1.5			Colour change to dark grey.				
								SC	**Clayey SAND:** fine to medium grained, dark grey, medium plasticity fines, with shell layer (interbedded).	W	MD/D		ESTUARINE
				D	-1.5	2.0							
									Pit collapsing from sides. Excavator having trouble staying stable. Test pit TP 7 terminated at 2.2m				
					-2.0	2.5							
					-2.5	3.0							
					-3.0	3.5							
					-3.5	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
▼ water level on date shown
► water inflow
◄ water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP 8**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383481.52 m | R.L. Surface: 2.85

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367793.26 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N			2.5	0.5			**TOPSOIL:** Silty SAND, fine to coarse grained, brown, rootlets to approximately 50mm.	D			TOPSOIL / AEOLIAN
				D	2.0	1.0		SM	**Silty SAND:** fine to coarse grained, pale brown.		MD/D		AEOLIAN
				D	1.5	1.5			Colour change to brown / orange-yellow.	M			
					1.0	2.0		SP	**SAND:** fine to coarse grained, pale brown / white-tan, traces of rounded to subrounded gravel, small pieces less than 1cm in size.				ALLUVIAL
				D	0.5	2.5		SP	**SAND:** fine to coarse grained, orange / brown, tan.	W			Slow inflow of groundwater in bottom of pit.
					0.0	3.0			Pit collapsing from sides. Test pit TP 8 terminated at 3.2m				
					-0.5	3.5							
					-1.0	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TESTPIT 20301AA LOGS TP'S.GPJ COFFEY.GDT 5.11.07

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Engineering Log - Excavation

Excavation No. **TP 9**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383345.06 m | R.L. Surface: 2.75

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367830.4 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
EX		N		D	2.5	0.5		SM	**Silty SAND:** fine to coarse grained, grey-brown, with some rootlets.	D	MD/D		TOPSOIL / AEOLIAN
					2.0	1.0			Colour change to grey-dark grey.	M			
			▶	D	1.5	1.5		SM	**Silty SAND:** fine to coarse grained, brown-pale brown with some small less than 5mm size gravel pieces, rounded.	M/W			ALLUVIAL
					1.0	2.0							
					0.5	2.5			Colour change to orange-brown / brown.				
				D	0.0	3.0							
					-0.5	3.5			Pit collapsing from sides and completely full of water at bottom of pit. Test pit TP 9 terminated at 3m				
					-1.0	4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP10**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383307.92 m | R.L. Surface: 7.0

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367693.94 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N	None Observed	D	6.5	0.5		SM	**Silty SAND:** fine to medium grained, dark brown-black.	D	MD/D		FILL / TOPSOIL / AEOLIAN
					6.0	1.0			Colour change to grey / white.	M			Plastic lids, petrol caps, beer bottles, household domestic rubbish??, encountered.
					5.5	1.5			Colour change to white, trace of silt.				
					5.0	2.0							
					4.5	2.5							
				Bs				SM	**Silty SAND:** dark brown / brown mixed with white sand medium to coarse grained.				
					4.0	3.0			Test pit TP10 terminated at 3m				
					3.5	3.5							
					3.0	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP11**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383171.46 m | R.L. Surface: 7.25

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367731.07 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
E		N	None Observed	D	7.0	0.5		SM	**Silty SAND:** fine to coarse grained, grey, with some rootlets.	D	MD/D		TOPSOIL / AEOLIAN
					6.5	1.0							
					6.0	1.5							
				Bs	5.5	2.0		SP	**SAND:** fine to coarse grained, grey-white.	M			AEOLIAN
					5.0	2.5							
				D	4.5	3.0			Colour change to mottled brown.				
					4.0	3.5			Pit collapsing from sides. Test pit TP11 terminated at 3.1m				
					3.5	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP12**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 383134.33 m | R.L. Surface: 2.60

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367594.61 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
E		N	None Observed		2.5				**TOPSOIL:** Silty SAND, fine to medium grained, brown.	D			TOPSOIL / AEOLIAN
				D	2.0	0.5		SM	**Silty SAND:** fine to medium grained, pale brown. Colour change to brown / orange.	M	MD		AEOLIAN
				D	1.5	1.0		SM	**Silty SAND:** medium to coarse grained, pale brown / orange-white.				
				D	1.0	1.5			thin layers of dark brown / orange, intermixed with white sand, trace of cemented / indurated sand nodules, dark brown /orange coloured.	W			
					0.5	2.0							
					0.0	2.5			Test pit TP12 terminated at 2.2m				
					-0.5	3.0							
					-1.0	3.5							
						4.0							

Sketch

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP13**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 382997.87 m | R.L. Surface: 2.40

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367631.75 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N		D	2.0	0.5		SM	**Silty SAND:** fine to medium grained, pale grey / brown.	D	MD		TOPSOIL / AEOLIAN
				D	1.5	1.0		SM	**Silty SAND:** fine to medium grained, dark brown / black, grading into indurated sands.	M	VD		INDURATED SANDS Slight organic odour present.
			►		1.0	1.5			Colour change slightly to brown / dark brown.	W			
				D	0.5	2.0							
					0.0	2.5							
					-0.5	3.0			Test pit TP13 terminated at 2.6m				
					-1.0	3.5							
					-1.5	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Engineering Log - Excavation

Excavation No. **TP14**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 382960.74 m | R.L. Surface: 1.55

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367495.29 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
E		N		D	1.0	0.5		SM	**Silty SAND:** fine to medium grained, dark brown-black, with some rootlets.	D	MD		TOPSOIL / AEOLIAN
					0.5	1.0				M			
			▶	D	0.0	1.5		SM	**Silty SAND:** fine to medium grained, dark brown / dark red (coffee colour) with lenses of indurated sand which are black.		VD		INDURATED SANDS Strong organic odour present.
					-0.5	2.0							
				D	-1.0	2.5				W			
					-1.5	3.0			Test pit TP14 terminated at 3m				
					-2.0	3.5							
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP15**

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **9.5.2007**

Principal:

Date completed: **9.5.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Test pit location: **TOMAGO ROAD, TOMAGO**

Checked by:

equipment type and model: CAT Excavator | Pit Orientation: | Easting: 382842.85 m | R.L. Surface: 1.70

excavation dimensions: 2.5m long 1.5m wide | Northing: 6367600.65 m | datum: AHD

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
E		N			1.5	0.5			**TOPSOIL:** Silty Clayey SAND, fine to medium grained, dark brown / black, with some rootlets to approximately 100mm, low plasticity fines.	M			TOPSOIL
			▶	D	1.0	1.0		SM	**Silty SAND:** fine to medium grained, dark brown / brown, trace of clay.		MD		AEOLIAN Strong organic odour present.
					0.5						D		
				D	0.0	1.5		SP	**SAND:** fine to coarse grained, pale brown-white.	W			
						2.0			Colour change to pale brown-brown.				
				D	-0.5	2.5							
					-1.0	3.0			Notes: Water appeared to be flowing from one side of pit. Pit infilling and collapsing from sides. Test pit TP15 terminated at 2.5m				
					-1.5	3.5							
					-2.0	4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Borehole No. **BH101**

Sheet 1 of 3

Project No: **GEOTSGTE20301AA**

Engineering Log - Borehole

Client: **ASQUITH & de WITT PTY LTD**

Date started: **6.6.2007**

Principal:

Date completed: **6.6.2007**

Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**

Logged by: **CW**

Borehole Location: **REFER TO FIGURE 1B**

Checked by:

drill model and mounting: 4WD Mounted | Easting: 383437 | slope: -90° | R.L. Surface: 2.69

hole diameter: mm | Northing 6367871 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
HF		C			2				**Silty SAND:** fine to coarse grained, brown grey, root affected.	M			TOPSOIL / AEOLIAN
				SPT 2,3,5 N*=8	1	1		SP	**SAND:** medium to coarse grained, dark brown.	M-W	MD		AEOLIAN
			8:26am										
				SPT 2,3,5 N*=8	0	2			Traces of gravel pieces <10mm and trace of root material.	W			ALLUVIAL
											D		
				SPT 3,6,7 N*=13	-1	3			Colour change to brown, trace of gravel pieces, <50mm size.				
						4					VL		
				SPT 3,2,1 N*=3	-2	5							
					-3	6							
				SPT 0,0,1 N=1									
					-4	7					D		
				SPT 4,9,17 N=26	-5	8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix e.g.	ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole No.	**BH101**
Sheet	2 of 3
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**6.6.2007**
Principal:	
Date completed:	**6.6.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 383437 | slope: -90° | R.L. Surface: 2.69

hole diameter: mm | Northing 6367871 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C			-6	9		SP	**SAND:** medium to coarse grained, dark brown. *(continued)*	W	D		
									Colour change to brown, trace of gravel pieces (continued).				
				SPT 9,32,24 N=56	-7	10							
				SPT 8,14,14 N=28	-8	11							
					-9	12							
				SPT 4,16,14 N*=30	-10	13							
				SPT 11,15,12 N=27	-11	14							
					-12	15							
				SPT 33,18,R N=R	-13	16							SPT at 15m, 18 blows for 40mm penetration - hammer bouncing.

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, C casing, N nil

penetration 1 2 3 4: no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH101**
Sheet	3 of 3
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**6.6.2007**
Principal:	
Date completed:	**6.6.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 383437 | slope: -90° | R.L. Surface: 2.69

hole diameter: mm | Northing 6367871 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C						SP	SAND: medium to coarse grained, dark brown. *(continued)*	W	MD		
				SPT 5,11,10 N=21	-14	17			Colour change to brown, trace of gravel pieces (continued). Colour change to grey / pale grey.				
					-15	18		CH	CLAY: medium to high plasticity, grey-dark grey, trace of sand fine grained.	M>Wp	St	× × ×	
				SPT 5,13,13 N*=26	-16	19							
				SPT 4,7,9 N*=16	-17	20						× × ×	
									Borehole BH101 terminated at 19.95m				
					-18	21							
					-19	22							
					-20	23							
					-21	24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, C casing, N nil

penetration: 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH104**
Sheet	1 of 3
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**15.8.2007**
Principal:	
Date completed:	**15.8.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: Track Mounted | Easting: 373573 | slope: -90° | R.L. Surface: 0.55

hole diameter: mm | Northing 6367618 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADT		C		U_{50}	0				**Silty CLAY:** medium plasticity, dark brown-brown, with some rootlets.	M>Wp	VS		ALLUVIAL
			▼	SPT 0,0,0 N*=0		1		CI-SC	**Clayey SAND / Sandy CLAY:** medium plasticity fines, grey, fine to medium grained, with some roots.	M-W		x	SPT at 0.6m, sunk under weight of hammer.
W				SPT 0,0,0 N*=0	-1			SC	**Clayey SAND:** fine to coarse grained, dark grey-grey, low to medium plasticity fines.		VL	x	SPT at 1.5m, sunk under weight of hammer.
					-2	2							
				SPT 0,0,0 N*=0		3							SPT at 3.0m, sunk under weight of hammer.
					-3								
						4							
				SPT 0,0,1 N*=1	-4								
					-5	5							
						6							
				SPT 5,7,12 N*=19	-6			SP	**SAND:** fine to coarse grained, pale brown-brown.		D		
						7							
				SPT 10,15,20 N*=35	-7								
						8							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix e.g. ADT

support
M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
▼ 10/1/98 water level on date shown
► water inflow
◄ water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07

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coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH104**
Sheet	2 of 3
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**15.8.2007**
Principal:	
Date completed:	**15.8.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: Track Mounted | Easting: 373573 | slope: -90° | R.L. Surface: 0.55

hole diameter: mm | Northing 6367618 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C			-8	9		SP	**SAND:** fine to coarse grained, pale brown-brown. *(continued)*	M-W	D		
				SPT 8,15,20 N*=35	-9	10				W			SPT at 9.0m, 20 blows for130mm penetration - hammer bouncing.
					-10	11					MD		
				SPT 3,5,8 N*=13	-11	12		SP	**SAND:** grey, fine to coarse grained, traces of fines.				
					-12	13							
					-13	14					VL		
				SPT 1,0,1 N*=1	-14	15		SC	**Clayey SAND:** fine to coarse grained, grey, low plasticity fines, trace of fine grained gravel subrounded-rounded and trace carbonaceous material.				
					-15	16							

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07

Form GEO 5.3 Issue 3 Rev.2

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	BH104
Sheet	3 of 3
Project No:	GEOTSGTE20301AA
Client:	ASQUITH & de WITT PTY LTD
Date started:	15.8.2007
Principal:	
Date completed:	15.8.2007
Project:	PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT
Logged by:	CW
Borehole Location:	REFER TO FIGURE 1B
Checked by:	

drill model and mounting: Track Mounted | Easting: 373573 | slope: -90° | R.L. Surface: 0.55

hole diameter: mm | Northing 6367618 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
W		C			-16	17		SC	**Clayey SAND:** fine to coarse grained, grey, low plasticity fines, trace of fine grained gravel subrounded-rounded and trace carbonaceous material. *(continued)*	W	VL		
				SPT 30 N=R	-17	18		SP	**Clayey Gravelly SAND:** fine to coarse grained, grey, fine to coarse grained gravel subangular to subrounded, low plasticity fines, gravel colours, orange, red, brown, green, white.		VD		SPT at 17m, 30 blows for 150mm penetration.
					-18	19			Borehole BH104 terminated at 17.15m				
					-19	20							
					-20	21							
					-21	22							
					-22	23							
					-23	24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix e.g.	ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH106**
Sheet	1 of 2
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**12.6.2007**
Principal:	
Date completed:	**12.6.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 383395 | slope: -90° | R.L. Surface: 4.67

hole diameter: mm | Northing 6367744 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C						SM	**TOPSOIL:** Silty SAND, fine to coarse grained, dark brown-black, root affected.	M	MD		TOPSOIL
									Silty SAND: fine to coarse grained, dark brown-black.				AEOLIAN
				SPT 1,2,3 N*=5	4	1		SP	**SAND:** fine to coarse grained, grey-pale grey.				
				SPT 2,2,2 N*=4	3	2		SP	**SAND:** fine to coarse grained, dark brown-black.				
			▼		2						L		
				SPT 0,1,2 N*=3	1	3		SP	**SAND:** fine to coarse grained, grey-pale grey-pale brown, traces of fine grained gravel, subrounded-rounded.	W			ALLUVIAL
						4					MD		
				SPT 0,3,8 N*=11	0	5							
					-1	6							
				SPT 0,2,6 N*=8	-2	7							
				SPT 0,2,8 N*=10	-3	8							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing

penetration 1 2 3 4
no resistance ranging to refusal

water
▼ 10/1/98 water level on date shown
► water inflow
◄ water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH106**
Sheet	2 of 2
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**12.6.2007**
Principal:	
Date completed:	**12.6.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 383395 | slope: -90° | R.L. Surface: 4.67

hole diameter: mm | Northing 6367744 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C			-4	9		SP	SAND: fine to coarse grained, grey-pale grey-pale brown, traces of fine grained gravel, subrounded-rounded. *(continued)*	W	MD		
				SPT 0,1,12 N*=13									
					-5	10			Borehole BH106 terminated at 9.45m				
					-6	11							
					-7	12							
					-8	13							
					-9	14							
					-10	15							
					-11	16							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix e.g. ADT

support
M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	BH113
Sheet	1 of 2
Project No:	GEOTSGTE20301AA
Client:	ASQUITH & de WITT PTY LTD
Date started:	12.6.2007
Principal:	
Date completed:	12.6.2007
Project:	PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT
Logged by:	CW
Borehole Location:	REFER TO FIGURE 1B
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 383171 | slope: -90° | R.L. Surface: 7.76

hole diameter: mm | Northing 6367736 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
HF		C							**TOPSOIL:** Silty SAND, fine to medium grained, dark brown-black, roots affected.	M			TOPSOIL / AEOLIAN
				SPT 2,2,3 N*=5	7	1		SP	**SAND:** medium to coarse grained, pale grey.		MD		AEOLIAN
				SPT 2,3,4 N*=7	6	2			Colour change to pale grey-white.				
					5	3					D		
				SPT 0,6,8 N*=14	4	4			Colour change to pale grey-pale brown.	W			
			▼	SPT 3,4,9 N*=13	3	5		SP	**SAND:** fine to coarse grained, pale brown-brown-dark brown.				
					2	6			Trace of gravel, fine grained rounded.				ALLUVIAL
				SPT 7,16,R N*=R	1	7							SPt at 6.0m, 20 blows for 90mm penetration - hammer bouncing.
				SPT 0,5,11 N*=16	0	8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, N nil, C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07

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coffey geotechnics

Engineering Log - Borehole

Borehole No.	BH113
Sheet	2 of 2
Project No:	GEOTSGTE20301AA
Date started:	12.6.2007
Date completed:	12.6.2007
Logged by:	CW
Checked by:	

Client: ASQUITH & de WITT PTY LTD

Principal:

Project: PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT

Borehole Location: REFER TO FIGURE 1B

drill model and mounting: 4WD Mounted | Easting: 383171 | slope: -90° | R.L. Surface: 7.76

hole diameter: mm | Northing 6367736 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C			-1	9		SP	SAND: fine to coarse grained, pale brown-brown-dark brown. *(continued)* Trace of gravel, fine grained rounded (continued).	W	D		
				SPT 0,6,16 N*=22									
					-2	10			Borehole BH113 terminated at 9.45m				
					-3	11							
					-4	12							
					-5	13							
					-6	14							
					-7	15							
					-8	16							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH116**
Sheet	1 of 2
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**14.8.2007**
Principal:	
Date completed:	**14.8.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: Track Mounted | Easting: 383319 | slope: -90° | R.L. Surface: 0.62

hole diameter: mm | Northing 6367471 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADT		C							**TOPSOIL:** CLAY, high plasticity, grey.	M>Wp	VS/F		TOPSOIL / ALLUVIAL
				U_{50}	0								
						1		CH	**Silty CLAY:** high plasticity fines, grey-dark grey.			×	ALLUVIAL
				SPT 0,0,0 N*=0	-1			SC-Cl	**Sandy CLAY / Clayey SAND:** medium plasticity, sand fine to coarse grained, dark grey, with some shells.	M/W			ESTUARINE SPT at 1.5m, sunk under weight of hammer.
W						2							
					-2								
				SPT 0,0,0 N*=0		3			Shell content decreasing.				SPT at 3.0m, sunk under weight of hammer.
					-3								
						4							
				SPT 2,0,1 N*=1	-4			Cl-SC	**Sandy CLAY / Clayey SAND:** medium plasticity, fine to medium grained, dark grey-grey, trace of fine grained rounded gravel.	W			ALLUVIAL
					-5	5							
						6							
				SPT 10,14,14 N*=28				SP	**SAND:** fine to medium grained, grey-pale grey, traces of clay lenses and fine grained gravel.		D/VD		SPT at 6m, 14 blows for 120mm penetration - hammer bouncing.
					-6								
						7							
				SPT 10,11,19 N*=30	-7				Grey-brown / pale grey-pale brown.				
						8							

method
AS auger screwing* | AD auger drilling* | RR roller/tricone | W washbore | CT cable tool | HA hand auger | DT diatube | B blank bit | V V bit | T TC bit
*bit shown by suffix e.g. ADT

support
M mud | N nil | C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown | water inflow | water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter | U_{63} undisturbed sample 63mm diameter | D disturbed sample | N standard penetration test (SPT) | N* SPT - sample recovered | Nc SPT with solid cone | V vane shear (kPa) | P pressuremeter | Bs bulk sample | E environmental sample | R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry | M moist | W wet | Wp plastic limit | W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07

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coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH116**
Sheet	2 of 2
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**14.8.2007**
Principal:	
Date completed:	**14.8.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: Track Mounted | Easting: 383319 | slope: -90° | R.L. Surface: 0.62

hole diameter: mm | Northing 6367471 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C						SP	**SAND:** fine to medium grained, grey-pale grey, traces of clay lenses and fine grained gravel. *(continued)* Grey-brown / pale grey-pale brown (continued).	W	D/VD		
					-8	9							
				SPT 12,10,12 N*=22					Trace of carbonaceous material.				
					-9	10							
				SPT 9,10,R N*=R	-10								SPT at 10.5m, 10 blows for 100mm penetration.
						11							
					-11								
						12							
				SPT 13,20,13 N*=33				SP	**SAND:** pale grey-grey, fine to coarse grained, trace of carbonaceous material.				SPT at 12.0m, 13 blows for 110mm penetration - hammer bouncing.
					-12								
						13							
				SPT 12,19,R N*=R	-13								SPT at 13.5m, 10 blows for 60mm penetration - hammer bouncing.
						14							
				SPT 10,17,19 N*=36	-14			SP	**SAND:** fine to coarse grained, pale grey-grey, trace of fine grained gravel, rounded and trace of shell fragments.				ESTUARINE SPT at 14.45m, 19 blows for 100mm penetration.
						15			Borehole BH116 terminated at 14.9m				
					-15								
						16							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix e.g.	ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH119**
Sheet	1 of 2
Project No:	**GEOTSGTE20301AA**
Client: **ASQUITH & de WITT PTY LTD**	Date started: **1.8.2007**
Principal:	Date completed: **1.8.2007**
Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**	Logged by: **CW**
Borehole Location: **REFER TO FIGURE 1B**	Checked by:

drill model and mounting: Track Mounted | Easting: 383182 | slope: -90° | R.L. Surface: 0.76

hole diameter: mm | Northing 6367504 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADT		C		U_{50}	0	1		CH	**Silty CLAY:** high plasicity, grey-dark grey, grass and root affected to 0.1m.	M	VS/F	×	ALLUVIAL
				SPT 0,0,1 N*=1				SC	**Clayey SAND:** fine to coarse grained, grey-dark grey, with some root material, medium plasticity fines.	W			SPT, at 0.95m, sunk 300mm under weight of hammer.
								CH	**Sandy CLAY:** medium plasticity, fine to coarse grained sand, grey-dark grey, some mottled brown.	W>Wp		×	
				SPT 1,3,4 N*=7	-1	2		CH-SC	**Sandy CLAY / Clayey SAND:** low plasticity, fine to medium grained sand, grey-dark grey mottled white.	W		×	
					-2	3							
W				SPT 0,0,0 N*=0	-3	4							SPT at 3.0m, sunk under weight of hammer.
				SPT 2,1,2 N*=3	-4	5		SC	**Clayey SAND:** fine to medium grained, pale brown with mottled dark brown / brown.		D		
					-5	6							
				SPT 2,5,8 N*=13	-6	7							
				SPT 10,11,R N*=R	-7	8		SP	**SAND:** fine to medium grained, pale grey-grey, trace of fine grained carbonaceous material, traces of fine grained gravel, rounded.				SPT at 7.5m, 5 blows for 100mm penetration - hammer bouncing.

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, N nil, C casing

penetration: 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No. **BH119**
Sheet 2 of 2
Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**
Date started: **1.8.2007**
Principal:
Date completed: **1.8.2007**
Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by: **CW**
Borehole Location: **REFER TO FIGURE 1B**
Checked by:

drill model and mounting: Track Mounted | Easting: 383182 | slope: -90° | R.L. Surface: 0.76
hole diameter: mm | Northing 6367504 | bearing: | datum:

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C			-8	9		SP	SAND: fine to medium grained, pale grey-grey, trace of fine grained carbonaceous material, traces of fine grained gravel, rounded. *(continued)*	W	D		
				SPT 5,7,R N*=R					Traces of fine to medium grained gravel, rounded.				SPT at 9.0m, 12 blows for 60mm penetration - hammer bouncing.
					-9	10			Borehole BH119 terminated at 9.39m				
					-10	11							
					-11	12							
					-12	13							
					-13	14							
					-14	15							
					-15	16							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing

penetration
1 2 3 4 no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No. **BH121**
Sheet 1 of 2
Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**
Date started: **12.6.2007**
Principal:
Date completed: **12.6.2007**
Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by: **CW**
Borehole Location: **REFER TO FIGURE 1B**
Checked by:

drill model and mounting: 4WD Mounted | Easting: 383019 | slope: -90° | R.L. Surface: 2.14
hole diameter: mm | Northing 6367700 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C	12-06-07 2:20pm		2				**TOPSOIL:** Silty SAND, fine to coarse grained, dark brown-black with some roots.	W			TOPSOIL / AEOLIAN
				SPT 3,3,4 N*=7	1	1		SM	**Silty SAND:** fine to medium grained, dark brown-black.		MD		AEOLIAN
				SPT 6,11 N*=R	0	2		SP	**SAND:** fine to coarse grained, dark brown-brown, trace of silt and trace of fine grained gravel.		D		ALLUVIAL SPT at 1.5m, 11 blows for 60mm penetration - hammer bouncing.
				SPT 3,12,17 N*=29	-1	3			Bands of colour change from pale brown-brown-dark brown and orange.				SPT at 3.0m, 17 blows for 130mm penetration - hammer bouncing.
				SPT 5,6,R N*=R	-2	4			With some fine grained gravel.				SPT at 4.5m, 6 blows for 100mm penetration - hammer bouncing.
					-3	5					MD		
				SPT 6,3,5 N*=8	-4	6		SP	**SAND:** fine to coarse grained, pale brown with some fine grained gravel.				
					-5	7					D		
				SPT 6,16 N*=R		8			Colour change to pale grey.				SPT at 7.5m, 16 blows for 130mm penetration - hammer bouncing.

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing
penetration 1 2 3 4 — no resistance ranging to refusal
water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07
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coffey geotechnics

Engineering Log - Borehole

Borehole No.	BH121
Sheet	2 of 2
Project No:	GEOTSGTE20301AA
Client:	ASQUITH & de WITT PTY LTD
Date started:	12.6.2007
Principal:	
Date completed:	12.6.2007
Project:	PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT
Logged by:	CW
Borehole Location:	REFER TO FIGURE 1B
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 383019 | slope: -90° | R.L. Surface: 2.14

hole diameter: mm | Northing 6367700 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
HF		C			-6			SP	**SAND:** fine to coarse grained, pale brown with some fine grained gravel. *(continued)*	W	D		
						9			Colour change to pale grey (continued).				
				SPT 13 N*=R	-7								SPT at 9.0m, 13 blows for 150mm penetration - hammer bouncing.
									Borehole BH121 terminated at 9.45m				
					-8	10							
					-9	11							
					-10	12							
					-11	13							
					-12	14							
					-13	15							
						16							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix e.g.	ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description
based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH128**
Sheet	1 of 2
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**31.7.2007**
Principal:	
Date completed:	**1.8.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: Track Mounted | Easting: 383140 | slope: -90° | R.L. Surface: 0.32

hole diameter: mm | Northing 6367372 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: Water and grass (knee length high and water logged). soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADT		C			0			CH	**CLAY:** high plasticity, grey, trace of silt, grass and root affected to 0.1m.	W	F		TOPSOIL / ALLUVIAL
				U_{50}						W>Wp		×	
				SPT 0,0,0 N*=0	-1	1		CH	**Sandy CLAY:** high plasticity, grey, fine to medium grained sand, trace of roots.		VS		SPT at 0.95m, sunk under weight of hammer. ALLUVIAL
				SPT 0,0,0 N*=0				CH	Shelly band approximately 50mm thick. **CLAY:** high plasticity, grey, trace of fine to medium grained sand.			×	SPT at 1.5m, sunk under weight of hammer.
W					-2	2							
			Drilling mud added.	SPT 0,0,0 N*=0	-3	3		CH-SC	**Sandy CLAY / Clayey SAND:** medium plasticity, fine to coarse grained sand, grey-dark grey, trace of fine grained gravel, rounded gravel.	W			SPT at 3.0m, sunk under weight of hammer.
					-4	4					VSt		
				SPT 2,4,7 N*=11				CH	**CLAY:** medium plasticity, grey-dark grey, trace of fine to medium grained sand.			×	
					-5	5		CH	**Sandy CLAY:** medium plasticity, pale brown-yellow, fine to coarse grained sand. Becoming grey.				
				SPT 6,10,13 N*=23	-6	6		SP	**SAND:** fine to coarse grained, pale grey-pale brown.		D		
					-7	7			Sand becoming fine to medium grained, trace of fine grained gravel present, subrounded and trace of fine grained black carbonaceous material.				
				SPT 5,11,11 N*=22		8							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix e.g. ADT

support
M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No. **BH128**
Sheet 2 of 2
Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**
Date started: **31.7.2007**
Principal:
Date completed: **1.8.2007**
Project: **PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by: **CW**
Borehole Location: **REFER TO FIGURE 1B**
Checked by:

drill model and mounting: Track Mounted | Easting: 383140 | slope: -90° | R.L. Surface: 0.32
hole diameter: mm | Northing 6367372 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C			-8	9		SP	**SAND:** fine to coarse grained, pale grey-pale brown. *(continued)*	W	D		
				SPT 6,10,13 N*=23	-9								
					-10	10			Borehole BH128 terminated at 9.45m				
					-11	11							
					-12	12							
					-13	13							
					-14	14							
					-15	15							
						16							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	BH134
Sheet	1 of 2
Project No:	GEOTSGTE20301AA
Client:	ASQUITH & de WITT PTY LTD
Date started:	31.7.2007
Principal:	
Date completed:	31.7.2007
Project:	PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT
Logged by:	CW
Borehole Location:	REFER TO FIGURE 1B
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 382960 | slope: -90° | R.L. Surface: 1.78

hole diameter: mm | Northing 6367495 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
ADT		N	None Observed						**TOPSOIL:** Silty SAND, fine to coarse grained, dark brown.	M			TOPSOIL / AEOLIAN
				SPT 2,2,3 N*=5	1	1		SM	**Silty SAND:** fine to coarse grained, dark brown, traces of fine grained gravel subrounded-rounded.		MD		ALLUVIAL
W				SPT 5,8,11 N*=19	0	2			Inclusion of root material.		D		
					-1	3							
				SPT 9,14,24 N=38	-2	4							
				SPT 7,8,15 N*=23	-3	5		SM	**Silty SAND:** fine to coarse grained, brown.	W			
					-4	6							
				SPT 6,7,10 N*=17				SM	**Silty SAND:** fine to coarse grained, brown, trace of carbonaceous material and fine grained subrounded to rounded gravel.				
					-5	7							
				SPT 6,14,16 N*=30	-6	8		SM	**Silty SAND:** fine to medium grained, brown, with some fine grained, subrounded to rounded gravel.				

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	BH134
Sheet	2 of 2
Project No:	GEOTSGTE20301AA
Client:	ASQUITH & de WITT PTY LTD
Date started:	31.7.2007
Principal:	
Date completed:	31.7.2007
Project:	PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT
Logged by:	CW
Borehole Location:	REFER TO FIGURE 1B
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 382960 | slope: -90° | R.L. Surface: 1.78

hole diameter: mm | Northing 6367495 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		N	None Observed	SPT 7,10,17 N=27	-7	9		SM	**Silty SAND:** fine to medium grained, brown, with some fine grained, subrounded to rounded gravel. *(continued)* Trace of carbonaceous material.	W	D		
					-8	10			Borehole BH134 terminated at 9.45m				
					-9	11							
					-10	12							
					-11	13							
					-12	14							
					-13	15							
					-14	16							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix e.g. ADT

support
M mud
C casing
N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH137**
Sheet	1 of 2
Project No:	**GEOTSGTE20301AA**
Client:	**ASQUITH & de WITT PTY LTD**
Date started:	**13.6.2007**
Principal:	
Date completed:	**13.6.2007**
Project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT**
Logged by:	**CW**
Borehole Location:	**REFER TO FIGURE 1B**
Checked by:	

drill model and mounting: 4WD Mounted | Easting: 382844 | slope: -90° | R.L. Surface: 1.84

hole diameter: mm | Northing 6367604 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C	9:29am	SPT 1,2,3 N*=5	1	1		SC	**Silty Clayey SAND:** fine to coarse grained, black, low plasticity, with some rootlets.	W	MD		TOPSOIL / ALLUVIAL
				SPT 2,4,6 N*=10	0	2		SP	**SAND:** fine to coarse grained, pale grey-white, with some and carbonaceous material.		D		ALLUVIAL
				SPT 8,18 N*=R	-1	3			Grading into white sand.				SPT at 3.0m, 18 blows for 150mm penetration - hammer bouncing.
				SPT 2,1,4 N*=5	-2	4					MD		
				SPT 8,17 N*=R	-3	5					D		
					-4	6			Grading into grey-brown.				SPT at 6.0m, 17 blows for 140mm penetration - hammer bouncing.
					-5	7		PT-OL	**PEAT / Clayey SILT:** medium plasticity, black, with fibrous wood / carbonaceous material.				PEAT
				SPT 0,1,2 N*=3	-6	8		SP	**Gravelly SAND:** fine to coarse grained, brown, fine grained gravel rounded.		L		ALLUVIAL
								SC					

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing

penetration
1 2 3 4 — no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07

Form GEO 5.3 Issue 3 Rev 2

coffey geotechnics

Engineering Log - Borehole

Borehole No. **BH137**

Sheet 2 of 2

Project No: **GEOTSGTE20301AA**

Client: *ASQUITH & de WITT PTY LTD*

Date started: *13.6.2007*

Principal:

Date completed: *13.6.2007*

Project: *PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT*

Logged by: *CW*

Borehole Location: *REFER TO FIGURE 1B*

Checked by:

drill model and mounting: 4WD Mounted | Easting: 382844 | slope: -90° | R.L. Surface: 1.84

hole diameter: mm | Northing 6367604 | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HF		C			-7	9		SC	Clayey SAND: fine to medium grained, brown-dark brown medium to high plasticity. *(continued)*	W	L / D		
				SPT 4,10,12 N*=22				SP	SAND: fine to coarse grained, brown.				
					-8	10							
				SPT 8,16,18 N*=34	-9	11		SP	SAND: fine to coarse grained, brown, trace of fine grained gravel and wooded black vegetation / or carbonaceous material.				SPT at 10.5m, 18 blows for 125mm penetration - hammer bouncing.
					-10	12							
				SPT 13,21 N*=R	-11	13							SPT at 12.5m, 21 blows for 150mm penetration - hammer bouncing.
				SPT 15 N*=R	-12	14							SPT at 13.05m, 15 blows for 150mm penetration.
					-13	15							
				SPT 7,2,1 N*=3				SP	SAND: fine to medium to coarse grained, grey with gravel bands fine grained.		VL		
					-14	16			Borehole BH137 terminated at 15.45m				

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

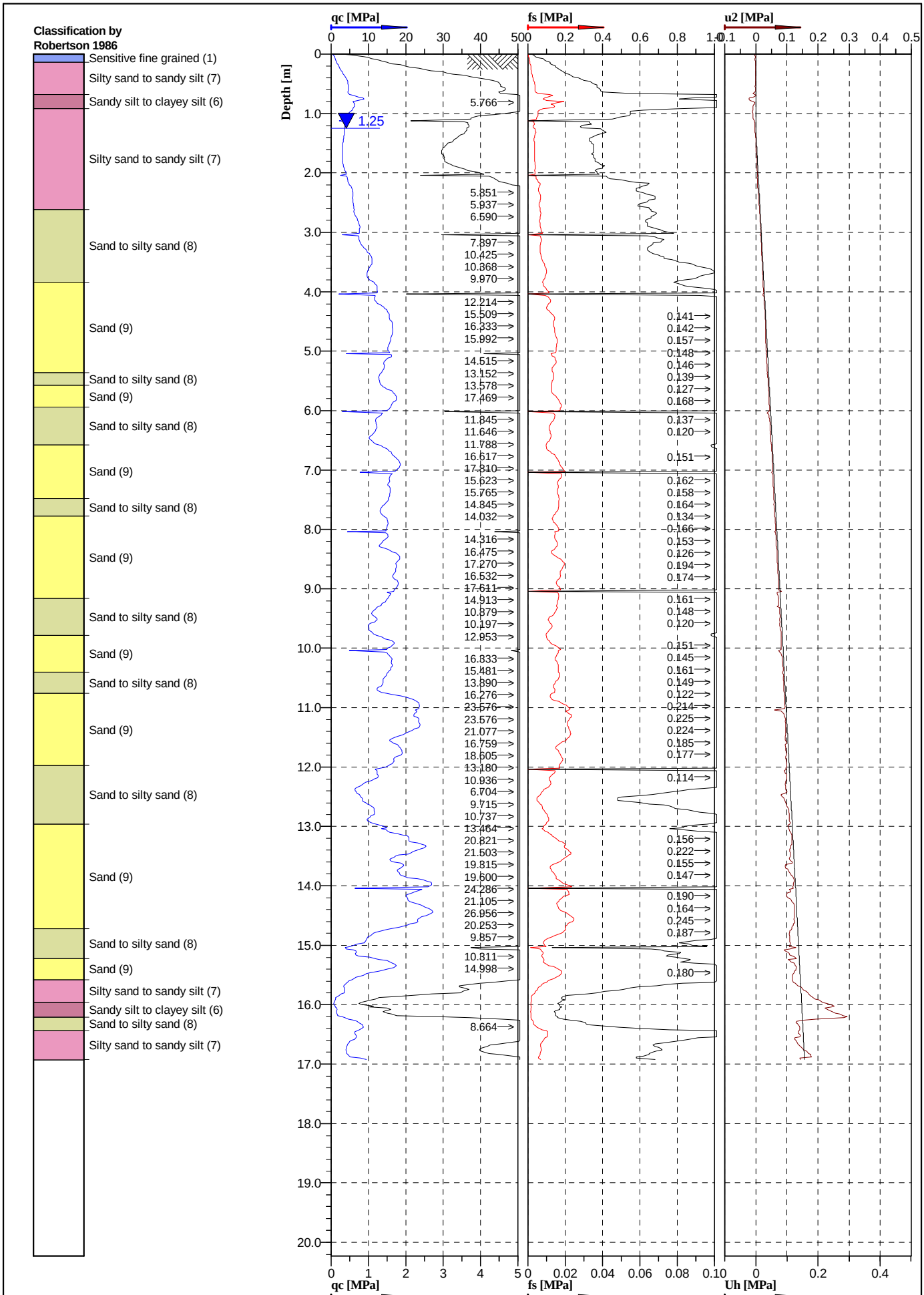
VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE 20301AA LOGS BH'S.GPJ COFFEY.GDT 5.11.07

Form GEO 5.3 Issue 3 Rev.2

Appendix B

Results of CTP Testing

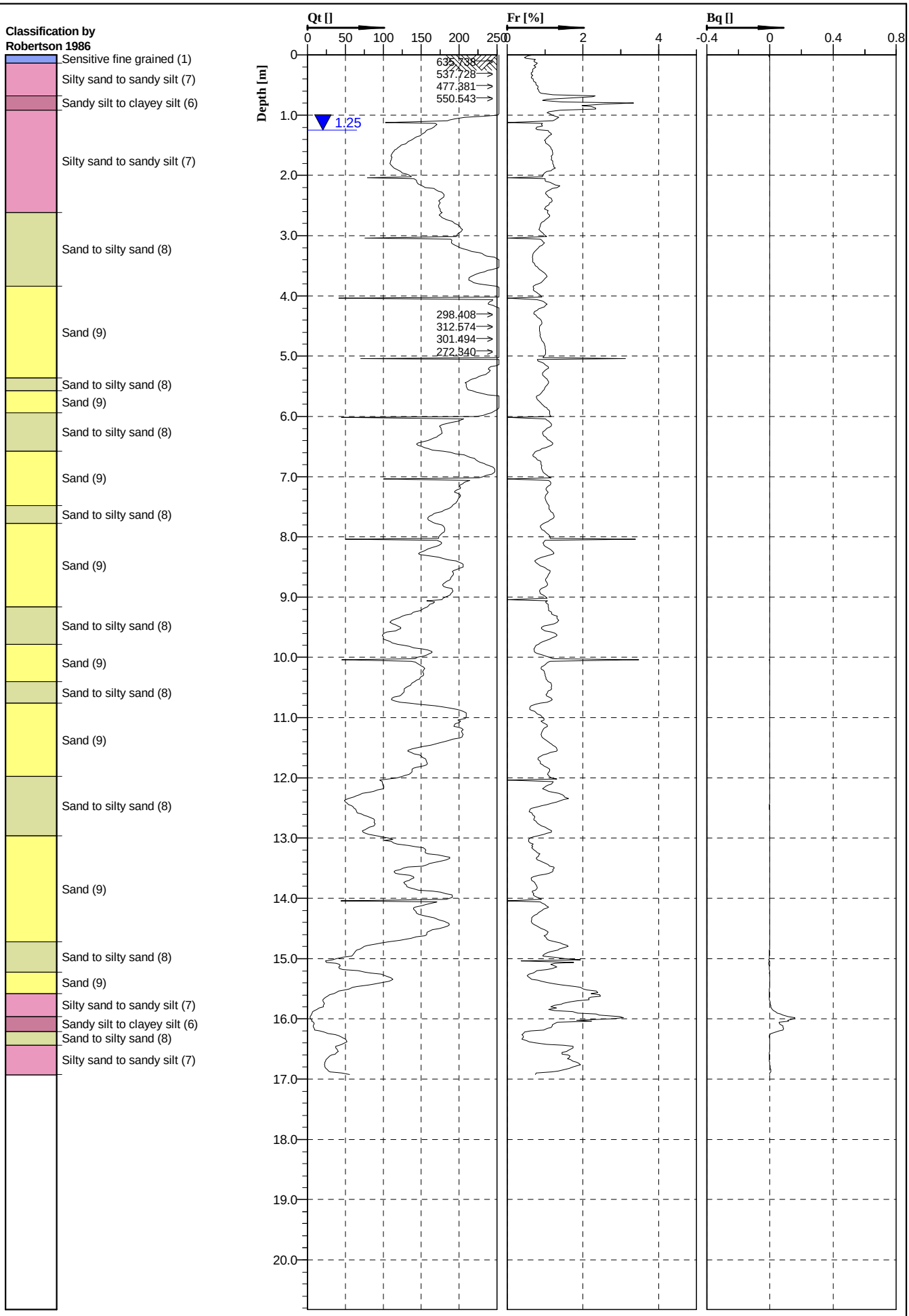


Location: Tomago Road, Tomago	Position: X: 383437 m, Y: 6367871 m	Ground level: 2.69	Test no: CPT101
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 1a
		File: CG-WI-C01.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

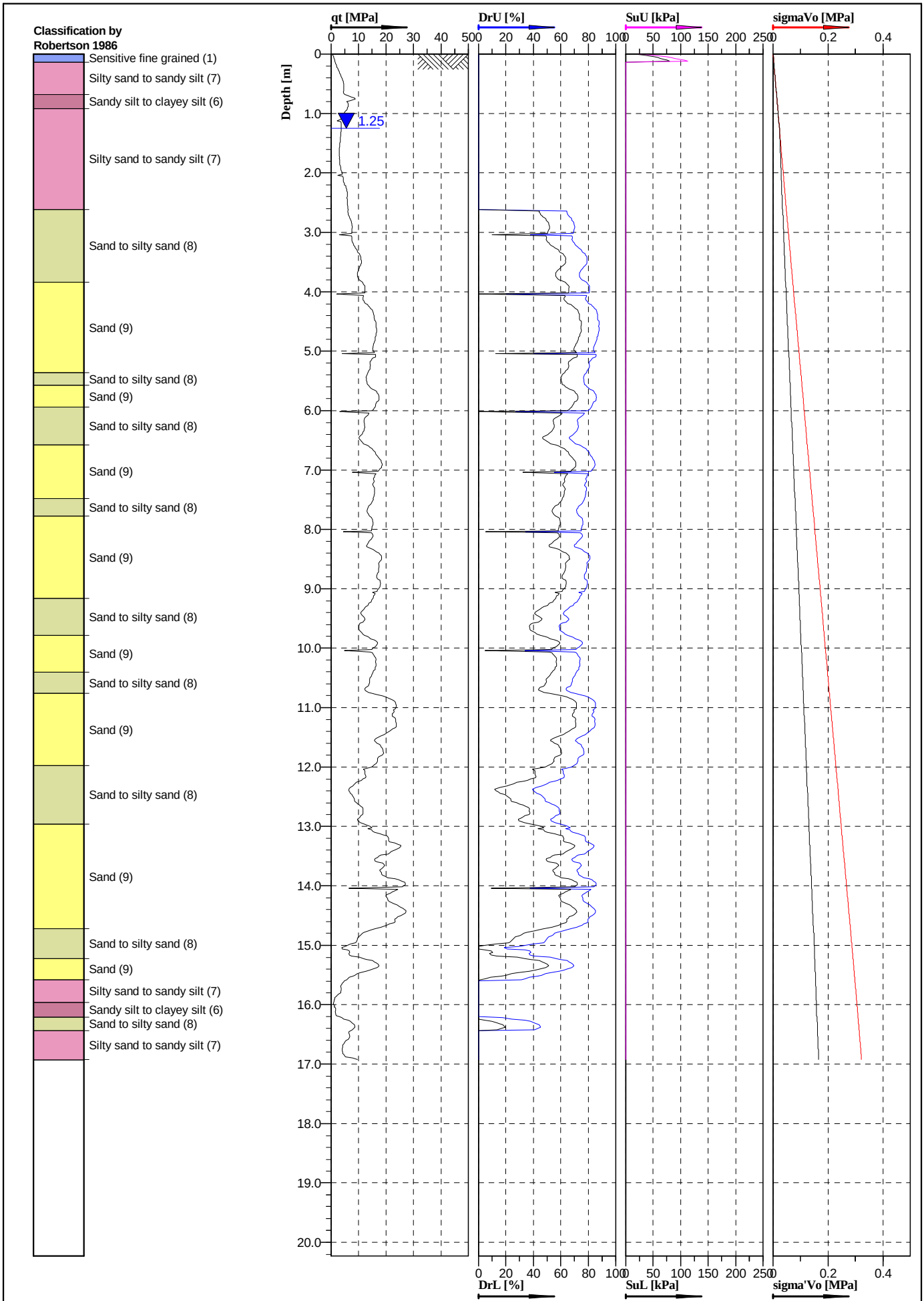


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383437 m, Y: 6367871 m	Ground level: 2.69	Test no: CPT101
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 1b
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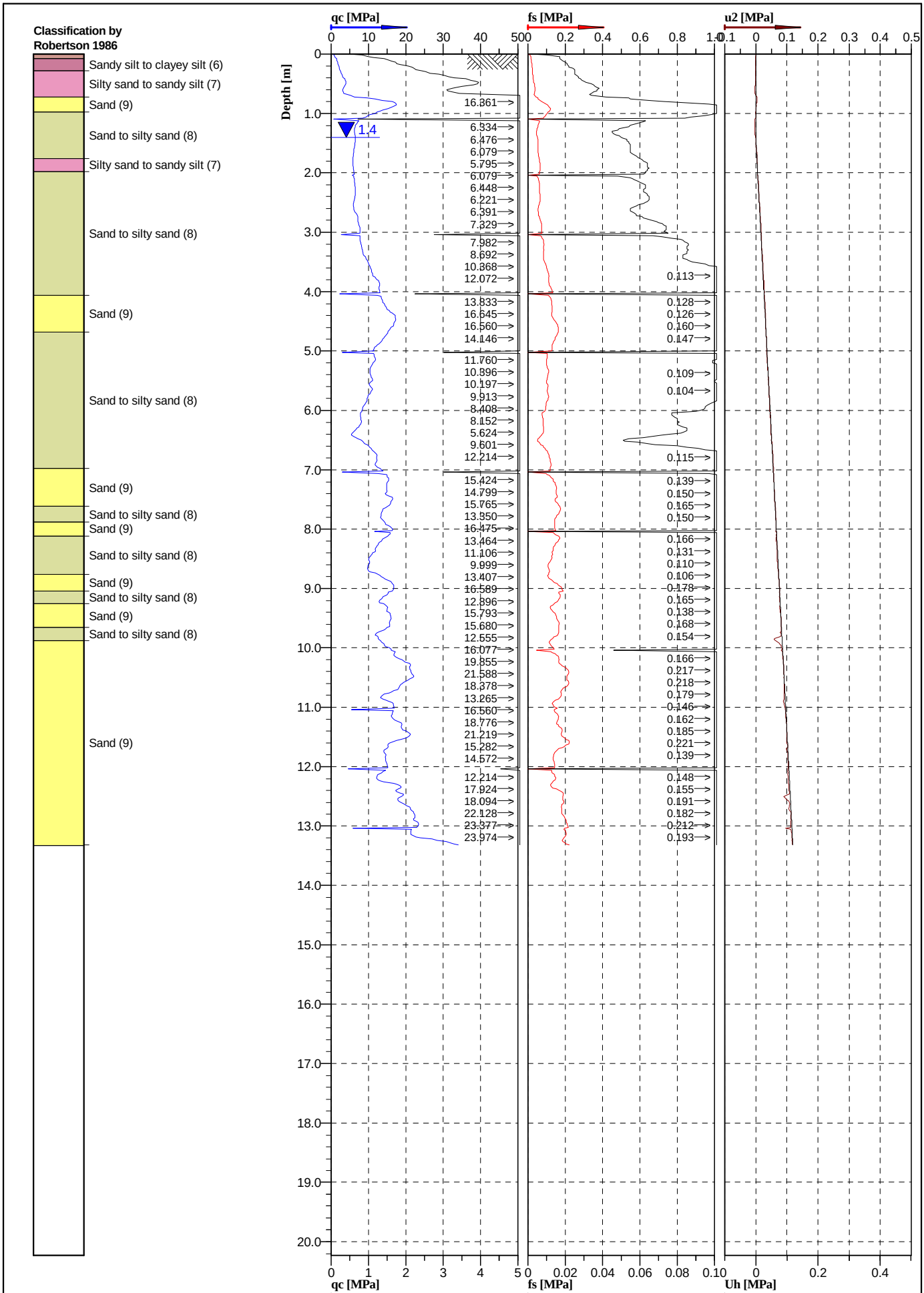


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383437 m, Y: 6367871 m	Ground level: 2.69	Test no: CPT101
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 1c
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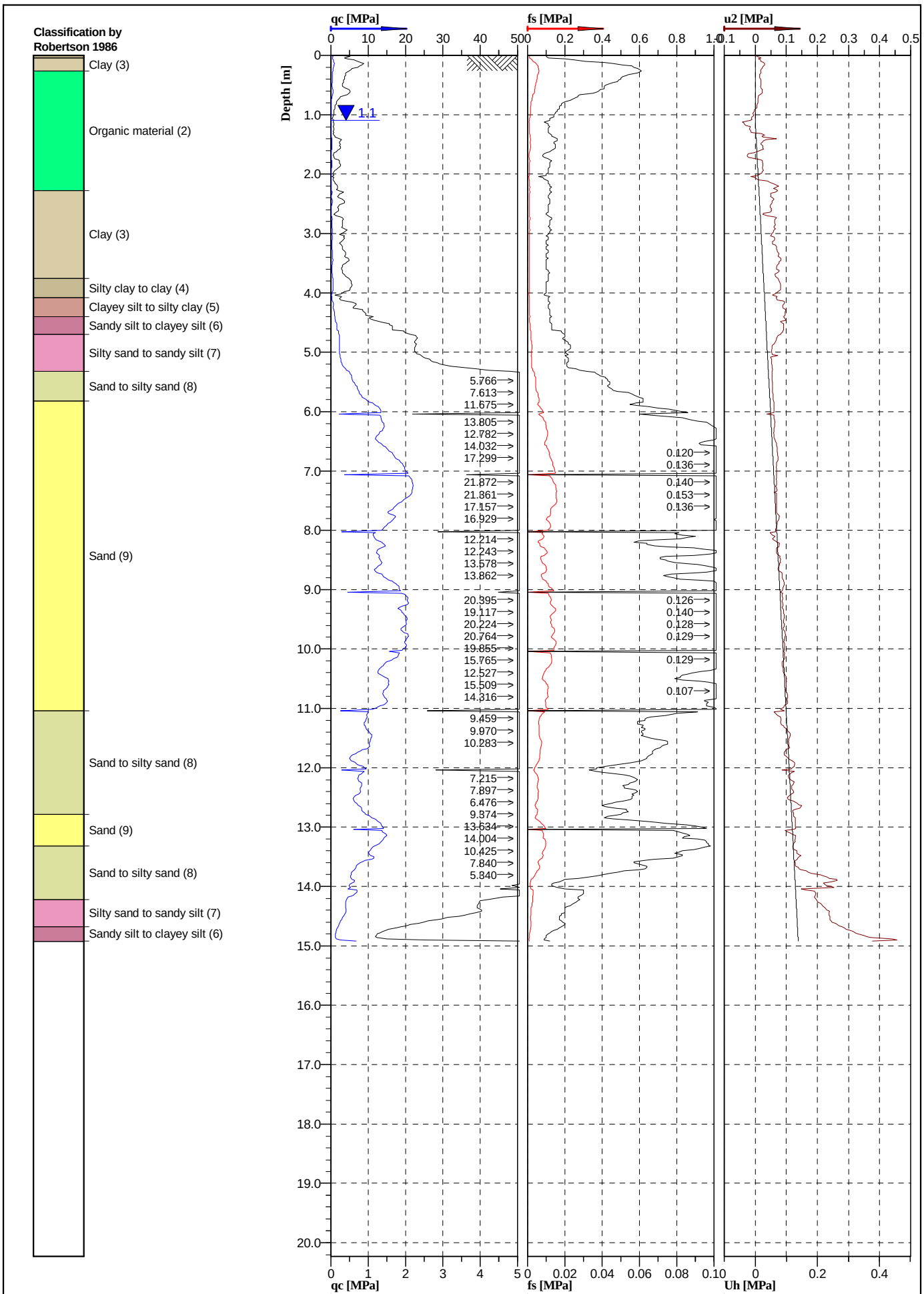


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383348 m, Y: 6367838 m	Ground level: 2.67	Test no: CPT105
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 2a
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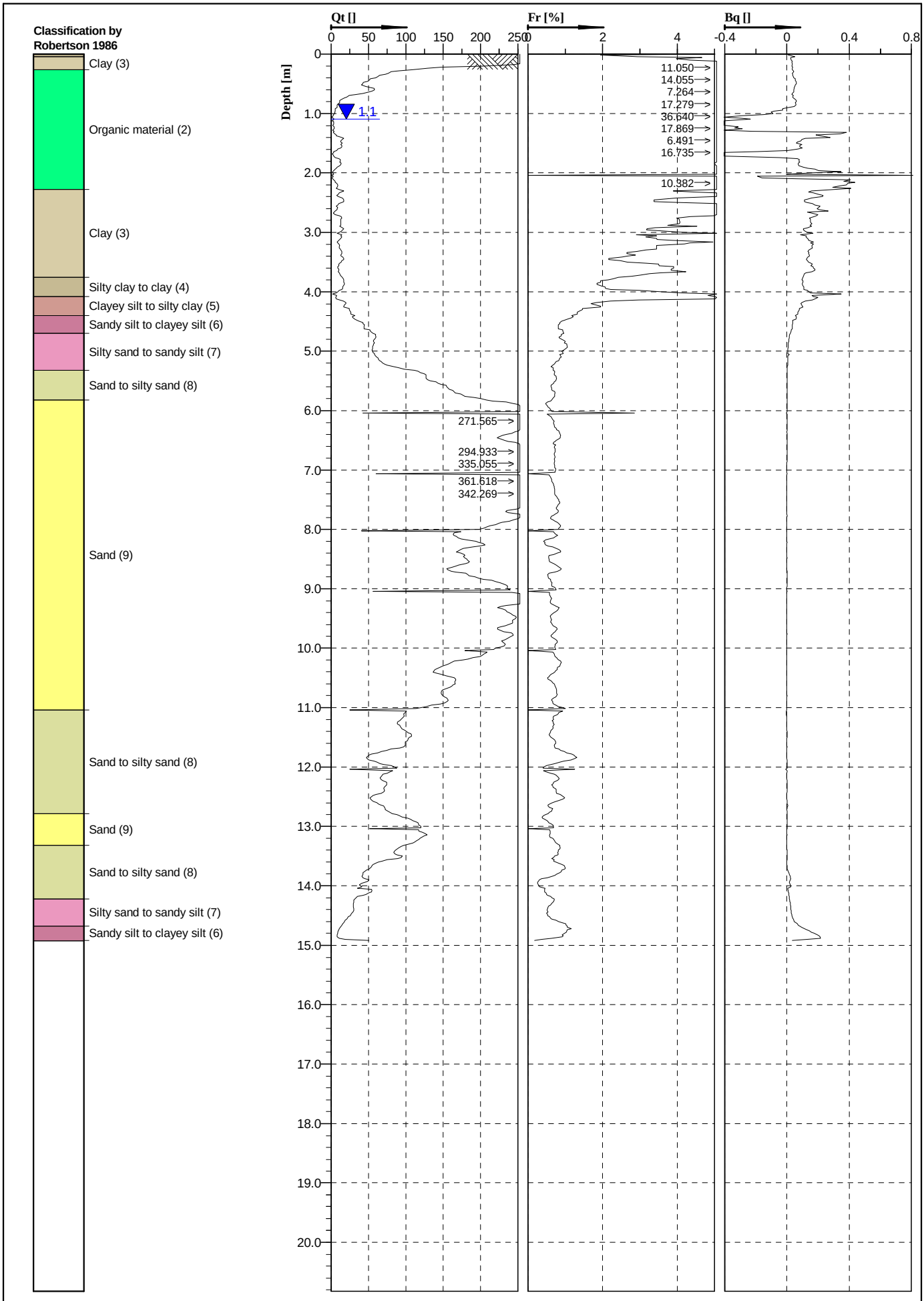


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.55	Test no: CPT104
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 16a
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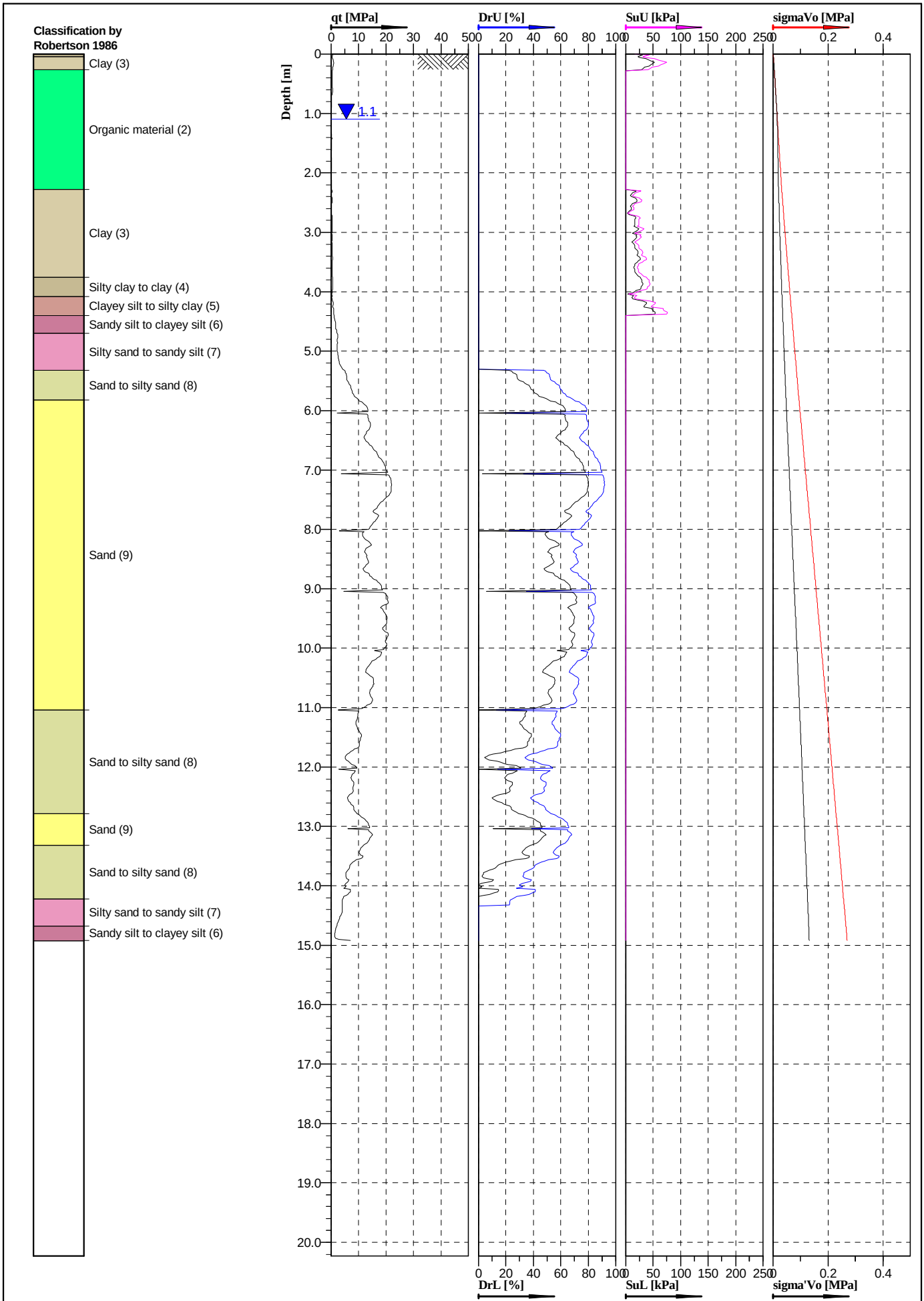


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.55	Test no: CPT104
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 16b
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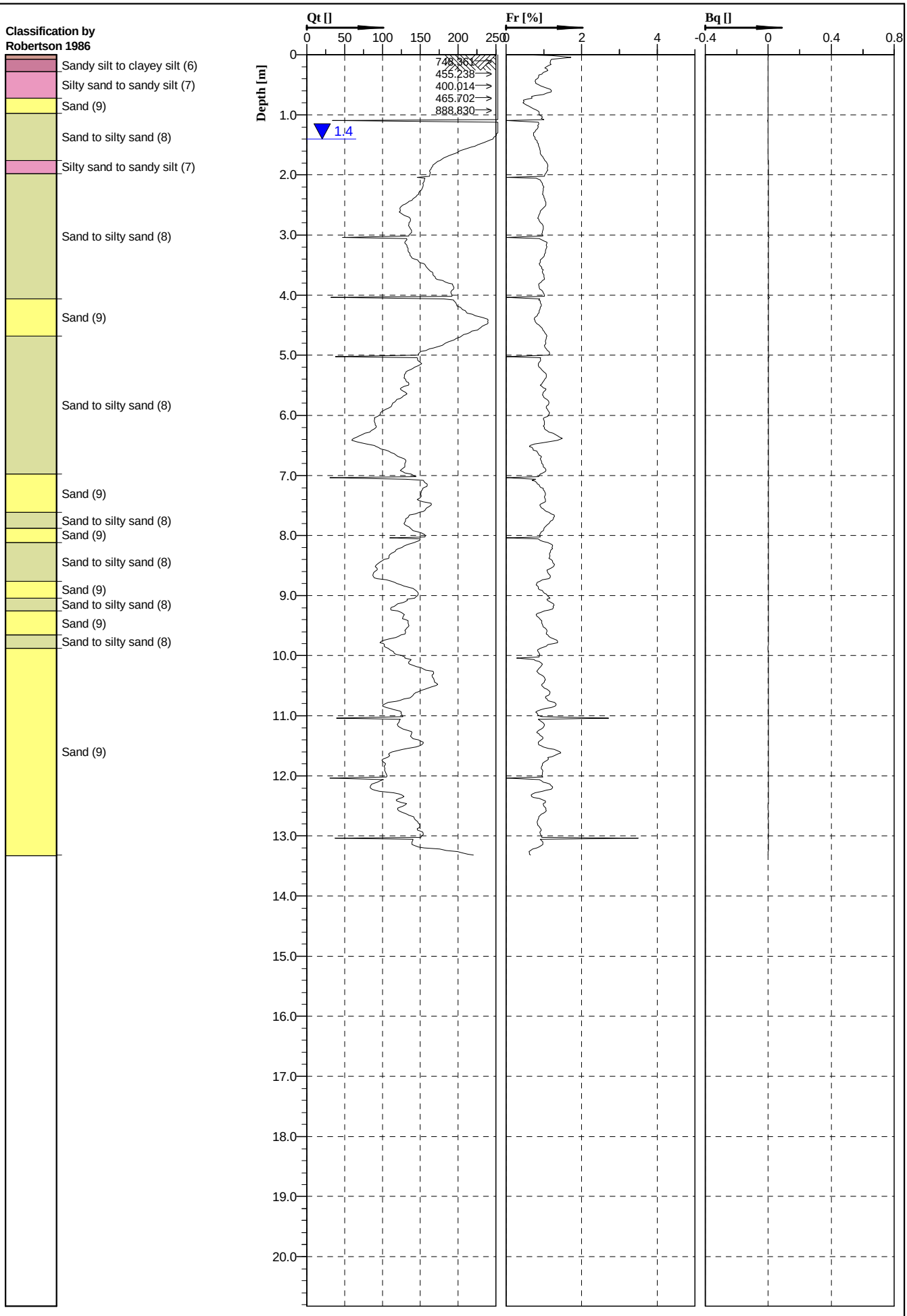


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.55	Test no: CPT104
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 16c
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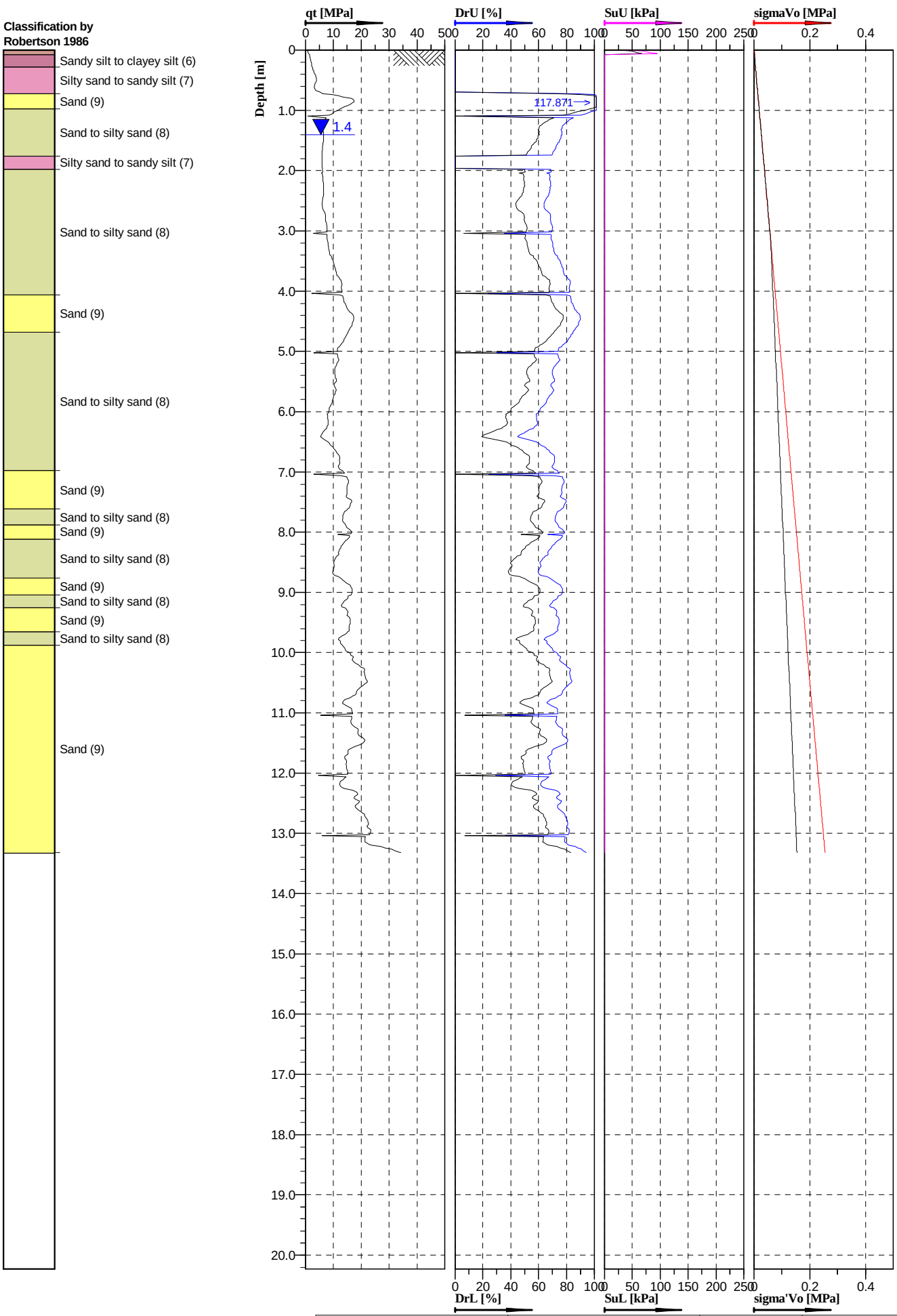


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383348 m, Y: 6367838 m	Ground level: 2.67	Test no: CPT105
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 2b
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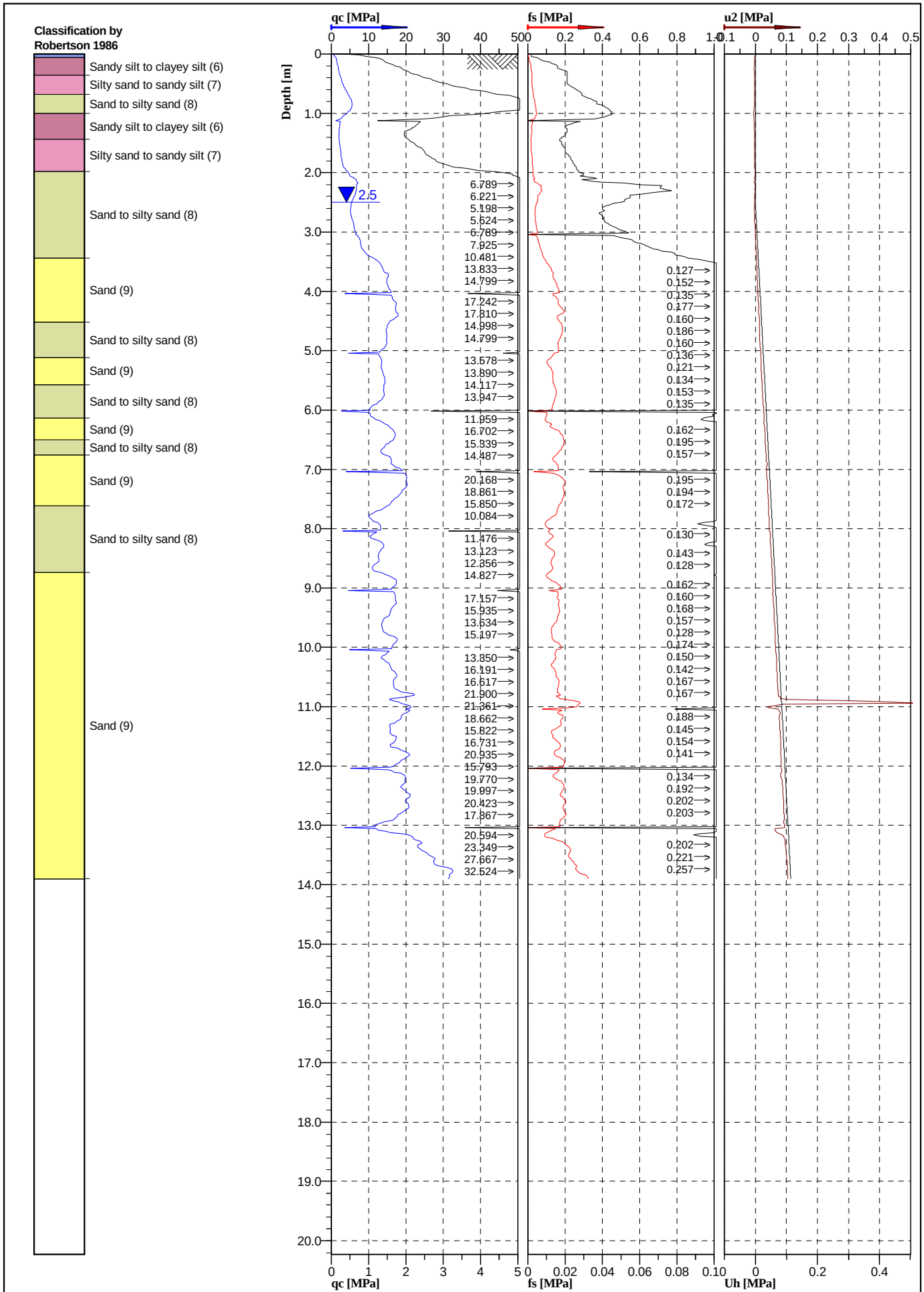


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383348 m, Y: 6367838 m	Ground level: 2.67	Test no: CPT105
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 2c
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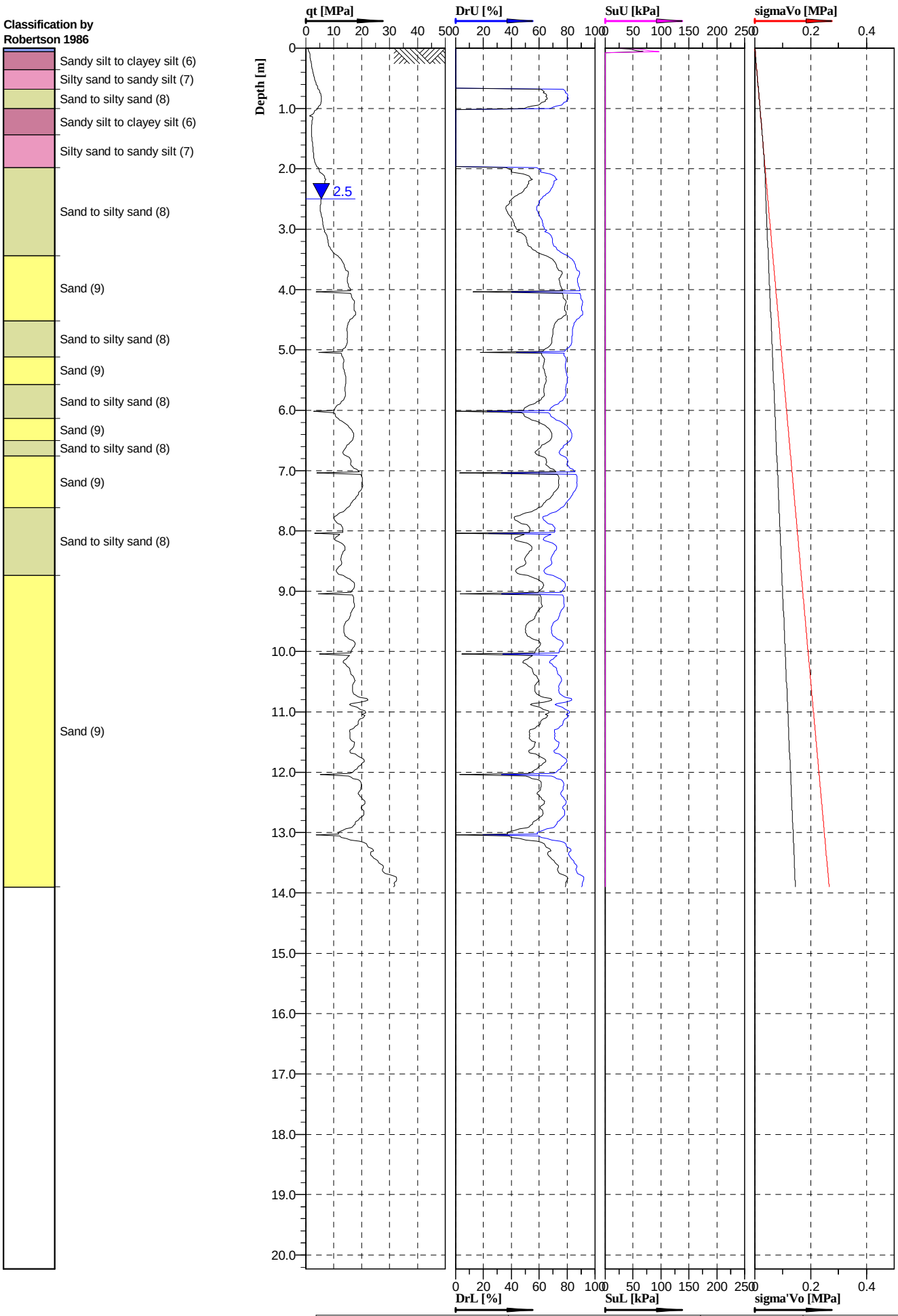


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383255 m, Y: 6367792 m	Ground level: 4.25	Test no: CPT109
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 3a
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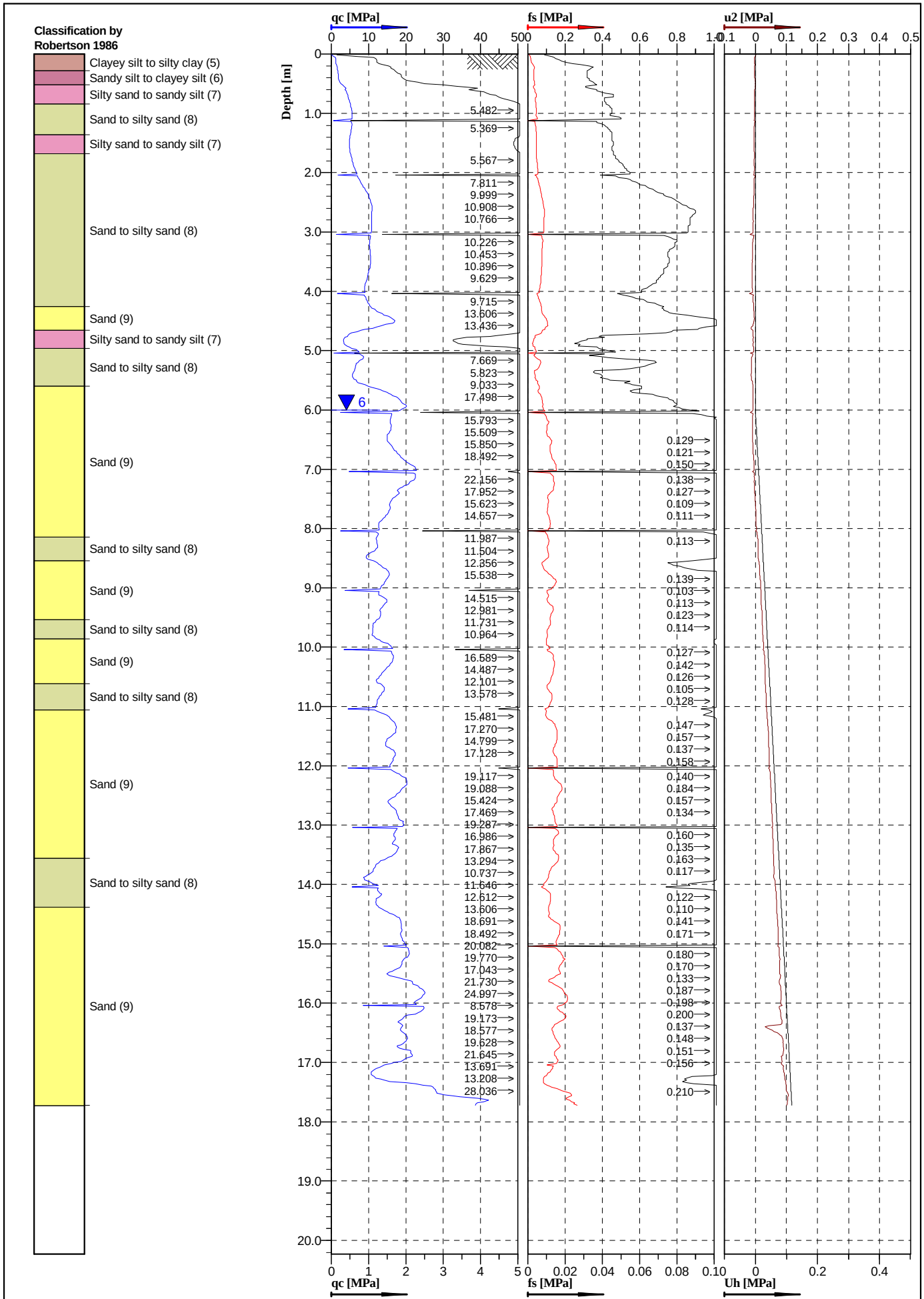


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383255 m, Y: 6367792 m	Ground level: 4.25	Test no: CPT109
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 3c
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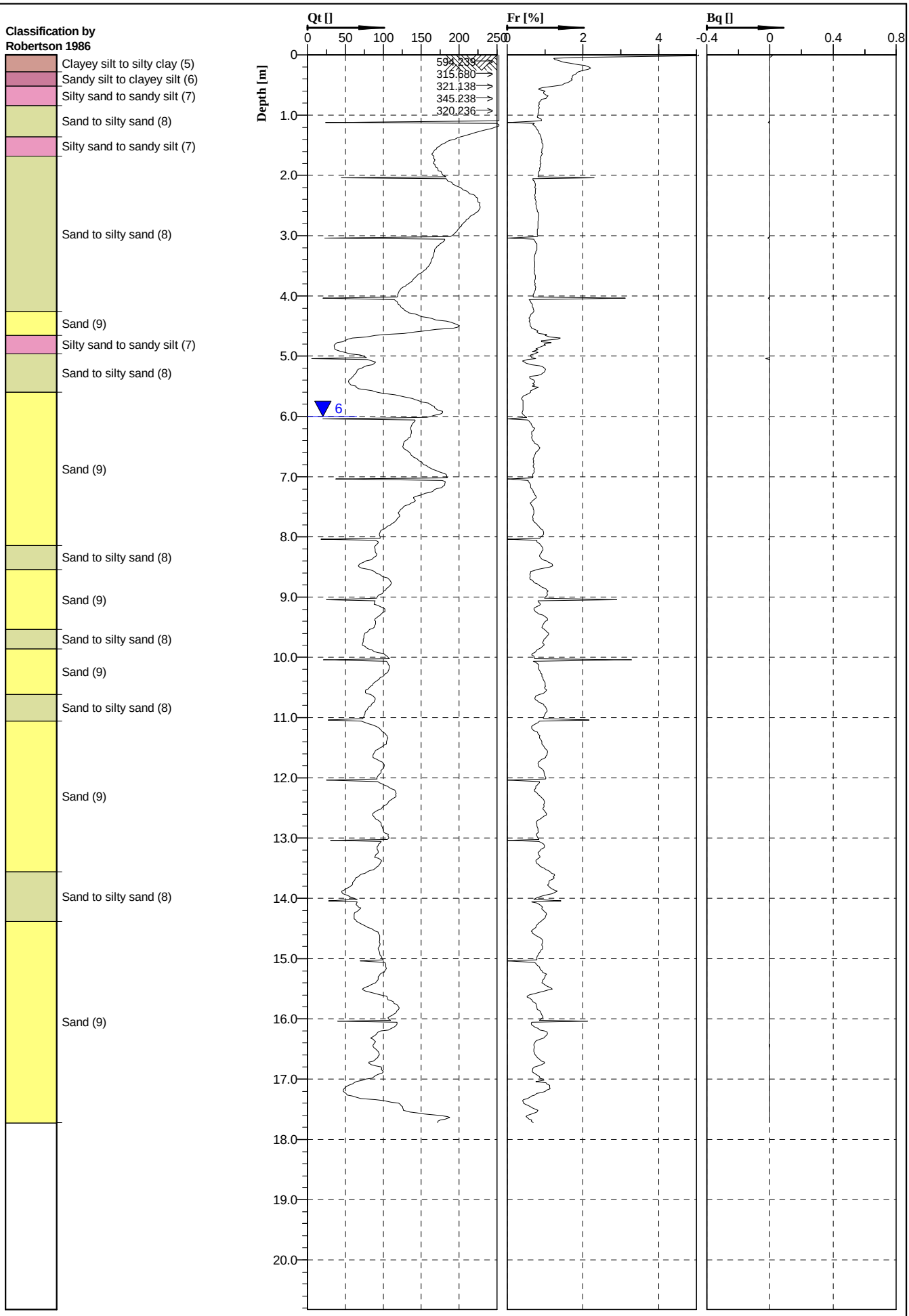


Location: Tomago Road, Tomago	Position: X: 383316 m, Y: 6367697 m	Ground level: 7.73	Test no: CPT110
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 6a
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coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

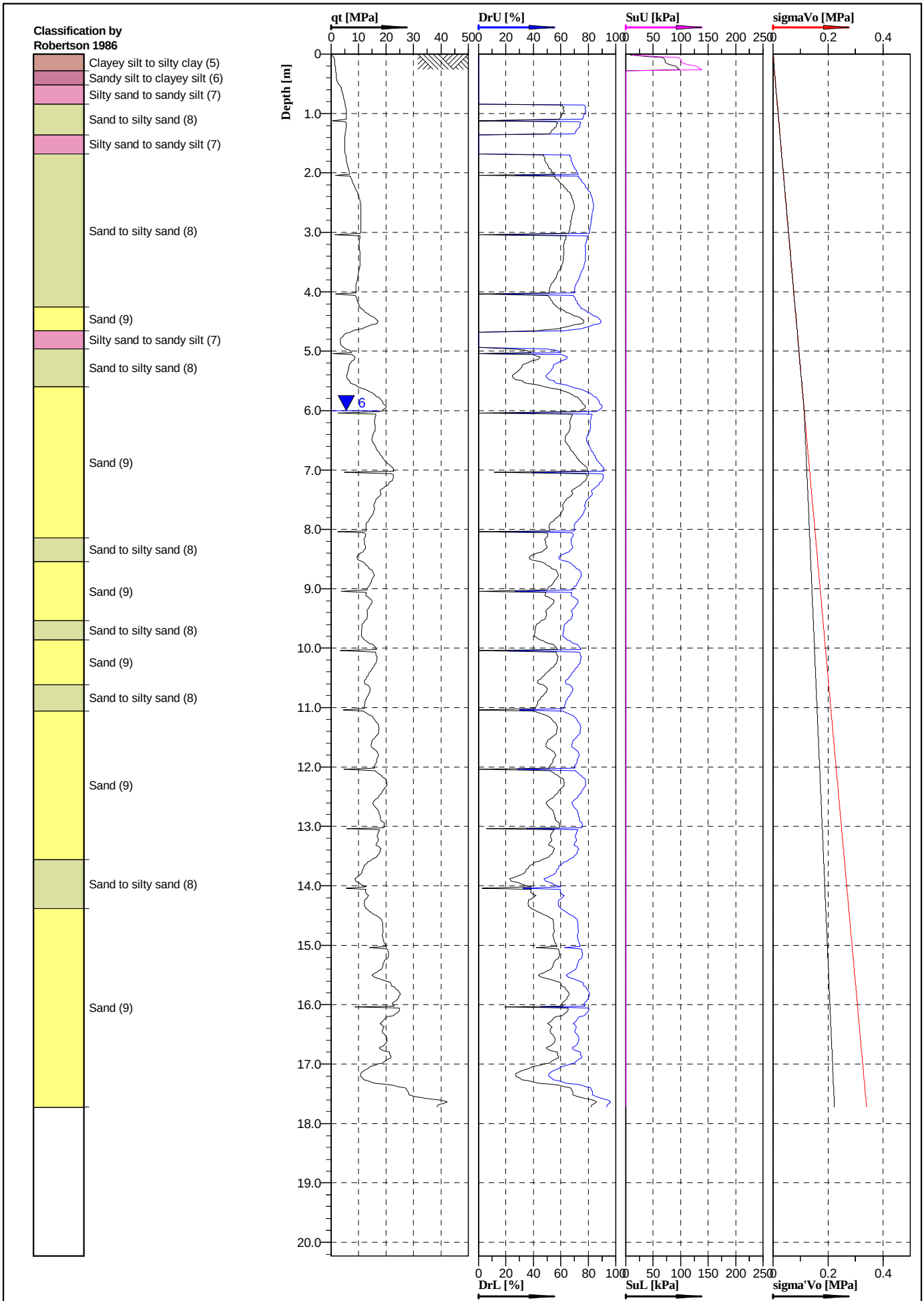


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383316 m, Y: 6367697 m	Ground level: 7.73	Test no: CPT110
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 6b
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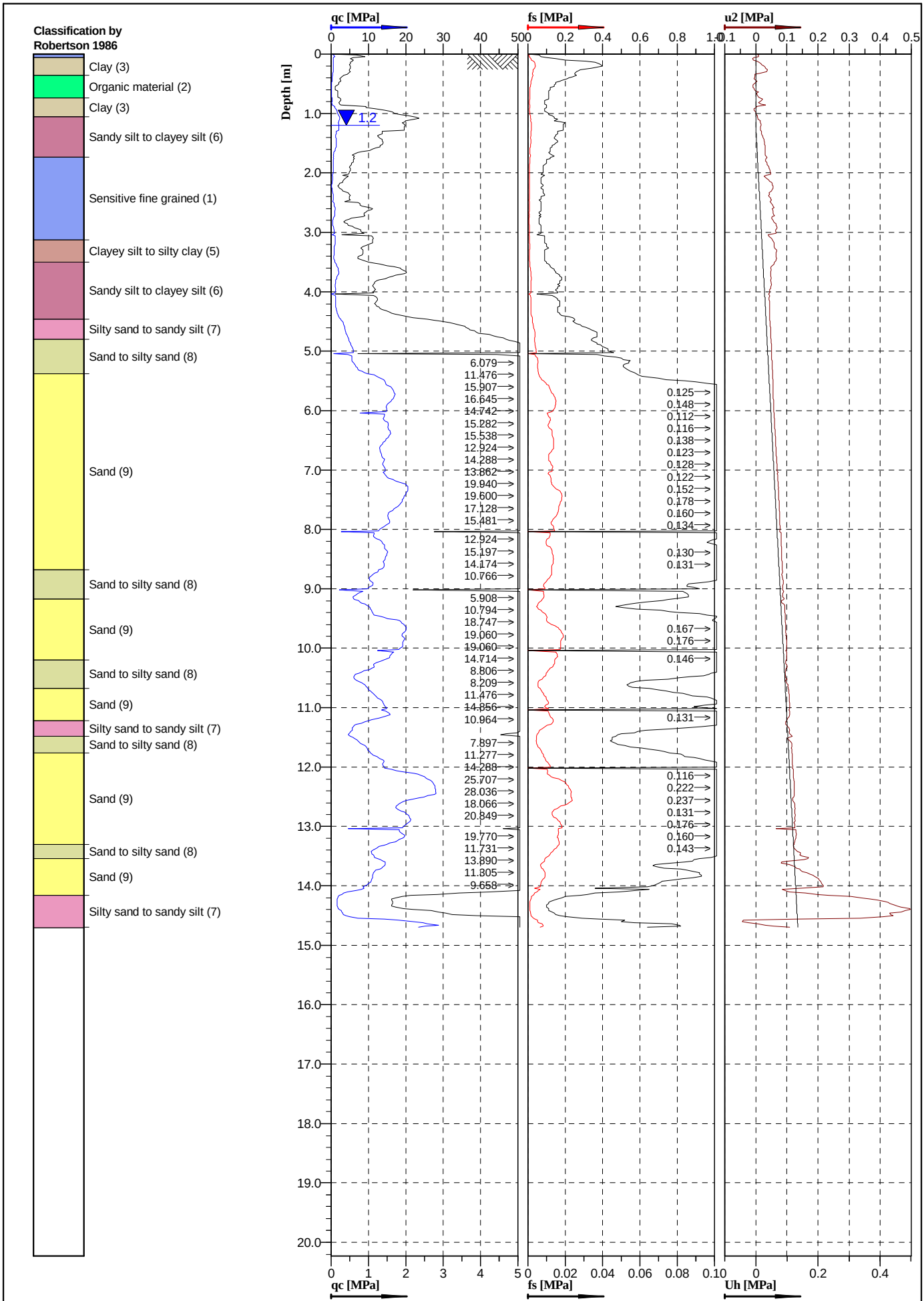


Location: Tomago Road, Tomago	Position: X: 383316 m, Y: 6367697 m	Ground level: 7.73	Test no: CPT110
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 6c
		File: CG-WI-C06.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

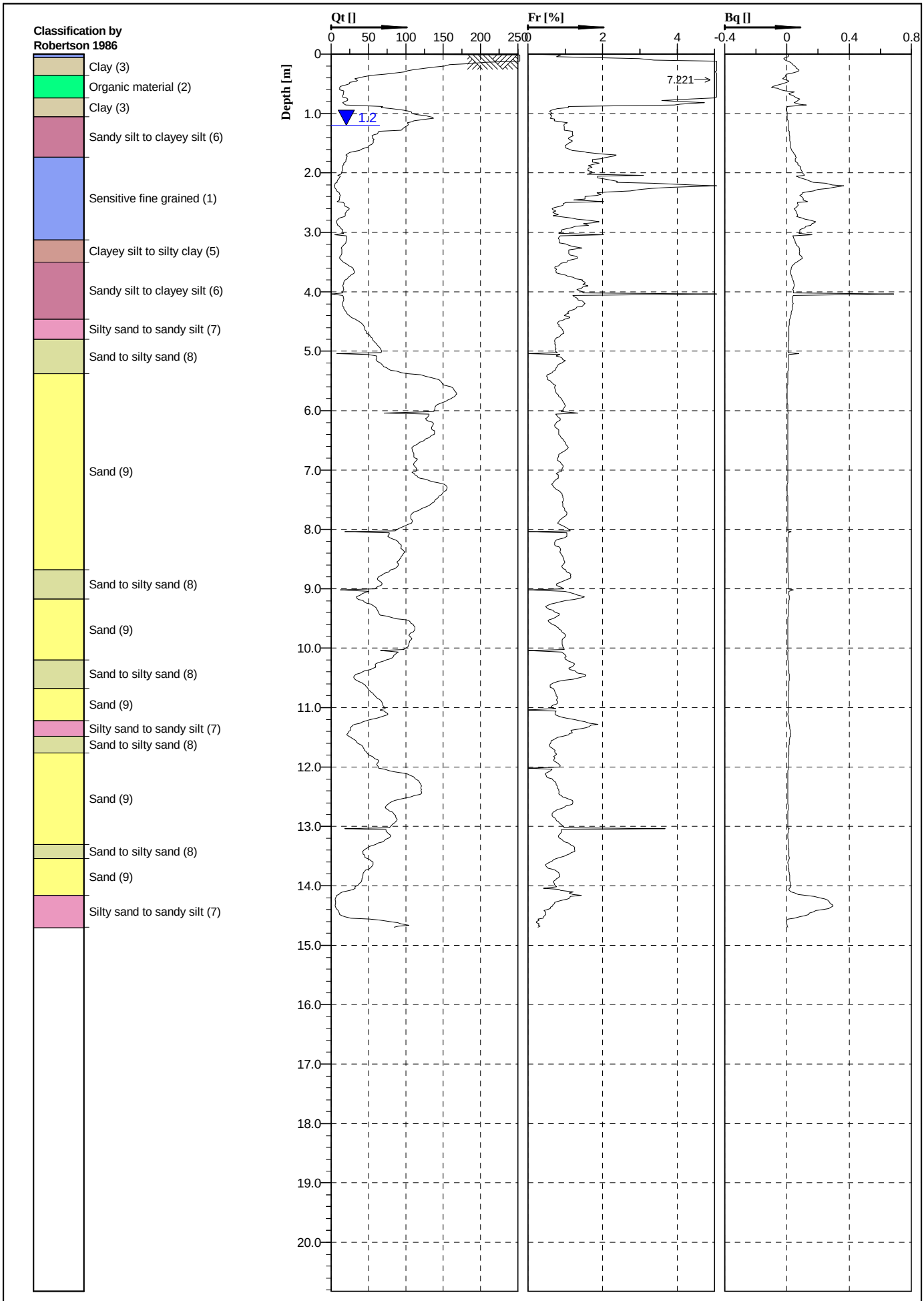


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383357 m, Y: 6367606 m	Ground level: 0.77	Test no: CPT111
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 11a
		File: CG-WI-C011.cpd	

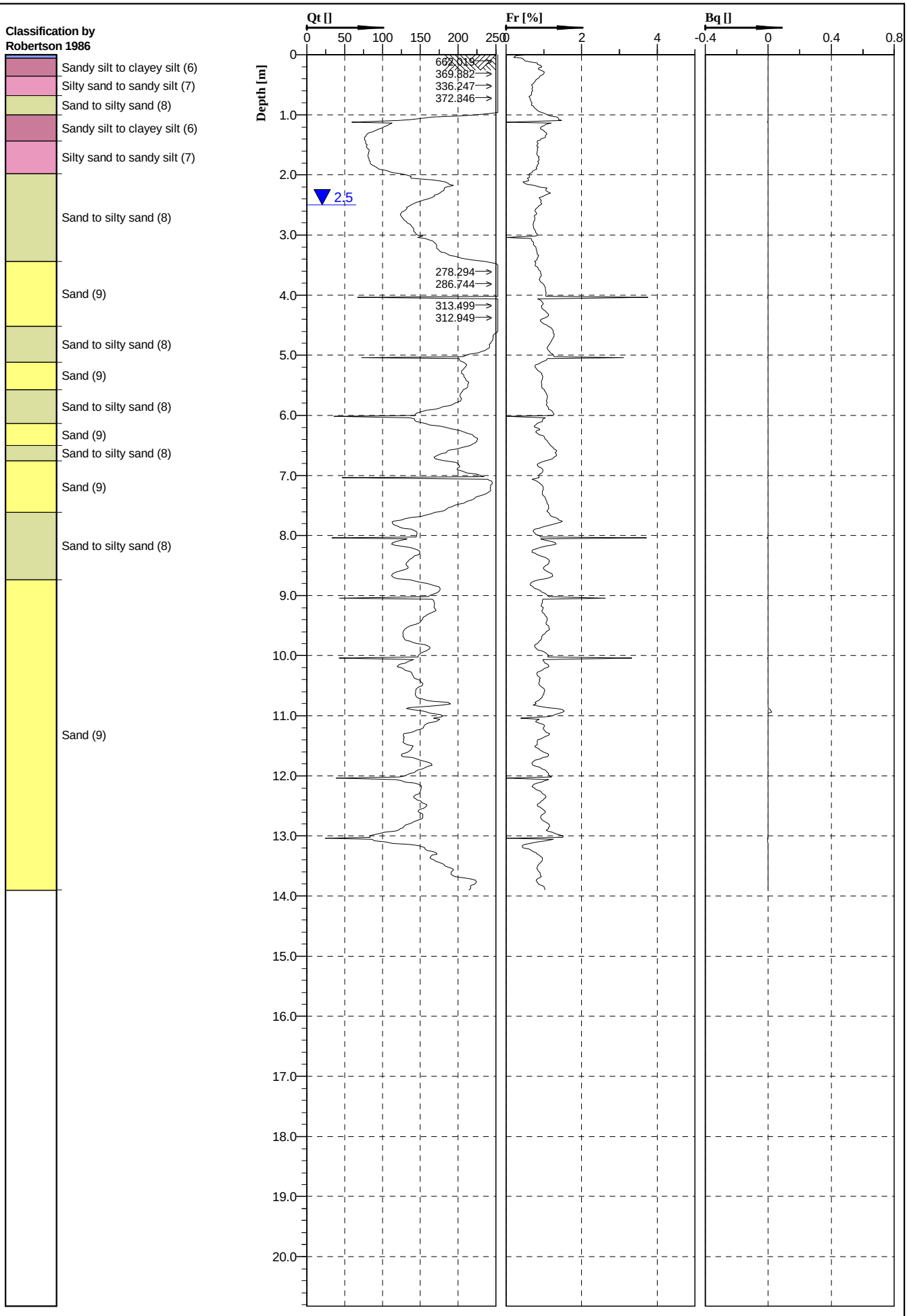


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383357 m, Y: 6367606 m	Ground level: 0.77	Test no: CPT111
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 11b
		File: CG-WI-C011.cpd	

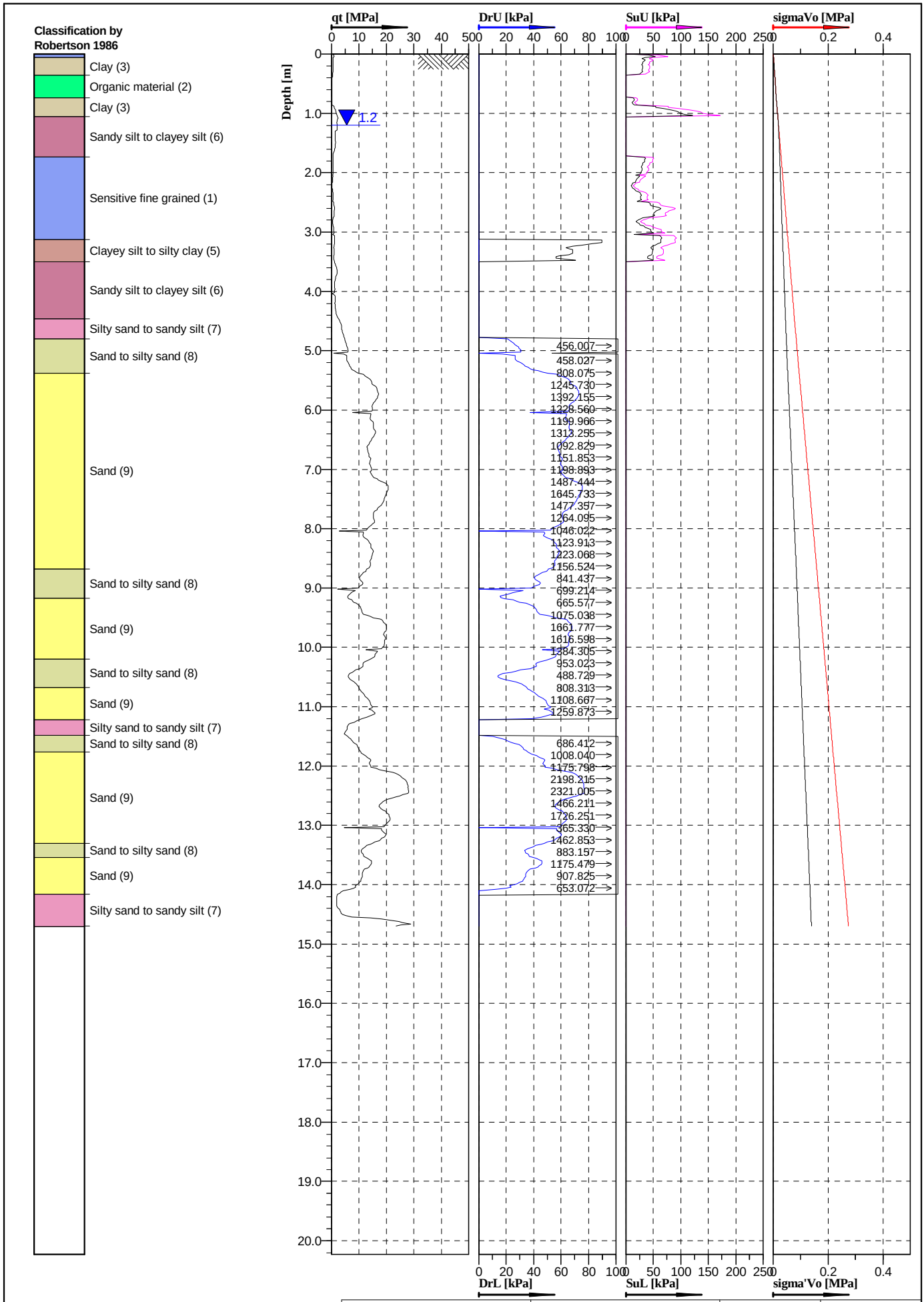


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383255 m, Y: 6367792 m	Ground level: 4.25	Test no: CPT109
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 3b
		File: CG-WI-C03.cpd	

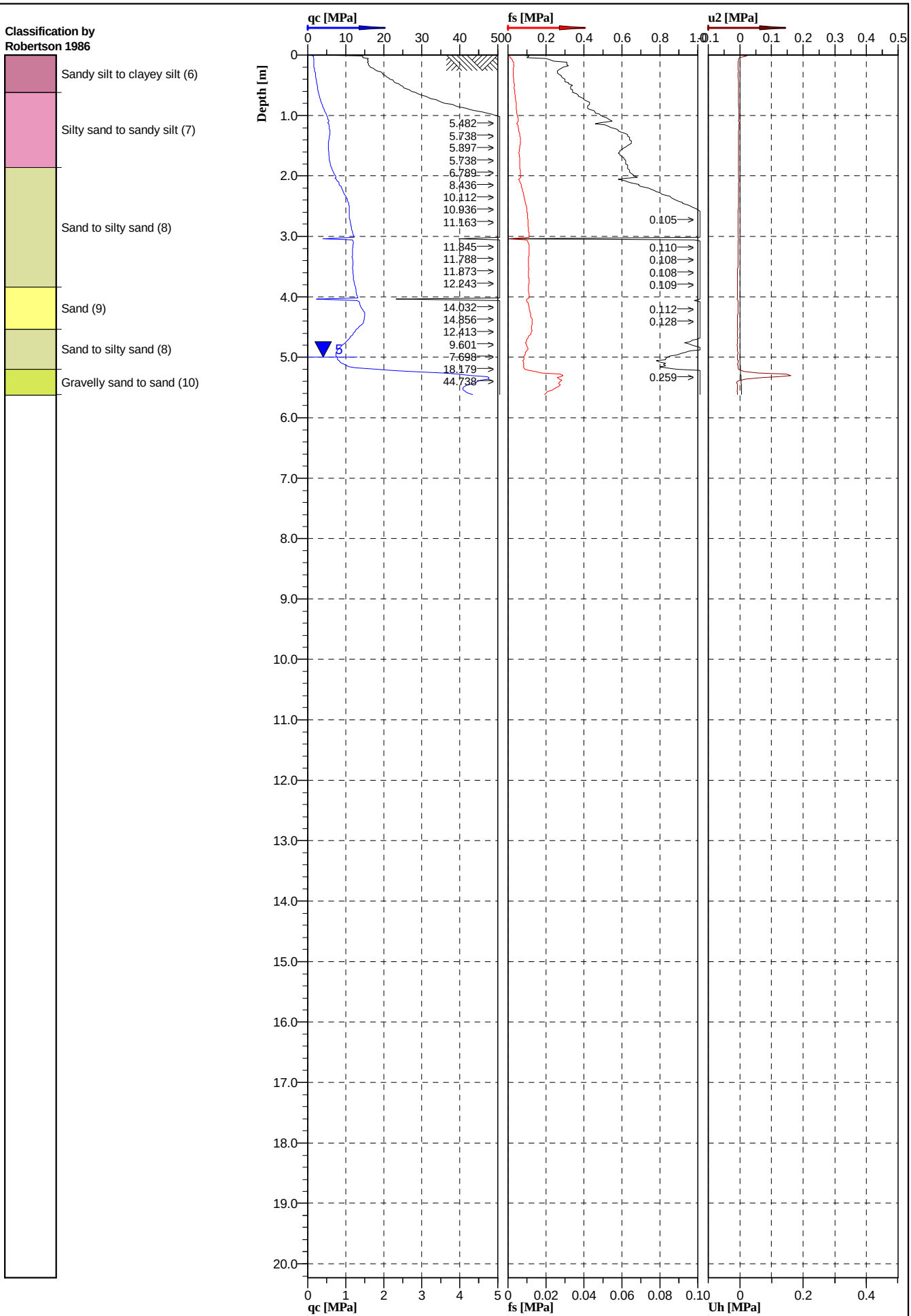


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383357 m, Y: 6367606 m	Ground level: 0.77	Test no: CPT111
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 11c
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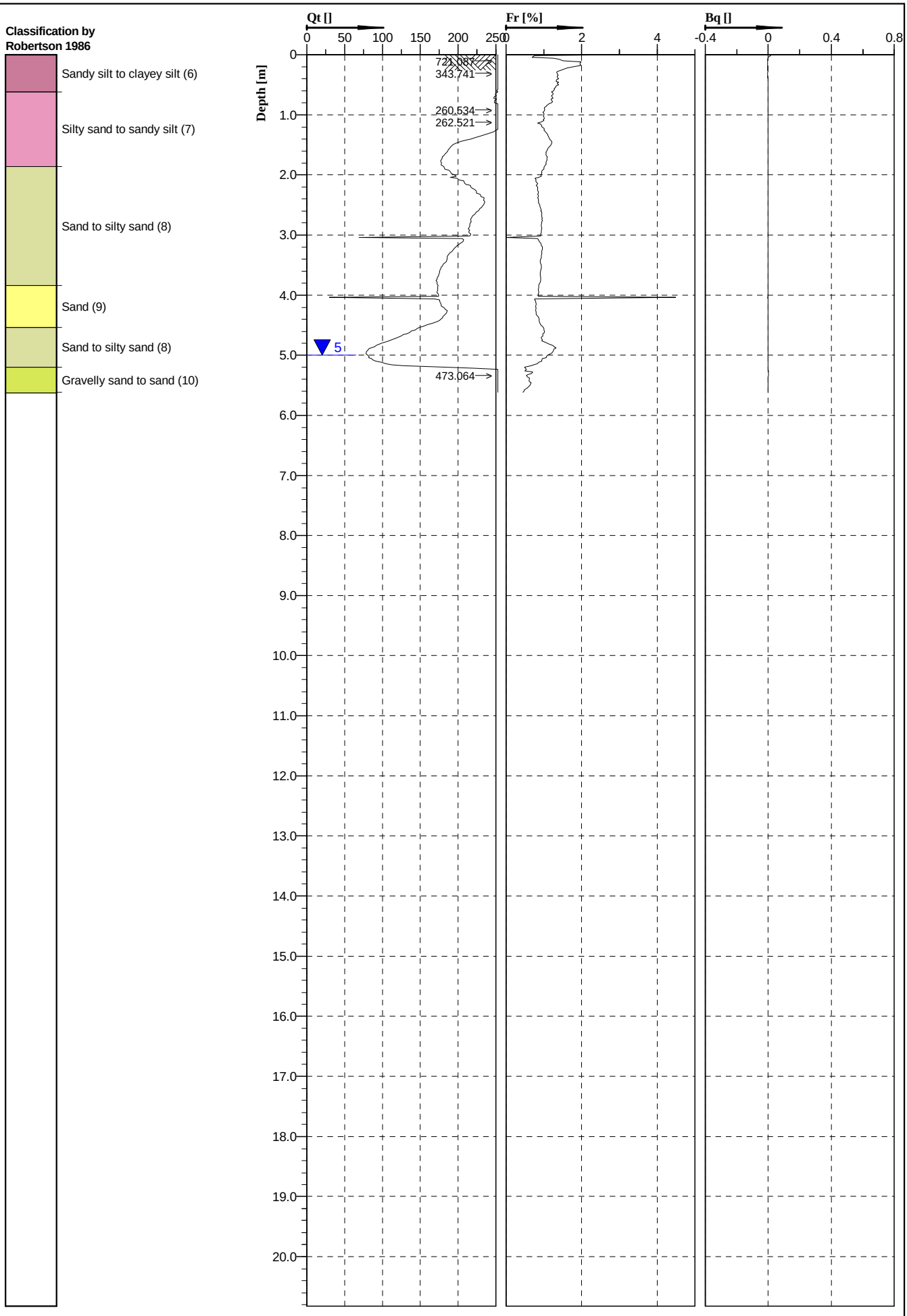


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383171 m, Y: 6367736 m	Ground level: 7.76	Test no: CPT113
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 4a
		File: CG-WI-C04.cpd	

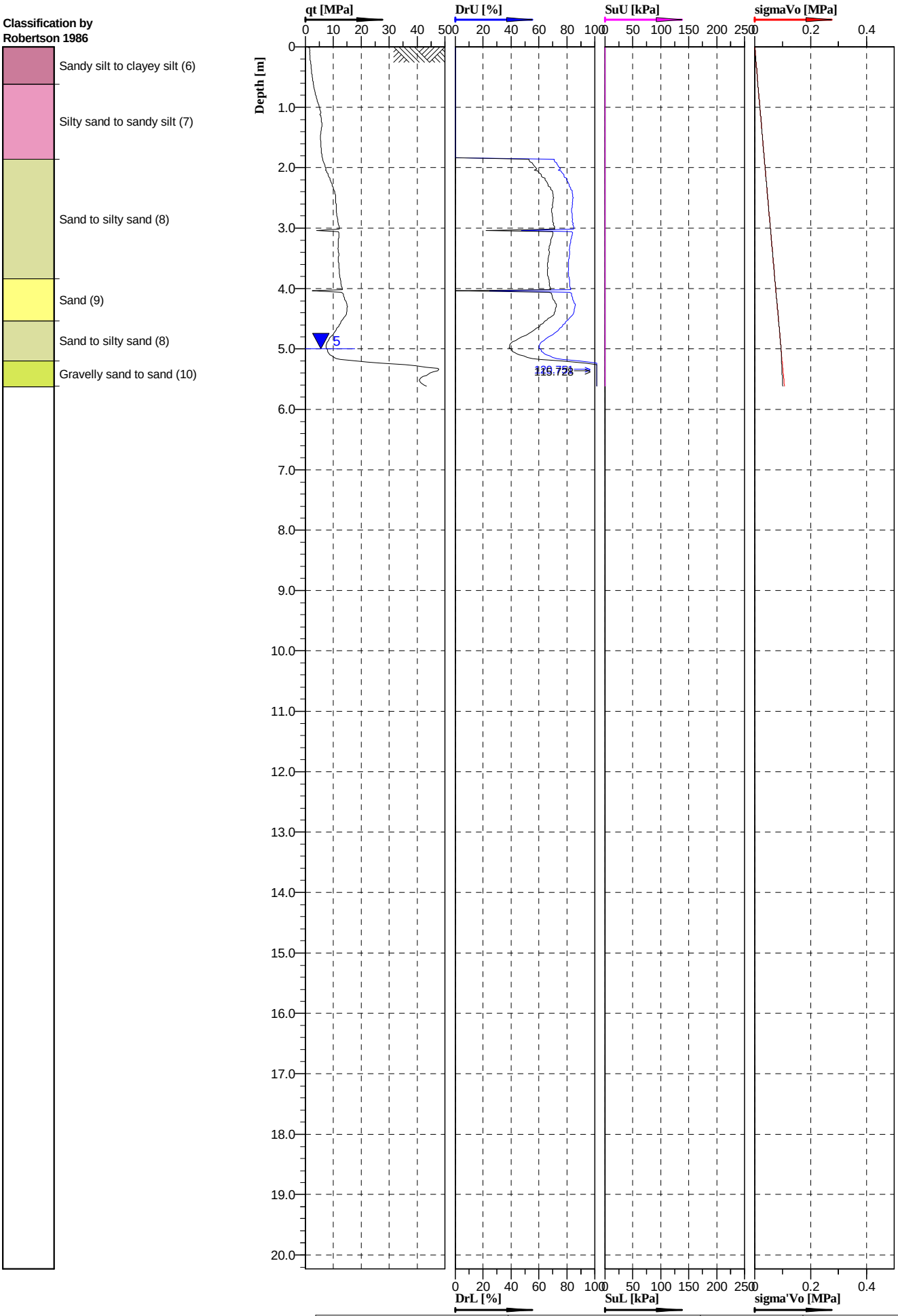


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383171 m, Y: 6367736 m	Ground level: 7.76	Test no: CPT113
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 4b
		File: CG-WI-C04.cpd	

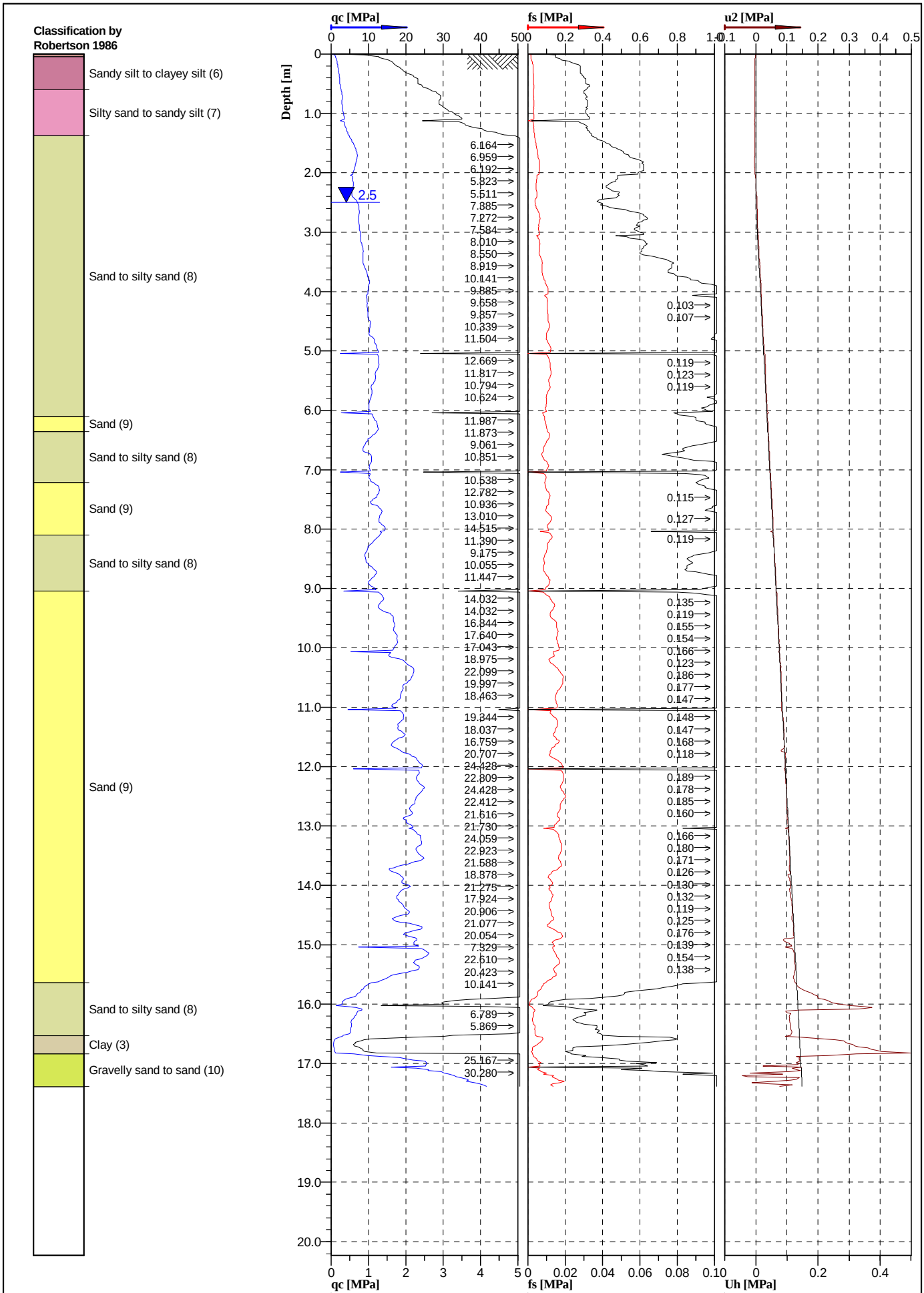


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383171 m, Y: 6367736 m	Ground level: 7.76	Test no: CPT113
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 7/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 4c
		File: CG-WI-C04.cpd	

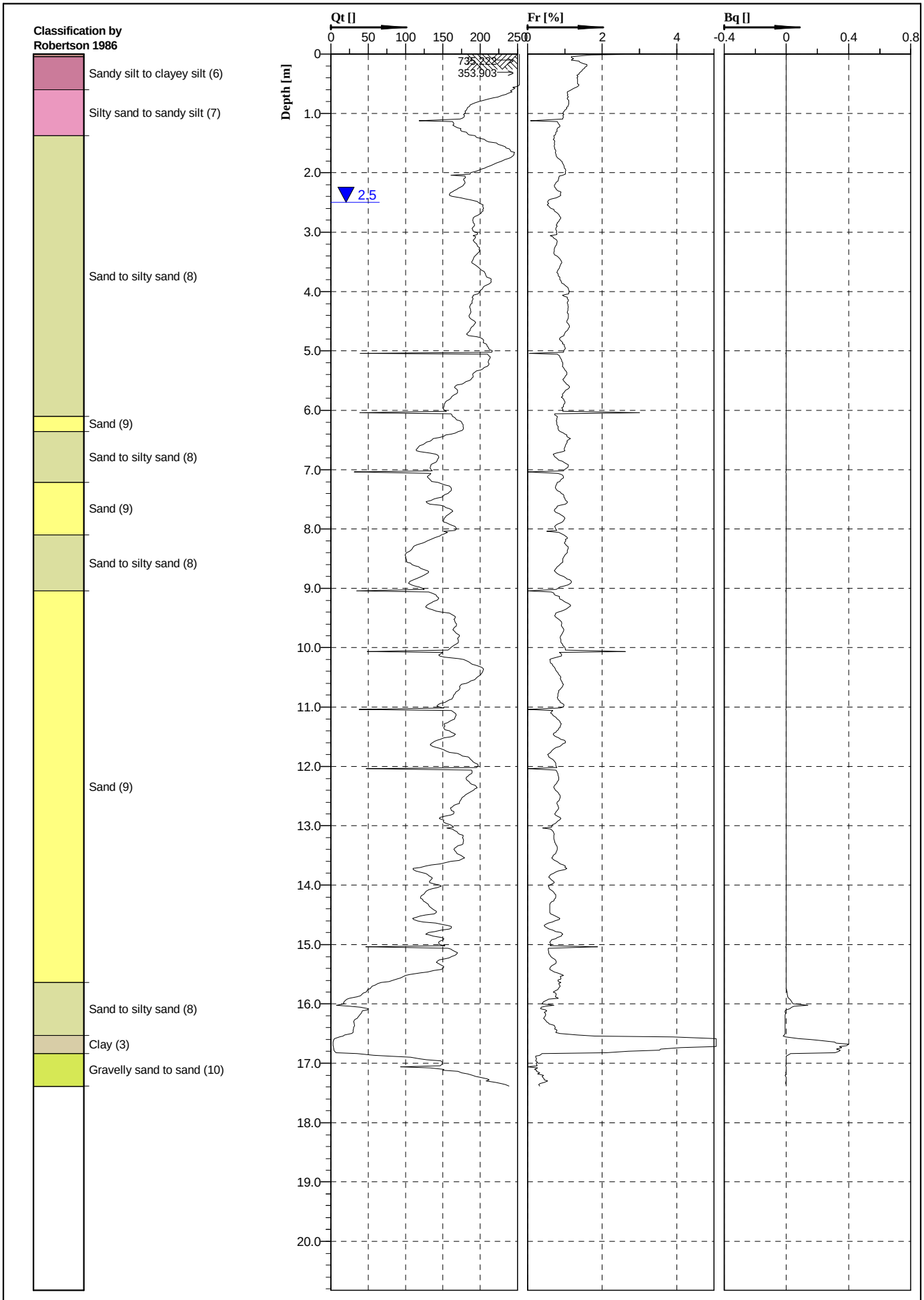


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383221 m, Y: 6367645 m	Ground level: 3.1	Test no: CPT114
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 5a
		File: CG-WI-C05.cpd	

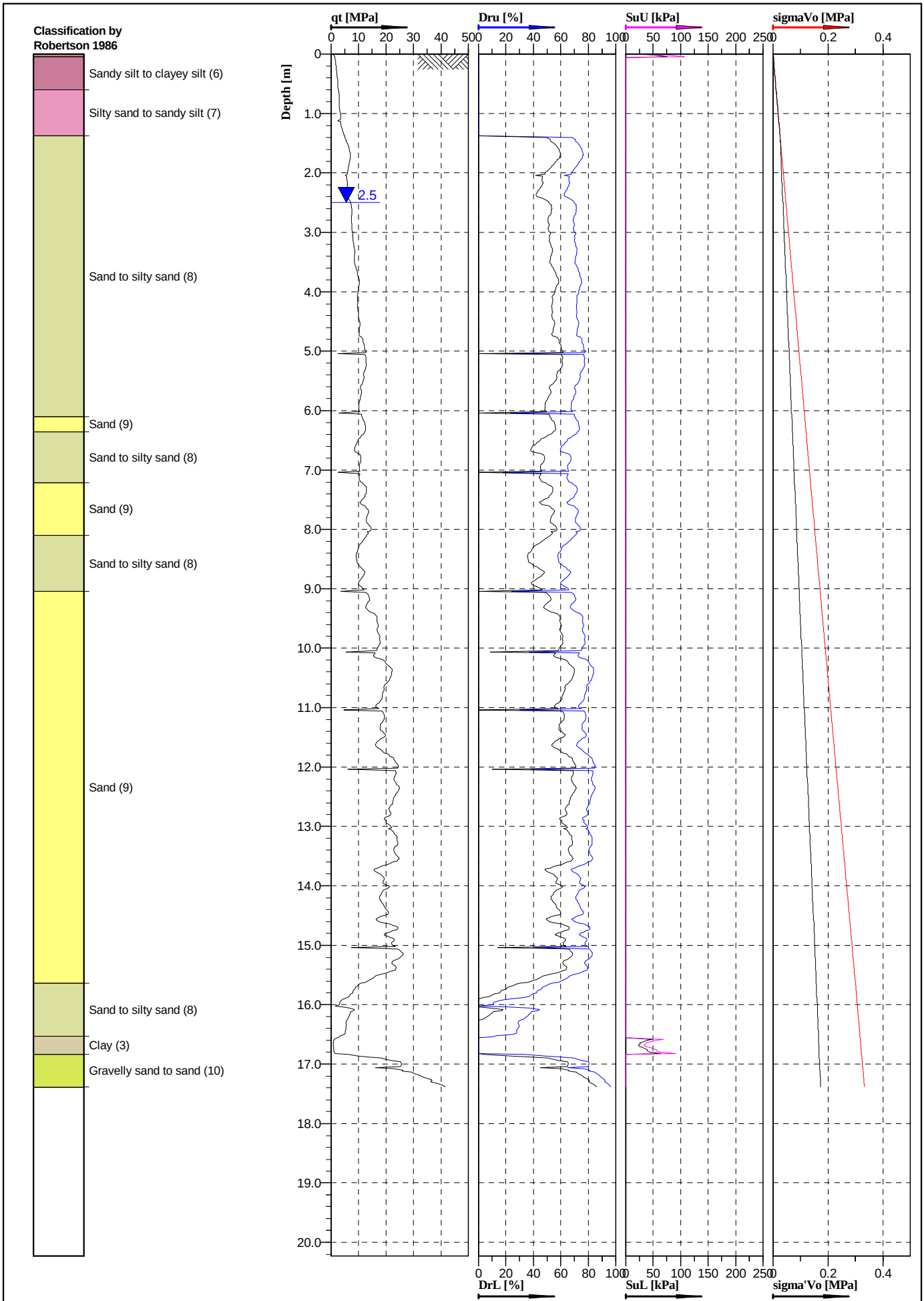


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383221 m, Y: 6367645 m	Ground level: 3.1	Test no: CPT114
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 5b
		File: CG-WI-C05.cpd	

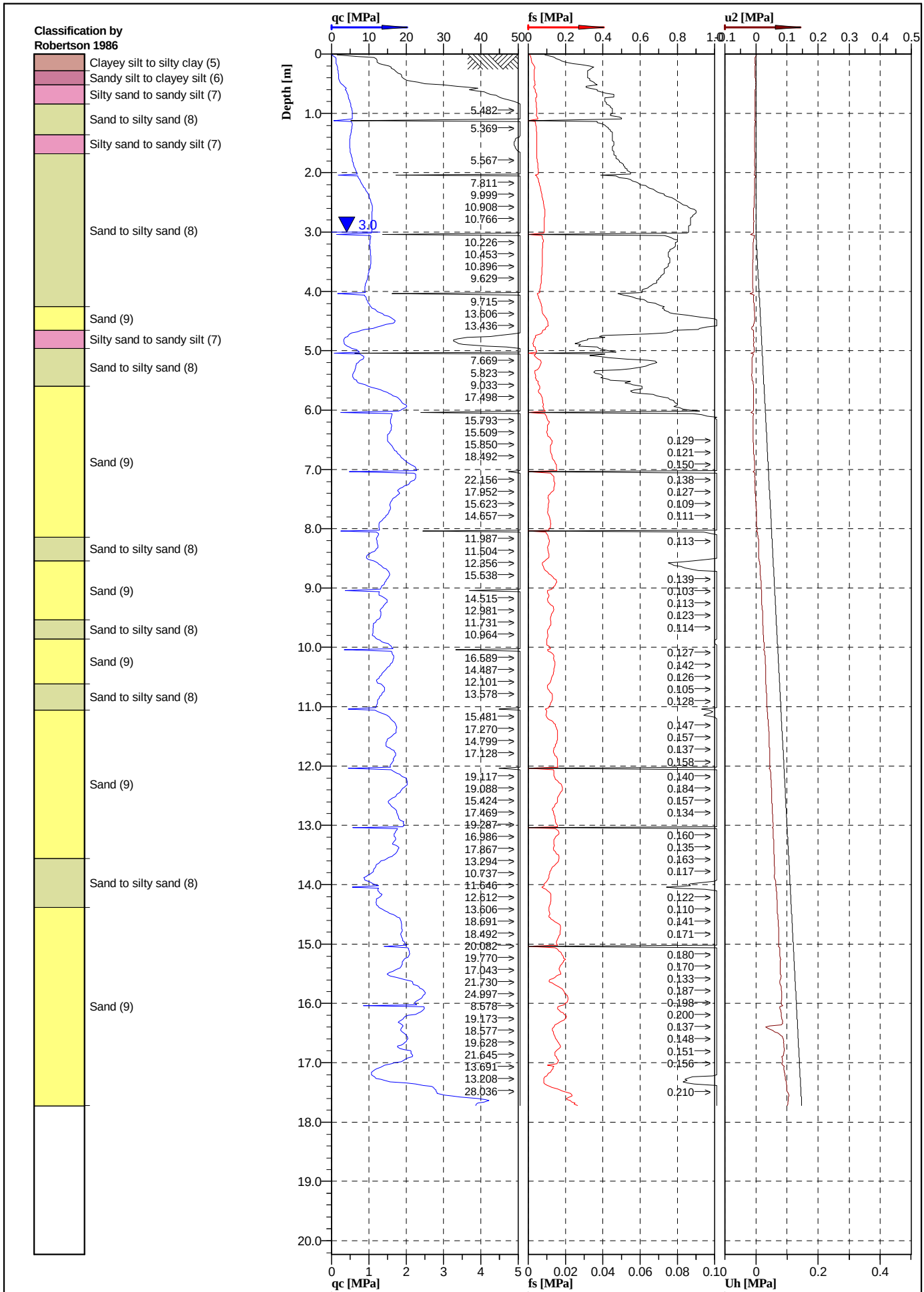


Location: Tomago Road, Tomago	Position: X: 383221 m, Y: 6367645 m	Ground level: 3.1	Test no: CPT114
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 5c
		File: CG-WI-C05.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

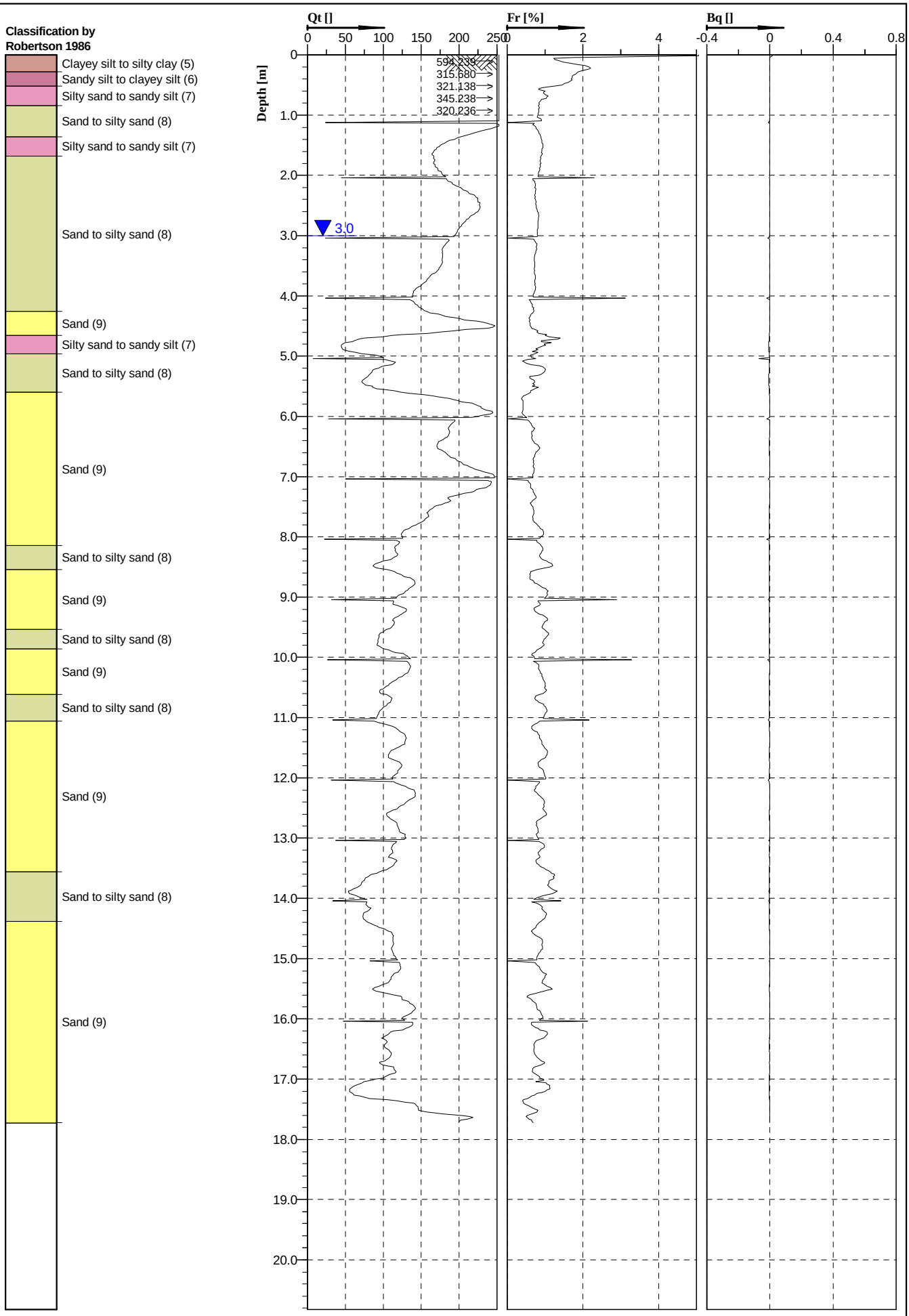


Location: Tomago Road, Tomago	Position: X: 383316 m, Y: 6367697 m	Ground level: 7.73	Test no: CPT110
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 6a
		File: CG-WI-C06.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

