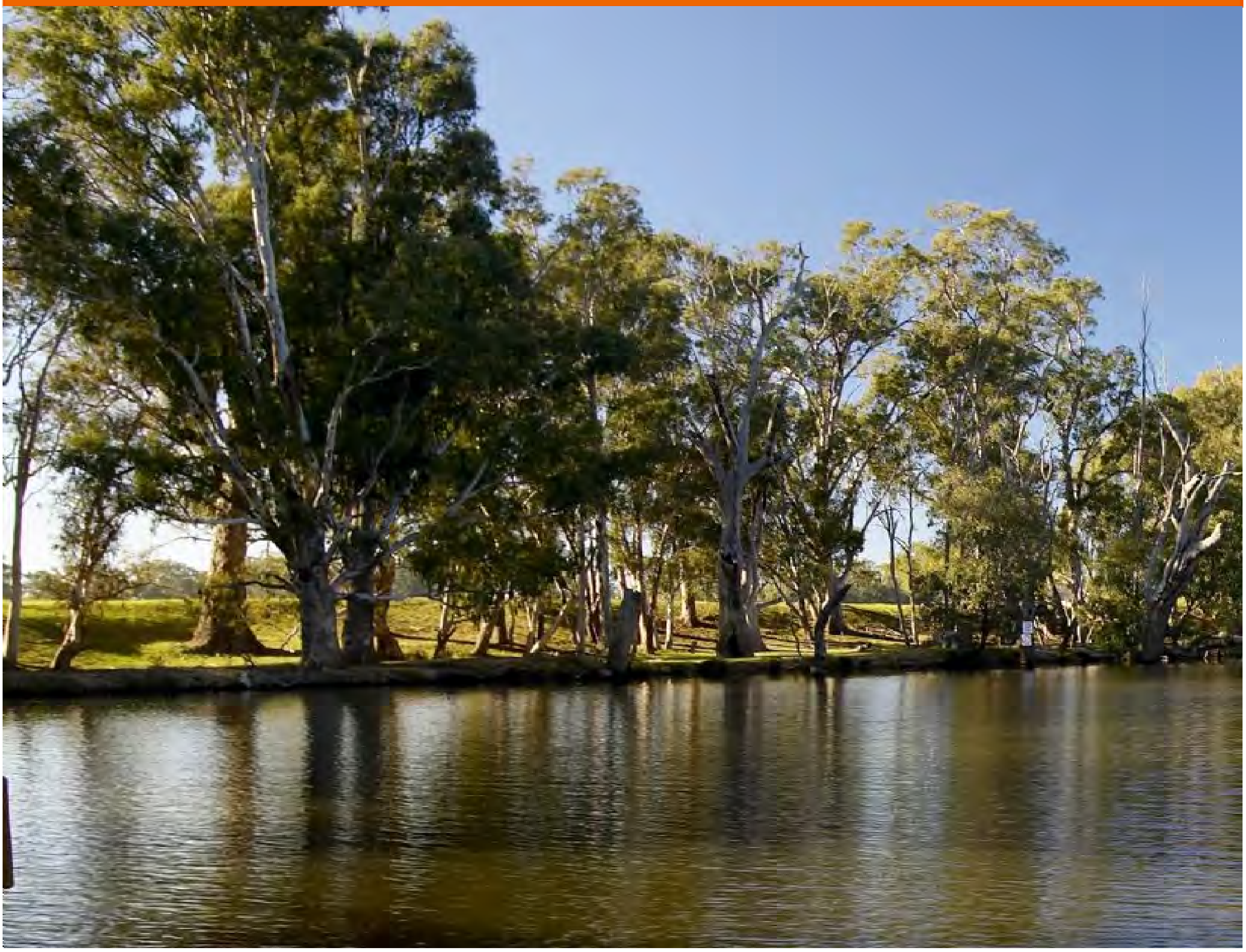
APPENDIX K

ACID SULPHATE INVESTIGATION AND SOIL MANAGEMENT PLAN

IRON GATES RESIDENTIAL DEVELOPMENT

Acid Sulfate Investigation and Soil Management Plan

08 JULY 2019



Incorporating

GOLD CORAL PTY LTD
IRON GATES RESIDENTIAL DEVELOPMENT

Acid Sulfate Investigation and Soil Management Plan

Author	Gerard Dick	
Checker	Simon Groth	
Approver	Lachlan Prizeman	

Report No F0003-10027302-AAR
Date 8/07/2019
Revision 01

This report has been prepared for Gold Coral Pty Ltd in accordance with the terms and conditions of appointment for Vantage, Evans Head dated March 2019. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	08/07/2019	Issued for Approval	GD	LP

CONTENTS

APPENDICES

APPENDIX A

GEOTECH INVESTIGATIONS (2015)

APPENDIX B

COFFEY PARTNERS INTERNATIONAL (1995)

APPENDIX C

DOUGLAS PARTNERS (1991)

1 INTRODUCTION

1.1 General Background

An Acid Sulphate Investigation and Soil Management Plan (ASI&SMP) is proposed for the construction of the proposed Iron Gates Residential development.

The ASI&SMP relates specifically to the construction of lot filling and installation of the proposed Sewer and Stormwater services at or below the natural surface level.

Initial investigations undertaken by Coffey Partners International (1995) and Geotech Investigations (2015) included a number Groundwater and Soil investigations, including 21 boreholes, and laboratory testing, both Reports recording the absence of any Actual or Potential Acid Sulfate Soils. Copies of the site Investigation Reports including the laboratory testing results are attached to this Report in the appendices.

As construction involves substantial filling and minimal disturbance of the existing soils on the site and given the absence of AASS or PASS soils recordered in the initial investigations, an Acid Sulphate Management Plan is not considered necessary.

The development site is mapped as Class 3 and Class 5 – Class 3 soils require a preliminary investigation where works greater than 1.0 m below ground level are proposed. The proposed development construction includes excavation and construction of sewer and stormwater services expected to be at a maximum depth of 1.5m.

Acid sulfate soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres of adjacent class 1,2,3 or 4 land. Works in a class 5 area that are likely to lower the water table below 1 metre AHD on adjacent class 1, 2, 3 or 4 land will trigger the requirement for assessment and may require management.

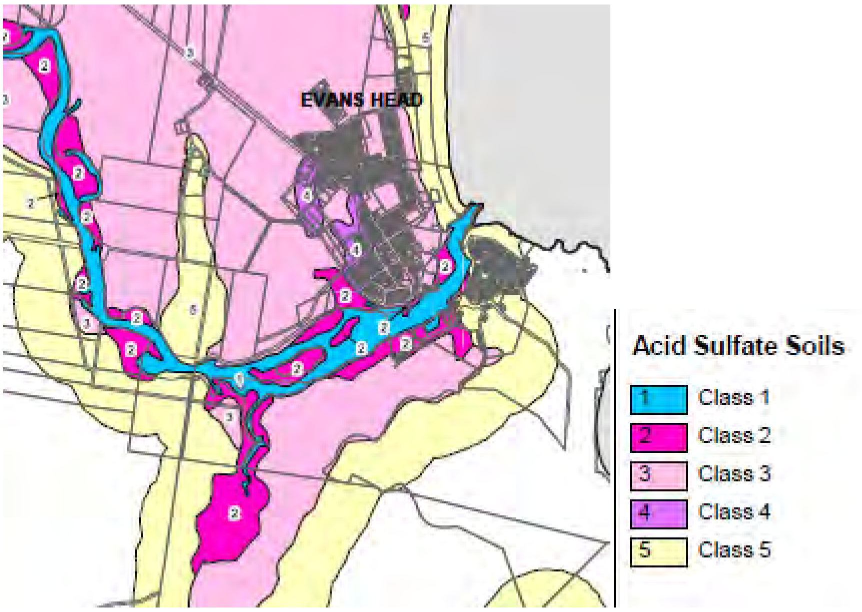


Figure 1: Richmond Valley Council Acid Sulfate Soil Mapping

This investigation and report is based on the Geotechnical, Groundwater and Acid Sulfate Assessment reports developed by Douglas Partners 1991; Coffey Geosciences Pty Ltd (Coffey) 1995; & Geotech Investigations Pty Ltd 2015 - with findings and results of laboratory testing forming the basis for this document herein.

The original site investigation carried out in 1991 by Douglas Partners included a report and laboratory testing of soil samples and identified:

The sandy soils were assessed for potential acid sulphate conditions. The completed laboratory tests indicate that at the sites indicated there is no evidence of (actual) acid sulphate material in any of the test pits. Further, field tests for pH decrease after oxidation in laboratory analysis for total sulphur (%) suggest that there are no potentially acid sulphate soils in any of the samples. These results should be representative of the survey area, according to Morse McVey & Associates. The soil analysis conclude that with respect to limitations imposed by the occurrence of acid sulphate materials, there is no reason why development should not proceed in this area. '

The Coffey Groundwater and Acid Sulfate Assessment 1995 also identified a general absence of Acid Sulfate Soils in the 23 borelog tests, this was confirmed by subsequent 5 laboratory testing results and are quoted in the extract below.

5.0 DISCUSSION

5.1 Acid Sulphate Soils

The field qualitative spot testing indicated a general absence or very low concentration of either ferrous monosulphide or pyrite in either the topsoil, sands above the water table or sands below the water table. This was confirmed by the laboratory testing which indicated nil acid sulphate potential and nil acid generating potential for all 5 samples submitted.

ANALYSIS OF SOIL SAMPLES
ACID SULPHATE POTENTIAL
IRON GATES ESTATE, EVANS HEAD
JOB NO. NR865/2

Date Collected: Not Specified
Date Received: 13.12.94
Date Analysed: 13.12.94 - 09.01.95

Sampled By: Client
Sampling Method: Not Specified

SAMPLE REGD. NO.	ANALYSIS S & B METHOD NO.	INITIAL pH (1:5) G090.	pH AFTER H_2O_2 OXID'N G090.	INITIAL SO_4 SC280.4 mg/kg	SO_4 AFTER OXID'N SC280.4 mg/kg	PYRITE S %	$CaCO_3$ SC015. %	ACID SULPHATE POTENTIAL SC120. *	ACID GENERATING POTENTIAL **
97297	50M 1.0 - 2.0 CB 944478	5.4	5.6	10.	150.	<0.01	<0.2	NIL	NIL
97298	150M 0.7 - 1.5 CB 944479	5.1	6.0	5.	125.	<0.01	<0.2	NIL	NIL
97299	250M 1.0 - 2.0 CB 944480	5.5	5.2	<5.	75.	<0.01	<0.2	NIL	NIL
97300	350M 1.0 - 2.0 CB 944481	5.6	5.2	<5.	75.	<0.01	<0.2	NIL	NIL
97301	465M 0.3 - 1.0 CB 944482	5.4	5.0	10.	125.	<0.01	<0.2	NIL	NIL

* Qualitative assessment based solely on % pyrite - not subject to NATA certification.
** Qualitative assessment based on % pyrite, % $CaCO_3$ and pH after oxidation - not subject to NATA certification.

This Laboratory is registered by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with its terms of registration. This document shall not be reproduced except in full.

SIMMONDS & BRISTOW PTY LTD

PER C. Graham

1.2 Soil Management Plan - Environmental Objectives

As field and laboratory testing by Coffey has indicated low acid generating potential, not actual or potential acid sulfate soil (ASS), specific management measures are not considered necessary for ASS. However, some non sulphuric actual acidity may be present in soils on site, therefore a Site Specific Soil Management Plan and measures will be adopted to deal with "incidental" acid generation where base materials are excavated, drained or dewatered for periods of greater than 24 hours during construction.

The specific environmental objectives of this Site Specific Soil Management plan are to:

- To prevent acid leachate to groundwater resources;
- To prevent acidification of storm water; and
- To prevent acidification of adjacent surface waters.

1.3 Scope of work

Development of a Site Specific Soil Management plan (SMP) having regard to the following:

- New South Wales Acid Sulfate Soils, 2002;
- Review of results identified within the investigation being Coffey Partners International Pty Ltd (Coffey) Geotechnical and Acid Sulfate Assessment report – dated 12th January 1995; and
- Development of a site specific SMP in recognition of the Richmond Valley Local Environmental Plan 2012 – Clause 6.1 for submission and approval to council prior to the commencement of works onsite.

1.4 Site Description & Location

The proposed development is at the Vantage development at Evans Heads. The property description is Lot 276 DP 755624, Lot 277 DP 755624 and Lot 163 on DP831052. The site is bounded by the Evans River and adjoining SEPP 14 Wetlands at the Western end of Irongates road and lies opposite the Bundjalung National Park on the southern shores of the Evans River.

2 NEW SOUTH WALES LEGISLATION & REFERENCES

To following New South Wales Legislation and references were used in preparation for the development of this report:

- New South Wales Acid Sulfate Soils Manual ;
- Richmond Valley Local Environmental Plan 2012 – Clause 6.1 Acid Sulfate Soils, 2012;
- Instructions for the Treatment and Management of Acid Sulfate Soils, EPA 200; and
- QASSIT Guidelines.

3 SOIL MANAGEMENT PLAN

3.1 Sensitive Receivers

Environmental Receivers

The most sensitive environmental receiver is the surface water, which eventually flows to Evans River to then enter the South Pacific Ocean.

Site Personnel

Potential health impacts have been considered as a minor risk for site personnel working closely with excavation and filling activities. Appropriate personnel protective equipment (PPE) (gloves, safety glasses, hard hat, long sleeves and trousers) must be worn at all times.

Surrounding Community and Stakeholders

The surrounding land uses are predominantly residential sections of the Town of Evans Heads approximately 1.2km downstream from the site, Coastal SEPP Wetlands to the East of the site , and the Bundjalung National Park on the southern side of the Evans River.

3.2 Operational Controls

Earthworks / Filling

Prior to the placement of filling earthworks it is recommended that additional ASS testing be carried out to determine whether it is necessary for a guard layer of fine agricultural lime equivalent to 10kg lime per square meter per meter depth of fill be spread over fill areas prior to the placement of any imported fill or soils from the excavation. Liming of the surface of the fill at the rate of 5 kg per square meter and incorporating to a depth of 300 mm may also be recommended following site filling.

Should any potential acid soil (PAS) materials be excavated during construction exposure shall be minimised and contained in an adequately bunded containment area for treatment with lime as required.

Surface water infiltration to groundwater shall be prevented from passing through PAS. Where required lime material shall be placed to intercept infiltration.

Any acid leachate detected during excavation, and earthworks shall be treated by liming at required doses prior to disposal or use on site as engineered fill.

As the proposed development will affect soils below 5m AHD and involves either:

a) The excavation of 100m3 or more of soil or sediment; or

b) The filling of land involving 500m3 or more of material with an average depth of 0.5m or greater,

The following conditions in relation to acid sulphate soil investigation, management plan preparation and submission of documents to council must be complied with.

Water Usage – construction management

The use of potable water will not be available for use in activities associated with road and pavement construction, the compaction of fill material or dust suppression. The use of recycled water is encouraged, especially where other alternative sources do not exist. Where recycled water is proposed to be used:

c) The use of the recycled water must be in accordance with any requirements of a developed Recycled Water Safety Plan, which sets out the requirements for transport and use of recycled water;

d) The contractor must first complete a recycled water training course, in accordance with the Safety plan. Proof of completion of the training course will be by issue of a valid certification card;

e) The applicant can only contract to use a recycled water carrier who is accredited and certified by Richmond Valley Council. Accreditation requires current authorised agreement between the water carrier and Richmond Valley; and

f) The water carrier is only allowed to employ certified tanker operator/drivers, who have completed the recycled-water training course and hold a valid certification card.

Dewatering

Dewatering activities during site filling and trench excavations shall be undertaken in a controlled manner to prevent acid leachate to waterways, and in accordance with the approved Dewatering Management Plan

Verification Testing

Acid Sulphate Soil Assessments by Coffey Partners concluded that soils on site are not actual or potential acid sulphate soils. The results indicate non sulphuric actual acidity may be present within soils onsite and as such general duty of care requires the managing of proposed earthworks.

Verification testing must follow the performance criteria attained for soil that has been treated for neutralisation as stated in Soil Management Guidelines as follows:

1 The neutralising capacity of the treated soil must exceed the existing plus potential acidity of the soil; and

- Post neutralisation, the soil pH is to be greater than 6.5; and

- Excess neutralising agent should remain within the soil until all acid generation reactions are complete and the soil has no further capacity to generate acid.

- The SPOCAS suite or “Chromium” suite is required for the verification testing at a rate of one test per 500 cubic metres.

2 If necessary all treatment of excavated soils shall be within a bunded area of the site filling area prior to final placement.

4 RESPONSIBILITIES

It will be the responsibility of the Site Project Engineer / Construction manager to ensure all site personnel are informed regarding the potential for PAS on site. All site personnel are expected to complete risk awareness training and or induction prior to arriving on site.

5 REPORTING & MONITORING

5.1 Performance Indicators

The pH of waters collected on-site shall be maintained between 6.5 and 8.5.

5.2 Monitoring

Visual Monitoring

At all times visual monitoring should be undertaken to check for signs of contamination, such as:

- Unexplained scalding, degradation or death of vegetation;
- Formation of the mineral jarosite and other acidic salts in exposed or excavated soils;
- Areas of green-blue or extremely clear water indicating high aluminium concentrations;
- A transition to, or an establishment of, a community dominated by acid tolerant species;
- Rust coloured deposits on plants and on the banks of drains; water bodies and watercourses indicating iron precipitates;
- Corrosion of concrete and/or steel structures in contact with soil or water; and
- Black to very coloured waters indicating de-oxygenation;
- Sulfurous smell (rotten egg gas).

Water Quality Monitoring

The water quality monitoring programme is to be undertaken by the principal consultant for pre-construction, during construction and post-construction activities. The principal consultant is responsible for performing and reporting on water quality in accordance with a Construction Site Based Management Plan (CSBMP) developed prior to construction.

Surface and stormwater runoff discharged from the site shall be monitored at discharge locations for pH, salinity, dissolved oxygen, suspended solids, temperature, iron, aluminium, total phosphorus and total nitrogen. All waters discharged are to meet the performance criteria and the environmental values and water quality objectives published within the ANZECC Water Quality Guidelines 2006.

Groundwater resources potentially affected by construction activities shall be monitored for pH, salinity, dissolved oxygen, temperature, iron, aluminium, total phosphorus and total nitrogen.

5.3 Corrective Actions

Non-conformance with this plan shall be documented and a corrective action request (CAR) issued. All CAR's shall be included in the non-conformance register.

Should a decline in water quality be observed, corrective action shall be undertaken in consultation with Council.

5.4 Reporting

The Contractor shall document any encounter of Potential and Actual ASS and report any such occurrence to the Proponent.

During construction, monthly reports are to be prepared on the water quality monitoring carried out. The reports are to include all test results and a summary of the findings for the period. The reports are to be submitted to council.

