31 March 2009

DRAFT REPORT

PRELIMINARY ACID SULPHATE SOIL INVESTIGATION, BUCKLAND PARK, SOUTH AUSTRALIA

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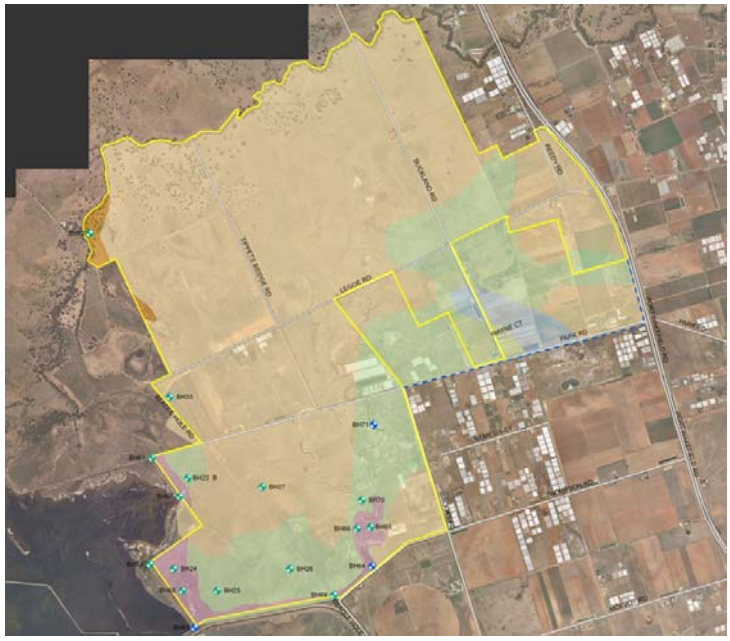

Report Number: 077662060 008 Rev4

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REPORT

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APPENDICES

FIGURES

1.0 INTRODUCTION

This report presents the results of a preliminary acid sulphate soil (ASS) investigation carried out by Golder Associates Pty Ltd (Golder) for the Buckland Park Proposal and Environmental Impact Statement (EIS). The location of the site is shown in Appendix A, Tab 1.

The investigation has been conducted in two distinct stages. The initial stage was conducted as part of a preliminary geotechnical investigation commissioned by Walker Corporation on 17 December 2007 (letter, Lewis/Proudman) following our proposal dated 28 November 2007 (reference P77662077b). The initial investigation, included limited ASS field and laboratory testing, and is summarised in our draft report '*Preliminary Geotechnical Investigation, Buckland Park, South Australia'*, dated 26 May 2008 (reference 077662060 004 R Rev0). ASS results from this initial stage of investigation are also been included in this report for completeness.

The second stage of ASS related investigation was commissioned by Walker Corporation on 25 June 2008 (letter, Lewis/O'Malley) following our proposal dated 13 June 2008 (077662060 005 R Rev0).

The aim of the second stage of investigation was to further assess the risk of ASS on the site.

The preliminary ASS investigation included:

- a desktop study of geological, groundwater and historical photograph information to identify portions to the site where ASS may be of concern;
- intrusive site investigations and soil sample collection targeting areas of concern;
- field and laboratory testing for ASS indicators;
- groundwater sampling and laboratory testing for ASS indicators;
- preparation of this report including the results of investigations, and possible management measures for the identification, storage and treatment of ASS encountered during construction works for the proposed development.

As part of the desktop study an extract of SKM's baseline report for the site (provided as Appendix C), specifically the hydrogeology, was provided by Walker Corporation for reference.

2.0 DESKTOP ASSESSMENT

2.1 Site Description

Buckland Park is located 32 km north of the Adelaide CBD. The site is bounded by Port Wakefield Road, the Gawler River, Cheetham Salt Limited salt pans and horticultural activities. The Site location is shown in Appendix A. The site area is 1,308 hectares, the certificates of title are tabled as within Appendix A.

The proposal comprises 12,000 residential lots, to be created over a 25 year time frame. Stage 1, proposed to commence in late 2009, is indicated within Appendix A and encompasses portions of the east sector and north sector east shown in Appendix A, Tab 5.

The site is generally flat, and has been used for agricultural purposes, primarily low intensive grazing. In the north west and south west parts of the site there are areas of remnant native vegetation.

Coastal ASS materials are generally located within soils at or below an elevation of 5 mAHD. A contour plan of the site was used to differentiate between land that is less than or greater than 5 mAHD. Figure 2 indicates the portion of the site with surface levels below 5 mAHD. The remainder of the site generally has surface levels 6 to 7 mAHD and up to 11 mAHD along the northern and eastern boundaries of the site.

Watercourses associated with the site include Gawler River, Thompson Creek and its tributaries, an unnamed watercourse in the southwest corner of the site and an inferred man made channel along the western and southern boundaries of south sector west. The Gawler River is the northern boundary of the site. Thompson Creek and its tributaries flow out to the coast through the Thompson Outfall Channel at Beagle Hole Road, south of the site, after meandering through the site from north sector east through the south sector and the eastern portion of south sector west.

2.2 Proposed Disturbances

We understand from Walbridge and Gilbert (W&G) (email, dated 6 June 2008) that an area has been identified in the south western corner of the Site that is likely to undergo ‘large excavations’ (W&G sketch is provided in Appendix B). In a telephone conversations on 10 June 2008 and 12 November 2008 (Byrne/Young) W&G stated the area would be a capture basin and may be excavated to a depth around the existing groundwater level.

W&G also indicated that other excavations may be required onsite include:

- drainage channels to around 2 m depth
- trenching for installation of stormwater pipes to around 2 m depth; and
- trenching for installation of sewer pipes as deep as 4 m, possibly placed below groundwater.

Other excavations identified by Golder that may be of concern are footings other than raft slabs for buildings such as piles that may extend deeper than groundwater.

2.3 Geology and Soils

The "*Gawler*" geological mapsheet[1] provides information on the geology of the central and eastern portions of the site and the "*Vincent*" geological mapsheet[2] provides information on the geology of the western portion of the site.

The mapsheets provide the following information on the site;

- Most of the site is underlain by Quaternary age 'Pooraka formation: Red-brown sandy clay and micaceous, clayey sand. Late Pleistocene (30,000 to 20,000 years before present) fluvial and alluvial deposits and abandoned channels'.
- The far north-west of the site is underlain by 'Holocene alluvium: Micaceous, red-brown and grey, fine sand and silty clay. Recent floodplain deposits and abandoned channels.'
- The far south-west of the site and partially inland from the outlet of Thompson Creek is underlain by 'St Kilda Formation: (Holocene marine and coastal marine sediments).'

The "Adelaide" soils mapsheet[3] indicates a large portion of the site, the southern portion of the site and inland to the central portion of the site, is underlain by St Kilda Formation. In addition Fulham sand is also shown in the south sector east portion of the site.

Bulletin 46 of the Geological Survey of South Australia[4] indicates that the site is part of the Lower Outwash Plain of the Para Fault scarp. The topography of the Lower Outwash Plain is dominated by outwash fan deposits of the streams draining the hills to the east (these form the Para Fault scarp). There is evidence of levee development in the Lower Outwash plain associated with the streams. The stream courses appear to have varied over time so that buried creek channels (alluvial deposits of sand and gravel) are present within the Plain, generally overlain with clay. Often these will be associated with shallow surface depressions.

Geology features from the "Gawler", "Vincent" and "Adelaide" mapsheets have been placed over a recent aerial photograph of the site as Figure 1b.

The Australian Soil Resource Information System (ASRIS) produced by the CSIRO and Atlas of South Australia Map produced by Planning SA provide reference maps to assess if a site has potential for acid sulphate soils. The maps do not indicate the potential for acid sulphate soils on the site (the mapping of the soil may have been limited due to private property boundaries), but indicates a high probability closer to the coast in St Kilda Formation and slightly inland of the coastline in Holocene Alluvium. Both of these soil formations are suspected to be on the site and therefore there is the potential for acid sulphate soils to be present.

2.4 Aerial Photographs

A review of aerial photographs indicated little change had occurred to the alignments of the watercourses on site over the past 60 years. Thompson Creek appears to extend further north into the north sector east in aerial photographs from 1989 and prior to this date. Post 1989 horticulture sheds appear to have been built over the top of the previous alignment of Thompson Creek in the south sector, north of Park Road.

The saltpans, south west of the site appear to have started construction nearer the coast pre 1959 and then closer to the site pre 1969. The channel around the south western portion of the site is suspected to have been built close to the time of building the salt pans closer to the site.

[1] Belperio, B.P. Scale 1:50,000, Geological Survey of South Australia (1988)
[2] Belperio, B.P. Scale 1:50,000, Geological Survey of South Australia (1988)
[3] Barnes, T. A. Scale 1:250,000, Department of Mines (1969)
[4] Taylor JK, Thomson BP and Shepherd RG, The soils and Geology of the Adelaide Area, Department of Mines (1974)

2.5 Hydrogeology

Groundwater was encountered at 25 of the geotechnical investigation locations at depths between 1 m and 5.1 m, at the south western corner and north eastern corner of the site respectively. Shallow groundwater (less than 2.5 m below the surface) was recorded mainly in the south sector east and south sector, with the exception of BH16 and BH09 in the southern portions of the northern sectors.

As discussed in an extract from SKM's draft report (Appendix C) the groundwater across the site varies between 1.38 mAHD in the south and 6.40 mAHD in the north of the site. Generally the groundwater flows westerly and south westerly, towards the coast. The measured groundwater level ranged from 0.88 m below ground level ('bgl') and 5.67 m bgl. For the majority of the site groundwater is considered to be less than 4 m bgl. Available data indicates that seasonal fluctuations in the groundwater table could be around 1 to 2 m.

2.6 Area of Investigation

The results of the desktop assessment have been used to provide an initial assessment of the risk of encountering ASS at the subject site. The site has been divided into a number of risk "sectors" as shown on Figure 3.

The following rationale was used to evaluate these risk sectors:

- High Risk of Encountering ASS – Areas underlain by St Kilda Formation or Holocene Alluvium where the ground surface is less than 5 mAHD
- Medium Risk of Encountering ASS – Areas underlain by St Kilda Formation or Holocene Alluvium where the ground surface is between 5m and 7mAHD and development will result in disturbance below 5m AHD and/or groundwater.
- Low Risk of Encountering ASS – Area outside of Medium and High Risk Areas.

The total area of the site with a high risk of encountering ASS was estimated to be about 200ha and 190 ha was estimated as a medium risk.

3.0 METHODS OF INVESTIGATION

3.1 Soil Investigation

3.1.1 Scope of Works Rationale

Field investigations were undertaken with reference to: The South Australian EPA Guidelines for "*Site Contamination – Acid Sulphate Soil Materials*" (November 2007). These guidelines do not provide recommendations in relation to sampling frequency or distribution. In the absence of such recommendations, the "*Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils (ASS) in Queensland, 1998*" (QASSIT Guidelines) were used to assist in scoping the field investigation. The action criteria of 0.03%S from the QASSIT guidelines was also adopted for assessment of the presence of ASS.

Opportunitistic sampling was conducted during the previous geotechnical investigation at locations mainly aimed at evaluating geotechnical conditions. However, the results of this limited initial assessment provide some coverage within low and medium risk sectors identified during the current desktop study.

The current investigation locations were chosen to target high risk sectors identified during the desktop study (see Figure 3). An additional borehole was also placed in the medium risk sector to the northwest of the site as this material type was not present elsewhere on the site

The number of sampling locations investigated during both stages of investigation is less than the two holes per hectare recommended in the QASSIT Guidelines. However, the targeted investigation locations are considered to be sufficient to assess if ASS are present at this site.

3.1.2 Site Works

ASS investigation conducted between 23 January and 24 April 2008 during the previous geotechnical investigation comprised:

- Drilling six boreholes (BH22B, BH24 to BH27 and BH33) to depths between 2.2 m and 5.1 m using a 4WD mounted 'Rockmaster' drill-rig;
- A total of fourteen soil samples were collected between depths of 1.0 m and 4.0 m.

The most recent stage of ASS investigation was conducted between 14 July and 16 July 2008 and comprised:

- Drilling twelve boreholes (BH61 to BH72) to depths between 2.0 m and 4.5 m (generally the proposed depth of disturbance plus 1m) using a 4WD mounted 'Rockmaster' drill-rig. A sediment sample was also collected from a surface water channel outside the site boundary, adjacent BH62.
- Soil samples were collected at 250 mm intervals during the investigation resulting in a total of one hundred and sixty-six samples.

An environmental scientist or engineer from Golder Associates positioned the boreholes, logged the materials encountered, recovered the soil samples, and carried out field screening tests (see Section 3.1.3). Test locations were recorded using a hand-held GPS. The locations of the boreholes are shown on Figures 1a and 1b.

Soil samples collected during the investigation were immediately placed in lock seal plastic bags, labelled and stored on ice in an esky. The samples were then transported to Golder Associates' office. At the office, samples were stored in a freezer until samples for laboratory analyses were selected.

The Reports of Boreholes are located in Appendix D, together with Notes and Abbreviations used in their preparation. Each borehole core tray was photographed during the investigation. These photos and other site photographs taken during fieldwork are presented in Appendix E on the attached CD-ROM.

3.1.3 Field Screening Tests

Field screening tests were conducted on soil samples recovered during both phases of investigation. The field screening tests were aimed at providing an initial evaluation of the presence of ASS and to assist in identifying soil samples for laboratory analysis. The methodology adopted for the field screening tests is described in the QASSIT Guidelines

Field tests (pH_F and pH_{FOX}) were conducted on all recovered soil samples. The pH_F tests were conducted on a portion of each recovered sample by mixing small individual subsamples of soil and deionised water (ratio of 1:5 respectively) and measuring the pH using a calibrated pH meter. The pH_{FOX} tests were also conducted on recovered samples following the addition of 30 % laboratory grade hydrogen peroxide. A description of the strength of reaction with peroxide and the pH_{FOX} measured using a calibrated pH meter were recorded for each sample. The field test results (pH_F, pH_{FOX}, reaction strength) are tabulated in Appendix F.

3.1.4 Laboratory Testing

Following review of the borehole logs and field screening tests a total of forty-six (7 samples form the initial investigation and 39 from the current investigation) were selected for laboratory chromium suite analysis. Laboratory analysis was conducted by SGS Environmental laboratory which is NATA accredited for performing this analysis. Laboratory certificates are presented in Appendix G on the attached CD-ROM.

3.2 Groundwater Investigation

3.2.1 Scope of Works

Monitoring wells W6, W7 and GW11, installed at the site by Connell Wagner and SKM were targeted for investigation of ASS indicators. These wells were selected due to their proximity to high risk sector identified during the desktop study. Each of the selected wells was purged until the field engineer believed the field parameters had stabilized and a water sample was then recovered for laboratory analysis. Field parameters (pH, RedOx, conductivity, dissolved oxygen and temperature) were measured using a TDS 90FLMV water quality meter. The results of the field measurements are provided in the groundwater sampling record forms contained in Appendix H.

A surface water sample was also collected from a channel outside the site boundary, adjacent BH62 where a sediment sample was also collected.

Groundwater and surface water sampling locations are shown on Figure 1b.

Samples were collected in containers provided by ALS Environmental (NATA accredited analytical testing laboratory). The samples to be analysed for metals were filtered using a 0.45 micron filter. A blind sample was collected from W6 for quality control purposes.

3.2.2 Laboratory Testing

Three primary groundwater samples and one field duplicate sample were analysed for ASS indicators - chloride, sulphate, total acidity, total alkalinity, aluminium and iron. One surface water sample was analysed for pH. Water samples were analysed by ALS Environmental who are NATA accredited for the tests performed. The analytical methods and laboratory reporting limits are presented in the laboratory certificates in Appendix G on the attached CD-ROM. The laboratory reporting limits were below the assessment guidelines/criteria for the parameters tested where possible.

4.0 RESULTS

4.1 Summary of Subsurface Conditions

The subsurface soil conditions encountered in the boreholes was generally consistent with the published geology.

Generally, sand, clayey sand or sandy clay were observed in the boreholes at varying depths. The colour of the soils recovered varied with depth. Typically the colour horizon varied from brown nearest to the surface grading to grey and then transitioning into mottled orange brown with depth. The grey and dark grey materials observed in boreholes BH62, BH63, BH64, BH66, BH67, BH68, BH70 and BH71 are consistent with the St Kilda Formation. The brown and orange brown mottled materials observed through BH64 and BH71 and below the surface soils or below St Kilda Formation (where present) are consistent with the Pooraka Formation.

Groundwater was encountered in all boreholes at depths between 0.5 m and 4.0 m with the exception of BH72.

4.2 Field Screening Tests

The procedures described in the QASSIT Guidelines were used to assist in interpreting the field screening test results. Interpreted field screening results from the initial investigation are summarised in Table 1 within Appendix F. The presence of actual acid sulfate soils (AASS) was not indicated and all soil samples were interpreted as having a low potential to be PASS.

Interpreted field screening results from the current investigation are summarised in Table 2 within Appendix F. The presence of actual acid sulfate soils (AASS) was not indicated by the field screening tests. Soil samples from three boreholes were interpreted as having a high PASS potential BH61 (0.75-1.0 m), BH63 (1.5-1.75 m) and BH64 (1.25-2.0 m). A soil sample from BH62 (1.5-1.75 m).was interpreted to have a medium PASS potential. Results on remaining soil samples were interpreted to indicate a low PASS potential.

4.3 Laboratory Testing - Soil

The chromium suite test results are summarised in Tables 3 and 4 in Appendix F. Summarised results include calculated net acidity using acid base accounting.

Chromium Reducible Sulfur (SCR) concentrations in all analysed soil samples from the initial investigations were below the QASSIT Action Criteria. These results and calculated net acidity results indicate that these are non-PASS materials.

Six soil samples from the current investigation had S_{CR} concentrations reported above the laboratory reporting limits. Five of those six samples (BH63-07, BH64-06, BH64-08, BH71-13 and BH71-16) had S_{CR} concentrations exceeding the QASSIT Action Criteria of 0.03%S. These materials confirm the presence of PASS at these locations. Figure 4 indicates these locations and depth of the soil layer where PASS has been detected.

Net acidity calculations (including Acid Neutralising Capacity) indicated that the identified PASS in BH71 was "self-neutralising" and therefore the risk associated with disturbance of this material should be low. However, net acidity calculations for positive soil samples from boreholes BH63 and BH64 confirmed that this PASS represents a risk that would need to be managed if these soils were disturbed.

The sediment sample collected from the channel adjacent to the site (but outside the site boundary), north of BH62 (labelled as creek@BH62) was identified as PASS by the chromium suite analysis.

4.4 Groundwater

4.4.1 Field Results

A summary of the field parameters, and level measurements prior to sampling the wells, are presented in Table 1.

Table 1: Summary of Groundwater Field Parameters

Monitoring Well	GW Depth (m BGL)	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)	Redox Potential (m V)
W6	0.916	20.9	2.12	6.8	87	46
W7	0.867	20.7	3.46	6.9	116	-7
GW11	1.287	23.4	1.08	7.4	17.6	92

m BRP – metres below ground level

4.4.2 Laboratory Testing

The chloride and sulphate laboratory results and pH values measured in the field are presented in Table 3 below. This table also presents the calculated chloride/sulphate ratios for these groundwater samples.

Table 2: Chloride and Sulphate Levels

Monitoring Wells	SO_4 (mg/L)	Cl (mg/L)	pH	Cl/SO_4 Ratio
W6	7290	41100	6.8	5.64
W7	6880	45200	6.9	6.57
GW11	1530	7430	7.4	4.86

Chloride/sulphate ratios and pH in groundwater can provide an indication of the presence of acid sulphate impacts in marine and coastal environments. Generally where the chloride/sulphate ratios are calculated to be less than 7.1 (seawater ratio) and where the measured groundwater pH is less than 7 it can be considered that some disturbance of PASS material may have occurred. However, it is noted that while the ratio in seawater is relatively consistent, it can vary within estuarine waters, in which case trends in ratios are more informative. Therefore further testing is recommended as part of the management measures.

The reported concentration of aluminium in the monitoring wells was less than the laboratory reporting limit. The concentration of iron was less that the reporting limit in W6 and GW11 however 1.93 mg/L was reported for monitoring well W7. This result exceeds the "Environment Protection (Water Quality) Policy 2003" [EPP(WQ)] assessment criteria for use as potable water, aquatic ecosystems - freshwater and irrigation.

Aluminium and iron are two metals that are leached out of the soil under acidic conditions and can be associated with AASS material.

SW01 was collected from surface water in a channel adjacent BH62. The sample was tested for pH only and the results were similar to those recorded for W6 and W7.

A summary of the groundwater results are presented in Appendix I.

4.5 QA/QC

Field QA / QC

The fieldwork for this investigation was performed in accordance with the following procedures:

- cleaning of sampling equipment prior to commencing and in between collection of samples;
- collection of samples in new bags and bottles supplied by the laboratories;
- preservation of samples in ice chests;
- preservation of soil samples in a freezer prior to transportation to the analysis laboratories; and
- transport of samples to ALS Environmental and SGS under chain of custody documentation.

QA/ QC Data Evaluation

To assess the acceptability of laboratory test results the relative percent difference (RPD) was calculated for the field duplicate sample analysed. The RPD is the difference between each set of duplicate results and their mean, with the results expressed as a percentage of the mean. The RPD was not calculated on data where one or both results are below the laboratory reporting levels.

The relative percentage differences (RPD) have been calculated for the duplicate analyses, and are presented in Appendix I. The RPD is calculated using the following formula:

$$RPD\ (\%) = \frac{(\text{Primary result} - \text{Duplicate result}) \times 100}{\text{Mean result}}$$

RPDs for the groundwater samples ranged from 0% to 8.6%, below the generally acceptable result of 50% and are therefore considered to be suitable to provide sufficient confidence in the primary data set.

Laboratory Quality Assurance / Quality Control

The laboratories used, ALS Environmental and SGS, are accredited by the National Association of Testing Authorities (NATA) for the analyses performed.

The results of the internal laboratory quality control data for the soil samples and groundwater samples have been presented with the laboratory certificates.

Summary of Quality Assurance / Quality Control

Based on the overall results of the field QA/QC, it is considered that the repeatability and reproducibility of the results is acceptable for the purposes of this project.

5.0 DISCUSSION

No AASS material or indicators of AASS were identified during investigations at this site.

PASS material was located within three boreholes and in an adjacent channel, off-site. In all cases the material was below groundwater and surface water in the channel. The three boreholes were located in or adjacent watercourses in the southern portion of the site and within sectors identified as having a high risk of encountering ASS material in the desktop study. However, PASS was not encountered within other portions of the high risk sectors. Therefore the PASS material at the site appears to be small localised areas within the St Kilda formation associated with former watercourse alignments.

Considering the above it is expected that PASS material on the site is at a low risk of being exposed unless it is planned to excavate below groundwater or undertake a process that will lower the groundwater table (such as dewatering) in areas or adjacent to identified high risk sectors. Management strategies that could be adopted should PASS disturbance be planned are discussed in the following section.

In areas where PASS material may be encountered acid production should be considered for the design of infrastructure. For example, the grade of concrete recommended should be appropriate for the conditions.

6.0 PASS MATERIAL MANAGEMENT STRATEGIES

6.1 Excavation

The principles for PASS management on the site should include:

- Avoiding excavation into the natural soil below groundwater.
- Avoiding dewatering in areas identified as St Kilda Formation in Figure 4.

Where excavation in theses areas cannot be avoided several broad management strategies could be adopted to reduce the impact on PASS disturbance.

- Bulk treatment – This strategy assumes that all excavated natural soils are PASS and will be treated with lime to neutralise their net acidity. Available results indicate that lime treatment rates of between 15.1 kg/m3 to 30.5 kg/m3 will be required.
- Selective treatment – This strategy involves stockpiling and drying of excavated natural soils, further sampling to characterise suspected acid sulphate soils and determine lime treatment rates to neutralise their net acidity.

After treatment of the PASS material, validation testing would be required to confirm suitable neutralisation prior to re-use as fill. Off-site disposal is not considered a suitable option for untreated PASS material.

