STORMWATER MANAGEMENT & TRUNK DRAINAGE STRATEGY LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT

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STORMWATER MANAGEMENT AND TRUNK DRAIANGE STRATEGY
LOT 5 DP 262213
ROPES CREEK EMPLOYMENT PRECINCT

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STORMWATER MANAGEMENT AND TRUNK DRAINAGE STRATEGY

LOT 5 DP 262213
ROPES CREEK EMPLOYMENT PRECINCT

1 INTRODUCTION

This Stormwater Management and Trunk Drainage Strategy has been prepared by Brown Consulting (NSW) Pty Ltd for Jacfin Pty Ltd to support the Proposed Concept and Project Application for the Ropes Creek Employment Precinct within Precinct 6 of the Western Sydney Employment Area (WSEA). The proposed development site is located within the Blacktown local government area as shown in Figure 1.

The study specifically describes the proposed stormwater quantity and quality management system using Water Sensitive Urban Design (WSUD) principles.

1.1 SITE DESCRIPTION

The subject development site known as Lot 5 in Deposited Plan 262213, is a part of 2,450 hectares of land earmarked for SEPP59 – WSEA, which incorporates ten precincts and is located near the intersection of the M4 and M7 motorways.

The Ropes Creek Employment Precinct comprises an area of 105 hectares, located within Precinct 6, which has a total area of 190 hectares. The site is bounded by Ropes Creek to the west, a Transgrid Substation to the east, land owned by Department of Planning to the north, and Sydney Catchment Authority water supply pipeline to the south.

The Ropes Creek site, shown on Figure 1, has historically been utilised as a rural farming area, showing evidence of tillage and soil improvements. The topography of the Site is gently sloping westwards to Ropes Creek. The whole site is cleared grazing land traversed by an E2 Conservation zone through the middle of the site and another in the south western area of the site. The Ropes Creek Corridor is also zoned E2 Environmental Conservation.

From the Transgrid Substation along the eastern boundary of the site, two high voltage transmission lines traverse the site to the west and south west.

1.1.1 Ropes Creek Catchment

Ropes Creek is a tributary of South Creek, part of the Hawkesbury Nepean River system, shown on Figure 2. Ropes Creek flows in a northerly direction to the confluence with South Creek approximately 13.5 kilometres north west of the site in the suburb of Ropes Crossing. The catchment area of Ropes Creek at the location of the Ropes Creek Employment Precinct is 2122 hectares. The land use catchment consists mainly of grassed paddocks and large lot rural residential subdivisions.

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Legend

- SITE EXTENTS
- CADASTRE
- SUBURB BOUNDARY

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

ROPES CREEK INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 1
SITE OVERVIEW

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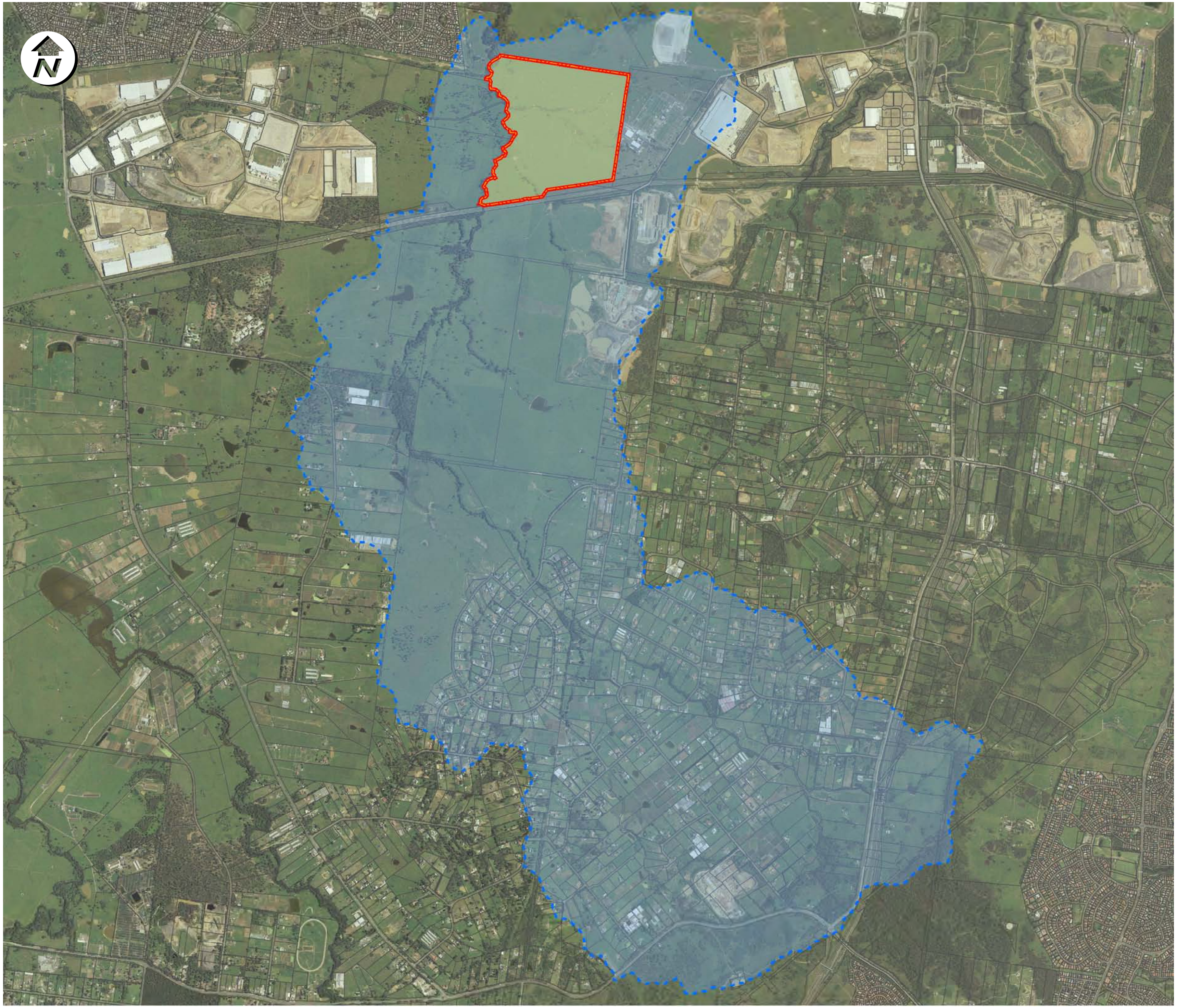
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 01
Issue	A



BROWN CONSULTING

Legend

- CATCHMENTE EXTENTS
- SITE EXTENTS
- CADASTRE

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

ROPES CREEK INDUSTRIAL SUBDIVISION

Drawing Title

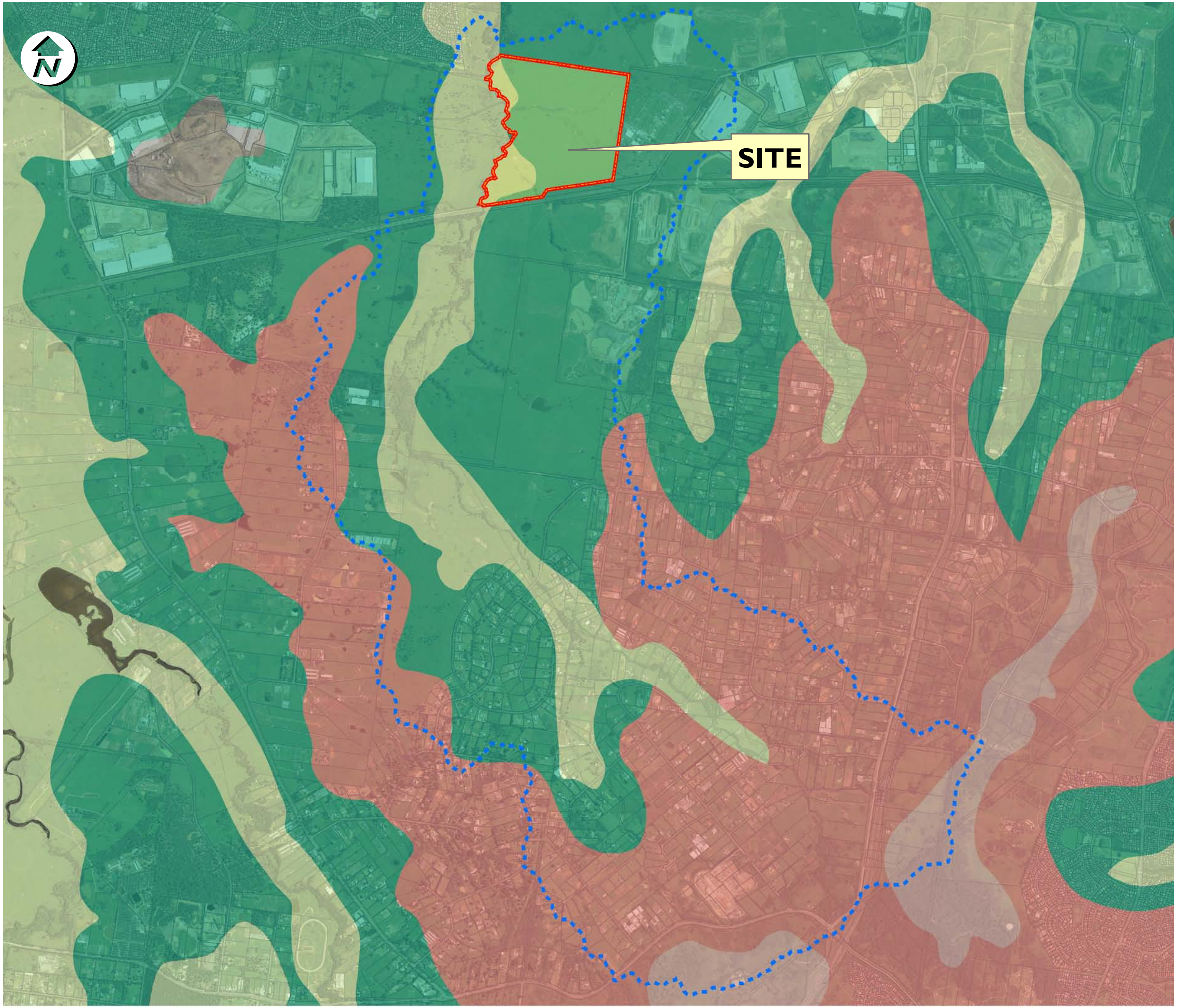
FIGURE 2
CATCHMENT PLAN

Scale	NTS
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 02
Issue	**A**

1.1.2 Soil Types

Soil types in the Ropes Creek catchment were mapped from the *Soil Landscapes of the Penrith 1:100,000 Sheet*, shown on Figure 3. The three main soil landscapes present on the site are:

- **South Creek Soil Landscape (sc)** – a fluvial soil landscape developed in floodplains, valley flats and drainage depressions with erosion channels. The South Creek soils are developed on alluvium derived from Wianamatta Group shales and are often very deep-layered sediments over bedrock or relict soils. Landscape limitations include flood hazard, waterlogging (seasonal or localised), permanently high water tables (localised) and high erosion hazard.
- **Blacktown Soil Landscape (bt)** – a residual soil landscape developed on gently undulating rises with local releif to 30 metres and slopes of less than 5% gradient. The Blacktown soils are derived from Wianamatta and Hawkesbury shales and are shallow to moderately deep. Crests, upper slopes and well drained areas are typically red and brown podzolic soils, with deep yellow podzolic soils located on lower areas of poor drainage. Limitation of these soils are that they are highly plastic, moderately reactive, of low fertility, poor soil drainage, localised salinity and moderate erodibility.
- **Luddenham Soil Landscape (lu)** – an erosional soil landscape developed on undulating to rolling hills with local releif of 50 to 80 metres with slopes of 10 to 20%. Luddenham soils are shallow and derived from Wianamatta Group shales, often associated with resistant sandstone beds. Crests and upper slopes are typically dark podzols and massive earthy clays, with lower slopes and drainage lines moderately deep yellow podzols. Limitations are the highly plastic subsoils of moderate reactivity, low to moderate shrink-swell potential, low to moderate soil fertility and moderate erodibility.



Legend

	SITE EXTENTS
	CADASTRE
	CATCHMENTE EXTENTS
SOIL LANDSCAPE	
	BLACKTOWN
	SOUTH CREEK
	LUDDENHAM
	DISTURBED TERRAIN
	PICTON
	BERKSHIRE PARK

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

ROPES CREEK INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 3
SOIL LANDSCAPE PLAN

Scale	NTS
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 03
Issue	A

1.2 STORMWATER OBJECTIVES OVERVIEW

The aim of this study is to establish a stormwater & trunk drainage strategy based on WSUD principles. The key objectives of this study include:

- Potential impact from the development with respect to stormwater quantity, quality and flooding on site and downstream of the site;
- Linking water infrastructure effectively to minimise the impacts of development upon runoff;
- Protecting downstream receiving waters (e.g. Riparian Corridors) from increased flow rates and water quality degradation; and
- Protect assets and the subdivision from flooding.

The specific objectives of the development application with regards to stormwater quantity management include:

- Attenuate peak storm flows for the 20 and 100 year ARI to existing rates.
- Incorporate safety considerations into the design in terms of batter slopes and ponding depths.
- Minimise potential for damages resulting from flooding

1.3 BACKGROUND – STATE ENVIRONMENTAL PLANNING POLICY (WESTERN SYDNEY EMPLOYMENT AREA) 2009

This Policy aims to protect and enhance the Western Sydney Employment Area for employment purposes. The Policy aims to ensure that development occurs in a logical, environmentally sensitive and cost-effective manner and only after a development control plan (including specific development controls) has been prepared for the land concerned.

This Stormwater Management and Trunk Drainage Strategy furthers the provisions of SEPP 59 by developing design criteria, indicative layouts and diagrams relating to the development of land within the Ropes Creek Employment Precinct. This Strategy incorporates the provisions of relevant Blacktown City Council planning policies into the concept design, integrating the aims, objectives and controls to achieve the outcomes required for consideration in the determination of the development application.

1.4 PROJECT OVERVIEW

The proposal involves the development of Lot 5 DP262213 in the suburb of Eastern Creek for industrial and employment purposes, including the subdivision of the lot, construction of roads and drainage infrastructure and the construction of industrial and employment buildings. An indicative lot and road layout is shown in Figure 4.

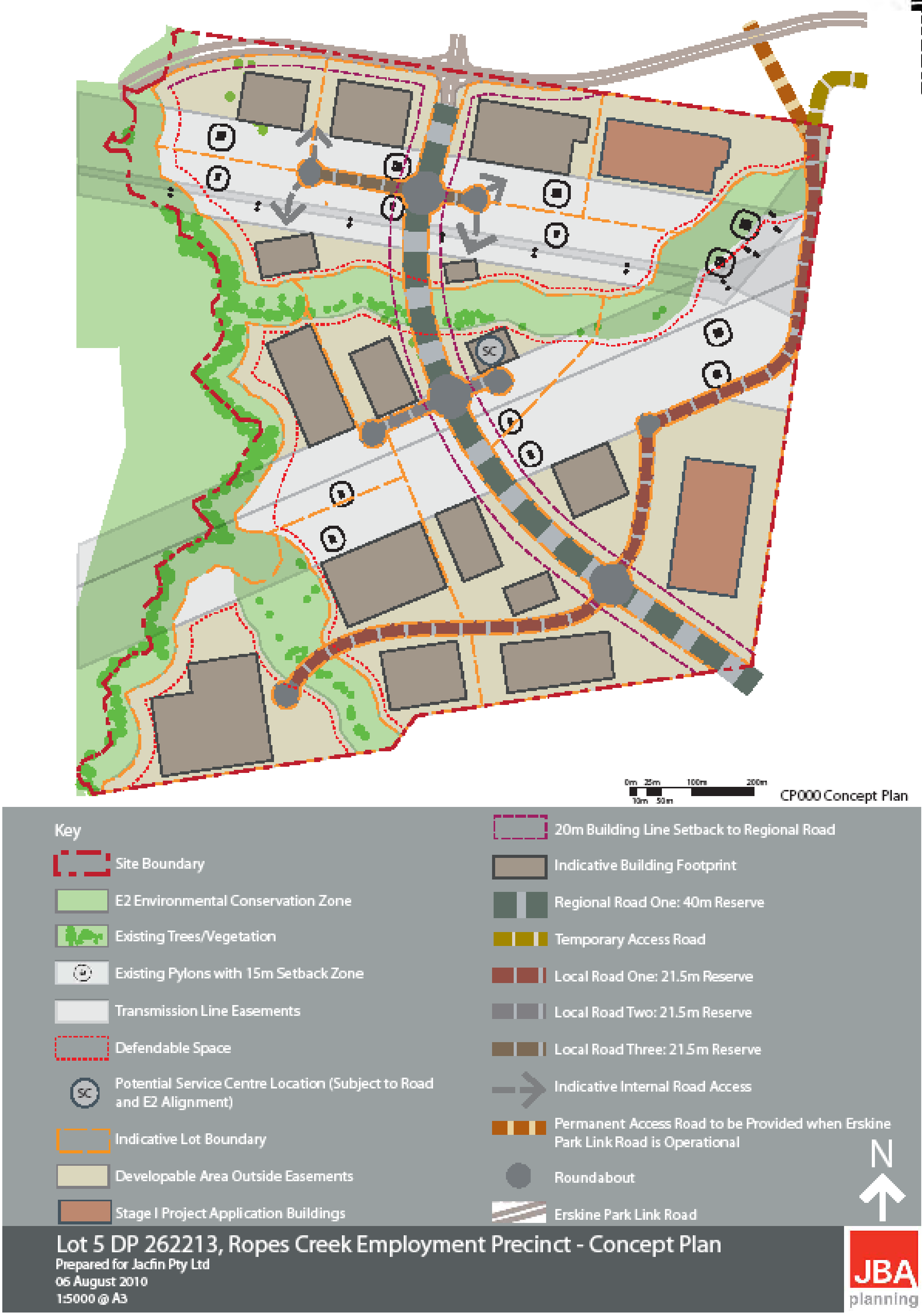


Figure 4 - Indicative Layout Plan

2 DRAINAGE DESIGN CRITERIA

This section outlines the planning context and design criteria relevant to Ropes Creek Employment Precinct. The section provides a brief description of relevant Western Sydney Employment Area and Blacktown City Council publications and concludes with a table that summarises the applicable design criteria. All the documents listed in this section address the key issues of the Director-General's requirements for the project relevant to Stormwater Management and Drainage Strategy.

2.1 STATE ENVIRONMENTAL PLANNING POLICY (WESTERN SYDNEY EMPLOYMENT AREA) 2009

Part 5 of the State Environmental Planning Policy (SEPP59 - WSEA) 2009 specifies the principal development standards. Section 5 of Schedule 4 outlines provisions for flooding.

