Appendix E

Acid Sulfate Soil Management Plan

Acid Sulfate Soil Management Plan for the Proposed Recycling Facility at Teralba

January, 2009

CiviLake

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1. Introduction

At the request of CiviLake (a business unit of Lake Macquarie City Council), Parsons Brinckerhoff (PB) has prepared an Acid Sulfate Soil Management Plan (ASSMP) for a proposed waste recycling facility at Teralba.

The investigation area encompasses Lots 42-43 and 53-54 DP16062 off The Weir Road Teralba, and is the site of the former Boolaroo Sanitary Depot. The site is located approximately 200m south of Cockle Creek and is currently unoccupied. The site location is shown on Figure-1.

The preparation of the ASSMP follows an environmental and geotechnical investigation carried out by PB at the site in May 2008 (Report ref 2118857A/PR-0394 Rev A), which identified the presence of potential acid sulfate soils (PASS) in the fill and alluvial soils at the site. Further investigation was carried out in November 2008, which targeted areas along the northwest side and northern end of the site which are to undergo significant excavation for construction of water storage ponds and excess stormwater retention basins.

Construction of the Waste Recycling Facility will involve excavation for construction of stormwater retention ponds, footings for structures (including pavements) and for laying services. The conceptual project layout is shown on Figure-2. Excavation and drainage of PASS can expose the soils to air and oxidation resulting in acid generation, which may have a detrimental effect on the surrounding environment.

The objective of the management plan is to reduce the likelihood of impact associated with excavation of PASS on the environment during construction of the Waste Recycling Facility. In addition, recommendations on construction techniques and soil and groundwater management are provided.

1.1 Definitions

The following definitions are used in this report:

ASS - acid sulfate soils include actual acid sulfate soils or potential acid sulfate soils. Actual and potential ASS are often found in the same profile, with actual ASS generally overlying potential ASS horizons.

AASS - actual acid sulfate soils are soils containing highly acidic soil horizons or layers resulting from the aeration of soil material that are rich in sulfides (typically iron sulfides). This oxidation produces hydrogen ions in excess of the soil's capacity to neutralise the acidity resulting in soils of pH 4 or less when measured in dry season conditions. These soils can usually be identified by the presence of pale yellow mottles and coatings of jarosite.

PASS - potential acid sulfate soils are soils which contain iron sulfides or sulfidic material which have not been exposed to air and oxidised. The field pH of these soils in their undisturbed state is pH 4 or more and may be neutral or slightly alkaline. These soils pose a considerable environmental risk when disturbed as they become severely acidic when exposed to air and oxidise.

ASSMP - acid sulfate soil management plan provides a framework to guide construction activity and work site management so as to mitigate the potential impacts of PASS/ASS on the surrounding environment.

2. ASS indicators and assessment criteria

The following assessment criteria for field and laboratory testing are based on those presented in the ‘Acid Sulfate Soil Manual’ published by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC, 1998).

Acid sulfate soils are usually found in estuarine areas up to 5 m AHD and generally consist of clays and sands containing pyritic material. The field indicators of actual acid sulfate soil (AASS) include:

- iron staining on any drain surfaces
- unusually clear or milky green water discharging from site
- jarosite horizons or mottling due to iron in the subsurface
- corrosion of concrete or steel structures
- field pH (pHf)<4.

Potential acid sulfate soils (PASS) are soils which contain iron sulfides or sulfidic material which have not been exposed to air and oxidised. PASS are generally waterlogged and the field pH of these soils in their undisturbed state is pH 4 or more and may be neutral or slightly alkaline. PASS may be identified by measuring and observing the response to the addition of a 30% hydrogen peroxide solution. The following may be indicators of PASS

- pH following oxidation with H_2O_2 (pHox) <3
- lowering of the pH (pHf – pHox) by at least 1 unit
- strength of oxidation reaction
- presence of any sulfurous odours.

The above field screening observations are used to guide selection of samples for laboratory analysis. Soil samples submitted for laboratory analysis are tested using the suspension peroxide oxidation combined acidity and sulfate (sPOCAS) method. The results were assessed against the criteria shown in Table 2-1 taken from ASSMAC 1998 associated with the disturbance of <1,000 or >1,000 tonnes of soil.

Table 2-1 Soil assessment criteria

Analyte	Units	Action criteria for soil types (< 1000 tonnes disturbed)		
		Coarse texture	**Medium texture**	**Fine texture**
S_{pos}	%S	0.03	0.06	0.1
TPA	Mole H+/Tonne	18	36	62
TSA	Mole H+/Tonne	18	36	62
Analyte	**Units**	**Action criteria for soil types (> 1000 tonnes disturbed)**		
		Coarse texture	**Medium texture**	**Fine texture**
S_{pos}	%S	0.03	0.03	0.03
TPA	Mole H+/Tonne	18	18	18
TSA	Mole H+/Tonne	18	18	18

Note: Spos – Peroxide oxidisable sulfur, TPA – Titratable potential acidity, TSA – Titratable sulfidic acidity

3. Project background

Development of the site for the recycling facility is likely to involve construction of the following:

- a 1.5 m high bund wall surrounding the site
- stormwater retention ponds
- pugmill batching plant
- a double storey gatehouse and weighbridge
- site offices and storage facilities
- bulk haulage access road
- product storage bays
- filling of the site by an additional 1m above the current ground level to address flooding conditions.

The environmental and geotechnical investigation carried out by PB in May 2008 involved excavation of 20 test pits (TP1 to TP20) to a maximum depth of 3.5m below ground level and drilling three boreholes (BH1 to BH3) to depths of 18.0 m, 20.5 m and 4.95 m respectively. In November 2008 five additional test pits (TP1 to TP5 Nov) were excavated in the location of the proposed storm water retention ponds as these areas may potentially undergo extensive excavation. Further testing may be carried out at the site for installation of services and foundations, however this would be localised.

Test pit and borehole locations are shown on Figure 2 and the November 2008 logs are attached in appendix A. The borehole and test pit logs from the May 2008 investigation are included in PB report 2118857A/PR-0394 Rev A.

The subsurface investigation found that test pits typically encountered uncontrolled fill consisting of sand, silt, gravel and clay, to depths up to greater than 2.9m. Fill materials were underlain by alluvial sand, silty sand, sandy clay and clayey sand to depths greater than 3.5m. Test pits TP1, TP2, TP3, TP6 and TP14 (May) encountered silty sand, clayey sand and sandy clay topsoil immediately below the fill. The topsoil thickness varied from 0.1m to 0.5m. Boreholes BH1 to BH3 typically encountered uncontrolled fill followed by alluvial sand, gravel and clay and highly weathered sandstone at between 16.5m and 19m.

Test pits TP1 to TP5 (Nov) typically found silty sand fill to depths of up to 1.9m followed by alluvial sand.

Groundwater was encountered at test locations BH1, BH2, TP9, TP10, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19 and TP20 (May) at depths ranging from 0.6 m to 2.8 m. Test pits TP1, TP2, TP3, TP4, TP5, TP7, TP10 and TP11 (May) all encountered water inflows at depths ranging from 0.1 m and 2.6 m. Test pits TP1, TP2, and TP5 (Nov) encountered groundwater inflow at approximately 1.8m. Groundwater was not encountered in test pits TP6 and TP8 (May) and test pits TP3 and TP4 (Nov).