An Acid Sulphate Soil Management Plan (ASSMP) would need to be produced that details the management procedures which should be followed should PASS disturbance be planned as part of the site development.

6.2 Dewatering

PASS materials located below the groundwater table do not pose a risk to the environment unless the groundwater level is depressed (e.g. dewatering) and sulphides are oxidised. For this reason, the disturbance of groundwater levels through dewatering should be avoided where possible.

If dewatering cannot be avoided then management of dewatering activities for excavations will need to be implemented. Management strategies for dewatering should include limiting the extent and period of drawdown. The pH of dewatering discharges and seepage into excavations should also be monitored at least on a daily basis. The water should be buffered to a pH between 6.5 and 8 prior to discharge to the ground surface.

The ASSMP would include details regarding the management requirements for dewatering during the site development.

6.3 Non - PASS Material

Non-PASS materials overlying the site are considered to be suitable for re-use as general fill subject to contamination status and geotechnical suitability.

6.4 Further Investigations

PASS material appears to be confined to small portions of the St Kilda Formation associated with former watercourse alignments (refer to Figure 4). This material is at a low risk of being exposed unless excavation occurs below the water table or the water table is lowered through dewatering.

Therefore, more detailed investigations should be undertaken prior to excavation beneath groundwater level or any activity that would lower groundwater within watercourses or the high or medium risk areas indicated on Figure 3 and appropriate management responses implemented.

No further investigations required in remainder of site.

7.0 LIMITATIONS OF THIS REPORT

Your attention is drawn to the document - “Limitations”, which is included in Appendix J of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

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FIGURES

BUCKLAND PARK PROPOSAL

ACID SULPHATE SOILS DESKTOP STUDY

Legend

- Geotechnical Borehole Location
- Acid Sulphate Soils Investigation Borehole Location
- Test Pit Location
- Road
- Site Boundary

DRAFT

0 500 1,000

Scale in metres

SCALE 1:22,500

N

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0001
Drawn:	KB	Date:	01.08.2008
Checked:		Date:	01.08.2008

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PH (08) 8213 2100
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FIGURE 1a

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BUCKLAND PARK PROPOSAL

DRAFT

Legend

- Borehole Location
- Proposed Borehole Location
- Test Pit Location
- Site Boundary
- Road
- Surface Water Sample
- GW — Connell Wagner Groundwater Well Location
- W — SKM Groundwater Well Location
- Pooraka Formation 1969 / 1988 Map
- St Kilda Formation 1969 Map
- St Kilda Formation 1988 Map
- Fulham Sand 1969 Map
- Holocene alluvium 1988 Map

0 500 1,000
Scale in metres

N

SCALE 1:21,000

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0011_Rev2
Drawn:	KB	Date:	11.07.2008
Checked:		Date:	11.07.2008

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FIGURE 1b

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BUCKLAND PARK PROPOSAL

5 mAHD Boundary

Legend

- Borehole Location
- Test Pit Location
- Site Boundary
- Road
- Connell Wagner Groundwater Well Location
- SKM Groundwater Well Location

Surface Elevation

- >5 mAHD
- < 5 mAHD

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0 500 1,000

Scale in metres

SCALE 1:21,000

DATUM GDA 1994
PROJECTION MGA Zone 54

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Project:	077662060	Figure No:	F0010
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FIGURE 2

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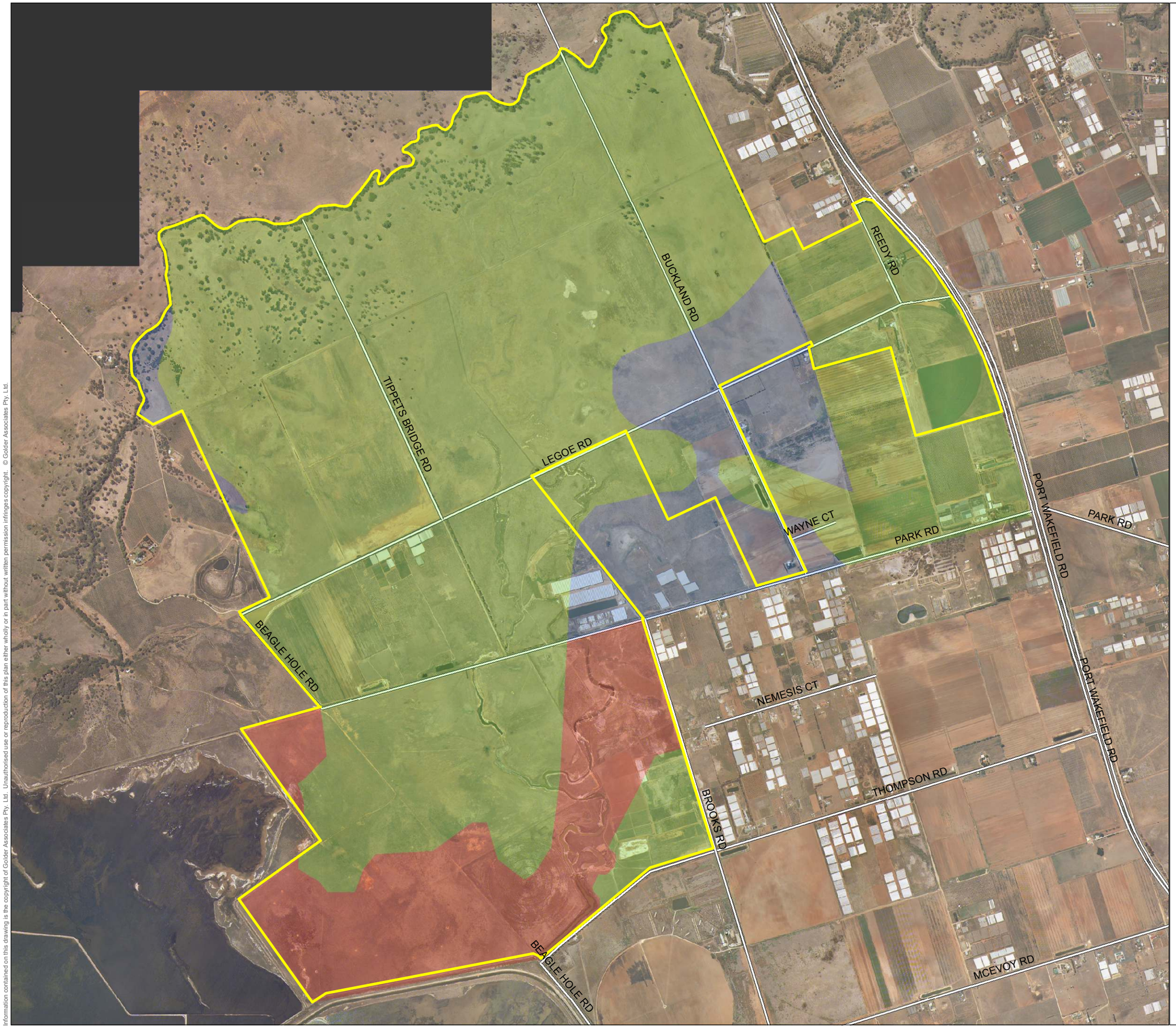

BUCKLAND PARK PROPOSAL

RISK OF ENCOUNTERING ACID SULPHATE SOILS SECTORS

Legend

- High Risk of Encountering ASS
- Medium Risk of Encountering ASS
- Low Risk of Encountering ASS
- Site Boundary
- Road

DRAFT

Base plan and scale sourced from Connell Wagner on 14-12-2007.
Aerial Photograph sourced from Connell Wagner.
Geology Formations data sourced from "Gawler & Vincent" Mapsheet, 1988, 1:50,000, Belperia, B.P. Geological Survey of South Australia and "Adelaide" Soils Mapsheet, 1969, 1:250,000, Barnes, T.A., Department of Mines.

DISCLAIMER

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0 500 1,000

Scale in metres

N

SCALE 1:21,000

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0014
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Checked:		Date:	12.08.2008

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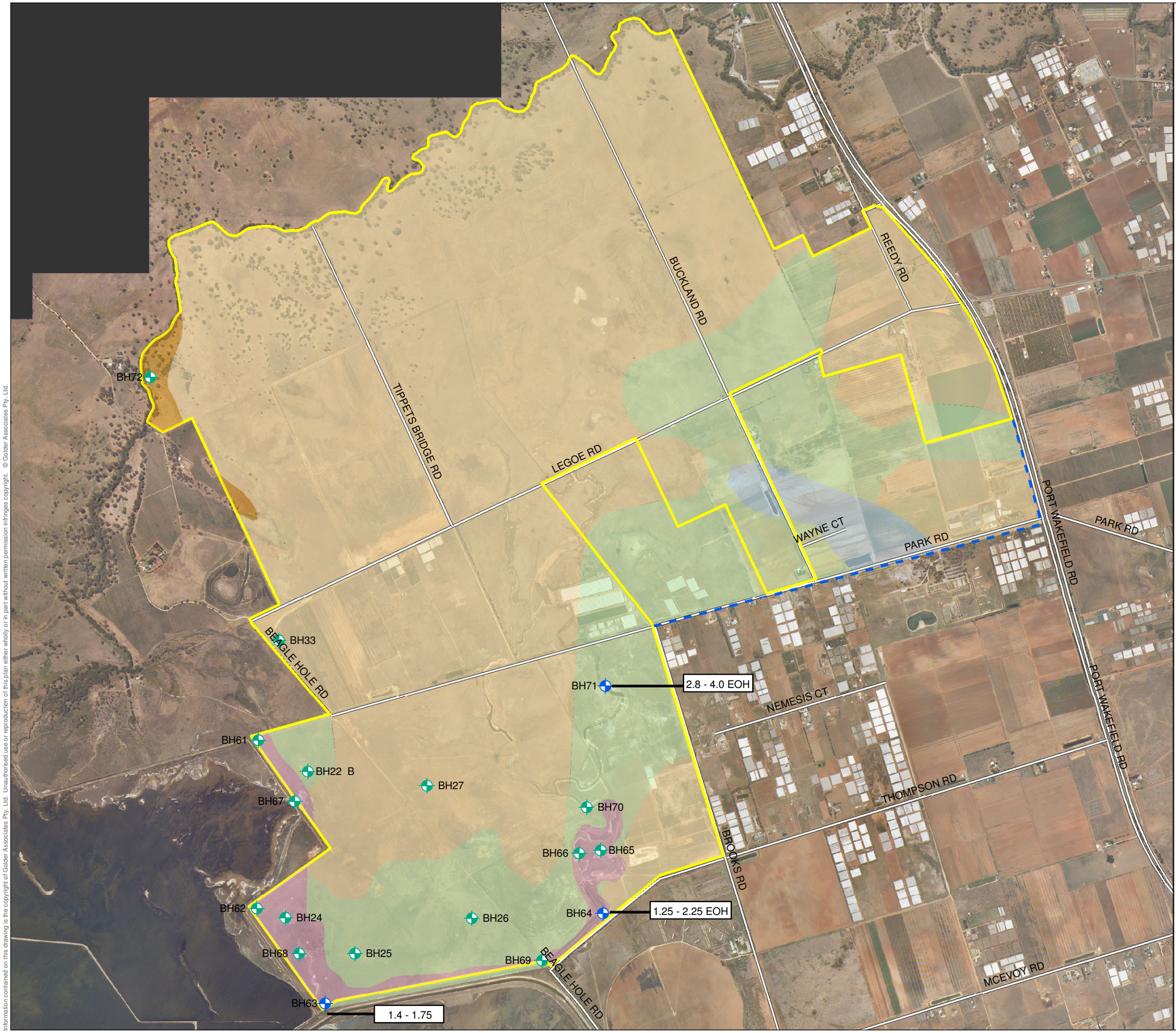
PH (08) 8213 2100 FAX (08) 8213 2101

FIGURE 3

J:\2007\Geo\077662060 - Buckland Park\GIS\Project\077662060_TMP_R_F0014_Rev0.mxd



BUCKLAND PARK PROPOSAL

DISTRIBUTION OF ACID SULPHATE SOILS OVERLAYING EXPECTED GEOLOGY FORMATIONS

DRAFT

Legend

- Borehole Location (PASS not encountered)
- Borehole Location (PASS encountered and Depth Range)
- Pooraka Formation 1969 / 1988 Map
- St Kilda Formation 1969 Map
- St Kilda Formation 1988 Map
- Fulham Sand 1969 Map
- Holocene alluvium 1988 Map
- Site Boundary
- Road

Depth (m)
1.25 - 1.5

EOH = Extent of Hole Depth Range of PASS Material Encountered

COPYRIGHT

Base plan and scale sourced from Connell Wagner on 14-12-2007.
Aerial Photograph sourced from Connell Wagner.
Geology Formations data sourced from "Gawler & Vincent" Mapsheet, 1988, 1:50,000, Belperia, B.P. Geological Survey of South Australia and "Adelaide" Soils Mapsheet, 1969, 1:250,000, Barnes, T.A., Department of Mines.

DISCLAIMER

"Golder Associates does not warrant the accuracy or completeness of information in the drawings and any person using or relying upon such information does so on the basis that Golder Associates shall bear no responsibility or liability for any errors, faults, defects or ommissions in the information".

0 500 1,000

Scale in metres

N

SCALE 1:21,000

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0012
Drawn:	KB	Date:	01.08.2008
Checked:		Date:	01.08.2008

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FIGURE 4

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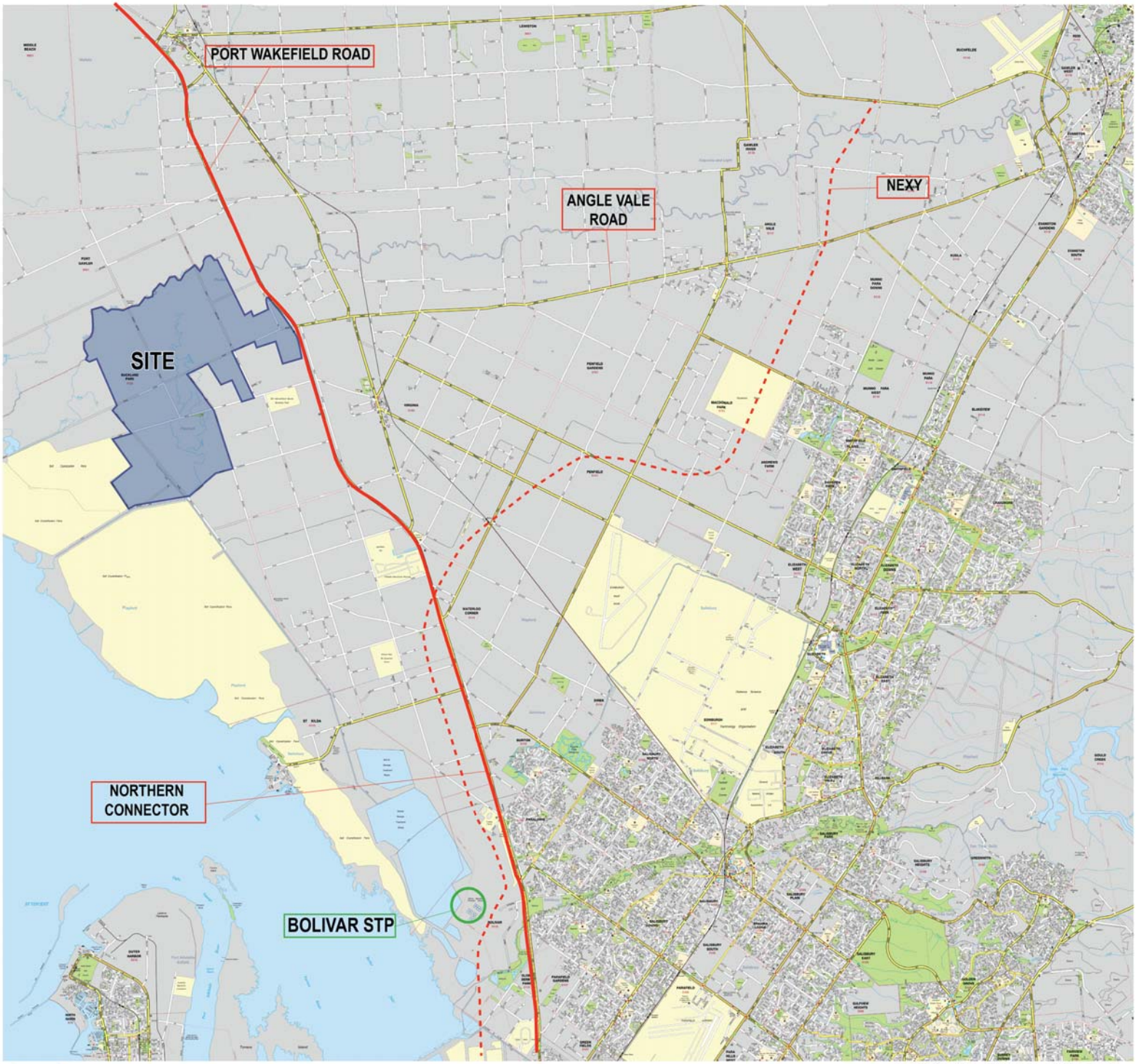
APPENDIX A

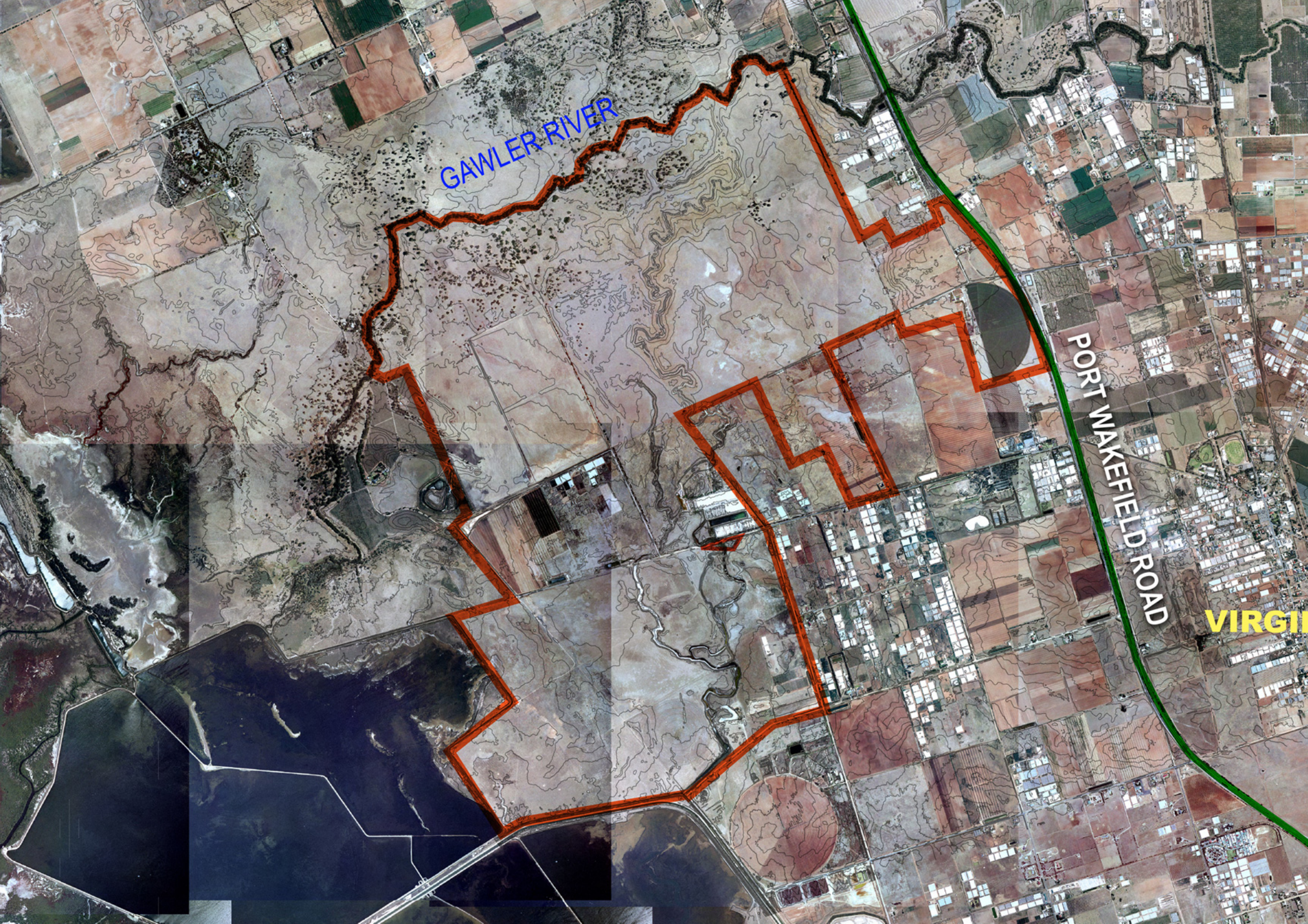
Figures Provided by Walker Corporation



Walker

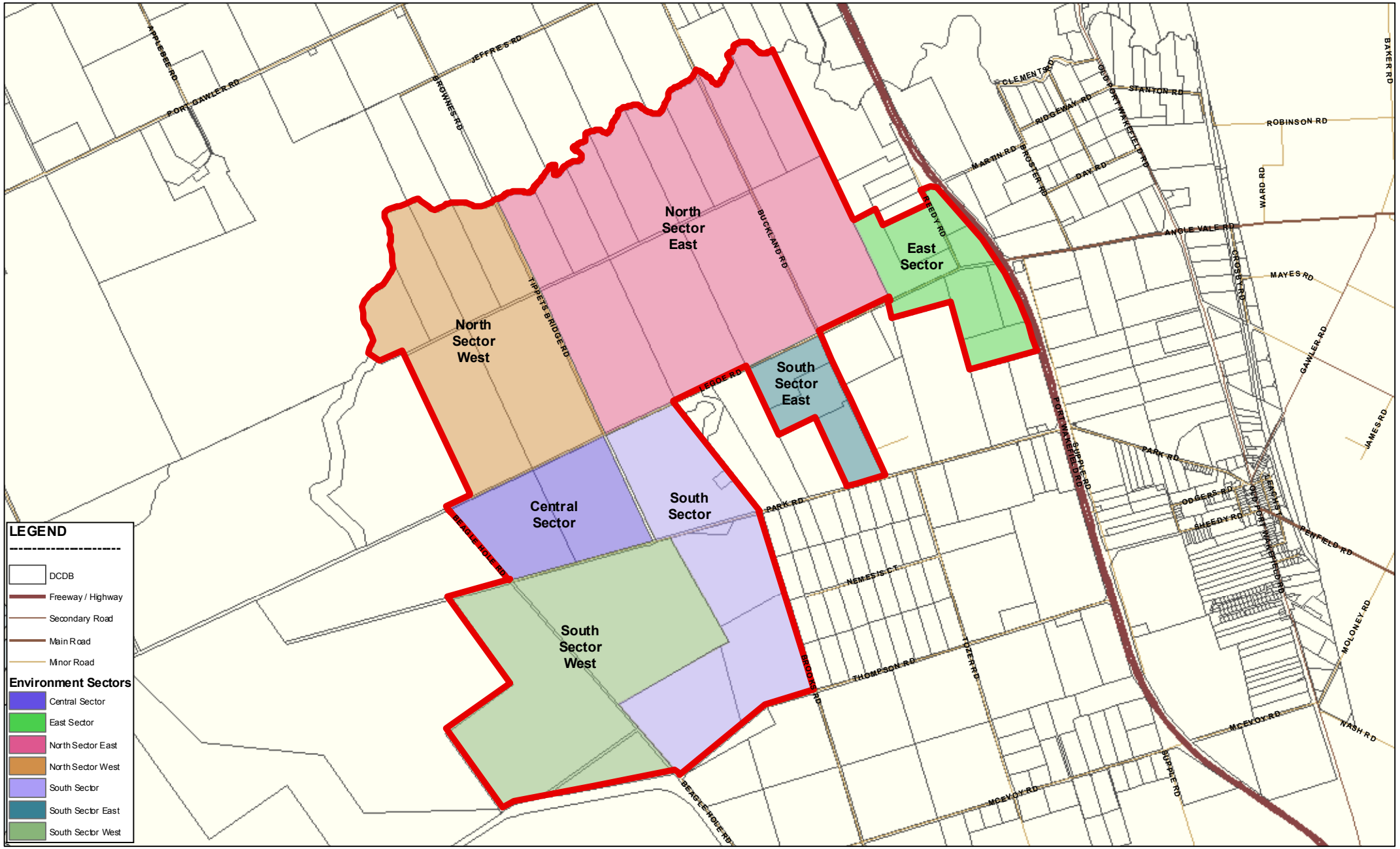
BUCKLAND PARK

OCTOBER 2008


GAWLER RIVER
PORT WAKEFIELD ROAD
VIRGI

Connell Wagner

BUCKLAND PARK



N

1:36,300

0 200 400 800 1,200 m

Produced By	Connell Wagner
Data Sources	DETI
Projection	Transverse Mercator
Datum	Geocentric Datum of Australia 1994
Compiled	21/04/08

Map created at A1 size

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Prior to undertaking any in ground excavation, testing on construction activity the contactor shall verify the location of all services within the subject area using service authority data and on site support and appropriate location techniques.