2.2 *BLACKTOWN CITY COUNCIL – ENGINEERING GUIDE FOR DEVELOPMENT (FEBRUARY 2005),*

This document outlines Blacktown City Council's recommended practice for drainage design. Section 4 Drainage Design and Appendix D Drainage Design Manual of these guidelines specifies drainage design procedures and sets relevant design criteria for design of drainage infrastructure.

2.3 BLACKTOWN CITY COUNCIL (2006) DEVELOPMENT CONTROL PLAN

Part E of this DCP outlines aims and objectives to reduce the impact of flooding and flood liability on individual owners and occupiers for Development in the Industrial Zones.

2.4 GROWTH CENTRES DEVELOPMENT CODE (DEC 2006)

The Development Code by the then Department of Environment and Conservation (DEC) provides the basis for the planning and design of precincts and neighbourhoods. It is intended to be a reference work, to stimulate ideas and provide a guide to best practice.
The Code is a guide for Precinct Planning in the Growth Centres. It is the link to the State Environmental Planning Policy (SEPP) and the Structure Plan principles and design elements set at the high level to improve the built environment. Sections of the Development Code specifically relevant to the design of the Ropes Creek site are:

- B-2 Water Sensitive Urban Design and Stormwater Management (pg B-16); and
- B-3 Riparian Corridors (pg B-31).

2.5 BLACKTOWN CITY COUNCIL (2005a) WORKS SPECIFICATION CIVIL

This specification contains technical design data for the calculation of flows, flood elevations and velocities along with technical standards for the design of drainage structures. The hydrologic parameters include rainfall intensity charts and runoff parameters for flow estimation. The handbook also outlines hydraulic parameters and design requirements for pits, culverts and pipes.

2.6 OTHER RELEVANT SPECIFICATIONS

The documents outlined above are to be read in conjunction with the following.

- AS/NZ3500.3 'Plumbing and Drainage - Stormwater Drainage;
- Australian Rainfall & Runoff (Engineers Australia);
- Australian Runoff Quality (Engineers Australia);
- 'Technical Note: Interim Recommended Parameters for Stormwater Modelling – North-West and South-West Growth Centres';
- Building Code of Australia Housing Provisions (current edition);
- Blacktown City Council's Local Environmental Plan;
- Relevant Blacktown City Council Development Control Plans;
- Managing Urban Stormwater - Soils and Construction (current edition);
- Water Sensitive Urban Design in the Sydney Region Resource Kit (2003);
- Water Sensitive Urban Design Technical Guidelines for Western Sydney (2004);
- NSW Floodplain Development Manual (2005);
- Floodplain Risk Management Guideline – Practical Consideration of Climate Change (DECC) and
- Designing Safer Subdivisions – Guidance on Subdivision Design in Flood Prone Areas - Hawkesbury-Nepean Floodplain Management Strategy Steering Committee, Parramatta, (June 2006)

Table 1 summarises the design criteria applicable to development of the Ropes Creek Employment Precinct, outlines the source of the criteria and provides any comments or departures from the criteria where applicable.

Table 1 Design Criteria

Parameter	Requirement			Source/Reference	Comments/ Departures
IFD data	2 year 1 hour 2 year 12 hour 2 year 72 hour 50 year 1 hour 50 year 12 hour 50 year 72 hour F2 F50 skew		30.6 6.58 1.97 59.0 12.9 4.33 4.30 15.81 0.0	Appendix D, Table 3.0 (BCC EGD Feb 2005)	Nil
Recurrence interval year (%AEP)	Piped drainage Major Flow Natural or Constructed Watercourses 5yr, 20yr, 100yr + PMF		20 year (5% AEP) 100 year (1% AEP)	Appendix D, 1.1 (BCC Engineering Guide for Development 2005) 9.3 Appendix D, (BCC Engineering Guide for Development 2005)	Nil
XP RAFTS hydrologic modelling parameters	Initial Loss Continuing Roughness	Pervious impervious Pervious impervious Pervious impervious	25 mm 1 mm 2.5 mm 0 mm 0.035 0.015		Nil
DRAINS hydrologic modelling parameters	Paved initial storage Paved continuing storage Grassed initial storage Grassed continuing storage Soil Type MAC Kinematic Roughness coefficient n* Road/Paved Area Parkland/grassed		1 mm 0mm/hr 5-10mm 2-5mm/hr 3 3 0.01 0.15	Table 1 Section 3.5.2 PCC 1997	Not used in this report – parameters are set for detailed design stage

Table 1 (cont.) Design Criteria

Parameter	Requirement		Source/Reference	Comments/ Departures
Table 2 Design Criteria				
Rational Method hydrologic parameters	Region B		ARR 1987	Nil
	C_{10}	0.845		
	FF_1	0.80		
	FF_2	0.85		
	FF_5	0.95		
	FF_{10}	1.00		
	FF_{20}	1.05		
	FF_{50}	1.15		
	FF_{100}	1.20		
Freeboard to overland flow level (mm)	Floor Level Land Level	300 N/A	Appendix D, 1.5 (BCC EGD Feb 2005)	Nil
Freeboard to Onsite Detention flow level (mm)	Floor Level Land Level	200 N/A	Appendix D, 1.5 (BCC EGD Feb 2005)	Nil
Freeboard to Trunk Drainage, Creeks and open channels (mm)	Floor Level Land Level	500 500	Appendix D, 1.5 (BCC EGD Feb 2005)	Nil
Gutter level	to be above 100 year elevation		Section 1.5 and Figure 1.1 BCC (2005) Appendix D	Nil
Blockage factor – grated pit	Kerb Inlet Grated Inlet	10% 30%	Appendix D, 4.3 (BCC EGD Feb 2005)	Nil
Velocity Depth product for overland flow on road	< 1.0 m^2/s for 100 year within road		Section 1.5 and Figure 1.1 BCC (2005) Appendix D	Nil

Table 1 (cont.) Design Criteria

Parameter	Requirement	Source/Reference	Comments/ Departures
Pipe Friction Coefficients (Mannings roughness n)	SRCP 0.012 FRC 0.011 UPVC 0.01	Appendix D, 6.0 (BCC EGD Feb 2005) AS/NZS 2179.2 AS/NZS 3500.3:2003 Table 5.5	Nil
Minimum gradient (pipe)	90 mm 1:100 100 mm 1:100 150 mm 1:100 225 mm 1:200 300 mm 1:250	AS/NZS 3500.3:2003 7.3.5 Table 7.2	Nil
Connection to Council Pipe	Pipe Extension min. diam . 375mm RCP	3.1.6 (FCC SDP Sept 2002)	Nil
Surface Inlet Pits	Depth(mm) <600 600-900 900-1200 >1200	Min Size(mm) 450x450 600x600 600x900 900x900	AS/NZS 3500.3: 2003 Table 8.2
Pipe Cover	Minimum Cover 300mm	4.7 (BCC EGD Feb 2005)	Nil
Minimum Pavement Grade	1:100		Nil
Plan scale	Small Sites 1:200 Large Scale 1:500	2.8 (BCC EGD Feb 2005)	Nil
MUSIC water quality modelling parameters			
Water Quality Pollutant Removal Targets (% removal)	Gross Pollutants 90 Total Suspended Solids 85 Total Phosphorous 65 Total Nitrogen 45	GCC 2006	Nil
Rainwater Tanks	Required for development to be approved by the Director-General	Part 5 Section 22 SEPP	Nil

3 PRE-DEVELOPMENT FLOW RATES

3.1 METHODOLOGY

The hydrologic modelling software *XP-RAFTS* (Version 9) was used for hydrological analysis of the site, including the wider Ropes Creek catchment. An *XP-RAFTS* model was developed of the existing catchment to obtain pre-development flows in order to set discharge limits for the developed catchment.

3.1.1 Ropes Creek XP-RAFTS Hydrological Model

The *XP-RAFTS* hydrological model of the entire Ropes Creek catchment was used to develop flow rates for existing conditions and for analysis of developed conditions. The layout of the model is presented on Figure 5.

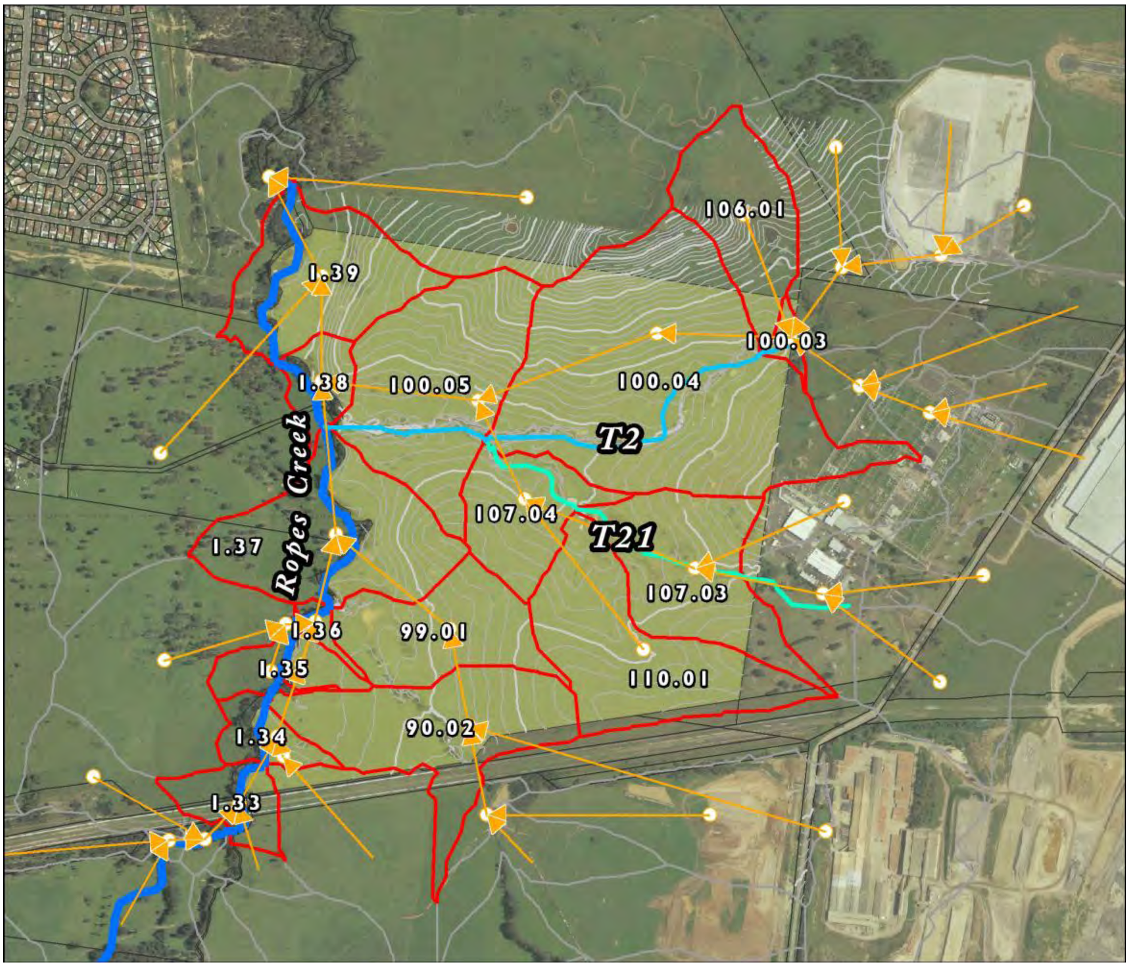


Figure 5 – *XP-RAFTS* Model Layout Plan

The Ropes Creek site, shown on Figure 1, has historically been utilised as a rural farming area, showing evidence of tillage and soil improvements. The topography of Ropes Creek is gently sloping westwards to Ropes Creek. The whole site is cleared grazing land. The Ropes Creek Corridor and areas along two creek lines are zoned E2 Environmental Conservation.

3.1.2 Hydrological Survey Sources

A digital elevation model was developed for the Ropes Creek catchment, including the Ropes Creek Employment Precinct, using 5 metre grided LIDAR data provided by the NSW Department of Lands.

3.1.3 Hydrological Model Parameters

The parameters used in the modelling of Ropes Creek catchment including the Ropes Creek Employment Precinct are provided in Table 1. These parameters have been determined by Brown Consulting in accordance with the procedures contained within Australian Rainfall and Runoff. Brown Consulting has used these parameters in *XP-RAFTS* models developed for catchments within Western Sydney and specifically within the Western Sydney Employment Area that have been approved by the Growth Centres Commission.

Manning values used in the catchments were 0.015 for the impervious fraction and 0.035 for the pervious fraction, representing urban and well grazed pasture landuses. The impervious fractions used for each landuse included 5% for open space areas and 100% for industrial/commercial areas.

3.1.4 Pre-developed Flow Rates

Flow rates for existing conditions were developed in the *XP-RAFTS* hydrologic modelling program using the parameters specified in Table 1. Storm durations from 5 minutes to 12 hours were analysed, with the results of total runoff from the Ropes Creek Employment Precinct for the 20 and 100 year recurrence interval presented in Table 2.

Table 2 Existing Condition Peak Flows and Total Catchment Areas

Node	*Peak Flow (m³/s)*		*Total Catchment Area (ha)*
	20 year	*100 year*	
RopesCk. - South Boundary (Node **1.33**)	165.2	209.7	1701.4
T3 - (Node **99.01**)	14.5	20.6	8.4
T21 - East Boundary (Node **107.03**)	4.7	6.8	41.5
T21 - (Node **107.04**)	6.4	9.4	61.1
T2 - East Boundary (Node **100.03**)	9.3	13.8	72.5
T2 – (Node **100.05**)	18.9	28.4	186.5
RopesCk. - (Node **1.37**)	183.3	232.9	1897.7
RopesCk. - North Boundary (Node **1.39**)	204.9	260.3	2121.7

The results in Table 2 show that pre-development critical storm for the 20 and 100 year ARI storms is a 9 hour duration along Ropes Creek. However, within the site the critical storm durations are the 2 hour and 4.5 hour. These peak flow rates in Table 2 will be used as the permissible site discharge rate for the design of the stormwater management system for the Ropes Creek Employment Precinct.

3.1.5 Calibration/Validation

The runoff parameters specified by Brown Consulting were applied to the *XP-RAFTS* model to estimate flows from the catchment for the 20 and 100 year ARI peak storm events. For the calibration, the Probabilistic Rational Method was used to estimate the flow for comparison to flows calculated using the *XP-RAFTS* model. The results of the flow calculations for the peak storm events for the total 2122 hectare area of the Ropes Creek catchment are presented in Table 3.

Table 3 Ropes Creek Employment Precinct XP-RAFTS and PRM Runoff Calculations

Average Recurrence Interval (years)	*XP-RAFTS Hydrologic Model Flow (m^3/s)*	*Probabilistic Rational Method Flow (m^3/s)*
20	204.9	153.6
100	260.3	228.4

The results in Table indicate that using the runoff parameters specified by Brown Consulting in Table 1 and used in the *XP-RAFTS* model generates larger flow estimates (30% for 20 year ARI and 12.5% for 100 year ARI) as using the Probabilistic Rational Method withBlacktown City Council specified parameters. Therefore at this stage, as a conservative approach, it is appropriate to use the XP-RAFTS results, for all hydrologic calculations undertaken in the design of drainage and detention infrastructure for Ropes Creek and the Ropes Creek Employment Precinct.

3.1.6 Post-developed Flow Rates

Flow rates for developed conditions were calculated in the *XP-RAFTS* hydrologic modelling program and are based on the Concept Plan. Sub-catchments were modelled using imperviousness between 50% and 90%. Storm durations from 5 minutes to 12 hours were analysed, with the results of total runoff from the Ropes Creek Employment Precinct for the 100 year recurrence interval presented in Table 4.

Table 4 Developed Conditions Peak Flows

Node	***Peak Flow** (m³/s)*	
	20 year	***100 year***
RopesCk. - South Boundary (Node **1.33**)	165.0	209.7
T3 - (Node **99.01**)	14.9	20
T21 - East Boundary (Node **107.03**)	4.6	6.8
T21 - (Node **107.04**)	10	12.2
T2 - East Boundary (Node **100.03**)	9.9	14.7
T2 – (Node **100.05**)	21.6	29
RopesCk. - (Node **1.37**)	184	233.5
RopesCk. - North Boundary (Node **1.39**)	208	263.6

The post-development peak flows for both 20 and 100 ARI storm event are from a 9 hour critical duration storm along Ropes Creek, while within the study area critical storm durations are 2 hour and 4.5 hour.

From the results presented in Table 2 and 4, detention is required to bring the post development flows to pre development levels. This is discussed in section 6.1 of this report.

4 FLOODING ANALYSIS

An analysis of flooding in Ropes Creek and local drainage within the Ropes Creek Employment Precinct was undertaken to assess the constraints caused by flooding and to develop flood planning levels (FPL) and road levels. Flow rates in Ropes Creek and tributaries were developed utilising parameters from modelling undertaken for investigations that have previously been submitted to the Growth Centres Commission, as discussed in Section 3.1.3. The hydraulic modelling software *SOBEK* was used to map flood extents for the 100 year ARI storm event.

4.1 METHODOLOGY

The hydraulic modelling of Ropes Creek and the local tributaries through the Ropes Creek Employment Precinct has been undertaken in *SOBEK* (Version 2.11.002) developed by Delft Hydraulics. This model enables efficient integration between river hydraulics, where flow can be considered 1D, and the floodplain where flows and associated storage effects are best described by a 2D model. Figure 6 shows the river and floodplain elements as treated by *SOBEK*. The 1D element is represented by a cross section which bisects the 2D surface, which is represented by a raster surface (often referred to as a Digital Elevation Model – DEM). *SOBEK* allows stacked raster grids of varying resolution to derive a surface detailed with the required accuracy.

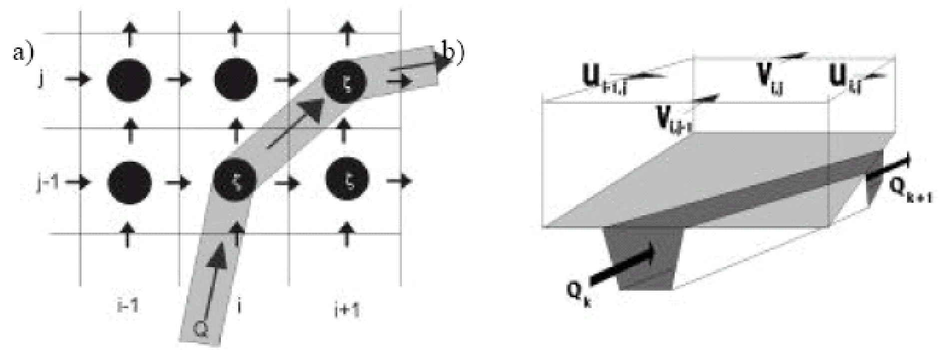


Figure 6 - Schematic Representations of the Integrated 1D/2D SOBEK Hydraulic Model

4.1.1 Survey Sources

Survey for the study area included ground survey from RPS which was used to form a TIN (triangular irregular network) from which a digital elevation model with 5 metre grid spacing was imported into *SOBEK* using the *12d* software package. The survey included spot levels taken across the floodplain along with relevant hydraulic features such as embankments, changes in bank and bed levels, and floodplain elevation.