Disturbed soil samples were taken at representative depths throughout the soil profile and stored on ice for ASS assessment. The samples were returned to the Newcastle office for field screening. The field screening results from the May 2008 investigation indicated that PASS was present at all test locations at depths ranging from 0.2 m to 17.65 m across the site. Field screening results from the November 2008 investigation indicated that PASS was present in all samples tested with the exception of samples from TP2, TP3/0.3-1.0 and TP5/1.5-1.8.

Based on the results of the field screening, twelve samples were selected and sent to a NATA accredited laboratory for sPOCAS testing. Of the twelve samples tested five samples exceeded the action criteria, which included fill and natural soil samples. The field screening and sPOCAS results are included in Appendix B.

4. ASS management plan

The following management plan should be adopted for the site. Note that the management plan requires the continuing involvement of an experienced ASS consultant to address changes in site conditions.

4.1 Extent of AASS

Field screening test results indicate that the pH of all of the tested samples is >4, therefore it's unlikely that any AASS are present at the site. Also none of the field indicators of AASS such as iron staining on drain surfaces or unusually clear or milky green water were noted during the investigation.

4.2 Extent of PASS

The 1:25 000 Wallsend ASS Map indicates that there is a high probability of ASS occurring within 1m of the ground surface in the southeast corner, and along the eastern boundary of the site. The remainder of the site is classified as having a low probability of ASS occurring at between 1 to 3 m depth.

The field screening results indicate that PASS is present at most test location across the site with the exception of TP2 (Nov). However, of the twelve samples sent for sPOCAS testing only five samples were confirmed as PASS and all of these samples came from depths of >1m and /or areas that will not undergo significant excavation.

4.3 Filling

The 1:25 000 Wallsend Topographic Sheet indicates that site levels are less than 10m AHD and CiviLake has indicated that the current level of the site is below the 1 in 20 year flood level. CiviLake's earthworks and site preparation plans involve raising site levels in two stages. Stage 1 will involve raising site levels to meet the 1 in 20 year flood level at 2.8m AHD and stage 2 will involve raising site levels to meet the 1 in 100 year flood level at 3.1m AHD. Site levels will be raised by importing and placing fill on the site. It's expected that approximately 30 000 tonnes of fill will be brought to the site each year until completion of the filling.

4.4 Excavation

Structures to be constructed at the site include a 1.5 m high bund wall, three stormwater retention ponds, pugmill, a double storey gatehouse and weighbridge, site offices, storage facilities, bulk haulage access road and product storage bays.

Lightly loaded structures such as the bund wall, site offices, storage facilities and the product storage bays are likely to be supported on shallow footings which will involve excavation in the imported fill which is unlikely to disturb PASS.

Heavily loaded structures such as the pugmill, the double storey gatehouse and the weighbridge are likely to be supported on piles which may require deeper excavations depending on the pile types used. The geotechnical report prepared by PB (Report ref 2118857A/PR-0394 Rev A) suggests that these structures should be supported on continuous flight auger (CFA) piles or driven piles due to the presence of a high water table and saturated, collapsible soils. If these structures are supported by driven piles disturbance of PASS should be minimal. If CFA or bored piles are selected then excavation and disturbance of PASS at depth is likely.

Construction of the three stormwater retention ponds is likely to involve excavation below the level of the imported fill. Provided that excavation for the ponds does not extend more than 1m below the existing surface it's unlikely that PASS will be disturbed.

Construction of the waste recycling plant will require services to be installed at the site. If underground services are proposed, then excavation of surface soils will be required. It's recommended that excavation depths for service trenches are minimised to reduce the likelihood of exposing PASS. If excavations extend more than 1m in to the existing fill then PASS may be disturbed.

Based on the pavement designs presented in PB report 2118857A/PR-0349 Rev A, excavations for boxing out road pavements are likely to extend approximately 0.5 m below the finished surface level in imported fill and therefore are unlikely to disturb PASS.

It's recommended that onsite monitoring is carried out during any deeper excavation earthworks carried out on site so that disturbance of PASS can be identified and PASS soils can be stockpiled and treated. Monitoring and stockpiling procedures are detailed in the following sections.

The results of laboratory analysis indicate that the soils between depths 1m and 5m of the exiting ground surface are capable of producing up to 1.2kg of sulfuric acid per tonne of excavated soil, and soils from between 14m and 17m depth are capable of producing 18.4kg to 49kg sulfuric acid per tonne of excavated soil. Consequently it is recommended that any soils suspected as PASS excavated from the site be stockpiled and treated with lime to neutralise any acid generated due to oxidation and managed in accordance with the recommendations in sections 4.5 and 4.6.

Clay materials should not be exposed for longer than two days, and sand soils should not be exposed for longer than one day without treatment due to oxidation rates.

The pH of any surface and groundwater pooling in excavations should be assessed prior to release. The pH of the water should be between 6.5 and 8.5. If the pH is not within these limits, neutralisation will be required prior to discharging the water off site. It's noted that it is CiviLake's intention that no water will leave the site and that the design of the proposed development will incorporate features to prevent surface water flows from entering or leaving the site. Approval from the DECC may be required prior to disturbance of PASS or onsite disposal of groundwater or potentially impacted surface water.

The operators of the excavation plant should be notified that they are working within an identified PASS area and that they will need to exercise caution and not over excavate.

4.5 Stockpiling

PASS excavated from greater than 1m depth (from the existing surface) should be stockpiled separately and treated in accordance with section 4.6. If CiviLake wish to confirm that the excavated soils are PASS prior to commencing treatment then the recommendations discussed in Section 4.8 should be followed.

Stockpiling of spoil should be viewed as a short-term material handling option and not a long term storage solution. Stockpiled soils should be managed as soon as possible. Stockpiles should be constructed as far as practical away from drainage lines. The surface area of stockpiles and the amount of infiltration water should be minimised and the run-on of stormwater into the stockpile area should be prevented.

Stockpiled PASS should be placed on an impervious surface to prevent the leaching of any residual acid to the surrounding environment. All stockpile areas should be bunded to prevent runoff leaving the stockpile area. The surface area of the stockpile exposed to oxidation should be minimised by using some form of artificial capping if storage is longer than a few days. Any water pooled within bund areas will require pH testing and treatment prior to discharging from the site.

4.6 Treatment

Due to the amount of filling required at the site to raise site levels to meet the appropriate flood requirements, CiviLake wish to reuse all excavated soils onsite. Following are options for treatment of PASS affected soil and water.

4.6.1 Soils

Alternatives for treating PASS from the site include neutralisation of sulfidic material present in the soil, or over-excavation in an acid sulfate soil free area and placing the material in a deep anaerobic void (below the permanent water table).

Treatment with agricultural lime is the recommended neutralisation method for PASS. Broad scale mechanical application methods such as rotary hoeing and tillage can be used to mix lime into soil over a large area. During the period of mixing and aeration, the rate of acid generation is likely to increase. However the lime should prevent a substantial lowering of the pH and the proliferation of bacteria which accelerate acid production.