Quarterly water quality reports after completion of the development will be prepared and submitted to council for a six month period.

APPENDIX A

GEOTECH INVESTIGATIONS (2015)

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-a
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P1

Location	N: 6778265 E: 540560	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, grey brown 0.5 m (SP) SAND: Fine sand, dry, pale grey 2.2 m (SP) SAND: Fine sand, wet, pale grey T.D. 3 m	
Water Table (estimated based on drilling)	2.2 m BSL	
Field Test Results	K_{sat} = 13.7 m/day = 572 mm/hr	K = 1.6 x 10^{-4} m/s
Test Hole Depth	1.1 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-b
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P2

Location	N: 6778474 E: 540581	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, grey brown 0.5 m (SP) SAND: Fine sand, moist, pale grey 1.4 m (SP) SAND: Trace silt, fine sand, moist, dark brown 1.6 m (SP) SAND: Trace silt, fine sand, moist, dark grey T.D. 3 m	
Water Table (estimated based on drilling)	Not identified	
Field Test Results	K_{sat} = 89.5 m/day = 3728 mm/hr	K = 1 x 10^{-3} m/s
Test Hole Depth	0.6 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-c
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P3

Location	N: 6778597 E: 540503	
Test Date	25/05/2015	
Soil Description	0 m (SP) SAND: With silt, fine sand, moist, grey 0.3 m (SM) Silty SAND: Fine sand, moist, dark brown 0.6 m (SP) SAND: Trace silt, fine sand, wet, pale grey 1.4 m (SP) SAND: Trace silt, fine sand, wet, dark brown T.D. 3 m	
Water Table (estimated based on drilling)	0.6 m BSL	
Field Test Results	K_{sat} = 16.8 m/day = 698 mm/hr	K = 1.9×10^{-4} m/s
Test Hole Depth	0.17 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

GEOTECH INVESTIGATIONS PTY LTD
ABN 81154555478
ACN 154555478
P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-d
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P4

Location	N: 6778425 E: 540493	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine to medium sand, moist, dark brown 0.7 m (SP) SAND: Trace silt, fine sand, moist, pale grey 1.7 m (SP) SAND: Trace silt, fine sand, wet, pale grey 2.0 m (SP) SAND: Trace silt, fine sand, wet, grey brown T.D. 3 m	
Water Table (estimated based on drilling)	1.7 m BSL	
Field Test Results	K_{sat} = 27.0 m/day = 1128 mm/hr	K = 3.1 x 10^{-4} m/s
Test Hole Depth	0.77 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-e
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P5

Location	N: 6778333 E: 540483	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, dark brown 0.6 m (SP) SAND: Trace silt, fine sand, dry, pale grey 1.4 m (SP) SAND: Trace silt, fine sand, moist to wet, pale grey 2.4 m (SP) SAND: Trace silt, fine sand, wet, grey brown T.D. 3 m	
Water Table (estimated based on drilling)	1.5 m BSL	
Field Test Results	K_{sat} = 4.2 m/day = 176 mm/hr	K = 4.9 x 10^{-5} m/s
Test Hole Depth	1.1 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech Investigations Pty Ltd

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-f
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P6

Location	N: 6778091 E: 540285	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, dark grey 0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey 0.8 m (SM) Silty SAND: Fine sand, moist, dark orange brown 1.2 m (SM) Silty SAND: Fine sand, moist, grey brown mottled orange brown 2.7 m (SM) Silty SAND: Fine sand, wet, grey brown mottled orange brown T.D. 3 m	
Water Table	2.7 m BSL	
Field Test Results	K_{sat} = 2.2 m/day = 91 mm/hr	K = 2.5 x 10^{-5} m/s
Test Hole Depth	1.1 m BSL	
Indicative Drainage Class	'well drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech Investigations Pty Ltd
ABN 81154555478
ACN 154555478
P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-g
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P7

Location	N: 6778447 E: 540402	
Test Date	25/05/2015	
Soil Description	0 m (SP) SAND: With silt, fine to medium sand, moist, grey brown 0.2 m (SP) SAND: Trace silt, fine sand, moist, pale grey 0.7 m (SM) Silty SAND: Trace clay, fine sand, wet, orange brown 1.1 m (SP) SAND: Trace silt, fine sand, wet, dark brown T.D. 3 m	
Water Table (estimated based on drilling)	0.7 m BSL	
Field Test Results	K_{sat} = 7.2 m/day = 300 mm/hr	K = 8.3 x 10^{-5} m/s
Test Hole Depth	0.87 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

OFFICE LOCATION
Unit 3 / 42 Machinery Drive
Tweed Heads South NSW 2486

www.geotechinvestigations.com

POSTAL ADDRESS
PO Box 6885
Tweed Heads South NSW 2486

Geotech Investigations PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-h
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P8

Location	N: 6778560 E: 540397	
Test Date	25/05/2015	
Soil Description	0 m (SP) SAND: Trace silt, fine sand, moist, brown 0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey 1.2 m (SP) SAND: Trace silt, fine sand, wet, pale grey 1.4 m (SM) Silty SAND: Fine sand, wet, dark brown 1.9 m (SP) SAND: Trace silt, fine sand, wet, dark grey / brown T.D. 3 m	
Water Table (estimated based on drilling)	0.6 m BSL	
Field Test Results	K_{sat} = 2.6 m/day = 109 mm/hr	K = 3.0 x 10^{-5} m/s
Test Hole Depth	0.07 m BSL	
Indicative Drainage Class	'well drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

<u>**James Walle**</u> *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

ABN 81154555478
ACN 154555478
P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-i
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P9

Location	N: 6778502 E: 540329	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine to medium sand, moist, dark grey 0.5 m (SP) SAND: Trace silt, fine sand, moist, pale grey 1.8 m (SM) Silty SAND: With clay, fine sand, wet, dark brown 2.0 m (SM) Silty SAND: Fine sand, wet, dark brown mottled orange brown 2.5 m (SP) SAND: Trace silt, fine sand, wet, dark brown T.D. 3 m	
Water Table (estimated based on drilling)	0.5 m BSL	
Field Test Results	K_{sat} = 18.6 m/day = 775 mm/hr	K = 2.2 x 10^{-4} m/s
Test Hole Depth	0.07 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

DRILLING ENVIRONMENTAL GEOTECHNICAL

PLAN OF SUBDIVISION

IRON GATES, EVANS HEAD

LOT	AREA	LOT	AREA	LOT	AREA
01	958.54m²	74	601.67m²	147	623.04m²
02	609.58m²	75	602.27m²	148	623.04m²
03	610.02m²	76	602.86m²	149	623.04m²
04	610.48m²	77	611.90m²	150	623.04m²
05	610.80m²	78	601.02m²	151	623.04m²
06	611.13m²	79	645.62m²	152	701.77m²
07	611.45m²	80	642.13m²	153	703.42m²
08	611.78m²	81	602.42m²	154	611.15m²
09	612.10m²	82	602.31m²	155	611.15m²
10	612.43m²	83	602.20m²	156	611.15m²
11	612.75m²	84	854.34m²	157	611.15m²
12	612.98m²	85	854.15m²	158	611.15m²
13	611.49m²	86	601.23m²	159	611.29m²
14	613.85m²	87	601.27m²	160	720.75m²
15	614.18m²	88	951.69m²	161	753.34m²
16	614.50m²	89	794.12m²	162	633.95m²
17	614.82m²	90	601.19m²	163	602.77m²
18	615.14m²	91	601.15m²	164	707.28m²
19	615.47m²	92	601.11m²	165	649.98m²
20	615.80m²	93	601.06m²	166	661.66m²
21	653.44m²	94	601.03m²	167	686.92m²
22	639.06m²	95	600.07m²	168	640.98m²
23	600.87m²	96	665.25m²	169	621.28m²
24	601.48m²	97	617.23m²	170	845.54m²
25	601.78m²	98	605.72m²	171	829.97m²
26	602.07m²	99	609.16m²	172	600.73m²
27	602.37m²	100	613.10m²	173	600.73m²
28	602.67m²	101	606.61m²	174	601.88m²
29	602.97m²	102	600.24m²	175	600.94m²
30	603.27m²	103	600.05m²	176	618.69m²
31	603.56m²	104	603.86m²		
32	603.87m²	105	606.12m²		
33	611.56m²	106	604.88m²		
34	602.69m²	107	644.68m²		
35	687.98m²	108	604.83m²		
36	744.04m²	109	603.24m²		
37	601.47m²	110	608.18m²		
38	601.47m²	111	606.58m²		
39	601.47m²	112	608.28m²		
40	601.47m²	113	736.06m²		
41	601.47m²	114	720.51m²		
42	601.47m²	115	1029.27m²		
43	601.47m²	116	602.49m²		
44	601.47m²	117	609.57m²		
45	601.47m²	118	607.83m²		
46	601.84m²	119	651.61m²		
47	600.97m²	120	603.93m²		
48	602.78m²	121	603.27m²		
49	601.06m²	122	604.77m²		
50	600.70m²	123	613.74m²		
51	604.45m²	124	602.29m²		
52	604.30m²	125	628.60m²		
53	604.17m²	126	603.18m²		
54	604.11m²	127	690.16m²		
55	603.12m²	128	601.05m²		
56	601.74m²	129	606.82m²		
57	600.79m²	130	632.34m²		
58	833.34m²	131	609.67m²		
59	783.87m²	132	606.00m²		
60	674.25m²	133	601.02m²		
61	612.30m²	134	600.03m²		
62	605.75m²	135	600.92m²		
63	604.82m²	136	600.85m²		
64	603.90m²	137	600.91m²		
65	602.98m²	138	639.85m²		
66	602.05m²	139	655.96m²		
67	601.13m²	140	795.02m²		
68	600.20m²	141	897.95m²		
69	603.67m²	142	603.25m²		
70	620.23m²	143	636.28m²		
71	603.10m²	144	722.96m²		
72	600.46m²	145	620.19m²		
73	601.06m²	146	623.04m²		

PLANIT CONSULTING

PROJECT TITLE: IRON GATES DEVELOPMENT, EVANS HEAD

DRAWING TITLE: PLAN OF SUBDIVISION - OPTION 7

BASE PROVIDED BY: N/A

CLIENT: GOLD CORAL

NO	DATE	REVISION	BY
-	-	-	-

SCALE: 1/1500 @ A1

DESIGN: PLANIT CONSULTING

DRAWN: ZP

DATE: 03/2015

CHECKED: AS

DRAWING NO: IRONGATES_PLNOFSUB_01

NORTH POINT:

SHEET NO: 01 OF 01

Level 1 2247 Gold Coast Hwy
Nobby Beach
PO Box 206 QLD 4218
Telephone: 07 5526 1500
Fax: 07 5526 1502
Email: admin@planitconsulting.com.au

APPENDIX B

COFFEY PARTNERS INTERNATIONAL (1995)

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources

COFFEY

530 Fairlawn Street
Nathan QLD 4111

PO Box 100
Salisbury QLD 4107
Australia

Fax (07) 274 4977
Telephone (07) 274 4411

Your Reference

Our Reference NR865/2-B GHD

Date 12th January, 1995

W P Brown & Partners Pty Ltd
PO Box 6527
UPPER MT GRAVATT QLD 4122

Attention: Mr Gary Spence

Dear Sir,

RE IRON GATES ESTATE - STAGE 1A
INVESTIGATION OF PROPOSED OPEN DRAIN

Please find enclosed our report on the geotechnical investigation for a proposed drain at the Iron Gates Estate. The investigation was carried out in general accordance with our proposal NRP294/17-A dated 21st November, 1994.

Should you have any queries regarding the contents of this report, please contact Geoff Drew or the undersigned at our Brisbane office.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

Philip Shaw

P.SHAW

TABLE OF CONTENTS

1.0 INTRODUCTION

It is proposed that an open drain be constructed adjoining the Iron Gates Estate Stage 1A development. Coffey Partners International Pty Ltd was commissioned verbally by Mr.Gary Spence of W.P.Brown & Partners Pty Ltd to perform an investigation of the subsurface conditions along the drain alignment. This report contains details of the field investigation and the laboratory chemical and geotechnical testing. Comment is provided on the impact of the proposed drain on a nearby wetland area and the possibility that acid sulphate soils will be exposed during excavation.

2.0 FIELD INVESTIGATION

A total of 9 holes was drilled using hand held (sand) auger equipment on 6th & 7th December, 1994. The holes were advanced to depths of 2m below the existing ground surface at 50m intervals along the alignment of Open Drain No.1, beginning at approximately ch.50m. Samples were taken for laboratory testing for acid sulphate soils and for particle size distribution analysis, and standing water levels (SWL) were measured.

Qualitative spot tests for the presence of either ferrous monosulphide or pyrite were performed at each drilling location in the surface layer and in the soils above and below the water table. Engineering logs of the boreholes along with explanation sheets describing the terms and symbols used are presented in Appendix A.

3.0 SITE DESCRIPTION

The site of the proposed drain is a generally flat sandy area with variable tree and grass cover. The ground surface along the alignment has a maximum elevation of about RL3.0m over most of the alignment and, at the end of the alignment, falls from an elevation of RL2.3m to the banks of the Evans River over a distance of 20m. The area comprises beach or coastal dune sands. The estate layout drawings show the proposed drain running from a point close to an area of wetlands directly to the Evans River.

The wetlands are swampy with large areas of surface water, thick weed growth and paperbark trees. Organic clays are reported to occur at approximately 300mm below the surface sands, but their thickness is not known. The topographic mapping of the area shows an elongated feature with a surface elevation a little below the RL2m contour trending south from the Open Space. Surface water within this depression may be either perched on the organic clay layer, or be a 'window' to the water table, or a combination of both in the case of a discontinuous organic clay layer.

4.0 LABORATORY TESTING

4.1 Acid Sulphate

The qualitative spot tests for the presence of acid sulphates all indicated nil to very low concentrations. Three samples from below the water table and two samples from above the water table were submitted for quantitative acid sulphate testing. Summary results of the laboratory testing are set out in Table 1 below, with laboratory test reports in Appendix C.

TABLE 1
Summary of Acid Sulphate Testing

Chainage	Depth (m)	pH		SO_4 (mg/kg)	
		initial	after oxidation	initial	after oxidation
50m	1.0 - 2.0	5.4	5.6	10	150
100m	0.7 - 1.5	5.1	6.0	5	125
250m	1.0 - 2.0	5.5	5.2	<5	75
350m	1.0 - 2.0	5.6	5.2	<5	75
465m	0.3 -1.0	5.4	5.0	10	125

Note: Pyrite S concentrations all <0.01%. $CaCO_3$ concentrations all <0.2%.

4.2 Particle Size Distribution

Field description of the sands gives a grain size in the fine to medium grained range. Laboratory testing indicates less than 5% passing 0.075mm and 98% passing 0.425mm sieves. Laboratory test results can are reported in Appendix B. Coefficient of Uniformity is less than 2, indicating high porosity.

A
E
C
D
E
F
G
H
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

5.0 DISCUSSION

5.1 Acid Sulphate Soils

The field qualitative spot testing indicated a general absence or very low concentration of either ferrous monosulphide or pyrite in either the topsoil, sands above the water table or sands below the water table. This was confirmed by the laboratory testing which indicated nil acid sulphate potential and nil acid generating potential for all 5 samples submitted.

5.2 Groundwater Movement

On the basis of the SWLs measured during the field investigation, a gradient averaging about 1:200 currently exists towards the river from ch.250m with a negligible gradient from ch.250m to ch.465m and an apparent slight mounding at about ch.250m. The water table is of the order of 1m below ground surface over most of the proposed drain alignment so can be said to roughly follow the ground surface contours, as is to be expected under phreatic conditions. Standing water levels in BH1 and BH2 drilled in August 1994 were 0.6m below a ground surface level which is assessed at about RL2.3m from contours on supplied plans. This indicates that the water table beyond the end of the proposed drain is relatively constant at about RL 1.75m which corresponds to the inferred free water surface level in the wetlands.

An estimated permeability (K) of between $3x10^{-3}$cm/sec (2.5m/day) and $4.5x10^{-3}$cm/sec (4.0m/day) can be inferred from the particle size characteristics of the sands. Specific Yield is estimated at 0.33. With this permeability and gradient, a steady regional groundwater flow would already be established towards the river, the flow being maintained by both direct infiltration of rainwater and leakage of some surface water from the wetlands area. The proportion of the existing flow attributable to the wetlands source would depend on the permeability and thickness of the organic clay layers underlying the wetlands. Total throughflow rates would vary with water table fluctuations resulting from changes in the availability of recharge, especially that deriving from direct infiltration of rainfall.

Design drawings show that the open drain will be excavated to a depth of about 1m below the water table. The effect of this excavation will be a localised lowering of the water table due to the creation of a new line of discharge. Homogeneous fine grained unconfined aquifers of the type encountered here are known to exhibit delayed drainage with the result that the lowering of water table will be gradual and, in the short term, of limited extent. Long term expansion of the zone of influence of the drain is likely to occur only during long periods without recharge. Other factors, such as evaporation and transpiration could then prove to be of greater importance to the wetlands than any induced drawdowns.

Estimations of drawdown at distances from the drain have been made using methods for estimating flow of groundwater to galleries (Huisman after Edelman). Assumptions made for these calculations are; 1 year (365 days) without recharge, instantaneous drawdown at the gallery of 1m, and aquifer thickness of 1.75m.

TABLE 2
Distance-Drawdown Estimations

Distance from Drain Centreline (m)	Drawdown (m) at	
	K=3.8m/day	K=2.5m/day
20	0.87	0.84
30	0.81	0.76
40	0.74	0.68
50	0.68	0.61
60	0.62	0.54
80	0.51	0.42
100	0.41	0.31

Significantly lower calculated drawdowns at distance from the drain are obtained by reducing the time without recharge (rainfall). Reducing the period without recharge to 100 days (3 months) results in drawdowns at 100m of 0.12m and 0.05m for permeabilities of 3.8 and 2.5m/day respectively.

The organic clay layer noted in the wetlands area was not present at a similar level along the proposed drain, so it can be inferred that it is specific to the wetland area. In this case, there is a high probability that the much lower permeability of the organic clay layer will tend to isolate the wetlands from the drawdowns induced by the drain excavation. Even if the isolating effect of the organic clays is less than expected it is likely that any loss of water to the proposed drain would be replaced by groundwater flow from other directions.

A E C D E F G H I J K L M N O P Q R S T U V W X Y Z

0574

Any potential impact of the drain on the area could be reduced if it was possible to modify the overall estate drainage design to allow the invert level of the drain to be raised so that it is closer to the present water table. As the drawdowns were calculated on the basis of a 1m lowering of water level at the drain, proportional adjustments can be made for any alteration in the depth of excavation below the water table. Flow to the drain given the assumptions described above is estimated to be of the order of 0.04m^3/day per metre length of excavation after 1 year without significant rainfall recharge.