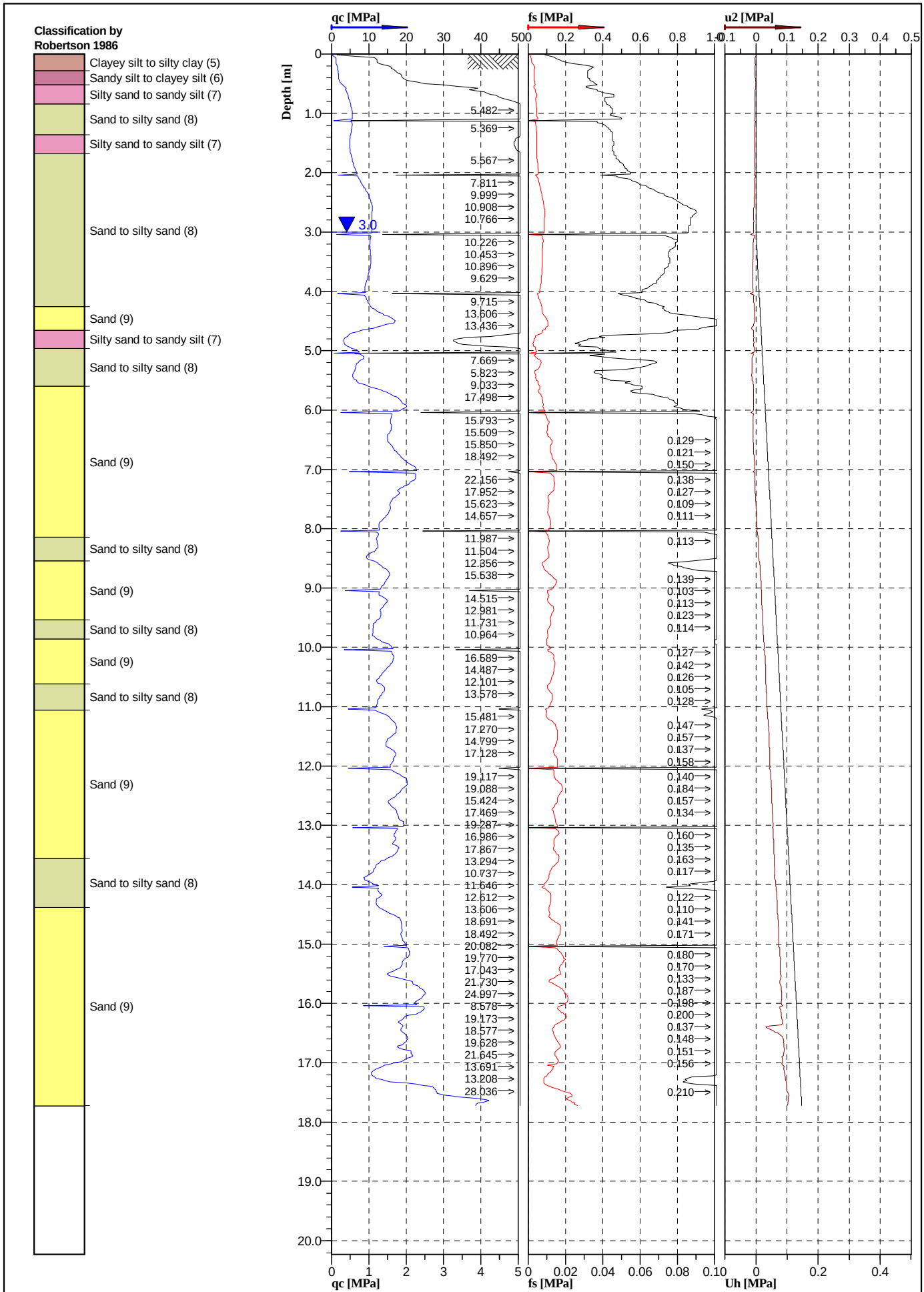


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383316 m, Y: 6367697 m	Ground level: 7.73	Test no: CPT110
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 6b
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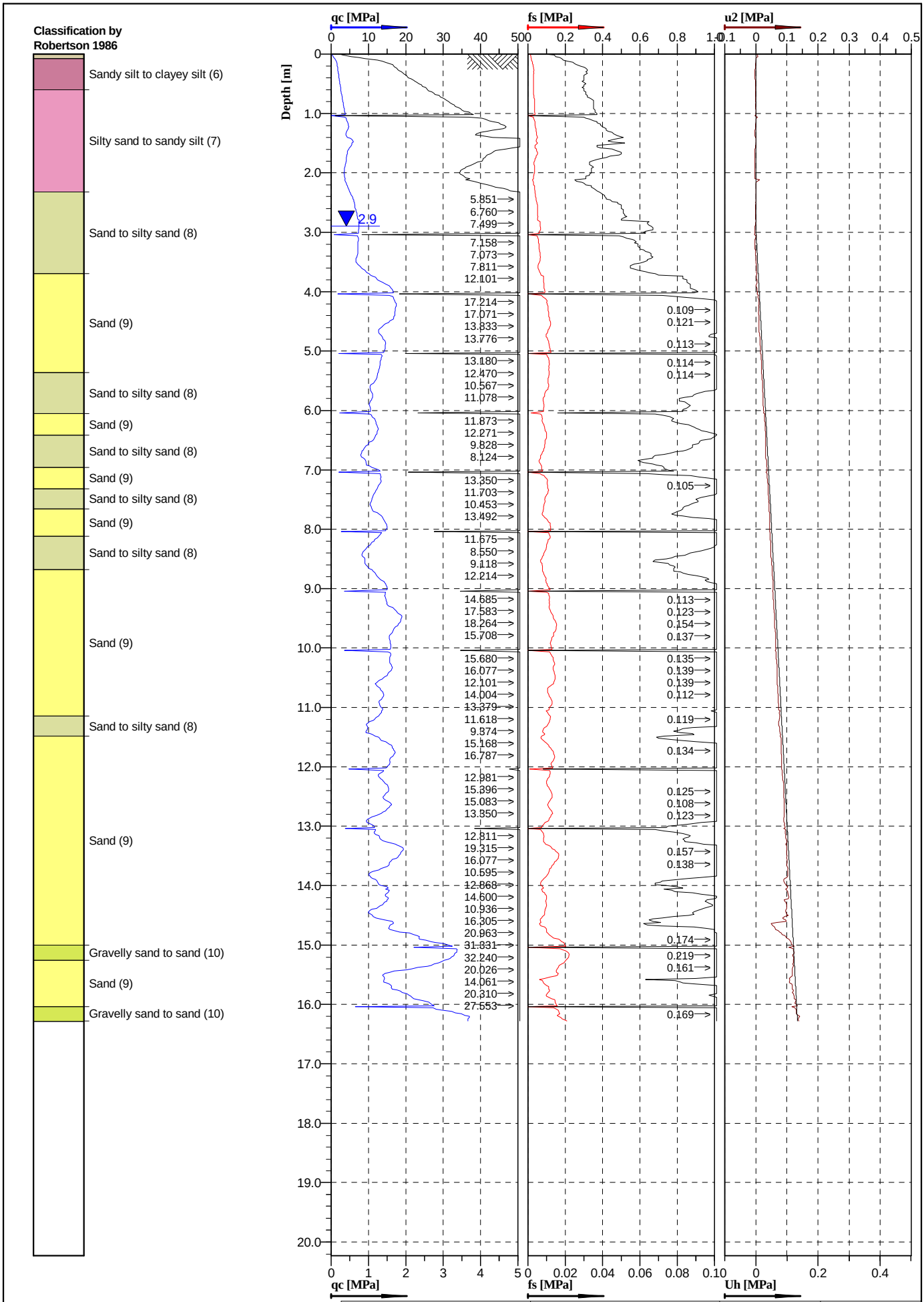


Location: Tomago Road, Tomago	Position: X: 383316 m, Y: 6367697 m	Ground level: 7.73	Test no: CPT110
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 6c
		File: CG-WI-C06.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

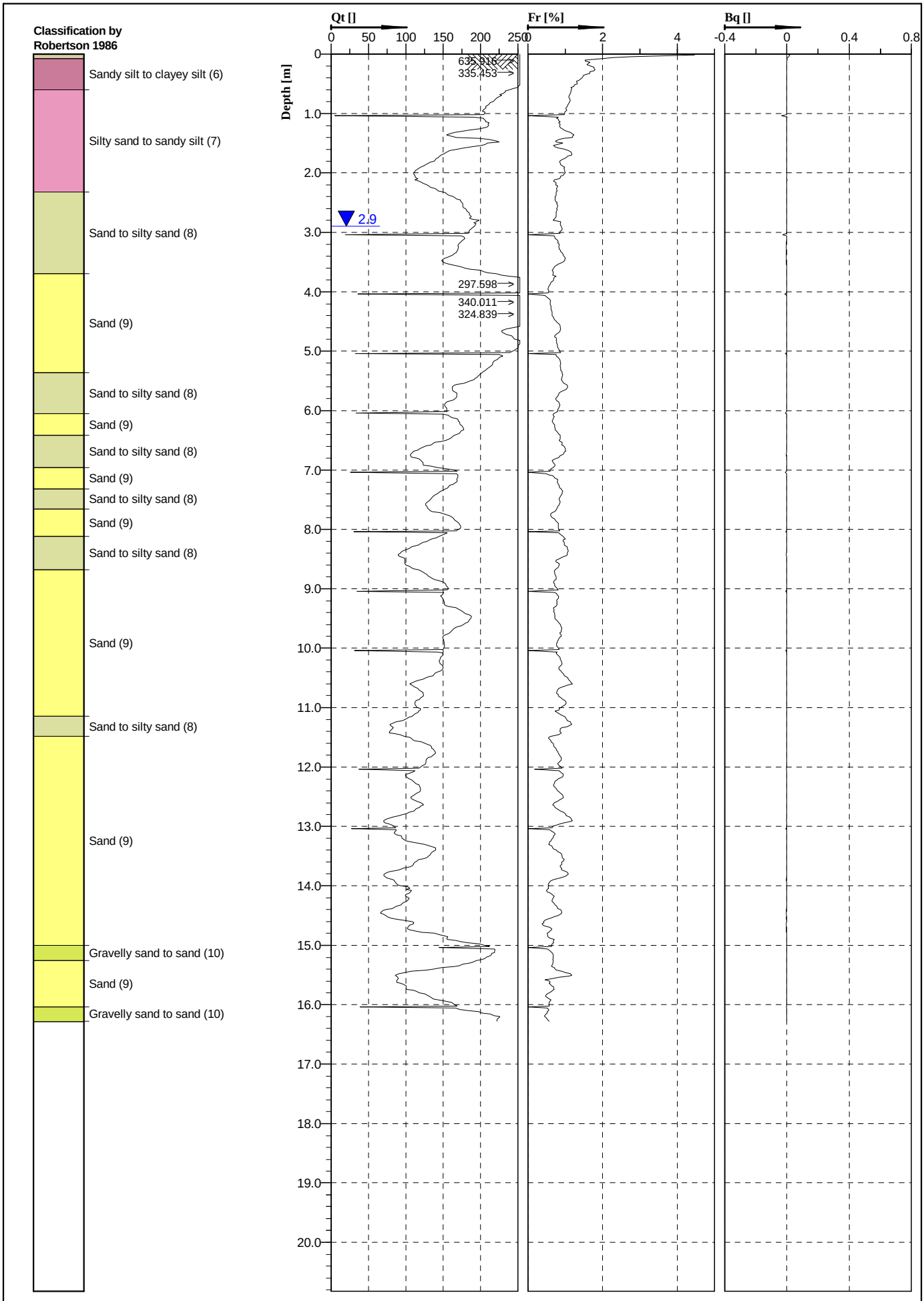


Location: Tomago Road, Tomago	Position: X: 383395 m, Y: 6367744 m	Ground level: 4.67	Test no: CPT106
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 7a
		File: CG-WI-C07.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

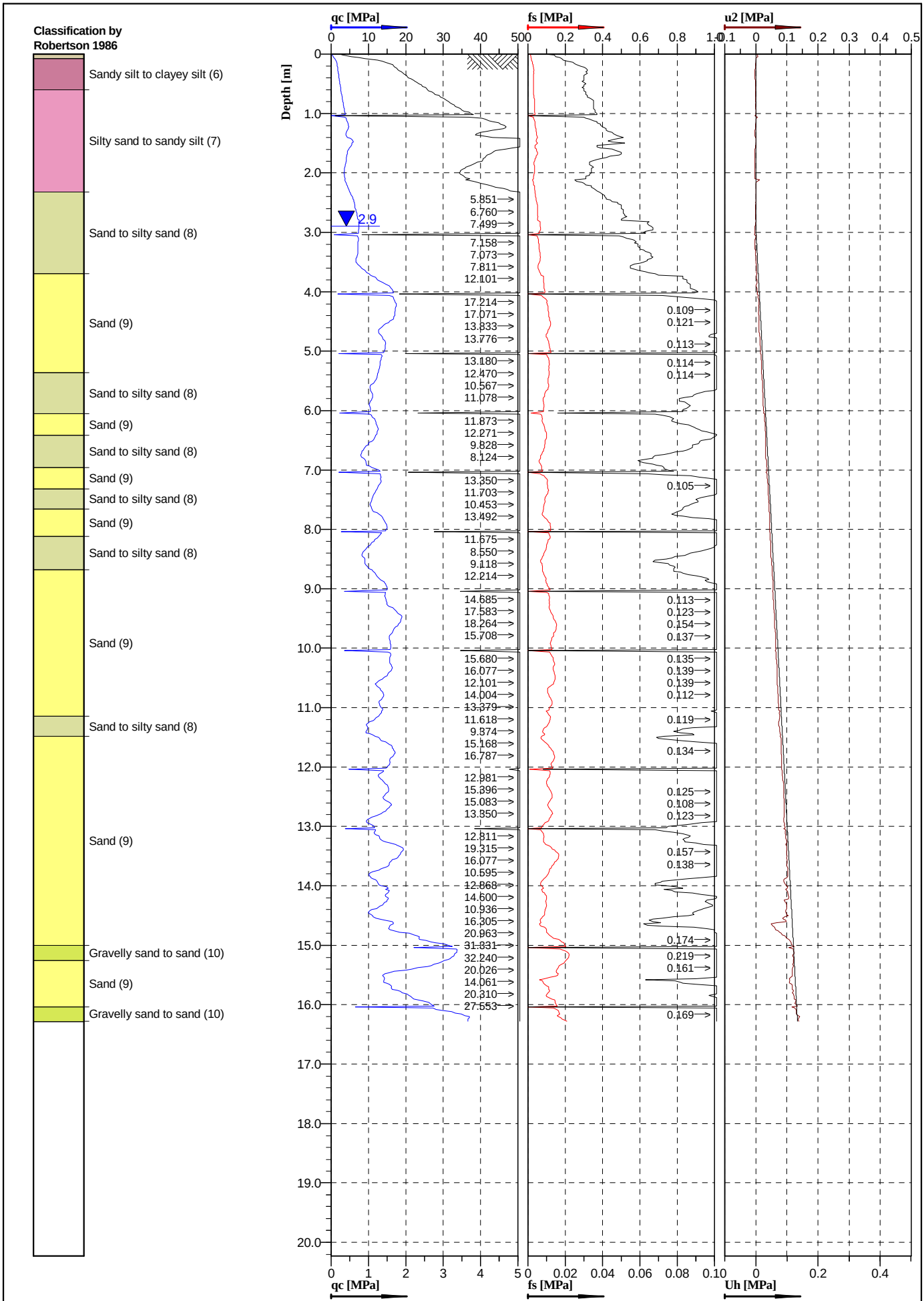


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383395 m, Y: 6367744 m	Ground level: 4.67	Test no: CPT106
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 7b
		File: CG-WI-C07.cpd	

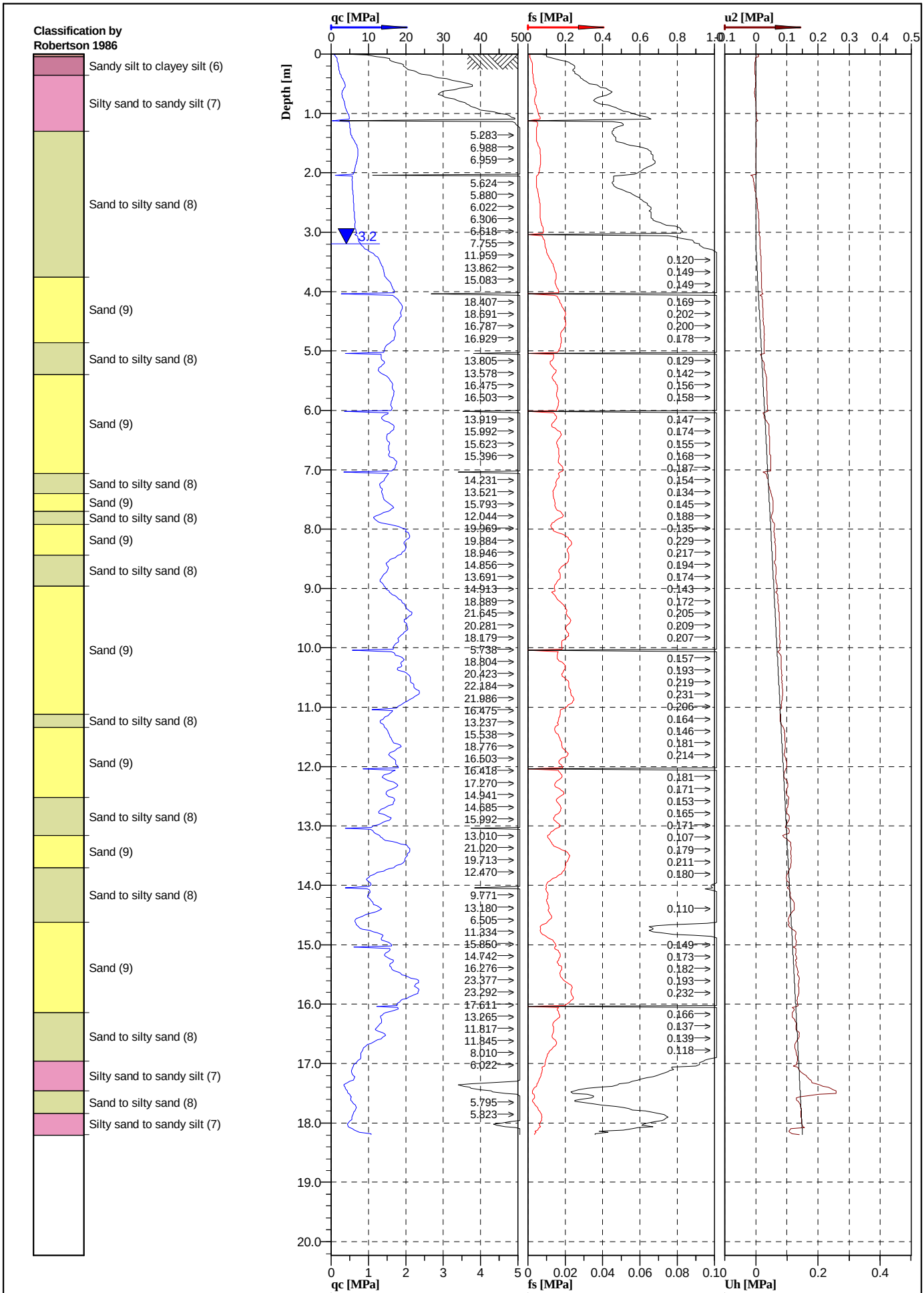


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383395 m, Y: 6367744 m	Ground level: 4.67	Test no: CPT106
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 7c
		File: CG-WI-C07.cpd	

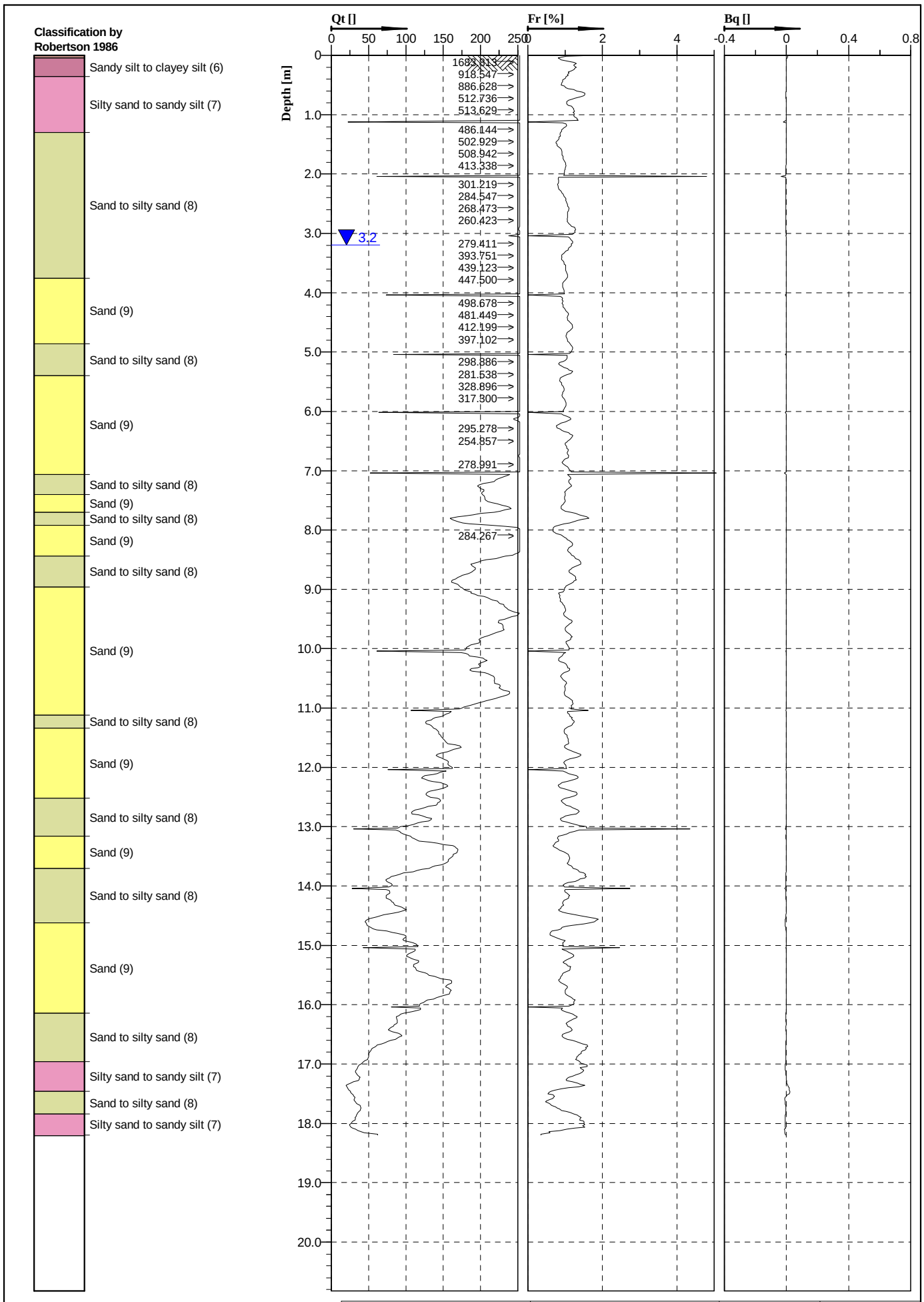


Location: Tomago Road, Tomago	Position: X: 383483 m, Y: 6367789 m	Ground level: 3.1	Test no: CPT102
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 8a
		File: CG-WI-C08.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

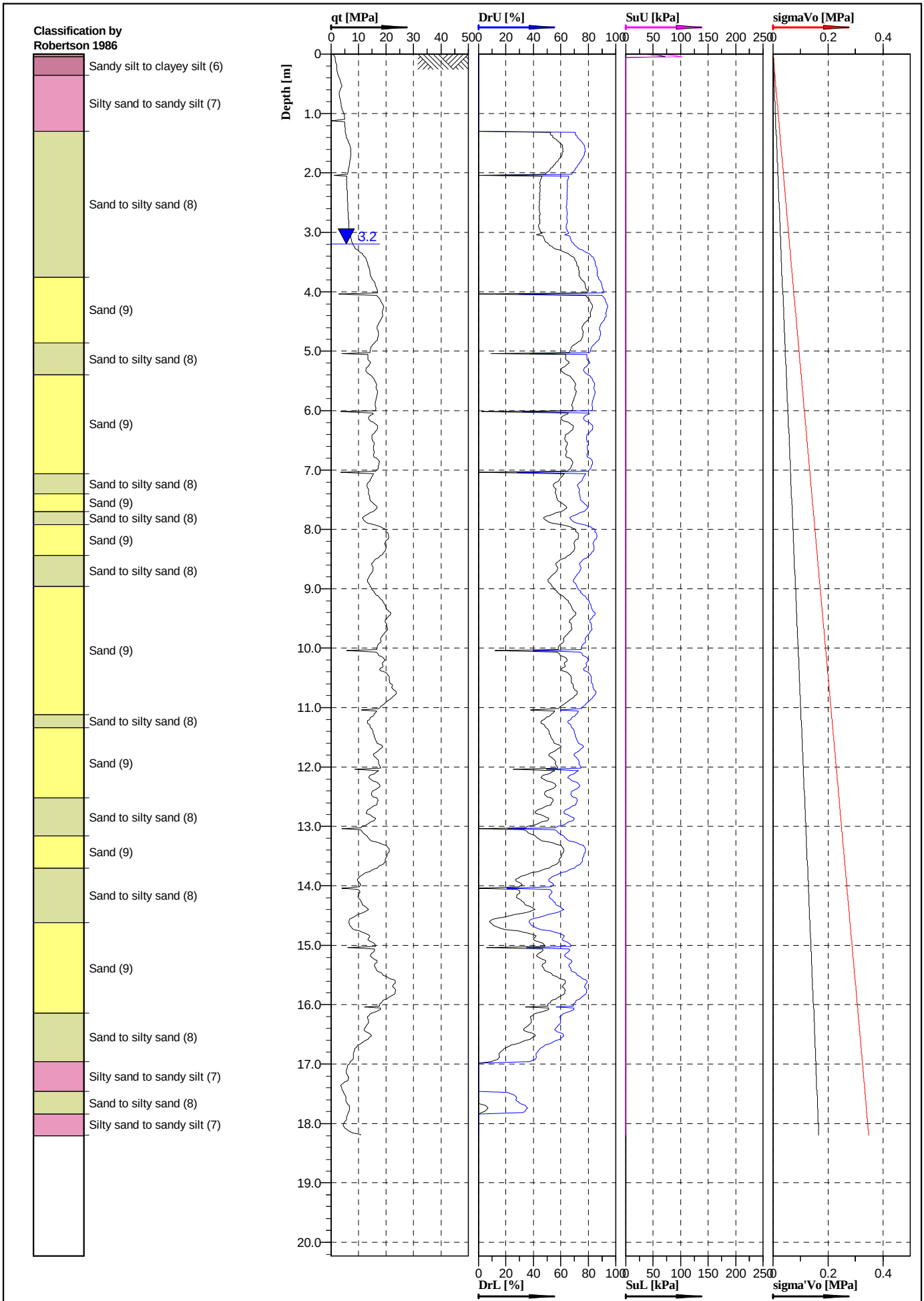


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383483 m, Y: 6367789 m	Ground level: 3.1	Test no: CPT102
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 8b
		File: CG-WI-C08.cpd	

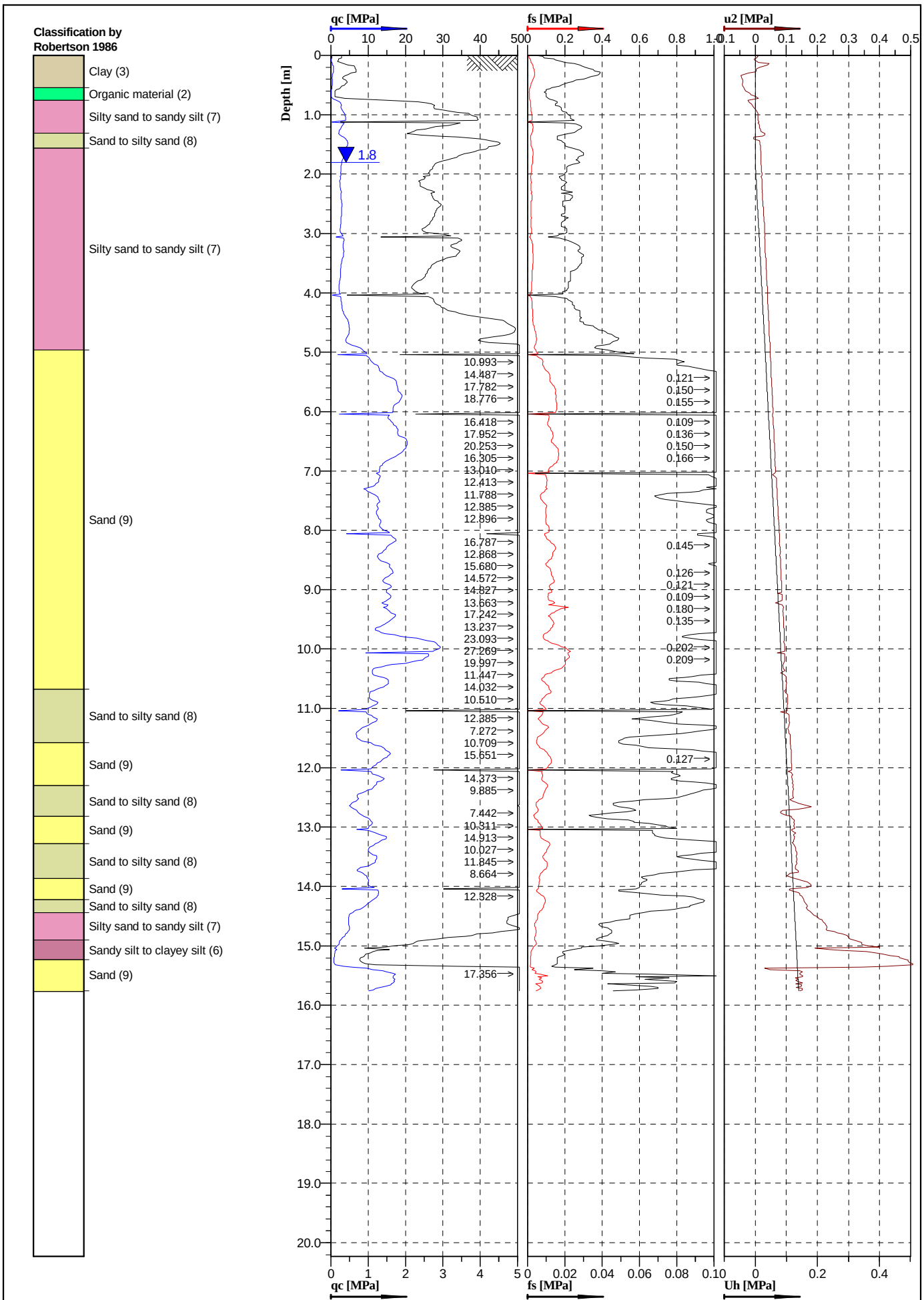


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383483 m, Y: 6367789 m	Ground level: 3.1	Test no: CPT102
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 8c
		File: CG-WI-C08.cpd	

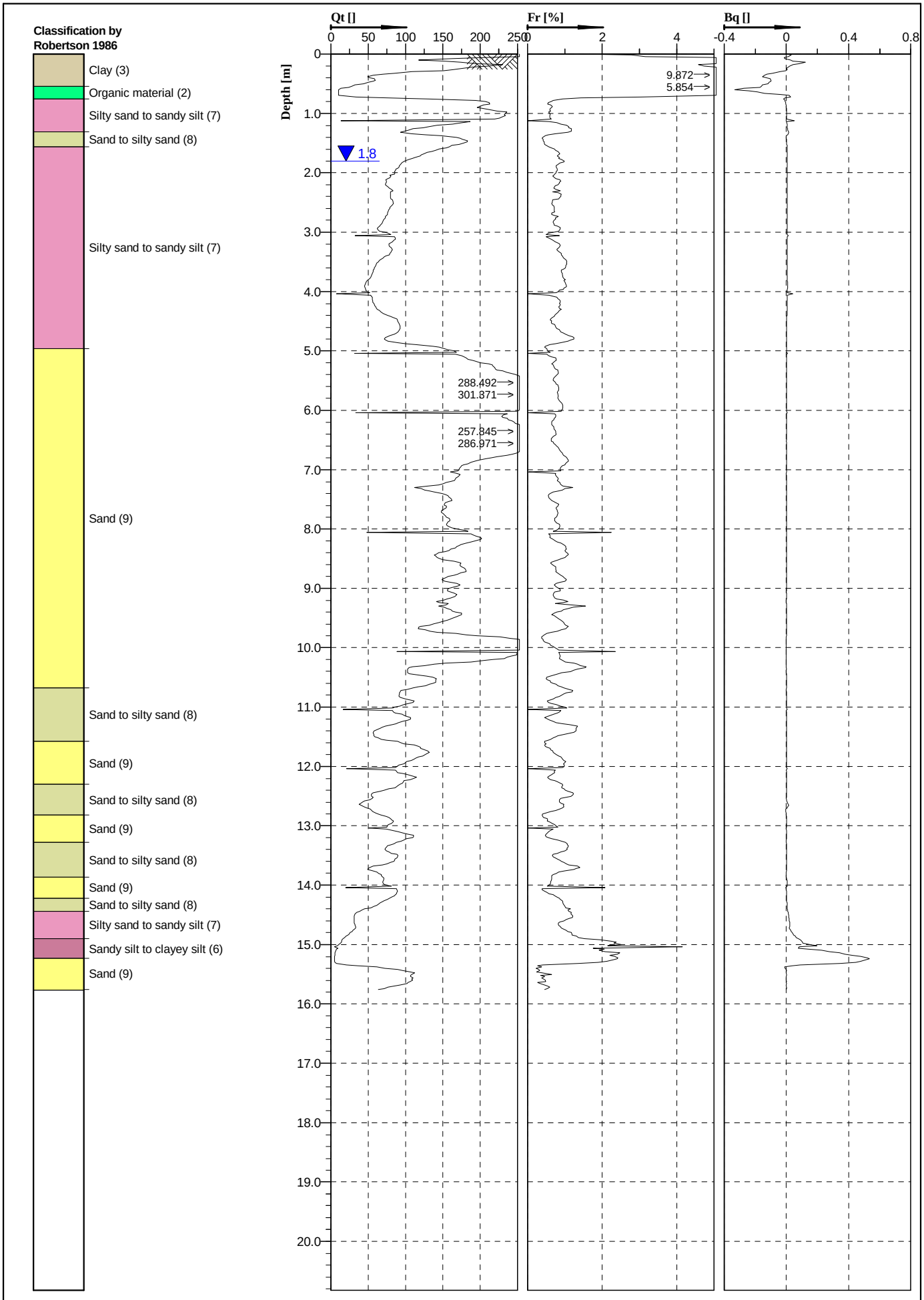


Location: Tomago Road, Tomago	Position: X: 383532 m, Y: 6367706 m	Ground level: 1.06	Test no: CPT103
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 9a
		File: CG-WI-C09.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

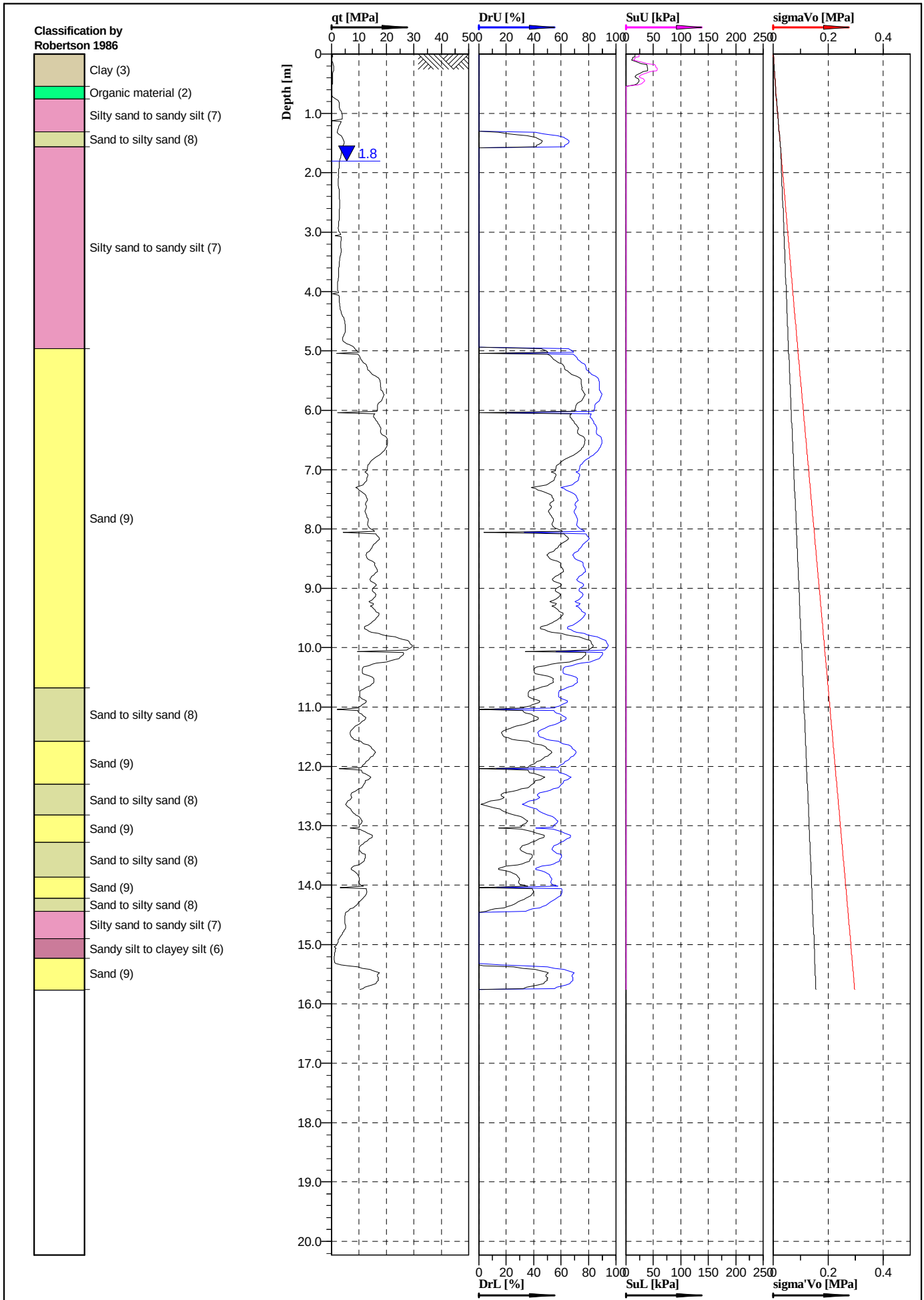


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383532 m, Y: 6367706 m	Ground level: 1.06	Test no: CPT103
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 9b
		File: CG-WI-C09.cpd	

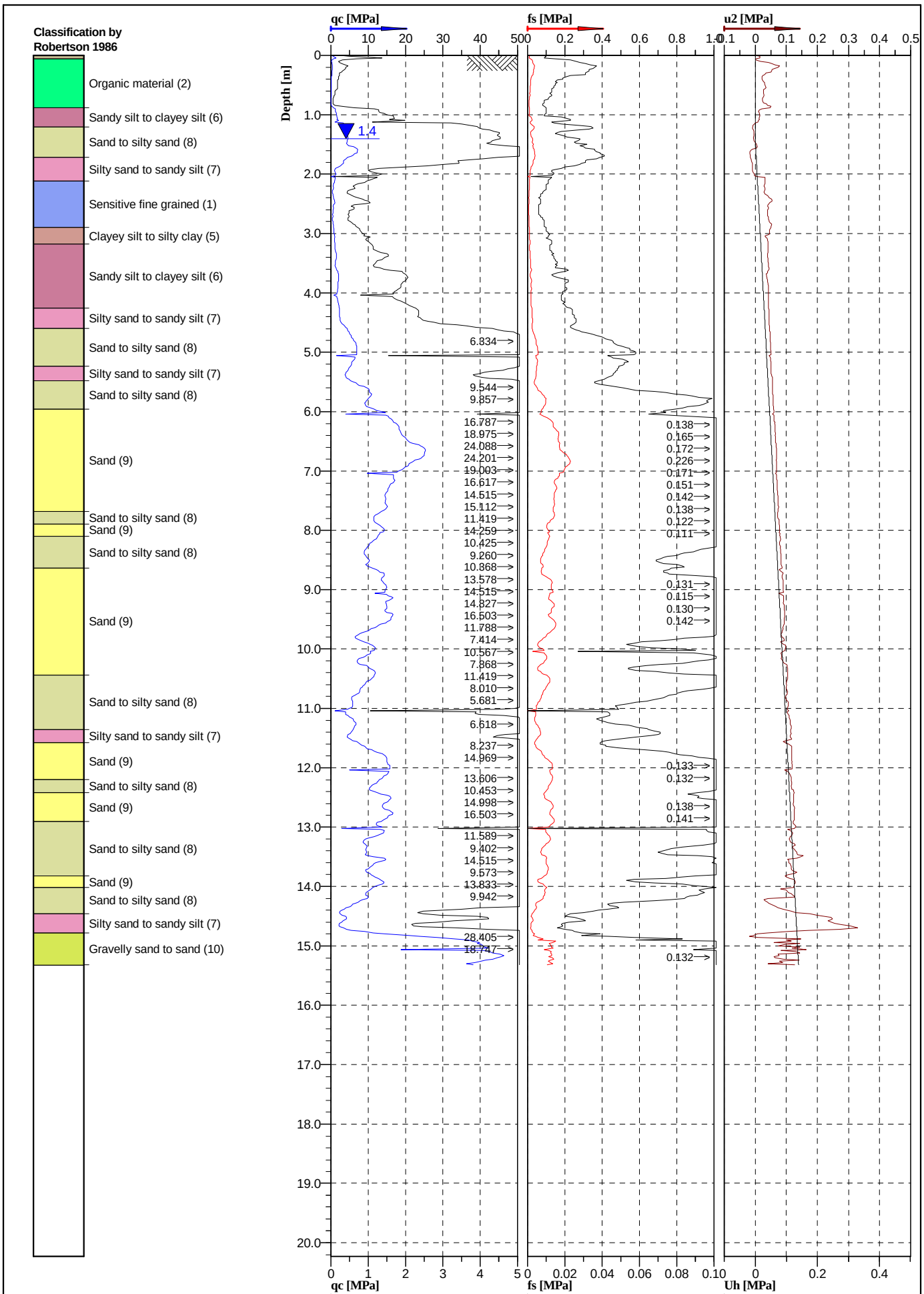


Location: Tomago Road, Tomago	Position: X: 383532 m, Y: 6367706 m	Ground level: 1.06	Test no: CPT103
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 8/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 9c
		File: CG-WI-C09.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

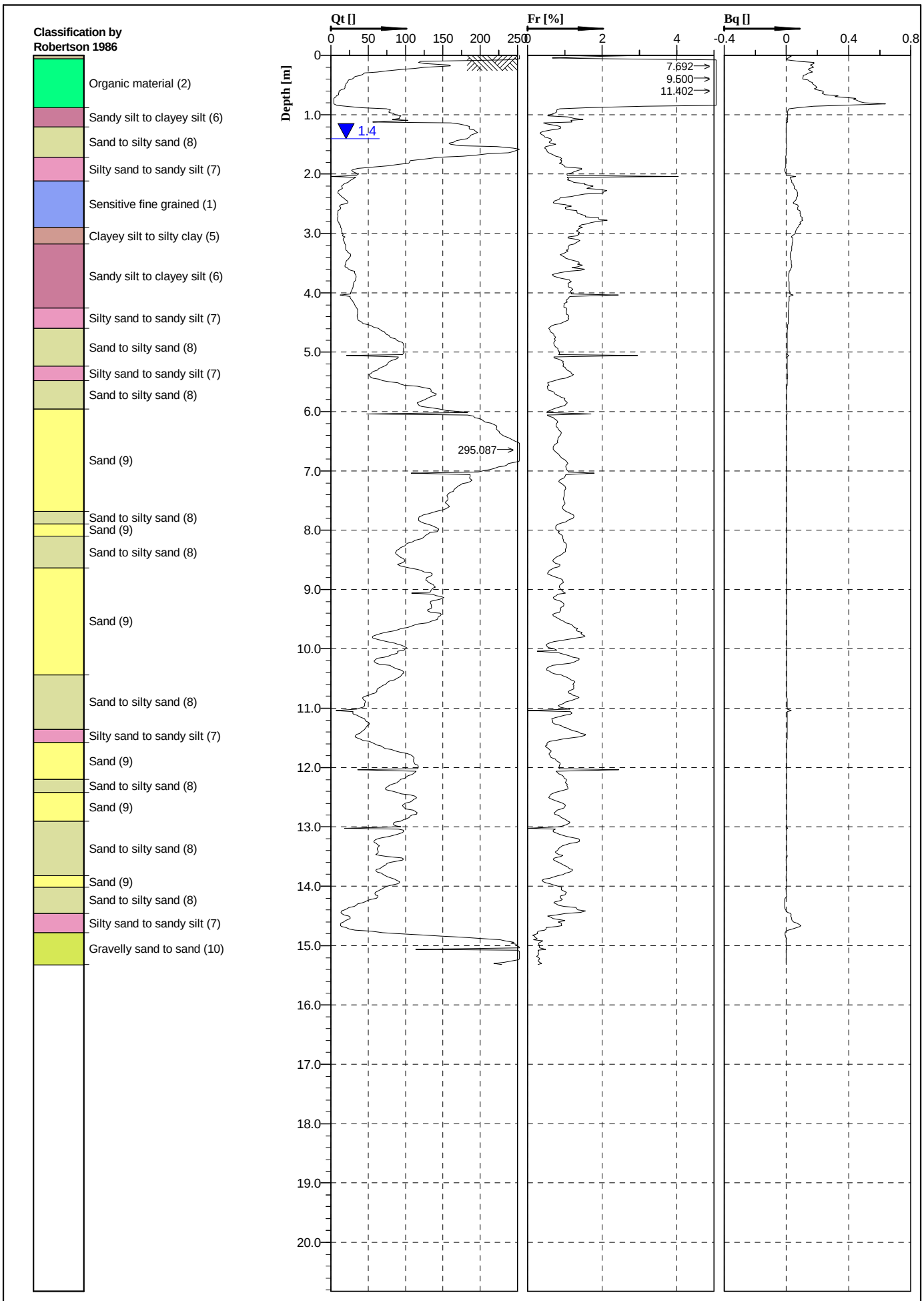


Location: Tomago Road, Tomago	Position: X: 383443 m, Y: 6367656 m	Ground level: 0.89	Test no: CPT107
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 10a
		File: CG-WI-C010.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

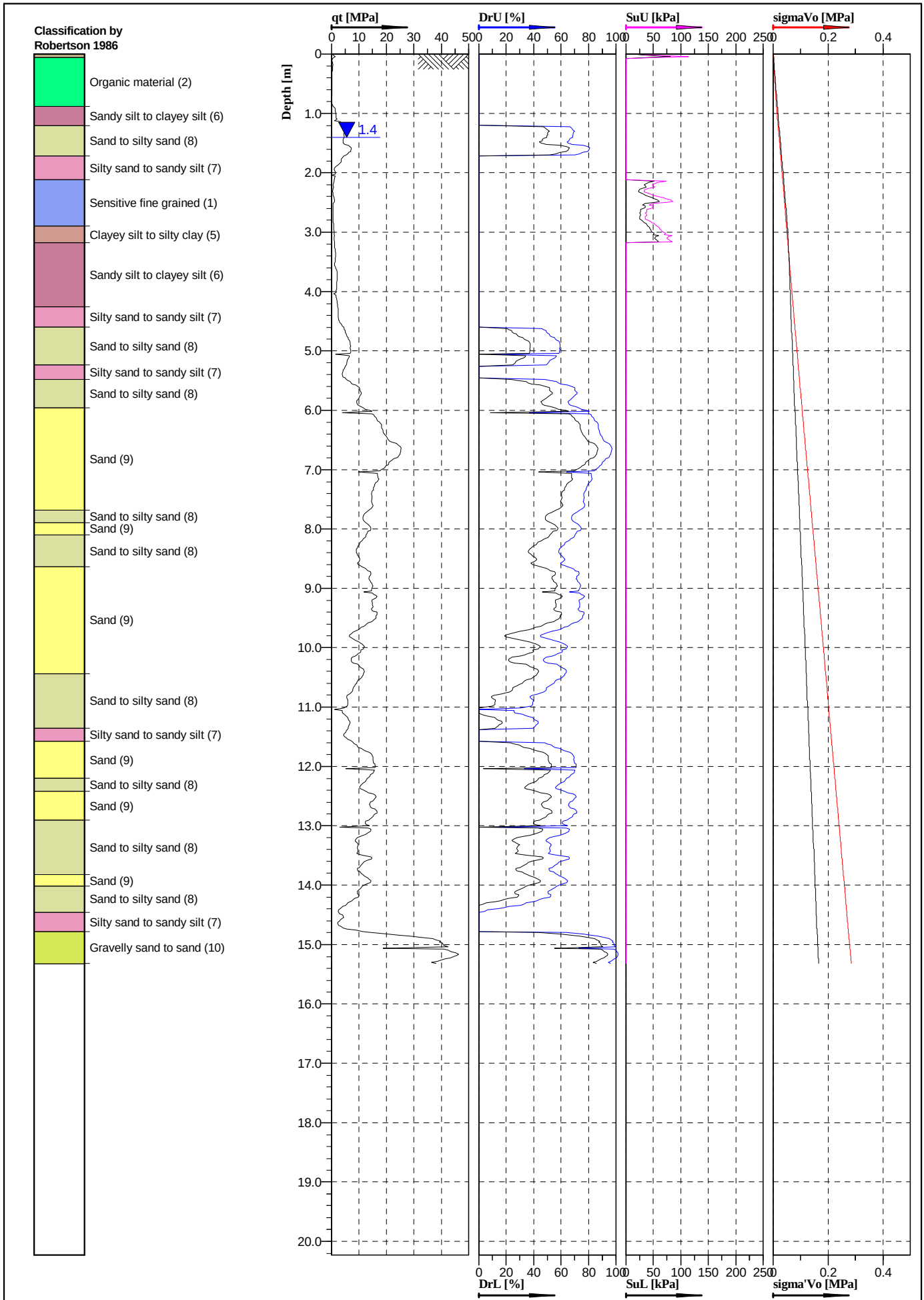


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383443 m, Y: 6367656 m	Ground level: 0.89	Test no: CPT107
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 10b
		File: CG-WI-C010.cpd	

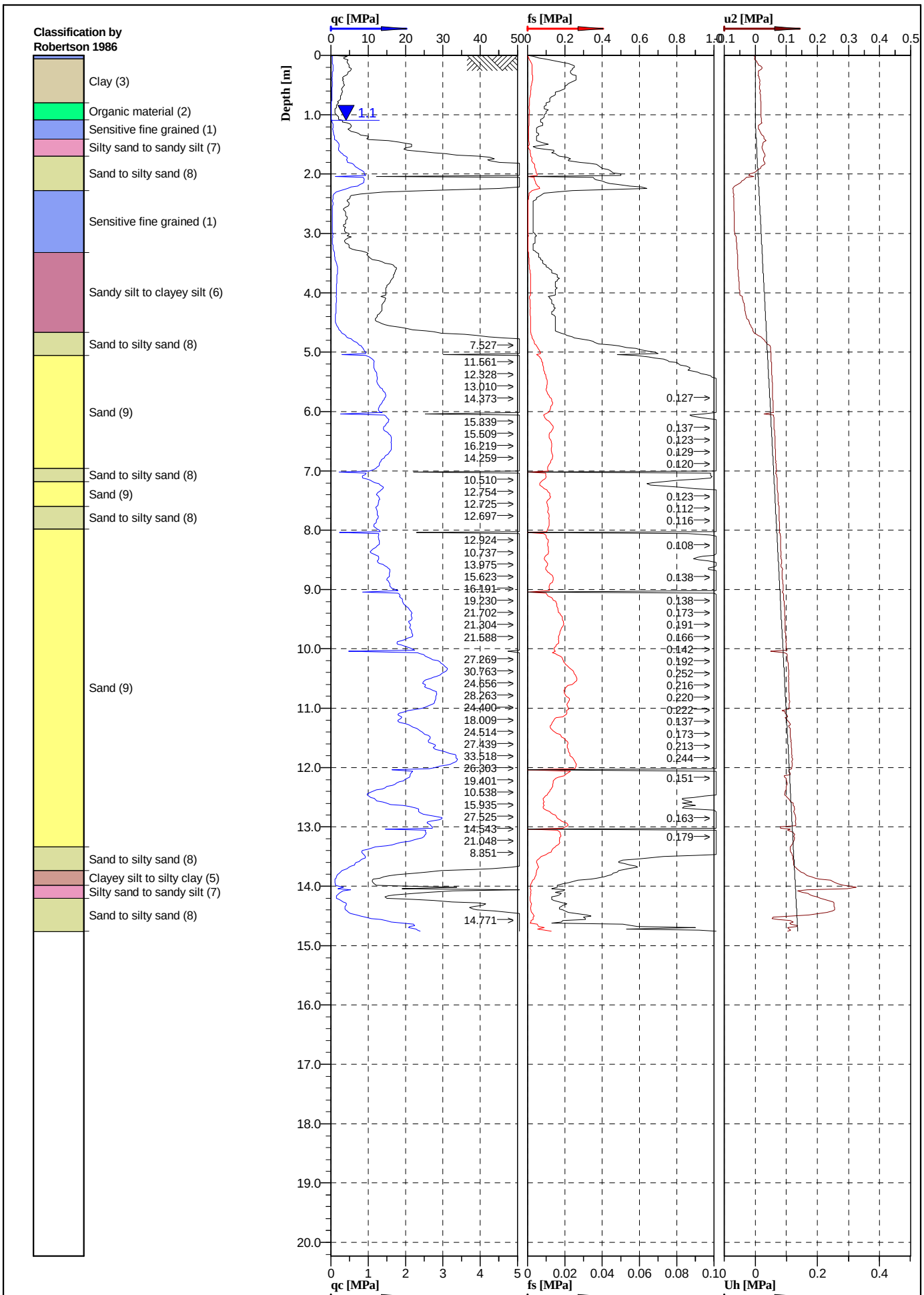


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383443 m, Y: 6367656 m	Ground level: 0.89	Test no: CPT107
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 10c
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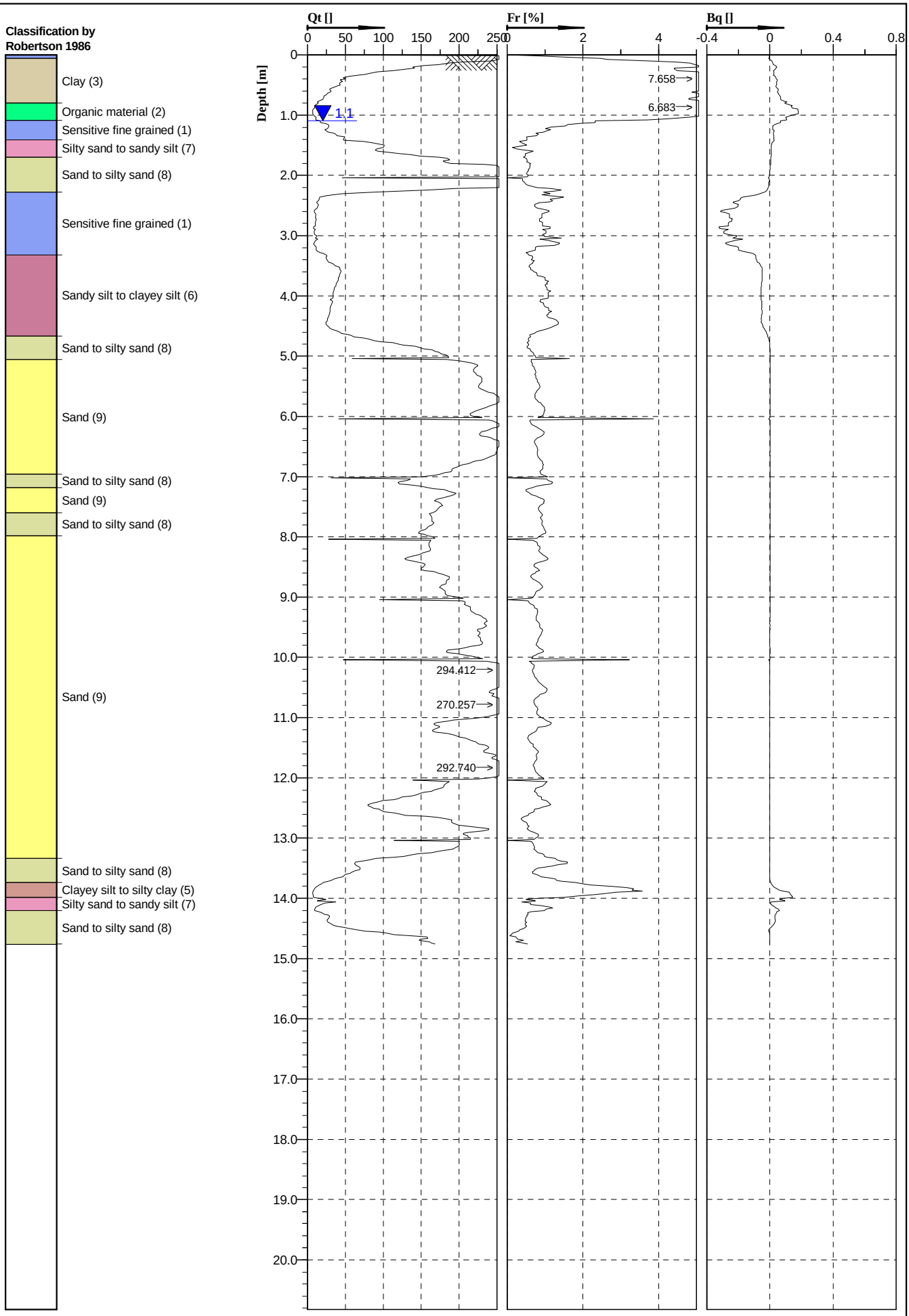


Location: Tomago Road, Tomago	Position: X: 383268 m, Y: 6367556 m	Ground level: 0.71	Test no: CPT115
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 12a
		File: CG-WI-C012.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

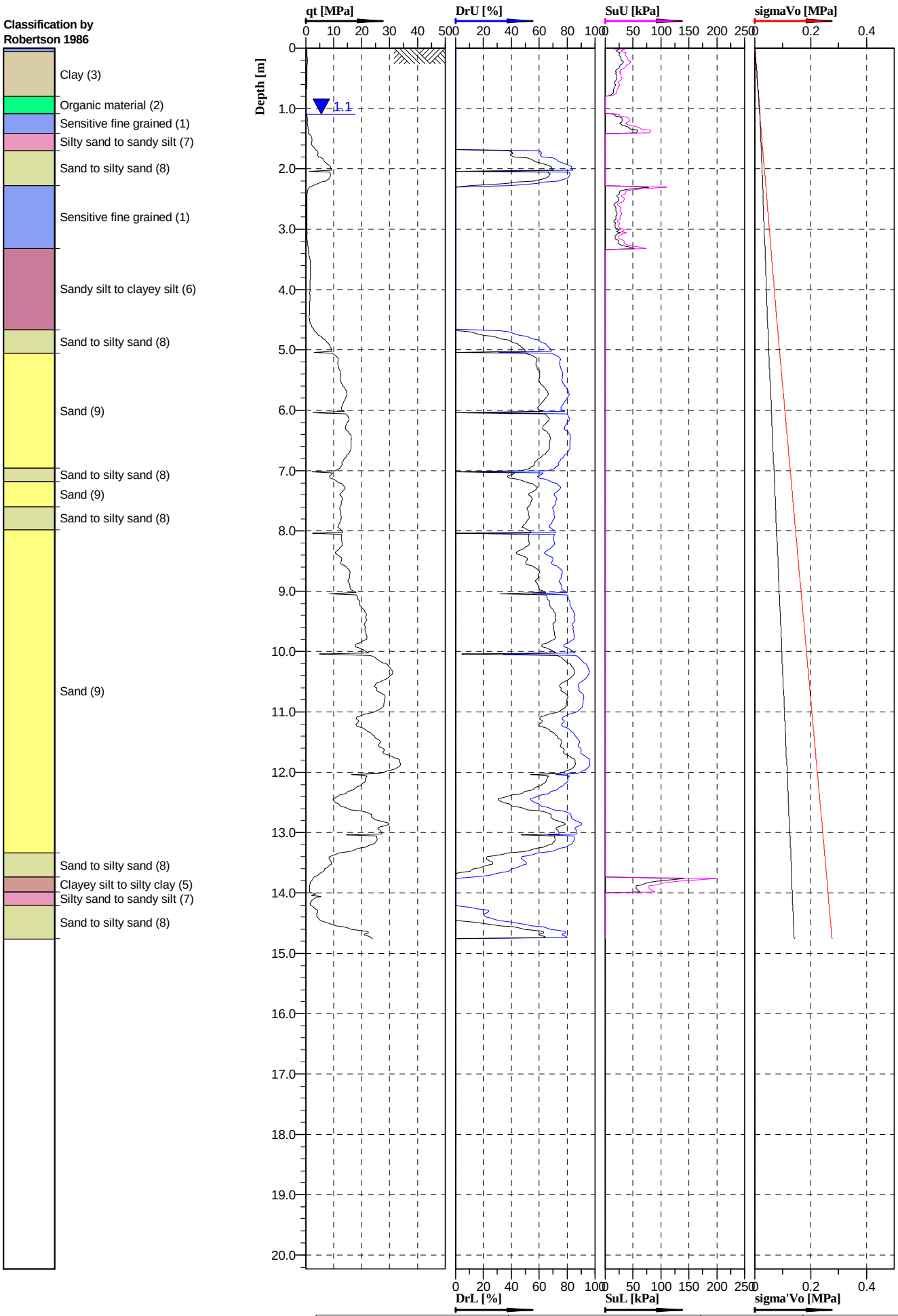


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383268 m, Y: 6367556 m	Ground level: 0.71	Test no: CPT115
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 12b
		File: CG-WI-C012.cpd	

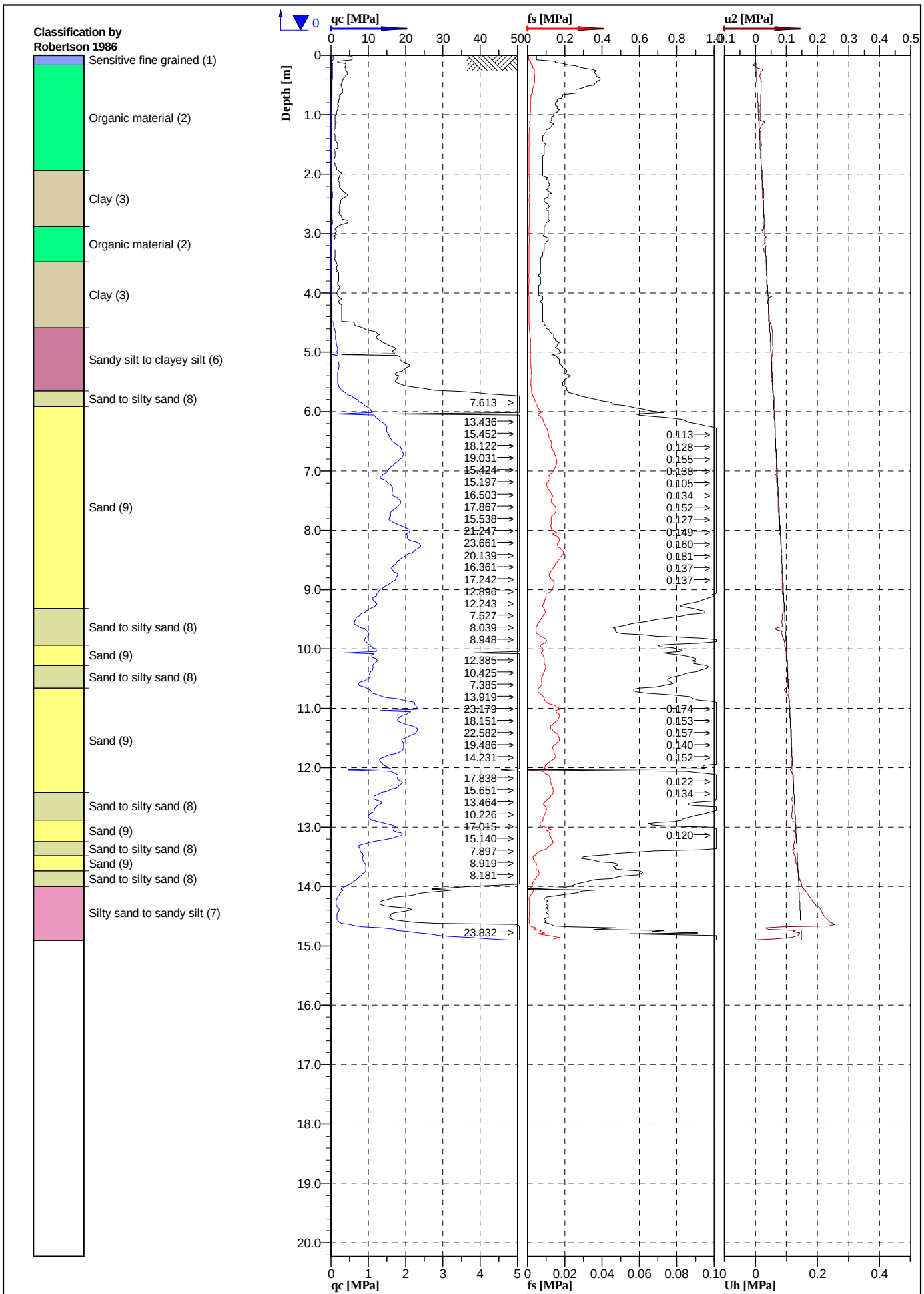


Location: Tomago Road, Tomago	Position: X: 383268 m, Y: 6367556 m	Ground level: 0.71	Test no: CPT115
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 12c
		File: CG-WI-C012.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

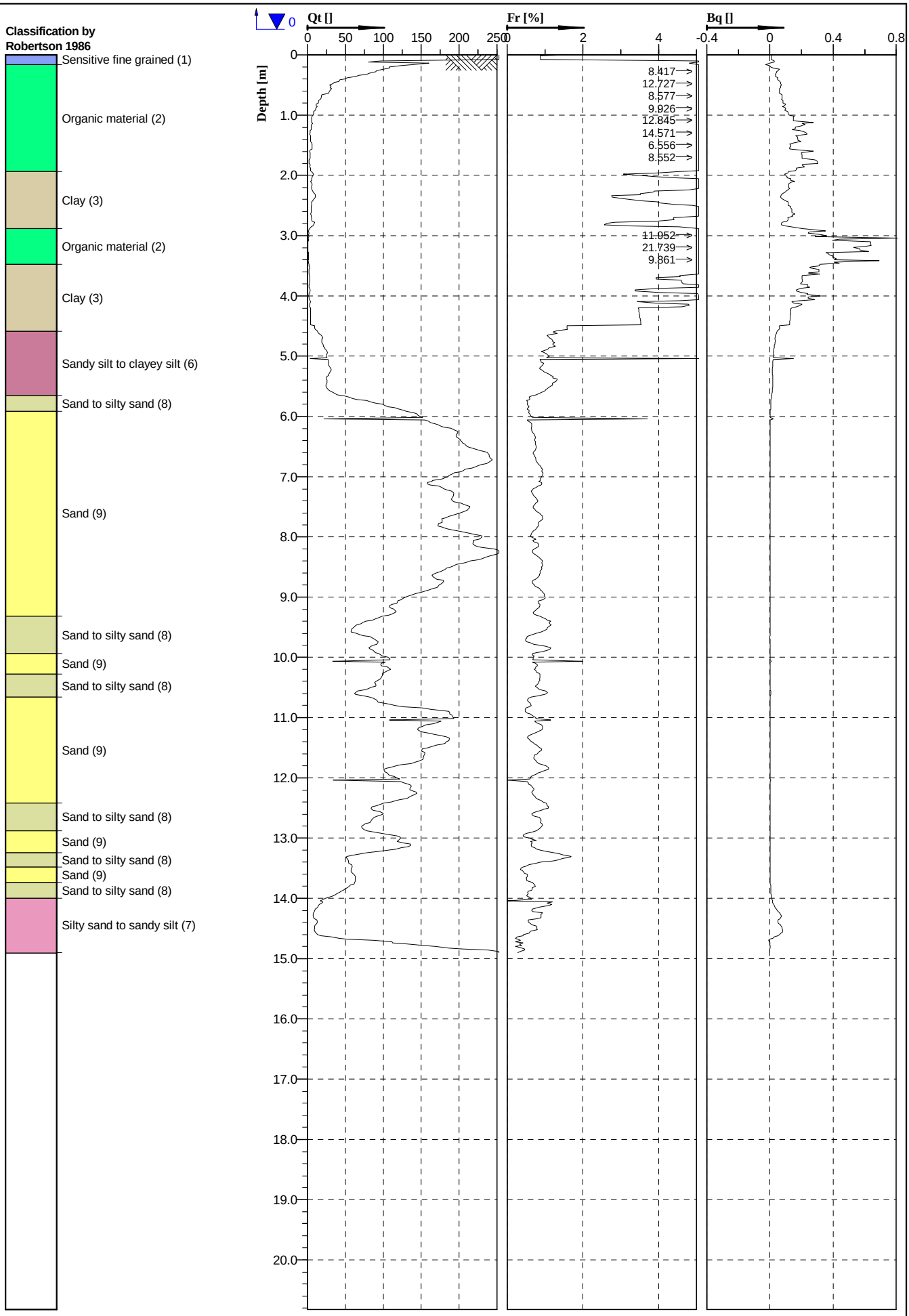


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.62	Test no: CPT116
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 13a
		File: CG-WI-C013.cpd	

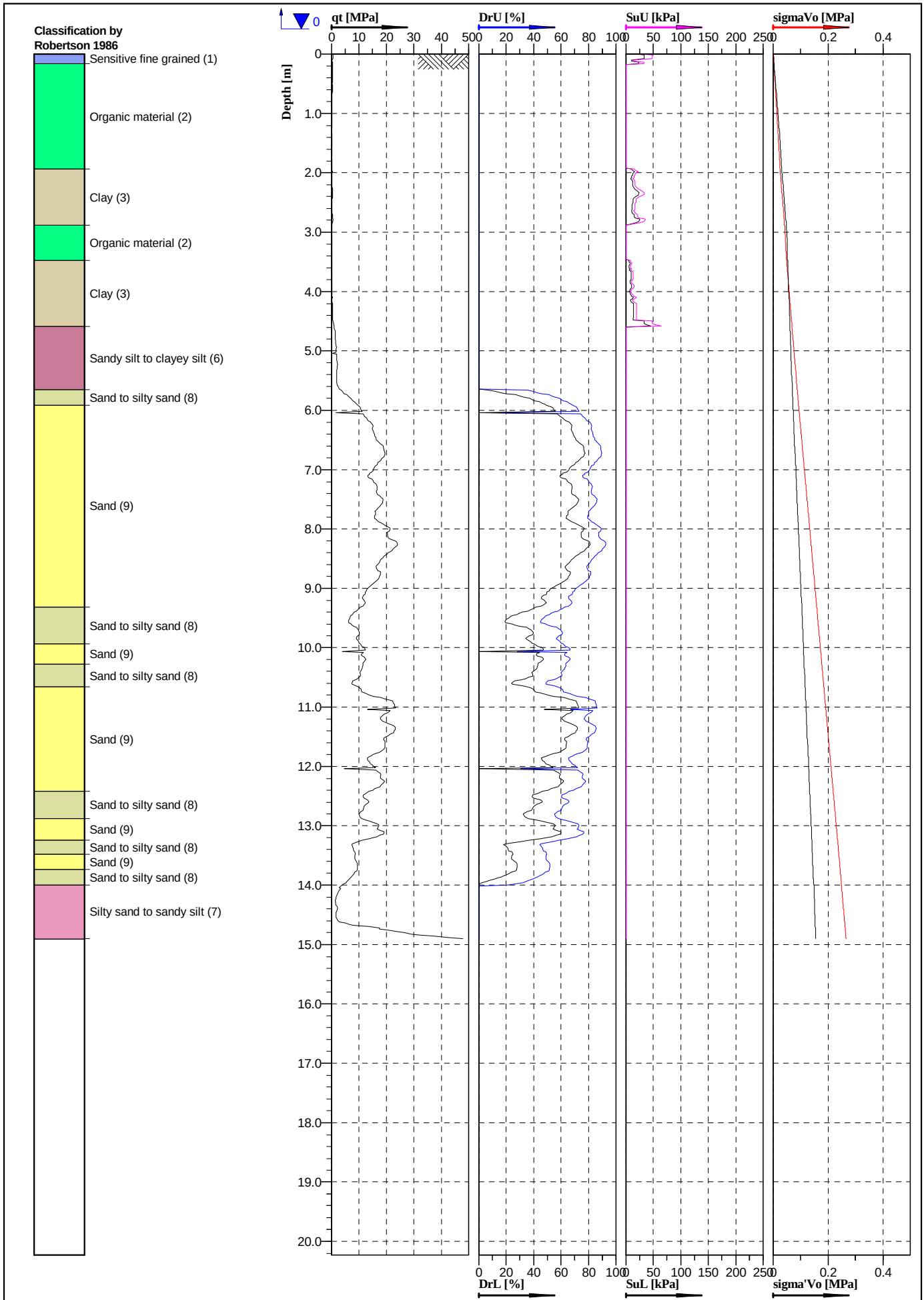


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.62	Test no: CPT116
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 13b
		File: CG-WI-C013.cpd	

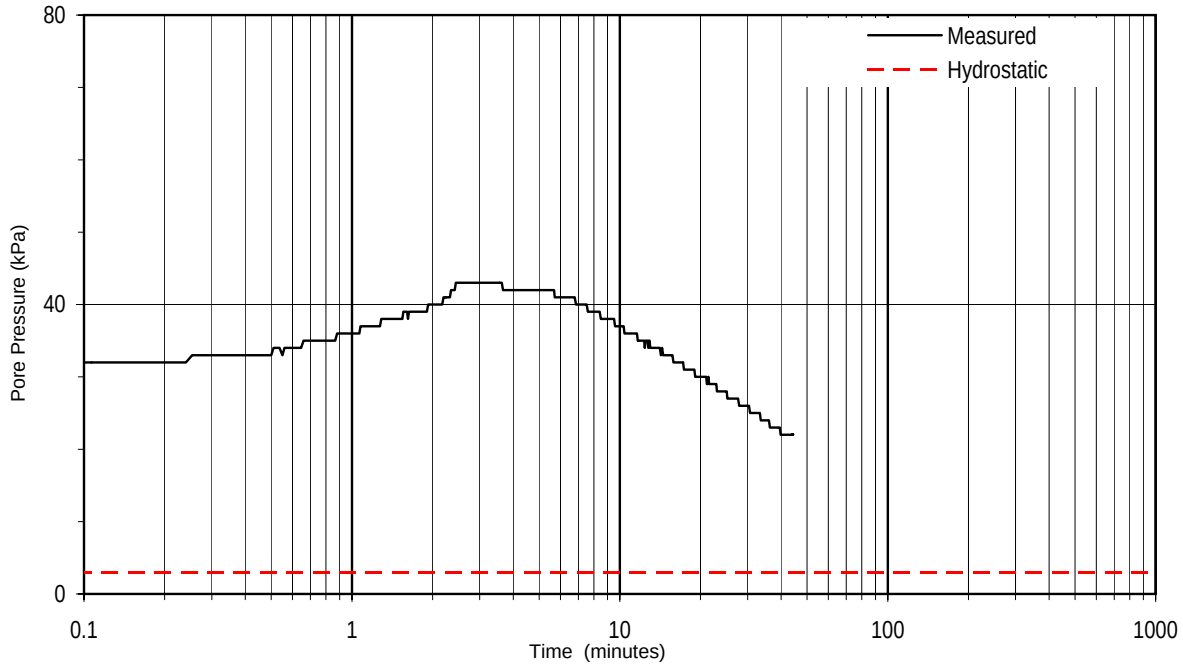


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.62	Test no: CPT116
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 9/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 13c
		File: CG-WI-C013.cpd	



TEST DATA & INFERRED SOIL PARAMETERS

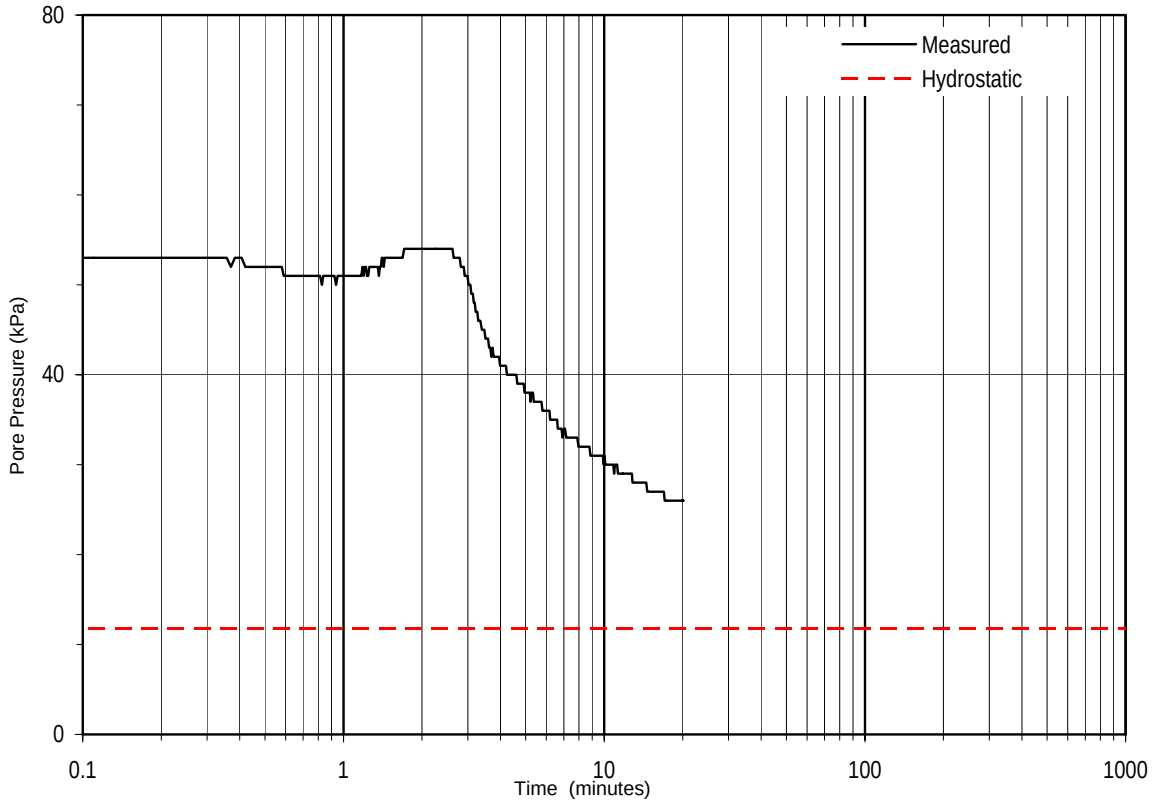
Inferred soil type:

Static pore pressure, u_o		**3**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i		**38**	kPa	(measured from test data)
Final pore pressure at end of test		**22**	kPa	(measured from test data)
Test duration		**44**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}		**25**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H		**7.99**	m^2/year	
	to	**11.34**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		**1.0** x 10^{-6}	cm/s	
	to	**1.5** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13/11/2007**			
scale	**NTS**		title:	**PIEZOCONE DISSIPATION TEST**
original size	**A4**		project no: **GEOTWARA20301AA**	Test Location & Depth: **C14 1.40**

F:\Job Files\GEOT\SGTE\SGTE 20300 - 20399\SGTE20301AA\Dissipation Test Results\[GEOTSGTE20301AA C14 1.4m Dissipation Test.xls]A4 Portrait Figure



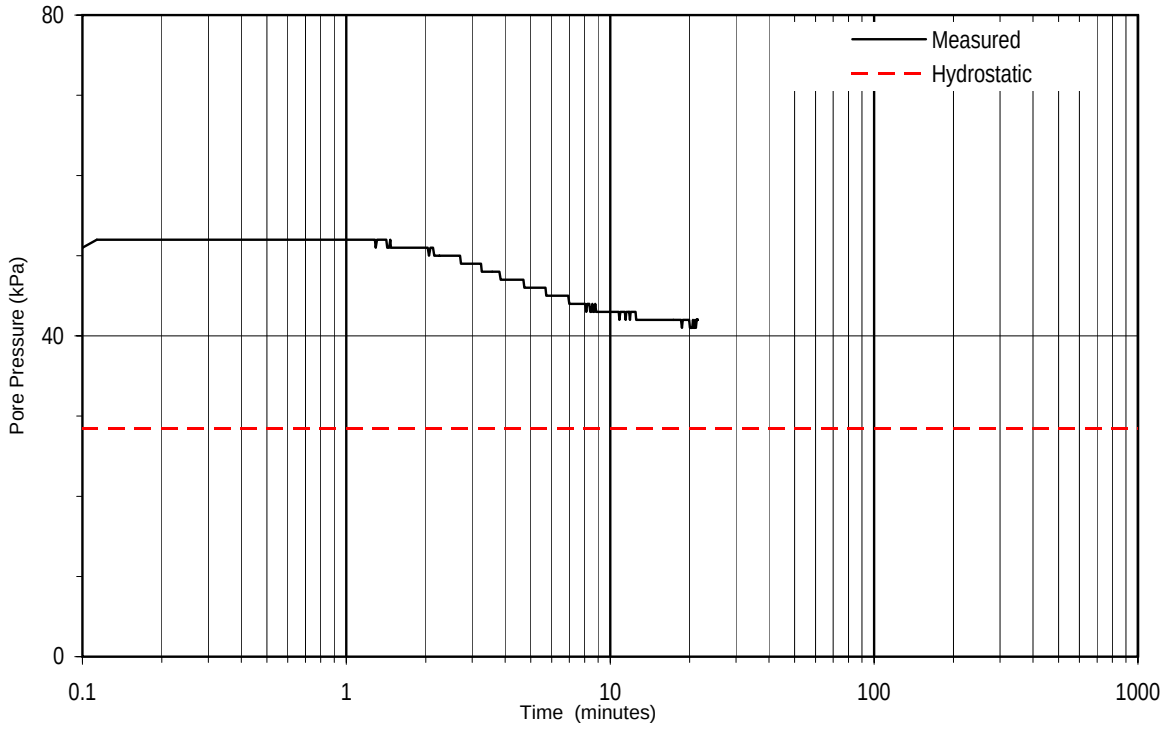
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type:

Static pore pressure, u_o	**12**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i	**53**	kPa	(measured from test data)
Final pore pressure at end of test	**26**	kPa	(measured from test data)
Test duration	**20**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}	**6**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H	**34.27**	m^2/year	
to	**48.63**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	**4.5** x 10^{-6}	cm/s	
to	**6.2** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13/11/2007**			
scale	**NTS**		title:	**PIEZOCONE DISSIPATION TEST**
original size	**A4**		project no: **GEOTWARA20301AA**	Test Location & Depth: **C14 2.30**



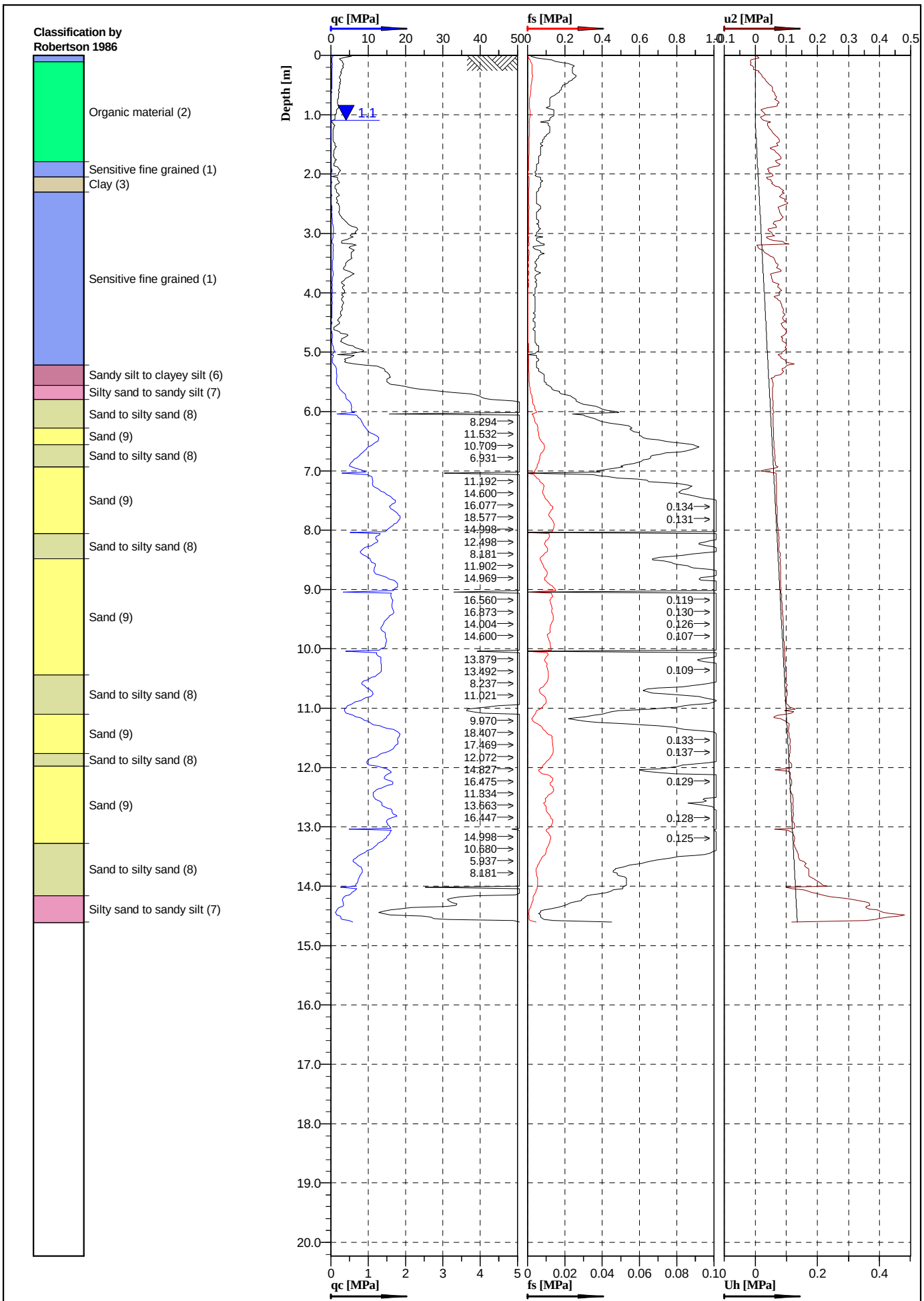
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type:

Static pore pressure, u_o		**28**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i		**51**	kPa	(measured from test data)
Final pore pressure at end of test		**42**	kPa	(measured from test data)
Test duration		**21**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}		**9**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H		**22.85**	m^2/year	
	to	**32.43**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		**3.0** x 10^{-6}	cm/s	
	to	**4.2** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13/11/2007**		title:	**PIEZOCONE DISSIPATION TEST**
scale	**NTS**		project no: **GEOTWARA20301AA**	Test Location & Depth: **C14 4.00**
original size	**A4**			

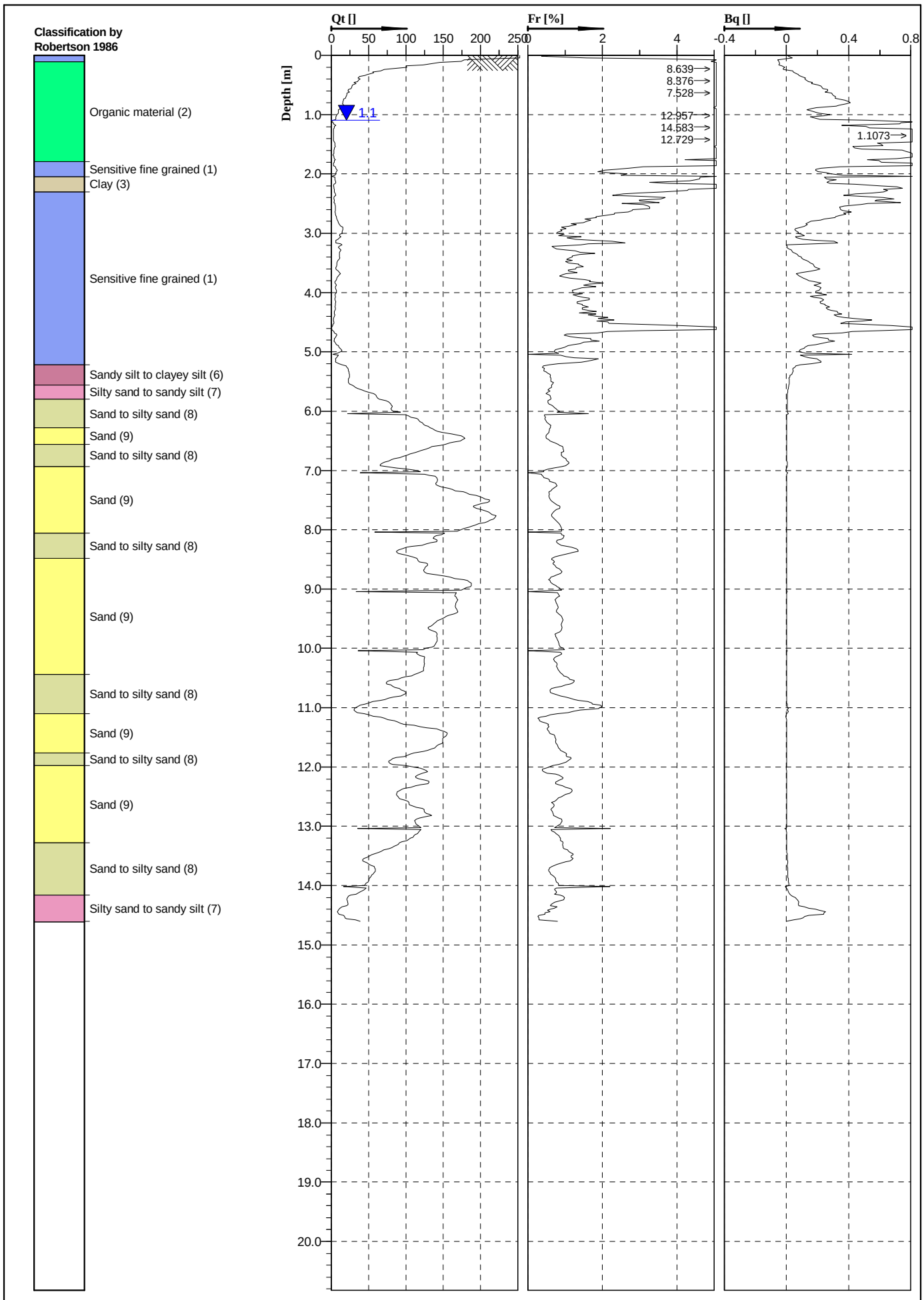


Location: Tomago Road, Tomago	Position: X: 383408 m, Y: 6367518 m	Ground level: 0.61	Test no: CPT112
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 14a
		File: CG-WI-C014.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

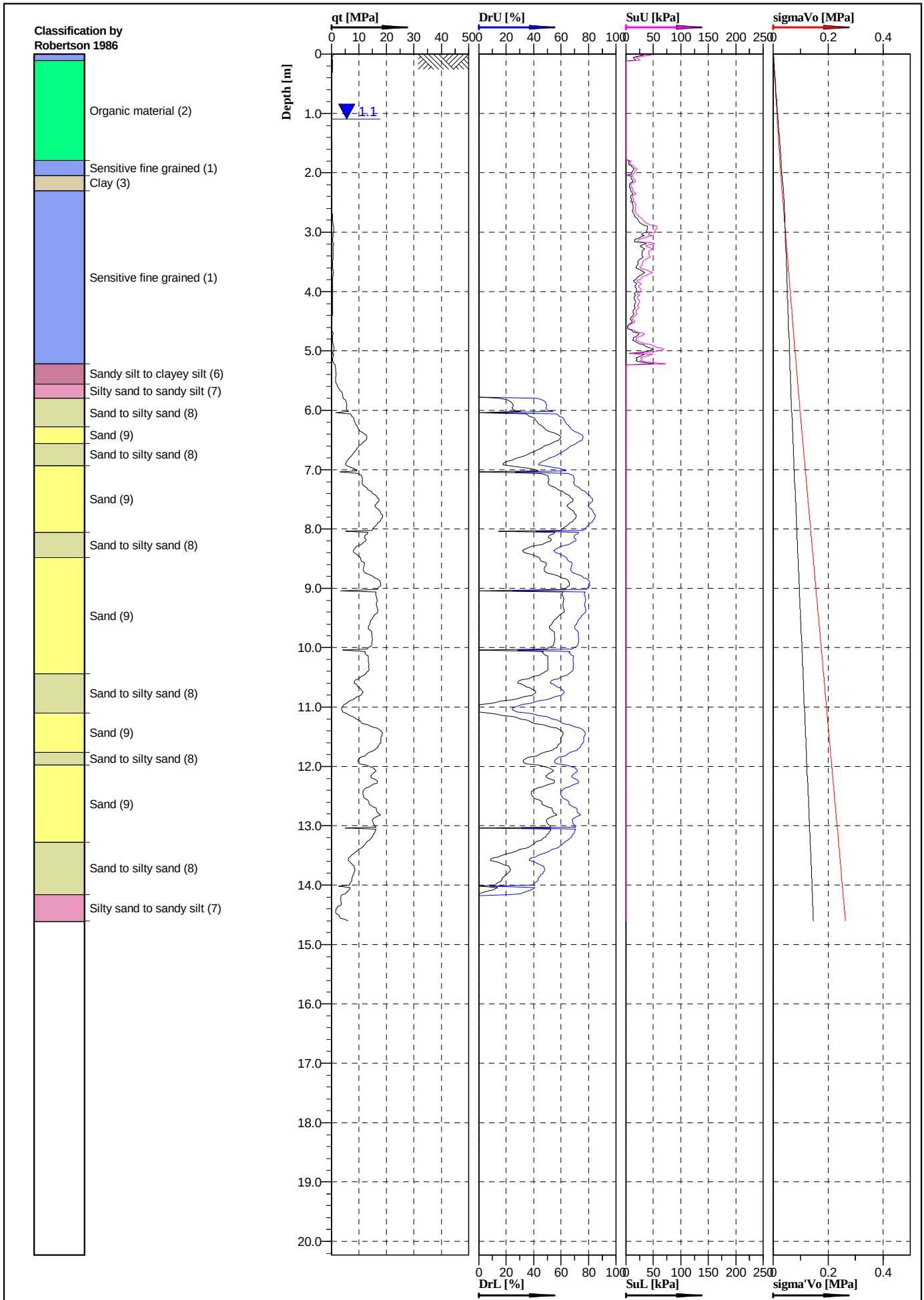


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383408 m, Y: 6367518 m	Ground level: 0.61	Test no: CPT112
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 14b
		File: CG-WI-C014.cpd	

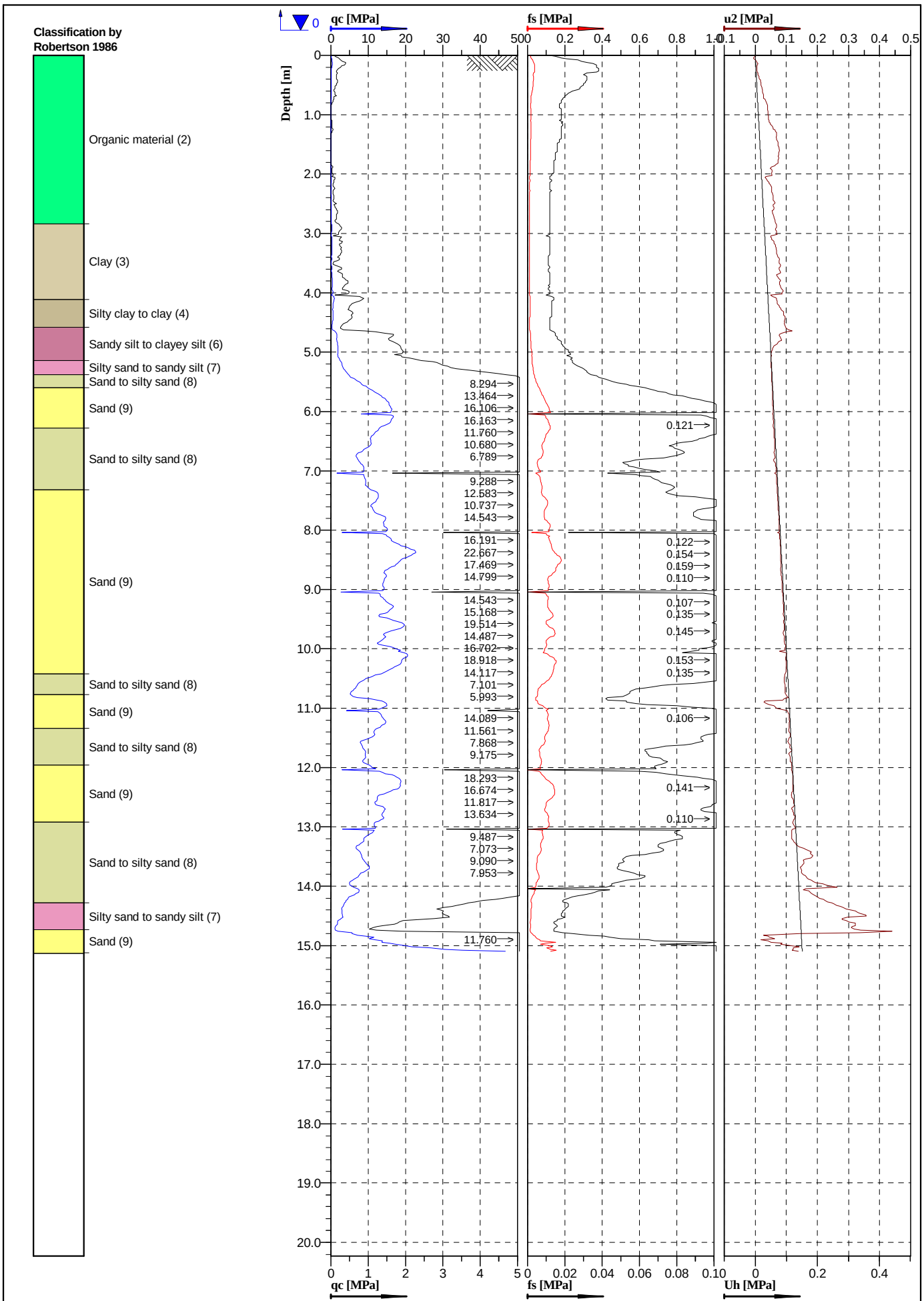


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383408 m, Y: 6367518 m	Ground level: 0.61	Test no: CPT112
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 14c
		File: CG-WI-C014.cpd	

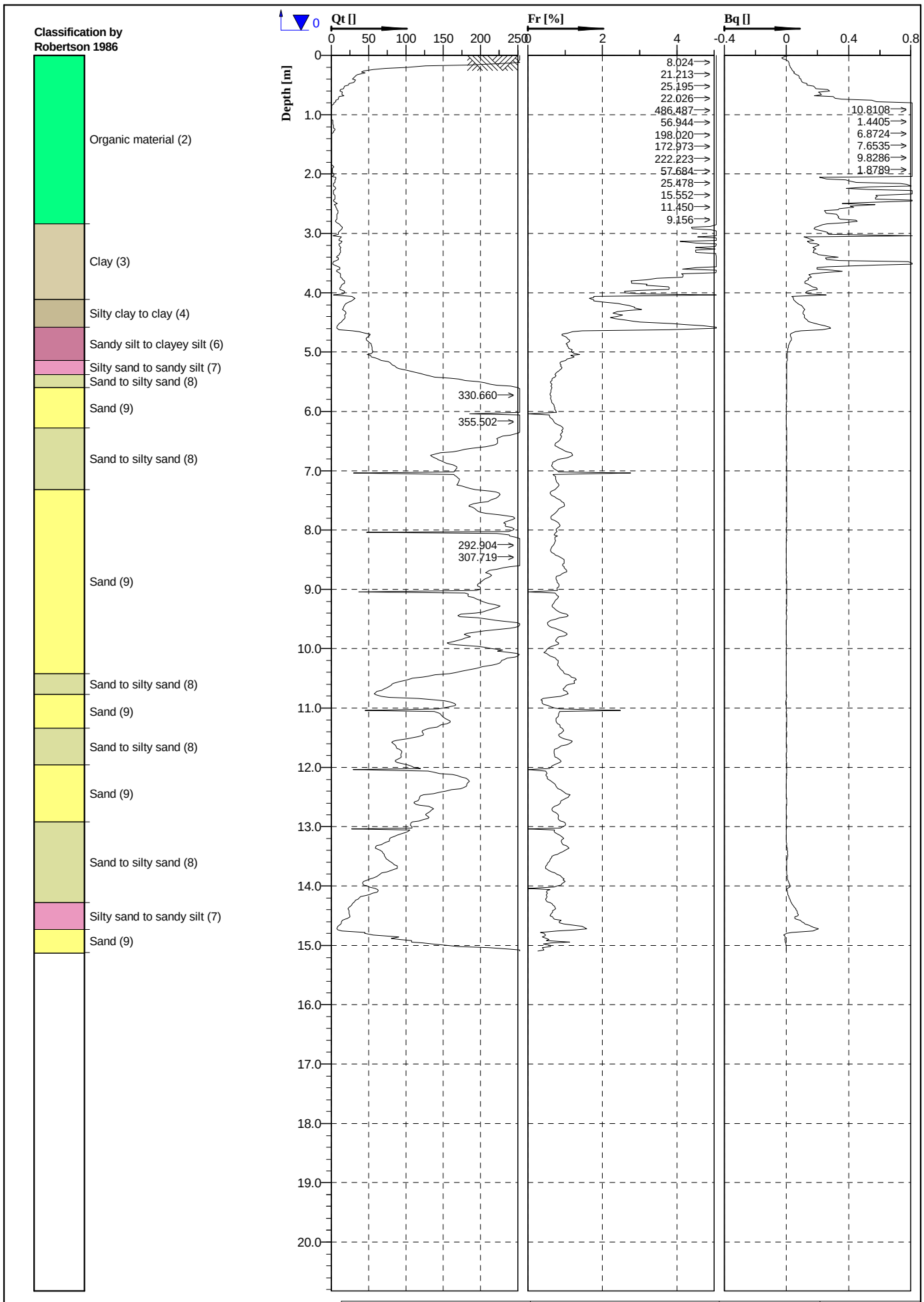


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383494 m, Y: 6367571 m	Ground level: 0.53	Test no: CPT108
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 15a
		File: CG-WI-C015.cpd	

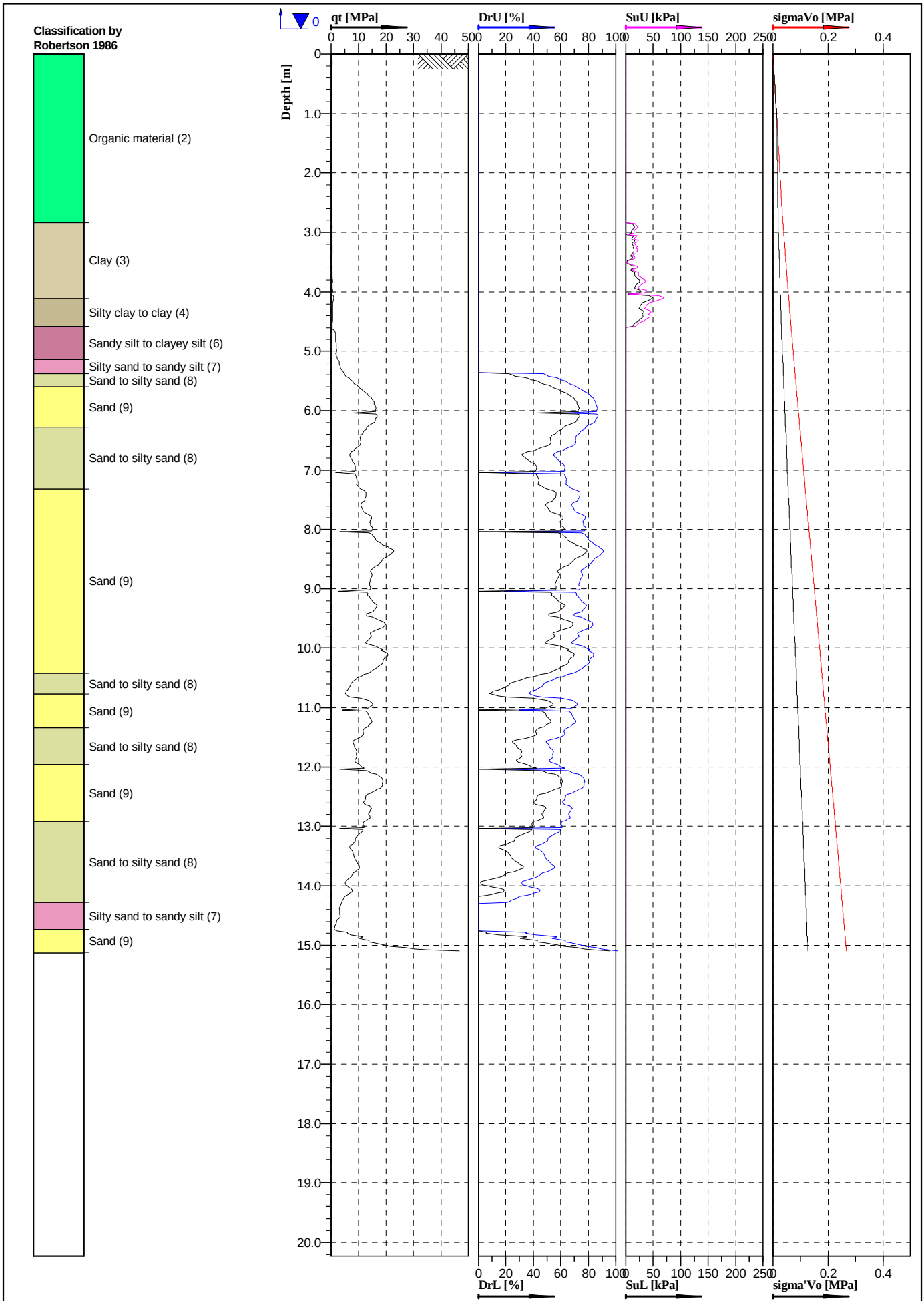


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383494 m, Y: 6367571 m	Ground level: 0.53	Test no: CPT108
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 15b
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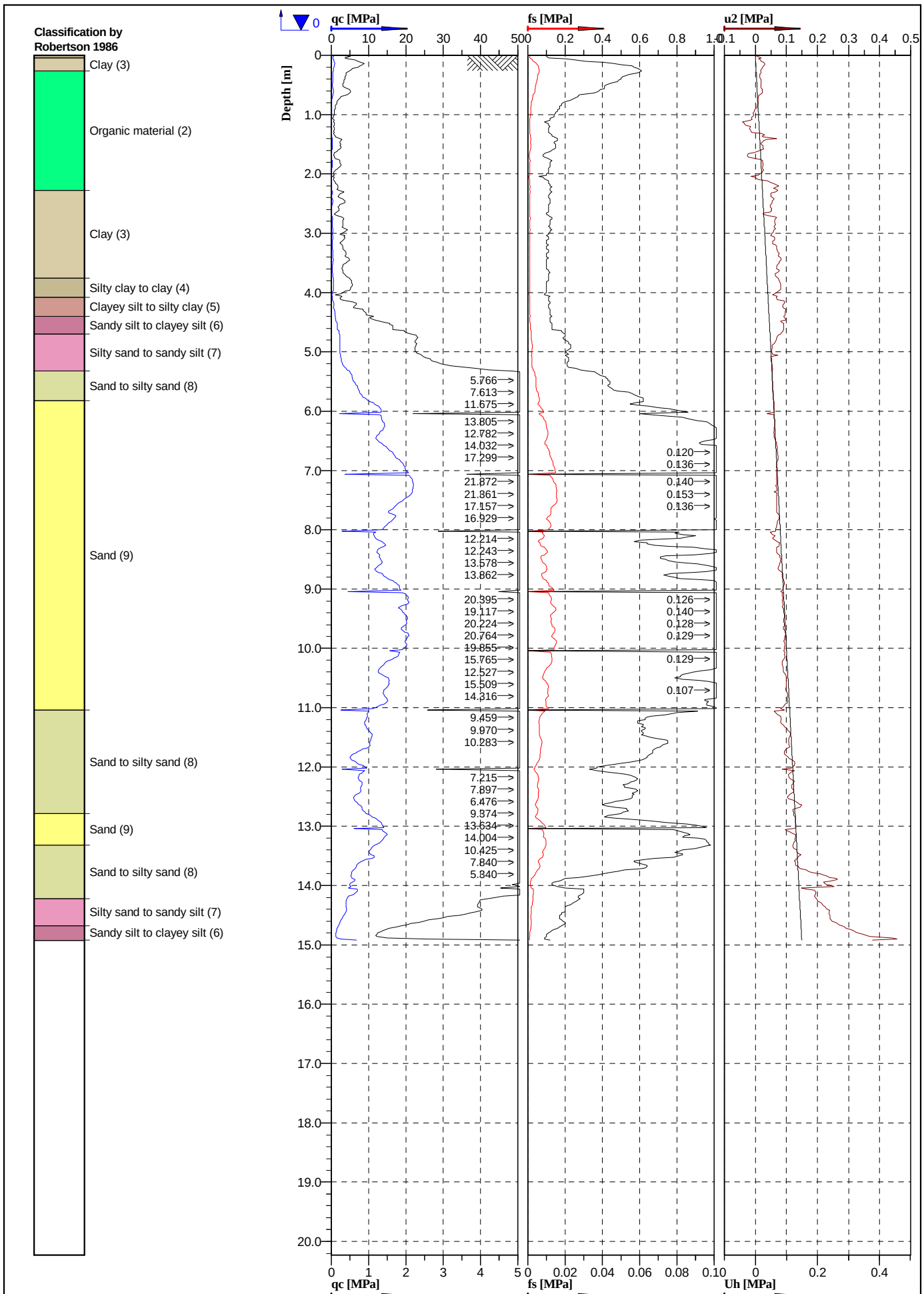


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383494 m, Y: 6367571 m	Ground level: 0.53	Test no: CPT108
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 15c
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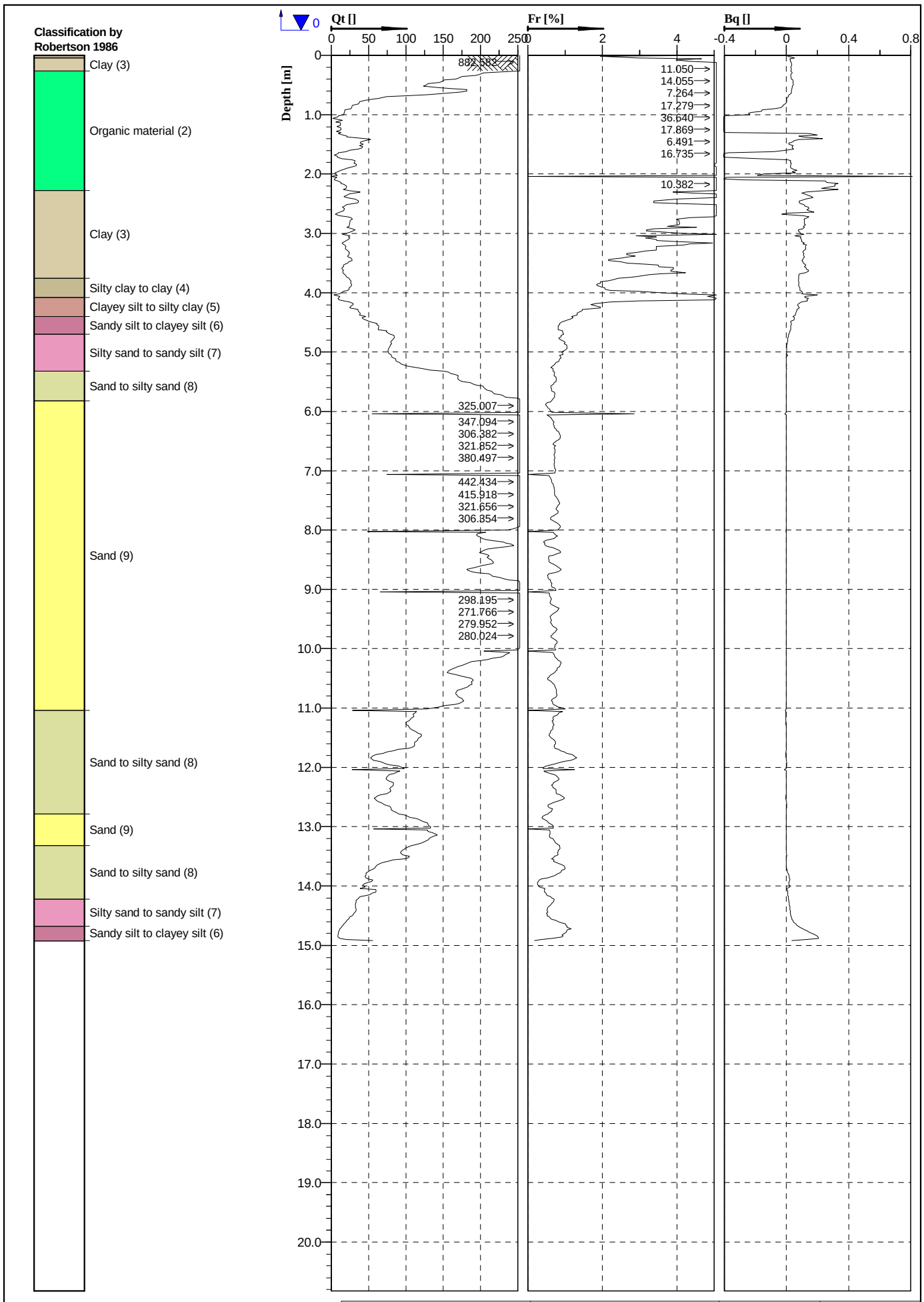


Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.62	Test no: CPT116
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 16a
		File: CG-WI-C016.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

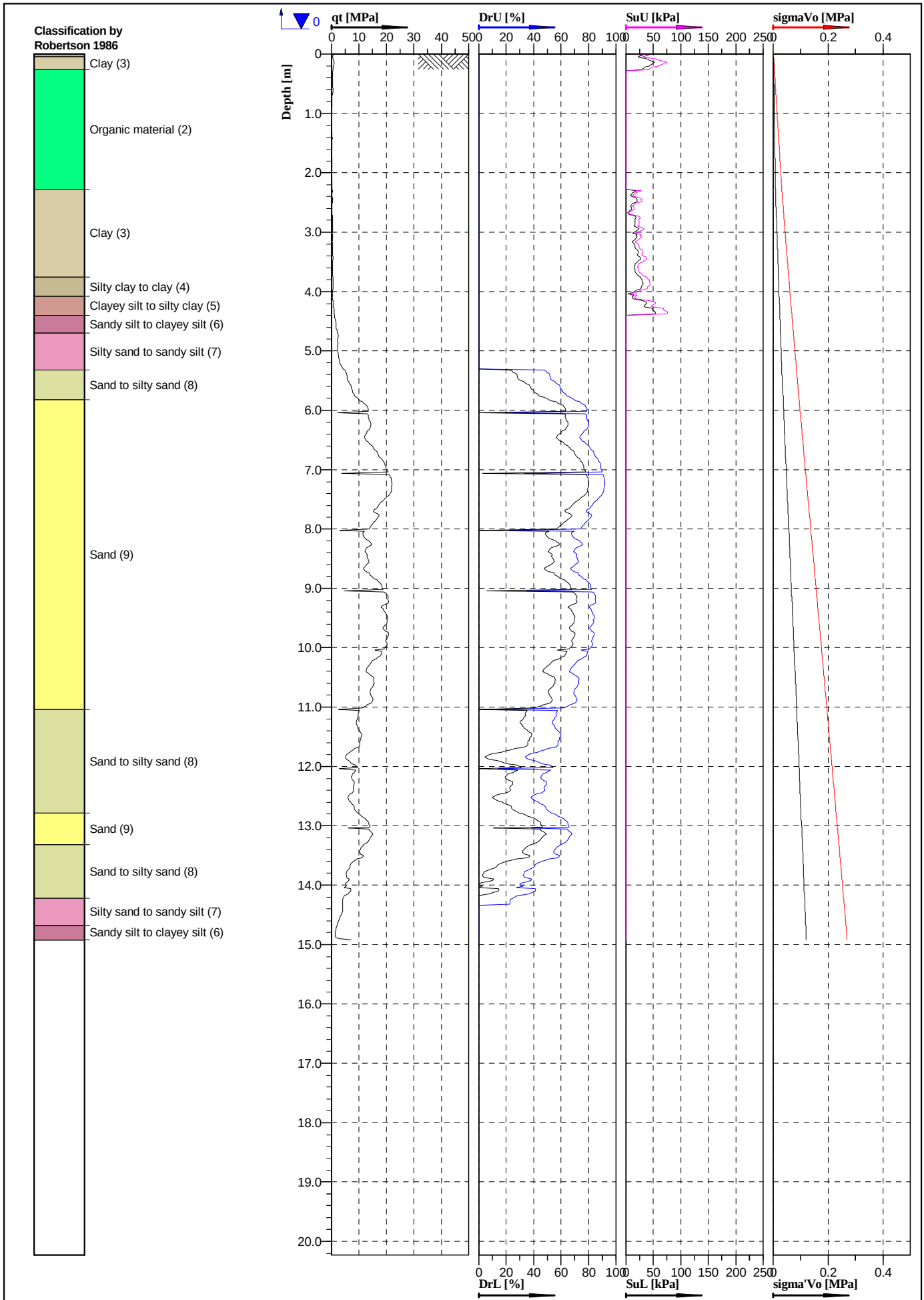


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.62	Test no: CPT116
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 16b
		File: CG-WI-C016.cpd	

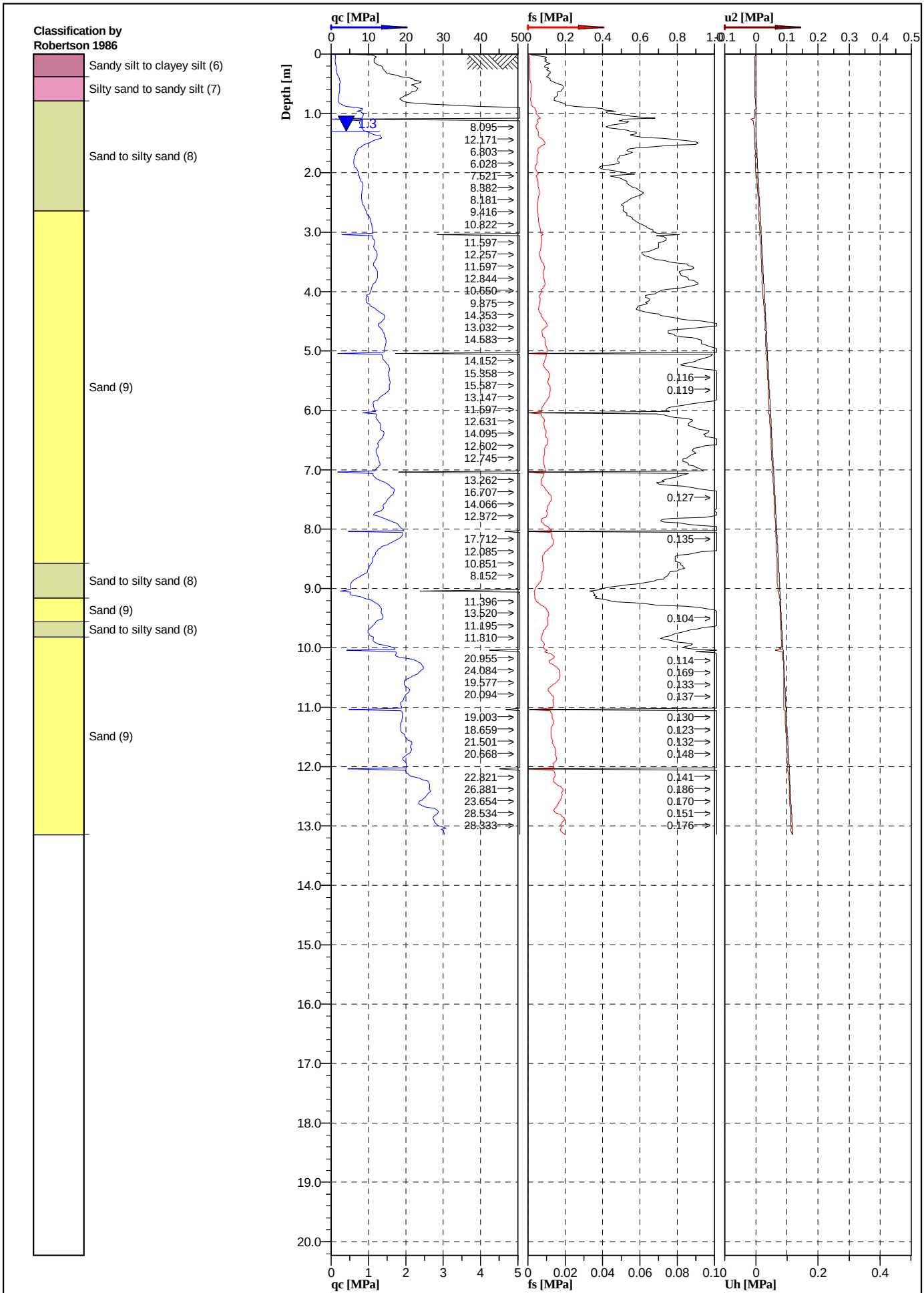


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3743
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383319 m, Y: 6367471 m	Ground level: 0.62	Test no: CPT116
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 10/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 16c
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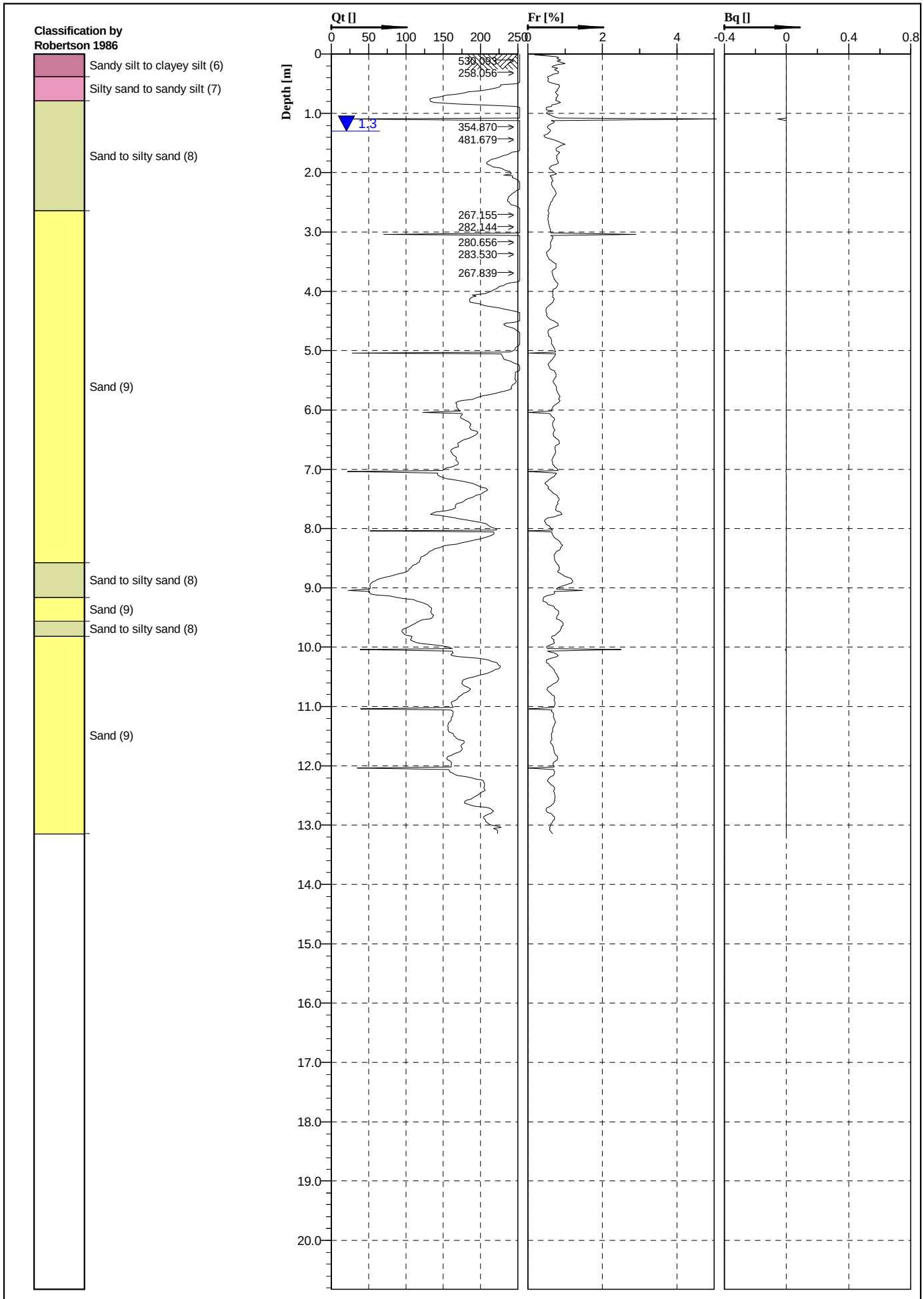


Location: Tomago Road, Tomago	Position: X: 383085 m, Y: 6367681 m	Ground level: 2.56	Test no: CPT117
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 35a
		File: CG-WI-C035.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

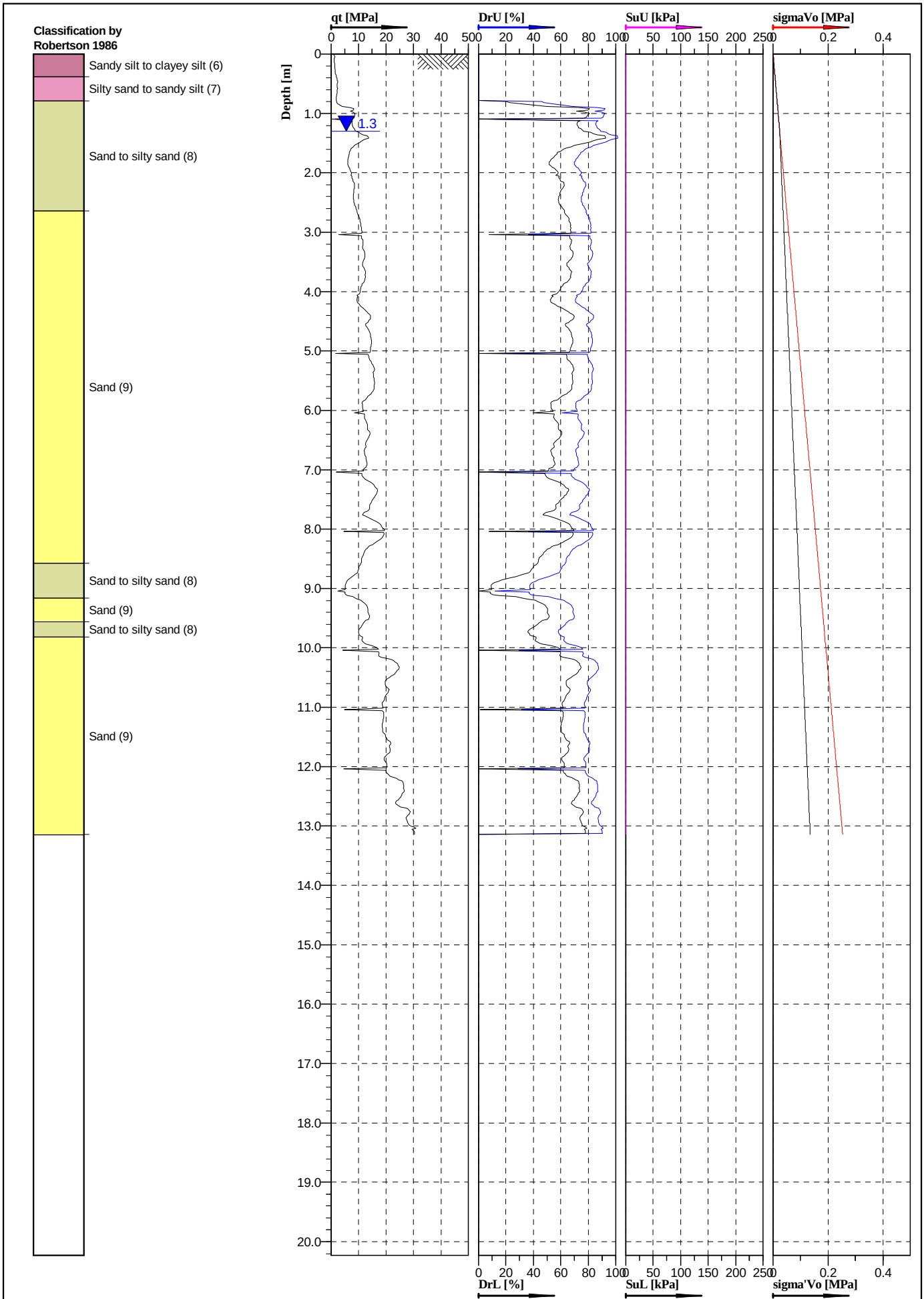


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383085 m, Y: 6367681 m	Ground level: 2.56	Test no: CPT117
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 35b
		File: CG-WI-C035.cpd	

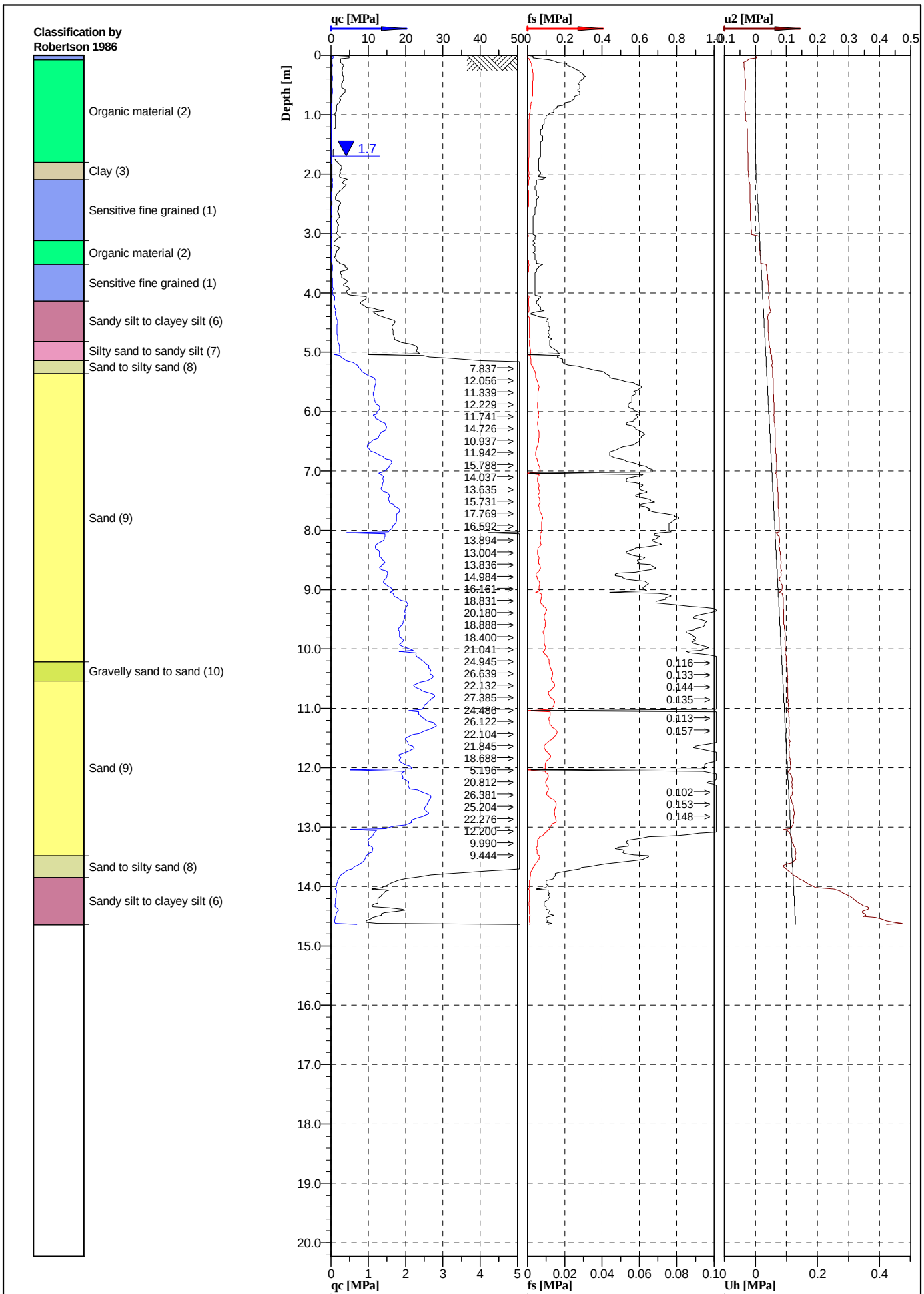


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383085 m, Y: 6367681 m	Ground level: 2.56	Test no: CPT117
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 35c
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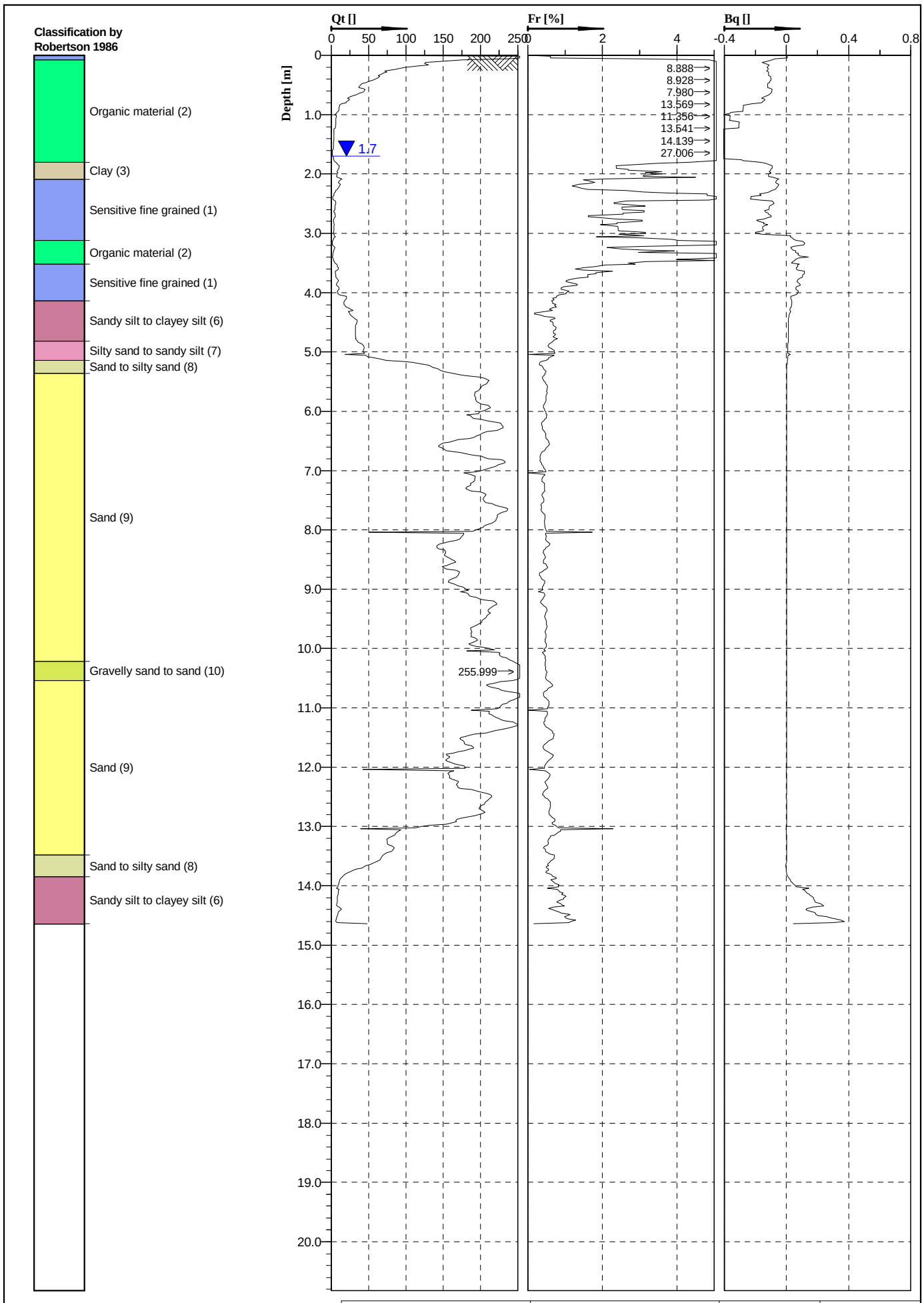


Location: Tomago Road, Tomago	Position: X: 383231 m, Y: 6367419 m	Ground level: 0.49	Test no: CPT120
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 17a
		File: CG-WI-C017.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