4.1.2 Roughness

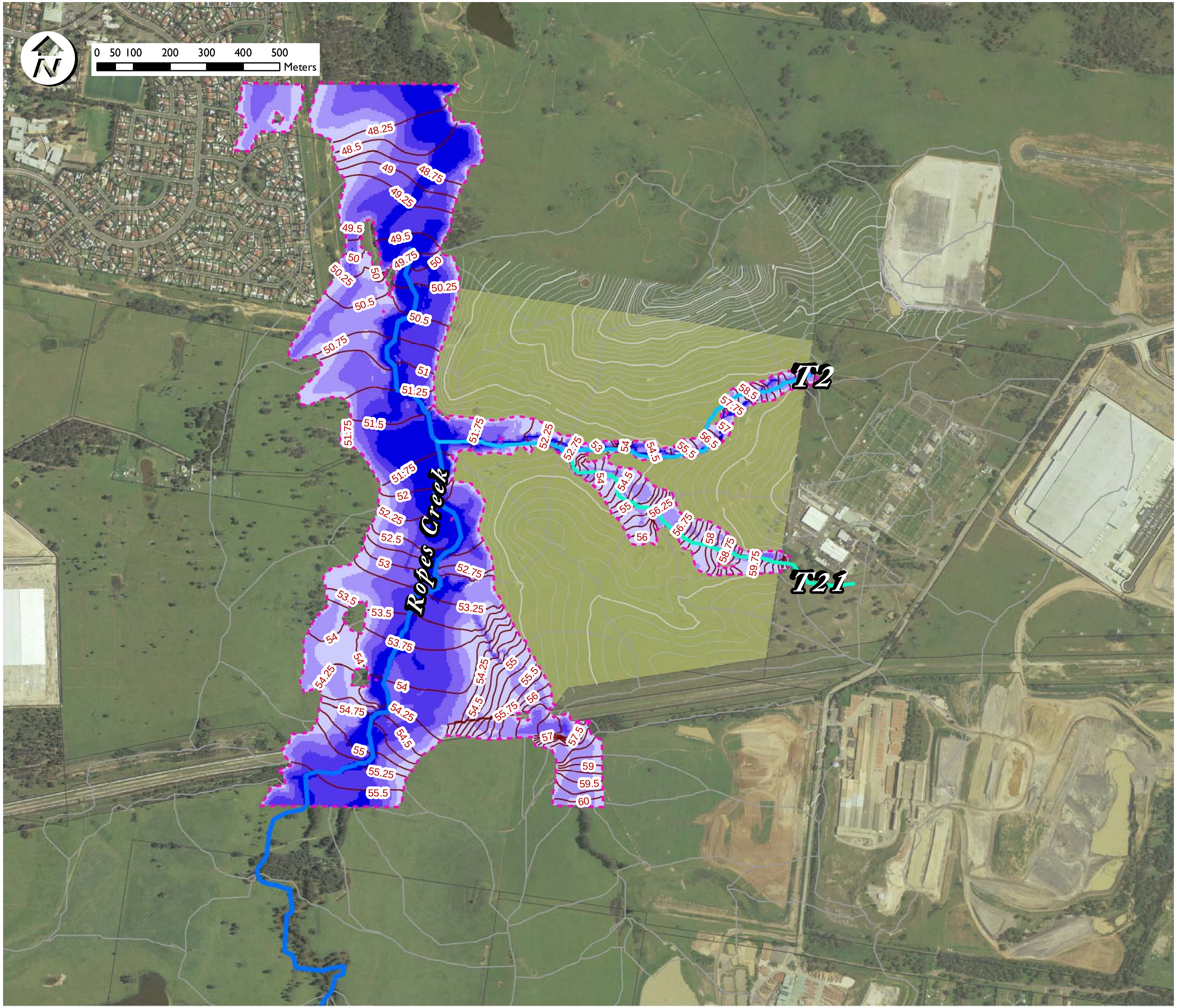
A uniform Manning's roughness value was described across the entire Ropes Creek model for the flood estimation. This coefficient of 0.035 for overbank/floodplain roughness and channel roughness was used based on values presented in Table 1.

4.2 EXISTING FLOOD EXTENTS

The existing 100 year flood extents, flood depth and flood surface elevations were calculated using *SOBEK* hydraulic modelling program. The 100 year flood extents within the Ropes Creek Employment Precinct are presented in Figure 7 with flood hazard mapped on Figure 8.

The *SOBEK* modelling has shown that the 100 year ARI flood levels vary from RL 57 m AHD in the location of the existing farm dam, to RL 48 m AHD at the downstream boundary of the site. Flood depths in the area of the Ropes Creek Employment Precinct for pre-development conditions range over the site.

The results show that the 100 year flood extends onto the proposed location of the lots in the Ropes Creek Employment Precinct.



BROWN CONSULTING

Legend

- 2m CONTOUR
- 5m CONTOUR
- CREEK - Ropes
- CREEK - T2
- CREEK - T21
- CATCHMENTS
- CADASTRE
- 100Y ARI PEAK EXTENTS

100Y ARI PEAK FLOOD DEPTH

Depth in Metres

- 0.00 - 0.20
- 0.21 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 3.76
- PEAK WSEL CONTOUR .25m

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

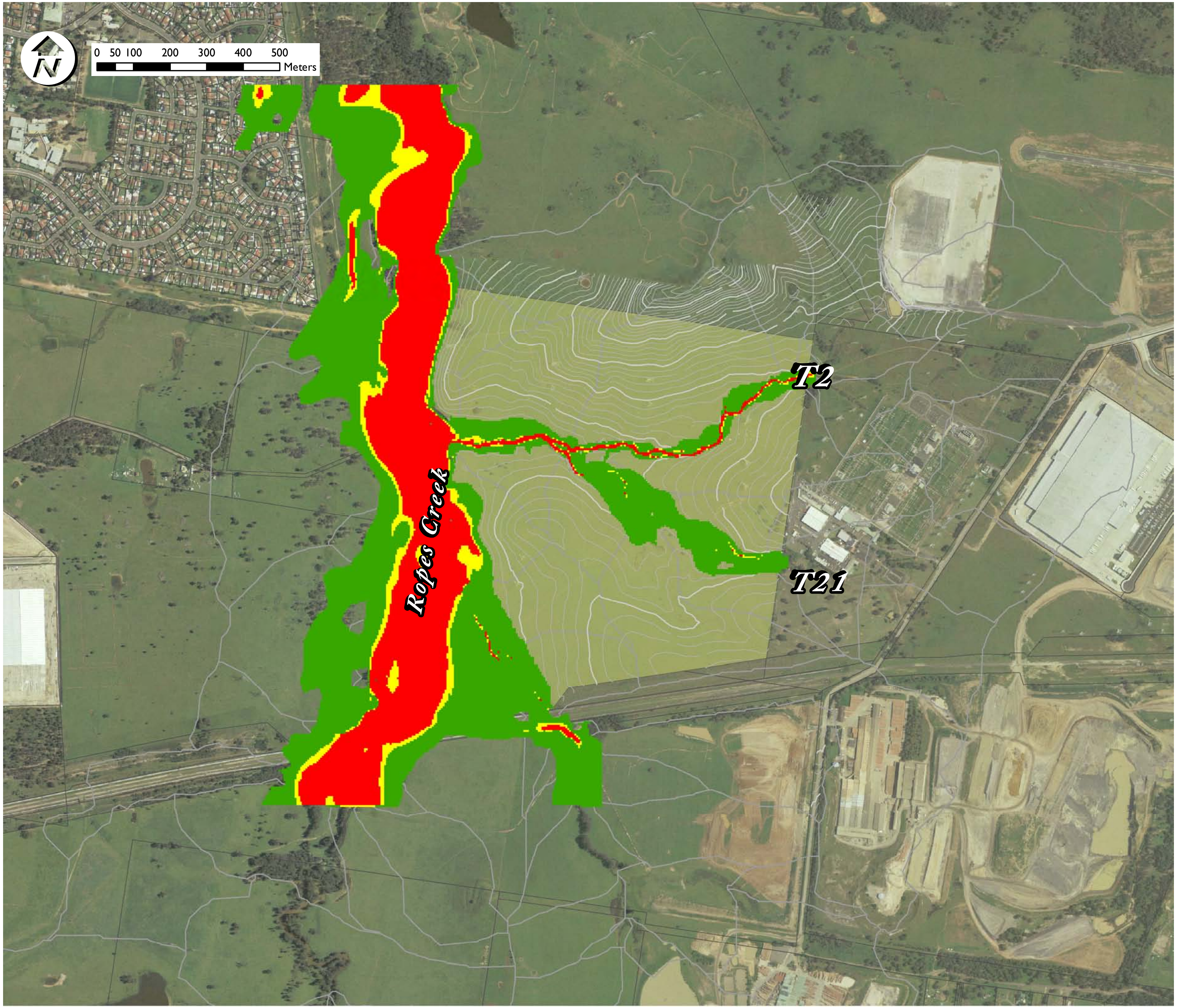
Project

ROPES CREEK
INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 7
100YEAR ARI PEAK
FLOOD EXTENTS
EXISTING CONDITIONS

Scale	1:10000@A3
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 07
Issue	**A**



BROWN CONSULTING

Legend

2m CONTOUR
5m CONTOUR
CATCHMENTS
CADASTRE

100Y ARI PEAK HAZARD

Velocity Depth Product

< 0.40
0.41 - 0.60
> 0.60

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

ROPES CREEK
INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 8
100YEAR ARI PEAK
FLOOD HAZARD
EXISTING CONDITIONS

Scale	1:10000@A3
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 08
Issue	**A**

4.3 PRELIMINARY DEVELOPED FLOOD EXTENTS

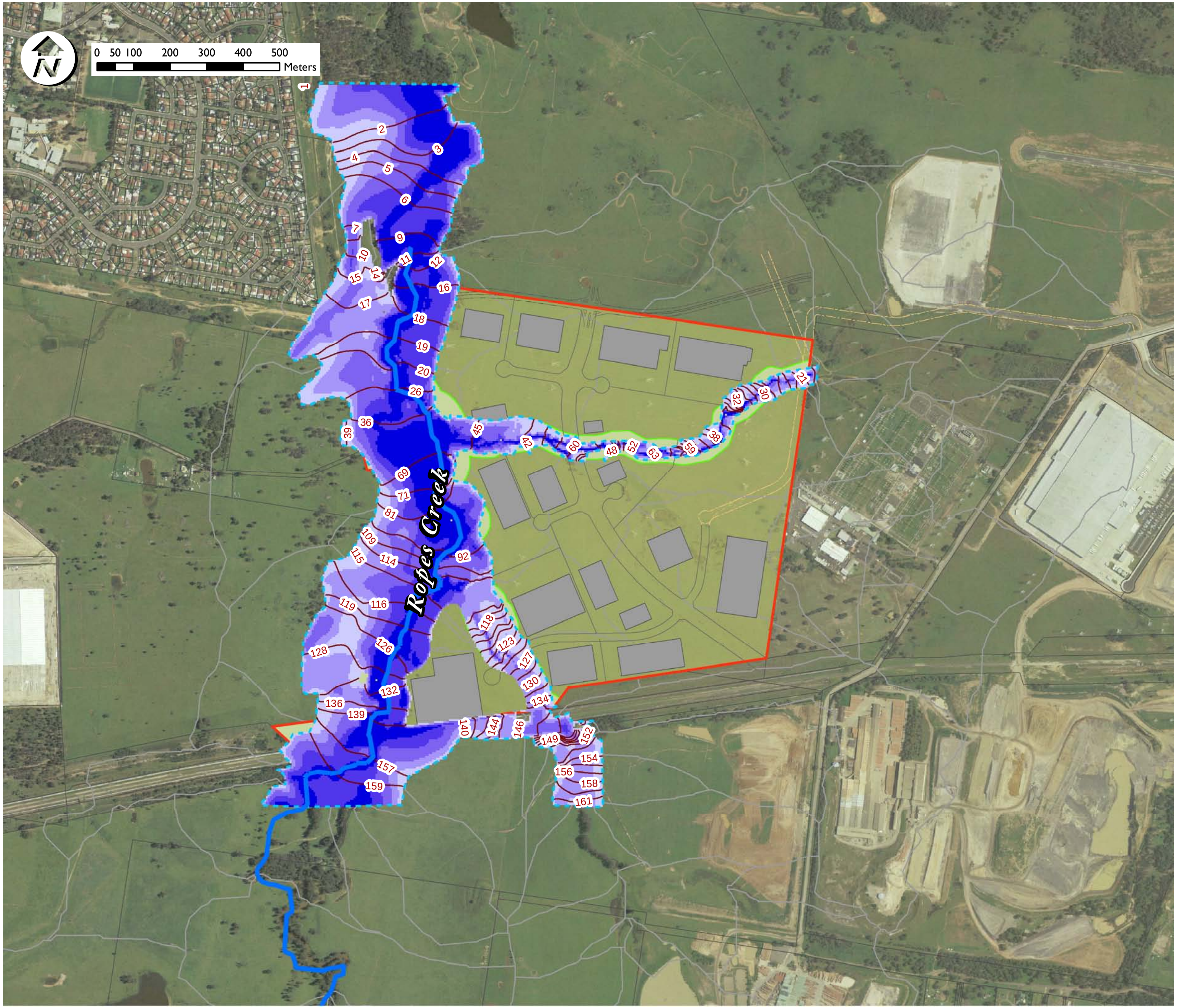
Preliminary building pads were modelled using the earthworks modelling program *12d* (Version 9) with pad levels set above the 100 year flood elevation.

The preliminary developed 100 year flood extents, flood depth and flood surface elevations were calculated using *SOBEK* hydraulic modelling program. The 100 year flood extents within the Ropes Creek Employment Precinct are presented in Figure 9 with preliminary flood hazard mapped on Figure 10.

The flood extents are contained within the E2 Conservation zones.

4.4 FLOOD PLANNING LEVELS & ROAD LEVELS

The minimum industrial buildings floor level will be 500 millimetres above the 100 year ARI flood level. All roads will be located above the 100 year ARI flood level. Preliminary road levels are presented on drawing set X10134.000-402.



BROWN CONSULTING

Legend

- BUILDINGS - Proposed
- RIPARIAN ZONE
- CREEK - Ropes
- CATCHMENTS
- CADASTRE
- 100Y ARI PEAK EXTENTS

100Y ARI PEAK FLOOD DEPTH

Depth in Metres

- 0.00 - 0.20
- 0.21 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 3.71
- WSEL CONTOUR .25m

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

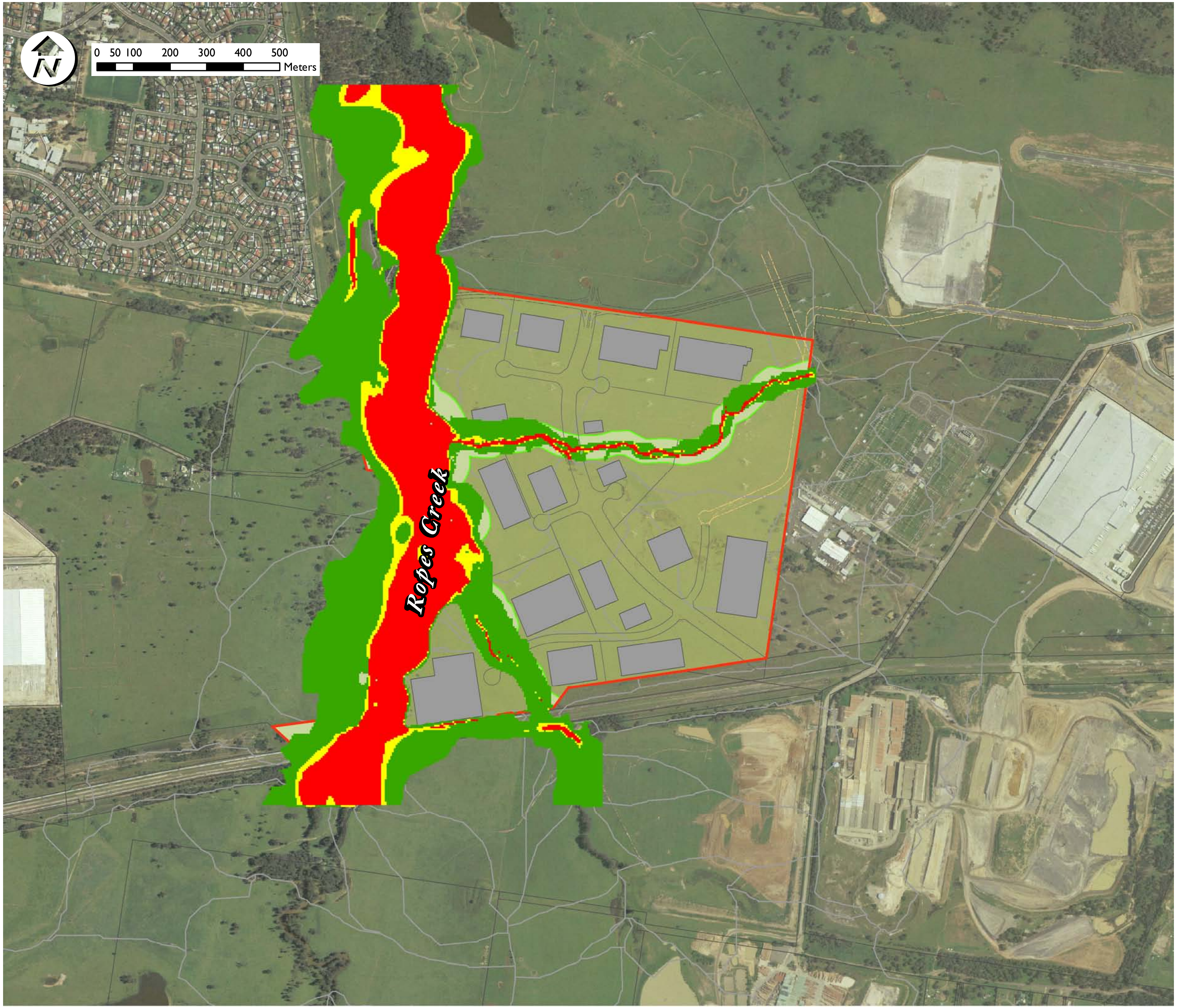
ROPES CREEK
INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 9
100YEAR ARI PEAK
FLOOD EXTENTS
DEVELOPED CONDITIONS

Scale	1:10000@A3
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 09

Issue **A**



BROWN CONSULTING

Legend

- CADASTRE
- CATCHMENTS
- BUILDINGS Proposed
- RIPARIAN ZONE

100Y ARI PEAK HAZARD

Velocity Depth Product

- < 0.40
- 0.41 - 0.60
- > 0.60

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

ROPES CREEK INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 10
100YEAR ARI PEAK FLOOD HAZARD DEVELOPED CONDITIONS

Scale	1:10000@A3
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 10
Issue	A

5 CONCEPT PLAN - DRAINAGE DESIGN

5.1 LOT DRAINAGE DESIGN

Runoff from the development area for storms up to the 20 year ARI will be collected by the following systems:

- For the car and truck parking/ manoeuvring areas, a combination pit and pipe and swale system discharging to a number of bioretention basins around the site. This water is then discharged into drains and then into the creek around the site.
- The roof water will be directed to rainwater harvesting tanks, to detention basins and from there will be discharged to the creek system.