The contractor shall satisfy all service authority requirements and obtain all service authority approvals prior to undertaking any excavation.

TAB 2

BUCKLAND PARK COUNTRY TOWNSHIP

DESCRIPTION OF THE SITE
2 MAY 2008

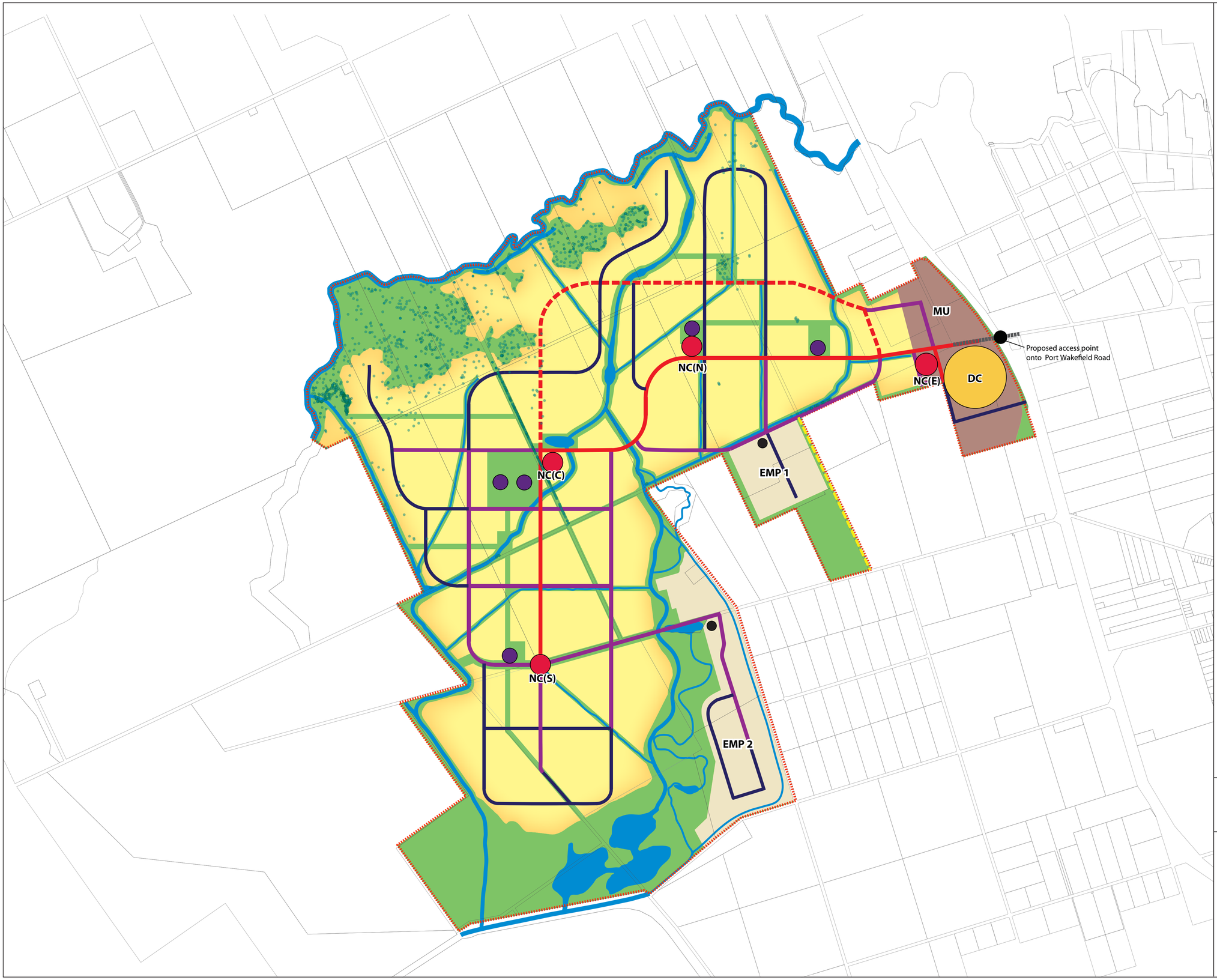
CERTIFICATE OF TITLE	LOT	DP/FP	AREA
5447/585	6	16853	44.780
5447/581	4	16853	39.660
5447/579	5	16853	38.970
5909/380	Sec 503	H105800	1.189
5909/379	Sec 173	H105800	57.870
5883/977	1	60145	15.400
5883/978	2	60145	15.240
5883/980	18	60145	15.490
5916/59	1	63928	7.487
5916/61	3	63928	12.220
5916/60	2	63928	15.460
5303/891	267	FP163235	6.737
5755/199	134	FP162483	6.611
5763/970	133	FP162482	4.937
5228/167	4	40170	12.600
5424/348	5	40170	17.300
5868/766	68	1671	65.330
5868/767	67	1671	65.190
5868/768	69	1671	65.300
5868/769	91	163644	66.580
5868/770	59	1671	25.500
5868/771	93	174427	17.600
5868/772	65	1671	57.150
5868/773	91	174403	19.700
5868/774	91	174425	24.000
5868/775	95	174429	3.440

TAB 2

BUCKLAND PARK COUNTRY TOWNSHIP

DESCRIPTION OF THE SITE
2 MAY 2008

CERTIFICATE OF TITLE	LOT	DP/FP	AREA
5868/776	94	174428	19.900
5868/777	62	1671	21.900
5868/778	66	1671	65.460
5868/779	91	174402	25.600
5868/780	92	174426	24.300
5868/781	S	1671	2.157
5868/782	60	1671	27.700
5868/783	61	1671	20.200
5868/784	63	1671	26.600
5868/785	58	1671	26.600
5875/910	1, 2, 3 & 4	40207	240.300
5399/95	179	105800	40.000
5399/96	174	105800	44.900
TOTAL HECTARES			**1,307.358**



0 250 500 750 1000m

1:12,500 @ A1

LEGEND

- Arterial Road (divided, 2+2)
- Sub-Arterial (2 lanes)
- Distributor
- Collector
- Emergency Vehicle Access Route
- District Centre
- Neighbourhod Centre
- Local Centre
- School
- Residential - Traditional
- Mixed Use
- Employment
- Open Space
- Floodways
- Subject Area
- DCBD
- Existing Trees

Buckland Park Master Plan (Version 6)

Revision 10

Original compiled: 7 August 2008
Revision dated: 19 February 2009
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994

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CONNOR HOLMES

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NEIGHBOURHOOD CENTRE

1 : 2,000 @ A1

25 50 75 100m

Dwelling Count	
Premium	288
Courtyard	175
Large Villa	91
Small Villa	32
Gatehouse	30
616	**TOTAL**

Buckland Park
Stage 1 Residential
Allotment Mix

Revision: D
Date compiled: 16 March 2009

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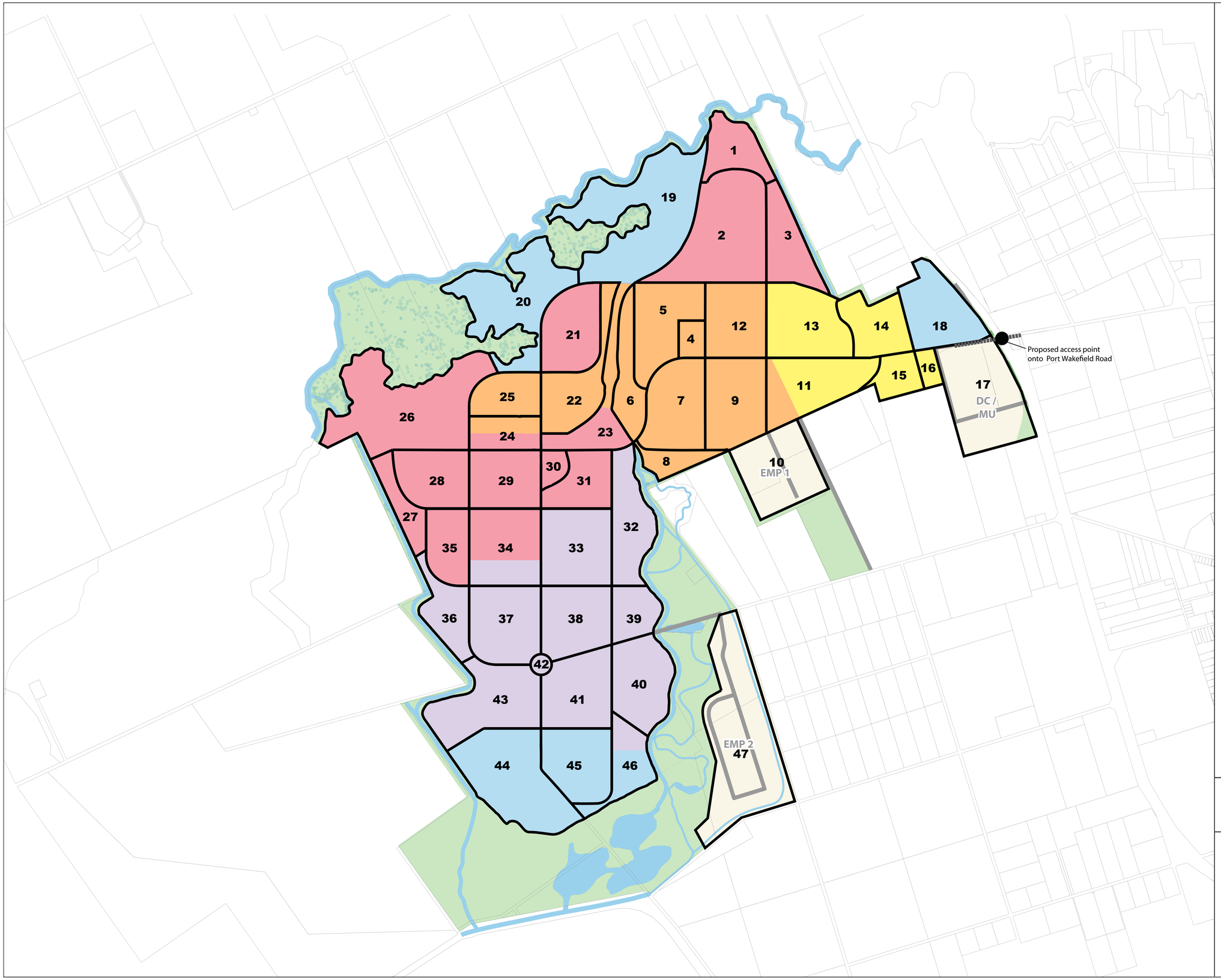

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LEGEND

Staging

- 2010 - 2016
- 2017 - 2021
- 2022 - 2026
- 2027 - 2031
- 2032 - 2036
- Precinct Boundary
- Non Residential Precincts

Buckland Park Residential Staging

Revision 1

Original compiled: 17 September 2008
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994

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APPENDIX B

W&G Sketch of Proposed Excavation Area

APPENDIX C

Extract Provided from SKM Draft Report

1 DATA REVIEW

1.1 Site Description

The site proposed for development at Buckland Park is situated to the west of Port Wakefield Road about 32 km north of Adelaide (Figure 1.1). The site covers around 1500 hectares immediately south of the Gawler River.

Current land use in the area includes agricultural land (grazing and horticulture) with smaller portions of residential development and the Cheetham Salt salt evaporation ponds immediately to the west and south of the site.

The landscape is characterised as low lying and low relief coastal plain, as illustrated by the ground surface topography presented in Figure 2.1. Two natural watercourses (Gawler River and Thomson Creek) provide the majority of natural drainage. Prior to alteration, the drainage systems of the Gawler River (being the larger of the two watercourses) would have ended in a raised coastal delta formation within the mangroves and tidal flats which remain along the coast on the western boundary of the study area.

An overview of the physical characteristics of the land across the study area has been provided by Rural Solutions (2007). The higher land on the margin of north sector east, which sits at around 10-12 m AHD, is the tail end of a very gently inclined plain with sand to sandy loam topsoils over clayey subsoils. The system is underlain by alluvial sediments deposited by the Gawler River as it meandered across the plain. The sediments are mantled by aeolian carbonates. As the land drops below 10 m towards north sector west, saline groundwater tables begin to influence soil profiles and productivity potential. As the land further drops away to the low lying coastal flats and associated with saline water courses the soils become poorly drained and the watertable is shallow and saline. In these areas the presence of land salinisation is recognisable either as saline subsoils or as surface seepage and the presence of salt tolerant vegetation.

1.2 Climate

The Adelaide coastal plain is characterised by a Mediterranean climate, with hot, dry summers and relatively cool, wet winters.

Local climate data has been sourced from the Bureau of Meteorology for the weather station on Sheedy Rd in Virginia, located approximately 2 km east of the Buckland Park site. This station was in operation during the period from 1889 through to 2005 and although it has now been closed, the data represent a long term climate record, spanning more than 100 years, that is situated very close to the present site. Annual rainfall totals and cumulative deviation from average annual rainfall are presented for the period of record in Figure 2.2 and mean monthly rainfall has been compared with mean monthly pan evaporation in Figure 2.3.

The average annual rainfall of 442mm occurs mostly in the winter months with average monthly rainfall between June and August around 53mm, in contrast to the months December to February with mean monthly rainfall around 22mm.

The average annual pan evaporation of 1860 mm exceeds average annual rainfall by more than four times. On average during the winter months evaporation is approximately equal to rainfall, while during summer evaporation exceeds rainfall by around 12 times.

The record of cumulative deviation from the average annual rainfall (Figure 2.1) shows that there have been a number of wetter and drier cycles over the last 100 years, with the most recent wet periods occurring in 2000 and then back in the mid 70's and again in the mid 50's. These wet periods correspond to years of above average rainfall.

1.3 Hydrology

The surface water hydrology of the Buckland Park area is largely controlled by the Gawler River situated immediately north of the site. The Gawler River extends across the northern and western boundary of the site. The ephemeral water course of the Gawler River can have large flows and flooding during the winter wet season but is largely dry, with only stagnant pools, during the drier summer months. The river channel has been incised below ground level by three to four metres. When flood flows break from the channel, flood waters will spill away from the channel towards lower lying areas. These flows generally do not re-enter the Gawler River channel.

Extending through the North Sector East and South Sector, Thompson Creek is a shallow intermittent ephemeral watercourse that channels surface flows during the wet season and periods of flooding when the Gawler River overflows. It is likely that this watercourse also acts as a shallow groundwater drain when the shallow watertable is elevated above the creek bed as a result of direct recharge during the wet season.

The two salt lakes present immediately to the southwest of the site are currently operated by Cheetham Salt. A representative of Cheetham Salt, Mr. Kevin Taylor (*pers. comm*., 22/2/2008), could not provide exact operational details for the lakes, but indicated that the northern of the two lakes is held at a level of about 2.85 m AHD and the southern lake is held at about 3.25 m AHD. Mr Taylor also indicated that the network of surface drains surrounding the lakes are intended to provide some management of the ingress of salt water onto the surrounding land. Survey data relating to the levels or inverts of the drains was not available, but Mr. Taylor did indicate that to the north the drains discharge via pumping into the Gawler River channel. Flow gradients in the area are very low and Mr. Taylor suggested that not a lot of flow occurs in the drains and that the primary out flux was probably by evaporation.

1.4 Soils and Geology

In "Natural History of the Adelaide Region" (Royal Society of SA, 1976) Northcote describes the dominant soils of the study area as permeable, alkaline, red brown soils/calcareous red pedal clays with a moderate to high bearing capacity and deficiencies in nitrogen, phosphorous and zinc.

Reference to the Geologic Survey of South Australia – Adelaide 1:250,000 map sheet (DME, 1969) indicates the near surface stratigraphy of the study area comprises the Quaternary sediments of the Pooraka Formation, across the majority of the site, and the St Kilda and Glanville Formations towards the coast. The Pooraka Formation is described as mottled clay and silt inter-bedded with sand, gravel and thin sandstone layers. The St Kilda formation is characterised by estuarine muds, sands, peats and shelly beds and often contains lenses of highly permeable sand layers.

The Late Quaternary sediments on the Northern Adelaide Plains overlie the older sediments of the Hindmarsh Clay, which is described as a layered sequence of mottled red-brown sandy clay and sand and gravel lenses. In a hydrogeological context together these units can be collectively described as clays containing lenses and discontinuous layers of silts, sands and gravels.

Interpretation of available lithological logs and drillers logs from the state Drillhole Enquiry System (DES) (locations shown on Figure 2.4) indicates that the near surface sediments comprise

discontinuous beds and lenses of clay, silt and sand. In a similar fashion to the site specific data, presented below, there is a high degree of variability in the logged sediments both laterally across the area, and vertically through the profile. However, it also became evident that interpretation of the data is confounded by a lack of detail in the near surface interval in many of the logs. A geological cross-section, based on the logs from DES (Figure 2.5) illustrates the variability from west to east across the site (location shown on Figure 2.4), but also seems to indicate a relatively consistent clay layer sitting at a depth of around 20 metres across the site.

1.5 Shallow Aquifer Sequence

The uppermost groundwater aquifers across the study area occur in the sand and gravel lenses of the Pooraka, St Kilda and Hindmarsh Clay Formations. While it appears that these thin shallow aquifers are often discontinuous it has also been suggested (REM, 2002) that the top Quaternary aquifer (Q1) is hydraulically connected with aquifers within the marine sediments of the St Kilda Formation forming a somewhat continuous aquifer system (and pathway) across the study area.

According to Martin and Hodgkin (2005), a shallow Quaternary aquifer is present in the area between Virginia and Gawler River. Wells to monitor this perched aquifer have been drilled to depths of between 2.5 and 9.5 m, but most commonly wells are completed at 4-6 m depth (Rural Solutions, 2007). According to AGT (2004), pumping test results for two sites close to Buckland Park showed that this perched aquifer can be hydraulically connected to the underlying Q1 aquifer, while the Q1 aquifer and underlying Q2 aquifer had almost no hydraulic connection. Three Quaternary aquifers (Q1 to Q3) are generally recognised in the Northern Adelaide Plains region with thicknesses ranging from about 3 to 15 m. They can be quite discontinuous with lateral extents of less than 2,000 m. Overall, the thickness of the Hindmarsh Clay diminishes northwards and can be as little as 20 to 30 m near the northern limit of the Northern Adelaide Plains PWA . Clay generally underlies the Q3 aquifer and forms a confining bed, although there are localised occurrences where the Q3 aquifer is in hydraulic continuity with the underlying aquifer.

A report produced by Rural Solutions SA (Rural Solutions, 2007) covering the nearby Virginia area provides information on aquifer delineation within the Quaternary sequence. According to that report, the unconfined Q1 aquifer, uppermost in a series of sandy layers in the Hindmarsh Clay, comprises thin layers of silt and sand at depths of around 5 to 10 m, although wells have been drilled to depths of up to 17 m to delineate the Q1 aquifer. To delineate the Q2 aquifer wells have been drilled to depths of between 13 and 28 m.

1.6 Groundwater Levels and Trends

Available existing data on groundwater levels in the watertable aquifer were obtained from the DWLBC database. These data, also assessed by REM (2003) showed that water levels are typically quite shallow, at between around 1 to 6 m bgl. Shallow groundwater occurs particularly in low lying areas and where clay layers cause perching. There was generally a decreasing trend in groundwater levels from the higher land to the north east towards the coast in the southwest. The available historical data was rather sparse, but some time series information was found. The locations of the few wells with time series data are shown in Figure 2.6. The data from these wells has been plotted up and an example is presented in Figure 2.7. Plots of the data from all the wells are attached in Appendix A. This information shows what appears to be a seasonal fluctuation in water levels, indicating diffuse rainfall recharge of the shallow aquifer. However, with rainfall amounts being quite variable in this region the seasonal fluctuations are somewhat less than regular. Seasonal watertable fluctuations appear to be in the order of around 1 to 2 m, obviously depending on the amount of seasonal rainfall.

1.7 Groundwater Salinity

The shallow groundwater is generally quite saline, but according to existing information assessed by REM (2003), salinity can range widely from almost potable (1,280 mg/L) to around that of sea water (30,000 mg/L). Typically fresh groundwater occurs where localised recharge has occurred from a surface water source such as river losses or excess irrigation water. Groundwater in much of the area is quite shallow and, particularly in low lying areas, evaporative processes are active in concentrating salts in the shallow watertable aquifer.

1.8 Data Gaps and Project Approach

The availability of hydrogeological information within the Buckland Park study area was limited prior to the field investigation programs undertaken as part of this project. The nearby Virginia area has been much more intensively investigated in the past due to the high level of activity there, but to the west of the Port Wakefield Road there has been much less activity and available stratigraphic and hydrogeological information is scattered and sparse.

The geological layering in the project area, particularly in the Quaternary sediments, appears to be highly variable. Soil type varies widely both spatially and with depth through the profile and as a result it does not appear to be possible to construct an obvious ‘layer cake’ of the profile that clearly represents the sequence of aquifers and aquitards beneath the area.

A field investigation program has been undertaken to support the analysis and provide additional information with which to understand the subsurface conditions. Lithological information and groundwater level and groundwater quality information were obtained from the drilling and installation of 11 groundwater monitoring wells by REM. Additional soil information was obtained from site investigations undertaken by Golder Associates and Connell Wagner as part of the EIS-related investigations, and groundwater level data were obtained from the 15 wells installed by Connell-Wagner.

While some historical groundwater level monitoring data was found for a few wells on or near some parts of the study area, the distribution and extent of the available time series information was not sufficient to warrant the development of a transient state groundwater flow model for the site. Rather it was considered more useful within the project framework to focus on the development of a steady state groundwater flow model and achieve model calibration using available existing information combined with newly generated groundwater level information. This model can still be used to assess relative potential changes to groundwater conditions at the site from a range of scenarios associated with the development.

A qualitative analysis of the likely transient behaviour of the groundwater system has been included in this assessment from interpretation of the few available water level hydrographs.

2 SITE INVESTIGATION RESULTS

2.1 Site Soils and Geology

Drilling logs were produced by REM from the installation of 11 groundwater monitoring wells to depths ranging from about 10 metres near the Gawler River to about 3.5 metres in the lower lying areas in South Sector West. In addition, logs were obtained from Golder Associates, covering depths of 3 to 6 metres, and from Connell Wagner, covering depths of 6 to 9 metres. Existing information from the Department of Water Land and Biodiversity Conservation (DWLBC) online Drillhole Enquiry System (DES) was also incorporated in this assessment.

This lithological information indicates a near surface geology that is highly variable both across the study area and with depth through the profile. Sediment composition included sand, silt and clay in varying proportions, but in general an abundance of clay and clayey sediments were identified across the site. Sand and silt appeared to be present in lenses and pockets that were not spatially continuous across the site. In the majority of holes an appreciable thickness of clay was present at or near the surface. In order to illustrate the spatial distribution of clay across the site, and the relative levels at which it occurs, a map of depth to clay (Figure 4.1) was produced from all available lithological logs. This interpretation shows that clay is likely to be present in the upper 4 m of the soil profile across nearly the entire site, and there are large areas where clay is at the ground surface. The few areas where clay is deeper than 4 m are isolated and mostly associated with only one or two data points.