A common approach is to spread out the PASS in thin layers typically 0.3 m thick over a thin bed of lime, air-drying and mechanically breaking up the clods as drying proceeds. When drying is complete, lime is added and the material is thoroughly mixed.

The amount of lime required for treatment of PASS material was estimated using a value of 0.09% oxidisable sulfur for soils between 1m and 5m depth and 0.04% to 1.58% oxidisable sulfur for soils at greater than 5m depth. Soils at less than 1m depth are unlikely to require treatment.

The estimations were made with reference to Tables 4-5 and 4-6 in the Acid Sulfate Soil Manual (ASSMAC, 1998). Based on the above, the preliminary dosing rate recommendation is 4kg of pure fine lime per tonne of soil excavated from between 1m to 5m depth (from the existing surface). For soils at greater than 5m depth (from the existing surface) dosing rates are expected to be between 2kg and 75kg of pure fine lime per tonne of excavated soil.

These dosage rates are based on a limited amount of testing. The dosing rate should be refined following further testing carried out during the construction phase. As with temporary storage areas, the ASS treatment and stockpile areas should be impervious and bunded with adequate leachate collection and treatment facilities.

4.6.2 Water

Prior to discharging water pooled within bund areas from the site, the pH of the water should be between 6.5 and 8.5, or within 0.2 of the pH value of local water bodies. Should the pH of the site discharge water be outside of these levels, neutralisation to these ranges will be required prior to discharge.

Neutralisation rates for water will be dependent on the pH of the leachate or groundwater, and the pH of nearby Cockle Creek. Table 7-1 in Appendix C is an extract from ASSMAC Management Guidelines and provides general guidelines for neutralising agent dose rates for water. Care should be taken when applying neutralising agent to ensure that sufficient mixing is achieved. Further screening of pH should be undertaken to ensure that neutralisation is complete prior to water discharge. Any flocculants should be removed prior to water discharge.

Agricultural lime has very low solubility, and can take considerable time to react. Hydrated lime is more soluble, however is quite caustic (pH12) and requires careful incremental addition and thorough pH checking so as not to overshoot the desired pH level.

From field measurements, the pH of groundwater is expected to be at around pH6, however may potentially be more acidic during construction activity. Generally, to treat pH5 groundwater to pH7, 0.5 grams per kilolitre of pure lime is required with no safety factor allowance. Controlled overdosing is recommended to adjust pH as fast as possible. Lime should be mixed to a slurry in a wheel barrow before dosing in order to increase mixing effectiveness.

4.7 Dewatering

Water inflows were noted in test pits TP1 to TP5 (Nov) located in the vicinity of the storm water retention ponds at depths of approximately 1.8m below the existing ground surface. CiviLake intend to minimise excavation for the retention ponds to reduce the impact on PASS at found at greater than 1m depth below the existing surface, therefore dewatering is unlikely to be required.

4.8 Monitoring

If disturbance of PASS is suspected to have occurred, parameters may need to be monitored daily. More frequent monitoring may also be required to assess the impact of events such as heavy rainfall. The monitoring program should be developed by the ASS consultant in conjunction with the project contractor.

Measurement and testing equipment should be operated by personnel experienced in water and soil sampling and testing, and using appropriately maintained and calibrated test equipment. If required, PB is able to provide training for CiviLake staff to carry out preliminary monitoring if PASS disturbance is suspected to have occurred during construction. The action criteria for treatment is summarised below in Table 4-1.

Table 4-1 Monitoring program action criteria

Medium	Indicator	Action
Water	6.5< pH>8.5 or +/-0.2 units of adjacent waters	pH outside this range is not suitable for discharge to the surrounding environment and requires treatment prior to discharge.
Soil	pH<4	Indicates that the excavated material is oxidising and would require treatment with lime to neutralise the acidity.

5. Limitations

This report should be read in conjunction with the appended ‘Limitations of Geotechnical Site Investigation’ in Appendix D, which provide important information regarding geotechnical investigation and assessment. Any changes to the scope of development of this site, or significant variation in subsurface conditions from those anticipated should be reported to this firm for reassessment.

6. References

ASSMAC (1998) 'Acid Sulfate Soils Assessment Guidelines' NSW Acid Sulfate Soils Management Advisory Committee, August 1998

Department of Land and Water Conservation (1997) 1: 25 000 Wallsend Acid Sulfate Soils Risk Map

Department of Land and Property Information (2002) 1: 25 000 Wallsend Topographic Map

PB Report (2008) Geotechnical and Environmental Site Assessment at Lots 42-43 and 53-54 DP16062, The Weir Road Teralba. Report ref 2118857A/PR-0394 Rev A

Appendix A

November 2008 logs

TEST PIT ENGINEERING LOG

TEST PIT NO.

TP01

SHEET 1 OF 1

Client:	**CiviLake**	Date Commenced:	**28/11/08**
Project:	**Waste Recycling Facility Teralba - ASSMP**	Date Completed:	**28/11/08**
Test Pit Location:	**See Plan**	Recorded By:	**AS**
Project Number:	**2118857D**	Log Checked By:	**MB**

Excavation Method: **JCB Backhoe**

Surface RL:

Co-ords:

Test Pit Information				Field Material Description						
1	2	3	4	5	6	7	8	9	10	11
WATER	RL(m) DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY (VS S FB F VL ST L VST MD D H VD)	HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
						TOPSOIL, organic material, compost				TOPSOIL
	0.10		D		(SM)	FILL, Silty SAND, fine grained, light brown				FILL
	0.30		D		(SM)	FILL, Silty SAND, fine grained, grey, trace clay				
	0.60		D		(SM)	Silty SAND, fine grained, orange, low plasticity silt	M			ALLUVIAL
▷	1.80					END OF TEST PIT AT 1.80 m				

This test pit log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

TEST PIT ENGINEERING LOG

TEST PIT NO.

TP02

SHEET 1 OF 1

Client:	**CiviLake**	Date Commenced:	**28/11/08**
Project:	**Waste Recycling Facility Teralba - ASSMP**	Date Completed:	**28/11/08**
Test Pit Location:	**See Plan**	Recorded By:	**AS**
Project Number:	**2118857D**	Log Checked By:	**MB**

Excavation Method: **JCB Backhoe**

Surface RL:
Co-ords:

Test Pit Information				Field Material Description						
1	2	3	4	5	6	7	8	9	10	11
WATER	RL(m) DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY (VS S F ST VST H / FB VL L MD D VD)	HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
						TOPSOIL, organic layer, compost	M			TOPSOIL
	0.05		D		(SM)	FILL, Silty SAND, fine grained, light brown				FILL
	0.25		D		(SM)	As above, but grey				
	1.00		D		(SP)	SAND, fine grained, orange/grey				ALLUVIAL
▷						END OF TEST PIT AT 1.70 m				

This test pit log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

TEST PIT ENGINEERING LOG

TEST PIT NO.