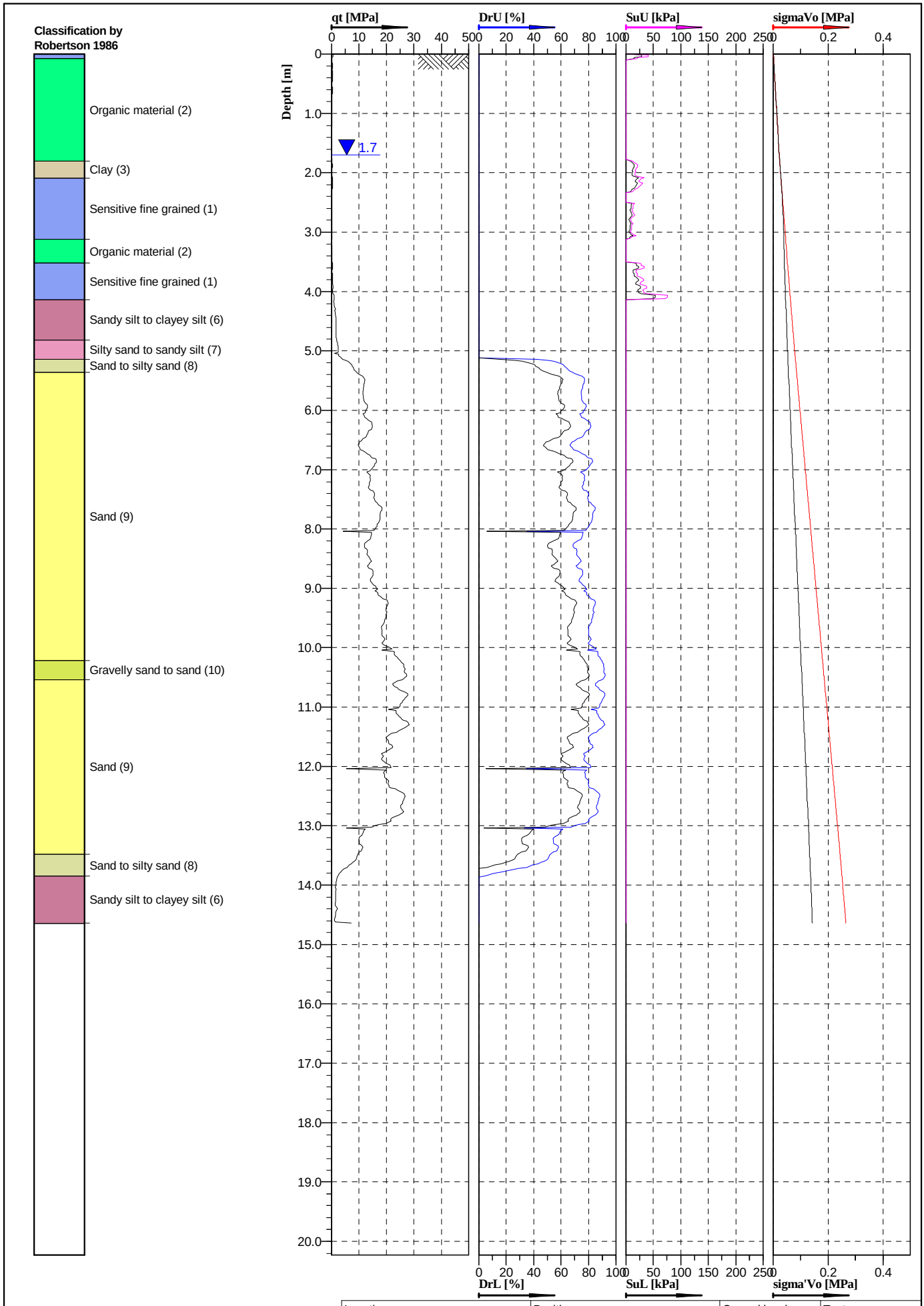


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383231 m, Y: 6367419 m	Ground level: 0.49	Test no: CPT120
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 17b
		File: CG-WI-C017.cpd	

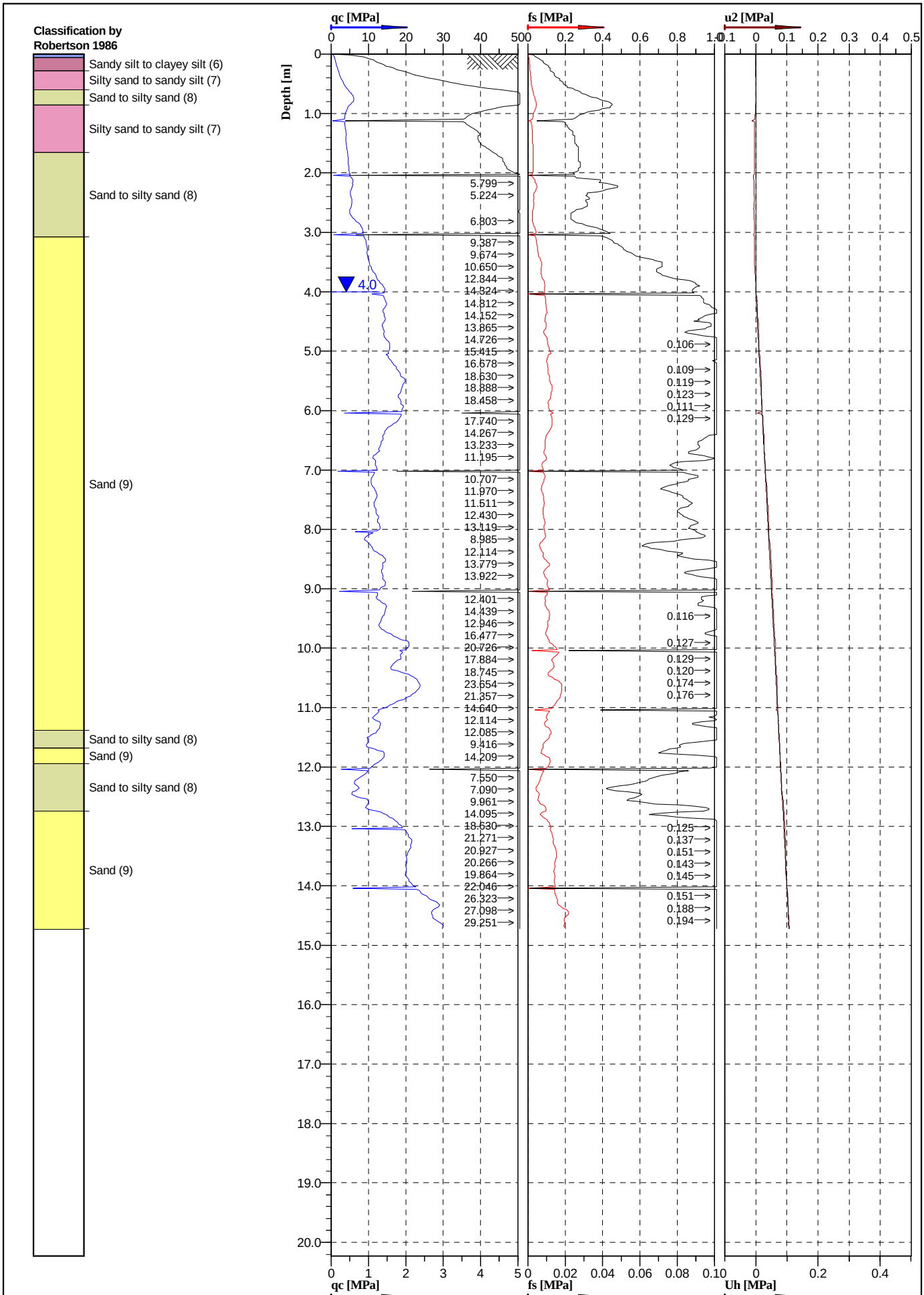


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383231 m, Y: 6367419 m	Ground level: 0.49	Test no: CPT120
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 17c
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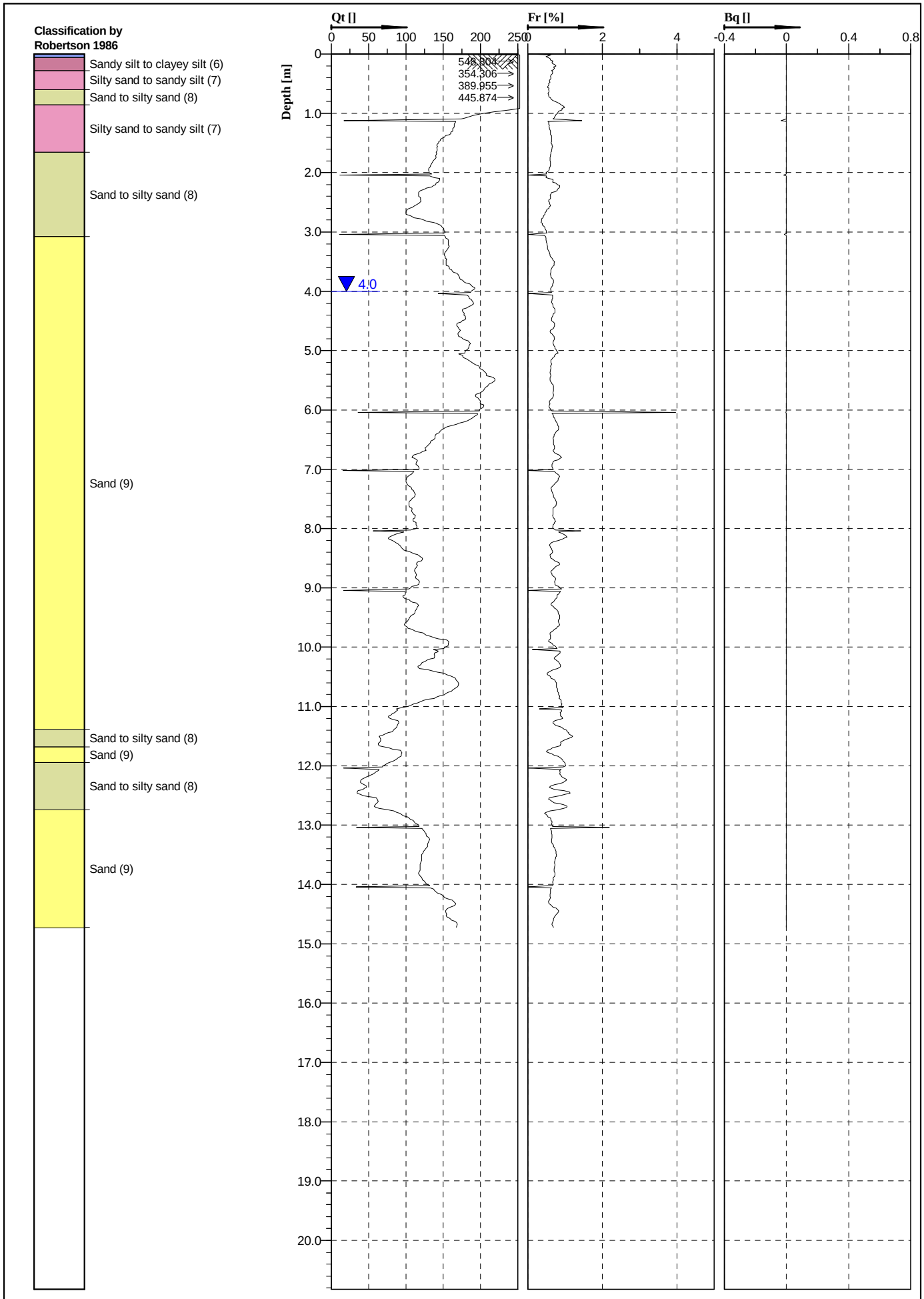


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383064 m, Y: 6367614 m	Ground level: 4.58	Test no: CPT122
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 34a
		File: CG-WI-C034.cpd	

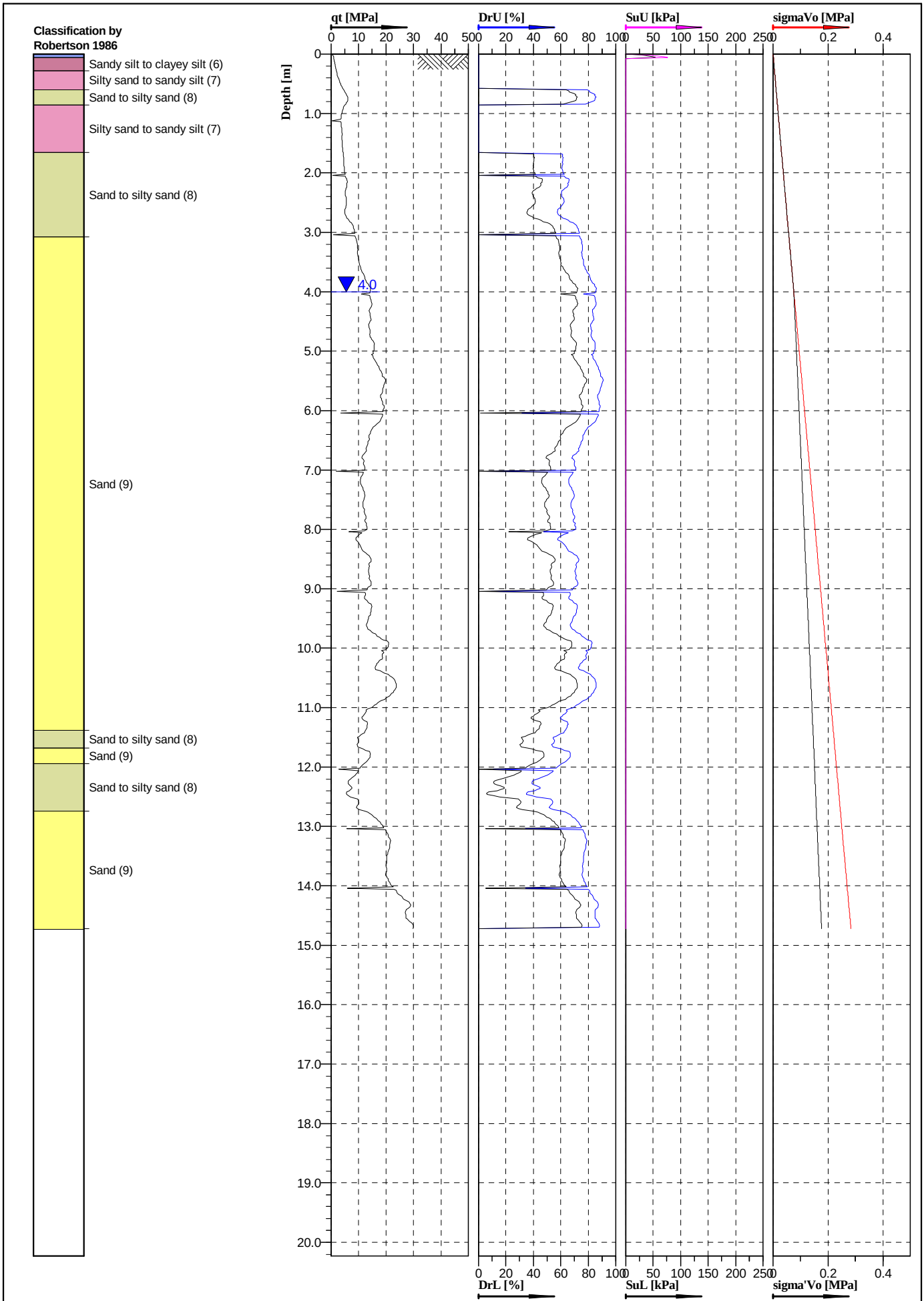


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383064 m, Y: 6367614 m	Ground level: 4.58	Test no: CPT122
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 34b
		File: CG-WI-C034.cpd	

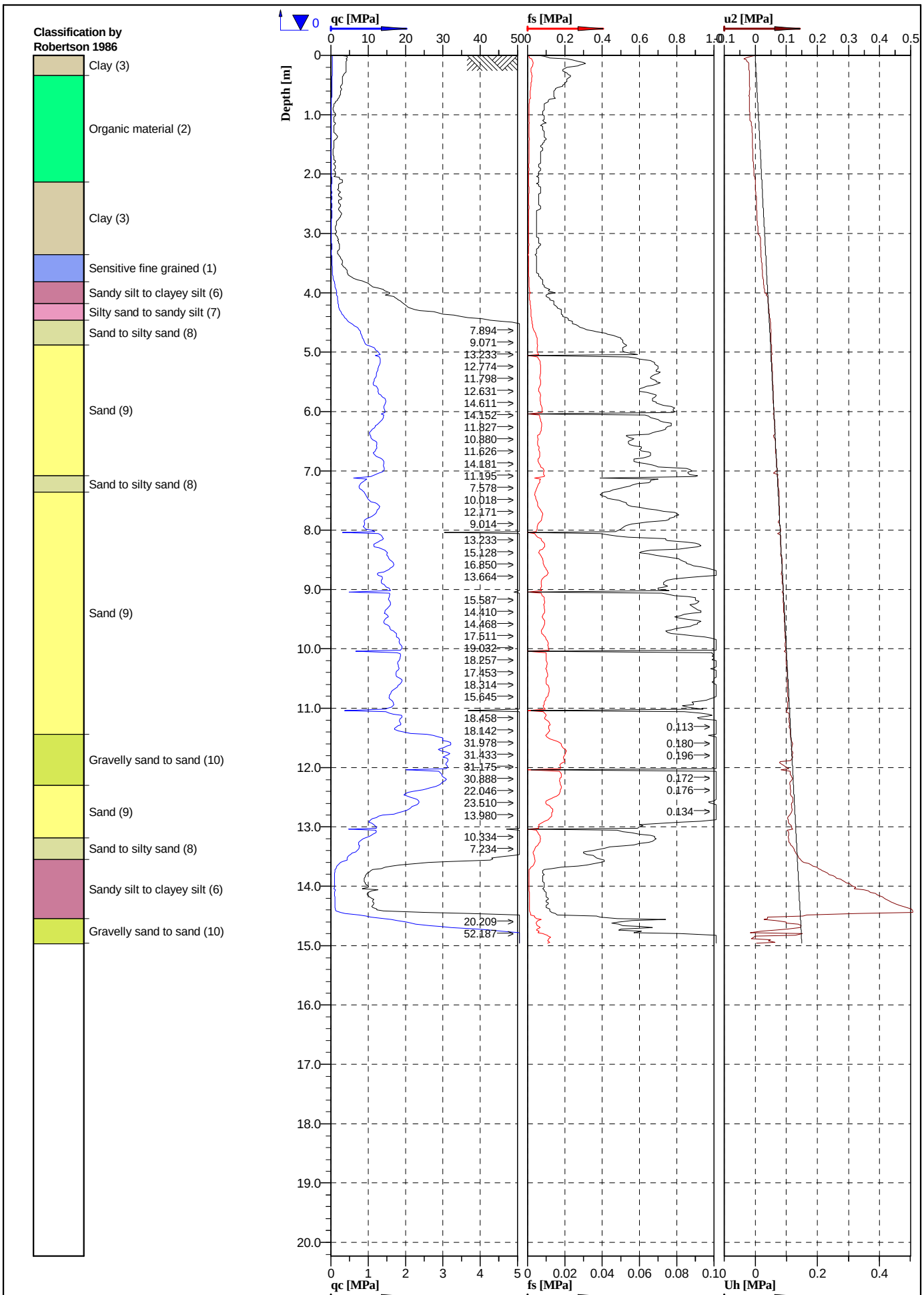


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383064 m, Y: 6367614 m	Ground level: 4.58	Test no: CPT122
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 34c
		File: CG-WI-C034.cpd	

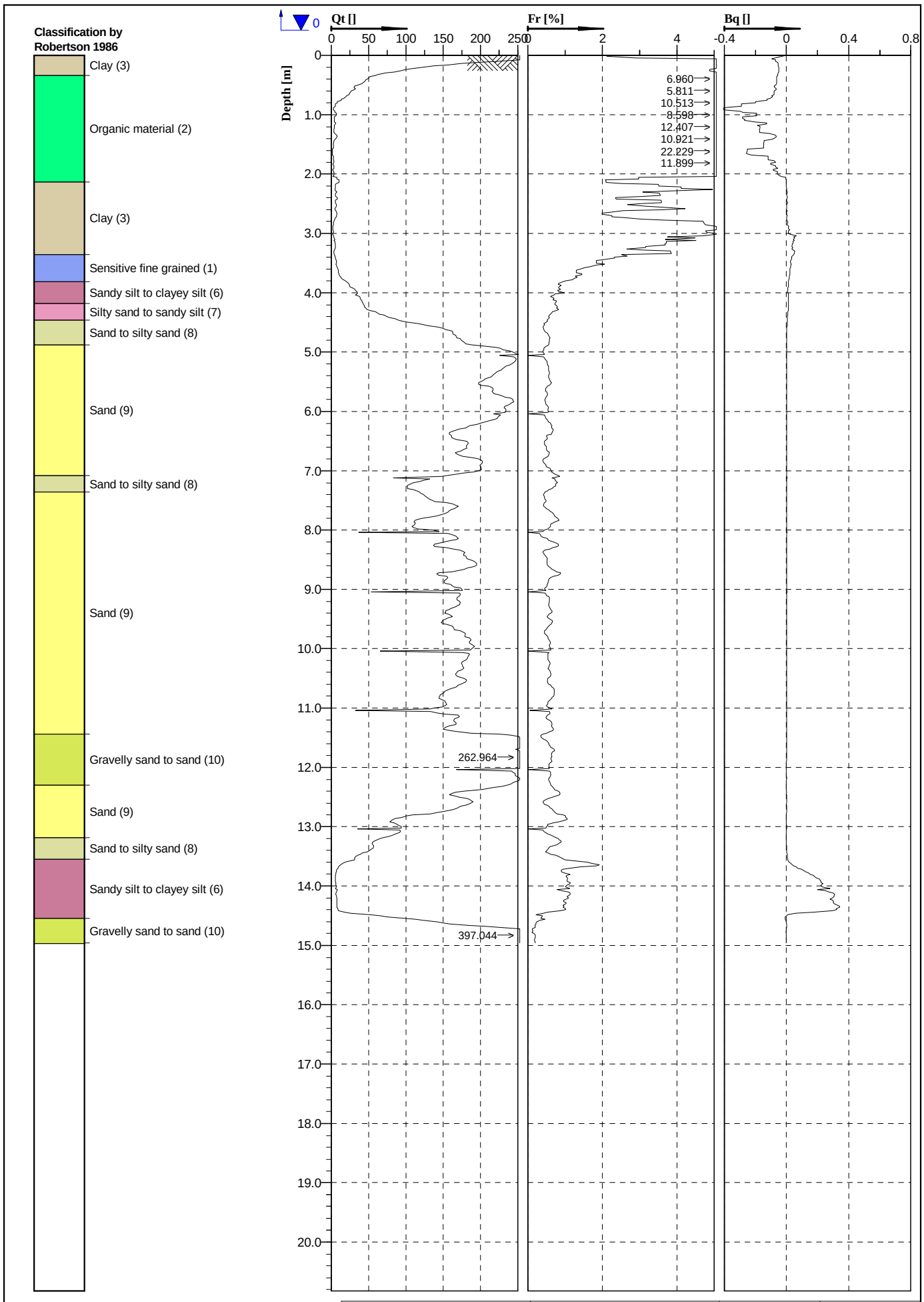


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383140 m, Y: 6367372 m	Ground level: 0.32	Test no: CPT128
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 18a
		File: CG-WI-C018.cpd	

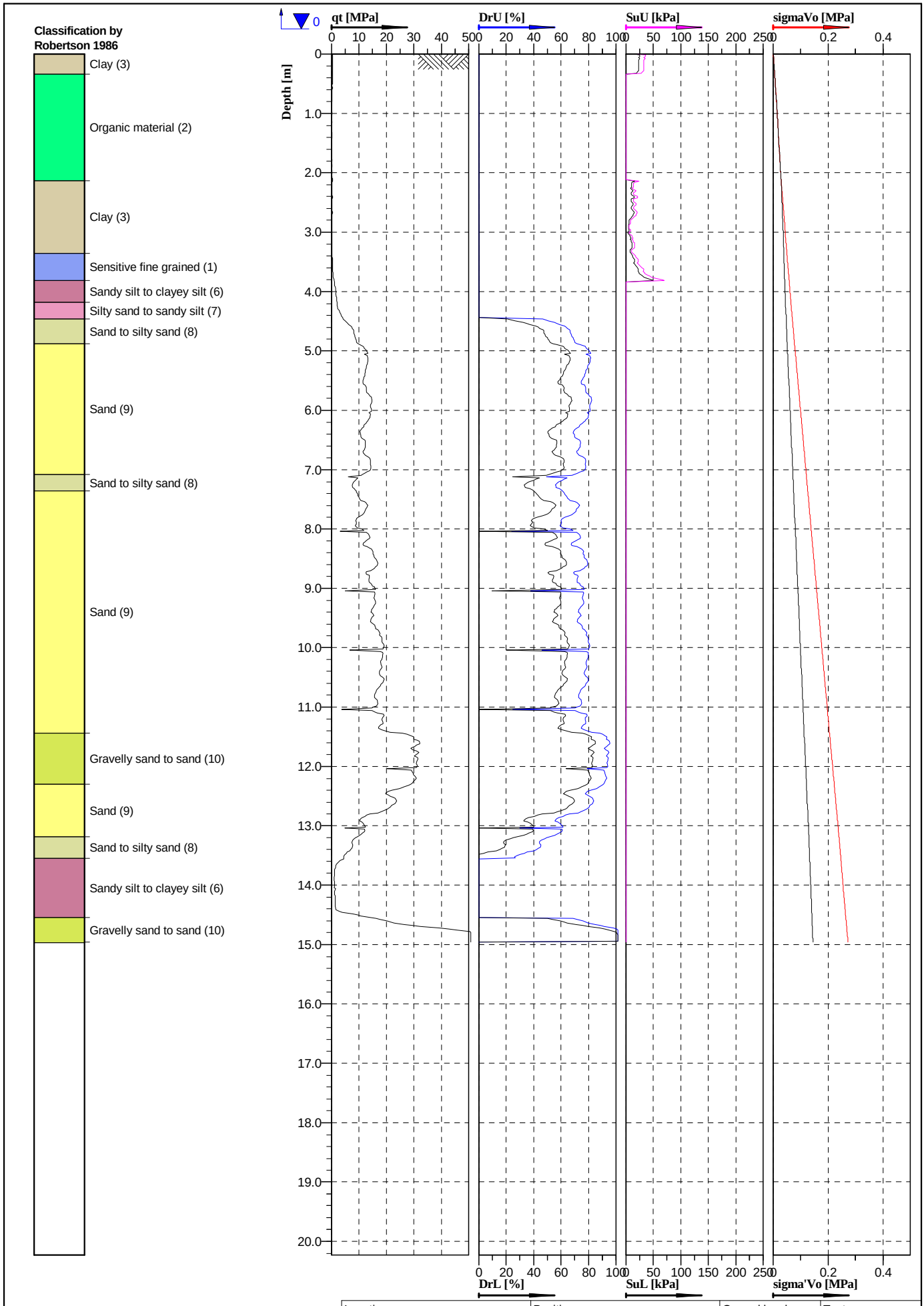


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383140 m, Y: 6367372 m	Ground level: 0.32	Test no: CPT128
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 18b
		File: CG-WI-C018.cpd	

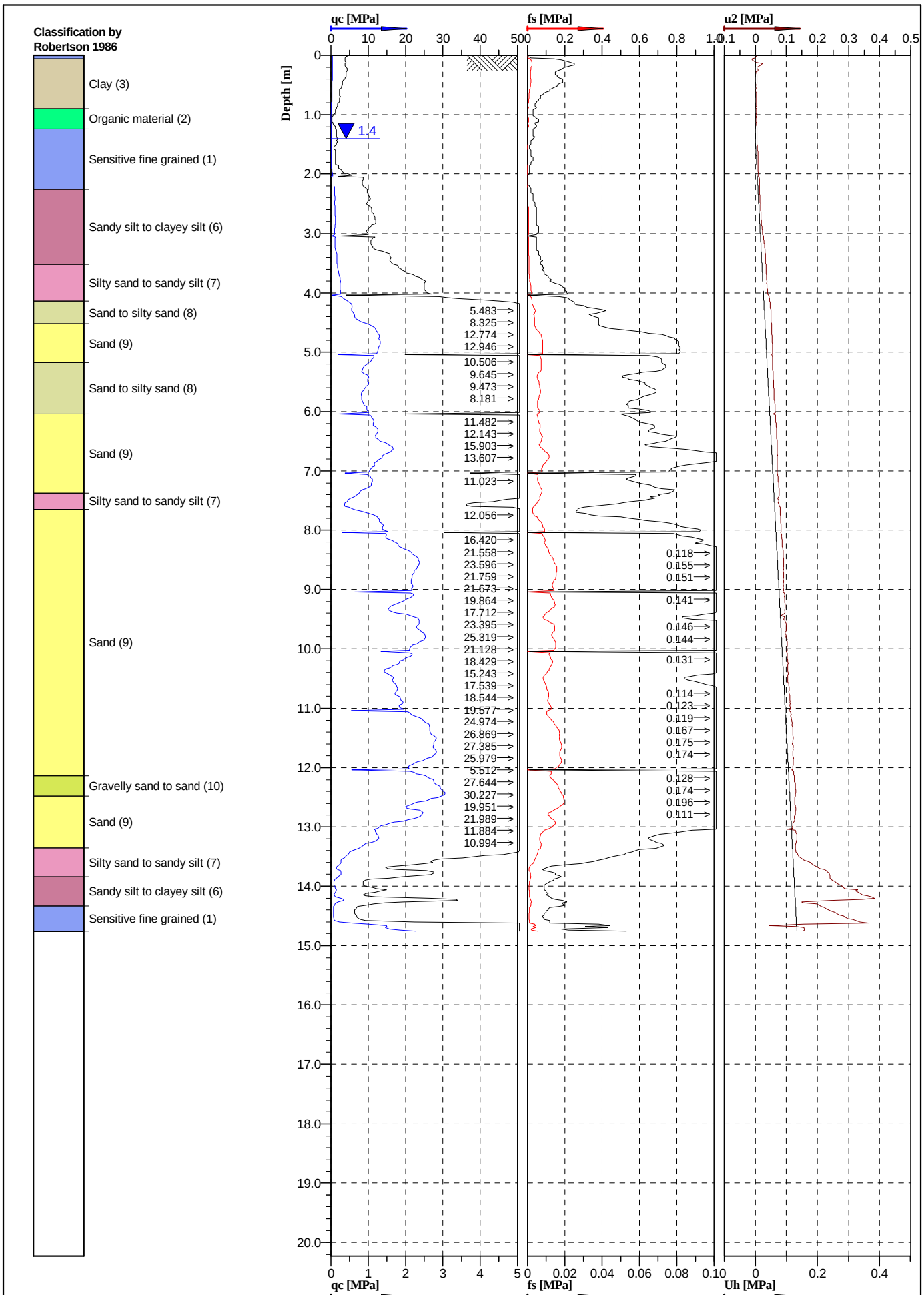


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383140 m, Y: 6367372 m	Ground level: 0.32	Test no: CPT128
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 18c
		File: CG-WI-C018.cpd	

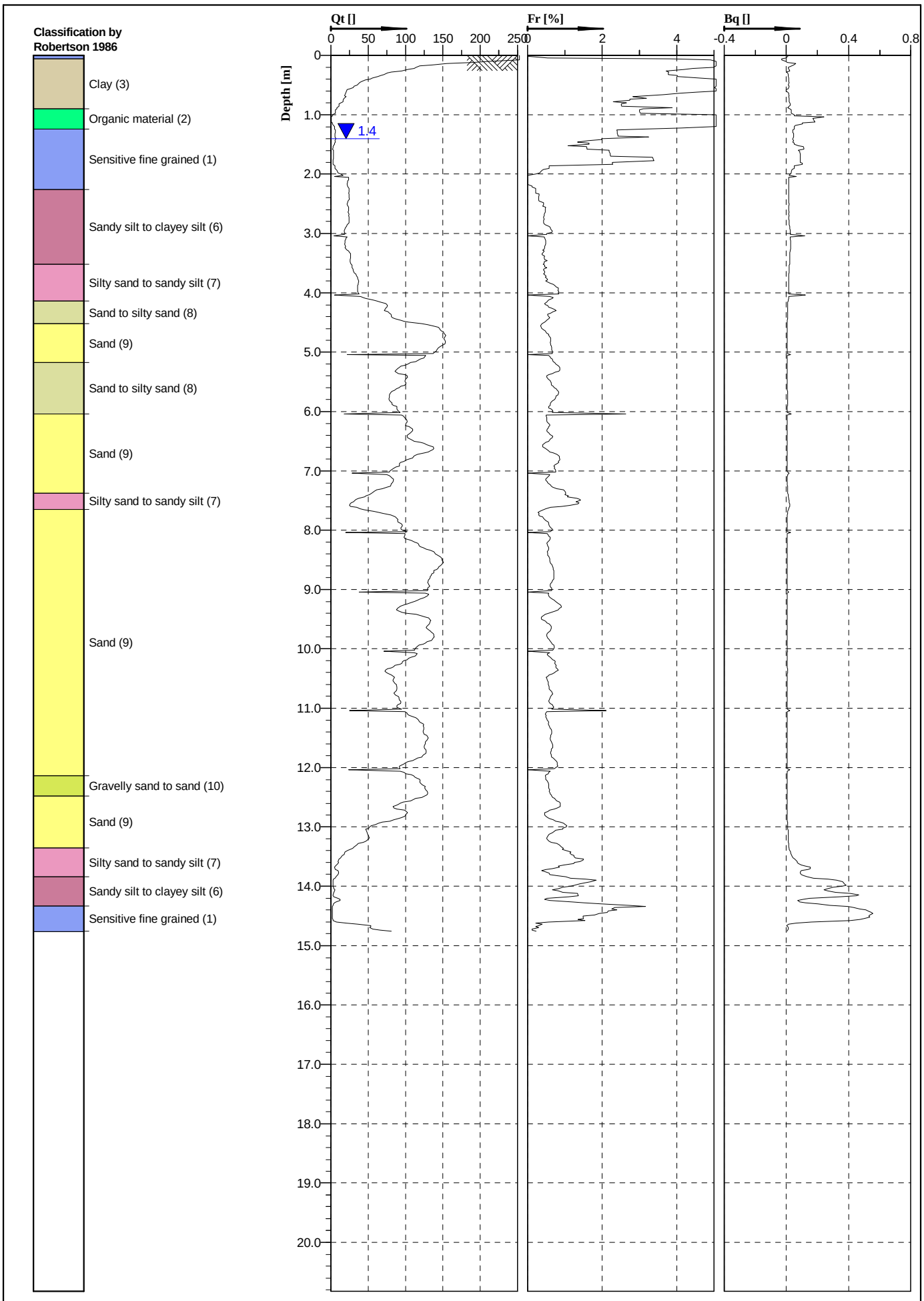


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383061 m, Y: 6367321 m	Ground level: 0.49	Test no: CPT136
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 19a
		File: CG-WI-C019.cpd	

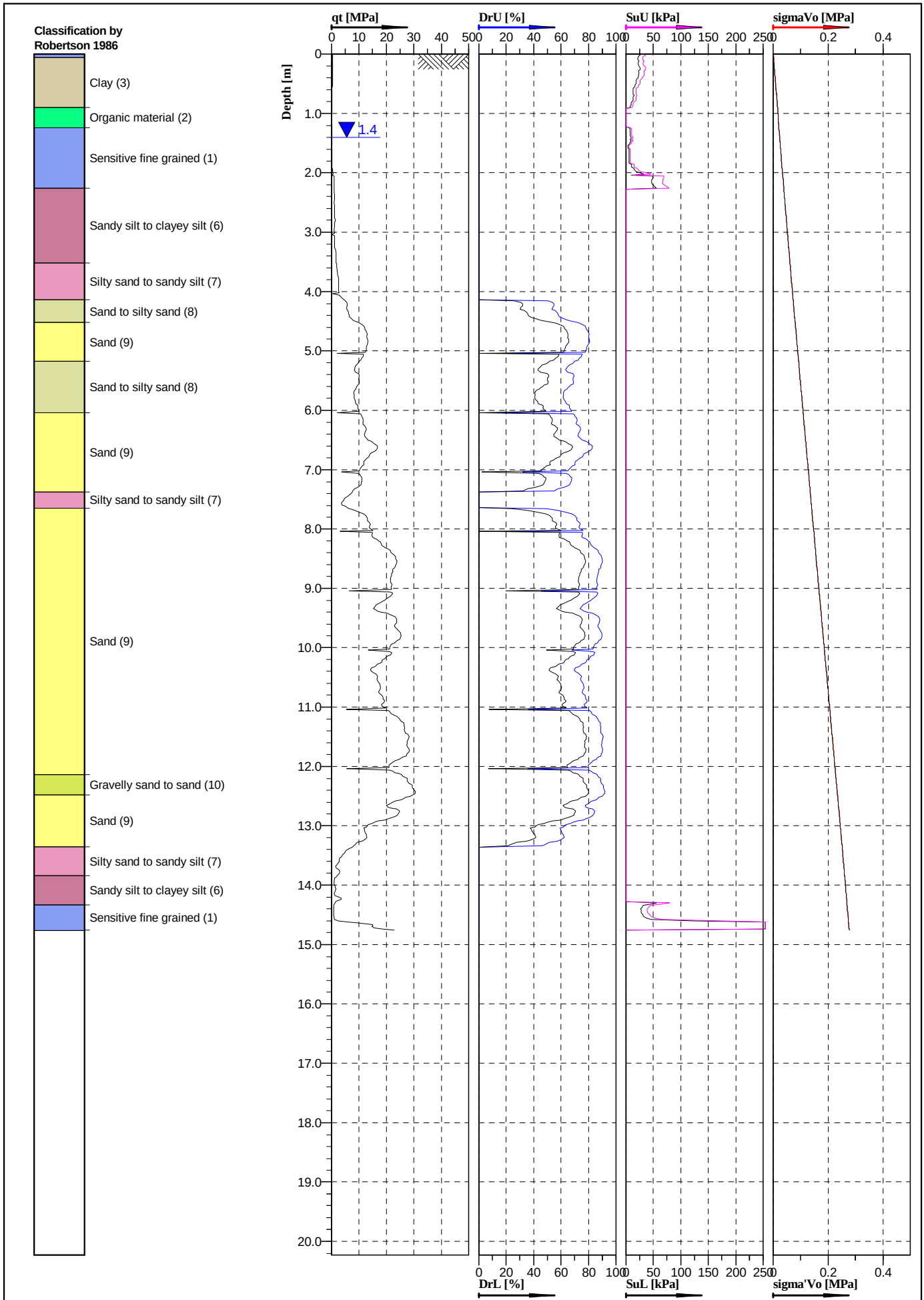


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383061 m, Y: 6367321 m	Ground level: 0.49	Test no: CPT136
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 19b
		File: CG-WI-C019.cpd	

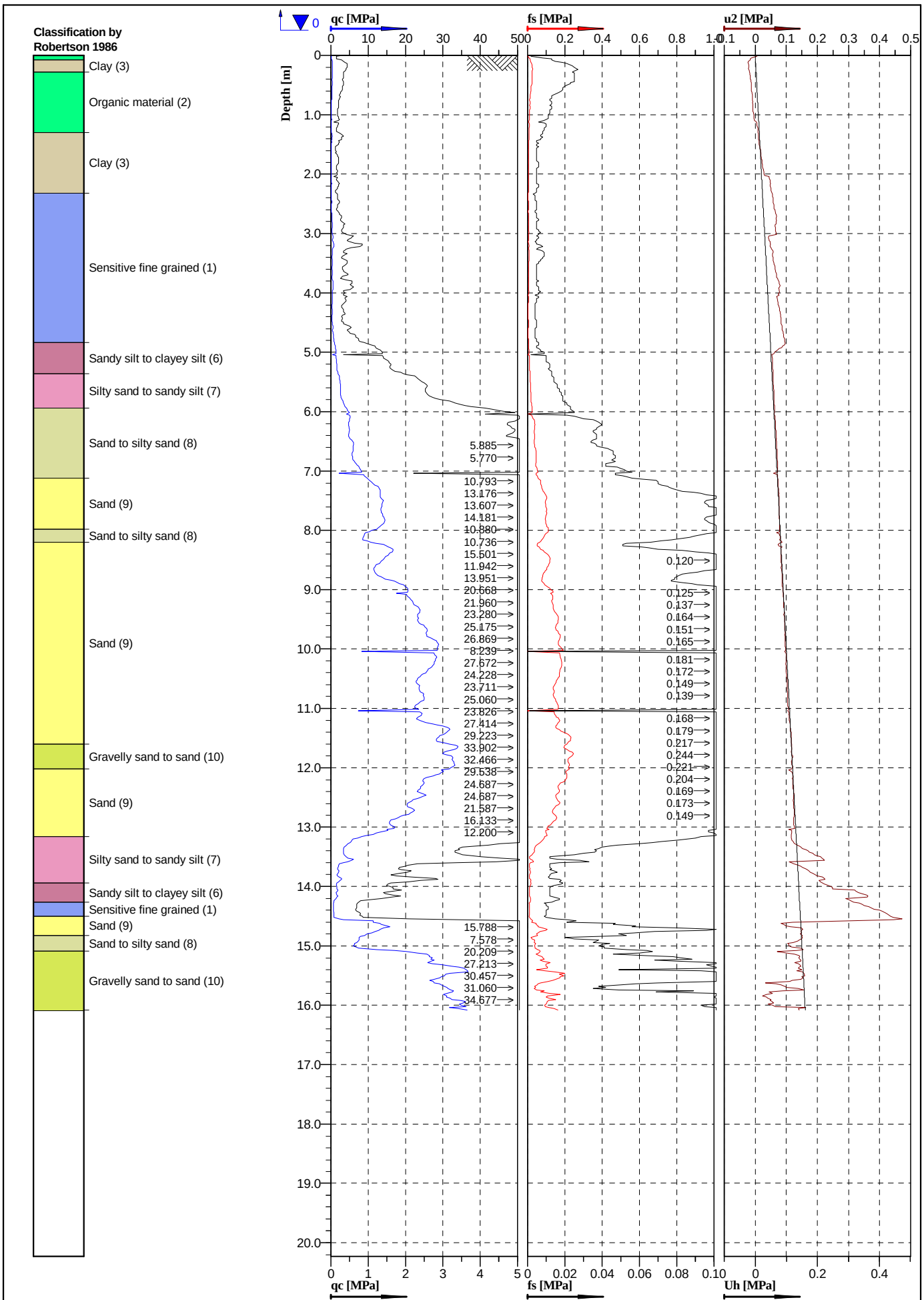


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383061 m, Y: 6367321 m	Ground level: 0.49	Test no: CPT136
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 19c
		File: CG-WI-C019.cpd	

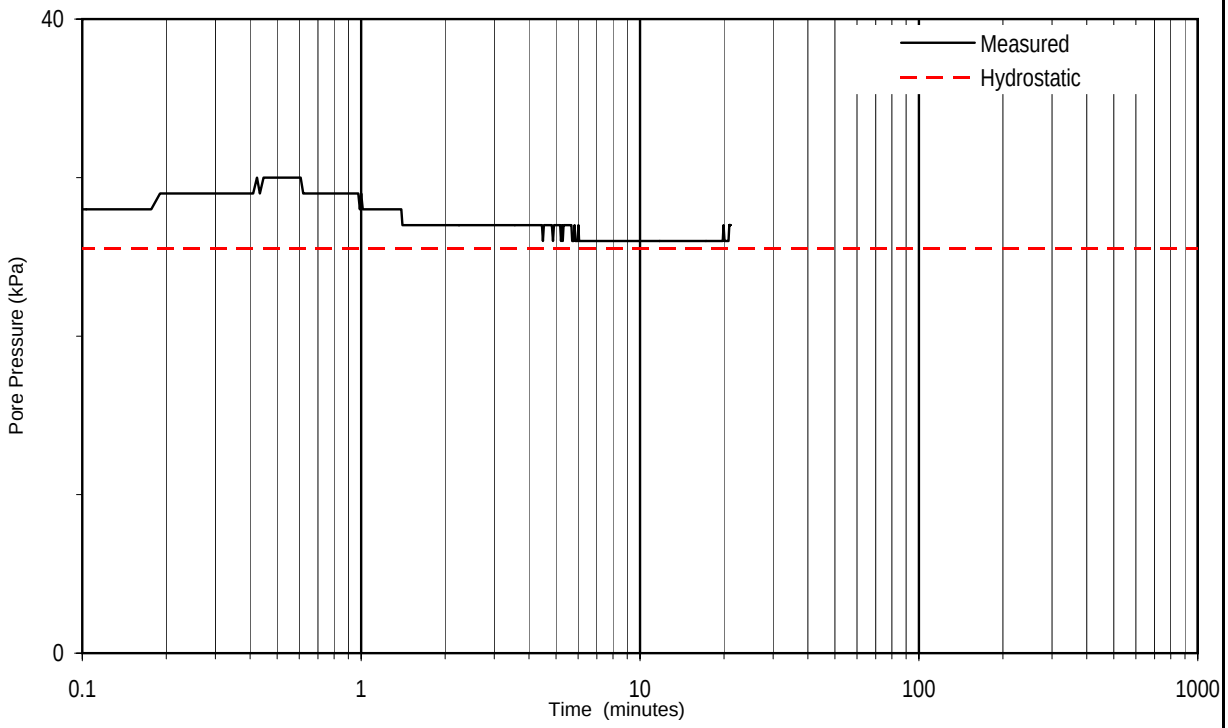


Location: Tomago Road, Tomago	Position: X: 383998 m, Y: 6367340 m	Ground level: 0.54	Test no: CPT140
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 20a
		File: CG-WI-C020.cpd	

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SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150



TEST DATA & INFERRED SOIL PARAMETERS

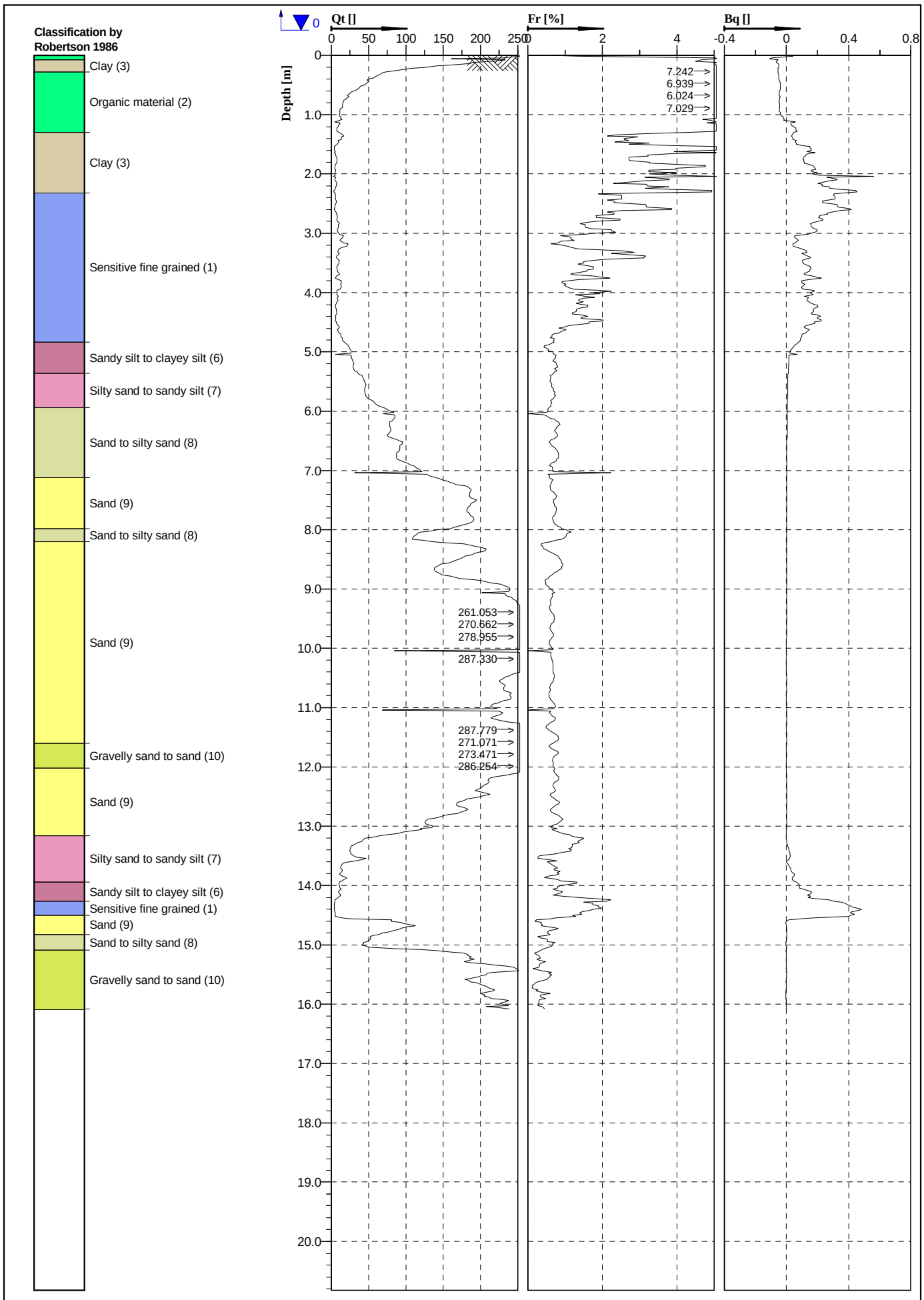
Inferred soil type:

Static pore pressure, u_o		**26**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i		**28**	kPa	(measured from test data)
Final pore pressure at end of test		**27**	kPa	(measured from test data)
Test duration		**21**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}		**2**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H		**105.2**	m^2/year	
	to	**149.3**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		**13.8** x 10^{-6}	cm/s	
	to	**19.1** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13/11/2007**		title:	**PIEZOCONE DISSIPATION TEST**
scale	**NTS**		project no:	**GEOTWARA20301AA**
original size	**A4**		**Test Location & Depth:**	C20 2.60

F:\Job Files\GEOT\SGTE\SGTE 20300 - 20399\SGTE20301AA\Dissipation Test Results\[GEOTSGTE20301AA C20 2.6m Dissipation Test.xls]Summary - Geotechnics

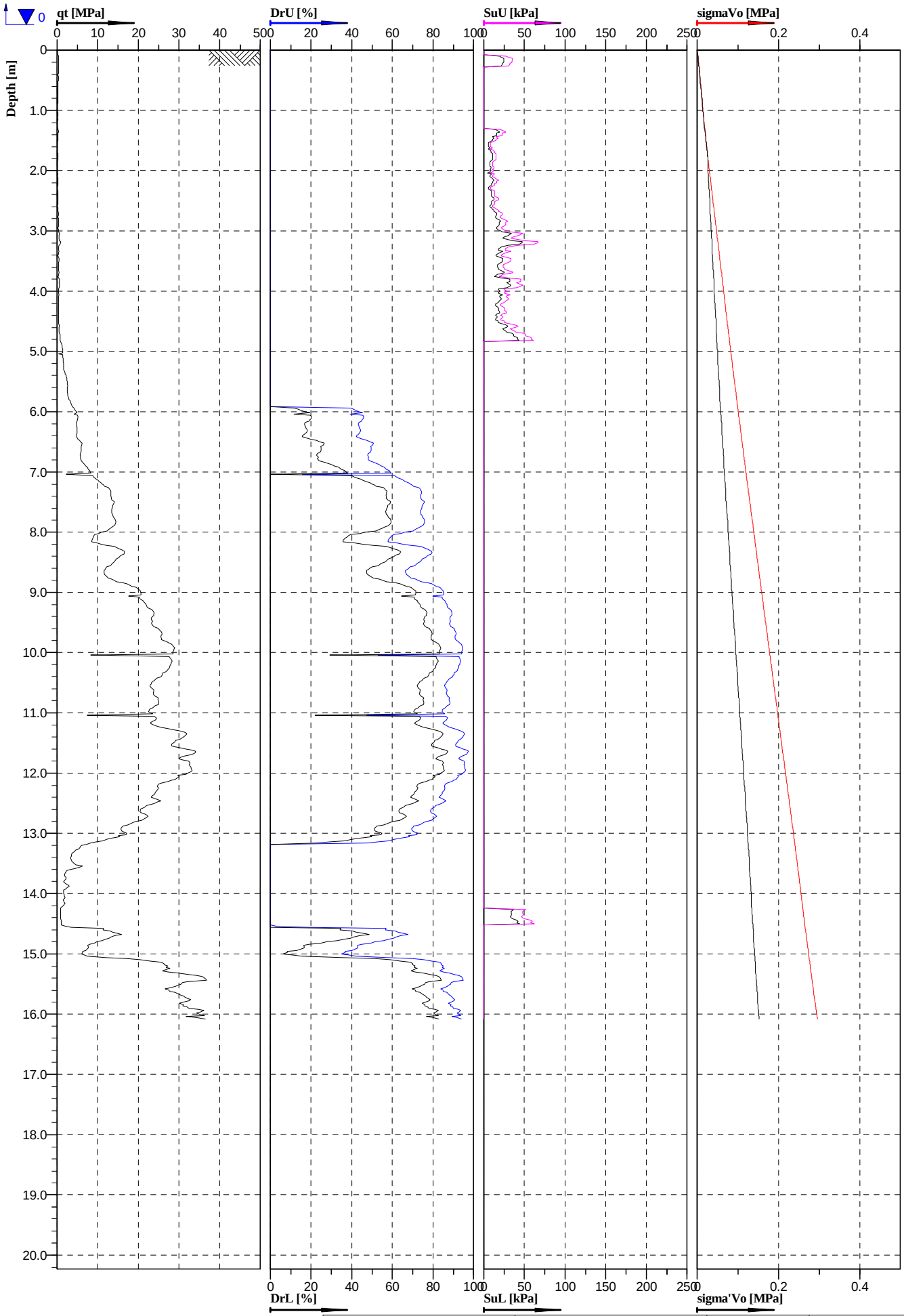


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SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383998 m, Y: 6367340 m	Ground level: 0.54	Test no: CPT140
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 20b
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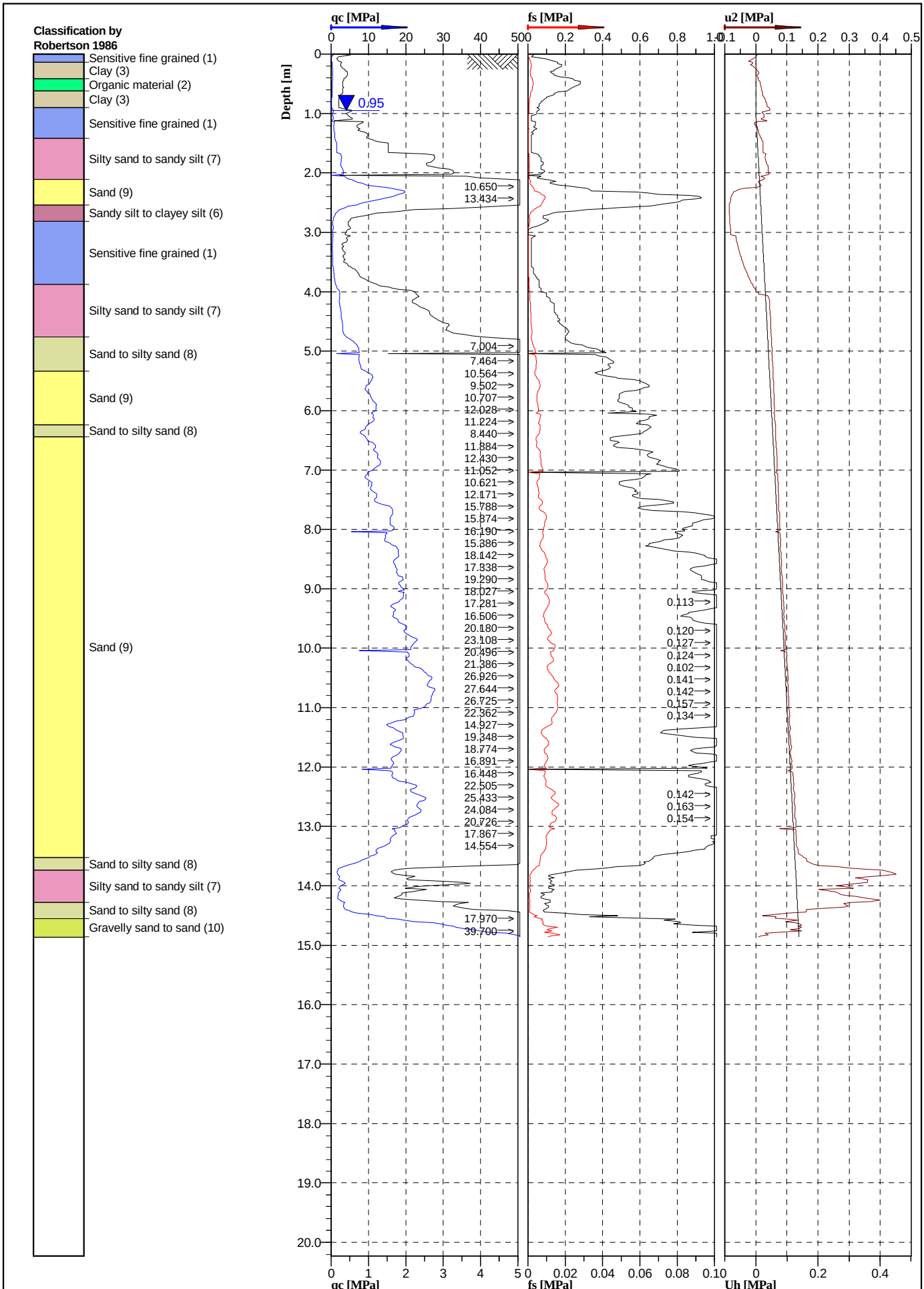


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383998 m, Y: 6367340 m	Ground level: 0.54	Test no: CPT140
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 11/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 20c
		File: CG-WI-C020.cpd	

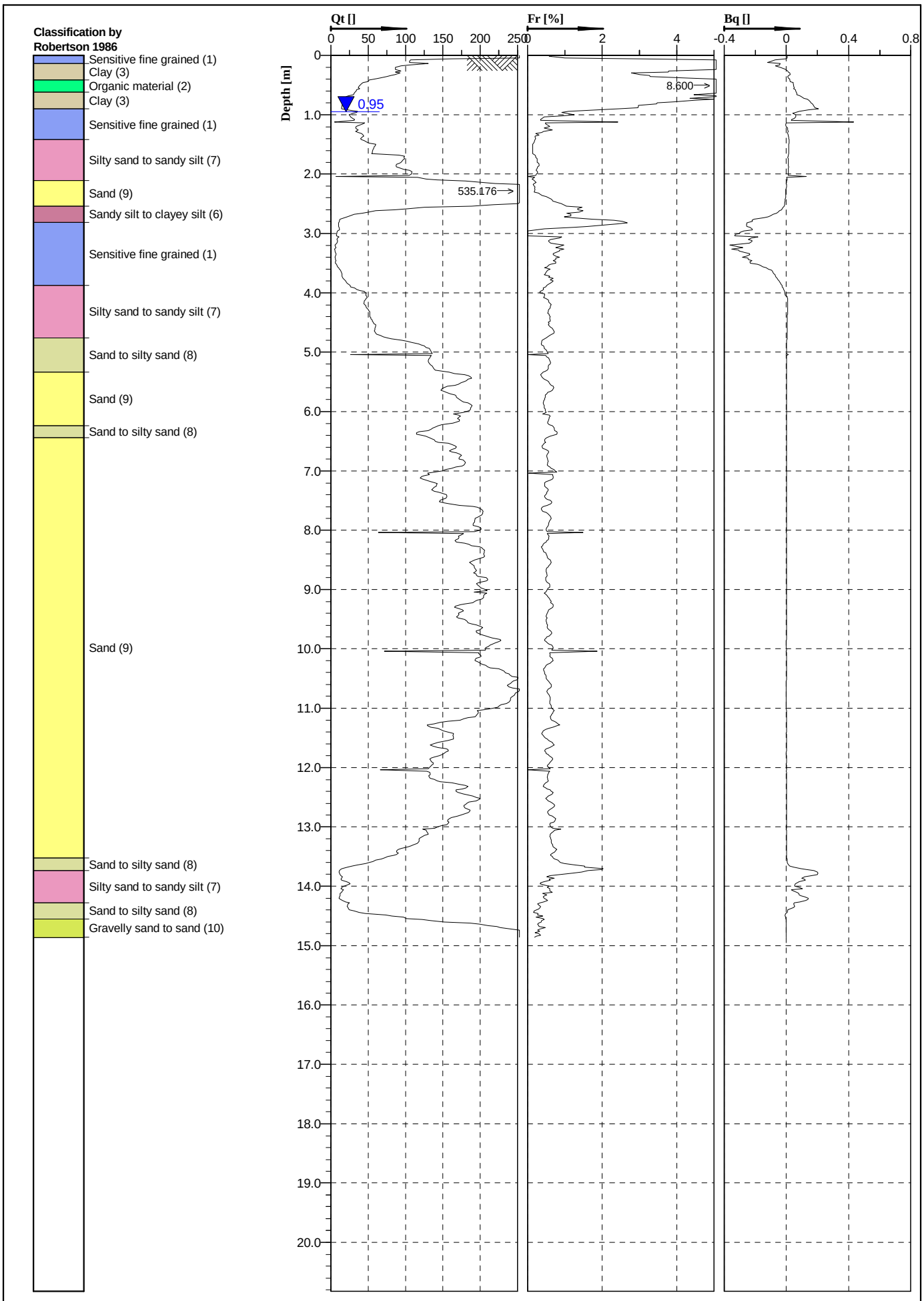


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383182 m, Y: 6367504 m	Ground level: 0.76	Test no: CPT119
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 23a
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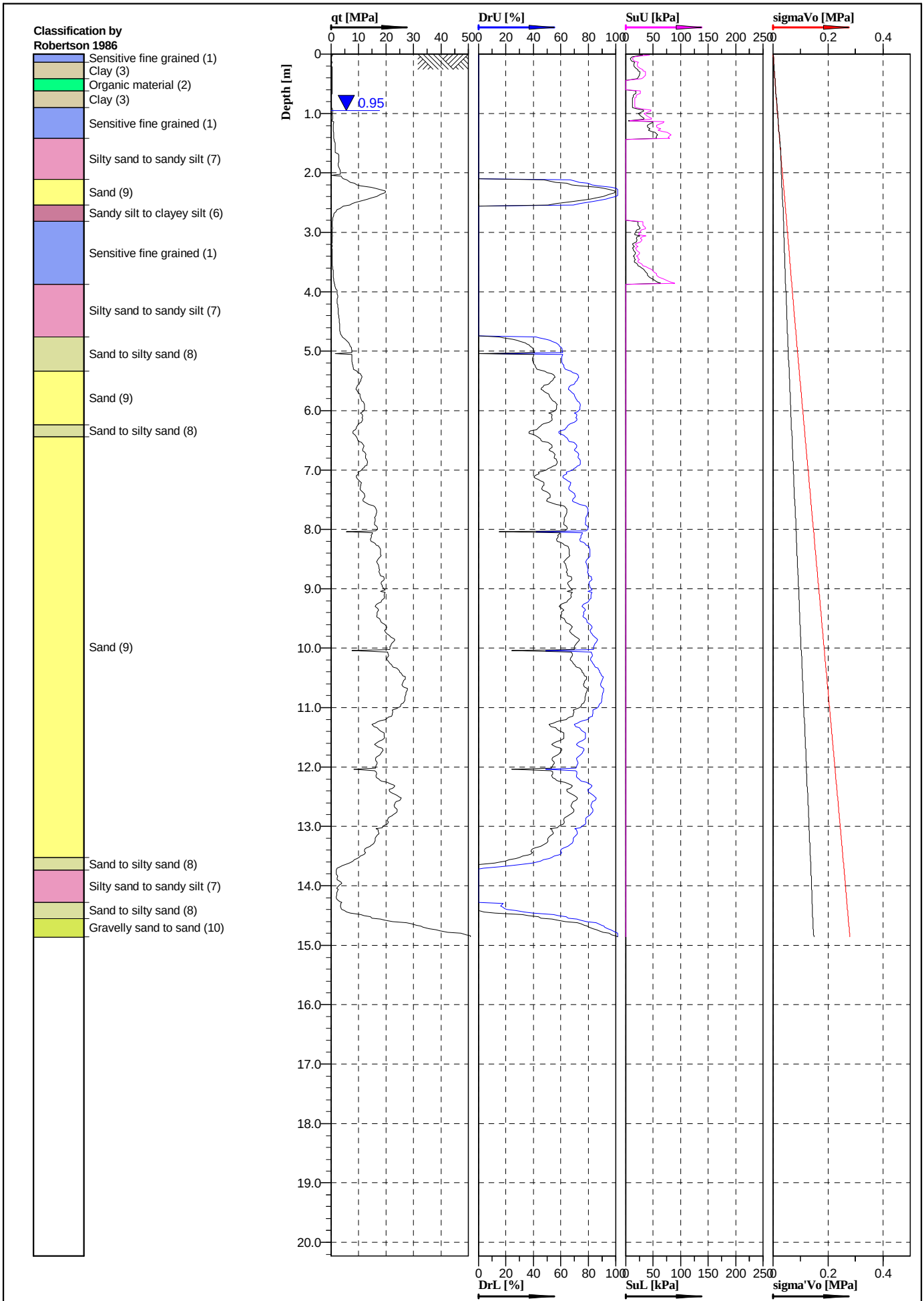


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383182 m, Y: 6367504 m	Ground level: 0.76	Test no: CPT119
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 23b
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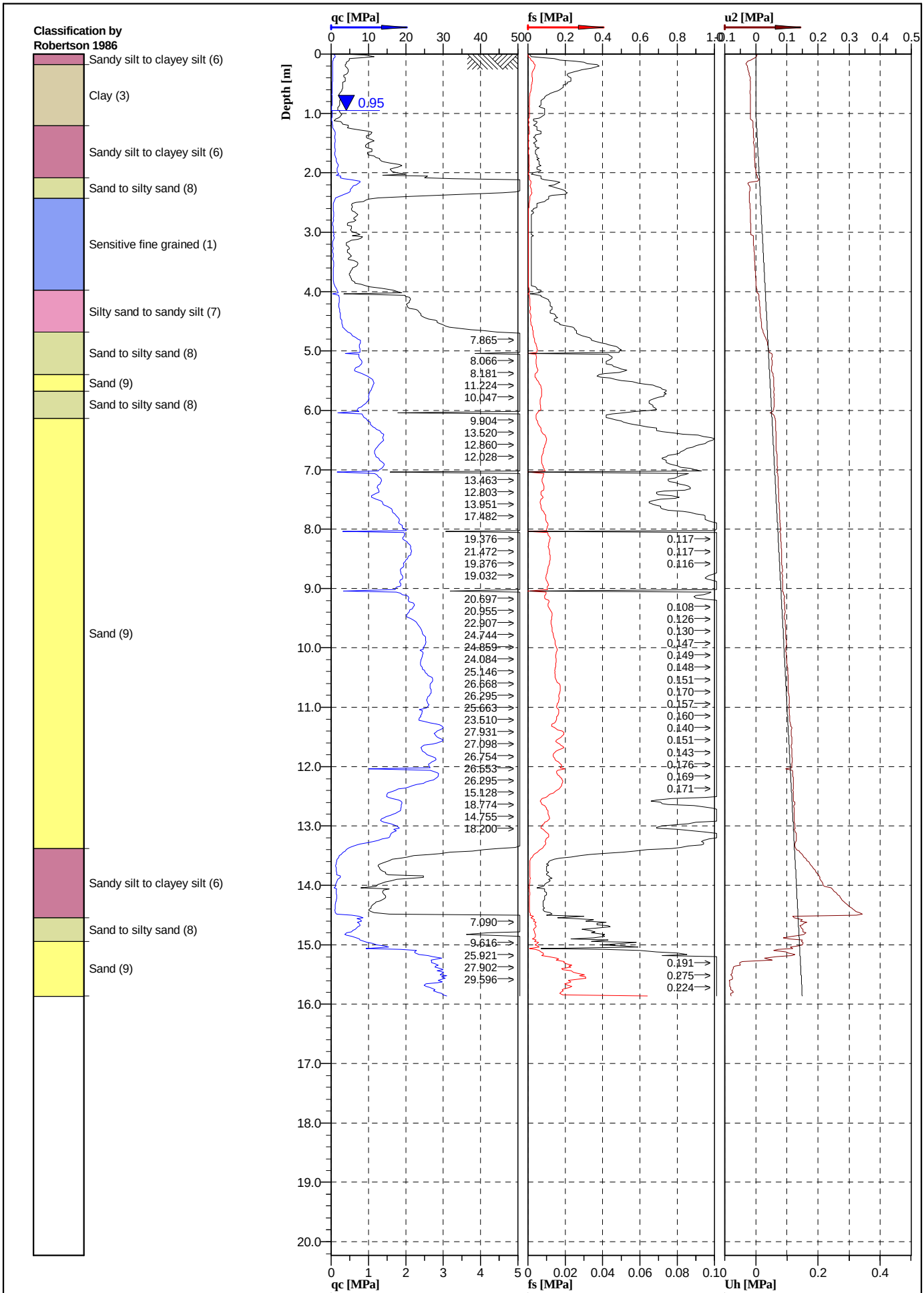


Location: Tomago Road, Tomago	Position: X: 383182 m, Y: 6367504 m	Ground level: 0.76	Test no: CPT119
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 23c
		File: CG-WI-C023.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

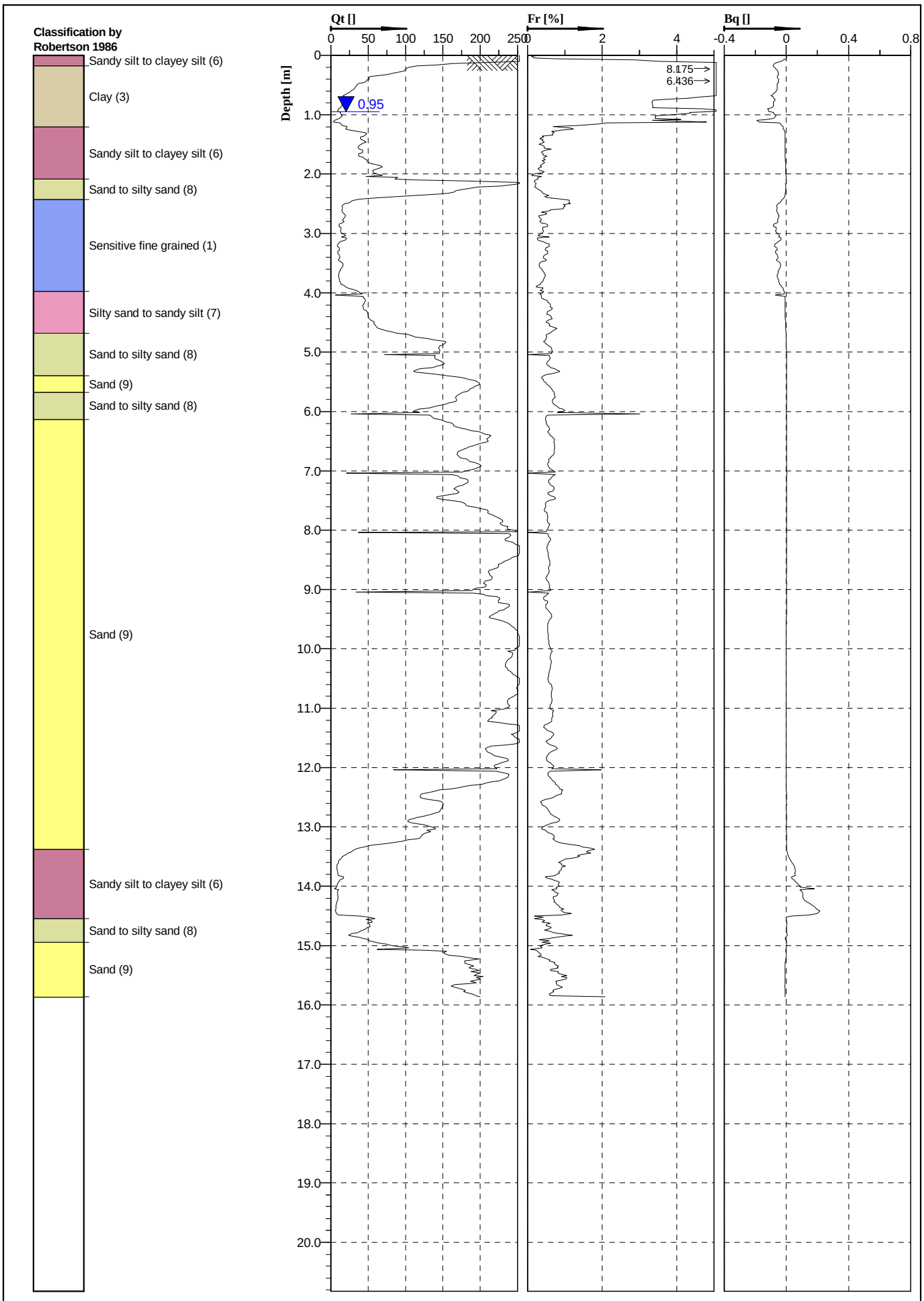


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383099 m, Y: 6367463 m	Ground level: 0.68	Test no: CPT127
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 24a
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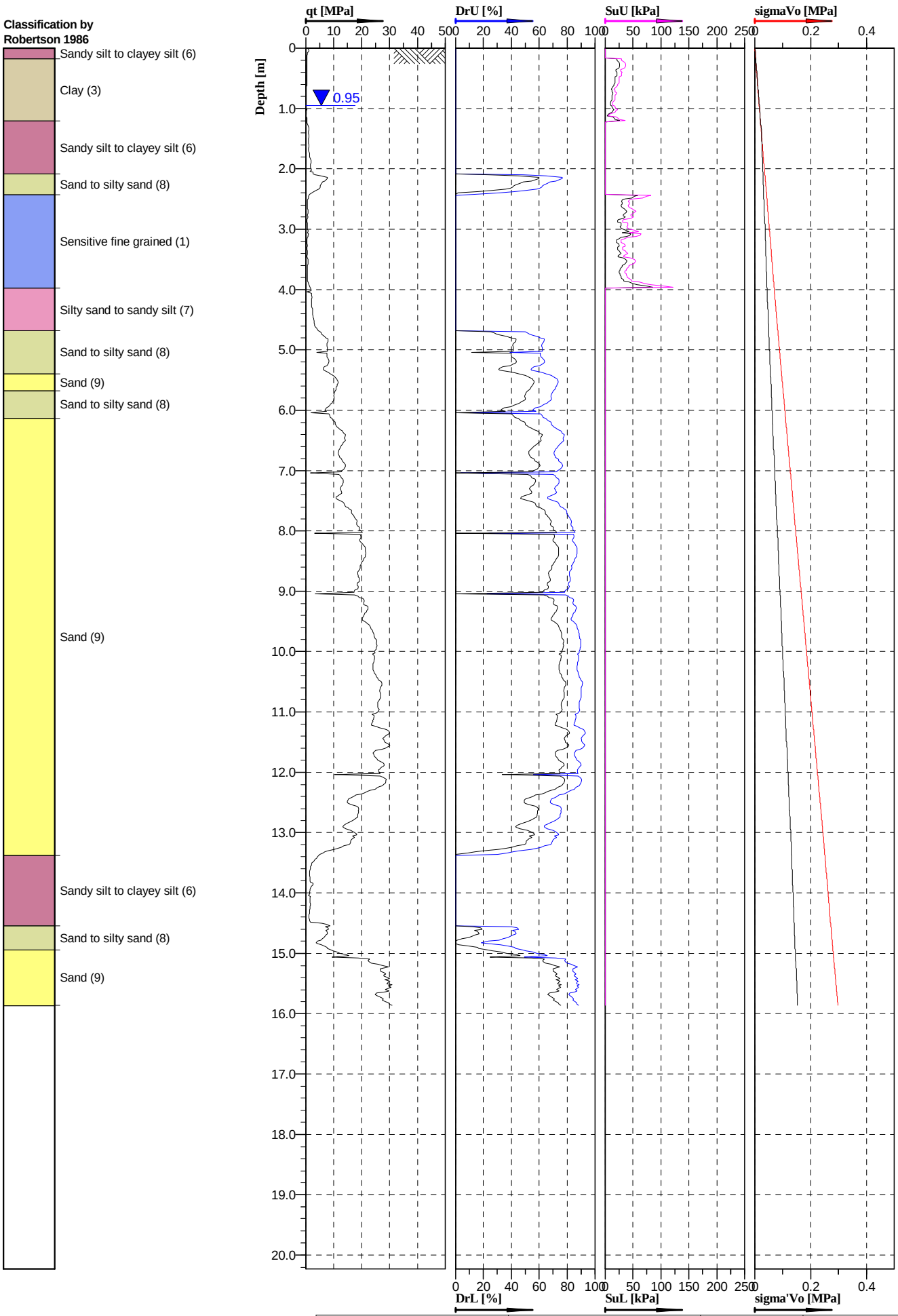


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383099 m, Y: 6367463 m	Ground level: 0.68	Test no: CPT127
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 24b
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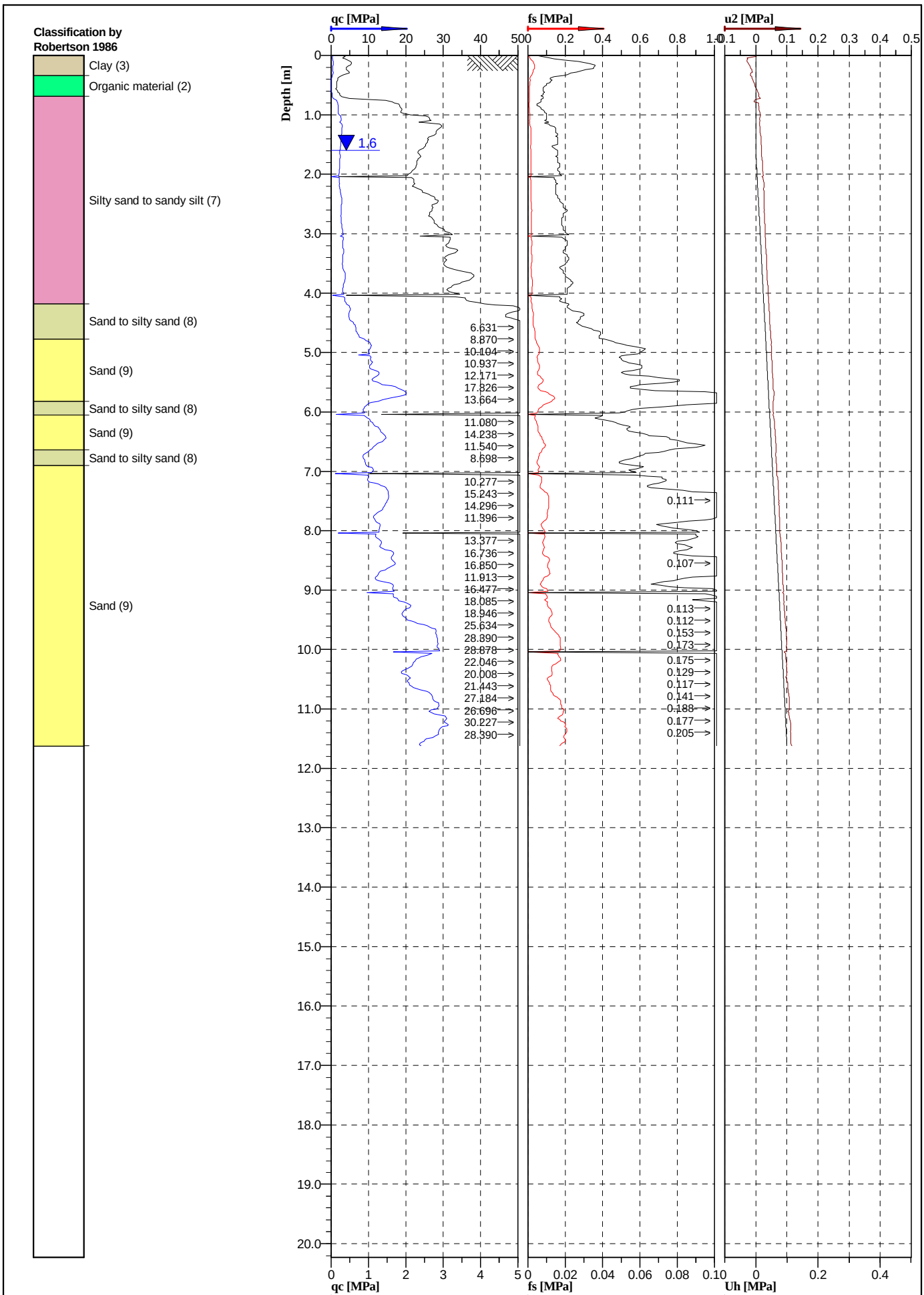


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383099 m, Y: 6367463 m	Ground level: 0.68	Test no: CPT127
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 24c
		File: CG-WI-C024.cpd	

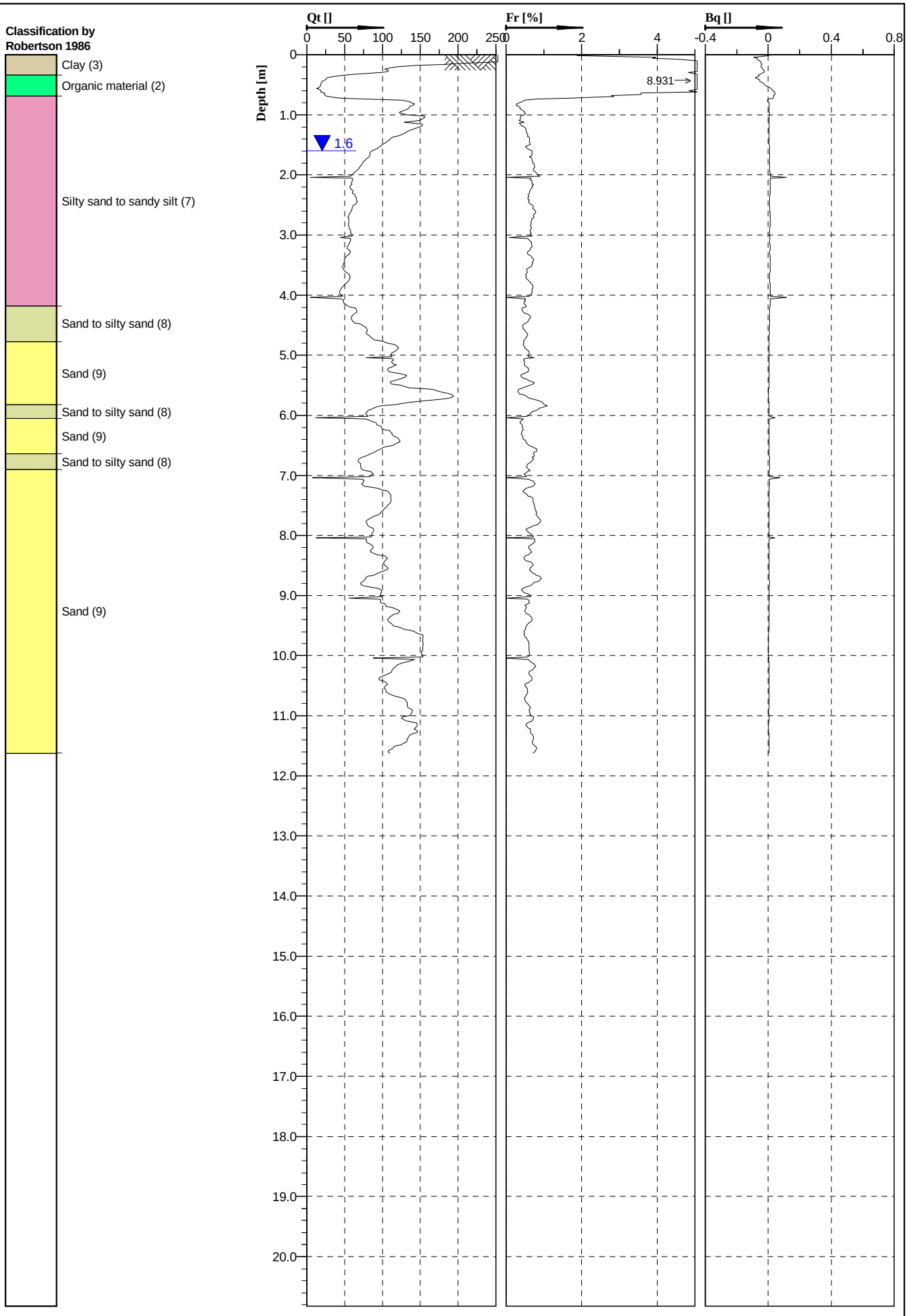


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383115 m, Y: 6367530 m	Ground level: 0.88	Test no: CPT123
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 28a
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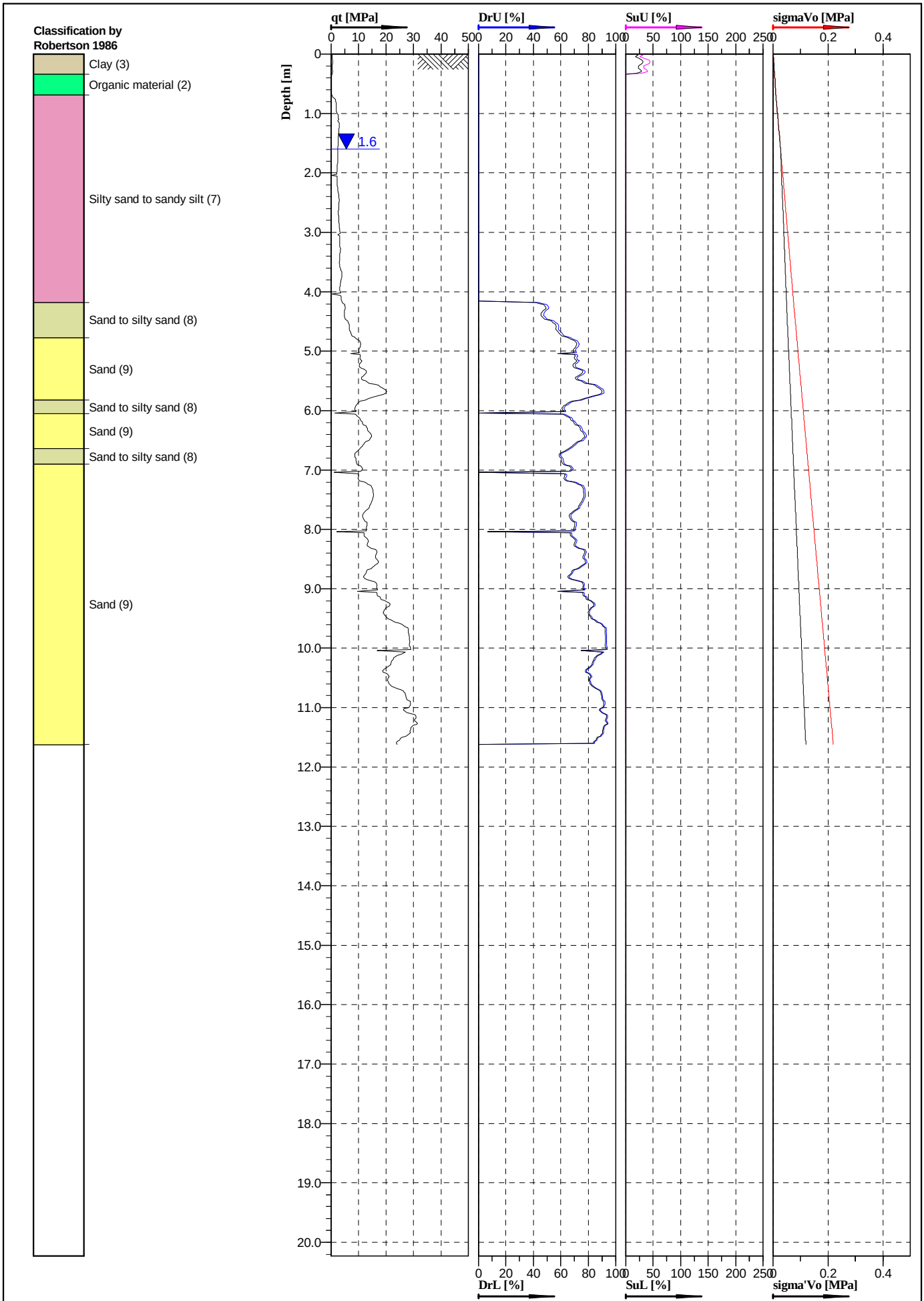


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SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383115 m, Y: 6367530 m	Ground level: 0.88	Test no: CPT123
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 28b
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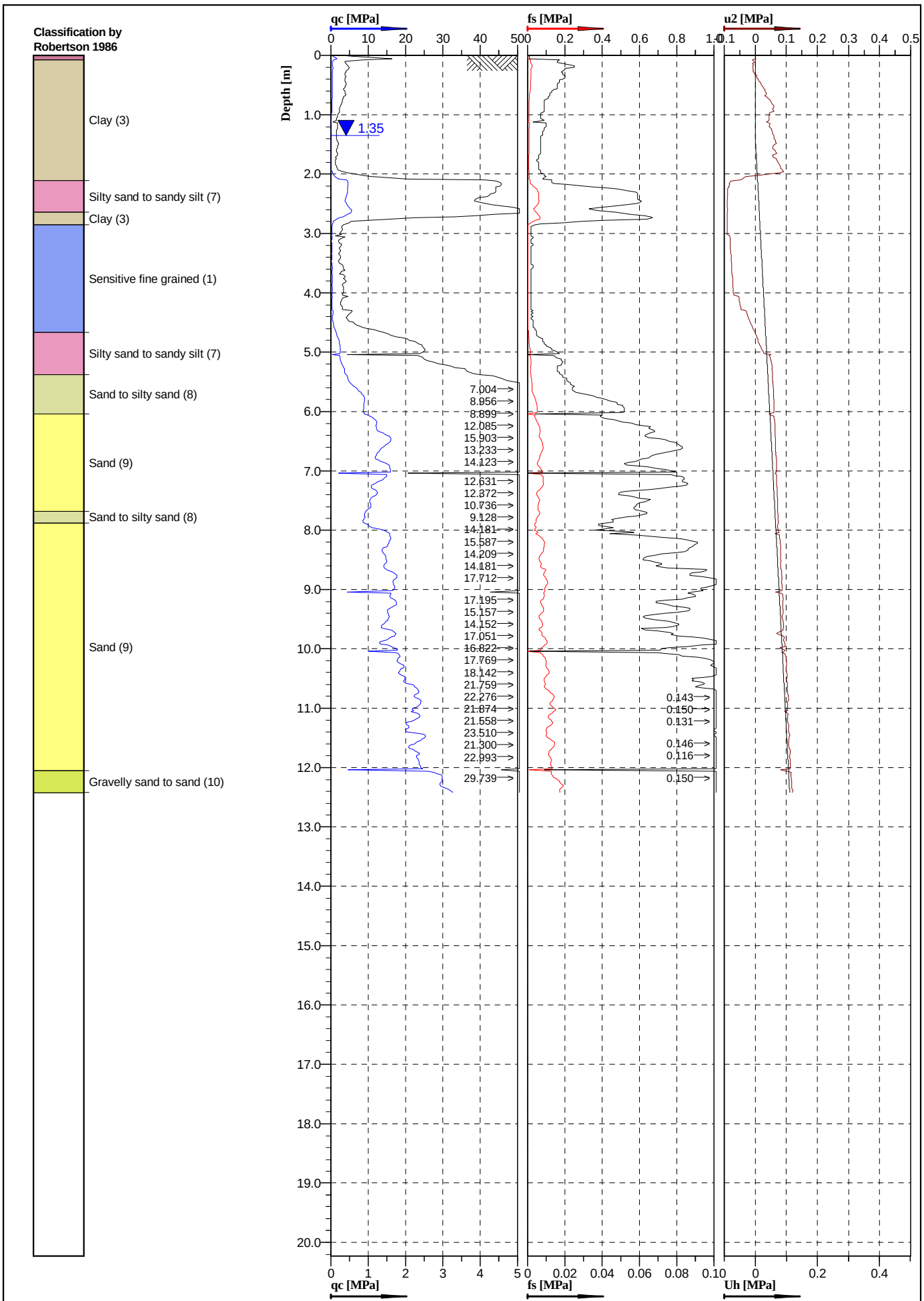


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383115 m, Y: 6367530 m	Ground level: 0.88	Test no: CPT123
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 28c
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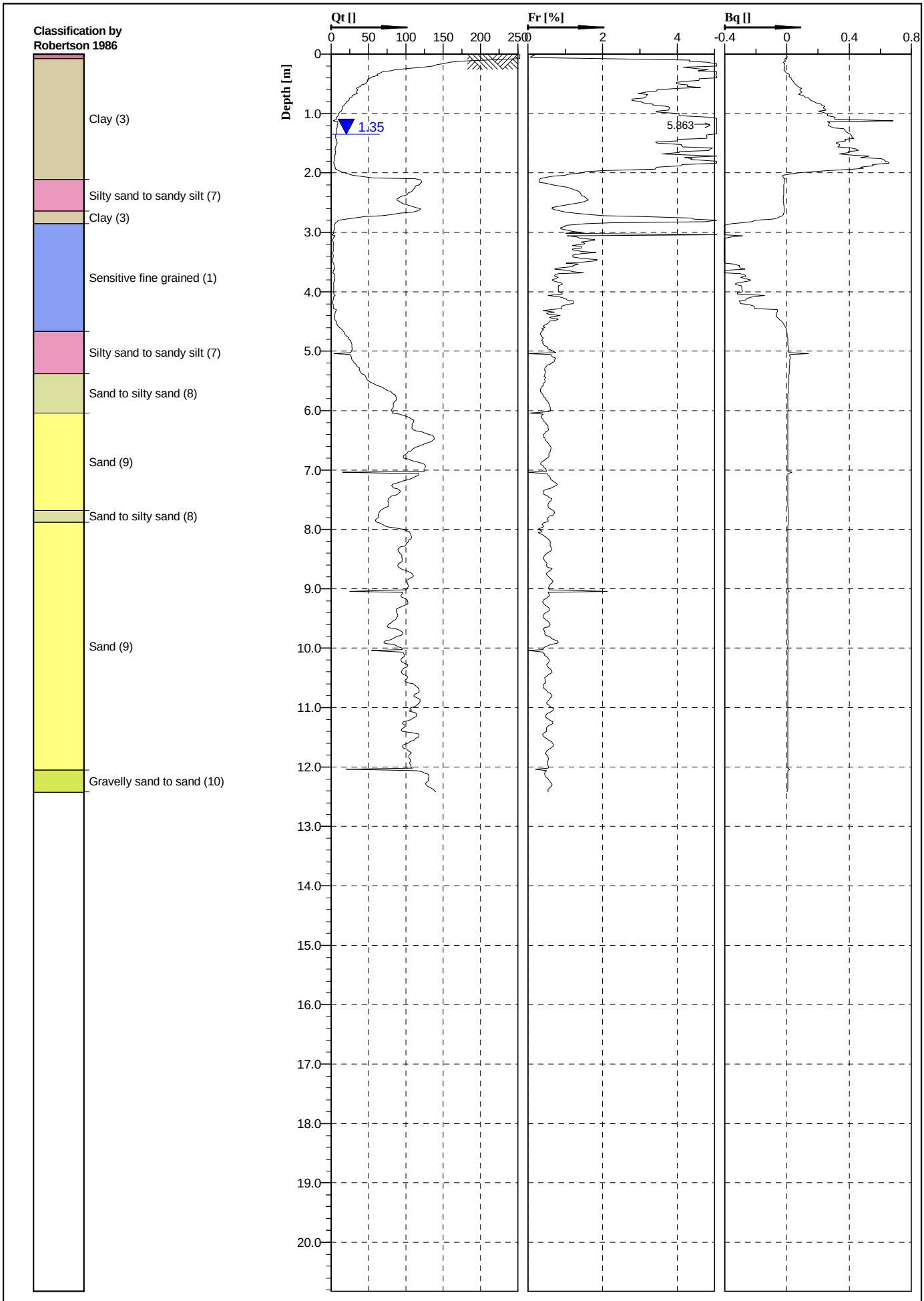


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Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 22a
		File: CG-WI-C22.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

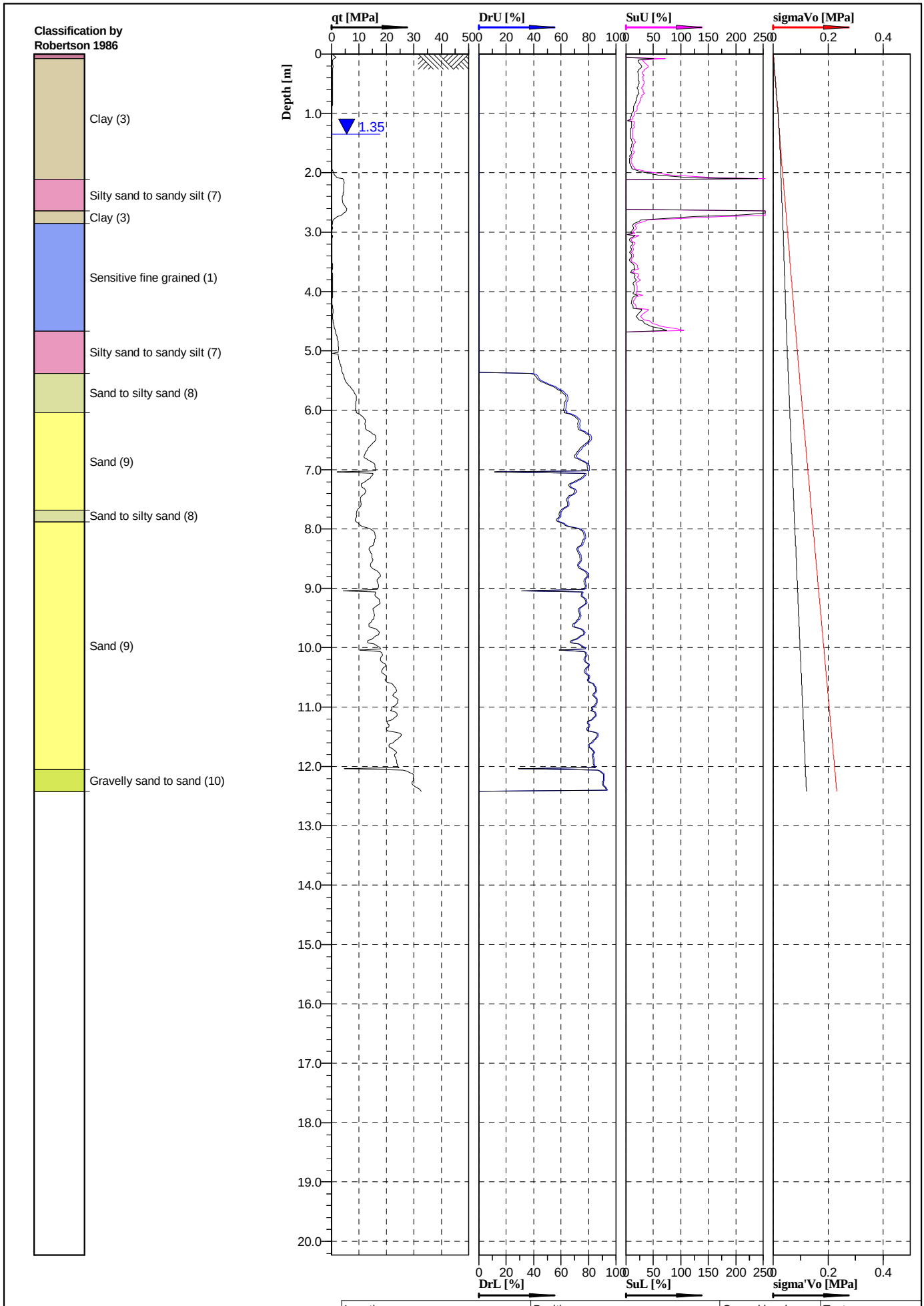


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383166 m, Y: 6367436 m	Ground level: 0.61	Test no: CPT124
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 22b
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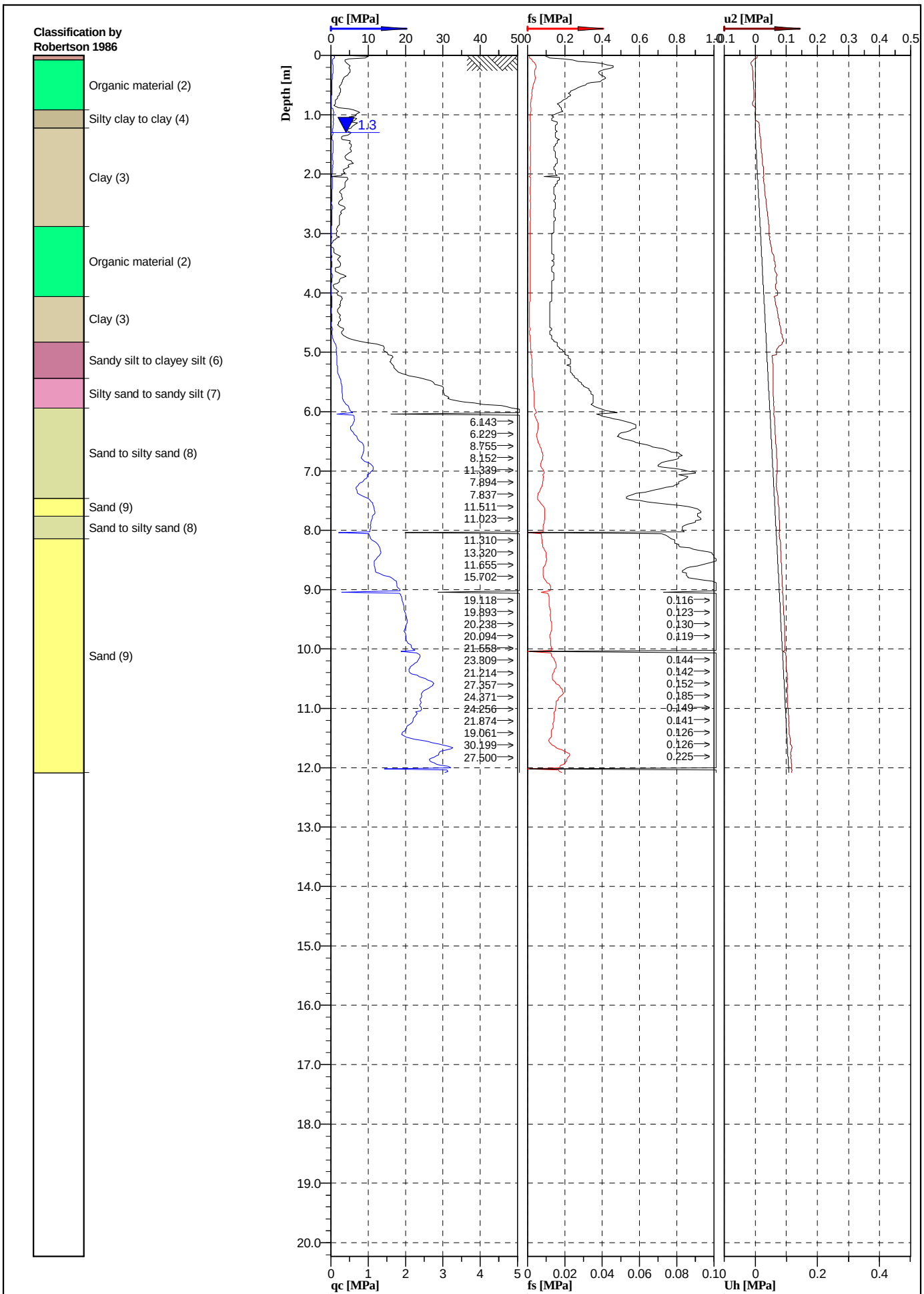


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383166 m, Y: 6367436 m	Ground level: 0.61	Test no: CPT124
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 22c
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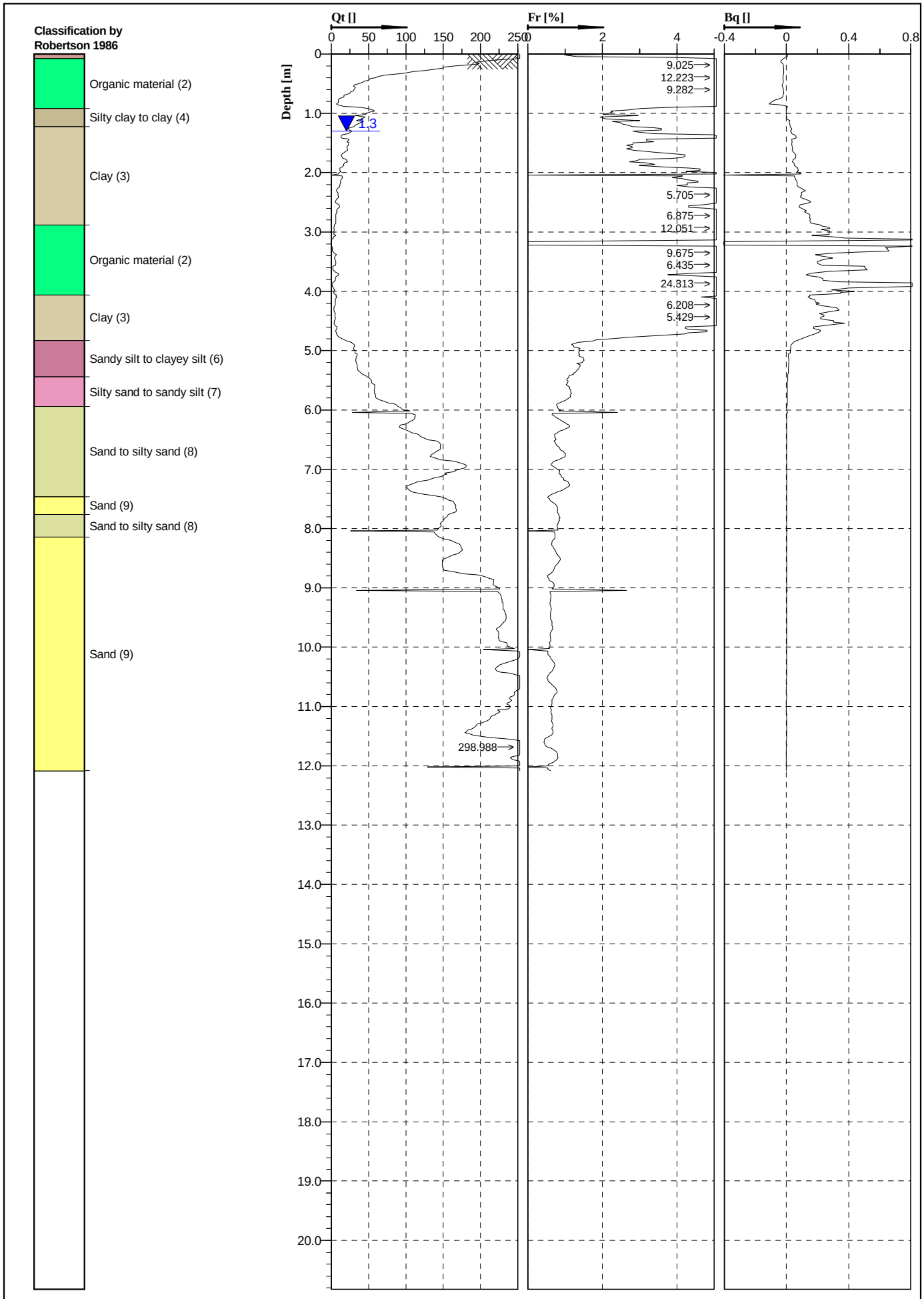


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383010 m, Y: 6367411 m	Ground level: 0.64	Test no: CPT135
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 25a
		File: CG-WI-C025.cpd	

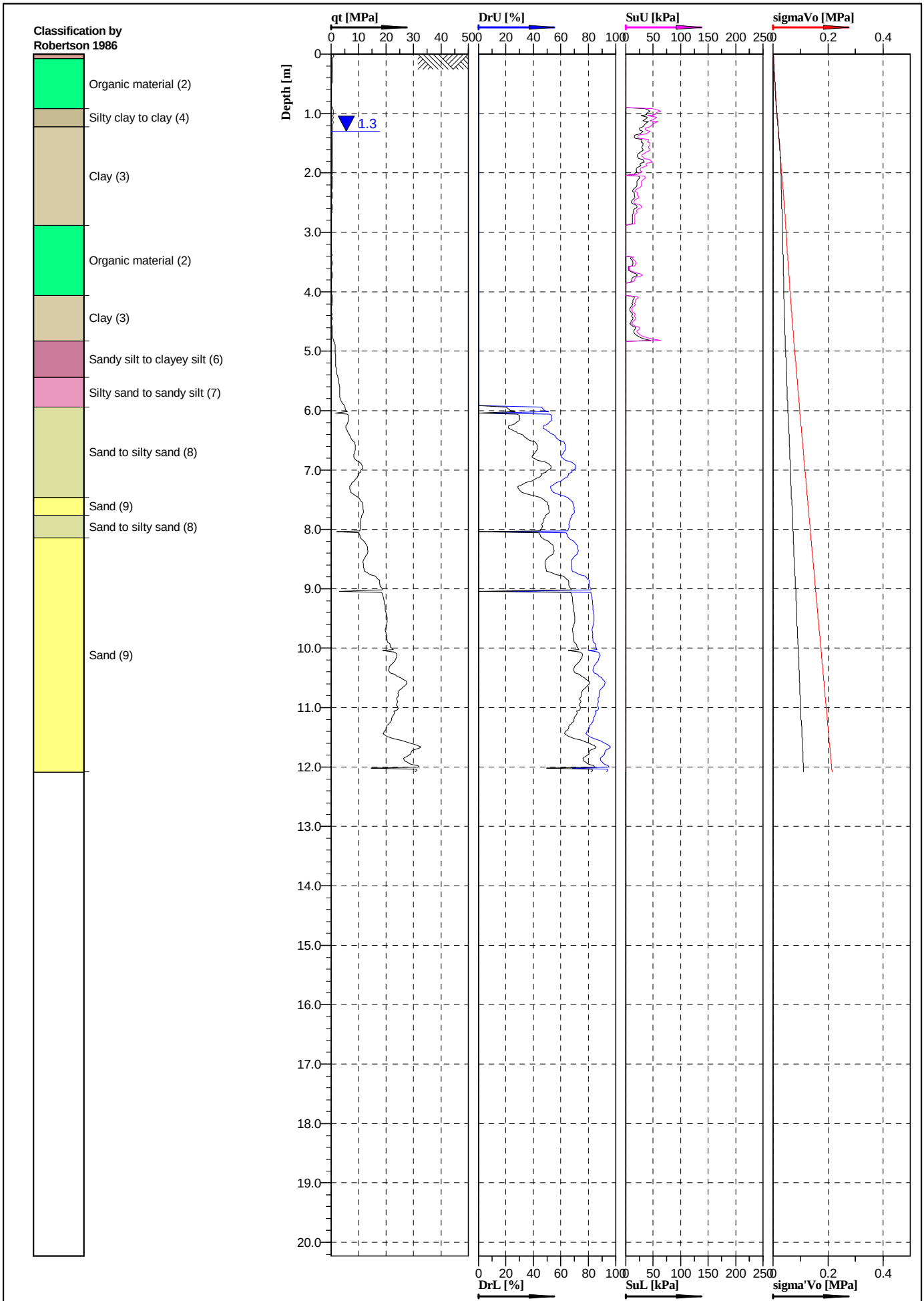


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383010 m, Y: 6367411 m	Ground level: 0.64	Test no: CPT135
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 25b
		File: CG-WI-C025.cpd	

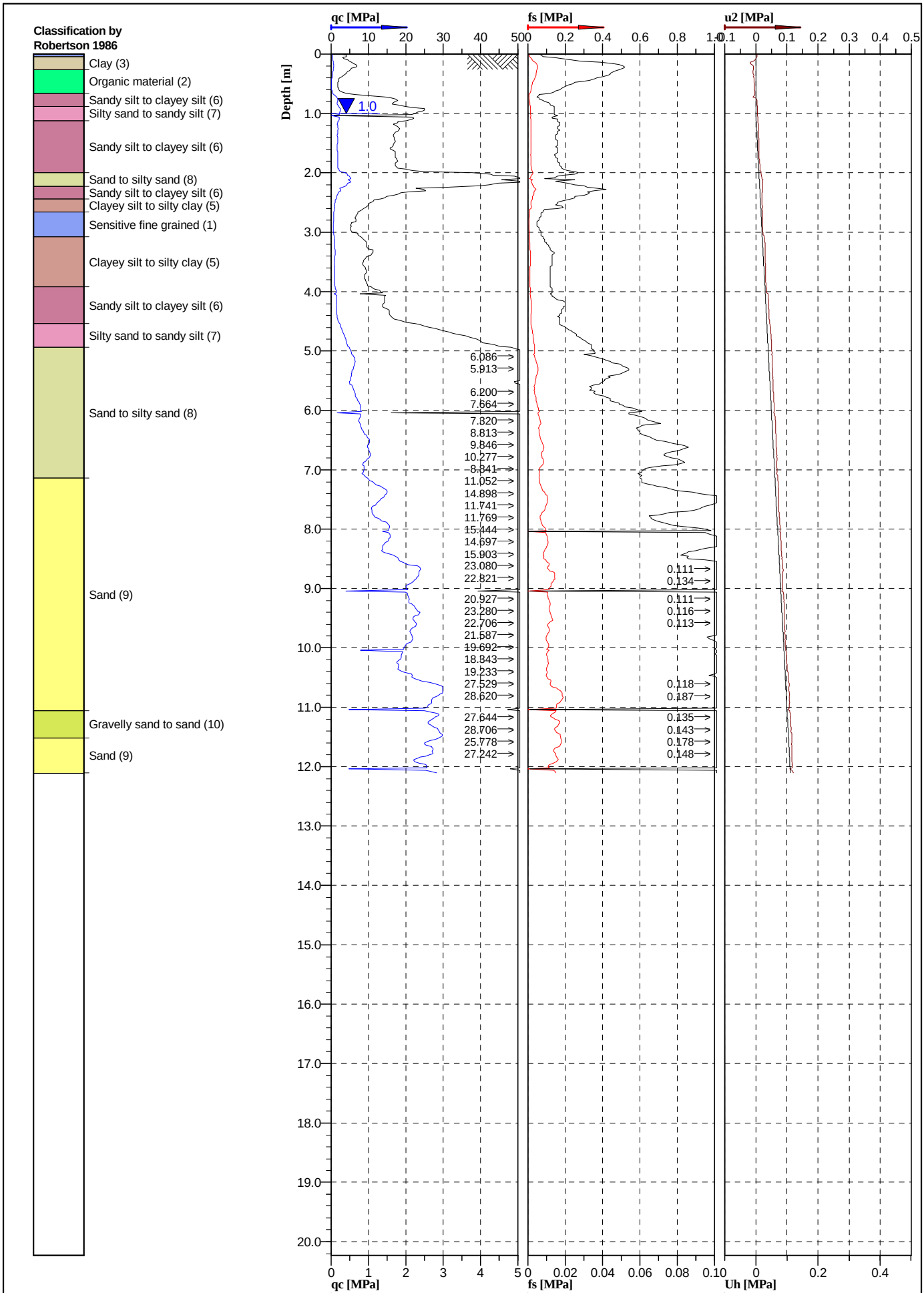


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383010 m, Y: 6367411 m	Ground level: 0.64	Test no: CPT135
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 25c
		File: CG-WI-C025.cpd	

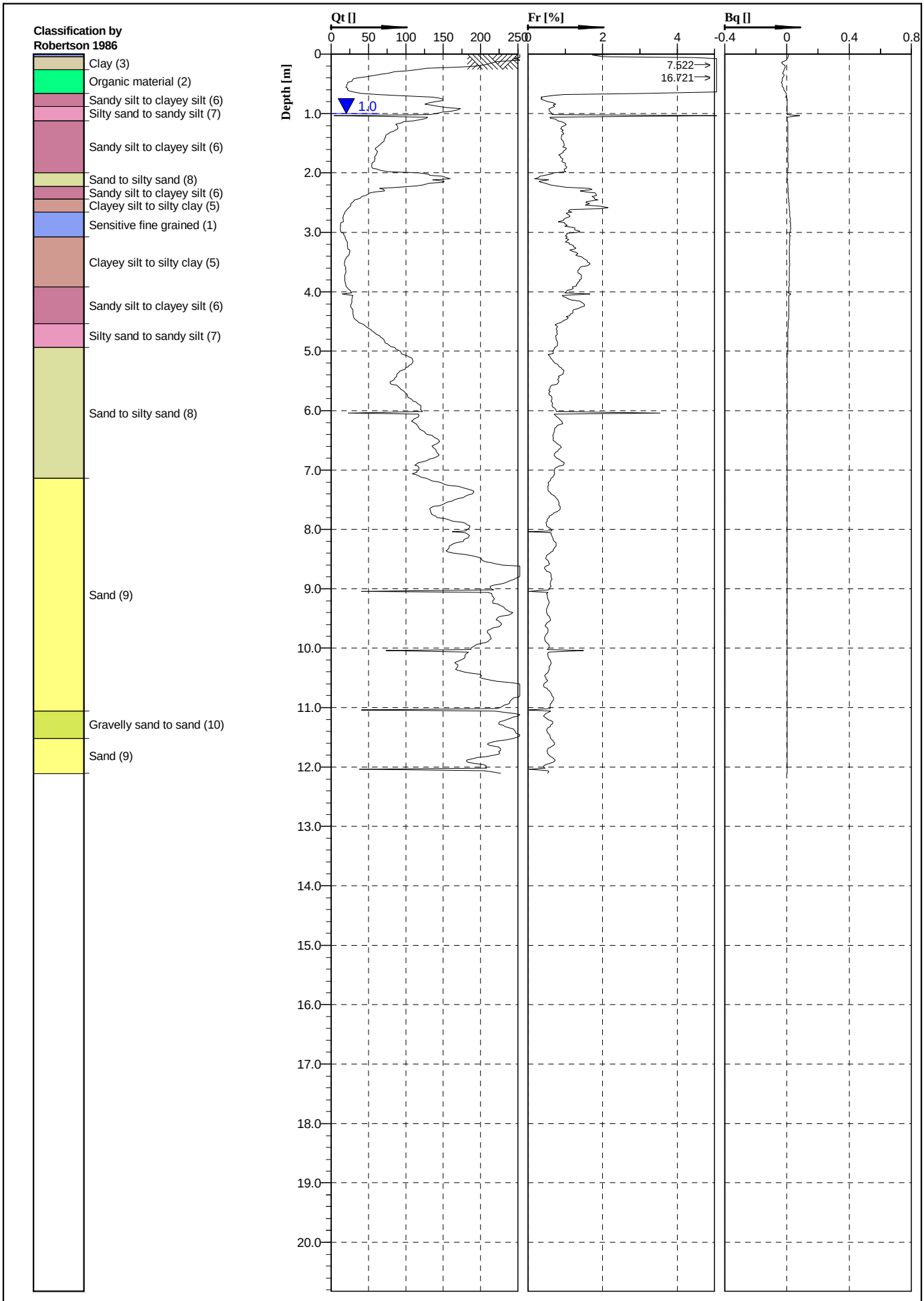


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382942 m, Y: 6367436 m	Ground level: 0.92	Test no: CPT139
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 26a
		File: CG-WI-C026.cpd	

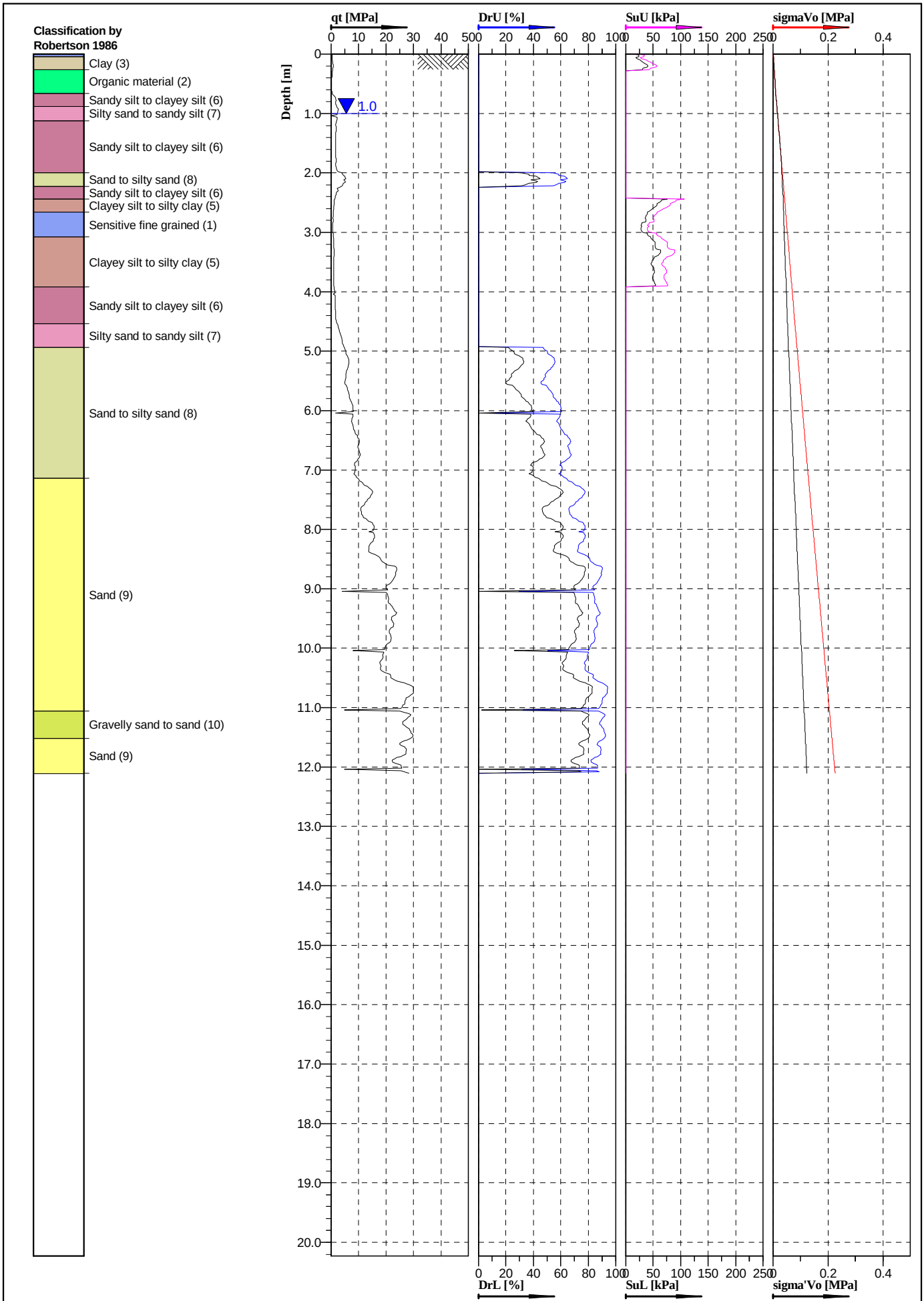


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382942 m, Y: 6367436 m	Ground level: 0.92	Test no: CPT139
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 26b
		File: CG-WI-C026.cpd	

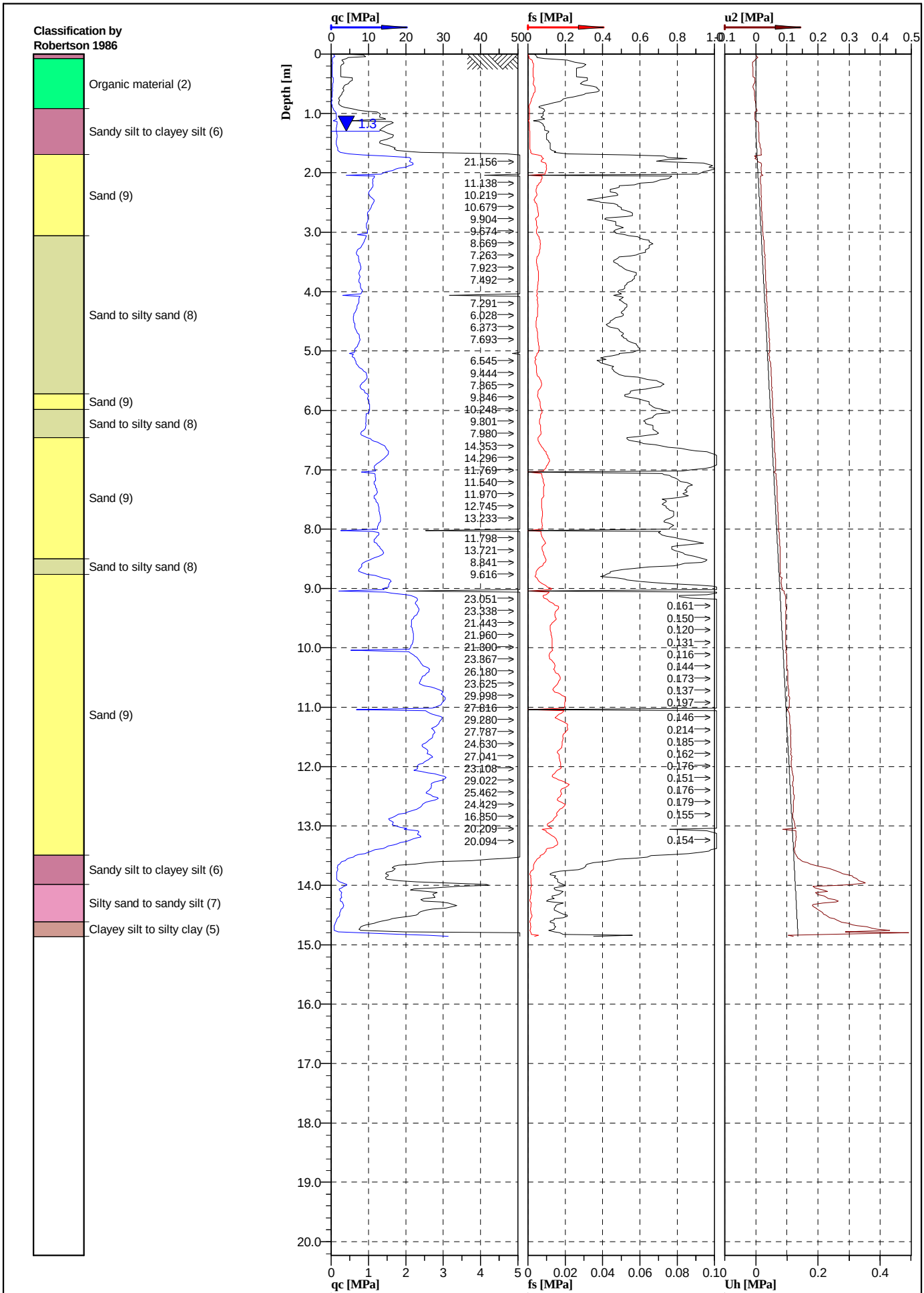


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382942 m, Y: 6367436 m	Ground level: 0.92	Test no: CPT139
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 26c
		File: CG-WI-C026.cpd	

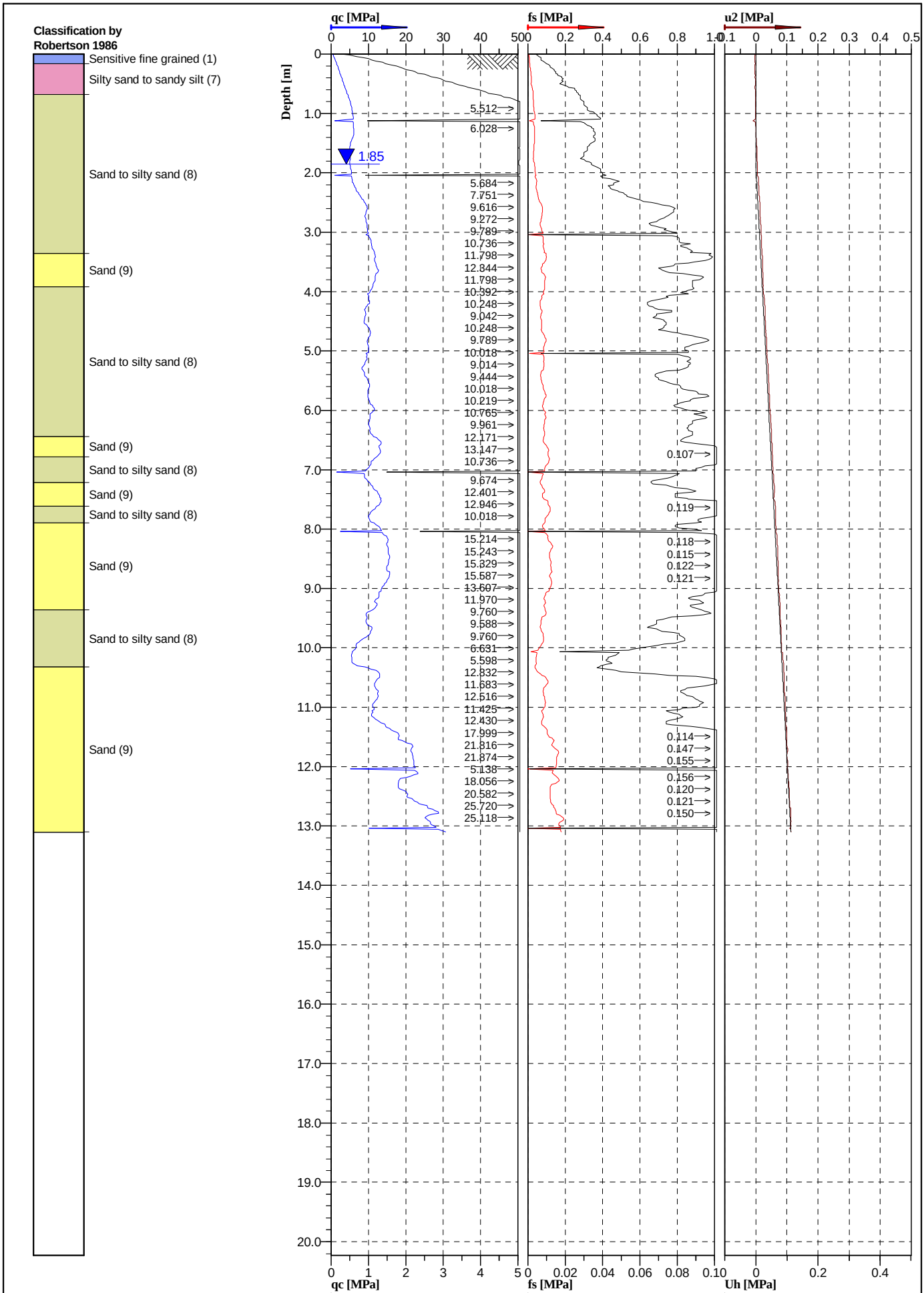


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383027 m, Y: 6367476 m	Ground level: 0.96	Test no: CPT131
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 27a
		File: CG-WI-C027.cpd	

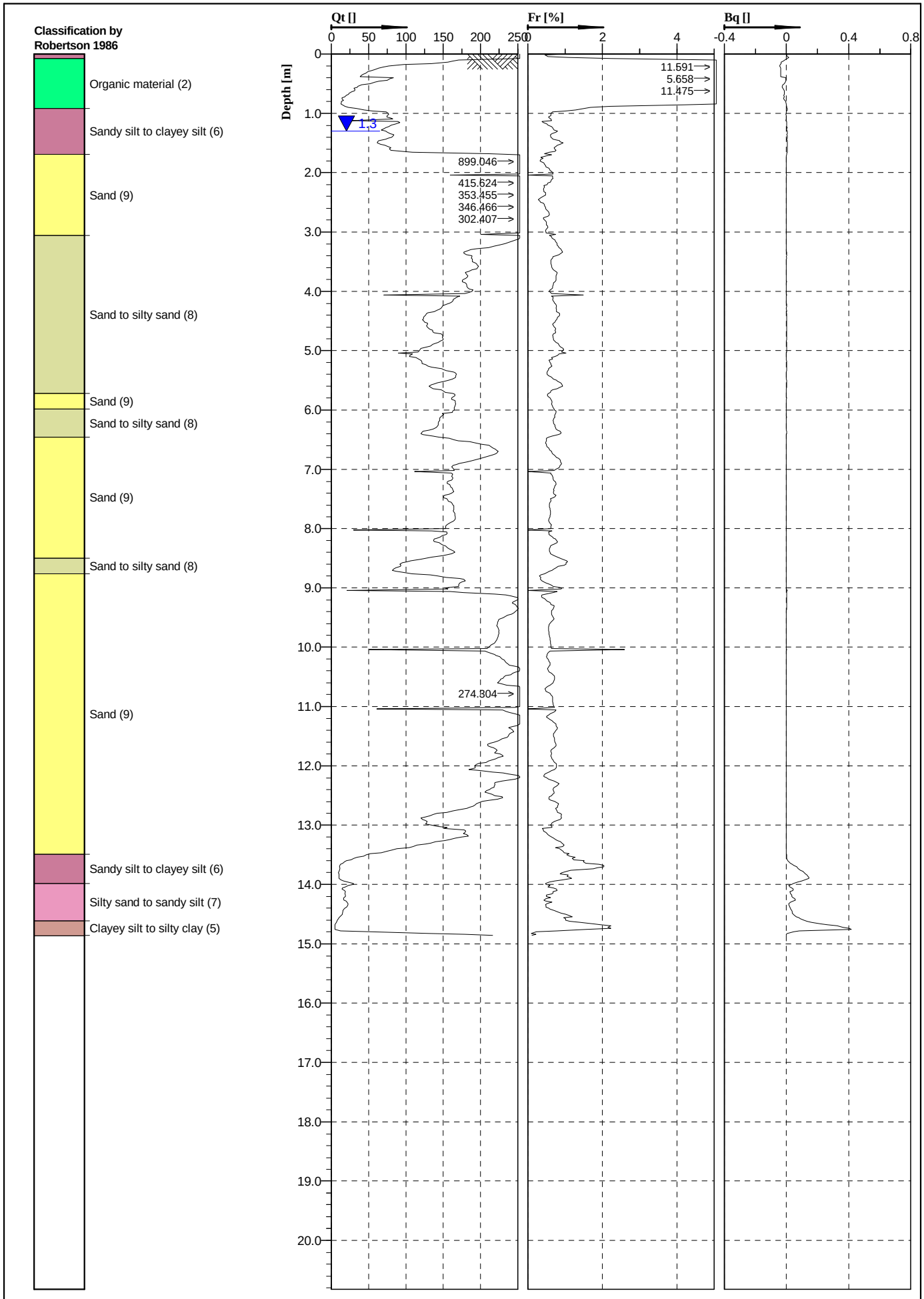


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383044 m, Y: 6367545 m	Ground level: 2.33	Test no: CPT126
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 30a
		File: CG-WI-C030.cpd	