Philip Shaw

For and on behalf of

COFFEY PARTNERS INTERNATIONAL PTY LTD

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration, the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations.

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report:

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one.
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed.

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts. Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

APPENDIX A

APPENDIX A

APPENDIX A

ENGINEERING LOGS OF BOREHOLES

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

descriptive terms soil and rock

COFFEY

Explanation Sheet 1

SOIL DESCRIPTIONS

Classification of Material based on Unified Classification System (refer SAA Site Investigation Code AS1726–1975 Add. No. 1 Table D1).

Moisture Condition based on appearance of soil

dry — Looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through hands.

moist — Soil feels cool, darkened in colour; cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hands on remoulding.

wet — Soil feels cool, darkened in colour; cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.

Consistency based on unconfined compressive strength (Qu) (generally estimated or measured by hand penetrometer).

term	very soft	soft	firm	stiff	very stiff	hard
Qu kPa	25	50	100	200	400	

If soil crumbles on test without meaningful result, it is described as **friable**.

Density Index (generally estimated or based on penetrometer results).

term	very loose	loose	medium dense	dense	very dense
density index I_D %	15	35	65	85	

ROCK DESCRIPTIONS

Weathering based on visual assessment

term	criterion
Fresh.	Rock substance unaffected by weathering.
Slightly Weathered.	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Moderately Weathered:	Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Highly Weathered:	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable.
Extremely Weathered:	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.

Strength based on point load strength index, corrected to 50 mm diameter - Is(50) (refer I.S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1). (Generally estimated; x indicates test result).

classification	extremely low	very low	low	medium	high	very high	extremely high
Is (50) MPa	0.03	0.1	0.3	1	3	10	

The unconfined compressive strength is typically about 20 x I_{S50} but the multiplier may range, for different rock types, from as low as 4 to as high as 30

Defect Spacing

classification	extremely close	very close	close	medium	wide	very wide	extremely wide
spacing m	0.03	0.1	0.3	1	3	10	

Defect description uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam (etc.) and character (roughness, extent, coating etc.).

SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass) [1]				GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
COARSE GRAINED SOILS (More than 50% of material less than 60 mm is larger than 0.06 mm; The 0.06 mm particle is about the smallest particle visible to the naked eye)	GRAVELS (More than half of coarse fraction is larger than 2.0 mm)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel - sand mixtures, little or no fines.	SYMBOL Give typical name, indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and strength of the coarse grains, colour, amount, plasticity of fine component. For undisturbed soils add information on moisture condition, degree of compactness, stratification, cementation, odour. Give local or geologic name and/ other pertinent descriptive information. Example: SM - Gravelly Silty SAND coarse to fine, pale brown, about 20% strong angular gravel particles - 10 mm maximum size, rounded and sub angular sand, about 15% non plastic fines, moist, dense, alluvial sand
			Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel - sand mixtures little or no fines	
		GRAVELS WITH FINES (Appreciable amount of fines)	Non plastic fines (for identification procedures see ML below)	GM	Silty gravels, poorly graded gravel - sand - silt mixtures	
			Plastic fines (for identification procedures see CL below)	GC	Clayey gravels, poorly graded gravel - sand - clay mixtures	
	SANDS (More than half of coarse fraction is smaller than 2.0 mm)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	SW	Well graded sands, gravelly sands, little or no fines.	
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines.	
		SANDS WITH FINES (Appreciable amount of fines)	Non plastic fines (for identification procedures see ML below)	SM	Silty sands, poorly graded sand - silt mixtures	
			Plastic fines (for identification procedures see CL below)	SC	Clayey sands, poorly graded sand - clay mixtures	

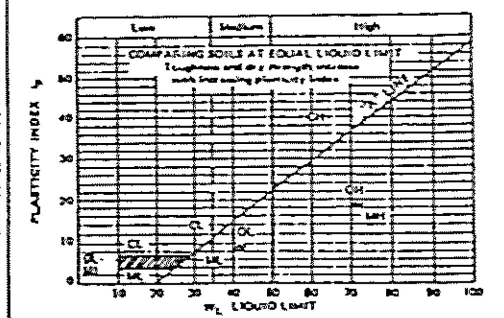
FINE GRAINED SOILS (More than 50% of material less than 60 mm is smaller than 0.06 mm)	IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 mm	DRY STRENGTH †	DILATANCY †	TOUGHNESS †	GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
	SILTS AND CLAYS (Liquid limit less than 50)	None to Low	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit. *	SYMBOL Give typical name, indicate degree and character of plasticity, colour, amount and size of coarse grains. For undisturbed soils add information on moisture condition, consistency, structure, stratification, odour. Give local or geologic name, and other pertinent descriptive information. Example: CL - Sandy CLAY of low plasticity pale grey and brown; Sand fine to medium, trace of fine gravel, dry, firm, numerous vertical root holes; (FILL).
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, * gravelly clays, sandy clays, silty clays.	
		Low to medium	Slow	Low	OL	Organic silts and organic silt - clays of low to medium plasticity. *	
	SILTS AND CLAYS (Liquid limit greater than 50)	Low to medium	Slow to none	Low to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit.	
		High to very high	None	High	CH	Inorganic clays of high plasticity. *	
		Medium to high	None to very slow	Low to medium	OH	Organic clays of high plasticity. *	
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	Peat and other highly organic soils.	

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION

LABORATORY CLASSIFICATION CRITERIA

Determine percentages of gravel and sand from grain size curve. Depending on percentage smaller than 0.06 mm size coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols.

$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3	
Not meeting all gradation requirements for GW		
Atterberg limits below "A" line or I_p less than 4.		Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
Atterberg limits above "A" line with I_p greater than 7		
$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3	
Not meeting all gradation requirements for SW		
Atterberg limits below "A" line or I_p less than 4		Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols.
Atterberg limits above "A" line with I_p greater than 7.		



PLASTICITY CHART (For laboratory classification of fine grained soils)

1. Boundary classifications - Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

* Low plasticity - Liquid Limit w_L less than 35% Medium plasticity - w_L between 35% and 50%.

Adapted from A.S. 1726-1981 (App.D)

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus 0.2 mm size particles. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

† TOUGHNESS (Consistency near plastic limit)

After removing particles larger than 0.2 mm size, a specimen of soil about 10cm³ in size is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about 3 mm in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.
After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.
The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil.
Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.
Highly organic clays have a very weak and spongy feel at the plastic limit.

† DILATANCY (Reaction to shaking)

After removing particles larger than 0.2 mm size, prepare a pat of moist soil with a volume of 10 cm³. Add enough water if necessary to make the soil soft but not sticky.
Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles.
The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.
Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

† DRY STRENGTH (Crushing characteristics)

After removing particles larger than 0.2 mm size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.
High dry strength is characteristic for clays of the CH group.
A typical inorganic silt possesses only very slight dry strength.
Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen.
Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

COFFEY
Coffey Partners International
Consulting Engineers in the geotechnical sciences

SOIL CLASSIFICATION CHART

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no.	HA1
sheet	1 of 1

office job no: NR065/2

client:	V P, BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch 50m	checked by:	SHO

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L.Surface:	2.33 approx.
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SM	SILTY SAND: fine to medium grained, dark grey, with 15% silt fines.	M	MD		ACID SULPHATE TEST CLEAR
				0				SP	SAND: fine to medium grained, light grey, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽	0		1		SP	SAND: As above.	W			ACID SULPHATE TEST CLEAR
						2			Borehole HA1 Terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD1

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
N not measured O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample,
N standard penetration test
Nn SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA2

sheet 1 of 1

office job no:	NR865/2
client:	W.P. BROWN & PARTNERS PTY LTD
principal:	
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD
borehole location:	DRAIN No.1 - Approx.Ch.100m
hole commenced:	7.12.94
hole completed:	7.12.94
logged by:	AEL
checked by:	[signature]
drill model and mounting	SAND AUGER
hole diameter	80mm
slope:	-90 DEG
bearing:	
R.L.Surface:	2.62 Approx.
datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND fine to medium grained, dark grey-brown, with some silt fines.	M	MD		
				D				SP	SAND fine to medium grained, brown & light brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
				D		1		SP	SAND as above.				ACID SULPHATE TEST CLEAR
			▽							W			
						2			Borehole HA2 terminated at 2.00 m				
						3							

METHOD
AS auger screwing†
AD auger drilling†
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
†bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
N not measured O none observed
▽ water level
◁ water outflow
▷ water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nm SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

client:	W.P. BROWN & PARTNERS PTY LTD	office job no:	NF065/2
principal:		hole commenced:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed:	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch 100m	logged by:	AEL
		checked by:	[signature]

drill model and mounting: SAND AUGER		slope:	-90 DEG	R.L.Surface:	2.62 approx.
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		
				D				SP	SAND: fine to medium grained, brown & light brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
				D		1		SP	SAND: As above.				ACID SULPHATE TEST CLEAR
			▽							W			
						2			Borehole HA2 terminated at 2.00 m				
						3							

METHOD
- AS auger screwing*
- AD auger drilling*
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- *bit shown by suffix
- B blank bit
- V V bit
- T TC bit
- e.g. ADT

SUPPORT
- Nil no support
- M mud
- C casing

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- X not measured
- O none observed
- ▽ water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- N standard penetration test
- Nm SPT + sample recovered
- Nc SPT with solid cone
- VS vane shear
- PM pressuremeter
- DP dynamic penetrometer
- WS water sample
- PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

COFFEY

borehole no: HA3
sheet 1 of 1

engineering log - borehole

client:	W.P. BROWN & PARTNERS PTY LTD	office job no:	N0065/2
principal:		hole commenced:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed:	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch.150m	logged by:	AEL
		checked by:	gtO.
drill model and mounting:	SAND AUGER	slope: -90 DEG	R.L.Surface: 2.78 approx.
hole diameter	80mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
SH		C		D				SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		ACID SULPHATE TEST CLEAR
				D		1		SP	SAND: fine to medium grained, brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			∇							W			
								SP	SAND: As above.				ACID SULPHATE TEST CLEAR
						2			Borehole HA3 Terminated at 2.00 m				
						3							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support
M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
∇ not measured
O none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bt bulk sample
E environmental sample
N standard penetration test
Nt SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Gd 2/3

A E C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA4
sheet 1 of 1

office job no: HN065/2

client:	K.P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch 200m	checked by:	SAO

drill model and mounting: SAND AUGER		slope:	-90 DEG	R.L.Surface:	2.8 approx..
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C		D				SM	SILTY SAND: fine to medium grained, dark grey-brown, with 15% silt fines.	M	MD		ACID SULPHATE TEST CLEAR
								SP	SAND: fine to medium grained, light grey-brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽			1		SP	SAND: AS above.	W			ACID SULPHATE TEST CLEAR
		NIL				2			Borehole HA4 terminated at 2.00 m				
						3							

METHOD		SUPPORT	SAMPLES, TESTS, ETC		CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION		CONSISTENCY/DENSITY INDEX	
AS	auger screwing*	Nil no support M mud	U	undisturbed sample (mm)	based on unified classification system		VS	very soft
AD	auger drilling*	C casing	D	disturbed sample			S	soft
RR	roller/tricone	PENETRATION 1 2 3 4 little resistance ranging to very slow progress	Bs	bulk sample			F	firm
W	washbore		E	environmental sample			St	stiff
CT	cable tool		N	standard penetration test			VSt	very stiff
HA	hand auger		Nr	SPT + sample recovered	MOISTURE		H	hard
DT	diatube	WATER	Nc	SPT with solid cone	D	dry	Fb	friable
*bit shown by suffix		X not measured D none observed	VS	vane shear	M	moist	VL	very loose
B	blank bit	▽ water level	PM	pressuremeter	W	wet	L	loose
V	V bit		DP	dynamic penetrometer	Wp	plastic limit	MD	medium dense
T	TC bit	water outflow	WS	water sample	Wl	liquid limit	D	dense
e.g.	ADT	water inflow	PZ	piezometer			VD	very dense

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HAS
sheet 1 of 1

client	K P. BROWN & PARTNERS PTY LTD	office job no:	NR065/2
principal:		hole commenced	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch 250m	logged by:	AEL
		checked by:	gW

drill model and mounting	SAND AUGER	slope:	-90 DEG	R.L.Surface	2.97 approx.
hole diameter	80mm	bearing:		datum	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		ACID SULPHATE TEST CLEAR
								SP	SAND: fine to medium grained, white, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽							W			
				D		1		SP	SAND: As above.				ACID SULPHATE TEST CLEAR
						2			Borehole HAS Terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

SUPPORT
Nil no support
M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured
O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
N* SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty. Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no.	HA6
sheet	1 of 1

client:	W.P. BROWN & PARTNERS PTY LTD	office job no:	NR065/2
principal:		hole commenced:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed:	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch 300m	logged by:	AEL
		checked by:	GAO.
drill model and mounting:	SAND AUGER	slope: -90 DEG	R.L.Surface: 2.83 approx
hole diameter:	80mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. m	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		
				D				SP	SAND: fine to medium grained, off-white, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽			1							
				D				SP	SAND: as above.				ACID SULPHATE TEST CLEAR
						2			Borehole HA6 Terminated at 2.00 m				
						3							

METHOD		SUPPORT		SAMPLES, TESTS, ETC		CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION		CONSISTENCY/DENSITY INDEX	
AS	auger screwing*	Nil	no support	U	undisturbed sample (mm)	based on unified classification system		VS	very soft
AD	auger drilling*	M	mud	D	disturbed sample			S	soft
RR	roller/tricone	C	casing	Bs	bulk sample			F	firm
W	washbore	PENETRATION 1 2 3 4	little resistance ranging to very slow progress	E	environmental sample			St	stiff
CT	cable tool			N	standard penetration test			VSt	very stiff
HA	hand auger	WATER		Nc	SPT + sample recovered	MOISTURE		H	hard
DT	diatube	N	not measured	Nc	SPT with solid cone	D	dry	Fb	friable
*bit shown by suffix		O	none observed	VS	vane shear	M	moist	VL	very loose
B	blank bit	▽	water level	PM	pressuremeter	W	wet	L	loose
V	V bit		water outflow	DP	dynamic penetrometer	Wp	plastic limit	MD	medium dense
T	TC bit		water inflow	WS	water sample	Wl	liquid limit	D	dense
e.g.	AD/T			PZ	piezometer			VD	very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA7
sheet 1 of 1

office job no: NR065/2

client:	W P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch.350m	checked by:	GD.

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L.Surface:	2.73 approx.
hole diameter	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND fine to medium grained, grey & brown, with some silt fines.	M	MD		
				D				SP	SAND fine to medium grained, off-white, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			water level							W			
				D		1		SP	SAND As above.				ACID SULPHATE TEST CLEAR
						2			Borehole HA7 terminated at 2.00 m				
						3							
						4							

METHOD		SUPPORT		SAMPLES, TESTS, ETC		CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION		CONSISTENCY/DENSITY INDEX	
AS	auger screwing*	Nil	no support	U	undisturbed sample 50mm	based on unified classification system		VS	very soft
AD	auger drilling*	C	casing	D	disturbed sample			S	soft
RR	roller/tricone	M	mud	Bs	bulk sample			F	firm
W	washbore	PENETRATION 1 2 3 4	little resistance ranging to very slow progress	E	environmental sample			St	stiff
CT	cable tool	WATER		N	standard penetration test			VSt	very stiff
HA	hand auger	X	not measured	Ns	SPT + sample recovered	MOISTURE		H	hard
DT	diatube	O	none observed	Nc	SPT with solid cone	D	dry	Fb	friable
*bit shown by suffix			water level	VS	vane shear	M	moist	VL	very loose
B	blank bit		water outflow	PM	pressuremeter	W	wet	L	loose
V	V bit		water inflow	DP	dynamic penetrometer	Wp	plastic limit	MD	medium dense
T	TC bit			WS	water sample	Wl	liquid limit	D	dense
e.g.	AD/T			PZ	piezometer			VD	very dense

GBF 230

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

COFFEY

engineering log - borehole

borehole no: HA9
sheet 1 of 1

office job no: N0865/2

client:	N P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch 465m	checked by:	
drill model and mounting:	SAND AUGER	slope: -90 DEG	R.L.Surface: 2.97 approx.
hole diameter:	80mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, light brown & brown, with a trace of silt lines.	M	MD		ACID SULPHATE TEST CLEAR
				D				SP	SAND: fine to medium grained, off-white, with a trace of silt lines.				ACID SULPHATE TEST CLEAR
			▽			1		SP	SAND: As above.	W			ACID SULPHATE TEST CLEAR
						2			Borehole HA9 terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing
AD auger drilling
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nt SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

APPENDIX B

A P P E N D I X B

PARTICLE SIZE DISTRIBUTION

A
B
C
D
E
F
G
H
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

Coffey Partners International Pty Ltd
A C N 003 692 019

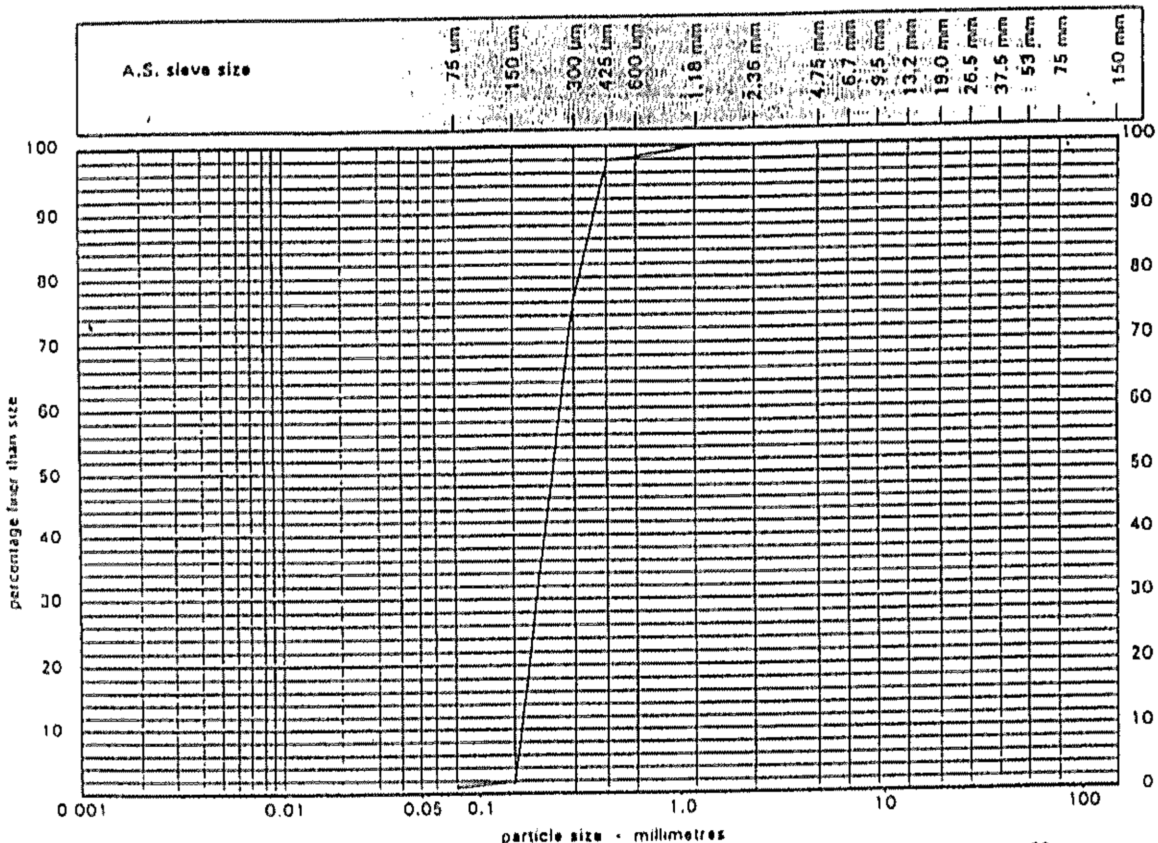
Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
53B Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