TP03

SHEET 1 OF 1

Client:	**CiviLake**	Date Commenced:	**28/11/08**
Project:	**Waste Recycling Facility Teralba - ASSMP**	Date Completed:	**28/11/08**
Test Pit Location:	**See Plan**	Recorded By:	**AS**
Project Number:	**2118857D**	Log Checked By:	**MB**

Excavation Method: **JCB Backhoe**

Surface RL:
Co-ords:

Test Pit Information				Field Material Description						
1	2	3	4	5	6	7	8	9	10	11
WATER	RL(m) / DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY (VS S F ST VST H / FB VL L MD D VD)	HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
N F G W O					(ML)	TOPSOIL, Sandy SILT, low plsticity, brown, organic material	M			TOPSOIL
	0.05		D		(SM)	FILL, Silty SAND, light brown				FILL
	0.30		D		(SM)	As above, but trace gravel				
	1.00		D		(CL)	FILL, Sandy CLAY, low plasticity, grey/brown, with gravel				
	2					END OF TEST PIT AT 2.00 m				

This test pit log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

TEST PIT ENGINEERING LOG

TEST PIT NO.

TP04

SHEET 1 OF 1

Client:	**CiviLake**	Date Commenced:	**28/11/08**
Project:	**Waste Recycling Facility Teralba - ASSMP**	Date Completed:	**28/11/08**
Test Pit Location:	**See Plan**	Recorded By:	**AS**
Project Number:	**2118857D**	Log Checked By:	**MB**

Excavation Method: **JCB Backhoe**

Surface RL:
Co-ords:

Test Pit Information				Field Material Description						
1	2	3	4	5	6	7	8	9	10	11
WATER	RL(m) DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY VS S F ST VST H FB VL L MD D VD	HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
N F G W O	0.05		D		(CL) (GP)	TOPSOIL, Silty Sandy CLAY, low plasicity, dark brown, fine sand FILL, Clayey Sandy GRAVEL, fine grained, grey/brown, fine sand	M			TOPSOIL FILL
	0.20		D		(CL)	FILL, Sandy Gravelly CLAY, low plasticity, grey brown				
	1.00 1		D		(CL)	As above				
	2					END OF TEST PIT AT 1.90 m				

This test pit log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

TEST PIT ENGINEERING LOG

TEST PIT NO.
TP05
SHEET 1 OF 1

Client:	**CiviLake**	Date Commenced:	**28/11/08**
Project:	**Waste Recycling Facility Teralba - ASSMP**	Date Completed:	**28/11/08**
Test Pit Location:	**See Plan**	Recorded By:	**AS**
Project Number:	**2118857D**	Log Checked By:	**MB**

Excavation Method: **JCB Backhoe**
Surface RL:
Co-ords:

Test Pit Information				Field Material Description						
1	2		3	4	5	6	7	8	9	10	11
WATER	RL(m)	DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY (VS S F ST VST H / FB VL L MD D VD)	HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
		0.05				(CL)	TOPSOIL, Sandy CLAY, low plasticity, dark brown	M			TOPSOIL
				D		(SP)	FILL, Clayey Silty SAND, fine to medium grained, light brown				FILL
		1.00		D		(CL)	FILL, Silty Sandy CLAY, low plasticity, grey/brown, trace gravel				
		1.50		D		(SP)	SAND, fine grained, grey/off-white				ALLUVIAL
▽		1.80					END OF TEST PIT AT 1.80 m				
		2									

This test pit log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

PARSONS BRINCKERHOFF

Explanatory Notes - Soil Description

In engineering terms soil includes every type of uncemented or partially cemented inorganic material found in the ground. In practice, if the material can be remoulded by hand in its field condition or in water it is described as a soil. The dominant soil constituent is given in capital letters, with secondary textures in lower case. The dominant feature is assessed from the Unified Soil Classification system and a soil symbol is used to define a soil layer as follows:

UNIFIED SOIL CLASSIFICATION

The appropriate symbols are selected on the result of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

USC Symbol	Description
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty Soil

MOISTURE CONDITION

Dry - Cohesive soils are friable or powdery
Cohesionless soil grains are free-running

Moist - Soil feels cool, darkened in colour
Cohesive soils can be moulded
Cohesionless soil grains tend to adhere

Wet - Cohesive soils usually weakened
Free water forms on hands when handling

For cohesive soils the following codes may also be used:

MC>PL Moisture Content greater than the Plastic Limit.
MC~PL Moisture Content near the Plastic Limit.
MC<PL Moisture Content less than the Plastic Limit.

PLASTICITY

The potential for soil to undergo change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (LL) is as follows:

Description of Plasticity	LL (%)
Low	<35
Medium	35 to 50
High	>50

COHESIVE SOILS - CONSISTENCY

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are assessed by the shear strength of the soil as observed visually, by the pocket penetrometer values and by resistance to deformation to hand moulding.

A Pocket Penetrometer may be used in the field or the laboratory to provide approximate assessment of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Strength	Symbol	Pocket Penetrometer Reading (kPa)
Very Soft	VS	< 25
Soft	S	20 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	> 400

COHESIONLESS SOILS - RELATIVE DENSITY

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silty and sandy material, and these are usually based on resistance to drilling penetration or the Standard Penetration Test (SPT) 'N' values. Other condition terms, such as friable, powdery or crumbly may also be used.

The Standard Penetration Test (SPT) is carried out in accordance with AS 1289, 6.3.1. For completed tests the number of blows required to drive the split spoon sampler 300 mm is recorded as the N value. For incomplete tests the number of blows and the penetration beyond the seating depth of 150 mm are recorded. If the 150 mm seating penetration is not achieved the number of blows to achieve the measured penetration is recorded. SPT correlations may be subject to corrections for overburden pressure and equipment type.

Term	Symbol	Density Index	N Value (blows/0.3 m)
Very Loose	VL	0 to 15	0 to 4
Loose	L	15 to 35	4 to 10
Medium Dense	MD	35 to 65	10 to 30
Dense	D	65 to 85	30 to 50
Very Dense	VD	>85	>50

COHESIONLESS SOILS 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	600mm to 2.36mm
	medium	200mm to 600mm
	fine	75mm to 200mm

Rock Description

The rock is described with strength and weathering symbols as shown below. Other features such as bedding and dip angle are given.

ROCK QUALITY

The fracture spacing is shown where applicable and the Rock Quality Designation (RQD) or Total Core Recovery (TCR) is given where:

$$RQD\ (\%) = \frac{\text{Sum of Axial lengths of core > 100mm long}}{\text{total length considered}}$$

$$TCR\ (\%) = \frac{\text{length of core recovered}}{\text{length of core run}}$$

ROCK STRENGTH

Rock strength is described using AS1726 and ISRM - Commission on Standardisation of Laboratory and Field Tests, "Suggested method of determining the Uniaxial Compressive Strength of Rock materials and the Point Load Index", as follows:

Term	Symbol	Point Load Index $Is_{(50)}$ (MPa)
Extremely Low	EL	<0.03
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	>10

● Diametral Point Load Index test

■ Axial Point Load Index test

ROCK MATERIAL WEATHERING

Rock weathering is described using the following abbreviation and definitions used in AS1726:

Abbreviation	Term
RS	Residual soil
XW	Extremely weathered
DW	Distinctly weathered
SW	Slightly weathered
FR	Fresh

DEGREE OF FRACTURING

Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm – 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm – 100 mm with occasional shorter and longer sections.
Slightly Fractured:	Core lengths are generally 300 mm – 1,000 mm with occasional longer sections and occasional sections of 100 mm – 300 mm.
Unbroken:	The core does not contain any fracture.