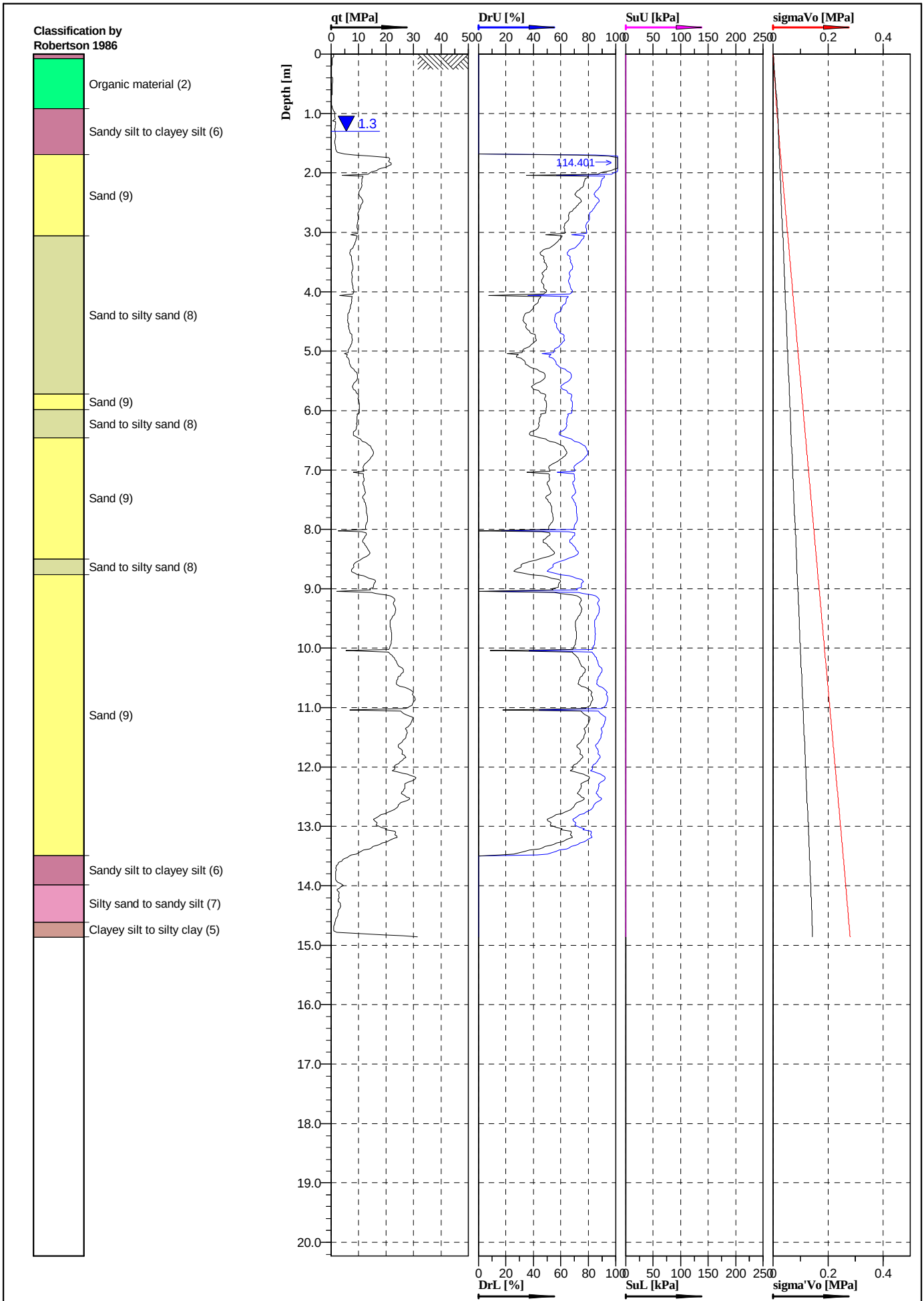


Location: Tomago Road, Tomago	Position: X: 383027 m, Y: 6367476 m	Ground level: 0.96	Test no: CPT131
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 27b
		File: CG-WI-C027.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

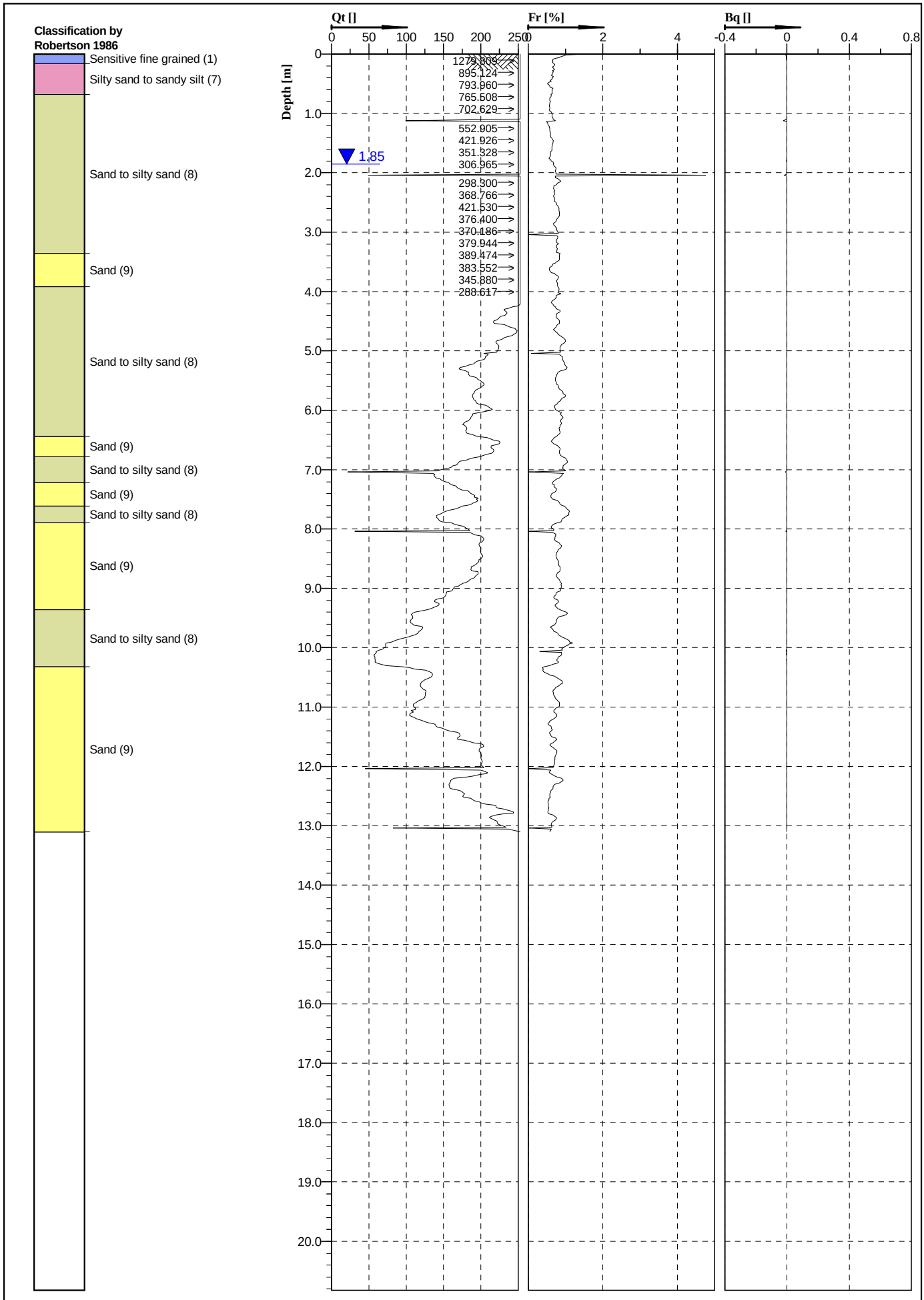


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383027 m, Y: 6367476 m	Ground level: 0.96	Test no: CPT131
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 27b
		File: CG-WI-C027.cpd	

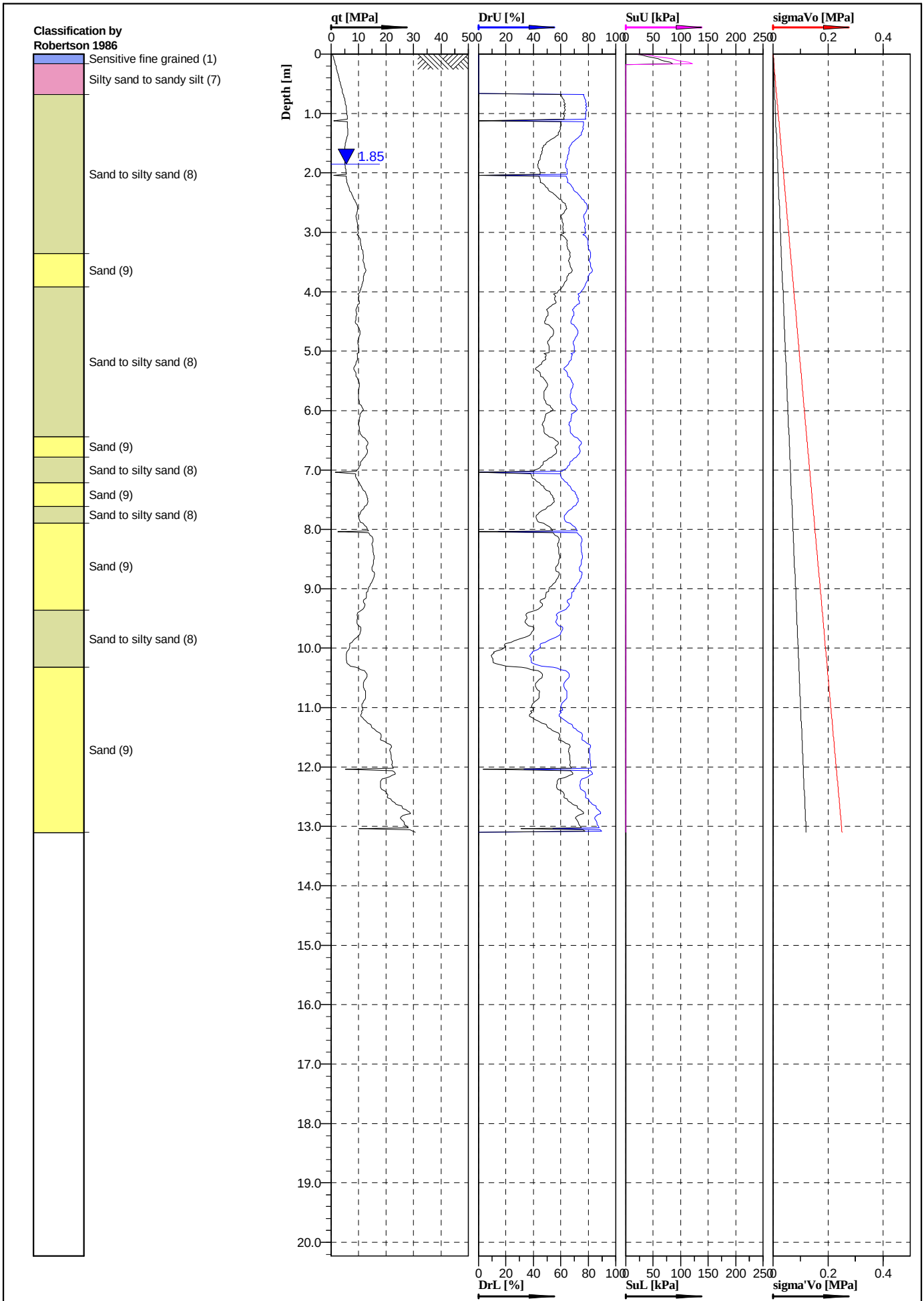


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383044 m, Y: 6367545 m	Ground level: 2.33	Test no: CPT126
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 30b
		File: CG-WI-C030.cpd	

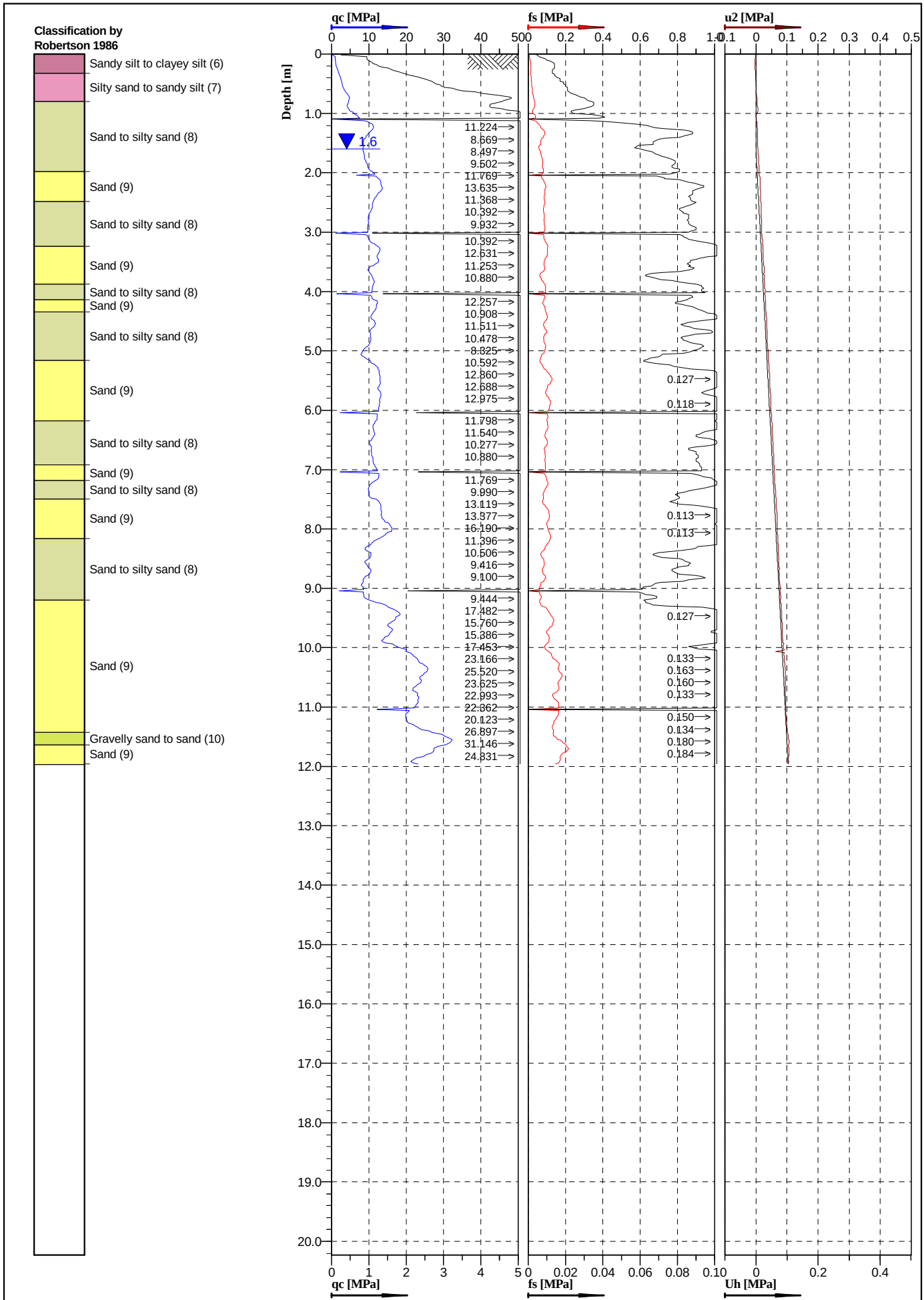


Location: Tomago Road, Tomago	Position: X: 383044 m, Y: 6367545 m	Ground level: 2.33	Test no: CPT126
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 30c
		File: CG-WI-C030.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

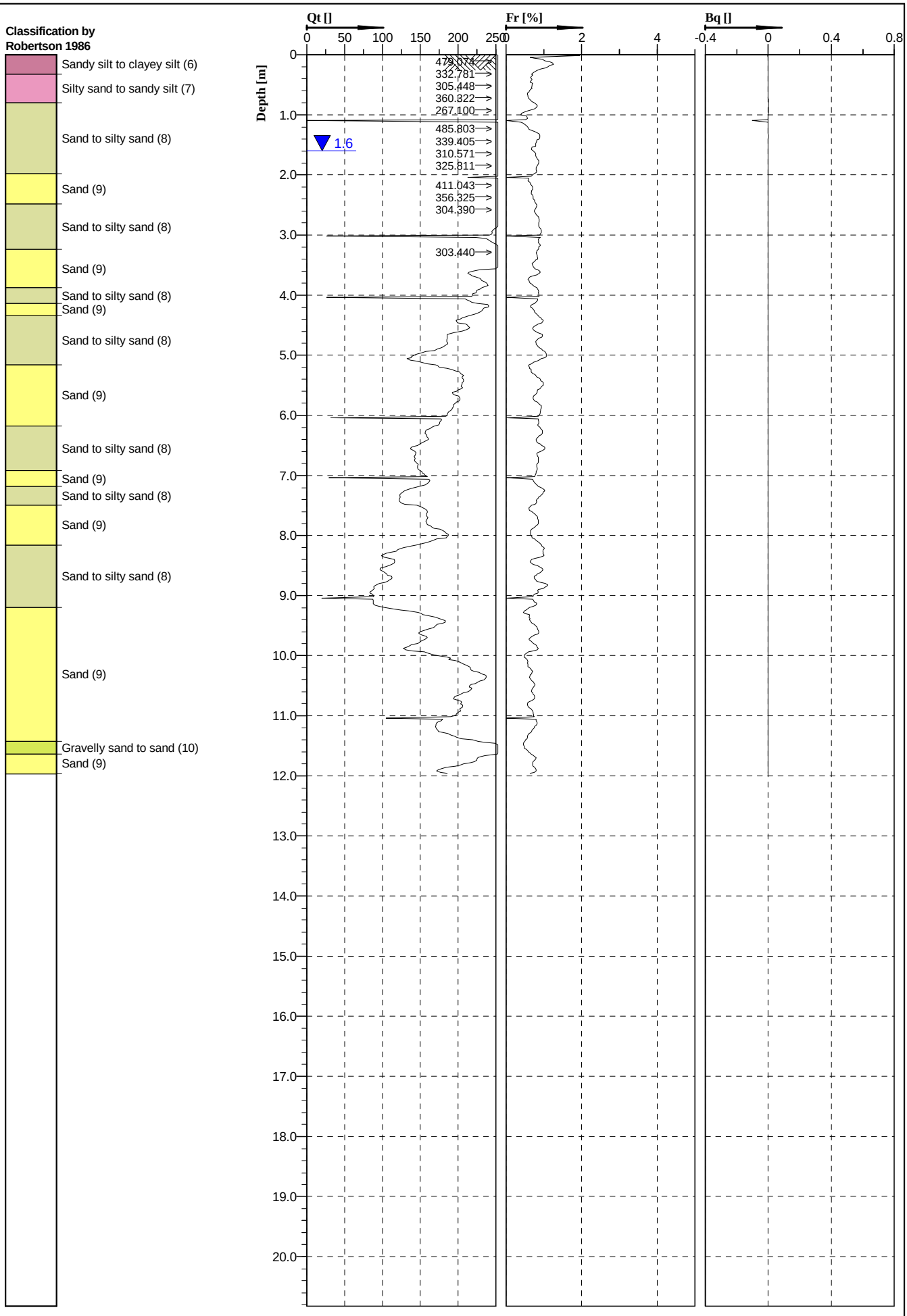


Location: Tomago Road, Tomago	Position: X: 382960 m, Y: 6367495 m	Ground level: 1.78	Test no: CPT134
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 31a
		File: CG-WI-C031.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

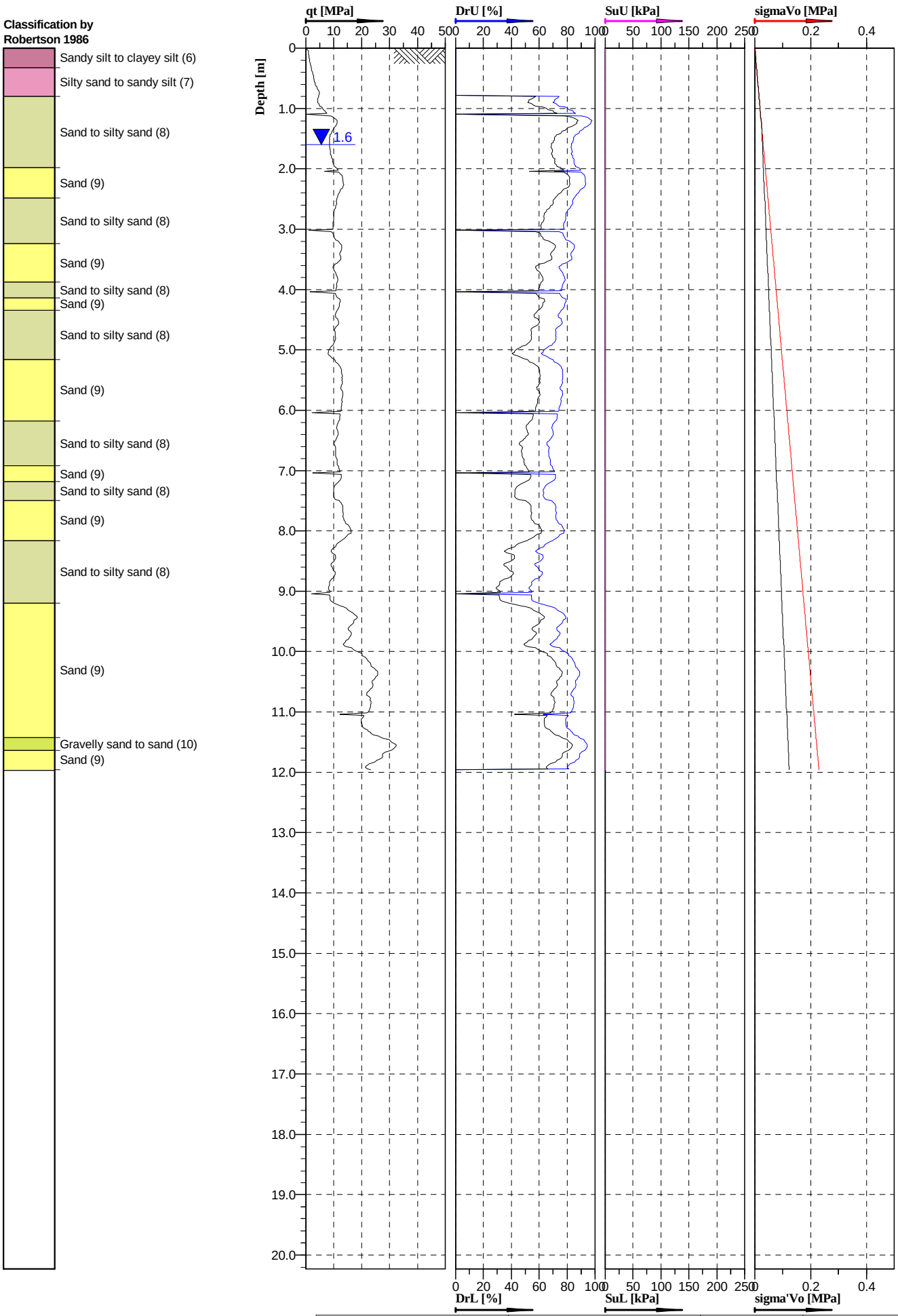


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382960 m, Y: 6367495 m	Ground level: 1.78	Test no: CPT134
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 31b
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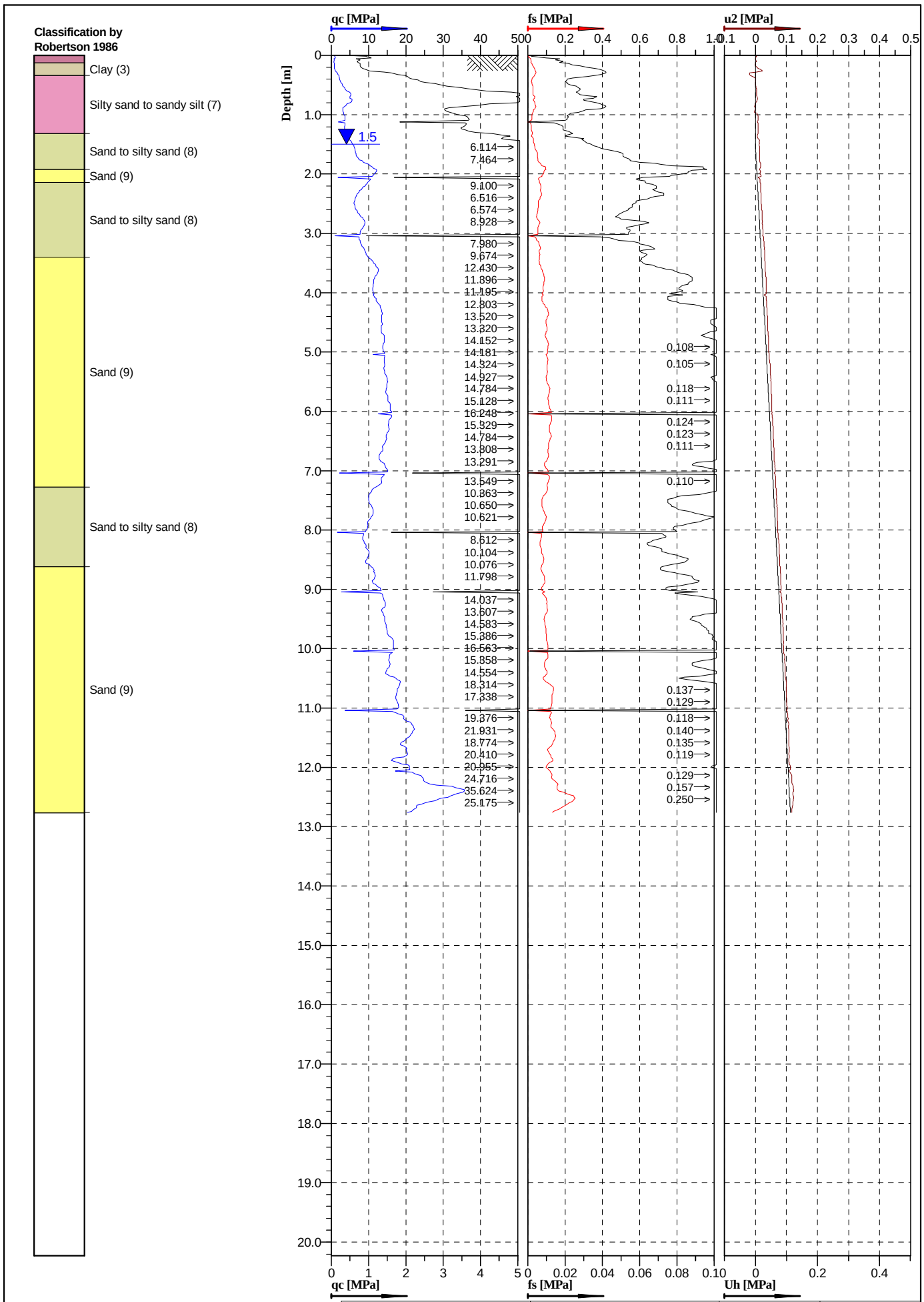


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382960 m, Y: 6367495 m	Ground level: 1.78	Test no: CPT134
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 31c
		File: CG-WI-C031.cpd	

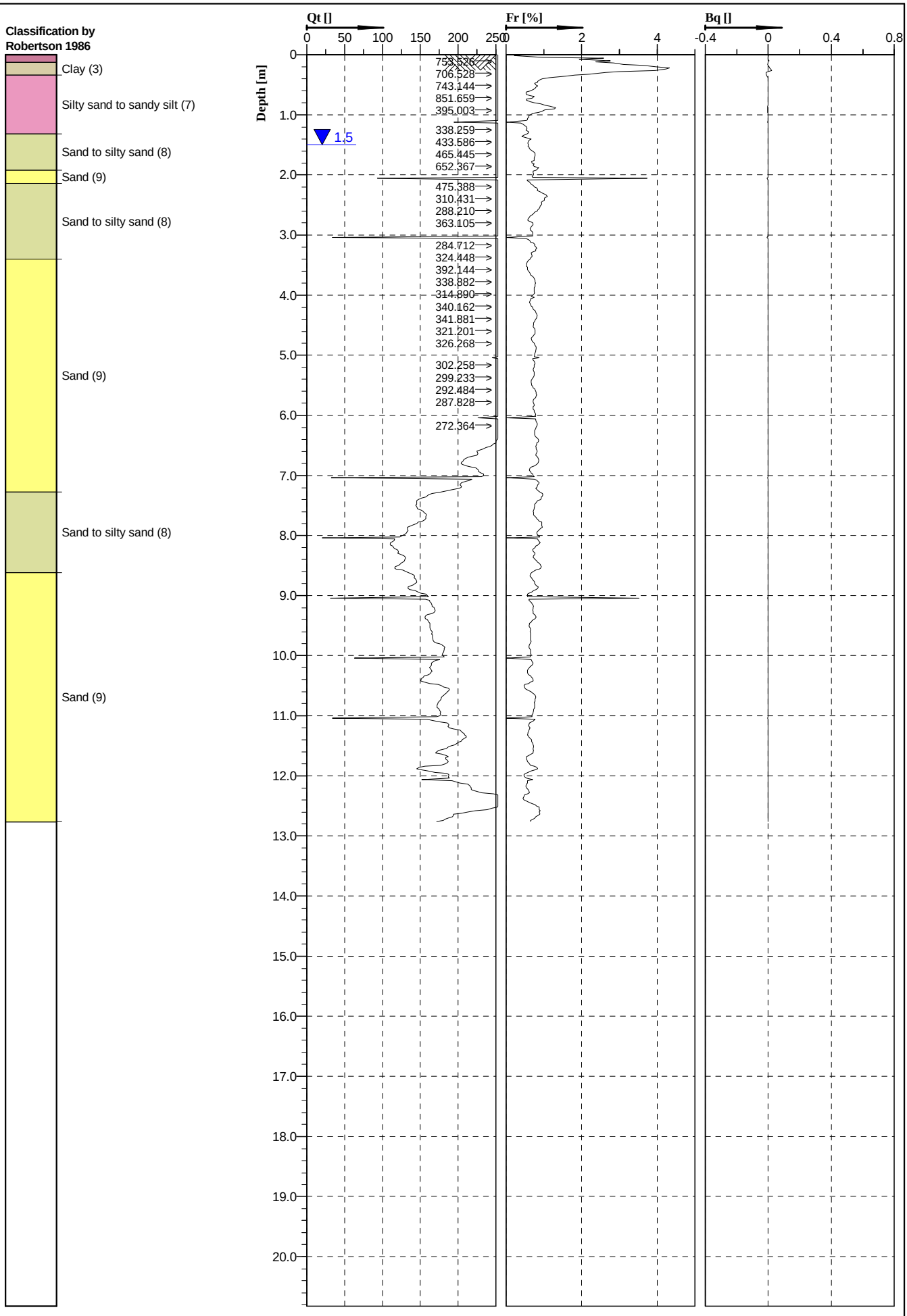


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382894 m, Y: 6367518 m	Ground level: 1.76	Test no: CPT138
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 32a
		File: CG-WI-C032.cpd	

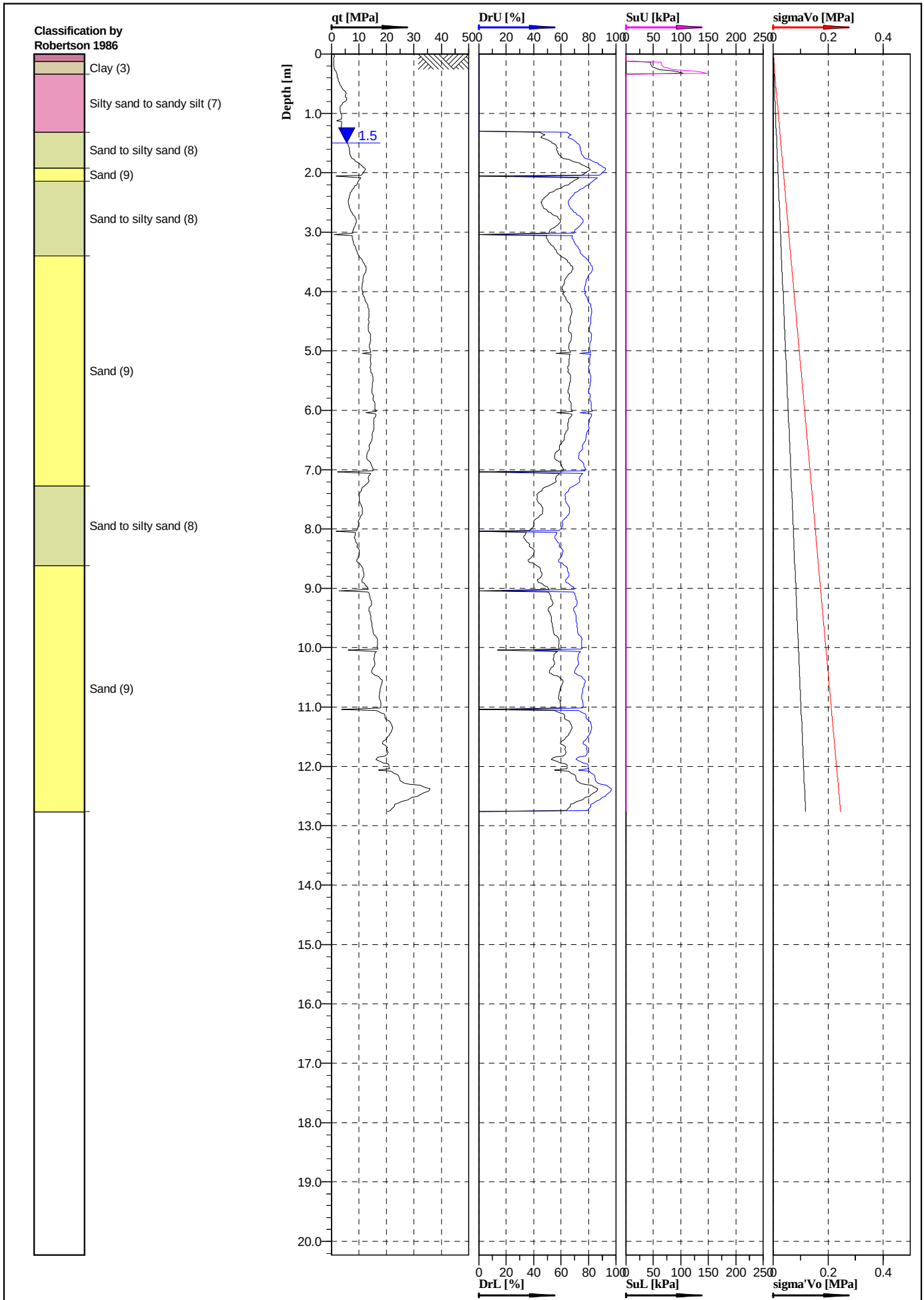


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382894 m, Y: 6367518 m	Ground level: 1.76	Test no: CPT138
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 32b
		File: CG-WI-C032.cpd	

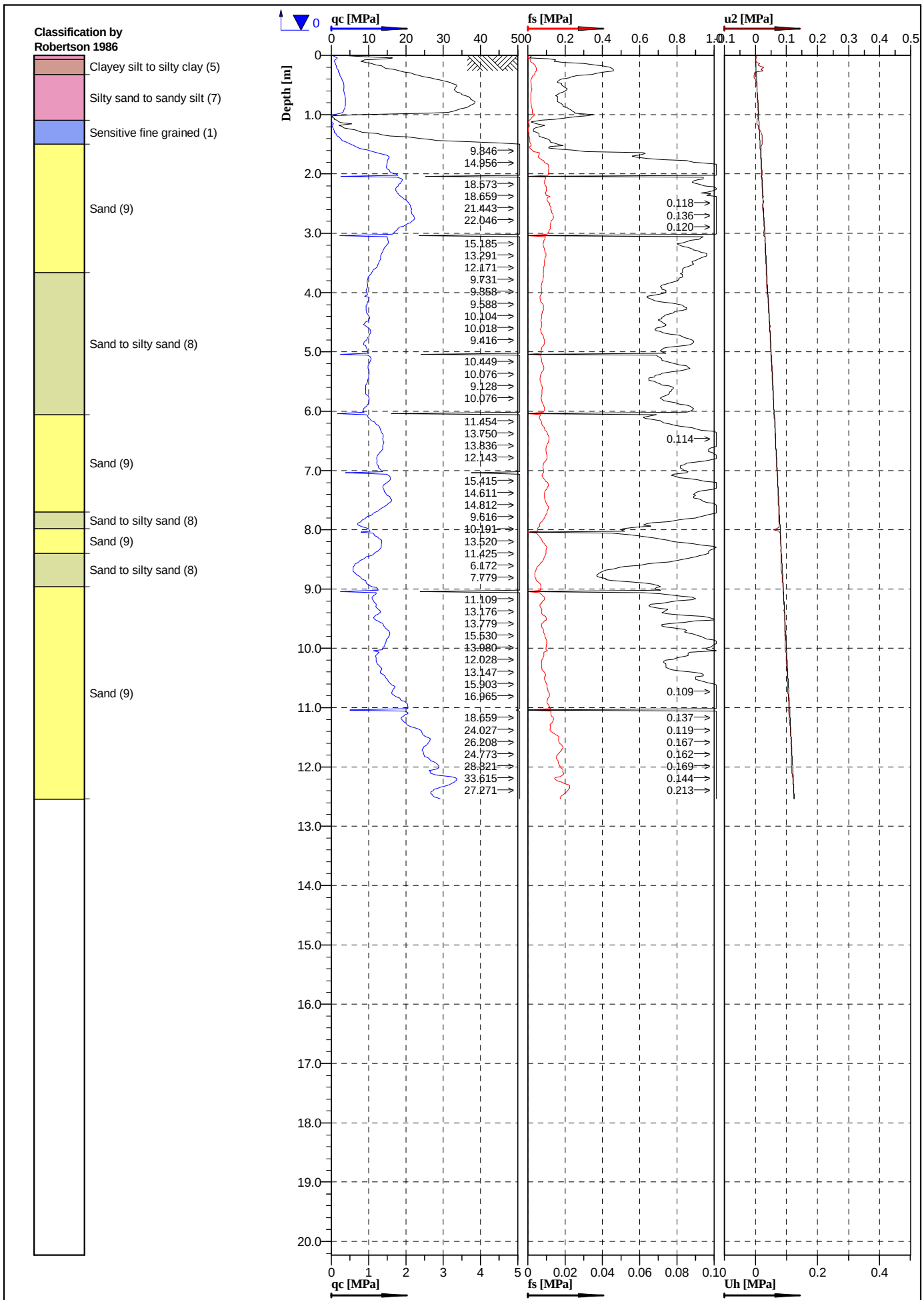


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382894 m, Y: 6367518 m	Ground level: 1.76	Test no: CPT138
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 32c
		File: CG-WI-C032.cpd	

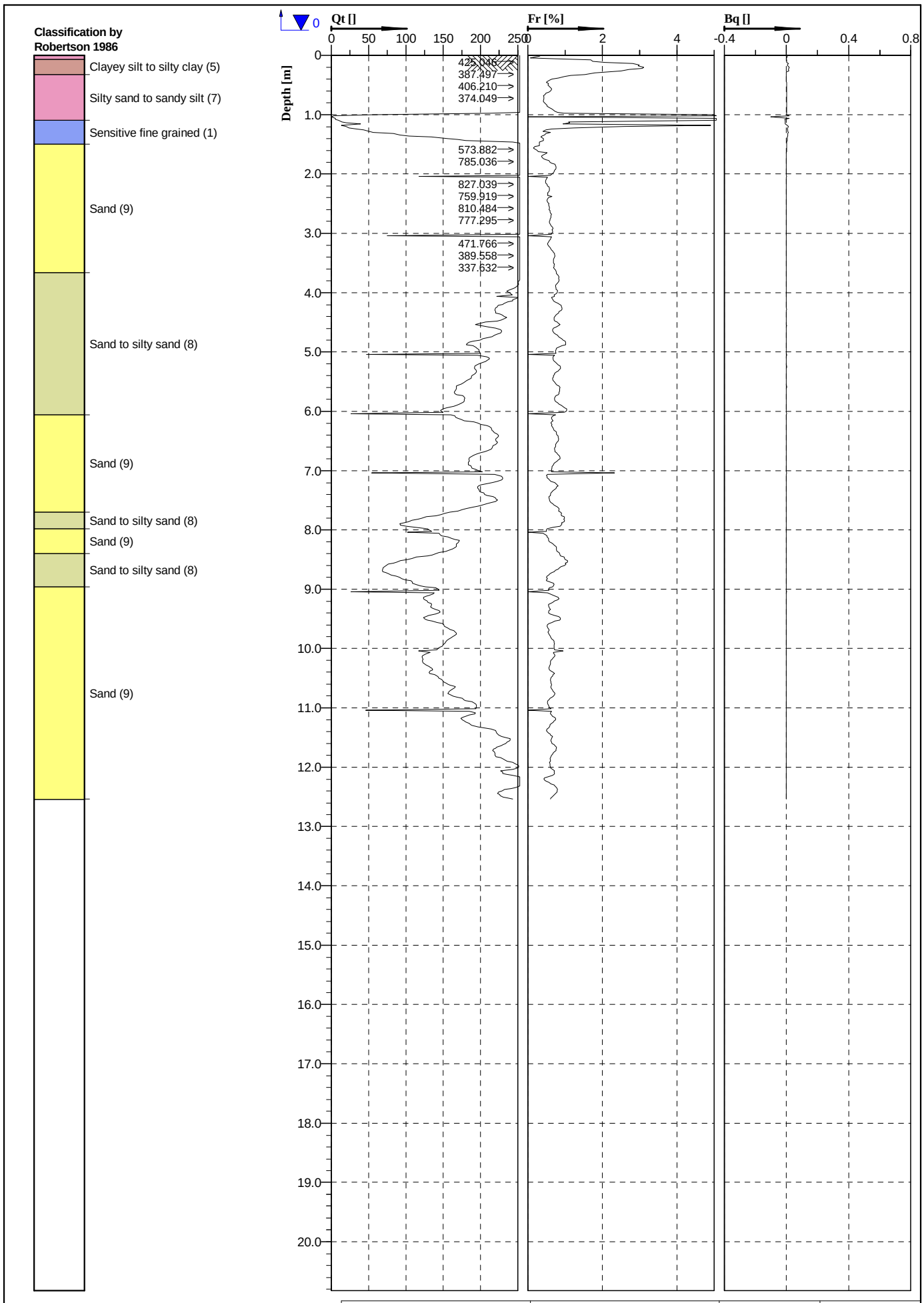


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382979 m, Y: 6367562 m	Ground level:	Test no: CPT130
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 33a
		File: CG-WI-C033.cpd	

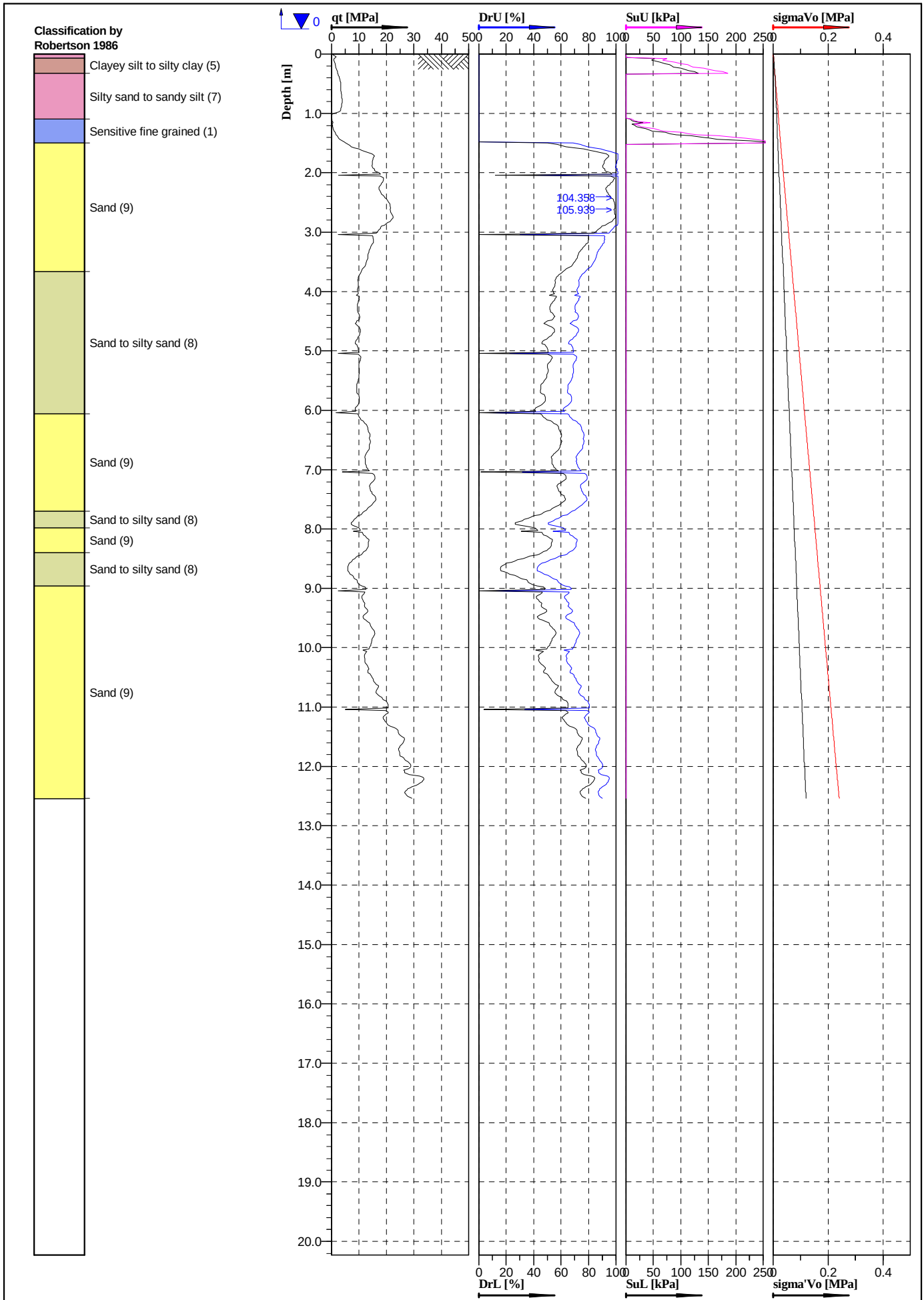


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382979 m, Y: 6367562 m	Ground level:	Test no: CPT130
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 33b
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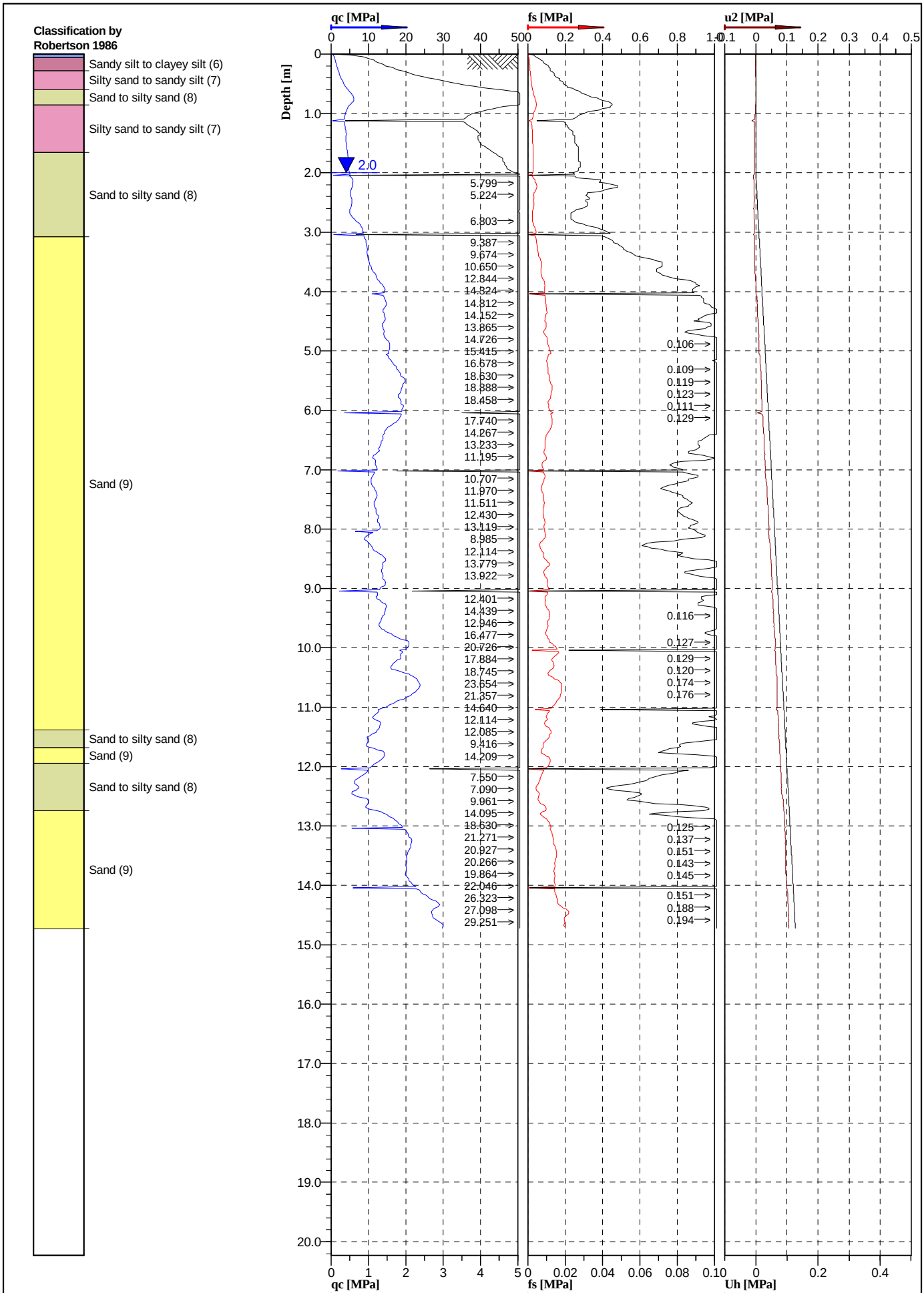


Location: Tomago Road, Tomago	Position: X: 382979 m, Y: 6367562 m	Ground level:	Test no: CPT130
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 33c
		File: CG-WI-C033.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

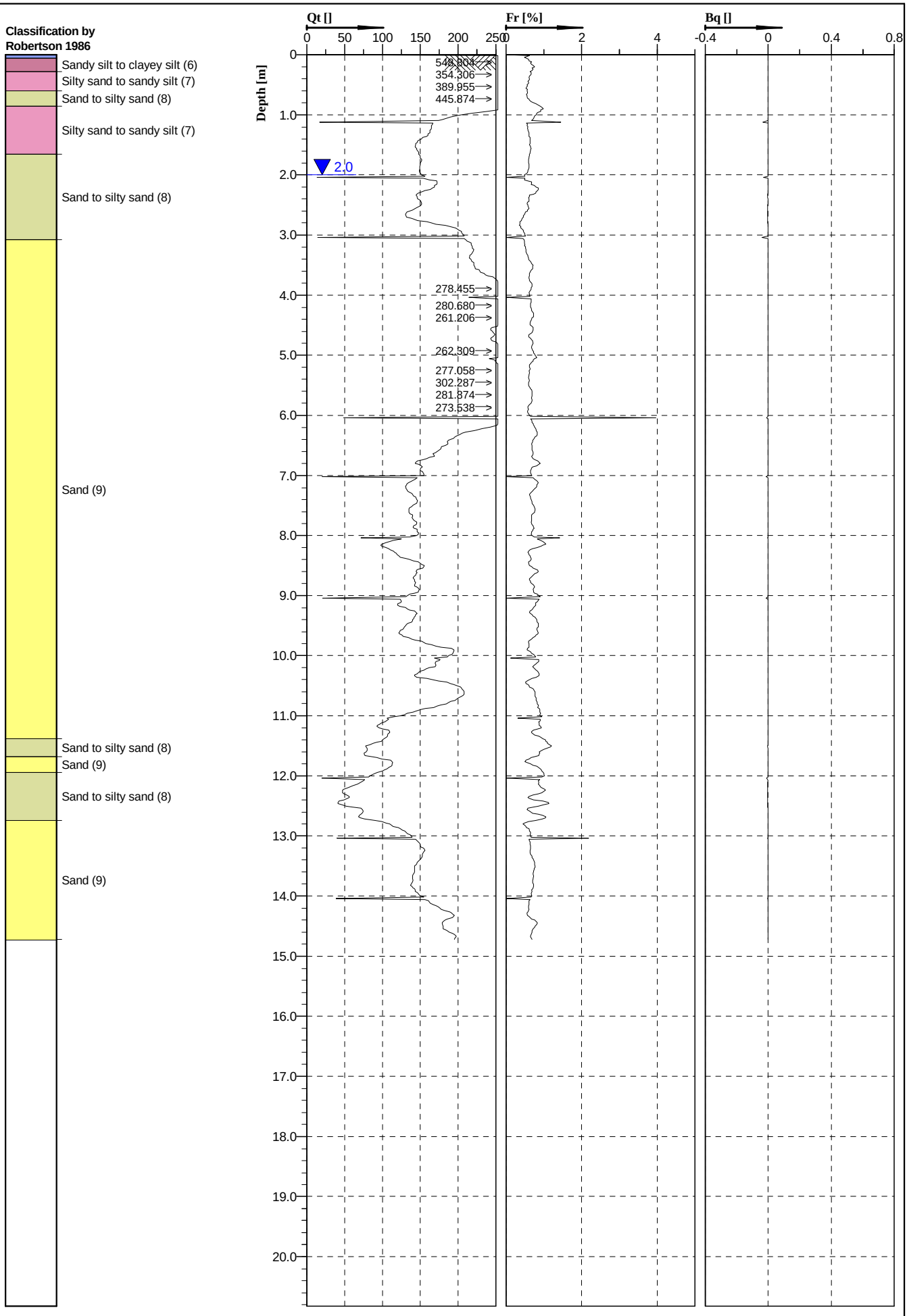


Location: Tomago Road, Tomago	Position: X: 383064 m, Y: 6367614 m	Ground level: 4.58	Test no: CPT122
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 34a
		File: CG-WI-C034.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

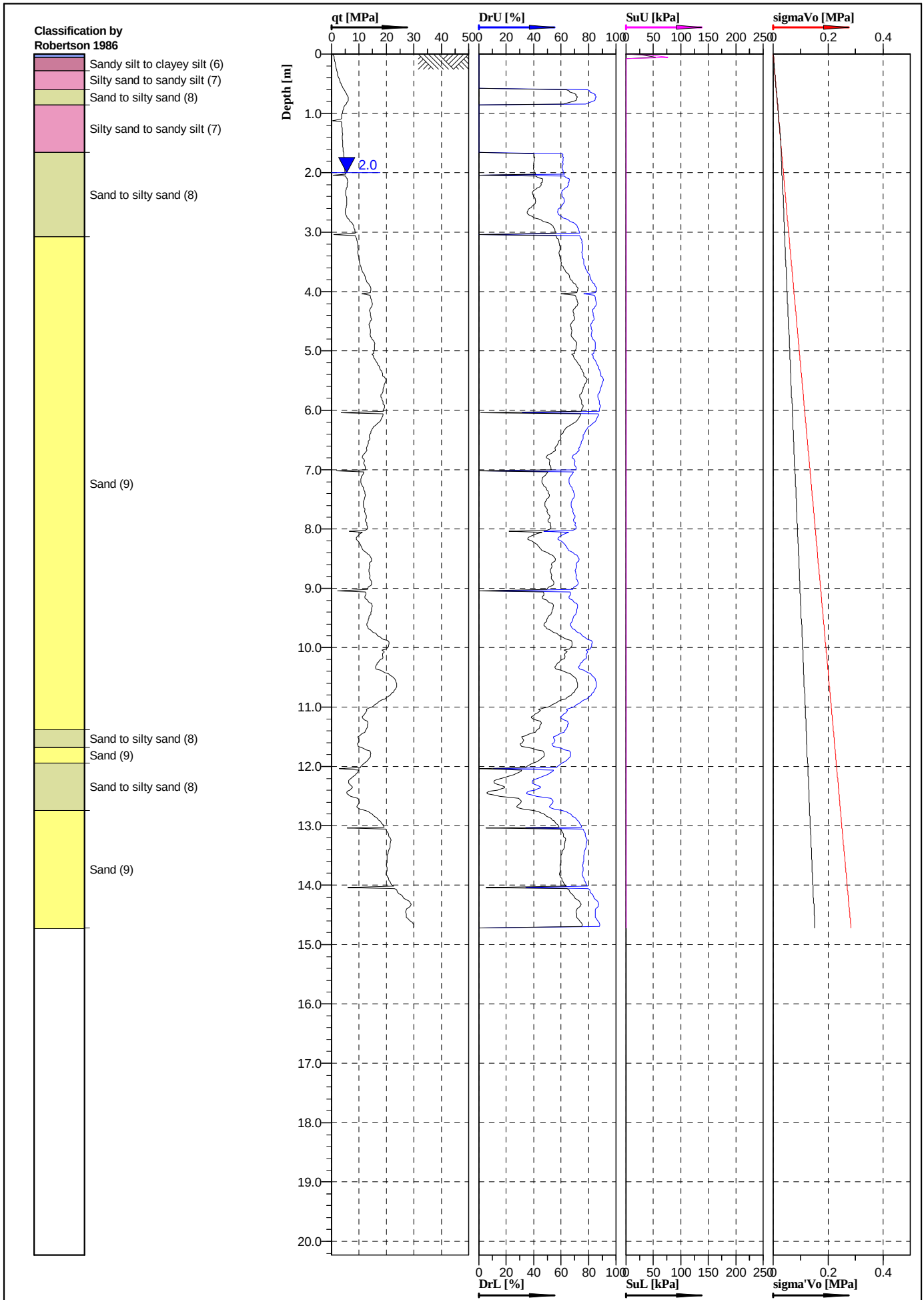


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383064 m, Y: 6367614 m	Ground level: 4.58	Test no: CPT122
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 34b
		File: CG-WI-C034.cpd	

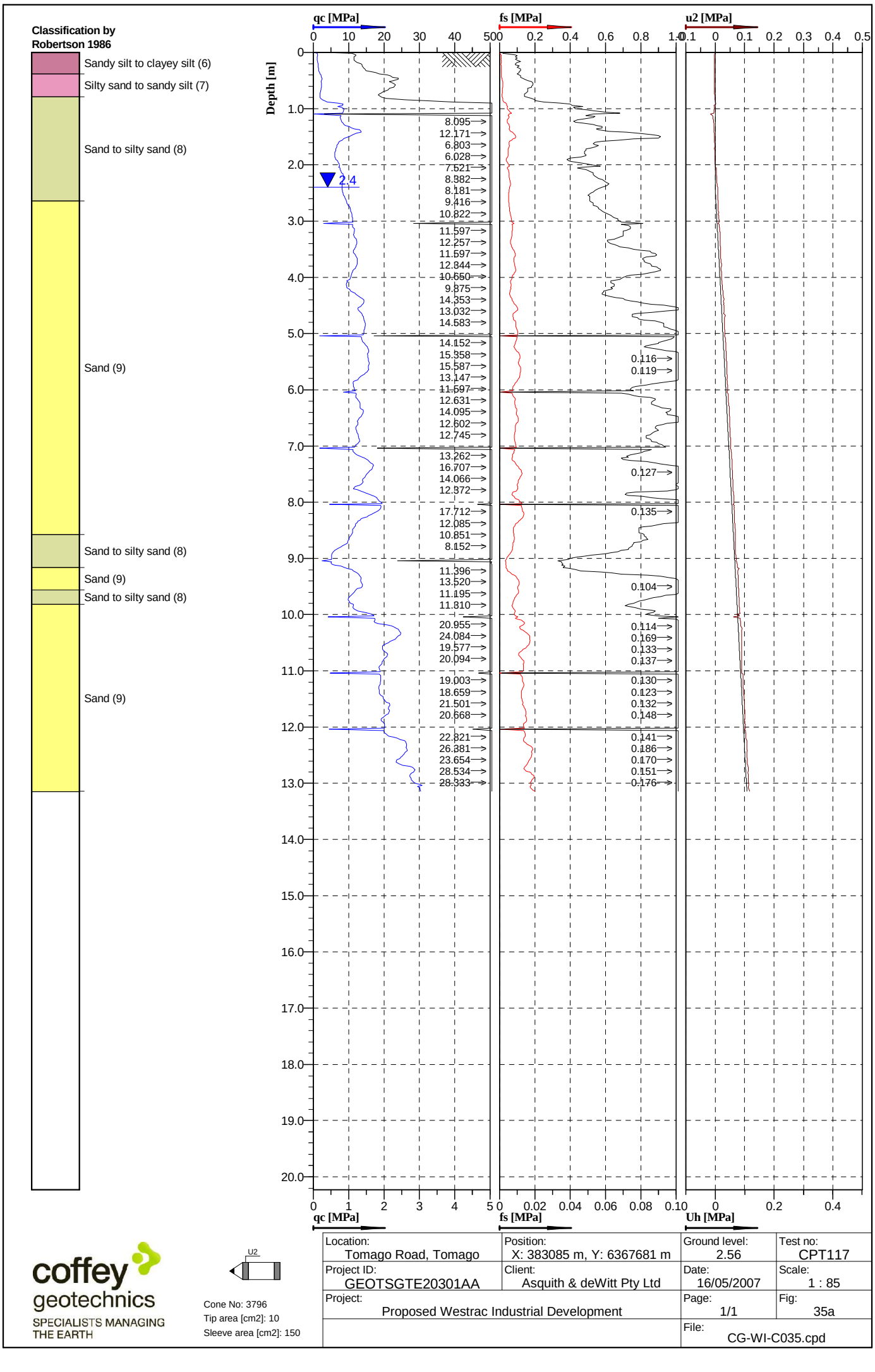


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383064 m, Y: 6367614 m	Ground level: 4.58	Test no: CPT122
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 34c
		File: CG-WI-C034.cpd	

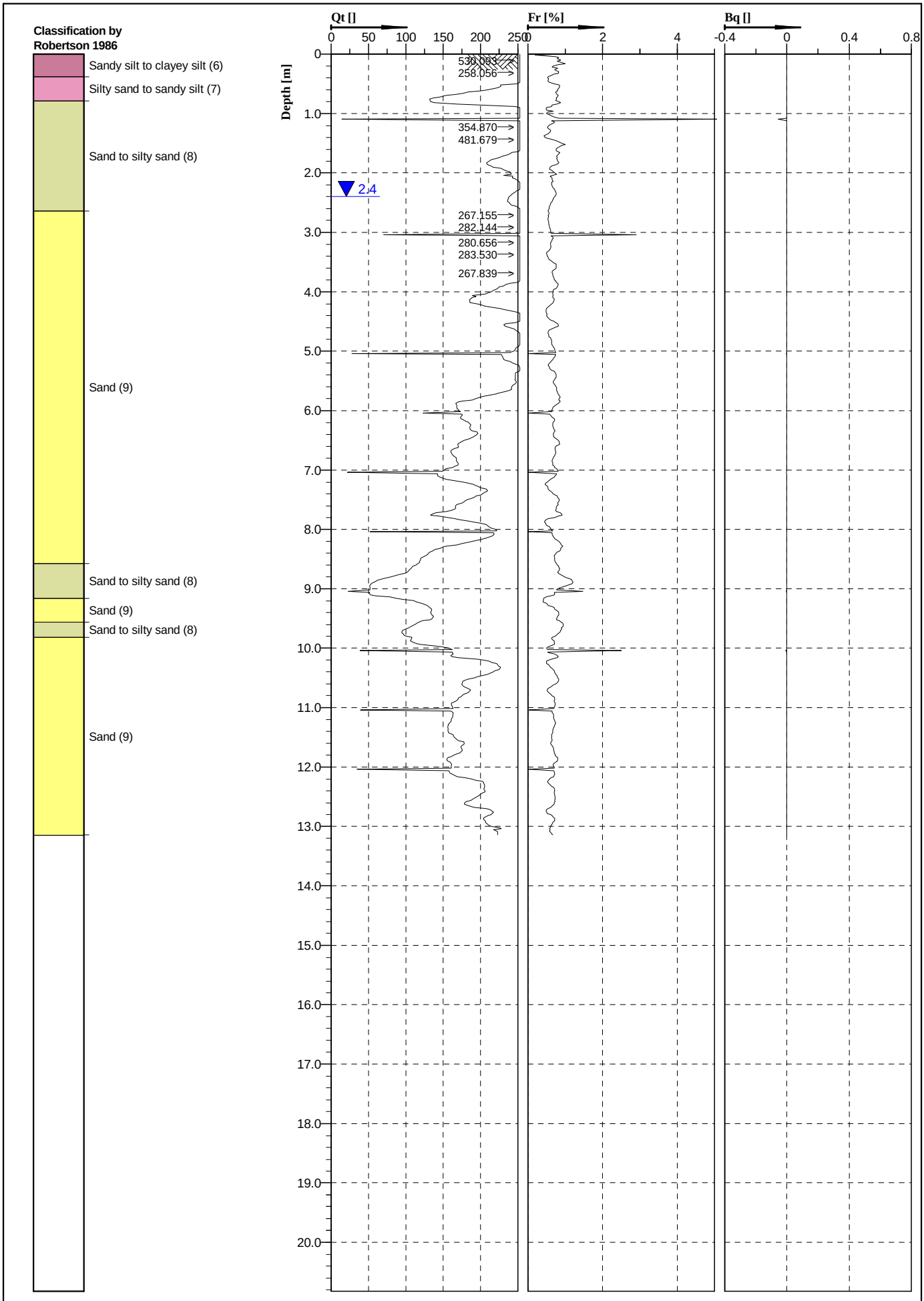


Location: Tomago Road, Tomago	Position: X: 383085 m, Y: 6367681 m	Ground level: 2.56	Test no: CPT117
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 35a
		File: CG-WI-C035.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

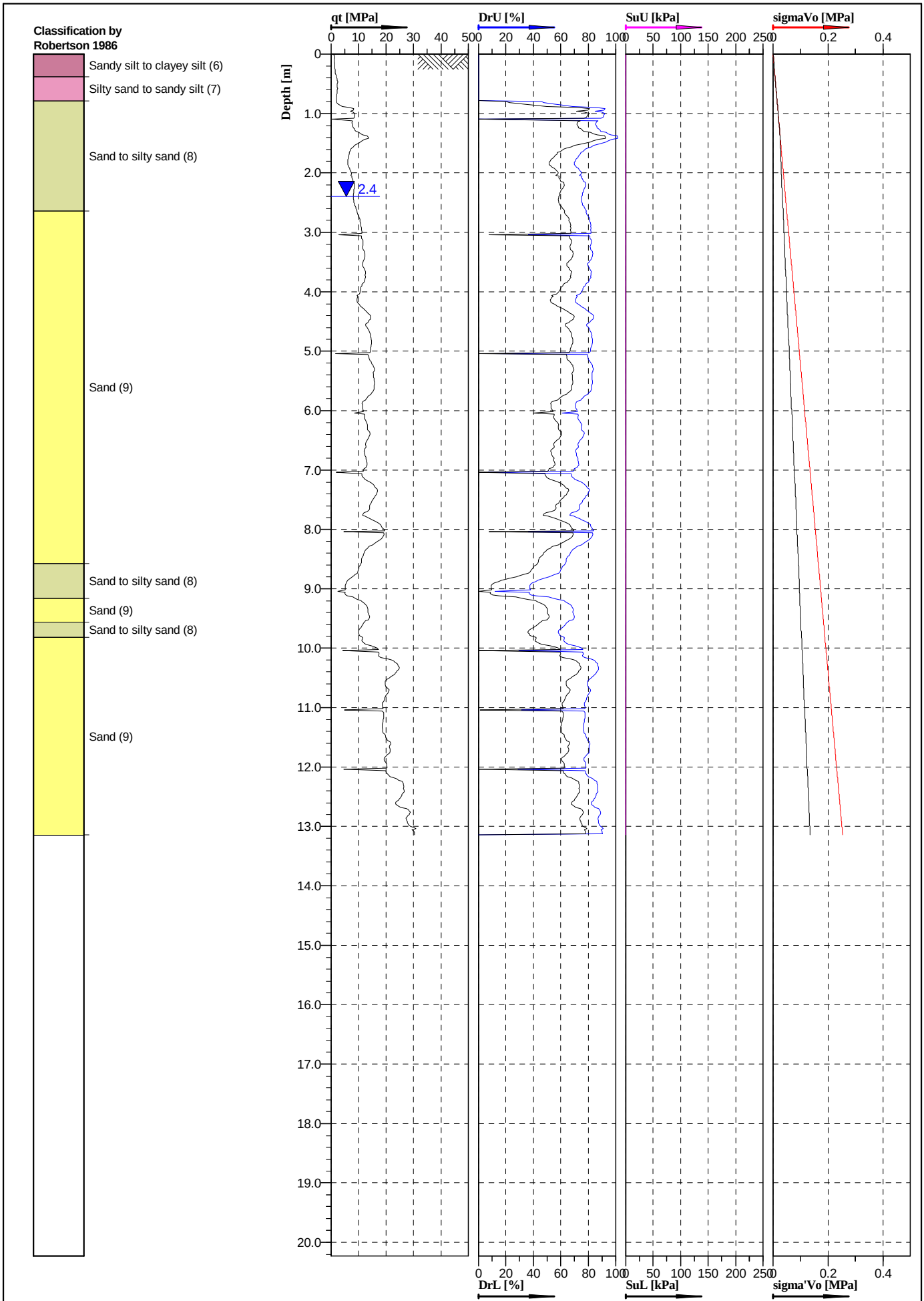


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383085 m, Y: 6367681 m	Ground level: 2.56	Test no: CPT117
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 35b
		File: CG-WI-C035.cpd	

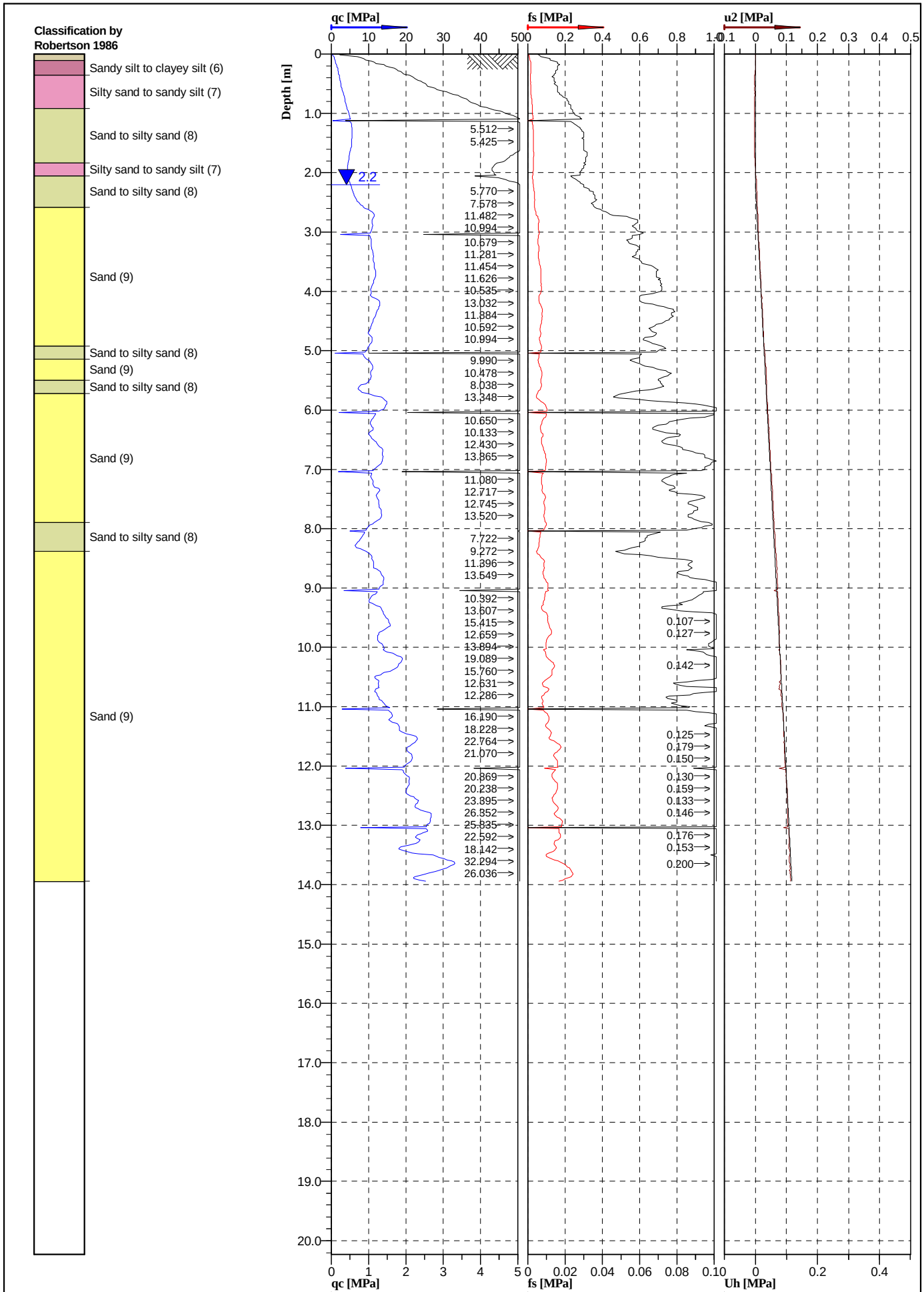


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383085 m, Y: 6367681 m	Ground level: 2.56	Test no: CPT117
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 35c
		File: CG-WI-C035.cpd	

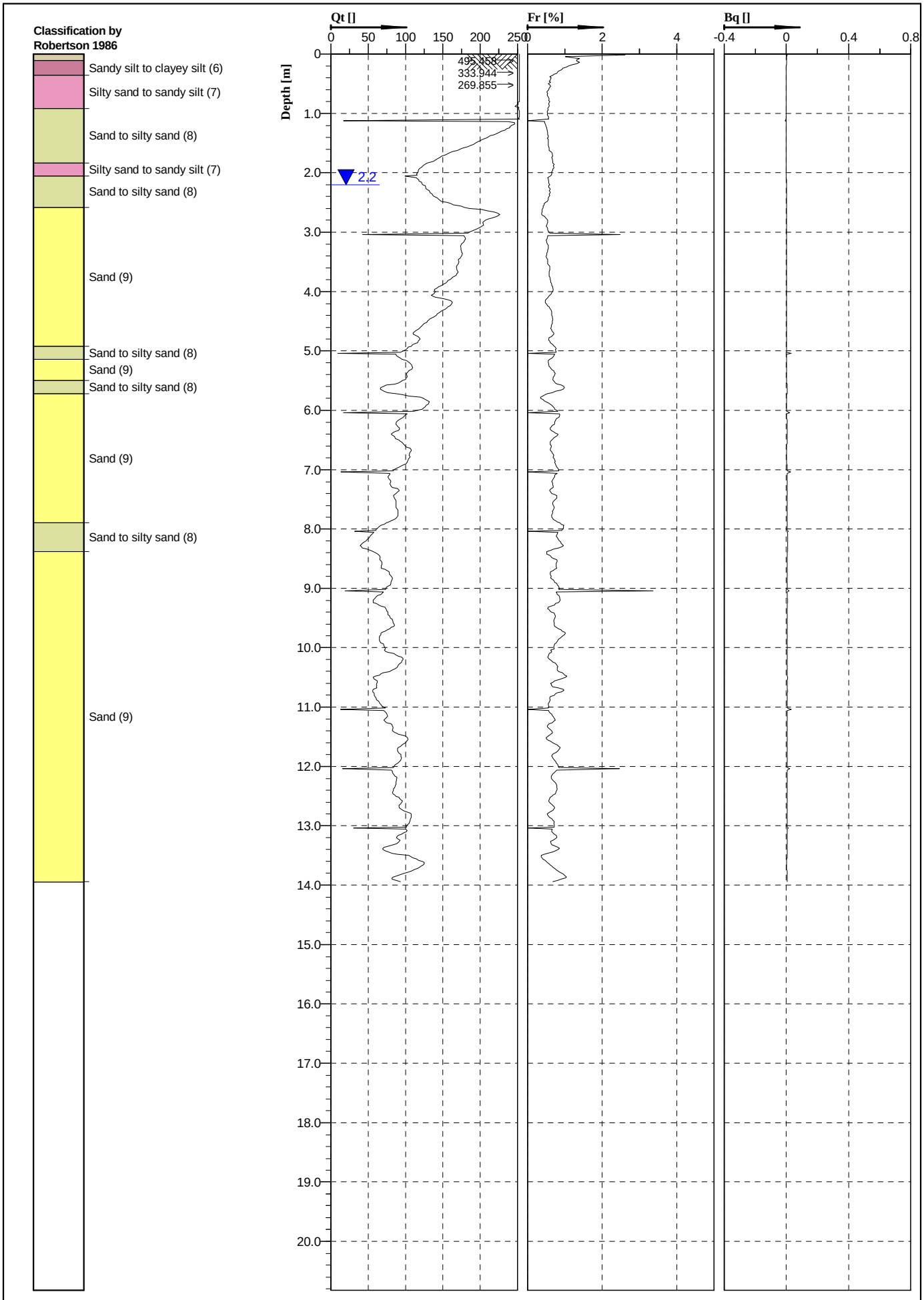


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383133 m, Y: 6367595 m	Ground level: 2.81	Test no: CPT118
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 29a
		File: CG-WI-C029.cpd	

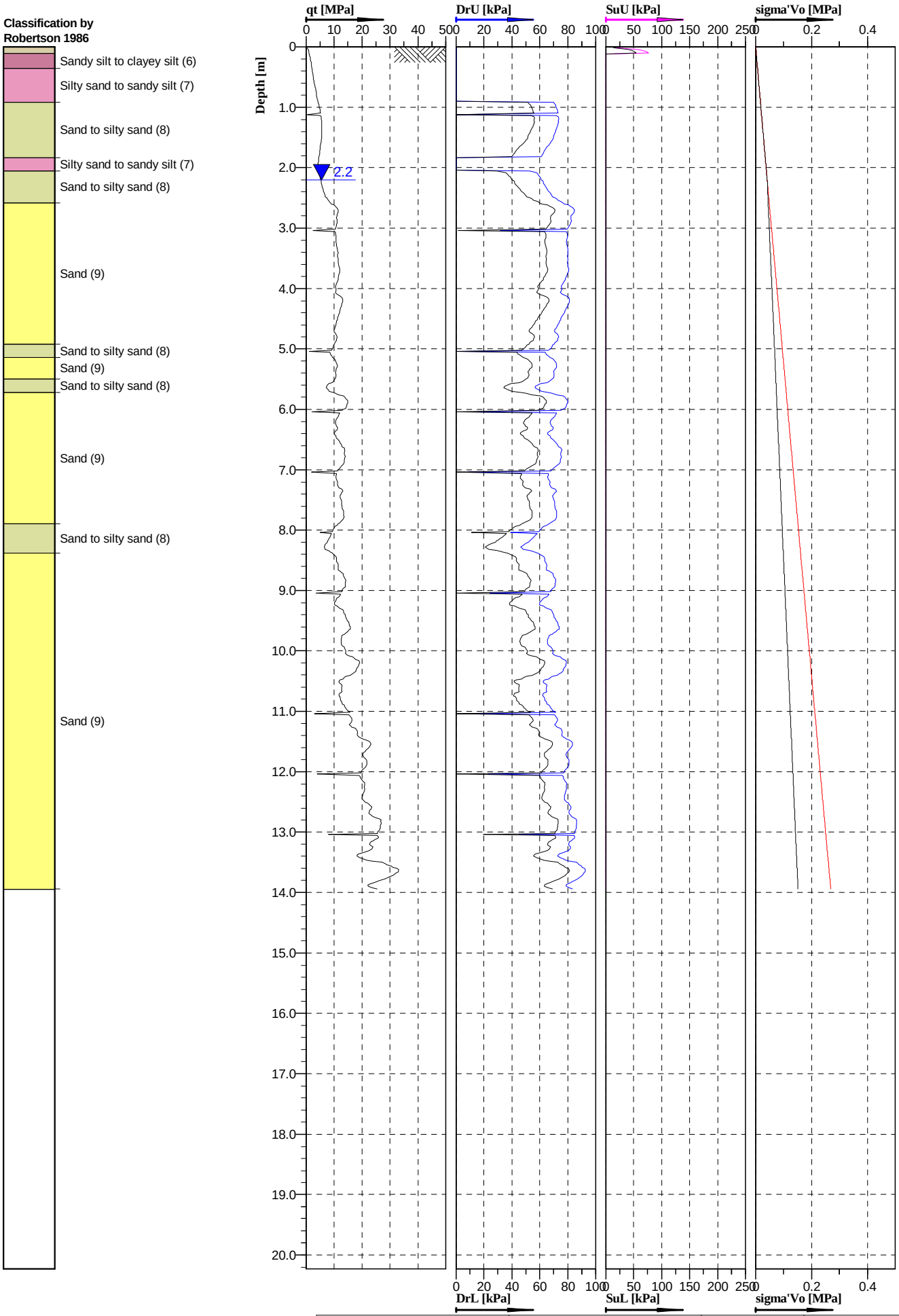


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383133 m, Y: 6367595 m	Ground level: 2.81	Test no: CPT118
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 29b
		File: CG-WI-C029.cpd	

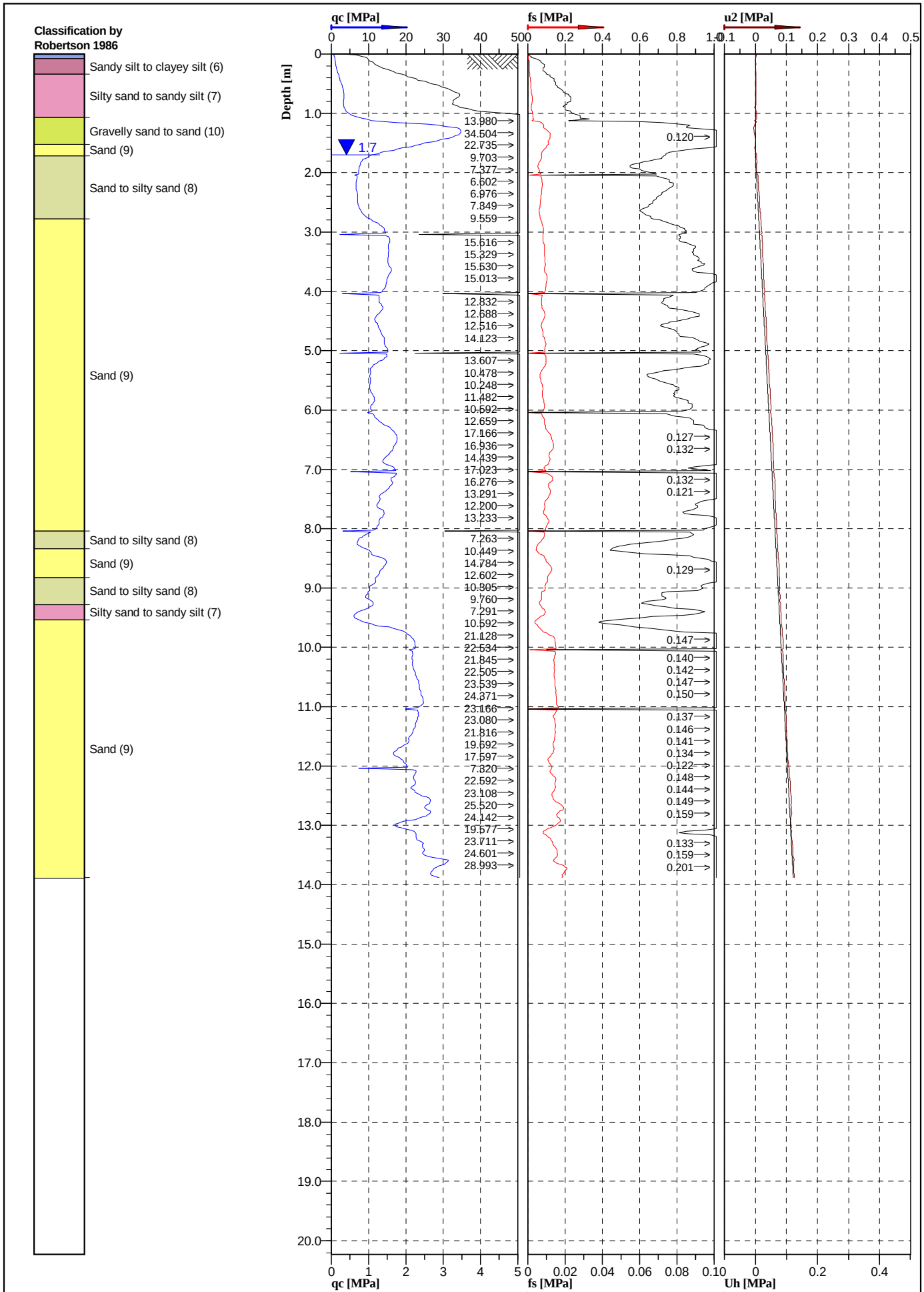


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383133 m, Y: 6367595 m	Ground level: 2.81	Test no: CPT118
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 15/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 29c
		File: CG-WI-C029.cpd	

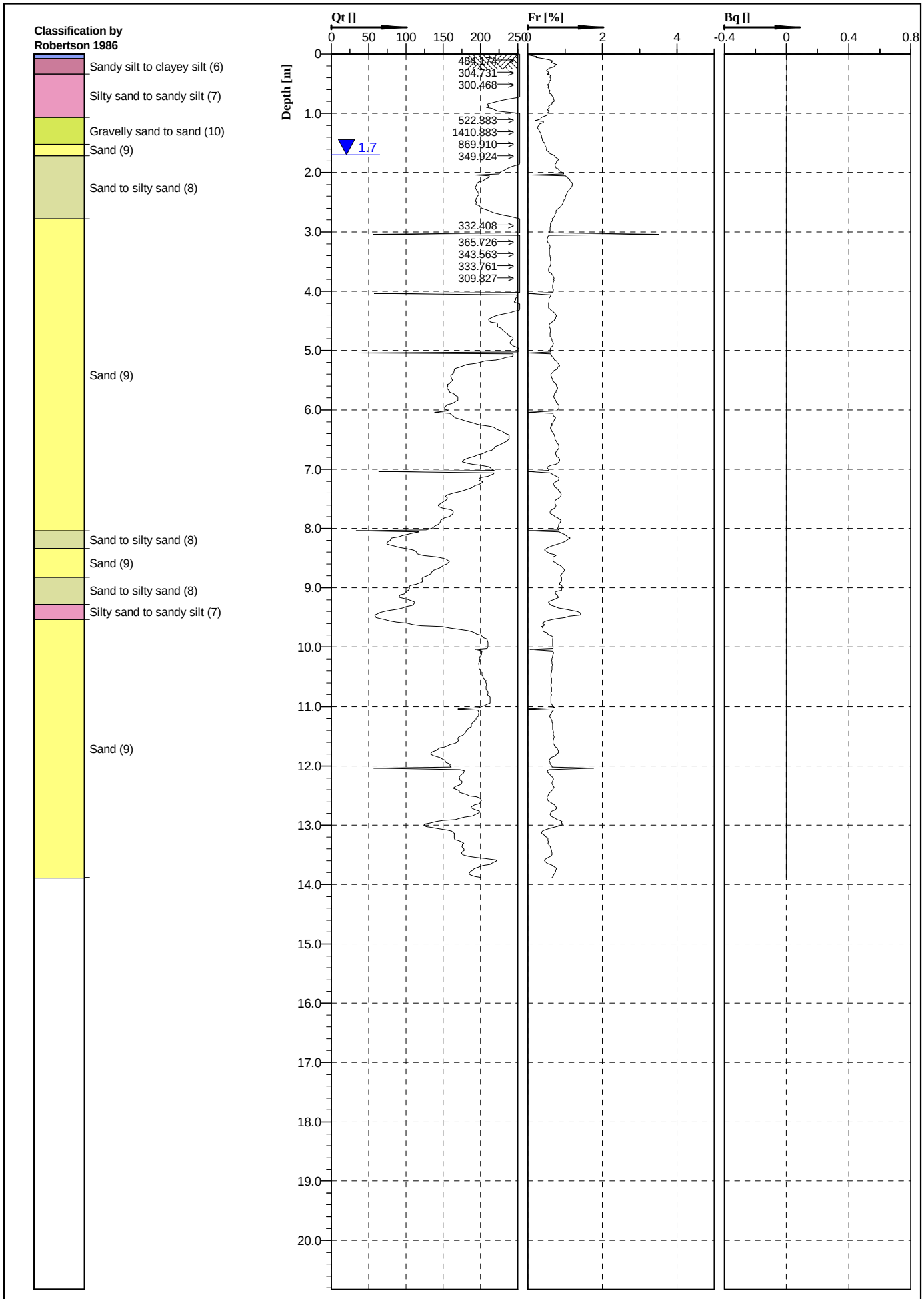


Location: Tomago Road, Tomago	Position: X: 382996 m, Y: 6367630 m	Ground level: 2.4	Test no: CPT125
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 36a
		File: CG-WI-C036.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

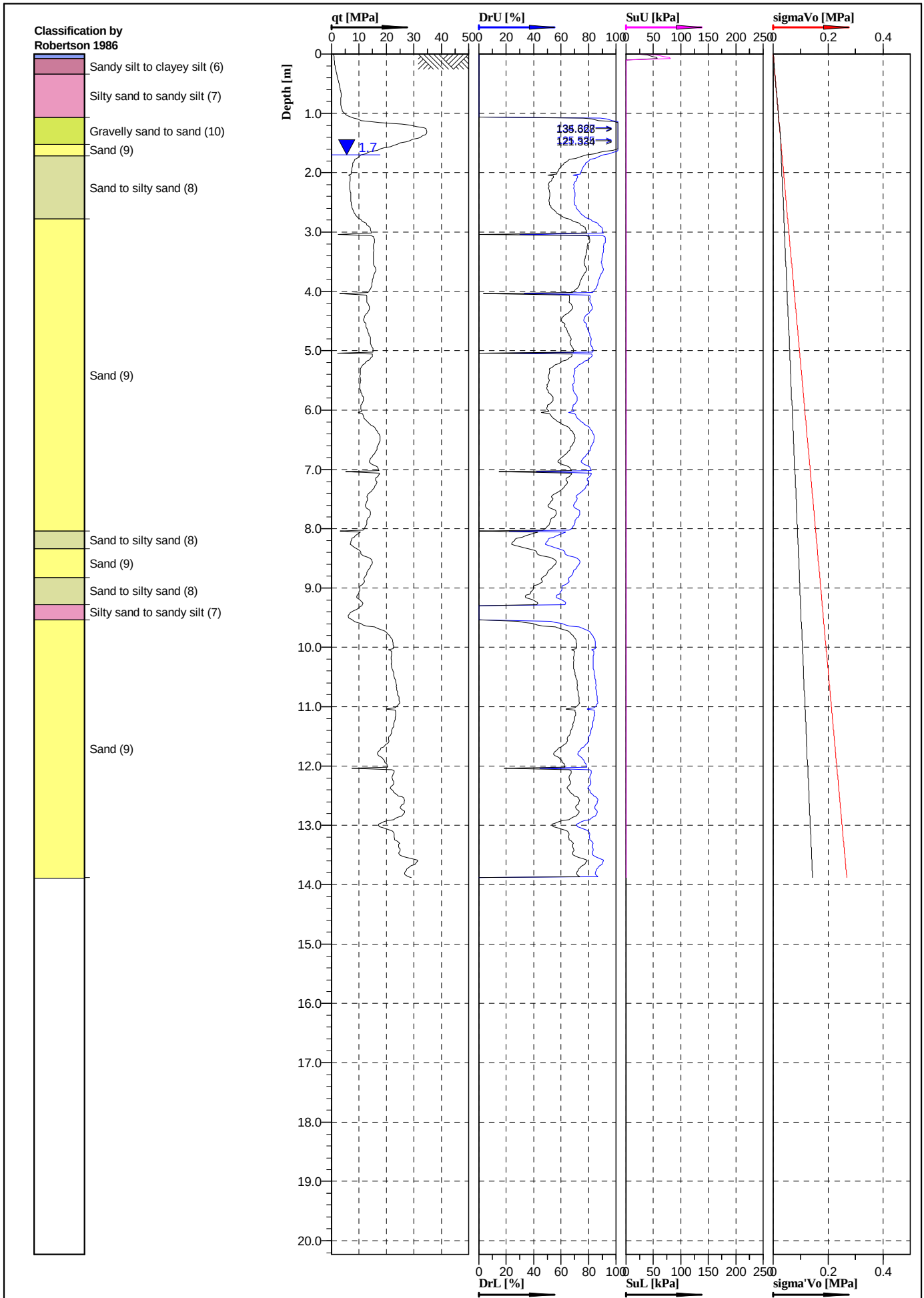


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382996 m, Y: 6367630 m	Ground level: 2.4	Test no: CPT125
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 36b
		File: CG-WI-C036.cpd	

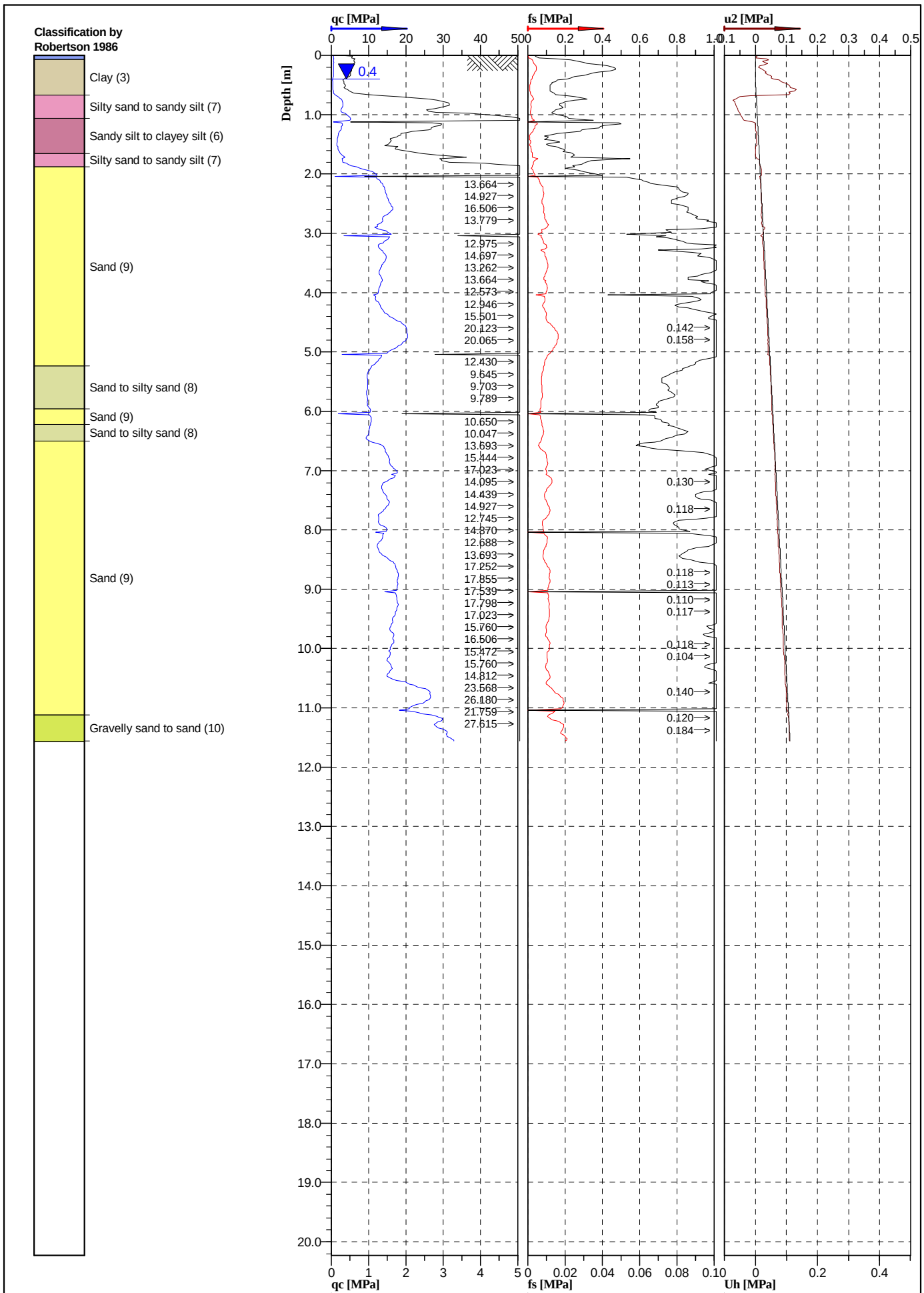


Location: Tomago Road, Tomago	Position: X: 382996 m, Y: 6367630 m	Ground level: 2.4	Test no: CPT125
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 36c
		File: CG-WI-C036.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

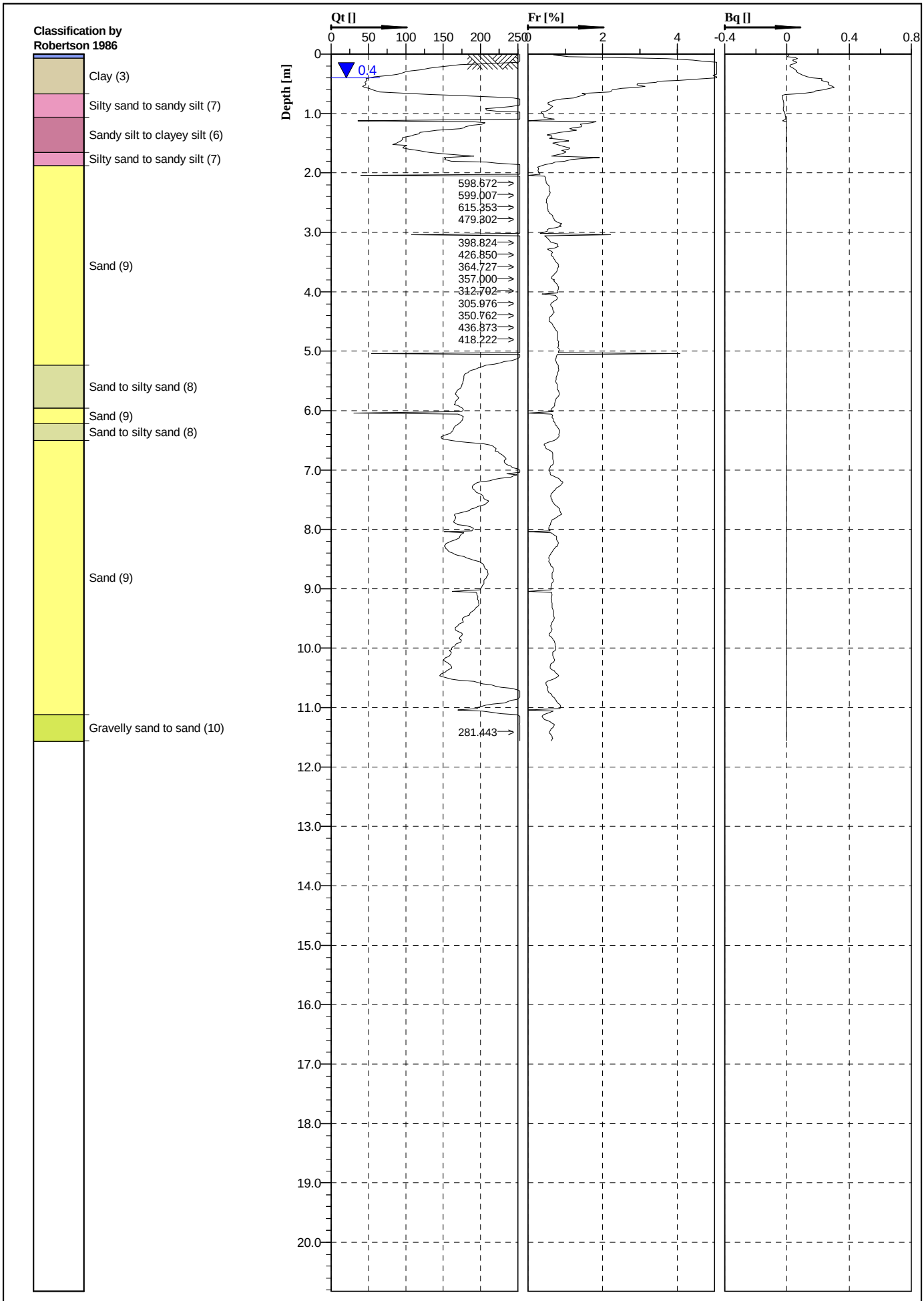


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382910 m, Y: 6367585 m	Ground level: 1.54	Test no: CPT133
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 37a
		File: CG-WI-C037.cpd	

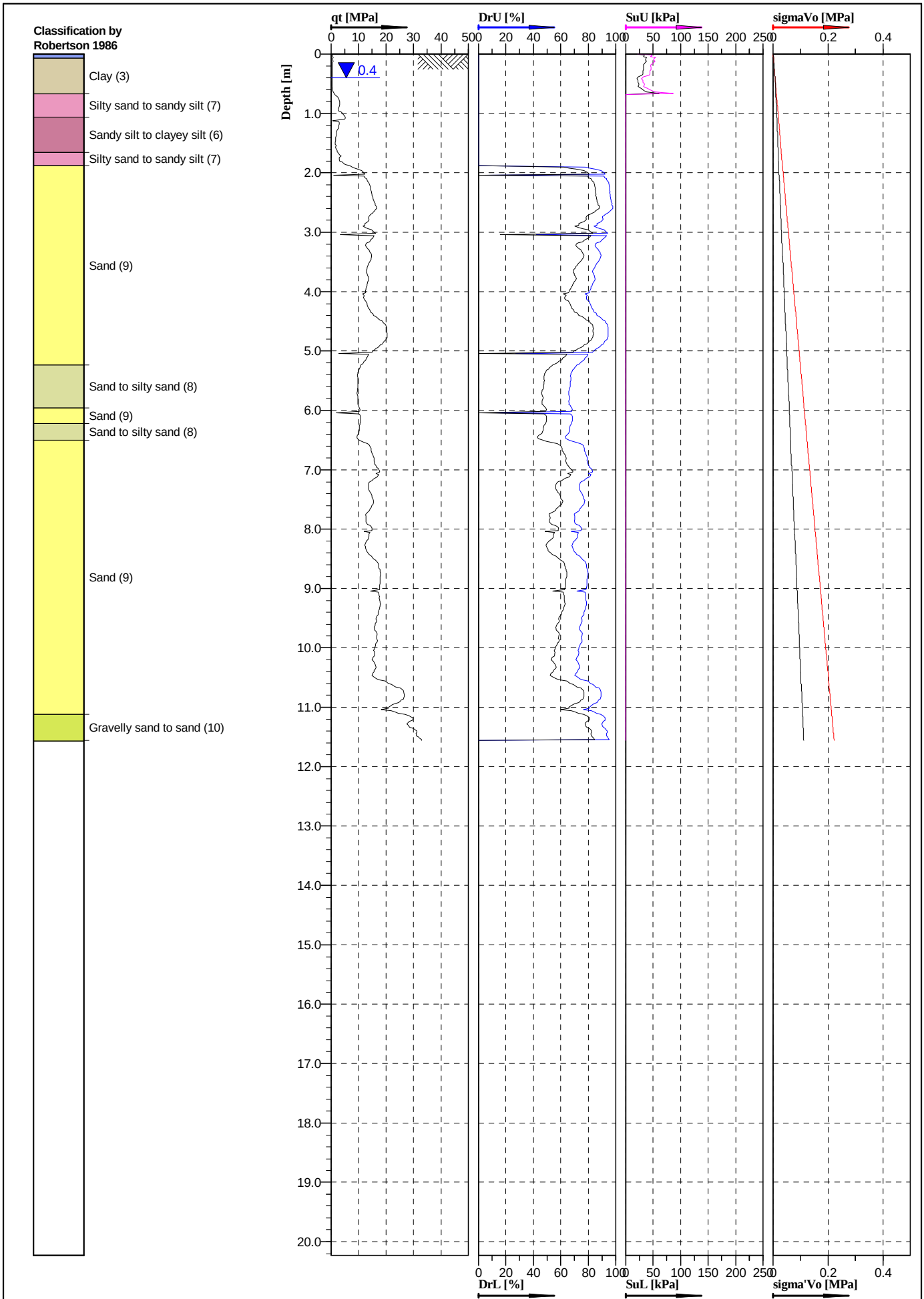


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382910 m, Y: 6367585 m	Ground level: 1.54	Test no: CPT133
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 37b
		File: CG-WI-C037.cpd	

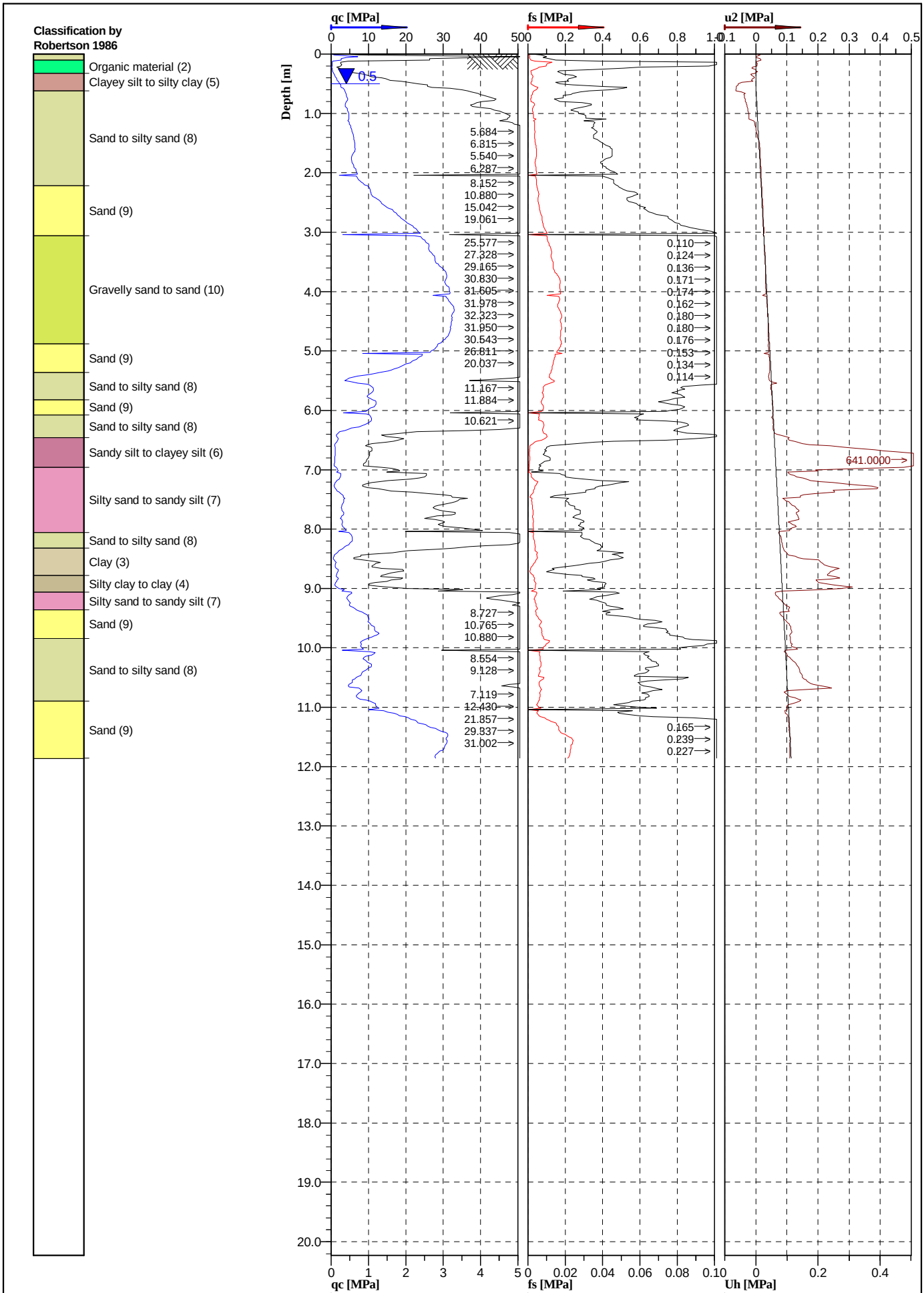


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382910 m, Y: 6367585 m	Ground level: 1.54	Test no: CPT133
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 37c
		File: CG-WI-C037.cpd	

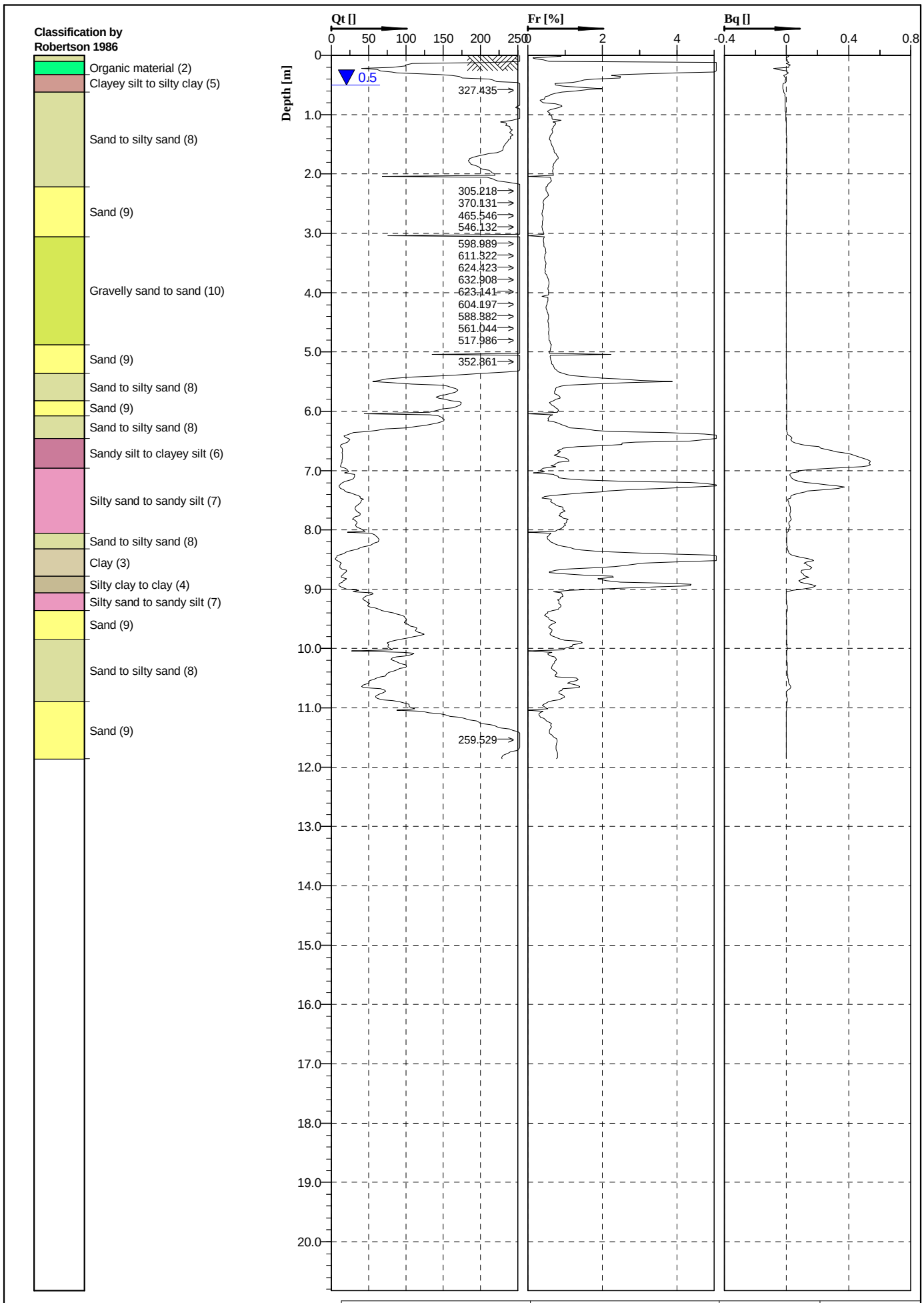


Location: Tomago Road, Tomago	Position: X: 382844 m, Y: 6367604 m	Ground level: 1.84	Test no: CPT137
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 38a
		File: CG-WI-C038.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

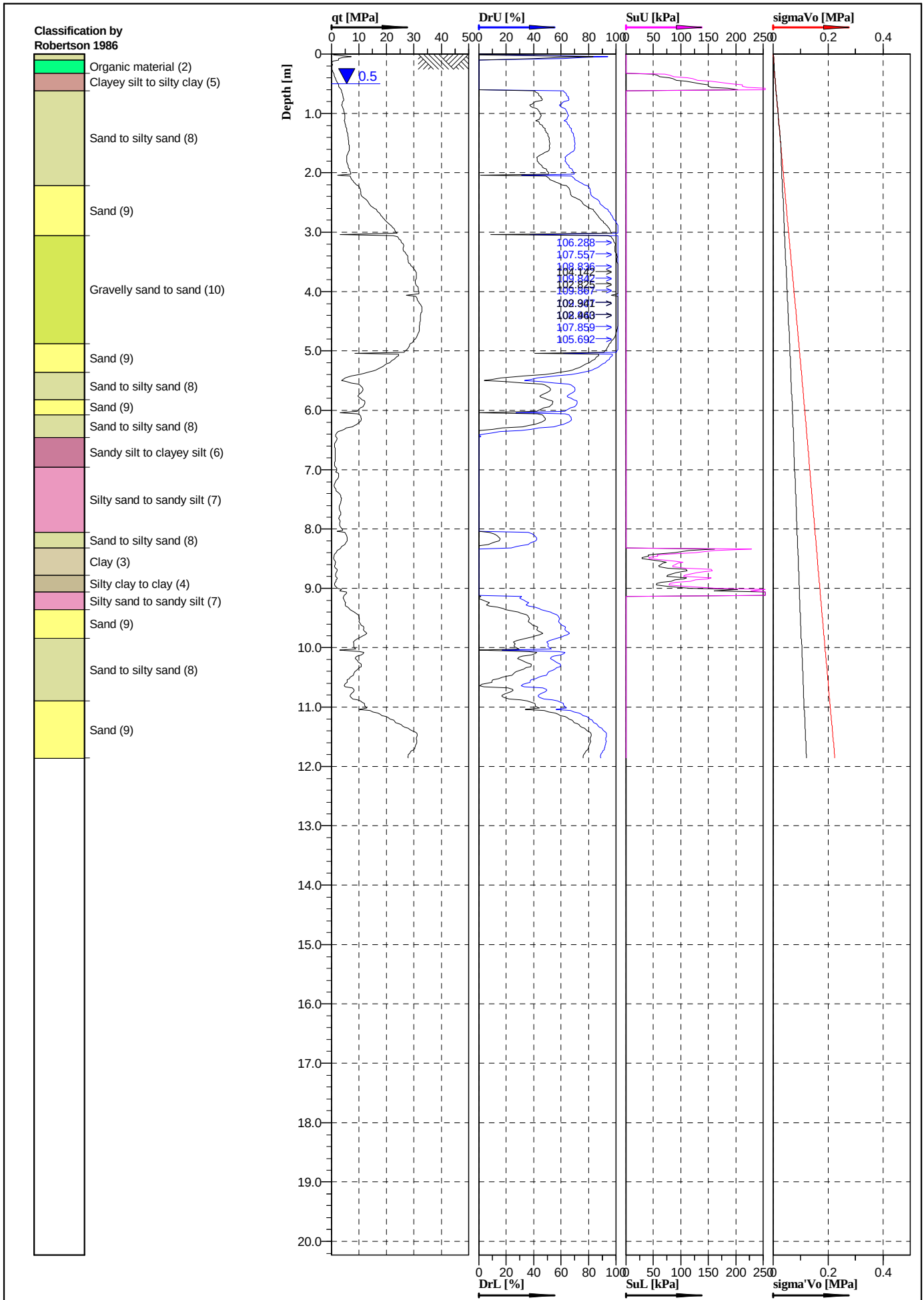


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382844 m, Y: 6367604 m	Ground level: 1.84	Test no: CPT137
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 38b
		File: CG-WI-C038.cpd	

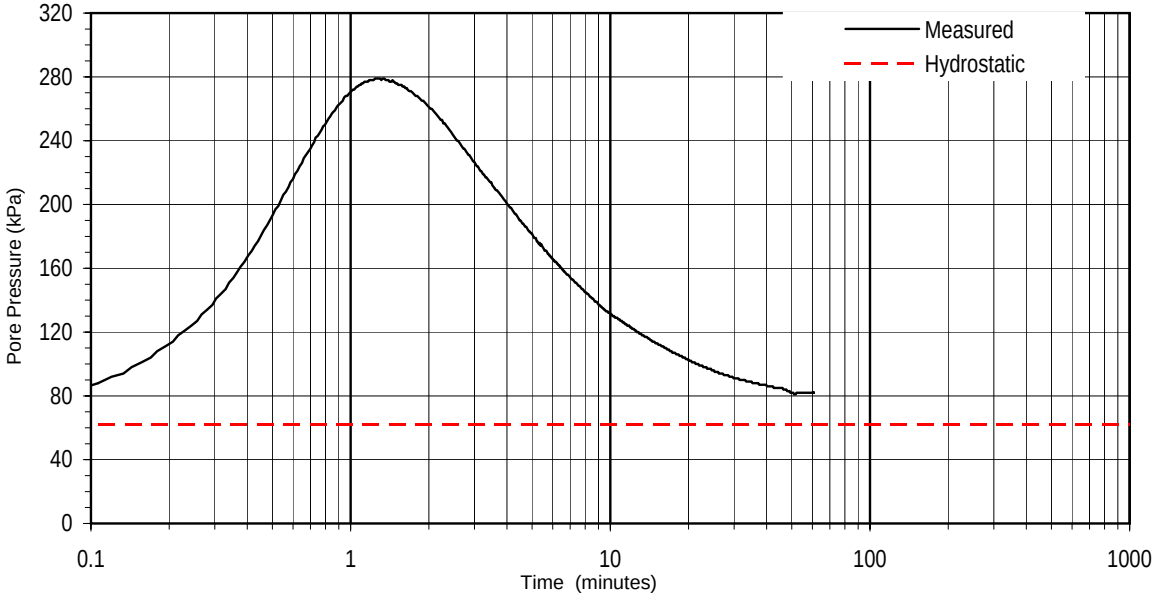


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382844 m, Y: 6367604 m	Ground level: 1.84	Test no: CPT137
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 38c
		File: CG-WI-C038.cpd	



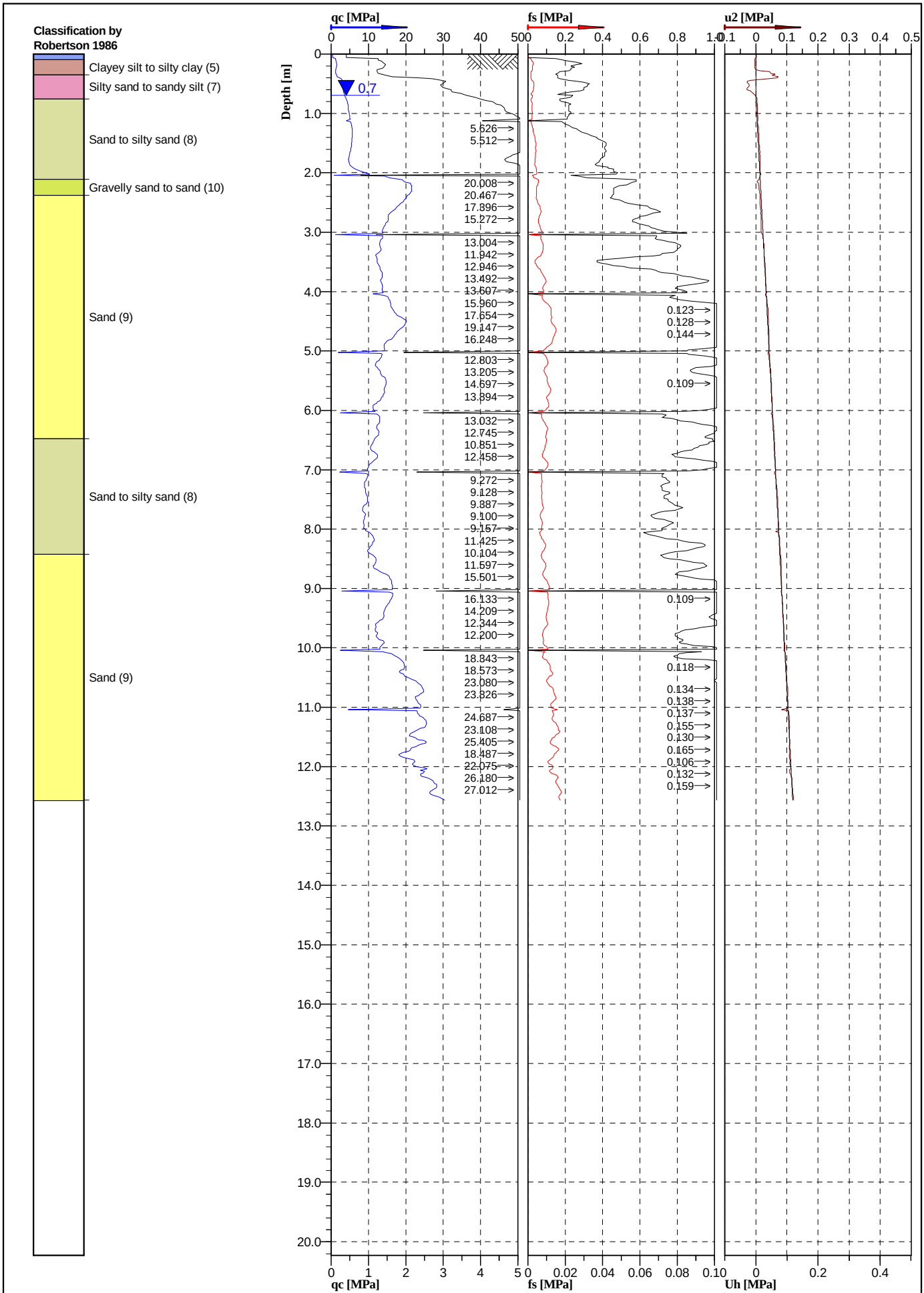
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type:

Static pore pressure, u_o	**62**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i	**85**	kPa	(measured from test data)
Final pore pressure at end of test	**82**	kPa	(measured from test data)
Test duration	**60**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}	**4**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H	**50.35**	m^2/year	
to	**71.45**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	**6.6** x 10^{-6}	cm/s	
to	**9.2** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13/11/2007**			
scale	**NTS**		title:	**PIEZOCONE DISSIPATION TEST**
original size	**A4**		project no: **GEOTWARA20301AA**	**Test Location & Depth: C38 6.80**

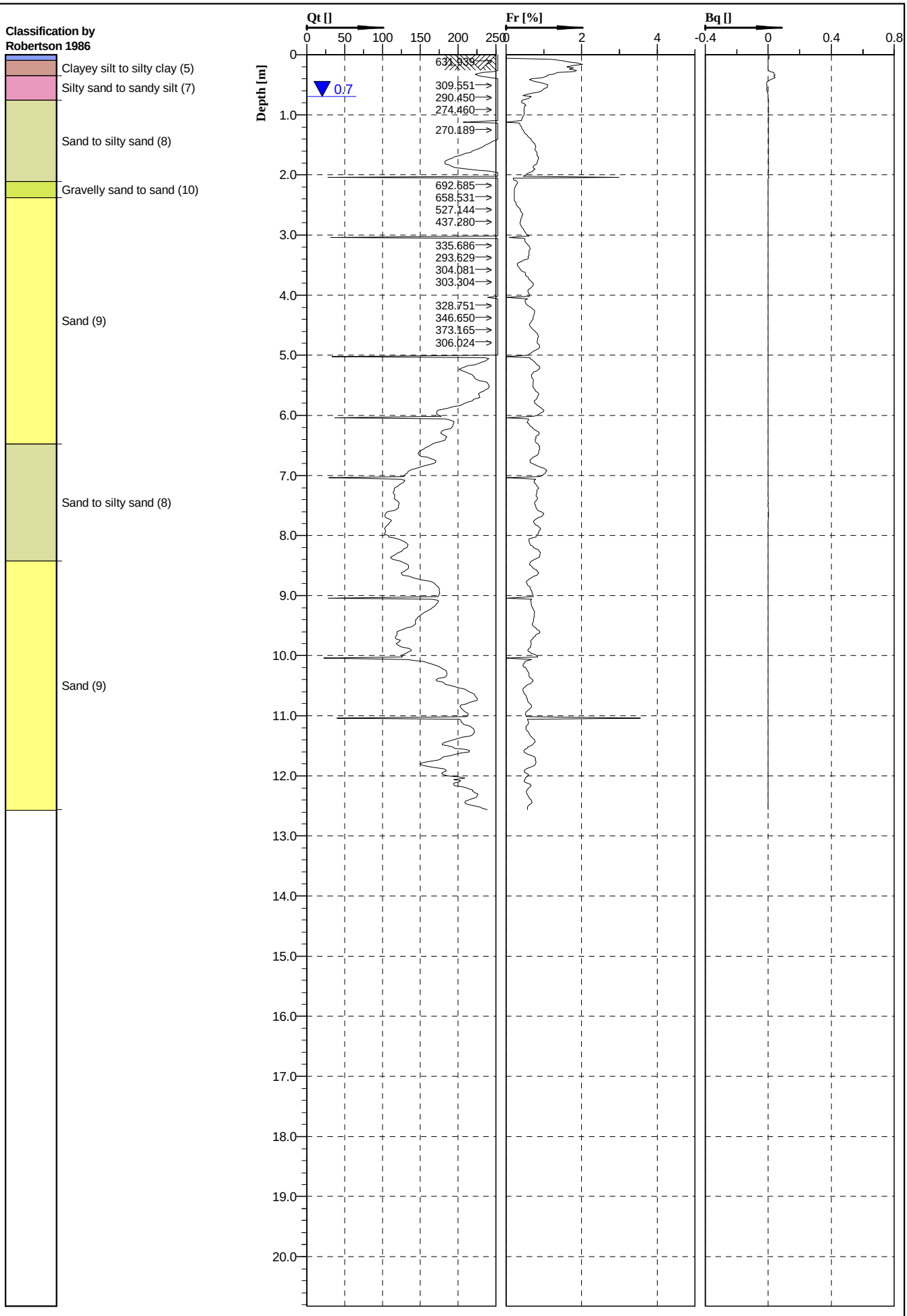


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382929 m, Y: 6367652 m	Ground level: 1.9	Test no: CPT129
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 39a
		File: CG-WI-C039.cpd	

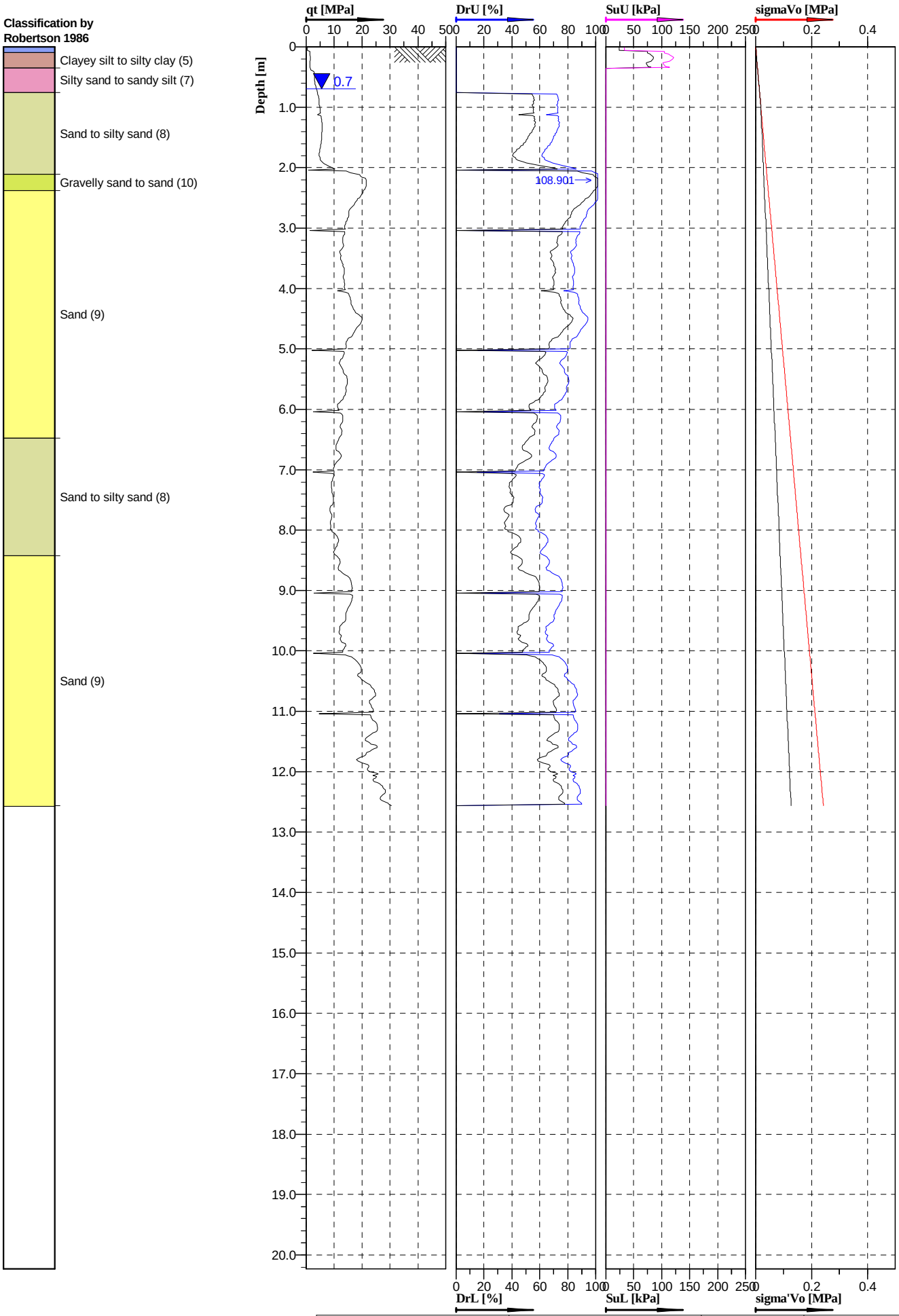


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 382929 m, Y: 6367652 m	Ground level: 1.9	Test no: CPT129
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 39b
		File: CG-WI-C039.cpd	

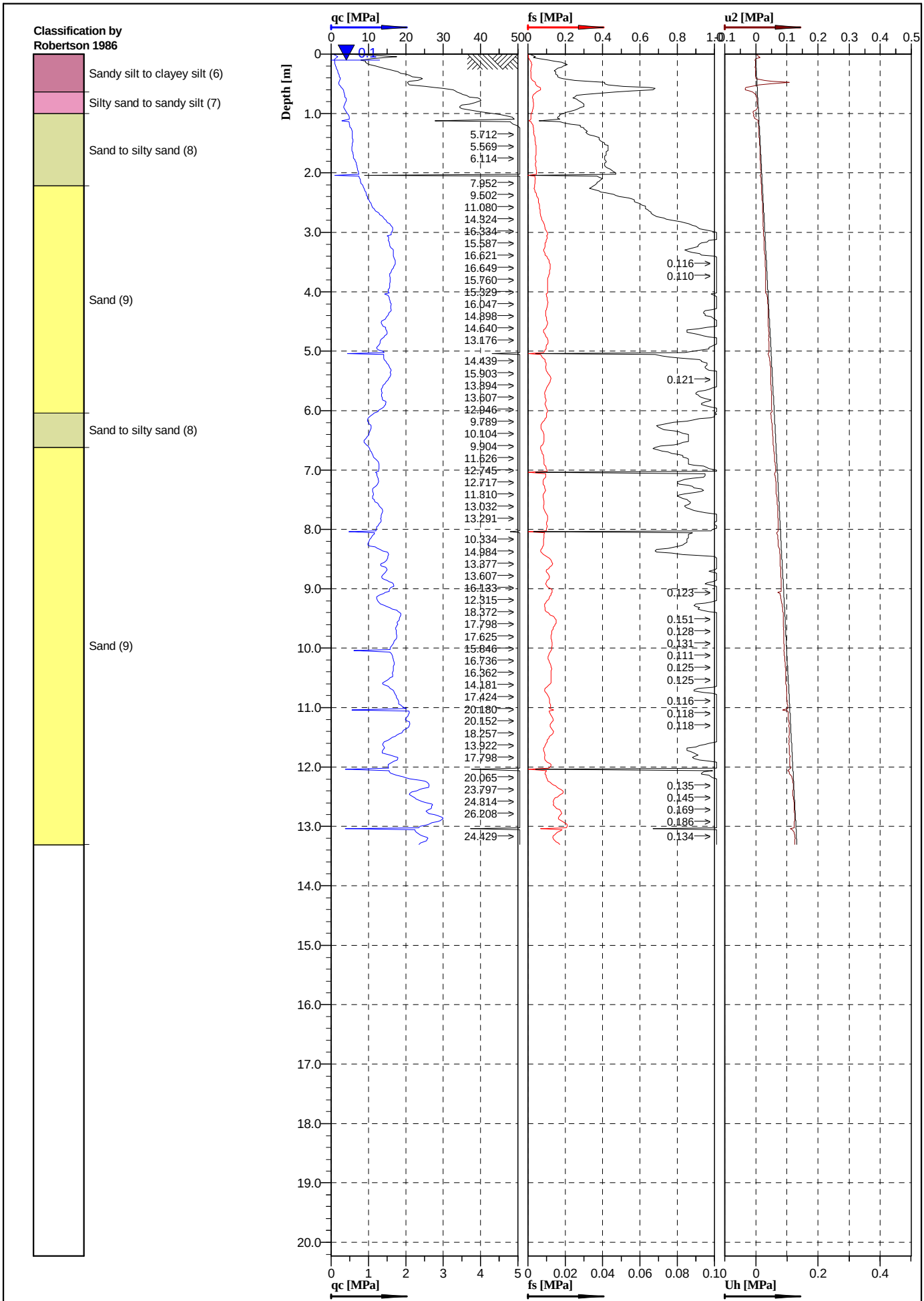


Location: Tomago Road, Tomago	Position: X: 382929 m, Y: 6367652 m	Ground level: 1.9	Test no: CPT129
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 39c
		File: CG-WI-C039.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

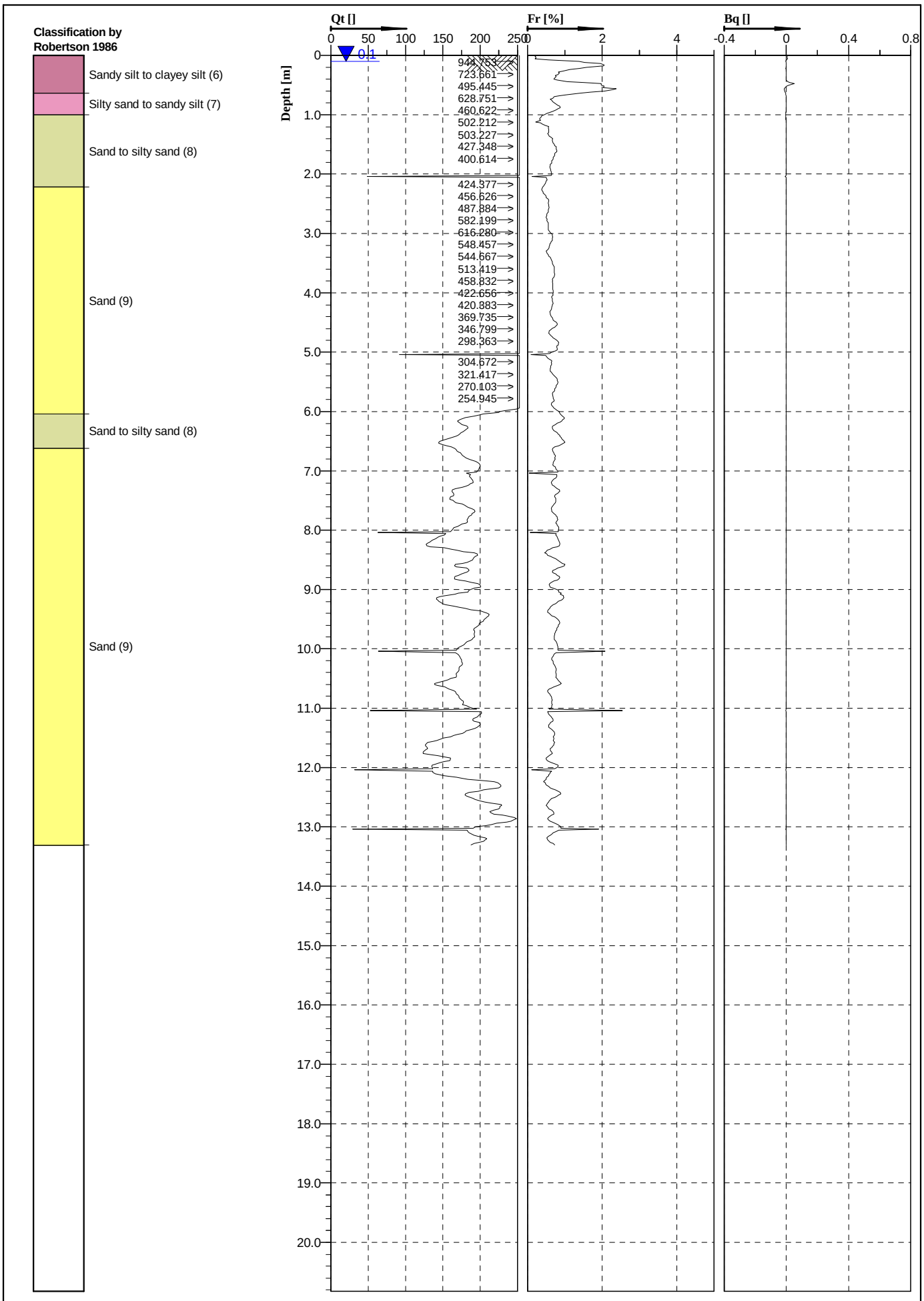


Location: Tomago Road, Tomago	Position: X: 383019 m, Y: 6367700 m	Ground level: 2.14	Test no: CPT121
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 40a
		File: CG-WI-C040.cpd	