COFFEY

particle size distribution

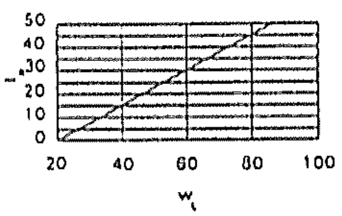
client :	WP BROWN & PARTNERS	job no :	NR865/2
principal :		laboratory :	BRISBANE
project :	IRON GATES ESTATE	date :	05/01/95
location :	EVANS HEAD	test report :	CB95001.ENG

sample identification : CB944483 Ch. 300m depth : 1.0 - 2.0m
test procedure : AS1289 C6.1



0.002				0.06			2.0			60	
clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

liquid limit	%	
plastic limit	%	
plasticity index	%	
linear shrinkage	%	
particle density	t/m³	
natural moisture	%	



classification :

Authorised Signature
NATA Reg. No. 596

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

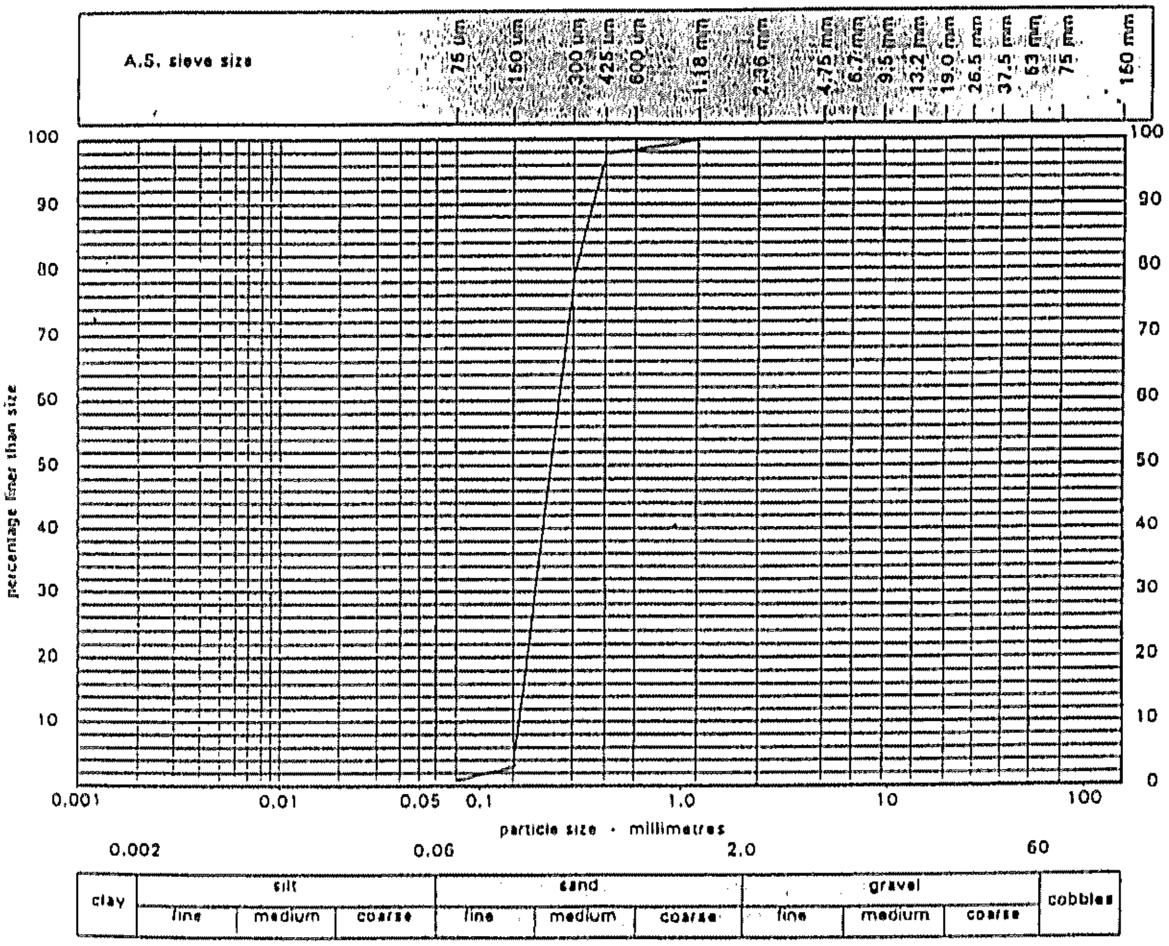
Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
53B Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

COFFEY

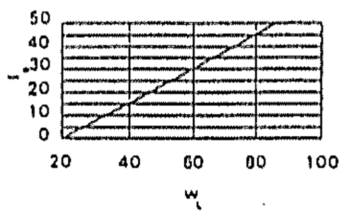
particle size distribution

client :	WP BROWN & PARTNERS	job no :	NR865/2
principal :		laboratory :	BRISBANE
project :	IRON GATES ESTATE	date :	05/01/95
location :	EVANS HEAD	test report :	CB95001.ENG

sample identification : CB944484 Ch. 100m depth : 1.0 - 2.0m
test procedure : AS1289 C6.1



liquid limit	%	
plastic limit	%	
plasticity index	%	
linear shrinkage	%	
particle density	t/m³	
natural moisture	%	



classification :

Authorised Signature
NATA Reg. No. 596

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

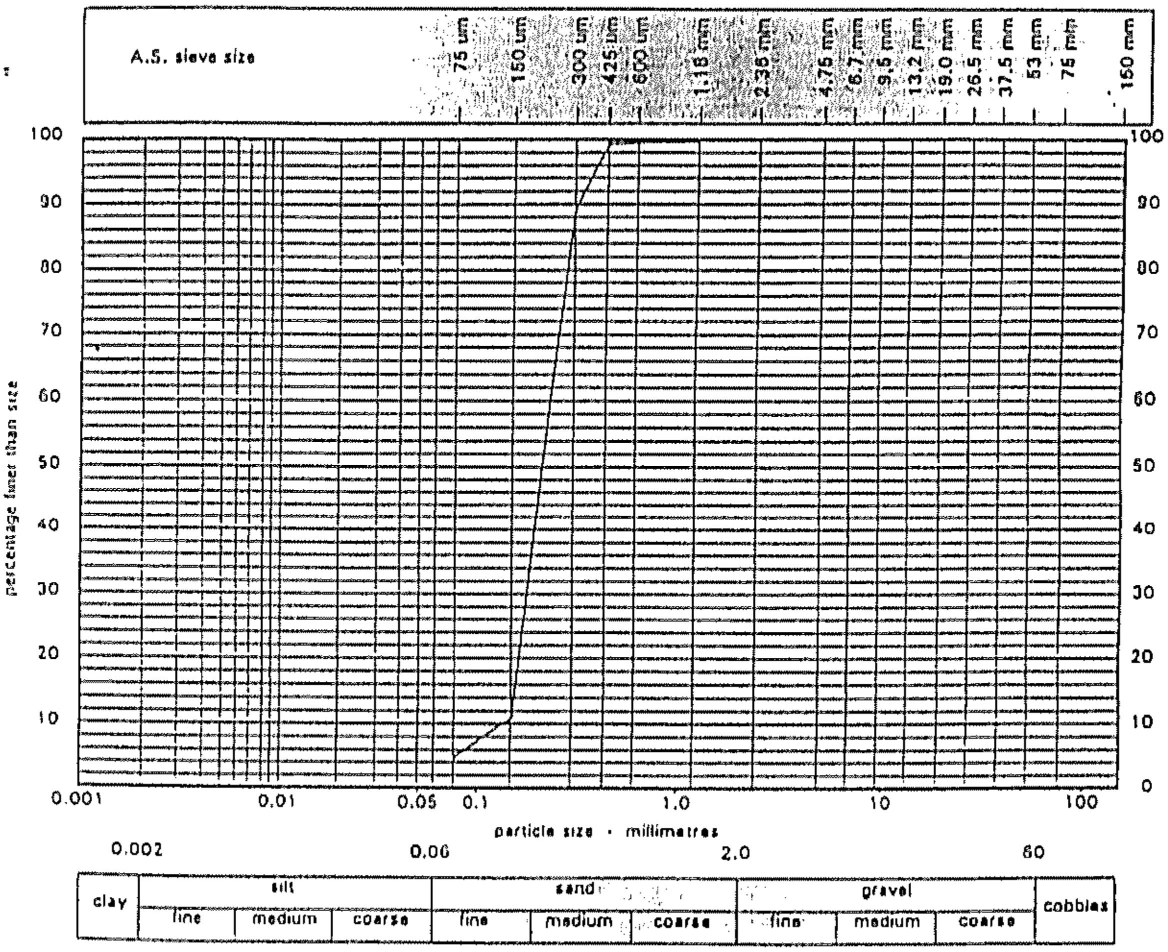
Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
538 Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

COFFEY

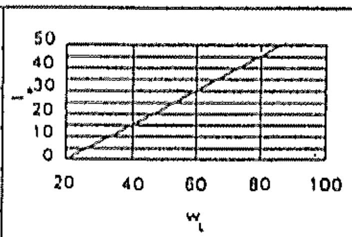
particle size distribution

client :	WP BROWN & PARTNERS	job no :	NR865/2
principal :		laboratory :	BRISBANE
project :	IRON GATES ESTATE	date :	05/01/95
location :	EVANS HEAD	test report :	CB95001.ENG

sample identification : CB944485 Ch. 50m   depth : 0.4 - 1.0m
test procedure : AS1289 C6.1



liquid limit	%	
plastic limit	%	
plasticity index	%	
linear shrinkage	%	
particle density	t/m³	
natural moisture	%	



classification :

NATA

This laboratory is registered by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with the terms of registration. This document shall not be reproduced except in full without the prior approval of the laboratory.

Authorised Signature
NATA Reg. No. 596

PHoward
05 JAN 1995

APPENDIX C

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

APPENDIX C

ACID SULPHATE TEST RESULTS

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

SIMMONDS & BRISTOW PTY. LTD.
A.C.N. 010 252 418
WATER & ENVIRONMENTAL ANALYSTS & CONSULTANTS

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

DN:PR

Ref. No. 27130
11 January 1995

The Manager,
Coffey Partners International Pty Ltd,
PO Box 108,
Salisbury, Qld 4107

Attention: Mr Brian Booker

Dear Sir,

ANALYSIS OF SOIL SAMPLES
ORDER NO. B17724 - JOB NO. NR865/2

Five (5) samples were received for testing on 13 December 19994. The results of analysis are presented in the Table attached.

Please advise if you have any queries.

Yours faithfully,
SIMMONDS & BRISTOW PTY. LTD.

D K Nial

David Nial
Supervisor - Soils Laboratory

Encl.

COFFEYS\NE

0599

A.C.N. 010 252 418

Water & Environmental Analysis & Consultants

30 Shottery Street,
Yeronga, Queensland,
Australia, 4104.
Telephone: (07) 848 7699
Fax No.: (07) 892 3345

Ref. No. 27130
COFFEY & PARTNERS BRISBANE

ANALYSIS OF SOIL SAMPLES
ACID SULPHATE POTENTIAL
IRON GATES ESTATE, EVANS HEAD
JOB NO. NR865/2

Date Collected: Not Specified
Date Received: 13.12.94
Date Analysed: 13.12.94 - 09.01.95

Sampled By: Client
Sampling Method: Not Specified

SAMPLE REGD. NO.	ANALYSIS S & B METHOD NO.	INITIAL pH (1:5) G090.	pH AFTER H_2O_2 OXID'N G090.	INITIAL SO_4 SC280.4 mg/kg	SO_4 AFTER OXID'N SC280.4 mg/kg	PYRITE S %	$CaCO_3$ SC015. %	ACID SULPHATE POTENTIAL SC120. *	ACID GENERATING POTENTIAL **
97297	50M 1.0 - 2.0 CB 944478	5.4	5.6	10.	150.	<0.01	<0.2	NIL	NIL
97298	150M 0.7 - 1.5 CB 944479	5.1	6.0	5.	125.	<0.01	<0.2	NIL	NIL
97299	250M 1.0 - 2.0 CB 944480	5.5	5.2	<5.	75.	<0.01	<0.2	NIL	NIL
97300	350M 1.0 - 2.0 CB 944481	5.6	5.2	<5.	75.	<0.01	<0.2	NIL	NIL
97301	465M 0.3 - 1.0 CB 944482	5.4	5.0	10.	125.	<0.01	<0.2	NIL	NIL

* Qualitative assessment based solely on % pyrite - not subject to NATA certification.
** Qualitative assessment based on % pyrite, % $CaCO_3$ and pH after oxidation - not subject to NATA certification.

NATA

SIMMONDS & BRISTOW PTY LTD

PER C. Cochrane ....

COFFEYS\BNE

APPENDIX C

DOUGLAS PARTNERS (1991)

Land of slope generally greater than 25-33% presents severe limitations on housing development and are generally best left in a relatively undisturbed state. These lands can, however, be utilised as the back blocks of larger allotments, or, with appropriate geotechnical engineering measures in place, capable of supporting special kinds of development e.g. "pole houses" or multi -level development.

In summary, the terrain over the whole development area consists of central ridge running north-south and rising to a knob of approximately 30 metres above sea level, the ridge comprising approximately a quarter of the whole site area. Slopes running off this central ridge vary from as steep as 15-25% adjacent to the knob with gentler slopes encountered within the central part of the ridge and footslope areas.

Aspect

Aspect is important as it modifies regional climate providing a local climate or a micro-climate. The most desirable aspect for residential living environments is a northerly aspect, and in particular a north-easterly aspect which attracts maximum sunlight and is protected from cold winter westerly winds, and is exposed to cooling summer breezes, the latter which would help to ease the effect of high humidity and high temperatures during summer periods.

Due to the north-south alignment of the central ridge which runs through the centre of the Iron Gates property, the generally flat to rolling topography encountered, the site is capable of enjoying the effects of cooling summer breezes and northerly aspect. The top of the central ridge enjoys some longer range views screened to some extent by existing vegetation. To the east of the central ridge lie lands with an easterly/northerly aspect, with lands to the west of the ridge enjoying a northerly/westerly aspect. Lower lying lands behind existing major vegetation stands would be sheltered from the effects of colder westerly winds. A similar situation applies in the case of the lands to the east of the central ridge system.

Soils and Geology

The coastal landscapes supporting much of the heath land and dune vegetation around Evans Head is understood to have developed during the Quaternary period. These comprise older Pleistocene deposits which formed the undulating plains and swamps away from the coast. The Quaternary marine deposits comprise uniform coarse textured sands with minor accumulations of organic matter in the topsoil. An analysis of the sandy soils of the lower lying parts of the Iron Gates property was undertaken by Morse McVey & Associates, in association with D. J. Douglas & Partners Pty Ltd in 1991. Ten back-hoe pits, ranging in depth from 0.8m to 2.8m were dug and consistent results were obtained, both among the test pits themselves, and based on observations of exposed soil profiles along the river bank.

In general terms, the profile of the sandy soils found on the site consist of a shallow layer of sandy topsoil with organic matter, underlain by fine-to-medium-grained sand. One test pit showed a layer of 200mm thick sandy clay.

The sandy soils were assessed for potential acid sulphate conditions. The completed laboratory tests indicate that at the sites indicated there is no evidence of (actual) acid sulphate material in any of the test pits. Further, field tests for pH decrease after oxidation in laboratory analysis for total sulphur (%) suggest that there are no potentially acid sulphate soils in any of the samples. These results should be representative of the survey area, according to Morse McVey & Associates. The soil analysis conclude that with respect to limitations imposed by the occurrence of acid sulphate materials, there is no reason why development should not proceed in this area.

Sedimentary rocks of the Triassic Clarence-Morton Basin occur along the Iron Gates Road ridge. Soils associated with these areas are shallow podsols with a base geology of shales, sand stones and conglomerates. Quaternary alluvial deposits occur along the river, forming flood plains and terraces.

2.5 VEGETATION

Overview, Past Disturbance of Site

The original vegetation pattern of the Iron Gates property has been affected by the previous history of land use of the site. Those areas which have been subject to significant clearing and/or site disturbance over the years may be summarised as follows:

- cleared land: found over much of the eastern part of the site adjoining the existing dwelling house on the property. This land has been cleared for decades and continued to be maintained in such a condition.
- Cleared and partly cleared hillside lands: comprising the larger proportion of the elevated hillside area lying to the north of the existing dwelling house and extending as far as the northern boundary of the site. These lands fall within a corridor of approximate width 150 metres. An additional area of cleared land occurs to the west of the main access track running into the property, situated to the west of the main hill.
- Disturbed heathland: previously subject to sand-mining activities, lying in the north-east corner of the property.