The data shows that subsurface clays occur extensively throughout the study area at depths of less than 4 m bgl. These clays will act as an impediment to downward movement of water and, in the case where they are overlain by more permeable sediments like sand or silt, there is potential for development of shallow perched watertables to develop.

For practical purposes, the soil profile relevant to the watertable aquifer system is assumed to extend to around 20 m bgl. This assumption is based on the more regional interpretation of lithological information presented in cross section in Figure 2.5. Below this depth the extensive occurrence of clay across the region is assumed to act as an aquitard separating the surface system from the deeper confined aquifers.

It should be noted that drill holes completed in this study were targeting either the groundwater table (REM and Connell-Wagner holes) or the shallow soil composition (Golder Associates), so the resulting lithological information covers only a portion of the profile associated with the upper Quaternary sedimentation and shallow aquifers. In particular, holes in North Sector East extend to near 10 metres, while those in South Sector West extend to only 3.5 metres.

2.2 Site Hydrogeology

2.2.1 Groundwater levels and flow direction

Groundwater level gauging of new and existing monitoring wells has been undertaken by REM, using an electronic dip meter, on four separate occasions as part of this investigation (Table 4.1). Initial water level gauging of available existing wells took place during REM's initial site visit on 8 January 2008 and during new monitoring well installation works on 15

January 2008. Gauging of all newly installed REM wells took place on 7 February 2008, followed by repeat gauging of all new REM wells and one existing well during groundwater sampling activities on 20-21 February 2008. Following installation of the additional wells by Connell Wagner, a last round of water level gauging was undertaken by REM on 2 July 2008, including all new and available existing wells.

The results of groundwater level gauging from 7 February 2008 showed the elevation of the watertable beneath the site ranging from a low of 1.38 m AHD in MWREM08, situated in the southernmost and lowest point of the site, to a high of 6.40 m AHD in MWREM01, situated in the northernmost and highest point of the site. As with most areas, the watertable elevation and groundwater flow direction across the study area generally mimics the shape of the land surface dropping down towards the coast. Groundwater elevations vary from around 8 m AHD immediately northeast of the site to 0 m AHD at sea level not far to the southeast and east of the site.

Groundwater elevation contours interpreted from the 7 February 2008 data (Figure 4.2) and the 2 July 2008 data (Figure 4.3) show that groundwater flow occurs in a general westerly and south westerly direction towards the coast. Comparison of the two sets of data show some minor changes in watertable elevation, but all of the main features of the groundwater flow pattern across the study area are essentially the same. This provides an improved level of confidence in the data. Two areas of groundwater mounding were quite well defined by both sets of data. The first area is situated in the vicinity of wells MWREM04, MWREM06 and GW2. The cause of more elevated groundwater levels in this area is not clear, but it may be associated with historic or current irrigation practices in that area. The second area is situated in the vicinity of well 6628-20004, which is completed at a depth of 3 m bgl. Groundwater mounding at that location is more obviously caused by roof runoff and possibly excess irrigation from adjacent glass house horticulture. This well is nested with an 8 m deep well, which recorded a water level of 1 - 2 m lower than the shallower well. This indicates that a perched watertable has developed in sediments on top of a shallow low permeability clay layer in this area. At this site REM personnel observed that downpipes channelled runoff from the glass house roofs to an area right next to the nested shallow wells. It seems likely that this localised source of recharge has affected the shallow groundwater levels in this area. While this water level data point has been included in the interpretation of groundwater elevation contours across the study area, it might have unduly influenced the interpretation of water levels in the surrounding area, causing groundwater mounding to appear more extensive than is actually the case.

The hydraulic gradient across the site varies between about 1 to 2 metres per kilometre (0.001 to 0.002) and is controlled by factors including hydraulic conductivity of aquifer materials, recharge, surface drainage and topography. The hydraulic gradient is somewhat steeper across the eastern part of the site and this could be due to factors including steeper surface topography, variable hydraulic parameters and/or higher recharge from irrigation activities.

Local variations to the shallow groundwater flow not picked up in this monitoring data might occur close to hydrological features including rivers and drains and near the salt lakes where groundwater mounds exist. Due to the elevated pool levels in the salt lakes immediately to the southwest of the site, it is likely that over time water from the salt lakes has seeped through the beds and caused mounding of shallow groundwater in that vicinity. However, during construction of the salt lakes a system of groundwater drains surrounding the lakes was also

installed, in an attempt to manage the effects of groundwater mounding on the surrounding land. These drains are supposed to collect seepage water and channel it into the natural drainage that discharges to the sea. In reality it would appear that flow gradients are so slight in that low lying area that most water discharge occurs as evaporative out flux from the open drains and from shallow groundwater tables.

A reduction in the groundwater flow gradient towards the coast is evident in the interpreted watertable elevation contours, but specific hydraulic effects of the elevated pool levels in the salt lakes are not apparent in the available data.

2.2.2 Depth to groundwater

The results of groundwater level gauging undertaken by REM reveal that the groundwater table is quite shallow, at less than 4 m, across the majority of the site. Depth to groundwater, measured on 7 February 2008 in the 11 new wells installed by REM (Table 4.2), ranged from 0.88 m bgl in MWREM07, situated in the low lying south sector west, to 5.67 m bgl in MWREM03 situated on the higher ground adjacent to the Gawler River along the northern boundary of the site. A subsequent round of water level gauging on 2 July 2008 (Table 4.2) showed minimal change at MWREM07 and a fall in the watertable at MWREM03 to 5.82 m bgl.

Mapping of depth to groundwater across the study area, covering all points in between the measured points obtained from groundwater gauging activities, was achieved by subtracting an interpolation of groundwater elevation from the ground surface elevation. This method minimises the error in the interpretation of groundwater depth because it accounts for the variability in the ground surface in addition to spatial trends identified in gauging data. However, it must be stressed that while the groundwater data is valid for the current situation, future changes to groundwater levels may occur that would require periodic updates to the data set.

Interpreted groundwater depth across the study area is presented in Figure 4.4, for the 2 July 2008 water level gauging event. This information shows a broad gradient in depth to groundwater, with deepest levels along the Gawler River to the north, and also highlights the fairly extensive occurrence of shallow groundwater (less than 4 m depth) across much the site, particularly along the south, east and west perimeter. The watertable could be less than 4 m bgl across much of the central sector, south sector and south sector west of the site. The occurrence of shallow groundwater is strongly controlled by the surface topography, with these areas occurring in the lower lying places and natural or artificial depressions in the landscape. The land along the Gawler River, in the north sector east and north sector west, is the only portion of the site where groundwater is likely to be deeper than about 4 m BGL. A spur of higher ground extending down the southwest of the site increases the depth to groundwater in that area slightly.

Problems associated with water logging and salinity are most likely to occur in areas where the depth to groundwater is less than 2 m bgl. This hazard is independent of whether the shallow groundwater is in the regional watertable aquifer or in a more localised perched aquifer sitting on top of a low permeability clay layer. The latter occurrence is typically of most concern when the top of said clay layer occurs within the top 4 m of the soil profile.

2.2.3 Hydraulic aquifer characteristics

Aquifer testing was undertaken on 20 - 21 February 2008 to provide aquifer property data for input to the numerical groundwater flow model. Water level recovery tests were conducted on the eleven newly installed wells MWREM01 thru MWREM09 and MWREM11 and MWREM12 plus one existing well with the state database Observation Number PTA058.

Hydraulic conductivity values are presented in Table 4.3. Values range from 0.01 to 1.12 m/day. Lower values are reported along the Gawler River where values of 0.01 and 0.07 m/day were recorded for bores MWREM01 and MWREM07 respectively. These are the lowest values on site with the other value of similar magnitude (0.06 m/day) occurring at MWREM09. Slightly more elevated values occur along the southern boundary (0.12 m/day at MWREM07, 0.18 m/day at MWREM08 and 0.19 m/day at MWREM12. Remaining wells have still slightly higher values of hydraulic conductivity but all of the wells tested display low hydraulic conductivities.

The information provided by the slug recovery testing on the shallow wells installed by REM provides perhaps an overly conservative indication of the permeability of near surface sediments across the study area. It is recognised that the wells were installed mainly to enable monitoring of groundwater levels and, as such, they do not fully penetrate the watertable aquifer. In many cases the well screen penetrates only partially into sandy sediments that were encountered. Therefore it is quite likely that the resulting permeability values obtained from these wells are an underestimation of the actual values of this parameter for the watertable aquifer system. Based on experience it is possible that actual aquifer permeability values could range from around 0.01 m/d for clayey sediments up to around 10 m/d for coarser sandy sediments.

2.3 Groundwater Analytical Results

Groundwater analytical results are presented in Table 4.4 and laboratory analytical reports are contained in Appendix F.

2.3.1 Field parameters

Field parameters (Table 4.5) measured during the groundwater sampling program, which was undertaken on 7 February and 13 February 2008, indicate the following hydro-geochemical conditions exist in groundwater sampled from wells across the Buckland Park site area:

- pH values range from 6.66 at MWREM06 to 7.97 at MWREM09. Groundwater was generally neutral to slightly alkaline. Groundwater sampled from MWREM06 and MWREM07, at the low lying southwest end of the site, was slightly acidic.

- Electrical conductivity of sampled groundwater ranged from 5.02 mS/cm at MWREM09 to 106.6 mS/cm at MWREM06.

- Temperature of sampled groundwater ranged from 18.7 ^{o}C at MWREM11 to 23.2^{o}C at MWREM06.

2.3.2 Groundwater salinity

The salinity of sampled groundwater from the Buckland Park site has been estimated, as total dissolved solids (TDS), from field measurements of groundwater electrical conductivity (EC). This approach has been adopted in favour of using the sum of cations and anions from the

analytical laboratory data because the charge balance error was in excess of acceptable limits.

The simple linear relationship reported in Hem (1985) was used to convert field measured EC in mS/cm into TDS in mg/L, by applying a multiplication factor of 750. In natural waters this multiplication factor commonly ranges between 550 and 750, with the higher values generally being associated with water high in sulphate concentration. Perusal of the analytical data for sampled groundwater from Buckland Park shows high sulphate concentrations for many of the samples, thus the higher multiplication factor was used.

The salinity of groundwater samples collected from the new wells installed by REM (Table 4.5) ranged from a relatively fresh 3,765 mg/L at MWREM09 to a hyper-saline 79,725 mg/L at MWREM07 and 79,950 mg/L at MWREM06. Both of these hyper-saline wells are situated adjacent to the salt lakes in the low lying southwest corner of the site.

When combined with available data from existing nearby wells this information provides a good indication of the spatial variability of the salinity of shallow groundwater across the study area. As shown in Figure 4.5, groundwater salinity is broadly more saline in the west and fresher to the east. Some notable features of the groundwater salinity data include the following points:

- The salinity of groundwater in MWREM09, located centrally in the south sector west, was measured at 3,765 mg/L, which is much fresher than that of surrounding nearby wells. This is an area that is suspected to have been subject to historic irrigation, and it is postulated that the lower salinity correlates to a lens of fresh water remaining from the historic irrigation.

- The salinity of groundwater in MWREM05, measured at 18,450 mg/L, was significantly higher than that of other nearby wells. Field observations made by REM staff and interpretation of the site aerial photo suggest that this well is adjacent to clay pans and a natural depression where water tends to pond. It is likely that groundwater in this area is subject to a higher rate of evaporative discharge and subsequent concentration of salts in groundwater.

- At sites where data from nested monitoring wells is available, the groundwater in the shallower well is usually much fresher than that in the deeper well. This suggests that perched groundwater does occur in some areas of the site and it is likely that this water originates from drainage of excess irrigation water. Thus it follows that perched groundwater would typically be expected in areas where such irrigation practices are in effect.

2.3.3 Analytical laboratory data

Major ions

Major ion chemistry data showed that the sampled groundwater at Buckland Park was generally very saline (average TDS of 28,930 mg/L), and the ionic composition of the groundwater samples was dominated by sodium and chloride, as is usual for most natural waters, but a significant proportion of sulphate was also present in most samples.

Sulphate concentrations exceeded the SA EPA (2003) guideline value for Livestock use of 1000 mg/L in samples from seven of the eleven wells across the site. The highest levels of

sulphate occurred in wells MWREM06 (6,990 mg/L), MWREM07 (9,820 mg/L) and MWREM08 (3,390 mg/L) all of which are situated in the hyper-saline area adjacent to the salt lakes. Other samples with sulphate levels of 1000 to 3000 mg/L were from MWREM03, MWREM04, MWREM05, MWREM08 and MWREM12.

Sulphate concentrations exceeded the SA EPA (2003) guideline value for Potable use of 500 mg/L in samples from ten of the eleven wells across the site. In addition to the wells listed above for exceeding the Livestock value, samples from wells MWREM01, MWREM02 and MWREM11 exceeded the Potable guideline value, with sulphate concentrations from 731 to 981 mg/L.

The ionic balance errors for MW3, MW9, MW12 and MW6 were reported to be greater than the 5% target amount due to analytes not quantified in the reported analysis. This is a limitation to the confidence that can be placed in the major ionic composition of these samples, but does not affect the validity of other samples or analytes. Re sampling and analysis of major ion chemistry and TDS would enable a more accurate determination of the cation and anion composition of these samples.

Flouride

Fluoride concentrations were reported for field duplicate samples analysed by Labmark. Fluoride concentrations exceeded the SA EPA (2003) guideline value for Livestock use of 2 mg/L in MWREM07 (3.2 mg/L). Fluoride concentrations also exceeded SA EPA (2003) guideline values for Irrigation use of 1 mg/L in MWREM11 (1.3 mg/L).

Nutrients

Groundwater analytical results for nutrients identified the following:

- Ammonia concentration exceeding the SA EPA (2003) Aquatic Ecosystem (Fresh) guideline value of 0.5 mg/L was reported in groundwater sampled from MWREM06 (0.61 mg/L). In addition, ammonia concentration exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.2 mg/L was reported in groundwater sampled from MWREM06 (0.61 mg/L) and MWREM07 (0.43 mg/L).

- Nitrate concentration exceeding the SA EPA EPP (2003) Water Quality (Potable Use) guideline value of 10 mg/L was reported in groundwater sampled from MWREM02 (23.4 mg/L).

- Total nitrogen concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 5 mg/L were reported in groundwater sampled from MWREM02 (26.4 mg/L), MWREM04 (7.4 mg/L), MWREM08 (5.6 mg/L) and MWREM11 (5.0 mg/L)

- Total phosphorous concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.5 mg/L were reported in groundwater sampled from MWREM01 (0.57mg/L), MWREM04 (0.97 mg/L), MWREM07 (0.5 mg/L) and MWREM08 (1.39 mg/L).

Metals

Groundwater analytical results for heavy metals identified the following:

- Chromium concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) Chromium VI guideline value of 0.0044 mg/L were reported in groundwater sampled from MWREM05 (0.005 mg/L), MWREM07 (0.014 mg/L) and MWREM09 (0.005 mg/L).

- Copper concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) Copper guideline value of 0.01 mg/L were reported in groundwater sampled from MWREM06 (0.016 mg/L), MWREM07 (0.04 mg/L) and MWREM08 (0.011 mg/L)

- Lead concentrations exceeding the SA EPA (2003) Potable Water use guideline value of 0.01 mg/L were reported in groundwater sampled from MWREM06 (0.014 mg/L) and MWREM07 (0.123 mg/L).

- Manganese concentrations exceeded the SA EPA (2003) Irrigation use guideline value of 2 mg/L were reported in groundwater sampled from MWREM01 (8.55 mg/L).

- Nickel concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.015 mg/L were reported in groundwater sampled from MWREM01 (0.016 mg/L), MWREM06 (0.015 mg/L) and MWREM08 (0.015 mg/L).

- Zinc concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.05 were reported in groundwater sampled from MWREM06 (0.302 mg/L) and MWREM07 (0.071 mg/L).

Three of the eleven samples analysed for chromium showed levels elevated above the SA EPA criteria for chromium VI in marine aquatic ecosystems. However, in the absence of specific industrial activities that generate chromium VI, chromium in the environment occurs as the relatively benign chromium III species. It is likely that the small amount of chromium detected in some of the samples from the Buckland Park site is the latter chromium III species.

TPH and BTEX

The SA EPA does not nominate a limit for TPH under Potable, Irrigation, Livestock or Aquatic Ecosystem guidelines. Dutch Intervention Levels state a limit of 600 µg/L for Total C10-C36. All samples analysed from the Buckland Park site were returned at levels below this standard.

Groundwater sampled from all but two bores reported levels of BTEX below detection limits. Those samples that did report BTEX components at detectable levels were well below SA EPA (2003) standards for Potable Water, Aquatic Ecosytems (Marine) or Aquatic Ecosystems (Fresh).

PAH's

The PAH criteria value specified by the SA EPA is known to be the limit for benzo-a-pyrene. No other values are specified. The laboratory standard detection limits of reporting for PAH's are higher than this SA EPA guideline value and higher than some of the ANZECC (2000) and Dutch Intervention Levels values but all samples analysed from the Buckland Park site came back at below the laboratory standard detection limit of reporting.

OCP's

Similarly, all samples analysed for organochlorine pesticides came back at below the laboratory standard detection limits of reporting, although for some individual analytes this limit was above the available guideline value.

Phenoxyacetic acid herbicides

The SA EPA does not nominate a limit for PAH under Potable, Irrigation, Livestock or Aquatic Ecosystem guidelines. Dutch Intervention Levels state a limit of 50 µg/L for MCPA. All samples analysed from the Buckland Park site were returned at levels below this standard.

2.4 Analytical Data Quality

The quality of analytical data produced for this project has been assessed with reference to the following issues:

- sampling technique;
- preservation and storage of samples upon collection and during transport to the laboratory;
- sample holding times;
- analytical procedures;
- laboratory limits of reporting;
- field duplicate agreement;
- laboratory quality assurance/quality control (QA/QC) procedures; and
- the occurrence of apparently unusual or anomalous results.

Laboratory QA/QC procedures and results are detailed in the certified laboratory results contained in Appendix F. A summary of the data quality assessment and a summary of the field duplicate sample relative percentage differences are included as Appendix G.

All samples were collected, stored and transported to the laboratory in accordance with standard REM protocols which are consistent with the requirements of Schedule B(2) of the NEPM (NEPC,1999). Laboratory analysis was undertaken within specified holding times and in accordance with National Association of Testing Authorities (NATA) accepted analytical procedures and the requirements of Schedule B(3) of the NEPM (NEPC,1999).

Laboratory quality control information indicates an acceptable degree of QA/QC information was collected and reported and the data provides confidence in the accuracy and precision of reported results.

Relative Percentage Differences (RPD's) were elevated for a range of analytes in some samples. The discrepancy is not considered significant in the interpretation of the results as the results were either close to the limit of reporting where precision is somewhat comprised or the absolute differences between reported concentration results were quite small. The remaining elevated RPD% of field duplicates were within acceptable limits giving confidence to the values reported by the primary laboratory.

Overall, the accuracy and precision of analytical data is considered suitable to form a basis for interpretation of results for the purposes of this assessment.

The Limit of Reporting (LOR) for some analytes in some samples was increased due to matrix interference as a result of high sample salinity. Increased LORs occurred for Ammonia, Metals and Phenoxy Acid Herbicides.

Three intra-laboratory duplicates (MW2, MW7 and MW11) and two inter-laboratory duplicates (MW7 and MW11) were undertaken as part of the sampling activities. For MW111 the primary and intra-lab duplicate samples were lost en-route to the lab for all analytes except TPH and BTEX. Two intra-lab duplicates and one inter-lab duplicate have therefore been reported, with the exception of TPH and BTEX for which all duplicates undertaken have been reported.

Elevated RPD's were identified between the primary (ALS) and the intra-laboratory duplicate (ALS) and the inter-laboratory duplicate (Labmark) for the following analytes:

- Nitrate between the primary and intra-lab duplicate samples for MW7. However, the detected concentrations are close to the LOR and are well below the relevant guideline values for nitrate.

- Total phosphorous between the primary and the intra-lab duplicate samples for MW2, however, the detected concentrations are close to the LOR so the actual exceedance is considered marginal. Total phosphorous between the primary and inter-lab duplicate samples for MW7, however, the exceedance is considered relatively small and neither value exceeded any of the relevant guideline values.

- Reactive phosphorous between the primary and the intra-lab duplicate samples for MW7, however, the exceedance is marginal and the reported values are close to the LOR and well below the relevant guideline values.

- Lead between the primary and intra- and inter-laboratory duplicates for W7. The intra- and inter-laboratory samples are more similar to, and considerably lower than the primary sample, thus placing the validity of the primary sample into question. It is likely that the actual lead concentration is lower than the value reported for the primary sample.

- Zinc between the primary and inter-lab duplicate samples for MW7. Also zinc between the primary and intra-lab duplicate samples for MW2.

- Toluene between the primary and intra-lab duplicate samples for MW2. However, the reported values are near or below the LOR and well below the relevant guideline value.