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

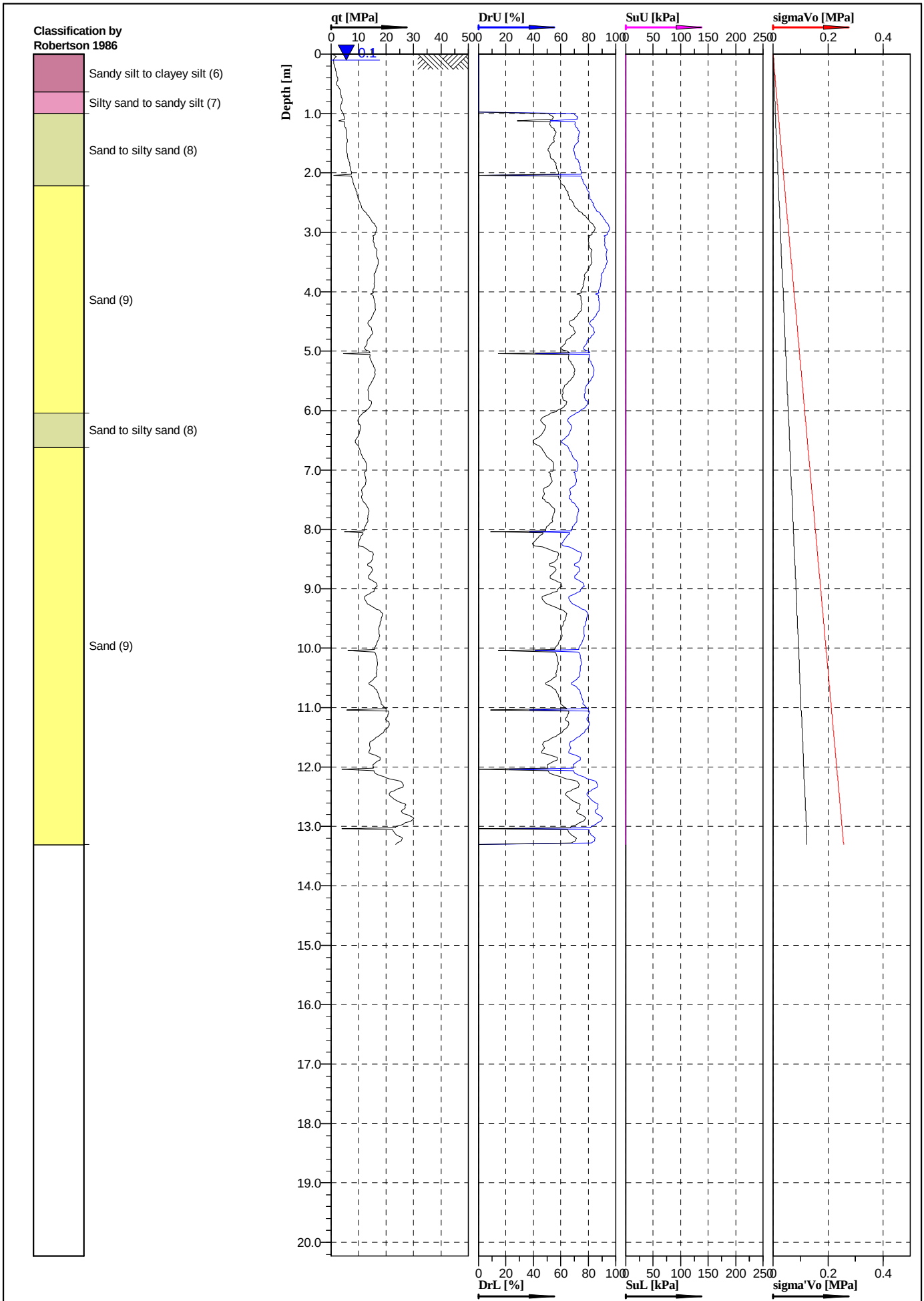


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383019 m, Y: 6367700 m	Ground level: 2.14	Test no: CPT121
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 40b
		File: CG-WI-C040.cpd	

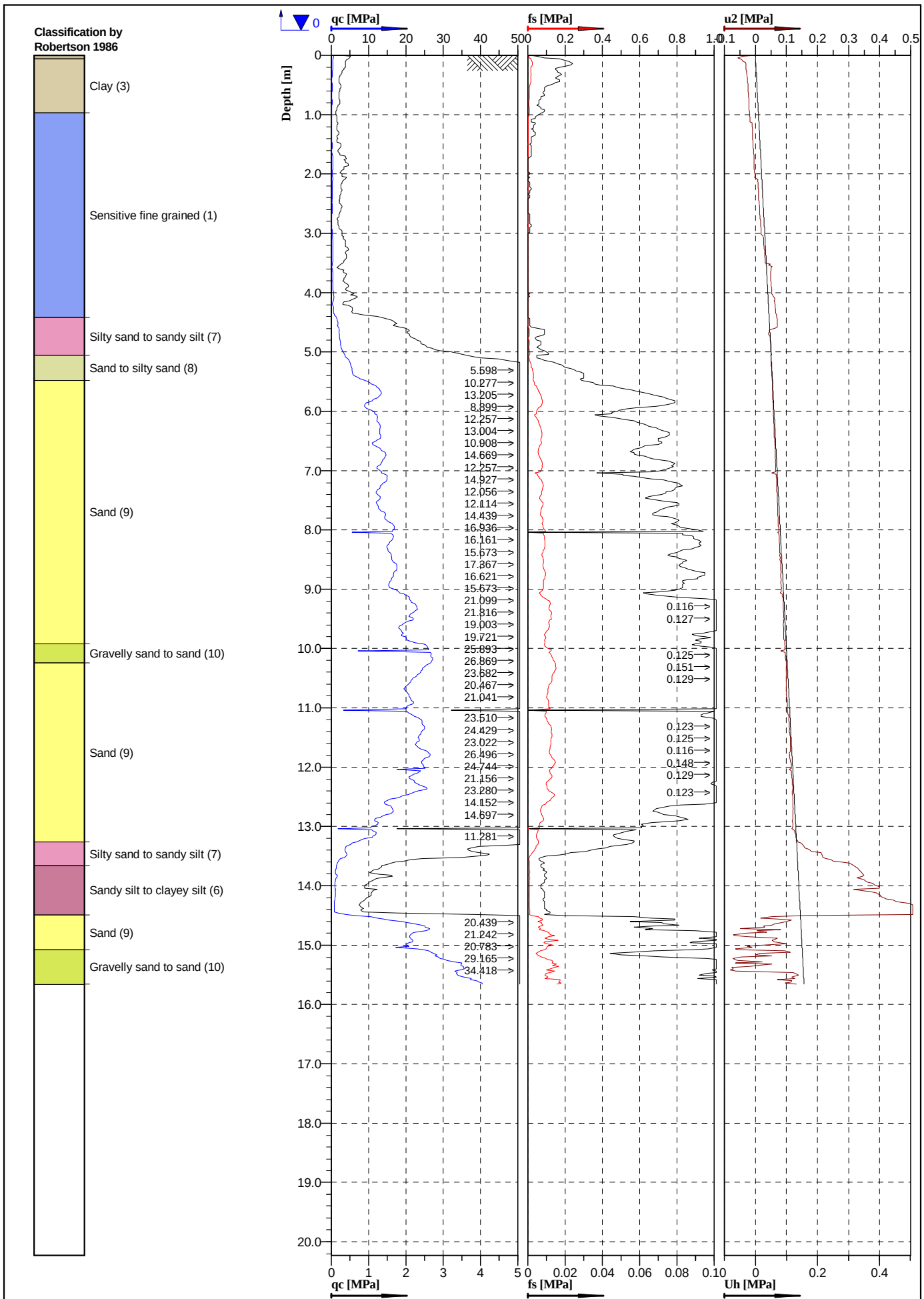


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383019 m, Y: 6367700 m	Ground level: 2.14	Test no: CPT121
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltdp	Date: 16/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 40c
		File: CG-WI-C040.cpd	

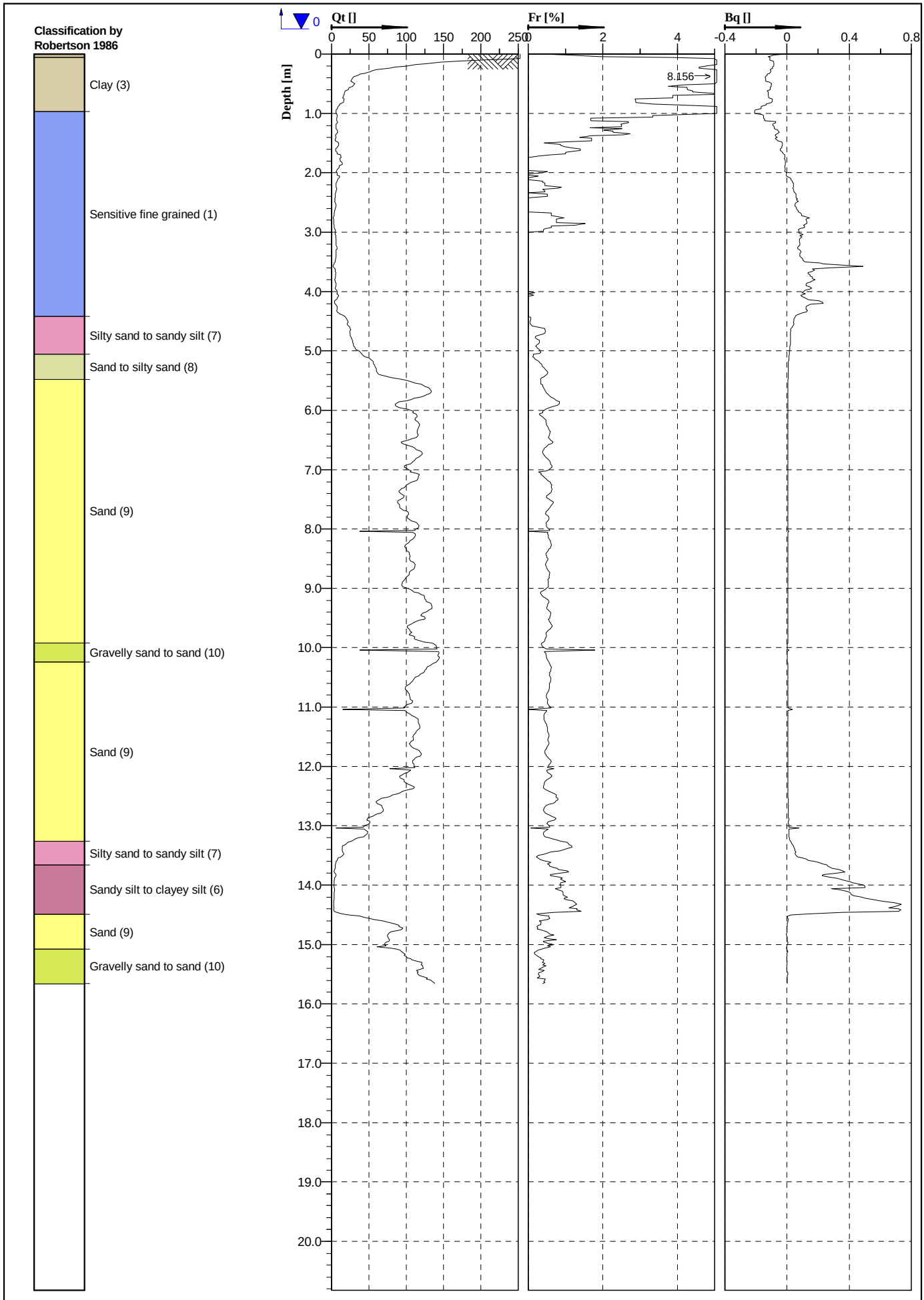


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383079 m, Y: 6367390 m	Ground level: 0.63	Test no: CPT132
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 21a
		File: CG-WI-C21.CPT	

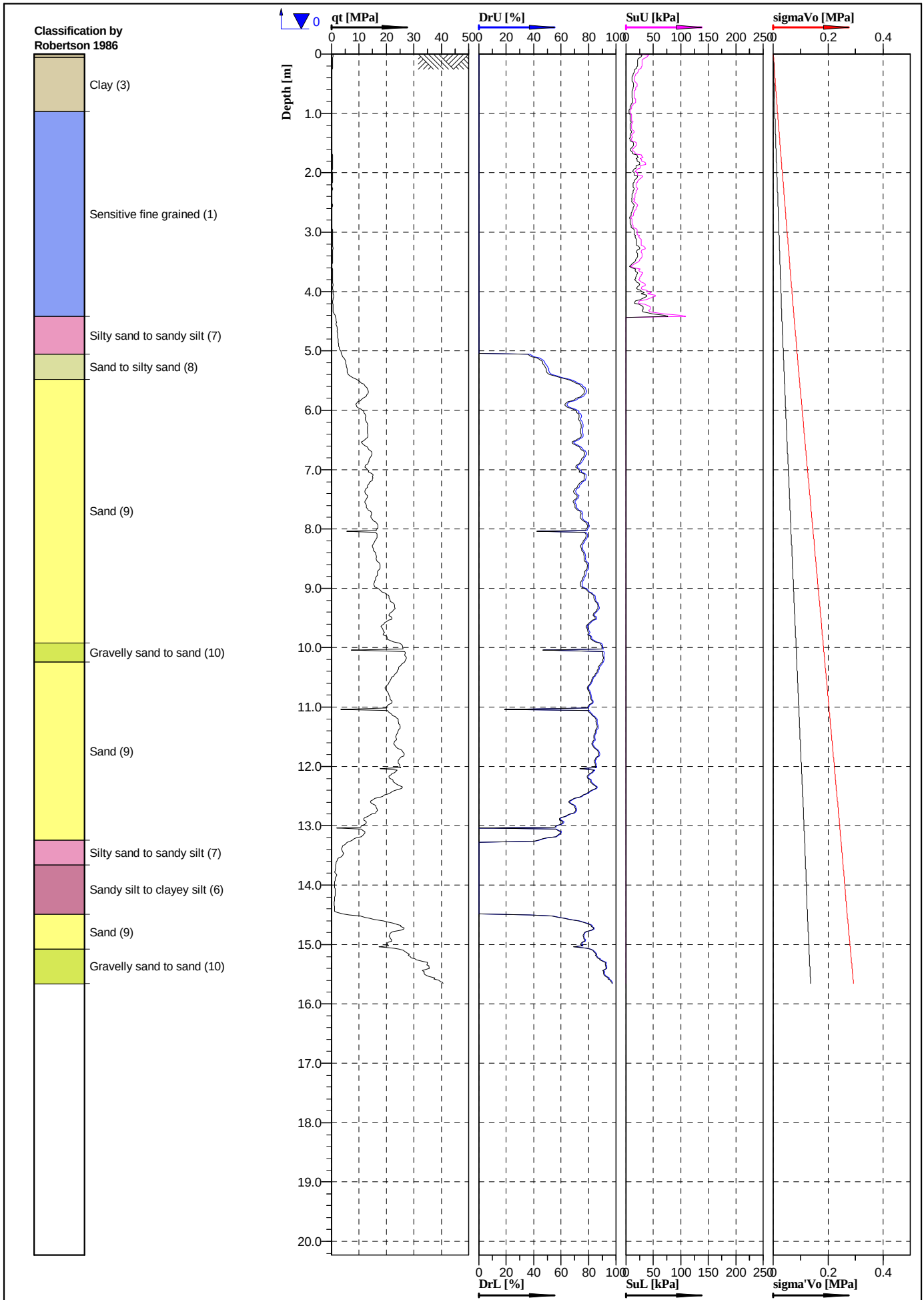


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383079 m, Y: 6367390 m	Ground level: 0.63	Test no: CPT132
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 21b
		File: CG-WI-C21.CPT	

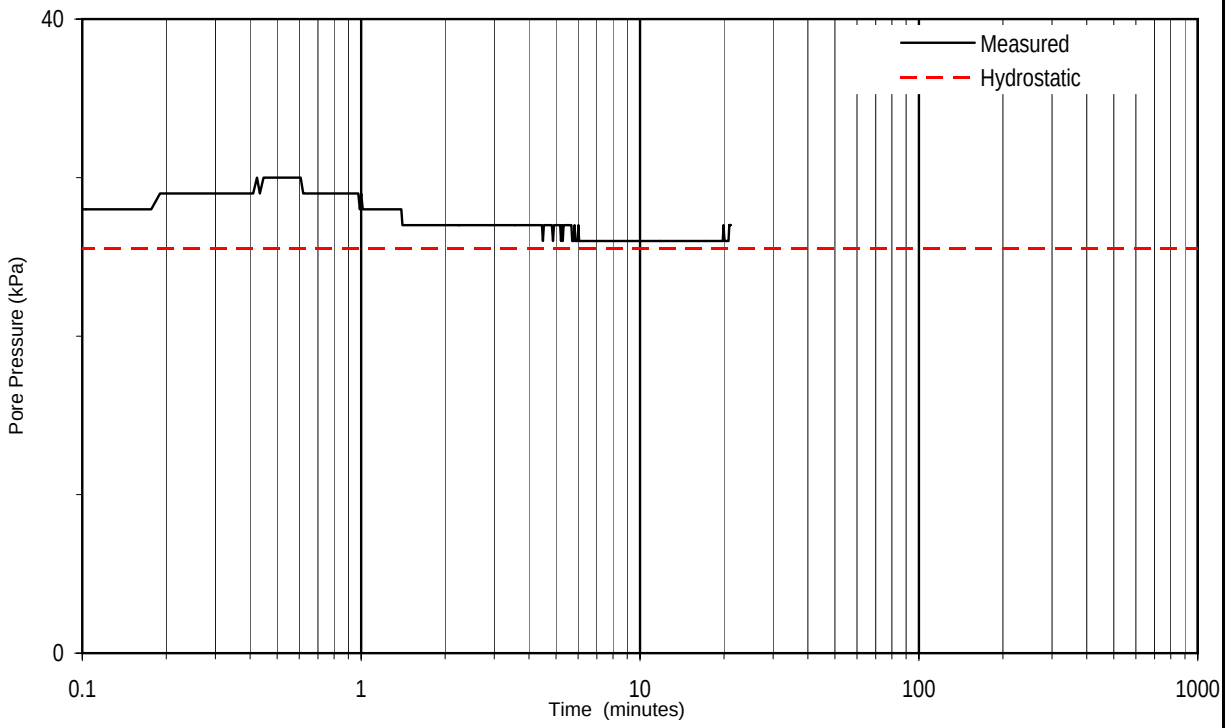


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

U2

Cone No: 3796
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 383079 m, Y: 6367390 m	Ground level: 0.63	Test no: CPT132
Project ID: GEOTSGTE20301AA	Client: Asquith & deWitt Pty Ltd	Date: 14/05/2007	Scale: 1 : 85
Project: Proposed Westrac Industrial Development		Page: 1/1	Fig: 21c
		File: CG-WI-C21.cpd	



TEST DATA & INFERRED SOIL PARAMETERS

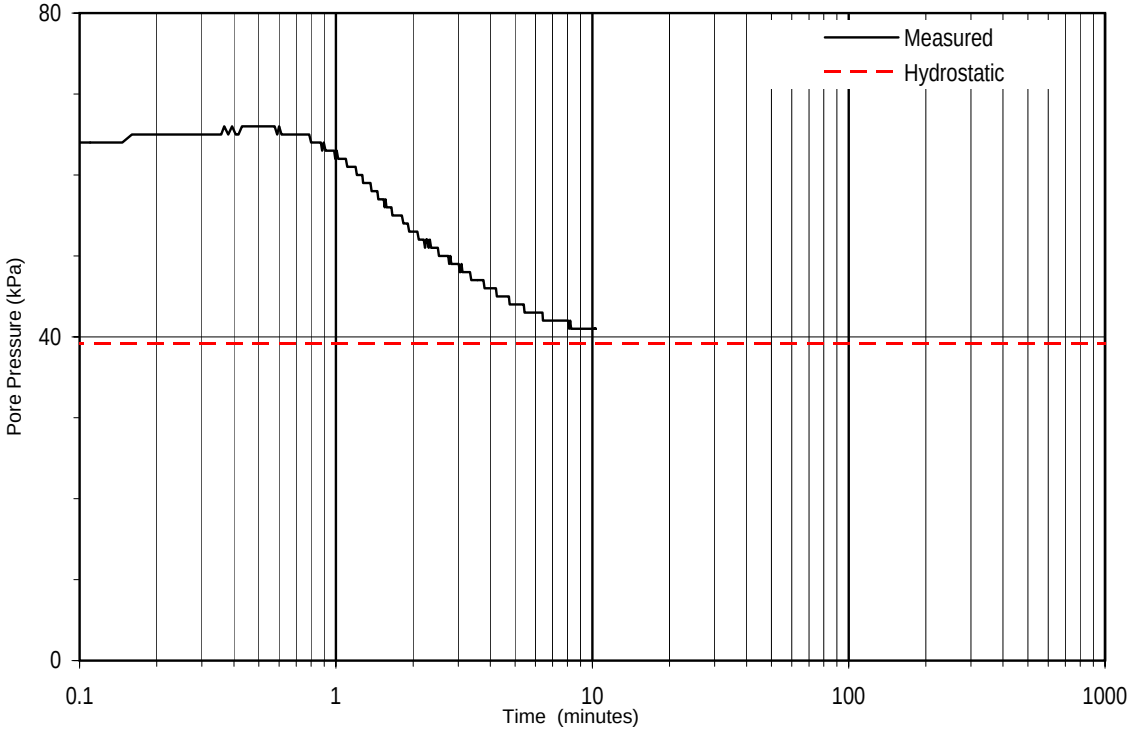
Inferred soil type:

Static pore pressure, u_o		**26**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i		**28**	kPa	(measured from test data)
Final pore pressure at end of test		**27**	kPa	(measured from test data)
Test duration		**21**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}		**2**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H		**105.2**	m^2/year	
	to	**149.3**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		**13.8** x 10^{-6}	cm/s	
	to	**19.1** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13/11/2007**		title:	**PIEZOCONE DISSIPATION TEST**
scale	**NTS**		project no:	**GEOTWARA20301AA**
original size	**A4**		**Test Location & Depth:**	C20 2.60

F:\Job Files\GEOT\SGTE\SGTE 20300 - 20399\SGTE20301AA\Dissipation Test Results\[GEOTSGTE20301AA C20 2.6m Dissipation Test.xls]Summary - Geotechnics



TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type:

Static pore pressure, u_o		**39**	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i		**64**	kPa	(measured from test data)
Final pore pressure at end of test		**41**	kPa	(measured from test data)
Test duration		**10**	min	(measured from test data)
Time for 50% dissipation of u, t_{50}		**1**	min	(extrapolated from test data)
Horizontal coefficient of consolidation, c_H		**154.6**	m^2/year	
	to	**219.4**	m^2/year	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		**20.3** x 10^{-6}	cm/s	
	to	**28.1** x 10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
2. Values of c_H presented above are based on a rigidity index, I_R, of between 20 and 40.
3. Values of k_H presented above are based on a rigidity index, I_R, of between 20 and 40, and a modulus of volume change, m_V, of 0.0042 kPa^{-1}.

drawn	**ALR**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & DE WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUTRIAL DEVELOPMENT**
date	**13/11/2007**			**TOMAGO ROAD, TOMAGO**
scale	**NTS**		title:	**PIEZOCONE DISSIPATION TEST**
original size	**A4**		project no: **GEOTWARA20301AA**	**Test Location & Depth: C20 4.00**

Appendix C

Results of Relevant Previous Investigation

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. *CBH 4*

Sheet 1 of 3

Office Job No.: *N09814/01*

Engineering Log - Borehole

Client: *ASQUITH & DE WITT PTY LTD*

Principal: *REDLAKE ENTERPRISES PTY LTD*

Project: *DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*

Borehole Location: *REFER TO DRAWING N09814/01-1*

Date started: *24.1.2006*

Date completed: *24.1.2006*

Logged by: *KM*

Checked by: *BWR*

Coffey

drill model and mounting: Atkins Truck Rig | Easting: 56383456 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		C			0	1		CH	**TOPSOIL:** CLAY, medium plasticity, brown/red-brown, white, organic matter and rootlets	D/M	VS		TOPSOIL
								CH	**CLAY:** high plasticity, grey/brown mottled, some sand fine to medium grained.	M>Wp		x	ESTUARINE
				U_{50}								x	Vane Shear Test 0.7-0.8m, Peak 23kPa, Residual 5kPa.
					-1	2							
W				U_{50}				SP-SC	**SAND:** fine grained, grey, some clay medium plasticity, trace sand coarse grained.	W	L		ALLUVIUM
					-2	3							
					-3			SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity, brown, clayey sand lense <100mm thick with shell material (<3mm) throughout. Fine subrounded gravel in Clayey Sand lense.		MD		
				SPT 3,4,4 N*=8		4							
					-4								
						5							
		M		SPT 7,11,12 N*=23	-5				Penetration varying - apparent medium dense to dense layers <200mm, thickness of layers.		MD-D		
						6							
					-6								
				SPT 6,7,9 N*=16		7							
				SPT 6,13,15 N*=28	-7						D		
						8							

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

Form GEO 5.3 Issue 3 Rev.2

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. **CBH 4**

Sheet 2 of 3

Office Job No.: *N09814/01*

Engineering Log - Borehole

Client: *ASQUITH & DE WITT PTY LTD*

Date started: *24.1.2006*

Principal: *REDLAKE ENTERPRISES PTY LTD*

Date completed: *24.1.2006*

Project: *DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*

Logged by: *KM*

Borehole Location: *REFER TO DRAWING N09814/01-1*

Checked by: *DWR*

Coffey

drill model and mounting: Atkins Truck Rig | Easting: 56383456 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		M			-8	9		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity, brown, clayey sand lense <100mm thick with shell material (<3mm) throughout. *(continued)*	W	D		
					-9								
				SPT 8,14,20 N*=34		10			Trace fine subrounded gravels in clayey sand layer at 9.7m. Carbonaceous material (<2mm) through grey sand layers from approximately 9.7m.				
					-10	11							
				SPT 7,10,10 N*=20	-11						MD/D		
						12							
					-12								
				SPT 6,9,12 N*=21		13							
					-13			SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity, trace fine subrounded gravels, trace carbonaceous material (3mm).		L-MD		
						14							
				SPT 1,2,1 N*=3	-14						L		
						15		SP	**Gravelly SAND:** fine to coarse grained, grey, trace shell material (<2mm). Water loss occurring.		MD/D		
					-15								
				SPT R N*=R		16		GP	**Sandy GRAVEL:** fine grained, grey, sand coarse grained. SPT refusal prior to first 150mm.				

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

Form GEO 5.3 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. *CBH 4*

Sheet 3 of 3

Office Job No.: *N09814/01*

Engineering Log - Borehole

Client: *ASQUITH & DE WITT PTY LTD*

Date started: *24.1.2006*

Principal: *REDLAKE ENTERPRISES PTY LTD*

Date completed: *24.1.2006*

Project: *DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*

Logged by: *KM*

Borehole Location: *REFER TO DRAWING N09814/01-1*

Checked by: *DMR*

drill model and mounting: Atkins Truck Rig | Easting: 56383456 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367558 | bearing: | datum: AHD

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		M			-16	17		GP	**Sandy GRAVEL:** fine grained, grey, sand coarse grained. *(continued)*	W	MD/D		
					-17	18							
					-18	19		CH	**Silty CLAY:** high plasticity, grey, low liquid limit, silt.	M>Wp	S/VS		
					-19				Sample collected from rock roller at 19.55m.				
				SPT 10,6,10 N*=16					SPT full of gravel most likely from higher in profile. Borehole CBH 4 terminated at 19.55m				
					-20	20							
					-21	21							
					-22	22							
					-23	23							
						24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Form GEO 5.3 Issue 3 Rev.2 BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering Log - Borehole

Borehole No. CBH 5
Sheet 1 of 3
Office Job No.: N09814/01

Client: ASQUITH & DE WITT PTY LTD
Date started: 25.1.2006

Principal: REDLAKE ENTERPRISES PTY LTD
Date completed: 25.1.2006

Project: DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO
Logged by: KM

Borehole Location: REFER TO DRAWING N09814/01-1
Checked by: BNR

drill model and mounting: Atkins Truck Rig | Easting: 56383640 | slope: -90° | R.L. Surface: 0.5
hole diameter: 100 mm | Northing 6367720 | bearing: | datum: AHD

drilling information								material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADV		C			0	1		CI	**TOPSOIL:** CLAY, low to medium plasticity, brown, with organics and rootlets.	D/M	S	×	TOPSOIL
								CH	**CLAY:** high plasticity, grey.	W>Wp	S/VS		ESTUARINE
			▼	U_{50}	-1							×	
				U_{50}		2		SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity.	W	L/VL		ALLUVIUM
W					-2	3							
					-3			SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity. Occasional brown clayey sand layers containing shell material (<3mm).		MD		
				SPT 4,5,7 N*=12	-4	4							
						5			No evidence of clayey sand layers containing shell material between 5.1m and 6.1m.		MD-D		
				SPT 5,9,11 N*=20	-5								
					-6	6		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity. Contains layers of carbonaceous material (<3mm) and layers containing trace sand coarse grained/gravel fine grained (SR) - layers generally <50mm (obs from SPT).		D-VD		
				SPT 19,20,22 N*=42		7							
					-7						MD-D		
						8							

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix e.g. ADT

support
M mud N nil
C casing

penetration
1 2 3 4 no resistance ranging to refusal

water
▼ 10/1/98 water level on date shown
► water inflow
◄ water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Form GEO 5.3 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. *CBH 5*

Sheet 2 of 3

Office Job No.: *N09814/01*

Engineering Log - Borehole

Client: *ASQUITH & DE WITT PTY LTD*

Date started: *25.1.2006*

Principal: *REDLAKE ENTERPRISES PTY LTD*

Date completed: *25.1.2006*

Project: *DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*

Logged by: *KM*

Borehole Location: *REFER TO DRAWING N09814/01-1*

Checked by: *DMR*

drill model and mounting: Atkins Truck Rig | Easting: 56383640 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367720 | bearing: | datum: AHD

drilling information							material substance					
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C		SPT 7,8,12 N*=20	-8	9		SP	**SAND:** fine to medium grained, light brown, trace clay medium plasticity. *(continued)*	W	MD-D		
				SPT 6,11,13 N*=24	-9	10		SP	**SAND:** fine to medium grained, grey, trace clay medium plasticity. Containing layers with carbonaceous material (<5mm) and brown clayey sand layers with some fine gravelly layers (< 100mm thick, subrounded gravel).		D		
				SPT 6,11,15 N*=26	-10	11			Possible clay layers based on cuttings.				
				SPT 10,23,35 N*=58	-11	12					D-VD		
					-12	13							
				SPT 0,1,- N*=R	-13	14		SC	**Clayey SAND:** fine to medium grained, grey, clay medium plasticity, some fine subrounded gravels.		VL/L		
					-14	15			SPT refusal after 400mm.				
								GP	**Sandy GRAVEL:** fine grained, subrounded gravels, grey/orange/black, sand fine to coarse grained.		D		
									CLAY: (physical characteristics unable to be determined from washbore cuttings).				
					-15	16		GP	**Sandy GRAVEL:** fine grained, subrounded gravels, grey/orange/black, sand fine to coarse grained.				

BOREHOLE N09814-01.GPJ COFFEY.GDT 03.03.06

Form GEO 5.3 Issue 3 Rev.2

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Borehole No. *CBH 5*

Sheet 3 of 3

Engineering Log - Borehole

Office Job No.: *N09814/01*

Client: *ASQUITH & DE WITT PTY LTD*

Date started: *25.1.2006*

Principal: *REDLAKE ENTERPRISES PTY LTD*

Date completed: *25.1.2006*

Project: *DUE DILIGENCE ASSESSMENT, TOMAGO ROAD, TOMAGO*

Logged by: *KM*

Borehole Location: *REFER TO DRAWING N09814/01-1*

Checked by: JMR

drill model and mounting: Atkins Truck Rig | Easting: 56383640 | slope: -90° | R.L. Surface: 0.5

hole diameter: 100 mm | Northing 6367720 | bearing: | datum: AHD

drilling information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
W		C			-16	17		GP	**Sandy GRAVEL:** fine grained, subrounded gravels, grey/orange/black, sand fine to coarse grained. *(continued)* Water loss.	W	D		
					-17	18							
					-18	19			Cant manage water loss, hole collapsing when lifting rods to introduce more water. Borehole CBH 5 terminated at 18m				
					-19	20							
					-20	21							
					-21	22							
					-22	23							
					-23	24							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

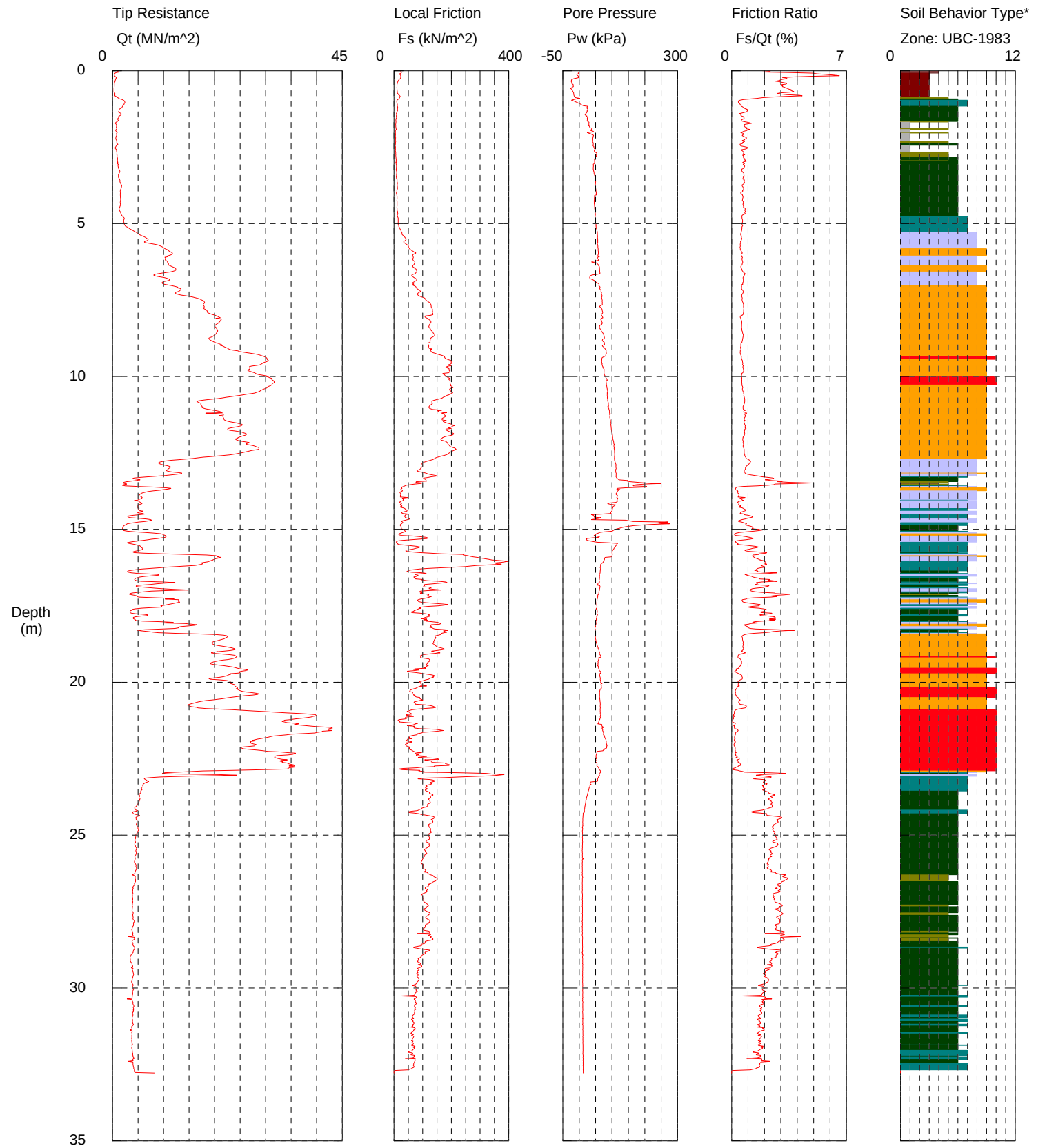
consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Tom-01
Cone Used: 5T4CH

CPT Date/Time: 01-19-06 21:09
Location: Tomago
Job Number: 249

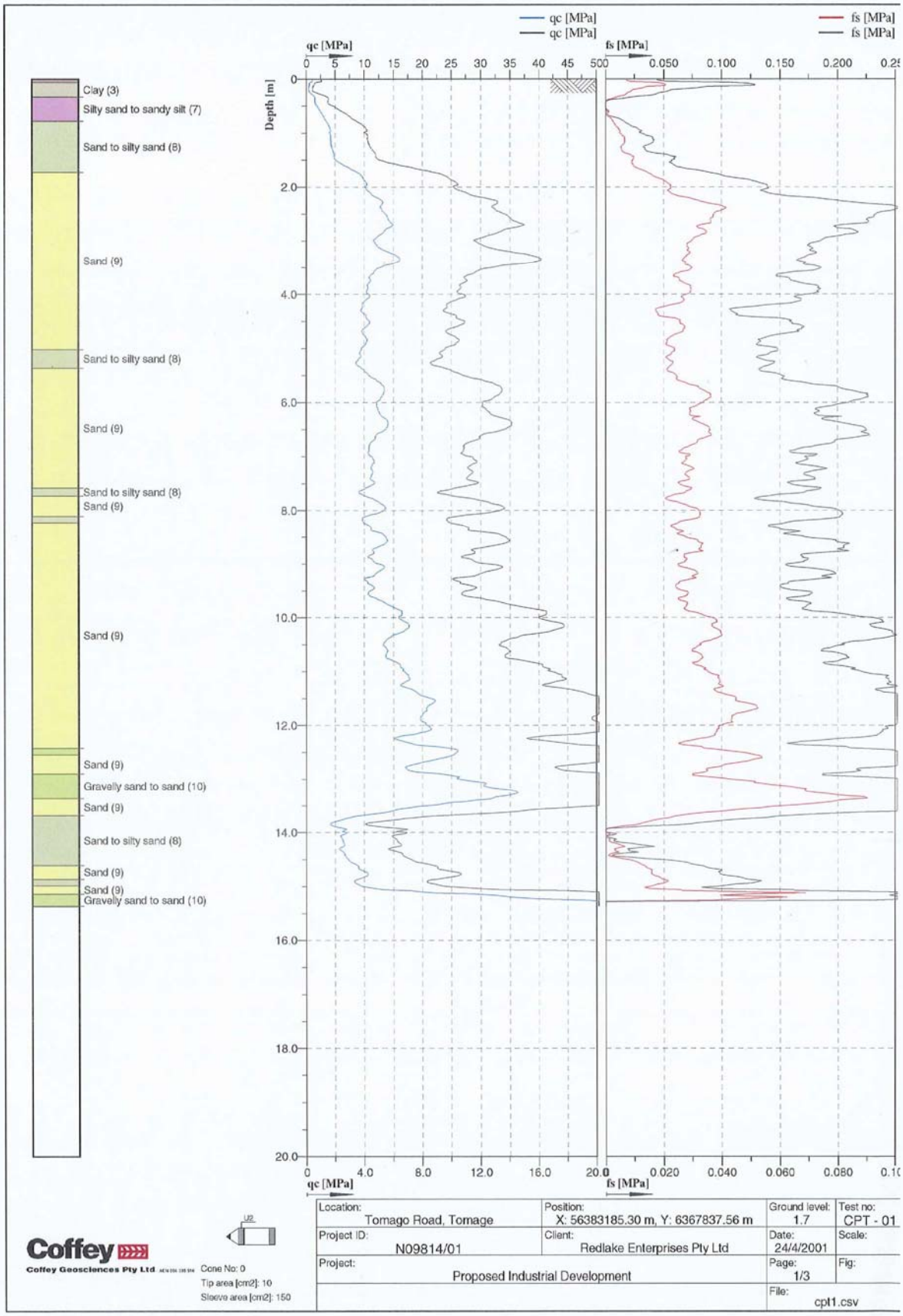


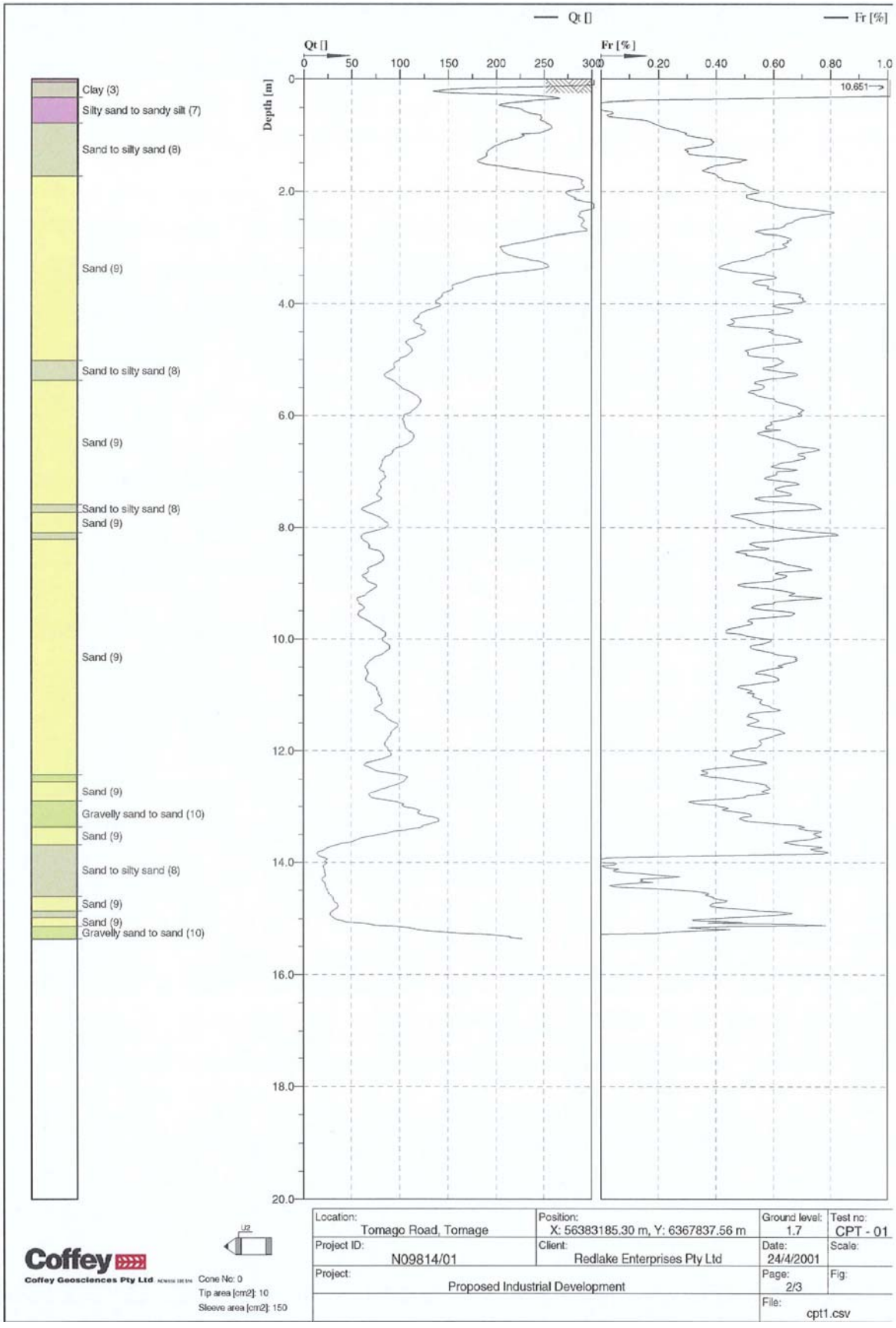
Maximum Depth = 32.78 meters

Depth Increment = 0.020 meters

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
qc [MPa]
fs [MPa]
Depth [m]
Clay (3)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Location: Tomago Road, Tomago
Position: X: 56383185.30 m, Y: 6367837.56 m
Ground level: 1.7
Test no: CPT - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/3
Fig:
File: cpt1.csv
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

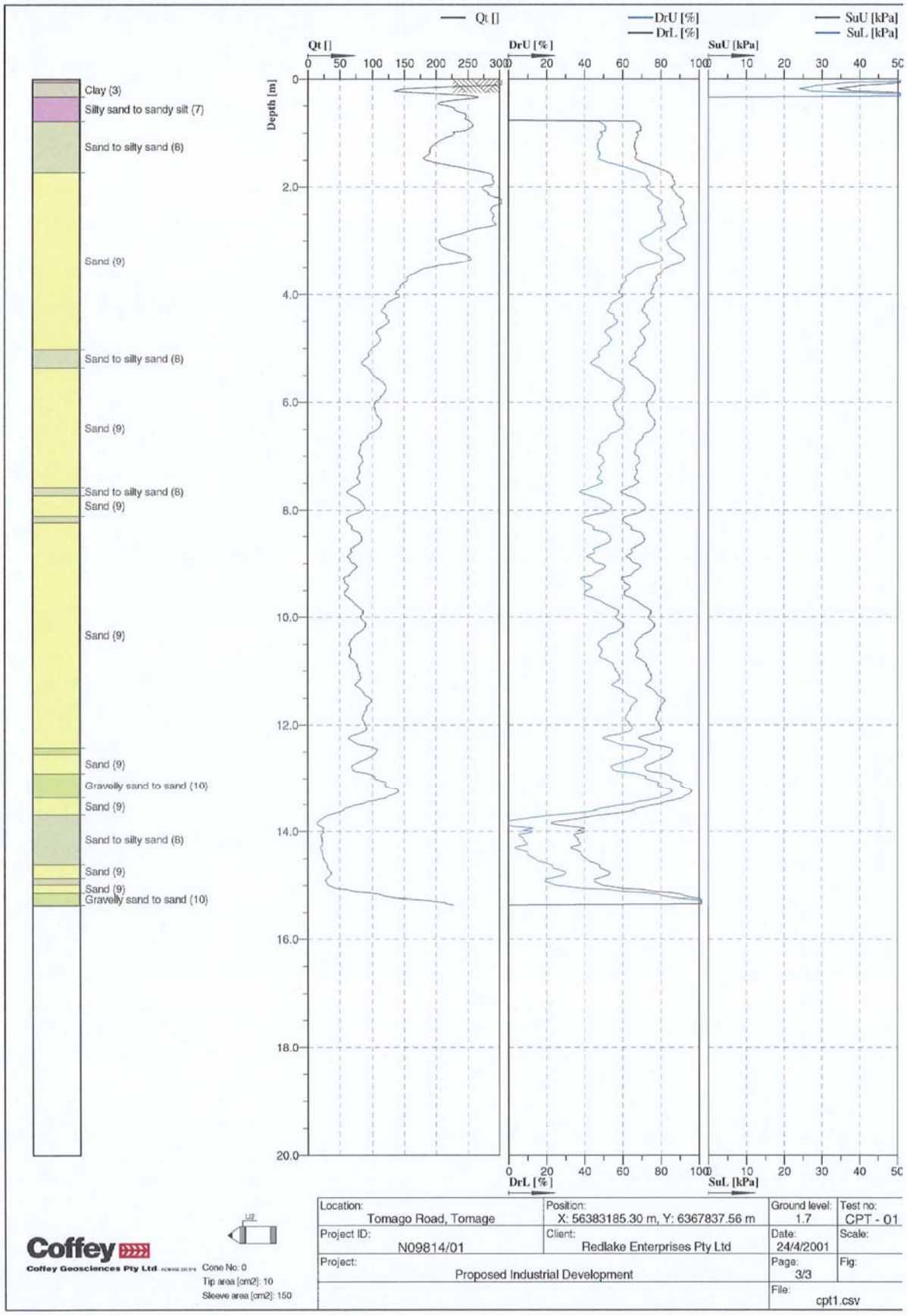


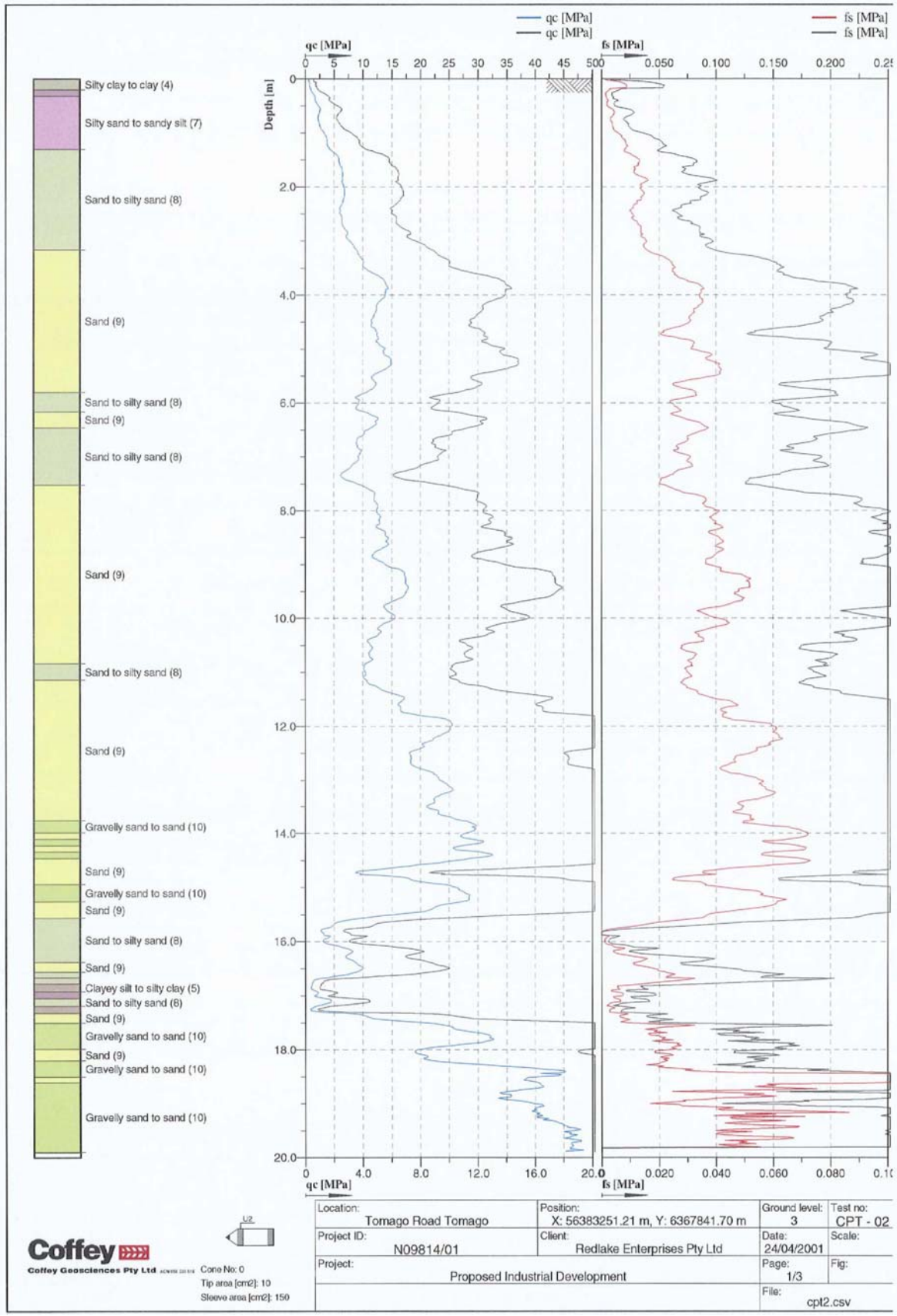
Coffey

Coffey Geosciences Pty Ltd

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Tomago Road, Tomago	Position: X: 56383185.30 m, Y: 6367837.56 m	Ground level: 1.7	Test no: CPT - 01
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 2/3	Fig:
		File: cpt1.csv	


Qt []
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Clay (3)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomage
Position: X: 56383185.30 m, Y: 6367837.56 m
Ground level: 1.7
Test no: CPT - 01
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 3/3
Fig:
File: cpt1.csv

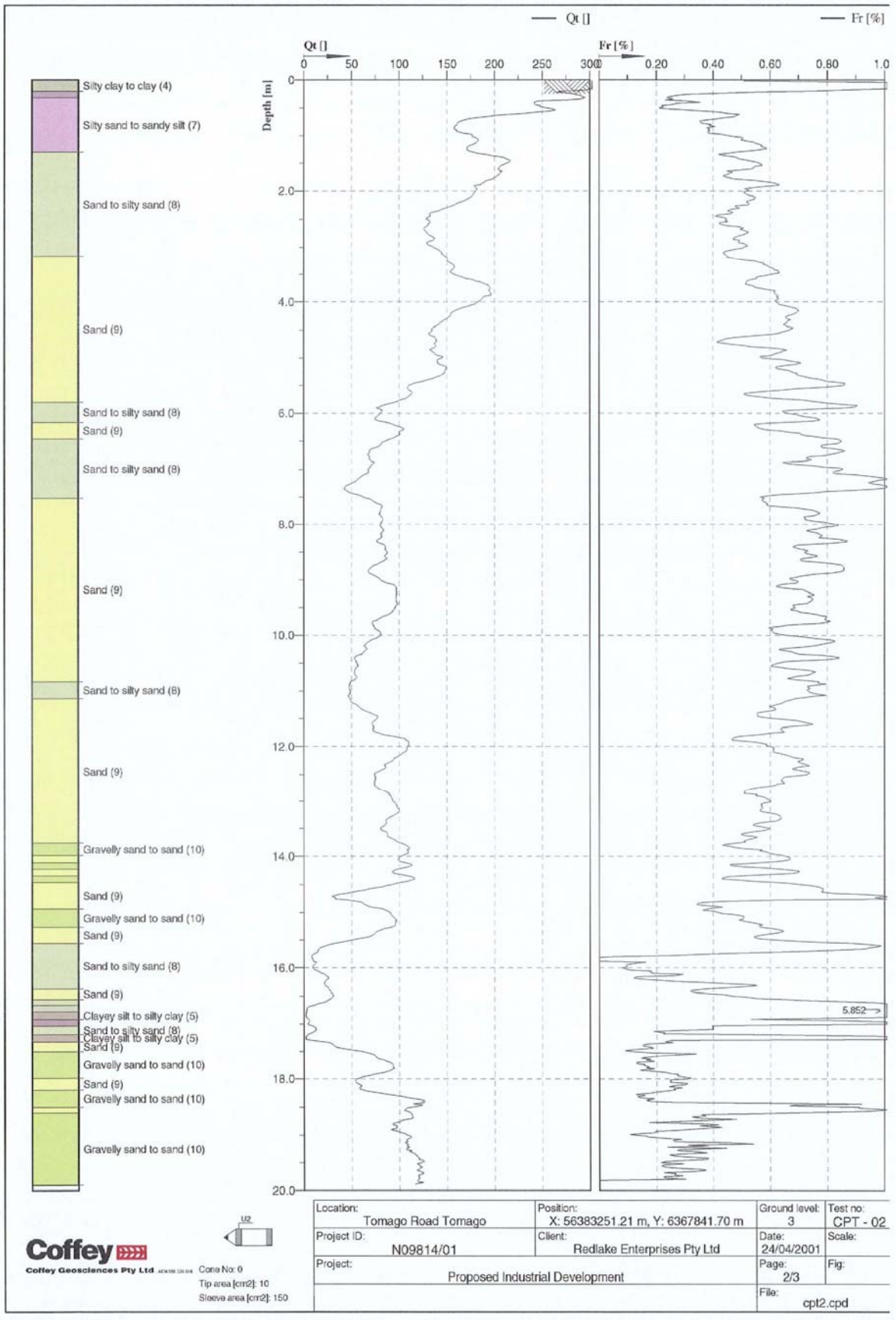


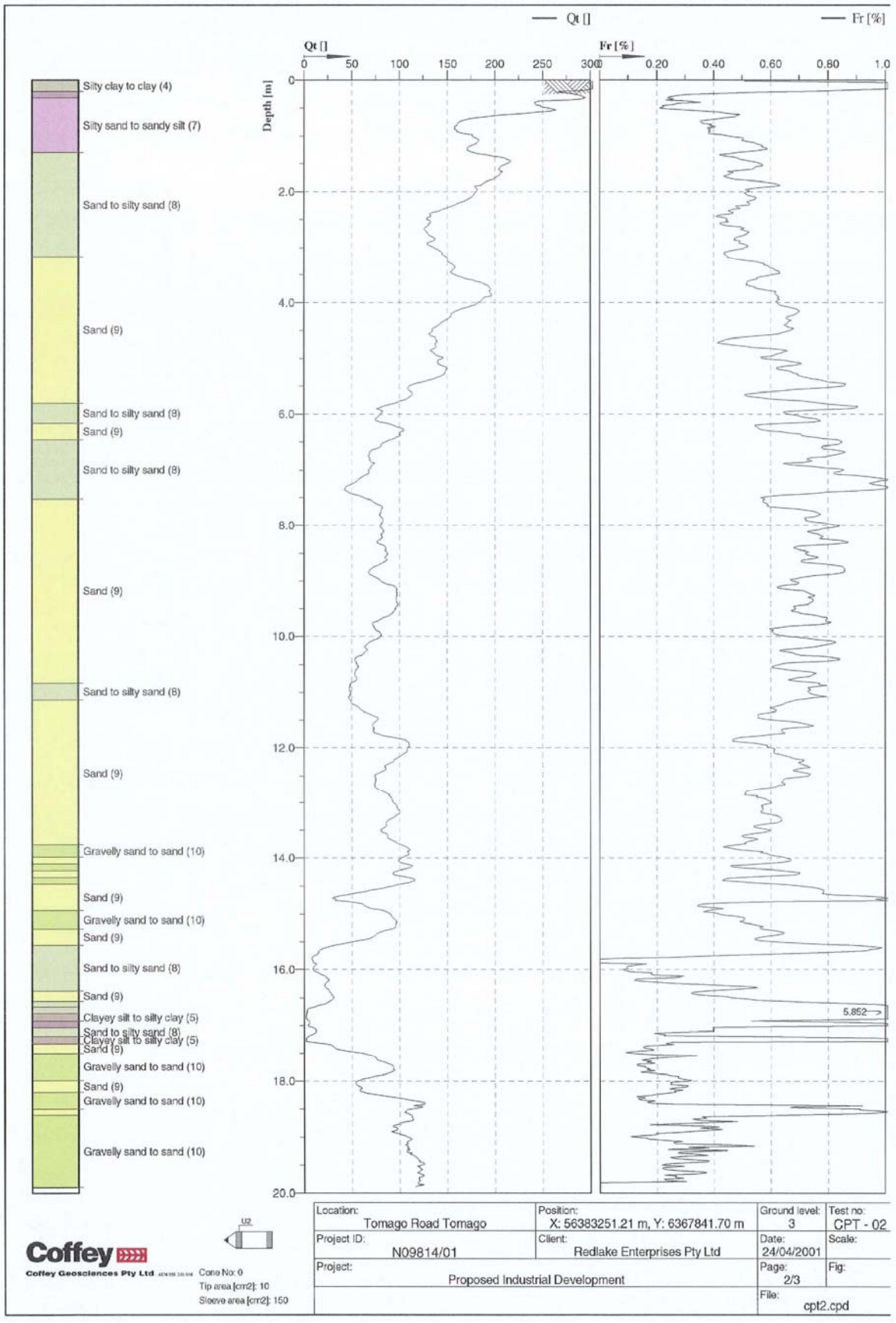
Coffey

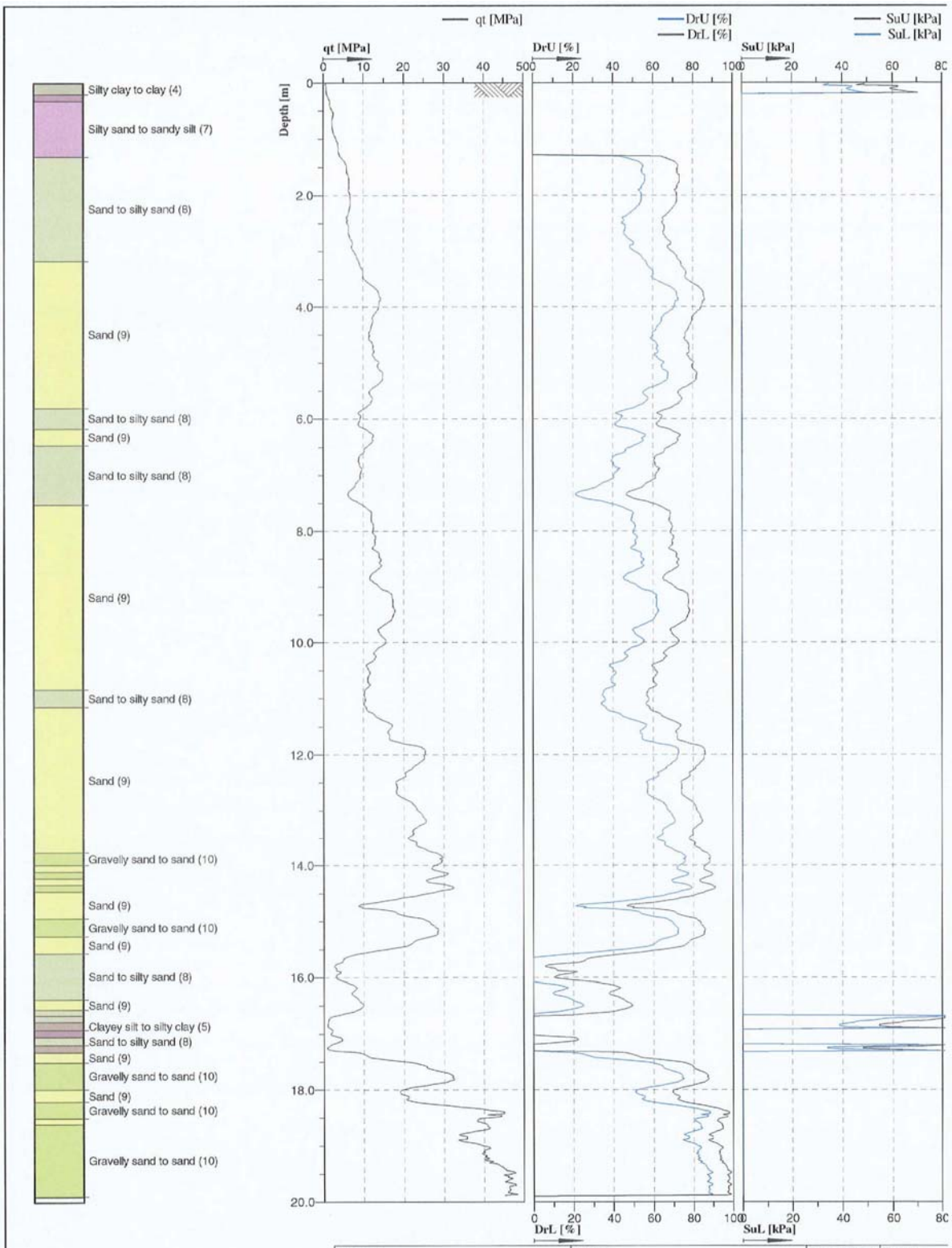
Coffey Geosciences Pty Ltd

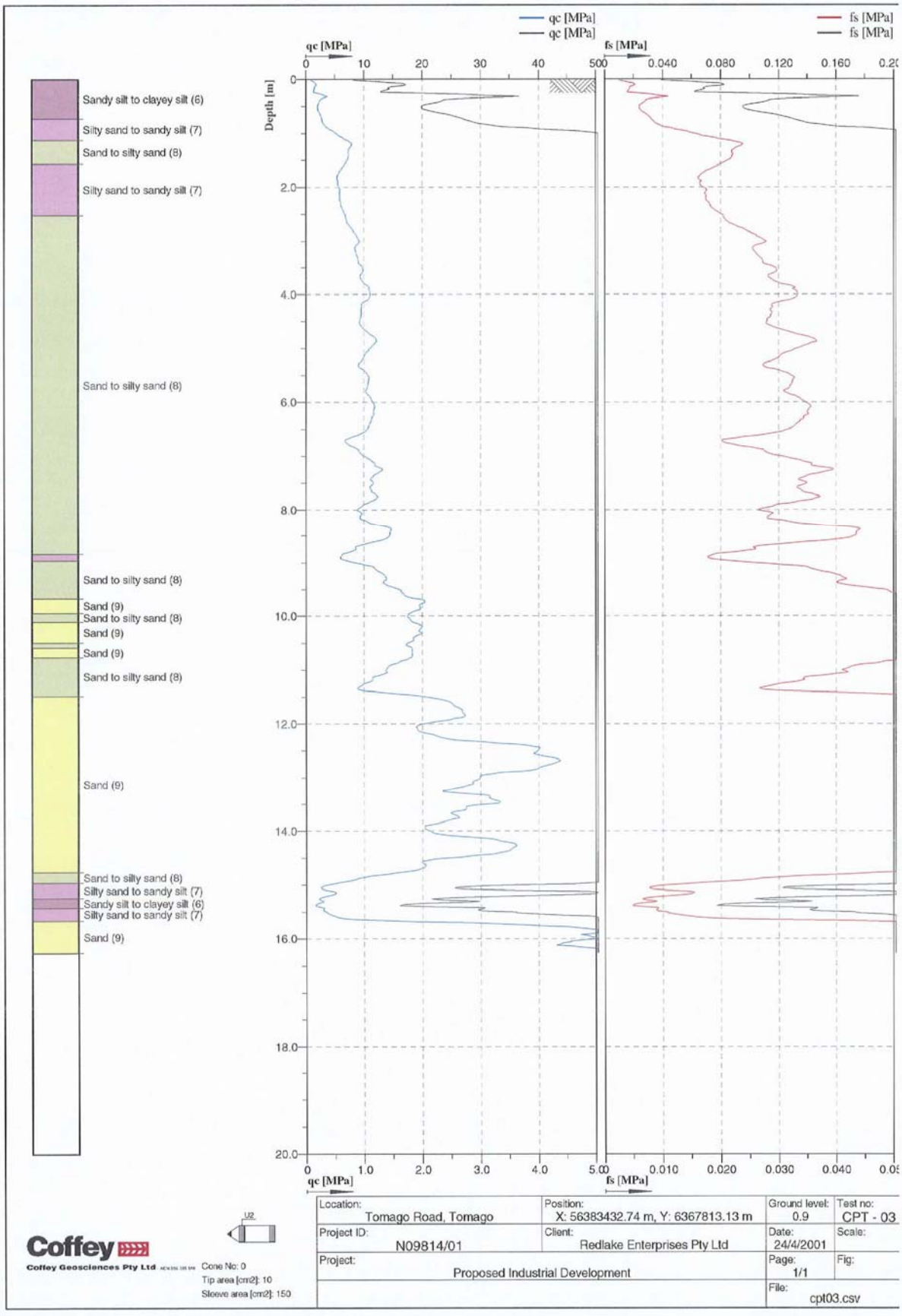
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

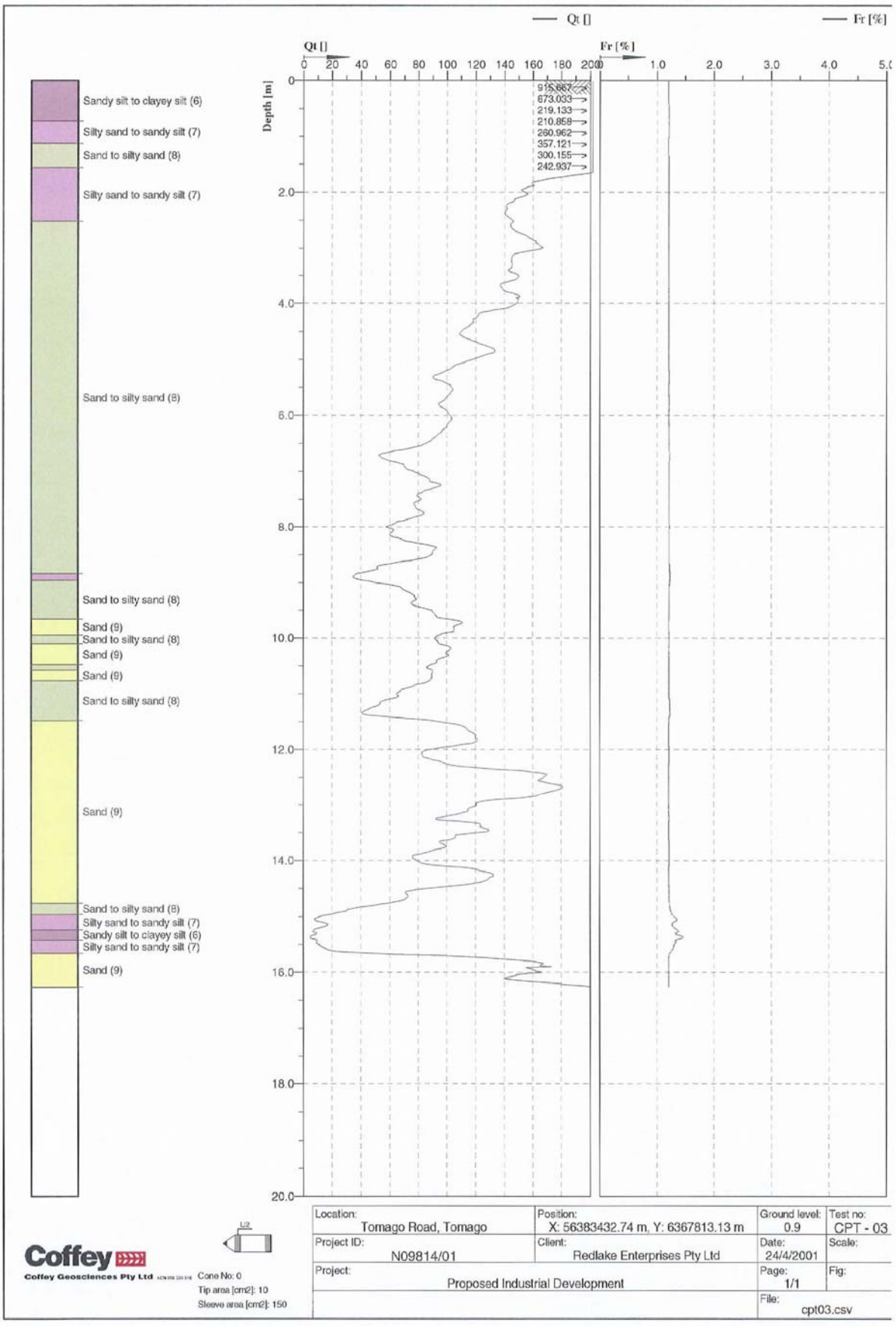
Location: Tomago Road Tomago	Position: X: 56383251.21 m, Y: 6367841.70 m	Ground level: 3	Test no: CPT - 02
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/04/2001	Scale:
Project: Proposed Industrial Development		Page: 1/3	Fig:
		File: cpt2.csv	


Qt []
Fr [%]
Qt []
Fr [%]
Depth [m]
0
50
100
150
200
250
300
0.00
0.20
0.40
0.60
0.80
1.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Clayey silt to silty clay (5)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Gravelly sand to sand (10)
5.852
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road Tomago
Position: X: 56383251.21 m, Y: 6367841.70 m
Ground level: 3
Test no: CPT - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt2.cpd


Qt []
Fr [%]
Depth [m]
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Clayey silt to silty clay (5)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Gravelly sand to sand (10)
5.852
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road Tomago
Position: X: 56383251.21 m, Y: 6367841.70 m
Ground level: 3
Test no: CPT - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt2.cpd


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand to silty sand (8)
Sand (9)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Gravelly sand to sand (10)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road Tomago
Position: X: 56383251.21 m, Y: 6367841.70 m
Ground level: 3
Test no: CPT - 02
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 3/3
Fig:
File: cpt2.csv


qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand (9)
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383432.74 m, Y: 6367813.13 m
Ground level: 0.9
Test no: CPT - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt03.csv

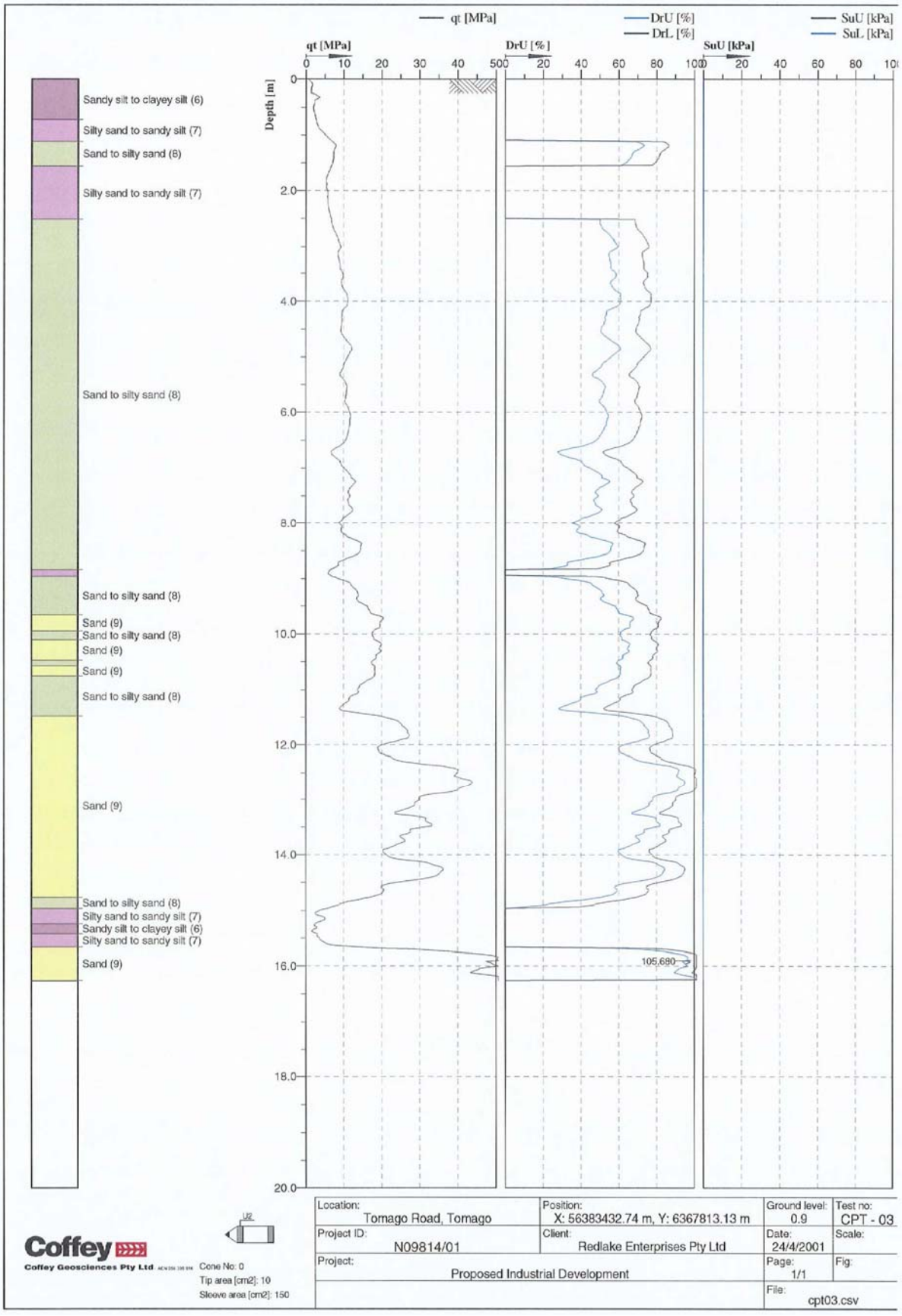


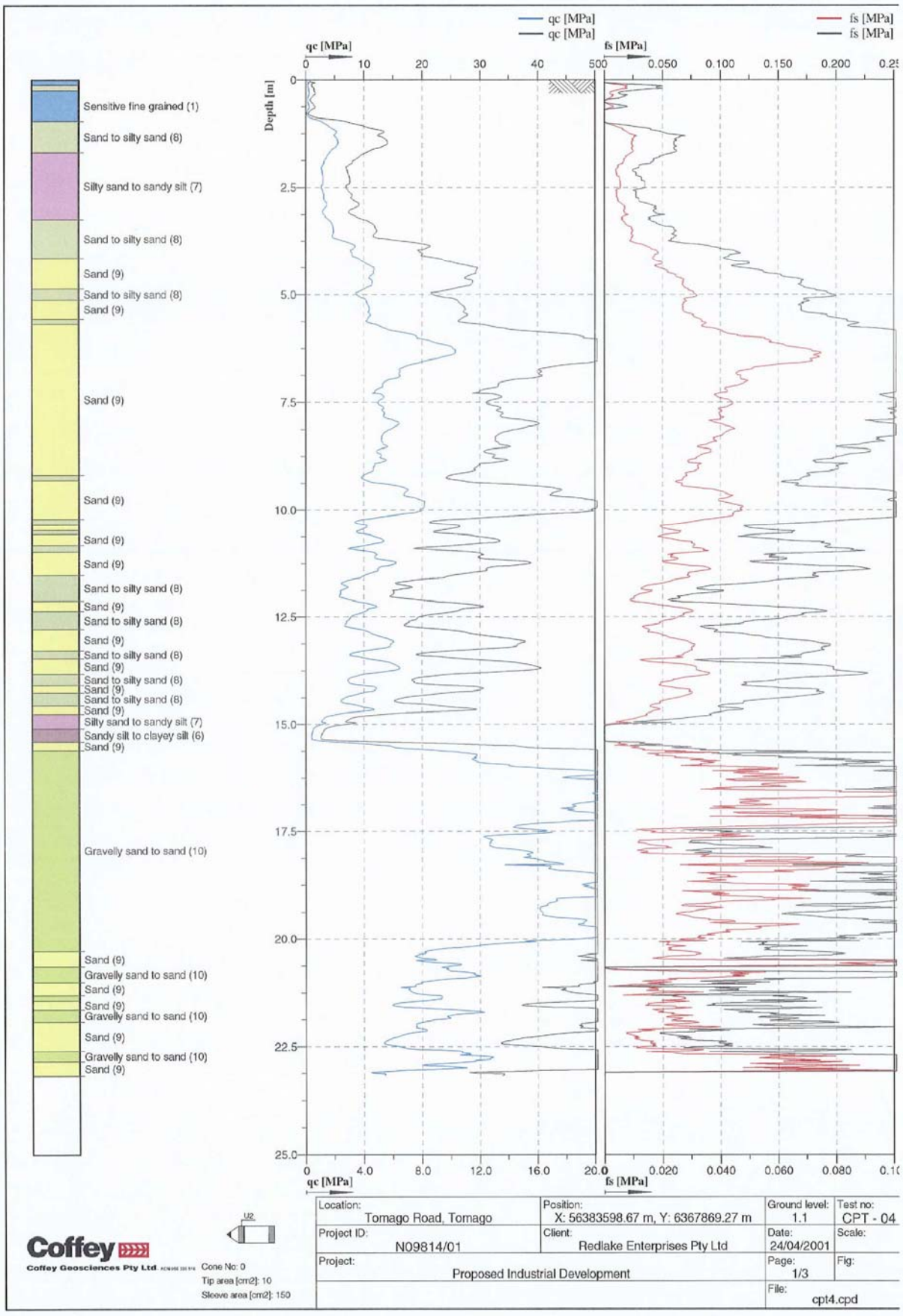
Coffey

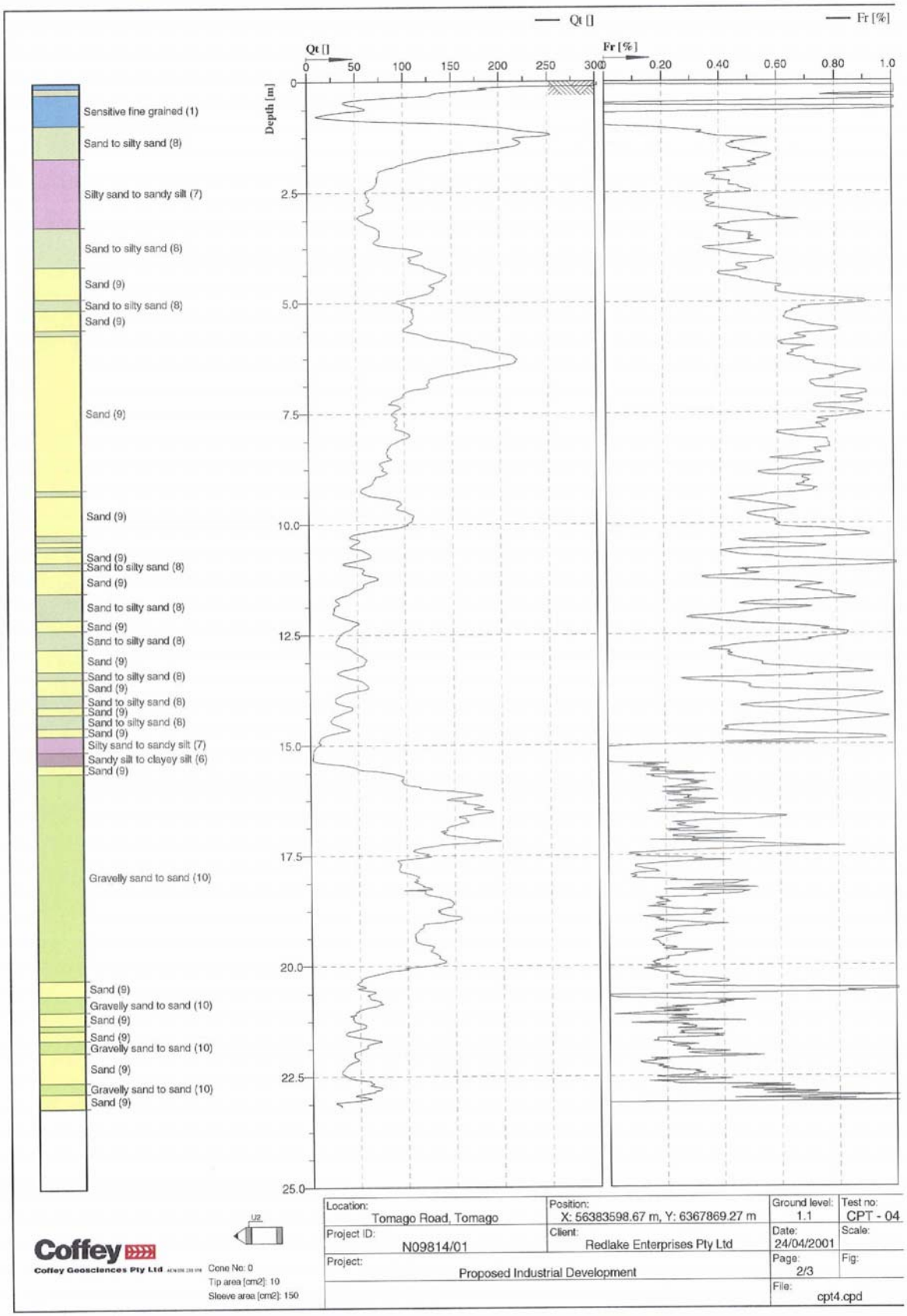
Coffey Geosciences Pty Ltd

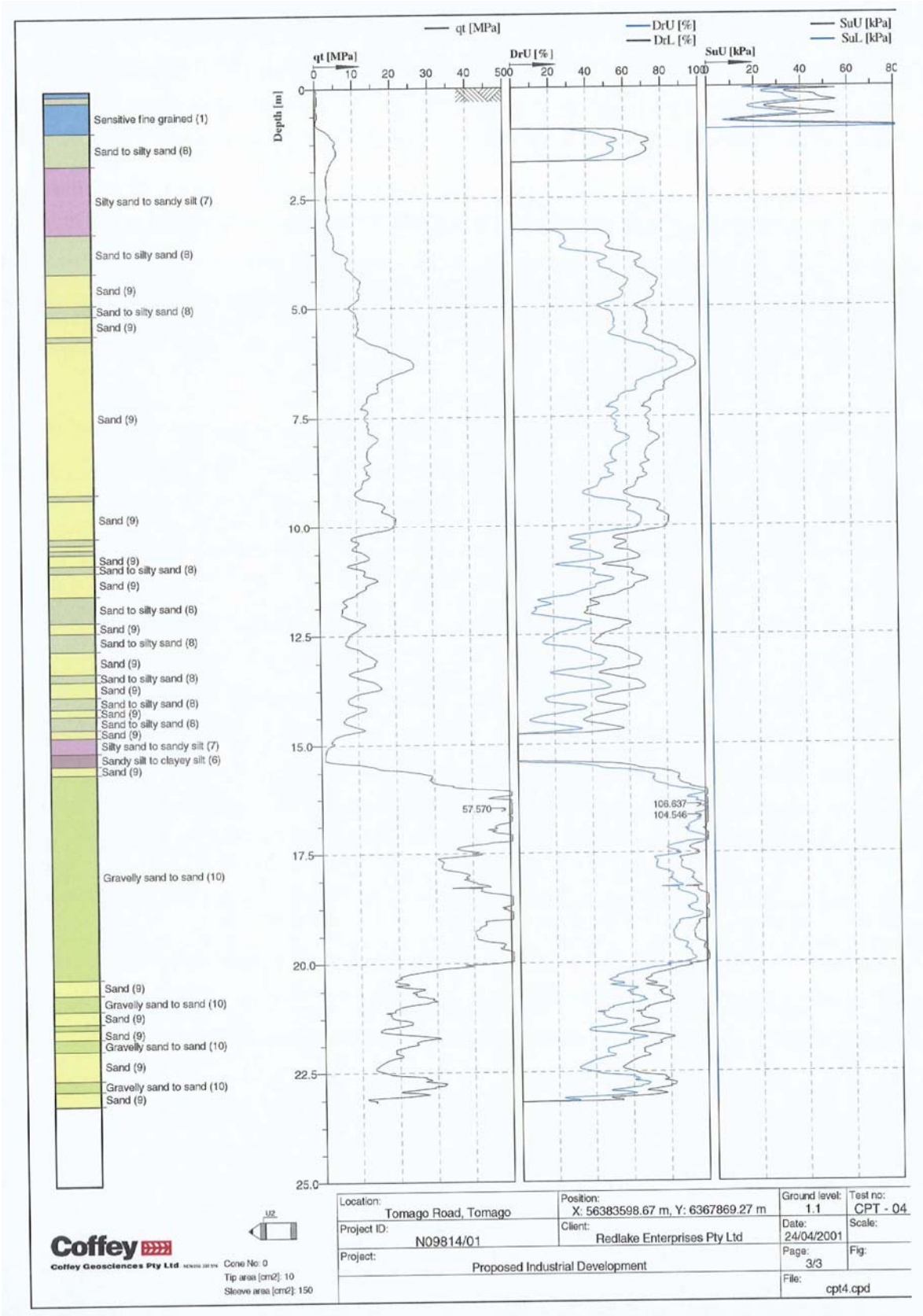
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Tip area [cm2]: 10
Sleeve area [cm2]: 150

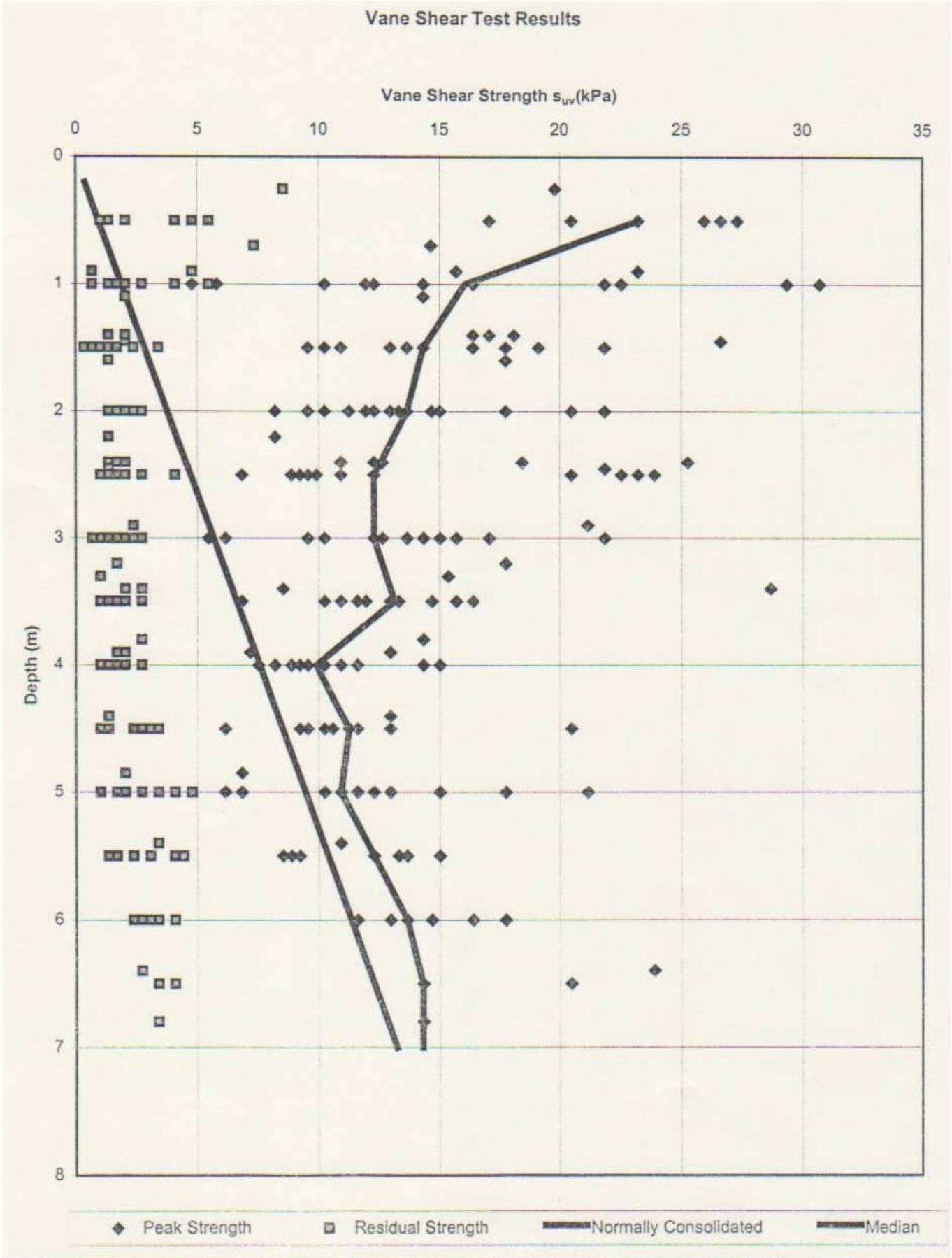
Location: Tomago Road, Tomago	Position: X: 56383432.74 m, Y: 6367813.13 m	Ground level: 0.9	Test no: CPT - 03
Project ID: N09814/01	Client: Redlake Enterprises Pty Ltd	Date: 24/4/2001	Scale:
Project: Proposed Industrial Development		Page: 1/1	Fig:
		File: cpt03.csv	


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Sand (9)
105,680
Location: Tomago Road, Tomago
Position: X: 56383432.74 m, Y: 6367813.13 m
Ground level: 0.9
Test no: CPT - 03
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/4/2001
Scale:
Project: Proposed Industrial Development
Page: 1/1
Fig:
File: cpt03.csv
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

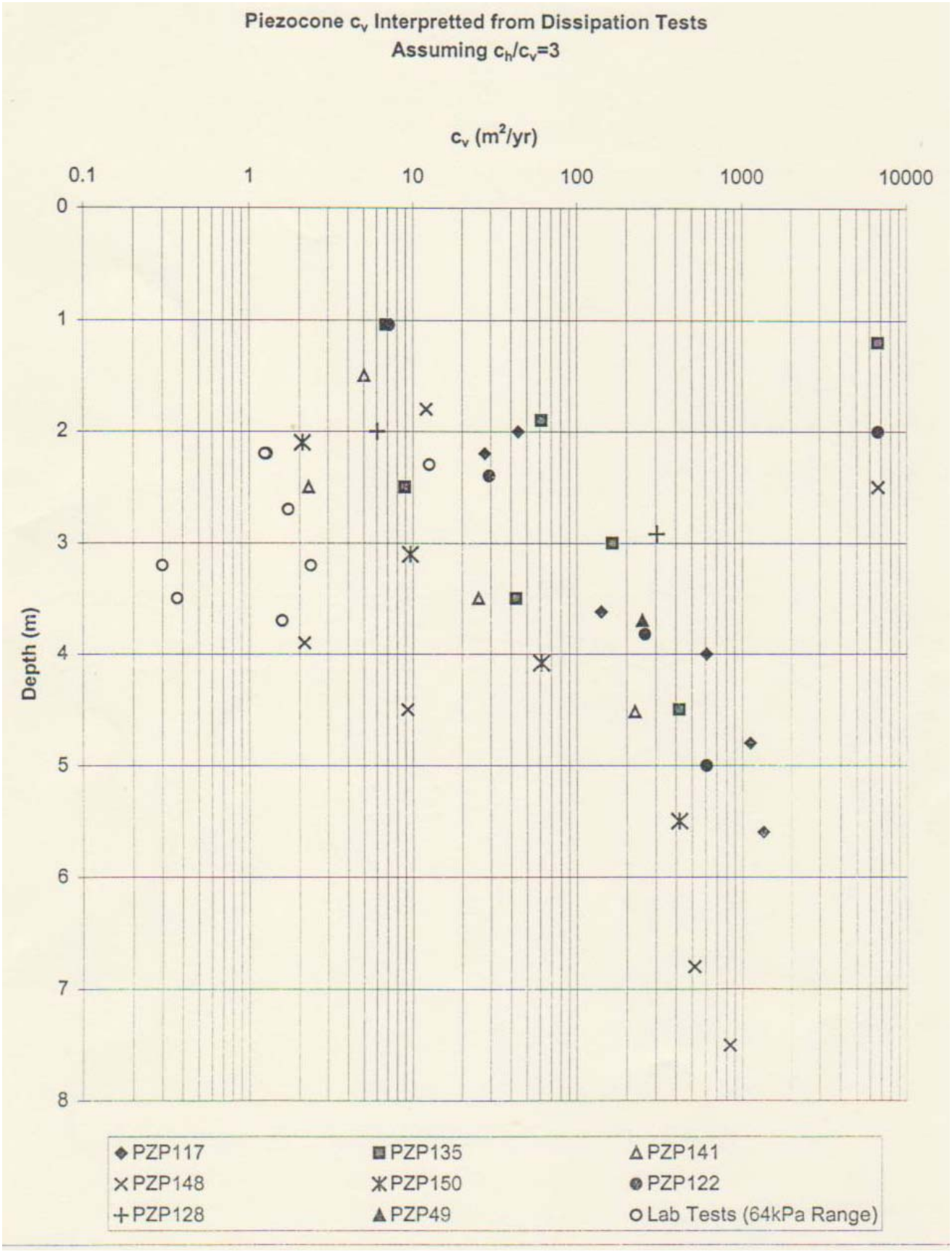

qc [MPa]
qc [MPa]
fs [MPa]
fs [MPa]
Depth [m]
Sensitive fine grained (1)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
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Sand to silty sand (8)
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Sand to silty sand (8)
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Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
0
10
20
30
40
500
0.050
0.100
0.150
0.200
0.25
0
4.0
8.0
12.0
16.0
20.0
0.020
0.040
0.060
0.080
0.1
qc [MPa]
fs [MPa]
U2
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383598.67 m, Y: 6367869.27 m
Ground level: 1.1
Test no: CPT - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 1/3
Fig:
File: cpt4.cpd


Qt []
Fr [%]
Depth [m]
Sensitive fine grained (1)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
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Sand to silty sand (8)
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Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383598.67 m, Y: 6367869.27 m
Ground level: 1.1
Test no: CPT - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 2/3
Fig:
File: cpt4.cpd


qt [MPa]
DrU [%]
DrL [%]
SuU [kPa]
SuL [kPa]
Depth [m]
Sensitive fine grained (1)
Sand to silty sand (8)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand (9)
Sand (9)
Sand (9)
Sand to silty sand (8)
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Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
Gravelly sand to sand (10)
Sand (9)
57.570
106.637
104.546
Coffey
Coffey Geosciences Pty Ltd
Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Tomago Road, Tomago
Position: X: 56383598.67 m, Y: 6367869.27 m
Ground level: 1.1
Test no: CPT - 04
Project ID: N09814/01
Client: Redlake Enterprises Pty Ltd
Date: 24/04/2001
Scale:
Project: Proposed Industrial Development
Page: 3/3
Fig:
File: cpt4.cpd



drawn	**NLS**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & de WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13-11-07**		title:	**CHART OF VANE SHEAR TEST REULTS FROM PREVIOUS INVESTIGATION**
scale	**AS SHOWN**		project no: **GEOTSGTE20301AA**	figure no: **SHEET 1**
original size	**A4**			



drawn	**NLS**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**ASQUITH & de WITT PTY LTD**
approved	RJP		project:	**PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT TOMAGO ROAD, TOMAGO**
date	**13-11-07**		title:	**ANALYSIS OF CONSOLIDATION PARAMETERS FROM PREVIOUS INVESTIGATION**
scale	**AS SHOWN**		project no: **GEOTSGTE20301AA**	figure no: **SHEET 2**
original size	**A4**			

Appendix D

Results of Laboratory Testing

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

19 Warabrook Boulevard, Warabrook, NSW, 2304
Ph: (02) 4016 2300 Fax (02) 4016 2380

test results

client : *COFFEY GEOTECHNICS*
19 WARABROOK BOULEVARD, WARABROOK NSW 2304

job no : *LABTSGTE00208AA*

principal : *ASQUITH & DE WITT PTY LTD*

laboratory : *NEWCASTLE*

project : *PROPOSED WESTRAC INDUSTRIAL DEVELOPMENT*

report date : *June 26, 2007*

location : *TOMAGO ROAD, TOMAGO* *GEOTSGTE20301AA*

test report no. : *JUNE26-01*

test procedure : *AS1289 2-1.1*

test date : *15-05-07*

SAMPLE IDENTIFICATION		MOISTURE CONTENT
TP 1	*0.5m - 0.6m*	*53.9*
TP 3	*0.5m - 0.6m*	*42.4*
TP 3	*1.6m - 1.7m*	*35.4*
TP 6	*0.5m - 0.6m*	*43.8*
TP 5	*0.5m - 0.6m*	*38.1*
TP 7	*0.5m - 0.6m*	*47.5*

remarks :

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NATA Accredited Laboratory No. 431
Approved Signatory: *Alan Cullen*

Date : *26 June 2006*

Form Number L1.UK1 Version 6.1

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coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Warabrook, Newcastle Laboratory

Coffey Geotechnics Pty Ltd
ABN 93 056 929 483
Lot 101, 19 Warabrook Boulevard
Warabrook NSW 2304

Telephone: +61 2 4016 2300
Facsimile: +61 2 4016 2380

Aggregate/Soil Test Report

Report No: MAT:WARA07S-07550
Issue No: 1
This report replaces all previous issues of report no 'MAT:WARA07S-07550'.

Client: Coffey Geotechnics (Warabrook)
19 Warabrook Boulevard
Warabrook NSW 2304
Principal: Asquith & de Witt Pty Ltd
Job No: LABTSGTE00208AA
Project: GEOTSGTE20301AA-Westrac Industrial Development
Lot No: **TRN:**

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Approved Signatory: Alan Cullen (Laboratory Manager)
NATA Accredited Laboratory Number: 431
Date of Issue: 8/11/2007

Sample Details

Sample ID: WARA07S-07550
Field Sample: 0058
Date Sampled: 19/10/2007
Source: BH104
Material: 0.60 - 1.05
Specification: No Specification
Sampling Method: AS1141.3.1 Clause 6.9.2
Location:

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	7.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	36	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	21	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

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Warabrook, Newcastle Laboratory

Coffey Geotechnics Pty Ltd
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Aggregate/Soil Test Report

Report No: MAT:WARA07S-07551
Issue No: 1
This report replaces all previous issues of report no 'MAT:WARA07S-07551'.

Client: Coffey Geotechnics (Warabrook)
19 Warabrook Boulevard
Warabrook NSW 2304
Principal: Asquith & de Witt Pty Ltd
Job No: LABTSGTE00208AA
Project: GEOTSGTE20301AA-Westrac Industrial Development
Lot No: **TRN:**

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Approved Signatory: Alan Cullen (Laboratory Manager)
NATA Accredited Laboratory Number: 431
Date of Issue: 8/11/2007

Sample Details

Sample ID: WARA07S-07551
Field Sample: 0059
Date Sampled: 19/10/2007
Source: BH116
Material: 1.50 - 1.95
Specification: No Specification
Sampling Method: AS1141.3.1 Clause 6.9.2
Location:

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	26	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	11	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

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SPECIALISTS MANAGING THE EARTH

Warabrook, Newcastle Laboratory

Coffey Geotechnics Pty Ltd
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Aggregate/Soil Test Report

Report No: MAT:WARA07S-07552
Issue No: 1
This report replaces all previous issues of report no 'MAT:WARA07S-07552'.

Client:	Coffey Geotechnics (Warabrook) 19 Warabrook Boulevard Warabrook NSW 2304
Principal:	Asquith & de Witt Pty Ltd
Job No:	LABTSGTE00208AA
Project:	GEOTSGTE20301AA-Westrac Industrial Development
Lot No:	**TRN:**

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Approved Signatory: Alan Cullen (Laboratory Manager)
NATA Accredited Laboratory Number: 431
Date of Issue: 8/11/2007

Sample Details

Sample ID:	WARA07S-07552
Field Sample:	0060
Date Sampled:	19/10/2007
Source:	BH119
Material:	0.95 - 1.40
Specification:	No Specification
Sampling Method:	AS1141.3.1 Clause 6.9.2
Location:	

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.0	
Mould Length (mm)		125	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	25	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	9	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

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Warabrook, Newcastle Laboratory

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Aggregate/Soil Test Report

Report No: MAT:WARA07S-07553
Issue No: 1
This report replaces all previous issues of report no 'MAT:WARA07S-07553'.

Client:	Coffey Geotechnics (Warabrook) 19 Warabrook Boulevard Warabrook NSW 2304
Principal:	Asquith & de Witt Pty Ltd
Job No:	LABTSGTE00208AA
Project:	GEOTSGTE20301AA-Westrac Industrial Development
Lot No:	**TRN:**

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Approved Signatory: Alan Cullen (Laboratory Manager)
NATA Accredited Laboratory Number: 431
Date of Issue: 8/11/2007

Sample Details

Sample ID:	WARA07S-07553
Field Sample:	0061
Date Sampled:	19/10/2007
Source:	BH128
Material:	1.50 - 1.95
Specification:	No Specification
Sampling Method:	AS1141.3.1 Clause 6.9.2
Location:	

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	6.5	
Mould Length (mm)		254	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	29	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	13	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

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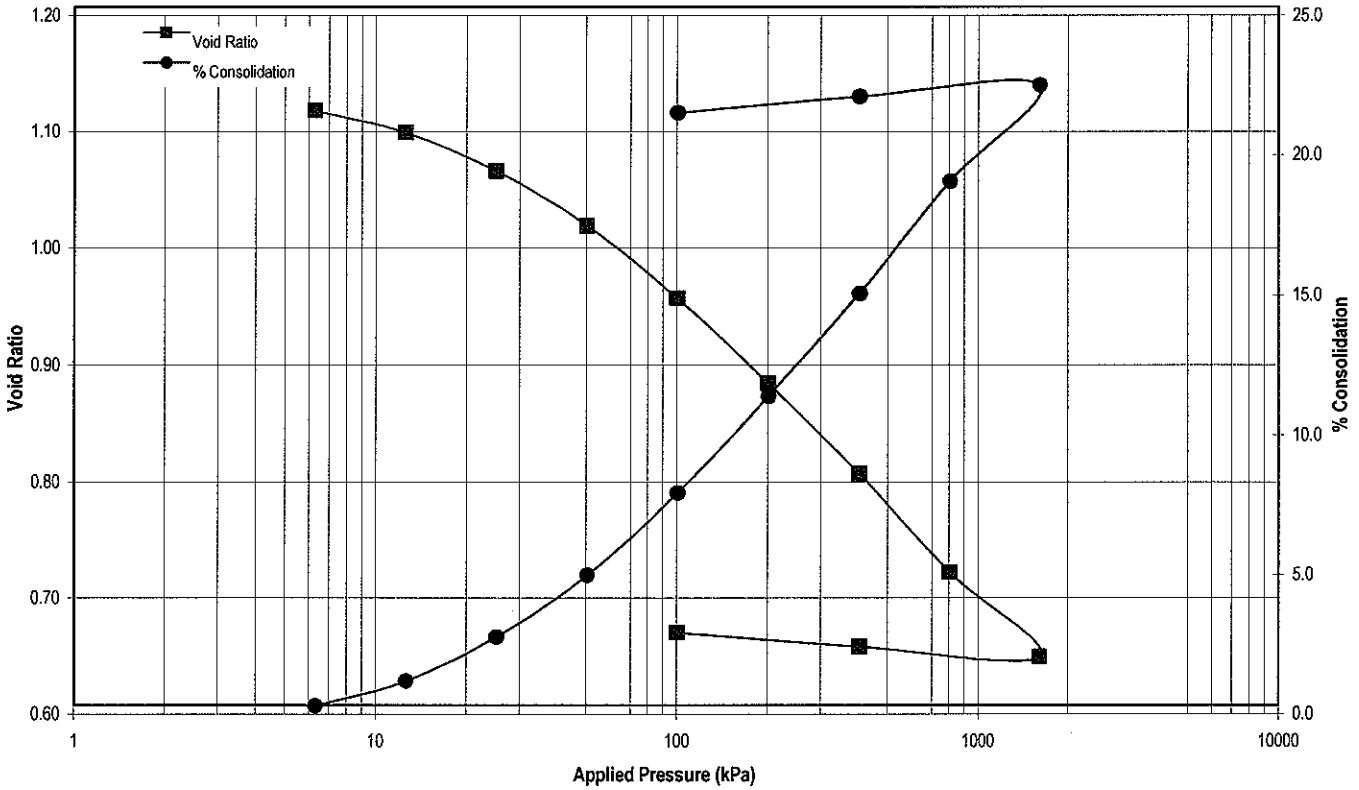
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Email: aglabs@bigpond.net.au

OEDOMETER TEST REPORT

Test Method: AS1289.6.6.1, 3.5.1

Client:	Coffey Geotechnics Pty Ltd	**Report No.:**	709016-OED
Project:	20301AA	**Test Date:**	4/09/2007
		Report Date:	20/09/2007
Client Id.:	BH 128	**Depth (m):**	0.5-0.86

Description: (CH) CLAY- grey, organics



Load (kPa)	6.25-12.5	12.5-25	25-50	50-100	100-200	200-400	400-800	800-1600	1600-400	400-100		
Cc	0.062	0.110	0.155	0.207	0.242	0.257	0.281	0.241	0.014	0.020		
Cv (m^2/yr) t_{50}	0.54	0.72	0.87	1.14	1.44	1.62	2.00	2.18	19.10	2.30		
t_{90}	0.87	1.05	1.18	1.63	1.67	2.14	3.14	5.13	376.36	261.97		
Mv ($kPa^{-1}x10^{-3}$)	1.425	1.269	0.908	0.618	0.374	0.206	0.117	0.053	0.004	0.024		
C_a x 10^{-3}	1.7	2.7	3.7	4.4	5.1	5.1	5.2	5.2	0.4	1.4		
% Consolidation	0.9	2.5	4.7	7.6	11.1	14.7	18.8	22.2	21.8	21.2		

Wet Density (t/m^3):	1.81	Initial Moisture (%):	47.0	Test Condition:	Inundated on load
Particle Density (t/m^3):	2.60	Initial Voids Ratio:	1.111	Initial Degree of Saturation (%):	110.3
Undisturbed sample supplied by the client		Remarks: Tested as received			Page 1 of 1

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Authorised Signatory

James Russell

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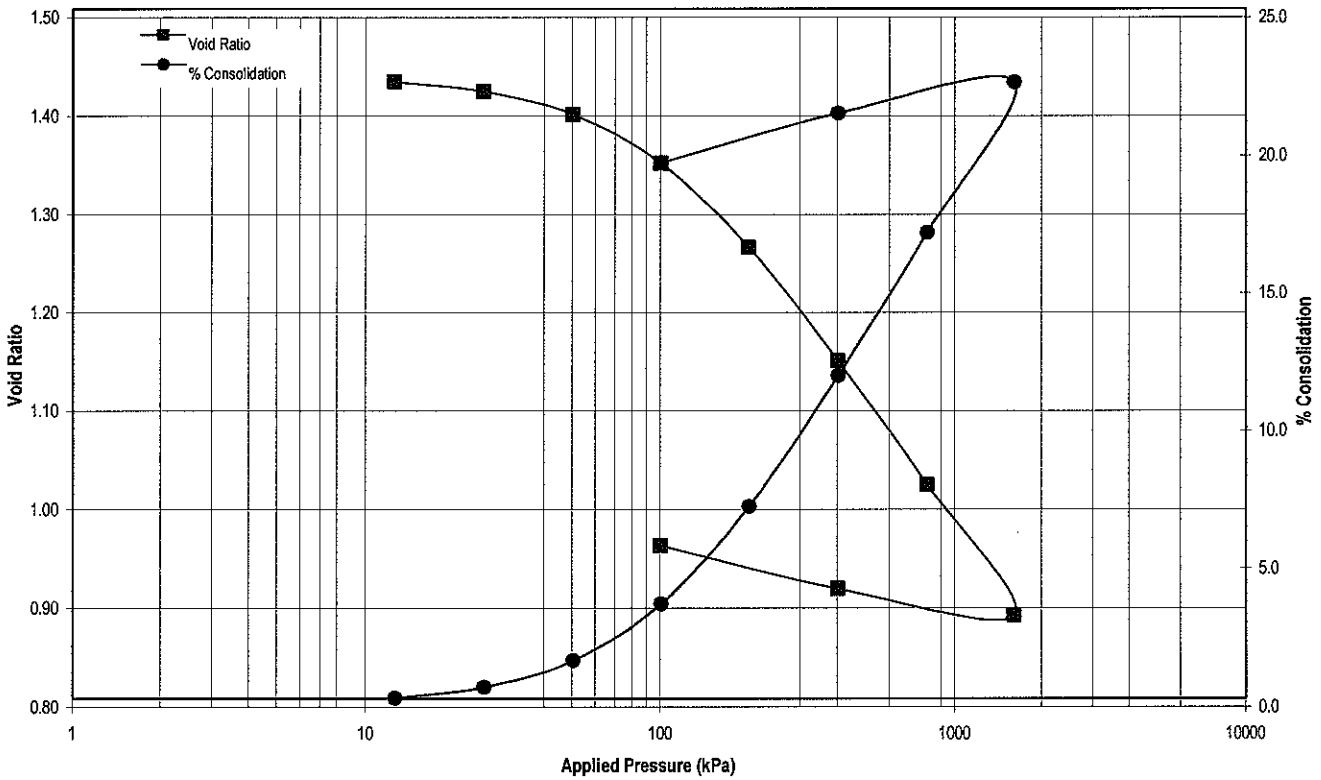
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OEDOMETER TEST REPORT

Test Method: AS1289.6.6.1, 3.5.1

Client:	Coffey Geotechnics Pty Ltd	**Report No.:**	709017-OED
Project:	20301AA	**Test Date:**	4/09/2007
		Report Date:	20/09/2007
Client Id.:	BH 119	**Depth (m):**	0.1-0.5

Description: (CH) SILTY CLAY- grey, organics



Load (kPa)	12.5-25	25-50	50-100	100-200	200-400	400-800	800-1600	1600-400	400-100			
Cc	0.032	0.078	0.165	0.284	0.383	0.419	0.439	0.045	0.072			
Cv (m^2/yr) t_{50}	1.38	1.62	2.09	1.86	1.29	1.14	0.82	1.24	0.42			
t_{90}	5.23	359.36	114.90	387.06	171.50	1.50	6.09	361.66	16.03			
Mv ($kPa^{-1}x10^{-3}$)	0.319	0.387	0.415	0.365	0.255	0.147	0.082	0.012	0.076			
C_a $x10^{-3}$	1.1	1.8	3.2	4.6	4.6	5.2	5.2	1.5	5.0			
% Consolidation	0.4	1.4	3.4	6.9	11.7	16.9	22.3	21.2	19.4			

Wet Density (t/m^3):	1.51	Initial Moisture (%):	24.5	Test Condition:	Inundated on load
Particle Density (t/m^3):	2.53	Initial Voids Ratio:	1.425	Initial Degree of Saturation (%):	50.8
Undisturbed sample supplied by the client		Remarks: Tested as received			Page 1 of 1

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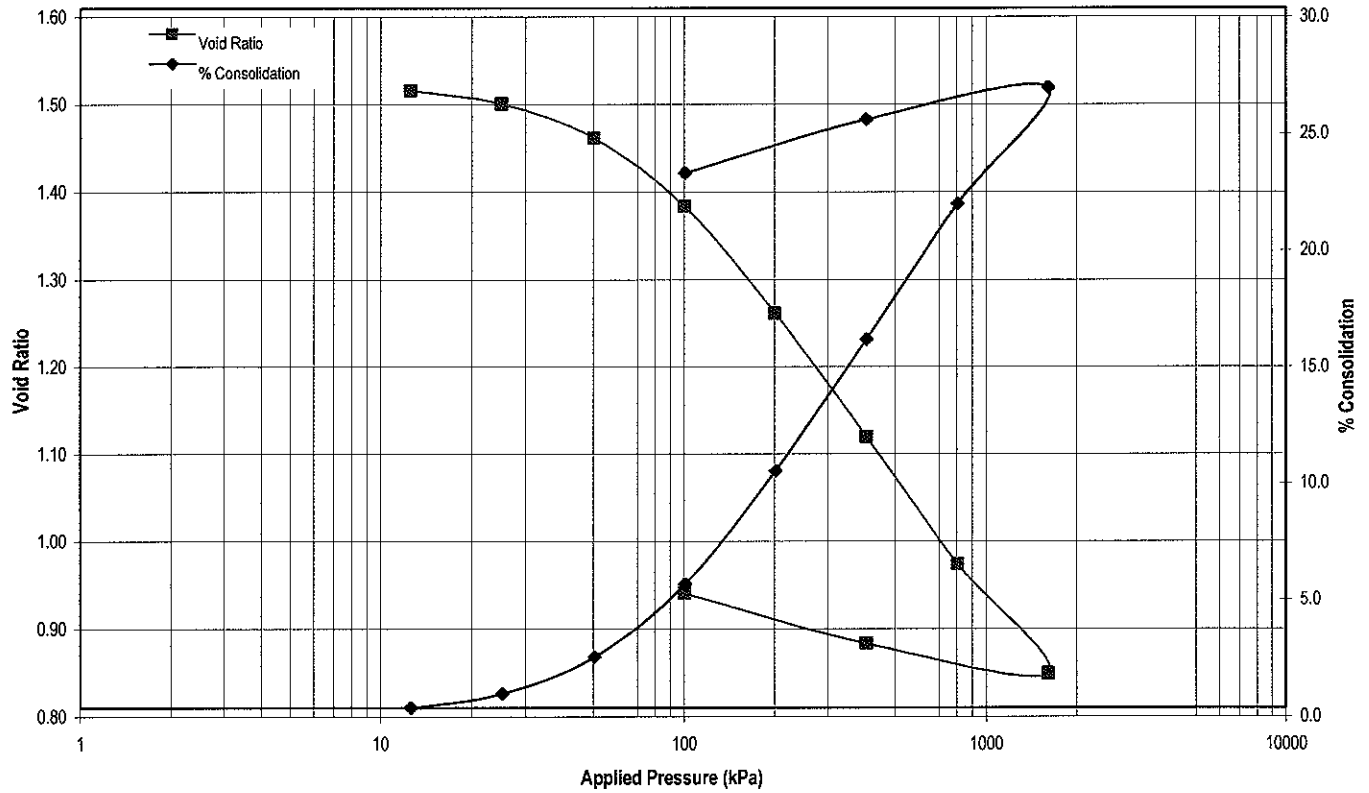
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OEDOMETER TEST REPORT

Test Method: AS1289.6.6.1, 3.5.1

Client:	Coffey Geotechnics Pty Ltd	**Report No.:**	709018-OED
Project:	20301AA	**Test Date:**	5/09/2007
		Report Date:	20/09/2007
Client Id.:	BH 116	**Depth (m):**	0.5-0.74

Description: (CH) CLAY-grey with organic matter



Load (kPa)	12.5-25	25-50	50-100	100-200	200-400	400-800	800-1600	1600-400	400-100			
Cc	0.05	0.13	0.26	0.40	0.47	0.48	0.41	0.06	0.10			
Cv (m^2/yr) t_{50}	1.44	0.87	0.65	0.42	0.45	0.42	0.44	0.80	0.34			
t_{90}	18.69	8.86	12.48	18.35	1.28	0.67	0.52	496.46	7.80			
Mv ($kPa^{-1}x10^{-3}$)	0.493	0.628	0.637	0.514	0.314	0.173	0.079	0.015	0.102			
C_a x 10^{-3}	1.2	2.8	4.4	4.5	7.2	7.0	4.3	1.3	5.1			
% Consolidation	0.6	2.2	5.3	10.2	15.8	21.6	26.6	25.2	22.9			

Wet Density (t/m^3):	1.63	Initial Moisture (%):	53.8	Test Condition:	Inundated on load
Particle Density (t/m^3):	2.66	Initial Voids Ratio:	1.505	Initial Degree of Saturation (%):	95.3
Undisturbed sample supplied by the client		Remarks:			Page 1 of 1

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J. Russell

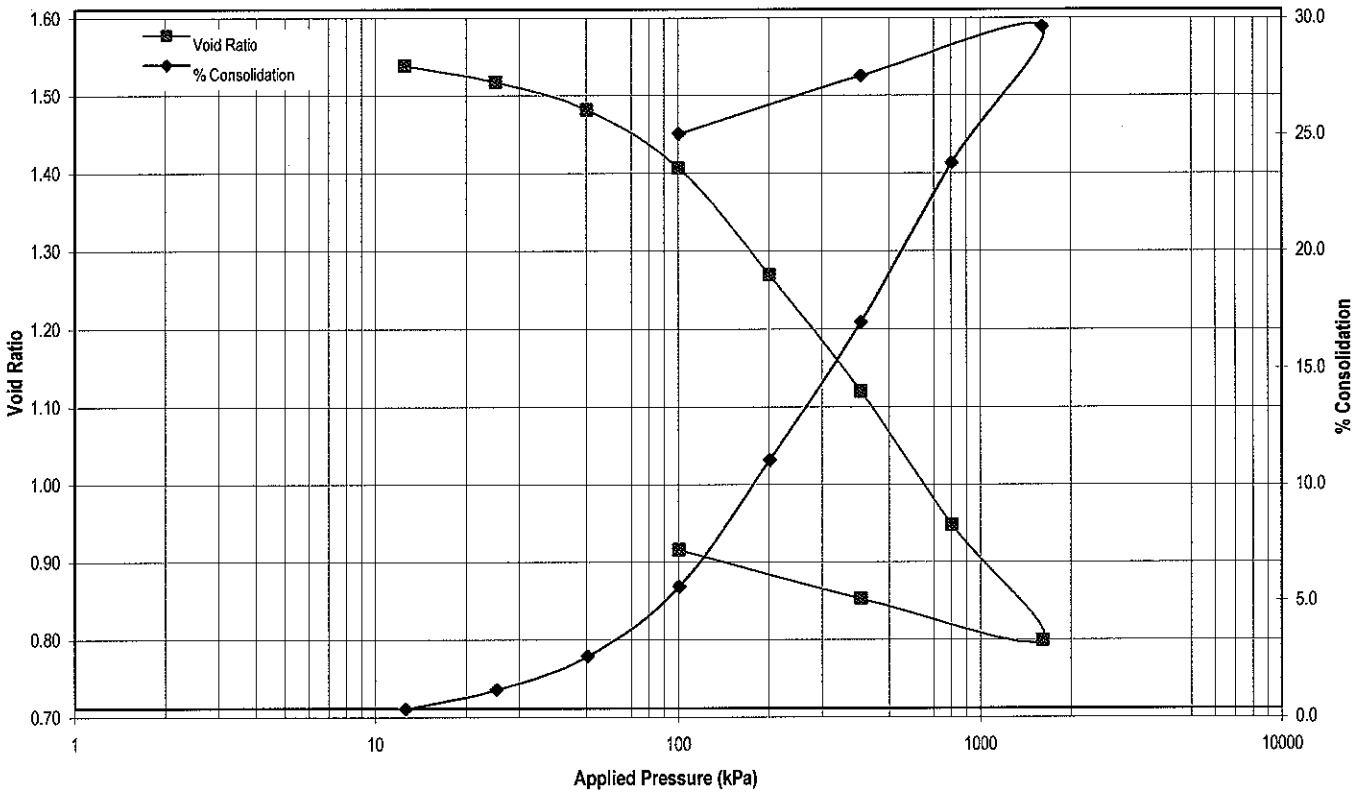
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OEDOMETER TEST REPORT

Test Method: AS1289.6.6.1, 3.5.1

Client:	Coffey Geotechnic Pty Ltd	**Report No.:**	709019-OED
Project:	20301AA	**Test Date:**	7/09/2007
		Report Date:	19/09/2007
Client Id.:	BH 104	**Depth (m):**	0.2-0.5

Description: (CH) SILTY CLAY - grey brown



Load (kPa)	12.5-25	25-50	50-100	100-200	200-400	400-800	800-1600	1600-400	400-100			
Cc	0.07	0.12	0.25	0.46	0.50	0.57	0.49	0.09	0.10			
Cv (m^2/yr) t_{50}	1.06	1.12	1.04	1.13	0.77	0.66	0.52	0.91	0.39			
t_{90}	259.80	10.32	26.38	91.61	3.05	1.38	1.12	21.65	1.79			
Mv ($kPa^{-1}x10^{-3}$)	0.661	0.578	0.611	0.573	0.331	0.204	0.096	0.025	0.114			
C_a $x10^{-3}$	1.5	2.9	4.9	6.1	6.8	7.4	8.3	1.6	6.6			
% Consolidation	0.8	2.3	5.2	10.7	16.6	23.4	29.3	27.1	24.6			

Wet Density (t/m^3):	1.65	Initial Moisture (%):	59.1	Test Condition:	Inundated on load
Particle Density (t/m^3):	2.61	Initial Voids Ratio:	1.523	Initial Degree of Saturation (%):	101.5
Undisturbed sample supplied by the client		Remarks:			Page 1 of 1

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California Bearing Ratio - Test Report

Report No: CBR:SGTE07S-02438
Issue No: 1
This report replaces all previous issues of report no ' ~~CBR:SGTE07S-02438~~*'*

Client:	Coffey Geotechnics (Sandgate) 13 Mangrove Road Sandgate NSW 2304
Principal:	Asquith & de Witt Pty Ltd
Job No:	LABTSGTE00208AA
Project:	GEOTSGTE20301AA-Westrac Industrial Development
Lot No:	**TRN:**

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Date of Issue: 12/06/2007

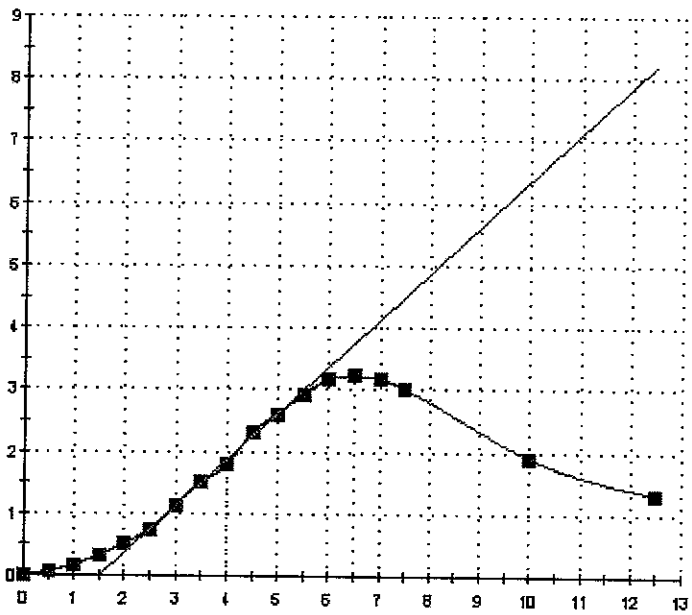
Sample Details

Product:	2.5-3.0m	**Date Sampled:**	9/05/2007
Source:	TP10	**Sampling Method:**	AS1141.3.1 Clause 6.9.2
Location:	Tomago Rd, Tomago	**Sample ID:**	SGTE07S-02438
Client Ref:	0017		

Test Results

Description	Result
Maximum Dry Density (t/m3)	1.712
Optimum Moisture Content (%)	19.3
Preparation	Soaked
CBR 2.5mm	14
CBR 5.0mm	**16**
Test Method	AS 1289.6.1.1
Initial Moisture Content (%)	18.5
Dry Density (t/m3)	1.615
Swell (%)	-0.5
Moisture after penetration (%)	17.3
Period of soaking	4
Moisture Content of top 30mm (%)	18.1
Compaction type	Std
Surcharge mass	4.5
Laboratory Moisture Ratio after compaction (%):	121
Laboratory Density Ratio after compaction (%):	94
Material retained on 19mm sieve excluded:	NO
Mass of material retained on sieve (%):	0.0

Chart



Comments

(SM) Silty SAND, Fine-coarse, grey.
FMC - 5.4%

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California Bearing Ratio - Test Report

Report No: CBR:SGTE07S-02439
Issue No: 1
This report replaces all previous issues of report no ' CBR:SGTE07S-02439 '.

Client:	Coffey Geotechnics (Sandgate) 13 Mangrove Road Sandgate NSW 2304
Principal:	Asquith & de Witt Pty Ltd
Job No:	LABTSGTE00208AA
Project:	GEOTSGTE20301AA-Westrac Industrial Development
Lot No:	**TRN:**

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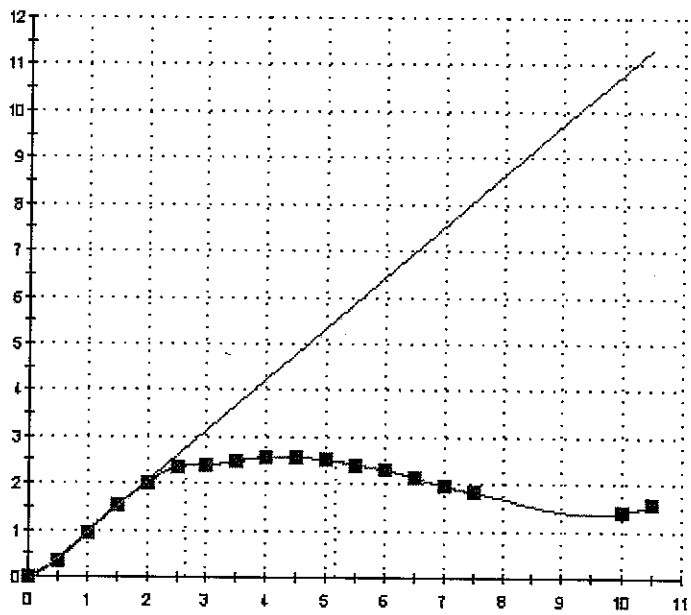
Sample Details

Product:	1.5-2.0m	**Date Sampled:**	9/05/2007
Source:	TP11	**Sampling Method:**	AS1141.3.1 Clause 6.9.2
Location:	Tomago Rd, Tomago	**Sample ID:**	SGTE07S-02439
Client Ref:	0018		

Test Results

Description	Result
Maximum Dry Density (t/m3)	1.663
Optimum Moisture Content (%)	20.0
Preparation	Soaked
CBR 2.5mm	**18**
CBR 5.0mm	13
Test Method	AS 1289.6.1.1
Initial Moisture Content (%)	18.9
Dry Density (t/m3)	1.629
Swell (%)	-1.0
Moisture after penetration (%)	20.3
Period of soaking	4
Moisture Content of top 30mm (%)	19.1
Compaction type	Std
Surcharge mass	4.5
Laboratory Moisture Ratio after compaction (%):	96
Laboratory Density Ratio after compaction (%):	98
Material retained on 19mm sieve excluded:	NO
Mass of material retained on sieve (%):	0.0

Chart



Comments

(SM) Silty SAND, fine-corase, white.
FMC - 4.4%

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California Bearing Ratio - Test Report

Report No: CBR:WARA07S-03772
Issue No: 1
This report replaces all previous issues of report no ~~CBR:WARA07S-03772~~.

Client: Coffey Geotechnics (Warabrook)
19 Warabrook Boulevard
Warabrook NSW 2304
Principal: Asquith & de Witt Pty Ltd
Job No: LABTSGTE00208AA
Project: GEOTSGTE20301AA-Westrac Industrial Development
Lot No: **TRN:**

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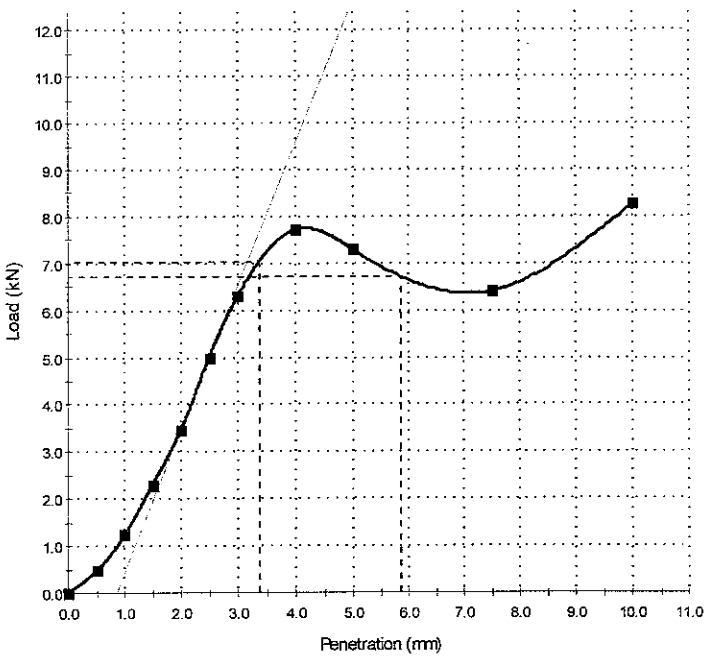
Product: 0.6-1.0m
Source: BH3
Location: Tomago Rd, Tomago
Client Ref: 0020

Date Sampled: 26/06/2007
Sampling Method: AS1289.1.3.1 Clause 5.5(a)
Sample ID: WARA07S-03772

Test Results

Description	Result
Test Method	RTA T117
Maximum Dry Density (t/m³)	1.900
Optimum Moisture Content (%)	9.7
CBR 2.5mm (%)	**50**
CBR 5.0mm (%)	35
Preparation	Soaked
Initial Moisture Content (%)	8.8
Achieved Dry Density (t/m³)	1.920
Achieved Moisture Content (%)	8.8
Swell (%)	0.0
Moisture After Penetration (%)	10.6
Period of Soaking (days)	10
Moisture Content of Top 30mm (%)	10.9
Moisture of Penetrated End (%)	
Compaction Type	Std
Oversize Material Excluded	YES
Percent Oversize Excluded	4.8

Chart



CBR (%): 50

Rate of Penetration

Comments

(SP) Silty Sand - Fine to Coarse Sand, Brown
FMC = 6.1%

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California Bearing Ratio - Test Report

Report No: CBR:WARA07S-03774
Issue No: 1
This report replaces all previous issues of report no ~~CBR:WARA07S-03774~~.

Client:	Coffey Geotechnics (Warabrook) 19 Warabrook Boulevard Warabrook NSW 2304
Principal:	Asquith & de Witt Pty Ltd
Job No:	LABTSGTE00208AA
Project:	GEOTSGTE20301AA-Westrac Industrial Development
Lot No:	**TRN:**

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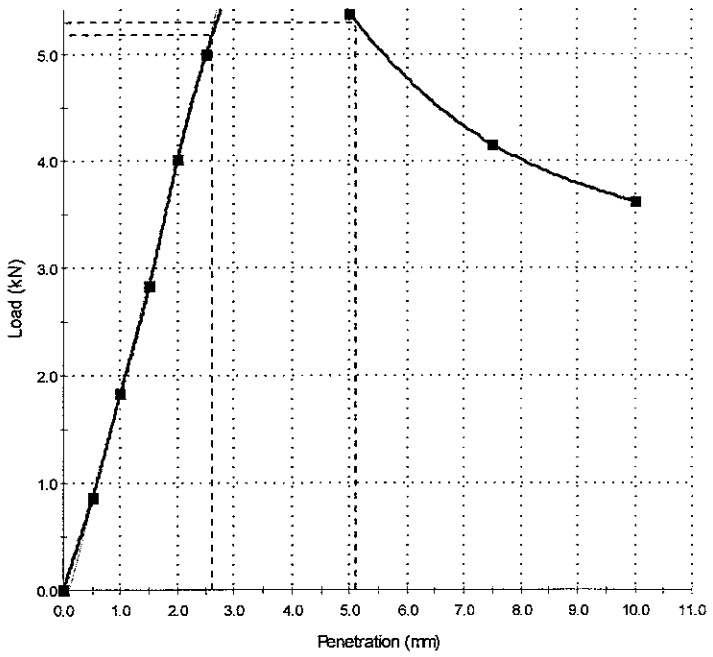
Sample Details

Product:	0.4-0.9m	**Date Sampled:**	26/06/2007
Source:	BH5	**Sampling Method:**	AS1289.1.3.1 Clause 5.5(a)
Location:	Tomago Rd, Tomago	**Sample ID:**	WARA07S-03774
Client Ref:	0022		

Test Results

Description	Result
Test Method	RTA T117
Maximum Dry Density (t/m³)	1.830
Optimum Moisture Content (%)	12.7
CBR 2.5mm (%)	**40**
CBR 5.0mm (%)	25
Preparation	Soaked
Initial Moisture Content (%)	11.6
Achieved Dry Density (t/m³)	1.860
Achieved Moisture Content (%)	11.6
Swell (%)	-0.5
Moisture After Penetration (%)	12.6
Period of Soaking (days)	10
Moisture Content of Top 30mm (%)	12.4
Moisture of Penetrated End (%)	
Compaction Type	Std
Oversize Material Excluded	YES
Percent Oversize Excluded	5.1

Chart



CBR (%): 40

Rate of Penetration

Comments

(SP) Gravelly SAND - Fine to Coarse Sand, Brown, Fine to Medium Gravel
FMC = 3.8%

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Appendix E

Results of Acid Sulfate Soils Testing

RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 1 of 1)

8 samples supplied by Coffey on 22nd May, 2007 - Lab. Job No. E7358

Analysis requested by Robert Pearce. - **Your Project: ASQUITH & DE WITT P/L**

Sample Site	Depth (m)	EAL lab code	Texture (note 6)	Moisture Content (% moisture)	Lab. Bulk Density tonne DW/m^3	TAA pH_{KCl}	Titratable Actual Acidity (TAA) mole H^+/tonne (to pH 6.5)	Reduced Inorganic Sulfur (% chromium reducible S) (%Scr) (note 2)	Reduced Inorganic Sulfur (Scr) mole H^+/tonne	NET ACIDITY Chromium Suite mole H^+/tonne (based on %Scrs)	LIME CALCULATION Chromium Suite kg $CaCO_3/m^3$ (includes 1.5 safety Factor)
Method No:						*23A*	*23F*	*22B*	*a- 22B*	*note 5*	*note 5*
TP 101	3.4-3.5	*E7358/1*	Fine	30.2	1.2	4.12	44	0.508	317	361	31
TP 102	1.4-1.5	*E7358/2*	Fine	22.4	1.3	4.01	51	0.013	8	59	6
TP 103	1.7-1.7	*E7358/3*	Medium	25.6	1.5	8.00	0	0.550	343	343	38
TP 104	3.5-3.6	*E7358/4*	Coarse	20.1	1.5	6.41	1	0.115	72	73	8
TP 105	2.1-2.2	*E7358/5*	Medium	27.9	1.3	7.99	0	0.670	418	418	41
TP 106	1.5-1.6	*E7358/6*	Coarse	18.7	1.7	5.70	6	0.002	1	7	1
TP 107	2.0-2.1	*E7358/7*	Medium	31.9	1.1	7.92	0	0.595	371	371	30
TP 114	2.5-2.6	*E7358/8*	Coarse	19.5	1.6	5.06	15	0.192	120	135	16

NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (Scr - Method 22B)

3 - Methods from Ahern, CR, McElnea AE , Sullivan LA (2004). ***Acid Sulfate Soils Laboratory Methods Guidelines.*** QLD DNRME.