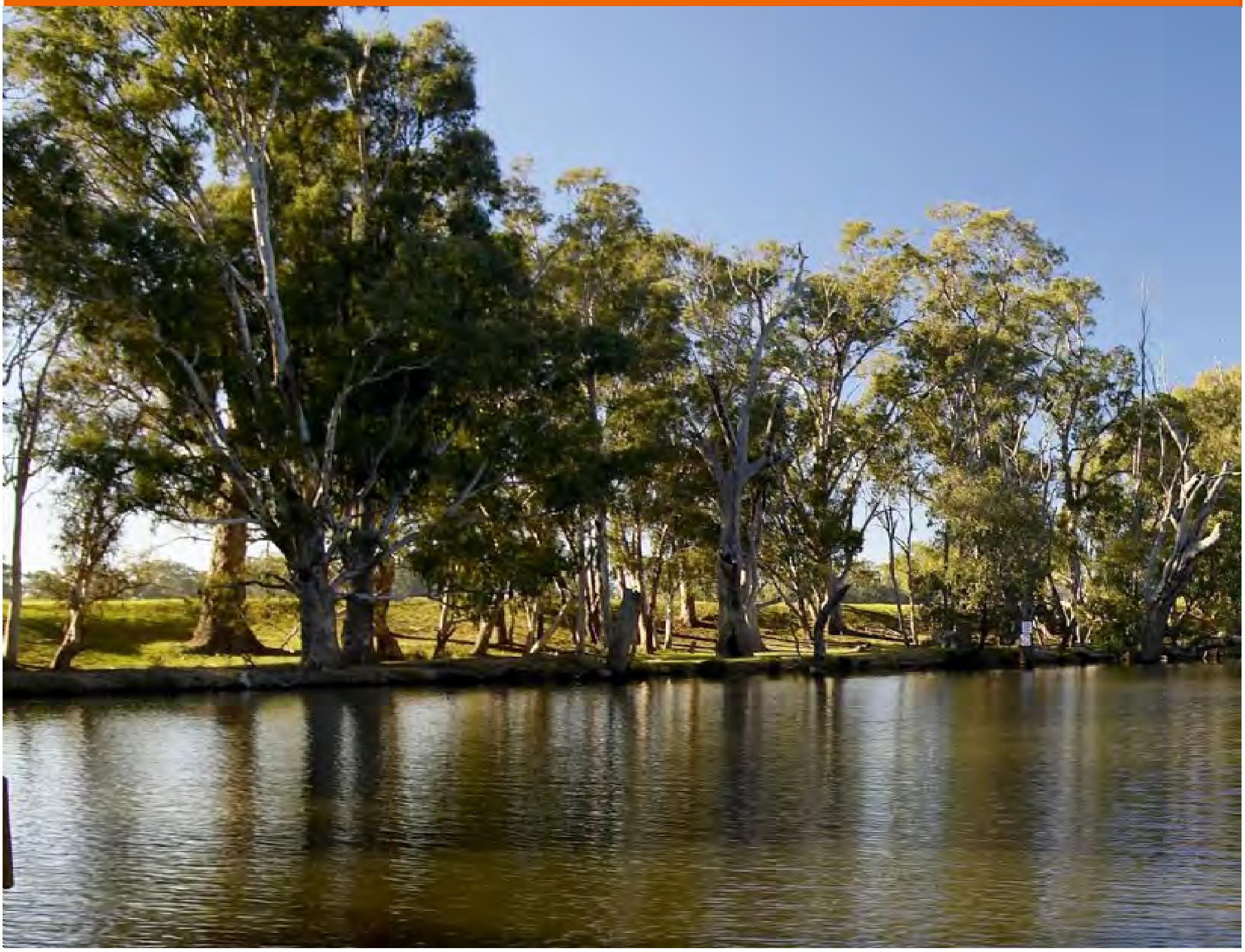
APPENDIX L

DEWATERING MANAGEMENT PLAN

IRON GATES RESIDENTIAL DEVELOPMENT

Dewatering Management Plan

08 JULY 2019



Incorporating

GOLDCORAL PTY LTD
IRON GATES RESIDENTIAL DEVELOPMENT

Dewatering Management Plan

Author	Gerard Dick
Checker	Simon Groth
Approver	Lachlan Prizeman

Report No	F0004-10027302-AAR
Date	8/07/2019
Revision	01

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	08/07/2019	Issued for Approval	GD	LP

CONTENTS

APPENDICES

1 INTRODUCTION

A Dewatering Management Plan (DMP) is proposed for the construction of the proposed Iron Gates development at Evans Head.

The DMP relates specifically to the installation of the proposed Sewer and Stormwater services below the natural water table level. These are the only services expected to be below the existing water table. The deeper sewer and stormwater trench excavations are envisaged to be 1.0 to 2.0m below the lowest finished design levels. Other services are expected to be above the water table.

Initial investigations undertaken by Coffey Partners International and Geotech Investigations included a number Groundwater and Soil investigations including 21 boreholes recording the interception of the Water Table, copies of these investigations can be found attached in the appendices. The groundwater levels varied from RL 2.30m located at the north east corner of the Development to RL 1.87m at the south east corner of the development, approximately 130m from the Evans River. The water table gradient across the site appears to be consistent with the natural ground levels and the fall towards the Evans River. Groundwater was encountered in the boreholes at depths of between 0.5m and 1.5m below the existing ground level. Typically, the standing ground water level would be expected at RL 0.0 to 0.5m with fluctuations of ±0.5m under normal (non-flood) conditions. Rises in groundwater to RL 1.5m to 2.0m (AHD) have been recorded in the immediate area following heavy and prolonged rainfall periods (flood conditions).

Water table levels can be expected to vary with seasonal and climatic conditions. Current finished surface design levels require a minimum flood free level of 3.3m and this will provide additional fill over the existing surface levels of a minimum 1.0m up to 2.0m. This will provide 2.7m to 1.5 m fill depths to the water table and retain the majority of the sewer and stormwater constructions above the water table. This Dewatering Management Plan will provide for the construction of those deeper services.

2 DEWATERING METHOD

It is envisaged that the limit of the excavations will be retained with a system of trench shoring bedded into the underlying indurated sands. A series of spear and or internal well points will be used to lower the water table on the site to a minimum depth of 0.5m below proposed excavation level.

For the proposed development, for only construction of the deeper services, dewatering to approximately 2.0m below existing ground level, will be required. It is expected that dewatering will require only a short term drawdown to about 2.5m depth will be required to enable construction of the services and backfilling of the trenches.

Water collected from the proposed dewatering system shall be directed towards a holding tank or suitably lined sampling pit prior to discharge or re-charging into the existing groundwater table. The holding tank/pit will then be used to monitor/test waters followed by remediation of any waters which are below acceptable discharge quality guidelines.

Water quality criteria must be maintained to those presented as baseline conditions plus or minus 10%, prior to discharge, in accordance with the release criteria for the project. It is proposed to either discharge the extracted groundwater into the adjacent groundwater system or into the existing site drainage system.

Given the extent of the proposed excavation numerous points are available around the perimeter of the site. As the dewatering management requirements for the development will vary during the dewatering operation, it is expected a number of discharge points will be utilised for discharge or recharge of the existing water table. The natural drainage system along the eastern boundary discharges into Evans River approximately 100 to 150m south of the site and will not be used for discharge without strict compliance with the Water quality criteria.

3 DEWATERING EFFECTS

The trench spear pumping system is envisaged to penetrate into the water table sufficient to allow dewatering of the trench alignments. This will limit the dewatering required and minimise the time of construction allowing for the watertable return to its original level.

Controlled recharge pumping may also be undertaken from the drainage system, where required to maintain the water table levels across the adjoining sensitive wetlands and rainforest areas development. The spear or well point pumping systems required to maintain the dewatering whilst installation and backfilling is completed will be dependent upon the groundwater inflows from the trenches, and are envisaged to vary during the relatively short construction period.

The construction period is understood to be in the order of 2 months. Drawdown of the groundwater levels of not more than 1000mm has been calculated to be restricted to a distance of not more than three times the depth of the drawdown, i.e. approximately 25m beyond the dewatering points. Given the location of proposed services this will be well away from the site boundaries any short-term drawdown will be entirely within the site.

On the basis of the original acid sulfate investigations undertaken for the development, and as part of the water table investigations, no acid sulfate soils are present on site in the dewatering zone, and beyond the depth of the excavation and therefore no acid sulfate groundwater conditions will be generated and no acid sulfate soils will be exposed as a result of the dewatering operation.

The effects of drawdown of the water table are not expected to create any adverse environmental impacts and recharging will be not be required to be mandatory unless boundary monitoring bores indicate significant changes and provided all water discharged from site lies within the acceptable range outlined in the ANZECC Water Quality Guidelines, as appropriate.

If subsequent testing of the pH of the water is below the release criteria, the pH can be raised by treatment with hydrated lime or caustic soda or similar. If the DO is below the release criteria aeration of the water at discharge can be undertaken,or an in-line aeration system installed.

The turbidity and suspended solids can be controlled through the use of settling tanks, the addition of slaking agents, flocking agents, geofabric filters and socks and, if required silt curtains at the discharge point. Provided the pH is controlled, it is likely the Fe and Al concentrations will be within the required release criteria.

Noise emissions resulting from the dewatering systems shall comply with the relevant provisions of the Interim Construction Noise Guideline, Protection of the Environment Operations Act 1997. The machinery shall be equipped with high efficiency mufflers and noise attenuated enclosures installed around the pumps if considered necessary.

4 GROUNDWATER MONITORING

4.1 Background Monitoring

Prior to works commencing on site groundwater monitoring wells shall be installed within nominally 20m to 25m of the adjoining Wetlands and Rainforest boundaries where monitoring is to be undertaken. The location of the monitoring wells will be determined on site prior to the commencement of the installation of the dewatering system, to allow optimal positioning of the wells for access throughout the life of the project. A plan will be developed at this stage, identifying the location of the monitoring wells, dewatering construction, locations and discharge retention wall and pump locations.

Background monitoring of the groundwater shall be undertaken weekly for a minimum of 4 weeks prior to the commencement of dewatering on site. The results of the background monitoring will be used to determine the groundwater quality trigger values that will indicate the need for corrective action to be undertaken during the dewatering operation.

The wells will be monitored for groundwater levels, pH, DO, turbidity, conductivity, SS, EC, Fe and Al. As a general guideline a deviation of 10% from the established baseline criteria for two or more of the water quality parameters would be considered a trigger for corrective action, however this should be reassessed depending on the results and consistency of the background monitoring.

4.2 Monitoring During Construction

The following groundwater monitoring frequency shall be adopted during dewatering operations. Daily monitoring of groundwater levels in the boundary standpipes and pH for the first 2-3 weeks. Weekly sampling and testing for pH, DO, temperature, turbidity, conductivity, Fe and Al for the construction period where requiring dewatering. If the monitoring results prove consistent after the first month of monitoring, the sampling frequency could be reduced to fortnightly for the duration of the dewatering operation, subject to Richmond Valley Council approval. Additionally, twice weekly monitoring by visual assessment of the areas external to the site shall be undertaken to ensure no adverse impacts are occurring as a result of the dewatering.

5 DISCHARGE MONITORING

A discharge monitoring program shall be implemented to provide feedback on the effectiveness of the dewatering management strategy and provide early warning should environmental degradation begin. Monitoring will be carried out at the holding tank/pit immediately prior to release into the environment.

The following monitoring frequency is recommended during any dewatering operations:

- Daily - pH, Dissolved Oxygen (DO), Turbidity and Conductivity; and
- Weekly - As above plus Fe, Al, SS.

If the results of monitoring prove consistent, the frequency of monitoring could be reduced, subject to Richmond Valley Council approval.

Prior to release, the groundwater discharge shall meet the ANZECC Water Quality Guidelines for Fresh and Marine Waters (2000) as summarised in Table 5-1 below.

Table 5-1 Water Quality Criteria

INDICATOR RELEASE CRITERIA	
ph	7.0-8.4
Dissolved Oxygen	>85% sat
Turbidity	55 NTU
Suspended Soils	20 (mg/e)
Pd (soluble)	4.4 ug/L
Cu (soluble)	1.3 ug/L
Cr (soluble)	4.4 ug/L
Fe (soluble)	1000 ug/L
Al (soluble	< 30 ug/L for pH < 6.5 < 300 ug/L for pH > 6.5

It is requirement that any proposed discharge water complies with the water quality criteria listed above.

6 RECOMMENDATIONS

Prior to commencement of dewatering operations on site the results of the background monitoring will be submitted to the Richmond Valley Council. A monthly dewatering report shall be prepared and submitted to Richmond Valley Council. The report shall include, as a minimum, details of the dewatering and retention method, water quality results, treatment required, status of the existing groundwater and any unforeseen issues. The DMP recommendations will be implemented by the Civil construction contractor for the proposed development. A NATA registered Geotechnical or Environmental Engineering shall be engaged by the Civil contractor to undertake the required background monitoring, and discharge monitoring during construction.

APPENDIX A

GEOTECH INVESTIGATIONS (2015)

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-a
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P1

Location	N: 6778265 E: 540560	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, grey brown 0.5 m (SP) SAND: Fine sand, dry, pale grey 2.2 m (SP) SAND: Fine sand, wet, pale grey T.D. 3 m	
Water Table (estimated based on drilling)	2.2 m BSL	
Field Test Results	K_{sat} = 13.7 m/day = 572 mm/hr	K = 1.6 x 10^{-4} m/s
Test Hole Depth	1.1 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-b
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P2

Location	N: 6778474 E: 540581	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, grey brown 0.5 m (SP) SAND: Fine sand, moist, pale grey 1.4 m (SP) SAND: Trace silt, fine sand, moist, dark brown 1.6 m (SP) SAND: Trace silt, fine sand, moist, dark grey T.D. 3 m	
Water Table (estimated based on drilling)	Not identified	
Field Test Results	K_{sat} = 89.5 m/day = 3728 mm/hr	K = 1 x 10^{-3} m/s
Test Hole Depth	0.6 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Our Ref: JW:jw: GI 2039-c
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P3

Location	N: 6778597 E: 540503	
Test Date	25/05/2015	
Soil Description	0 m (SP) SAND: With silt, fine sand, moist, grey 0.3 m (SM) Silty SAND: Fine sand, moist, dark brown 0.6 m (SP) SAND: Trace silt, fine sand, wet, pale grey 1.4 m (SP) SAND: Trace silt, fine sand, wet, dark brown T.D. 3 m	
Water Table (estimated based on drilling)	0.6 m BSL	
Field Test Results	K_{sat} = 16.8 m/day = 698 mm/hr	K = 1.9 x 10^{-4} m/s
Test Hole Depth	0.17 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-d
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P4

Location	N: 6778425 E: 540493	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine to medium sand, moist, dark brown 0.7 m (SP) SAND: Trace silt, fine sand, moist, pale grey 1.7 m (SP) SAND: Trace silt, fine sand, wet, pale grey 2.0 m (SP) SAND: Trace silt, fine sand, wet, grey brown T.D. 3 m	
Water Table (estimated based on drilling)	1.7 m BSL	
Field Test Results	K_{sat} = 27.0 m/day = 1128 mm/hr	K = 3.1 x 10^{-4} m/s
Test Hole Depth	0.77 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-e
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P5

Location	N: 6778333 E: 540483	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, dark brown 0.6 m (SP) SAND: Trace silt, fine sand, dry, pale grey 1.4 m (SP) SAND: Trace silt, fine sand, moist to wet, pale grey 2.4 m (SP) SAND: Trace silt, fine sand, wet, grey brown T.D. 3 m	
Water Table (estimated based on drilling)	1.5 m BSL	
Field Test Results	K_{sat} = 4.2 m/day = 176 mm/hr	K = 4.9 x 10^{-5} m/s
Test Hole Depth	1.1 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-f
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P6

Location	N: 6778091 E: 540285	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine sand, moist, dark grey 0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey 0.8 m (SM) Silty SAND: Fine sand, moist, dark orange brown 1.2 m (SM) Silty SAND: Fine sand, moist, grey brown mottled orange brown 2.7 m (SM) Silty SAND: Fine sand, wet, grey brown mottled orange brown T.D. 3 m	
Water Table	2.7 m BSL	
Field Test Results	K_{sat} = 2.2 m/day = 91 mm/hr	K = 2.5 x 10^{-5} m/s
Test Hole Depth	1.1 m BSL	
Indicative Drainage Class	'well drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD
ABN 81154555478
ACN 154555478
P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-g
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P7

Location	N: 6778447 E: 540402	
Test Date	25/05/2015	
Soil Description	0 m (SP) SAND: With silt, fine to medium sand, moist, grey brown 0.2 m (SP) SAND: Trace silt, fine sand, moist, pale grey 0.7 m (SM) Silty SAND: Trace clay, fine sand, wet, orange brown 1.1 m (SP) SAND: Trace silt, fine sand, wet, dark brown T.D. 3 m	
Water Table (estimated based on drilling)	0.7 m BSL	
Field Test Results	K_{sat} = 7.2 m/day = 300 mm/hr	K = 8.3 x 10^{-5} m/s
Test Hole Depth	0.87 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-h
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P8

Location	N: 6778560 E: 540397	
Test Date	25/05/2015	
Soil Description	0 m (SP) SAND: Trace silt, fine sand, moist, brown 0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey 1.2 m (SP) SAND: Trace silt, fine sand, wet, pale grey 1.4 m (SM) Silty SAND: Fine sand, wet, dark brown 1.9 m (SP) SAND: Trace silt, fine sand, wet, dark grey / brown T.D. 3 m	
Water Table (estimated based on drilling)	0.6 m BSL	
Field Test Results	K_{sat} = 2.6 m/day = 109 mm/hr	K = 3.0 x 10^{-5} m/s
Test Hole Depth	0.07 m BSL	
Indicative Drainage Class	'well drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-i
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

REPORT ON IN-SITU PERMEABILITY TESTING
IRON GATES DRIVE, EVANS HEAD

Test ID: Test P9

Location	N: 6778502 E: 540329	
Test Date	25/05/2015	
Soil Description	0 m (SM) Silty SAND: Fine to medium sand, moist, dark grey 0.5 m (SP) SAND: Trace silt, fine sand, moist, pale grey 1.8 m (SM) Silty SAND: With clay, fine sand, wet, dark brown 2.0 m (SM) Silty SAND: Fine sand, wet, dark brown mottled orange brown 2.5 m (SP) SAND: Trace silt, fine sand, wet, dark brown T.D. 3 m	
Water Table (estimated based on drilling)	0.5 m BSL	
Field Test Results	K_{sat} = 18.6 m/day = 775 mm/hr	K = 2.2 x 10^{-4} m/s
Test Hole Depth	0.07 m BSL	
Indicative Drainage Class	'rapidly drained'	

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
K_{sat} – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
Geotech Investigations Pty Ltd