DEGREE OF DEVELOPMENT OF BEDDING

Massive	No obvious development of bedding - rock appears homogeneous
Poorly Developed	Bedding is barely obvious as faint mineralogical layering or grain size banding, but bedding planes are poorly defined.
Well Developed	Bedding is apparent in outcrops or drill core as distinct layers or lines marked by mineralogical or grain size layering.
Very Well Developed	g is often marked by a distinct colour banding as well as by mineralogical or grain size layering.

DEFECT DESCRIPTION

Type:	
B	Bedding
BP	Bed Parting
F	Fault
C	Cleavage
J	Joint
S	Shear Zone
CS	Clay Seam

Planarity	Description
P	Planar
Un	Undulating
St	Stepped
Ir	Irregular

Roughness	Description
Sm	Smooth
R	Rough
Sk	Slickensided
Fe	Ironstained

The inclination if defects are measured from perpendicular to the core axis.

WATER

▽	**Water level at date shown**
◁	**Partial water loss**
▷	**Water inflow**
◀	**Complete water loss**
NFGWO	**No Free Groundwater Observed** The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

Graphic Symbols for Soils & Rocks

Typical symbols for soils and rocks are as follows. Combinations of these symbols may be used to indicate mixed materials such as clayey sand.

Soil Symbols

Main components

- CLAY
- SILT
- SAND
- GRAVEL
- BOULDERS / COBBLES
- TOPSOIL
- PEAT

Minor Components

- Clayey
- Silty
- Sandy
- Gravelly

Other

- FILL
- BITUMEN
- CONCRETE

Rock Symbols

Sedimentary Rocks

- SANDSTONE
- SILTSTONE
- CLAYSTONE, MUDSTONE
- SHALE
- LAMINITE
- COAL
- LIMESTONE
- CONGLOMERATE

Igneous Rocks

- GRANITE
- BASALT
- UNDIFFERENTIATED IGNEOUS

Metamorphic Rocks

- SLATE, PHYLLITE, SCHIST
- GNEISS
- QUARTZITE

NFGWE No Free Groundwater Encountered: The borehole/test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

Appendix B

Laboratory results

PARSONS BRINCKERHOFF

ABN: 84 797 323 433

Acid Sulfate Soils Test

PROJECT:	Proposed Recycling Facility	STORAGE:	Freezer (<0°)
PROJECT NO:	2118857D	TESTED BY:	NC/NR
CLIENT:	LMCC	DATE:	12-May-08
SAMPLING METHOD:	disturbed airtight samples on ice	CHECKED BY:	JNA
DATE SAMPLED	1,2,5 May 2008	DATE:	29-May-08

Sample ID	Depth (m)	pH_F	pH_{FOX}	pH_F - pH_{FOX}	Reaction#	Inferred Presence of ASS*
BH1	0.50 to 0.95	7.30	4.2	3.14	2	PASS
	1.50 to 1.95	7.90	4.8	3.10	1 to 2	PASS
	4.50 to 4.95	8.14	5.3	2.81	2	PASS
	7.40 to 7.60	8.65	5.33	3.32	2	PASS
	9.60 to 10.05	8.29	5.3	2.99	2	PASS
	11.10 to 11.55	8.01	5.1	2.96	2	PASS
	15.60 to 16.05	6.80	2.28	4.52	2	PASS
	17.10 to 17.35	7.66	3.05	4.61	2	PASS
BH2	0.50 to 0.95	6.83	5	1.83	2	PASS
	1.50 to 1.95	6.00	4.45	1.55	2	PASS
	3.00 to 3.45	8.49	5.07	3.42	1	PASS
	4.50 to 4.95	5.80	4.1	1.70	1	PASS
	7.10 to 7.20	5.80	3.1	2.70	2	PASS
	9.70 to 10.15	5.80	3.4	2.40	2	PASS
	11.20 to 11.65	6.05	2.35	3.70	2	PASS
	12.70 to 13.15	6.90	3.33	3.57	2	PASS
	14.20 to 14.65	8.45	2.47	5.98	2 to 3	PASS
	17.20 to 17.65	6.92	2.33	4.59	4	PASS
BH3	0.50 to 0.95	7.10	5.27	1.83	2	PASS
	1.50 to 1.95	7.10	5.38	1.72	1	PASS
	3.00 to 3.45	7.10	5.18	1.92	1	PASS
	4.50 to 4.95	8.51	4.76	3.75	1	PASS
TP1	2.40 to 2.50	4.90	3.9	1.00	2	PASS
TP4	1.4 to 1.5	6.72	4.49	2.23	2	PASS
	3.00 to 3.10	6.85	4.4	2.45	1	PASS
TP5	1.20 to 1.30	4.70	3.14	1.56	2	PASS
	1.90 to 2.00	7.32	4.16	3.16	2 to 3	PASS
TP7	1.20 to 1.30	8.45	5.22	3.23	2	PASS
	2.80 to 2.90	7.09	5.08	2.01	2 to 3	PASS
	3.10 to 3.20	8.73	5.56	3.17	2	PASS
TP10	0.90 to 1.00	5.55	4.58	0.97	2 to 3	PASS
	1.50 to 1.60	8.55	5.3	3.25	2	PASS
	2.00 to 2.10	6.92	4.47	2.45	2	PASS
TP11	0.40 to 0.50	5.80	4.47	1.33	2	PASS
	1.10 to 1.20	9.06	5.57	3.49	2	PASS
	3.30 to 3.40	8.50	5.53	2.97	2	PASS
TP12	0.80 to 0.90	6.30	5.08	1.22	1	PASS
TP13	0.50 to 0.60	7.50	5.43	2.07	2	PASS
	2.50 to 2.60	4.55	4.21	0.34	2	N

* PASS - Potential Acid Sulfate Soil
AASS - Actual Acid Sulfate Soil
N - No ASS Present

 # Reaction Intensity

1 - No reaction | 2 - Mild reaction | 3 - Vigorous reaction | 4 - Violent reaction

pH_F - Field pH; pH_{FOX} - Field pH after hydrogen peroxide oxidation

CALIBRATION DETAILS		pH Meter No:	WP-81(TPS) 121132
		pH of Hydrogen Peroxide:	4.01
Standard Buffer pH 4	x	Use by Date:	Jan-09
Standard Buffer pH 6.88	x	Use by Date:	Nov-08

PARSONS BRINCKERHOFF
ABN: 84 797 323 433

Acid Sulfate Soils Test

PROJECT:	Proposed Recycling Facility	STORAGE:	Freezer (<0°)
PROJECT NO:	2118857D	TESTED BY:	NC/NR
CLIENT:	LMCC	DATE:	12-May-08
SAMPLING METHOD:	disturbed airtight samples on ice	CHECKED BY:	JNA
DATE SAMPLED	1,2,5 May 2008	DATE:	29-May-08