5.2 TRUNK DRAINAGE DESIGN

Major flows are considered those flows in excess of the 20 year ARI peak flow. Such flows from the parking and manoeuvring areas will be directed overland using the internal access-ways and swales (where appropriate). From here the flows are conveyed to the bioretention basins, where detention is provided to reduce the peak flows to pre development levels.

Stormwater flows from the roof areas will be directed to the detention basin within the site. The downpipes and drainage network for this system need to be sized to convey the 100 year ARI flows to the basin.

It is proposed to provide an overland flowpath for the upstream site along the northern section of the eastern boundary of the site. This system will consist of a pipe system sized to convey the 20 year ARI flow and a swale to convey additional flows up to the 100 year ARI.

The floor levels of the buildings will be set a minimum of 500 mm above the 100 year ARI flood level.

6 STORMWATER BASIN DESIGN

Section 4 of this report has determined that stormwater detention basins are required to mitigate the floods from the proposed development. The preliminary location of the stormwater control basins for the Ropes Creek Employment Precinct are located adjacent to the E2 environment zone. The basins have been designed with a bioretention system in the base, with extended detention above, and the base detention basin storage volume above the extended detention., This arrangement minimises space requirements of the basin while meeting pollutant removal performance targets. Bioretention basin and the pollutant removal performance is discussed in more details in Section 6.3.

The basins were designed to treat flow from 86.6 hectares of area of the Ropes Creek Employment Precinct.

6.1 DETENTION REQUIREMENTS

The detention strategy requires that individual lot detention basins manage 2 year ARI flows, with large scale community basins alongside the E2 zone managing 100 year ARI flows to pre-development rates from the catchment. This arrangement ensures no increase in peak flows at Ropes Creek upstream or downstream of the Ropes Creek Employment Precinct. The design requirements of the basins are required to limit flows to peak flow rates for the 100 year events as presented in Table 1.

The master stormwater layout for the Ropes Creek Employment Precinct incorporates five basins.
The concept basin detentions are modelled in *DRAINS* to determine the effectiveness of the basins to limit flows to pre-development levels of this development. The DRAINS outputs are detailed in Table 5 and Table 6.

Table 5 100 year ARI Peak Flows at Detention Basin locations

Basin No.	*Exs.Con. (m^3/s)*	*Dev.Con. (m^3/s)*	*Dev.with Basin (m^3/s)*
Basin 1	9.29	11.4	8.98
Basin 2	10.2	12.6	9.86
Basin 3	2.7	3.32	2.67
Basin 4	4.1	5.03	3.89
Basin 5	7.67	9.41	7.14

Table 6 Detention Basins requirements

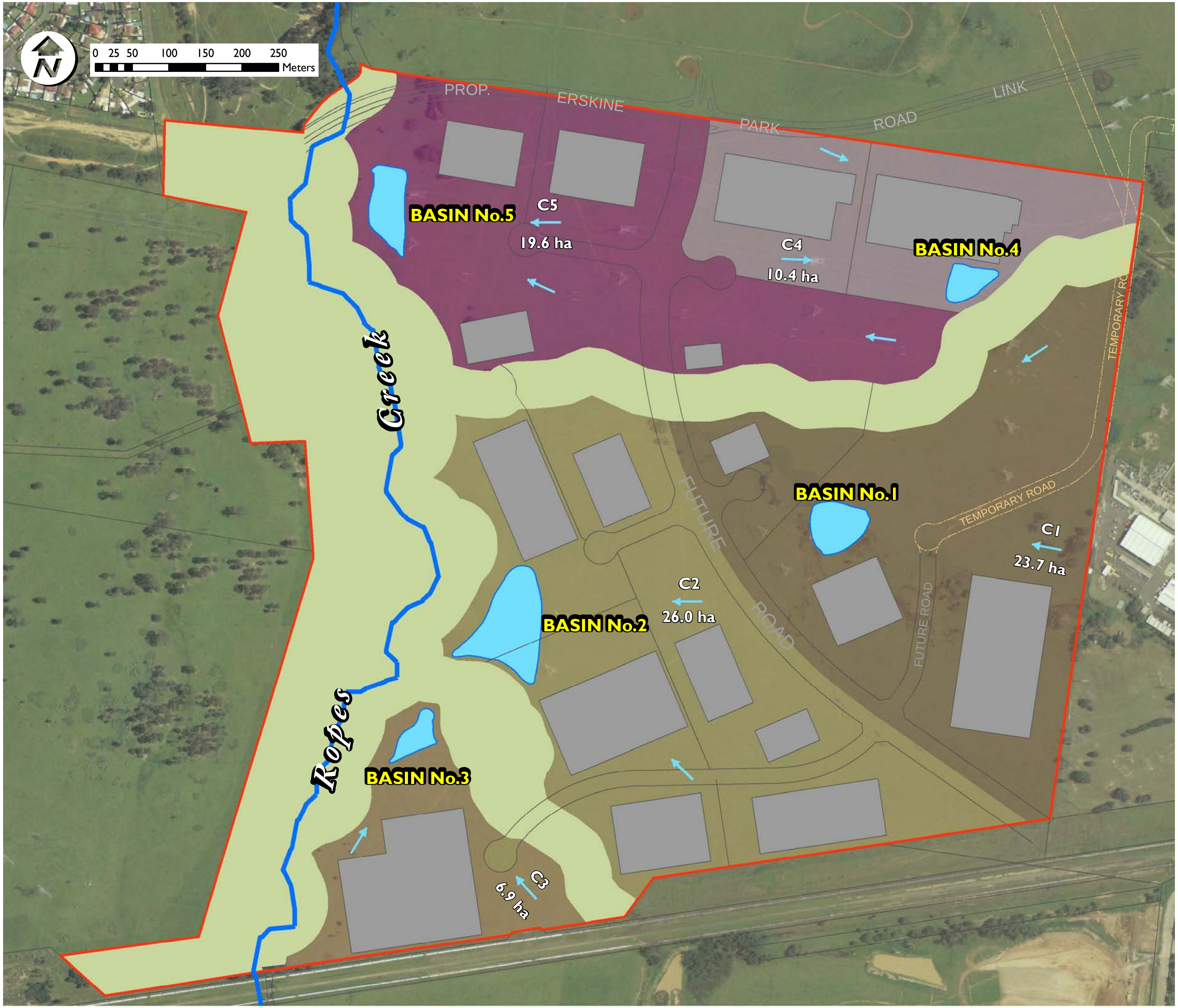
Basin No.	*Surf.Area (m2)*	*Bioret.Area (m2)*	*Catch.Area (ha)*	*Volume (m3)*
Basin 1	7,110	4,500	23.7	2,200
Basin 2	7,800	5,000	26	2,300
Basin 3	2,070	1,300	6.9	1,300
Basin 4	3,120	2,000	10.4	1,400
Basin 5	5,880	3,600	19.6	1,700

Indicative size of surface area of bioretention filter media for five detention basins, presented in Table 6 has been determined to meet the water quality targets outlined in Table 1 from the Growth Centres Development Code (DEC 2006). These areas would be readily incorporated in the base of the proposed larger basin areas as presented in Table 6.

6.2 DETENTION BASIN DESIGN

The detention basins have been designed with a batter slope of 1V:6H and maximum ponding depth of 1.3 metres above the extended detention will be required for the basin.

The outlet of the basin will be sized to meet Blacktown City Council design requirements of attenuating the 100 year flows. This outlet will be sized using the *DRAINS* hydrologic modelling program using parameters specified in Table 1. Preliminary basin locations are presented on Figure 11 and sizing in Section 6.1 of this report.



BROWN CONSULTING

Legend

- CADASTRE
- BASINS
- BUILDINGS
- RIPARIAN ZONE
- FLOW DIRECTION
- CREEK - Ropes

STORWATER COLLECTION AREAS

- Basin 1 - 23.7ha
- Basin 2 - 26.0ha
- Basin 3 - 6.9ha
- Basin 4 - 10.4ha
- Basin 5 - 19.6ha

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

FIGURE 11
ROPES CREEK
INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 11
PRELIMINARY BASIN LOCATIONS
& STORMWATER MASTERPLAN

Scale	1:5000@A3
Drawn	TWC
Checked	SC
Job No.	X10134
Drawing No.	FIGURE 11
Issue	A

6.3 WATER QUALITY REQUIREMENTS

The then Department of Environment and Conservation (DEC), now the NSW Office of Water under the Department of Environment, Climate Change and Water (DECCW) has established stormwater management targets as part of the Development Code under the State Environmental Planning Policy "Growth Centres". The targets are outlined in Table 1 and are slightly different to those commonly adopted throughout NSW. The targets in Table 1 are in-line with current best practice nutrient level reductions.

6.3.1 Gross Pollutant Traps

Gross pollutant traps (GPT) are typically placed in-line with the drainage system prior to discharge into a bioretention basin. These capture litter, debris, coarse sediment, oils and greases. While the pollutant capture efficiency of various traps may vary, as a conservative measure for modelling purposes the GPT is assumed to be capable of removing the following annual load:

- Gross Pollutants 90%
- Suspended Sediments 0%
- Total Phosphorous 0%
- Total Nitrogen 0%

It is proposed to install GPTs at the inlets of the detention basins for litter control.

6.3.2 Bioretention Basins

Bioretention basins will be utilised to perform the majority of the water treatment from the site. Bioretention basins consist of shallow areas over most of their surface area to incorporate macrophytes for nutrient uptake.

The bioretention basins have been conceptually designed on the basis of a 0.4m deep filter medium with a maximum depth of ponding of 0.55m and a 48 hour drawdown.

Suitable wetland macrophyte species for the bioretention basin, would include species such as; *baumea articulata*, *carex appressa*, *cyperus difformis, cyperus polystachyos, eleocharis sphacelata*, *eleocharis cylindrostachys, cyperus flaccidus, juncus prisatocarpus, juncus remotiflourus, juncus usitatus, lomandra longifolia, phragmites australis and phragmites lanuginosum.* All these species exhibit good nutrient removal rates and are hardy. Landscape drawings will be provided at Project Plan stage to detail the actual species mix to be used in the basin.

Plantings within the bioretention basins must be complementary to the adjacent local native plant communities of the riparian corridor and be able to withstand periods of inundation and some long dry periods between rain events. Suitable littoral or transitional plant species (DLWC 1998) for the bioretention basin would include species such as: *Baumea juncea, Carex appressa, Carex fascicularis, Cyperus exaltatus, Carex polystachyus, Gahnia sieberana, Juncus prismatocarpus, Juncus usitatus, Lomandra longifolia, Paspalum distichum,* and *Schoenus brevifolius*. This is subject to further detailed landscape desugn.

It is recommended that the bioretention basin filter media be installed after 80% of development is completed within the catchment in order to prevent the filter from being clogged prematurely from construction run off. Prior to installation of the filter media, the bioretention basin will be turfed with *Paspalum distichum*.

Sizing of the bioretention basins has been undertaken using the WSUD Technical Guidelines for Western Sydney and results are presented in Section 6.1.

7 STAGE 1 PROJECT APPLICATION

The proposed developed area and general site layout of Stage 1 of the development of Ropes Creek Employment Precinct are presented on drawings X10134-000 and X10134-001. The layout of the drainage infrastructure of Stage 1 of the development of Ropes Creek Employment Precinct is presented on drawings X10134-102 and X10134-103.

7.1 DETENTION REQUIREMENTS

The implementation of the large scale community basins will be staged with each project application to ensure the detention and water quality objectives are met with each development. This arrangement ensures no increase in peak flows at Ropes Creek upstream or downstream of the Ropes Creek Employment Precinct.

The concept basin detentions of Basin No.1 and Basin No.4 for Stage 1 were modelled in *DRAINS* to determine the size and effectiveness of the basins to limit flows to pre-development levels of this Stage 1 development. The DRAINS outputs are detailed in Table 7 and Table 8.

Table 7 Stage 1 - 100 year ARI Peak Flows at Detention Basin locations

Basin No.	*Existing (m^3/s)*	*Developed (m^3/s)*	*Dev.with Basin (m^3/s)*
Basin 1	2.28	2.8	2.17
Basin 4	1.23	1.51	1.02

Table 8 Stage 1 - Detention Basins requirements

Basin No.	*Surface Area (m^2)*	*Bioret.Area (m^2)*	*Catch.Area (ha)*	*Volume (m^3)*
Basin 1	2,300	1,400	7.6	1,100
Basin 4	1,600	1,000	5.3	700

7.2 WATER QUALITY REQUIREMENTS

The then Department of Environment and Conservation (DEC), now the NSW Office of Water under the Department of Environment, Climate Change and Water (DECCW) has established stormwater management targets as part of the Development Code under the State Environmental Planning Policy "Growth Centres". The targets are outlined in Table 1 and are slightly different to those commonly adopted throughout NSW. The targets in Table 1 are in-line with current best practice nutrient level reductions and will be used for the design of the Stage 1 detention basin.

Providing the surface area of bioretention filter media as presented in Table 8 for both detention basins for the Stage 1, will ensure that the treated water meets the required GCC water quality requirements.

7.3 RAINWATER HARVESTING REQUIREMENTS

The roof water will be directed to rainwater harvesting tanks, to detention basins and from there will be discharged to the creek system. These rainwater tanks will be designed to accommodate the non-potable water used within the development and reduce the demand on potable water supplies. The sizes of rainwater tanks required for the proposed Stage 1 developments have been calculated to be 23 kL for Building 1 and 16 kL for Building 2.

8 SOIL & WATER MANAGEMENT DURING CONSTRUCTION

8.1 SOIL AND WATER MANAGEMENT PLAN

A Soil and Water Management Plan (SWMP) will be prepared and implemented to minimise potential impacts on hydrology and water quality during the construction period. This plan will incorporate the design and installation of erosion controls in accordance with the requirements *Managing Urban Stormwater: Soils and Construction* published by Landcom (colloquially known as the *"Blue Book"*).

The plan will include the following:

- At the vegetation clearing stage, cleared vegetation will be mulched and spread over disturbed area to provide a natural erosion barrier
- Prior to commencement of earthworks, a range of measures will be put in place including:
  - Construction of cut-off drains to prevent clean water from upstream of the corridor flowing onto and eroding disturbed areas
  - The diversion of site discharge points to erosion control measures such as silt fences and sedimentation basins in order to control dirty water areas
  - The stabilisation of exposed areas as soon as practical following the construction of each section of works
- Controls outside the specific work area would be put in place including:
  - Refuelling of plant and machinery within bunded areas or off site in appropriate locations
  - Minimisation of disturbed areas so that the potential export of sediment is minimised
  - The establishment and maintenance of stabilised construction compounds to reduce the overall disturbance area for the Project.
- Temporary sediment basins will be constructed to capture water and sediment before it can leave the site or enter the receiving water bodies. Conceptual design of the temporary sediment basins will be included in the SWMP and follow the methodology outlined in the "*Blue Book*" with the following features:
  - Sediment basins are to be located at points near where dirty water would discharge to receiving waters or leave the site
  - Basins are to be designed for Type F/D soils, as outlined in Section 6.3.4 of the Blue Book, in accordance with the soil type classifications
  - The minimum depth of the basins will be 0.6 metres with an average depth of 1 metre.

A surface water quality monitoring program for the construction period will be developed to monitor water quality upstream and downstream of the construction areas. Construction period monitoring will be carried out periodically and after rainfall events as part of the assessment of the operation of water quality mitigation measures. Monitoring during the construction phase of the project would examine the following indicators:

- pH
- Electrical conductivity
- Turbidity
- Dissolved oxygen

8.2 DUST MANAGEMENT PLAN

A Dust Management Plan will be prepared and implemented to provide best management strategies for dust control and an approved monitoring program for identified key issues and areas of concern, to achieve target dust deposition and minimise adverse impacts and complaints relating to dust emissions.

The sources of dust and emissions during construction include the following:

- Wind-blown sand and dust due to large exposed areas during reclamation
- Earthworks activities
- Stockpiling sand on reclamation
- Loading and unloading materials
- Transport of sand and other spoil
- Use of haul roads

Dust Control Measures include:

- Dust monitoring conducted both prior and during construction activities (installing dust deposition gauges at identified locations; daily and weekly visual surveillance of dust emissions, dust controls, plant emissions; meteorological daily data collection such as wind speed, rain, temperature, humidity etc.)
- Where possible, minimise disturbed and exposed areas
- Locate stockpiles as far away from public and residential areas as possible
- Dust control on short-term stockpiles (≤ 3 months) will be controlled using water sprays, drift fencing and daily inspections and long-term (≥ 3 months) progressive vegetation and bitumen emulsions

- Construct wind-breaks or drift fences made of geo-fabric screens at regular intervals around stockpiles and erodible areas
- Apply a thin layer of bitumen or grass in completed reclamation areas
- Inspect equipment and vehicles exhaust emissions at start up and during construction and do not leave machinery and vehicles running when not in use
- Cement will be delivered to site in sealed tankers and pumped to silos, providing a closed system to prevent dust emissions
- Restrict construction traffic to defined areas and speed limits
- Wherever possible, seal internal construction-related roads
- Cover unsealed roads with road base rock and gravel and keep moist
- Operate a water spray system over any gravel stockpiles
- During dry and windy conditions spray water over the road surfaces to prevent wind erosion

The volume of water required for dust suppression will vary according to prevailing climatic conditions, the extent of haul road development and the usage of the haul roads. It is considered that on days that the daily rainfall exceeds evaporation it is unlikely that dust suppression will be required. As such the yearly rate for haul road watering has been calculated using the effective evaporation for the site multiplied by the area of haul road to be watered (assumed width of 30 m) and multiplied by a factor of 1.4 to allow for increased evaporation due to vehicle movements on the haul road. Based on this calculation, the typical annual water demand for haul dust suppression will range from 13 ML/km to 16 ML/km of haul road for a wet rainfall year and dry rainfall year respectively.

9 CONCLUSION

The hydrological and hydraulic modelling has shown that the proposed subdivision and supporting roads of the Ropes Creek Employment Precinct can be constructed while meeting Blacktown City Council, DECCW and NSW Office of Water requirements for stormwater quantity and quality management.