James Walle *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

LOT	AREA	LOT	AREA	LOT	AREA
01	958.54m²	74	601.67m²	147	623.04m²
02	609.58m²	75	602.27m²	148	623.04m²
03	610.02m²	76	602.86m²	149	623.04m²
04	610.48m²	77	611.90m²	150	623.04m²
05	610.80m²	78	601.02m²	151	623.04m²
06	611.13m²	79	645.62m²	152	701.77m²
07	611.45m²	80	642.13m²	153	703.42m²
08	611.78m²	81	602.42m²	154	611.15m²
09	612.10m²	82	602.31m²	155	611.15m²
10	612.43m²	83	602.20m²	156	611.15m²
11	612.75m²	84	854.34m²	157	611.15m²
12	612.98m²	85	854.15m²	158	611.15m²
13	611.49m²	86	601.23m²	159	611.29m²
14	613.85m²	87	601.27m²	160	720.75m²
15	614.18m²	88	951.69m²	161	753.34m²
16	614.50m²	89	794.12m²	162	633.95m²
17	614.82m²	90	601.19m²	163	602.77m²
18	615.14m²	91	601.15m²	164	707.28m²
19	615.47m²	92	601.11m²	165	649.98m²
20	615.80m²	93	601.06m²	166	661.66m²
21	653.44m²	94	601.03m²	167	686.92m²
22	639.06m²	95	600.07m²	168	640.98m²
23	600.87m²	96	665.25m²	169	621.28m²
24	601.48m²	97	617.23m²	170	845.54m²
25	601.78m²	98	605.72m²	171	829.97m²
26	602.07m²	99	609.16m²	172	600.73m²
27	602.37m²	100	613.10m²	173	600.73m²
28	602.67m²	101	606.61m²	174	601.88m²
29	602.97m²	102	600.24m²	175	600.94m²
30	603.27m²	103	600.05m²	176	618.69m²
31	603.56m²	104	603.86m²		
32	603.87m²	105	606.12m²		
33	611.56m²	106	604.88m²		
34	602.69m²	107	644.68m²		
35	687.98m²	108	604.83m²		
36	744.04m²	109	603.24m²		
37	601.47m²	110	608.18m²		
38	601.47m²	111	606.58m²		
39	601.47m²	112	608.28m²		
40	601.47m²	113	736.06m²		
41	601.47m²	114	720.51m²		
42	601.47m²	115	1029.27m²		
43	601.47m²	116	602.49m²		
44	601.47m²	117	609.57m²		
45	601.47m²	118	607.83m²		
46	601.84m²	119	651.61m²		
47	600.97m²	120	603.93m²		
48	602.78m²	121	603.27m²		
49	601.06m²	122	604.77m²		
50	600.70m²	123	613.74m²		
51	604.45m²	124	602.29m²		
52	604.30m²	125	628.60m²		
53	604.17m²	126	603.18m²		
54	604.11m²	127	690.16m²		
55	603.12m²	128	601.05m²		
56	601.74m²	129	606.82m²		
57	600.79m²	130	632.34m²		
58	833.34m²	131	609.67m²		
59	783.87m²	132	606.00m²		
60	674.25m²	133	601.02m²		
61	612.30m²	134	600.03m²		
62	605.75m²	135	600.92m²		
63	604.82m²	136	600.85m²		
64	603.90m²	137	600.91m²		
65	602.98m²	138	639.85m²		
66	602.05m²	139	655.96m²		
67	601.13m²	140	795.02m²		
68	600.20m²	141	897.95m²		
69	603.67m²	142	603.25m²		
70	620.23m²	143	636.28m²		
71	603.10m²	144	722.96m²		
72	600.46m²	145	620.19m²		
73	601.06m²	146	623.04m²		

PLAN OF SUBDIVISION

IRON GATES, EVANS HEAD

PLANIT CONSULTING

PROJECT TITLE: IRON GATES DEVELOPMENT, EVANS HEAD

DRAWING TITLE: PLAN OF SUBDIVISION - OPTION 7

BASE PROVIDED BY: N/A

CLIENT: GOLD CORAL

NO	DATE	REVISION	BY
-	-	-	-

SCALE: 1/1500 @ A1

DESIGN: PLANIT CONSULTING

DRAWN: ZP

DATE: 03/2015

CHECKED: AS

DRAWING NO: IRONGATES_PLNOFSUB_01

NORTH POINT:

SHEET NO: 01 OF 01

Level 1 2247 Gold Coast Hwy
Nobby Beach
PO Box 206 QLD 4218
Telephone: 07 5526 1500
Fax: 07 5526 1502
Email: admin@planitconsulting.com.au

APPENDIX B

COFFEY PARTNERS INTERNATIONAL (1995)

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources

COFFEY

530 Fairlawn Street
Nathan QLD 4111

PO Box 100
Salisbury QLD 4107
Australia

Fax (07) 274 4977
Telephone (07) 274 4411

Your Reference
Our Reference NR865/2-B GHD
Date 12th January, 1995

W P Brown & Partners Pty Ltd
PO Box 6527
UPPER MT GRAVATT QLD 4122

Attention: Mr Gary Spence

Dear Sir,

RE IRON GATES ESTATE - STAGE 1A
INVESTIGATION OF PROPOSED OPEN DRAIN

Please find enclosed our report on the geotechnical investigation for a proposed drain at the Iron Gates Estate. The investigation was carried out in general accordance with our proposal NRP294/17-A dated 21st November, 1994.

Should you have any queries regarding the contents of this report, please contact Geoff Drew or the undersigned at our Brisbane office.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

Philip Shaw
P.SHAW

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

0560

TABLE OF CONTENTS

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

0570

1.0 INTRODUCTION

It is proposed that an open drain be constructed adjoining the Iron Gates Estate Stage 1A development. Coffey Partners International Pty Ltd was commissioned verbally by Mr.Gary Spence of W.P.Brown & Partners Pty Ltd to perform an investigation of the subsurface conditions along the drain alignment. This report contains details of the field investigation and the laboratory chemical and geotechnical testing. Comment is provided on the impact of the proposed drain on a nearby wetland area and the possibility that acid sulphate soils will be exposed during excavation.

2.0 FIELD INVESTIGATION

A total of 9 holes was drilled using hand held (sand) auger equipment on 6th & 7th December, 1994. The holes were advanced to depths of 2m below the existing ground surface at 50m intervals along the alignment of Open Drain No.1, beginning at approximately ch.50m. Samples were taken for laboratory testing for acid sulphate soils and for particle size distribution analysis, and standing water levels (SWL) were measured.

Qualitative spot tests for the presence of either ferrous monosulphide or pyrite were performed at each drilling location in the surface layer and in the soils above and below the water table. Engineering logs of the boreholes along with explanation sheets describing the terms and symbols used are presented in Appendix A.

3.0 SITE DESCRIPTION

The site of the proposed drain is a generally flat sandy area with variable tree and grass cover. The ground surface along the alignment has a maximum elevation of about RL3.0m over most of the alignment and, at the end of the alignment, falls from an elevation of RL2.3m to the banks of the Evans River over a distance of 20m. The area comprises beach or coastal dune sands. The estate layout drawings show the proposed drain running from a point close to an area of wetlands directly to the Evans River.

The wetlands are swampy with large areas of surface water, thick weed growth and paperbark trees. Organic clays are reported to occur at approximately 300mm below the surface sands, but their thickness is not known. The topographic mapping of the area shows an elongated feature with a surface elevation a little below the RL2m contour trending south from the Open Space. Surface water within this depression may be either perched on the organic clay layer, or be a 'window' to the water table, or a combination of both in the case of a discontinuous organic clay layer.

4.0 LABORATORY TESTING

4.1 Acid Sulphate

The qualitative spot tests for the presence of acid sulphates all indicated nil to very low concentrations. Three samples from below the water table and two samples from above the water table were submitted for quantitative acid sulphate testing. Summary results of the laboratory testing are set out in Table 1 below, with laboratory test reports in Appendix C.

TABLE 1
Summary of Acid Sulphate Testing

Chainage	Depth (m)	pH		SO_4 (mg/kg)	
		initial	after oxidation	initial	after oxidation
50m	1.0 - 2.0	5.4	5.6	10	150
100m	0.7 - 1.5	5.1	6.0	5	125
250m	1.0 - 2.0	5.5	5.2	<5	75
350m	1.0 - 2.0	5.6	5.2	<5	75
465m	0.3 -1.0	5.4	5.0	10	125

Note: Pyrite S concentrations all <0.01%. $CaCO_3$ concentrations all <0.2%.

4.2 Particle Size Distribution

Field description of the sands gives a grain size in the fine to medium grained range. Laboratory testing indicates less than 5% passing 0.075mm and 98% passing 0.425mm sieves. Laboratory test results can are reported in Appendix B. Coefficient of Uniformity is less than 2, indicating high porosity.

5.0 DISCUSSION

5.1 Acid Sulphate Soils

The field qualitative spot testing indicated a general absence or very low concentration of either ferrous monosulphide or pyrite in either the topsoil, sands above the water table or sands below the water table. This was confirmed by the laboratory testing which indicated nil acid sulphate potential and nil acid generating potential for all 5 samples submitted.

5.2 Groundwater Movement

On the basis of the SWLs measured during the field investigation, a gradient averaging about 1:200 currently exists towards the river from ch.250m with a negligible gradient from ch.250m to ch.465m and an apparent slight mounding at about ch.250m. The water table is of the order of 1m below ground surface over most of the proposed drain alignment so can be said to roughly follow the ground surface contours, as is to be expected under phreatic conditions. Standing water levels in BH1 and BH2 drilled in August 1994 were 0.6m below a ground surface level which is assessed at about RL2.3m from contours on supplied plans. This indicates that the water table beyond the end of the proposed drain is relatively constant at about RL 1.75m which corresponds to the inferred free water surface level in the wetlands.

An estimated permeability (K) of between 3×10^{-3}cm/sec (2.5m/day) and 4.5×10^{-3}cm/sec (4.0m/day) can be inferred from the particle size characteristics of the sands. Specific Yield is estimated at 0.33. With this permeability and gradient, a steady regional groundwater flow would already be established towards the river, the flow being maintained by both direct infiltration of rainwater and leakage of some surface water from the wetlands area. The proportion of the existing flow attributable to the wetlands source would depend on the permeability and thickness of the organic clay layers underlying the wetlands. Total throughflow rates would vary with water table fluctuations resulting from changes in the availability of recharge, especially that deriving from direct infiltration of rainfall.

Design drawings show that the open drain will be excavated to a depth of about 1m below the water table. The effect of this excavation will be a localised lowering of the water table due to the creation of a new line of discharge. Homogeneous fine grained unconfined aquifers of the type encountered here are known to exhibit delayed drainage with the result that the lowering of water table will be gradual and, in the short term, of limited extent. Long term expansion of the zone of influence of the drain is likely to occur only during long periods without recharge. Other factors, such as evaporation and transpiration could then prove to be of greater importance to the wetlands than any induced drawdowns.

Estimations of drawdown at distances from the drain have been made using methods for estimating flow of groundwater to galleries (Huisman after Edelman). Assumptions made for these calculations are; 1 year (365 days) without recharge, instantaneous drawdown at the gallery of 1m, and aquifer thickness of 1.75m.

TABLE 2
Distance-Drawdown Estimations

Distance from Drain Centreline (m)	Drawdown (m) at	
	K=3.8m/day	K=2.5m/day
20	0.87	0.84
30	0.81	0.76
40	0.74	0.68
50	0.68	0.61
60	0.62	0.54
80	0.51	0.42
100	0.41	0.31

Significantly lower calculated drawdowns at distance from the drain are obtained by reducing the time without recharge (rainfall). Reducing the period without recharge to 100 days (3 months) results in drawdowns at 100m of 0.12m and 0.05m for permeabilities of 3.8 and 2.5m/day respectively.

The organic clay layer noted in the wetlands area was not present at a similar level along the proposed drain, so it can be inferred that it is specific to the wetland area. In this case, there is a high probability that the much lower permeability of the organic clay layer will tend to isolate the wetlands from the drawdowns induced by the drain excavation. Even if the isolating effect of the organic clays is less than expected it is likely that any loss of water to the proposed drain would be replaced by groundwater flow from other directions.

A E C D E F G H I J K L M N O P Q R S T U V W X Y Z

0574

Any potential impact of the drain on the area could be reduced if it was possible to modify the overall estate drainage design to allow the invert level of the drain to be raised so that it is closer to the present water table. As the drawdowns were calculated on the basis of a 1m lowering of water level at the drain, proportional adjustments can be made for any alteration in the depth of excavation below the water table. Flow to the drain given the assumptions described above is estimated to be of the order of $0.04m^3$/day per metre length of excavation after 1 year without significant rainfall recharge.

Philip Shaw

For and on behalf of

COFFEY PARTNERS INTERNATIONAL PTY LTD

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration, the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations.

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report:

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one.
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed.

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts. Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

APPENDIX A

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

APPENDIX A

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

APPENDIX A

ENGINEERING LOGS OF BOREHOLES

Coffey Partners International Pty Ltd
ACN 003 692 019

descriptive terms soil and rock

COFFEY

Explanation Sheet 1

SOIL DESCRIPTIONS

Classification of Material based on Unified Classification System (refer SAA Site Investigation Code AS1726—1975 Add. No. 1 Table D1).

Moisture Condition based on appearance of soil

- dry — Looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through hands.
- moist — Soil feels cool, darkened in colour; cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hands on remoulding.
- wet — Soil feels cool, darkened in colour; cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.

Consistency based on unconfined compressive strength (Qu) (generally estimated or measured by hand penetrometer).

term	very soft	soft	firm	stiff	very stiff	hard
Qu kPa	25	50	100	200	400	

If soil crumbles on test without meaningful result, it is described as **friable**.

Density Index (generally estimated or based on penetrometer results).

term	very loose	loose	medium dense	dense	very dense
density index I_D %	15	35	65	85	

ROCK DESCRIPTIONS

Weathering based on visual assessment

term	criterion
Fresh.	Rock substance unaffected by weathering.
Slightly Weathered.	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Moderately Weathered:	Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Highly Weathered:	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable.
Extremely Weathered:	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.

Strength based on point load strength index, corrected to 50 mm diameter - Is(50) (refer I.S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1). (Generally estimated: x indicates test result).

classification	extremely low	very low	low	medium	high	very high	extremely high
Is (50) MPa	0.03	0.1	0.3	1	3	10	

The unconfined compressive strength is typically about $20 \times I_{S50}$ but the multiplier may range, for different rock types, from as low as 4 to as high as 30

Defect Spacing

classification	extremely close	very close	close	medium	wide	very wide	extremely wide
spacing m	0.03	0.1	0.3	1	3	10	

Defect description uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam (etc.) and character (roughness, extent, coating etc.).

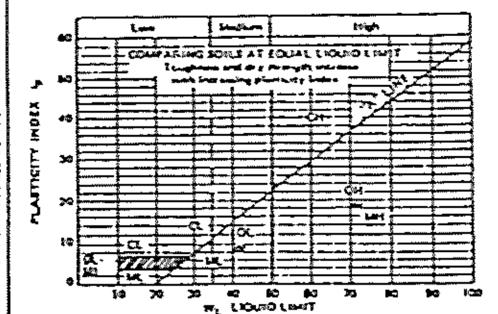
A B C D E F G H K L M N O P Q R S T U V W X Y Z

SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

			FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass) 1			GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS — More than 50% of material less than 60 mm is larger than 0.06 mm (The 0.06 mm particle is about the smallest particle visible to the naked eye)	GRAVELS — More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes			GW	Well graded gravels, gravel - sand mixtures, little or no fines.	SYMBOL. Give typical name, indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and strength of the coarse grains, colour, amount, plasticity of fine component. For undisturbed soils add information on moisture condition, degree of compactness, stratification, cementation, odour. Give local or geologic name and other pertinent descriptive information. Example: SM - Gravelly Silty SAND coarse to fine, pale brown, about 20% strong angular gravel particles - 10 mm maximum size, rounded and sub angular sand, about 15% non plastic fines, moist, dense, alluvial sand	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing			GP	Poorly graded gravels, gravel - sand mixtures, little or no fines.		Not meeting all gradation requirements for GW	
		GRAVELS WITH FINES (Appreciable amount of fines)	Non plastic fines (for identification procedures see ML below)			GM	Silty gravels, poorly graded gravel - sand - silt mixtures.		Atterberg limits below "A" line or I_p less than 4.	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
			Plastic fines (for identification procedures see CL below)			GC	Clayey gravels, poorly graded gravel - sand - clay mixtures.		Atterberg limits above "A" line with I_p greater than 7	
	SANDS — More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes			SW	Well graded sands, gravelly sands, little or no fines.		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing			SP	Poorly graded sands, gravelly sands, little or no fines.		Not meeting all gradation requirements for SW	
		SANDS WITH FINES (Appreciable amount of fines)	Non plastic fines (for identification procedures see ML below)			SM	Silty sands, poorly graded sand - silt mixtures		Atterberg limits below "A" line or I_p less than 4	Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols.
			Plastic fines (for identification procedures see CL below)			SC	Clayey sands, poorly graded sand - clay mixtures		Atterberg limits above "A" line with I_p greater than 7	
			IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 mm							
			DRY STRENGTH †	DILATANCY †	TOUGHNESS †					
FINE GRAINED SOILS — More than 50% of material less than 60 mm is smaller than 0.06 mm	SILTS AND CLAYS — Liquid limit less than 50		None to Low	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit. *	SYMBOL. Give typical name, indicate degree and character of plasticity, colour, amount and size of coarse grains. For undisturbed soils add information on moisture condition, consistency, structure, stratification, odour. Give local or geologic name, and other pertinent descriptive information. Example: CL - Sandy CLAY of low plasticity pale grey and brown; Sand fine to medium, trace of fine gravel, dry, firm, numerous vertical root holes; (FILL).		
			Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays. *			
			Low to medium	Slow	Low	OL	Organic silts and organic silt - clays of low to medium plasticity. *			
	SILTS AND CLAYS — Liquid limit greater than 50		Low to medium	Slow to none	Low to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit.			
			High to very high	None	High	CH	Inorganic clays of high plasticity. *			
			Medium to high	None to very slow	Low to medium	OH	Organic clays of high plasticity. *			
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.			Pt	Peat and other highly organic soils.			

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION

Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 0.06 mm size) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols.



PLASTICITY CHART (for laboratory classification of fine grained soils)

1. Boundary classifications — Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW–GC, well graded gravel-sand mixture with clay binder.

* Low plasticity — Liquid Limit W_L less than 35%. Medium plasticity — W_L between 35% and 50%.

Adapted from A.S. 1726-1981 (App.D)

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus 0.2 mm size particles. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

† **TOUGHNESS** (Consistency near plastic limit)

After removing particles larger than 0.2 mm size, a specimen of soil about 10 cm³ in size is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about 3 mm in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached. After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles. The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line. Highly organic clays have a very weak and spongy feel at the plastic limit.

† **DILATANCY** (Reaction to shaking)

After removing particles larger than 0.2 mm size, prepare a pat of moist soil with a volume of 10 cm³. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil. Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

† **DRY STRENGTH** (Crushing characteristics)

After removing particles larger than 0.2 mm size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity. High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

COFFEY

Coffey Partners International

Consulting Engineers in the geotechnical sciences

SOIL CLASSIFICATION CHART

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

0583

Coffey Partners International Pty. Ltd
ACN 003 692 019

COFFEY

engineering log - borehole

borehole no. HA1
sheet 1 of 1

office job no: NR065/2

client:	V P, BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch 50m	checked by:	SAO.