APPENDIX D

Reports of Boreholes (with Explanatory Notes)

REPORT OF BOREHOLE: BH22B

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270901 m E 6160178 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 2.20 m

DRILL RIG: ROCKMASTER
DRILLER: GEODRILL
LOGGED: JV DATE: 24/4/08
CHECKED: JO DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M	24/4/08 ▽	0.0	0.20				SC	Clayey SAND, fine to coarse grained, red brown, low plasticity fines.	D		Inferred topsoil. Trace of fine to medium roots.
				0.45				SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines, trace of fine to coarse calcareous gravel.			
			0.5					CH	Sandy CLAY, high plasticity, mottled brown / orange brown, trace of fine to coarse calcareous gravel.	M	St	
					PP = 180 kPa							
					PP = 180 kPa							
			1.0		BH22b/01 (1.0-1.05m) PASS Sample							
				1.20	BH22b/02 (1.15-1.2m) PASS Sample			SC	Clayey SAND, fine to coarse grained, orange brown, low plasticity fines, trace of fine to course calcareous gravel.	W		
			1.5		BH22b/03 (1.5-1.55m) PASS Sample							
				1.80				CH	Sandy CLAY, high plasticity, mottled orange brown / pale grey / pale brown, fine to coarse sand.	M	St	Trace of calcareous material.
			2.0	2.00	PP = 100 kPa			SP	SAND, fine to coarse grained, mottled orange brown / pale brown, trace of low plasticity fines.	W		
				2.20					END OF BOREHOLE @ 2.20 m GROUNDWATER ENCOUNTERED @ 1.1m.			
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

REPORT OF BOREHOLE: BH25

Golder Associates

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271168 m E 6159157 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: ND/MH DATE: 23/1/08
CHECKED: DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CH	Sandy CLAY, high plasticity, brown / dark brown, fine to coarse grained sand.	D	Fb	Inferred topsoil. Trace of fine roots.
				0.40	PP = >500 kPa			CH	Sandy CLAY, high plasticity, brown / yellow brown, fine to coarse grained sand, trace of calcareous nodules.		H	Trace of fine roots.
			0.5	0.60				SP	Gravelly SAND, fine to coarse grained, yellow brown, fine to coarse gravel.			
				1.00				CH	Sandy CLAY, high plasticity, mottled brown / brown yellow, fine to coarse grained sand, trace of gravel.		Fb, H	Highly calcareous lens 1.1 - 1.15m. Increasing clay content with depth, with transition to sand.
			1.0	1.30	PP = >500 kPa			SC	Gravelly Clayey SAND, fine to coarse, brown / dark brown / brown yellow, high plasticity fines.			Clay and gravel content varies throughout layer. Calcareous inclusions.
			1.5	1.90				SC	Clayey SAND, fine to coarse, high plasticity fines.	W		Calcareous.
	MH	23/1/08	2.0									
			2.5	2.60				CH	Sandy CLAY, high plasticity, mottled brown / pale brown / yellow / red, fine to coarse grained sand.		H	Calcareous.
			3.0	3.00	PP = >500 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTED @ 2.0m			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

REPORT OF BOREHOLE: BH24

Golder Associates

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270773 m E 6159338 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: ND/MH DATE: 23/1/08
CHECKED: DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT			0.0					CH	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand.	D	Fb	Inferred topsoil. High organic content (fine roots and plant material). Calcareous nodules. Increasing sand content with depth.
			0.5	0.50				CH	Sandy CLAY, high plasticity, brown / yellow / red, fine to coarse grained sand.			Calcareous.
	MH	23/1/08		0.90				CH	Sandy CLAY, high plasticity, mottled orange brown / brown / yellow brown / dark grey.		H	Calcareous.
			1.0	1.00	PP = >500 kPa			SC	Clayey SAND, fine to coarse, brown yellow / yellow / red, high plasticity fines, trace of calcareous nodules.	D-M		Trace of fine roots.
	M		1.5		BH24 (1.2 - 1.4 m) PASS Sample BH24 (1.4 - 1.5 m) PASS Sample							
				1.90				CH	Sandy CLAY, high plasticity, mottled brown / pale brown / yellow / red / red brown, fine to coarse grained sand, trace of calcareous nodules.	M	F - H	Increasing calcareous material and root fibres with depth. Increasing grey mottling with depth. Trace of roots.
			2.0		PP = 100 kPa PP = >500 kPa							
			2.5									
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED AT 1.0m.			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH26

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271832 m E 6159337 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: MH / JV DATE: 23/1/08
CHECKED: DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M	MH / JV 23/1/08	0.0	0.30				SC	Clayey SAND, fine to coarse grained, dark brown, low plasticity fines.	D		Root material.
			0.5	0.55	PP = 250 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand.		Fb, Vst	
				0.85				SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines.			Sand content increases with depth. Calcareous nodules.
			1.0	1.15				SP	SAND, fine to coarse grained, orange brown, with low plasticity fines.			
					PP = 150 kPa			CL	Sandy CLAY, low plasticity, orange brown, fine to coarse sand.		Fb, St	Calcareous nodules.
			1.5	1.75				CH	Sandy CLAY, high plasticity, orange brown, fine to coarse grained sand.	M	Fb, VSt	Calcareous mottling and nodules at 2.25 - 2.5m.
				2.10	PP = 250 kPa				Mottled orange brown and pale grey.			
			2.5	2.70				SP	SAND, fine to coarse grained, mottled orange red and pale grey, with low plasticity fines.	W		Organic matter inclusions.
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.7m.			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

REPORT OF BOREHOLE: BH27

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271578 m E 6160087 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 5.10 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: MH / JV DATE: 23/1/08
CHECKED: DATE: 29/5/08

Drilling: METHOD	Drilling: PENETRATION RESISTANCE	Drilling: WATER	Drilling: DEPTH (metres)	Drilling: DEPTH RL	Sampling: SAMPLE OR FIELD TEST	Sampling: RECOVERED	Field Material Description: GRAPHIC LOG	Field Material Description: USC Symbol	Field Material Description: SOIL / ROCK MATERIAL DESCRIPTION	Field Material Description: MOISTURE	Field Material Description: CONSISTENCY DENSITY	Field Material Description: STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CL	Sandy CLAY, low plasticity, brown, fine to coarse grained sand.	D	Fb	Topsoil, root material.
			0.5	0.50	PP = >500 kPa			CL	Sandy CLAY, low plasticity, brown / grey, fine to coarse grained sand.		H	Root material. Calcareous nodules.
			1.0	1.20					Dark brown / brown / grey mottled.			Black flecks.
			1.5	1.70				SP	SAND, fine to coarse grained, brown, with low plasticity clay.	M		Black flecks. Trace of Mica.
			2.0	2.35				CH	Sandy CLAY, high plasticity, brown / grey, fine to coarse grained sand.			
			2.5	2.45				SC	Clayey SAND, fine to coarse grained, brown / pale grey, low plasticity fines.			
				2.60	PP = 160 kPa			CL	Sandy CLAY, low plasticity, brown / pale brown / orange brown, fine to coarse grained sand.		St	
			3.0	3.05	PP = 200 kPa			CL	Sandy CLAY, low plasticity, red brown / brown, fine to coarse grained sand.		St	Calcareous.
			3.5	3.50	BH22/01 (3.5-3.6) PP = 500 kPa PP = 360 kPa			CH	CLAY, high plasticity, red brown, with fine to coarse sand.		H	Calcareous nodules.
		23/1/08 MH / JV		3.65				CH	Sandy CLAY, high plasticity, brown / pale brown, fine to coarse grained sand.		VSt - H	Calcareous nodules. Calcareous cementation at 3.75 - 4.0m.
			4.0		BH22/02 (3.9-4.0)							
			4.5	4.45	PP = >500 kPa			CH	CLAY, high plasticity, red brown, with fine to coarse sand.	W	H	Calcareous nodules.
			5.0	5.10					END OF BOREHOLE @ 5.10 m GROUNDWATER ENCOUNTERED @ 3.95m.			
			5.5									
			6.0									
			6.5									

DRAFT

REPORT OF BOREHOLE: BH33

Golder Associates

CLIENT:	WALKER CORPORATION	COORDS: 270736 m E 6160912 m N 54 AMG84	SHEET: 1 OF 1
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB DATE: 31/1/08
			CHECKED: DATE: 29/4/08

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	D		
			0.5	0.50				SP	SAND, fine to medium grained, brown, with plastic fines.			
				0.70				SP	SAND, fine to medium grained, orange/brown, with plastic fines and fine pale brown gravel.	M		
			1.5	1.70				SC	Sandy CLAY interbedded with Clayey SAND. SAND is fine to medium grained, CLAY is high plasticity. Brown, with fine to medium pale brown calcareous gravel.		S - St	
			2.0		PP = 160 kPa PP = 130 kPa PP = <50 kPa							
				2.30					Brown, mottled grey.	W		
			2.5	2.60	PP = 50 kPa BH33/02 (2.4-2.5) PP = 50 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium grained sand, with pale brown fine to medium calcareous gravel.		St - VSt	
		AJB 31/01/2008		3.00	PP = 110 kPa BH33/01 (2.75-2.8) PP = 210 kPa PP = 230 kPa PP = 330 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.7			
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

REPORT OF BOREHOLE: BH61

Golder Associates

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270574 m E 6160354 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 3.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 14/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 14/07/08	0.0					SP	SAND, fine to coarse grained, brown, trace of fines.	M		Grass at surface and roots to 0.1m.
				0.40				SP	Colour change to orange brown.			
			0.5									
			1.0							W		
				1.20				SP	Increased fines.			
				1.40								
			1.5		PP = 100 kPa			CL	Sandy CLAY, low plasticity, brown, fine to medium sand.	M (cPL)	F	
				1.60				SC	Clayey SAND, fine to coarse grained, mottled pale orange brown / orange brown / pale grey, medium to high plasticity fines, trace of fine to medium gravel.	M		Lenses of orange brown medium to coarse sand. Fine roots in grey material. Calcareous. Percentage of grey material increasing with depth.
			2.0									
				2.30				SP	SAND, fine to coarse grained, trace of fine plasticity clay.			
			2.5	2.50				SP	SAND, fine to coarse grained, grey, with orange brown mottling decreasing with depth, trace of high plasticity clay.			
				3.00								
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 0.9m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			3.5									
			4.0									
			4.5									
			5.0									

DRAFT

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF BOREHOLE: BH62

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270556 m E 6159379 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 2.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 14/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 14/07/08	0.0	0.30				SP	SAND, fine to coarse grained, brown, trace of fines.	D-M		Grass at surface. Fine roots.
			0.5	0.50				SP	SAND, fine to coarse grained, grey, with high plasticity clay.	D-M		Fine roots. Dark grey veins and orange brown mottling.
				1.40				SP	SAND, fine to coarse grained, pale grey, trace of fines.	M-W		Clay percentage increases with depth.
			1.5	1.60				SP	SAND, fine to coarse grained, pale grey.			
				2.00				SC	Clayey SAND, fine to coarse grained, mottled pale orange brown / orange brown, high plasticity fines, trace of fine calcareous gravel.	M		Calcareous.
			2.0						END OF BOREHOLE @ 2.00 m GROUNDWATER ENCOUNTERED @ 0.5m. ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									

REPORT OF BOREHOLE: BH63

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270961 m E 6158798 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 2.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 14/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 14/07/08	0.0					SP	SAND, fine to coarse grained, brown, trace of fines.	D-M		Trace of crystalised salt
				0.20				SP	SAND, fine to coarse grained, pale brown, with low plasticity clay.	D-M		Trace of shells <5mm. Calcareous.
			0.5	0.50				SC	Clayey SAND, fine to coarse grained, grey with pale orange brown mottling, high plasticity fines.	M (>PL)		
				0.90				CH	Sandy CLAY, high plasticity, grey with pale brown mottling, fine to coarse grained sand.	W	S-F	
			1.0		PP = 40 kPa PP = 40 kPa PP = 80 kPa							
				1.40				CH	Sandy CLAY, high plasticity, grey, fine to coarse grained sand.	M	St	
			1.5		PP = 120 kPa PP = 120 kPa							
				1.65				CH	Sandy CLAY, high plasticity, grey brown with pale brown mottling, fine to coarse grained sand.	D-M	VSt	Calcareous.
				2.00	PP = 300 kPa PP = 340 kPa							
			2.0						END OF BOREHOLE @ 2.00 m GROUNDWATER ENCOUNTERED @ 1.0m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									

REPORT OF BOREHOLE: BH64

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272578 m E 6159363 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 2.25 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 14/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT			0.0	0.10				CH	Sandy CLAY, medium to high plasticity, brown, fine to coarse grained sand.		St (Fb)	Surface grasses.
					PP = 120 kPa			CH	Sandy CLAY, high plasticity, grey brown, fine to coarse grained sand.			Roots.
				0.30				SC	Clayey SAND, fine to coarse grained, brown, high plasticity fines.	M (>PL)		
			0.5									
	SY	14/07/08		0.65				SC	Clayey SAND, mottled pale grey / pale brown, medium to high plasticity fines, trace of gravel.	W		Fine roots. Gravel sized cemented red brown sand.
				0.90				SP	SAND, fine to coarse grained, pale grey, with trace of brown mottling and fines.			
			1.0									
				1.30				SC	Clayey Silty SAND, fine to medium grained, grey, low to medium plasticity fines.			Slight "rotten" odour.
			1.5									
			2.0									
				2.25					END OF BOREHOLE @ 2.25 m GROUNDWATER ENCOUNTERED @ 0.65m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									

REPORT OF BOREHOLE: BH65

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272565 m E 6159721 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 3.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 14/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT		SY 14/07/08	0.0	0.25				CH	Silty Sandy CLAY, medium to high plasticity, dark brown, fine to coarse grained sand.	D-M	Fb	Surface grasses. Roots.
				0.35				CH	Sandy CLAY, high plasticity, grey brown, fine to coarse grained sand.			Fine roots.
			0.5		PP = >500 kPa PP = 500 kPa PP = 320 kPa PP = 120 kPa			CH	Sandy CLAY, high plasticity, mottled grey brown / orange brown, fine to coarse grained sand, trace of dark brown flecks.		St - H	
				0.70				SC	Clayey SAND, fine to coarse grained, mottled grey brown / orange brown, high plasticity fines.	M		Sand and orange brown material increases with depth.
				0.90				SC	Clayey SAND, fine to coarse grained, mottled pale brown / pale orange brown, low plasticity fines, trace of fine to coarse calcareous gravel.	M (>PL)		Calcareous.
			1.0					SP	SAND, with clay.	W		
			1.5	1.60				SP	SAND, fine to coarse grained, mottled grey brown / pale orange brown, trace of clay and calcareous gravel.			
				2.40				CH	Sandy CLAY, high plasticity, mottled grey brown / pale orange brown, fine to coarse grained sand, trace of calcareous gravel.	M (<PL)	St - Vst	
			2.5		PP = 260 kPa PP = 360 kPa PP = 300 kPa							
			3.0	3.00	PP = 180 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 1.6m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			3.5									
			4.0									
			4.5									
			5.0									

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REPORT OF BOREHOLE: BH66

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272443 m E 6159705 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 4.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 14/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 14/07/08	0.0	0.10				SP	SAND, fine to coarse grained, brown, trace of fines.	D-M		Surface grasses.
				0.25				SP	SAND, fine to medium grained, pale brown.			Roots.
				0.35				SC	Clayey SAND, fine to coarse grained, mottled brown / orange brown, high plasticity fines.			
			0.5					SP	SAND, fine to coarse grained, brown.			
			1.0	1.00				CH	Clayey SAND, fine to coarse grained, brown, high plasticity fines.	M		
				1.20				CH	Sandy CLAY, medium to high plasticity, brown, fine to coarse grained sand, trace of calcareous material.		VSt	Sand lense at 1.5 - 1.7m.
			1.5		PP = 260 kPa PP = 340 kPa PP = 380 kPa							
				1.90				SC	Clayey SAND, fine to coarse grained, mottled grey / brown, high plasticity fines.			Brown mottling decreasing with depth.
			2.0									
			2.5	2.70				SP	SAND, fine to coarse grained, mottled grey / orange brown, trace of fines.	W		
			3.0	3.10	PP = <20 kPa			CH	Silty Sandy CLAY, medium to high plasticity, grey, fine to coarse grained sand.		VS	
			3.5	3.85				SP	SAND, fine to coarse grained, grey to pale brown.			
			4.0	4.00					END OF BOREHOLE @ 4.00 m GROUNDWATER ENCOUNTERED @ 1.7m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples			
			4.5									
			5.0									

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REPORT OF BOREHOLE: BH67

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270826 m E 6159999 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 2.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 16/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0	0.15				SC	Clayey SAND, fine to coarse grained, mottled brown / grey brown, high plasticity fines.			Roots.
				0.35				SC	Clayey SAND, fine to coarse grained, grey, high plasticity fines.	M		Dark brown around roots.
		SY 16/07/08	0.5	0.50				SP	SAND, fine to coarse grained, grey, with high plasticity fines.			
PT	L			0.90				SP	Clay percentage decreases to trace.	W		
			1.0	1.20				SP	Pale brown mottling.			
				1.35				SC	Clayey SAND, fine to coarse grained, grey, high plasticity fines.	M (cPL)		
			1.5	1.70				SP	SAND, fine to coarse grained, mottled pale brown / pale orange brown, with high plasticity fines.	M		Calcareous.
			2.0	2.00				SP	Mottled pale brown / orange brown / pale grey.			
									END OF BOREHOLE @ 2.00 m GROUNDWATER ENCOUNTERED @ 0.5m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on samples 0.0m - 1.75m.			
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									

REPORT OF BOREHOLE: BH68

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270851 m E 6159137 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 3.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 16/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 16/07/08	0.0	0.20				SC	Clayey SAND, fine to coarse grained, dark brown, medium to high plasticity fines.	D-M		Roots.
				0.40				SC	Clayey SAND, fine to coarse grained, brown, medium to high plasticity.	M		
			0.5	0.60				SC	Mottled with pale grey / pale brown / orange brown.			
				0.80	PP = 20 kPa			CH	Sandy CLAY, medium to high plasticity, grey, fine to coarse grained sand.	M (>PL)	VS	
			1.0					SP	SAND, fine to coarse grained, grey, trace of fines.	W		
			1.5	1.50				SC	Clayey SAND, medium to high plasticity, mottled grey / red brown, fine to coarse grained sand.	M-W		
			2.0	2.00				SP	SAND, fine to coarse grained, red brown / grey, trace of fines.	W		Lenses of saturated sandy clay. Poor recovery.
			2.5	2.50				SP	Red brown sand becomes lightly cemented.			
				2.75				SC	Clayey SAND, fine to coarse grained, grey brown with veins of pale grey, medium to high plasticity fines.			
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 0.9m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on samples 0.0 - 2.5m and 2.75 - 3.0m..			
			3.5									
			4.0									
			4.5									
			5.0									

REPORT OF BOREHOLE: BH69

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272232 m E 6159097 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 3.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 16/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 16/07/08	0.0					CH	Sandy CLAY, medium to high plasticity, dark brown, fine to coarse grained sand.	D		Roots and bulbs. Sand percentage decreases with depth.
				0.40				CH	Sandy CLAY, medium to high plasticity, mottled brown / grey brown, fine to coarse grained sand.	M (<PL) M (≈PL)	VSt (Fb)	Contains vesicules.
			0.5		PP = 400 kPa PP = 340 kPa							
			1.0		PP = 220 kPa PP = 240 kPa							
				1.25				SC	Clayey SAND, fine to coarse grained, orange brown / grey, medium to high plasticity fines.	M (>PL)		
				1.50				SC	Clayey SAND, fine to coarse grained, mottled pale yellow brown / pale grey / pale brown, medium to high plasticity fines.	W		Mottled with pale brown calcareous material. Clay percentage decreases with depth. Orange brown mottling between 1.85 - 2.1m.
			1.5									
			2.0									
				2.40				SP	SAND, fine to coarse grained, trace of clay.			
			2.5									
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 1.5m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on samples 0.0 - 0.75m, 1.0 - 2.0m and 2.25 - 2.75m.			
			3.5									
			4.0									
			4.5									
			5.0									

REPORT OF BOREHOLE: BH70

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK .
JOB NO: 077662060

COORDS: 272485 m E 6159966 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 3.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 16/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L		0.0					SC	Clayey SAND, fine to coarse grained, grey brown, low to medium plasticity fines.	M		Trace of fine roots. Mottled with orange sand @ 0.55m.
			0.5	0.70				CH	Silty Sandy CLAY, high plasticity, mottled grey / dark grey, fine to coarse grained sand.	M (dPL)	Fb	Roots.
			1.0	1.00				SP	SAND, fine to coarse grained, mottled grey / pale brown / orange brown, with medium to high plasticity clay.	M		
				1.20				SC	Clayey SAND, fine to coarse grained, mottled grey brown / grey, high plasticity fines.	W		
		SY 16/07/08	1.5	1.70				SP	SAND, fine to coarse grained, pale brown, trace of clay. (with lenses of grey brown / brown clayey sand).			
			2.0									
			2.5									
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 1.7m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			3.5									
			4.0									
			4.5									
			5.0									

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REPORT OF BOREHOLE: BH71

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272592 m E 6160655 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 4.00 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 16/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	SY 16/07/08	0.0	0.30				SC	Clayey SAND, fine to coarse grained, dark brown, medium to high plasticity fines.	D-M		Roots.
			0.5					SC	Clayey Silty SAND, fine to coarse grained, brown, high plasticity fines.	M		Contains vesicules. Trace of dark grey material, inferred decomposing root.
			1.0									
			1.5	1.50				SP	SAND, mottled brown / grey brown, with high plasticity clay.	W		
			2.0	2.05				SP	Clay percentage reduces to trace.			
			2.5	2.80				SC	Clayey SAND, fine to medium grained, grey.			
			3.0	3.15				SP	SAND, fine to coarse grained, grey, trace of clay.			Calcareous.
			3.5									
			4.0	4.00					END OF BOREHOLE @ 4.00 m GROUNDWATER ENCOUNTERED @ 1.5m ASS samples collected every 250mm for total depth of borehole. Field tests carried out on all samples.			
			4.5									
			5.0									

REPORT OF BOREHOLE: BH72

Golder Associates

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270006 m E 6162408 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 50 mm HOLE DEPTH: 4.50 m

DRILL RIG: DINGO
DRILLER: SOIL SURVEYS
LOGGED: SY DATE: 16/7/08
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.20				CH	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand.	M (<PL)		Surface grasses. Roots.
			0.5					CL	Sandy CLAY, low to medium plasticity, grey brown (mottled with black organic matter throughout).		Fb	Contains vesicules. Lenses of sand. Organic matter. Pale orange brown mottling between 0.8 - 1.0m.
			1.0	1.40				SP	SAND, grey brown, with trace of fines.			Mottled with black organic matter throughout.
			1.5	1.80				CH	Sandy CLAY, high plasticity, mottled red / grey brown, fine to coarse grained.	D		Pale brown calcareous inclusions. Material becomes darker brown @ 2.7m.
			2.0									
			2.5									
			3.0	3.00				CH	CLAY, high plasticity, mottled dark grey / orange brown, with fine to coarse grained sand.		Fb	
				3.20				CH	Sandy CLAY, high plasticity, fine to coarse grained sand.			
			3.5									
			4.0	4.25				SP	SAND, fine to coarse grained, with high plasticity clay.			
			4.5	4.50					END OF BOREHOLE @ 4.50 m GROUNDWATER NOT ENCOUNTERED			
			5.0									

GAP gINT FN. F01a
RL2

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

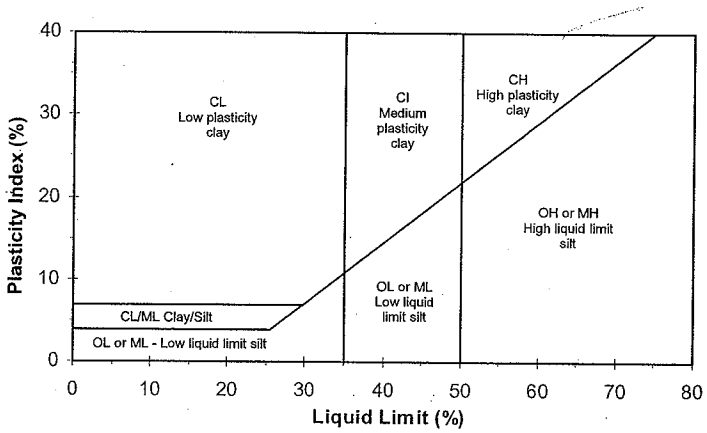
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	HQ	Diamond Core - 63 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	NQ	Diamond Core - 47 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	BH	Tractor Mounted Backhoe
HA	Hand Auger	PT	Push Tube	EX	Tracked Hydraulic Excavator
ADH	Hollow Auger	CT	Cable Tool Rig	EE	Existing Excavation
DTC	Diatube Coring	JET	Jetting	HAND	Excavated by Hand Methods
WB	Washbore or Bailer	NDD	Non-destructive drilling		

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT 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.
GROUNDWATER NOT 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.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-1993
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\textit{Length of core recovered}}{\textit{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \textit{Length of cylindrical core recovered}}{\textit{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \textit{Axial lengths of core} > 100\,mm}{\textit{Length of core run}} \times 100$$

APPENDIX E

Fieldwork Photographs


077662060
Buckland Park
23/1/08 AJB/MH
BH25 0-3m
GLAD
SNAP LOCK


077662060
Buckland Park
23/1/08 AJB/MH
BH26 0-3m


07662060
Buckland Park
23/1/08 AJB/MH
BH27 0-3m


Buckland Park
07662060
AJB 31/1/08
BH33
0-3m
BH34


Buckland Park
077662060
AJB 31/1/08
BH33, BH34
0-3m


Buckland Park
077662060
AJB 31/1/08
BH33, BH34
0-3m


077662060
Buckland Park
23/1/08 AJB/MH
BH2.2 0-3m


077662060
Buckland Park
23/1/08 AJB/MH
BH2.4 0-3m


07766206O
BH65
14/07/200


14/07/200


14/07/200


07766206O
BH66
0-4m
S4 14-7-08
14/07/200


14/07/200


077662
16/07/200
BH6


14/07/200


077662060
BH67
0-2m
SY 16-7-08
16/07/200


16/07/200


16/07/200


662060
H67
16/07/200


077662060
BH68
0-3m
SY 16-7-08
16/07/200


16/07/200


16/07/200


16/07/200


16/07/200


16/07/200


16/07/200


077662060
BH70
0-3m
SY 16-7-08
16/07/200


16/07/200


077662060
BH71
0-4m
SY 16-7-05
16/07/200


16/07/200


16/07/200


16/07/200


16/07/200


077662060
BH61
0-3m
SY 14-7-08
14/07/200


077662060
BH72
0-4.5m
SY 16-7-08
16/07/200


16/07/200


14/07/200


14/07/200


14/07/200


14/07/200


14/07/200


14/07/200


077662060
BH62
0-2m
14/07/200


14/07/200


14/07/200


14/07/200


077662060
BH63
0-2m
S4 14-7-08
14/07/200


14/07/200


14/07/200


14/07/200


077662060
BH64
0-2.2m
S4 14-7-08
14/07/200


14/07/200

APPENDIX F

Summary of Acid Sulphate Soil Field and Laboratory Test Results

TABLE 1 FIELD pH TEST RESULTS - STAGE 1
WALKER CORPORATION
BUCKLAND PARK

Sample No.	Depth (m)	Soil Type	pH	pH fox	reaction	Interpreted PASS Potential		
						high	medium	low
BH22b/01	1.0 - 1.05	brown sand	7.8	6.5	no			X
BH22b/02	1.15 - 1.2	brown clayey sand	8.0	5.8	no			X
BH22b/03	1.5 - 1.55	pale brown sand	7.9	6.7	minor			X
BH24	1.2 - 1.4	red-brown sand	8.0	6.0	minor			X
BH24	1.4 - 1.5	orange-brown sand	7.8	5.6	minor			X
BH25	2.0 - 2.3	red-brown sand	7.9	6.2	minor			X
BH25	2.5 -2.7	brown sandy clay	7.8	6.5	no			X
BH26	2.0 - 2.2	brown clayey sand	8.2	6.5	minor			X
BH26	2.5 - 2.6	brown clay	7.8	5.8	no			X
BH27/01	3.5 - 3.1	orange sand	8.0	6.9	minor			X
BH27/02	3.9 - 4.0	brown sandy clay	8.2	7.0	reaction			X
BH27/02b	3.9 - 4.0	brown sandy clay	8.2	6.1	minor			X
BH33/01	2.75 - 2.8	red-brown sandy clay	7.8	5.9	no			X
BH33/02	2.4 - 2.5	brown sandy clay	8.1	6.3	minor			X

Note: pH meter calibrated prior to use.