The objectives and performance targets (quantity and quality) are achieved by using a mix of water sensitive urban design (WSUD) components throughout the subdivision, including rainwater tanks and bio-retention basins with detention storage.

10 REFERENCES

Faculty for Advancing Water Biofiltration (FAWB) (2009). *Adoption Guidelines for Stormwater Biofiltration Systems*, Facility for Advancing Water Biofiltration, Monash University, June 2009.

Institution of Engineers Australia 2001. *Australian Rainfall & Runoff*.

NSW Department of Environment and Conservation (DEC, now DECCW) 2006, *Growth Centres Development Code*

NSW Department of Environment and Conservation (DEC, now DECCW) 2007, *Growth Centres Commission Oran Park Development Control Plan*

NSW Department of Land and Water Conservation 1998, *The Constructed Wetland Manual*

NSW Department of Planning, July 2009, *Oran Park & Turner Road Waterfront Land Strategy* (NSW Government Gazette)

WSUD Technical Guidelines for Western Sydney (2004)

11 GLOSSARY OF TERMS

Afflux	The rise in water level upstream of a hydraulic structure such as a bridge or culvert, caused by losses incurred from the hydraulic structure.
Australian Height Datum	National survey datum corresponding approximately to mean sea level.
Annual Exceedance Probability	The chance of a flood of a given size or larger occurring in any one year, generally expressed as percentage probability. For example, a 100 year ARI flood is a 1% AEP flood. An important implication is that when a 1% AEP flood occurs, there is still a 1% probability that it could occur the following year.
Average Recurrence Interval	Is the long term average number of years between the occurrence of a flood as big as, or larger than the selected flood event.
Catchment	The catchment at a particular point is the area of land which drains to that point.
Design floor level	The minimum (lowest) floor level specified for a building.
Design flood	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood). The design flood may comprise two or more single source dominated floods.
Development	Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.
Discharge	The rate of flow of water measured in terms of volume over time. It is not the velocity of flow which is a measure of how fast the water is moving rather than how much is moving. Discharge and flow are interchangeable.
Digital Terrain Model	A three-dimensional model of the ground surface that can be represented as a series of grids with each cell representing an elevation (DEM) or a series of interconnected triangles with elevations (TIN).
Effective warning time	The available time that a community has from receiving a flood warning to when the flood reaches their location.
Flood	Above average river or creek flows which overtop banks and inundate floodplains.
Flood awareness	An appreciation of the likely threats and consequences of flooding and an understanding of any flood warning and evacuation procedures. Communities with a high degree of flood awareness respond to flood warnings promptly and efficiently, greatly reducing the potential for damage and loss of life and limb. Communities with a low degree of flood awareness may not fully appreciate the importance of flood warnings and

	flood preparedness and consequently suffer greater personal and economic losses.
Flood behaviour	The pattern / characteristics / nature of a flood.
Flooding	The State Emergency Service uses the following definitions in flood warnings: *Minor flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges *Moderate flooding:* low-lying areas inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. *Major flooding:* extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded.
Flood frequency analysis	An analysis of historical flood records to determine estimates of design flood flows.
Flood fringe	Land which may be affected by flooding but is not designated as a floodway or flood storage.
Flood hazard	The potential threat to property or persons due to flooding.
Flood level	The height or elevation of flood waters relative to a datum (typically the Australian Height Datum). Also referred to as “stage”.
Flood liable land	Land inundated up to the probable maximum flood – flood prone land.
Floodplain	Land adjacent to a river or creek which is inundated by floods up to the probable maximum flood that is designated as flood prone land.
Flood Planning Levels	Are the combinations of flood levels and freeboards selected for planning purposes to account for uncertainty in the estimate of the flood level.
Flood proofing	Measures taken to improve or modify the design, construction and alteration of buildings to minimise or eliminate flood damages and threats to life and limb.
Floodplain Management	The coordinated management of activities which occur on flood liable land.
Floodplain Management Manual	A document by the NSW Government (2001) that provides a guideline for the management of flood liable land. This document describes the process of a floodplain risk management study.
Flood source	The source of the flood waters.
Floodplain Management Standard	A set of conditions and policies which define the benchmark from which floodplain management options are compared and assessed.
Flood standard	The flood selected for planning and floodplain management activities. The flood may be an historical or design flood. It should be based on an understanding of the flood behaviour and the associated flood hazard. It should also take into account social, economic and ecological considerations.

Flood storages	Floodplain areas which are important for the temporary storage of flood waters during a flood.
Floodways	Those areas of the floodplain where a significant discharge of flow occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if they are partially blocked, would cause significant redistribution of flood flows, or a significant increase in flood levels.
Freeboard	A factor of safety usually expressed as a height above the flood standard. Freeboard tends to compensate for the factors such as wave action, localised hydraulic effects and uncertainties in the design flood levels.
Geographical Information System	A form of computer software developed for mapping applications and data storage. Useful for generating terrain models and processing data for input into flood estimation models.
High hazard	Danger to life and limb; evacuation difficult; potential for structural damage, high social disruption and economic losses. High hazard areas are those areas subject to a combination of flood depth and flow velocity that are deemed to cause the above issues to persons or property.
Historical flood	A flood which has actually occurred – Flood of Record.
Hydraulic	The term given to the study of water flow in rivers, estuaries with coastal systems.
Hydrograph	A graph showing how a river or creek's discharge changes with time.
Hydrology	The term given to the study of the rain-runoff process in catchments.
Low hazard	Flood depths and velocities are sufficiently low that people and their possessions can be evacuated.
Management plan	A clear and concise document, normally containing diagrams and maps, describing a series of actions that will allow an area to be managed in a coordinated manner to achieve defined objectives.
Map Grid Australia	A national coordinate system used for the mapping of features on a representation of the earths surface. Based on the geographic coordinate system 'Geodetic Datum of Australia 1994'.
Peak flood level, flow or velocity	The maximum flood level, flow or velocity occurring during a flood event.
Probable Maximum Flood	An extreme flood deemed to be the maximum flood likely to occur at a particular location.
Probable Maximum Precipitation	The greatest depth of rainfall for a given duration meteorologically possible over a particular location. Used to estimate the probable maximum flood.
Probability	A statistical measure of the likely frequency or occurrence of flooding.

Riparian Zone	Areas that are located adjacent to watercourses. Their definition is vague and can be characterised by landform, vegetation, legislation or their function.
Runoff	The amount of rainfall from a catchment which actually ends up as flowing water in the river of creek.
Stage hydrograph	A graph of water level over time.
Velocity	The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section.
Water Sensitive Urban Design	An approach to planning and design of urban development that aims to minimise the negative impacts on the natural water cycle. This design philosophy aims to protect the health of aquatic ecosystems by integrating “natural” features into the stormwater, water supply and sewage management of a development.

12 APPENDICES

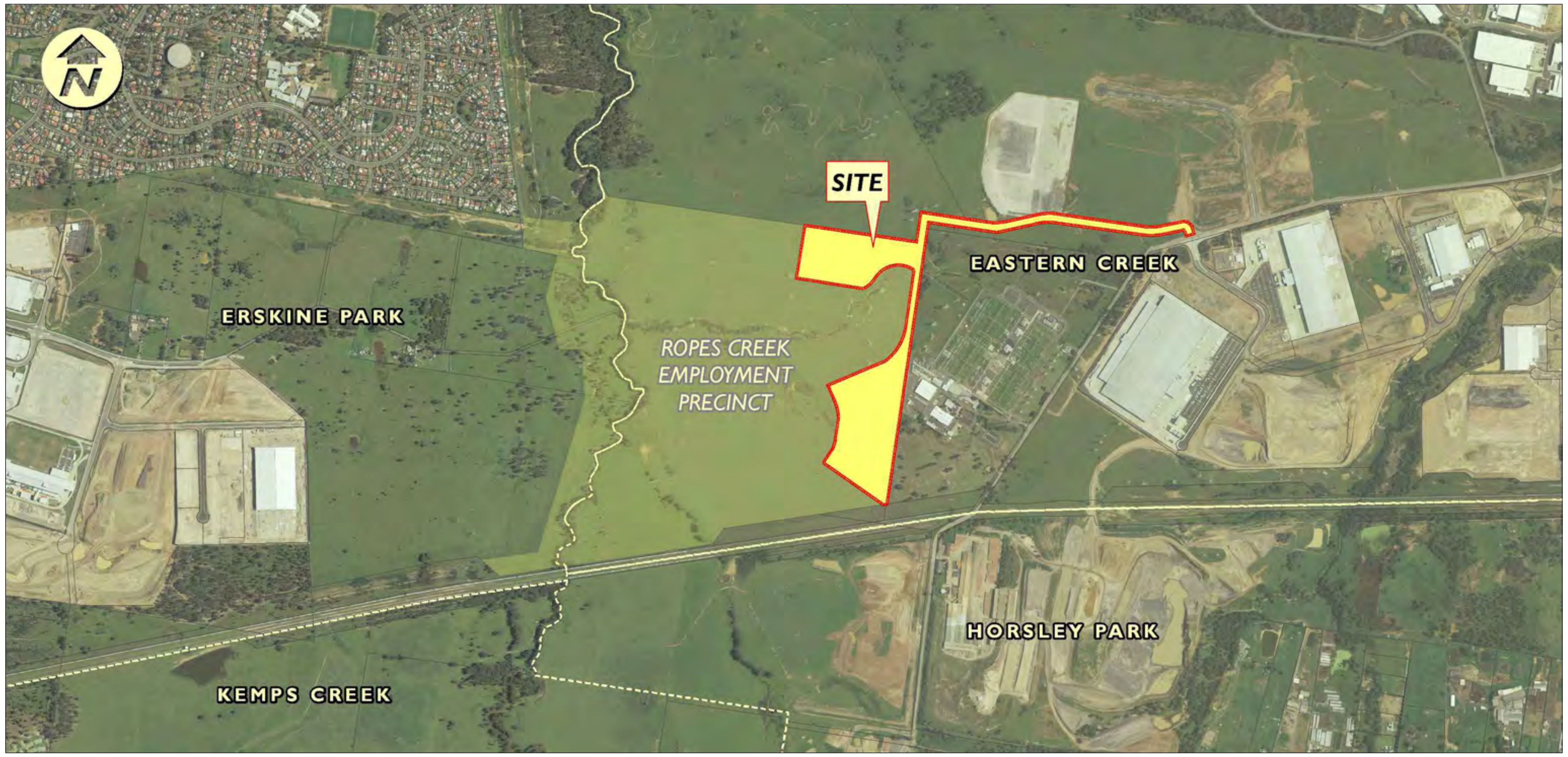
Appendix A Drawings

APPENDIX A

DRAWINGS

LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT

ROAD & BULK EARTHWORK



LOCALITY PLAN
N.T.S.

LGA BLACKTOWN COUNCIL

JACFIN PTY LTD

DRAWING LIST

GENERAL

000 COVER SHEET
001 GENERAL SITE LAYOUT

ENGINEERING

101 ENGINEERING PLAN SHEET 1 OF 3
102 ENGINEERING PLAN SHEET 2 OF 3
103 ENGINEERING PLAN SHEET 3 OF 3

ROADWORKS

201 ROAD No.01 LONGSECTION SHEET 1 OF 3
202 ROAD No.01 LONGSECTION SHEET 2 OF 3
203 ROAD No.01 LONGSECTION SHEET 3 OF 3
301 ROAD No.01 CROSS SECTIONS SHEET 1 OF 4
302 ROAD No.01 CROSS SECTIONS SHEET 2 OF 4
303 ROAD No.01 CROSS SECTIONS SHEET 3 OF 4
304 ROAD No.01 CROSS SECTIONS SHEET 4 OF 4

SITE GRADING

401 SITE GRADING SHEET 1 OF 2 BUILDING 2
402 SITE GRADING SHEET 2 OF 2 BUILDING 1

BROWN

LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK
JOB No: X10134

Brown Consulting (NSW) Pty Ltd
Level 2, 2 Burbank Place, Norwest Business Park
Baulkham Hills NSW Australia 2153
Telephone: 02 8808 5000 Facsimile: 02 8808 5099

DRAWING 000
REVISION B

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

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Quality Endorsed Company
ACEA

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APPROVAL
BY: TOBY TAMES
BE (Hons) GradDlpMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: GENERAL SITE LAYOUT

Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:1000
Project No: X10134
Drawing No: 001
Revision: B

Saved: 09.08.2010, By: michael noonan
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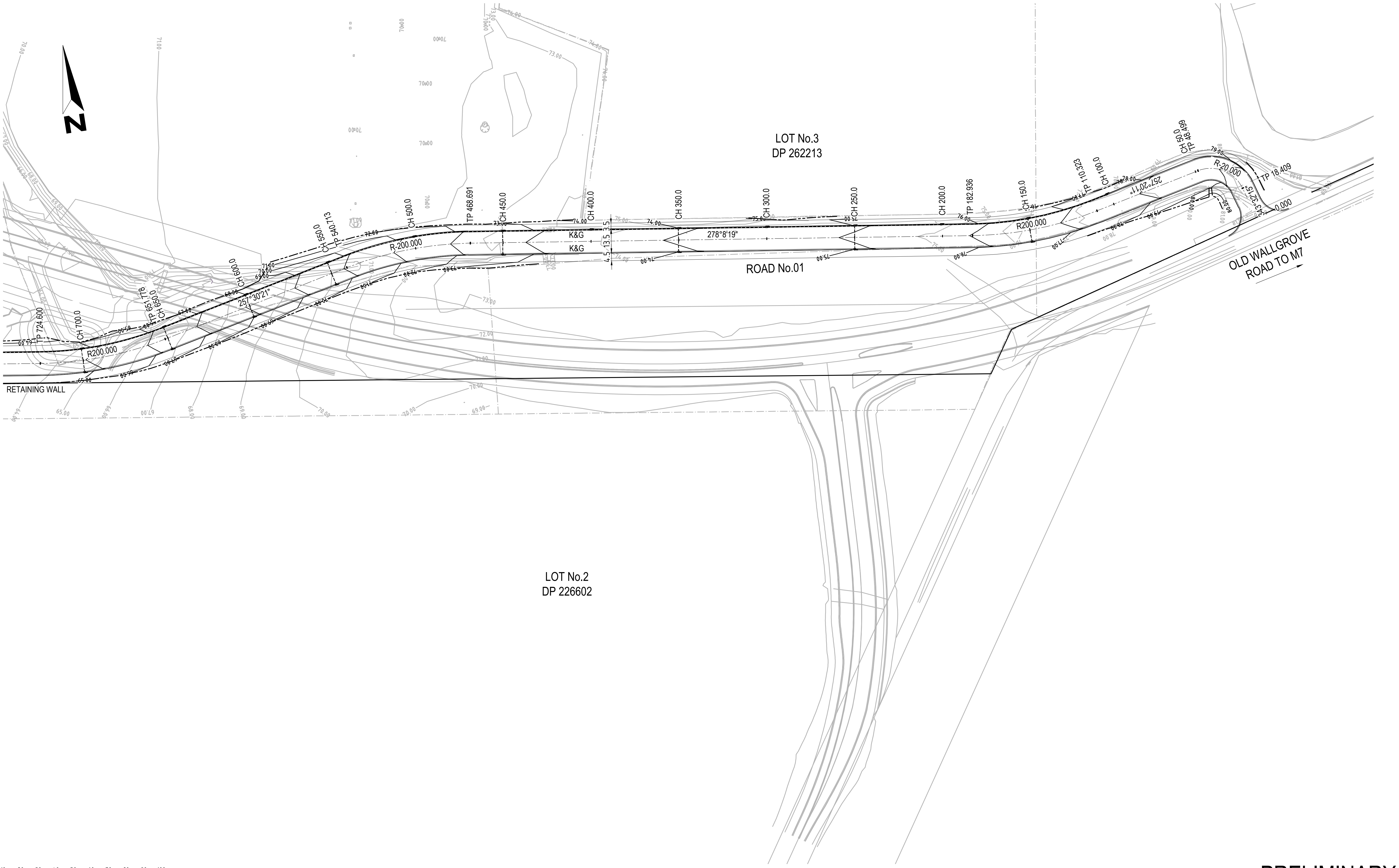

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SCALE 1:1000 (A1) SCALE 1:2000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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BY: TOBY TAMES
BE (Hons) GradDlpMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ENGINEERING PLAN SHEET 1 OF 3

Drawn by: A.Mc	Scale(A1): 1:1000
Design by: M.N.	
Project No: X10134	
Drawing No: 101	Revision: B

Saved: 09.08.2010, By: michael noonan
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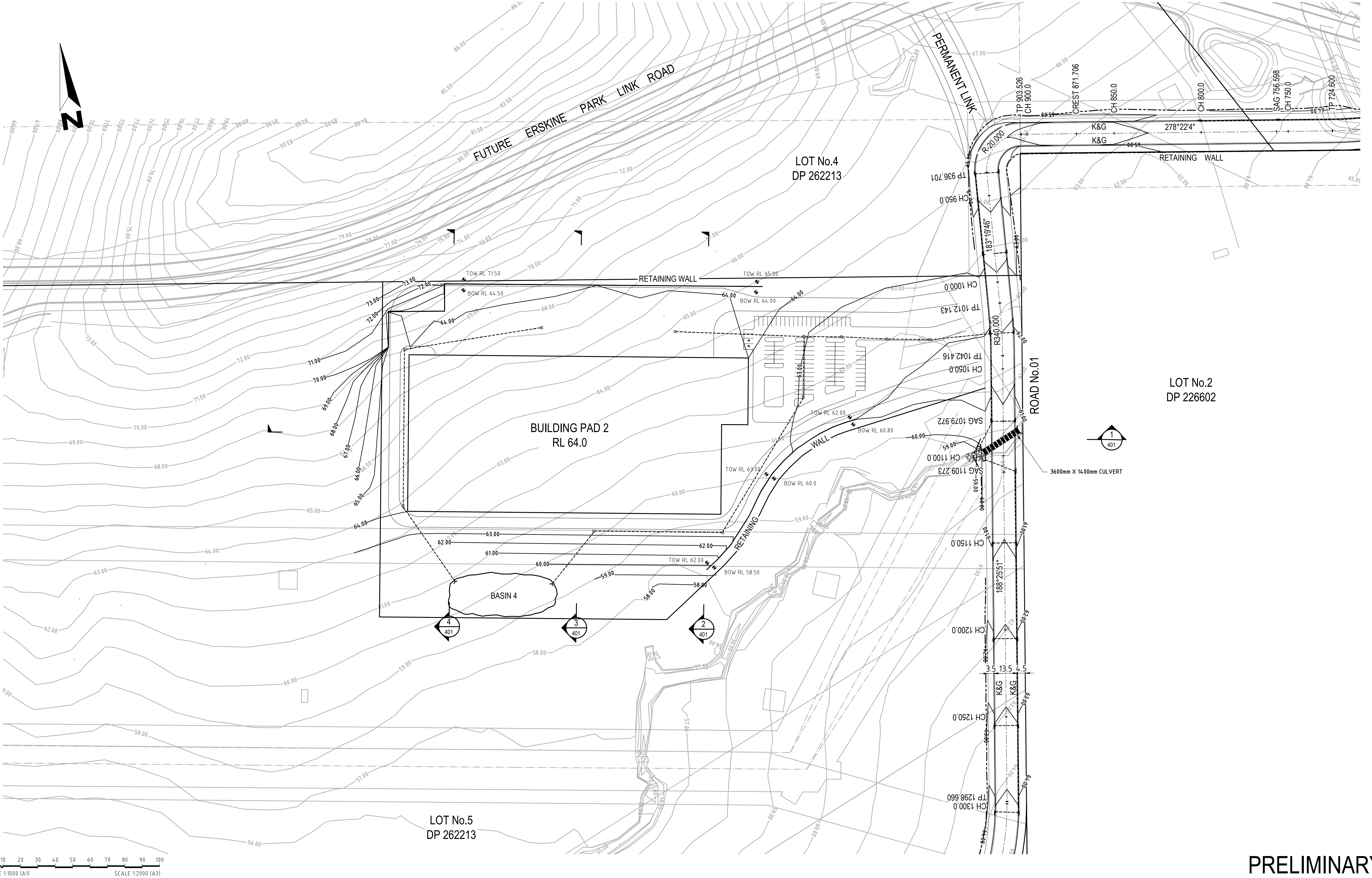