Sample ID	Depth (m)	pH_F	pH_{FOX}	$pH_F - pH_{FOX}$	Reaction#	Inferred Presence of ASS*
TP14	0.20 to 0.30	8.43	4.90	3.53	3 to 4	PASS
	1.00 to 1.10	9.10	5.30	3.80	2	PASS
	1.70 to 1.80	8.04	5.54	2.50	1	PASS
TP16	0.20 to 0.30	4.67	3.00	1.67	2	PASS
	0.50 to 0.60	4.70	3.59	1.11	2	PASS
	1.50 to 1.60	6.69	5.49	1.20	1	PASS
TP17	0.20 to 0.30	6.00	4.75	1.25	2	PASS
	1.90 to 2.00	6.28	4.94	1.34	2 to 3	PASS
	2.50 to 2.60	6.30	4.96	1.34	1	PASS
TP18	0.90 to 1.00	6.93	5.60	1.33	1	PASS
TP19	0.20 to 0.30	8.10	5.30	2.80	1	PASS
	1.00 to 1.10	8.50	5.12	3.38	1	PASS

* PASS - Potential Acid Sulfate Soil
AASS - Actual Acid Sulfate Soil
N - No ASS Present

 # Reaction Intensity
1 - No reaction 2 - Mild reaction 3 - Vigorous reaction 4 - Violent reaction
pH_F - Field pH; pH_{FOX} - Field pH after hydrogen peroxide oxidation

CALIBRATION DETAILS		pH Meter No:	WP-81(TPS) 121132
		pH of Hydrogen Peroxide:	4.01
Standard Buffer pH 4	x	Use by Date:	Jan-09
Standard Buffer pH 6.88	x	Use by Date:	Nov-08

PARSONS BRINCKERHOFF
ABN: 84 797 323 433

Acid Sulfate Soils Test

PROJECT:	Proposed Recycling Facility	STORAGE:	Freezer (<0°)
PROJECT NO:	2118857D	TESTED BY:	AS/NR
CLIENT:	LMCC	DATE:	3-Dec-08
SAMPLING METHOD:	disturbed airtight samples on ice	CHECKED BY:	MB
DATE SAMPLED	28-Nov-08	DATE:	23-Dec-08

Sample ID	Depth (m)		pH_F	pH_{FOX}	pH_F - pH_{FOX}	Reaction#	Inferred Presence of ASS*
TP1	0.10 -	0.30	7.01	5.8	1.19	NIL	PASS
	0.30	0.60	6.83	5.8	1.03	NIL	PASS
	1.00	1.50	6.94	5.9	1.02	NIL	PASS
TP2	0.05	0.25	6.85	5.92	0.93	NIL	N
	0.25	1.00	6.53	5.63	0.90	NIL	N
	1.00	1.70	6.44	5.84	0.60	NIL	N
TP3	0.05	0.30	6.82	5.7	1.16	NIL	PASS
	0.30	1.00	6.63	5.78	0.85	NIL	N
	1.00	2.00	6.65	5.53	1.12	NIL	PASS
TP4	0.05	0.20	6.87	5.59	1.28	colour change	PASS
	0.50	1.00	7.15	5.7	1.45	colour change	PASS
	1.00	1.90	7.22	5.25	1.97	NIL	PASS
TP5	0.05	0.50	5.70	4.7	1.00	NIL	PASS
	0.50	1.00	6.80	5.8	1.05	NIL	PASS
	1.00	1.50	6.95	5.71	1.24	NIL	PASS
	1.50	1.80	6.97	6.4	0.57	NIL	N

* PASS - Potential Acid Sulfate Soil
AASS - Actual Acid Sulfate Soil
N - No ASS Present

 # Reaction Intensity
1 - No reaction | 2 - Mild reaction | 3 - Vigorous reaction | 4 - Violent reaction

pH_F - Field pH; pH_{FOX} - Field pH after hydrogen peroxide oxidation

CALIBRATION DETAILS		pH Meter No:	WP-81(TPS) 121132
		pH of Hydrogen Peroxide:	4.01
Standard Buffer pH 4	x	Use by Date:	Jan-09
Standard Buffer pH 6.88	x	Use by Date:	Nov-08

SPOCAS results

Sample	Depth (m)	Soil type	Spos %S	TPA mole H+/tonne	TSA mole H+/tonne	TAA mole H+/tonne	Exceeds action criteria*
BH2 May	14.2-14.65	Sandy CLAY/Clayey SAND	1.58	836	822	14	YES
BH2 May	17.2-17.65	SAND	0.58	242	232	10	YES
BH3 May	4.5-4.95	Sandy CLAY	0.04	15	15	<2	YES
TP10 May	1.5-1.6	Silty SAND/SAND	<0.02	<2	<2	<2	NO
TP11 May	1.1-1.2	Silty SAND/SAND	<0.02	<2	<2	<2	NO
TP11 May	3.3-3.4	SAND	<0.02	<2	<2	<2	NO
TP14 May	0.2-0.3	Clayey SAND/Sandy CLAY Fill	0.03	<2	<2	<2	NO
TP2 Dec	1.0-1.7	SAND	<0.02	<2	<2	<2	NO
TP4 Dec	0.5-0.2	SAND Fill	0.03	<2	<2	9	NO
TP4 Dec	0.2-1.0	CLAY Fill	0.03	<2	<2	3	NO
TP4 Dec	1.0-1.9	SAND Fill	0.08	<2	<2	<2	YES
TP5 Dec	1-1.5	CLAY Fill	0.09	<2	<2	<2	YES

Note-

* Exceeds action criteria for >1000t of disturbed soil shown in Table 2.1 of the report

CERTIFICATE OF ANALYSIS

Work Order	: **EB0816916**	Page	: 1 of 4
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Brisbane
Contact	: MICHELLE BLACK	Contact	: Tim Kilmister
Address	: PO BOX 1162 NEWCASTLE NSW, AUSTRALIA 2300	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: mblack@pb.com.au	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 02 49298300	Telephone	: +61-7-3243 7222
Facsimile	: +61 02 49297299	Facsimile	: +61-7-3243 7218
Project	: 2118857D	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 03-DEC-2008
Sampler	: ----	Issue Date	: 10-DEC-2008
Site	: ----		
		No. of samples received	: 5
Quote number	: EN/008/08	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = Chemistry Abstract Services number
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.**
- **Retained Acidity not required because pH KCl greater than or equal to 4.5**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	TP4 0.5-0.2	TP4 0.2-1	TP4 1-1.9	TP5 1-1.5	TP2 1-1.7
			Client sampling date / time	28-NOV-2008 11:30	28-NOV-2008 11:30	28-NOV-2008 11:30	28-NOV-2008 11:30	28-NOV-2008 11:30
Compound	CAS Number	LOR	Unit	EB0816916-001	EB0816916-002	EB0816916-003	EB0816916-004	EB0816916-005
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**5.6**	**6.2**	**6.6**	**8.2**	**6.7**
pH OX (23B)	----	0.1	pH Unit	**6.8**	**7.0**	**7.0**	**7.1**	**6.0**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**9**	**3**	<2	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S	**0.03**	**0.03**	**0.08**	**0.09**	<0.02
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	**0.03**	**0.03**	**0.08**	**0.09**	<0.02
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	**19**	**20**	**47**	**54**	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	**0.08**	**0.14**	**0.16**	**0.26**	**0.04**
Peroxide Calcium (23Wh)	----	0.02	% Ca	**0.15**	**0.21**	**0.27**	**0.40**	**0.06**
Acid Reacted Calcium (23X)	----	0.02	% Ca	**0.07**	**0.08**	**0.11**	**0.14**	<0.02
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**36**	**38**	**55**	**71**	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	**0.06**	**0.06**	**0.09**	**0.11**	<0.02
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg	**0.02**	<0.02	**0.02**	**0.02**	<0.02
Acid Reacted Magnesium (23U)	----	0.02	% Mg	**0.02**	<0.02	**0.02**	**0.02**	<0.02
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	**17**	<10	**20**	**20**	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	**0.03**	<0.02	**0.03**	**0.03**	<0.02
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	**0.15**	**0.32**	**0.40**	**0.40**	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	**30**	**64**	**79**	**79**	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	**0.05**	**0.10**	**0.13**	**0.13**	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**