Prepared by	ND	Date	22/05/2008
Checked by		Date	

TABLE 2 FIELD pH TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Hole No.	Depth (m)		Soil Type	pH	pH fox	pH Diff	reaction	Interpreted PASS Potential		
								high	medium	low
BH 61 - 01	0	0.25	B sand	8.1	4.1	4.0	3			X
BH 61 - 02	0.25	0.5	B sand	7.9	5.1	2.8	3			X
BH 61- 03	0.5	0.75	OB sand	7.0	4.7	2.3	2			X
BH 61- 04	0.75	1	OB sand	8.0	2.4	5.6	3	X		
BH 61 - 05	1	1.25	OB sand	7.1	3.8	3.3	2			X
BH 61 - 06	1.25	1.5	OB sand, trace of fines	7.4	6.0	1.3	1			X
BH 61 - 07	1.5	1.75	B sandy clay	7.6	5.8	1.8	2			X
BH 61 - 08	1.75	2	POB/OB/PG clayey sand	7.8	4.7	3.1	2			X
BH 61 - 09	2	2.25	POB/OB/PG clayey sand	8.0	5.6	2.4	2			X
BH 61 - 10	2.25	2.5	POB/OB/PG sand	7.9	6.0	1.9	2			X
BH 61 - 11	2.5	2.75	G sand	6.5	6.0	0.5	2			X
BH 61 - 12	2.75	3	G sand	7.5	5.3	2.3	3			X
BH 62 - 01	0	0.25	B sand	7.3	5.8	1.5	3			X
BH 62 - 02	0.25	0.5	G sand with clay	7.9	6.1	1.9	3			X
BH 62 - 03	0.5	0.75	PG sand, trace of fines	6.5	5.8	0.7	2			X
BH 62 - 04	0.75	1	PG sand, trace of fines	7.1	4.3	2.8	2			X
BH 62 - 05	1	1.25	PG sand, trace of fines	7.9	5.0	2.9	1			X
BH 62 - 06	1.25	1.5	PG sand, trace of fines	7.2	4.6	2.6	1			X
BH 62 - 07	1.5	1.75	PG sand	6.8	3.0	3.8	1		X	
BH 62 - 08	1.75	2	POB/OB clayey sand	7.1	6.2	0.9	2			X
Creek @ BH 62	surface sample		DG sand	7.1	6.4	0.7	3			X

Note: pH meter calibrated prior to use.

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Input By: MW
Date: 12/08/2008
Checked By: PKS
Date: 12/08/2008

TABLE 2 FIELD pH TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Hole No.	Depth (m)		Soil Type	pH	pH fox	Diff	reaction	Interpreted PASS Potential		
								high	medium	low
BH 63 - 01	0	0.25	B sand, trace of fines	7.3	6.3	1.0	3			X
BH 63 - 02	0.25	0.5	PB sand with clay	7.1	6.4	0.8	3			X
BH 63 - 03	0.5	0.75	G clayey sand	8.6	6.3	2.3	4			X
BH 63 - 04	0.75	1	G clayey sand	7.0	4.4	2.6	2			X
BH 63 - 05	1	1.25	G sandy clay	7.3	4.3	3.0	2			X
BH 63 - 06	1.25	1.5	G sandy clay	6.9	5.5	1.4	2			X
BH 63 - 07	1.5	1.75	G sandy clay	7.2	1.5	5.7	2	X		
BH 63 - 08	1.75	2	GB sandy clay	8.0	6.5	1.5	3			X
BH 64 - 01	0	0.25	B clayey sand	8.0	6.6	1.5	3			X
BH 64 - 02	0.25	0.5	B clayey sand	7.6	6.3	1.3	3			X
BH 64 - 03	0.5	0.75	B clayey sand	8.0	5.5	2.5	3			X
BH 64 - 04	0.75	1	PG/PB clayey sand	7.4	5.0	2.4	2			X
BH 64 - 05	1	1.25	PG sand, trace of fines	7.1	4.9	2.3	2			X
BH 64 - 06	1.25	1.5	G clayey silty sand	8.5	1.1	7.4	5	X		
BH 64 - 07	1.5	1.75	G clayey silty sand	8.0	1.7	6.4	5	X		
BH 64 - 08	1.75	2	G clayey silty sand	7.4	1.1	6.2	3	X		
BH 64 - 09	2	2.25	G clayey silty sand	7.9	5.9	1.9	3			X

Note: pH meter calibrated prior to use.

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Input By: MW
Date: 12/08/2008
Checked By: PKS
Date: 12/08/2008

TABLE 2 FIELD pH TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Hole No.	Depth (m)		Soil Type	pH	pH fox	Diff	reaction	Interpreted PASS Potential		
								high	medium	low
BH 65 - 01	0	0.25	DB sandy silty clay	8.3	4.7	3.5	2			X
BH 65 - 02	0.25	0.5	GB/OB sandy clay	8.6	6.8	1.8	3			X
BH 65 - 03	0.5	0.75	GB/OB sandy clay	8.0	5.6	2.4	2			X
BH 65 - 04	0.75	1	GB/OB clayey sand	8.7	6.6	2.2	3			X
BH 65 - 05	1	1.25	PB/POB clayey sand	8.0	6.7	1.3	3			X
BH 65 - 06	1.25	1.5	PB/POB sand with clay	8.4	6.3	2.1	3			X
BH 65 - 07	1.5	1.75	GB/POB sand, trace of clay	8.0	5.5	2.5	2			X
BH 65 - 08	1.75	2	GB/POB sand, trace of clay							
BH 65 - 09	2	2.25	GB/POB sand, trace of clay	7.7	5.1	2.6	1			X
BH 65 - 10	2.25	2.5	GB/POB sand, trace of clay	7.5	6.3	1.2	3			X
BH 65 - 11	2.5	2.75	GB/POB sandy clay	8.0	6.0	2.0	2			X
BH 65 - 12	2.75	3	GB/POB sandy clay	7.9	5.2	2.6	3			X
BH 66 - 01	0	0.25	B/PB sand, trace of fines	7.2	4.8	2.4	3			X
BH 66 - 02	0.25	0.5	B/DB clayey sand	8.2	5.7	2.5	4			X
BH 66 - 03	0.5	0.75	B sand	8.4	5.5	2.9	3			X
BH 66 - 04	0.75	1	B sand	7.9	5.6	2.2	2			X
BH 66 - 05	1	1.25	B clayey sand	8.3	6.5	1.7	3			X
BH 66 - 06	1.25	1.5	B sandy clay	8.0	6.4	1.7	2			X
BH 66 - 07	1.5	1.75	B sandy clay	8.1	5.5	2.6	2			X
BH 66 - 08	1.75	2	B sandy clay	8.2	7.4	0.9	2			X
BH 66 - 09	2	2.25	B/G clayey sand	7.9	6.2	1.8	2			X
BH 66 - 10	2.25	2.5	B/G clayey sand	7.6	5.2	2.4	2			X
BH 66 - 11	2.5	2.75	B/G clayey sand	7.6	5.9	1.7	3			X
BH 66 - 12	2.75	3	G/OB sand	8.2	7.1	1.1	2			X
BH 66 - 13	3	3.25	G sandy silty clay	7.6	6.3	1.3	3			X
BH 66 - 14	3.25	3.5	G sandy silty clay	8.2	6.0	2.2	2			X
BH 66 - 15	3.5	3.75	G sandy silty clay	8.3	6.1	2.2	3			X
BH 66 - 16	3.75	4	G/PB sand	8.0	5.7	2.3	2			X

Note: pH meter calibrated prior to use.

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Input By: MW
Date: 12/08/2008
Checked By: PKS
Date: 12/08/2008

TABLE 2 FIELD pH TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Hole No.	Depth (m)		Soil Type	pH	pH fox	Diff	reaction	Interpreted PASS Potential		
								high	medium	low
BH67 - 01	0	0.25	B/GB clayey sand	8.4	6.6	1.9	3			
BH67 - 02	0.25	0.5	G clayey sand	8.3	6.3	1.9	3			X
BH67 - 03	0.5	0.75	G sand with clay	8.5	7.1	1.4	3			X
BH67 - 04	0.75	1	G sand with clay	8.1	6.1	2.1	2			X
BH67 - 05	1	1.25	G/PB sand with clay	8.1	5.8	2.3	2			X
BH67 - 06	1.25	1.5	G clayey sand	8.4	6.8	1.6	2			X
BH67 - 07	1.5	1.75	PB/POB sand with clay	8.6	6.9	1.7	2			X
BH67 - 08	1.75	2	PB/POB sand with clay							
BH68 - 01	0	0.25	DB clayey sand	7.4	5.7	1.7	4			X
BH68 - 02	0.25	0.5	B clayey sand	8.5	7.5	1.0	3			X
BH68 - 03	0.5	0.75	PG/PB/OB clayey sand	8.5	6.1	2.3	3			X
BH68 - 04	0.75	1	G sandy clay	8.5	4.2	4.2	1			X
BH68 - 05	1	1.25	G sand	8.4	5.2	2.7	2			X
BH68 - 06	1.25	1.5	G sand	8.0	5.4	3.1	1			X
BH68 - 07	1.5	1.75	G/RB sandy clay	8.4	6.1	2.2	2			X
BH68 - 08	1.75	2	G/RB sandy clay	8.3	5.9	2.3	2			X
BH68 - 09	2	2.25	G/RB sandy clay	8.2	4.9	3.2	2			X
BH68 - 10	2.25	2.5	G/RB sandy clay	8.1	4.5	3.6	2			X
BH68 - 11	2.5	2.75	G/RB sandy clay							
BH68 - 12	2.75	3	GB clayey sand	8.8	4.8	3.9	3			X

Note: pH meter calibrated prior to use.

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Input By: MW
Date: 12/08/2008
Checked By: PKS
Date: 12/08/2008

TABLE 2 FIELD pH TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Hole No.	Depth (m)		Soil Type	pH	pH fox	Diff	reaction	Interpreted PASS Potential		
								high	medium	low
BH69 - 01	0	0.25	DB sandy clay	5.5	3.3	2.2	3			X
BH69 - 02	0.25	0.5	DB sandy clay	6.0	5.7	0.4	3			X
BH69 - 03	0.5	0.75	B/GB sandy clay	8.6	6.6	2.0	3			X
BH69 - 04	0.75	1	B/GB sandy clay							
BH69 - 05	1	1.25	B/GB sandy clay	8.5	6.0	2.5	3			X
BH69 - 06	1.25	1.5	OB/G clayey sand	8.6	6.1	2.6	3			X
BH69 - 07	1.5	1.75	PYB/PG/PB clayey sand	8.3	6.4	1.9	3			X
BH69 - 08	1.75	2	PYB/PG/PB clayey sand	9.0	6.2	2.8	2			X
BH69 - 09	2	2.25	PYB/PG/PB clayey sand							
BH69 - 10	2.25	2.5	PYB/PG/PB clayey sand	8.3	6.3	2.0	3			X
BH69 - 11	2.5	2.75	PYB/PG/PB sand	8.5	6.4	2.1	3			X
BH69 - 12	2.75	3	PYB/PG/PB sand							
BH70 - 01	0	0.25	GB clayey sand	7.8	6.1	1.7	3			X
BH70 - 02	0.25	0.5	GB clayey sand	7.8	6.6	1.3	3			X
BH70 - 03	0.5	0.75	GB clayey sand	8.3	6.6	1.7	3			X
BH70 - 04	0.75	1	G/DG silty sandy clay	8.9	7.0	1.9	4			X
BH70 - 05	1	1.25	G/PB/OB sand with clay	8.4	8.6	-0.2	5			X
BH70 - 06	1.25	1.5	GB/G clayey sand	8.4	6.0	2.4	2			X
BH70 - 07	1.5	1.75	GB/G clayey sand	8.5	6.3	2.2	3			X
BH70 - 08	1.75	2	PB sand, trace of clay	8.4	6.4	2.0	3			X
BH70 - 09	2	2.25	PB sand, trace of clay	8.5	6.2	2.3	3			X
BH70 - 10	2.25	2.5	PB sand, trace of clay	8.1	5.8	2.3	3			X
BH70 - 11	2.5	2.75	PB sand, trace of clay	8.8	5.7	3.1	3			X
BH70 - 12	2.75	3	PB sand, trace of clay	8.4	6.1	2.3	3			X

Note: pH meter calibrated prior to use.

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Input By: MW
Date: 12/08/2008
Checked By: PKS
Date: 12/08/2008

TABLE 2 FIELD pH TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Hole No.	Depth (m)		Soil Type	pH	pH fox	Diff	reaction	Interpreted PASS Potential		
								high	medium	low
BH71 - 01	0	0.25	DB clayey sand	5.5	5.1	0.5	4			X
BH71 - 02	0.25	0.5	B clayey silty sand	8.6	7.5	1.1	3			X
BH71 - 03	0.5	0.75	B clayey silty sand	9.2	6.1	3.1	3			X
BH71 - 04	0.75	1	B clayey silty sand	9.0	6.9	2.1	3			X
BH71 - 05	1	1.25	B clayey silty sand	9.1	7.0	2.2	3			X
BH71 - 06	1.25	1.5	B clayey silty sand	9.0	6.8	2.1	4			X
BH71 - 07	1.5	1.75	B/GB sand with clay	8.5	6.0	2.6	3			X
BH71 - 08	1.75	2	B/GB sand with clay	8.8	6.0	2.7	3			X
BH71 - 09	2	2.25	B/GB sand, trace of clay	8.5	5.8	2.7	3			X
BH71 - 10	2.25	2.5	B/GB sand, trace of clay	8.6	5.6	3.0	3			X
BH71 - 11	2.5	2.75	B/GB sand, trace of clay	8.7	6.3	2.4	3			X
BH71 - 12	2.75	3	G clayey sand	8.7	5.6	3.1	3			X
BH71 - 13	3	3.25	G clayey sand	9.0	5.6	3.4	3			X
BH71 - 14	3.25	3.5	G sand, trace of clay	8.9	5.9	3.0	3			X
BH71 - 15	3.5	3.75	G sand, trace of clay	9.0	6.1	2.8	4			X
BH71 - 16	3.75	4	G sand, trace of clay	9.1	6.2	3.0	3			X
BH72 - 01	0	0.25	DB sandy clay	7.7	4.9	2.8	5			X
BH72 - 02	0.25	0.5	GB sandy clay	7.8	5.4	2.4	5			X
BH72 - 03	0.5	0.75	GB sandy clay	8.0	5.5	2.4	5			X
BH72 - 04	0.75	1	GB sandy clay	8.1	5.3	2.8	5			X
BH72 - 05	1	1.25	GB sandy clay	8.1	5.1	3.1	2			X
BH72 - 06	1.25	1.5	GB sandy clay	7.9	6.3	1.6	3			X
BH72 - 07	1.5	1.75	GB sand, trace of clay	8.3	6.0	2.3	3			X
BH72 - 08	1.75	2	R/GB sandy clay	8.3	7.4	1.0	5			X
BH72 - 09	2	2.25	R/GB sandy clay	8.7	7.4	1.3	3			X
BH72 - 10	2.25	2.5	R/GB sandy clay	8.7	6.6	2.0	3			X
BH72 - 11	2.5	2.75	R/GB sandy clay	8.9	6.9	1.9	3			X
BH72 - 12	2.75	3	R/GB sandy clay	9.0	9.2	-0.2	5			X
BH72 - 13	3	3.25	DG/OB clay with sand							
BH72 - 14	3.25	3.5	DG/OB sandy clay							
BH72 - 15	3.5	3.75	DG/OB sandy clay							
BH72 - 16	3.75	4	DG/OB sandy clay							
BH72 - 17	4	4.25	DG/OB sandy clay							
BH72 - 18	4.25	4.5	DG/OB sand with clay							

Note: pH meter calibrated prior to use.

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Input By: MW
Date: 12/08/2008
Checked By: PKS
Date: 12/08/2008

TABLE 3 LABORATORY ASS TEST RESULTS - STAGE 1
WALKER CORPORATION
BUCKLAND PARK

Test Location	Depth Range (m - BGL)	Material Description	pH_{KCl}	TAA	sTAA Converted to %S*	S_{NAS} (if pH less than 4.5)	Existing Acidity %S (sTAA + 0.75 x S_{NAS})	Chromium Reduceable Sulfur (S_{CR})	Acid Neutralising Capacity %CaCO3 (if pH	Net Acidity %S (S_{CR}+Existing Acidity -	Is This ASS	Is This PASS	Liming Rate for Net Acidity (Neutralises both AASS & PASS) (kg/m3)
BH24	1.2-1.4	Clayey Sand	9.2	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH24	1.2-1.4	Clayey Sand	9.3	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH24	1.4-1.5	Clayey Sand	9.2	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH25	2.0-2.3	Clayey Sand	9.4	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH25	2.5-2.7	Sandy Clay	9.5	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH26	2.0-2.2	Sandy Clay	9.3	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH26	2.5-2.6	Sandy Clay	9.2	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA

Note: * Equivalent oxidisable sulphur calculated as TAA/30.59
Liming rates assume a bulk density of 1.6t/m^3
Fineness Factor = 3
No chemical result

Prepared by	SY	Date	29/05/2008
Checked by		Date	

Input By: ???
Date: 12/08/2008
Checked By: ???
Date: 12/08/2008

TABLE 4 LABORATORY ASS TEST RESULTS - STAGE 2
WALKER CORPORATION
BUCKLAND PARK

Test Location	Depth Range (m - BGL)		Material Description	pH_{ox}	TAA	sTAA Converted to %S*	S_{NAS} (if pH less than 4.5)	Existing Acidity %S ($sTAA + 0.75 \times S_{NAS}$)	Chromium Reduceable Sulfur (S_{CR})	Acid Neutralising Capacity %CaCO3 (if pH more than 6.5)	Net Acidity %S (S_{CR}+Existing Acidity - ANC/FF)	Is This ASS	Is This PASS	Liming Rate for Net Acidity (Neutralises both AASS & PASS) (kg/m3)
BH 61 - 01	0	0.25	B sand	7.7	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 61- 04	0.75	1	OB sand	8.9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 61 - 05	1	1.25	OB sand	8.7	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 61 - 08	1.75	2	POB/OB/PG clayey sand	8.9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 61 - 12	2.75	3	G sand	8.8	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 62 - 02	0.25	0.5	G sand with clay	8.7	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 62 - 04	0.75	1	PG sand, trace of fines	8.3	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 62 - 07	1.5	1.75	PG sand	8.1	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
Creek @ BH 62	**surface sample**		**DG sand**	**8.9**	**< 0.5**	**< 0.016**		**0.000**	**0.190**	**2.2**	**-0.045**	**No**	**YES**	**No Additional Lime Required**
BH 63 - 03	0.5	0.75	G clayey sand	8.2	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 63 - 05	1	1.25	G sandy clay	8.1	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 63 - 07	**1.5**	**1.75**	**G sandy clay**	**6.4**	**< 0.5**	**< 0.016**		**0.000**	**0.200**	**NA**	**0.200**	**No**	**YES**	**15.1**
BH 64 - 03	0.5	0.75	B clayey sand	9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 64 - 06	**1.25**	**1.5**	**G clayey silty sand**	**7.7**	**< 0.5**	**< 0.016**		**0.000**	**0.490**	**1**	**0.383**	**No**	**YES**	**29.0**
BH 64 - 08	**1.75**	**2**	**G clayey silty sand**	**7.4**	**< 0.5**	**< 0.016**		**0.000**	**0.470**	**0.63**	**0.403**	**No**	**YES**	**30.5**
BH 65 - 01	0	0.25	DB sandy silty clay	7.4	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 65 - 06	1.25	1.5	PB/POB sand with clay	9.1	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 65 - 09	2	2.25	GB/POB sand, trace of clay	8.9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 65 - 12	2.75	3	GB/POB sandy clay	8.0	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 66 - 03	0.5	0.75	B sand	8.4	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 66 - 07	1.5	1.75	B sandy clay	8.8	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 66 - 09	2	2.25	B/G clayey sand	8.2	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH 66 - 14	3.25	3.5	G sandy silty clay	8.6	< 0.5	< 0.016		0.000	0.018	NA	NA	No	No	NA
BH67 - 02	0.25	0.5	G clayey sand	9.3	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH67 - 05	1	1.25	G/PB sand with clay	9.2	< 0.5	< 0.016		0.000	< 0.005	NA	0.005	No	No	NA
BH68 - 04	0.75	1	G sandy clay	8.2	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH68 - 06	1.25	1.5	G sand	9.3	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH68 - 10	2.25	2.5	G/RB sandy clay	7.8	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH68 - 12	2.75	3	GB clayey sand	9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH69 - 06	1.25	1.5	OB/G clayey sand	8	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH69 - 08	1.75	2	PYB/PG/PB clayey sand	9.4	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH70 - 06	1.25	1.5	GB/G clayey sand	9.3	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH70 - 11	2.5	2.75	PB sand, trace of clay	9.4	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH71 - 03	0.5	0.75	B clayey silty sand	9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH71 - 10	2.25	2.5	B/GB sand, trace of clay	8.9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH71 - 13	**3**	**3.25**	**G clayey sand**	**8.7**	**< 0.5**	**< 0.016**		**0.000**	**0.074**	**2.5**	**-0.193**	**No**	**YES**	**No Additional Lime Required**
BH71 - 16	**3.75**	**4**	**G sand, trace of clay**	**9.6**	**< 0.5**	**< 0.016**		**0.000**	**0.32**	**13**	**-1.068**	**No**	**YES**	**No Additional Lime Required**
BH72 - 05	1	1.25	GB sandy clay	7.7	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA
BH72 - 10	2.25	2.5	R/GB sandy clay	7.9	< 0.5	< 0.016		0.000	< 0.005	NA	NA	No	No	NA

Note: * Equivalent oxidisable sulphur calculated as TAA/30.59
Liming rates assume a bulk density of 1.6t/m^3
Fineness Factor = 3
No chemical result

Prepared by	SY	Date	28/07/2008
Checked by		Date	

Input By: ???
Date: 12/08/2008
Checked By: ???
Date: 12/08/2008

APPENDIX G

Soil & Groundwater Chemical Testing Laboratory Certificates and COCs

Chain of Custody Record - Soil/Sediment Samples

little white

Sheet 1 of 1

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Subdivision	**DATE RESULTS REQUIRED:**	5 days after receipt
PROJ No.:	077662060	**E-MAIL RESULTS:**	syoung@golder.com.au
SAMPLED BY:	SY	**CC RESULTS:**	adelaide@golder.com.au
CONTACT:	Sarah/Aaron	**LABORATORY:**	SGS - Cairns
		QUOTE No:	07/268.ARv6

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Chromium Suit	59761
	BH24	23/01/2008	Natural	1.2-1.4	☑	
	BH24	23/01/2008	Natural	1.4-1.5	☑	
	BH25	23/01/2008	Natural	2.0-2.3	☑	
	BH25	23/01/2008	Natural	2.5-2.7	☑	
	BH26	23/01/2008	Natural	2.0-2.2	☑	
	BH26	23/01/2008	Natural	2.5-2.6	☑	
				Totals :		

Any samples heavily contaminated? No / Yes .....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Siganture
RELEASED BY:	S.Young	Golder Associates	*Yes*	*Yes*	*20/05/08*	*PM*	
RECEIVED BY:			*Esky Intact* / *Yes / No*	*Security Seals Intact* / *Yes / No*			
RELEASED BY:			*Yes / No*	*Yes / No*			
RECEIVED BY:	Jamie	SGS	*Esky Intact* / *Yes / No*	*Security Seals Intact* / *Yes / No*	21/5/08	am	

Laboratory Use Only

LABORATORY REPORT COVERSHEET

Date: 28 July 2008

To: Golder Associates Pty Ltd
199 Franklin Street
ADELAIDE SA 5000

Attention: Sarah Young

Your Reference: Subdivision 077662060
Laboratory Report No: 60449
Samples Received: 22/07/2008
Samples / Quantity: 16 Soils

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.