4 - Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

5 - **ABA Equation: Net Acidity = Potential Sulfidic Acidity (ie. Scrs or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF**

6 - For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays

7 - .. Denotes not requested or required

8 - CRS, TAA and ANC are NATA certified but other SPOCAS segments are currently not NATA certification

9- Results at or below detection limits are replaced with '0' for calculation purposes.

10 - Projects that disturb >1000 tonnes of soil, the ≥0.03% S classification guideline would apply.

Lab. Accred. No.: 14960

(Classification of potential acid sulfate material if: coarse Scr≥0.03%S or 19mole H+/t; medium Scr≥0.06%S or 37mole H+/t; fine Scr≥0.1%S or 62mole H+/t)

checked: .....

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20301AA
sheet 1 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *ASQUITH & DE WITT*
date: *17.5.07*
principal:
test location: *NEWCASTLE LABORATORY*
project: *LABTSGTE00208AA*
tested by: *GE*
location: *PROPOSED WESTRAC INDUSTRIAL ESTATE*
checked by:

date samples recovered:
pH meter used/serial no: HORBIA
date of calibration: *17.5.07*
hydrogen peroxide pH prior to use: *5.19*
hydrogen peroxide temperature prior to use: *23.9*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP101	0.5-0.6		Clay	5.45	10	3.41	27.0	B	N	N	2.04	
TP101	1.3-1.4		Silty Sand	6.00	10	3.14	94.0	C	N	Brown-Yellow	2.86	
TP101	2.4-2.5		Silt	4.45	2	2.47	90.0	C	Y	Brown-pale brown	1.98	Strong smoke
TP101	3.4-3.5		Silt	3.95	5	2.22	91.1	C	Y	Brown-pale brown	1.73	Strong smoke
TP102	0.5-0.6		Clay	6.39	10	4.11	25.0	B	N		0.94	
TP102	1.4-1.5		Silty Clay	3.78	10	2.99	90.9	C	Y	Brown-pale brown	0.79	Strong smoke
TP102	2.5-2.6		Sand	5.9	10	1.92	28.9	A	N	N	3.98	Slight bubbles
TP102	3.1-3.2		Sand	4.87	10	1.83	90.9	C	Y	Brown-pale brown	3.04	Strong smoke
TP103	0.5-0.6		Clay	6.31	10	5.06	28.9	A	N	N	1.25	Slight bubbles
TP103	1.5-1.6		Silty Sand	6.50	10	3.11	35.0	B	N		3.30	

NOTES:
1. **Observed Reaction:** a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. **Strong Odour:**

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SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20301AA
sheet 2 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *ASQUITH & DE WITT*
date: *17.5.07*
principal:
test location: *NEWCASTLE LABORATORY*
project: *LABTSGTE00208AA*
tested by: *GE*
location: *PROPOSED WESTRAC INDUSTRIAL ESTATE*
checked by:

date samples recovered: pH meter used/serial no: HORBIA date of calibration: *17.5.07*

hydrogen peroxide pH prior to use: *5.19* hydrogen peroxide temperature prior to use: *23.9*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP103	*1.6-1.7*		*Sand*	*7.39*	*10*	*2.48*	*90.7*	*C*	*Y*	Brown-pale brown	*4.91*	Strong smoke
TP103	*2.8-2.9*		*Sand*	*7.45*	*10*	*2.88*	*89.6*	*C*	*Y*	Brown-pale brown	*4.57*	Strong smoke
TP103	*3.0-3.1*		*Silty Clay*	*6.05*	*10*	*2.28*	*75.0*	*C*	*N*		*4.11*	
TP104	*0.5-0.6*		*Clay*	*5.96*	*10*	*4.80*	*24.0*	*B*	*N*		*1.16*	
TP104	*1.6-1.7*		*Sand*	*5.05*	*10*	*1.77*	*28.0*	*B*	*N*		*4.38*	
TP104	*3.5-3.6*		*Sand*	*6.12*	*10*	*1.78*	40.9	B	N	Brown-pale brown	4.34	
TP104	*2.5-2.6*		*Sand*	*6.04*	*10*	*1.86*	37.9	B	N	Brown-pale brown	4.18	
TP105	*0.5-0.6*		*Clay*	*6.76*	*10*	*2.37*	90.7	B	2	Brown-Pale Brown	4.39	Strong Smoke
TP105	*1.5-1.6*		*Clay Silt*	*7.12*	*10*	*1.98*	91.7	B	2	Brown-Pale Brown	5.15	Smoke
TP105	*2.1-2.2*		*Clay Silt*	*7.26*	*10*	*2.58*	91.2	B	2	Brown-Pale Brown	4.68	Strong Smoke

NOTES: 1. **Observed Reaction:** a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. **Strong Odour:**

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SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20301AA
sheet 3 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *ASQUITH & DE WITT* date: *17.5.07*

principal: test location: *NEWCASTLE LABORATORY*

project: *LABTSGTE00208AA* tested by: *GE*

location: *PROPOSED WESTRAC INDUSTRIAL ESTATE* checked by:

date samples recovered: pH meter used/serial no: HORBIA date of calibration: *17.5.07*

hydrogen peroxide pH prior to use: *5.19* hydrogen peroxide temperature prior to use: *23.9*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP106	*0.5-0.6*		*Clay*	*5.01*	*10*	*3.72*	27.0	A	1	N	1.29	
TP106	*1.5-1.6*		*Sand*	*5.96*	*10*	*2.93*	89.4	B	2	Brown-Pale Brown	3.03	Strong Smoke
TP106	*2.3-2.4*		*Sand*	*5.04*	*10*	*2.48*	47.5	B	2	Brown-Pale Brown	2.86	Strong Smoke
TP106	*3.0-3.1*		*Clay*	*5.81*	*10*	*2.30*	89.8	B	2	Brown-Pale Brown	3.51	Strong Smoke
TP107	*0.5-0.6*		*Clay*	*6.95*	*10*	*4.89*	45.0	B	1	N	2.06	Slight Effervescence
TP107	*1.4-1.5*		*Clay*	*6.75*	*10*	*3.55*	47.0	B	1	N	3.20	Slight Effervescence
TP107	*2.0-2.1*		*Clay Silt*	*7.43*	*10*	*2.43*	49.0	B	2	Brown-Pale Brown	5.00	Strong Smoke
TP108	*0.5-0.6*		*Sand*	*6.09*	*10*	*4.39*	25.2	A	N		1.70	
TP108	*1.4-1.5*		*Sand*	*5.79*	*10*	*4.32*	22.7	B	N	N	1.47	Slight bubbles
TP108	*2.6-3.0*		*Sand*	*5.78*	*10*	*5.02*	22.3	A	N	N	0.76	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20301AA
sheet 4 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *ASQUITH & DE WITT* date: *17.5.07*

principal: test location: *NEWCASTLE LABORATORY*

project: *LABTSGTE00208AA* tested by: *GE*

location: *PROPOSED WESTRAC INDUSTRIAL ESTATE* checked by:

date samples recovered: pH meter used/serial no: HORBIA date of calibration: *17.5.07*

hydrogen peroxide pH prior to use: *5.19* hydrogen peroxide temperature prior to use: *23.9*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP109	*0.5-0.6*		*Sand*	*5.20*	*10*	*3.75*	22.0	A	N	N	1.45	
TP109	*1.4-1.5 BS*		*Sand*	*5.97*	*10*	*5.20*	22.5	A	N	N	0.77	
TP109	*2.5-2.6*		*Sand*	*6.40*	*10*	*5.23*	25.3	B	N		1.17	
TP110	*0.5-0.6*		*Sand*	*6.82*	*10*	*4.91*	32.0	C	N		1.91	
TP111	*0.5-0.6*		*Sand*	*6.01*	*10*	*4.91*	23.4				1.10	
TP111	*2.5-3.0*		*Sand*	*5.57*	*10*	*4.23*	23.5				1.34	
TP112	*0.5-0.6*		*Sand*	*5.94*	*10*	*5.07*	24.9	B	N		0.87	
TP112	*0.5-0.6*		*Sand*	*5.61*	*10*	*4.73*	23.4				0.88	
TP112	*1.4-1.5*		*Sand*	*5.81*	*10*	*5.20*	21.6	A	N	N	0.61	
TP112	*2.1-2.2*		*Sand*	*6.35*	*10*	*5.55*	23.4	A	N		0.8	

NOTES: 1. **Observed Reaction:** a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. **Strong Odour:**

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SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20301AA
sheet 5 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *ASQUITH & DE WITT*
date: *17.5.07*
principal:
test location: *NEWCASTLE LABORATORY*
project: *LABTSGTE00208AA*
tested by: *GE*
location: *PROPOSED WESTRAC INDUSTRIAL ESTATE*
checked by:

date samples recovered:
pH meter used/serial no: HORBIA
date of calibration: *17.5.07*

hydrogen peroxide pH prior to use: *5.19*
hydrogen peroxide temperature prior to use: *23.9*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP113	*1.5-1.6*		*Sand*	*6.55*	*10*	*4.78*	23.7	A	N		1.77	
TP113	*2.5-2.6*		*Sand*	*4.75*	*10*	*3.94*	*23.6*				*0.81*	
TP114	*0.5-0.6*		*Sand*	*4.80*	*10*	*3.99*	21.8	A	N	N	0.81	
TP114	*1.5-1.6*		*Sand*	*5.59*	*10*	*4.72*	21.6	A	N	N	0.87	
TP114	*2.5-2.6*		*Sand*	*4.81*	*10*	*1.55*	36.7	B	N	Brown/ pale brown	3.26	Slight large bubbles
TP114	*2.9-3.0*		*Silty Sand*	*5.94*	*10*	*1.98*	26.0	B	N	Brown-Yellow	4.07	
TP115	*0.5-0.6*		*Sand*	*5.69*	*10*	*4.54*	23.4				1.15	
TP115	*1.5-1.6*		*Sand*	*6.53*	*10*	*5.56*	24.1	A	N		0.97	
TP115	*2.0-2.5*		*Sand*	*5.01*	*10*	*4.42*	24.6	A	N		0.59	

NOTES:
1. **Observed Reaction:** a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. **Strong Odour:**

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SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA
sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *19-09-07*
principal: *ASQUITH & DE WITT PTY LTD* test location: *TOMAGO ROAD*
project: *GEOTSGTE20301AA* tested by: *GREG E*
location: *TOMAGO* checked by: *Q*

date samples recovered: - pH meter used/serial HORIBA D-24 date of calibration: *19/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *22.7°C*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH104	*0.60-1.05*	*05797*	*Clay*	*5.46*	*10*	*1.82*	24.1	B	1	Nil	3.64	
	1.50-1.95	*05798*	*Sand*	*3.84*	*10*	*2.03*	86.1	C	Nil	Nil	1.81	
	3.00-3.45	*05799*	*Silty Clay*	*4.27*	*10*	*1.49*	26.7	B	Nil	Nil	2.78	
	4.50-4.95	*05800*	*Silty Clay*	*4.05*	*10*	*1.51*	23.3	A	Nil	Nil	2.54	
	6.50-6.95	*05801*	*Sand*	*6.19*	*10*	*3.55*	23.2	A	Nil	Nil	2.64	
	7.50-7.95	*05802*	*Sand*	*4.99*	*10*	*2.55*	22.7	A	Nil	Nil	2.44	
	9.00-9.45	*08803*	*Sand*	*5.70*	*10*	*2.94*	21.4	B	2	Grey-pale green/grey	2.76	
	12.00-12.45	*05804*	*Sand*	*4.40*	*10*	*1.51*	94.1	C	2	Grey-pale brown	2.88	
	15.00-15.45	*05805*	*Sand*	*6.14*	*10*	*2.68*	90.8	C	Nil	Nil	3.46	
	17.00-17.15	*05806*	*Sand*	*6.82*	*10*	*5.41*	23.2	A	Nil	Nil	1.41	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *19-09-07*

principal: *ASQUITH & DE WITT PTY LTD* test location: *TOMAGO ROAD*

project: *GEOTSGTE20301AA* tested by: *GREG E*

location: *TOMAGO* checked by: *Ø*

date samples recovered: - pH meter used/serial HORIBA D-24 date of calibration: *19/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *22.7°C*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH116	*1.50-1.95*	*05807*	*Clay*	*7.09*	*10*	*4.30*	23.5	A	Nil	Nil	2.79	
	3.00-3.45	*05808*	*Clay*	*4.66*	*10*	*2.19*	85.9	A	Nil	Nil	2.47	
	4.50-4.95	*05809*	*Clay*	*5.40*	*10*	*2.34*	23.3	C	Nil	Brown-pale brown	3.06	
	6.00-6.45	*05810*	*Sand*	*6.01*	*10*	*3.99*	20.3	B	Nil	Nil	2.02	
	7.50-7.95	*05811*	*Sand*	*6.26*	*10*	*2.98*	22.7	B	Nil	Nil	3.28	
	9.00-9.45	*05812*	*Sand*	*6.40*	*10*	*4.15*	20.5	B	Nil	Nil	2.25	
	10.50-10.95	*05813*	*Sand*	*6.92*	*10*	*3.94*	23.1	A	Nil	Nil	2.98	
	12.00-12.41	*05814*	*Sand*	*5.28*	*10*	*1.85*	22.3	B	Nil	Nil	3.43	
	13.50-13.84	*05815*	*Sand*	*5.61*	*10*	*1.88*	22.7	B	Nil	Grey-pale brown	3.73	
	14.45-14.90	*05816*	*Sand*	*5.94*	*10*	*2.30*	24.7	B	Nil	Grey-pale brown	3.64	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction

2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *19-09-07*

principal: *ASQUITH & DE WITT PTY LTD* test location: *TOMAGO ROAD*

project: *GEOTSGTE20301AA* tested by: *GREG E*

location: *TOMAGO* checked by: *J*

date samples recovered: - pH meter used/serial HORBIA D-24 date of calibration: *19/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *22.7°C*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH119	*0.95-1.40*	*05817*	*Sandy Clay*	*5.63*	*10*	*3.19*	23.0	A	Nil	Nil	2.44	
	1.50-1.95	*05818*	*Sand*	*6.27*	*10*	*4.00*	21.9	A	Nil	Brown-pale brown	2.27	
	3.00-3.45	*05819*	*Sand*	*6.69*	*10*	*2.21*	22.8	B	Nil	Nil	4.48	
	4.50-4.95	*05820*	*Sand*	*5.80*	*10*	*3.89*	24.0	A	Nil	Nil	1.91	
	6.00-6.45	*05821*	*Sand*	*6.23*	*10*	*3.46*	22.9	A	Nil	Nil	2.77	
	7.50-7.85	*05822*	*Sand*	*5.95*	*10*	*3.81*	22.0	A	Nil	Nil	2.14	
	9.00-9.39	*05823*	*Sand*	*6.10*	*10*	*3.90*	22.1	B	Nil	Nil	2.20	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LT*
date: *25-09-07*
principal: *ASQUITH & DE WITT PTY LTD*
test location: *TOMAGO ROAD*
project: *GEOTSGTE20301AA*
tested by: *GREG E*
location: *TOMAGO*
checked by: *G*

date samples recovered: - pH meter used/serial HORIBA D-24 date of calibration: *25/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *22.1°C*

sample location	depth (m)	RL (Mahd)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH121	*6.00-6.45*	*05769*	*Sand*	*6.00*	*10*	*5.59*	21.0	A	Nil	Nil	0.41	
	7.50-7.95	*05770*	*Sand*	*6.20*	*10*	*5.10*	21.3	A	Nil	Nil	1.10	
	9.00-9.45	*05771*	*Sand*	*6.92*	*10*	*5.79*	21.5	A	Nil	Nil	1.13	
BH128	*0.95-1.40*	*05772*	*Clay*	*6.18*	*10*	*2.63*	23.8	C	Nil	Brown-pale brown	3.55	
	1.50-1.95	*02723*	*Clay*	*4.68*	*10*	*2.83*	91.6	C	Nil	Brown-pale brown	1.85	
	3.00-3.45	*05724*	*Sandy Clay*	*4.85*	*10*	*2.35*	41.7	A	Nil	Nil	2.50	
	4.50-4.95	*05725*	*Sand*	*5.75*	*10*	*3.69*	22.7	A	Nil	Nil	2.06	
	6.00-6.45	*05726*	*Sand*	*6.33*	*10*	*4.07*	22.1	A	Nil	Brown-pale brown	2.26	
	7.50-7.95	*05727*	*Sand*	*6.49*	*10*	*4.71*	23.1	A	Nil	Brown-pale brown	1.78	
	9.00-9.45	*05728*	*Sand*	*5.77*	*10*	*2.50*	22.7	A	Nil	Nil	3.27	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *25-09-07*

principal: *ASQUITH & DE WITT PTY LTD* Test location: *TOMAGO ROAD*

project: *GEOTSGTE20301AA* tested by: *GREG E*

location: *TOMAGO* checked by:

date samples recovered: - pH meter used/serial HORBIA D-24 date of calibration: *25/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *20.2*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH134	*0.50-0.95*	*05729*	*Sand*	*5.80*	*10*	*4.89*	20.2	A	Nil	Nil	0.91	
	1.50-1.95	*05730*	*Sand*	*5.52*	*10*	*4.94*	21.7	A	Nil	Nil	0.58	
	3.00-3.45	*05731*	*Sand*	*5.77*	*10*	*2.58*	23.9	A	Nil	Nil	3.19	
	4.50-4.95	*05732*	*Sand*	*5.74*	*10*	*3.22*	22.7	B	Nil	Nil	2.52	
	6.00-6.45	*05733*	*Sand*	*6.06*	*10*	*2.91*	20.9	B	Nil	Nil	3.15	
	7.50-7.95	*05734*	*Sand*	*6.69*	*10*	*4.71*	21.1	B	Nil	Nil	1.98	
	9.00-9.45	*05785*	*Sand*	*5.57*	*10*	*2.96*	20.2	A	Nil	Nil	2.61	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction

2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *25/09/07*

principal: *ASQUITH & DE WITT PTY LTD* test location: *TOMAGO ROAD*

project: *GEOTSGTE20301AA* tested by: *GREG E*

location: *TOMAGO* checked by: *[signature]*

date samples recovered: - Ph meter used/serial no: HORIBA D-24 date of calibration: *25/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *21.0°C*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH137	*0.5-0.95*	*05786*	*Sand*	*4.95*	*10*	*4.75*	23.0	A	Nil	Nil	0.2	
	1.5-1.95	*05787*	*Clay*	*5.49*	*10*	*3.50*	22.8	A	Nil	Nil	1.99	
	3.0-.45	*05788*	*Sand*	*6.44*	*10*	*5.85*	24.2	A	Nil	Nil	0.59	
	4.5-4.95	*05789*	*Sand*	*6.57*	*10*	*5.59*	22.0	A	Nil	Nil	0.98	
	6.0-6.45	*05790*	*Sand*	*4.02*	*10*	*2.75*	22.0	A	Nil	Nil	1.27	
	7.5-7.95	*05791*	*Sand*	*5.40*	*10*	*4.93*	21.0	A	Nil	Nil	0.47	
	9.0-9.45	*05792*	*Sand*	*4.89*	*10*	*3.22*	22.9	A	Nil	Nil	1.67	
	10.5-10.95	*05793*	*Sand*	*5.21*	*10*	*2.56*	23.2	A	Nil	Nil	2.65	
	12.5-12.95	*05794*	*Sand*	*4.68*	*10*	*2.98*	22.1	A	Nil	Nil	1.70	
	13.5-13.95	*05795*	*Sand*					No Sample				
	15.0-15.45	*05796*	*Sand*	*3.66*	*10*	*1.84*	24.2	A	Nil	Brown – Pale Brown	1.82	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction

2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA
sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *26/09/07*
principal: *ASQUITH & DE WITT PTY LTD* test location: *TOMAGO ROAD*
project: *GEOTSGTE20301AA* tested by: *GREG E*
location: *TOMAGO* checked by:

date samples recovered: - pH meter used/serial HORIBA D-24 date of calibration: *26/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *20°C*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH101	*0.75-1.03*	*05824*	*Sand*	*4.97*	*10*	*4.13*	19.6	B	Nil	Nil	0.84	
	1.5-1.95	*05825*	*Sand*	*4.91*	*10*	*3.94*	20.6	A	Nil	Nil	0.97	
	3.0-3.45	*05826*	*Sand*	*5.80*	*10*	*4.31*	20.0	A	Nil	Nil	1.49	
	4.5-4.65	*05827*	*Sand*	*6.01*	*10*	*5.17*	20.0	A	Nil	Nil	0.84	
	6.0-6.45	*05828*	*Sand*	*4.75*	*10*	*4.75*	22.0	A	Nil	Nil	1.00	
	7.5-7.95	*05829*	*Sand*	*5.98*	*10*	*3.23*	20.8	B	Nil	Nil	2.75	
	9.0-9.45	*05830*	*Sand*	*5.80*	*10*	*4.51*	21.0	A	Nil	Nil	1.29	
	10.5-10.85	*05831*	*Sand*	*5.73*	*10*	*4.38*	22.1	A	Nil	Nil	1.35	
	12.0-12.45	*05832*	*Sand*	*5.91*	*10*	*4.63*	20.8	A	Nil	Nil	1.28	
	13.5-13.95	*05833*	*Sand*	*5.39*	*10*	*3.99*	21.4	A	Nil	Nil	1.40	
	15.0-15.45	*05834*	*Sand*	*4.23*	*10*	*2.93*	21.8	A	Nil	Brown – Pale Brown	1.30	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: COFFEY GEOTECHNICS PTY LTD
date: 26/09/07
principal: ASQUITH & DE WITT PTY LTD
test location: TOMAGO ROAD
project: GEOTSGTE20301AA
tested by: GREG E
location: TOMAGO
checked by:

date samples recovered: -
pH meter used/serial HORIBA D-24
date of calibration: 26/09/07

hydrogen peroxide pH prior to use: 5.4
hydrogen peroxide temperature prior to use: 22.1°C

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH101	16.8-16.95	05835	Sand	3.45	10	2.19	22.1	A	Nil	Nil	1.26	
	18.0-18.45	05836	Clay	5.60	10	4.44	82.9	B	Nil	Nil	1.16	
	19.5-19.55	05837	Clay	5.04	10	4.18	61.9	C	Nil	Nil	0.86	
BH106	0.5-0.95	05838	Sand	5.68	10	4.27	20.1	B	Nil	Nil	1.41	
	1.5-1.95	05839	Sand	6.37	10	4.88	20.6	A	Nil	Nil	1.49	
	3.0-3.45	05753	Sand	6.58	10	5.76	20.3	A	Nil	Nil	0.82	
	4.5-4.95	05754	Sand	5.76	10	5.40	20.0	A	Nil	Nil	0.36	
	6.0-6.45	05755	Sand	6.27	10	5.72	20.0	A	Nil	Nil	0.55	
	7.5-7.95	05756	Sand	6.47	10	4.75	20.7	A	Nil	Nil	1.72	
	9.0-7.45	05757	Sand	6.33	10	5.83	20.1	A	Nil	Nil	0.50	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00208AA

sheet 1 of 1

acid sulfate soil screening test

office: NEWCASTLE

client: *COFFEY GEOTECHNICS PTY LTD* date: *27/09/07*

principal: *ASQUITH & DE WITT PTY LTD* test location: *TOMAGO ROAD*

project: *GEOTSGTE20301AA* tested by: *GREG E*

location: *TOMAGO* checked by:

date samples recovered: - pH meter used/serial HORIBA D-24 date of calibration: *27/09/07*

hydrogen peroxide pH prior to use: *5.4* hydrogen peroxide temperature prior to use: *20.0°C*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH113	*0.5-0.95*	*05758*	*Sand*	*5.84*	*10*	*3.11*	21.3	B	Nil	Nil	2.73	
	1.5-1.95	*05759*	*Sand*	*6.28*	*10*	*5.50*	21.0	A	Nil	Nil	0.78	
	3.0-3.45	*05760*	*Sand*	*5.89*	*10*	*5.74*	20.6	A	Nil	Nil	0.15	
	4.5-4.95	*05761*	*Sand*	*5.79*	*10*	*5.13*	20.5	A	Nil	Nil	0.66	
	6.0-6.45	*05762*	*Sand*	*6.40*	*10*	*5.55*	21.1	A	Nil	Nil	0.85	
	7.5-7.95	*05763*	*Sand*	*6.80*	*10*	*5.85*	20.9	A	Nil	Nil	0.95	
	9.0-9.45	*05764*	*Sand*	*6.89*	*10*	*5.79*	20.2	B	Nil	Nil	1.10	
BH121	*0.5-0.95*	*05765*	*Sand*	*6.45*	*10*	*5.50*	21.0	A	Nil	Nil	0.95	
	1.5-1.95	*05766*	*Sand*	*6.08*	*10*	*3.81*	21.0	A	Nil	Nil	2.27	
	3.0-3.45	*05767*	*Sand*	*5.51*	*10*	*4.50*	21.1	A	Nil	Nil	1.01	
	4.5-4.95	*05768*	*Sand*	*6.10*	*10*	*4.28*	21.4	A	Nil	Nil	1.82	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction

2. Strong Odour:

Appendix N

CONTAMINATION REPORT

REDLAKE ENTERPRISES PTY LTD

ASQUITH & DEWITT PTY LTD

PRE-PURCHASE CONTAMINATION INVESTIGATION

197-325 TOMAGO ROAD, TOMAGO

PRELIMINARY SITE CONTAMINATION ASSESSMENT

N09814/02-AF

25 August 2006

N09814/02-AF KJM
25 August 2006

Redlake Enterprises Pty Ltd
C/- Asquith & de Witt Pty Ltd
PO Box 179
CHARLETOWN NSW 2290

Attention: Craig Marler

Dear Sir

RE: PRE-PURCHASE CONTAMINATION INVESTIGATION
197-325 TOMAGO ROAD, TOMAGO
PRELIMINARY SITE CONTAMINATION ASSESSMENT

Coffey Geosciences Pty Ltd (Coffey) is pleased to provide our Preliminary Site Contamination Assessment (PSCA) report for the above site.

We draw your attention to the enclosed sheet entitled *'Important Information about your Coffey Environmental Assessment'* which should be read in conjunction with this report.

If you have any questions regarding this matter, please do not hesitate to contact the undersigned.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

ARTHUR LOVE

Distribution:	Original	Held by Coffey Geosciences Pty Ltd
	1 Copy	Coffey Geosciences Pty Ltd Library
	3 Copies	Asquith and DeWitt Pty Ltd

13 Mangrove Road Sandgate
NSW 2304 Australia
Telephone +61 2 **4967 6377**
Facsimile +61 2 4967 5402
Email newcastl@coffey.com.au

EXECUTIVE SUMMARY

This report presents the results of a Preliminary Site Contamination Assessment (PSCA) carried out by Coffey Geosciences Pty Ltd (Coffey) on behalf of Redlake Enterprises Pty Ltd (Redlake) for the site located between 197 and 325 Tomago Road, Tomago, NSW (as shown in Figure 1).

It is understood that redevelopment works are currently being proposed for the site and Redlake are seeking a pre-purchase contamination investigation to assess the possibility for widespread contamination to be present at the site. On the basis of our understanding of the project, the proposed development will be divided into three stages. We understand that Redlake intend to use the subject lands for industrial purposes. Development of Stages 1 and 2 will include the following:

- Assembly, maintenance and repair of heavy earthmoving equipment;
- Warehousing and distribution of parts;
- Earthmoving machinery operator training;
- Ancillary office and administration.

We understand that development of Stage 3 is intended for related, but presently unspecified industrial purposes.

It is understood that the PSCA is required to allow Redlake to make an assessment of contamination issues for each property prior to the acquisition.

The objectives of the PSCA were to:

- Identify potentially contaminating activities that are currently being performed on the site and that may have been performed on the site in the past;
- Make a preliminary assessment of the contamination status of surface soils across the site by undertaking limited sampling and laboratory analysis;
- Make a preliminary assessment of the suitability of the site for the proposed landuse;
- Assess the need for further investigations and/or remediation requirements for the site to be suitable for the proposed landuse.

The proposed scope of work for the project included:

- A site history review and site visit to identify potential areas of environmental concern (AECs) and chemicals of concern (CoCs);
- Limited field investigations;
- Limited laboratory analysis;
- Data assessment and reporting.

This scope of work excludes consideration of possible environmental issues, other than those associated with land contamination, arising from the development of the site, given that a portion of Lot 161 DP 774440 forms part of the Kooragang Nature Reserve.

The site history review revealed that contamination could potentially have been introduced to the site through:

- Atmospheric fallout of contamination from nearby Tomago Aluminium Smelter;
- Importation of contaminated fill material;

- Leaching or weathering of zinc, lead or asbestos from current/former buildings and structures;
- Application of pesticides during use for agricultural purposes.

Limited sampling and laboratory analysis were undertaken to make a preliminary assessment of the presence of soil contamination associated with the potential contaminating sources.

A review of the laboratory data indicates that PAHs, BTEX, OCPs and PCBs were not detected above the laboratory limit of reporting in the samples analysed. Heavy metals were detected as some locations at concentrations considered to be elevated with respect to anticipated natural background levels however were not detected above the NSW EPA (1998) health based investigation levels for commercial/industrial use. TPH was not detected above the NSW EPA (1994) soil investigation level for sensitive sites in samples collected across the site and was generally below laboratory detection limits. TPH was detected at elevated concentrations below the NSW EPA (1994) soil investigation level for sensitive sites in sampling locations across the paddock areas, however these TPH detections are considered to most likely represent natural organic material rather than petroleum hydrocarbon related contamination. Asbestos cement fragments were detected at two locations in the vicinity of a former building and an abandoned building. Asbestos fibres were not detected in surface soils surrounding these areas.

Based on the findings of the results of the site history review and the limited sampling and laboratory analysis, the following conclusions can be made:

- The potential for widespread soil contamination associated with atmospheric fallout from the nearby Tomago Aluminium Smelter to be present at the site is low;
- The potential for widespread gross contamination to be present in fill material at the site is low. However, it is noted that the number of samples collected relative to the volume of fill observed to be present at the site is low and as such the potential for contaminated fill material to be present at the site cannot be precluded;
- Fragments of asbestos cement material were found in surface soils in the vicinity of an abandoned shed located in the north western portion of Lot 1 DP1003492 (numerous fragments) as well as in the vicinity of a former building located upon the peak of the dune in the northern portion of Lot 161 DP 774440(one fragment). Asbestos fibres were not detected in soils samples collected near where asbestos cement fragments were found. With the exception of the identified asbestos contamination, the potential for widespread contamination associated with the weathering of building materials to be present at the site is low;
- The potential for widespread soil contamination associated with the application of pesticides to be present at the site is low.

The potential for localised contamination of surface soils by fragments of asbestos cement material exists in the vicinity of structures, or former structures. The risk to human health from asbestos is related to inhalation of fibres. The bonding in fibre cement fragments means that fibres are generally bound and not normally released to the air. Thus, the isolated fragments of asbestos cement material present on the site would not be expected to pose a significant risk to the health of site users, provided such material is not broken up or abraded during future land use.

However, the current interim NSW EPA policy is that there should be no asbestos in surface soils. Given this policy, it is considered that a specialist asbestos consultant should be engaged to conduct a survey of the areas of the site where asbestos cement fragments have been identified to further assess the presence of asbestos containing materials. If Redlake acquire the property, it is recommended that the areas where asbestos contamination has been identified be fenced to restrict access until such time that the areas are further assessed and appropriate remediation works or management procedures are implemented.

Based on the above, subject to the adequate assessment and management/remediation of the identified asbestos contamination, it is considered that the site is likely to be suitable for the proposed industrial development.

It is noted that this assessment has not included an assessment of groundwater contamination beneath the site. Based on the findings of this PSCA, it is considered that the potential for site originated groundwater contamination to be present at the site is low. It is noted there is some potential for offsite originated groundwater contamination from the nearby Tomago Aluminium Smelter (if present) to have migrated to beneath the site, although as the site is approximately 2km from the smelter this is considered to be unlikely.

It is also noted that the area lies within an area identified to be a high risk of acid sulphate soils, however as it is understood that the proposed redevelopment of the site will not involve major excavations and inversely will most likely comprise significant filling, it is considered unlikely that the presence of potential acid sulphate soils will pose a constraint to the development.

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1. INTRODUCTION

This report presents the results of a Preliminary Site Contamination Assessment (PSCA) carried out by Coffey Geosciences Pty Ltd (Coffey) on behalf of Redlake Enterprises Pty Ltd (Redlake) for the site located between 197 and 325 Tomago Road, Tomago, NSW (as shown in Figure 1).

It is understood that redevelopment works are currently being proposed for the site and Redlake are seeking a pre-purchase contamination investigation to assess the possibility for widespread contamination to be present at the site. On the basis of our understanding of the project, the proposed development will be divided into three stages. We understand that Redlake intend to use the subject lands for industrial purposes. Development of Stages 1 and 2 will include the following:

- Assembly, maintenance and repair of heavy earthmoving equipment;
- Warehousing and distribution of parts;
- Earthmoving machinery operator training;
- Ancillary office and administration.

We understand that development of Stage 3 is intended for related, but presently unspecified industrial purposes.

It is understood that the PSCA is required to allow Redlake to make an assessment of contamination issues for each property prior to the acquisition.

1.1 Objectives and Scope of Work

The objectives of the PSCA were to:

- Identify potentially contaminating activities that are currently being performed on the site and that may have been performed on the site in the past;
- Make a preliminary assessment of the contamination status of surface soils across the site by undertaking limited sampling and laboratory analysis;
- Make a preliminary assessment of the suitability of the site for the proposed landuse;
- Assess the need for further investigations and/or remediation requirements for the site to be suitable for the proposed landuse.

The proposed scope of work for the project included:

- A site history review and site visit to identify potential areas of environmental concern (AECs) and chemicals of concern (CoCs);
- Limited field investigations;
- Limited laboratory analysis;
- Data assessment and reporting.

This scope of work excludes consideration of possible environmental issues, other than those associated with land contamination, arising from the development of the site, given that a portion of Lot 161 DP 774440 forms part of the Kooragang Nature Reserve.

2. SITE LOCATION, IDENTIFICATION, FEATURES AND LOCAL GEOLOGY/HYDROGEOLOGY

2.1 Site Location and Identification

The site is located between 197 and 325 Tomago Road, Tomago. The site comprises Lot 161 DP 774440, Lot 1 DP 1003492, Lot 1 DP 597372 and Lot 513 DP 585256 which occupy a total area of approximately 115 hectares.

2.2 Site Features

The main site features observed during a site walkover undertaken by a Coffey Environmental Scientist on 19 January 2006 revealed the following:

- The site was observed to be a relatively flat low lying alluvial plain with the portion of the property adjacent to Tomago Road higher in elevation than the remainder of the site (approximately 1m-2m within the north western portion of Lot 1 DP 1003492 and approximately 3m-8m higher in the northern portion of Lot 161 DP774440). Exposed soils in the elevated portions of the site adjacent to Tomago Road (sands) indicate that these elevated areas represent a sand dune;
- Lot 1 DP 597372 was observed to comprise a residential dwelling with some sheds and grassed areas. A 1m high wire fence was present along the western, southern and eastern boundaries;
- Lot 513 DP 585256 was observed to comprise a flat vacant grassed area adjacent to the north western corner of Lot 1 DP1003492. A 1m high wire fence was present along the southern and eastern boundaries;
- Lot 1 DP 1003492 was observed to comprise a residential dwelling with some sheds and a former stockyard in the north western corner with the remainder of the lot comprising open grassland currently being used for cattle grazing. A 1m high wire fence was present along the northern, eastern, southern and western boundaries;
- A shed located in the north western corner of Lot 1 DP1003492 was observed to be abandoned, with the walls having partially collapsed. The remnant portions of the walls of the shed and debris in the vicinity of the shed were observed to comprise potentially asbestos containing fibre cement sheeting;
- Evidence of a previous structure/building (concrete pads) was observed adjacent to the south western corner of Lot 1 DP 597372 within Lot 1 DP 1003492;
- Evidence of a filled area was observed to the east and south east of Lot 1 DP 597372 within Lot 1 DP 1003492. The fill material was observed at the surface to comprise gravels, boulder-sized pieces of concrete, bricks and some black cemented gravelly material;
- Evidence of filling was observed along a vehicle track running through Lot 1 DP 1003492. The fill material was observed to predominantly comprise fine black gravels with some areas also containing bricks and concrete fragments;
- Lot 161 DP 774440 was observed to comprise a number of building remnants (concrete pads, corrugated iron) in the vicinity of the peak of the sand dune in the northern portion of the property with the remainder of the property comprising open pastureland and bush. A 1m high wire fence was present along the northern, eastern, southern and western boundaries;
- One potentially asbestos containing fibre cement fragment was observed within an area where buildings were apparently previously present at the peak of the dune located in the northern portion of Lot 161 DP774440;

- Anecdotal evidence from a local resident indicated that the properties adjacent to the south western corner of the site were formerly used for turf farming and that the site was used by Tomago Aluminium as a 'buffer zone' during the 1980's and 1990's;
- With the exception of potentially asbestos containing materials, no potential onsite sources of contamination were observed during the site walkover;
- No evidence of underground storage tanks or any other potentially contaminating chemical/product storage was observed across the site;
- No evidence of stressed vegetation, indicative of soil contamination, was observed across the site.

2.3 Current Surrounding Land Use

At the time of the field investigations (January 2006), the surrounding landuse comprised:

- Kooragang Nature Reserve (wetlands) to the south west, south and south east;
- Agricultural/residential properties to the north east and west;
- Residential properties to the north across Tomago Road;
- Commercial/industrial properties immediately west of the north western portion of Lot 1 DP1003492 as well as to the north west across Tomago Road.

The Tomago Aluminium Smelter is located approximately 2km to the west of the site. Prevailing winds are from the northwest to west for approximately half the time, based on average annual wind speed and direction at the Williamtown weather station (Bureau of Meteorology web site).

The Tomago Sand Beds water supply works is located approximately 1km to the north of the site.

2.4 Local Geology and Hydrogeology

The topography generally comprises a broad, flat alluvial flood plain, with the elevation of the ground surface over the majority of the study area typically lower than 1m AHD. A small sand ridge occupies the northern margin of Lot 161 DP 774440, adjacent to Tomago Road, with a maximum elevation of approximately 8.5m AHD.

The site is located in the Quaternary aged alluvial and fluvial deposits associated with the meandering river valley of the Hunter River, defined by the geology maps as Quaternary Alluvium. As such, the site is underlain by sedimentary deposits comprising mixtures of sands, silts, clays and gravels. Beneath these sediments, the bedrock comprises interbedded sandstone, siltstone, mudstone and coal of the Permian aged Tomago Coal Measures.

Broadly, units within the Quaternary Alluvium comprise (from oldest to youngest) Pleistocene clay, Pleistocene barrier sands, Holocene estuarine clay and recent floodplain deposits. The Pleistocene clay is typically stiff to hard, and forms the basal surface for the younger deposits. The depth to the Pleistocene clay may be typically of the order of 10m to 15m, but can be as deep as 30m to 50m within paleochannels.

The Pleistocene barrier sands are typically quartz sands, ranging from 5m to 35m in thickness. Within the sand deposits are cemented 'Coffee Rock' deposits. The Holocene clay and recent floodplain deposits are typically soft to very soft. Deep deposits of the Holocene clay are founded within the paleochannels cut through the Pleistocene clay.

Coffey's experience in the alluvium within the Hexham, Tomago and Raymond Terrace area is that lenses of barrier sand and channel deposits that exist within the profile are erratically distributed, and both vertically and laterally discontinuous. Soil conditions can vary considerably over relatively short distances in a meandering river valley setting.

Acid Sulfate Soil risk maps for the area indicate that there is a high probability of occurrence of Acid Sulfate Soils (ASS) at shallow depth over the low-lying flood plains.

3. SITE HISTORY REVIEW

A site history study was undertaken by Coffey which included:

- A site visit;
- A review of historic title information for the site;
- A search of Port Stephens Council records for the site;
- A search of WorkCover NSW Dangerous Goods records for the site;
- A review of historical aerial photography for the last 50 years for the site;
- A check of NSW EPA records for notices on the site.

3.1 Site Visit

A Coffey Environmental Scientist visited the site on 20 January 2006. Observations made during the site visits are summarised in Section 2.1 and Section 2.2. Photographs taken during the site visit are presented in Appendix A.

3.2 Titles Search

A list of past registered proprietors and lessors of the site was obtained from the Land Titles Office. The current title details, a summary table of historical ownership and cadastral plan are included in Appendix B.

The title search revealed the following:

- Lot 161 DP 774440 - the property was owned by numerous private landholders (some with occupation listed as farmer) between 1887 and 2001 when it was transferred to Tomago Aluminium Company Pty Ltd from 1983 to 2003 following which it was transferred to the current owner, the NSW Treasury – Crown property portfolio;
- Lot 1 DP 1003492 – the property was owned by numerous private landholders (some with occupation listed as farmer) between 1887 and 1999 when it was transferred to the current owner, Geoffrey Allen Graham. It is noted that the occupation of the private owner of the property between 1964 and 1999 was a service station proprietor;
- Lot 1 DP 597372 – the property was owned by numerous private landholders (some with occupation listed as farmer) between 1887 and 2001 when it was transferred to Tomago Aluminium Company Pty Ltd from 1983 to 2003, following which it was transferred to the current owner, the NSW Treasury – Crown property portfolio. It is noted that the occupation of the private owner of the property between 1964 and 1979 was service station proprietor;
- Lot 513 DP 585256 – the property was owned by numerous private landholders (some with occupation listed as farmer) between 1887 and 1999 when it was transferred to the current owner, Geoffrey Allen Graham. It is noted that the occupation of the private owner of the property between 1977 and 1999 was service station proprietor.

3.3 Port Stephens Shire Council Records

Port Stephens Shire Council holds information pertaining to historical building applications and development applications relating to properties in the Port Stephens Local Government Area. A letter from Port Stephens Shire Council is presented in Appendix C.

The letter for Port Stephens Shire Council indicates that there were no historic building applications nor development applications for any of the properties comprising the site after 1960. The letter indicated that there may be some historic building application or development applications for the site prior to 1960, however Port Stephens Council's search system was not able to obtain information pre 1960.

3.4 WorkCover NSW Records

A search of WorkCover NSW Stored Chemical Information Database (SCID) and the microfiche records held by WorkCover indicated that there were no historic records of licensed dangerous goods having been stored on the properties. A copy of a letter from WorkCover NSW Dangerous Goods is presented in Appendix D.

3.5 Aerial Photograph Review

Aerial photographs of the site, representing selected years between 1954 and 2004, were purchased from the Department of Planning and Natural Resources and reviewed by a Coffey Environmental Scientist. A copy of the aerial photographs reviewed is presented in Appendix E. The results of the review are summarised in Table 1.

TABLE 1 – AERIALPHOTOGRAPH REVIEW

YEAR	SITE	SURROUNDING LAND
1954	The site appears to be being used for residential/agricultural land uses. A building (most likely a residential dwelling) is present towards to the northern corner of Lot 161 DP 774440. A number of small buildings (possibly sheds) are present in the north western corner of Lot 1 DP 1003492. The remainder of the site is cleared land with the area adjacent to the southern boundary of the site apparently being used for crops.	The properties to the north east and south west of the site appear to be being utilised for agricultural /residential purposes with scattered buildings and some evidence of crops visible. Tomago Road is observable to the north west of the site and is predominantly in its current (2006) alignment. The land to the north west of Tomago Road is predominantly bushland with no evidence of any residential, agricultural or commercial./industrial development. Wetlands are present to the south east of the site.
1975	The site appears to be similar to the 1954 aerial photograph.	The land to the north east, south west and south east of the site appears to be similar to the 1954 aerial photograph. The land to the north west of the site (across Tomago Road) appears to have been partially developed with some small buildings (most likely residential dwellings) and a large scale industrial facility present to the north west of Lot 1 DP 1003492 / Lot 1 DP 597372 across Tomago Road. There is also evidence of road construction to the north west of Tomago Road. The remainder of the surrounding land appears to be similar to the 1954 aerial photograph.

YEAR	SITE	SURROUNDING LAND
1992	The building previously present in the northern corner of Lot 161 DP 774440 is no longer visible. There is no longer evidence of crops on Lot 161 DP 774440. A building (most likely a residential dwelling) has been constructed on Lot 1 DP 597372. It is noted that the construction of the property was not noted in Port Stephens Shire Council records. The remainder of the site appears to be similar to the 1975 aerial photograph.	The density of small buildings (most likely residential dwellings) to the north west of Lot 1 DP 1003492 / Lot 1 DP 597372 across Tomago Road has significantly increased. A number of larger buildings (most likely commercial/industrial buildings) have been constructed to the north west of Lot 513 DP 585256 across Tomago Road. A single large building (most likely a commercial/industrial building) has been constructed to the south west of Lot 513 DP 585256 on the southern side of Tomago Road. The remainder of the surrounding land appears to be similar to the 1975 aerial photograph.
2004	There is no longer evidence of crops on Lot 1 DP 1003492. The remainder of the site appears to be similar to the 1992 aerial photograph.	The surrounding land appears to be similar to the 1992 aerial photograph.

3.6 NSW EPA Records

A check with the NSW EPA website www.environment.nsw.gov.au revealed that no notices have been issued for any of the properties comprising the site or the surrounding properties under the Contaminated Land Management Act (1997).

3.7 Summary of Site History

A summary of the main findings of the site history review with respect to potential contamination issues at the site is summarised below:

- Based on aerial photographs and title records, it is considered that the four properties were most likely used for residential/agricultural purposes between the late 1800's and the 1970's. The nature of the agricultural use of the land is not clear however there is some evidence of crops in the aerial photographs viewed during this period. Anecdotal evidence from a local resident indicates that the properties have been previously used for turf farming;
- Historic title information indicates that the portions of the site were owned by Tomago Aluminium for a number of years between 1983 and 2003. Aerial photographs do not indicate that any large scale industrial works were undertaken at the site during this period. Anecdotal evidence from a local resident indicates that the properties were used by Tomago Aluminium as a 'buffer zone';
- Historic title information indicates that portions of the site were owned by a private landholder with an occupation listed as 'service station proprietor'. No evidence of a service station ever having had operated at the site was identified in the WorkCover NSW Dangerous Goods records, aerial photographs or the site walkover;
- Fill material of an unknown source and contamination status was observed to the south east of Lot 1 DP597372 as well as within an unsealed roadway running through Lot 1 DP 1003492;

- Potentially asbestos containing fibre cement material was observed in the vicinity of an abandoned shed located within the north western corner of Lot 1 DP 1003492 as well as within the vicinity of a former building located upon the peak of the sand dune within the northern corner of Lot 161 DP 774440;
- The NSW EPA has no notices for any of the properties comprising the site or the surrounding properties under the Contaminated Land Management Act (1997);
- The site is within 2km of the Tomago Aluminium Smelter and as such the site may have been subject to contamination associated with atmospheric fallout from the smelter, given that the prevailing wind is frequently from the Smelter towards the site.

4. AREAS AND CHEMICALS OF CONCERN

Based on the site walkover and the site history assessment, the main visible potential contamination sources on the Site are outlined in Table 2 below.

TABLE 2 – SUMMARY OF POTENTIAL AREAS AND CHEMICALS OF CONCERN

AREA OF CONCERN	DESCRIPTION OF POTENTIALLY CONTAMINATING ACTIVITY	CoCs*	LIKELIHOOD OF CONTAMINATION (BASED ON SITE HISTORY STUDY ONLY)**	COMMENTS
1. Entire site	Atmospheric fallout from nearby Tomago Aluminium plant	Fluoride, PAHs	Moderate	Property was formerly owned by Tomago Aluminium and it is understood was used as a ''buffer zone'.
2. Majority of site	Use of pesticides across crop areas.	OCP/PCB	Low	Low likelihood of widespread pesticide contamination being present as property has most likely predominantly been used for grazing or turf farming.
3. Area in vicinity of current and former residential dwellings	Weathering of metallic building members and presence of asbestos containing materials.	Heavy metals and asbestos	Moderate	Evidence of potentially asbestos containing materials and rusted metallic building materials were observed during the site walkover.

AREA OF CONCERN	DESCRIPTION OF POTENTIALLY CONTAMINATING ACTIVITY	CoCs*	LIKELIHOOD OF CONTAMINATION (BASED ON SITE HISTORY STUDY ONLY)**	COMMENTS
4. Area to east and south east of Lot 1 DP 597372 and roadway running through Lot 1 DP 1003492	Importation of potentially contaminated fill material	Heavy metals, PAHs, TPH, BTEX, OCP, PCBs	Moderate	Fill containing anthropogenic materials was observed in some portions of the site.

NOTE

**CoC - Chemicals of Concern*

*** It is important to note that this is not an assessment of the financial risk associated with the AEC in the event contamination is detected, but a qualitative assessment of the potential for contamination being detected at the potential AEC based on the site history study.*
Heavy Metals - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc
BTEX - Benzene, Toluene, Ethylbenzene and Xylene, TPH - Total Petroleum Hydrocarbons
PAH – Polycyclic Aromatic Hydrocarbons
OCP – Organochlorine Pesticides
PCB – Polychlorinated Biphenyls

5. REGULATORY BACKGROUND AND APPLICABLE GUIDELINES

The investigation criteria for soil will be established based on the following references:

- NSW EPA (1998) Guidelines for the NSW Auditor Scheme;
- NSW EPA (1994) Guidelines for Assessing Service Station Sites;
- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Measure (NEPM).

Other references were used to supplement the above references where appropriate.

The NSW EPA (1998) *Guidelines for the NSW Site Auditor Scheme* present health based investigation levels for different land uses (eg. industrial/commercial, residential, recreational etc.) as well as provisional phytotoxicity based investigation levels.

The future land use on the site is intended to be industrial. Therefore the investigation levels for commercial/industrial landuse have been adopted as the primary investigation criteria.

For commercial/industrial landuse, the human health based threshold levels listed in Column 4 of the table in NSW EPA (1998) may be adopted as investigation criteria for the respective contaminants of concern.

The NSW EPA (1998) *Guidelines for the NSW Site Auditor Scheme* does not provide investigation criteria for total petroleum hydrocarbons (TPH). The NSW EPA (1994) *Guidelines for Assessing Service Station Sites* provides acceptable threshold concentrations for petroleum hydrocarbons compounds at service station sites to be reused for sensitive land uses such as residential. The EPA has advised that these should also be used as investigation criteria for all sites to be used for less sensitive land uses, including commercial/industrial.

There are currently no national or NSW guidelines for asbestos in soil[a]. The NSW EPA has advised that asbestos is a human health issue and not an environmental issue. On the advice of the NSW Department of Health, the NSW EPA have advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that "no asbestos in the soil at the surface is permitted". The phrase 'at the surface' has not been defined.

There are currently no national or NSW guidelines for fluoride in soil. The US EPA Region 9 Preliminary Remediation Goals (PRG's) present a human health based threshold for soluble fluoride in soil for industrial soil of 37,000mg/kg. In the absence of an applicable health or environmental based criteria, the US EPA Region 9 PRG for soluble fluoride in soil will be used for comparison purposes during this assessment.

6. FIELD INVESTIGATIONS

6.1 Field Investigations

Field investigations were undertaken on 1 February 2006 by a Coffey Environmental Scientist. The field investigations included the collection of surface (0.0m-0.1m) and near surface samples (0.1m-0.2m) across the site at 25 locations identified as HA1 to HA25 targeting AEC's identified during the site history review. The sample locations were selected using a judgemental sampling pattern based on the findings of the site history review.

Soil samples were collected by hand directly from the ground surface following breaking of the soil with a shovel or hand trowel. Each sample was divided into two sub-samples. One sub-samples was placed into a laboratory-supplied, acid-rinsed 250mL glass jar and placed in an ice-chilled cooler box. The other was bagged for field headspace screening. A photoionisation detector (PID) was used to screen the headspace gases of the bagged soil samples during initial field investigations. The PID provides a semi-quantitative indication of the presence of ionisable volatile organic compounds (VOCs) in the soil. The PID had a 10.6eV lamp calibrated with isobutylene gas at 100ppm prior to the commencement of fieldwork.

The sampling locations are presented in Figure 2.

It is noted that sampling locations HA5 and HA6 were inadvertently located in Lot 2 DP 598139 (located to the west of Lot 1 DP597372) which is understood to not be part of this assessment. The laboratory results from these sampling locations have not been considered as part of this report.

Based on the potential contamination sources and areas of environmental concern, it is considered that 23 sampling locations located using a judgemental sampling pattern across the site is sufficient to make a preliminary assessment of the contamination status of soils across the site. It is considered that the judgemental sampling pattern implemented as part of this PSCA is applicable in accordance with Section 3.1 of the NSW EPA (1995) Sampling Design Guidelines as the site history review has provided adequate information regarding the probable locations of the contamination.

In addition to the surface sampling, samples were also collected of potentially asbestos containing material identified during the field investigations in the vicinity of an abandoned shed in the north western corner of Lot 1 DP1003492 (A1 and A2) and in the vicinity of a former building located upon the peak of the sand dune in the northern portion of Lot 161 DP 774440 (A3).

[a] Enhealth (who were previously known as NEHF) are currently considering guidelines for asbestos in a non-occupational environment, including asbestos in soil.

6.2 Field Quality Assurance/Quality Control

Environmental sampling activities were based on procedures and protocols outlined in Coffey's Environmental Field Manual (QP15/5-E, June 1995, revised September 1997) which is based on industry accepted standard practice.

The shovel/hand trowel used in sampling was decontaminated between sampling locations by physically removing soil material attached to the sampling tool. A clean pair of disposable gloves was used when handling each sample.

One wash blank sample identified as WB1 was collected from the shovel following decontamination to assess the efficacy of decontamination procedures.

Three duplicate soil samples identified as DUP1 (intra-laboratory duplicate of HA3 0.0-0.05), DUP2 (intra-laboratory duplicate of HA18 0.0-0.1) and DUP3 (intra-laboratory duplicate of HA16 0.0-0.1) were submitted for laboratory analysis. The duplicate samples were used to check whether the field sampling and laboratory procedures adequately reproduced results.

Trip spike and trip blank samples were not required as volatiles were not contaminants of concern for the investigation, given that no VOCs were detected from headspace testing in the field.

7. LABORATORY TESTING

Primary soil samples and intra-laboratory duplicates were dispatched under chain of custody conditions to AMDEL, a NATA registered laboratory for the analysis undertaken.

Selected soil samples were subjected to laboratory analysis, while other samples were held in the laboratory for further analysis, if required. The soil samples were selected for analysis based on a combination of sample location and field observations (i.e. material type, odours etc).

One sample from each sampling location was analysed for a combination of heavy metals (As, Cd, Cr, Cu, Hg, Pb, Ni and Zn), total petroleum hydrocarbons (TPH), benzene/toluene/ethylbenzene/xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), fluoride and asbestos. The analytical suite for each sample was selected based on the potential chemicals of concern identified during the site history review. Chain of custody documentation detailing the laboratory analysis undertaken on each sample analysed is presented in Appendix D.

8. RESULTS

8.1 Laboratory Results

A summary of the laboratory results from the samples analysed as part of the assessment is presented in Table LR1. Certified laboratory analytical certificates and chain of custody documentation is presented in Appendix F.

8.2 PID Results

PID readings were not observed above 0.0ppm in any surface or any near surface samples collected during the investigation.

8.3 QA/QC Results

Primary laboratory analysis was undertaken by AMDEL, which is a NATA registered laboratory for the analysis undertaken. Samples were received by AMDEL within the recommended holding times and they were chilled when received. Copies of the Chain of Custody documentation are included in Appendix F.

All samples were collected in appropriately preserved sampling containers and kept chilled in the field and during transit to the laboratory. The soil samples were dispatched on 1 February 2006 under chain of custody conditions. All samples were received by the laboratory in good condition. All samples were extracted and analysed within the respective holding times for each analyte.

Three primary/intra-laboratory duplicate pairs were collected in addition to the 25 primary samples analysed. This represents the collection of duplicate samples at a rate of greater than one duplicate per ten samples and is considered to be adequate for the purposes of this investigation.

Relative Percent Differences (RPDs) between primary and intra-laboratory duplicate pairs B2 0.0-0.1 / DUP1 and TP2 0.0-0.2 / DUP2 were within the normal acceptance criteria (50%) for contamination studies with the majority of analytes tested with RPD results predominantly being less than 20%.

Zinc was detected at a concentration of 0.014mg/L in wash blank sample WB1. As other heavy metals were not detected in the wash blank sample, though were detected in the soil samples analysed, it is considered that the zinc detection is most likely related to low levels of zinc being present within the rinsate water. As such, it is considered that the decontamination procedures used during the field investigations were adequate.

A review of the laboratory internal quality assurance/quality control reports indicate that the appropriate laboratory quality assurance/quality control procedures were undertaken at an appropriate rate for contamination studies and that:

- Contaminant concentrations in the laboratory method blanks were below the laboratory detection limits;
- Matrix spike recoveries were within control limits for inorganics (70% to 130%);
- RPDs for the laboratory duplicates were within control limits (60% to 120%);
- Surrogate recoveries were within the control limits for inorganics (70% to 130%).

Based on the above, it is considered that the data is directly usable.

8.4 Comparison of Results with Investigation levels

A comparison of the laboratory results to the investigation criteria is presented in Table LR1. No exceedances of the investigation criteria were detected, with the exception of the detection of asbestos containing fibre cement material.

9. DISCUSSION

The following presents a discussion of the laboratory results with respect to the area and chemicals of concern identified during the site history review.

9.1 Contamination Association with Atmospheric Fallout from Nearby Tomago Aluminium Smelter

Surface samples collected across the site were analysed for contaminants typically associated with atmospheric fallout for aluminium smelters (fluoride and PAHs). A review of the laboratory data from surface samples collected across the site indicates that PAHs were not detected above the laboratory detection limits in the samples analysed and fluoride was either not detected or was detected at low concentrations most likely to be indicative of natural background levels (<10mg/kg). As such, it is considered that the potential for widespread soil contamination associated with atmospheric fallout from the nearby Tomago Aluminium Smelter to be present at the site is low.

9.2 Presence of Contaminated Fill Material

Fill material was identified during the field investigations to the south east of Lot 1 DP 597372 as well as along a road running through Lot 1 DP 1003492. Laboratory results from samples collected from this material indicate that the fill material at the locations sampled does not contain heavy metal or TPH at concentrations exceeding the site investigation criteria or BTEX, PAHs, OCPs or PCBs at concentrations above the laboratory detection limits. As such, it is considered that the potential for widespread contamination, at concentrations above the site investigation criteria, to be present in fill material at the site is low. It is noted that the number of samples collected relative to the volume of fill observed to be present at the site is low and, as such, the potential for contaminated fill material to be present at the site cannot be precluded.

9.3 Contamination from Weathering of Building Products on Onsite Structures

Surface samples collected from the vicinity of current and former buildings across the site were analysed for heavy metals and asbestos in order to assess the potential for contamination associated with the weathering of building materials. A review of the heavy metals data indicates that heavy metals were not detected at concentrations exceeding the site investigation criteria in the samples analysed in the vicinity of former/current buildings. It is noted that lead and zinc were detected at concentrations considered to be slightly elevated with respect to natural background concentrations at some sampling locations, however these concentrations were well below the site investigation criteria.

Asbestos was identified in samples of fibre cement fragments collected in the vicinity of the abandoned shed located in the north western corner of Lot 1 DP1003492 and in the vicinity of the former building located at the highest portion of the dune in the northern portion of Lot 161 DP 774440. It is noted that asbestos fibres were not detected in soil samples collected near where the asbestos cement fragments were found.

A number of asbestos cement sheeting fragments were observed within a 5m radius of the southern extent of the shed. It is possible that some asbestos cement sheeting fragments may be partially buried in the vicinity of the shed.

Although only one asbestos cement fragment was identified in the vicinity of the former building in the northern portion of Lot 161 DP 774440, as the area was heavily overgrown with grass, it is considered that the area would be required to be cleared and subsequently reassessed in order to adequately assess the extent of asbestos cement fragments in this area.

9.4 Contamination Associated with Application of Pesticides Across Site

Surface samples collected across the site (including the residential areas, stockyards and paddocks) were analysed for heavy metals, OCPs and PCBs to assess the presence of contamination associated with the application of pesticides. A review of the laboratory data from samples collected across the site indicates that OCPs and PCBs were not detected above the laboratory detection limits in the samples analysed and heavy metals concentrations (particularly arsenic) do not indicate potential pesticide contamination. As such, it is considered that the potential for widespread pesticide contamination to be present at the site is low.

9.5 Low Level TPH Concentrations

TPH C_{10}-C_{36} was detected at concentrations (range from less than 50mg/kg to 500mg/kg, compared with the investigation criterion of 1,000mg/kg) in surface samples collected across the paddocks within Lot 1 DP1003492 and Lot 161 DP 774440. Based on the lack of visual/olfactory evidence of contamination, the lack of PID readings, the low lying swampy nature of much of the site, the predominant TPH chain length (C_{29}-C_{36}) and the absence of PAHs in the samples, it is considered that the low levels of TPH detected in the samples are likely to be representative of organic sources, such as humic substances in plant matter, and are unlikely to represent petroleum hydrocarbons. Review of historical land use did not identify a source for wide-spread presence of petroleum hydrocarbon compounds across the site.

10. CONCLUSIONS

The site history review revealed that contamination could potentially have been introduced to the site through:

- Atmospheric fallout of contamination from nearby Tomago Aluminium Smelter;
- Importation of contaminated fill material;
- Leaching or weathering of zinc, lead or asbestos from current/former buildings and structures;
- Application of pesticides during use for agricultural purposes.

Limited sampling and laboratory analysis were undertaken to make a preliminary assessment of the presence of soil contamination associated with the potential contaminating sources.

Based on the findings of the investigation presented above, the following conclusions are made:

- The potential for widespread soil contamination associated with atmospheric fallout from the nearby Tomago Aluminium Smelter to be present at the site is low;
- The potential for widespread contamination, at concentrations exceeding the site investigation criteria, to be present in fill material at the site is low. However, it is noted that the number of samples collected relative to the volume of fill observed to be present at the site is low and as such the potential for contaminated fill material to be present at the site cannot be precluded;
- Asbestos cement fragments were found in surface soils in the vicinity of an abandoned shed located in the north western portion of Lot 1 DP1003492 (numerous fragments) as well as in the vicinity of a former building located upon the peak of the dune in the northern portion of Lot 161 DP 77444(one fragment). Asbestos fibres were not detected in soils samples collected near where asbestos cement fragments were found. With the exception of the identified asbestos contamination, the potential for widespread contamination associated with the weathering of building materials to be present at the site is low;
- The potential for widespread soil contamination associated with the application of pesticides to be present at the site is low.

The potential for localised contamination of surface soil by asbestos, in the form of fragments of bonded asbestos cement building material, exists at locations where structures are, or were formerly, present on the site. The risk to human health from asbestos is related to inhalation of fibres. The bonding in fibre cement fragments means that fibres are generally bound and not normally released to the air. Given that the asbestos fibres in fibre cement sheeting are generally bound in and not normally released to the air, the isolated fragments of fibre present on the site would not be expected to pose a significant risk to the health of site users, provided such material is not broken up or abraded during future land use.

However, the current interim NSW EPA policy is that there should be no asbestos in surface soils. Given this policy, it is considered that a specialist asbestos consultant should be engaged to conduct a survey of the areas of the site where asbestos cement fragments have been identified to further assess the presence of asbestos containing materials. If Redlake acquire the property, it is recommended that the areas where asbestos contamination has been identified be fenced to restrict access until such time that the areas are further assessed and appropriate remediation works or management procedures are implemented.

Based on the above, subject to the adequate assessment and management/remediation of the identified asbestos contamination, it is considered that the site is likely to be suitable for the proposed industrial development.

It is noted that this assessment has not included an assessment of groundwater contamination beneath the site. Based on the findings of this PSCA, it is considered that the potential for site originated groundwater contamination to be present at the site is low. It is noted there is some potential for offsite originated groundwater contamination from the nearby Tomago Aluminium Smelter (if present) to have migrated to beneath the site, although as the site is approximately 2km from the smelter this is considered to be unlikely.

It is also noted that the area lies within an area identified to be a high risk of acid sulphate soils, however it is understood that the proposed redevelopment of the site will not involve major excavations and instead will most likely comprise significant filling, it is considered unlikely that the presence of potential acid sulphate soils will pose a constraint to the development.

11. LIMITATIONS

The findings contained within this report are the result of discrete/specific sampling methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

As per the project brief relatively limited sampling and analysis was undertaken, which is consistent with the preliminary nature of this assessment. As such, the conclusions of the report should be considered as preliminary only.

It is also important to note that the possibility of contaminated material, other than that identified, being present at the site cannot be precluded. If during redevelopment of the site, contaminated material or contamination sources such as oily or odorous material, drums, tanks, metal or plastic chemical containers, potentially asbestos containing material, or brightly coloured material etc. were to be encountered, work in that part of the site should cease and advice should be sought from a suitably qualified environmental consultant.

This PSCA excludes consideration of possible environmental issues, other than those associated with land contamination, arising from the development of the site, given that a portion of Lot 161 DP 774440 forms part of the Kooragang Nature Reserve.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD



ARTHUR LOVE

REFERENCES:

NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Measure;

NSW EPA (1995) Contaminated Sites: Sampling Design Guidelines for Contaminated Sites, NSW EPA;

NSW EPA (1997) *Contaminated Sites: Gui*delines for Consultants Reporting on Contaminated Sites, NSW EPA;

NSW EPA (1998) Contaminated Sites: Guidelines for the NSW Site Auditor Scheme, NSW EPA.

Coffey

N09814/02-AF
25 August 2006

LABORATORY RESULT SUMMARY TABLES

Coffey

TABLE LR1
SUMMARY OF LABORATORY RESULTS
197 - 325 TOMAGO ROAD, TOMAGO
All results in mg/kg

Sample ID/Depth	THRESHOLD		HA1 0.0-0.05	HA2 0.0-0.05	HA3 0.0-0.05	HA4 0.0-0.05	HA7 0.0-0.05
Geological Origin	CONCENTRATION		TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL
Date of Sampling	Industrial		1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006
HEAVY METALS							
Arsenic	500	1	<5	<5	<5	<5	<5
Cadmium	100	1	<0.5	<0.5	0.7	<0.5	<0.5
Chromium	60	1	7	<5	6	<5	<5
Copper	5000	1	<5	5	26	<5	5
Nickel	3000	1	<2	2	4	2	<2
Lead	1500	1	7	76	140	11	14
Zinc	35000	1	15	43	260	45	12
Mercury	75	1	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	37000	2	-	-	-	-	-
TOTAL PETROLEUM HYDROCARBONS							
C6 - C9 Fraction	65	3	-	<5	<5	-	-
C10 - C14 Fraction			-	<10	<10	-	-
C15 - C28 Fraction			-	<50	<50	-	-
C29 - C36 Fraction			-	<50	70	-	-
Total C10-C36	1000	3	-	ND	70	-	-
BTEX							
Benzene	1	3	-	<0.2	<0.2	-	-
Toluene	130	3	-	<1	<1	-	-
Ethylbenzene	50	3	-	<1	<1	-	-
m&p-Xylene	25	3	-	<2	<2	-	-
o-Xylene			-	<1	<1	-	-
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)							
Naphthalene			<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene			<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene			<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene			<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene			<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene			<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene			<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene			<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene			<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)&(k)fluorant			<1	<1	<1	<1	<1
Benzo(a)pyrene	5	1	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene			<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(ah)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(ghi)perylene			<0.5	<0.5	<0.5	<0.5	<0.5
Total PAHs	100	1	ND	ND	ND	ND	ND
ORGANOCHLORINE PESTICIDIES (OCPs)							
Total OCPs			ND	ND	ND	ND	ND
POLYCHLORINATED BIPHENYLS (PCBs)							
Total PCBs			ND	ND	ND	ND	ND
ASBESTOS	Not Detected	4	-	-	ND	ND	-

NOTES
Concentration exceeds site investigation criteria
1 NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme, Column 4
2 Based on US EPA Region 9 Preliminary Remediation Goals (PRG's)
3 NSW EPA (1994) Guidelines for Assessing Service Station Sites, Table 3
4 Based nn the advice of the NSW Department of Health, the NSW EPA have advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that there should be no asbestos in surface soils.
- Not Analysed
ND Not detected above the laboratory limit of reporting
PACM Potentially Asbestos Containing Material

TABLE LR1
SUMMARY OF LABORATORY RESULTS
197 - 325 TOMAGO ROAD, TOMAGO
All results in mg/kg

Sample ID/Depth	THRESHOLD		HA8 0.0-0.05	HA9 0.2-0.25	HA10 0.15-0.2	HA11 0-0.05	HA12 0.15-0.2	HA13 0.0-0.1
Geological Origin	CONCENTRATION		TOPSOIL	FILL	FILL	TOPSOIL	TOPSOIL	TOPSOIL
Date of Sampling	Industrial		1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006
HEAVY METALS								
Arsenic	500	1	<5	<5	<5	<5	<5	<5
Cadmium	100	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	60	1	<5	6	9	<5	<5	<5
Copper	5000	1	<5	<5	<5	<5	7	15
Nickel	3000	1	<2	<2	2	<2	2	3
Lead	1500	1	14	<5	<5	<5	<5	170
Zinc	35000	1	50	<5	7	6	29	150
Mercury	75	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	37000	2	-	-	-	1	-	<1
TOTAL PETROLEUM HYDROCARBONS								
C6 - C9 Fraction	65	3	-	<5	<5	-	<5	-
C10 - C14 Fraction			-	<10	<10	-	<10	-
C15 - C28 Fraction			-	<50	<50	-	<50	-
C29 - C36 Fraction			-	60	90	-	<50	-
Total C10-C36	1000	3	-	60	90	-	ND	-
BTEX								
Benzene	1	3	-	<0.2	<0.2	-	<0.2	-
Toluene	130	3	-	<1	<1	-	<1	-
Ethylbenzene	50	3	-	<1	<1	-	<1	-
m&p-Xylene	25	3	-	<2	<2	-	<2	-
o-Xylene			-	<1	<1	-	<1	-
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)								
Naphthalene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)&(k)fluorant			<1	<1	<1	<1	<1	<1
Benzo(a)pyrene	5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(ah)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(ghi)perylene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total PAHs	100	1	ND	ND	ND	ND	ND	ND
ORGANOCHLORINE PESTICIDIES (OCPs)								
Total OCPs			ND	ND	ND	ND	ND	ND
POLYCHLORINATED BIPHENYLS (PCBs)								
Total PCBs			ND	ND	ND	ND	ND	ND
ASBESTOS	Not Detected	4	-	ND	ND	-	-	-

NOTES
Concentration exceeds site investigation criteria
1 NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme, Column 4
2 Based on US EPA Region 9 Preliminary Remediation Goals (PRG's)
3 NSW EPA (1994) Guidelines for Assessing Service Station Sites, Table 3
4 Based nn the advice of the NSW Department of Health, the NSW EPA have advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that there should be no asbestos in surface soils.
- Not Analysed
ND Not detected above the laboratory limit of reporting
PACM Potentially Asbestos Containing Material

TABLE LR1
SUMMARY OF LABORATORY RESULTS
197 - 325 TOMAGO ROAD, TOMAGO
All results in mg/kg

Sample ID/Depth	THRESHOLD		HA14 0.0-0.1	HA15 0.0-0.1	HA16 0.0-0.1	HA17 0.0-0.1	HA18 0.0-0.1	HA19 0.0-0.1
Geological Origin	CONCENTRATION		TOPSOIL	TOPSOIL	FILL	TOPSOIL	TOPSOIL	TOPSOIL
Date of Sampling	Industrial		1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006
HEAVY METALS								
Arsenic	500	1	<5	<5	<5	6	<5	7
Cadmium	100	1	<0.5	0.5	<0.5	<0.5	<0.5	<0.5
Chromium	60	1	<5	25	7	49	31	40
Copper	5000	1	9	25	10	38	25	41
Nickel	3000	1	3	15	7	40	26	34
Lead	1500	1	160	50	6	29	19	35
Zinc	35000	1	140	110	32	130	86	130
Mercury	75	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	37000	2	-	-	-	-	<1	7
TOTAL PETROLEUM HYDROCARBONS								
C6 - C9 Fraction	65	3	-	-	<5	-	-	-
C10 - C14 Fraction			-	-	<10	-	-	-
C15 - C28 Fraction			-	-	<50	-	-	-
C29 - C36 Fraction			-	-	60	-	-	-
Total C10-C36	1000	3	-	-	60	-	-	-
BTEX								
Benzene	1	3	-	-	<0.2	-	-	-
Toluene	130	3	-	-	<1	-	-	-
Ethylbenzene	50	3	-	-	<1	-	-	-
m&p-Xylene	25	3	-	-	<2	-	-	-
o-Xylene			-	-	<1	-	-	-
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)								
Naphthalene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)&(k)fluorant			<1	<1	<1	<1	<1	<1
Benzo(a)pyrene	5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(ah)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(ghi)perylene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total PAHs	100	1	ND	ND	ND	ND	ND	ND
ORGANOCHLORINE PESTICIDIES (OCPs)								
Total OCPs			ND	ND	ND	ND	ND	ND
POLYCHLORINATED BIPHENYLS (PCBs)								
Total PCBs			ND	ND	ND	ND	ND	ND
ASBESTOS	Not Detected	4	-	-	-	-	-	-

NOTES
Concentration exceeds site investigation criteria
1 NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme, Column 4
2 Based on US EPA Region 9 Preliminary Remediation Goals (PRG's)
3 NSW EPA (1994) Guidelines for Assessing Service Station Sites, Table 3
4 Based nn the advice of the NSW Department of Health, the NSW EPA have advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that there should be no asbestos in surface soils
- Not Analysed
ND Not detected above the laboratory limit of reporting
PACM Potentially Asbestos Containing Material

TABLE LR1
SUMMARY OF LABORATORY RESULTS
197 - 325 TOMAGO ROAD, TOMAGO
All results in mg/kg

Sample ID/Depth	THRESHOLD		HA20 0.0-0.1	HA21 0.15-0.2	HA22 0.0-0.1	HA23 0.0-0.1	HA24 0.0-0.05	HA25 0.0-0.1
Geological Origin	CONCENTRATION		FILL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	FILL
Date of Sampling	Industrial		1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006	1/02/2006
HEAVY METALS								
Arsenic	500	1	<5	13	12	6	<5	<5
Cadmium	100	1	<0.5	0.6	<0.5	0.5	<0.5	<0.5
Chromium	60	1	25	31	31	33	<5	24
Copper	5000	1	27	34	29	34	<5	24
Nickel	3000	1	20	39	35	40	<2	12
Lead	1500	1	29	22	23	30	20	30
Zinc	35000	1	130	110	110	130	56	76
Mercury	75	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	37000	2	--	--	-	3	-	--
TOTAL PETROLEUM HYDROCARBONS								
C6 - C9 Fraction	65	3	<5	<5	-	<5	-	<5
C10 - C14 Fraction			10	<10	-	<10	-	<10
C15 - C28 Fraction			100	<50	-	<50	-	140
C29 - C36 Fraction			200	140	-	280	-	360
Total C10-C36	1000	3	310	140	-	280	-	500
BTEX								
Benzene	1	3	<0.2	<0.2	-	<0.2	-	<0.2
Toluene	130	3	<1	<1	-	<1	-	<1
Ethylbenzene	50	3	<1	<1	-	<1	-	<1
m&p-Xylene	25	3	<2	<2	-	<2	-	<2
o-Xylene			<1	<1	-	<1	-	<1
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)								
Naphthalene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)&(k)fluorant			<1	<1	<1	<1	<1	<1
Benzo(a)pyrene	5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(ah)anthracene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(ghi)perylene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total PAHs	100	1	ND	ND	ND	ND	ND	ND
ORGANOCHLORINE PESTICIDIES (OCPs)								
Total OCPs			ND	ND	ND	ND	ND	ND
POLYCHLORINATED BIPHENYLS (PCBs)								
Total PCBs			ND	ND	ND	ND	ND	ND
ASBESTOS	Not Detected	4	-	-	-	-	-	-

NOTES
Concentration exceeds site investigation criteria
1 NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme, Column 4
2 Based on US EPA Region 9 Preliminary Remediation Goals (PRG's)
3 NSW EPA (1994) Guidelines for Assessing Service Station Sites, Table 3
4 Based nn the advice of the NSW Department of Health, the NSW EPA have advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that there should be no asbestos in surface soils
- Not Analysed
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PACM Potentially Asbestos Containing Material

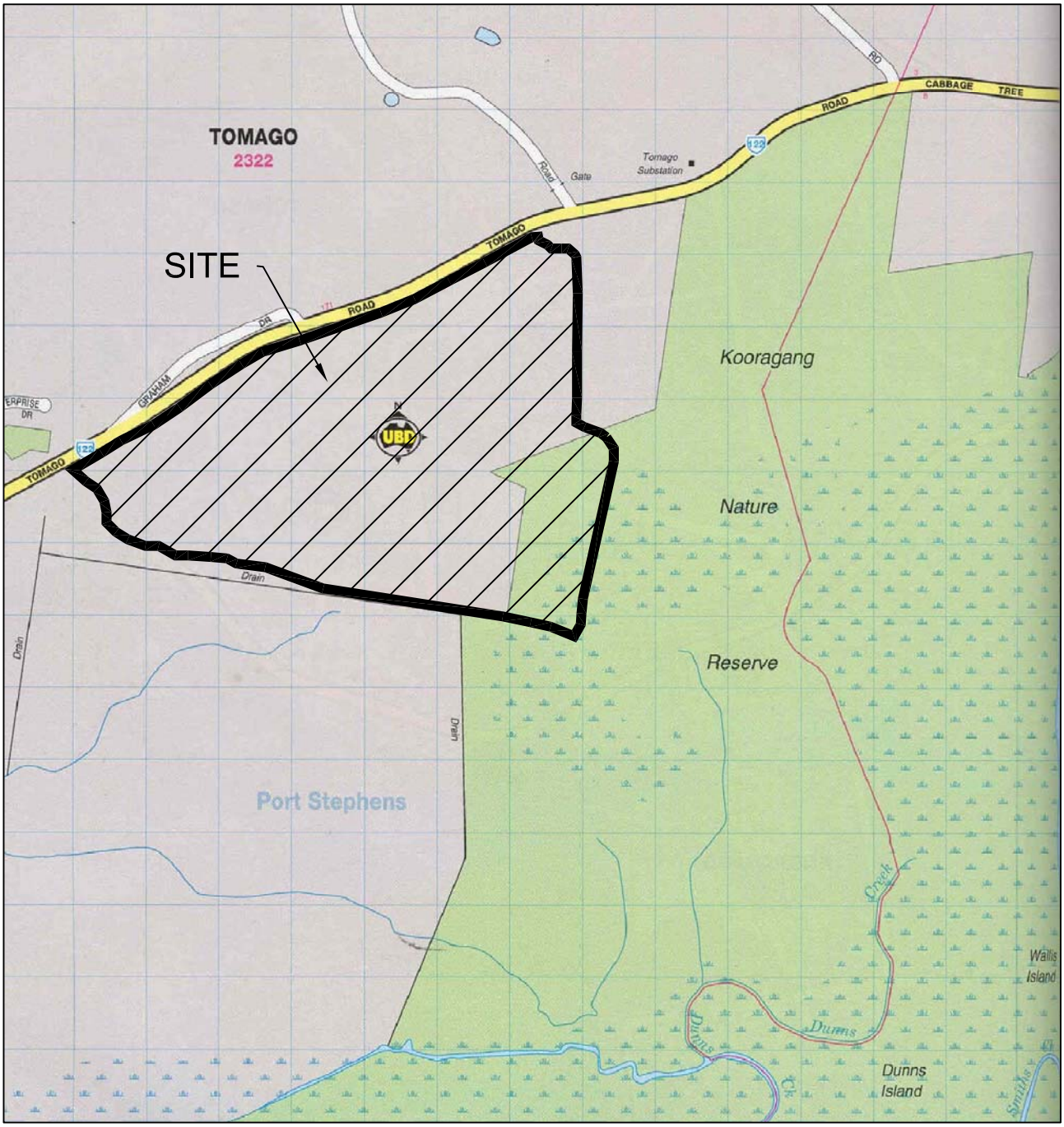
TABLE LR1
SUMMARY OF LABORATORY RESULTS
197 - 325 TOMAGO ROAD, TOMAGO
All results in mg/kg

Sample ID/Depth Geological Origin Date of Sampling	THRESHOLD CONCENTRATION Industrial		A1 PACM 1/02/2006	A2 PACM 1/02/2006	A3 PACM 1/02/2006
HEAVY METALS					
Arsenic	500	1	-	-	-
Cadmium	100	1	-	-	-
Chromium	60	1	-	-	-
Copper	5000	1	-	-	-
Nickel	3000	1	-	-	-
Lead	1500	1	-	-	-
Zinc	35000	1	-	-	-
Mercury	75	1	-	-	-
Fluoride	37000	2	-	-	-
TOTAL PETROLEUM HYDROCARBONS					
C6 - C9 Fraction	65	3	-	-	-
C10 - C14 Fraction			-	-	-
C15 - C28 Fraction			-	-	-
C29 - C36 Fraction			-	-	-
Total C10-C36	1000	3	-	-	-
BTEX					
Benzene	1	3	-	-	-
Toluene	130	3	-	-	-
Ethylbenzene	50	3	-	-	-
m&p-Xylene	25	3	-	-	-
o-Xylene			-	-	-
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)					
Naphthalene			-	-	-
Acenaphthylene			-	-	-
Acenaphthene			-	-	-
Fluorene			-	-	-
Phenanthrene			-	-	-
Anthracene			-	-	-
Fluoranthene			-	-	-
Pyrene			-	-	-
Benzo(a)anthracene			-	-	-
Chrysene			-	-	-
Benzo(b)&(k)fluorant			-	-	-
Benzo(a)pyrene	5	1	-	-	-
Indeno(123-cd)pyrene			-	-	-
Dibenz(ah)anthracene			-	-	-
Benzo(ghi)perylene			-	-	-
Total PAHs	100	1	-	-	-
ORGANOCHLORINE PESTICIDES (OCPs)					
Total OCPs			-	-	-
POLYCHLORINATED BIPHENYLS (PCBs)					
Total PCBs			-	-	-
ASBESTOS	Not Detected	4	Chrysotile Asbestos Detected	Chrysotile Asbestos Detected	Chrysotile Asbestos Detected

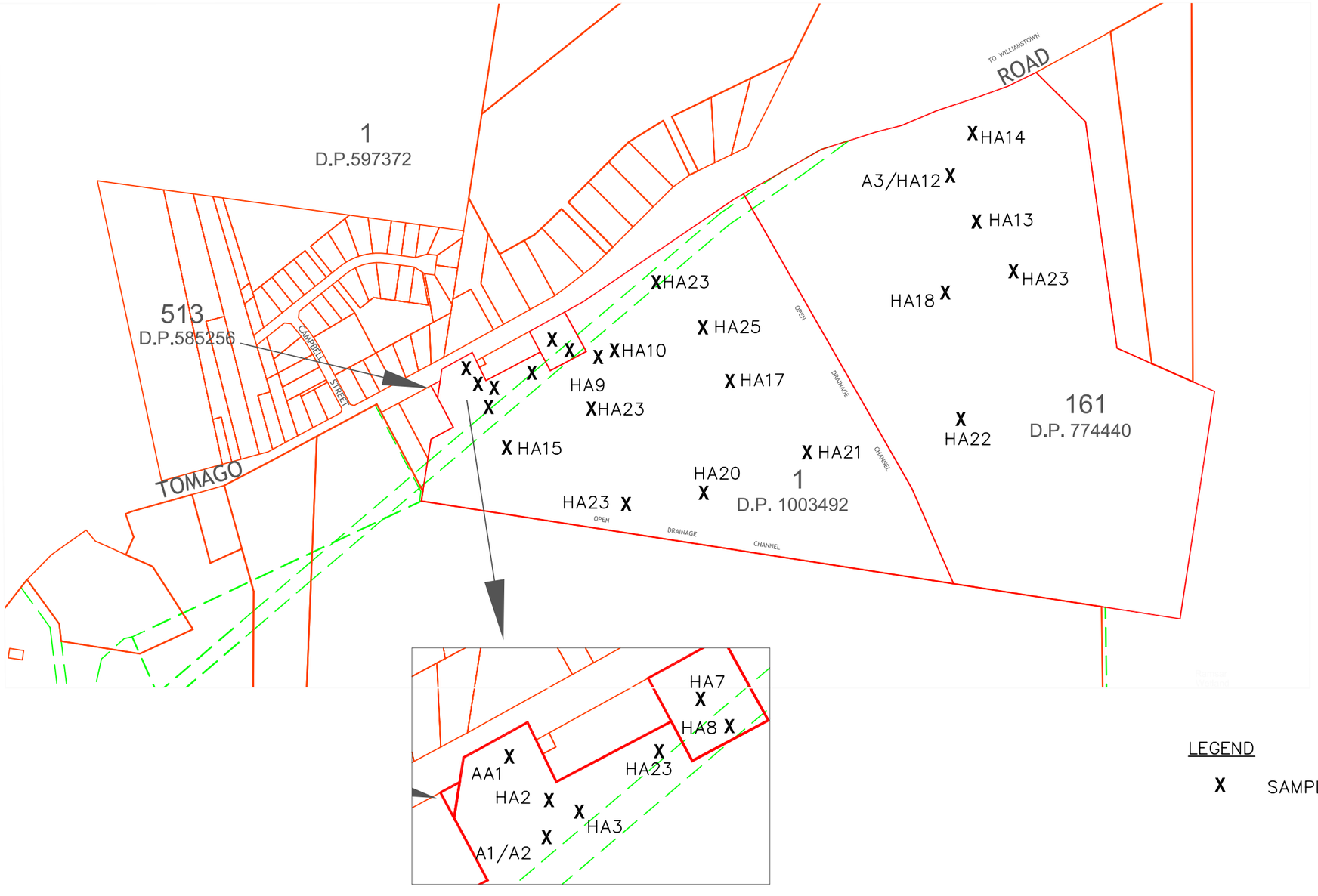
NOTES
Concentration exceeds site investigation criteria
1 NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme, Column 4
2 Based on US EPA Region 9 Preliminary Remediation Goals (PRG's)
3 NSW EPA (1994) Guidelines for Assessing Service Station Sites, Table 3
4 Based nn the advice of the NSW Department of Health, the NSW EPA have advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that there should be no asbestos in surface soils
- Not Analysed
ND Not detected above the laboratory limit of reporting
PACM Potentially Asbestos Containing Material

N09814/02-AF
25 August 2006

DRAWINGS



Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical | **Resources** | Environmental | **Technical** | Project Management		
	Drawn	NLS	**REDLAKE ENTERPRISES C/- ASQUITH AND deWITT** **PRELIMINARY SITE CONTAMINATION ASSESSMENT** **197 - 325 TOMAGO ROAD, TOMAGO** **SITE LOCATION PLAN**	Drawing No: **FIGURE 1**
	Approved			
	Date	13–02–06		
	Scale	NTS		Job no: **N09814/02**



Coffey Geosciences Pty Ltd ACN 056 335 516

Geotechnical | **Resources** | Environmental | **Technical** | Project Management

0 10 20 40 50
Scale (metres)

Revision	Description	Drawn	Approved	Date

Drawn	NLS
Approved	
Date	20–02–06
Scale	1:10000

REDLAKE ENTERPRISES C/- ASQUITH AND deWITT
PRELIMINARY SITE CONTAMINATION ASSESSMENT
197 - 325 TOMAGO ROAD, TOMAGO
SITE PLAN SHOWING SAMPLING LOCATIONS

Drawing No: **FIGURE 2**

Job no: **N09814/02-AF**

APPENDIX A

Site Photographs



Photo 1 – Filled area to south east of Lot 1 DP 597372



Photo 2 – Abandoned shed constructed of asbestos cement sheeting in north western corner of Lot 1 DP 1003492

Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I **Resources** I Environmental I **Technical** I Project Management	
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PHASE 1 PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO SITE PHOTOGRAPHS	Drawing no: PHOTOS 1 & 2
Approved			
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AB



Photo 3 – Remnants of former building in north eastern portion of Lot 161 DP 774440



Photo 4 – Building remnants on top of dune in northern portion of Lot 161 DP 774440

Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I **Resources** I Environmental I **Technical** I Project Management	
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PHASE 1 PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO SITE PHOTOGRAPHS	Drawing no: PHOTOS 3 & 4
Approved			
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AB



Photo 5 – Asbestos cement fragment in vicinity of building remnants on top of dune in northern portion of Lot 161 DP 774440



Photo 6 – Filled road running through Lot 1 DP 1003492

Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I **Resources** I Environmental I **Technical** I Project Management	
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PHASE 1 PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO SITE PHOTOGRAPHS	Drawing no: PHOTOS 5 & 6`
Approved			
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AB



Photo 7 – Looking towards north eastern portion of Lot 161 DP 774440 from centre of Lot 1 DP 1003492



Photo 8 – Looking towards north western corner of Lot 1 DP 1003492 from centre of property

Coffey Geosciences Pty Ltd ACN 056 335 516	Geotechnical **I Resources I** Environmental **I Technical I** Project Management		
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PHASE 1 PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO SITE PHOTOGRAPHS	Drawing no: PHOTOS 7 & 8
Approved			
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AB

N09814/02-AF
25 August 2006

APPENDIX B

Title Search Documents

ADVANCE LEGAL SEARCH PTY LIMITED

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16 January 2006

COFFEY GEOSCIENCES Pty Ltd
13 Mangrove Rd
SANDGATE NSW 2304

Attention Kane Mitchell

RE: **Tomago Rd, Tomago**
Ref: NO9814/2 AB
PO 12800

Note 1: **Folio Identifier 1/597372**
Note 2: **Folio Identifier 513/585256**
Note 3: **Folio Identifier 1/1003492**
Note 4: **Folio Identifier 161/774440**

Note 1:

Current Search

Folio Identifier 1/597372 (attached)
DP 597372 (plan attached)
Dated 10 January 2006
Registered Proprietor:
HER MOST GRACIOUS MAJESTY QUEEN ELIZABETH II
(NSW TREASURY - CROWN PROPERTY PORTFOLIO)

Title Tree
Lot 1 DP 597372

Folio Identifier 1/597372

Certificate of Title Volume 13741 Folio 150

IVA 29221

Conveyance BK 2723 No. 14

Conveyance BK 2723 No. 13

Conveyance BK 1601 No. 462

Conveyance BK 365 No. 199

*****

Summary of Proprietor(s)
Lot 1 DP 597372

Year	Proprietor
	(Lot 1 DP 597372)
2003 – todate	Her Most Gracious Majesty Queen Elizabeth II (NSW Treasury - Crown Property Portfolio)
2001 – 2003	Tomago Aluminium Company Pty Limited
1988- 2001	Garry Mark Pegler Wendy Joy Pegler
	(Lot 1 DP 597372 - CT Vol 13741 Fol 150)
1979 – 1988	Garry Mark Pegler, blacksmith Wendy Joy Pegler
1978 – 1979	Stanley Graham, contractor Marjorie Joy Graham
	(Part Portion 16 Parish Stockton - Area 129 Acres 1 Rood 5 ¼ Perches)
1964 – 1978	Stanley Graham, service station proprietor Marjorie Joy Graham
1964 – 1964	Charles Ernest Walters, textile worker
1963 – 1964	William Henry George Barrett, fitter Henry Albert Barrett, laboratory tester Ronald Alan Barrett, shire employee
	(Part Portion 16 Parish Stockton & other lands - Area 137 Acres 2 Roods)
1954 – 1963	Susan Bertha Barrett, widow
1930 – 1954	William Barrett, farmer Susan Bertha Barrett
1928 – 1930	Mary McDonald, wife of farmer Annie Keith, widow
	(Part Portion 16 Parish Stockton & other lands)
1887 – 1928	Andrew McDonald, farmer

*****

Note 2:

Current Search

Folio Identifier 513/585256 (attached)
DP 585256 (plan attached)
Dated 10 January 2006
Registered Proprietor:
GEOFFREY ALLAN GRAHAM

Title Tree
Lot 513 DP 585256

Folio Identifier 513/585256

Certificate of Title Volume 13301 Folio 209

Certificate of Title Volume 12941 Folio 34

IVA 17291

Conveyance BK 3165 No. 92

Conveyance BK 2679 No. 802

Conveyance BK 1884 No. 539

Conveyance BK 1644 No. 26

Conveyance BK 1522 No. 116

Conveyance BK 323 No. 845

*****

Summary of Proprietor(s)
Lot 513 DP 585256

Year	Proprietor
	(Lot 513 DP 585256)
2000 – todate	Geoffrey Allan Graham
1999 – 2000	Geoffrey Allan Graham Wendy Joy Graham
1995 – 1999	Stanley Graham
1988 – 1995	Stanley Graham, service station proprietor Marjorie Joy Graham
	(Lot 513 DP 585256 - CT Vol 13301 Fol 209)
1977 – 1988	Stanley Graham, service station proprietor Marjorie Joy Graham
1977 – 1977	Industrial Switchgear Pty Limited
	(Lot 51 DP 577334 - CT Vol 12941 Fol 34)
1976 – 1977	Industrial Switchgear Pty Limited
1975 – 1976	Elders Nominees Limited
	(Lot 5 in Registered Plan 876 - Area 187 Acres)
1974 – 1975	Elders Nominees Limited
	(Lots 5 to 9 in Reginald Plan 876 - Area 231 Acres 1 Rood)
1963 – 1974	Robert William Campbell, farmer Phyllis Marguerite Campbell
1958 – 1963	Henrietta Christina Campbell, widow Ralph Engel Gillespie Campbell, farmer Robert William Campbell, farmer
1940 – 1958	Robert George Campbell, farmer
1932 – 1940	Richard Windeyer, kings counsellor
1928 – 1932	William Archibald Windeyer Mary Emily Ralston
1900 – 1928	Jane Windeyer, spinster Margaret Windeyer, spinster Lucy Baldwin, wife of gentleman Edward Windeyer, auctioneer
1885 – 1900	William Charles Windeyer

*****

Note 3:

Current Search

Folio Identifier 1/1003492 (attached)
DP 1003492 (plan attached)
Dated 10 January 2006
Registered Proprietor:
GEOFFREY ALLAN GRAHAM

Title Tree
Lot 1 DP 1003492

Folio Identifier 1/1003492

Conveyance BK 4239 No. 226

Conveyance BK 2723 No. 14

Conveyance BK 2723 No. 13

Conveyance BK 1601 No. 462

Conveyance BK 365 No. 199

*****

Summary of Proprietor(s)
Lot 1 DP 1003492

Year	Proprietor
	(Lot 1 DP 1003492)
2000 – todate	Geoffrey Allan Graham
1999 – 2000	Geoffrey Allan Graham Wendy Joy Pegler
	(Part Portion 16 Parish Stockton - Area 129 Acres 1 Rood 5 ¼ Perches)
1999 – 1999	Geoffrey Allan Graham Wendy Joy Pegler
1964 – 1999	Stanley Graham, service station proprietor
	(Part Portion 16 Parish Stockton & other lands - Area 137 Acres 2 Roods)
1954 – 1964	Susan Bertha Barrett, widow
1930 – 1954	William Barrett, farmer Susan Bertha Barrett
1928 – 1930	Mary McDonald, wife of farmer Annie Keith, widow
	(Part Portion 16 Parish Stockton & other lands)
1887 – 1928	Andrew McDonald, farmer

****

Note 4:

Current Search

Folio Identifier 161/774440 (attached)
DP 774440 (plan attached)
Dated 10 January 2006
Registered Proprietor:
HER MOST GRACIOUS MAJESTY QUEEN ELIZABETH II
(NSW TREASURY - CROWN PROPERTY PORTFOLIO)

Title Tree
Lot 161 DP 774440

Folio Identifier 161/774440

P A 60547

Conveyance BK 3569 No. 426

Conveyance BK 3165 No. 91

Conveyance BK 3165 No. 89

Conveyance BK 2990 No. 826

Conveyance BK 2082 No. 209

Conveyance BK 1618 No. 505

Conveyance BK 365 No. 199

*****

Summary of Proprietor(s)
Lot 161 DP 774440

Year	Proprietor
	(Lot 161 DP 774440)
2003 – todate	Her Most Gracious Majesty Queen Elizabeth II (NSW Treasury- Crown property portfolio)
1988 -2003	Tomago Aluminium Company Pty Limited
	(Part Portion 16 Parish Stockton - Area 166 Acres 3 Roods 22 ½ Perches)
1983 – 1988	Tomago Aluminium Company Pty Limited
1974 – 1983	Elder's Nominees Limited
1973 – 1974	Robert William Campbell, farmer Phyllis Marguerite Campbell
1973 – 1973	Alma Slade, married woman Irma Anschau, married woman
1970 – 1973	Albert Edward Blanch
1958 – 1970	Joseph Campbell McQueen, accountant Jean McKenzie McQueen, single woman
1949 – 1958	Maud Gertrude McQueen, widow
1943 – 1949	Maud Gertrude McQueen, widow Angus McAuley Matthewson, farmer
1930 – 1943	Samuel McQueen, farmer
1915 – 1930	Samuel McQueen, farmer Larne McMillan, wife of farmer Jane Upton, wife of farmer Magnus Campbell, grazier
1887 – 1915	Samuel McQueen, farmer

*****

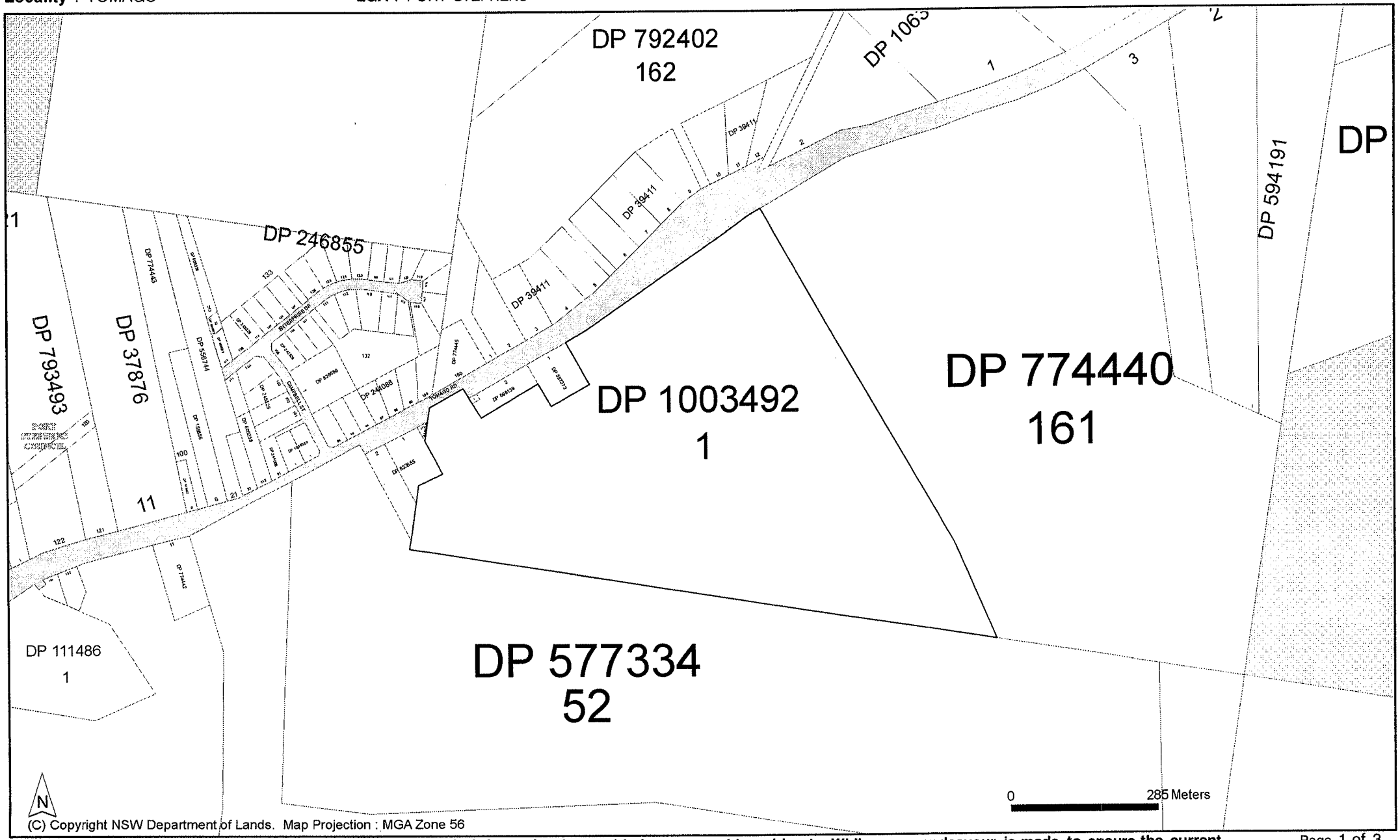
Department of Lands
Reliable from the ground up

Cadastral Records Enquiry Report

Box : 97 **Reference** : Coffey – Tamago

Requested Parcel : Lot 1 DP 1003492 **Identified Parcel** : Lot 1 DP 1003492

Locality : TOMAGO **LGA** : PORT STEPHENS **Parish** : STOCKTON **County** : GLOUCESTER



(C) Copyright NSW Department of Lands. Map Projection : MGA Zone 56

Report Generated 2:08:13 PM, 12 January, 2006

This information is provided as a searching aid only. While every endeavour is made to ensure the current cadastral pattern is accurately reflected, the Registrar General cannot guarantee the information provided

N09814/02-AF
25 August 2006

APPENDIX C

Port Stephens Shire Council Letter

FACSIMILE

Port Stephens
C·O·U·N·C·I·L
a community partnership

Send to:	Kane Mitchell
Company Name:	Coffey Geosciences Pty Ltd
FAX No:	4967 5402
No of Pages:	1 (inc. header)
Subject:	Records search 4 properties at Tomago Road
File No:	

From:	Karen Picton
Position Title	Customer Support Officer
Date:	11/1/06
Fax No:	49873612
Phone No:	49800215

DETAILS:

Lot 1 DP597372 - 297 Tomago Rd

Lot 513 DP585256 – 325 Tomago Rd

Lot 1 DP1003492 – 319 Tomago Rd

Lot 161 DP774440 – 197 Tomago Rd

– No records on file any buildings would probably be pre-sixties

TOTAL P.01

APPENDIX D

WorkCover NSW Letter

WorkCover
NEW SOUTH WALES

COFFEY GEOSCIENCES
PTY LTD
NEWCASTLE
9 MAR 2006

Our Ref: D06/003885
Your Ref: N09814/2AB

6 March 2006

Attention: Mr Kane Mitchell
Coffey Geosciences
13 Mangrove Rd
SANDGATE NSW 2304

Dear Mr Mitchell

RE SITE: 197, 297, 319, 325 Tomago Rd, Tomago

I refer to your search request of 23 January 2006 requesting information on licences to Keep Dangerous Goods for the above site.

A search of the Stored Chemical Information Database (SCID) and the microfiche records held by WorkCover has not located any records pertaining to the above-mentioned premises.

If you have any further queries, please contact Dangerous Goods Licensing staff on (02) 4321 5500.

Brent Jones
Team Leader
Dangerous Goods

APPENDIX E

Aerial Photographs



Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical **I Resources I** Environmental **I Technical I** Project Management	
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PRELIMINARY SITE CONTAMINATION ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO NEWCASTLE RUN2 - 22-07-1954	Drawing no: PLATE 1
Approved	KM		
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AF

N



Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I **Resources** I Environmental I **Technical** I Project Management	
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PRELIMINARY SITE CONTAMINATION ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO NEWCASTLE RUN 6 - 27-05-1975	Drawing no: PLATE 2
Approved	KM		
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AF

N



Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I **Resources** I Environmental I **Technical** I Project Management	
Drawn	NLS	REDLAKE ENTERPRISES C/- ASQUITH & DEWITT PRELIMINARY SITE CONTAMINATION ASSESSMENT 197 – 325 TOMAGO ROAD, TOMAGO NEWCASTLE RUN 9 - 23-02-1992	Drawing no: PLATE 3
Approved	KM		
Date	15-02-06		
Scale	NTS		Job no: N09814/02-AF-

N09814/02-AF
25 August 2006

APPENDIX F

Laboratory Results and Chain of Custody Documentation

AUSTRALIAN SAFER ENVIRONMENT & TECHNOLOGY PTY LTD

ABN 36 088 095 112

Our ref : ASET7649/ 10695 / 1 - 8
Your ref :6E0256 -
NATA Accreditation No: 14484

7 February 2006

Amdel Laboratories Ltd
99, Mitchell Road,,
Cardiff,
NSW 2285.

Attn:Ms Angela Karsch,
Fax No:02 - 4902 4899

Dear Angela,
Asbestos Identification
This report presents the results of eight samples, forwarded by Amdel Laboratories Ltd on 2 February 2006, for analysis for asbestos.

1.Introduction: Eight samples forwarded were examined and analysed for the presence of asbestos.

2. Methods : The samples were examined under a Stereo Microscope and selected fibres were analysed by Polarized Light Microscopy in conjunction with Dispersion Staining method **(Safer Environment Method 1.)**

3. Results :

Sample No. 1. ASET7649 / 10695 / 1. 6E0256 - E244534 - HA3 - 0.0 - 0.05.
Approx dimensions 3.5 cm x 3.5 cm x 5.0 cm
The sample consisted of mixture of sandy soil, stones and plant matter.
No asbestos detected.

Sample No. 2. ASET7649 / 10695 / 2. 6E0256 - E244535 - HA4 - 0.0 - 0.05.
Approx dimensions 3.5 cm x 3.5 cm x 4.5 cm
The sample consisted of mixture of sandy soil, stones and plant matter.
No asbestos detected.

Sample No. 3. ASET7649 / 10695 / 3. 6E0256 - E244540 - HA9 - 0.2 - 0.25.
Approx dimensions 3.5 cm x 3.5 cm x 5.25 cm
The sample consisted of mixture of blackish sandy soil, stones and plant matter.
No asbestos detected.

Sample No. 4. ASET7649 / 10695 / 4. 6E0256 - E244541 - HA 10 - 0.15 - 0.2.
Approx dimensions 3.5 cm x 3.5 cm x 5.0 cm
The sample consisted of mixture of blackish sandy soil, stones and plant matter.
No asbestos detected.

Sample No. 5. ASET7649 / 10695 / 5. 6E0256 - E244543 - DUP 1.
Approx dimensions 3.5 cm x 3.5 cm x 5.5 cm
The sample consisted of mixture of blackish sandy soil, stones and plant matter.
No asbestos detected.

Sample No. 6. ASET7649 / 10695 / 6. 6E0256 - E244560 - A 1.
Approx dimensions 4.0 cm x 3.75 cm x 1.0 cm
The sample consisted of a fragment of a fibre cement material.
Chrysotile asbestos detected.

UNIT 7 LEVEL 2, 1 LEONARD STREET, HORNSBY NSW 2077 – P.O. BOX 1644 HORNSBY NORTHGATE NSW 1635
PHONE: (02) 99872183 FAX: (02)99872151 EMAIL: asett@bigpond.net.au WEBSITE: www.aset.com.au

OCCUPATIONAL HEALTH & SAFETY STUDIES • INDOOR AIR QUALITY SURVEYS • HAZARDOUS MATERIAL SURVEYS • RADIATION SURVEYS • ASBESTOS SURVEYS
ASBESTOS DETECTION & IDENTIFICATION • REPAIR & CALIBRATION OF SCIENTIFIC EQUIPMENT • AIRBORNE FIBRE & SILICA MONITORING

Sample No. 7. ASET7649 / 10695 / 7. 6E0256 - E244561 - A 2.
Approx dimensions 7.5 cm x 5.0 cm x 1.0 cm
The sample consisted of a fragment of a fibro plaster cement material.
Chrysotile asbestos detected.

Sample No. 8. ASET7649 / 10695 / 8. 6E0256 - E244562 - A 3.
Approx dimensions 3.0 cm x 2.0 cm x 0.75 cm
The sample consisted of a fragment of a fibre cement material.
Chrysotile asbestos detected.

Analysed and reported by,

Mahen De Silva . BSc. MSc. Grad Dip (Occ Hyg)
Occupational Hygienist / Approved Signatory.

NATA Accredited Laboratory
Number: 14484

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.

Gamdel

NATA

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NATA Accreditation number: 1464
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ANALYTICAL SERVICES DIVISION
ABN 30 008 127 802
Correspondence to:
PO Box 331
HUNTER REGIONAL MAIL
CENTRE NSW 2310

99 Mitchell Rd
CARDIFF NSW 2285
Telephone: (02) 4902 4800
Facsimile: (02) 4902 4899

CERTIFICATE OF ANALYSIS

Contents :
1. Cover Pages (3)
2. Analysis Report Pages
3. QA/QC Appendix
4. Additional Reports - External (if applicable)
5. Chain of Custody (if applicable)

Report No. : 6E0256

Attention : Kain Mitchell

Client : Coffey Geosciences Pty Ltd
: 13 Mangrove Rd
: SANDGATENSW 2304

Samples : 33

Reference/Order : N09814/2

Project : N09814/2

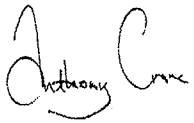
Received Samples : 01/02/06 Instructions : 01/02/06

Date Reported : 08/02/06

PLEASE SEE FOLLOWING PAGES FOR METHOD LISTING AND RESULTS

RESULTS

All samples were analysed as received. This report relates specifically to the samples as received. Results relate to the source material only to the extent that the samples as supplied are truly representative of the sample source. This report replaces any preliminary results issued. Note that for methods indicated with "#", NATA accreditation does not cover the performance of this service. Three significant figures (or 2 for < 10PQL) are reported for statistical purposes only. Where "Total" concentrations are reported for organic suites of compounds this is the summation of the individual compounds and the PQL is noted for reporting purposes only. This report has been authorized by the NATA signatories listed in the method descriptions section on the following page.



Anthony Crane
Operations Manager

Gamdel

NATA

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Please note: Where samples are collected/submitted over several days, the date on which the last samples were analysed or extracted is reported.
Unless Ferrous Iron is determined on site, the possibility of a ferrous-ferric ratio change may occur.

Method	Description	Extracted	Analysed	Authorised	
E7500	Moisture (%w/w)	02/02/06	06/02/06	GTO	096
E1230	TPH C6-C9 by Purge and Trap	01/02/06	03/02/06	GTO	094
E1221	TPH (C10-C36)	01/02/06	02/02/06	GTO	094
E1010	BTEX in Soil	01/02/06	03/02/06	GTO	094
E5910	Metals by ICP-AES	03/02/06	03/02/06	DLU	093
E5950	Mercury in Soil	03/02/06	03/02/06	DLU	093
E1110	# Polycyclic Aromatic Hydrocarbons	01/02/06	07/02/06	#	095
E1081	# Organochlorine Pesticides and total PC	01/02/06	03/02/06	#	095
E3500	Fluoride (Soluble) in Soil	03/02/06	03/02/06	DBL	101
E4870	Dissolved Metals by ICP-MS	06/02/06	06/02/06	DLU	093
E4850	Mercury	03/02/06	03/02/06	DLU	093

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NATA Signatory

Initials	Name	Sections/Methods
GTO	Greg Towers	094, 096
DLU	Darrel Luck	093, 096
MAV	Merrin Avery	101, 096
DBL	Dianne Blane	101, 096
NCO	Nathan Cooper	101, 096
AGR	Alison Graham	101, 096

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Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244532	E244533	E244534	E244535	E244536
		HA1	HA2	HA3	HA4	HA5
	Sample Id	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05
	PQL					
E7500 Moisture (%w/w) in Soil						
Moistures test performed at 105oC						
Moisture Content	1	5%	3%	13%	5%	4%
E1230 TPH in Soil by Purge & Trap/GC-MS						
C6-C9 Fraction	5	--	nd	nd	--	--
E1221 TPH in Soil						
C10-C14 Fraction	10	--	nd	nd	--	--
C15-C28 Fraction	50	--	nd	nd	--	--
C29-C36 Fraction	50	--	nd	70	--	--
E1010 BTEX (P&T) in Soil						
Benzene	0.2	--	nd	nd	--	--
Toluene	1	--	nd	nd	--	--
Ethylbenzene	1	--	nd	nd	--	--
m&p-Xylene	2	--	nd	nd	--	--
o-Xylene	1	--	nd	nd	--	--
4-Bromofluorobenzene-SURROGATE	1	--	114%	102%	--	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244537	E244538	E244539	E244540	E244541
		HA6	HA7	HA8	HA9	HA10
	Sample Id	0.0-0.05	0.0-0.05	0.0-0.05	0.2-0.25	0.15-0.2
	PQL					
E7500 Moisture (%w/w) in Soil						
Moistures test performed at 105oC						
Moisture Content	1	6%	5%	4%	11%	10%
E1230 TPH in Soil by Purge & Trap/GC-MS						
C6-C9 Fraction	5	--	--	--	nd	nd
E1221 TPH in Soil						
C10-C14 Fraction	10	--	--	--	nd	nd
C15-C28 Fraction	50	--	--	--	nd	nd
C29-C36 Fraction	50	--	--	--	60	90
E1010 BTEX (P&T) in Soil						
Benzene	0.2	--	--	--	nd	nd
Toluene	1	--	--	--	nd	nd
Ethylbenzene	1	--	--	--	nd	nd
m&p-Xylene	2	--	--	--	nd	nd
o-Xylene	1	--	--	--	nd	nd
4-Bromofluorobenzene-SURROGATE	1	--	--	--	106%	105%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244542	E244543	E244544	E244545	E244546
		HA11	DUP1	HA12	HA13	HA14
	Sample Id	0-0.05	1/2/06	0.15-0.2	0.0-0.1	0.0-0.1
	PQL					
E7500 Moisture (%w/w) in Soil						
Moistures test performed at 105oC						
Moisture Content	1	4%	15%	11%	2%	9%
E1230 TPH in Soil by Purge & Trap/GC-MS						
C6-C9 Fraction	5	--	--	nd	--	--
E1221 TPH in Soil						
C10-C14 Fraction	10	--	--	nd	--	--
C15-C28 Fraction	50	--	--	nd	--	--
C29-C36 Fraction	50	--	--	nd	--	--
E1010 BTEX (P&T) in Soil						
Benzene	0.2	--	--	nd	--	--
Toluene	1	--	--	nd	--	--
Ethylbenzene	1	--	--	nd	--	--
m&p-Xylene	2	--	--	nd	--	--
o-Xylene	1	--	--	nd	--	--
4-Bromofluorobenzene-SURROGATE	1	--	--	80%	--	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244547	E244548	E244549	E244550	E244551
		HA15	HA16	HA17	HA18	HA19
	Sample Id	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1
	PQL					
E7500 Moisture (%w/w) in Soil						
Moistures test performed at 105oC						
Moisture Content	1	69%	16%	59%	40%	48%
E1230 TPH in Soil by Purge & Trap/GC-MS						
C6-C9 Fraction	5	--	nd	--	--	--
E1221 TPH in Soil						
C10-C14 Fraction	10	--	nd	--	--	--
C15-C28 Fraction	50	--	nd	--	--	--
C29-C36 Fraction	50	--	60	--	--	--
E1010 BTEX (P&T) in Soil						
Benzene	0.2	--	nd	--	--	--
Toluene	1	--	nd	--	--	--
Ethylbenzene	1	--	nd	--	--	--
m&p-Xylene	2	--	nd	--	--	--
o-Xylene	1	--	nd	--	--	--
4-Bromofluorobenzene-SURROGATE	1	--	105%	--	--	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244552	E244553	E244554	E244555	E244556
		HA20	HA21	HA22	HA23	HA24
	Sample Id	0.0-0.1	0.15-0.2	0.0-0.1	0.0-0.1	0.0-0.05
	PQL					
E7500 Moisture (%w/w) in Soil						
Moistures test performed at 105oC						
Moisture Content	1	36%	38%	52%	71%	7%
E1230 TPH in Soil by Purge & Trap/GC-MS						
C6-C9 Fraction	5	nd	nd	--	nd	--
E1221 TPH in Soil						
C10-C14 Fraction	10	10	nd	--	nd	--
C15-C28 Fraction	50	100	nd	--	nd	--
C29-C36 Fraction	50	200	140	--	280	--
E1010 BTEX (P&T) in Soil						
Benzene	0.2	nd	nd	--	nd	--
Toluene	1	nd	nd	--	nd	--
Ethylbenzene	1	nd	nd	--	nd	--
m&p-Xylene	2	nd	nd	--	nd	--
o-Xylene	1	nd	nd	--	nd	--
4-Bromofluorobenzene-SURROGATE	1	88%	93%	--	89%	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244557	E244558	E244559	E244586
	Sample Id	HA25	DUP2	DUP3	HA1
	PQL	0.0-0.1	1/2/06	1/2/06	0.15-0.2
E7500 Moisture (%w/w) in Soil					
Moistures test performed at 105oC					
Moisture Content	1	68%	37%	15%	6%
E1230 TPH in Soil by Purge & Trap/GC-MS					
C6-C9 Fraction	5	nd	--	nd	--
E1221 TPH in Soil					
C10-C14 Fraction	10	nd	--	nd	--
C15-C28 Fraction	50	140	--	nd	--
C29-C36 Fraction	50	360	--	70	--
E1010 BTEX (P&T) in Soil					
Benzene	0.2	nd	--	nd	--
Toluene	1	nd	--	nd	--
Ethylbenzene	1	nd	--	nd	--
m&p-Xylene	2	nd	--	nd	--
o-Xylene	1	nd	--	nd	--
4-Bromofluorobenzene-SURROGATE	1	97%	--	110%	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244532	E244533	E244534	E244535	E244536
	Sample Id	HA1	HA2	HA3	HA4	HA5
	PQL	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05
E5910 Metals in Soil						
Arsenic	5	nd	nd	nd	nd	nd
Cadmium	0.5	nd	nd	0.7	nd	nd
Chromium	5	7	nd	6	nd	nd
Copper	5	nd	5	26	nd	11
Nickel	2	nd	2	4	2	2
Lead	5	7	76	140	11	56
Zinc	5	15	43	260	45	160
E5950 Mercury in Soil						
Mercury	0.05	nd	nd	nd	nd	nd
E3500 Fluoride (soluble) in Soil						
Fluoride	1	--	--	--	--	2

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244537	E244538	E244539	E244540	E244541
	Sample Id	HA6	HA7	HA8	HA9	HA10
		0.0-0.05	0.0-0.05	0.0-0.05	0.2-0.25	0.15-0.2
	PQL					
E5910 Metals in Soil						
Arsenic	5	nd	nd	nd	nd	nd
Cadmium	0.5	nd	nd	nd	nd	nd
Chromium	5	nd	nd	nd	6	9
Copper	5	6	5	nd	nd	nd
Nickel	2	nd	nd	nd	nd	2
Lead	5	27	14	14	nd	nd
Zinc	5	54	12	50	nd	7
E5950 Mercury in Soil						
Mercury	0.05	nd	nd	nd	nd	nd
E3500 Fluoride (soluble) in Soil						
Fluoride	1	--	--	--	--	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244542	E244543	E244544	E244545	E244546
	Sample Id	HA11	DUP1	HA12	HA13	HA14
		0-0.05	1/2/06	0.15-0.2	0.0-0.1	0.0-0.1
	PQL					
E5910 Metals in Soil						
Arsenic	5	nd	nd	nd	nd	nd
Cadmium	0.5	nd	0.8	nd	nd	nd
Chromium	5	nd	7	nd	nd	nd
Copper	5	nd	20	7	15	9
Nickel	2	nd	4	2	3	3
Lead	5	nd	140	nd	170	160
Zinc	5	6	340	29	150	140
E5950 Mercury in Soil						
Mercury	0.05	nd	0.11	nd	nd	nd
E3500 Fluoride (soluble) in Soil						
Fluoride	1	1	--	--	nd	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244547	E244548	E244549	E244550	E244551
	Sample Id	HA15	HA16	HA17	HA18	HA19
	PQL	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1
E5910 Metals in Soil						
Arsenic	5	nd	nd	6	nd	7
Cadmium	0.5	0.5	nd	nd	nd	nd
Chromium	5	25	7	49	31	40
Copper	5	25	10	38	25	41
Nickel	2	15	7	40	26	34
Lead	5	50	6	29	19	35
Zinc	5	110	32	130	86	130
E5950 Mercury in Soil						
Mercury	0.05	nd	nd	nd	nd	nd
E3500 Fluoride (soluble) in Soil						
Fluoride	1	--	--	--	nd	7

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244552	E244553	E244554	E244555	E244556
	Sample Id	HA20	HA21	HA22	HA23	HA24
	PQL	0.0-0.1	0.15-0.2	0.0-0.1	0.0-0.1	0.0-0.05
E5910 Metals in Soil						
Arsenic	5	nd	13	12	6	nd
Cadmium	0.5	nd	0.6	nd	0.5	nd
Chromium	5	25	31	31	33	nd
Copper	5	27	34	29	34	nd
Nickel	2	20	39	35	40	nd
Lead	5	29	22	23	30	20
Zinc	5	130	110	110	130	56
E5950 Mercury in Soil						
Mercury	0.05	nd	nd	nd	nd	nd
E3500 Fluoride (soluble) in Soil						
Fluoride	1	--	--	--	3	--

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244557	E244558	E244559	E244586
		HA25	DUP2	DUP3	HA1
	Sample Id	0.0-0.1	1/2/06	1/2/06	0.15-0.2
	PQL				
E5910 Metals in Soil					
Arsenic	5	nd	nd	nd	--
Cadmium	0.5	nd	nd	nd	--
Chromium	5	24	30	8	--
Copper	5	24	23	10	--
Nickel	2	12	24	7	--
Lead	5	30	16	7	--
Zinc	5	76	68	34	--
E5950 Mercury in Soil					
Mercury	0.05	nd	nd	nd	--
E3500 Fluoride (soluble) in Soil					
Fluoride	1	--	--	--	1

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244532	E244533	E244534	E244535	E244536
		HA1	HA2	HA3	HA4	HA5
	Sample Id	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05
	PQL					
E1110 Priority PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd	nd	nd
Pyrene	0.5	nd	nd	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd	nd	nd
Chrysene	0.5	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd	nd	nd
Total USEPA Priority PAHs	0.5	nd	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	94%	90%	75%	94%	89%
Anthracene-d10-SURROGATE	1	91%	84%	72%	90%	84%
p-Terphenyl-D14-SURROGATE	1	86%	81%	71%	88%	84%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244537	E244538	E244539	E244540	E244541
	Sample Id	HA6	HA7	HA8	HA9	HA10
		0.0-0.05	0.0-0.05	0.0-0.05	0.2-0.25	0.15-0.2
	PQL					
E1110 Priority PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd	nd	nd
Pyrene	0.5	nd	nd	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd	nd	nd
Chrysene	0.5	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd	nd	nd
Total USEPA Priority PAHs	0.5	0.8	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	85%	86%	80%	85%	82%
Anthracene-d10-SURROGATE	1	81%	82%	76%	83%	78%
p-Terphenyl-D14-SURROGATE	1	79%	81%	75%	83%	75%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244542	E244543	E244544	E244545	E244546
	Sample Id	HA11	DUP1	HA12	HA13	HA14
		0-0.05	1/2/06	0.15-0.2	0.0-0.1	0.0-0.1
	PQL					
E1110 Priority PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd	nd	nd
Pyrene	0.5	nd	nd	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd	nd	nd
Chrysene	0.5	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd	nd	nd
Total USEPA Priority PAHs	0.5	nd	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	84%	80%	84%	83%	78%
Anthracene-d10-SURROGATE	1	80%	76%	79%	79%	73%
p-Terphenyl-D14-SURROGATE	1	78%	73%	75%	76%	70%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244547	E244548	E244549	E244550	E244551
	Sample Id	HA15 0.0-0.1	HA16 0.0-0.1	HA17 0.0-0.1	HA18 0.0-0.1	HA19 0.0-0.1
	PQL					
E1110 Priority PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd	nd	nd
Pyrene	0.5	nd	nd	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd	nd	nd
Chrysene	0.5	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd	nd	nd
Total USEPA Priority PAHs	0.5	nd	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	84%	102%	86%	90%	80%
Anthracene-d10-SURROGATE	1	81%	98%	79%	87%	78%
p-Terphenyl-D14-SURROGATE	1	78%	99%	79%	83%	80%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244552	E244553	E244554	E244555	E244556
	Sample Id	HA20 0.0-0.1	HA21 0.15-0.2	HA22 0.0-0.1	HA23 0.0-0.1	HA24 0.0-0.05
	PQL					
E1110 Priority PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd	nd	nd
Pyrene	0.5	nd	nd	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd	nd	nd
Chrysene	0.5	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd	nd	nd
Total USEPA Priority PAHs	0.5	nd	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	89%	97%	83%	81%	79%
Anthracene-d10-SURROGATE	1	87%	97%	80%	79%	77%
p-Terphenyl-D14-SURROGATE	1	87%	97%	75%	75%	72%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244557	E244558	E244559
		HA25	DUP2	DUP3
	Sample Id	0.0-0.1	1/2/06	1/2/06
	PQL			
E1110 Priority PAH's in Soil				
Naphthalene	0.5	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd
Fluorene	0.5	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd
Anthracene	0.5	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd
Pyrene	0.5	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd
Chrysene	0.5	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd
Total USEPA Priority PAHs	0.5	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	85%	84%	80%
Anthracene-d10-SURROGATE	1	83%	82%	77%
p-Terphenyl-D14-SURROGATE	1	81%	79%	74%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244532	E244533	E244534	E244535	E244536
		HA1	HA2	HA3	HA4	HA5
	Sample Id	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05	0.0-0.05
	PQL					
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd	nd	nd	nd
a-BHC	0.1	nd	nd	nd	nd	nd
g-BHC	0.1	nd	nd	nd	nd	nd
Heptachlor	0.1	nd	nd	nd	nd	nd
Aldrin	0.1	nd	nd	nd	nd	nd
b-BHC	0.1	nd	nd	nd	nd	nd
d-BHC	0.1	nd	nd	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd	nd	nd
Endosulfan 1	0.1	nd	nd	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd	nd	nd
DDE	0.1	nd	nd	nd	nd	nd
Dieldrin	0.1	nd	nd	nd	nd	nd
Endrin	0.1	nd	nd	nd	nd	nd
DDD	0.1	nd	nd	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd	nd	nd
DDT	0.1	nd	nd	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	78%	96%	73%	75%	99%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244537	E244538	E244539	E244540	E244541
		HA6	HA7	HA8	HA9	HA10
	Sample Id	0.0-0.05	0.0-0.05	0.0-0.05	0.2-0.25	0.15-0.2
	PQL					
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd	nd	nd	nd
a-BHC	0.1	nd	nd	nd	nd	nd
g-BHC	0.1	nd	nd	nd	nd	nd
Heptachlor	0.1	nd	nd	nd	nd	nd
Aldrin	0.1	nd	nd	nd	nd	nd
b-BHC	0.1	nd	nd	nd	nd	nd
d-BHC	0.1	nd	nd	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd	nd	nd
Endosulfan 1	0.1	nd	nd	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd	nd	nd
DDE	0.1	nd	nd	nd	nd	nd
Dieldrin	0.1	nd	nd	nd	nd	nd
Endrin	0.1	nd	nd	nd	nd	nd
DDD	0.1	nd	nd	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd	nd	nd
DDT	0.1	nd	nd	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	95%	91%	84%	103%	94%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244542	E244543	E244544	E244545	E244546
		HA11	DUP1	HA12	HA13	HA14
	Sample Id	0-0.05	1/2/06	0.15-0.2	0.0-0.1	0.0-0.1
	PQL					
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd	nd	nd	nd
a-BHC	0.1	nd	nd	nd	nd	nd
g-BHC	0.1	nd	nd	nd	nd	nd
Heptachlor	0.1	nd	nd	nd	nd	nd
Aldrin	0.1	nd	nd	nd	nd	nd
b-BHC	0.1	nd	nd	nd	nd	nd
d-BHC	0.1	nd	nd	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd	nd	nd
Endosulfan 1	0.1	nd	nd	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd	nd	nd
DDE	0.1	nd	nd	nd	nd	nd
Dieldrin	0.1	nd	nd	nd	nd	nd
Endrin	0.1	nd	nd	nd	nd	nd
DDD	0.1	nd	nd	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd	nd	nd
DDT	0.1	nd	nd	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	97%	103%	99%	98%	98%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244547	E244548	E244549	E244550	E244551
	Sample Id	HA15	HA16	HA17	HA18	HA19
	PQL	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd	nd	nd	nd
a-BHC	0.1	nd	nd	nd	nd	nd
g-BHC	0.1	nd	nd	nd	nd	nd
Heptachlor	0.1	nd	nd	nd	nd	nd
Aldrin	0.1	nd	nd	nd	nd	nd
b-BHC	0.1	nd	nd	nd	nd	nd
d-BHC	0.1	nd	nd	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd	nd	nd
Endosulfan I	0.1	nd	nd	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd	nd	nd
DDE	0.1	nd	nd	nd	nd	nd
Dieldrin	0.1	nd	nd	nd	nd	nd
Endrin	0.1	nd	nd	nd	nd	nd
DDD	0.1	nd	nd	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd	nd	nd
DDT	0.1	nd	nd	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	116%	80%	84%	85%	83%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244552	E244553	E244554	E244555	E244556
	Sample Id	HA20	HA21	HA22	HA23	HA24
	PQL	0.0-0.1	0.15-0.2	0.0-0.1	0.0-0.1	0.0-0.05
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd	nd	nd	nd
a-BHC	0.1	nd	nd	nd	nd	nd
g-BHC	0.1	nd	nd	nd	nd	nd
Heptachlor	0.1	nd	nd	nd	nd	nd
Aldrin	0.1	nd	nd	nd	nd	nd
b-BHC	0.1	nd	nd	nd	nd	nd
d-BHC	0.1	nd	nd	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd	nd	nd
Endosulfan I	0.1	nd	nd	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd	nd	nd
DDE	0.1	nd	nd	nd	nd	nd
Dieldrin	0.1	nd	nd	nd	nd	nd
Endrin	0.1	nd	nd	nd	nd	nd
DDD	0.1	nd	nd	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd	nd	nd
DDT	0.1	nd	nd	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	75%	75%	77%	85%	76%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244557	E244558	E244559
	Sample Id	HA25 0.0-0.1	DUP2 1/2/06	DUP3 1/2/06
	PQL			
E1081 OC's & Total PCB's in Soil				
HCB	0.1	nd	nd	nd
a-BHC	0.1	nd	nd	nd
g-BHC	0.1	nd	nd	nd
Heptachlor	0.1	nd	nd	nd
Aldrin	0.1	nd	nd	nd
b-BHC	0.1	nd	nd	nd
d-BHC	0.1	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd
Endosulfan 1	0.1	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd
DDE	0.1	nd	nd	nd
Dieldrin	0.1	nd	nd	nd
Endrin	0.1	nd	nd	nd
DDD	0.1	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd
DDT	0.1	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	99%	86%	72%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E0256
Client : Coffey Geosciences Pty Ltd
Reference : N09814/2
Project : N09814/2

Analyte	Lab No	E244563
	Sample Id	WB1 1/2/06
	PQL	
E4870 Dissolved Metals in Waters		
Arsenic	0.001	nd
Cadmium	0.0001	nd
Chromium	0.001	nd
Copper	0.001	nd
Nickel	0.001	nd
Lead	0.001	nd
Zinc	0.002	0.014
E4850 Dissolved Mercury in Waters		
Mercury	0.001	nd

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

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AMDEL INTERNAL QUALITY CONTROL REVIEW.

Job No. 6E0256

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes and Laboratory Control Samples are included in this QC Report where applicable. Additional QC data may be available on request
2. Amdel QC Acceptance / Rejection Criteria is documented in AS-POL-002 and is available on request.
3. Proficiency trial results are available on request.
4. Actual PQLs are matrix dependent. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spike or surrogate recoveries.
6. Test samples duplicated or spiked, are from this job only and are identified in the following QC report.
7. SVOC analyses on waters are performed on homogenized, unfiltered samples, unless noted otherwise.
8. When individual results are qualified in the body of the report, refer to the qualifier descriptions on the following page.

Holding Times

Please refer to 'Sampling and Preservation Chart for Soils & Waters' for holding times. (Amdel from AS-FOR_ADM-020).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgement.
If the laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Chain of Custody and Sample Integrity	Yes/No/NA
Chain of Custody / instructions received with samples	Yes
Custody seals were received intact (if used)	Yes
Chain of Custody completed and attached (if applicable)	Yes
Samples were received chilled or chilling in good condition	Yes
Samples received with other preservation appropriate for all tests	Yes
VOC/SVOC samples were received with Teflon lined lids	Yes
Samples received with Zero Headspace (if applicable)	Yes

Please refer to the following pages for the laboratory's Quality Control data.

Additional Comments



Anthony Crane
Operations Manager

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AMDEL STANDARD LABORATORY QUALIFIER CODES.

Job No. 6E0256

Qualifier Codes	Description
*	PQLs are raised due to matrix interference.
@	PQLs are raised due to insufficient sample provided for analysis.
$	The mass imbalance indicates the presence of other ions not measured as part of this procedure.
nd	<PQL
--	Not applicable
LNR	The sample was listed on the COC, but not received.
IS	Insufficient sample was supplied to conduct this analysis.
AN	The analysis indicates the presences of an analyte that has been 'tentatively' identified, and the associated numerical value represents it's approximate concentration.
A	Sample results are reported on an 'as received' basis (not moisture corrected).
B	The sample was not received in a suitable timeframe to allow completion within the recommended holding time.
C	This sample was received with headspace.
D	This sample was received with the incorrect preservation for this analysis.
E	The raw data indicates the absence of 0.055g of Copper Sulphate in the sample.
F	This sample contained significant amounts of solids and was therefore analysed by settling and decanting the aqueous phase to avoid including the solid in the analysis portion.
G	This test was performed outside the recommended holding time.
H	This sample contained significant material >5mm which was removed prior to analysis.
ISD	Insufficient sample was supplied to conduct duplicate analyses.
ISM	Insufficient sample was supplied to conduct matrix spike analyses.
W	The spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.
J	The duplicate %RPD is outside the recommended acceptance criteria. Further analysis indicates sample heterogeneity as the cause.
K	The matrix spike concentration is less than five times the background concentration in the sample, and therfore the spike recovery can not be determined.
L	The surrogate recovery is outside of the recommended acceptance criteria, due to matrix interference.
M	The surrogate recovery is outside of the recommended acceptance criteria. Insufficent sample remains to perform re-analysis.
N	Results are expressed in mg/L (ppm) due to the high concentration of the analyte.
O	The results reported are 'recoverable organics' for this fraction, as the chromatogram and peak shape indicates the presence of a significant concentration of polar compounds.
P	The concentration reported is mainly due to a single peak.
Q	This samples contains volatile halogenated oxygenated or other compounds that are included and quantitated as part of TPH C6-9.
R	Theoretically the total result should be greater or equal to the dissolved concentration. However the difference reported is within the uncertainty of the individual tests.
S	The mass imbalance was equal to or less than 0.2 milli-equivalents.
T	During Kjeldahl digestion, nitrate (>10mg/L) can oxidise ammonia resulting in a negative TKN interference, which may have occurred for this sample.
U	Theoretically the TKN result should be greater or equal to ammonia concentration. However the difference reported is within the uncertainty of the individual tests.
V	This sample contained significant amounts of sediment which was included in the analysis portion as requested.
SUR	Surrogate recoveries could not be determined due to the dilution required to quantify the analyte.