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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APPROVAL
BY: TOBY TAMES
BE (Hons) GradDlpMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ENGINEERING PLAN SHEET 2 OF 3

Drawn by: A.Mc
Design by: M.N.
Project No: X10134
Scale(A1): 1:1000
Drawing No: 102
Revision: B

Saved: 09.08.2010, By: michael noonan
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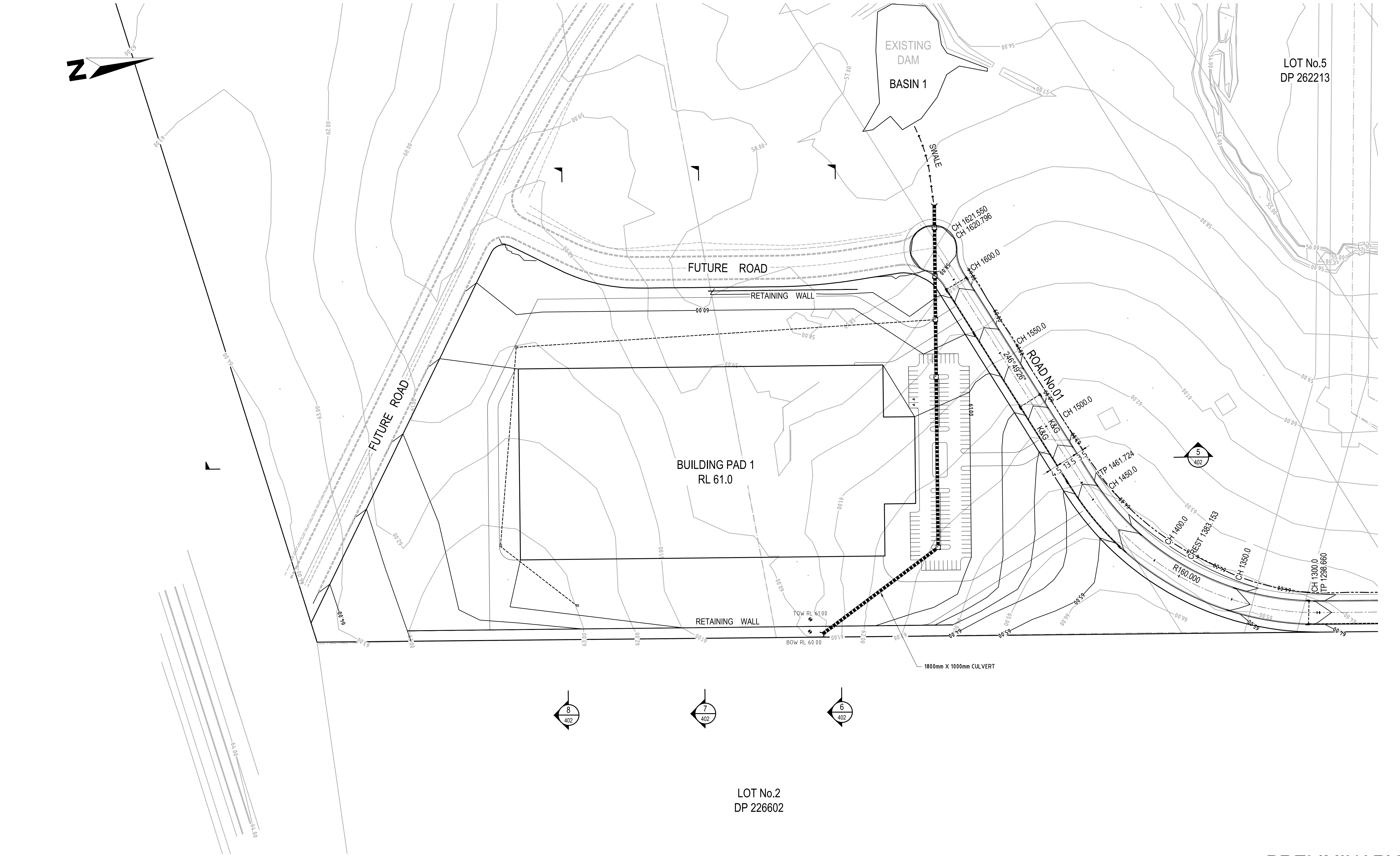

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SCALE 1:1000 (A1) SCALE 1:2000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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BE (Hons) GradDlpMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ENGINEERING PLAN SHEET 3 OF 3

Drawn by: A.Mc
Design by: M.N.
Project No: X10134
Scale(A1): 1:1000
Drawing No: 103
Revision: B

Saved: 09.08.2010, By: michael noonan
H:\X10\X10134 - Ropes Creek Industrial Subdivision\Drawings\Civil\X10134-103.dwg

V.C.
GRADE
HORIZ. GEOMETRY
DATUM R.L. 68

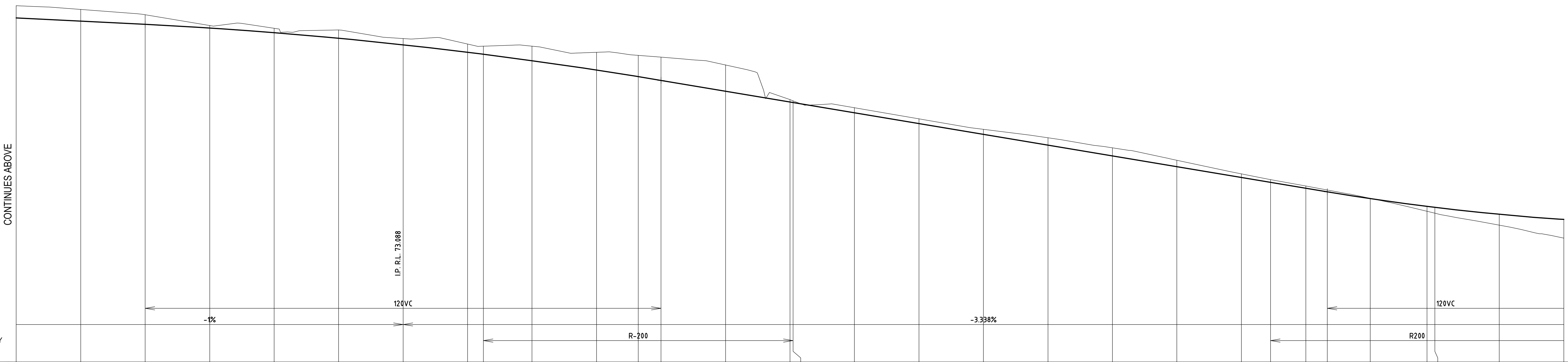
CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
0	79.751	
15	79.439	79.09
18.409	79.368	79.088
30	79.127	79.025
33.454	79.055	78.952
45	78.815	78.719
48.499	78.742	78.649
60	78.502	78.453
75	78.19	78.14
90	77.878	77.853
105	77.566	77.486
110.323	77.455	77.353
120	77.253	76.968
135	76.941	76.765
140	76.837	76.58
146.63	76.701	76.378
150	76.633	76.334
165	76.345	75.981
180	76.077	75.63
182.936	76.026	75.565
195	75.829	75.324
200	75.75	75.22
210	75.601	75.049
225	75.393	74.854
240	75.206	74.735
255	75.039	74.658
260	74.988	74.653
270	74.888	74.644
285	74.738	74.663
300	74.588	74.692
315	74.438	74.729
330	74.288	74.736
345	74.138	74.683
360	73.988	74.557

CONTINUES BELOW

LONGSECTION ROAD NO.01

Scale: 1:500(H) 1:100(V)

CONTINUES ABOVE



V.C.
GRADE
HORIZ. GEOMETRY
DATUM R.L. 58

CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
360	73.988	74.557
375	73.838	74.38
390	73.688	74.137
405	73.516	73.638
420	73.3	73.503
435	73.041	73.426
450	72.737	73.028
465	72.39	72.77
468.691	72.298	72.671
480	71.999	72.674
495	71.564	72.391
504.702	71.259	72.25
510	71.085	72.169
525	70.585	71.812
540	70.084	70.191
540.713	70.06	70.137
555	69.583	69.817
570	69.082	69.301
585	68.582	68.813
600	68.081	68.421
615	67.58	67.954
630	67.08	67.376
645	66.579	66.747
651.778	66.353	66.479
660	66.078	66.182
665	65.911	65.999
675	65.596	65.609
688.189	65.235	65.006
690	65.191	64.916
705	64.868	64.364
720	64.627	63.759

FOR CONTINUATION REFER TO DRAWING No. 202

0 5 10 15 20 25 30 35 40 45 50
SCALE 1:500 (A1) SCALE 1:1000 (A3)

0 1 2 3 4 5 6 7 8 9 10
SCALE 1:100 (A1) SCALE 1:200 (A3)

LONGSECTION ROAD NO.01 CONT'D

Scale: 1:500(H) 1:100(V)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
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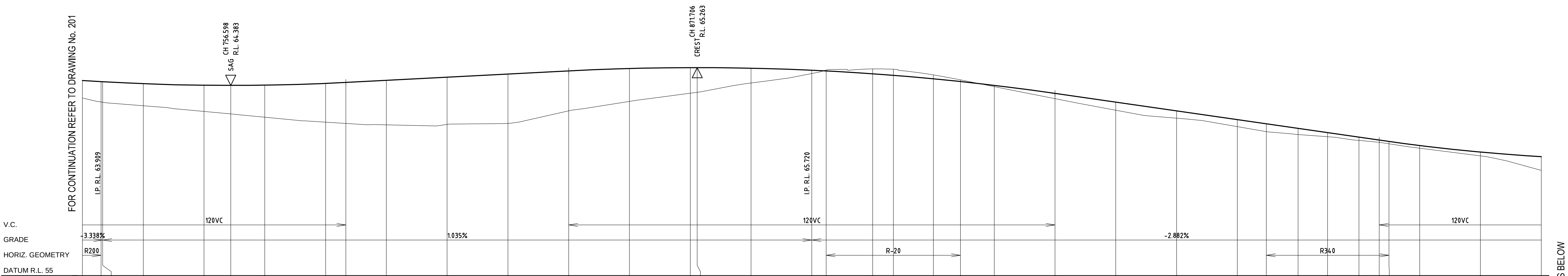
APPROVAL
BY: TOBY TAMES
BE (Hons) GradDlpMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ROAD No.01 LONGSECTION
SHEET 1 OF 3

Drawn by: A.Mc
Design by: M.N.
Scale(A1): AS NOTED
Project No: X10134
Drawing No: 201
Revision: B



CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
720	64.627	63.759
724.6	64.569	63.563
725	64.564	63.549
735	64.468	63.38
750	64.39	63.096
756.598	64.383	62.976
765	64.395	62.814
780	64.482	62.57
785	64.53	62.509
795	64.633	62.439
810	64.788	62.46
825	64.944	62.504
840	65.099	63.13
855	65.217	63.593
870	65.262	63.998
871.706	65.263	64.042
885	65.234	64.499
900	65.132	64.974
903.526	65.098	65.138
915	64.957	65.2
920.113	64.88	65.183
930	64.708	64.905
936.701	64.573	64.657
945	64.386	64.323
960	63.99	63.729
975	63.558	63.159
990	63.126	62.769
1005	62.693	62.351
1012.143	62.487	62.102
1020	62.261	61.963
1027.28	62.051	61.847
1035	61.829	61.672
1040	61.685	61.574
1042.416	61.616	61.502
1050	61.417	61.286
1065	61.094	60.903
1080	60.865	60.191

LONGSECTION ROAD NO.01 CONT'D
Scale: 1:500(H) 1:100(V)

CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
1080	60.865	60.191
1095	60.729	58.48
1100	60.704	60.019
1109.273	60.686	60.01
1110	60.686	60.013
1125	60.738	60.096
1140	60.883	
1155	61.121	
1160	61.222	
1170	61.433	
1185	61.749	61.775
1200	62.066	61.992
1215	62.382	62.318
1230	62.699	62.629
1245	63.016	62.944
1260	63.332	63.29
1275	63.649	63.69
1290	63.965	64.134
1298.66	64.148	64.344
1305	64.282	64.46
1320	64.599	64.66
1335	64.915	64.763
1340	65.021	64.809
1350	65.207	64.713
1365	65.396	64.625
1380	65.474	64.739
1380.192	65.474	64.74
1383.153	65.476	64.774
1395	65.442	64.842
1400	65.407	64.836
1410	65.3	64.804
1425	65.048	64.723
1440	64.686	64.464

LONGSECTION ROAD NO.01 CONT'D
Scale: 1:500(H) 1:100(V)

SCALE 1:500 (A1) — SCALE 1:1000 (A3)
SCALE 1:100 (A1) — SCALE 1:200 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
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REVISIONS

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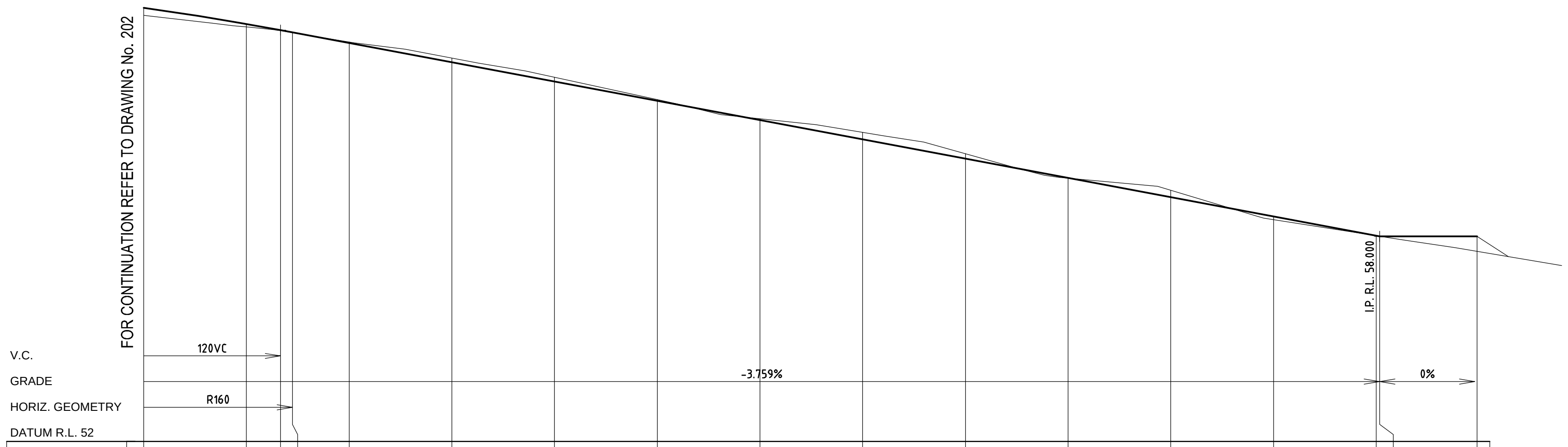
APPROVAL
BY: BE (Hons) GradDipMgt CPESC CPEng MIEAust Director
SIGN:
DATE:

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ROAD No.01 LONGSECTION SHEET 2 OF 3

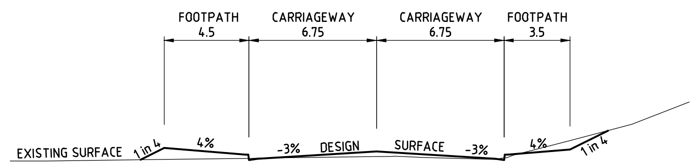
Drawn by: A.Mc
Design by: M.N.
Scale(A1): AS NOTED
Project No: X10134
Drawing No: 202
Revision: B



DESIGN LEVEL	64.686	64.214	64.032	63.967	63.656	63.092	62.529	61.965	61.401	60.837	60.273	59.71	59.146	58.582	58.018	58.000	58.000
EXISTING LEVEL	64.464	64.131	64.015	63.958	63.686	63.214	62.652	62.001	61.443	61.042	60.419	59.7	59.346	58.484	58.013	57.998	57.558
CHAINAGE	1440	1455	1460	1461.724	1470	1485	1500	1515	1530	1545	1560	1575	1590	1605	1620	1620.486	1634.711

LONGSECTION ROAD NO.01 CONT'D

Scale: 1:500(H) 1:100(V)



TYPICAL SECTION ROAD NO.01

Scale: 1:200

0 5 10 15 20 25 30 35 40 45 50
SCALE 1:500 (A1) SCALE 1:1000 (A3)

0 1 2 3 4 5 6 7 8 9 10
SCALE 1:100 (A1) SCALE 1:200 (A3)

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0
SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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Singapore

APPROVAL
BY: TOBY TAMES
BE (Hons) GradDipMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

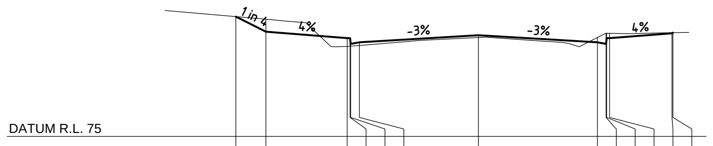
Client:
JACFIN PTY LTD

Project:
LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing:
ROAD No.01 LONGSECTION
SHEET 3 OF 3