Shey Goddard
Administration Manager
CAIRNS

Jon Dicker
Manager
CAIRNS

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Unit 2, 58 Comport Street, Portsmith 4870 QLD Australia
t +61 (0)7 4035 5111 f +61 (0)7 4035 5122

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60449
PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60449-1 BH67 - 02 16/07/2008	60449-2 BH67 - 05 16/07/2008	60449-3 BH68 - 04 16/07/2008
Date Extracted		23/07/2008	23/07/2008	23/07/2008
Date Analysed		28/07/2008	28/07/2008	28/07/2008
Moisture	% w/w	22	18	15
pH KCl	pH Units	9.3	9.2	8.2
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

Chromium Suite Our Reference Your Reference Date Sampled	Units	60449-4 BH68 - 06 16/07/2008	60449-5 BH68 - 10 16/07/2008	60449-6 BH68 - 12 16/07/2008
Date Extracted		23/07/2008	23/07/2008	23/07/2008
Date Analysed		28/07/2008	28/07/2008	28/07/2008
Moisture	% w/w	19	18	23
pH KCl	pH Units	9.3	7.8	9.0
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60449
PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60449-7 BH69 - 06 16/07/2008	60449-8 BH69 - 08 16/07/2008	60449-9 BH70 - 06 16/07/2008
Date Extracted		23/07/2008	23/07/2008	23/07/2008
Date Analysed		28/07/2008	28/07/2008	28/07/2008
Moisture	% w/w	26	18	20
pH KCl	pH Units	8.0	9.4	9.3
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	<0.005	<0.005	<0.005
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

Chromium Suite Our Reference Your Reference Date Sampled	Units	60449-10 BH70 - 11 16/07/2008	60449-11 BH71 - 03 16/07/2008	60449-12 BH71 - 10 16/07/2008
Date Extracted		23/07/2008	23/07/2008	23/07/2008
Date Analysed		28/07/2008	28/07/2008	28/07/2008
Moisture	% w/w	18	20	18
pH KCl	pH Units	9.4	9.0	8.9
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	<0.005	<0.005	<0.005
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60449

PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60449-13 BH71 - 13 16/07/2008	60449-14 BH71 - 16 16/07/2008	60449-15 BH72 - 05 16/07/2008
Date Extracted		23/07/2008	23/07/2008	23/07/2008
Date Analysed		28/07/2008	28/07/2008	28/07/2008
Moisture	% w/w	23	17	12
pH KCl	pH Units	8.7	9.6	7.7
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	0.074	0.32	<0.005
Acid Neutralisation Capacity	% $CaCO_3$	2.5	13	NA

Chromium Suite Our Reference Your Reference Date Sampled	Units	60449-16 BH72 - 10 16/07/2008
Date Extracted		23/07/2008
Date Analysed		28/07/2008
Moisture	% w/w	15
pH KCl	pH Units	7.9
TAA pH 6.5	kg H_2SO_4/tonne	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005
Acid Neutralisation Capacity	% $CaCO_3$	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60449
PROJECT: Subdivision 077662060

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Chromium Suite			
Date Extracted			
Date Analysed			
Moisture	% w/w	0.1	AN002
pH KCl	pH Units	0.1	ASSMAC_23A / CEI-401
TAA pH 6.5	kg H_2SO_4/tonne	0.5	ASSMAC_23F / CEI-401
Chromium Reducible Sulfur (S_{CR})	% w/w	0.005	ASSMAC_22B / CEI-405
Acid Neutralisation Capacity	% $CaCO_3$	0.01	AN214 CEI-402

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60449
PROJECT: Subdivision 077662060

LABORATORY REPORT

QUALITY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Date Extracted		[NT]	60449-1	23/07/2008 || 23/07/2008
Date Analysed		[NT]	60449-1	28/07/2008 || 28/07/2008
Moisture	% w/w	[NT]	60449-1	22 || [N/T]
pH KCl	pH Units	[NT]	60449-1	9.3 || 9.3 || RPD: 0
TAA pH 6.5	kg H_2SO_4/tonne	[NT]	60449-1	<0.5 || <0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	[NT]	60449-1	<0.005 || <0.005
Acid Neutralisation Capacity	% $CaCO_3$	[NT]	60449-1	NA || NA
QUALTY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Date Extracted		[NT]	60449-11	23/07/2008 || 23/07/2008
Date Analysed		[NT]	60449-11	28/07/2008 || 28/07/2008
Moisture	% w/w	[NT]	60449-11	20 || [N/T]
pH KCl	pH Units	[NT]	60449-11	9.0 || 9.0 || RPD: 0
TAA pH 6.5	kg H_2SO_4/tonne	[NT]	60449-11	<0.5 || <0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	[NT]	60449-11	<0.005 || <0.005
Acid Neutralisation Capacity	% $CaCO_3$	[NT]	60449-11	NA || NA

NOTES:
LOR - Limit of Reporting.

Analysis Date: **Between** 22/07/08 **and** 28/07/08

Chain of Custody Record - Soil/Sediment Samples

60449

Sheet 1 of 4

Golder Associates Pty Ltd
9 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT: Subdivision
DATE RESULTS REQUIRED: 5 days after receipt
PROJ No.: 077662060
E-MAIL RESULTS: syoung@golder.com.au
SAMPLED BY: SY
CC RESULTS: adelaide@golder.com.au
CONTACT: Sarah/Aaron
LABORATORY: SGS - Cairns
QUOTE No:

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Analyses Required: Chromium Suit	ON HOLD
	BH67 - 01	16/07/2008	N	0	0.25		
1	BH67 - 02	16/07/2008	N	0.25	0.5	/	
	BH67 - 03	16/07/2008	N	0.5	0.75		
	BH67 - 04	16/07/2008	N	0.75	1		
2	BH67 - 05	16/07/2008	N	1	1.25	/	
	BH67 - 06	16/07/2008	N	1.25	1.5		
	BH67 - 07	16/07/2008	N	1.5	1.75		
	BH67 - 08	16/07/2008	N	1.75	2		
	BH68 - 01	16/07/2008	N	0	0.25		
	BH68 - 02	16/07/2008	N	0.25	0.5		
	BH68 - 03	16/07/2008	N	0.5	0.75		
3	BH68 - 04	16/07/2008	N	0.75	1	/	
	BH68 - 05	16/07/2008	N	1	1.25		
4	BH68 - 06	16/07/2008	N	1.25	1.5	/	
	BH68 - 07	16/07/2008	N	1.5	1.75		
	BH68 - 08	16/07/2008	N	1.75	2		
	BH68 - 09	16/07/2008	N	2	2.25		
5	BH68 - 10	16/07/2008	N	2.25	2.5	/	
	BH68 - 11	16/07/2008	N	2.5	2.75		
6	BH68 - 12	16/07/2008	N	2.75	3	/	
					Totals :	6	15

Any samples heavily contaminated? No / Yes .....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	B WESSLING	Golder Associates	Yes	Yes	21/07/08	PM	
RECEIVED BY:	LES	AAE	Esky Intact (Yes) / No	Security Seals Intact (Yes) / No	21/7/08	PM	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:	Fiona	SGS CAIRNS	Esky Intact (Yes) / No	Security Seals Intact (Yes) / No	22/7/08	PM	

Laboratory Use Only

Chain of Custody Record - Soil/Sediment Samples

60449

Sheet 2 of 4

Golder Associates Pty Ltd
199 Frank Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Subdivision	**DATE RESULTS REQUIRED:**	5 days after receipt
PROJ No.:	077662060	**E-MAIL RESULTS:**	syoung@golder.com.au
SAMPLED BY:	SY	**CC RESULTS:**	adelaide@golder.com.au
CONTACT:	Sarah/Aaron	**LABORATORY:**	SGS - Cairns
		QUOTE No:	

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Chromium Suit		ON HOLD														
	BH69 - 01	16/07/2008	N	0	0.25			/														
	BH69 - 02	16/07/2008	N	0.25	0.5			/														
	BH69 - 03	16/07/2008	N	0.5	0.75			/														
	BH69 - 04	16/07/2008	N	0.75	1			/														
	BH69 - 05	16/07/2008	N	1	1.25			/														
7	BH69 - 06	16/07/2008	N	1.25	1.5	/																
	BH69 - 07	16/07/2008	N	1.5	1.75			/														
8	BH69 - 08	16/07/2008	N	1.75	2	/																
	BH69 - 09	16/07/2008	N	2	2.25			/														
	BH69 - 10	16/07/2008	N	2.25	2.5			/														
	BH69 - 11	16/07/2008	N	2.5	2.75			/														
	BH69 - 12	16/07/2008	N	2.75	3			/														
	BH70 - 01	16/07/2008	N	0	0.25			/														
	BH70 - 02	16/07/2008	N	0.25	0.5			/														
	BH70 - 03	16/07/2008	N	0.5	0.75			/														
	BH70 - 04	16/07/2008	N	0.75	1			/														
	BH70 - 05	16/07/2008	N	1	1.25			/														
9	BH70 - 06	16/07/2008	N	1.25	1.5	/																
	BH70 - 07	16/07/2008	N	1.5	1.75			/														
	BH70 - 08	16/07/2008	N	1.75	2			/														
	BH70 - 09	16/07/2008	N	2	2.25			/														
	BH70 - 10	16/07/2008	N	2.25	2.5			/														
10	BH70 - 11	16/07/2008	N	2.5	2.75	/																
	BH70 - 12	16/07/2008	N	2.75	3			/														
					Totals :	4		20														

Any samples heavily contaminated? No / Yes .....

Laboratory Use Only

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	B WESSLING	Golder Associates	Yes	Yes	21/07/08	PM	
RECEIVED BY:	LES	APE	Esky Intact Yes / No	Security Seals Intact Yes / No	21/7/08	PM	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:	FIONA	SGS CAIRNS	Esky Intact Yes / No	Security Seals Intact Yes / No	22/7	PM	

Chain of Custody Record - Soil/Sediment Samples

60469

Sheet 3 of 4

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Subdivision	**DATE RESULTS REQUIRED:**	5 days after receipt
PROJ No.:	077662060	**E-MAIL RESULTS:**	syoung@golder.com.au
SAMPLED BY:	SY	**CC RESULTS:**	adelaide@golder.com.au
CONTACT:	Sarah/Aaron	**LABORATORY:**	SGS - Cairns
		QUOTE No:	

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Chromium Suit		ON HOLD															
	BH71 - 01	16/07/2008	N	0	0.25			/															
	BH71 - 02	16/07/2008	N	0.25	0.5			/															
11	BH71 - 03	16/07/2008	N	0.5	0.75	/																	
	BH71 - 04	16/07/2008	N	0.75	1			/															
	BH71 - 05	16/07/2008	N	1	1.25			/															
	BH71 - 06	16/07/2008	N	1.25	1.5			/															
	BH71 - 07	16/07/2008	N	1.5	1.75			/															
	BH71 - 08	16/07/2008	N	1.75	2			/															
	BH71 - 09	16/07/2008	N	2	2.25			/															
12	BH71 - 10	16/07/2008	N	2.25	2.5	/																	
	BH71 - 11	16/07/2008	N	2.5	2.75			/															
	BH71 - 12	16/07/2008	N	2.75	3			/															
13	BH71 - 13	16/07/2008	N	3	3.25	/																	
	BH71 - 14	16/07/2008	N	3.25	3.5			/															
	BH71 - 15	16/07/2008	N	3.5	3.75			/															
14	BH71 - 16	16/07/2008	N	3.75	4	/																	
					Totals :	4		12															

Laboratory Use Only

Any samples heavily contaminated? No / Yes .....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	B WESSLING	Golder Associates	Yes	Yes	21/07/08	PM	
RECEIVED BY:	LES	AAE	*Esky Intact* (Yes) / No	*Security Seals Intact* (Yes) / No	21/7/08	pm	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:	FIONA	SGS CAIRNS	*Esky Intact* (Yes) / No	*Security Seals Intact* (Yes) / No	22/7	PM	

Chain of Custody Record - Soil/Sediment Samples

60449

Sheet 4 of 4

Golder Associates Pty Ltd
99 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT: Subdivision **DATE RESULTS REQUIRED:** 5 days after receipt

PROJ No.: 077662060 **E-MAIL RESULTS:** syoung@golder.com.au

SAMPLED BY: SY **CC RESULTS:** adelaide@golder.com.au

CONTACT: Sarah/Aaron **LABORATORY:** SGS - Cairns

QUOTE No:

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Chromium Suit		ON HOLD																
	BH72 - 01	16/07/2008	N	0	0.25			/																
	BH72 - 02	16/07/2008	N	0.25	0.5			/																
	BH72 - 03	16/07/2008	N	0.5	0.75			/																
	BH72 - 04	16/07/2008	N	0.75	1			/																
15	BH72 - 05	16/07/2008	N	1	1.25	/																		
	BH72 - 06	16/07/2008	N	1.25	1.5			/																
	BH72 - 07	16/07/2008	N	1.5	1.75			/																
	BH72 - 08	16/07/2008	N	1.75	2			/																
	BH72 - 09	16/07/2008	N	2	2.25			/																
16	BH72 - 10	16/07/2008	N	2.25	2.5	/																		
	BH72 - 11	16/07/2008	N	2.5	2.75			/																
	BH72 - 12	16/07/2008	N	2.75	3			/																
	BH72 - 13	16/07/2008	N	3	3.25			/																
	BH72 - 14	16/07/2008	N	3.25	3.5			/																
	BH72 - 15	16/07/2008	N	3.5	3.75			/																
	BH72 - 16	16/07/2008	N	3.75	4			/																
	BH72 - 17	16/07/2008	N	4	4.25			/																
	BH72 - 18	16/07/2008	N	4.25	4.5			/																
					Totals :	2		16																

Any samples heavily contaminated? No / Yes .....

Laboratory Use Only

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	B WESSLING	Golder Associates	*Yes*	*Yes*	*21/07/08*	*PM*	
RECEIVED BY:	LES	APE	*Esky Intact* (Yes) / No	*Security Seals Intact* (Yes) / No	21/7/08	PM	
RELEASED BY:			*Yes / No*	*Yes / No*			
RECEIVED BY:	FIONA	SGS CAIRNS	*Esky Intact* (Yes) / No	*Security Seals Intact* (Yes) / No	22/7	PM	

LABORATORY REPORT COVERSHEET

Date: 25 July 2008

To: Golder Associates Pty Ltd
199 Franklin Street
ADELAIDE SA 5000

Attention: Sarah Young

Your Reference: Subdivision 077662060
Laboratory Report No: 60425
Samples Received: 21/07/2008
Samples / Quantity: 23 Soils

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.

Shey Goddard
Administration Manager
CAIRNS

Jon Dicker
Manager
CAIRNS

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Unit 2, 58 Comport Street, Portsmith 4870 QLD Australia
t +61 (0)7 4035 5111 f +61 (0)7 4035 5122

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425
PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-1 BH 61 - 01 14/07/2008	60425-2 BH 61 - 04 14/07/2008	60425-3 BH 61 - 05 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	10	15	17
pH KCl	pH Units	7.7	8.9	8.7
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-4 BH 61 - 08 14/07/2008	60425-5 BH 61 - 12 14/07/2008	60425-6 BH 62 - 02 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	16	14	19
pH KCl	pH Units	8.9	8.8	8.7
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425
PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-7 BH 62 - 04 14/07/2008	60425-8 BH 62 - 07 14/07/2008	60425-9 Creek @ BH 62 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	18	17	30
pH KCl	pH Units	8.3	8.1	8.9
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	0.19
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	2.2

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-10 BH 63 - 03 14/07/2008	60425-11 BH 63 - 05 14/07/2008	60425-12 BH 63 - 07 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	19	21	21
pH KCl	pH Units	8.2	8.1	6.4
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	0.20
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425
PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-13 BH 64 - 03 14/07/2008	60425-14 BH 64 - 06 14/07/2008	60425-15 BH 64 - 08 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	22	30	37
pH KCl	pH Units	9.0	7.7	7.4
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	0.49	0.47
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	1.0	0.63

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-16 BH 65 - 01 14/07/2008	60425-17 BH 65 - 06 14/07/2008	60425-18 BH 65 - 09 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	16	17	18
pH KCl	pH Units	7.4	9.1	8.9
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425

PROJECT: Subdivision 077662060

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-19 BH 65 - 12 14/07/2008	60425-20 BH 66 - 03 14/07/2008	60425-21 BH 66 - 07 14/07/2008
Date Extracted		22/07/2008	22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008	24/07/2008
Moisture	% w/w	18	10	10
pH KCl	pH Units	8.0	8.4	8.8
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005
SHCl ^	% w/w	NA	NA	NA
S KCl ^	% w/w	NA	NA	NA
S NAS ^	% w/w	NA	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA	NA

Chromium Suite Our Reference Your Reference Date Sampled	Units	60425-22 BH 66 - 09 14/07/2008	60425-23 BH 66 - 14 14/07/2008
Date Extracted		22/07/2008	22/07/2008
Date Analysed		24/07/2008	24/07/2008
Moisture	% w/w	22	29
pH KCl	pH Units	8.2	8.6
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	0.018
SHCl ^	% w/w	NA	NA
S KCl ^	% w/w	NA	NA
S NAS ^	% w/w	NA	NA
Acid Neutralisation Capacity	% $CaCO_3$	NA	NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425
PROJECT: Subdivision 077662060

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Chromium Suite			
Date Extracted			
Date Analysed			
Moisture	% w/w	0.1	AN002
pH KCl	pH Units	0.1	ASSMAC_23A / CEI-401
TAA pH 6.5	kg H_2SO_4/tonne	0.5	ASSMAC_23F / CEI-401
Chromium Reducible Sulfur (S_{CR})	% w/w	0.005	ASSMAC_22B / CEI-405
S_{HCl} ^	% w/w	0.005	ASSMAC_20B
S KCl ^	% w/w	0.005	ASSMAC_23Ce
S NAS ^	% w/w	0.005	ASSMAC_20J
Acid Neutralisation Capacity	% $CaCO_3$	0.01	AN214 CEI-402

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425
PROJECT: Subdivision 077662060

LABORATORY REPORT

QUALITY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Date Extracted		[NT]	60425-1	22/07/2008 || 22/07/2008
Date Analysed		[NT]	60425-1	24/07/2008 || 24/07/2008
Moisture	% w/w	[NT]	60425-1	10 || <0.1
pH KCl	pH Units	[NT]	60425-1	7.7 || 7.8 || RPD: 1
TAA pH 6.5	kg H_2SO_4/tonne	[NT]	60425-1	<0.5 || <0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	[NT]	60425-1	<0.005 || <0.005
S_{HCl} ^	% w/w	[NT]	60425-1	NA || NA
S KCl ^	% w/w	[NT]	60425-1	NA || NA
S NAS ^	% w/w	[NT]	60425-1	NA || NA
Acid Neutralisation Capacity	% $CaCO_3$	[NT]	60425-1	NA || NA
QUALTY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Date Extracted		[NT]	60425-11	22/07/2008 || 22/07/2008
Date Analysed		[NT]	60425-11	24/07/2008 || 24/07/2008
Moisture	% w/w	[NT]	60425-11	21 || NT
pH KCl	pH Units	[NT]	60425-11	8.1 || 8.0 || RPD: 1
TAA pH 6.5	kg H_2SO_4/tonne	[NT]	60425-11	<0.5 || <0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	[NT]	60425-11	<0.005 || <0.005
S_{HCl} ^	% w/w	[NT]	60425-11	NA || NA
S KCl ^	% w/w	[NT]	60425-11	NA || NA
S NAS ^	% w/w	[NT]	60425-11	NA || NA
Acid Neutralisation Capacity	% $CaCO_3$	[NT]	60425-11	NA || NA

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 60425
PROJECT: Subdivision 077662060

LABORATORY REPORT

QUALTY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Date Extracted		[NT]	60425-21	22/07/2008 || 22/07/2008
Date Analysed		[NT]	60425-21	24/07/2008 || 24/07/2008
Moisture	% w/w	[NT]	60425-21	10 || NT
pH KCl	pH Units	[NT]	60425-21	8.8 || 8.9 || RPD: 1
TAA pH 6.5	kg H_2SO_4/tonne	[NT]	60425-21	<0.5 || <0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	[NT]	60425-21	<0.005 || <0.005
S_{HCl} ^	% w/w	[NT]	60425-21	NA || NA
S KCl ^	% w/w	[NT]	60425-21	NA || NA
S NAS ^	% w/w	[NT]	60425-21	NA || NA
Acid Neutralisation Capacity	% $CaCO_3$	[NT]	60425-21	NA || NA

NOTES:
LOR - Limit of Reporting.

Analysis Date: **Between** 21/07/08 **and** 25/07/08

SGS Terms and Conditions are available from www.au.sgs.com

Chain of Custody Record - Soil/Sediment Samples

60425

Sheet 1 of 3

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

002

GOLDER ASSOCIATES

18/07 2008 13:18 FAX 08 8213 2101

PROJECT:	Subdivision	**DATE RESULTS REQUIRED:**	5 days after receipt
PROJ No.:	077662060	**E-MAIL RESULTS:**	syoung@golder.com.au
SAMPLED BY:	SY	**CC RESULTS:**	adelaide@golder.com.au
CONTACT:	Sarah/Aaron	**LABORATORY:**	SGS - Cairns
		QUOTE No:	

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Chromium Suit		ON HOLD													
1	BH 61 - 01	14/07/2008	Natural	0	0.25	/															
	BH 61 - 02	14/07/2008	Natural	0.25	0.5			/													
	BH 61- 03	14/07/2008	Natural	0.5	0.75			/													
2	BH 61- 04	14/07/2008	Natural	0.75	1	/															
3	BH 61 - 05	14/07/2008	Natural	1	1.25	/															
	BH 61 - 06	14/07/2008	Natural	1.25	1.5			/													
	BH 61 - 07	14/07/2008	Natural	1.5	1.75			/													
4	BH 61 - 08	14/07/2008	Natural	1.75	2	/															
	BH 61 - 09	14/07/2008	Natural	2	2.25			/													
	BH 61 - 10	14/07/2008	Natural	2.25	2.5			/													
	BH 61 - 11	14/07/2008	Natural	2.5	2.75			/													
5	BH 61 - 12	14/07/2008	Natural	2.75	3	/															
	BH 62 - 01	14/07/2008	Natural	0	0.25			/													
6	BH 62 - 02	14/07/2008	Natural	0.25	0.5	/															
	BH 62 - 03	14/07/2008	Natural	0.5	0.75			/													
7	BH 62 - 04	14/07/2008	Natural	0.75	1	/															
	BH 62 - 05	14/07/2008	Natural	1	1.25			/													
	BH 62 - 06	14/07/2008	Natural	1.25	1.5			/													
8	BH 62 - 07	14/07/2008	Natural	1.5	1.75	/															
	BH 62 - 08	14/07/2008	Natural	1.75	2			/													
9	Creek @ BH 62	14/07/2008	Natural	surface sample		/															
					Totals :																

Any samples heavily contaminated? No / Yes .....