Analytical Results

Sub-Matrix: **SOIL**			Client sample ID	**TP4 0.5-0.2**	**TP4 0.2-1**	**TP4 1-1.9**	**TP5 1-1.5**	**TP2 1-1.7**
			Client sampling date / time	28-NOV-2008 11:30	28-NOV-2008 11:30	28-NOV-2008 11:30	28-NOV-2008 11:30	28-NOV-2008 11:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB0816916-001**	**EB0816916-002**	**EB0816916-003**	**EB0816916-004**	**EB0816916-005**
EA029-H: Acid Base Accounting - Continued								
Net Acidity (sulfur units)	----	0.02	% S	**0.04**	**0.04**	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	**28**	**23**	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	**2**	**2**	<1	<1	<1

Appendix C

Table 7.1 ASSMAC 1998

Table 7.1 Quantity of pure neutralising agent required to raise from existing pH to pH 7 for 1 megalitre of low salinity acid water.

Current Water pH	*[H^+] {mol/L}*	*H^+ in 1 Megalitre {mol}*	*Lime to neutralise 1 Megalitre {kg pure $CaCO_3$}*	*Hydr. lime to neutralise 1 Megalitre {kg pure $Ca(OH)_2$}*	*Pure $NaHCO_3$/ 1 Megalitre {kg }*
0.5	.316	316,228	15,824	11,716	26,563
1.0	.1	100,000	5,004	3705	8390
1.5	.032	32,000	1,600	1185	2686
2.0	.01	10,000	500	370	839
2.5	.0032	3,200	160	118	269
3.0	.001	1,000	50	37	84
3.5	.00032	320	16	12	27
4.0	.0001	100	5	4	8.4
4.5	.000032	32	1.6	1.18	2.69
5.0	.00001	10	0.5	0.37	0.84
5.5	.0000032	3.2	0.16	0.12	0.27
6.0	.000001	1	0.05	0.037	0.08
6.5	.00000032	.32	0.016	0.12	0.027

Appendix D

Limitations statement

LIMITATIONS OF GEOTECHNICAL SITE INVESTIGATION

Scope of Services

This geotechnical site assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Parsons Brinckerhoff (PB) ("scope of services"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, PB has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

Geotechnical Investigation

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared to meet the specific needs of individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor or even some other consulting civil engineer. This report was prepared expressly for the Client and expressly for purposes indicated by the Client or his representative. Use by any other persons for any purpose, or by the Client for a different purpose, might result in problems. The Client should not use this report for other than its intended purpose without seeking additional geotechnical advice.

This Geotechnical Report is Based on Project-specific Factors

This geotechnical engineering report is based on a subsurface investigation which was designed for project-specification factors, including the nature of any development, its size and configuration, the location of any development on the site and its orientation, and the location of access roads and parking areas. Unless further geotechnical advice is obtained this geotechnical engineering report cannot be used:

- when the nature of any proposed development is changed; or
- when the size, configuration location or orientation of any proposed development is modified.

This geotechnical engineering report cannot be applied to an adjacent site.

The Limitations of Site Investigation

In making an assessment of a site from a limited number of boreholes or test pits there is the possibility that variations may occur between test locations. Site exploration identifies specific subsurface conditions only at those points from which samples have been taken. The risk that variations will not be detected can be reduced by increasing the frequency of test locations; however this often does not result in any overall cost savings for the project. The investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of the subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form an inferred geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies.

The borehole logs are the subjective interpretation of subsurface conditions at a particular location, made by trained personnel. The interpretation may be limited by the method of investigation, and can not always be definitive. For example, inspection of an excavation or test pit allows a greater area of the subsurface profile to be inspected than borehole investigation, however, such methods are limited by depth and site disturbance restrictions. In borehole investigation, the actual interface between materials may be more gradual or abrupt than a report indicates.

Subsurface Conditions are Time Dependent

Subsurface conditions may be modified by changing natural forces or man-made influences. A geotechnical engineering report is based on conditions which existed at the time of subsurface exploration.

Construction operations at or adjacent to the site, and natural events such as floods, or groundwater fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept appraised of any such events, and should be consulted to determine if additional tests are necessary.

Avoid Misinterpretation

A geotechnical engineer should be retained to work with other appropriate design professionals explaining relevant geotechnical findings and in reviewing the adequacy of their plans and specifications relative to geotechnical issues.

Bore/Profile Logs Should Not Be Separated from the Engineering Report

Final bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports. These logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings. To minimise the likelihood of bore/profile log misinterpretation, contractors should be given access to the complete geotechnical engineering report prepared or authorised for their use. Providing the best available information to contractors helps prevent costly construction problems. For further information on this matter 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.

Geotechnical Involvement During Construction

During construction, excavation is frequently undertaken which exposes the actual subsurface conditions. For this reason geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed and to conduct additional tests which may be required and to deal quickly with geotechnical problems if they arise.