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L.Surface:	2.33 approx.
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SM	SILTY SAND: fine to medium grained, dark grey, with 15% silt fines.	M	MD		ACID SULPHATE TEST CLEAR
				D				SP	SAND: fine to medium grained, light grey, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽	D		1		SP	SAND: As above.	W			ACID SULPHATE TEST CLEAR
						2			Borehole HA1 Terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD1

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
N not measured D none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample,
N standard penetration test:
Nn SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

office job no: NR865/2

client:	W.P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch.100m	checked by:	
drill model and mounting	SAND AUGER	slope: -90 DEG	R.L.Surface: 2.62 Approx.
hole diameter	80mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C				0		SP	SAND fine to medium grained, dark grey-brown, with some silt fines.	M	MD		
				D				SP	SAND fine to medium grained, brown & light brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
				D		1		SP	SAND as above.				ACID SULPHATE TEST CLEAR
										W			
						2			Borehole HA2 terminated at 2.00 m				
						3							

METHOD		SUPPORT	SAMPLES, TESTS, ETC		CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION	CONSISTENCY/DENSITY INDEX	
AS	auger screwing	Nil no support M mud	U	undisturbed sample (mm)	based on unified classification system	VS	very soft
AD	auger drilling	C casing	D	disturbed sample		S	soft
RR	roller/tricone	PENETRATION 1 2 3 4	Bs	bulk sample		F	firm
W	washbore	little resistance ranging to very slow progress	E	environmental sample		St	stiff
CT	cable tool		N	standard penetration test		VSt	very stiff
HA	hand auger		Nm	SPT + sample recovered	MOISTURE	H	hard
DT	diatube	WATER	Nc	SPT with solid cone	D dry	Fb	friable
bit shown by suffix		X not measured O none observed	VS	vane shear	M moist	VL	very loose
B	blank bit	water level	PM	pressuremeter	W wet	L	loose
V	V bit		DP	dynamic penetrometer	Wp plastic limit	MD	medium dense
T	TC bit	water outflow	WS	water sample	Wl liquid limit	D	dense
e.g.	ADT	water inflow	PZ	piezometer		VD	very dense

Coffey Partners International Pty Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

office job no: NF065/2

client:	W.P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch 100m	checked by:	[signature]

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L.Surface:	2.62 approx.
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		
				D				SP	SAND: fine to medium grained, brown & light brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
				D		1		SP	SAND: As above.				ACID SULPHATE TEST CLEAR
			▽							W			
						2			Borehole HA2 terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
N not measured O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nm SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA3

sheet 1 of 1

client:	W.P. BROWN & PARTNERS PTY LTD	office job no:	N0065/2
principal:		hole commenced:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed:	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch.150m	logged by:	AEL
		checked by:	gto.

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L.Surface:	2.78 approx.
hole diameter	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
SA		C		D				SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		ACID SULPHATE TEST CLEAR
				D		1		SP	SAND: fine to medium grained, brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽							W			
								SP	SAND: As above.				ACID SULPHATE TEST CLEAR
						2			Borehole HA3 terminated at 2.00 m				
						3							

METHOD		SUPPORT		SAMPLES, TESTS, ETC		CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION		CONSISTENCY/DENSITY INDEX	
AS	auger screwing*	Nil	no support M mud	U	undisturbed sample (mm)	based on unified classification system		VS	very soft
AD	auger drilling*	C	casing	D	disturbed sample			S	soft
RR	roller/tricone	PENETRATION 1 2 3 4	little resistance ranging to very slow progress	Bt	bulk sample	MOISTURE		F	firm
W	washbore	WATER		E	environmental sample	D	dry	St	stiff
CT	cable tool	X	not measured 0 none observed	N	standard penetration test	M	moist	VSt	very stiff
HA	hand auger	▽	water level	Nc	SPT + sample recovered	W	wet	H	hard
DT	diatube		water outflow	Nc	SPT with solid cone	Wp	plastic limit	Fb	friable
*bit shown by suffix			water inflow	VS	vane shear	Wl	liquid limit	VL	very loose
B	blank bit			PM	pressuremeter			L	loose
V	V bit			DP	dynamic penetrometer			MD	medium dense
T	TC bit			WS	water sample			D	dense
e.g.	AD/T			PZ	piezometer			VD	very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

COFFEY

engineering log - borehole

borehole no: HA4
sheet 1 of 1

client:	K.P. BROWN & PARTNERS PTY LTD	office job no:	NR065/2
principal:		hole commenced:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed:	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch 200m	logged by:	AEL
		checked by:	SAO

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L. Surface:	2.8 approx..
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
SA		C		D				SM	SILTY SAND: fine to medium grained, dark grey-brown, with 15% silt fines.	M	MD		ACID SULPHATE TEST CLEAR
								SP	SAND: fine to medium grained, light grey-brown, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽			1		SP	SAND: As above.	W			ACID SULPHATE TEST CLEAR
						2			Borehole HA4 terminated at 2.00 m				
						3							

METHOD		SUPPORT		SAMPLES, TESTS, ETC		CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION		CONSISTENCY/DENSITY INDEX	
AS	auger screwing*	Nil	no support	U	undisturbed sample (mm)	based on unified classification system		VS	very soft
AD	auger drilling*	C	casing	D	disturbed sample			S	soft
RR	roller/tricone	M	mud	Bs	bulk sample			F	firm
W	washbore	PENETRATION 1 2 3 4	little resistance ranging to very slow progress	E	environmental sample			St	stiff
CT	cable tool	WATER		N	standard penetration test			VSt	very stiff
HA	hand auger	X	not measured	Nr	SPT + sample recovered	MOISTURE		H	hard
DT	diatube	D	none observed	Nc	SPT with solid cone	D	dry	Fb	friable
*bit shown by suffix		▽	water level	VS	vane shear	M	moist	VL	very loose
B	blank bit		water outflow	PM	pressuremeter	W	wet	L	loose
V	V bit		water inflow	DP	dynamic penetrometer	Wp	plastic limit	MD	medium dense
T	TC bit			WS	water sample	Wl	liquid limit	D	dense
e.g.	ADT			PZ	piezometer			VD	very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HAS
sheet 1 of 1

office job no: NR065/2

client	K P. BROWN & PARTNERS PTY LTD	hole commenced	7.12.94
principal:		hole completed	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch 250m	checked by:	gwO

drill model and mounting	SAND AUGER	slope:	-90 DEG	R.L.Surface	2.97 approx.
hole diameter	80mm	bearing:		datum	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, dark grey-brown, with some silt fines.	M	MD		ACID SULPHATE TEST CLEAR
								SP	SAND: fine to medium grained, white, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽	D		1		SP	SAND: As above.	W			ACID SULPHATE TEST CLEAR
						2			Borehole HAS Terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured 0 none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd
ACN 003 692 019

COFFEY

engineering log - borehole

borehole no.	HA6
sheet	1 of 1

office job no: HR065/2

client:	W.P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx. Ch 300m	checked by:	GAO.
drill model and mounting:	SAND AUGER	slope: -90 DEG	R.L. Surface: 2.83 approx
hole diameter:	80mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. m	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND fine to medium grained, dark grey-brown, with some silt fines.	M	MD		
				D				SP	SAND fine to medium grained, off-white, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽										
				D		1		SP	SAND as above.				ACID SULPHATE TEST CLEAR
						2			Borehole HA6 Terminated at 2.00 m				
						3							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

SUPPORT
NIL no support
C casing
M mud

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
N not measured
O none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nr SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA7
sheet 1 of 1

office job no: N0065/2

client:	W P. BROWN & PARTNERS PTY LTD	hole commenced:	7.12.94
principal:		hole completed:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	logged by:	AEL
borehole location:	DRAIN No.1 - Approx.Ch.350m	checked by:	GD.
drill model and mounting:	SAND AUGER	slope: -90 DEG	R.L.Surface: 2.73 approx.
hole diameter	80mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, grey & brown, with some silt fines.	M	MD		
				D				SP	SAND: fine to medium grained, off-white, with a trace of silt fines.				ACID SULPHATE TEST CLEAR
			▽							W			
				D		1		SP	SAND: As above.				ACID SULPHATE TEST CLEAR
						2			Borehole HA7 terminated at 2.00 m				
						3							
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

GDF 2.30

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

Coffey Partners International Pty Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: HA9
sheet 1 of 1

client:	W P. BROWN & PARTNERS PTY LTD	office job no:	N0865/2
principal:		hole commenced:	7.12.94
project:	IRON GATES ESTATE - STAGE 1A - EVANS HEAD	hole completed:	7.12.94
borehole location:	DRAIN No.1 - Approx.Ch 465m	logged by:	AEL
		checked by:	JKO.

drill model and mounting:	SAND AUGER	slope:	-90 DEG	R.L. Surface:	2.97 approx.
hole diameter:	80mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
HA		C						SP	SAND: fine to medium grained, light brown & brown, with a trace of silt lines.	M	MD		ACID SULPHATE TEST CLEAR
				D				SP	SAND: fine to medium grained, off-white, with a trace of silt lines.				ACID SULPHATE TEST CLEAR
			▽			1		SP	SAND: As above.	W			ACID SULPHATE TEST CLEAR
						2			Borehole HA9 terminated at 2.00 m				
						3							

METHOD
AS auger screwing
AD auger drilling
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

SUPPORT
Nil no support
M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured
O none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test;
Nt SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

APPENDIX B

A P P E N D I X B

PARTICLE SIZE DISTRIBUTION

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

Coffey Partners International Pty Ltd
A C N 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
530 Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

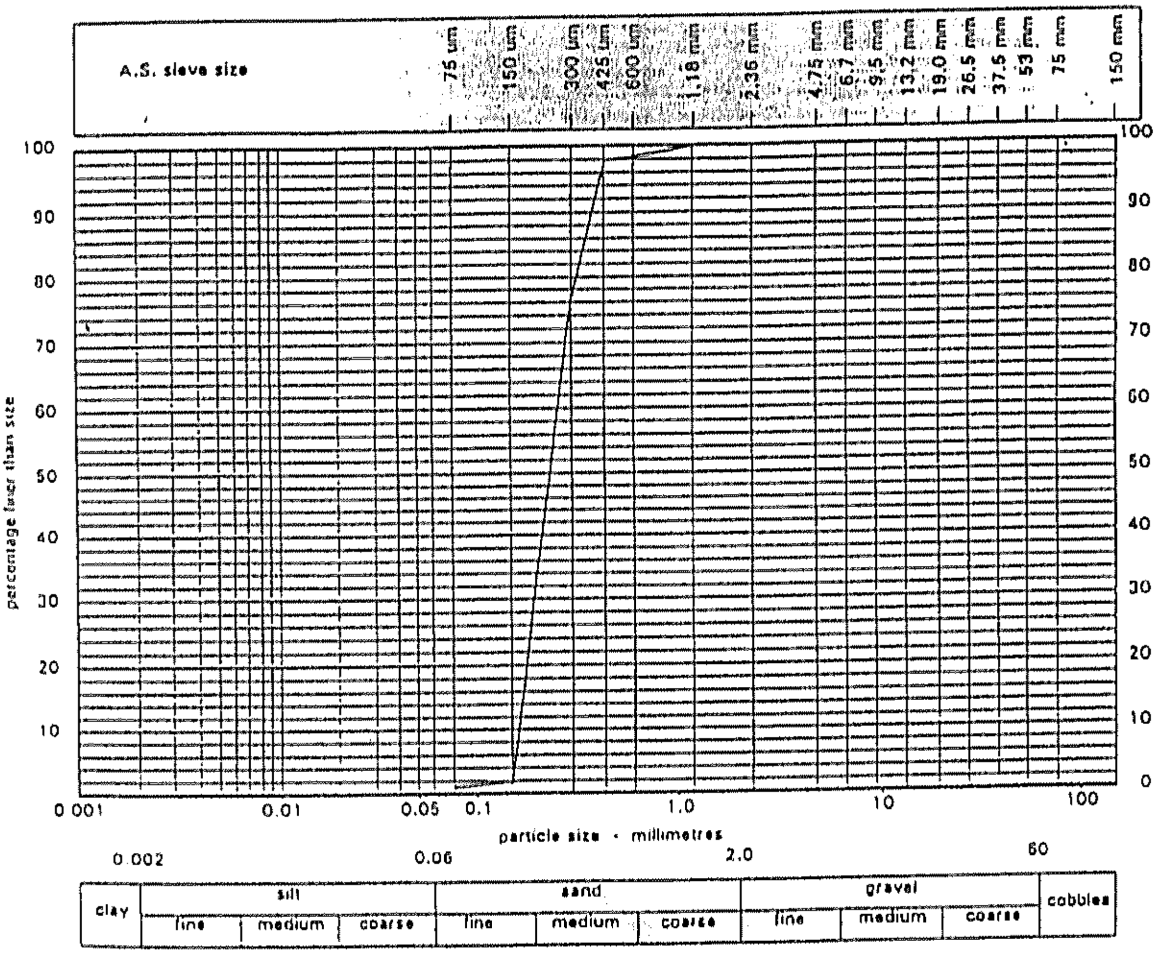
COFFEY

particle size distribution

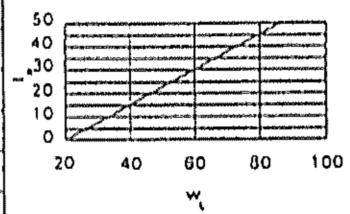
client :	WP BROWN & PARTNERS	job no :	NR865/2
principal :		laboratory :	BRISBANE
project :	IRON GATES ESTATE	date :	05/01/95
location :	EVANS HEAD	test report :	CB95001.ENG

sample identification : CB944483 Ch. 300m depth : 1.0 - 2.0m

test procedure : AS1289 C6.1



liquid limit	%	
plastic limit	%	
plasticity index	%	
linear shrinkage	%	
particle density	t/m³	
natural moisture	%	



classification :

Authorised Signature
NATA Reg. No. 596

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

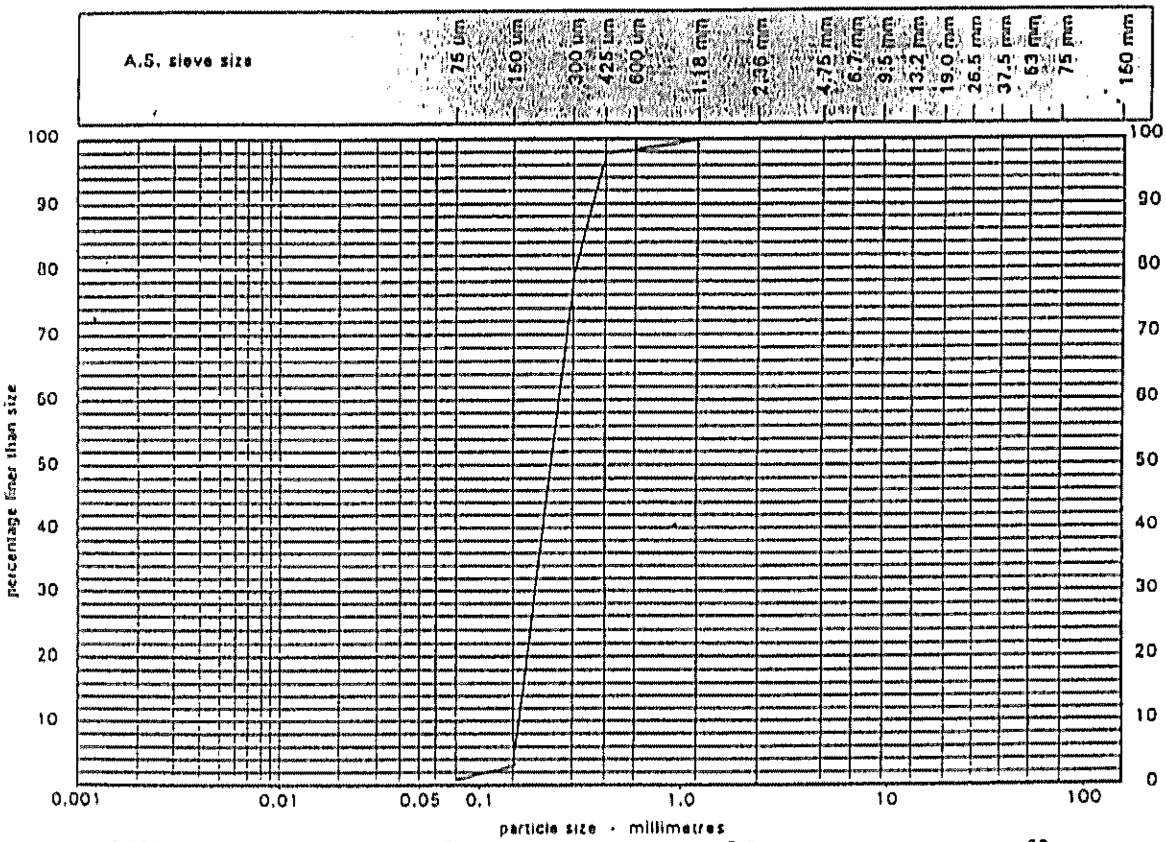
Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
53B Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

COFFEY

particle size distribution

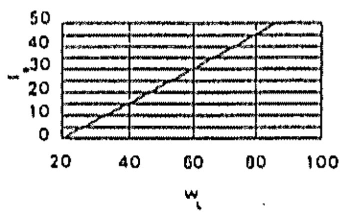
client :	WP BROWN & PARTNERS	job no :	NR865/2
principal :		laboratory :	BRISBANE
project :	IRON GATES ESTATE	date :	05/01/95
location :	EVANS HEAD	test report :	CB95001.ENG

sample identification : CB944484 Ch. 100m depth : 1.0 - 2.0m
test procedure : AS1289 C6.1



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

liquid limit	%	
plastic limit	%	
plasticity index	%	
linear shrinkage	%	
particle density	t/m³	
natural moisture	%	



classification :