Laboratory Use Only

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Siganture
RELEASED BY:	B WESSLING	Golder Associates	Yes	Yes	16/07/08	PM	
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	LES	AAE	Yes	Yes	16/07/08	PM	
RELEASED BY:			*Yes / No*	*Yes / No*			
			Esky Intact	*Security Seals Intact*			

Q:/quality/masters/coc masters/GAP-A-FM04

GAP-A-FM04
RL 8

Chain of Custody Record - Soil/Sediment Samples

60425

Sheet 2 of 3

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

18/07 2008 13:20 FAX 08 8213 2101 GOLDER ASSOCIATES 003

PROJECT: Subdivision
DATE RESULTS REQUIRED: 5 days after receipt
PROJ No.: 077662060
E-MAIL RESULTS: syoung@golder.com.au
SAMPLED BY: SY
CC RESULTS: adelaide@golder.com.au
CONTACT: Sarah/Aaron
LABORATORY: SGS - Cairns
QUOTE No:

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Chromium Suit		ON HOLD													
	BH 63 - 01	14/07/2008	Natural	0	0.25			/													
	BH 63 - 02	14/07/2008	Natural	0.25	0.5			/													
10	BH 63 - 03	14/07/2008	Natural	0.5	0.75	/															
	BH 63 - 04	14/07/2008	Natural	0.75	1			/													
11	BH 63 - 05	14/07/2008	Natural	1	1.25	/															
	BH 63 - 06	14/07/2008	Natural	1.25	1.5			/													
12	BH 63 - 07	14/07/2008	Natural	1.5	1.75	/															
	BH 63 - 08	14/07/2008	Natural	1.75	2			/													
	BH 64 - 01	14/07/2008	Natural	0	0.25			/													
	BH 64 - 02	14/07/2008	Natural	0.25	0.5			/													
13	BH 64 - 03	14/07/2008	Natural	0.5	0.75	/															
	BH 64 - 04	14/07/2008	Natural	0.75	1			/													
	BH 64 - 05	14/07/2008	Natural	1	1.25			/													
14	BH 64 - 06	14/07/2008	Natural	1.25	1.5	/															
	BH 64 - 07	14/07/2008	Natural	1.5	1.75			/													
15	BH 64 - 08	14/07/2008	Natural	1.75	2	/															
	BH 64 - 09	14/07/2008	Natural	2	2.25			/													
					Totals :	6		11													

Any samples heavily contaminated? No / Yes .....

Laboratory Use Only

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	B WESSLING	Golder Associates	(Yes)	(Yes)	16/07/08	PM	
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	LES	AAE	(Yes)	(Yes)	16/07/08	PM	
RELEASED BY:			Yes / No	Yes / No			
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	Fiona	21/7/08	Yes / No	Yes / No			

Chain of Custody Record - Soil/Sediment Samples

60425

Sheet 3 of 3

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Subdivision	**DATE RESULTS REQUIRED:**	5 days after receipt
PROJ No.:	077662060	**E-MAIL RESULTS:**	syoung@golder.com.au
SAMPLED BY:	SY	**CC RESULTS:**	adelaide@golder.com.au
CONTACT:	Sarah/Aaron	**LABORATORY:**	SGS - Cairns
		QUOTE No:	

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)		Analyses Required: Chromium Suit		ON HOLD
16	BH 65 - 01	14/07/2008	Natural	0	0.25	✓		✓
	BH 65 - 02	14/07/2008	Natural	0.25	0.5			✓
	BH 65 - 03	14/07/2008	Natural	0.5	0.75			✓
	BH 65 - 04	14/07/2008	Natural	0.75	1			✓
	BH 65 - 05	14/07/2008	Natural	1	1.25			✓
17	BH 65 - 06	14/07/2008	Natural	1.25	1.5	✓		✓
	BH 65 - 07	14/07/2008	Natural	1.5	1.75			✓
	BH 65 - 08	14/07/2008	Natural	1.75	2			✓
18	BH 65 - 09	14/07/2008	Natural	2	2.25	✓		✓
	BH 65 - 10	14/07/2008	Natural	2.25	2.5			✓
	BH 65 - 11	14/07/2008	Natural	2.5	2.75			✓
19	BH 65 - 12	14/07/2008	Natural	2.75	3	✓		✓
	BH 66 - 01	14/07/2008	Natural	0	0.25			✓
	BH 66 - 02	14/07/2008	Natural	0.25	0.5			✓
20	BH 66 - 03	14/07/2008	Natural	0.5	0.75	✓		✓
	BH 66 - 04	14/07/2008	Natural	0.75	1			✓
	BH 66 - 05	14/07/2008	Natural	1	1.25			✓
	BH 66 - 06	14/07/2008	Natural	1.25	1.5			✓
21	BH 66 - 07	14/07/2008	Natural	1.5	1.75	✓		✓
	BH 66 - 08	14/07/2008	Natural	1.75	2			✓
22	BH 66 - 09	14/07/2008	Natural	2	2.25	✓		✓
	BH 66 - 10	14/07/2008	Natural	2.25	2.5			✓
	BH 66 - 11	14/07/2008	Natural	2.5	2.75			✓
	BH 66 - 12	14/07/2008	Natural	2.75	3			✓
	BH 66 - 13	14/07/2008	Natural	3	3.25			✓
23	BH 66 - 14	14/07/2008	Natural	3.25	3.5	✓		✓
	BH 66 - 15	14/07/2008	Natural	3.5	3.75			✓
	BH 66 - 16	14/07/2008	Natural	3.75	4			✓
					Totals :	8		20

Any samples heavily contaminated? No / Yes .....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Siganture
RELEASED BY:	B WESSLING	Golder Associates	Yes	Yes	16/07/08	PM	
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	LES	AAE	Yes	Yes	16/07/08	PM	
RELEASED BY:			*Yes / No*	*Yes / No*			
RECEIVED BY:	Fiona	21/7/08	*Esky Intact*	*Security Seals Intact*			
			Yes / No	*Yes / No*			

Laboratory Use Only

18/07 2008 13:21 FAX 08 8213 2101 GOLDER ASSOCIATES 004

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES0810166**	Page	: 1 of 5
Client	: GOLDER ASSOCIATES	Laboratory	: Environmental Division Sydney
Contact	: MS SARAH YOUNG	Contact	: Victor Kedicioglu
Address	: 193-199 FRANKLIN ST ADELAIDE SA, AUSTRALIA 5000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: syoung@golder.com.au	E-mail	: victor.kedicioglu@alsenviro.com
Telephone	: +61 08 8213 2100	Telephone	: +61-2-8784 8555
Facsimile	: +61 08 8213 2101	Facsimile	: +61-2-8784 8500
Project	: 0776622060 BUCKLAND PARK	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 17-JUL-2008
Sampler	: ANNA	Issue Date	: 28-JUL-2008
Order number	: ----		
		No. of samples received	: 5
Quote number	: EN/002/05	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 Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005: pH							
Clear Plastic Bottle - Natural							
SW01	**16-JUL-2008**	**----**	----	----	**17-JUL-2008**	16-JUL-2008	×
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural							
W6, W7, GW11, BD1	**16-JUL-2008**	**---**	---	----	**18-JUL-2008**	30-JUL-2008	✓
ED038A: Acidity							
Clear Plastic Bottle - Natural							
W6, W7, GW11, BD1	**16-JUL-2008**	**----**	----	----	**21-JUL-2008**	30-JUL-2008	✓
ED040F: Dissolved Major Anions							
Clear Plastic Bottle - Natural							
W6, W7, GW11, BD1	**16-JUL-2008**	**---**	---	----	**18-JUL-2008**	13-AUG-2008	✓
ED045G: Chloride Discrete analyser							
Clear Plastic Bottle - Natural							
W6, W7, GW11, BD1	**16-JUL-2008**	**----**	----	----	**17-JUL-2008**	13-AUG-2008	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified							
W6, W7, GW11, BD1	**16-JUL-2008**	**---**	---	----	**21-JUL-2008**	12-JAN-2009	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acidity as Calcium Carbonate	ED038	1	6	**16.7**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	4	31	**12.9**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	13	**15.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	17	**11.8**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Filtered	ED040F	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH	EA005	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Acidity as Calcium Carbonate	ED038	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	2	31	**6.5**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	13	**15.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	17	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Filtered	ED040F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Acidity as Calcium Carbonate	ED038	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	17	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Filtered	ED040F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	13	**7.7**	**5.0**	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	17	**5.9**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by both manual measurement and automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Acidity as Calcium Carbonate	ED038	WATER	APHA 21st ed., 2310 B Acidity is determined by titration with a standardised alkali to an end-point pH of 8.3. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Major Anions - Filtered	ED040F	WATER	APHA 21st ed., 3120 Sulfur and/or Silcon content is determined by ICP/AES and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Chloride by Discrete Analyser	ED045G	WATER	The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005: pH						
Clear Plastic Bottle - Natural						
SW01	----	----	----	17-JUL-2008	16-JUL-2008	**1**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

LABORATORY REPORT COVERSHEET

Date: 27 May 2008

To: Golder Associates Pty Ltd
199 Franklin Street
ADELAIDE SA 5000

Attention: Sarah Young

Your Reference: 077662060 - Subdivision
Laboratory Report No: 59761
Samples Received: 21/05/2008
Samples / Quantity: 6 Samples

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.

Shey Goddard
Administration Manager
CAIRNS

Jon Dicker
Manager
CAIRNS

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Unit 2, 58 Comport Street, Portsmith 4870 QLD Australia
t +61 (0)7 4035 5111 f +61 (0)7 4035 5122

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 59761
PROJECT: 077662060 - Subdivision

LABORATORY REPORT

Chromium Suite Our Reference Your Reference Date Sampled	Units	59761-1 BH24 - 1.2-1.4 23/01/2008	59761-2 BH24 - 1.4-1.5 23/01/2008	59761-3 BH25 - 2.0-2.3 23/01/2008
Moisture	% w/w	16	19	16
pH KCl	pH Units	9.2	9.2	9.4
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005

Chromium Suite Our Reference Your Reference Date Sampled	Units	59761-4 BH25 - 2.5-2.7 23/01/2008	59761-5 BH26 - 2.0-2.2 23/01/2008	59761-6 BH26 - 2.5-2.6 23/01/2008
Moisture	% w/w	20	20	22
pH KCl	pH Units	9.5	9.3	9.2
TAA pH 6.5	kg H_2SO_4/tonne	<0.5	<0.5	<0.5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	<0.005	<0.005

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 59761

PROJECT: 077662060 - Subdivision

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Chromium Suite			
Moisture	% w/w	0.1	AN002
pH KCl	pH Units	0.1	ASSMAC_23A / CEI-401
TAA pH 6.5	kg H_2SO_4/tonne	0.5	ASSMAC_23F / CEI-401
Chromium Reducible Sulfur (S_{CR})	% w/w	0.005	ASSMAC_22B / CEI-405

CLIENT: Golder Associates Pty Ltd **Laboratory Report No:** 59761

PROJECT: 077662060 - Subdivision

LABORATORY REPORT

QUALITY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Moisture	% w/w	[NT]	59761-1	16 || [N/T]
pH KCl	pH Units	[NT]	59761-1	9.2 || 9.3 || RPD: 1
TAA pH 6.5	kg H_2SO_4/tonne	[NT]	59761-1	<0.5 || <0.5
Chromium Reducible Sulfur (S_{CR})	% w/w	[NT]	59761-1	<0.005 || <0.005

NOTES:

LOR - Limit of Reporting.

Analysis Date: **Between** 21/05/08 **and** 27/05/08

SGS Terms and Conditions are available from www.au.sgs.com

APPENDIX H

Groundwater Sampling Records

GROUNDWATER SAMPLING - RECORD FORM

BORE ID	W6

PROJECT INFORMATION

Project Number:	077662060	**Site Location:**	Buckland Park
Client:	Walker Crop	**Date of Sampling:**	16-Jul-08
Purged By:	AJB	**Sampled By:**	ABJ

GROUNDWATER BORE DATA

Diameter of Column (mm)	100
Diameter of Bore (mm)	50
Standing Water Level (m BRP)	1.516
Total Depth of Bore (m BRP)	4.01
Depth of Water in Column (m)	2.494
Standpipe height (m above gl)	0.6

Bore Volume (L): 15.2

Interface probe used?	YES
Depth to product (m BRP)	-
Depth to water (m BRP)	1.516
Thickness of product (m BRP)	-

BRP - Below Reference Point

PURGING RECORD AND FIELD PARAMETER MEASUREMENTS

Time Start hr: min: **8:30**

Volume Purged (L) (discrete*)	Time (min) (accume*)	Time (seconds)	Rate, L/min	Depth to WL, m	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)	Redox Potential (mV)
10	4	10	2.40	2.07	21.0	3.84	6.75	113.2	221
10	7	45	2.79	2.06	21.0	2.14	6.87	114.8	69
10	11	25	2.73	2.12	21.2	1.87	6.81	92.8	50
10	14	45	3.00	2.12	21.1	2.14	6.83	90.2	46
15	19	50	2.95	2.13	20.9	2.12	6.83	87.2	46

Total volume purged (L): 55 **No. bore volumes purged:** 3.6

Time Finish hr:min: **8:50**

Water Quality Meter type: TDS 90FLMV **Water Dipper type:** Solist interface dipper

Pumping Method: Waterra Tubing with Submersible Pump and Regulator

SAMPLING RECORD

Minimum Water Level during Purging (m): 2.13

Rinsate sample taken BEFORE/AFTER this well? NO Rinsate ID:

Samples taken? YES Duplicate taken? YES Duplicate ID: BD1

Time between sampling & purging: none

Water level prior to sampling (m): 2.13

Samples filtered? YES for metals? Filter method: 0.45 mm filter

Container:	**Preservation:**
Vial ☐	HCl
1l Plastic 2	none
500ml Plastic 2	none
125 ml Plastic 2	none
250ml / 500 ml / 1l Plastic / Glass ☐	none / other:

OBSERVATIONS

Samples: Colour: Clear, colourless Turbidity Low

Odour: none Sheen? No

Weather Conditions: *Sampling Day* Wind, overcast Temperature 15°C

Previous Week Temperature

Notes:

*Refer to "Groundwater Sampling Guidelines" VicEPA Publication 669 *discrete means to restart or batch the volumes and times (non accumulative)*

GROUNDWATER SAMPLING - RECORD FORM

BORE ID	GW11

PROJECT INFORMATION

Project Number:	077662060	**Site Location:**	Buckland Park
Client:	Walker Crop	**Date of Sampling:**	16-Jul-08
Purged By:	AJB	**Sampled By:**	ABJ

GROUNDWATER BORE DATA

Diameter of Column (mm)	100		
Diameter of Bore (mm)	50		
Standing Water Level (m BRP)	2.087		
Total Depth of Bore (m BRP)	4.48		
Depth of Water in Column (m)	2.393	Bore Volume (L)	14.6
Standpipe height (m above gl)	0.8		

Interface probe used?	YES
Depth to product (m BRP)	-
Depth to water (m BRP)	2.087
Thickness of product (m BRP)	-

BRP - Below Reference Point

PURGING RECORD AND FIELD PARAMETER MEASUREMENTS

Time Start hr: min	12:00

Volume Purged (L) (discrete*)	Time (min) (accume*)	Time (seconds)	Rate, L/min	Depth to WL, m	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)	Redox Potential (mV)
10	6	5	1.64	2.83	22.0	1.89	7.46	13.0	74
10	9	20	3.08	3.77	21.6	1.19	7.52	10.37	84
10	12	10	3.53	3.86	23.2	0.98	7.43	17.18	84
10	15	25	3.08	3.98	23.4	1.30	7.42	17.8	90
10	18	38	3.11	3.93	23.4	1.12	7.42	17.71	91
10	21	30	3.49	3.90	23.4	1.08	7.42	17.56	92

Total volume purged (L)	60	**No. bore volumes purged**	4.1

Time Finish hr:min	12:22

Water Quality Meter type: TDS 90FLMV **Water Dipper type:** Solist interface dipper

Pumping Method: Waterra Tubing with Submersible Pump and Regulator

SAMPLING RECORD

Minimum Water Level during Purging (m): 3.98

Rinsate sample taken BEFORE/AFTER this well? NO Rinsate ID:

Samples taken? YES Duplicate taken? NO Duplicate ID:

Time between sampling & purging: none

Water level prior to sampling (m): 3.9

Samples filtered? YES for metals? Filter method: 0.45 mm filter

Container:	**Preservation:**
Vial ☐	HCl
1l Plastic ☑ 1	none
500ml Plastic ☑ 1	none
125 ml Plastic ☑ 1	none
250ml / 500 ml / 1l Plastic / Glass ☐	none / other:

OBSERVATIONS

Samples: Colour: Brown Turbidity Low

Odour: none Sheen? No

Weather Conditions: *Sampling Day* Wind, overcast Temperature 15°C

Previous Week Temperature

Notes:

*Refer to "Groundwater Sampling Guidelines" VicEPA Publication 669 *discrete means to restart or batch the volumes and times (non accumulative)*

GROUNDWATER SAMPLING - RECORD FORM

BORE ID	W7

PROJECT INFORMATION

Project Number:	077662060	**Site Location:**	Buckland Park
Client:	Walker Crop	**Date of Sampling:**	16-Jul-08
Purged By:	AJB	**Sampled By:**	ABJ

GROUNDWATER BORE DATA

Diameter of Column (mm)	100		
Diameter of Bore (mm)	50		
Standing Water Level (m BRP)	1.467		
Total Depth of Bore (m BRP)	4.21		
Depth of Water in Column (m)	2.743	Bore Volume (L)	16.7
Standpipe height (m above gl)	0.6		

Interface probe used?	YES
Depth to product (m BRP)	
Depth to water (m BRP)	1.467
Thickness of product (m BRP)	

BRP - Below Reference Point

PURGING RECORD AND FIELD PARAMETER MEASUREMENTS

Time Start hr: min	**10:00**								
Volume Purged (L) (discrete*)	Time (min) (accume*)	Time (seconds)	Rate, L/min	Depth to WL, m	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)	Redox Potential (mV)
10	5	19	1.88	2.79	19.4	8.54	7.15	109.6	129
10	14	0	1.15	3.30	20.2	2.62	7.00	93.10	111
10	24	10	0.98	2.83	20.2	3.27	6.93	113.00	9
10	34	20	0.98	2.88	20.6	4.04	6.89	114.70	1
8	42	11	1.02	3.36	20.7	3.46	6.87	116.3	-7

Total volume purged (L)	48	**No. bore volumes purged**	2.9

Time Finish hr:min	**10:42**

Water Quality Meter type: TDS 90FLMV **Water Dipper type:** Solist interface dipper

Pumping Method: Waterra Tubing with Submersible Pump and Regulator

SAMPLING RECORD

Minimum Water Level during Purging (m): 3.36

Rinsate sample taken BEFORE/AFTER this well? NO Rinsate ID:

Samples taken? YES Duplicate taken? NO Duplicate ID:

Time between sampling & purging: none

Water level prior to sampling (m): 3.36

Samples filtered? YES for metals? Filter method: 0.45 mm filter

Container:	**Preservation:**
Vial ☐	HCl
1l Plastic ☑ 1	none
500ml Plastic ☑ 1	none
250 ml Plastic ☑ 1	none
250ml / 500 ml / 1l Plastic / Glass ☐	none / other:

OBSERVATIONS

Samples: Colour: Brown Turbidity Low

Odour: none Sheen? No

Weather Conditions: *Sampling Day* Wind, overcast Temperature 15°C

Previous Week Temperature

Notes:

*Refer to "Groundwater Sampling Guidelines" VicEPA Publication 669 *discrete means to restart or batch the volumes and times (non accumulative)*

APPENDIX I

Summary of Groundwater Results

Table 1
Acid Sulphate Soil Investigation - Stage 2
Walker Corporation
Subdivision

Groundwater Results

ANALYTICAL RESULTS													
				Major Cations / Anions (mg/L)							Metals (mg/L)	
Sample Number	Sample Date	Laboratory Used	pH	Hydroxide as CaCO3	Carbonate as CaCO3	Bicarbonate as CaCO3	Total Alkalinity as CaCO3	Acidity as CaCO3	Sulphate	Chloride	Aluminium	Iron
W6	16/07/2008	ALS	-	<1	<1	287	287	79	7290	41100	<0.10	<0.50
W7	16/07/2008	ALS	-	<1	<1	229	229	56	6880	45200	<0.10	1.93
GW11	16/07/2008	ALS	-	<1	<1	736	736	28	1530	7430	<0.01	<0.05
SW01	16/07/2008	ALS	6.79	-	-	-	-	-	-	-	-	-
ASSESSMENT CRITERIA / GUIDELINES												
EPP (WQ) 2003 criteria for Drinking water 'Potable' (mg/L)			6.5 - 8.5	-	-	-	-	-	500	250^	0.2^	0.3^
EPP (WQ) 2003 criteria for aquatic ecosystems 'Marine Water' (mg/L)			-	-	-	-	-	-	-	-	-	-
EPP (WQ) 2003 criteria for aquatic ecosystems 'Freshwater' (mg/L)			6.5 - 9	-	-	-	-	-	-	-	0.1	1
EPP (WQ) 2003 criteria for agriculture ' stockwatering' (mg/L)			-	-	-	-	-	-	-	-	5	-
EPP (WQ) 2003 criteria for agriculture ' Irrigation' (mg/L)			4.5 - 9	-	-	-	-	-	-	30 - 700 ^	1	1

Duplicate Sample

GW11	16/07/2008	ALS	-	<1	<1	287	287	79	7290	41100	<0.10	<0.50
BD1	16/07/2008	ALS	-	<1	<1	287	287	84	7160	44800	<0.10	<0.50
		RPD%	n/a	n/a	n/a	0.0	0.0	6.1	1.8	8.6	n/a	n/a

Prepared by	SY	Date	5/08/2008
Checked by		Date	

Notes:

1. '-' represents sample not analysed / no published criteria or guideline
2. NEPM = National Environment Protection (Assessment of Site Contamination) Measure, 1999 GIL = Groundwater investigation level
3. Where result is less than the reporting limit, half the reporting limit has been adopted for statistical purposes
4. Where result is less than the reporting limit, the result has been italicised
5. EPP criteria for Potable (ug/L), Marine Water (ug/L), Freshwater (ug/L) and Agriculture - Irrigation (ug/L) have been adopted as the primary assessment criteria
6. ^ NEPM GIL for Drinking Water (ug/L), Marine Water (ug/L), Freshwater (ug/L) and Agricultural - Irrigation (ug/L) have been adopted as the secondaty assessment criteria
7. ^^ NEPM GILs for potable 'drinking water' (ug/L) have been adopted for individual pesticides
8. # Dutch Intervention Guidelines for Freshwater (ug/L) and Marine Water (ug/L) have been adopted as the tertiary assessment criteriaused for Total Petroleum Hydrocarbons are the Dutch Intervention Values, 2000
9. ## Dutch Intervention Guidelines for freshwater (ug/L) have been adopted for individual pesticides
10. ### Dutch Intervention Guidelines for freshwater (ug/L) have been adopted for individual chlorinated hydrocarbons
11. Results are in ug/L unless otherwise specified, i.e. major cations and anions mg/L

APPENDIX J

Limitations LEG04

LIMITATIONS

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