Report for Benefit of Client

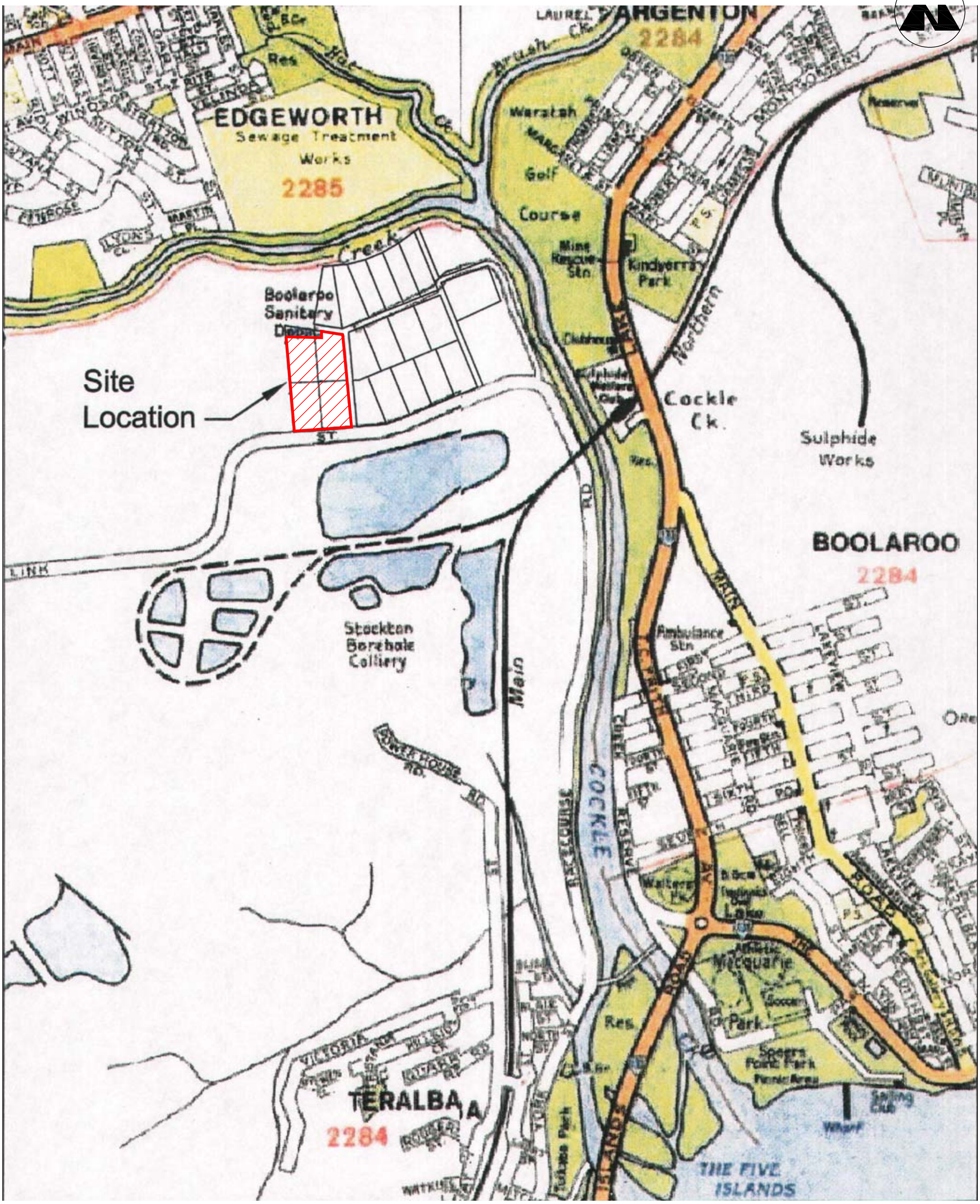
The report has been prepared for the benefit of the Client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

PB will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Figures

Client: LMCC
Project: Proposed Recycling Facility
Location: The Weir Road
Teralba



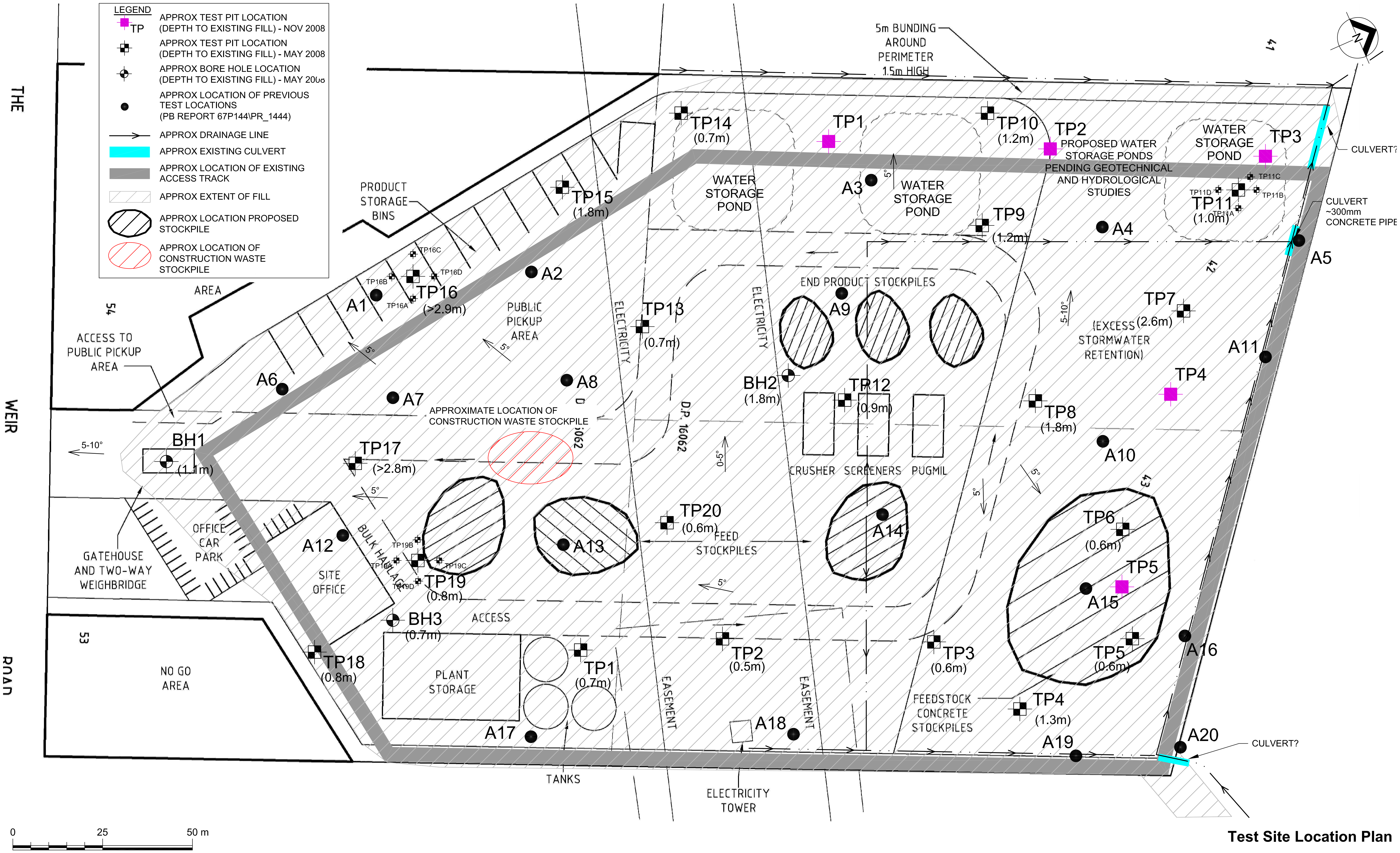
Locaility Plan

Figure 1

Plot Date: 07/07/08 - 14:08 Cad File: J:\A237 - HUN\PROJ\2118857A___CLMGEO_LMCC_TE\09_CADD\DRAWINGS\2118857A-GEO-F001.dwg

Client: LMCC
Project: Proposed Concrete Recycling Facility
Location: The Weir Road
Teralba

PARSONS BRINCKERHOFF



Scale 1: 1000

Test Site Location Plan

Figure 2