Authorised Signature
NATA Reg. No. 596

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

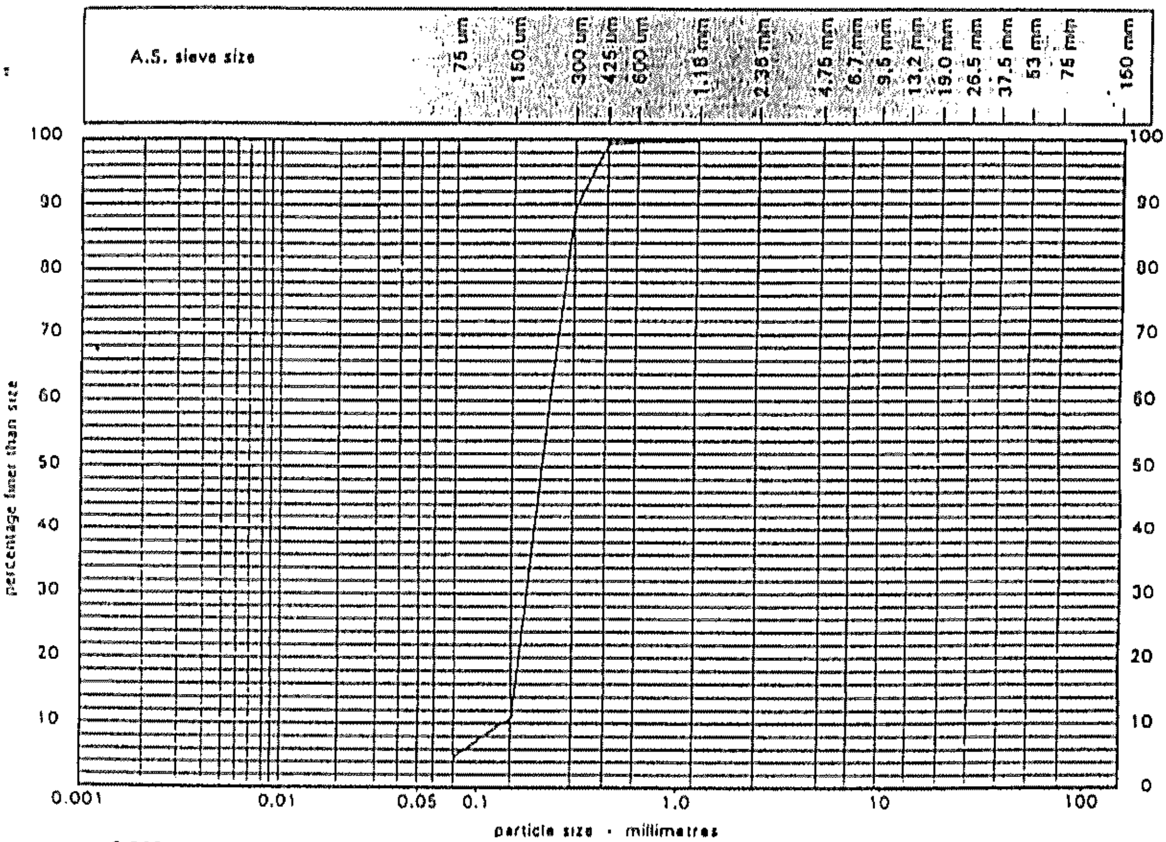
Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
53B Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

COFFEY

particle size distribution

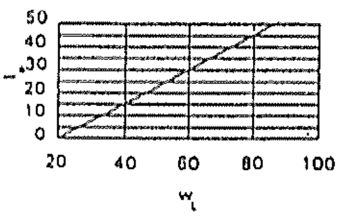
client :	WP BROWN & PARTNERS	job no :	NR865/2
principal :		laboratory :	BRISBANE
project :	IRON GATES ESTATE	date :	05/01/95
location :	EVANS HEAD	test report :	CB95001.ENG

sample identification : CB944485 Ch. 50m depth : 0.4 - 1.0m
test procedure : AS1289 C6.1



0.002			0.06			2.0			60	
clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

liquid limit	%	
plastic limit	%	
plasticity index	%	
linear shrinkage	%	
particle density	t/m³	
natural moisture	%	



classification :

Authorised Signature
NATA Reg. No. 596

HHoward
05 JAN 1995

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

0500

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

APPENDIX C

APPENDIX C

ACID SULPHATE TEST RESULTS

SIMMONDS & BRISTOW PTY. LTD.
A.C.N. 010 252 410
WATER & ENVIRONMENTAL ANALYSTS & CONSULTANTS

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

DN:PR

Ref. No. 27130
11 January 1995

The Manager,
Coffey Partners International Pty Ltd,
PO Box 108,
Salisbury, Qld 4107

Attention: Mr Brian Booker

Dear Sir,

ANALYSIS OF SOIL SAMPLES
ORDER NO. B17724 - JOB NO. NR865/2

Five (5) samples were received for testing on 13 December 19994. The results of analysis are presented in the Table attached.

Please advise if you have any queries.

Yours faithfully,
SIMMONDS & BRISTOW PTY. LTD.

D K Nial

David Nial
Supervisor - Soils Laboratory

Encl.

COFFEYSUINE

Simmonds & Bristow Pty. Ltd.
30 Shottery Street, Yeronga.
Queensland. 4104. Australia.

"For when you demand — Initiative, Accuracy & Reliability"

Phone (07) 848 7699
Fax (07) 892 3345

A.C.N. 010 252 418

Water & Environmental Analysis & Consultants

30 Shottery Street,
Yeronga, Queensland,
Australia, 4104.
Telephone: (07) 848 7699
Fax No.: (07) 892 3345

Ref. No. 27130
COFFEY & PARTNERS BRISBANE

ANALYSIS OF SOIL SAMPLES
ACID SULPHATE POTENTIAL
IRON GATES ESTATE, EVANS HEAD
JOB NO. NR865/2

Date Collected: Not Specified
Date Received: 13.12.94
Date Analysed: 13.12.94 - 09.01.95

Sampled By: Client
Sampling Method: Not Specified

SAMPLE REGD. NO.	ANALYSIS S & B METHOD NO.	INITIAL pH (1:5) G090.	pH AFTER H_2O_2 OXID'N G090.	INITIAL SO_4 SC280.4 mg/kg	SO_4 AFTER OXID'N SC280.4 mg/kg	PYRITE S %	$CaCO_3$ SC015. %	ACID SULPHATE POTENTIAL SC120. *	ACID GENERATING POTENTIAL **
97297	50M 1.0 - 2.0 CB 944478	5.4	5.6	10.	150.	<0.01	<0.2	NIL	NIL
97298	150M 0.7 - 1.5 CB 944479	5.1	6.0	5.	125.	<0.01	<0.2	NIL	NIL
97299	250M 1.0 - 2.0 CB 944480	5.5	5.2	<5.	75.	<0.01	<0.2	NIL	NIL
97300	350M 1.0 - 2.0 CB 944481	5.6	5.2	<5.	75.	<0.01	<0.2	NIL	NIL
97301	465M 0.3 - 1.0 CB 944482	5.4	5.0	10.	125.	<0.01	<0.2	NIL	NIL

* Qualitative assessment based solely on % pyrite - not subject to NATA certification.
** Qualitative assessment based on % pyrite, % $CaCO_3$ and pH after oxidation - not subject to NATA certification.

NATA

SIMMONDS & BRISTOW PTY LTD

PER C. Cochrane ....

COFFEYSBNE

0601

A B C D E F G H . K L M N O P Q R S T U V W X Y Z

APPENDIX M

ELECTRICAL AND COMMUNICATIONS SUPPLY AVAILABILITY

Preferred ENERGY Pty Ltd
electrical consultants

Energy by Design
A C N 089 041 896 A division of the
Don Family Trust ABN 33 839 164 100

12/07/19
The Technical Director
ARCADIS
Level 7 Premion Place,
Cnr Queen and High Streets
SOUTHPORT. QLD 4215
By email to: Gerard.dick@arcadis.com

Re: Electrical and Telecommunications Supply Availability

Dear Sir

I refer to your request to review the availability of electricity supply and communications infrastructure to the proposed 175 lots of the Iron Gates Development.
It will be necessary to construct new infrastructure within the development and within Iron Gates Drive to make connection available to the existing electricity and communications infrastructure within Wattle Street near the corner of Cherry Street.

Electricity Supply
When the development was planned for Construction previously the Electricity authority existing at the time was NorthPower. This authority has subsequently been merged and rebadged several times with the current network owner now known as Essential Energy. In September 1996 NorthPower made an offer to supply the development which is attached (File name EE Original 260996.pdf). I have confirmed with Essential Energy that the connection method proposed in 1996 is still appropriate and that supply would be available to the development from a connection point in Wattle Street. It should be noted that the construction of these works has been deregulated since 1996 and Essential Energy would not do the construction work but would supervise its design and installation. On completion of the works (by Authorised Contractors to an approved design) the assets would be gifted to Essential Energy and they would become responsible for the ongoing operation and maintenance of the assets. Essential Energy will not formalise this offer without an approved current DA. See EE Response 170519.pdf. Once the DA is approved EE will formalise the design requirements after receiving an application.

Communications Infrastructure
In a similar manner to Essential Energy NBN do not carry out works within the development but rely on the developer to arrange an authorised design and installation of pit and pipe infrastructure. This is then gifted to NBN prior to land registration. NBN require a contribution from the developer for each connection required as well as a contribution for lead in works to extend the NBN network to the boundary of the pit and pipe installed by the

developer. NBN have made an offer to the developer and is attached as NBN Offer 210817.pdf. This offer establishes an NBN Developer Reference number which is used for the design and construction of the pit and pipe and the contractual payments between the developer and NBN. The next step in this process is to do an NBN design and submit to NBN for Approval.

Summary

In terms of connection availability to the overall development I can confirm that technically nothing has changed since 1996 in terms of the connection points and supply availability. Since this time the administrative procedures, technical standards for the new equipment and mechanism for its installation has changed. None of these changes have affected the concept that supply will be available from both networks provided the necessary installation works are carried out by the developer.

Yours Sincerely

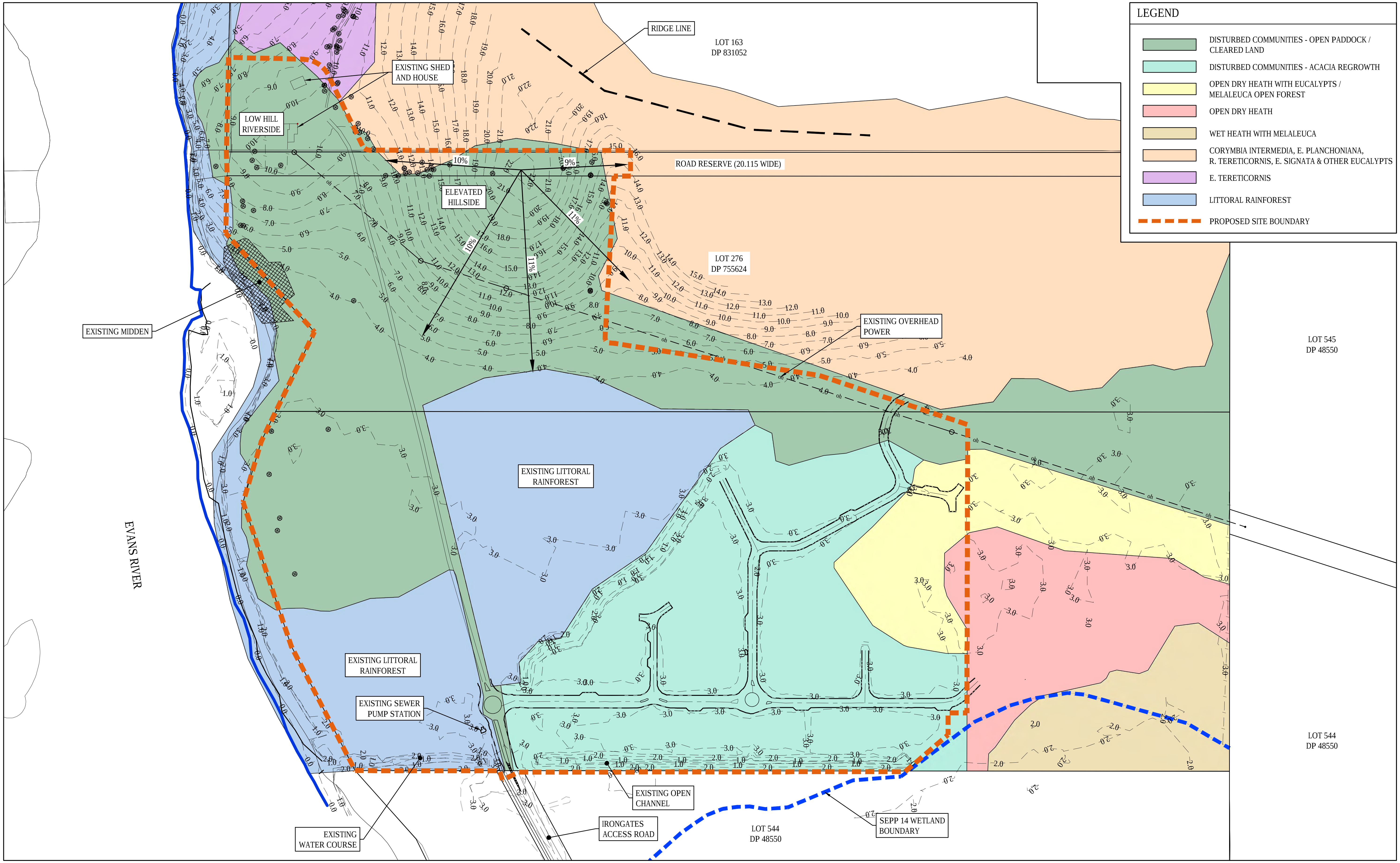
Greg Don

Greg Don
B.Sc., B.E., M.B.A., M.I.E.
Director
Preferred Energy Pty Ltd
Level 3 ASP no 3479

Suite 8a, 19-21 Coldstream St
YAMBA NSW 2464
preferred.energy@bigpond.com
0438426631

APPENDIX N

SITE ANALYSIS & DESIGN RESPONSE PLANS



Issue	Description	By	Ckd	RPEQ	Date
01	ORIGINAL ISSUE	NF	GD		17.07.19

Scale
0 15 30 60 90 120 150m
1 : 1500

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename SiteAnalysisPlan2.dwg

Client
GOLDCORAL PTY LTD

Status
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Approved
R.P.E.Q No :

Scales	1:1500	Original Issue Signatures
		Drawn N. FAHEY
Original Size	A1	Designed G. DICK
Height Datum	AHD	Project Manager G. DICK
Grid		Ⓒ Copyright reserved

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

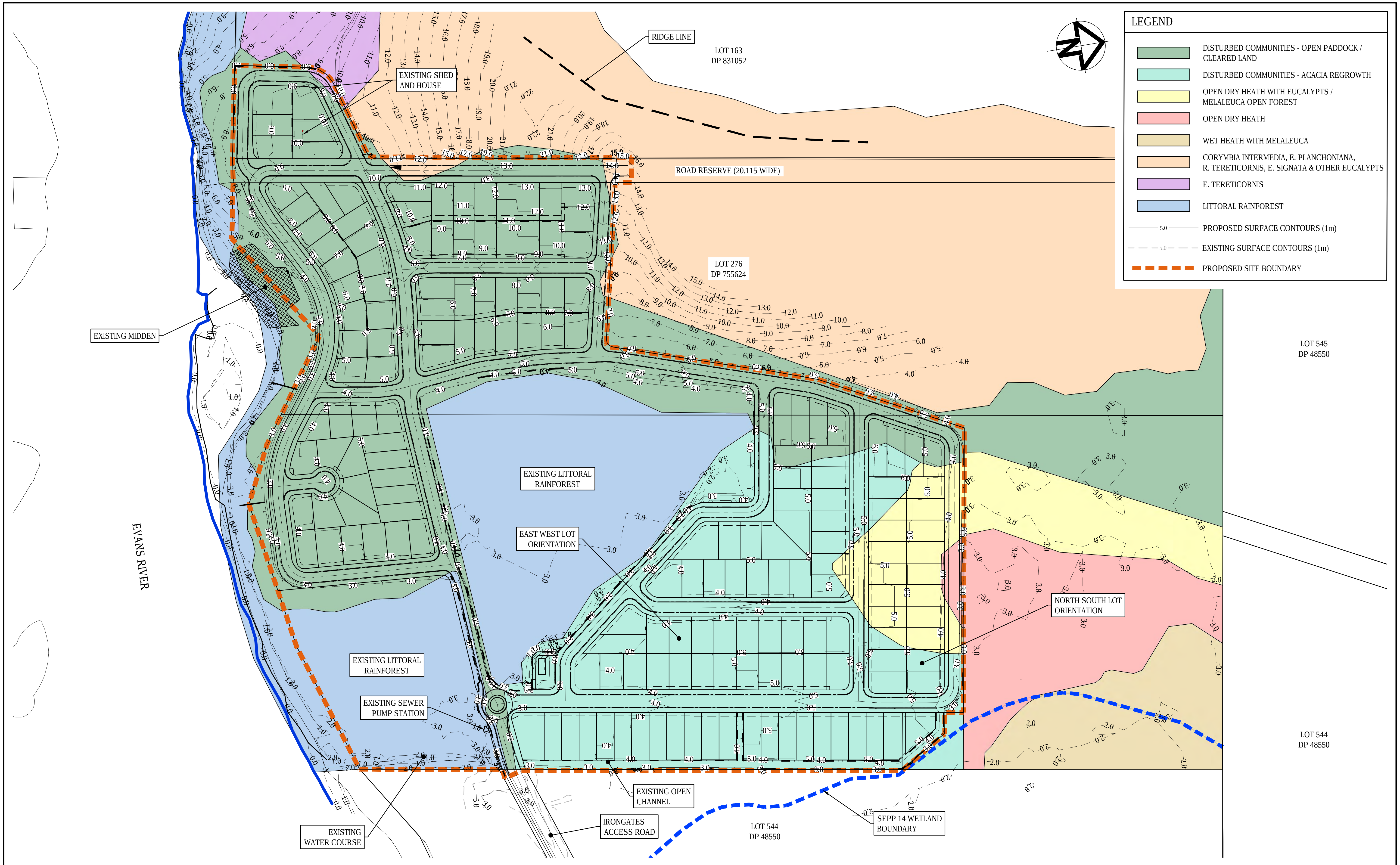
Title
SITE ANALYSIS PLAN

ARCADIS
Arcadis Australia Pacific Pty Limited
P O Box, 1653
Southport QLD 4215
ABN 76 104 485 289
Tel No: +61 7 5532 3933
Fax No: +61 7 5591 4778
www.arcadis.com

Drawing No.	Project No.	Issue
####	AA007094	01

100mm on Original

F:\AA007094\E-CAD\C-Civil\B-Sketches\SiteAnalysisPlan2.dwg 17/Jul/2019 10:08 AM V1



Issue	Description	By	Ckd	RPEQ	Date
01	ORIGINAL ISSUE	NF	GD		17.07.19

Scale

0 15 30 60 90 120 150m

1 : 1500

Surveyor: ROBERT A HARRIES SURVEYOR

Architect

Filename: DesignResponse.dwg

Client: GOLDCORAL PTY LTD

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Approved

R.P.E.Q No :

Scales: 1:1500

Original Issue Signatures

Drawn: N. FAHEY

Designed: G. DICK

Original Size: A1

Project Manager: G. DICK

Height Datum: AHD

Grid

Project: RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title: DESIGN RESPONSE PLAN

ARCADIS
Arcadis Australia Pacific Pty Limited
P O Box, 1653
Southport QLD 4215
ABN 76 104 485 289
Tel No: +61 7 5532 3933
Fax No: +61 7 5591 4778
www.arcadis.com

Drawing No.	Project No.	Issue
####	AA007094	01

100mm on Original

F:\AA007094\E-CAD\C-Civil\B-Sketches\DesignResponse.dwg 17/Jul/2019 10:50 AM V1