Last updated: 19 May 2003

amdel

Job Number : 6E0256

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E1230 TPH in Soil by Purge & Trap/GC-MS (E244533,E244552)							
C6-C9 Fraction	50	46		93%			
E1221 TPH in Soil (E244540,E244552)							
C10-C14 Fraction							
C15-C28 Fraction	550	580		107%			
C29-C36 Fraction							
E1010 BTEX (P&T) in Soil (E244533,E244552)							
Benzene	5	5.6		112%			
Toluene	5	5		108%			
Ethylbenzene	5	5		110%			
m&p-Xylene	10	11		112%			
o-Xylene	5	6		110%			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E1230 TPH in Soil by Purge & Trap/GC-MS							
C6-C9 Fraction	50	47			93%		
E1221 TPH in Soil							
C10-C14 Fraction							
C15-C28 Fraction	550	540			99%		
C29-C36 Fraction							
E1010 BTEX (P&T) in Soil							
Benzene	5	5.6			111%		
Toluene	5	5			106%		
Ethylbenzene	5	5			110%		
m&p-Xylene	10	11			110%		
o-Xylene	5	6			110%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E0256

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E1230 TPH in Soil by Purge & Trap/GC-MS (E244533.E244534)								
C6-C9 Fraction	nd	nd			nd	nd		
E1221 TPH in Soil (E244540.E244541)								
C10-C14 Fraction	nd	nd			nd	nd		
C15-C28 Fraction	nd	nd			nd	nd		
C29-C36 Fraction	nd	60	60		200	90	140	75%
E1010 BTEX (P&T) in Soil (E244533.E244534)								
Benzene	nd	nd			nd	nd		
Toluene	nd	nd			nd	nd		
Ethylbenzene	nd	nd			nd	nd		
m&p-Xylene	nd	nd			nd	nd		
o-Xylene	nd	nd			nd	nd		

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Method Blank(s)

ANALYTE	Sample ID / PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E1230 TPH in Soil by Purge & Trap/GC-MS						
C6-C9 Fraction	5	nd				
E1221 TPH in Soil						
C10-C14 Fraction	10	nd	nd			
C15-C28 Fraction	50	nd	nd			
C29-C36 Fraction	50	nd	nd			
E1010 BTEX (P&T) in Soil						
Benzene	0.2	nd				
Toluene	1	nd				
Ethylbenzene	1	nd				
m&p-Xylene	2	nd				
o-Xylene	1	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E0256

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E5910 Metals in Soil (E244532,E244552)							
Arsenic	50	47	46	95%	92%	93%	3%
Cadmium	50	46	44	91%	87%	89%	4%
Chromium	50	48	40	96%	79%	88%	19%
Copper	50	48	35	96%	71%	83%	30%
Nickel	50	47	40	95%	79%	87%	18%
Lead	50	43	55	86%	110%	98%	25%
Zinc	50	38	49	76%	98%	87%	25%
E5950 Mercury in Soil (E244532,E244552)							
Mercury	0.50	0.62	0.55	125%	111%	118%	12%

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E5910 Metals in Soil							
Arsenic	50	49	48		97%	96%	
Cadmium	50	47	47		94%	93%	
Chromium	50	51	52		103%	103%	
Copper	50	51	50		101%	100%	
Nickel	50	50	49		99%	99%	
Lead	50	48	47		96%	95%	
Zinc	50	44	44		87%	88%	
E5950 Mercury in Soil							
Mercury	0.50	0.56	0.58		113%	115%	
E3500 Fluoride (soluble) in Soil							
Fluoride	10	9			87%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E5910 Metals in Soil (E244532,E244533)								
Arsenic	nd	nd			nd	nd		
Cadmium	nd	nd			nd	nd		
Chromium	7	7	7	0%	nd	nd		
Copper	nd	nd			6	5	6	18%
Nickel	nd	nd			nd	2	2	
Lead	6	7	7	15%	83	76	80	8%
Zinc	12	15	14	22%	49	43	46	13%
E5910 Metals in Soil (E244552)								
Arsenic	5	nd	5					
Cadmium	nd	nd						
Chromium	21	25	23	17%				
Copper	25	27	26	7%				
Nickel	19	20	20	5%				
Lead	32	29	31	9%				
Zinc	160	130	150	20%				
E5950 Mercury in Soil (E244532,E244533)								
Mercury	nd	nd			nd	nd		
E5950 Mercury in Soil (E244552)								
Mercury	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

QAQC : Method Blank(s)

ANALYTE	Sample ID / PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E5910 Metals in Soil						
Arsenic	5	nd	nd			
Cadmium	0.5	nd	nd			
Chromium	5	nd	nd			
Copper	5	nd	nd			
Nickel	2	nd	nd			
Lead	5	nd	nd			
Zinc	5	nd	nd			
E5950 Mercury in Soil						
Mercury	0.05	nd	nd			
E3500 Fluoride (soluble) in Soil						
Fluoride	1	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E0256

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E1110 Priority PAH's in Soil (E244540,E244554)							
Naphthalene	5	4.4	4.4	86%	87%	87%	1%
Acenaphthylene	5	4.8	4.8	95%	98%	97%	2%
Acenaphthene	5	4.4	4.4	87%	89%	88%	2%
Fluorene	5	4.4	4.6	89%	91%	90%	2%
Phenanthrene	5	4.4	4.4	87%	89%	88%	2%
Anthracene	5	4.4	4.4	88%	89%	89%	1%
Fluoranthene	5	4.4	4.6	88%	91%	89%	4%
Pyrene	5	4.4	4.4	88%	89%	89%	2%
Benz(a)anthracene	5	4.4	4.8	88%	96%	92%	8%
Chrysene	5	4.2	4.4	85%	88%	86%	4%
Benzo(b) & (k)fluoranthene	10	8	9	78%	88%	83%	11%
Benzo(a)pyrene	5	4.0	4.6	78%	92%	85%	16%
Indeno(1.2.3-cd)pyrene	5	4.2	5.0	83%	99%	91%	18%
Dibenz(a.h)anthracene	5	4.4	4.6	89%	91%	90%	3%
Benzo(g.h.i)perylene	5	4.4	4.0	88%	81%	85%	9%

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E1110 Priority PAH's in Soil							
Naphthalene	5	4.8	4.6		95%	93%	
Acenaphthylene	5	5.4	5.2		107%	104%	
Acenaphthene	5	4.8	4.8		97%	95%	
Fluorene	5	5.0	5.0		100%	98%	
Phenanthrene	5	4.8	4.8		97%	94%	
Anthracene	5	4.8	4.8		98%	96%	
Fluoranthene	5	4.8	4.8		97%	96%	
Pyrene	5	5.0	4.8		98%	96%	
Benz(a)anthracene	5	4.6	4.6		92%	91%	
Chrysene	5	4.8	4.8		97%	95%	
Benzo(b) & (k)fluoranthene	10	9	9		85%	85%	
Benzo(a)pyrene	5	4.2	4.2		83%	84%	
Indeno(1.2.3-cd)pyrene	5	4.6	4.6		91%	94%	
Dibenz(a.h)anthracene	5	5.0	4.8		100%	95%	
Benzo(g.h.i)perylene	5	4.4	4.4		86%	88%	

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E0256

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E1110 Priority PAH's in Soil (E244540,E244541)								
Naphthalene	nd	nd			nd	nd		
Acenaphthylene	nd	nd			nd	nd		
Acenaphthene	nd	nd			nd	nd		
Fluorene	nd	nd			nd	nd		
Phenanthrene	nd	nd			nd	nd		
Anthracene	nd	nd			nd	nd		
Fluoranthene	nd	nd			nd	nd		
Pyrene	nd	nd			nd	nd		
Benz(a)anthracene	nd	nd			nd	nd		
Chrysene	nd	nd			nd	nd		
Benzo(b) & (k)fluoranthene	nd	nd			nd	nd		
Benzo(a)pyrene	nd	nd			nd	nd		
Indeno(1.2.3-cd)pyrene	nd	nd			nd	nd		
Dibenz(a.h)anthracene	nd	nd			nd	nd		
Benzo(g.h.i)perylene	nd	nd			nd	nd		

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E1110 Priority PAH's in Soil (E244554)								
Naphthalene	nd	nd						
Acenaphthylene	nd	nd						
Acenaphthene	nd	nd						
Fluorene	nd	nd						
Phenanthrene	nd	nd						
Anthracene	nd	nd						
Fluoranthene	nd	nd						
Pyrene	nd	nd						
Benz(a)anthracene	nd	nd						
Chrysene	nd	nd						
Benzo(b) & (k)fluoranthene	nd	nd						
Benzo(a)pyrene	nd	nd						
Indeno(1.2.3-cd)pyrene	nd	nd						
Dibenz(a.h)anthracene	nd	nd						
Benzo(g.h.i)perylene	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

QAQC : Method Blank(s)

ANALYTE	Sample ID	Blank1	Blank2	Blank3	Blank4	Blank5
	PQL					
E1110 Priority PAH's in Soil						
Naphthalene	0.5	nd	nd			
Acenaphthylene	0.5	nd	nd			
Acenaphthene	0.5	nd	nd			
Fluorene	0.5	nd	nd			
Phenanthrene	0.5	nd	nd			
Anthracene	0.5	nd	nd			
Fluoranthene	0.5	nd	nd			
Pyrene	0.5	nd	nd			
Benz(a)anthracene	0.5	nd	nd			
Chrysene	0.5	nd	nd			
Benzo(b) & (k)fluoranthene	1	nd	nd			
Benzo(a)pyrene	0.5	nd	nd			
Indeno(1.2.3-cd)pyrene	0.5	nd	nd			
Dibenz(a.h)anthracene	0.5	nd	nd			
Benzo(g.h.i)perylene	0.5	nd	nd			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E1081 OC's & Total PCB's in Soil (E244536,E244556)							
HCB	0.5						
a-BHC	0.5	0.5	0.5	102%	100%	101%	2%
g-BHC	0.5	0.5	0.5	100%	98%	99%	2%
Heptachlor	0.5	0.5	0.5	100%	96%	98%	4%
Aldrin	0.5	0.5	0.5	100%	98%	99%	2%
b-BHC	0.5	0.5	0.5	100%	98%	99%	2%
d-BHC	0.5	0.5	0.5	102%	100%	101%	2%
Oxychlordane	0.5						
Heptachlor epoxide	0.5	0.5	0.5	102%	98%	100%	4%
Endosulfan 1	0.5	0.5	0.5	100%	98%	99%	2%
Chlordane-Trans	0.5	0.5	0.5	102%	98%	100%	4%
Chlordane-Cis	0.5	0.5	0.5	100%	98%	99%	2%
trans-Nonachlor	0.5						
DDE	1.0	1.0	1.0	101%	98%	100%	3%
Dieldrin	0.5	0.5	0.5	100%	98%	99%	2%
Endrin	0.5	0.5	0.5	98%	96%	97%	2%
DDD	1	1.0	1.0	107%	109%	108%	2%
Endosulfan 2	0.5	0.5	0.5	102%	98%	100%	4%
DDT	1.0	0.8	0.8	84%	76%	80%	10%
Endosulfan sulfate	0.5	0.5	0.5	98%	94%	96%	4%
Methoxychlor	0.5	0.5	0.4	92%	80%	86%	14%
Total Polychlorinated biphenyl							

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E1081 OC's & Total PCB's in Soil							
HCB							
a-BHC	0.5	0.4	0.6		84%	116%	
g-BHC	0.5	0.4	0.6		82%	116%	
Heptachlor	0.5	0.4	0.6		88%	120%	
Aldrin	0.5	0.4	0.6		86%	120%	
b-BHC	0.5	0.4	0.6		86%	118%	
d-BHC	0.5	0.4	0.6		80%	116%	
Oxychlordane							
Heptachlor epoxide	0.5	0.4	0.6		86%	120%	
Endosulfan 1	0.5	0.4	0.6		86%	120%	
Chlordane-Trans	0.5	0.4	0.6		88%	120%	
Chlordane-Cis	0.5	0.4	0.6		88%	120%	
trans-Nonachlor							
DDE	1.0	0.9	1.2		86%	121%	
Dieldrin	0.5	0.4	0.6		84%	120%	
Endrin	0.5	0.4	0.6		86%	120%	
DDD	1	0.9	1.2		88%	120%	
Endosulfan 2	0.5	0.4	0.6		86%	118%	
DDT	1.0	0.9	1.2		92%	124%	
Endosulfan sulfate	0.5	0.5	0.6		94%	124%	
Methoxychlor	0.5	0.5	0.6		100%	124%	
Total Polychlorinated biphenyl							

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E0256

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E1081 OC's & Total PCB's in Soil (E244536,E244537)								
HCB	nd	nd			nd	nd		
a-BHC	nd	nd			nd	nd		
g-BHC	nd	nd			nd	nd		
Heptachlor	nd	nd			nd	nd		
Aldrin	nd	nd			nd	nd		
b-BHC	nd	nd			nd	nd		
d-BHC	nd	nd			nd	nd		
Oxychlordane	nd	nd			nd	nd		
Heptachlor epoxide	nd	nd			nd	nd		
Endosulfan 1	nd	nd			nd	nd		
Chlordane-Trans	nd	nd			nd	nd		
Chlordane-Cis	nd	nd			nd	nd		
trans-Nonachlor	nd	nd			nd	nd		
DDE	nd	nd			nd	nd		
Dieldrin	nd	nd			nd	nd		
Endrin	nd	nd			nd	nd		
DDD	nd	nd			nd	nd		
Endosulfan 2	nd	nd			nd	nd		
DDT	nd	nd			nd	nd		
Endosulfan sulfate	nd	nd			nd	nd		
Methoxychlor	nd	nd			nd	nd		
Total Polychlorinated biphenyl	nd	nd			nd	nd		

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E1081 OC's & Total PCB's in Soil (E244556)								
HCB	nd	nd						
a-BHC	nd	nd						
g-BHC	nd	nd						
Heptachlor	nd	nd						
Aldrin	nd	nd						
b-BHC	nd	nd						
d-BHC	nd	nd						
Oxychlordane	nd	nd						
Heptachlor epoxide	nd	nd						
Endosulfan 1	nd	nd						
Chlordane-Trans	nd	nd						
Chlordane-Cis	nd	nd						
trans-Nonachlor	nd	nd						
DDE	nd	nd						
Dieldrin	nd	nd						
Endrin	nd	nd						
DDD	nd	nd						
Endosulfan 2	nd	nd						
DDT	nd	nd						
Endosulfan sulfate	nd	nd						
Methoxychlor	nd	nd						
Total Polychlorinated biphenyl	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

QAQC : Method Blank(s)

ANALYTE	Sample ID / PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd			
a-BHC	0.1	nd	nd			
g-BHC	0.1	nd	nd			
Heptachlor	0.1	nd	nd			
Aldrin	0.1	nd	nd			
b-BHC	0.1	nd	nd			
d-BHC	0.1	nd	nd			
Oxychlordane	0.1	nd	nd			
Heptachlor epoxide	0.1	nd	nd			
Endosulfan 1	0.1	nd	nd			
Chlordane-Trans	0.1	nd	nd			
Chlordane-Cis	0.1	nd	nd			
trans-Nonachlor	0.1	nd	nd			
DDE	0.1	nd	nd			
Dieldrin	0.1	nd	nd			
Endrin	0.1	nd	nd			
DDD	0.1	nd	nd			
Endosulfan 2	0.1	nd	nd			
DDT	0.1	nd	nd			
Endosulfan sulfate	0.1	nd	nd			
Methoxychlor	0.1	nd	nd			
Total Polychlorinated biphenyl	1	nd	nd			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

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Job Number : 6E0256

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E4850 Dissolved Mercury in Waters (E244532,E244563)							
Mercury	0.010		0.010		100%		

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E4870 Dissolved Metals in Waters							
Arsenic	0.100	0.098			98%		
Cadmium	0.1000	0.097			97%		
Chromium	0.100	0.100			100%		
Copper	0.100	0.095			95%		
Nickel	0.100	0.096			96%		
Lead	0.100	0.098			98%		
Zinc	0.100	0.094			94%		
E4850 Dissolved Mercury in Waters							
Mercury	0.010	0.010			100%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E0256

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E4850 Dissolved Mercury in Waters (E244563)								
Mercury	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E0256

QAQC : Method Blank(s)

ANALYTE	Sample ID / PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E4870 Dissolved Metals in Waters						
Arsenic	0.001	nd				
Cadmium	0.0001	nd				
Chromium	0.001	nd				
Copper	0.001	nd				
Nickel	0.001	nd				
Lead	0.001	nd				
Zinc	0.002	nd				
E4850 Dissolved Mercury in Waters						
Mercury	0.001	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

Appendix O

ACOUSTIC REPORT

Project No: 07359

Noise Impact Assessment
WesTrac Facility and Industrial Subdivision
Tomago, NSW

Prepared for:

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On behalf of:

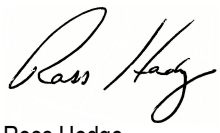
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November 2007

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1.0 INTRODUCTION

This report provides the results and findings of a noise impact assessment of the proposed WesTrac facility and industrial subdivision at Tomago NSW.

The Minister for Planning has confirmed that the proposal is a "major project" to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies. This assessment has been undertaken as part of an Environmental Assessment (EA) of the proposal. The following NSW Department of Environment and Climate Change (DECC) documents provide noise criteria and guidelines for the assessment methodology:

1. *NSW Industrial Noise Policy* (INP, 2000);
2. *Environmental Noise Control Manual* (ENCM, 1994);
3. *Environmental Criteria for Road traffic Noise* (ECRTN, 1999).

2.0 DESCRIPTION OF TERMS

This section of the report aims to convey an understanding of several commonly used acoustical terms. Various terms are explained in plain language and the effects of certain atmospheric phenomena on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 "Acoustics – Glossary of terms and related symbols".

2.1 General Terms

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as "L_w" or "SWL", the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. L_w is usually calculated from a measured sound pressure level.

Sound pressure Level

The "noise level", in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as "SPL", the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The "A-weighting" is a correction applied to the measured noise signal to account for the ear's ability to hear sound differently at different frequencies. The A-weighted sound pressure level therefore represents the measured (or predicted) noise level as it would be heard by the typical human ear.

Temperature Inversion

An atmospheric state in which the air temperature increases with altitude. Sound travels faster in warmer air than in cold air, so that during an inversion the top of a "sound wave" will move faster than the bottom. This bends (refracts) sound back towards the ground. The result is a "trapping" of sound energy near the ground and an increase in noise levels. Similarly, daytime air temperatures typically reduce with altitude (approximately 1-2 ^{0}C/100m called the adiabatic lapse rate) and sound refracts upward slightly. The result is slightly reduced noise levels compared with a uniform or 'neutral' atmosphere.

Wind Shear

A moving air mass will experience a "friction drag" at the ground in much the same way as a lava flow will flow quickly on top and "roll over" the lava beneath which must drag along the ground. This increasing wind speed with altitude is called "wind shear".

For a sound wave travelling down wind, the top of the wave moves faster than the bottom and the wave bends towards the ground. However, for a wave travelling into the wind the top of the wave is slowed down more than the bottom is and the wave bends upwards. **Figure 1** shows several examples of how atmospheric effects can bend sound waves.

FIGURE 1
Sound refraction under temperature inversions and wind gradients.

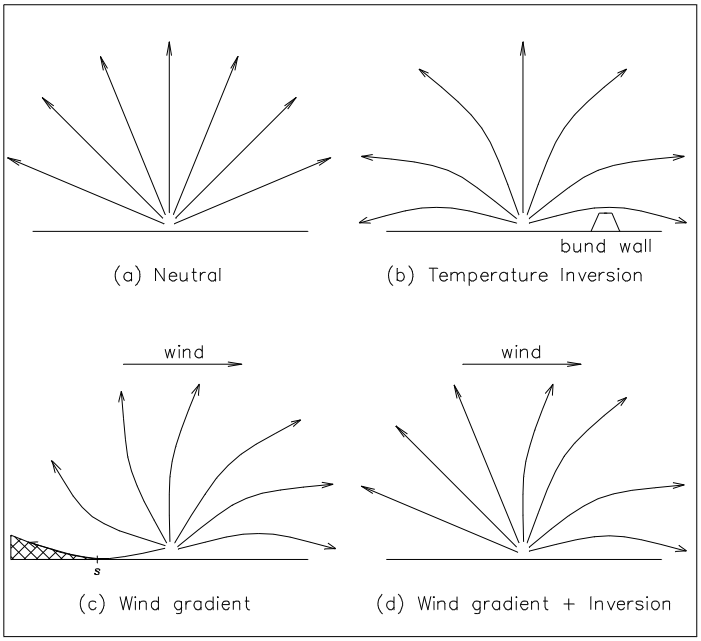


Figure 1 shows that sound rays can be refracted over a barrier (usually a bund wall or small hill) during a temperature inversion, increasing noise levels in the 'shadow zone'.

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23^0C from ground level to an altitude of 200m or more. There are no fluctuations in density or humidity and no wind. Such conditions rarely occur, as temperature will usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Prevailing Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These will typically include seasonal wind directions and velocities. Temperature inversions will be included as prevailing if they occur, on average, for more than 2 nights per week in winter.

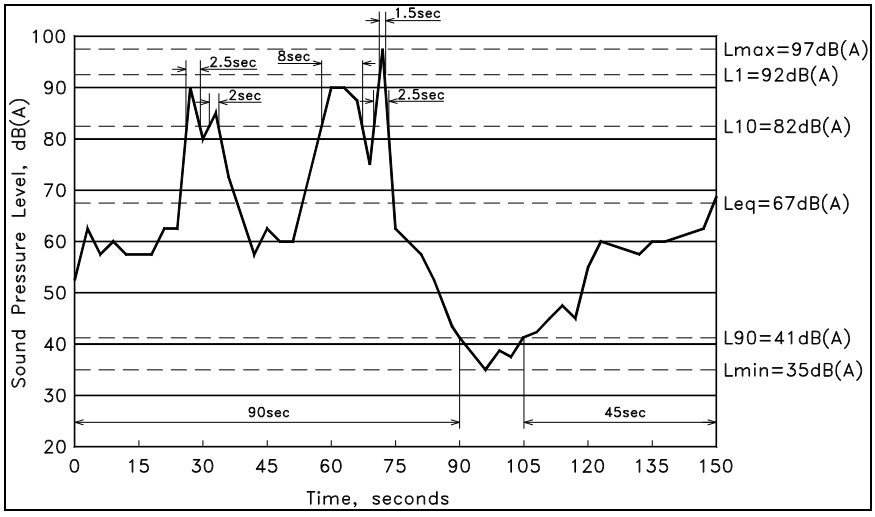
Adverse Atmospheric Conditions

Adverse conditions will include simultaneous winds and temperature inversions, even if the inversions occur for less than 2 nights per week in winter. This represents the worst case scenario for potential noise enhancement due to atmospheric effects.

2.2 Noise Level Percentiles

A noise level percentile (L_n) is the noise level (SPL) in decibels which is exceeded for "n" % of a given monitoring period. Several important L_n percentiles will be explained by considering the hypothetical time signal in **Figure 2**.

FIGURE 2
Hypothetical time-trace of 150-second sound signal.



The signal in Figure 3 has a duration of 2.5 minutes (ie 150 seconds) with noises occurring as follows:

- The person holding the instrument is standing beside a road and hears crickets in nearby grass at a level of around 60 dB (A);

- At about the 30 second mark a motorcycle passes on the road, followed by a car;
- At 60 seconds a truck passes;
- After the truck passes it sounds its air horn at the 73 second mark;
- The crickets are startled into silence as the truck fades into the distance;
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds;
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

L_{A1} Noise Level

Near the top of Figure 3, there is a dashed line at 92 dB(A). A small spike of 1.5 sec duration extends above this line at around 73 seconds. Since 1.5 sec is 1% of the signal duration (150 seconds), the L_1 (or L_{A1} to signify A-weighting) noise level of this sample is 92 dB(A). The L_1 percentile is often called the *average peak noise level* and is used by the NSW Department of Environment and Conservation (DEC) as a measure of potential disturbance to sleep.

L_{A10} Noise Level

The dashed line at 82 dB(A) is exceeded for four periods of duration 2.5 sec, 2 sec, 8 sec and 2.5 sec, respectively. The total of these is 15 sec, which is 10% of the total sample period. Therefore, the L_{A10} noise level of this sample is 82 dB(A). The L_{A10} percentile is called the *average maximum noise level* and has been widely used as an indicator of annoyance caused by noise.

L_{A90} Noise Level

In similar fashion to L_{A1} and L_{A10}, Figure 3 shows that the noise level of 41 dB(A) is exceeded for 135 seconds (90 + 45 =135). As this is 90% of the total sample period, the L_{A90} noise level of this sample is 41 dB(A). The L_{A90} percentile is called the *background noise level*.

L_{Aeq} Noise Level

Equivalent continuous noise level. As the name suggests, the L_{Aeq} of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. L_{Aeq} can be thought of as a kind of 'average' noise level. Recent research suggests that L_{Aeq} is the best indicator of annoyance caused by industrial noise and the DEC *NSW Industrial Noise Policy* (INP) takes this into consideration.

L_{Amax} and L_{Amin} Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to Figure 3 shows these values to be 97 dB(A) and 35 dB(A), respectively.

3.0 THE PROPOSAL

WesTrac is the dealer for Caterpillar earthmoving machinery in Western Australia, New South Wales, the Australian Capital Territory and Northern China. The Company assembles, sells and services new and used machinery. Stage 1 of the proposed development is for the establishment of an integrated WesTrac facility on the northern half of Lot 161 DP774440, Tomago Road, which will be their NSW/ACT Headquarters.

Stage 2 of the proposal involves subdividing the adjoining land to the west (Lot 1 DP1003492) for sale to related and unrelated industrial users. This assessment considers the potential noise impacts from Stage 1 on nearby residential receivers and provides a general assessment of the proposed Stage 2 subdivision.

3.1 Hours of Operation

It is anticipated that the WesTrac facility will operate 24 hours per day, using three shifts, 7 days per week. Industries in the Stage 2 are also assumed to operate 24 hours per day.

3.2 Employment

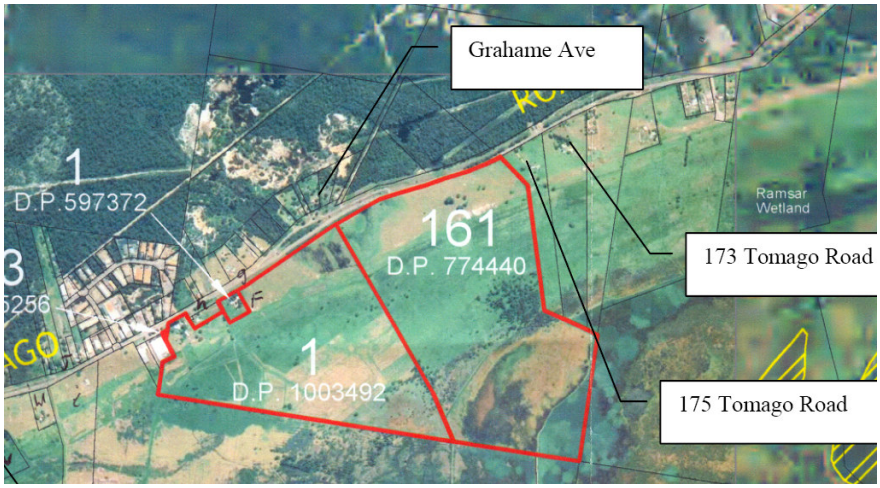
The WesTrac facility is expected to employ 400-600 people during the construction stage. Operation of the facility is expected to generate 300-400 jobs. Substantial additional employment opportunities will result from the future industries in the Stage 2 development.

3.3 Residential Receivers

The nearest residential receivers to the site are located to the east at 173 and 175 Tomago Road and in Graham Avenue.

The locations of the project site and the nearest residences are shown in **Figure 3**.

FIGURE 3
Project site and residential receivers.



4.0 THE EXISTING ENVIRONMENT

The existing meteorological and acoustic environments have been studied as part of this EA. The acoustical climate has been quantified at two representative residential locations around the project site.

4.1 Meteorology

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. Meteorological data from the Bureau of Meteorology's Nobbys Head station were analysed to determine dominant wind directions in the 0-3 m/s category. The following data are the most significant with respect to noise propagation:

- Extremes of relative humidity (RH) are rarely experienced. For modelling purposes, a value of 70% RH was adopted;

- Mild temperature inversions are likely to occur on at least 20-25% of mornings and evenings in winter. An inversion strength of $+3^0$C/100m was adopted in the noise models (as per procedures in the INP, Appendix C).

- Gradient winds are predominantly south-easterly in summer and north-westerly in winter. A wind speed of 3m/s (at 10m above ground level) from each of these directions was modelled to determine the noise impact under each of these 'prevailing' wind conditions.

Typical calm daytime conditions of no wind, 70% RH and -1^{o}C/100m vertical temperature gradient (ie, dry adiabatic lapse rate, DALR) was also modelled to represent daytime noise levels under calm conditions.

4.2 Ambient Noise Levels

Ambient noise monitoring was conducted at 175 Tomago Rd (immediately east of the site) and 308 Tomago Rd (west of the site) during the period 17-23 October 2007. Noise levels were recorded for 15 minute statistical intervals over the entire measurement period using Svan 949 Environmental Noise Loggers in accordance with the relevant DECC guidelines and AS 1055-1997 "Acoustic Description and Measurements of environmental noise". Calibration certificates for these loggers are attached in **Appendix A**. Periods of adverse weather conditions were excluded from the data as per the procedures outlined in Appendix B of the INP.

Background noise levels were calculated from the measured data using the tenth percentile method as specified in the INP. These are referred to as "Rating Background Levels" (RBL). Existing L_{Aeq} and L_{A90} (Rating Background levels, RBL) levels are summarised in **Table 1**. Noise data charts are shown in **Appendix B**.

TABLE 1
Measured ambient noise levels (October 2007).

Location	L_{Aeq}, period			L_{A90}, period		
	Day	Evening	Night	Day	Evening	Night
175 Tomago Rd	57	55	53	38	33	30
308 Tomago Rd	57	53	52	40	32	30

The contribution of existing industrial and transport noise sources to the measured ambient L_{Aeq} levels is estimated as follows:

175 Tomago Road
No industrial noise sources observed nearby and no industrial noise audible during deployment or retrieval of noise logger. Noise levels at this site are dominated by traffic on Tomago road.

308 Tomago Road
Slight industrial noise audible to the west, but not dominant. Noise levels at this site are also dominated by traffic on Tomago road.

5.0 NOISE CRITERIA

This section derives construction, operational and traffic noise criteria from the relevant DECC guidelines. The construction and operational criteria are based on measured background levels as shown in Table 1 above. In the interests of conservatism, the lower of the measured background levels in Table 1 will be adopted for all receivers. These levels are:

Day	38 dB(A),L_{90}
Evening	32 dB(A),L_{90}
Night	30 dB(A),L_{90}

5.1 Construction Noise

Recommended construction noise criteria vary depending on construction duration, as outlined in Section 157 of the DECC *Environmental Noise Control Manual* (ENCM) and reproduced below:

- Construction period less than 4 weeks:
  L_{A10} level restricted to background (L_{A90}) + 20dB
- Construction period more than 4 weeks but less than 26 weeks:
  L_{A10} level restricted to background (LA_{90}) + 10dB

DECC recommends construction during daytime hours only. For construction periods longer than 26 weeks, a construction noise criterion of background (LA_{90}) + 5dB is usually adopted.

Construction activities (including land-fill and building construction) are expected to take longer than 6 months and the criterion of 'daytime background level + 5dB' or **43 dB(A),L_{10}** would apply.

5.2 Operational Noise

In setting operational noise goals for a particular project, the INP considers both Amenity and Intrusiveness criteria. The former is set to limit continuing increase in noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source. Given the receivers are not subject to significant existing industrial noise levels, the intrusiveness criteria are those applicable to setting the project specific noise goals. That is, the Rating Background Level (RBL) for the time period, plus 5 dB(A).

The Project-Specific Noise Levels (PSNL) for the development are therefore;

43dB(A) $L_{eq\ (15\ min)}$	**Day (7am – 6pm)**
37dB(A) $L_{eq\ (15\ min)}$	**Evening (6pm – 10pm)**
35dB(A) $L_{eq\ (15\ min)}$	**Night (10pm – 7am)**

5.3 Sleep Disturbance

As the project would operate 24 hours per day, it is necessary to assess the potential for impact noises to cause disturbance to residents' sleep during night time hours. DECC considers that a $L_{A1(1\ minute)}$ level, effectively the maximum noise level, should generally not exceed the nigh time background noise level by more than 15 dB (Ref. ENCM). Based on the measured background level of 30dB(A),L90 the sleep disturbance criterion is 45dB(A),L_{max}.

The ENCM is an old document, however, and more recent findings referenced in the DECC's *Environmental Criteria for Road Traffic Noise* (ECRTN, Appendix B3) lead to the following conclusions (p29):

- *Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions.*

- *One or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly.*

Since the main objective of this assessment is to determine potential noise impacts on amenity, rather than on health and wellbeing, it is conservatively assumed from the above conclusions that disturbance to sleep may be minimised by ensuring that internal maximum noise levels do not exceed 50 dB(A). It is also accepted by DECC, and generally, that the noise loss through an open window to the centre of a room is 10 dB. The maximum acceptable external noise level is therefore **60 dB(A),L_{max}**.

5.4 Traffic Noise

Noise from vehicle movements on public roads is subject to criteria in the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN). The ECRTN recommends various criteria based on the functional categories of roads applied by the Roads and Traffic Authority (RTA).

The RTA differentiates roads based on a number of factors including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options. Vehicles accessing the site would do so via Tomago Road, which is accessed from the Pacific Highway to the west and Masonite Road and Nelson Bay Roads to the east.

Since the Pacific Highway and Nelson Bay Road are arterials, this assessment will only consider potential traffic noise impacts at residences along Tomago Road, which is a 'collector' road with lower noise criteria. **Table 2** below shows the noise criteria relevant to traffic on collector roads extracted from Table 1 of the ECRTN. For the assessment of traffic noise, the day time period is from 7am to 10pm, whilst night is from 10pm to 7am.

TABLE 2
Road traffic noise criteria.

Situation	Recommended Criteria, $L_{eq(1\ hour)}$	
	Day (7am to 10pm)	Night (10pm to 7am)
13. Landuse developments with potential to create additional traffic on **collector** roads	60 dB(A)	55 dB(A)

The ECRTN also advises that, where criteria are already exceeded:

"In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB."

Existing traffic noise levels in Table 1 do not exceed the levels in Table 2, so the Table 2 levels will apply as the project traffic noise criteria.

6.0 ASSESSMENT METHODOLOGY

6.1 Stage 1 WesTrac

6.1.1 Construction Noise

Construction would first involve depositing and levelling fill material over an area of 23 Ha. This would involve the use of road-going tip-trucks delivering fill and then levelling with a small tracked dozer (CAT D8 or similar). The dozer would also be used to spread a sand ridge on the northern site frontage over the site. A typical sound power level of 108 dB(A) was used for the tip-trucks and 113 dB(A) for the dozer.

It is generally assumed that, since the site requires some 1.9m of fill, filling the WesTrac site would commence on the eastern site boundary and extend to the west. This would provide a noise buffer between trucks importing fill and residences east of the site.

A 3km x 1.5km area was digitised into the Environmental Noise Model (ENM v3.06) software to model noise emissions from the site. The above noise sources were entered as points and the point calculation mode was used to determine noise levels at the assessed receivers. Similarly, building construction works were modelled to each receiver location. Construction of the administration building and general workshop were considered as worst cases for receivers to the west and east, respectively.

Significant noise sources included metal fabrication (105 dB(A)), a crane (102 dB(A)), diesel generator (98 dB(A)) and light vehicle movements (100 dB(A)).

6.1.2 Operational Noise

A comprehensive occupational noise study was conducted at the existing Mt Thorley site by Global Acoustics in September 2007. Noise emissions from most activities on site were measured, as well as L_{Aeq} noise levels inside and outside the various buildings. The Global Acoustics report provides noise levels suitable for determining the internal noise levels of all buildings to be constructed at the Tomago site.

This assessment assumes the buildings would be constructed from sheet metal and calculates external noise levels from the measured internal levels. External wall surfaces of all buildings were represented by point sources in the ENM model equivalent to the total sound power level of the plane surfaces.

The machinery workshops and other potential noise sources are generally on the eastern side of the site. The proposed layout of the eastern half of the site is shown in **Figure 4**. Full details of the site layout and surrounding areas are shown elsewhere in the EA documents.

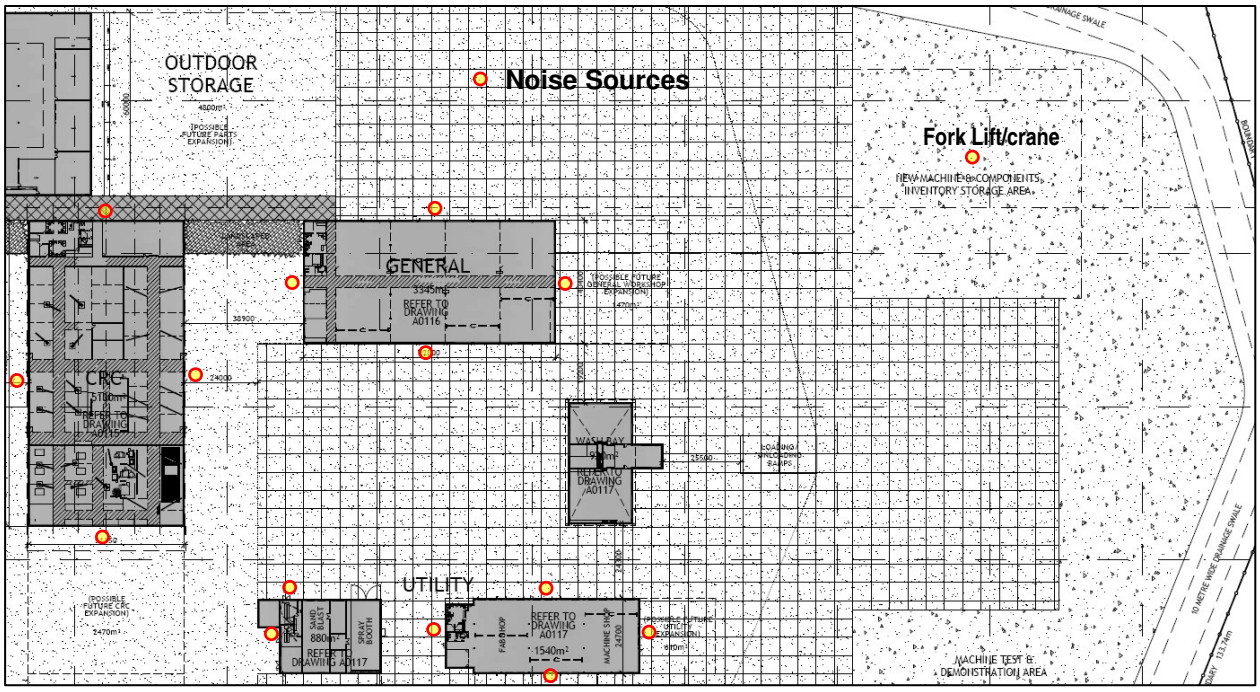


Figure 4. Source locations on eastern half of project site.

Point sources were generated for external walls of the Component Rebuild Centre (CRC), general workshop, fabrication/machine shop and the dynamometer. A small crane was also assumed to be operating in the New Machine and Components Inventory Storage Area at the eastern end of the site.

An example calculation for the east wall of the CRC is shown in **Table 3**.

TABLE 3
L_{Aeq} sound power level calculation for east wall of CRC.

Propagation element	Sum	Octave band centre frequency, Hz							
		31.5	63	250	500	1k	2k	4k	8k
Internal dB(A)	74	30	42	46	57	62	69	68	69
internal dB(lin)	77	69	68	62	66	65	69	67	68
STL[1] steel wall		7	13	15	17	22	27	32	37
SPL outside	63	62	55	47	49	43	42	35	31
Area gain (1000m^2)		30	30	30	30	30	30	30	30
Lw, wall	93	92	85	77	79	73	72	65	61

[1] Sound Transmission Loss of 0.8mm steel sheeting.

The dynamometer was identified as being a potentially noisy source, although the existing unit at Mt Thorley only operates occasionally and was not available for testing within the timeframe of this assessment. It was observed on the Mt Thorley site, however, that the dynamometer was housed in a 200mm thick concrete enclosure. Staff at the site confirmed that normal conversation was possible immediately outside the enclosure with the unit running, suggesting levels well below 85 dB(A).

An estimate of the dynamometer's noise emissions was achieved by using file data of a 1000 kw V16 turbo-diesel engine operating at full revs inside an enclose (the major noise source in a dynamometer), subtracting

the sound transmission loss of 150mm (nominal) pre-cast concrete and adding a surface area gain over the enclosure surfaces. The enclosure in which the engine was measured was lined with perforated sheet steel over 50mm thick acoustic insulation. This treatment reduces internal reverberation (and therefore external noise) by typically 6dB although it will be assumed that the proposed dynamometer enclosure at the Tomago site will not be similarly lined. The calculated sound power level of the western wall of the dynamometer enclosure is shown in **Table 4**.

TABLE 4
L_{Aeq} sound power level calculation for west wall of dynamometer enclosure.

Propagation element	Sum	Octave band centre frequency, Hz							
		31.5	63	125	250	500	1k	2k	4k
Internal dB(A)	99	53	67	75	84	80	95	95	91
internal dB(lin)	101	92	93	91	93	83	95	94	90
Enclosure[1]		6	6	6	6	6	6	6	6
STL[2] 150mm concrete		24	30	34	38	41	50	57	62
SPL outside	76	74	69	63	61	48	51	43	34
Area gain (75m^2)		19	19	19	19	19	19	19	19
Lw, wall	94	93	88	82	80	67	70	62	53

[1] Reverberant build-up of 6dB inside enclosure.
[2] Sound Transmission Loss of 150mm concrete.

Assessment of operational noise was conducted using RTA Technologies Environmental Noise Model (ENM) v3.06. Each of the noise sources discussed above was included in the model. Noise modelling was undertaken for the atmospheric conditions described below:

Calm – 20^{0}C, 70% R.H., no wind (neutral atmospheric),

Inversion - +3^{0}C/100m temperature inversion,

South East wind - 20^{0}C, 70% R.H., 3m/s wind from the south east, and

North West wind - 20^{0}C, 70% R.H., 3m/s wind from the north west,

6.1.3 Sleep Disturbance

Maximum impact noises would occur within workshops (hammering, welding, grinding, rattle gun, air arc gouging, oxy cutting, etc) and in external areas where steel parts are being handled by the fork lift or crane. Maximum noise levels presented in the Global Acoustics report were up to 20dB higher than L_{Aeq} levels. This correction was applied to predicted L_{Aeq} (operational) levels to estimate worst case impact noise levels.

6.1.4 Traffic Noise

The potentially most affected residences with regard to traffic noise are near the site or on Tomago Road. Existing traffic numbers on Tomago Road and proposed traffic numbers to be generated by the Project during the landfill stage were sourced from the Traffic Management Plan prepared by Mark Waugh Pty Limited, dated June 2007.

No significant number of vehicle movements would be generated from the site, except at shift changes. Traffic numbers from employees at the site were estimated from the employee numbers. The resulting ratios have been converted to equivalent noise levels (or noise level variations) for comparison with the criteria in **Table 2**.

6.2 Stage 2 Industrial Development

There is no information available relating to the Stage 2 industrial development. Noise criteria for future industries will depend on the recommended amenity levels for cumulative industrial noise levels and the predicted levels from the WesTrac facility. Discussion of noise limits for future development will be possible after completion of the assessment of the WesTrac facility.

7.0 WESTRAC FACILITY ASSESSMENT

7.1 Construction Noise

7.1.1 Earthworks

The ENM noise model was utilised in point calculation mode to determine construction noise levels (landfill stage) at the two receivers closest to the site. Construction activities (dominated by the dozer on site spreading fill material) were modelled at the nearest points to each receiver. The results of the point calculations for the four modelled scenarios are shown in **Table 5**. Inversion conditions have been modelled for completeness but are normally not considered for daytime activities.

TABLE 5
Predicted construction noise levels dB(A),$L_{10(15minute)}$.

Location	Meteorological Condition				
	Neutral	Inversion	SE wind	NW wind	Criterion[1]
175 Tomago Road	41	43	40	43	43
Graham Avenue	40	42	43	38	43

[1] Construction activities are generally only approved for daytime hours of 7am-6pm, so only the daytime criterion applies.

The results in Table 4 suggest that worst case noise emissions would be less than or equal to the daytime construction noise criteria during the landfill phase of the project. If possible, land filling should commence at the nearest point to the residences and progress into the site (generally to the south west) to further reduce the likelihood of noise disturbance.

7.1.2 Building Construction

Major noise sources for building construction works potentially include include:

Source	Lw, dB(A)
Oxy Cutting	89
Hammering steel	108
5-inch grinder	105
Drop-saw	107

These particularly loud sources may all operate at one time, producing a total sound power level of 111 dB(A). If there are two such sets of activities, the total sound power would increase to 114 dB(A). This is equal to the total sound power level adopted for the landfill stage. Table 5 shows landfill noise not exceeding the noise criterion. Since the building construction noise sources would be further from residences than the worst case location of landfill activities, and are of a more high-frequency nature which dissipates more rapidly with distance, then the noise from building construction would be lower than the levels in Table 5 and compliant with the criterion.

7.2 Operational Noise

The ENM noise model was utilised in contour calculation mode to determine noise levels at the two receivers closest to the site. Predicted noise levels for the four modelled scenarios are shown in **Table 6**. Noise contours are included as **Figure B1** in **Appendix B**.

TABLE 6
Predicted operational noise levels dB(A), $L_{eq(15minute)}$.

Location	Meteorological Condition				
	Neutral	Inversion	SE wind	NW wind	Criteria[1]
175 Tomago Road	40	42	40	42	43 / 37 / 35
Graham Avenue	25	27	27	22	43 / 37 / 35

[1] Day / Evening / Night criteria as defined in Section 5.2.

The results in Table 6 suggest that noise emissions could be up to 5 dB above the evening criterion and 7dB above the nigh time criterion at 175 Tomago Road. Since the exceedance is 5dB or more, these are considered 'major' exceedances and noise control should be applied. The ranked noise sources in the point calculations reveal the following noise contributions to the predicted noise level at 175 Tomago Road under inversion conditions:

Crane in inventory area:	42
Fabrication building:	20
Dynamometer:	20
CRC:	<20
TOTAL	42

The dominant source at this residence is the crane operating outdoors in the inventory area. At times when there is no outdoor activity, general noise levels from within the workshop areas are expected to be well below the night time criteria.

If the Proponent wishes to be able to move parts around in the inventory area during the evening or at night, it is recommended that a 3.5m high acoustic barrier be erected along a portion of the eastern site boundary to provide 7dB attenuation to 175 Tomago Road. The recommended location and minimum extent of the acoustic barrier is shown in **Figure 5**.

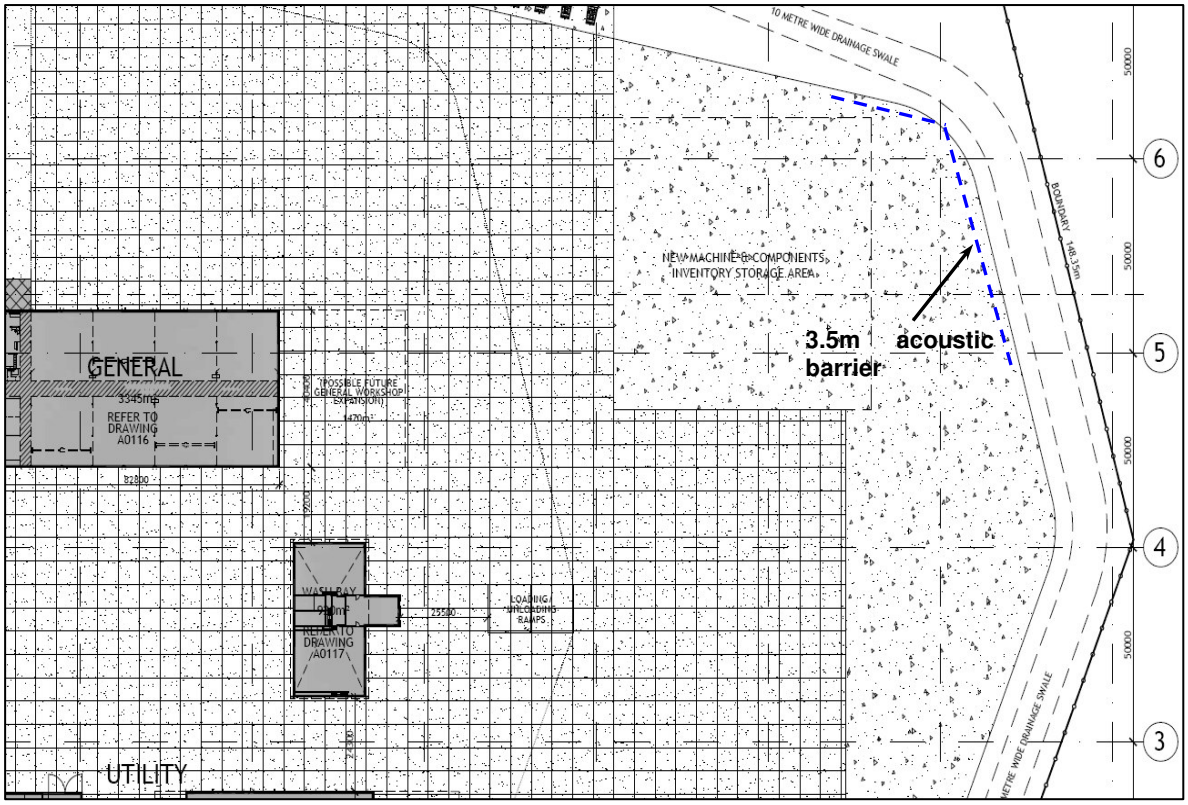


Figure 5. Location of recommended acoustic barrier.

Noise levels were re-calculated using ENM with the 3.5m barrier in place as shown in Figure 5. Predicted noise levels are summarised in **Table 7**. Noise contours showing the effect of the acoustic barrier under inversion conditions are shown in **Figure B2** in Appendix B.

TABLE 7
Predicted operational noise levels with 3.5m acoustic barrier.

Location	Meteorological Condition				
	Neutral	Inversion	SE wind	NW wind	Criteria[1]
175 Tomago Road	31	34	30	34	43 / 37 / 35
Graham Avenue	25	27	27	22	43 / 37 / 35

[1] Day / Evening / Night criteria as defined in Section 5.2.

The calculation results in Table 7 suggest that the proposed 3.5m acoustic barrier will provide sufficient attenuation of noise from the outside inventory area to satisfy the night-time operational noise criterion.

7.3 Sleep Disturbance

Maximum impact noise levels from activities *inside buildings* (ie the CRC and other workshops) may be conservatively estimated by adding 20dB

to predicted noise levels without the external activities included. Resulting maximum noise levels are summarised in **Table 8**.

TABLE 8
Predicted maximum noise levels from workshop activities.

Location	Meteorological Condition				
	Neutral	Inversion	SE wind	NW wind	Criteria[1]
175 Tomago Road	41	43	40	43	45 / 60
Graham Avenue	40	40	41	39	45 / 60

[1] ENCM and ECRTN criteria as defined in Section 5.3.

Results in Table 8 are all below the ENMS's 'screening test' criterion of 45dB(A),L_{max} for potential disturbance to sleep. This suggests very little potential for 24-hour workshop activities to present a sleep disturbance problem.

Maximum noise emissions from all sources (including activities in the outdoor inventory area) and with the 3.5m acoustic barrier in place are summarised in **Table 9**.

TABLE 9
Predicted maximum noise levels from all site activities.

Location	Meteorological Condition				
	Neutral	Inversion	SE wind	NW wind	Criteria[1]
175 Tomago Road	51	54	50	54	45 / 60
Graham Avenue	45	47	47	42	45 / 60

[1] ENCM and ECRTN criteria as defined in Section 5.3.

The maximum noise levels in Table 9 are above the 'screening criterion' of 45 dB(A) by up to 2dB at Graham Avenue residences. This is considered a minor exceedance not requiring further attention. Predicted exceedances up to 9dB at 175 Tomago Road suggest that the potential for sleep disturbance should be considered further.

Considering the predicted level in the context of the existing noise environment, **Figure 6** shows the worst case noise level of 54dB(A),L_{max} from WesTrac and the measured night time average L_{Amax} levels from existing traffic on Tomago road. Figure 6 also shows the existing night-time average traffic noise (L_{Aeq}) and background (L_{A90}) levels.

Figure 6
Predicted maximum noise levels and existing noise parameters.

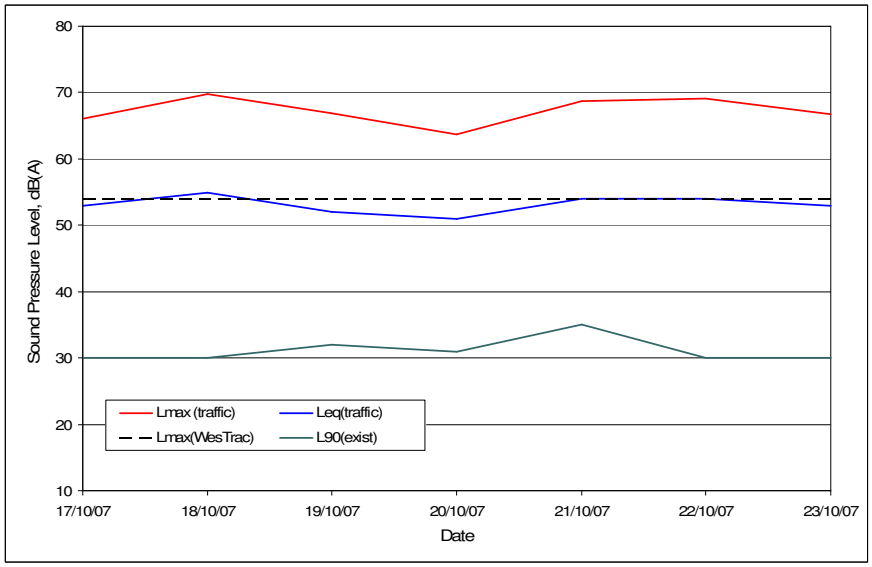


Figure 6 shows that the expected maximum noise level of 54 dB(A) from WesTrac is approximately equal to the night-time L_{Aeq} level from traffic on Tomago Road. This is at least 10 dB below the existing maximum levels of 65-70 dB(A) from individual passing vehicles. The worst case noise levels from WesTrac would therefore not be a major noise source in the context of 175 Tomago Road, would be 10 dB below existing noise from individual vehicles and would be 6dB below the level of 60 dB at which disturbance to sleep is considered unlikely by DECC.

7.4 Traffic Noise

Peak hour traffic numbers passing the site on Tomago Road (east of McIntyre Road) are presented in the traffic noise assessment by Steve Waugh Pty Ltd (SWPL) and summarised below in **Table 10**.

TABLE 10
Peak hout traffic volumes (from SWPL).

Direction	AM peak hour volume	PM peak hour volume	Volume/ capacity AM	Volume/ capacity PM
Eastbound	169	164	0.12	0.12
Westbound	196	226	0.14	0.16
TOTAL	365	390	0.13	0.14

Analysis of the noise logger data for the morning (7:30 – 8:30 am) and afternoon (3:30 – 4.30 pm) peaks shows a $L_{Aeq(1\text{-hour})}$ noise level up to 59 dB(A). This is 2 dB above the 57 dB(A) average daytime traffic noise measured at both locations, as would be expected due to the increased traffic numbers.

The 24-hour operation at WesTrac is likely to operate as three shifts, and it is possible that up to 266 vehicles may cross over during each shift change. This equates to one-third of the total 400 employees arriving in the half hour before shift change and one-third departing in the half hour after shift change. It is assumed that 60% of these vehicles would arrive from the west (Pacific Highway) and only 40% from the east. This gives

the possibility that up 160 vehicles may pass by residences west of the site and 106 may pass by residences east of the site at shift-change.

The peak hour traffic volume of 390 vehicles/hour recorded by SWPL coincides with a measured noise level of 59 dB(A). It will be assumed that all of this noise is attributed to traffic.

Correcting for the lower number of vehicles that would be generated by WesTrac gives:

160 vehicles: $59 + 10\times\log_{10}(160/390) = 55$ dB(A).
106 vehicles: $59 + 10\times\log_{10}(106/390) = 53$ dB(A).

These estimated worst case levels do not exceed the traffic noise criteria in Table 2. It is also observed that all of the employee vehicles would be light vehicles and there would be close to 0% contribution from heavy vehicles, which are considerably louder. Since the existing traffic volume comprises 10% heavy vehicles (SWPL) the predicted levels from WesTrac at shift change would be lower than the values estimated above.

8.0 STAGE 2 INDUSTRIAL DEVELOPMENT

There is currently no information relating to the industrial subdivision upon which a quantitative assessment may be based. The following sections provide general planning criteria for the staged development.

8.1 Amenity Noise Criteria

Overall cumulative noise criteria for emissions from a number of industries are contained in the DECC amenity criteria in the INP. Considering the receiver area as 'suburban', the appropriate amenity criteria are summarised in **Table 11**.

TABLE 11
Amenity criteria for Stage 2 Industrial Development.

Receiver Type	Noise Amenity Area	Time of day	Acceptable L_{Aeq} noise levels
Residence	Suburban	Day	55
		Evening	45
		Night	40

8.2 Individual Noise Criteria

Conservatively assuming that the background noise levels would not increase after commencement of the WesTrac operations, the intrusive criteria for an individual industry planning to enter Stage 2 would be:

43dB(A) $L_{eq\ (15\ min)}$	Day (7am – 6pm)
37dB(A) $L_{eq\ (15\ min)}$	Evening (6pm – 10pm)
35dB(A) $L_{eq\ (15\ min)}$	Night (10pm – 7am)

It is typically the case that only a small number of industries may front Tomago Road (closest to residences) and the rest would occupy spaces deeper into the subdivision (south of Tomago Road) and would be substantially shielded from residence by industries along the road frontage. It is there frontage industries that would present the greatest potential for cumulative noise impacts.

The large WesTrac facility would provide a substantial buffer distance, and screening, for industries in stage 2 with regards to potential impacts at 173 Tomago Road and residences further to the east.

The amenity criteria may be 'partitioned' amongst 3-4 future industries by limiting the noise contribution from each one to a level 5 dB below the total recommended industrial noise level. Equitable operational noise criteria for future industries in Stage 2 are summarised below.

43dB(A) $L_{eq\ (15\ min)}$	50dB(A) $L_{eq\ (11\ hour)}$	Day (7am – 6pm)
37dB(A) $L_{eq\ (15\ min)}$	40dB(A) $L_{eq\ (4\ hour)}$	Evening (6pm – 10pm)
35dB(A) $L_{eq\ (15\ min)}$	35dB(A) $L_{eq\ (9\ hour)}$	Night (10pm – 7am)

Individual future industries would be required to submit noise impact assessments as part of the Development Application process. These assessments would need to consider the above criteria (unless future conditions require re-assessment), construction noise and traffic noise in accordance with the applicable standards and guidelines.

The above indicative criteria are realistically achievable and do not indicate that the site is inappropriate for industrial development, on acoustic grounds.

9.0 CONCLUSION

An assessment of the proposed WesTrac facility and industrial subdivision at Tomago has been conducted.

The assessment of the WesTrac facility has highlighted the potential for night time noise criterion exceedances at one residence east of the site. The exceedance can be mitigated by constructing a 3.5m high acoustic barrier along a portion of the site boundary as indicated in this report.

An acoustic barrier comprises an earth mound or a fence or a fence on a mound. An acoustic fence requires a minimum mass of 15 kg/m2 and must make contact with the ground. There are to be no significant gaps in the fence. Timber fences are commonly used in similar situations. These typically comprise two layers of overlapping treated pine palings with a cap (or coping) running along the top to prevent separation of the palings.

No exceedances of traffic noise criteria have been predicted. The periods of maximum traffic generation by the WesTrac facility would occur at shift changes and would comprise light vehicles.

Individual assessment of future industries in the Stage 2 development would be required, and an assessment of likely operational noise criteria has found that the site is able to accommodate the managed noise output from multiple industries.

We conclude that the project could proceed without impacting on the acoustical amenity of nearby residents, provided the recommendations in this report are adopted.

10.0 REFERENCES

Environment Protection Authority (EPA). *Environmental Criteria for Road Traffic Noise* (ECRTN, 1999), Sydney.

Environment Protection Authority (EPA). *NSW Industrial Noise Policy* (INP, 2000), Sydney.

State Pollution Control Commission (SPCC). *Environmental Noise Control Manual* (ENCM, 1994).

APPENDIX A

NOISE LOGGER CALIBRATION CERTIFICATES

CONFORMANCE CERTIFICATE

We certify that the equipment listed below has been checked, adjusted and aligned to conform to manufacturers specifications.

Certificate No: 7759

INSTRUMENT: Sound & Vibration Anayser
Svantek

Type No: Svan-949 **Serial No:** 9757

Owner: Spectrum Acoustics Pty Ltd
1 Roath St
Cardiff NSW 2285

CONDITION OF TEST:

Ambient Pressure: 1007 **mbar**

Temperature: 23 **°C** **Relative Humidity:** 37 **%**

Date of Calibration: 6/10/06

CHECKED BY: JK **AUTHORISED SIGNATORY:** .....
Jack Kielt

The tests, calibrations or measurements covered by this document are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full. The equipment listed above has been calibrated in this laboratory. The equipment performed satisfactorily in all the tests conducted.

NATA
WORLD RECOGNISED ACCREDITATION
Accredited Lab. No. 9262
Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS

HEAD OFFICE
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Tel: (02) 9680-8133 Fax: (02) 9680-8233
Mobile: 0413 809 806
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Page 1 of 1
AVCERT4 Rev.1 03.09.04

CONFORMANCE CERTIFICATE

We certify that the equipment listed below has been checked, adjusted and aligned to conform to manufacturers specifications.

Certificate No: 7758

INSTRUMENT: Sound & Vibration Anayser
Svantek

Type No: Svan-949 **Serial No:** 9758

Owner: Spectrum Acoustics Pty Ltd
1 Roath St
Cardiff NSW 2285

CONDITION OF TEST:

Ambient Pressure: 1007 **mbar**

Temperature: 23 **°C** **Relative Humidity:** 37 **%**

Date of Calibration: 6/10/06

CHECKED BY: JK **AUTHORISED SIGNATORY:** .....
Jack Kielt

The tests, calibrations or measurements covered by this document are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full. The equipment listed above has been calibrated in this laboratory. The equipment performed satisfactorily in all the tests conducted.

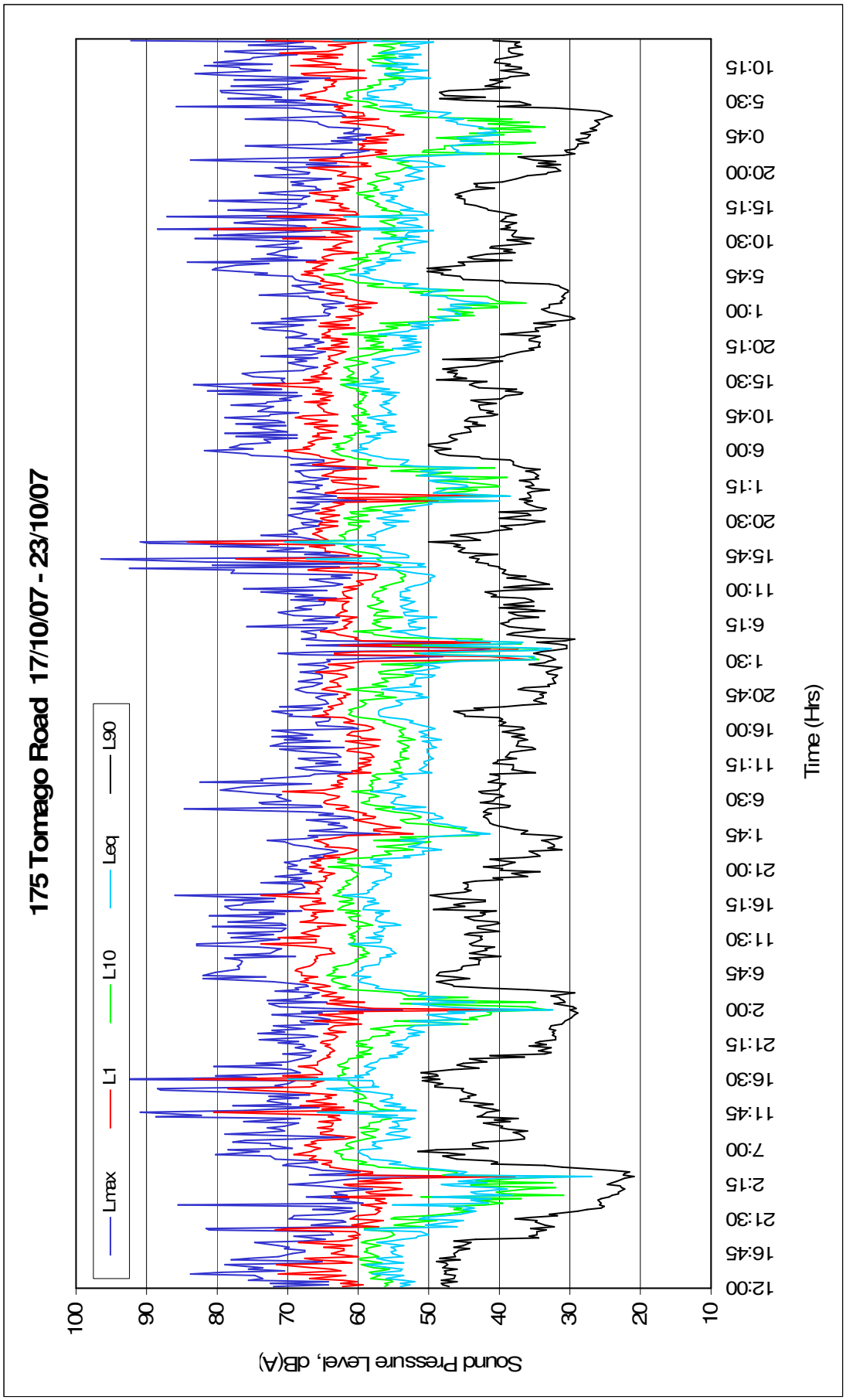
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Acoustic and Vibration Measurements

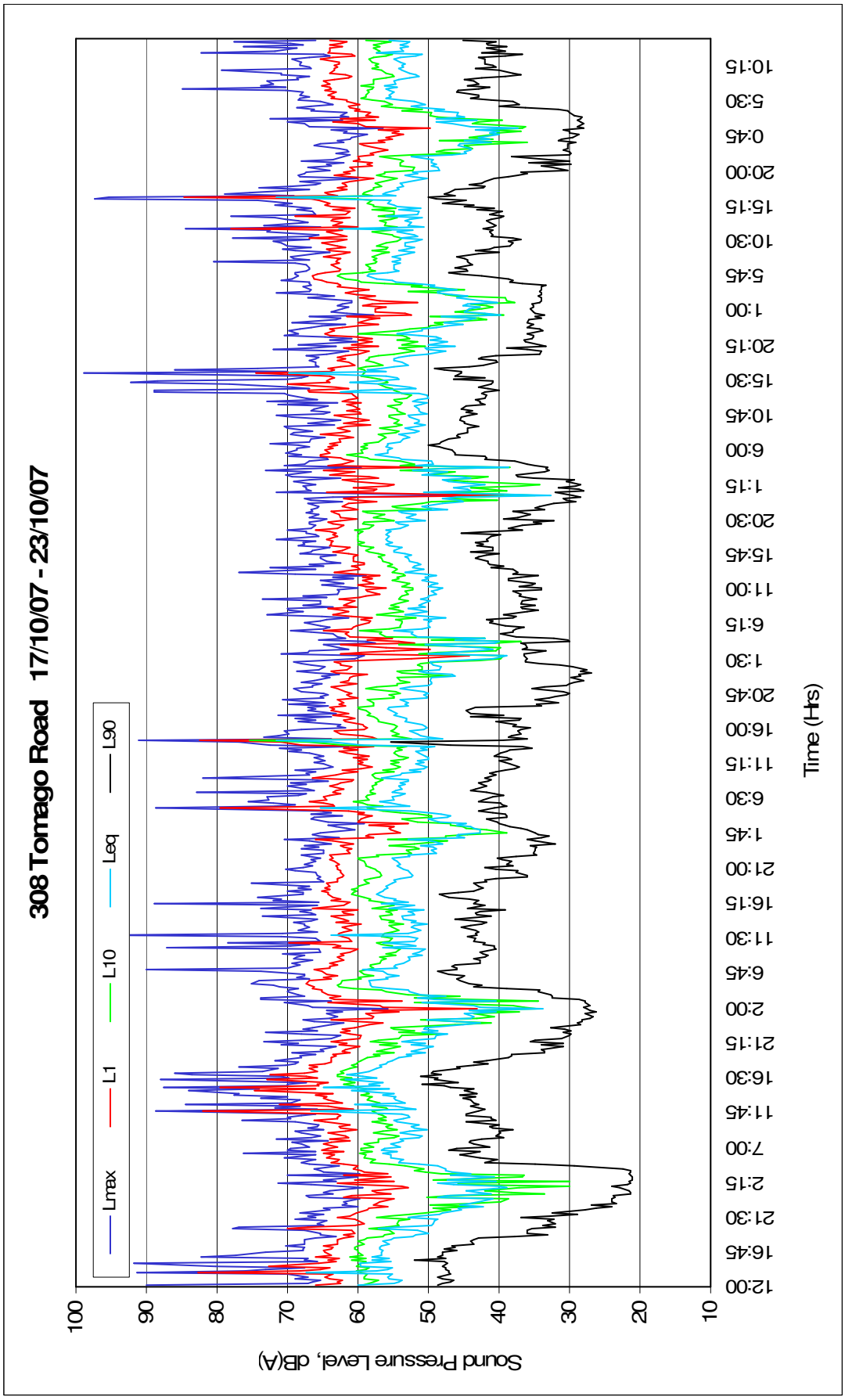
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APPENDIX B

NOISE MONITORING DATA


175 Tomago Road 17/10/07 - 23/10/07
Lmax
L1
L10
Leq
L90
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
20
10
Time (Hrs)
12:00
16:45
21:30
2:15
7:00
11:45
16:30
21:15
2:00
6:45
11:30
16:15
21:00
1:45
6:30
11:15
16:00
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1:00
5:45
10:30
15:15
20:00
0:45
5:30
10:15


308 Tomago Road 17/10/07 - 23/10/07
Lmax
L1
L10
Leq
L90
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
20
10
Time (Hrs)
12:00
16:45
21:30
2:15
7:00
11:45
16:30
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16:15
21:00
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APPENDIX C

NOISE CONTOURS

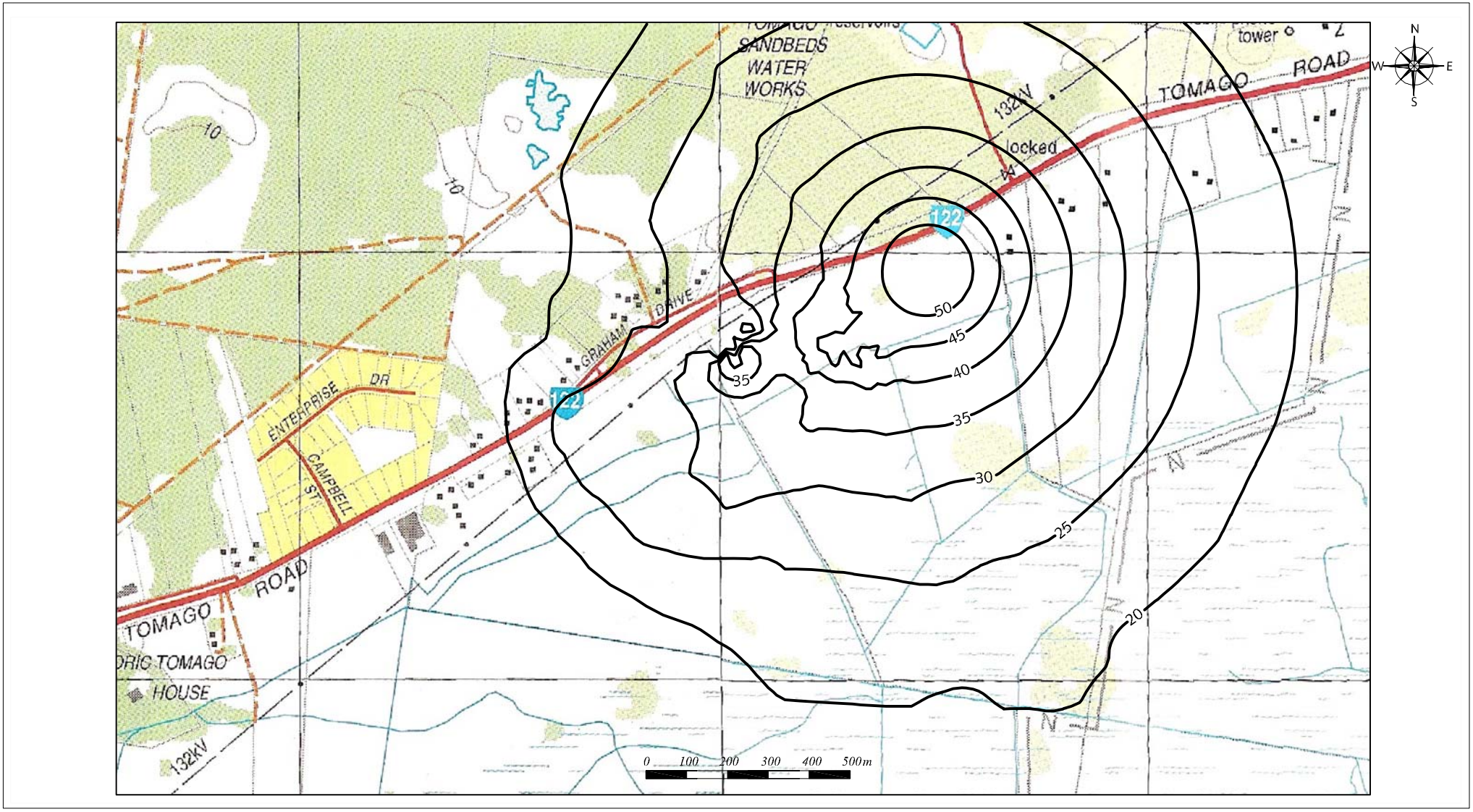


FIGURE B1

Noise Contours dB(A), L_{eq} (15 min)
Temperature Inversion - No Acoustic Barrier

Base Source: Williamtown 1 : 25 000 Orthophoto 9232-2N & Beresfield 1 : 25 000 Orthophoto 9232-3N

SPECTRUM ACOUSTICS

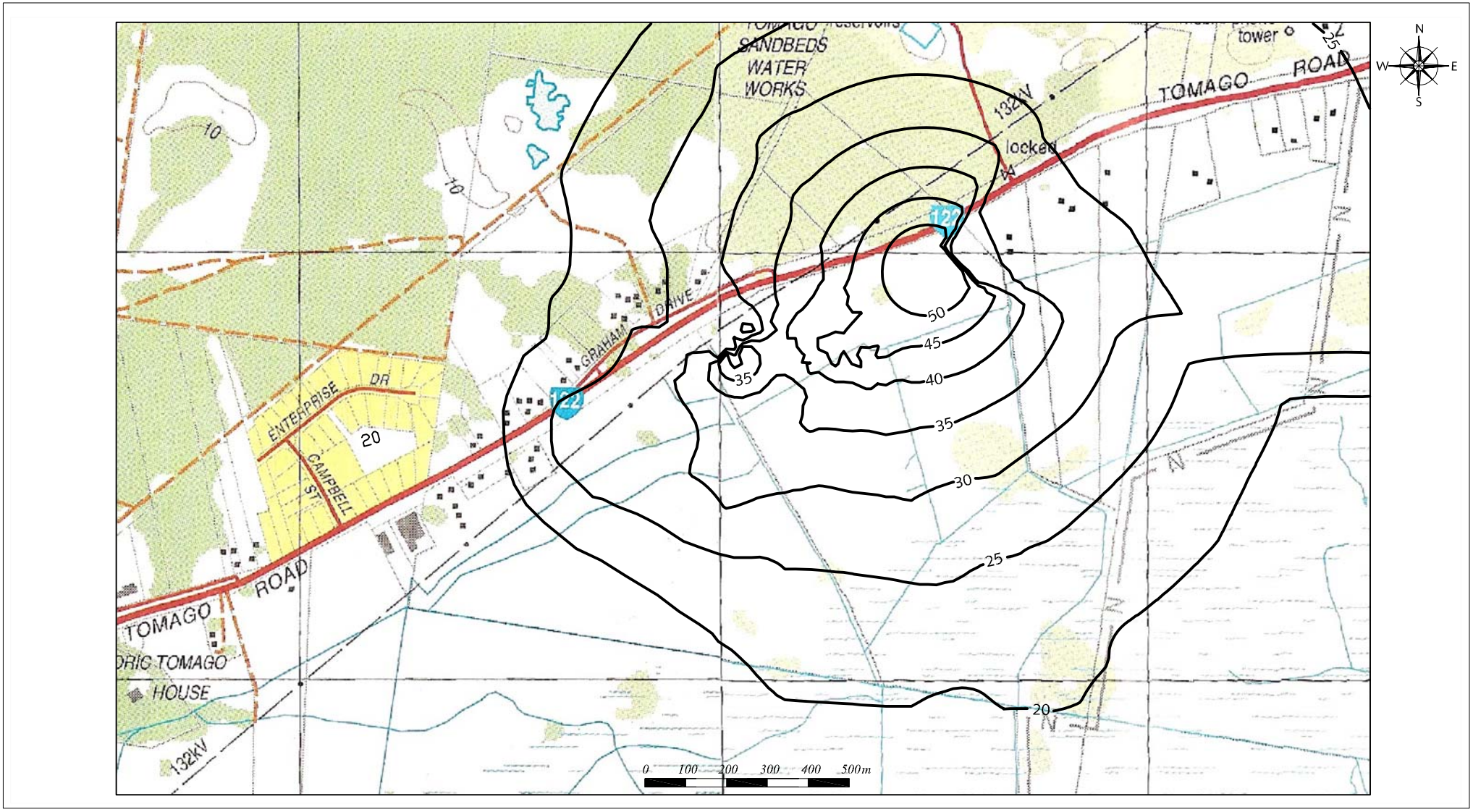


FIGURE B2

Noise Contours dB(A), L_{eq} (15 min)
Temperature Inversion - 3.5m Acoustic Barrier

Base Source: Williamtown 1 : 25 000 Orthophoto 9232-2N & Beresfield 1 : 25 000 Orthophoto 9232-3N

SPECTRUM ACOUSTICS

KG4104_FIGB2.DWG

NOVEMBER 2007

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FAX

To Company:	Asquith & deWitt	Fax:	4978 5199
Attention:	Craig Marler	Date:	29/2/08
From:	Neil Pennington	Ref:	07359/2495
Copies to:		Pages:	3

☐ Urgent ☐ Please Reply ☐ For your files ☐ No action required

Subject: Tomago Industrial Subdivision

Dear Craig,

Thanks you for forwarding comments on the noise component of the Tomago EA, provided by DECC and DoP. The two issues raised by DoP relate to construction noise levels and road traffic noise. We respond to these issues as follows:

1) Construction noise scenarios considered earthworks (landfill) over the entire project site with noise sources (dozer and trucks) located at the nearest points to residential receivers. The total sound power level of earthworks sources was 114 dB(A). This is equal to the sound power level expected from two building construction sites (see section 7.1.2 of acoustic assessment). Building construction works would always be at a greater distance from residences than earthworks, and earthworks in later stages would be no closer to residences than earthworks at the Westrac site. Therefore it was concluded that since earthworks at the Westrac site were predicted to comply with construction noise criteria, then all other construction activities would also comply.

2) Existing daytime traffic noise levels were determined from noise logger data as 59 dB(A),$L_{eq(1hour)}$ during peak hours and 57 dB(A),$L_{eq(1hour)}$ averaged throughout the day. Table 2.1 of the Traffic Impact Study by Better Transport Futures (BTF) shows a PM peak traffic volume of 390 vehicles/hour which was taken as corresponding to the measured peak noise levels. Table 4.2 of the BTF report forecasts a PM peak traffic volume of 265 vehicles from the Westrac Facility. Noise levels from this volume of traffic would be 57 dB(A). This is 3 dB lower than the daytime criterion of 60 dB(A) in the ECRTN. Adding this to the existing daytime level (peak) gives 61 dB(A) which equals the maximum recommended noise level increase of 2 dB over existing levels. For the further development of Stages 2 and 3, traffic noise levels should not increase by more than a further 2 dB. This level of noise increase would require an additional 412 vehicle movements in peak hour. Tables 4.3 and 4.4 of the BTF report suggest that only a little over half this number of vehicle would be generated by Stages 2 and 3 and unacceptable traffic noise levels will not result.

DECC raised the issue of potential noise impacts on migratory birds in the SEPP 14 and RAMSAR wetland areas south of the project site. There is no definitive industrial noise level at which there may be disruption to the normal habits of migratory birds. The following comments and observations are offered for DECC's consideration of the likelihood that noise from the site would have a detrimental impact on these birds..

Noise contours prepared for the Westrac Facility (Appendix B of acoustic assessment) show noise levels of approximately 20 dB(A),L_{eq} at the nearest point of the wetland area (with no acoustic barrier and under inversion conditions). Maximum impact levels of up to 32 dB(A) are also likely at this distance. A level of 20 dB(A) is at least 10 dB below the existing background noise level and the predicted maximum level of 32 dB(A) is comparable with the background level. Such low levels of noise are not likely to disturb or even be noticed by wetland birds (see information below).

The noise contours also show noise levels of approximately 47 dB(A),L_{eq} at the southern boundary of the Westrac site (with no acoustic barrier and under inversion conditions). Maximum impact levels of up to 59 dB(A) are also likely at this distance. These levels will be adopted as indicative levels that may be experienced by migratory birds close to the southern-most industrial development in the south-east corner of the project site. Reference to the project site layout in relation to the wetland area shows that the site boundary slopes towards the northwest from the southeast corner and the distance to the nearest point of the wetland increases to a distance of over 1 km, thereby greatly reducing potential noise impacts.

An article in the University of Sydney Science Alliance newsletter (September 2007) detailed the progress made by researchers aiming to reduce bird strikes at Sydney Airport by using 'ecological principles'. Professor Dickman of USyd claims a better result with these methods than "..sending airport workers out to check what birds are around and then shooting them…". Professor Dickman notes that habitat around Sydney Airport is attractive to birds with the coast, nearby bushland and freshwater wetlands in abundance. Ecological control methods include controlling food sources (dispersing schooling fish), locking garbage bins, remaining vigilant to birds' migratory habits, mowing surrounding grasses to 20cm and netting the banks of local wetlands to stop "…a lot of species from coming in…".

It may be inferred from the above study that birdlife of all kinds thrives close to Sydney Airport (a major noise source), to the point where methods are needed to scare or encourage birds to move to safer, more distant locations. The noise level within 500m of Sydney Airport (at ground level) would regularly exceed the maximum level of 59 dB(A) likely to emanate from the Tomago development.

Another relevant study presented at the 2001 Third Joint Annual Meeting of the Bird-Strike Committee-USA/Canada (2001) by Aimee Hutchinson of Birds Australia looked at the effectiveness of gas scare guns in dispersing birds near Sydney Airport. The study consisted of installing gas guns at 100m spacing along the seawall of runway 16L/34R. The guns were detonated in sequence every 10 minutes from 6:45 to 7:45 am for a week and bird dispersion rates/directions and number counts were compared with the weeks prior to and after the study. A pertinent finding was that birds in flight showed a greater aversion response than birds on the ground and most of the response was displayed by birds within 150m of the gas guns. This suggests that birds nesting greater than 150m from a series of gas guns fired regularly may not be particularly disturbed by the noise. The study recommended the permanent placement of gas guns at Sydney Airport, so even this source of very high noise levels would need to occur constantly in the hope of dislodging the nearby bird colonies.

The above findings and the general proximity of Hunter wetland bird colonies to existing industry and infrastructure suggest that these existing colonies may be subjected to, and tolerant of, much higher man-made noise levels than those predicted to be emitted from the Tomago development. Regarding natural noise sources: maximum noise levels from within a bird colony itself; nearby birds such as galahs; frogs and insects such as crickets and cicadas would regularly exceed 65-70 dB(A) at the site of a nesting bird within the wetland habitat. Thunder claps are also known to be extremely loud but are not known to overly disrupt bird colonies (although other non-noise disturbance may result from an approaching storm).

These considerations suggest that 59 dB(A) is a relatively low level of noise impact compared with what might currently be experienced by birds within the wetland areas south of the project site, and is certainly much less than the level of noise that would be experienced by established bird colonies near coastal airports.

Should you require any further information please contact the undersigned on 4954 2276 or 0406 670677.

Yours faithfully,

Spectrum Acoustics Pty Limited



Neil Pennington
Principal/Director

Appendix P

ABORIGINAL ARCHAELOGICAL REPORT

AN ARCHAEOLOGICAL ABORIGINAL HERITAGE ASSESSMENT OF THE

Proposed Industrial Development
Tomago Road, Tomago

For:

Redlake Enterprises Pty Ltd (Redlake)
C/- Asquith & deWitt
P O Box 179
Charlestown 2290

Prepared by:

INDIGENOUS OUTCOMES
P. O. Box 433
The Junction,
NEWCASTLE NSW 2300

Date: March 2006

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Enquires should be addressed to Indigenous Outcomes Pty Ltd.

EXECUTIVE SUMMARY

This investigation was performed for Redlake Enterprises Pty Ltd (the proponent), Asquith and de Witt, on behalf of Redlake Enterprises Pty Ltd, commissioned Indigenous Outcomes to conduct an Aboriginal archaeological assessment of Lot 161 DP 774440 & Lot 1 DP 1003492, Lot 1 DP 597372 & Lot 513 DP 585256 Tomago Road, Tomago, to meet Port Stephens Shire Council requirements for the lodgement of a proposed Industrial subdivision development application.

In the period February 24th to March 1st, 2006 a systematic survey of the study area was undertaken with the assistance of representatives from the Worimi Local Aboriginal Land Council, to test the predictive model of the site location. The investigation was undertaken with Jamie Merrick and Brendan Lilley, Aboriginal Sites Officers of the Worimi Local Aboriginal Land Council.

As part of the assessment, the Department of Environment and Conservation Aboriginal Heritage Information Management System site data base was consulted to determine if sites were located in the study area or in close proximity to the study area. The search indicated that there were no registered sites within the study area. An analysis was also undertaken of prior archaeological studies in the general area in order to obtain information that could be used to predict the likely location and nature of previously unrecorded sites within the study area. This analysis indicated that the most likely location for Aboriginal sites was in proximity to permanent watercourses and the ridge crests.

There were 7 sites identified, these comprised of approximately 128 stone artefacts.

The survey involved the inspection of low lying swamp land and a sample of other landscape elements. During the survey it was observed that prior infrastructure, such as residential dwelling and development of the low lands had disturbed the study area significantly and erosion following land clearance activities has resulted in substantial loss of topsoil throughout the area. Despite generally low conditions of archaeological visibility along the survey transects, the level of survey coverage enabled an effective assessment of the identified and potential archaeological resources to be made.

Assessment of the significance of the identified sites is constrained by the limited information currently available about their extent, nature of contents, sub-surface deposits and level of integrity. Worimi Local Aboriginal Land Council has identified Aboriginal cultural heritage values within the project area.

Based on the assessment of the archaeological material found in the study area, measures should be implemented for an archaeological salvage program to recover material and information for future research.

Discussions regarding Aboriginal cultural assessment were undertaken by the archaeologist, heritage consultant and the representatives of Worimi Local Aboriginal Land Council. As a result of these discussions, the Worimi LALC expressed the view that the study area is significant. The Worimi Local Aboriginal Land Council has advised that there are constraints on the basis of Aboriginal cultural issues to the proposed development application for Lot 161 DP 774440 & Lot 1 DP 1003492, Lot 1 DP 597372 & Lot 513 DP 585256 Tomago Road, Tomago.

Based on the comprehensive investigation and analysis of both the Aboriginal cultural heritage values of the study area, and consultation with the local Aboriginal community, this report has concluded that the area is considered to be archaeologically or culturally sensitive and therefore to determine the suitability of the site for development further investigation is required below the surface and it will be necessary to obtain a Section 87 Permit in this regard.

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1.0 INTRODUCATION

Background

Asquith and de Witt, on behalf of Redlake Enterprises Pty Ltd (Redlake), commissioned Indigenous Outcomes to conduct an Aboriginal archaeological assessment of an area of land at Tomago Road, Tomago. The archaeological study was designed to identify the potential impacts of the development on Aboriginal objects ('objects' as defined by the New South Wales National Parks and Wildlife Act 1994). This report provides the information necessary to satisfy the requirements of the local Aboriginal community and DEC (NPWS) in relation to the management of cultural heritage values at Tomago.

This report documents the Aboriginal cultural heritage values of the proposed industrial development and presents the methodology used in the assessment of the survey area. The report assesses the implications of the Indigenous Outcomes investigation for the identification and management of Aboriginal cultural heritage within the current site. The subject land is located east of the township of Raymond Terrace and is approached right from the New England Highway.

A surface archaeological survey was conducted in consultation with the Worimi LALC. Evidence of Aboriginal cultural heritage material was identified and although there were no knowledge of areas of cultural significance within the subject area the land council representatives requested further investigation of the area.

The management recommendations have been developed in consultation with the Worimi Local Aboriginal Land Council (WLALC) within whose area the proposed development is located, and background information was gathered from previous reports prior to any investigations being undertaken at the site.

The field component of the study was conducted from Friday 24th February and Wednesday 1st March, 2006 by:

Donna McKay, archaeologist,

Tracey Skene, Heritage Consultant

Jamie Merrick and Brendan Lilley, Aboriginal Sites Officers, Worimi Local Aboriginal Land Council.

A statement from the Worimi LALC is included as Appendix 1

This report and study has been prepared at the request of Asquith & deWitt Pty Ltd, to assess possible impact of a proposed Industrial Development on Aboriginal Cultural Heritage on land at Tomago (study area).

Map 1 shows the regional location of the study area.

1.1 Project Scope and Objectives

The objectives of this report are to describe the Aboriginal archaeological survey and heritage assessment of the survey area and to record any archaeological objects and

sites that might be present. Further, the report documents the participation of Aboriginal representatives in the field survey area. Finally, the report includes a statement as to the recommendations for the future development of the survey area according to the directives outlined below.

The study was commissioned to:

- determine whether any Aboriginal archaeological sites or objects were present in the study area likely to constrain development
- assess the significance of such sites
- evaluate potential impacts of likely development on any such sites or significance
- provide management recommendations to mitigate potential impacts

The objectives are:

- To identify and map areas of Aboriginal Archaeological potential and sensitivity, for archaeological values

- Identify Aboriginal conservation/management options for the study area, taking into account the local and regional context.

- The tasks are defined as:

- Consultation with the Aboriginal community

- Refinement of predictive models of Aboriginal use of the landscape and the distribution of evidence

- Definition and matching of land surface disturbance in terms of its potential for revealing or concealing archaeological material

- To identify and map any areas of cultural significance

The study will take a landscaped approach to determine any potential Aboriginal archaeological evidence. This will require the identification of the range of landscape units, which are likely to contain Aboriginal archaeological evidence, rather than only attempting to identify individual sites across the study area. This will ensure that their landscape context is assessed for significance. The landscape approach as well as previous archaeological work in the area will determine a predictive model of Aboriginal occupation of the study area.

1.2 Aboriginal Consultation

The *NPWS Aboriginal Cultural Heritage Guidelines (1997)* outline three principles behind the collaborative approach to Aboriginal heritage survey and site management required by the Service. These principles are that Aboriginal culture is a living culture, which the Aboriginal communities are the rightful owner's of cultural heritage information and that DEC decision making on Aboriginal heritage issues is transparent. Indigenous Outcomes supports the principles underlying the DEC

approach and aims to involve the relevant Aboriginal community/communities in all its heritage assessments. This study's aims are:

- To initiate consultation with all Aboriginal stakeholders prior to the survey, to identify any areas of special significance to the Aboriginal stakeholders;
- To incorporate into the heritage assessment processes, the views, concerns and recommendations provided by the Aboriginal Stakeholders;
- To undertake a general literature review;
- To arrange for representatives of the all the known Aboriginal stakeholders to participate in the fieldwork to ensure Aboriginal community representation in discussions relating to the significance, protection and management of all objects identified in the archaeological survey;
- To assess the significance of Aboriginal culture and heritage sites recorded.

The study area lies in the area of interest of the Worimi Local Aboriginal Land Council. Representatives from the Worimi Local Aboriginal Land Council were involved throughout the archaeological survey and assessment. All correspondence from Worimi Local Aboriginal Land Council (WLALC) is included in Appendices 1.

Under section 90 of the NPW Act (2001), developers and consent authorities need to undertake due diligence when they assess the impacts of a development proposal on Aboriginal heritage. The NPWS has developed draft Aboriginal Heritage Impact Assessment Guidelines to consider the full range of Aboriginal heritage values, rather than focusing only on pre-contact archaeological sites and objects. This is a response to emerging landscape-based understandings of Aboriginal heritage, and requires formal Aboriginal involvement as well as consultation in the assessment process.

The NPWS acknowledges that it is primarily Aboriginal people who should determine the significance of their heritage. The DEC recognises that Aboriginal heritage includes traditional, historical and contemporary associations of Aboriginal people with the environment as well as physical items within the environment. In assessment processes, the NPWS requires the applicant to demonstrate that Aboriginal people have been involved (or have had reasonable opportunity to be involved) in the identification, assessment and management decisions relating to their heritage.

This study aims to integrate archaeological and Aboriginal significance and management recommendations for sites, features or the landscape.

Indigenous Outcomes advertised in the Port Stephens Examiner Classified on the 13th January, 2006 the intention to survey the subject area for possible Aboriginal Heritage. Representatives of the Worimi Local Aboriginal Land Council were contacted to comment on the project. Val Merrick (Acting Co-ordinator) of the *Worimi Local Aboriginal Land Council* (WLALC) responded to provide advice and information on cultural heritage issues of Aboriginal stakeholders in the local area. Worimi LALC was selected to carry out the heritage survey for the present study a map and outline of the study was presented to them before the survey was completed. Val Merritt of the *Worimi Local Aboriginal Land Council* (WLALC) was contracted to provide representatives to be present during the survey. Arrangements were made for the

representatives of the Worimi LALC to participate in the field survey for the assessment.

The Worimi LALC representatives were involved in all aspects of the fieldwork for this project. The Land Council has also had an opportunity to review the draft report of the project and to discuss the recommendations with Indigenous Outcomes. The Land Council's formal response to the investigation process and management recommendations is presented in *Appendix 1*.

1.3 Overview of Assessment Process

The assessment process of the project area incorporated:

- A search of the DEC Aboriginal Heritage Information Management System (AHIMS) Site Register for known sites in the project area or in the vicinity of the project area;
- A Native Title search to identify any Native Title claimants;
- An assessment of the topography and physical environment of the subject area;
- An analysis and assessment of the data obtained from the above research;
- A systematic survey of the subject area;
- A significance assessment of the subject area;
- A consideration of appropriate management options within the subject area; and
- The formulation of management recommendations.

The DEC AHIMS site search provided information of previous archaeological survey reports undertaken in the vicinity of the subject area. Although sites registered with DEC have been located through a number of means, the majority have been recorded through commercial archaeological surveys. The site cards and reports from DEC provide the primary source of information on the characteristics of archaeological sites.

1.4 Personnel

The archaeological field survey was undertaken on Monday, 24th February and 3rd March 2006 by Donna McKay and Tracey Skene (Archaeologists and Aboriginal Cultural Heritage Officer, Indigenous Outcomes Pty Limited) in the company of;

- Jamie Merrick and Brendan Lilley representatives of the Worimi Local Aboriginal Land Council;

2.0 THE PROPOSAL AND THE NATURE OF ITS IMPACT

This section provides details of the location of the study area, outlines the proposed development and discusses the potential impact the proposal has on cultural heritage sites within the study area.

2.1 Location

The subject land is located approximately 6 klm south of the township of Raymond Terrace and 8 klm west of Williamstown along the Tomago Road, Tomago.

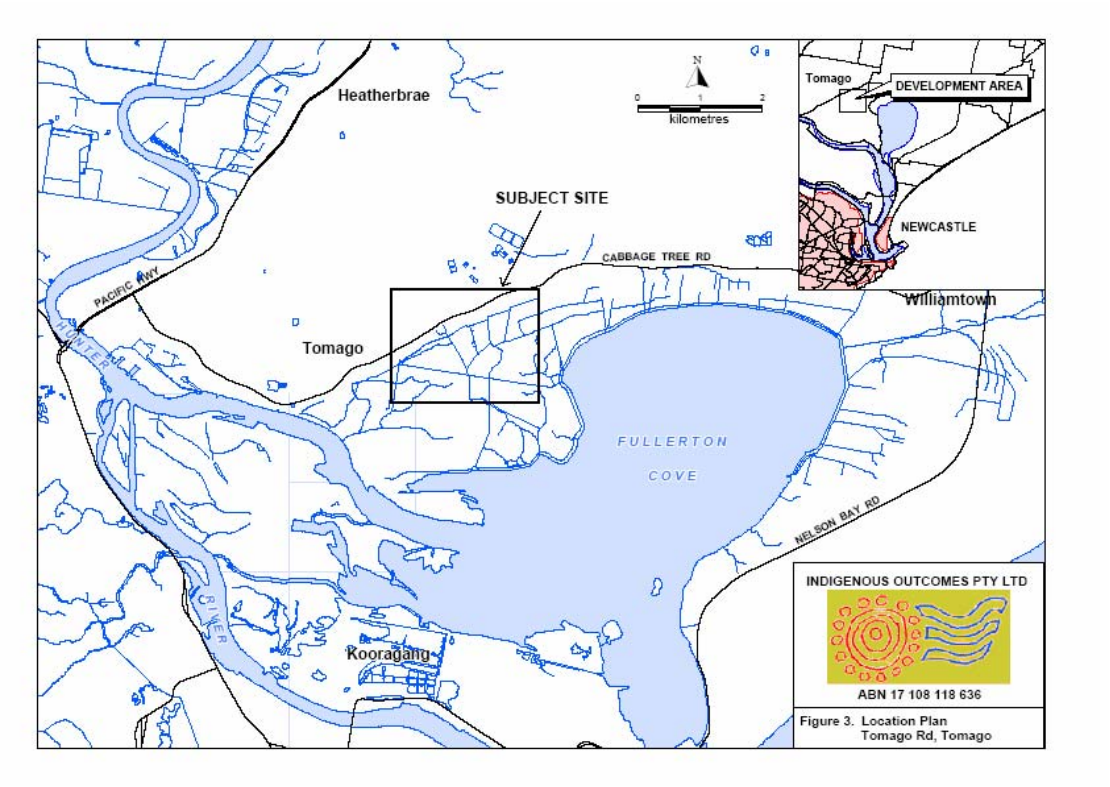
The property description is Lot 161 DP 774440 & Lot 1 DP 1003492, Lot 1 DP 597372 & Lot 513 DP 585256 Tomago Road, Tomago.

The overall site has an area of about 114.85 ha. The area has been proposed or an industrial development.

The proposal is to redevelop the entire area of the study land. The proposal will include the following:

- Drainage Easements
- Access Roads
- (2)50,000 square metres Ware houses
- Car Parks
- Administration Buildings
- Offices
- Part Ware house
- Work shops
- Specialization Work shops
- Service Building
- Wash Pad area
- Filling of the site

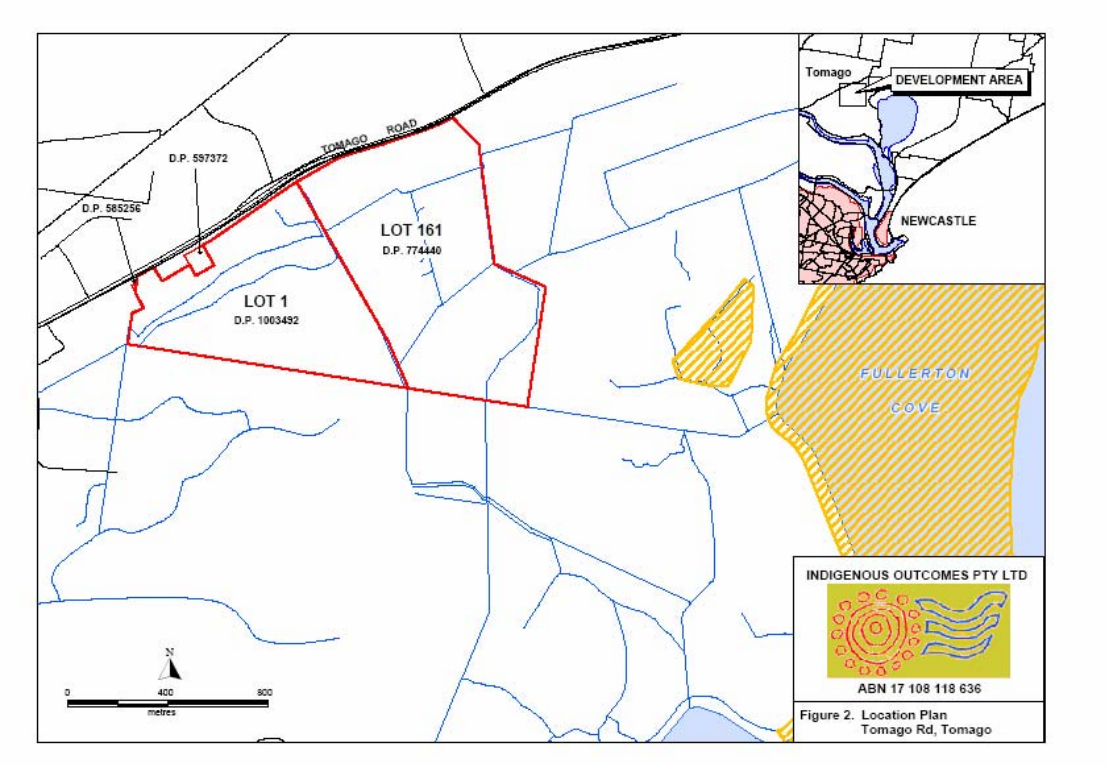
The study has been carried out in accordance with the statutory protection afforded Aboriginal sites and objects by the *Environmental Planning and Assessment Act* (1979) and the *National Parks and Wildlife Act* (1974).



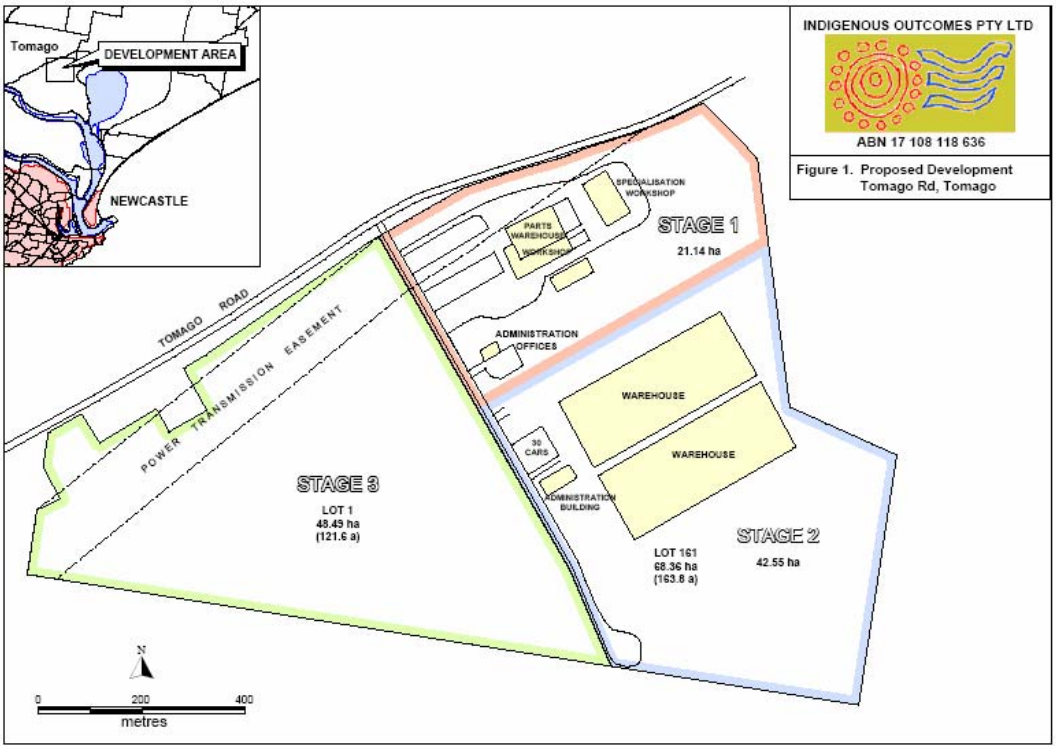
Map 1 Regional Location Plan

Topographical maps reference: Beresfield 9232-3N & Williamstown 9232-2N

The land is identified as being of a rural zone and comprises four lots varying in size with a total site are of around 115 Hectares. The area is made up of a three stage proposal.



Map 2 Location Area



Map 3 Proposed Developments, Tomago

2.2 Possible Impact of Development

The proposed development at the Tomago site would destroy archaeological material from an extensive area and finds known to occur on all land units. The sites and finds which would probably be affected have already been substantially disturbed by previous land uses.

The impacts of the development may be manifest by ground disturbance immediate to the sand dunes that run west to east through the study area.

The known distribution of archaeological material in the project area is interpreted as variation in past Aboriginal use of the landscape, rather than environmental determinism. The sites and finds have the potential to provide information on past Aboriginal use of the landscape.

It is considered that more sites and finds are likely to be present in the project area, hidden by thick grass and buried in uneroded soils. However, the surface survey within the area of proposed impact has provided a good indication of the nature and range of archaeological material. Test excavation for EIS is necessary.

In summary, destruction of the Aboriginal sites and finds is not desirable, but most are of sufficient archaeological significance as to prevent the proposed development from proceeding.

3.0 Environmental Context

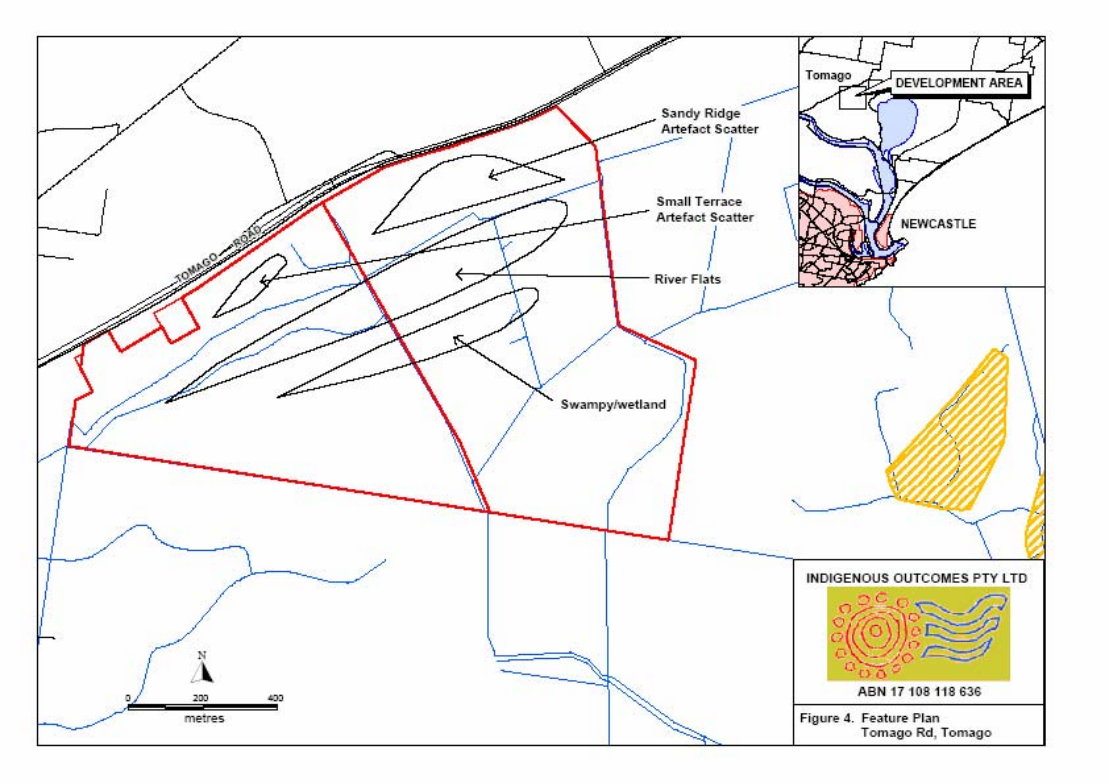
3.1 Topography

The study area is within the Duck Hole land system as defined in Storey et al (1963) and is situated on the Tomago Coastal Plain. The principal topographic feature is a dune field of Pleistocene origin, which contained a mixture of dunes and swamps, or wetlands between the dunes (see Thom et al 1992) the dunes apparently formed a part of dune barrier during the late Pleistocene blocking off existing valleys. Towards the end of the Pleistocene (c10, 000) these dunes were extensively reworked by wind and an outer dune barrier was formed as it is apparent that the precise sequence and geomorphic features are likely to be specific to a particular area. This section of the report presents information about the physical environment of the survey area, focusing on the aspects, which may have had implications for the use of the area by Aboriginal people. (Stuart, 2000)

The original vegetation would have been a mixture of wet and dry health depending on the drainage on the dunes. The wet heath would have been dominated by Angophora's, Swamp gums and various Paperbarks and a variety of healthy understorey plants while the dry health would have been had low forms of Bloodwoods and Banksias with a bracken understorey. In the areas along Windeyer's Creek the vegetation would have been a mixture of She oak and Paperbark (Matthei 1995). Matthei comments that the dune's suitability for plant growth is poor due to infertile, rapidly permeable soils of low water.

Apart form the areas to the south of study area the rest of the study area was cleared with little original vegetation remaining.

The study area consists of a flood plain with sandy Ridges and small built up Terraces



Map 4 Feature Plan of Survey areas

The main watercourse on the study area is the Hunter River, the project area lies on the Flood Plain of this River surrounded by many swampy/wet lands.

3.2 Geology and Soils

The Lower Hunter River delta is located within a bedrock paleo-valley, which has undergone numerous alternate phases of sedimentation and erosion, and comprises floodplain alluvium and channel sands overlying estuarine muds (Roy, 1993). Alone the coast, extensively reworked Holocene and Pleistocene marine sand deposits stretch from the Newcastle area to Port Stephens. (Thom et al, 1992).

Broadly, the study area is located within the *Tomago Coastal Plain* physiographic region, one of the ten regions identified in the greater Newcastle area (Matthie, 1995:2). Refer to Figure 3.2. The *Tomago Coastal Plain* comprises the northern Newcastle region and accommodates the flood plains of the Lower Williams, Patterson and Hunter Rivers. The region extends from Raymond Terrace and Port Stephens to the north to Newcastle Harbour in the south, and west to Maitland. Dominant soil landscapes of the *Tomago Coastal Plain* region include:

- Hunter
- Millers Forest
- Hexham Swamp
- Bob's Farm
- Fullerton Cove
- Hamilton
- Wallis Creek
- Rivermead

To the south of this region, lay the Lower Hunter Plain dominated by rolling hills. The Tomago Coastal Plain region features quaternary sediments including marine and aeolien sand, silt and clay deposits.

3.3 Vegetation

The land of the Lower Hunter/Tomago area has been largely cleared of vegetation. Remnant patches of native vegetation retained in uncleared areas (including parks and reserves), on the coast and along creeks and the river, indicate the following:

Floodplain

- On the quaternary alluvium of the Tomago floodplain where there is saline influence, Swamp Oak (*Eucalyptus glauca*) is the dominant species.

- On alluvium closest to the coast, Swamp Mahogany (*Eucalyptus robusta*), Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Cabbage Tree Palm (*Livistonia australis*) occur.

Creeklines

- Alluvial bands along streams occasionally support closed-forest remnants including Flooded Gum (*Eucalyptus grandis*) and Weeping Lilypilly (*Waterhousia floribunda*).

Inter-tidal Zones

- In estuarine sediment in areas of frequent tidal inundation, Grey and River Mangroves (*Avicennia marina* and *Aegiceras corniculatum*) occur. Salt marshes featuring Sea Rush (*Juncus kruasii*), Coastal Club-rush (*Bolboscoenus caldwellii*) and Glasswork (*Sarcocornia quinqueflora*) occur in areas of occasional inundation.

Beaches & Dunes

- Beaches are generally devoid of vegetation, however in protected areas, Coastal Tea-tree (*Leptospermum laevigatum*), coastal Banksia (*Banksia integrifolia*), and Sydney Golden Wattle (*Arcacia longifolia sophorae*) occur in association with Bracken (*Pteridium esculentum*) and Blady Grass (*Imperata cylindrica*).

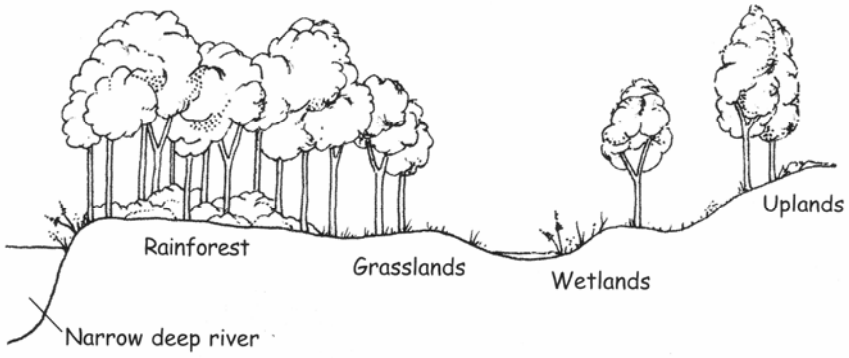
- On dunes and low beach ridges occasional open-forest dominated by Blackbutt (*Eucalyptus Pilularis*), Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Eucalyptus gummifera*) and Old Man Banksia (*Banksia serrata*) occurs in association with a tall shrub understorey.

- A wet heath occurs in poorly drained areas and includes Grass Tree (*Xanthorrhoea fulva*), Red Bottlebrush (*Callistemon citrinus*) and Yellow Tea Tree (*Leptospermum polygalifolium*) (Matthie, 1995:5-7)

4.0 ARCHAEOLOGICAL CONTEXT

This section of the report presents the known archaeological context of the project area.

Map 5 landscape of the Hunter River at European settlement



Pre-European Hunter River

The land closest to the river was covered with a thick rainforest and in some places this went back a long way before merging into open grasslands and wetlands. The land then went into uplands which were covered with a eucalypt forest and grassland.

4.1 Ethnohistory

Tindale (1974) compiled an assessment of Aboriginal clan territories in Australia. The project area lies within the territory of the Worimi people, Tindale (1974) describes the territory as extending north of the Hunter River from Maitland and Newcastle with Awabakal in the south. To the north of the Worimi, lay the tribal territory of the Biripai. The Wonnarua people are said to occupy an extensive territory from west of Maitland to the Dividing Range.

The Aboriginal history of the Tomago area is remembered by the people, recorded in historical documents, and imprinted on the land. Physical evidence of the Aboriginal occupation and use of the area is found both in and around Tomago and has been recorded during amateur collection and through systematic survey and archaeological excavation. Much of the information about Aboriginal cultural heritage in the area has resulted from consultancy work associated with the preparation of Environmental Impact Statements (EISs), and from the results of personal research, such as that undertaken by Len Dyall in the 1960's and 1970's

Most of the archaeological sites that have been subject to direct dating are of Holocene age (The Holocene equates to the last 10 000 years of geological time), with the exception of the Moffatt Swamp site at Medowie, which has been dated to the Pleistocene epoch (The Pleistocene epoch dates to between c1.8million years ago and 10 000 years ago).

Aboriginal site types recorded in the greater area include:

- Lithic scatters (open sites)
- Shell middens
- Hatchet-head grinding grooves'
- Stone procurement places (quarries)
- Rock shelters with cultural deposits
- Ceremonial & mythological sites

- Scarred trees
- Burials

- Post-contact campsites
- Aboriginal pathways

(Griffin NRM, 2002)

Researchers have suggested that is likely that other Pleistocene archaeological sites do, or did, exist in the greater Newcastle area. These sites would have been created when sea level was lower than it is today (c25 000 – 12 000 years ago) and are likely have been inundated or buried during the marine transgression that followed the last Ice Age. (Griffin NRM, 2002)

4.2 Recent land Use

Non-Aboriginal land-use practices have affected the study area to varying extents. Timber has been selectively removed and is mostly cleared and replaced with pasture grasses. Evidence for agricultural practices is evident in some sections of the property, although some tilling of the soil may have been involved in establishing the pasture grasses. Cattle have been grazed on at least the pastures and probably within the natural forested areas, during historical times.

A number of fence lines and a series of vehicle tracks, traverse the study area. Several minor clearings or areas of ground disturbance exist. Household refuse have been deposited at various locations around the study area.

4.3 The Archaeological Record

The review of the previous archaeological research relevant to the project area was directed at determining:

- Site types previously recorded in the region or within the project area;
- The archaeological sensitivity of the landforms in the project area: and
- The characteristics of sites likely to be located during field survey of the project area (location, size, contents).

Information to address these issues was derived from:

- A search of the Department of Environment and Conservation, Aboriginal Heritage Information Management Service (DEC AHIMS) Aboriginal Site Register;
- An evaluation of the DEC/NPWS Site Cards; and
- A review of the relevant archaeological literature.

4.3.1 Definition of Site Types

A site is defined for this study as an area where *evidence* of traditional Aboriginal occupation occurs in the landscape. The results of the previous archaeological survey in the study area and surrounding areas indicated that the following site types have been previously reported in the Tomago area.

- Artefact scatters, ranging from isolated artefacts to concentrations of hundreds of flaked stone artefacts;
- Estuarine shell middens (eg containing remains of *Anadara, Ostrea, Pyrazus*), some of which also contain flaked and/or ground stone implements;
- Coastal shell middens (principally pipi, but also containing rock platforms species), some of which also contain flaked and/or ground stone implements;
- Scarred trees;
- Grinding grooves, in sets ranging from two to forty grooves;
- Ceremonial sites such as bora grounds and other stone arrangements; and
- Burials.

In addition to these physical site types, previous studies demonstrated that numerous landscape features are associated with stories about the past, both historical and mythological. In these cases, there may be no physical evidence of past Aboriginal activities, but there is a high community value associated with these places.

Each of the site types occurs within a landscape context that can be defined in terms of the resources potentially available to Aboriginal people in their daily lives. These 'resources' include plants that are known ethnographically to have been used in the project area as foods, medicines or as raw materials for making implements , animals with similar purposes, fresh water supply, outlooks, easy pathways for traversing from one area to another etc. These landscape resources, in combination with the distribution of physical evidence of past occupation, make up a series of 'cultural landscapes' in the project area.

The locations of all sites and places and cultural resources are valued by the local Aboriginal community as part of their link to their heritage. Many families also still visit places and engage in activities (such as fishing and shellfish gathering) that have continuity with the past. In this way, the values of traditional resources are transferred to the contemporary Aboriginal community.

Other site types which are found in Australia and could occur in the study area are listed in Table 5.

Table 1
Australian Aboriginal Archaeology Site Types

Site Types Defined
Isolated Find/Artefact Where a stone artefact is found in an area with a radius of approximately 100 metres with no other artefacts it is classified as and 'isolated find' or 'isolated artefact'.
Artefact Scatter or Open Camp Site Artefact shatter/open campsite refers to areas in the open landscape (not rockshelters or caves), that contain two or more stone artefacts generally located within 50 metres of each other

Grinding Grooves Grinding grooves are grooves on rock surfaces created by sharpening stone axe heads, stone chisels or fire hardened wooden spear points. Grinding grooves are commonly located on sandstone ledges that outcrop in creek and river beds, as water enhances the speed of the grinding process. Less commonly, grinding grooves are located on rock surfaces away from water and on stone types other than sandstone.
Stone Quarries Stone quarries are places where raw material was sourced to manufacture tools. Quarries may be cobble beds in rivers or on beaches, or they may be rock outcrops. When outcrops are exploited the quarrying technique may be the flaking of rock from the outcrop itself, or scree from below the outcrop may be used instead. In some areas the stone may be dug from beneath the earth as Aboriginal stone knappers often preferred rock which had not been dried out by exposure to the elements (Tindale 1965: Jones and White 1988)
Ceremonial Grounds In the Hunter region the main type of ceremonial ground recorded was the Bora. Bora grounds generally consisted of two earthen rings or two rings outlined with stones.
Scarred and Carved Trees Aboriginal people often removed bark from some tree trunks for toe holds (to aid in climbing to extract hone or possums from tree hollows), bowls, shields, spear throwers, coolamons, and canoes and/or for roofing material for shelters. Bark removal leaves scars on the tree trunk which indicates the Aboriginal use of an area. Other trees were carved with designs which are used to mar ceremonial grounds and burials (Etheridge 1918;McBryde 1974)
Rock Art Site 'Rock art site' generally refers to Aboriginal ochre/charcoal paintings or drawings located on a rock slab, boulder, cliff-face, wall or roof of a cave or rockshelter, or on a rock overhang. The majority of rock art sites that survive today are found in positions sheltered from the elements.
Engraving Site 'Engraving site' refers to places where Aboriginal people have incised (using pecking or abrasion technique) forms of motifs on a rock slab, boulder, cliff-face, wall or roof of a cave or rockshelter, or on a rock overhang. Engraving sites are not necessarily located in sheltered positions, but are most often located on softer rock types (like sandstone).
Rockshelter Sites 'Rockshelter site' refers to rockshelter/rock overhangs which contain evidence of human occupation, such as stone artefacts and/or bones and/or plant remains (from meals eaten at the site) and/or hearths (fireplaces)
Stone Arrangements Stone arrangements may be single or multiple cairns, upright standing stones, lines or rings of stones or even stones arranged into figurative designs such as snakes or turtles. The location of many recorded stone arrangements suggest they were related to ceremonial grounds and in particular initiation grounds (McBryde 1974), while others appear to mark tribal boundaries (Leney 1907)
Shell Middens Middens are accumulations of shells discarded after human (Aboriginal) consumption. Midden sites are commonly located along the coast and estuaries and less often located in inland areas in association with waterways and lakes. Middens sometimes contain burials.

4.3.2 DEC Aboriginal Sites Register Search

A search was undertaken of the DEC AHIMS site Register indicating that several of the site types listed in Table 4 has been recorded within a 5 kilometre radius of the centre of the study area. The literature search provided information of previous archaeological survey reports undertaken in the vicinity of the project area. Although sites registered with DEC have been located through a number of means, the

majority have been recorded through commercial archaeological surveys. The site cards and reports from DEC provide the primary source of information on the characteristics of archaeological sites.

The results of the register search cannot be regarded as being a representative sample of the total archaeological resource (identified and unidentified sites) present, because only recorded sites are listed on the register, survey biases exist in previous investigations (e.g. confined to small areas of proposed developments), biases exist towards discovery of obtrusive site types which can be recorded by untrained observers, and recent land uses may have obliterated a greater proportion of one site type over another.

Table 2 – Site Type Frequency

Site Type	**Frequency (n)**
Open camp site	13
Midden	1
Axe-grinding	0
Shelter with art and / deposit	0
Waterhole/well	1*
Total	**15**

*NB. The waterhole is located in an area approximately 9 klms north-east of the study area.

From the results of the site search it is possible to see that:

- The most frequently recorded site type is the open campsites (13).

4.3.3 Previous Archaeological Investigations

The NPWS Register (AHIMS) of Aboriginal sites contain records of a variety of types of Aboriginal cultural heritage material, and virtually all of these have been identified in the lower Hunter Valley. However, there is no information regarding the study area in the AHIMS register.

Archaeological material was identified during the survey and it was concluded that there is likelihood of more material being present. Sites found in the study area have been identified as either a quarry site or camp site, with evidence of large artefacts and shell material in all of the sites. It was concluded that the area was suitable for long-term campsites. However, there was no evidence of bark removal or carving on trees, which could be related to the activities of Aboriginal people.

An overview of pertinent studies that may have a connection with the current study area is contained in the Thornton Master Plan, of Maitland City Council undertaken to identify issues that require consideration in the context of development planning. Part of that Masterplan included a desktop survey of Aboriginal Heritage potential. Angela Besant, a noted archaeologist, undertook the desktop survey of the area and concluded that all types of landscapes adjacent to wetlands ought to be considered as having potential for archaeological significance. Her work was well researched and gave a definitive overview of probable Aboriginal occupation of the area.

Near Maitland several studies in close proximity to the Hunter River have identified artefact scatter sites.

Brayshaw (1984b) surveyed a 120ha property adjacent to the Hunter River at Bolwarra Heights, three kilometres north of Maitland. The property comprises undulating terrain (Primarily simple slopes) covered by pasture grass. One artefact scatter containing 40 artefacts was recorded. Brayshaw (1995) resurveyed an 86ha part of the property in 1995. Conditions of surface visibility were higher and two new artefact scatters were recorded. Recommendations were presented for sub-surface testing which has subsequently been undertaken by Baker (1996), confirming that sources of the raw material silcrete were present within the property.

Ruig (1995) surveyed 10.54 ha for the proposed Tenambit Wetlands Project. The property comprises Crown Reserve R89147, County of Northumberland, off Metford Road north of Metford. Most of the area comprises swampland or floodplain of low elevation. Surface visibility was extremely low. Three isolated artefacts were located (two "mudstone" flakes and one silcrete flake). Considering the conditions of low visibility and high potential for further sites, a programme of sub-surface testing was recommended.

Kuskie (1994a) surveyed Lot 1 DP 559519, Thornton, for a proposed residential development. The 228 ha property is located adjacent to the Thornton urban area, although 85 ha of State Environmental Planning Policy 14 (SEPP 14) Wetland No. 828 was excluded from the assessment. Lot 1 consists of two broad low ridge spurs descending to the adjacent wetlands of Woodberry Swamp. Gradients of the ridge side- slopes and basal slopes are generally low (less than five degrees), except in the vicinity of several gullies. Several minor watercourses and gullies drain into adjacent Woodberry Swamp. Landscape units present include low, broad ridge spurs, simple slopes, basal slopes, alluvial flats and wetlands. The underlying geology of the elevated landscape units consists of siltstone, sandstone and conglomerate of the Permian Mulbring Siltstone Formation. Lot 1 was used for pastoral purposes and therefore dominated by a dense cover of grass. Despite conditions of low surface visibility, nine artefact scatters and one isolated artefact were located.

Kuskie (1994b: 1) undertook the sub-surface investigations recommended for Lot 1 DP 559519, at Thornton, "in order to adequately assess the extent of the sites previously recorded by him to determine whether the recorded sites contained sub-surface deposits of artefacts to adequately assess the significance of each site and to effectively assess the majority of the study area in which low surface visibility had restricted the effectiveness of the initial survey."

A trend was identified for artefact density on the simple slopes and basal slopes to be greater than on the ridge crests. It was also demonstrated that higher artefact densities tended to occur closer to the wetlands. … This supports predictions that the wetlands were a major focus of activity in the locality and that more abundant evidence for occupation and land use is likely to be located around the margins of the wetlands. Comparisons of artefact density with elevation were also undertaken, because it may provide indirect evidence of the relationship between intensity of land use and the wetlands (which are at the lowest elevation). While the study area is all lower than 25m a.s.1. The ridges tend to have the highest elevations, while the simple slopes and basal slopes around the margins of the wetlands are lower. There is a tentative trend towards increased artefact density at lower elevations (Kuskie 1994b).

4.4 Predictive Model

A predictive model of site location is constructed to identify areas of high archaeological potential (i.e. locations where there is a high probability of an archaeological site occurring), so it can be used as a basis for the planning and management of Aboriginal sites. Predictive modelling involves reviewing existing literature to determine basic patterns of site distribution. These patterns are then modified according to the specific environment of the study area to form a predictive model of site location. A sampling strategy is employed to test the predictive model and the results of the survey used to confirm, refute or modify aspects of the model.

The use of land systems and environmental factors in predictive modelling is based upon the assumption they provided distinctive sets of constraints which influenced Aboriginal land use patterns. Following from this is the exception that land use patterns may differ between each zone, because of differing environmental constraints, and that this may result in the physical manifestation of different spatial distributions and forms of archaeological remains (Hall & Lomas 1993:26)

The predictive model is based on information from the sources discussed in preceding sections:

- Identification of land systems and landform units;
- Previous archaeological surveys conducted with the region;
- Distribution of recorded sites and known site density;
- Traditional Aboriginal land use patterns; and
- Known importance of any parts of the study area to the local Aboriginal community.

In certain circumstances, such as where low surface visibility or recent sediment deposition precludes effective assessment of the potential archaeological resource, sub-surface testing may be a viable alternative for further testing the predictive model and assessing the study area.

The study area is located within the Tomago area and is comprised of the following landform units; simple slopes, gullies, drainage depressions and swamp.

The following site location predictions are made for the study area:

Stream Channel/Banks

Open campsites and isolated stone artefacts are the most likely form of archaeological evidence close to drainage lines throughout the study area where there is potential for sub-surface archaeological material to be preserved.

Mid slopes

Mid-slopes are unlikely to contain outcropping sandstone suitable for rockshelter formation and open campsites are unlikely to occur.

Although the presence of scarred/carved trees is possible, the history of logging in this area mean trees of sufficient age are relatively rare and thus scarred/carved trees are unlikely.

5.0 THE SURVEY

5.1 Field Survey

Various models have been proposed by archaeologists to explain Aboriginal occupation and use of the landscape environments in NSW.

Present archaeological evidence indicates that Aboriginal archaeological sites are most likely to occur along coastal and estuarine precincts. Sites within the hinterland are less common and generally less intensive.

The predictive or contextual model for the archaeological assessment of the site forms the basis for developing a picture of Aboriginal occupation. The predictive model takes into account the landform, geology, vegetation, previous archaeological data as well as the historical context of the area.

The assessment of the data enables a prediction of what form of Aboriginal occupation was likely to have existed on the study area and would show the potential for finding Aboriginal Sites. A field survey is then able to evaluate the prediction and to extrapolate reasons as to why the survey did or did not match the prediction.

The study methodology was based on data research, field survey of the site and report compilation.

Data research included:

- maps and plans
- previous archaeological reports in the area and region
- historic and scientific literature
- NPWS Aboriginal sites data register
- consultation with Aboriginal community and other local people
- consultation with government officers

The Survey included

- design of survey strategy and prediction based on archaeological and landscape context
- field inspection of study site
- assessment of findings and potential impact

Before the commencement of the fieldwork an archival search of the DEC AHIMS site data base was performed relative to land within a five kilometre radius of the study area. The Worimi Local Aboriginal Land Council was also consulted to comment on the cultural heritage history of the subject area.

No sites were recorded on the AHIMS database and there is no known cultural history of the study area.

Fieldwork for the current study was designed to investigate and provide an up to date assessment and definition of areas. An archaeological survey of the study areas was conducted on foot, including the inspection of all tracks where vegetation allowed. Poor ground surface visibility in 80% of the study area meant that only a sample of the area was examined, however it was considered a fairly even coverage of all landform elements was undertaken.

Aboriginal cultural heritage sites/ archaeological sites were located during the survey as were artefact scatters (such as flaked stones), no tree markings, or markings on rock ledges observed.

The objective of the survey was to gain a comprehensive coverage of each landform unity that exists in the study area. The following questions were addressed during the surveys:

- Whether mature trees were present, and if so, whether they bore markings to indicate Aboriginal activity;
- Whether sandstone formations were present, and if so, whether they bore marking to indicate Aboriginal activity;
- Whether ground surface exposures existed, and if so, whether they contained artifactual evidence indicating Aboriginal activity; and
- Whether any other features existed this would be significant from an archaeological perspective.

Data recorded for each land unit included the type of ground surface exposures present, exposure dimensions, visibility within the exposure and factors which inhibit visibility (e.g. grass cover, leaf litter).

5.2 Survey Methodology

The survey was undertaken on the February 24th to March 1st, 2006.

Participants included:

Donna McKay and Tracey Skene (Archaeologists and Aboriginal Cultural Heritage Advisor, Indigenous Outcomes Pty Ltd) in the company of;

- Jamie Merrick and Brendan Lilley, Aboriginal Sites Officers, Worimi Local Aboriginal Land Council;

Fieldwork for the current study was designed to investigate and provide an up to date assessment and definition of areas. An archaeological survey of the study areas was conducted on foot, including the inspection of all tracks where vegetation allowed. Surface visibility ranged up to 20% within the study area, but was typically low due to the dense cover of grass. Archaeological visibility, the actual visible ground surface with potential for heritage evidence (accounts for factors such as ground disturbance and sediment deposition), was typically much lower. The extent of topsoil removal

associated with previous agriculture practises and residential use is the primary contributing factor. Grass and vegetation cover typically limited surface visibility across the study area, both within and outside the areas directly sampled. Almost all exposure relates to areas of vehicle and pedestrian tracks and in areas affected by erosion.

No mature trees were identified within the study area. No silcrete cobbles or tuff outcrops were identified within the study area. There was no evidence of sandstone and sedimentary bedrock outcrops within the study area.

Coverage Data
A summary of the effective survey coverage follows.

Survey unit	**Topography**	***Surface slopes***	**Visibility**	***Area available for detection***	**Finds**
Upper Slope Unit 1	Well grassed, with patchy exposures on the upper slopes. Contained old remnants of dwellings, bottle and ceramic dump. Old Fig trees, Gentle South slope. (Sandy Ridge and Small Terrace.)	<5%	Fair	100%	yes
River Flats Unit 2	Well grassed, impact from vehicle tracks, cattle's , some scattered trees(Casuarina's, Pine's)	<5%	poor	100%	nil

Table 3 Effective Survey Coverage

Despite the generally low conditions of surface visibility, the level and nature of effective survey coverage is considered satisfactory enough to present an effective assessment of the Aboriginal heritage resources identified and potentially present within the study area. The survey coverage is estimated to have sampled many of the ground surface exposures within the study area, and therefore is also likely to have resulted in the recording of most locations with exposed heritage evidence. Hence, the survey provides a valid basis for determining the probable impacts of the proposal and formulating recommendations for the management of the identified and potential Aboriginal heritage resources.

6.0 RESULTS OF THE SURVEY

The Archaeological report has concluded that the development will impact on Aboriginal cultural heritage sites. Additionally, any undetected sites that occur within the study area of impact are likely to comprise either isolated artefacts or small scatters of flaked stone. These would be virtually impossible to locate by any standard survey or monitoring strategy.

The areas for the proposed industrial sites have been heavily impacted by past development practices. It is concluded that there has been considerable disturbance to the integrity of the site from previous land use activities. The Archaeological report has concluded that the development will impact on any Aboriginal cultural heritage sites. Although, there was thick vegetation and poor visibility throughout the study area sites were found along the eroded banks on the south section of the study area. There were seven sites found comprising of stone flakes, cores and backed blades found.

The Worimi LALC expressed the view that the entire study area is of Aboriginal significance. It has also been established that the study area has archaeological significance since there were seven sites where archeological material was found in the study area.

The following recommendations are based upon the legal requirements and automatic statutory protection provided under the terms of the *National parks and Wildlife Act* of 1994 (as amended), where:

> *It is an offence to knowingly damage, deface or destroy Aboriginal sites or relics without the prior consent of the Director General of the National Parks and Wildlife Services.*

In conjunction with the results of the archaeological investigations of the study site which are documented in this report and the views and concerns expressed by the Worimi LALC**:**

The study area is considered to be archaeologically or culturally sensitive therefore is unsuitable for development until cultural material has been removed from the study area.

6.1 Aboriginal Sites

The two day survey did locate seven Aboriginal sites in the study area. The survey area was found to be highly disturbed by activities associated with prior infrastructure, such as clearing of vegetation, dumping of domestic waste and rural development. Visibility in highly eroded areas was relatively high. An opportunity to identify sites in heavily revegetated areas, where some soil may remain, was restricted by poor visibility. For a site to be able to contribute to an understanding of cultural sequences, it must contain distinguishable features or aspects that can be shown to have been created at different times within the context of that site or between sites. For such relationship to be possible the artefacts or features within the sites need to be located within a stratified context. This is highly likely within the study area.