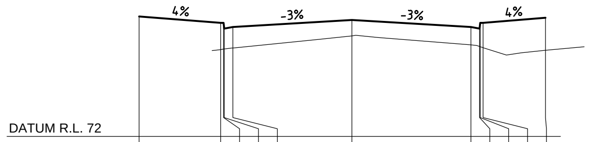
Drawn by: A.Mc
Design by: M.N.
Scale(A1): AS NOTED
Project No: X10134
Drawing No: 203
Revision: B

Saved: 09.08.2010 By: michael noonan
H:\X10\X10134 - Ropes Creek Industrial Subdivision\Drawings\Civil\X10134-203.dwg



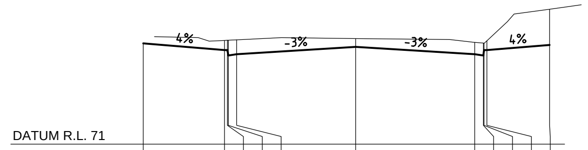
DESIGN LEVEL	78.161	77.763	77.591	77.591	77.441	77.481	77.67	77.481	77.441	77.591	77.591	77.723	77.736
EXISTING LEVEL	78.161	78.091	77.377	77.383	77.384	77.402	77.61	77.613	77.722	77.721	77.72	77.735	77.736
OFFSET	-12.84	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	10.3

CH 100



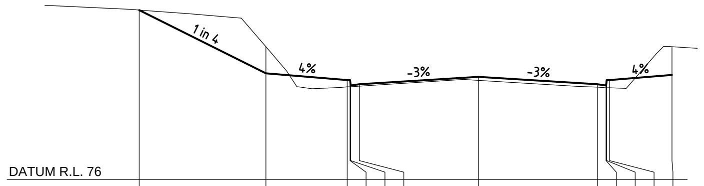
DESIGN LEVEL	75.186	75.014	75.014	74.864	74.904	75.093	74.904	74.864	75.014	75.014	75.146
EXISTING LEVEL		74.306	74.315	74.317	74.345	74.669	74.426	74.388	74.381	74.356	74.281
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 250



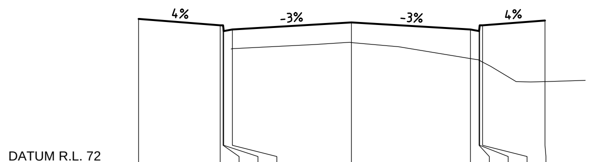
DESIGN LEVEL	73.672	73.499	73.499	73.349	73.389	73.578	73.389	73.349	73.499	73.499	73.632
EXISTING LEVEL		73.751	73.755	73.756	73.768	73.804	73.702	73.679	73.677	73.745	74.583
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 400



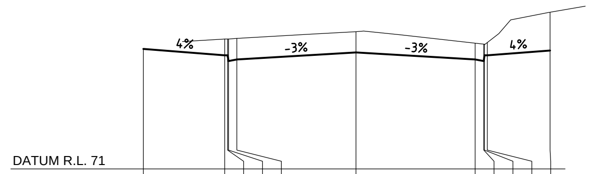
DESIGN LEVEL	80.477	78.804	78.632	78.632	78.481	78.522	78.71	78.522	78.481	78.632	78.632	78.764
EXISTING LEVEL	80.477	79.508	78.447	78.452	78.454	78.468	78.624	78.438	78.428	78.427	78.424	79.513
OFFSET	-17.942	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 50



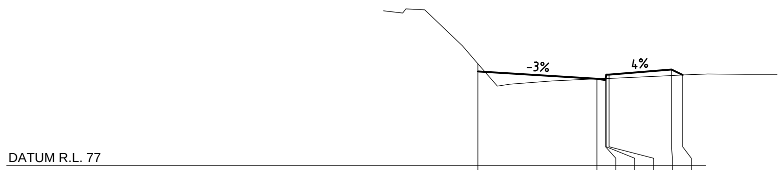
DESIGN LEVEL	75.844	75.671	75.671	75.521	75.561	75.75	75.561	75.521	75.671	75.671	75.804
EXISTING LEVEL					75.054	75.22	74.793	74.753	74.743	74.704	74.189
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 200



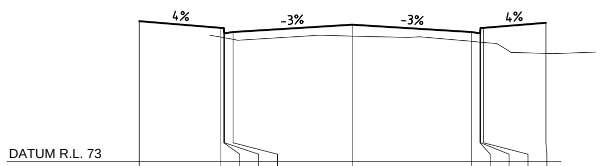
DESIGN LEVEL	74.182	74.009	74.009	73.859	73.899	74.088	73.899	73.859	74.009	74.009	74.142
EXISTING LEVEL		74.443	74.447	74.448	74.462	74.641	74.333	74.307	74.305	74.355	75.157
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 350



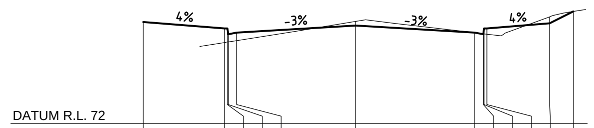
DESIGN LEVEL	79.498	79.309	79.269	79.419	79.419	79.551	79.405
EXISTING LEVEL	79.706	79.303	79.313	79.314	79.317	79.392	79.405
OFFSET	0	6.3	6.75	6.79	6.94	10.25	10.835

CH 12.187



DESIGN LEVEL	76.727	76.554	76.554	76.404	76.444	76.633	76.444	76.404	76.554	76.554	76.687
EXISTING LEVEL		76.303	76.29	76.287	76.247	76.334	76.192	76.172	76.171	76.164	75.874
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 150



DESIGN LEVEL	74.682	74.509	74.509	74.359	74.399	74.588	74.399	74.359	74.509	74.509	74.642	74.957
EXISTING LEVEL		74.14	74.152	74.155	74.19	74.692	74.396	74.369	74.367	74.358	74.818	74.957
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	11.512

CH 300

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

BROWN
Brown Consulting (NSW) Pty Ltd
Level 2, 2 Burbank Place Norwest Business Park NSW Australia 2153
Telephone: 02 8808 5000 Facsimile: 02 8808 5099
Sydney
Canberra
Brisbane
Melbourne
Singapore

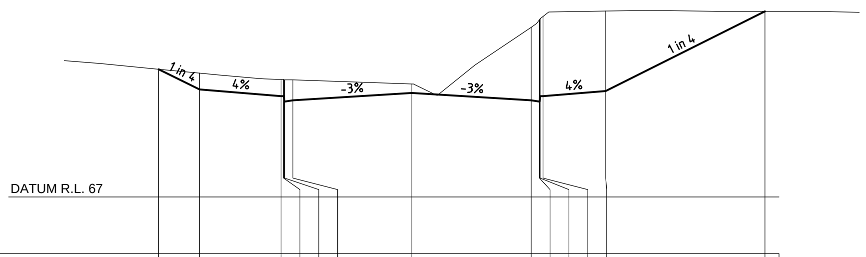
APPROVAL
BY: TOBY TAMES
BE (Hons) GradDipMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client:
JACFIN PTY LTD

Project:
LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

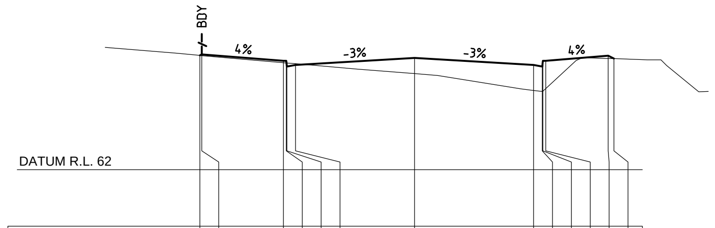
Drawing:
ROAD No.01 CROSS SECTIONS
SHEET 1 OF 4

Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:200
Project No: X10134
Drawing No: 301
Revision: B



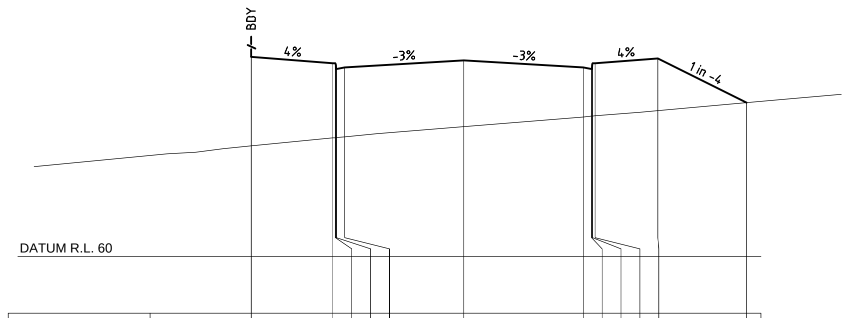
DESIGN LEVEL	70.383	69.843	69.671	69.671	69.521	69.561	69.75	69.561	69.521	69.671	69.671	69.803	71.911
EXISTING LEVEL	70.383	70.278	70.107	70.104	70.104	70.096	69.989	71.487	71.691	71.715	71.776	71.917	71.911
OFFSET	-13.409	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	18.682

CH 550



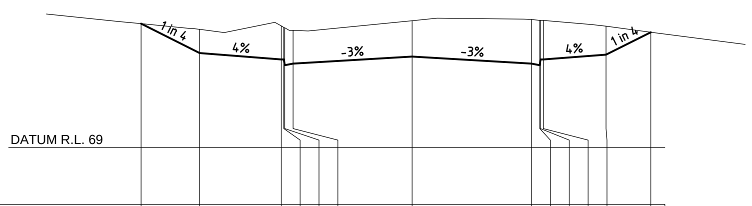
DESIGN LEVEL	65.031	65.06	64.887	64.887	64.737	64.777	64.966	64.777	64.737	64.887	64.887	65.02	64.945
EXISTING LEVEL	65.031	65.027	64.839	64.832	64.83	64.811	64.545	64.103	64.079	64.079	64.149	64.95	64.945
OFFSET	-11.363	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	10.549

CH 700



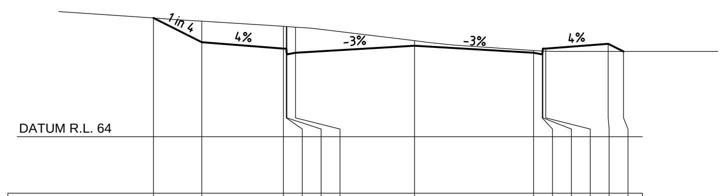
DESIGN LEVEL	65.279	65.107	65.107	64.957	64.997	65.186	64.997	64.957	65.107	65.107	65.239	64.065
EXISTING LEVEL	62.923	63.134	63.141	63.143	63.165	63.436	63.693	63.711	63.713	63.719	63.857	64.065
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	14.946

CH 850



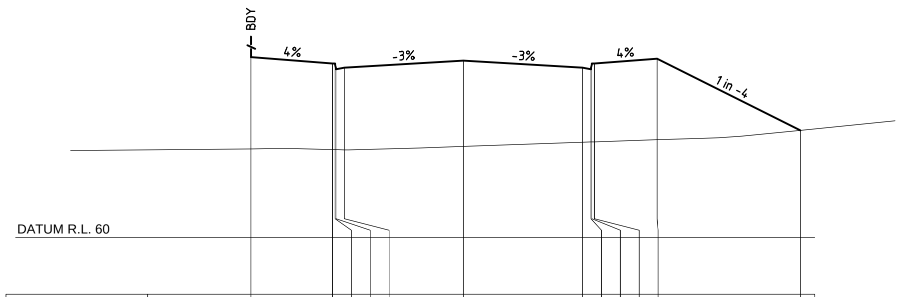
DESIGN LEVEL	72.278	71.503	71.33	71.33	71.18	71.22	71.409	71.22	71.18	71.33	71.33	71.463	72.056
EXISTING LEVEL	72.278	72.126	72.225	72.182	72.171	72.098	72.36	72.387	72.369	72.367	72.361	72.209	72.056
OFFSET	-14.352	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	12.622

CH 500



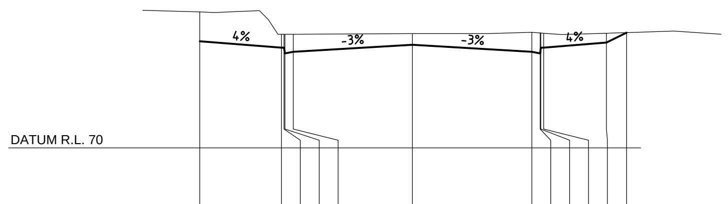
DESIGN LEVEL	67.148	66.505	66.333	66.333	66.183	66.223	66.412	66.223	66.183	66.333	66.333	66.465	66.264
EXISTING LEVEL	67.148	67.064	66.927	66.922	66.921	66.907	66.546	66.285	66.273	66.272	66.269	66.264	66.264
OFFSET	-13.821	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	11.057

CH 650



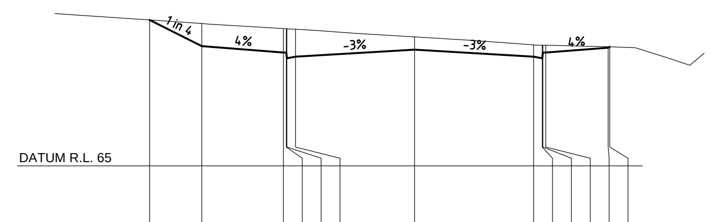
DESIGN LEVEL	64.778	64.606	64.606	64.456	64.496	64.685	64.496	64.456	64.606	64.606	64.738	62.84
EXISTING LEVEL	62.351	62.329	62.327	62.327	62.321	62.415	62.523	62.531	62.531	62.534	62.591	62.84
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	17.843

CH 800



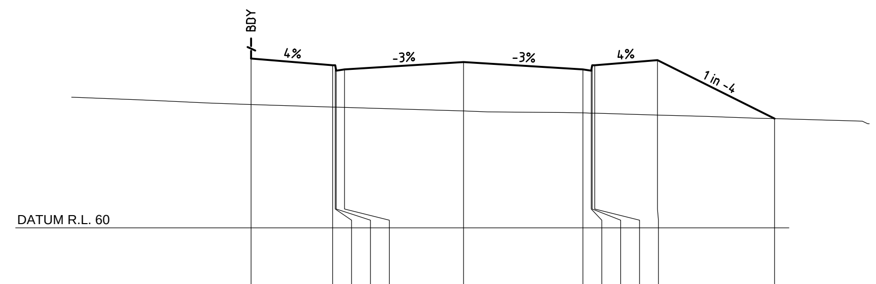
DESIGN LEVEL	72.831	72.658	72.658	72.508	72.548	72.737	72.548	72.508	72.658	72.658	72.791	73.058
EXISTING LEVEL	73.605	73.017	73.017	73.017	73.018	73.028	73.066	73.049	73.047	73.042	73.041	73.058
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	11.321

CH 450



DESIGN LEVEL	68.868	68.174	68.002	68.002	67.852	67.892	68.081	67.892	67.852	68.002	68.002	68.134	68.154
EXISTING LEVEL	68.868	68.775	68.642	68.637	68.636	68.622	68.421	68.208	68.2	68.199	68.197	68.155	68.154
OFFSET	-14.026	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	10.329

CH 600



DESIGN LEVEL	64.484	64.311	64.311	64.161	64.201	64.39	64.201	64.161	64.311	64.311	64.444	62.892
EXISTING LEVEL	63.271	63.204	63.202	63.201	63.194	63.096	63.045	63.039	63.038	63.036	62.988	62.892
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	16.457

CH 750

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
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REVISIONS

BROWN

Brown Consulting (NSW) Pty Ltd
Level 2, 2 Burbank Place Norwest Business Park NSW Australia 2153
Telephone: 02 8808 5000 Facsimile: 02 8808 5099
Sydney Canberra Brisbane Melbourne Singapore

APPROVAL
BY: TOBY TAMES
BE (Hons) GradDipMgt CPESC CPEng MIEAust Director
SIGN:
DATE: 06/08/2010

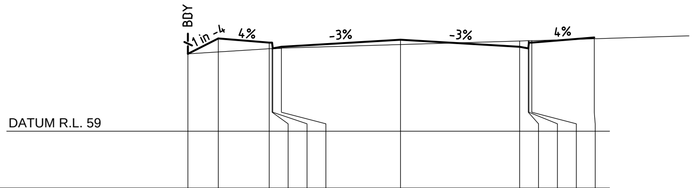
Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ROAD No.01 CROSS SECTIONS
SHEET 2 OF 4

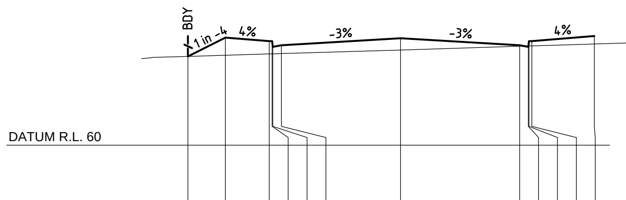
Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:200
Project No: X10134
Drawing No: 302
Revision: B

Saved: 09.08.2010, By: michael noonan
H:\X10\X10134 - Ropes Creek Industrial Subdivision\Drawings\Civil\X10134-302.dwg



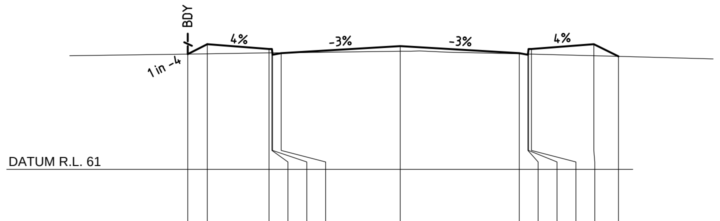
DESIGN LEVEL	61.043	61.446	61.338	61.338	61.188	61.228	61.417	61.228	61.188	61.338	61.338	61.471
EXISTING LEVEL	61.043	61.094	61.175	61.179	61.18	61.19	61.286	61.382	61.389	61.389	61.391	61.442
OFFSET	-11.25	-9.637	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 1050



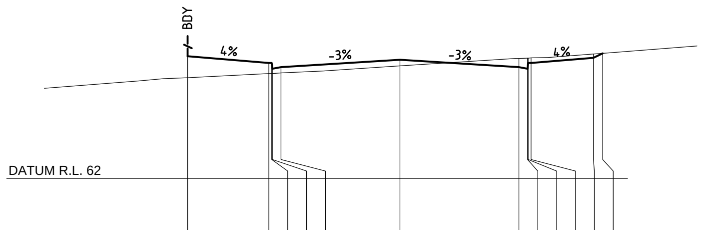
DESIGN LEVEL	62.354	62.852	62.759	62.759	62.609	62.649	62.838	62.649	62.609	62.759	62.759	62.891
EXISTING LEVEL	62.354	62.384	62.419	62.422	62.422	62.429	62.525	62.621	62.628	62.629	62.631	62.681
OFFSET	-11.25	-9.259	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 1000



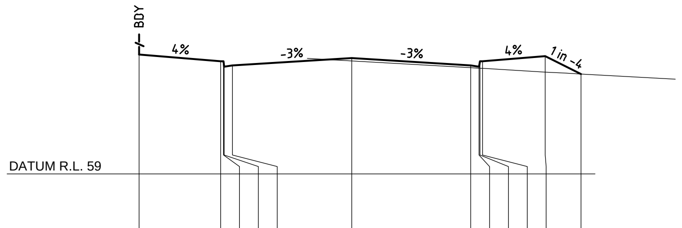
DESIGN LEVEL	64.052	64.314	64.183	64.183	64.033	64.073	64.262	64.073	64.033	64.183	64.183	64.316	63.99
EXISTING LEVEL	64.052	64.059	64.08	64.081	64.082	64.085	64.126	64.057	64.05	64.05	64.048	64.006	63.99
OFFSET	-11.25	-10.20	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	11.554

CH 950



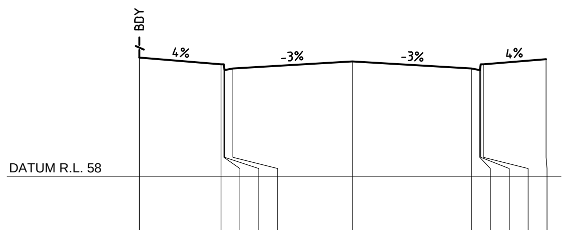
DESIGN LEVEL	65.226	65.053	65.053	64.903	64.943	65.132	64.943	64.903	65.053	65.053	65.186	65.306
EXISTING LEVEL	64.664	64.771	64.775	64.776	64.787	64.974	65.174	65.18	65.181	65.183	65.288	65.306
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	10.731

CH 900



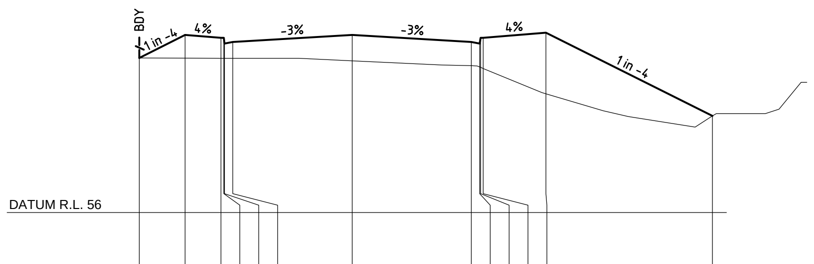
DESIGN LEVEL	62.159	61.987	61.987	61.837	61.877	62.066	61.877	61.837	61.987	61.987	62.119	61.646
EXISTING LEVEL						61.992	61.812	61.799	61.798	61.793	61.699	61.646
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	12.142

CH 1200



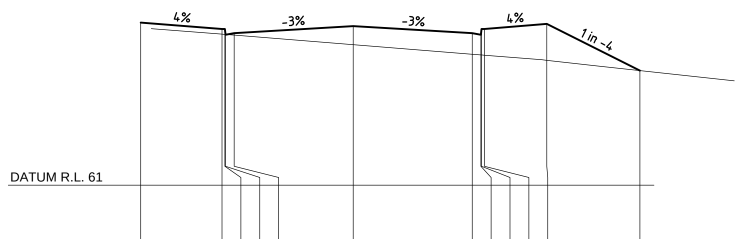
DESIGN LEVEL	61.125	60.952	60.952	60.802	60.842	61.031	60.842	60.802	60.952	60.952	61.085
EXISTING LEVEL											
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25

CH 1150



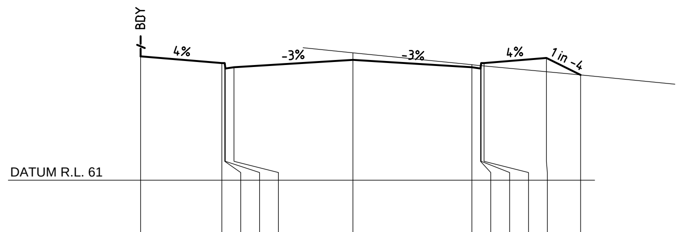
DESIGN LEVEL	60.094	60.701	60.625	60.625	60.475	60.515	60.704	60.515	60.475	60.625	60.625	60.758	58.557
EXISTING LEVEL	60.094	60.091	60.088	60.088	60.088	60.087	60.019	59.888	59.855	59.847	59.816	59.142	58.557
OFFSET	-11.25	-8.824	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	19.052

CH 1100



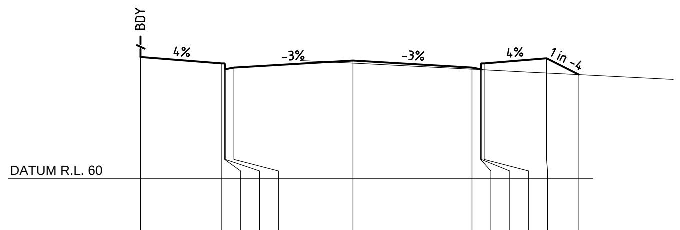
DESIGN LEVEL	65.301	65.128	65.128	64.978	65.018	65.207	65.018	64.978	65.128	65.128	65.261	64.03
EXISTING LEVEL		64.989	64.983	64.982	64.964	64.713	64.463	64.445	64.443	64.437	64.302	64.03
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	15.172

CH 1350



DESIGN LEVEL	64.27	64.097	64.097	63.947	63.987	64.176	63.987	63.947	64.097	64.097	64.23	63.778
EXISTING LEVEL						64.37	64.053	64.031	64.029	64.022	63.864	63.778
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	12.057

CH 1300



DESIGN LEVEL	63.215	63.042	63.042	62.892	62.932	63.121	62.932	62.892	63.042	63.042	63.175	62.748
EXISTING LEVEL						63.051	62.892	62.88	62.879	62.875	62.792	62.748
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	11.955

CH 1250

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

BROWN

Brown Consulting (NSW) Pty Ltd
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Telephone: 02 8808 5000 Facsimile: 02 8808 5099
Sydney
Canberra
Brisbane
Melbourne
Singapore

APPROVAL
BY: BE (Hons) GradDipMgt CPESC CPEng MIEAust Director
SIGN:
DATE:

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ROAD No.01 CROSS SECTIONS SHEET 3 OF 4

Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:200
Project No: X10134
Drawing No: 303
Revision: B

Saved: 09.08.2010, By: michael noonan
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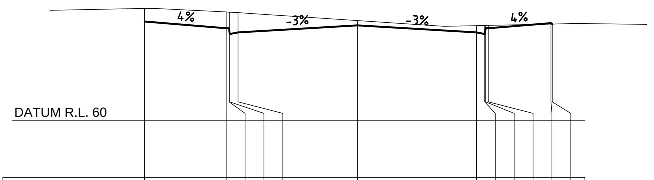
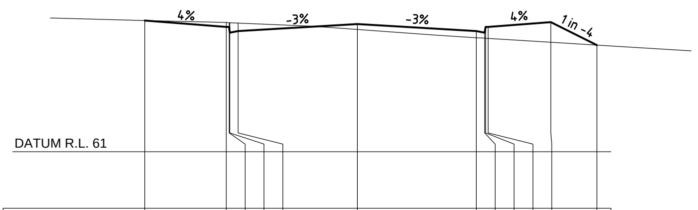


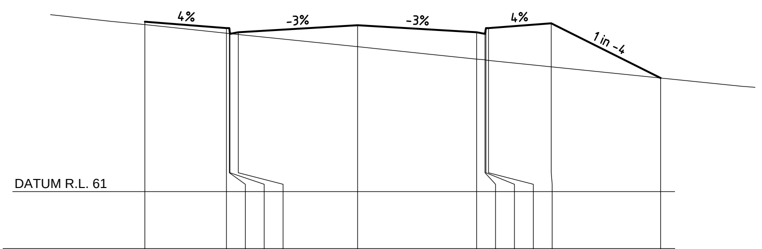
DESIGN LEVEL	62.622	62.45	62.45	62.3	62.34	62.529	62.34	62.3	62.45	62.45	62.582	62.563
EXISTING LEVEL	62.972	62.877	62.873	62.872	62.86	62.652	62.517	62.522	62.523	62.524	62.562	62.563
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	10.328

CH 1500



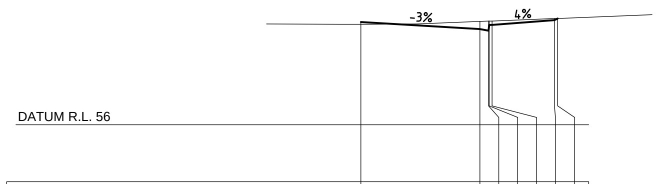
DESIGN LEVEL	64.477	64.304	64.304	64.154	64.194	64.383	64.194	64.154	64.304	64.304	64.437	63.827
EXISTING LEVEL	64.477	64.422	64.42	64.419	64.409	64.238	64.021	64.007	64.006	64.001	63.901	63.827
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	12.69

CH 1450



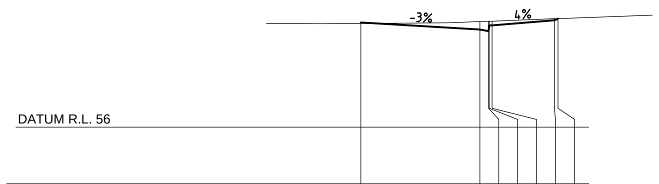
DESIGN LEVEL	65.5	65.328	65.328	65.178	65.218	65.407	65.218	65.178	65.328	65.328	65.46	64.011
EXISTING LEVEL	65.419	65.196	65.188	65.186	65.163	64.836	64.511	64.488	64.486	64.478	64.309	64.011
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	16.046

CH 1400



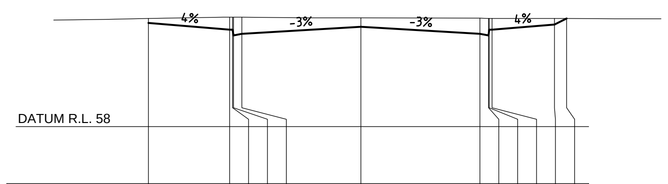
DESIGN LEVEL	58.723	58.534	58.494	58.644	58.644	58.776	58.817
EXISTING LEVEL	58.664	58.738	58.747	58.748	58.751	58.814	58.817
OFFSET	0	6.3	6.75	6.79	6.94	10.25	10.413

CH 1601.259



DESIGN LEVEL	58.77	58.581	58.541	58.691	58.691	58.823	58.868
EXISTING LEVEL	58.741	58.789	58.798	58.799	58.801	58.865	58.868
OFFSET	0	6.3	6.75	6.79	6.94	10.25	10.428

CH 1600



DESIGN LEVEL	60.743	60.57	60.57	60.42	60.46	60.649	60.46	60.42	60.57	60.57	60.703	60.862
EXISTING LEVEL	60.865	60.899	60.899	60.898	60.897	60.881	60.87	60.869	60.869	60.869	60.863	60.862
OFFSET	-11.25	-6.94	-6.79	-6.75	-6.3	0	6.3	6.75	6.79	6.94	10.25	10.886

CH 1550

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
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A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

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Brisbane
Melbourne
Singapore

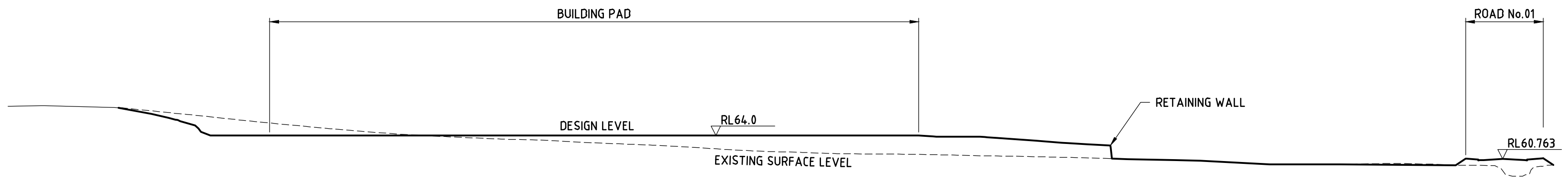
APPROVAL
BY: TOBY TAMES
BE (Hons) GradDipMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 06/08/2010

Client: JACFIN PTY LTD

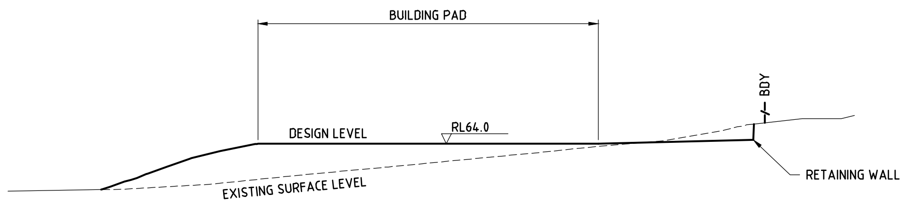
Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: ROAD No.01 CROSS SECTIONS
SHEET 4 OF 4

Drawn by: A.Mc
Design by: M.N.
Project No: X10134
Scale(A1): 1:200
Drawing No: 304
Revision: B



SECTION 1
Scale: 1:1000(H) 1:500(V)



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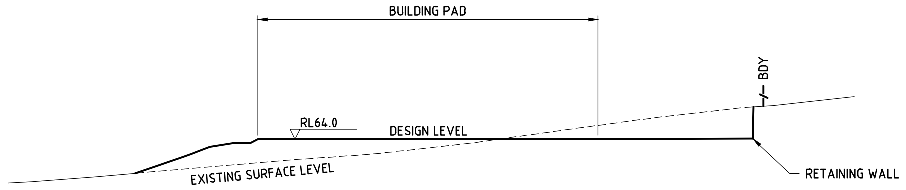

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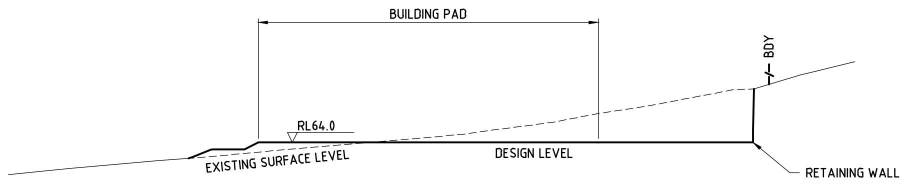

SECTION 4
Scale: 1:1000(H) 1:500(V)

0 10 20 30 40 50 60 70 80 90 100
SCALE 1:1000 (A1) SCALE 1:2000 (A3)

0 5 10 15 20 25 30 35 40 45 50
SCALE 1:500 (A1) SCALE 1:1000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

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Quality System Quality Endorsed Company

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APPROVAL
BY:
BE (Hons) GradDipMgt CPESC CPEng MIEAust
Director
SIGN:
DATE:

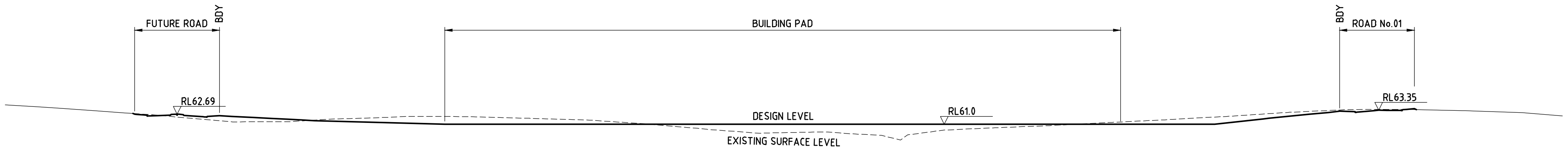
Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

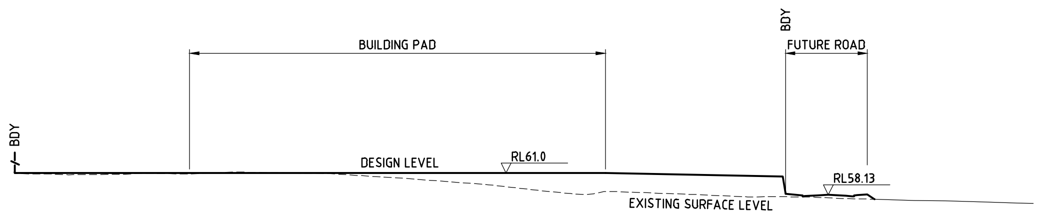
Drawing: SITE GRADING SHEET 1 OF 2
BUILDING 2

Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:1000 (H)
Project No: X10134
Drawing No: 401
Revision: B

Saved: 09.08.2010, By: michael noonan
H:\X10\X10134 - Ropes Creek Industrial Subdivision\Drawings\Civil\X10134-401.dwg



SECTION 5
Scale: 1:1000(H) 1:500(V)



SECTION 6
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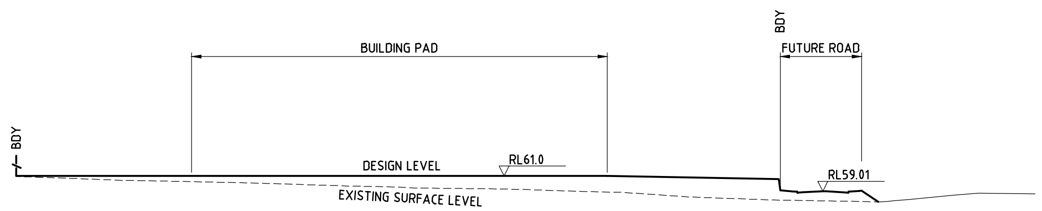
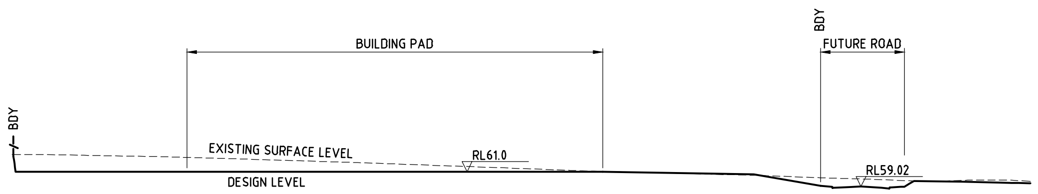


SECTION 7
Scale: 1:1000(H) 1:500(V)



SECTION 8
Scale: 1:1000(H) 1:500(V)

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SCALE 1:1000 (A1) SCALE 1:2000 (A3)

0 5 10 15 20 25 30 35 40 45 50
SCALE 1:500 (A1) SCALE 1:1000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
B	09/08/2010	DRAINAGE LAYOUT AMENDED	MN	PF	TT
A	06/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

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SIGN:
DATE:

Client: JACFIN PTY LTD

Project: LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT
ROAD & BULK EARTHWORK

Drawing: SITE GRADING SHEET 2 OF 2
BUILDING 1

Drawn by: A.Mc
Design by: M.N.
Project No: X10134
Drawing No: 402
Scale(A1): 1:1000 (H)
Revision: B

Saved: 09.08.2010, By: michael noonan
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