A site may also be able to contribute to our understanding of Aboriginal use of an area if the investigation of that site can add to the knowledge base in a more general sense. For this to be possible the site must contain a complex assemblage of artefacts (generally large numbers of artefacts and/or artefacts types). Prior archaeological research in the area suggests that such complex sites are likely in the study area.

The seven artefact scatters were located on a small terrace and sandy ridge, with one isolated find found in the north-east corner of Lot 161 DP 774440, these sites were found in an erosion scar on the mid slope although many of the erosion scars were separated by grass coverage it is evident that the area is one large site, possibly a midden site, all erosion scalds were < 50 metres apart, with only 20 % visibility in Lot 513 DP 585256 and Lot 1 DP 597372.

Table 4 Summary of Lithic Items recorded in study area.

Site	Raw material	Length	Width	Thickness	Descriptions
T1 Erosion scald measuring 15 metres x 10 metres on small sandy terrace in Lot 1 DP 1003492					Visibility 70% GPS 56 382833 E 63 67605 N
	White mudstone	4cm	4cm	1cm	Broken flake at proximal end Platform: faceted Comments: Weathered, broken right margin.
	Red silcrete	0.4cm	0.7cm	0.2cm	Broken flake proximal end Platform: plain
	Cream mudstone	4.5cm	5.3cm	1.3cm	Broken flake Comments: left lateral margin snap, 10% cortex
	Cream mudstone	2cm	3cm	0.8cm	Flake Platform: plain Comments: Use wear on the distal end
	Cream mudstone	3.4cm	2.3cm	0.5cm	Flake Platform: faceted
	Cream mudstone	2.2cm	2.3cm	0.7cm	Flakes piece
	Cream mudstone	1.5cm	1cm	0.2cm	Broken flake at proximal end Platform: plain
	Pink silcrete	1.7cm	1cm	1.5cm	
	Cream mudstone	0.6cm	0.9cm	0.1cm	Flake Platform: plain Comments: heat effected
	Cream mudstone	4.5cm	5.5cm	1.5cm	Flake proximal end Platform: plain Comments: weathered
	Orange silcrete	1.2cm	0.9cm	0.1cm	Flaked piece
	White mudstone	1.2cm	0.4cm	0.9cm	Flaked piece
	White mudstone	1.1cm	1.9cm	0.4cm	Flaked piece
	White mudstone	1.7cm	0.5cm	0.4cm	Flaked piece
	Cream mudstone	1.2cm	1.7cm	0.2cm	Flake
	Cream mudstone	2.5cm	1.2cm	0.5cm	Broken flake
	Cream mudstone	2.4cm	1.5cm	0.3cm	Flake Platform: plain
	Cream mudstone	6.5cm	3cm	2cm	Core – 14 scar flakes
	Cream mudstone	3.2cm	4.6cm	1.5cm	Flake Comments: Use wear on distal end
	Pink silcrete	4.3cm	4.2cm	2.4cm	Flake piece
	Cream mudstone	2.3cm	2.4cm	0.4cm	Flake Platform: plain
	Orange silcrete	3cm	1.3cm	0.2cm	Flaked piece
	Silcrete	2.4cm	4.1cm	0.5cm	Broken flake Platform: faceted
	Cream mudstone	5.7cm	4.2cm	1.2cm	Flakes piece
	Cream mudstone	3.9cm	2.7cm	1.9cm	Flaked piece
	Mudstone	5.4cm	1.5cm	1.6cm	Flaked piece Comment: 80% cortex
	Cream mudstone	4.1cm	3.1cm	1.3cm	Flaked piece
	Cream mudstone	3.6cm	2.3cm	1.4cm	Flaked piece
	Cream mudstone	4.7cm	4.8cm	1.5cm	Flakes piece Comment: 60% cortex
	Cream mudstone	3.8cm	2.1cm	1cm	Flaked piece
	Cream mudstone	2cm	2cm	1.7cm	Flake Platform: plain
	Cream mudstone	2.3cm	1.5cm	1cm	Flaked piece 10% cortex

	Cream mudstone	3.2cm	3.6cm	1.4cm	Flaked piece
	Cream mudstone	3.7cm	1.1cm	0.5cm	Broken flake – distal end
	Red silcrete	1.7cm	2.4cm	0.4cm	flake
	Cream mudstone	1.9cm	2.5cm	0.9cm	Flake Platform: faceted
	Cream mudstone	3.6cm	1.7cm	0.9cm	Flaked piece
	White quartz	1.7cm	1.0cm	0.4cm	Flaked piece
	Cream mudstone	1.0cm	0.9cm	0.4cm	Flaked piece
	Cream mudstone	1.1cm	1.8cm	0.2cm	Flake Platform: plain
	Cream mudstone	2.1cm	1.0cm	0.4cm	Flake
	River pebble				Possible hammer stone, 12.5cm length
T2 Erosion scald 50 mtrs west from TI on small sandy terrace in Lot 1 DP 1003492					GPS 38 2779 E 63 67583 N
	Orange silcrete	2.5cm	2cm	1.7cm	Flake Platform: Facietted
	Cream mudstone	2cm	1.8cm	0.5cm	Flake Platform: plain
	Cream mudstone	0.5cm	0.6cm	0.3cm	Flaked piece
T3 Erosion scald on small sandy terrace in Lot 1 DP 1003492					GPS 56 382703 E 63 67 533 N
	Cream mudstone	1.5cm	2.5cm	1.8cm	Broken flake –distal end
	Cream mudstone	3.5cm	2.4cm	1cm	Broken flake
	Red silcrete	2.4cm	1.7cm	1.4cm	Flaked piece
	Cream mudstone	2.8cm	1.6cm	0.5cm	Flake Platform: Facietted
T4 Erosion scald on mid slope of a sandy ridge in area DP 774440.					Visibility 60% GPS 56 383419 E 63 67848 N
	Cream mudstone	2.1cm	3.4cm	0.8cm	Flake Platform: plain
	White mudstone	0.8cm	1.3cm	0.2cm	Flake
T5 Erosion scald < 50 metres east of site T4					Visibility 70% GPS 56 383419 E 6367848 N
	Orange silcrete	1cm	1.5cm	0.4cm	Flake piece
T6 Erosion scald on mid slope of sandy ridge					Bones located in area, were found to be canine GPS 56 383428 E 63 67863 N
T7 Erosion scald on mid slope of sandy ridge					GPS 56 383428 E 63 67863 N
	Cream mudstone	1.8cm	0.5cm	0.6cm	Flake Platform: Facietted
	Mudstone	7.5cm	9.2cm	4.4cm	Flake Platform: plain
	Grey silcrete	5.5cm	4cm	2.2cm	Flaked piece
	Banded mudstone	4.5cm	1.5cm	1.3cm	Blade core

					Comments: 8 scar flakes
	Orange silcrete	2.2cm	2.3cm	0.6cm	Flake Platform: plain
	White banded mudstone	3.5cm	1.1cm	0.8cm	Flake piece
	Banded mudstone	1.6cm	2cm	0.5cm	Flake Platform: plain
	White mudstone	4.7cm	1.6cm	1cm	Flake piece
	White mudstone	2.5cm	1.2cm	0.9cm	Flaked piece
	Banded mudstone	2cm	0.7cm	0.2cm	Flake piece
	Orange silcrete	2cm	2.2cm	0.5cm	Flake Platform: Facietted
	Banded mudstone	1.9cm	0.6cm	0.2cm	Flake piece
	Grey silcrete	2.5cm	2.8cm	2.3cm	Flake piece
	Grey silcrete	3.5cm	1.1cm	0.7cm	Flake piece
	Banded mudstone	2.5cm	1.7cm	0.8cm	Flake piece
	Cream mudstone	2.4cm	1.5cm	0.7cm	Flake piece
	Cream mudstone	1.7cm	1.5cm	0.3cm	Flake Platform: plain
	Red/Orange silcrete	6.5cm	4.5cm	1.8cm	Flake Platform: plain Comments: heat effected/colour change
	White mudstone	2.4cm	1.5cm	0.5cm	Flaked piece
	Cream mudstone	5.3cm	3cm	0.4cm	Flake Platform: plain
	Grey silcrete	2.9cm	1.7cm	1.4cm	Flaked piece
	White mudstone	1.7cm	0.9cm	0.7cm	Flaked piece
	Red silcrete	1.5cm	2cm	0.2cm	Flaked piece
	Cream mudstone	1.5cm	1.8cm	0.2cm	Flake Platform: plain
	Cream mudstone	1.6cm	0.7cm	0.4cm	Flaked piece
	White mudstone	2.1cm	2.2cm	0.7cm	Flake Platform: plain
	Cream mudstone	1.6cm	1.8cm	0.4cm	Flake piece
	White mudstone	7cm	6.5cm	2.5cm	Flake piece
	Cream mudstone	6.5cm	5.8cm	3cm	Flake Comments: 5% cortex
	White mudstone	4cm	2.2cm	0.6cm	Broken flake Platform: plain Comments: proximal end heat affected
	White mudstone	3.4cm	1.5cm	0.2cm	Flake piece
	White mudstone	1.7cm	2.5cm	0.5cm	Flake Platform: plain
	White mudstone	3.2cm	3.3cm	0.5cm	Flake Platform: plain
	Cream mudstone	5cm	4cm	1.6cm	Flaked piece
	Cream mudstone	3.5cm	4cm	1.4cm	Flaked piece
	Orange silcrete	1.7cm	2.5cm	0.6cm	Flake Platform: Facietted
	Banded mudstone	3cm	1.4cm	0.5cm	Flake
	White mudstone	2.7cm	1.7cm	0.8cm	Flaked piece
	Red silcrete	1.5cm	1.1cm	0.4cm	Flake piece
	cream silcrete	2cm	1.3cm	0.4cm	Flake piece
	White mudstone	1.7cm	0.6cm	0.4cm	Flake piece
	Banded mudstone	1.7cm	1cm	0.2cm	Broken flake Comments: proximal end
	Red silcrete	1.8cm	1.7cm	1.2cm	Flake
	cream silcrete	1.7cm	1.3cm	0.4cm	Flake piece
	Banded mudstone	1.8cm	0.7cm	0.4cm	Microlith
	Banded mudstone	2.4cm	1cm	0.4cm	Flake Platform: plain

	Cream mudstone	1.6cm	1.5cm	1.2cm	flake
	White mudstone	2.5cm	2cm	0.5cm	Flake
	White mudstone	2cm	1cm	0.5cm	Flake piece
	White mudstone	1.8cm	1.2cm	0.4cm	Flake
	Cream mudstone	1.4cm	0.7cm	0.4cm	Flake
	Cream mudstone	3cm	1.8cm	1.3cm	Flake piece
	Banded mudstone	1.3cm	0.6cm	0.4cm	Flake piece
	White mudstone	2cm	1.3cm	0.4cm	Flake
	White mudstone	1.2cm	1cm	0.3cm	Flake piece
	Cream mudstone	1.5cm	1cm	0.2cm	Flake Platform: plain
	Banded mudstone	1/2cm	0.7cm	0.4cm	Backed blade
	White mudstone	0.7cm	1cm	0.4cm	Flake piece
	White mudstone	1.2cm	0.4cm	0.1cm	Flaked piece
	Silcrete core				
	River pebble	17.5cm	12cm	4.5cm	Possible grinding stone
T8 Erosion scald on mid slope of sandy ridge in DP 774440 area only 5 metres east of site T7					Visibility 70%
	Mudstone	4cm	1.8cm	1.5cm	Flake piece
	Mudstone	3cm	2cm	1.7cm	Flake Platform: Facietted
	Mudstone	1.5cm	2.2cm	0.4cm	Flake
	Mudstone	1cm	1cm	0.2cm	Flake piece
	Red silcrete				Heat shattered
	White Mudstone	1.4cm	1.7cm	0.5cm	Broken flake – proximal end
	White Mudstone	2.2cm	1.1cm	0.5cm	Flake piece
	White Mudstone	1.7cm	1.5cm	0.5cm	Flake piece
	White Mudstone	0.9cm	1cm	0.1cm	Flake piece
	Mudstone	1.5cm	1cm	0.5cm	Mid section broken blade
	Cream Mudstone	1cm	2cm	0.3cm	Flake piece
	Cream Mudstone	4.5cm	2.5cm	1.5cm	Flake piece
	Isolated find				Small erosion scar 1m x 2 m in north-east corner of Lot DP 774440 and 100 mtrs from main road

6.2 Potential for Archaeological Deposit (PAD)

PADs are places where the sub-surface soil profile is assessed as having a probability of containing cultural heritage material in a relatively undisturbed context. Factors that need to be considered when assessing if an area can be identified as a PAD include:

- The depth of the 'A' horizon profile;
- Any potential disturbances to the sub-surface environment (e.g. ploughing, erosion);
- The probability of cultural materials being present as assessed through the environmental setting and/or a surface artefact assemblage; and

- Any geomorphic agencies likely to have affected the area (e.g. creek channel migration, colluvial or alluvial depositional processes, slope wash).

For an area identified as a PAD to be able to contribute to an understanding of cultural sequences, it must contain distinguishable features or aspects that can be shown to have been created at different times within the context of that PAD or between other PADs/sites. For such relationships to be possible the artefacts or features within the PAD need to be located within the stratified context. Due to prior disturbance this is highly unlikely within the project area.

A PAD may also be able to contribute to our understanding of Aboriginal use of an area if the investigation of the PAD can add to the knowledge base in a more general sense. For this to be possible the PAD must contain a complex assemblage of artefacts (generally large numbers of artefacts and/or artefact types). Prior archaeological research in the area suggests that such complex PADs are unlikely in the project area.

In summary, it is very likely that the study area contains areas that could be identified as PADs.

The archaeological material that has been found in the study area suggests that the site may be a midden site as stone artefacts are evident with shell material in all major exposed areas along the sand ridges.

6.3 Significance Assessment

Cultural Heritage significance is a measure of the relative value or importance of heritage features. Significance is assessed according to principles outlined originally in Australia in the Burra Charter, which was adapted from the UNESCO sponsored ICOMOS (International Council for Monuments and Sites) Venice Charter. The assessment of significance of a place assists in the determination of appropriate management procedures.

The discussion will relate to Aboriginal significance and archaeological or scientific significance.

Aboriginal Cultural Significance

The Aboriginal cultural significance can only be assessed by the local Aboriginal community. The significance of the Aboriginal sites to the Worimi people and Worimi LALC has been documented in this report.

The assessment of heritage significance is based on the identification and articulation of heritage values. The definitions of heritage values provided here are drawn directly form the draft *Guidelines for Aboriginal Heritage Impact Assessment* (prepared by the NSW Department of Environment and Conservation).

Social Value

Social value (sometimes termed Aboriginal value) refers to the spiritual, traditional, historical or contemporary associations and attachments which the place or area has for the present-day Aboriginal community. Places of social significance have associations with contemporary community identity. These places can have associations with tragic or warmly remembered experiences, periods or events.

Communities can experience a sense of loss should a place of social significance be damaged or destroyed. These aspects of heritage significance can only be determined through consultative processes with one or more Aboriginal communities.

Historic Value

Historic value refers to the associations of a place with a person, event, phase or activity of importance to the history of an Aboriginal community. Historic places may or may not have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). These places may have 'shared' historic values with other (non-Aboriginal) communities. Places of post-contact Aboriginal history have generally been poorly recognized in investigations of Aboriginal heritage, and the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives.

Scientific Value

Scientific value (sometimes referred to as archaeological value) refers to the importance of a landscape, area, place or object because of its archaeological and/or other technical aspects. Assessment of scientific value is often based on the likely research potential of the area, place or object and will consider the importance of the data involved, its rarity, quality or representative ness, and the degree to which it may contribute further substantial information.

6.3.1 Summary of Significance

The Archaeological significance of the study area has been assessed by the Worimi LALC as high for all aspects of cultural and archaeological significance. The eroded sand banks have exposed an abundance of archaeological and cultural heritage material, thus making this site appropriate for further investigation.

7.0 MANAGEMENT OPTIONS

Several strategies can be considered for the management and conservation of the identified and predicted archaeological resources within the study area.

Option A (Further Investigation)

In circumstances where a site is identified, but the extent of the site, the nature of its contents, its level in integrity and/or its level of significance cannot be adequately assessed solely through surface survey (generally because of conditions of low surface visibility), sub-surface testing may be an appropriate strategy to further assess the site.

Testing is also appropriate in locations where artefacts deposits are predicted to occur through application of the predictive model of site location, in order to identify whether such deposits exist and their nature, extent, integrity and significance.

This is a pro-active strategy, which should result in the identification, assessment and management of the Aboriginal heritage resource prior to any development activity occurring. Following assessment of each Aboriginal site, management strategies as outlined below (B – D) can be applied.

The alternative strategy for zones where archaeological deposits are predicted to occur is to monitor construction, particularly any initial ground disturbance works, for the presence of artefacts. However, practical experience indicates that monitoring has few benefits, unless soil from the spoil heap is passed through wire mesh sieves. Monitoring for artefacts is a reactive strategy that is not preferred within the context of the current investigation, because it could result in substantial and costly delays to construction, late revisions to development plans, and/or cause undesirable impacts to sites of Aboriginal or archaeological significance.

Option B (Destruction)

A development proponent can apply to DEC for Consent to destroy permit for any known relics. This permit must be obtained prior to the commencement of works affecting any sites, because all relics are protected under the terms of the *NSW National parks and Wildlife Act, 1974.* The support of the Worimi Local Aboriginal Land Council should be obtained through further liaison, for any Consent to Destroy application. DEC guarantees to process Permit applications within eight weeks, subject to receipt of all necessary information. This strategy is typically suitable when a site is of low archaeological significance, the local Aboriginal community holds no objections, and it is unfeasible to implement any other strategy.

Option C (Salvage):

In circumstances where an artefact occurrence is of moderate or high significance within a local context, but the options for conservation are limited and the surface collection of artefacts or excavation of deposits could yield benefits to the Aboriginal community and/or the study of Aboriginal occupation, the strategy of salvage could be considered. Salvage may include the collection of surface artefacts or systematic excavation of deposits, as part of a Consent to destroy and Permit to salvage required from DEC. This strategy is a primary means of minimising impacts to Aboriginal heritage from development projects where the option of conservation in not feasible.

7.1 Issues to be addressed by Management Options

DEC AHIMS Site Register indicates that there are no registered sites in the study area. Although during the systematic survey of the study area did located seven sites and has located and identified areas as PADs within the study area.

7.2 Management Options and Evaluations

Several strategies can be considered for the management and conservation of the identified and predicted archaeological resources within the study area.

8.0 MANAGEMENT RECOMMENDATIONS

The Management recommendations outlined below have been prepared with regard to:

- Respect and consideration of the views of the local Aboriginal community;

- The requirements of Section 90 of the *National Parks and Wildlife Act 1974.* Under this Act all known Aboriginal sites are protected from destruction or disturbance without the written consent of the Director-General of NPWS;

- Providing clear guidance to Redlake Enterprises Pty Ltd about the protection of cultural heritage values; and

- In view of the results of the archaeological survey and assessment of the project area.

It is recommended:

1. The investigations have discovered sufficient cultural and archaeological reason to require further investigation (sub surface) before the development should proceed.

2. Systems be developed and implemented to ensure that should skeletal remains be uncovered by during investigation works; the following actions be taken
    a. work at that site will cease
    b. the following groups be notified:
        i. DEC;
        ii. NSW Police Department;

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Cheryl Kitchener (B.A. Archaeology)
Chairman
Indigenous Outcomes Pty Ltd
12th March, 2006

List of Appendices

Appendix 1	Worimi Local Aboriginal Land Council
Appendix 2	Advertisement
Appendix 3	Site Photos
Appendix 4	DEC site cards

Appendix 1 Worimi Local Aboriginal Land Council

WORIMI LOCAL ABORIGINAL LAND COUNCIL

ABN: 51 352 201 603
P.O Box 56 Tanilba Bay NSW 2319
173 Nelson Bay Rd, Williamtown NSW 2318
PHONE: (02) 4965 1500 FAX: (02) 4965 1799
email: worimi@bigpond.com

21st March 2006

Tomago Site Survey Report

Methodology

The Worimi Local Aboriginal Land Council (LALC) was contacted by Indigenous Outcomes Pty Ltd to participate in a site survey on lands within the Worimi boundaries. The work was conducted over two separate days, Friday 24th February & Wednesday 1st March, 2006.

Those persons who conducted the survey were an Archaeologists and Cultural Advisor employed by Indigenous Outcomes Pty Ltd, accompanied by two licensed Worimi LALC Site Officers & Traditional Owners, Mr Jamie Merrick and Mr Brendan Lilley.

Location of Fieldwork / Survey

The surveyed lands in question are Lot 161 DP 774440 & Lot 1 DP 1003492, Lot 1 DP 597372 & Lot 513 DP 585256 Tomago Rd, Tomago.

Findings

The majority of the land surveyed was covered in thick pastoral grass; however a number of key eroded areas were identified. On further investigation into these eroded areas, several significant stone artefacts were found. Based on the search conducted, it is exceedingly likely that any additional investigations will unearth further significant sites and artefacts within the proposed development areas.

Recommendations

It is the opinion of the Worimi LALC, in agreement with its Sites Officers, that further investigation is required prior to any development consent being granted, along with a 'Management Plan' introduced to recover all significant materials within the proposed development areas. Worimi LALC insist on being immediately notified and sufficient time given for Worimi Site Officers to be on site to participate in 'all' excavation work being conducted. Following an agreement of these conditions being met, the Worimi LALC sees no reason to prohibit applications for a Section 87 Research Permit & a Section 90 Salvage Permit being lodged. It is the condition of the Worimi LALC that there be a minimum of two Worimi LALC Site Officers present at all times.

Andrew Smith
General Manager
Worimi Local Aboriginal Land Council

Appendix 2 Advertisement

Port Stephens Examiner Classifieds

PROOF

Date: 13.1.06 Fax Number: 49576221

To: Cheryl/Tracey Of: Indegenous Outcomes Pty Ltd.

From: Paula Coleman **Ph:** (02) 49 849 333 **Fax:** (02) 49 811 356

Classified Deadline ~ 12 NOON Tuesdays

Following is a proof of your Classified Ad/s to appear in the Port Stephens Examiner on 19.1.06 at a Cost of $ (incl. GST) per insertion.
Please Check your ad thoroughly and confirm by return fax.

FAXED Date: 13/1/06

Investigation For Sites of Aboriginal Cultural Significance

In accordance DEC interim guidelines for Aboriginal Community Consultation, notice is hereby given of a proposal for a field investigation for Aboriginal sites of Cultural Significance on Lot 1 DP 597372, Lot 161 DP 774440, Lot 1 DP 1003492, Lot 513 DP 585256, Tomago Road, Tomago. Aboriginal Stakeholder groups wishing to be consulted about the project are invited to register their interest within 14 days to:

Indigenous Outcomes
Phone/fax 02 4957 6221

Appendix 3 Site Photos



View of site T2 looking west.



View of site T1 Artefact site types.



View of site T3 looking southeast.



Site T7 and T8 erosion sites.



Site T7 Artifacts site types.

Indigenous Outcomes Pty Ltd



Subsurface Archaeological Investigations of Selected Aboriginal Sites at the Proposed Industrial Site, Tomago Road, Tomago NSW

Report to

Redlake Enterprises Pty Ltd

October 2006

PO Box 433 The Junction Telephone 49442074 Fax 49576991

ABN 17 108 118 636

SUMMARY

Asquith and deWitt Pty Ltd, on behalf of Redlake Enterprises Pty Ltd, commissioned Indigenous Outcomes to undertake subsurface investigations of three archaeological sites at Tomago in the Port Stephens areas in New South Wales. The sites had been recorded during a previous Aboriginal heritage assessment of a proposed Industrial subdivision development application.

The study area covers a sand ridge. The proposal is to develop the land to permit an industrial subdivision. Major upgrades are also planned for the area including buildings, and provision of ancillary services.

In March 2006, Indigenous Outcomes Pty Ltd conducted a systematic survey of the area and recorded 7 archaeological sites. All were artefact scatters, ranging from isolated artefacts to sites with 1 to 61 artefacts, found where bare ground had been exposed by erosion or some other disturbance. Three sites were identified as being in locations with potential to contain intact and reasonably deep upper soil horizons that may contain evidence of past Aboriginal occupation.

Sub-surface investigations of the three sites were conducted in October 2006, under a section 87 permit issued by the NSW Department of Environment and Conservation (DEC). Indigenous Outcomes and representatives from the local Worimi Local Aboriginal Land Council conducted the investigations.

Fieldwork involved sub-surface investigations using the technique of excavating small shovel test pits at regular intervals along a series of transects. Transects were strategically positioned to incorporate undisturbed land surfaces in the vicinity of the previously recorded surface artefacts. Excavated material was passed through nested 3 and 5mm sieves. A total of 32 shovel pits were excavated along 12 transects between 0 to 15 metres long, giving a total of 150 metres of transects. The average size of the shovel probes was 33cm and all were dug to the B soil horizon, characterised by composites of dark sand. The depth of the sand layer varied from 10 cm to 33 cm below the surface.

There were no artefacts collected from the surface of any of the three sites. Attempts were made to match them to the original descriptions provided in the original investigation by Indigenous Outcomes but this proved difficult. Discrepancies between the original and subsequent recordings of surface artefacts at three of the sites demonstrate the profound influences of taphonomic processes – both natural and humanly induced, in the seven months since the original recordings. The only material that was found was at site T7 one mudstone broken flake with small fragments of charcoal and shell material were located.

Subsurface investigations excavated approximately 3.295m^3 of deposit that contained a total of 1 artefact. This very low density of sub-surface cultural material suggests that over the last few thousand years, the land now part of the study area appears to have supported very low numbers of Aboriginal people, who were probably passing through on a sporadic seasonal basis. This interpretation is consistent with models developed from the previous heritage assessment and is supported anecdotally by the views of local Aboriginal people involved in the fieldwork and consulted as part of this investigation. We are confident that the results of the fieldwork are an accurate reflection of the local archaeological record as the transects and shovel pits were designed to intersect those areas with the highest potential for containing cultural material *viz*. the deeper and less disturbed sections of the A soil horizon.

The Aboriginal heritage evidence recorded within the study area is protected by the *National Parks and Wildlife Act 1974*. No disturbance can occur legally within the

immediate vicinity of any of the recorded site *loci* without a permit issued under s. 90 of this Act. On the basis of the results of fieldwork and discussions with the Aboriginal people who participated in the fieldwork, the following recommendations are made:

- The proponent should seek s.90 permits from DEC for those sections of the sites T2, T3, T4, and T5, to salvage existing artefacts without a requirement for any further archaeological investigation or assessment;
- The due to the intensive investigations and the analysis of the Tomago area it has been established that the area where the sites were found is from a previous fill site and that the artefacts were not in situ. Due to these findings the local Aboriginal community have no objections to the proposed development by Redlake Enterprises Pty Ltd.

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1 PROJECT SUMMARY

1.1 Introduction and Site Identification

Indigenous Outcomes Pty Ltd was commissioned in February 2006 to undertake archaeological fieldwork at the proposed Industrial site at Tomago in the Port Stephens Local Government Area (Figure 1). The fieldwork took place on the 28th and 29th October, 2006 and with the assistance of representatives of the Worimi Local Aboriginal Land Council.

The work involved test excavation and surface collection from three previously recorded archaeological sites. These were low density artefact scatters visible on highly disturbed and eroded ground within the study area, recorded during archaeological fieldwork undertaken by Indigenous Outcomes in March 2006. This survey recorded 8 sites within the 114.85 hectare property and one of the management scenarios recommended additional work in the vicinity of several of the recorded sites because of the potential for relatively undisturbed sub-surface deposits to exist (Kitchener 2006).

1.2 Reason for the Current Investigation

A major development is planned for the study area. State legislation required environmental impact assessments and this study has been carried out in accordance with the statutory protection afforded Aboriginal sites and objects by the *Environmental Planning and Assessment Act (1979)* and the *National Parks and Wildlife Act (1974*). If development proceeds in the subject area all of the recorded sites will be destroyed by Redlake Pty Ltd (hereafter called 'the developer' or 'the proponent') and will therefore require 'consents to destroy' under section 90 of the *National Parks and Wildlife Act (1974*). Kitchener concluded that of the 8 recorded sites, three had potential for containing relatively undisturbed deposits close to the surface artefacts. Kitchener recommended that the remaining sites, all designated as being of low archaeological significance could be subjected to 'consents to destroy' without any further work.

The Aboriginal community groups subsequently advised the developer that they were not prepared to sign off on any 'consents to destroy'until further consultation and further archaeological investigation occurred. Indigenous Outcomes Pty Ltd prepared a program for subsurface investigation and surface collection in the study area and was designed in consultation by Cheryl Kitchener and Worimi LALC. The program was based on the recommendations outlined in Kitchener's report and also on discussions held between the Aboriginal organisations and the developers.

The study design was submitted to the Department of Environment and Conservation (DEC) together with a permit application under s.87 (1) of the *National Parks and Wildlife Act (1974*). Permit #2504 was issued to Cheryl Kitchener on 3rd May, 2006.

In summary, the reason for the current study is to undertake further archaeological investigations at three of the 8 known sites within the Tomago development precinct. The information gained from these investigations will enable Aboriginal community groups and DEC to be better informed about the significance of the sites when making judgements about any future applications from the developers for 'consents to destroy'. The fieldwork has also provided an avenue for Aboriginal community groups to continue and consolidate their involvement in the development project.

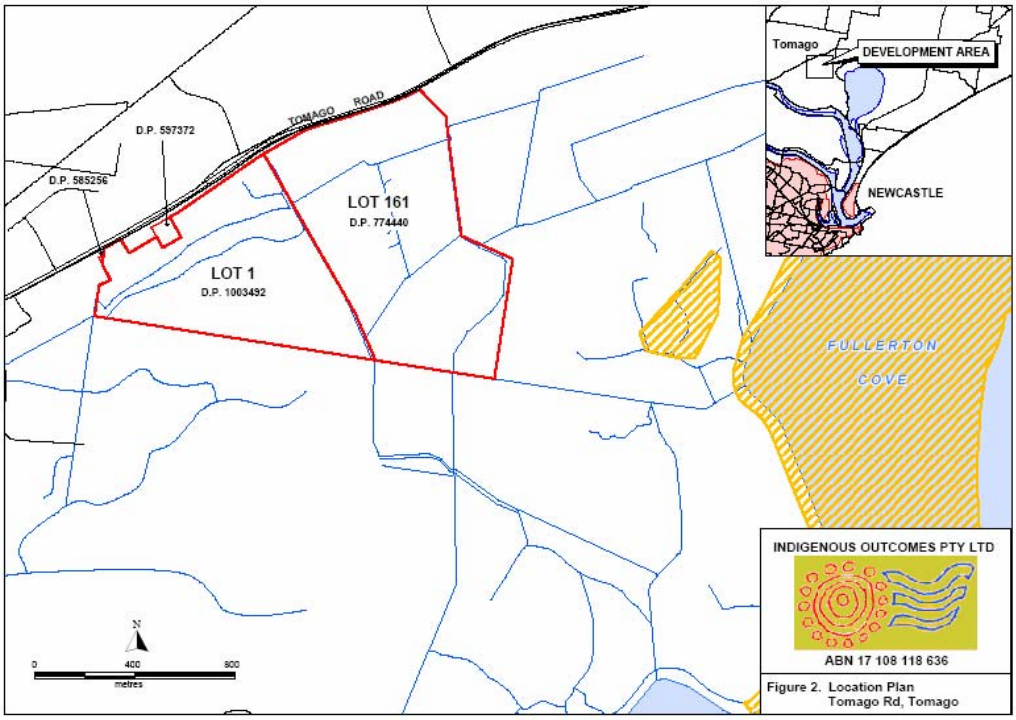
1.3 Previous Archaeological Investigations

This report builds on the archaeological survey work already undertaken at the Tomago site by Indigenous Outcomes (Kitchener 2006). As part of this work, Kitchener carried out a comprehensive literature review of previous archaeological research in the lower Port Stephens area. Thus, rather than duplicate information that is readily available in the Kitchener report, this current study uses background information to focus on three main areas of investigation:

- Addressing the questions outlined in the s.87 permit application, through detailed descriptions and analysis of the material found during the subsurface testing and surface collection.
- Analysing stratigraphic data to explain the geomorphological processes that have produced the relationship between artefacts and sediments that is seen today.
- Ensuring that Aboriginal interests, views and opinions on the cultural values of the sites and their broader landscape setting are adequately documented and heard.

Archaeologists and Aboriginal people studying the history of Aboriginal occupation in the Port Stephens area are fortunate because of the amount of survey work has been conducted over the last decade, mostly in association with sand mining developments and residential subdivision. DEC has a large number of consultants' reports on the archaeology of the Port Stephens area in its catalogue, as well as numerous recorded sites on its Aboriginal heritage database (AHIMS). An excellent review of previous archaeological research in the Port Stephens area is presented in Kitchener's report (Kitchener 2006). The great majority of sites are stone artefact scatters ranging in size from an isolated find to many hundreds of artefacts. Axe grinding grooves are reasonably common and a range of other site types have also been recorded.

Careful analysis of the contents of the recorded sites and an understanding of geomorphological processes has enabled development of quite reliable models for predicting the location of sites in unsurveyed areas. The model of stone artefact distribution that Aboriginal people and archaeologists have come up with for the Port Stephens area shows a strong relationship between the location of the site, the type of landform and most importantly the size of the water course (i.e. whether it is a major river or a minor tributary). There also seems to be a strong correlation between the size of the site and the proximity to a stream confluence, with the largest sites being near confluences of 1st and 2nd order tributaries with major rivers.



Map 1: Tomago Industrial Development (outlined in red) Base Map is Beresfield 9232-3N & Williamstown 9232-2N 1:25000 topographic map sheet.

1.4 Project Scope & Objectives

1.4.1 Aboriginal Community Consultation

The objectives of consultation with the Aboriginal community were to:

- arrange for the local Aboriginal community organisation to participate in the archaeological fieldwork; and
- Incorporate the views, concerns and recommendations provided by the group into the report, including those not directly related to the archaeological study.

1.4.2 Background Research

The objectives of the background research were to:

- review previous archaeological and Aboriginal heritage assessment data from the subject land and the Port Stephens area generally, especially with respect to identifying landforms where test excavation may reveal undisturbed cultural deposits; and
- Evaluate methods and techniques appropriate for addressing the questions pertinent to the current study.

1.4.3 Field Survey

The objectives of the field-based investigation were to:

- undertake collection of previously recorded and unrecorded artefacts on the ground surface at site *loci* T1, T7, and T8; and
- Conduct test excavations in the vicinity of the three site *loci* through use of shovel probes and test pitting along transects.

1.4.4 Report

To prepare a report describing and analysing the results of the fieldwork, recommending options for future site management and presenting the views of the Aboriginal community groups to meet the requirements of the *NSW NPWS Aboriginal Cultural Heritage Standards & Guidelines Kit* (Draft September 1997)

1.5 Aboriginal Community Consultation

Indigenous Outcomes Pty Ltd arranged for representatives from the local Aboriginal community organisation to participate in the fieldwork. The Worimi LALC was represented by Brendan Lily, Debbie Dates and Felicity Towers on different days. All are experienced in archaeological fieldwork techniques, having worked with archaeologists in the Port Stephens and Awabakal areas.

A meeting and a brief field inspection were held prior to commencement of fieldwork, outlining the fieldwork methodology and confirming who from the Aboriginal community groups would be participating in fieldwork. The meeting was attended by the Worimi Local Aboriginal Land Council representatives and Indigenous Outcomes Pty Ltd. This was a very useful meeting for establishing good working relationships for impending fieldwork. A debriefing meeting was held after completion of fieldwork, attended by Indigenous Outcomes Pty Ltd, the representative from the Worimi Local Aboriginal Land Council. The purpose of the meeting was to discuss potential recommendations emerging from the fieldwork and to ascertain whether there were any areas of significant difference between the views of the archaeologists and those of the Aboriginal community.

The Worimi Local Aboriginal Land Council provided three representatives on different days of the fieldwork, enabling the project to be completed on time and to have maximum involvement by the Aboriginal community. Brendan Lily, Debbie Dates and Felicity Towers were the representatives from the Worimi LALC and they attended the excavations on differing days. During the fieldwork, the consultant archaeologists (Tracey Skene and Donna McKay also attended and worked with the local Aboriginal community) and the Aboriginal community representatives collaborated over the position of all transects and on decisions about when to extend the shovel pits. The archaeological expertise of the local Aboriginal people and their familiarity with the landscape has been invaluable for this current study.

Brendan Lily had also worked on the Tomago archaeological site survey project in March 2006 with Indigenous Outcomes. The response of his organisations to Kitchener report expressed some concerns about some of the recommendations in her report, particularly in relation to 'consents to destroy' being issued for sites without any further investigation. The developers subsequently contracted Cheryl Kitchener of Indigenous Outcomes Pty Ltd to negotiate with the community organisations to develop a programme that would address their issues. These negotiations occurred over a number of weeks during 2006 during which the communities requested that further investigations proceed before any development is considered and an application for an excavation permit be applied for to undertake sub-surface archaeological investigations of sites T1, T7 and T8.

The communities' requests demonstrate a clear emphasis on non-scientific/archaeological issues and this is reinforced in letters from the Worimi LALC to Indigenous Outcomes advising that archaeological or scientific value was of lesser concern for them than the cultural context of the study area. The community requested that they be involved in the management planning for the whole study area and appropriate on-going consultation with Aboriginal communities.

1.6 Authorship

This report has been written by Cheryl Kitchener for Indigenous Outcomes Pty Ltd.

2 CULTURAL CONTEXT

Tindale (1974) compiled an assessment of Aboriginal clan territories in Australia. The project area lies within the territory of the Worimi people, Tindale (1974) describes the territory as extending north of the Hunter River from Maitland and Newcastle with Awabakal in the south. To the north of the Worimi, lay the tribal territory of the Biripai. The Wonnarua people are said to occupy an extensive territory from west of Maitland to the Dividing Range.

The Aboriginal history of the Tomago area is remembered by the people, recorded in historical documents, and imprinted on the land. Physical evidence of the Aboriginal occupation and use of the area is found both in and around Tomago and has been recorded during amateur collection and through systematic survey and archaeological excavation. Much of the information about Aboriginal cultural heritage in the area has resulted from consultancy work associated with the preparation of Environmental Impact Statements (EISs), and from the results of personal research, such as that undertaken by Len Dyall in the 1960's and 1970's.

Descriptions of traditional Aboriginal lifestyles suggest a strong division of labour between men and women, with women fishing for mullet and whiting, gathering oysters and other shellfish, digging for roots, carrying wood and water and keeping the fires alight and cooking. The men hunted kangaroos, wallabies and other animals and manufactured weapons (Fawcett 1898). There is also evidence for trade between coastal and inland tribes – "Iron tomahawks, sea-shells…. are thus frequently exchanged for opossum skins" (Dawson in Robinson 1987).

Like the rest of southern Australia, European settlement had a devastating impact on Aboriginal people in the Port Stephens area. However, despite loss of much customary knowledge, Aboriginal communities are successfully regaining and renewing cultural ties with the land and the water ways. Recording and protection of cultural heritage, including archaeological sites is a critical component of cultural revival and empowerment.

Aboriginal people involved in the fieldwork at Tomago have a strong interest in their traditional lands and have undertaken extensive archival research to support native title claims currently in place over these lands.

Local Aboriginal people in the Port Stephens area hold considerable knowledge of the written, oral and archaeological evidence relating to their history. The insights and perspectives derived from this knowledge are invaluable during investigations such as the one at Tomago.

3 ENVIRONMENTAL CONTEXT

3.1 General Environmental Context

3.1.1 Topography

The study area is within the Duck Hole land system as defined in Storey et al (1963) and is situated on the Tomago Coastal Plain. The principal topographic feature is a dune field of Pleistocene origin, which contained a mixture of dunes and swamps, or wetlands between the dunes (see Thom et al 1992) the dunes apparently formed a part of dune barrier during the late Pleistocene blocking off existing valleys. Towards the end of the Pleistocene (c10, 000) these dunes were extensively reworked by wind and an outer dune barrier was formed as it is apparent that the precise sequence and geomorphic features are likely to be specific to a particular area. This section of the report presents information about the physical environment of the survey area, focusing on the aspects, which may have had implications for the use of the area by Aboriginal people. (Stuart, 2000)

The original vegetation would have been a mixture of wet and dry heath depending on the drainage of the dunes. The wet heath would have been dominated by Angophora's, Swamp gums and various Paperbarks and a variety of healthy understorey plants while the dry heath would have had low forms of Bloodwoods and Banksias with a bracken understorey. In the areas along Windeyer's Creek the vegetation would have been a mixture of She oak and Paperbark (Matthei 1995). Matthei comments that the dune's suitability for plant growth is poor due to infertile, rapidly permeable soils of low water.

Apart form the areas to the south of the study area the rest of the study area was cleared with little original vegetation remaining.

The study area consists of a flood plain with sandy Ridges and small built up Terraces.

The main watercourse on the study area is the Hunter River, the project area lies on the Flood Plain of this River surrounded by many swampy/wet lands.

3.1.2 Geology and Soils

The Lower Hunter River delta is located within a bedrock paleo-valley, which has undergone numerous alternate phases of sedimentation and erosion, and comprises floodplain alluvium and channel sands overlying estuarine muds (Roy, 1993). Along the coast, extensively reworked Holocene and Pleistocene marine sand deposits stretch from the Newcastle area to Port Stephens. (Thom et al, 1992).

Refer to Figure 3.2. The *Tomago Coastal Plain* comprises the northern Newcastle region and accommodates the flood plains of the Lower Williams, Patterson and Hunter Rivers. The region extends from Raymond Terrace and Port Stephens to the north to Newcastle Harbour in the south, and west to Maitland. Dominant soil landscapes of the *Tomago Coastal Plain* region include:

- Hunter
- Millers Forest
- Hexham Swamp
- Bob's Farm
- Fullerton Cove
- Hamilton

- Wallis Creek
- Rivermead

To the south of this region, lay the Lower Hunter Plain dominated by rolling hills. The Tomago Coastal Plain region features quaternary sediments including marine and aeolien sand, silt and clay deposits.

3.1.3 Vegetation

The land of the Lower Hunter/Tomago area has been largely cleared of vegetation.

Remnant patches of native vegetation retained in uncleared areas (including parks and reserves), on the coast and along creeks and the river, indicate the following:

Floodplain

- On the quaternary alluvium of the Tomago floodplain where there is saline influence, Swamp Oak (*Eucalyptus glauca*) is the dominant species.

- On alluvium closest to the coast, Swamp Mahogany (*Eucalyptus robusta*), Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Cabbage Tree Palm (*Livistonia australis*) occur.

Creeklines

- Alluvial bands along streams occasionally support closed-forest remnants including Flooded Gum (*Eucalyptus grandis*) and Weeping Lilypilly (*Waterhousia floribunda*).

Inter-tidal Zones

- In estuarine sediment in areas of frequent tidal inundation, Grey and River Mangroves (*Avicennia marina* and *Aegiceras corniculatum*) occur. Salt marshes featuring Sea Rush (*Juncus kruasii*), Coastal Club-rush (*Bolboscoenus caldwellii*) and Glasswork (*Sarcocornia quinqueflora*) occur in areas of occasional inundation.

Beaches & Dunes

- Beaches are generally devoid of vegetation, however in protected areas, Coastal Tea-tree (*Leptospermum laevigatum*), coastal Banksia (*Banksia integrifolia*), and Sydney Golden Wattle (*Arcacia longifolia sophorae*) occur in association with Bracken (*Pteridium esculentum*) and Blady Grass (*Imperata cylindrica*).

- On dunes and low beach ridges occasional open-forest dominated by Blackbutt (*Eucalyptus Pilularis*), Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Eucalyptus gummifera*) and Old Man Banksia (*Banksia serrata*) occurs in association with a tall shrub understorey.

- A wet heath occurs in poorly drained areas and includes Grass Tree (*Xanthorrhoea fulva*), Red Bottlebrush (*Callistemon citrinus*) and Yellow Tea Tree (*Leptospermum polygalifolium*) (Matthie, 1995:5-7)

4 ARCHAEOLOGICAL CONTEXT

This section of the report presents the known archaeological context of the project area.

Most of the archaeological sites that have been subject to direct dating are of Holocene age (The Holocene equates to the last 10 000 years of geological time), with the exception of the Moffatt Swamp site at Medowie, which has been dated to the Pleistocene epoch (The Pleistocene epoch dates to between c1.8million years ago and 10 000 years ago).

Aboriginal site types recorded in the greater area include:

- Lithic scatters (open sites)
- Shell middens
- Hatchet-head grinding grooves'
- Stone procurement places (quarries)
- Rock shelters with cultural deposits
- Ceremonial & mythological sites
- Scarred trees
- Burials
- Post-contact campsites
- Aboriginal pathways

(Griffin NRM, 2002)

Researchers have suggested that is likely that other Pleistocene archaeological sites do, or did, exist in the greater Newcastle area. These sites would have been created when sea level was lower than it is today (c25 000 – 12 000 years ago) and are likely have been inundated or buried during the marine transgression that followed the last Ice Age. (Griffin NRM, 2002)

An overview of pertinent studies that may have a connection with the current study area is contained in the Thornton Master Plan, of Maitland City Council undertaken to identify issues that require consideration in the context of development planning. Part of that Masterplan included a desktop survey of Aboriginal Heritage potential. Angela Besant, a noted archaeologist, undertook the desktop survey of the area and concluded that all types of landscapes adjacent to wetlands ought to be considered as having potential for archaeological significance. Her work was well researched and gave a definitive overview of probable Aboriginal occupation of the area.

Near Maitland several studies in close proximity to the Hunter River have identified artefact scatter sites.

Brayshaw (1984b) surveyed a 120ha property adjacent to the Hunter River at Bolwarra Heights, three kilometres north of Maitland. The property comprises undulating terrain (Primarily simple slopes) covered by pasture grass. One artefact scatter containing 40 artefacts was recorded. Brayshaw (1995) resurveyed an 86ha part of the property in 1995. Conditions of surface visibility were higher and two new artefact scatters were recorded. Recommendations were presented for sub-surface testing which has subsequently been undertaken by Baker (1996), confirming that sources of the raw material silcrete were present within the property.

Ruig (1995) surveyed 10.54 ha for the proposed Tenambit Wetlands Project. The property comprises Crown Reserve R89147, County of Northumberland, off Metford Road north of Metford. Most of the area comprises swampland or floodplain of low elevation. Surface visibility was extremely low. Three isolated artefacts were located (two "mudstone" flakes and one silcrete flake). Considering the conditions of low visibility and high potential for further sites, a programme of sub-surface testing was recommended.

Kuskie (1994a) surveyed Lot 1 DP 559519, Thornton, for a proposed residential development. The 228 ha property is located adjacent to the Thornton urban area, although 85 ha of State Environmental Planning Policy 14 (SEPP 14) Wetland No. 828 was excluded from the assessment. Lot 1 consists of two broad low ridge spurs descending to the adjacent wetlands of Woodberry Swamp. Gradients of the ridge side- slopes and basal slopes are generally low (less

than five degrees), except in the vicinity of several gullies. Several minor watercourses and gullies drain into adjacent Woodberry Swamp. Landscape units present include low, broad ridge spurs, simple slopes, basal slopes, alluvial flats and wetlands. The underlying geology of the elevated landscape units consists of siltstone, sandstone and conglomerate of the Permian Mulbring Siltstone Formation. Lot 1 was used for pastoral purposes and therefore dominated by a dense cover of grass. Despite conditions of low surface visibility, nine artefact scatters and one isolated artefact were located.

Kuskie (1994b: 1) undertook the sub-surface investigations recommended for Lot 1 DP 559519, at Thornton, "in order to adequately assess the extent of the sites previously recorded by him to determine whether the recorded sites contained sub-surface deposits of artefacts to adequately assess the significance of each site and to effectively assess the majority of the study area in which low surface visibility had restricted the effectiveness of the initial survey."

A trend was identified for artefact density on the simple slopes and basal slopes to be greater than on the ridge crests. It was also demonstrated that higher artefact densities tended to occur closer to the wetlands. This supports predictions that the wetlands were a major focus of activity in the locality and that more abundant evidence for occupation and land use is likely to be located around the margins of the wetlands. Comparisons of artefact density with elevation were also undertaken, because it may provide indirect evidence of the relationship between intensity of land use and the wetlands (which are at the lowest elevation). While the study area is all lower than 25m a.s.1. The ridges tend to have the highest elevations, while the simple slopes and basal slopes around the margins of the wetlands are lower. There is a tentative trend towards increased artefact density at lower elevations (Kuskie 1994b).

4.1 Context of the three sites to be excavated

The study area is underlain by Permian age (2.98 million years ago) sandstones, shales, tuffs and conglomerates that are moderately soft and have been eroded to a low relief (Galloway 1963). The Quaternary period (over the last 1.8 million years) has had the greatest influence on the topography of the study area. Great fluctuations in climate and sea level have caused both erosion and deposition of unconsolidated deposits. (Galloway 1963). In low lying sites, such as the study area, they form the raw material for the soil as seen in the soil profiles recorded during the fieldwork. The estuary of the Hunter River once extended as far inland as Maitland, where marine sediments were deposited when the sea level was much higher than it is now. These are overlain by fluviatile (river) deposits composed of alluvium, generally forming terraces. The younger, better preserved terraces that occur in the study area consist of sand, silt and clay. The oldest, highest alluvial terraces have been eroded away within the study area and the main terrace that characterises the contemporary landscape probably dates from the late Pleistocene. All the sites excavated in this study occur in these unsorted Quaternary alluvial deposits.

Quaternary colluvial (slope wash) deposits are also known to occur in the general area (Galloway 1963) but they can be difficult to distinguish from alluvial sediments.

The last 150 years, following the arrival of the British was accompanied by major landscape changes through vegetation clearing. This greatly increased erosion on slopes and led to much more deposition in the valley bottoms.

This study centres on the locations of three previously recorded archaeological sites. In her original survey, Kitchener had divided the landscape up into elements within which the surface expression of the archaeology (stone artefacts) was recorded as *foci*. Thus site T1, T7, and T8 occurs on a gently sloping spur crest overlooking the low lying swamp area within the Fullerton Cove. Other disturbance to the landform element is from pastoral use which has led to gully erosion, to depths of 20cm along the lower end of the study area.

Site T1 was described by Kitchener as occurring in a gentle inclined crest measuring 15 metres x 10 metres on small sandy terrace. However, the forty-two recorded artefacts were probably not *in situ*, with the most likely location for undisturbed deposits being on the gently sloping spur crest and simple slope adjacent to the drainage line below.

Site T7 is located in an erosion scald on the mid slope of a sandy ridge comprising ground sloping gently down to Fullerton Cove. The site occurs towards the middle of the slope in an area of considerable disturbance. Kitchener identified the basal slopes closer to the low lying swamp area as having a high potential for undisturbed deposits.

Whereas T8 is located in an erosion scald on the mid slope of sandy ridge only 5 metres east of the site T7. Such high levels of disturbance have occurred at this location that it is difficult to reconstruct the original landscape. Much of the original extent of the site may have been destroyed when the area was developed for pastoral and residential purposes.

Site	Raw material	Length	Width	Thickness	Descriptions
T1* Erosion scald measuring 15 metres x 10 metres on small sandy terrace in Lot 1 DP 1003492					Visibility 70% GPS 56 382833 E 63 67605 N
	White mudstone	4cm	4cm	1cm	Broken flake at proximal end Platform: faceted Comments: Weathered, broken right margin.
	Red silcrete	0.4cm	0.7cm	0.2cm	Broken flake proximal end Platform: plain
	Cream mudstone	4.5cm	5.3cm	1.3cm	Broken flake Comments: left lateral margin snap, 10% cortex
	Cream mudstone	2cm	3cm	0.8cm	Flake Platform: plain Comments: Use wear on the distal end
	Cream mudstone	3.4cm	2.3cm	0.5cm	Flake Platform: faceted
	Cream mudstone	2.2cm	2.3cm	0.7cm	Flakes piece
	Cream mudstone	1.5cm	1cm	0.2cm	Broken flake at proximal end Platform: plain
	Pink silcrete	1.7cm	1cm	1.5cm	
	Cream mudstone	0.6cm	0.9cm	0.1cm	Flake Platform: plain Comments: heat effected
	Cream mudstone	4.5cm	5.5cm	1.5cm	Flake proximal end Platform: plain Comments: weathered

	Orange silcrete	1.2cm	0.9cm	0.1cm	Flaked piece
	White mudstone	1.2cm	0.4cm	0.9cm	Flaked piece
	White mudstone	1.1cm	1.9cm	0.4cm	Flaked piece
	White mudstone	1.7cm	0.5cm	0.4cm	Flaked piece
	Cream mudstone	1.2cm	1.7cm	0.2cm	Flake
	Cream mudstone	2.5cm	1.2cm	0.5cm	Broken flake
	Cream mudstone	2.4cm	1.5cm	0.3cm	Flake Platform: plain
	Cream mudstone	6.5cm	3cm	2cm	Core – 14 scar flakes
	Cream mudstone	3.2cm	4.6cm	1.5cm	Flake Comments: Use wear on distal end
	Pink silcrete	4.3cm	4.2cm	2.4cm	Flake piece
	Cream mudstone	2.3cm	2.4cm	0.4cm	Flake Platform: plain
	Orange silcrete	3cm	1.3cm	0.2cm	Flaked piece
	Silcrete	2.4cm	4.1cm	0.5cm	Broken flake Platform: faceted
	Cream mudstone	5.7cm	4.2cm	1.2cm	Flakes piece
	Cream mudstone	3.9cm	2.7cm	1.9cm	Flaked piece
	Mudstone	5.4cm	1.5cm	1.6cm	Flaked piece Comment: 80% cortex
	Cream mudstone	4.1cm	3.1cm	1.3cm	Flaked piece
	Cream mudstone	3.6cm	2.3cm	1.4cm	Flaked piece
	Cream mudstone	4.7cm	4.8cm	1.5cm	Flakes piece Comment: 60% cortex
	Cream mudstone	3.8cm	2.1cm	1cm	Flaked piece
	Cream mudstone	2cm	2cm	1.7cm	Flake Platform: plain
	Cream mudstone	2.3cm	1.5cm	1cm	Flaked piece 10% cortex
	Cream mudstone	3.2cm	3.6cm	1.4cm	Flaked piece
	Cream mudstone	3.7cm	1.1cm	0.5cm	Broken flake – distal end
	Red silcrete	1.7cm	2.4cm	0.4cm	flake
	Cream mudstone	1.9cm	2.5cm	0.9cm	Flake

					Platform: faceted
	Cream mudstone	3.6cm	1.7cm	0.9cm	Flaked piece
	White quartz	1.7cm	1.0cm	0.4cm	Flaked piece
	Cream mudstone	1.0cm	0.9cm	0.4cm	Flaked piece
	Cream mudstone	1.1cm	1.8cm	0.2cm	Flake Platform: plain
	Cream mudstone	2.1cm	1.0cm	0.4cm	Flake
	River pebble				Possible hammer stone, 12.5cm length
T2 Erosion scald 50 mtrs west from TI on small sandy terrace in Lot 1 DP 1003492					GPS 38 2779 E 63 67583 N
	Orange silcrete	2.5cm	2cm	1.7cm	Flake Platform: Facietted
	Cream mudstone	2cm	1.8cm	0.5cm	Flake Platform: plain
	Cream mudstone	0.5cm	0.6cm	0.3cm	Flaked piece
T3 Erosion scald on small sandy terrace in Lot 1 DP 1003492					GPS 56 382703 E 63 67 533 N
	Cream mudstone	1.5cm	2.5cm	1.8cm	Broken flake –distal end
	Cream mudstone	3.5cm	2.4cm	1cm	Broken flake
	Red silcrete	2.4cm	1.7cm	1.4cm	Flaked piece
	Cream mudstone	2.8cm	1.6cm	0.5cm	Flake Platform: Facietted
T4 Erosion scald on mid slope of a sandy ridge in area DP 774440.					Visibility 60% GPS 56 383419 E 63 67848 N
	Cream mudstone	2.1cm	3.4cm	0.8cm	Flake Platform: plain
	White mudstone	0.8cm	1.3cm	0.2cm	Flake
T5 Erosion scald < 50 metres east of					Visibility 70%

site T4					GPS 56 383419 E 6367848 N
	Orange silcrete	1cm	1.5cm	0.4cm	Flake piece
T6 Erosion scald on mid slope of sandy ridge					Bones located at site identified as canine GPS 56 383428 E 63 67863 N
T7* Erosion scald on mid slope of sandy ridge					GPS 56 383428 E 63 67863 N
	Cream mudstone	1.8cm	0.5cm	0.6cm	Flake Platform: Facietted
	Mudstone	7.5cm	9.2cm	4.4cm	Flake Platform: plain
	Grey silcrete	5.5cm	4cm	2.2cm	Flaked piece
	Banded mudstone	4.5cm	1.5cm	1.3cm	Blade core Comments: 8 scar flakes
	Orange silcrete	2.2cm	2.3cm	0.6cm	Flake Platform: plain
	White banded mudstone	3.5cm	1.1cm	0.8cm	Flake piece
	Banded mudstone	1.6cm	2cm	0.5cm	Flake Platform: plain
	White mudstone	4.7cm	1.6cm	1cm	Flake piece
	White mudstone	2.5cm	1.2cm	0.9cm	Flaked piece
	Banded mudstone	2cm	0.7cm	0.2cm	Flake piece
	Orange silcrete	2cm	2.2cm	0.5cm	Flake Platform: Facietted
	Banded mudstone	1.9cm	0.6cm	0.2cm	Flake piece
	Grey silcrete	2.5cm	2.8cm	2.3cm	Flake piece
	Grey silcrete	3.5cm	1.1cm	0.7cm	Flake piece
	Banded mudstone	2.5cm	1.7cm	0.8cm	Flake piece
	Cream mudstone	2.4cm	1.5cm	0.7cm	Flake piece
	Cream mudstone	1.7cm	1.5cm	0.3cm	Flake Platform: plain

	Red/Orange silcrete	6.5cm	4.5cm	1.8cm	Flake Platform: plain Comments: heat effected/colour change
	White mudstone	2.4cm	1.5cm	0.5cm	Flaked piece
	Cream mudstone	5.3cm	3cm	0.4cm	Flake Platform: plain
	Grey silcrete	2.9cm	1.7cm	1.4cm	Flaked piece
	White mudstone	1.7cm	0.9cm	0.7cm	Flaked piece
	Red silcrete	1.5cm	2cm	0.2cm	Flaked piece
	Cream mudstone	1.5cm	1.8cm	0.2cm	Flake Platform: plain
	Cream mudstone	1.6cm	0.7cm	0.4cm	Flaked piece
	White mudstone	2.1cm	2.2cm	0.7cm	Flake Platform: plain
	Cream mudstone	1.6cm	1.8cm	0.4cm	Flake piece
	White mudstone	7cm	6.5cm	2.5cm	Flake piece
	Cream mudstone	6.5cm	5.8cm	3cm	Flake Comments: 5% cortex
	White mudstone	4cm	2.2cm	0.6cm	Broken flake Platform: plain Comments: proximal end heat affected
	White mudstone	3.4cm	1.5cm	0.2cm	Flake piece
	White mudstone	1.7cm	2.5cm	0.5cm	Flake Platform: plain
	White mudstone	3.2cm	3.3cm	0.5cm	Flake Platform: plain
	Cream mudstone	5cm	4cm	1.6cm	Flaked piece
	Cream mudstone	3.5cm	4cm	1.4cm	Flaked piece
	Orange silcrete	1.7cm	2.5cm	0.6cm	Flake Platform: Facietted
	Banded mudstone	3cm	1.4cm	0.5cm	Flake
	White mudstone	2.7cm	1.7cm	0.8cm	Flaked piece
	Red silcrete	1.5cm	1.1cm	0.4cm	Flake piece

	cream silcrete	2cm	1.3cm	0.4cm	Flake piece
	White mudstone	1.7cm	0.6cm	0.4cm	Flake piece
	Banded mudstone	1.7cm	1cm	0.2cm	Broken flake Comments: proximal end
	Red silcrete	1.8cm	1.7cm	1.2cm	Flake
	cream silcrete	1.7cm	1.3cm	0.4cm	Flake piece
	Banded mudstone	1.8cm	0.7cm	0.4cm	Microlith
	Banded mudstone	2.4cm	1cm	0.4cm	Flake Platform: plain
	Cream mudstone	1.6cm	1.5cm	1.2cm	flake
	White mudstone	2.5cm	2cm	0.5cm	Flake
	White mudstone	2cm	1cm	0.5cm	Flake piece
	White mudstone	1.8cm	1.2cm	0.4cm	Flake
	Cream mudstone	1.4cm	0.7cm	0.4cm	Flake
	Cream mudstone	3cm	1.8cm	1.3cm	Flake piece
	Banded mudstone	1.3cm	0.6cm	0.4cm	Flake piece
	White mudstone	2cm	1.3cm	0.4cm	Flake
	White mudstone	1.2cm	1cm	0.3cm	Flake piece
	Cream mudstone	1.5cm	1cm	0.2cm	Flake Platform: plain
	Banded mudstone	1/2cm	0.7cm	0.4cm	Backed blade
	White mudstone	0.7cm	1cm	0.4cm	Flake piece
	White mudstone	1.2cm	0.4cm	0.1cm	Flaked piece
	Silcrete core				
	River pebble	17.5cm	12cm	4.5cm	Possible grinding stone
T8* Erosion scald on mid slope of sandy ridge in DP 774440 area only 5 metres east of site T7					Visibility 70%
	Mudstone	4cm	1.8cm	1.5cm	Flake piece

	Mudstone	3cm	2cm	1.7cm	Flake Platform: Facietted
	Mudstone	1.5cm	2.2cm	0.4cm	Flake
	Mudstone	1cm	1cm	0.2cm	Flake piece
	Red silcrete				Heat shattered
	White Mudstone	1.4cm	1.7cm	0.5cm	Broken flake – proximal end
	White Mudstone	2.2cm	1.1cm	0.5cm	Flake piece
	White Mudstone	1.7cm	1.5cm	0.5cm	Flake piece
	White Mudstone	0.9cm	1cm	0.1cm	Flake piece
	Mudstone	1.5cm	1cm	0.5cm	Mid section broken blade
	Cream Mudstone	1cm	2cm	0.3cm	Flake piece
	Cream Mudstone	4.5cm	2.5cm	1.5cm	Flake piece
	Isolated find				Small erosion scar 1m x 2 m in north-east corner of Lot DP 774440 and 100 mtrs from main road

Table 1: Summary of sites recorded in Tomago precinct (after Kitchener 2006). *Sites investigated during the current study.

It was considered that the sites to be investigated would add little to the existing body of knowledge about past Aboriginal occupation of the Port Stephens area because of their disturbed nature and low artefact numbers. Additionally, local Aboriginal interests are not directed towards increasing archaeological knowledge. The study design was aimed, therefore, at minimising time and effort in undertaking work that would address high-level questions of a scientific or archaeological nature.

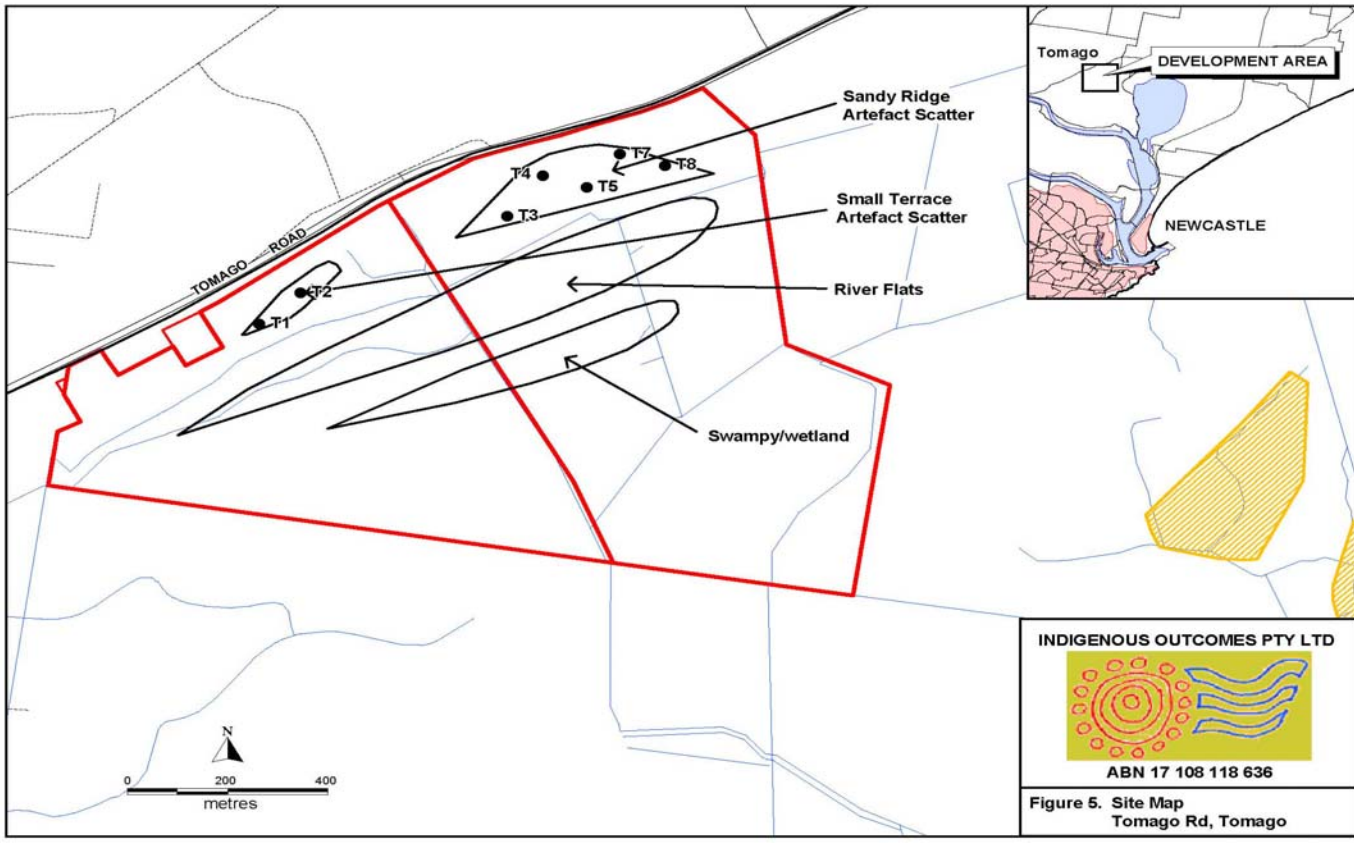
The focus of the additional work was to work with the Aboriginal community groups to facilitate their participation in interpreting the archaeological evidence and the range of values that it has for them. This interpretation will be valuable in negotiating with the developers for production of a management plan for the area.

Further investigation of the sites recorded by Kitchener (2006) and possible discovery of new sites by the subsurface testing programme has the potential to provide data that could address several research questions. Aboriginal community groups have advised that no heavy motorised plant such as backhoes are to be used for excavating, which places some limitations on the types of questions that can be asked. Hand-dug excavation pits expose much less sediment and reduce the capacity to develop a landscape approach to interpreting the association between micro-landscape units and the archaeological material. This type of approach has already been used elsewhere in the lower Hunter valley and has been successful in developing high level models of Aboriginal occupation so the time and expense of repeating the process is probably not warranted in this instance. The low numbers of artefacts and their generally disturbed context also precludes rigorous testing of the theories put forward by Kuskie and Kamminga (2000) about stone artefact manufacture and curation.

Additionally, questions relating to site function and identification of discrete activity areas within sites can only be answered if organic remains are present and this seems unlikely. Thus, the

questions considered appropriate for this study area and endorsed by DEC in issuing an s.87 permit are:

- To what extent does the surface expression of the archaeology reflect that which is beneath the surface in terms of site location, artefact density, artefact types, ratio of debitage to tools, raw materials, etc.?
- Has sub-surface testing enabled identification of site edges/boundaries?
- Does the archaeology of this section of the Hunter Valley conform to prevailing paradigms on temporal and spatial patterns of Aboriginal occupation of the Hunter valley generally?
- At a localised scale, is it possible to infer a relationship between concentrations of artefacts and landforms that reflect probable settlement patterns?
- Are the artefact assemblages generally consistent with those elsewhere in the lower Hunter valley?
- Does the subsurface testing change the models put forward by Kuskie for Aboriginal occupation of the Heritage Green Precinct?
- Is additional research required?



Map 2: Tomago Industrial development Cultural heritage sites found in landscape

5 FIELD METHODOLOGY

The methods adopted for this project included both archaeological fieldwork and on-site and off-site discussions amongst stakeholders. Fieldwork for the project was conducted over two days 28th – 29th October, 2006. Five people participated in the fieldwork, all with considerable

experience in site survey and excavation techniques. The two components of the fieldwork comprised:-

- Collection of visible surface artefacts from sites T1, T7 and T8.
- Subsurface testing of relatively undisturbed deposits within the survey areas of T1, T7 and T8.

5.1 Artefact Collections

Preliminary investigations of the area on Day 1 indicated that the situation had changed somewhat during the seven months since the initial surveys were done. Ground visibility had been affected by changes in vegetation cover and erosion from rain and humanly induced disturbance. Fortunately, three of the field crew, were able to re-locate the sites and comment on changes that had occurred as observed by them. However, it became clear that it was going to be impossible to re-locate individual artefacts recorded by Kitchener and that there was little point in carrying out any systematic collections because of the dynamic and changing nature of the land surface.

Kitchener's report contained reasonably detailed descriptions of the artefacts recorded during the initial survey and every attempt was made to match artefacts found during this project with those previously recorded. However, this proved very difficult to do and in fact there was minimal match between the original and subsequent assemblages.

Prior to any sub-surface testing occurring, some of the field team carefully examined the general area where artefacts had been previously recorded. In order to be consistent with previous recordings of surface artefacts, the only areas with reasonable ground visibility were examined ie. leaf litter or grass cover was not purposely removed. As a result, one artefact was found with fragments of shell and charcoal in the study area.

5.2 Sub-Surface Testing

Sub-surface testing is a commonly used technique when it is necessary to find out more about the nature and extent of a site before deciding whether further research, including full-scale excavation is required. It is important to recognise that it is not the same as salvaging a site, which involves retrieving as much physical evidence as possible, usually prior to a site being destroyed by the impending development. If sub-surface testing suggests the site is significant, salvage may be a condition of a s. 90 permit.

Sub-surface testing has proved to be valuable when a site, usually an artefact scatter has been identified on the surface, but the recorder is not certain of the extent of the site, due to poor surface visibility or sediment deposition. It is also used in areas where site location models predict that a site should be present but nothing is visible on the surface. In some cases where there is likelihood for *in-situ* deposits to occur, sub-surface testing can be used to locate these deposits. The work undertaken in the vicinity of sites T1, T7 and T8 is in response to all three of the above and is directed towards answering the questions in the study design for the s.87 permit.

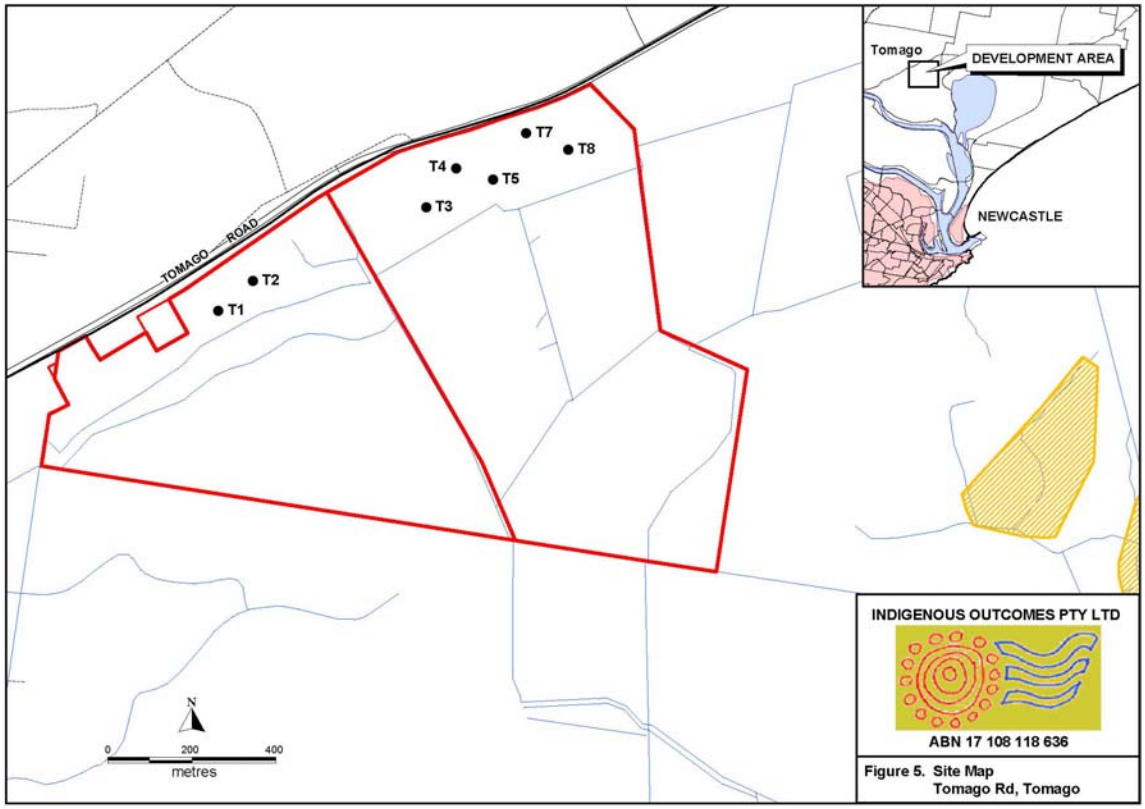
Testing for sub-surface deposits can be done in several different ways, depending on the questions being asked in the study design. An appropriate approach and one advocated in the Australia ICOMOS Burra Charter is to "*do as much as necessary but as little as possible*", meaning that sufficient intrusion into the archaeological record is undertaken to answer the questions being asked, but that disturbance is kept to a minimum to retain as much of the site's integrity as possible in case there is a possibility of amending development plans to conserve the archaeological deposits.

A wide range of sub-surface testing techniques have been adopted in the Port Stephens, Lake Macquarie and Hunter Valley, including auger holes, shovel pits, mechanically excavated trenches and mechanically executed surface scrapes. Clearly, different volumes of sediment will be removed and analysed by these techniques. Shovel pits were used by Dagg (1996) in his investigations of archaeological sites in the West Rutherford area.

Shovel pits were dug to the clay layer (B Horizon) as (approximately) a spade width x spade length. When the clay layer was too deep to allow retrieval of the shovel, the hole was lengthened to enable the spade to reach the base of the hole. The hole was also extended when artefacts appeared in the sieves or in the stratigraphic sections and this occurred on nine occasions.

Dimensions were recorded for each shovel pit together with their stratigraphic profiles. All sediments were put through nested 3 mm sieves, and in some cases the sediment was spread out on tarpaulins to dry before being sieved. Artefacts retrieved from the sieves or pits were bagged and labelled. Bulk soil samples were taken from several shovel pits for analysis.

Map 3 Site map



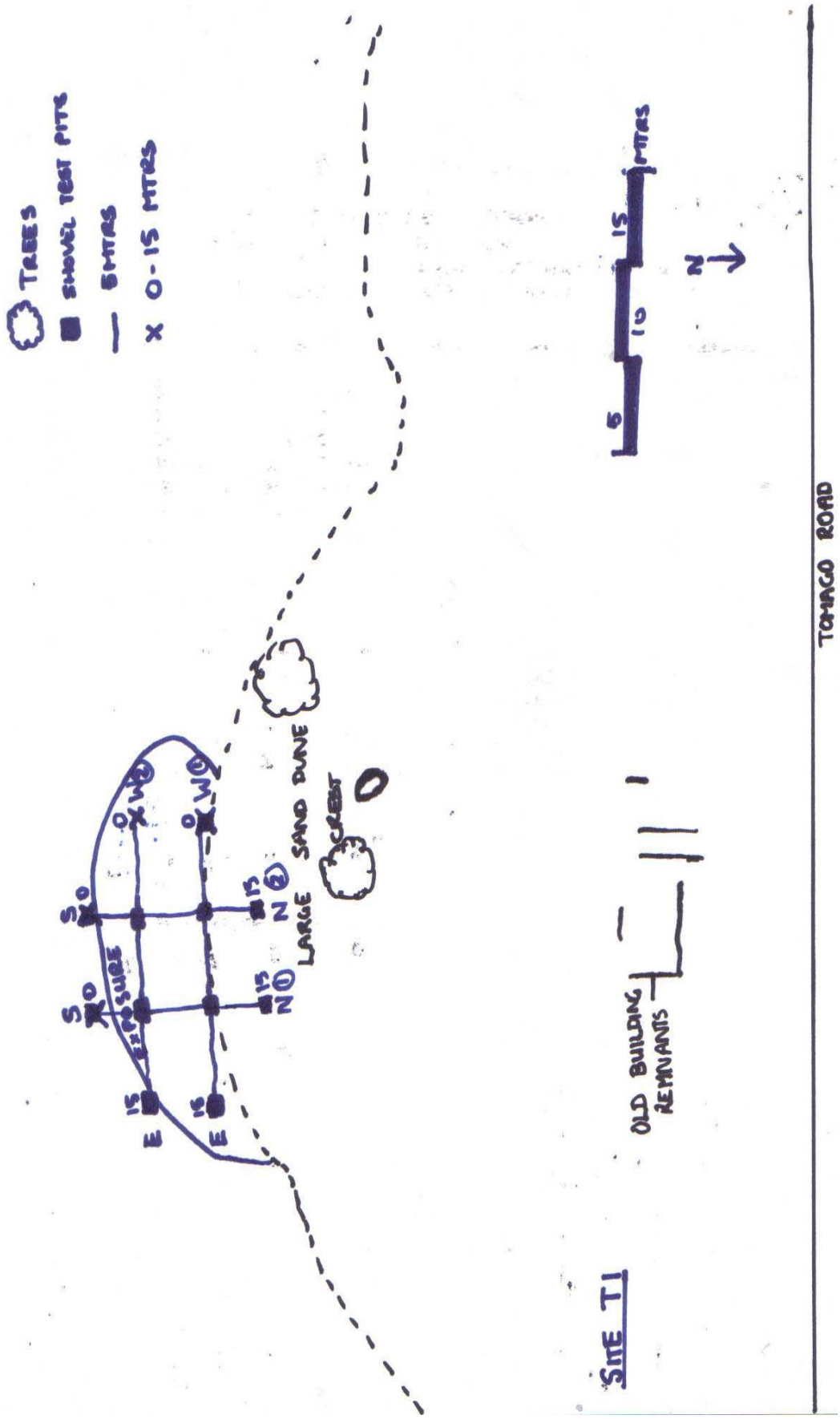


Figure 2: Site Plan Aboriginal Site T1, showing the location of shovel test transects.

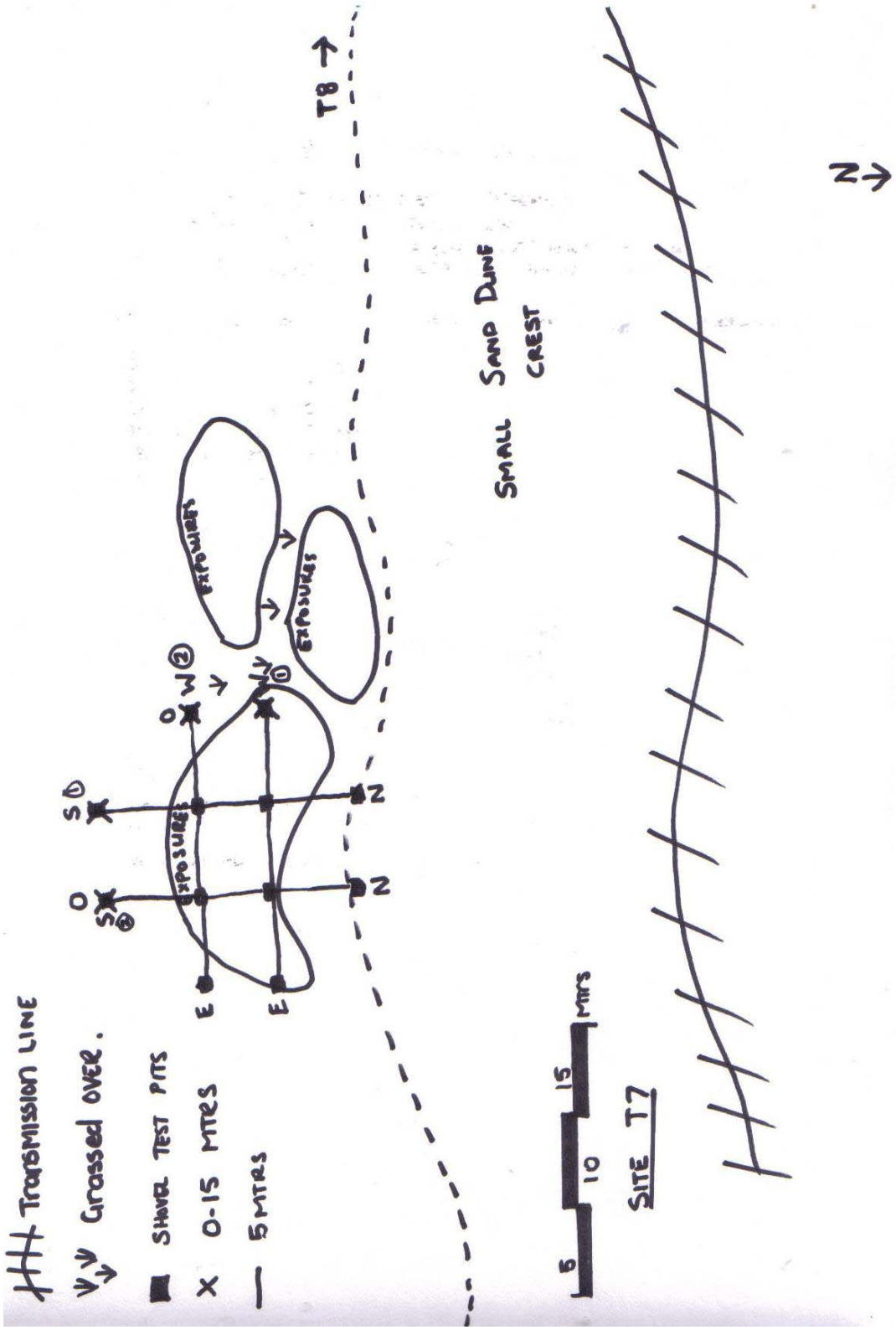


Figure 3: Site Plan Aboriginal Site T7 and T8 showing the location of shovel test transects.

6 RESULTS AND CONCLUSIONS

6.1 Shovel Test Pits

A total of 35 shovel pits along twelve transects, one artefact was recovered. The results of the test pitting program are summarised in Table 3. Details of individual shovel test pits including soil profiles and other information are included at Appendix 3.

Site	Total Transect Length	No. of Shovel Tests	No. Artefacts Recovered
T1	60m	30	0
T7	60m	30	1
T8	60m	30	0
TOTAL	**120m**	**90**	**1**

Table 3: Summary of results of shovel test pits at Tomago.

6.2 Surface Artefact Assemblages

A comprehensive inspection of all areas of localised disturbance at sites T1, T&, and T8 was undertaken by the Aboriginal community representatives and archaeologists. No stone artefacts were relocated.

6.3 Sub-Surface Artefact Assemblages

A comprehensive inspection of all areas of localised disturbance at sites T1, T&, and T8 was undertaken by the Aboriginal community representatives and archaeologists. One stone artefact was discovered.

6.4 Discussion of Results

The main outcome from the investigations is that the investigation of the subject site has revealed that it does not contribute to the understanding of the cultural significance of the broader Tomago area. In Kitchener's discussions with the local Aboriginal community, the communities concerns were of the cultural context of the area and the amount of cultural material that was located in the initial survey. Unfortunately and as circumstances have decreed there is no evidence of occupation or activity at this location. Kitchener's original interpretation of the area as a place that was not intensively utilised by Aboriginal people in pre-contact times has been justified. This is not surprising given the presence of more productive resource zones much closer to the Hunter River and it associated wetlands systems just a few kilometres away. The very low density of artefacts across the landscape, with few well-defined loci suggests it represents a transitory population of small groups of Worimi people. One possible model is a concentration of people around wetlands and rivers who took short forays along the tributaries to obtain specialist resources at certain times of the year.

An interesting comparison can be made with some the archaeological investigations carried out at Hexham Swamps (Dean-Jones 1996). These have demonstrated that it is possible for large numbers of sub-surface artefacts to occur even if nothing is visible on the surface, usually when rapid sediment deposition has buried a soil horizon. The opposite seems to be happening at Tomago, with many more artefacts on the surface than beneath it at three of the sites.

For example, sixty-one artefacts were recorded on the surface at Site T7 but only one was found during excavations, despite the expansion of the shovel pits to cover a larger surface area. The explanation for this could be that the extensive disturbance caused by residential and activities at some time in the past had removed the greater part of the original artefact scatter leaving residual artefacts in the disturbed and subsequently deflated deposits along the edge of the cutting. Under this scenario, the artefacts recovered from the surface collection are 'lag' deposits, that is, the sediments containing the artefacts have been eroded away by wind or water, leaving the artefacts deposited on an older surface. Some of the artefacts have moved down the soil profile due to bio-turbation or other disturbance and this is what is seen in the shovel pits. Of all the sites recorded at Tomago, the one most likely to contain archaeological deposits is siteT7.

6.5 Analysis against the questions formulated for the fieldwork program.

Question	Outcome
To what extent does the surface expression of the archaeology reflect that which is beneath the surface in terms of site location, artefact density, artefact types, ratio of debitage to tools, raw materials, etc.?	The surface scatters contain a higher artefact density than in subsurface deposits. But the raw materials, artefact types and ratios are broadly similar.
Has sub-surface testing enabled identification of site edges/boundaries?	One artefact was found in shovel pits of transects at T1, T7 and T8. The difference between surface artefact numbers recorded during the original and this survey demonstrate that the boundaries of sites change constantly depending on a range of factors affecting ground visibility.
Does the archaeology of this section of the Port Stephens area conform to prevailing paradigms on temporal and spatial patterns of Aboriginal occupation of the Port Stephens area generally?	The low density of artefacts on and below the surface in the study area supports the current models of Aboriginal occupation occurring adjacent to wetlands and major watercourses, rather than in the adjacent lowlands.
At a localised scale, is it possible to infer a relationship between concentrations of artefacts and landforms that reflect probable settlement patterns?	Artefact densities are too low for any inferences to be made. Factors that support the model of large artefact scatters close to confluences are the surface scatter at T7, although the assemblage may have been concentrated by run-off and erosion
Are the artefact assemblages generally consistent with that elsewhere in the Port Stephens area?	Numbers are too low to make definitive conclusions. Raw materials and artefact types are typical of those found throughout the Port Stephens area.
Does the subsurface testing change the models put forward by Kitchener for Aboriginal occupation of the Tomago Precinct?	Re-evaluation of surface scatters and the results of sub-surface investigations support Kitchener's model of low levels of occupation and use by Aboriginal people.
Is additional research required?	Artefacts to be collected from the surface as a condition of s.90 consent for sites to be destroyed by the development. No Further examination is required.

Table 2: Research questions addressed as part of this investigation.

7. SIGNIFICANCE ASSESSMENT

The assessment of heritage significance is based on the identification and articulation of heritage values. The definitions of heritage values provided here are drawn directly form the draft *Guidelines for Aboriginal Heritage Impact Assessment* (prepared by the NSW Department of Environment and Conservation).

7.1 Social Value

Social value (sometimes termed Aboriginal value) refers to the spiritual, traditional, historical or contemporary associations and attachments which the place or area has for the present-day Aboriginal community. Places of social significance have associations with contemporary community identity. These places can have associations with tragic or warmly remembered experiences, periods or events. Communities can experience a sense of loss should a place of social significance be damaged or destroyed. These aspects of heritage significance can only be determined through consultative processes with one or more Aboriginal communities.

7.2 Historic Value

Historic value refers to the associations of a place with a person, event, phase or activity of importance to the history of an Aboriginal community. Historic places may or may not have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). These places may have 'shared' historic values with other (non-Aboriginal) communities. Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage, and the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives.

7.3 Scientific Value

Scientific value (sometimes referred to as archaeological value) refers to the importance of a landscape, area, place or object because of its archaeological and/or other technical aspects. Assessment of scientific value is often based on the likely research potential of the area, place or object and will consider the importance of the data involved, its rarity, quality or representativeness, and the degree to which it may contribute further substantial information.

7.4 Assessment Criteria – Register of the National Estate

The Australian Heritage Council – the Commonwealth Government's lead agency of heritage issues – is responsible for managing the Register of the National Estate (RNE). Places of significance can be listed on the register if they meet one or more of the following criteria used to assess heritage significance.

Whilst inclusion on the RNE is largely symbolic, affecting only the actions of the Commonwealth Government or its agencies, the assessment criteria have become widely used in other jurisdictions as a best-practice model for assessing significance.

The Aboriginal sites identified during the field investigation have been assessed in this section against the RNE criteria (included at Appendix 2) in keeping with the draft *Guidelines for Archaeological and Aboriginal Heritage Assessments.*

8 RECOMMENDATIONS

This archaeological investigation has resulted in finding a very low density of artefacts in the sediments that mantle the landscape in the Tomago precinct. One artefact was recovered from 90 exploratory excavations across three loci

distinguished by surface scatters of stone artefacts. The surface collections from the three sites produced a total of 116 artefacts, with considerable variation (more and less) when compared to the numbers recorded previously at the remaining 4 sites. These findings support previous views based on recordings of surface artefact assemblages – that the area was only sporadically occupied by transitory groups of mobile Worimi people during the last few thousand years.

Factors to consider when developing recommendations for the three sites include:

- The views and wishes of the Aboriginal community groups;
- The potential for the sites to reveal more archaeological information;
- The future of the other 4 sites recorded in the study area; and
- The possibility of protecting some of the sites.

8.1 Views & Wishes of Aboriginal Community Groups

Community representatives participated in the fieldwork and have a sound understanding of the nature and extent of the archaeology of the area. Discussions were held during fieldwork and in the debriefing session following the fieldwork to ensure adequate involvement in decision making. It is our understanding that the community representatives are in agreement with the recommendations given below.

8.2 Potential for More Archaeological Information to be revealed

The extremely low density of artefacts, generally disturbed nature of the ground surface and absence of any diagnostic artefacts or definite cultural features limits the potential of the sites to contribute to the archaeological knowledge of the local area.

8.3 The future of the other 4 recorded sites in the Study Area.

It has been recommended by the local Aboriginal community that all the surface artefacts associated with these sites should be identified on the ground and an s90 application applied for to salvage any artefacts, all the artefacts are to be relocated, to the Worimi LALC.

8.4 Other Recommendations

1. Section 90 of the *National Parks and Wildlife Act 1974* makes it an offence to damage, disturb or destroy any Aboriginal site or relic without first having obtained the consent. Significant penalties apply to breaches of the Act. As a result all parties associated with the proposed development at Tomago should be made aware of the findings of this report and its recommendations.
2. If any works or activities (including earthworks, excavation or the introduction of fill) are to be undertaken that could result in damage, disturbance or destruction of an Aboriginal site or relic (including a potential archaeological deposit) at Tomago, it will be necessary to obtain the appropriate consents under the *National Parks and Wildlife Act 1974*. Obtaining consent under section 90 of the Act will require further consultation with representatives of the Aboriginal community.
3. Copies of this report should be forwarded to:

Archaeologist North East Branch Environment Protection and Regulation Division	3 copies

Department of Environment & Conservation
LB 914
Coffs Harbour NSW 2450

Coordinator — 1 copy
Worimi LALC
PO Box 56

Tanilba Bay 2319

Redlake Pty Ltd — 2 copies

C/- Asquith & deWitt

P O Box 179

Charlestown 2290

4. No on ground work associated with the proposed development should proceed until confirmation of acceptance of this report has been received from the Department of Environment & Conservation and all necessary permits have been obtained.

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APPENDIX 1
CORRESPONDENCE FROM ABORIGINAL COMMUNITY GROUPS



WORIMI LOCAL ABORIGINAL LAND COUNCIL

ABN: 51 352 201 603
P.O Box 56Tanilba Bay NSW 2319
2163Nelson BayRd,W illiam town NSW 2318
PHO NE:(02)49651500FAX:(02)49651799
Em ail: w orim i@ bigpond.com

10th November 2006

Indigenous Outcomes Pty Ltd Attention: Cheryl Kitchener

Re: Proposed Industrial Site, Tomago Road, Tomago NSW

Thank you for your report on the subsurface Archaeological Investigations (dated October 2006) outlining the significance (social, historical & scientific), along with the methodology & recommendations for the above-mentioned site.

Response to Consultation & Methodology
Worimi Local Aboriginal Land Council ("WLALC") is satisfied with the consultation process and methodology, undertaken by Indigenous Outcomes Pty Ltd, in conducting the subsurface Archaeological investigations

Recommendation
In consultation with WLALC Site Officers Brendan Lilley, Debbie Dates & Felicia Towers, WLALC endorses the recommendations to be submitted to Redlake Enterprises Pty Ltd, as outlined by Indigenous Outcomes Pty Ltd, documented at 8 – 8.4 of the report.

The decision to support these recommendations is based on the lack of Cultural & Heritage materials found and the degree of disturbance that has severely impacted on the cultural value of the project area.

Culture & Heritage Management Plan
In the event of the Proposed Industrial Site being development, if 'ANY' Aboriginal artefacts or materials are unearthed at any stage of the construction, it is in the best interest of the developers that the Worimi Local Aboriginal Land Council be contacted immediately on (02) 4965 1500 or mobile number 0428 618 874 to ensure proper management of any such items.

If you have any further questions relating to this report or the project area, please don't hesitate to contact me on the numbers listed above.

Yours sincerely



Andrew Smith General Manager Worimi Local Aboriginal Land Council

APPENDIX 2
DESCRIPTIONS OF SHOVEL TEST PITS

Design and outline of Shovel test pits

The initial shovel test pits commenced in the vicinity of Site T8 and T7 as permitted by the section 87 permit, transects were set out at an east/west aspect and north/south aspect and shovel test pits were dug every 5 meters.

Site T8

The majority of site T8 exposures have grassed over at this location leaving only few artefacts and remnants of shell visible since preliminary survey that was carried out in March 2006 also natural build up of sand has contributed to not relocating original artefacts/shell material.

Shovel Test Pits varied in depth depending on stabilization of sand in the area. Some holes had changes of colour in the texture of the sand deposit from Black to Dark Brown with moisture forming at the base of some test pits. (Colour changes shown in photographs). Sand granules were very fine in size at this site.

No artefacts or possible middens were located at Site T8.

Site T7

Grass has grown over a portions of this site leaving it difficult to find original surface artefacts/shells material that were previously recorded in March 2006, added to this was the natural sand build up that has occurred since the earlier survey.

Shovel test pits in this site varied in depth with colour changes to the sand deposits from dark brown to black. Sand Granules were very fine in size at this site.

Only a low density's of artefacts were found in some test pits along with charcoal and remnants of shells. (Periwinkles, oysters and pipie shells)

- Shown in diagrams and Artefact recordings of each site.

29/09/06

Worimi Local Aboriginal Land Council Representatives:

Debbie Dates, Felicity Towers.

Indigenous Outcomes:

Donna McKay, Tracey Skene.

Site T1

Shovel test pits were prepared according to section 87 permit.

Transects were set up east/west aspect and north /south aspect with shovel test pits at every 5 mtrs. Relocation of original artefacts were difficult to find due to high disturbance of the area from cattle and natural sand coverage from steep erosion of the slope being > 5%.

Sand granules were fine in size and with varied colour changes in some test pits being light brown to dark brown. (As shown in photographs)

Hole Description:

Site T8

EW transect 1:5 metre test pit had 3cm of fine light colour sand which changed to a damp dark moist colour from the 4 cm mark to the base of pit.

Depth was 26 cm; 2 buckets of 10 kg in weight were sieved through a 3mm mesh sieve no artefacts were found in this pit.

10 mtr test pit had grass cover and roots in the first 12 cm of this test pit which had light sand which changed at the base of the pit to dark moist sand. Depth was 29 cm and 2 buckets weighing 10 kg were sieved into a 3mm mesh sieve.

No artefact found.

15 mtr test pit had a light sand deposit with moisture at the base with a depth of 29 cm.

Two buckets weighing 10 kg was sieved from this hole into a 3mm mesh sieve, no artefacts found.

EW transect 2 : 5 mtr test pit has dark brown fine moist sand with no grass cover and a total of 2 buckets of sand weighing 10 kg which was sieved through a 3mm mesh sieve , depth of test pit was 33 cm, no artefacts were found in this pit.

10 mtr test pit has brown moist sand to the depth of the pit with some small roots protruding from the walls of the pit.

Depth of pit is 30 cm and a total of two buckets weighing 8 kg each were sieved from this pit into a 3mm mesh sieve, no artefacts were located.

15 mtr test pit has dark fine moist sand with no grass cover a total of two buckets weighing 10 kg each was sieved into a 3mm mesh sieve, no artefacts were found.

NS transect 1: 5 mtr test pit has 6 cm of grass cover which changes at the 7 cm mark to a black moist fine sand to the base of the pit.

A total of 1 and a half buckets were sieved weighing 10 kgs and 5 kgs.

Depth of hole was 30 cm, no artefacts were found.

10 mtr test pit has grass cover and small roots, colour of the sand is light fine moist sand which changes to a dark moist sand at the base.

Depth of pit is 29 cm and a total of two buckets were sieved into a 3mm mesh sieve each weighing 10 kgs and 7 kgs , no artefacts found.

15 mtr test pit has 6 cm of grass cover with black fine moist sand to the base with some small roots protruding out of bottom of pit, Depth of pit was 30 cm, total of two buckets were sieved weighing 10 kgs and 9 kgs they were sieved into a 3mm mesh sieve, no artefacts were found.

NS transect 2: 5 mtr test pit has brown moist sand to the base of the pit to a depth of 30 cm, a total of two buckets weighing 10 kgs each were sieved into a 3mm mesh sieve no artefacts were found.

10 mtr test pit has some grass cover with black moist sand the depth of the pit is 30 cm with a total of two buckets were sieved weighing 10 kgs each, no artefacts were found.

15 mtr test pit has a black fine moist sand to base at a depth of 31 cm a total of two bucket were sieved weighing 10 kgs each , no artifacts were found.

Site T7

EW transect 1 : 5 mtr test pit has light to dark sand the first 5 cm of pit it has grass coverage with some small roots a total of two bucket weighing 10 kgs each was sieved into a 3mm mesh sieve ,no artefacts present.

10 mtrs test pit has light to medium coloured sand in the first 18 cm of the pit the remaining 15 cm changes to brown moist sand, a total of two buckets were sieved into a 3m mesh sieve each weighing 10 kgs, no artefacts were present.

15 mtr test pit has dry dark sand , first 6 cm of pit has grass coverage and small roots remaining 24 cm of pit is consistent in colour , a total of two buckets weighing 10 kgs each as sieved into a 3mm mesh sieve no artefacts were found.

EW transect 2: 5 mtr test pit has light to dark sand and has grass cover , a total of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve , no artefacts were located.

10 mtr test pit has a light to medium colour sand at a depth of 30 cm, a total of two buckets were weighed at 10 kgs and sieved into a 3 mm mesh sieve, no artefacts were found.

15 mtr test pit, the first 7 cm of pit has grass cover with some small roots, total of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, no artefacts were found.

NS transect 1:5 mtr shovel test pit has a depth of 30 cm with no grass cover but has some small roots at the base of the pit ,sand has a dark colour with moisture , a total of two buckets was sieved into a 3mm mesh sieve , no artefacts were found.

10 mtr shovel test pit has dark brown moist sand and a depth of 30 cm, a total of two buckets were sieved into a 3 mm mesh sieve each weighing 10 kgs each, no artefacts were found.

15 mtr shovel test pit has a depth of 30 cm with the first 6 cm of grass cover and small roots, light to dark sand and a total of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, once small broken artefact flake and fragments of shell/charcoal were identified in this pit.

NS transect 2 : 5 mtr shovel test pit has a light to medium colour sand at a depth of 30 cm and a total of two buckets was sieved into a 3m mesh sieve , no artifacts were found.

10 mtr shovel test pit has light brown to dark sand to a depth of 33 cm a total of two buckets was sieved into a 3 mm mesh sieve , no artefacts was found in this pit.

15 mtr shovel test pit has dark sand to a depth of 36 cm with grass cover and small roots in the first 8 cm of the pit , total of two buckets was sieved into a 3mm mesh sieve , some small amounts of shell was found in this pit.

Tomago Survey 29/09/06

Worimi Local Aboriginal Land Council

Debbie Dates and Felicity Towers.

Indigenous Outcomes

Donna McKay , Tracey Skene.

Shovel test pits were carried out in this area as permitted by section 87 permit, transects were set out at an East/West aspect and a North /South aspect and shovel test pits every 5 mtrs.

EW transect 1 : 5 mtr Shovel test pit has light dry loose sand and impossible to get an accurate pit due to collapsing walls. A rough estimate of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, no Artefacts.

10 mtr shovel test pit has light dry loose sand and unstable walls to get a pit, a total of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, no artefacts were recovered from this pit.

15 mtr shovel test pit has no grass cover and medium to dark sand with a darker colour on the north wall of the pit a clump of dark sand was collected in soil sample which appears to have characteristics of being burnt, a total of two bucket weighing 10 kgs each was sieved into a 3mm mesh sieve, no artefacts were present.

EW transect 2 : 5 mtr shovel test pit has dark to medium colour loose sand and unstable to get a pit , 80% of this pit has collapsed before an accurate hole description could be completed, a rough estimate of two 10 kgs buckets were sieved into a 3mm mesh sieve, no artefacts were found.

10 mtr shovel test pit has brown loose sand with collapsing walls in the pit a total of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve , no artefacts were located.

15 mtr shovel test pit has medium brown loose sand with collapsing characteristics in pit a rough estimate of two bucket weighing 9 kgs and 10 kgs were sieved into a 3mm mesh sieve, no artifacts were found.

NS transect 1 : 5 mtr shovel test pit has light dry sand and a depth of 29 cm with 5cm of grass roots, a total of two buckets weighing 10 kgs each was sieved into 3 m mesh sieve, no artefacts were found.

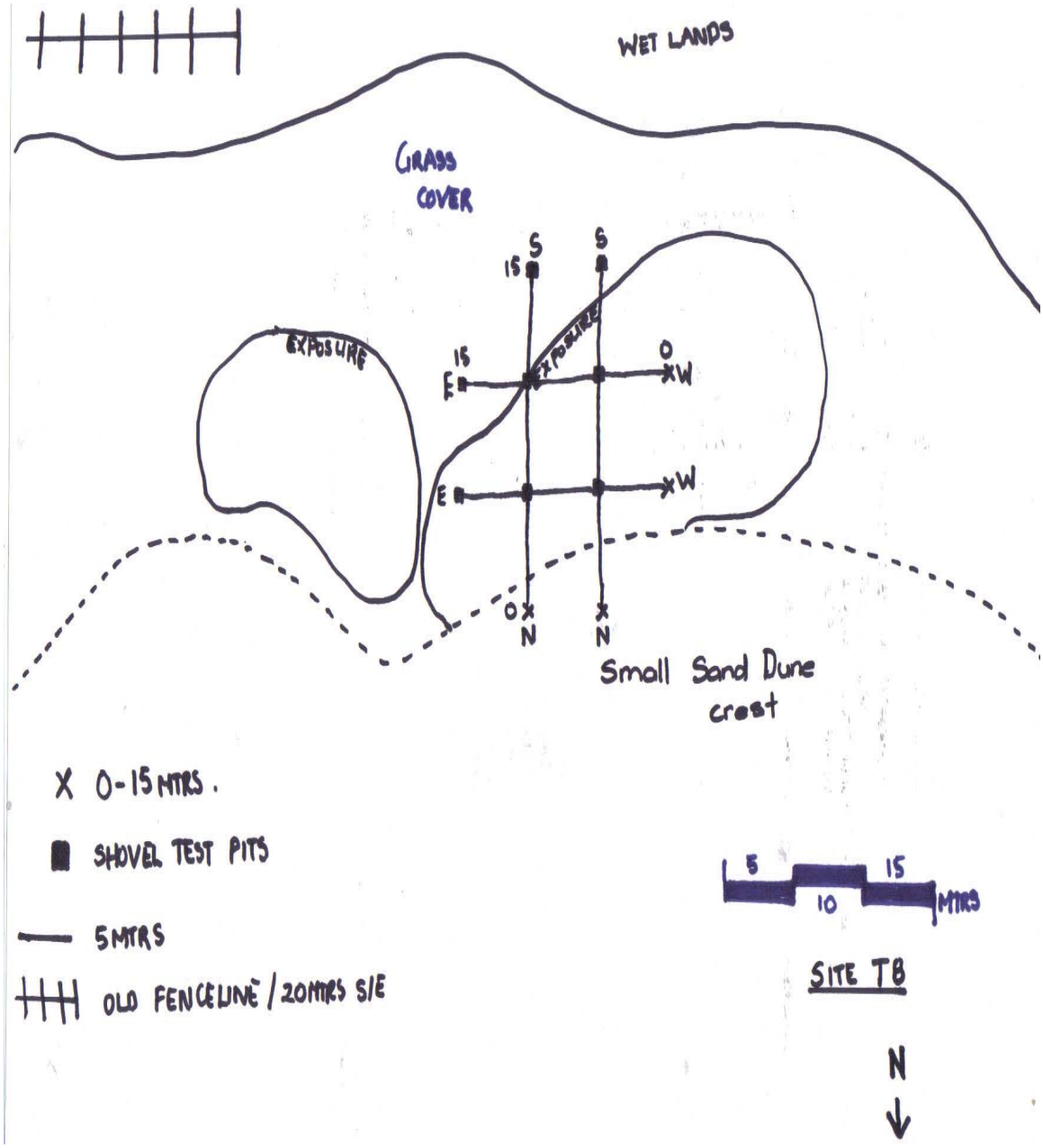
10 mtr shovel test pit has no grass coverage and a depth of 33 cm with light moist sand and a total of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, no artefacts were found.

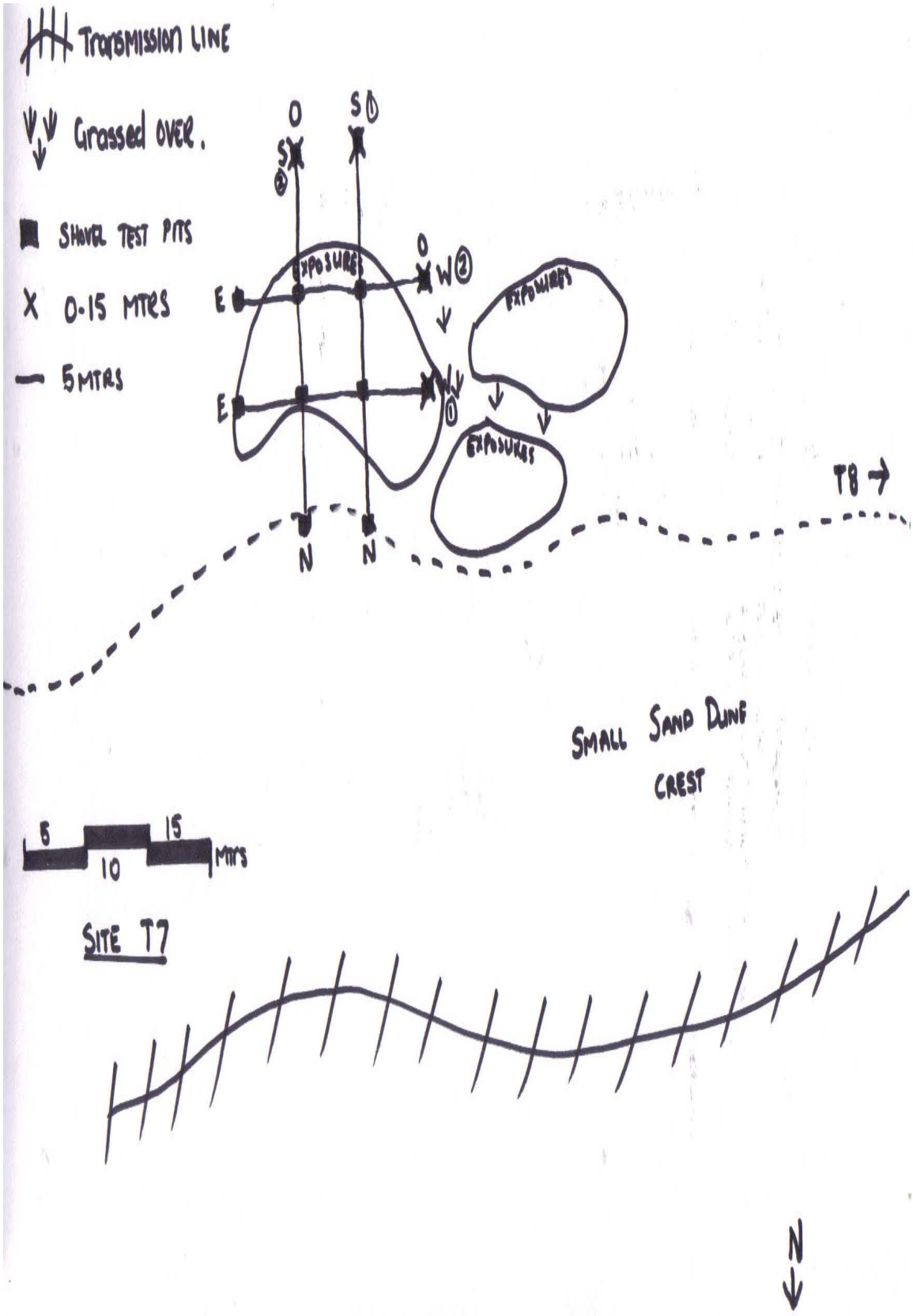
15 mtr shovel test pit has medium to brown loose sand and a depth of 30 cm each weighing 10 kgs each was sieved into a 3 mm mesh sieve no artefacts were found.

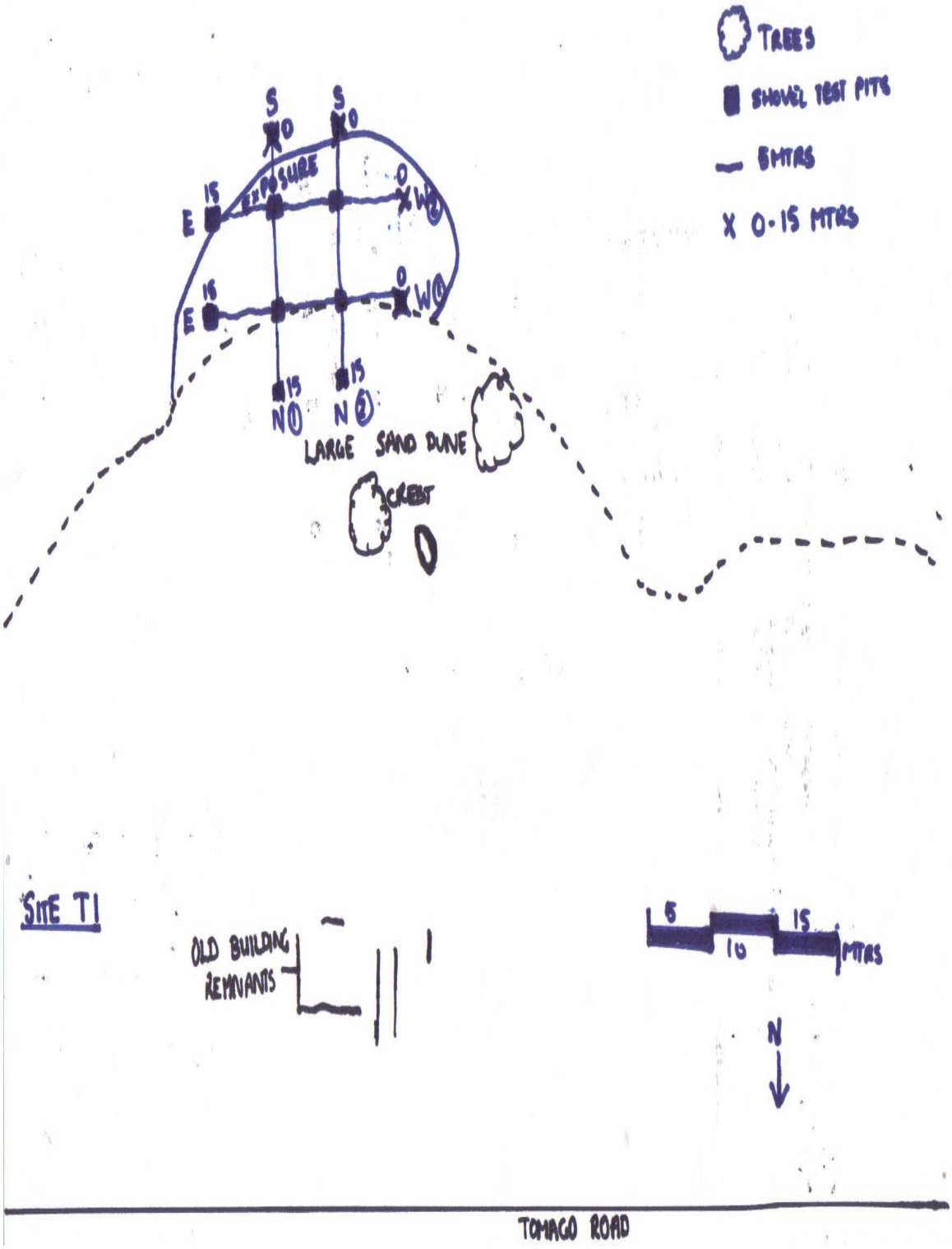
NS transect 2:5 mtr shovel test pit has light colour loose sand, unable to get a accurate measurements of pit due to collapsing walls, a rough estimate of two buckets weighing 10 kgs each was sieved into a 3 mm mesh sieve, no artefacts were found.

10 mtr shovel test pit has light loose colour sand with some moisture this pit has collapsed before hole discretion could be taken, a rough estimate of two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, no artefacts were found.

15 mtr shovel test pit has sparse grass coverage at the edge of pit with some small roots at the base the sand is light and loose with signs of caving in on some3 sides of pit, a depth of 28 cm with two buckets weighing 10 kgs each was sieved into a 3mm mesh sieve, no artefacts were found.


WET LANDS
GRASS COVER
EXPOSURE
EXPOSURE
S
S
15
15
E
O
W
E
W
O
N
N
Small Sand Dune crest
X 0-15 MTRS.
SHOVEL TEST PITS
5 MTRS
OLD FENCELINE / 20MTRS S/E
5
15
10
MTRS
SITE T8
N

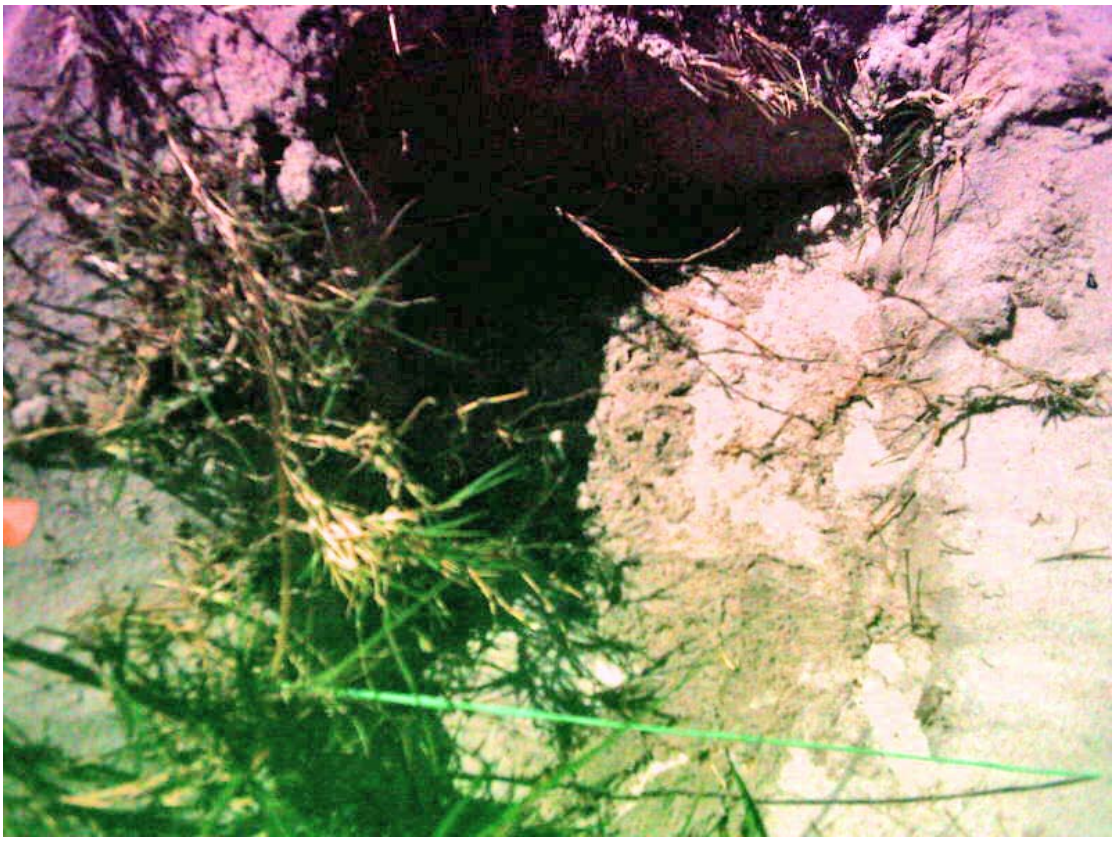

Transmission Line
Grassed over.
Shovel Test Pits
X 0-15 Mtrs
5 Mtrs
O
S
S
O
W
E
E
Exposures
Exposures
Exposures
T8
N
N
Small Sand Dune
Crest
5
15
10
Mtrs
Site T7
N


TREES
SHOVEL TEST PITS
5MTRS
X 0-15 MTRS
S
S
EXPOSURE
E
E
W
W
N
N
LARGE SAND DUNE
CREST
SITE T1
OLD BUILDING REMNANTS
5
15
10
MTRS
N
TOMAGO ROAD

APPENDIX 3
REGISTER OF THE NATIONAL ESTATE SIGNIFICANCE CRITERIA

Criterion		Sub-Criteria
A	Its importance in the course, or pattern, of Australia's natural or cultural history.	A.1 Importance in the evolution of Australian flora, fauna, landscapes or climate. A.2 Importance in maintaining existing processes or natural systems at the regional or national scale. A.3 Importance in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features. A.4 Importance for association with events, developments or cultural phases, which have had a significant role in the human occupation and evolution of the nation, State, region or community.
B	Its possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.	B.1 Importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness. B.2 Importance in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised, in danger of being lost, or of exceptional interest
C	It's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.	C.1 Importance for information contributing to a wider understanding of Australian natural history, by virtue of its use as a research site, teaching site, type locality, reference or benchmark site. C.2 Importance for information contributing to a wider understanding of the history of human occupation of Australia.
D	Its importance in demonstrating the principal characteristics of: (i) a class of Australia's natural or cultural places; or (ii) a class of Australia's natural or cultural environments.	D.1 Importance in demonstrating the principal characteristics of the range of landscapes, environments or ecosystems, the attributes of which identify them as being characteristic of their class. D.2 Importance in demonstrating the principal characteristics of the range of human activities in the Australian environment (including way of life, philosophy, custom, process, land use, function, design or technique).
E	Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.	E.1 Importance for a community for aesthetic characteristics held in high esteem or otherwise valued by the community.
F	Its importance in demonstrating a high degree of creative or technical achievement at a particular period.	F.1 Importance for its technical, creative, design or artistic excellence, innovation or achievement.
G	Its strong or special associations with a particular community or cultural group for social, cultural or spiritual reasons.	G.1 Importance as a place highly valued by a community for reasons of religious, spiritual, symbolic, cultural, educational, or social associations.
H	Its special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.	H.1 Importance for close associations with individuals whose activities have been significant within the history of the nation, State or region.

APPENDIX 4
PHOTOGRAPHIC RECORD



Site T1 area overgrown, soil types changed as pit progressed, no evidence of artefacts from this site



Site T7 Test pit showing gradient of sand, no evidence of artefacts or shell material in test pit



Site T8 example of overgrown site, and depth of test pit, no evidence of artifact material in this test pit.

Appendix Q

HAZARDS ASSESSMENT

SEPP 33 SCREENING REPORT

FOR

WESTRAC - TOMAGO

FOR

REDLAKE ENTERPRISES

BY

BARRY EADIE CONSULTING PTY LTD

16 November 2007

Version A

1. EXECUTIVE SUMMARY

(i) Scope of Report.

This report is to identify if the proposed development should be considered under SEPP 33, based upon the broad assessment requirements of the SEPP 33 Policy.

(ii) Summary of major findings

Based upon the assessment of this report in relation to the dangerous goods stored on site the proposal is not considered as *potentially hazardous.*

(iii) Recommendations

It is recommended that a transport assessment be carried out in accordance with the Policy.

2. INFORMATION TO BE PROVIDED TO THE CONSENT AUTHORITY PRIOR TO LODGEMENT OF DEVELOPMENT APPLICATION

The applicant is required to indicate:

- all hazardous substances involved in the proposed development - including raw materials, intermediates and products,
- dangerous goods classifications (including all subsidiary classes) for all dangerous goods held on site,
- quantities of hazardous substances involved in the proposed development,
- if developing an existing site, all existing hazardous substances and their quantities,
- types of activities the hazardous substances are involved in (storage, processing, etc),
- distance from the boundary for each hazardous substance,
- annual number of deliveries of hazardous substances to and from the facility,
- site layout plan showing proposed development and any existing development on site,
- are any dangerous goods licences required? If so, for which substances,
- are any EPA licences required? If so, which ones.

3. OVERVIEW OF THE SITE

SITE LOCATION, SURROUNDING LAND USES AND LAYOUT

3.1 SITE IDENTIFICATION DETAILS

The subject site is located on Tomago Road Tomago and comprises the following parcels of land:

- Lot 161 DP 774440;
- Lot 1 DP 1003492;
- Lot 1 DP 597372; and
- Lot 513 DP 585256.

3.2 SITE LOCATION

The following plans show the site location.





The site is located some 8km south west of Raymond Terrace and some 12km north west of Newcastle CBD. The site is located 1.3km from Fullerton Cove to the east and 1.6km from the Hunter River to the south and south west. The site is located with good access to major road links, the Port of Newcastle and Williamtown Airport, which is experiencing strong growth. Access to the Port is important to WesTrac for the importation of equipment and parts.

The subject site comprises an area of approximately 115.69ha, and is a State Significant Site under the Major Projects SEPP. The site is predominantly zoned IN1 General Industrial under the SEPP

3.3 PROCESS DESCRIPTION

- Develop as Stage 1 approximately 23 hectares for the purpose of an integrated WesTrac facility for the following:

    - Manufacture/assembly, display, sale, maintenance and servicing of predominantly large earth moving and mining machinery but also smaller machinery;

    - Warehouse and distribution of associated parts to all branches in NSW / ACT;

    - Servicing of on highway trucks;

    - WesTrac/Institute for WesTrac NSW/ACT apprentices and general training in new technologies and procedures.

    - Administration and offices associated with the above functions.

- Subdivision of the balance of the land for sale to related and unrelated land users in a number of stages.

3.4 PROPERTIES OF MATERIALS BEING HANDLED/PROCESSED

Inventory of hazardous materials;

See **Appendix A**

3.5 STORAGE

Inventory of all storage (see **Appendix A**)

Storage layout will be within racking on shelves or in the case of oils and fuels as per the designated areas shown on the plans.

Storage conditions will be as shown on the plans.

3.6 ENVIRONMENTAL PROTECTION SYSTEMS

Environment protection systems.

DECC have advised that no licences are required.

4. QUANTITIES OF DANGEROUS GOODS SCREENING:

Class 2.1 Flammable Gases

The development application indicates that the proposal involves 3,006.9 litres (3.0069m^3) of LPG stored aboveground. From Table 3, if there is less than a total of 16 m^3 stored above ground, the proposal is not *potentially hazardous.* Therefore this is not *potentially hazardous.*

Class 2.2 Non-flammable, Non-toxic Gases

The development application indicates that the proposal involves 2,380 litres (2.38m^3) of non-flammable, non-toxic gases that are not considered to be potentially hazardous with respect to off-site risk.

Class 3 Flammable and Combustible liquids.

The development application indicates that the proposal involves 5,219 litres (5.219m^3) of Flammable liquids, as the packaging group for the flammable liquids has not been nominated PG1 has been applied to all the Class 3 Flammable liquids which is the most stringent requirement. From Figure 8 as there is more than 1 m^3 on site, the 'screening distance' for 5.219 m^3 is determined as approximately 9 m from the boundary. The development application indicates that the storage area is greater than 9 m from the site boundary. Therefore this is not *potentially hazardous.*

Class 4.1 Flammable solids.

The development application indicates that the proposal involves 0.5 L. From Table 3, if there is less than a total of 5 tonnes stored, the proposal is not *potentially hazardous.* Therefore this is not *potentially hazardous.*

Class 5.1 Oxidizing agents.

The development application indicates that the proposal involves 1,175.5 kg. From Table 3, if there is less than a total of 5 tonnes stored, the proposal is not *potentially hazardous.* Therefore this is not *potentially hazardous.*

Class 6.1 Toxic (Poisonous) Substances.

The development application indicates that the proposal involves 440.5 kg stored. From Table 3, if there is less than a total of 500 kg is stored, the proposal is not *potentially hazardous.* Therefore this is not *potentially hazardous.*

Class 8 Corrosive Substances.

The development application indicates that the proposal involves 298.6 litres ($0.2986m^3$) stored. From Table 3, if there is less than a total of 5 m^3 stored above ground, the proposal is not *potentially hazardous.* Therefore this is not *potentially hazardous.*

Class 9 Miscellaneous.

The development application indicates that the proposal involves 2.5 litres ($0.0025m^3$) of miscellaneous products that are not considered to be potentially hazardous with respect to off-site risk.

5. CONCLUSIONS:

Based upon the assessment of this report in relation to the dangerous goods stored on site the proposal is not considered as *potentially hazardous.*

6. GLOSSARY OF ABBREVIATIONS.

SEPP: State Environmental Planning Policy

APPENDIX A

Tomago - Chemical Register

Last updated: 09/11/2007

Product Name	Location	Supplier	Hazardous Substance?	Dangerous Goods	DG Class	Colour Rating	Quantity in Litres	MSDS Date	Infosafe #	On Infosafe
ELC (Extended Life Coolant) CONCENTRATE	Coolant Area	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	4025			
16334 ELC (Extended Life Coolant) PREMIX 50/50	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	7400			
DIESEL			Yes	No		Amber	4265			
KEROSENE			Yes	Yes	3	Amber	1250			
Cerium (IV) Sulphate Solution 0.1N	Coolant Area	MERCK PTY LTD	Yes	No		Amber	1L			
ACETIC ACID GLACIAL (APS CHEMICALS)	Corrosives	APS CHEMICALS	Yes	Yes	8 & 3	Red	2.5L			
AMMONIUM CERIUM SULPHATE 0.1 MOL/LANALAR VOLUMETRIC SOLUTION	Corrosives	MERCK PTY LTD	Yes	Yes	8	Red	1.1L			
CHROMIC ACID	Corrosives	APS CHEMICALS	Yes	Yes	5.1 & 8	Red	2.5L			
DUROFIX-2 POWDER	Corrosives	STRUERS A/S	Yes	No		Amber	1L			
HYDROCHLORIC ACID 32%	Corrosives	APS CHEMICALS	Yes	Yes	8	Red	2.5L			
NITRIC ACID 62% SOLUTION	Corrosives	WESFARMERS CSBP LTD	Yes	Yes	5.1 & 8	Red	2.5L			
ROWE ACETOUS SOLUTION	Corrosives	ROWE SCIENTIFIC	Yes	Yes	8 & 3	Red	8L			
ROWE STANDARDISATION SOLUTION (TBN)	Corrosives	ROWE SCIENTIFIC	Yes	Yes	3 & 8	Amber	2.5L			
ROWE TITRATION SOLVENT (TBN)	Corrosives	ROWE SCIENTIFIC	Yes	Yes	3 & 8	Amber	70L			
SODIUM HYDROXIDE	Corrosives	APS CHEMICALS	Yes	Yes	8	Red	2L			
SODIUM PERCHLORATE MONOHYDRATE	Corrosives	APS CHEMICALS	Yes	Yes	5.1	Amber	0.5L			
SULPHURIC ACID (34% SOLUTION)		WESFARMERS CSBP LTD	Yes	Yes	8	Red	10			
SULPHURIC ACID (98% SOLUTION)	Corrosives	WESFARMERS CSBP LTD	Yes	Yes	8	Red	30			
HYDROFLOURIC ACID			Yes	Yes	8 & 6.1	Red	20			
DICHLOROMETHANE (METHYLENE CHLORIDE)	Flammable Cabinet	APS CHEMICALS	Yes	Yes	6.1	Amber	20			
DPX MOUNTANT FOR MICROSCOPY	Flammable Cabinet	MERCK PTY LTD	Yes	Yes	3	Amber	0.5			
ETHANOL 96% GPR	Flammable Cabinet	MERCK PTY LTD	Yes	Yes	3	Amber	5L			
ETHYLENE GLYCOL	Flammable Cabinet	APS CHEMICALS	Yes	Yes	9	Amber	2.5L			
HEXANE (EXTRACTION GRADE)	Flammable Cabinet	SHELL COMPANY OF AUSTRALIA	Yes	Yes	3	Amber	3.5L			
METHYLATED SPIRITS	Flammable Cabinet	APS CHEMICALS	Yes	Yes	3	Amber	205			
ROWE POTASSIUM HYDROXIDE 0.1M STANDARD ALCOHOLIC (TAN)	Flammable Cabinet	ROWE SCIENTIFIC	Yes	Yes	3	Amber	3.5L			
SOLVENT ROWE TITRATION (TAN)	Flammable Cabinet	ROWE SCIENTIFIC	Yes	Yes	3	Amber	27			
SODIUM CHROMATE	Flammable Cabinet	APS CHEMICALS	Yes	Yes	6.1	Red	0.5L			
SULPHUR POWDER	Flammable Cabinet	APS CHEMICALS	No	Yes	4.1	Amber	0.5L			
TOLUENE	Flammable Cabinet	APS CHEMICALS	Yes	Yes	3	Amber	40L			
XYLENE	Flammable Cabinet	BP AUSTRALIA LIMITED	Yes	Yes	3	Amber	1L			
PAINT E 427 SUPERSHEEN SPRAYING ENAMEL	Parts	CAMELEON PAINTS	Yes	Yes	3	Amber	975			
PAINT ACRYLIC			Yes	Yes	3	Amber	20			
PAINT INTERLAC 649 NEW WESTRAC YELLOW	Parts	INTERNATIONAL PAINT (AUS)	Yes	Yes	3	Amber	475			
PAINT PAVECOAT CONCRETE SEALER	Parts	NUTECH PAINT	Yes	Yes	3	Amber	335			
PAINT QD SATIN BLACK	Parts	CAMELEON PAINTS	Yes	Yes	3	Amber	75			
PRIMER			Yes	Yes	3	Amber	44			
THINNERS E243	Parts	CAMELEON PAINTS	Yes	Yes	3	Amber	1150			
ACRYLIC THINNERS	Parts	S & S INDUSTRIES	Yes	Yes	3	Amber	60			
CAT CHAIN & CABLE LUBRICANT AEROSOL	Parts	CATERPILLAR OF AUSTRALIA	No	Yes	2.1	Green	52			
AEROGAURD LOW SCENT PERSONAL INSECT REPELLANT AEROSOL	Parts	RENCKITT BENCKISER (AUSTRALIA) PTY LTD	Yes	Yes	2.1	Green	8			

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Product Name	Location	Supplier	Hazardous Substance?	Dangerous Goods	DG Class	Colour Rating	Quantity in Litres	MSDS Date	Infosafe #	On Infosafe
CATERPILLAR ANTIFREEZE DILUTED	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	2500			
CATERPILLAR COOLING SYSTEM CONDITIONER	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	20			
BLACK MUFFLER PAINT	Storage Shed	VALSPAR CORP (USA)	Yes	Yes	3	Amber	25			
CALIBRATION FLUID (CAT)	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	75			
CAT BEARING MOUNT COMPOUND	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	1			
CAT BLACK PAINT GLOSS	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	Yes	3	Amber	2.5			
CAT DEAC ANTIFREEZE COOLANT	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	60			
CAT DESERT GOLD GREASE	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	15KG			
CAT RTV SILICONE SEALENT	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	4KG			
CAT YELLOW PAINT AEROSOL	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	Yes	2.1	Amber	500KG			
REFRIDGERANT OIL HIGH VISCOSITY (CAT)	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	2.5			
CATERPILLAR THREAD LOCK	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	2			
CEMENT	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	Yes	3	Amber	35			
COOLING SYSTEM CLEANER	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	Yes	8	Amber	100			
EPOXY RESIN	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	2			
THREADLOCKER HIGH STREBGTH	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	420			
LIQUID NITROGEN		BOC	No	Yes	2.2	Amber	10 G SIZE CYLINDERS			
NITROGEN COMPRESSED	Storage Shed	LINDE GAS	NO	Yes	2.2	Amber	9 G SIZE CYLINDERS			
NITROGEN COMPRESSED	Storage Shed	LINDE GAS	NO	Yes	2.2	Amber	1 D SIZE CYLINDERS			
OXYGEN COMPRESSED			No	Yes	2.2 & 5.1	Green	23 G SIZE CYLINDERS			
OXYGEN COMPRESSED			No	Yes	2.2 & 5.1	Green	2 D SIZE CYLINDERS			
PROPANE		BOC	No	Yes	2.1	Amber	2.9KG			
ULTRA BLUE TRV SILICONE	Storage Shed	CATERPILLAR OF AUSTRALIA	Yes	No		Amber	30			
ANTI RUST PROTECTANT			Yes	Yes	3	Amber	60			
PSX PART A			Yes	No		Amber	44			
PSX PART B			Yes	Yes	3	Amber	21			
DUTHIN 700			Yes	Yes	3	Amber	40			
SEPTOME (GLEME)			Yes	No		Amber	19			
ACETYLENE			No	Yes	2.1	Amber	15 G SIZE CYLINDERS			
ACETYLENE			No	Yes	2.1	Amber	1 T SIZE CYLINDERS			
ACETYLENE			No	Yes	2.1	Amber	3 D SIZE CYLINDERS			
AGROSHIELD			No	Yes	2.1	Amber	9 G SIZE CYLINDERS			

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Product Name	Location	Supplier	Hazardous Substance?	Dangerous Goods	DG Class	Colour Rating	Quantity in Litres	MSDS Date	Infosafe #	On Infosafe
HYDROGEN COMPRESSED			No	Yes	2.1	Green	12 G SIZE CYLINDERS			
TRICHLOROETHANE			Yes	Yes	6.1	Amber	200			
TRICHLOROETHYLENE			Yes	Yes	6.1	Amber	200			
RUSTILO			Yes	Yes	3	Amber	240			
LPG (LIQUID PETROLEUM GAS)			Yes	Yes	2.1	Amber	1 G SIZE CYLINDERS			
LPG (LIQUID PETROLEUM GAS)			Yes	Yes	2.1	Amber	2 X 45 KG			
LPG (LIQUID PETROLEUM GAS)			Yes	Yes	2.1	Amber	1 X 20 KG			
PENETRATING OIL (BULK 5.56 CRC)			No	Yes	2.1	Amber	580			
LUBRICOOL BLUE			Yes	No		Amber	200			
BRAKE CLEANER			Yes	Yes	2.1	Amber	20			
CLEANTREAT			Yes	Yes	8	Amber	45			
UNLEADED PETROL			Yes	Yes	3	Amber	20			
ARDROX			No	Yes	2.1	Amber	72			
ARDROX AEROSOL			Yes	Yes	2.1	Amber	82			
HELIUM COMPRESSED			No	Yes	2.2	Amber	5 G SIZE CYLINDERS			
ROUNDUP			Yes	No		Amber	10			
FUEL ZOOM 50 2 STROKE			Yes	Yes	3	Amber	3			
TECTYL			Yes	Yes	3	Amber	20			