

JOHN HOLLAND PTY LTD

**SOUTHWOOD PROJECT – GEOTECHNICAL & HYDROGEOLOGICAL
INVESTIGATIONS**

HUON DISTRICT, TASMANIA

HO154/1-AG

30 August 2002


Coffey

HO154/1-AG AG
30 August 2002

John Holland Pty Limited,
70 Trenerry Crescent,
ABBOTSFORD VIC 3067

Attention: Mr Trevor Webster

Dear Sir,

RE: Southwood Project –Geotechnical & Hydrogeological Investigation

Please find attached our report on the geotechnical and hydrogeological assessment of the proposed Southwood project development at a site near the confluence of the Arve and Huon rivers.

Please feel free to contact the undersigned if you have any queries on this report.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

BARRY MCDOWELL

HOBART OFFICE MANAGER



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1. INTRODUCTION

1.1 General

This report describes the geotechnical investigations and hydrogeological investigations carried out for John Holland Pty Ltd (JH) on the proposed project located at the Southwood site, Huon, Tasmania.

Mr. Trevor Webster of JH commissioned Coffey Geosciences Pty Ltd (Coffey) to carry out the geotechnical investigation works for this project following acceptance of Coffey's proposal ref Ho154/1-AB of 1 August 2002, based on the brief supplied by John Holland Development Investment Pty Ltd (JHDI).

It is understood that the project comprises the construction of the following main features:

- Power Station;
- Mechanising Yard;
- Veneer Mill and Saw Mill;
- Wood fibre Mill and Fuel processing; and
- Stormwater Pond 1

Coffey has undertaken a preliminary geotechnical assessment for this site and the information is presented in the report referenced HO53/1-AB, dated 23 August 2000. The findings of that report have been addressed as part of the evaluation carried out in this report.

An A1 sized contour plan of the site and proposed layout was provided by Forestry Tasmania for field use. Preliminary earthworks site plans and sections produced by GHD, were provided by JHDI in PDF format to assist in planing the field work and provide a base for geotechnical plans. Recent air photos (24/2/02) were sourced from Services Tasmania.

The development is expected to cover some 40ha area. Preliminary earthworks sections for the merchandising yard (GHD drawings 3210596-04 to -07) indicate cuts and fills up to 9m high, but typically 2 to 4m high.

1.2 Scope of Work

The purpose of this investigation, as described in the JHDI brief are to:

- Meet the relevant conditions set out in the development approval (Geo1, Geo2, GW1, part GW3, and GW4);
- Provide information to enable the economic design of the various structures on site.

The scope of work was limited by JH due to time constraints and site access issues prior to construction commencing. The scope is, however consistent with a staged approach appropriate to investigation and development of such a large site where final decisions on the exact location and nature of development have yet to be finalised. The scope of work adopted was as follows:

- 1 borehole to assess foundation conditions for potential pile or large scale footings at the power station site. To be converted to a temporary groundwater monitoring well (destroyed during construction of the power station) to satisfy GW4 and GEO1 assessment;
- 1 'deep' groundwater monitoring well (to standard environmental protocols) to assess and monitor

groundwater conditions before and during construction and operation. Location to be confirmed with GHD and MRT;

- 1 borehole completed as a groundwater monitoring well (replaces the original probe hole in JH brief) to be located immediately down gradient of the proposed stormwater storage dam (as shown on current drawings) to assess groundwater conditions on the up slope part of the site and allow monitoring down gradient of the storage dam during operations;
- 4 test pits across the proposed mil sites to assess foundation bearing capacities;
- 3 pits to obtain CBR samples from the sub grade depth (to be confirmed) for proposed hardstand areas (pavement design can be provided by Coffey if required);
- Clay borrow assessment by test pitting in areas identified by the walkover;
- Laboratory testing of clay borrow materials to assess suitability in terms of DPIWE guidelines and relevant national standards;
- Laboratory testing of subgrade samples to assess CBR characteristics;
- Development, permeability testing and sampling of groundwater monitoring wells;
- Reporting of geotechnical findings and recommendations for bearing capacities, cut and fill batter angles, foundation concepts, pond concepts and any further work required to achieve detailed design;
- Assessment of hydrogeological conditions on the site, development of a conceptual model for input to an impact risk assessment by GHD (water quality data will not be available in time to incorporate in a draft report).

2. FIELD WORK

2.1 General

The field work consisted of:

- Drilling three boreholes (SMB1, SMB2 and SMB3) using a truck-mounted drill rig at the locations shown on Figure 1, to a maximum depth of 31.5 metres (BH1). Locations were limited by the inability to access areas away from established roads and formed tracks. Logging of the materials penetrated was undertaken during drilling, followed by installation of groundwater monitoring wells in the three boreholes for water sampling. Development, purging, sampling and permeability testing of the monitoring wells was also conducted (see Section 2.2);
- Excavation of 13 test pits using a 20t excavator at the locations shown on Figure 1, to a maximum depth of 6.7 metres (TP1). Logging, soil sampling and observations of groundwater conditions were carried out during excavation. Some of these test pits were excavated to recover samples for CBR and associated testing (STP2, STP3 & STP13), while STP1, STP4, STP5, STP7 and STP8 are "foundation" pits for the assessment of the soils at the formation levels of proposed building. Test pits STP6, and STP9 to STP12 were excavated at the north western corner of the development site investigating the presence of clayey materials for construction of a dam, intended to be located in that vicinity.

- Geological and geomorphological observations from site walkovers, and office based assessment of air photos.

The three boreholes were planned to intersect varying underlying geological conditions, due to proposed drill depths and location within the Southwood site. Unforeseen conditions present in SMB1 resulted in extension of the borehole some 20m beyond the proposed target depth to establish bedrock. Easy washbore drilling in silt, sand and clay layers, with only 2 recognised gravel/ cobble horizons, persisted to a depth of 27.2 metres, before any rock core was recoverable. The conditions encountered in this borehole extended the total drill metres for the project, and the total drilling program by 1.5 days.

The other two boreholes (SMB2 and SMB3) did not encounter hard rock that could deliver a core sample. SPT tests were carried out within clay layers in these boreholes.

The borehole drilling and excavation of the test pits were carried out in the period 12 to 15 August 2002. Site walkovers were undertaken on 8 August and 27 August 2002, with bore permeability testing conducted on 20 August 2002.

The engineering logs and photos of boreholes and test pits are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation. Monitoring well details and falling head permeability testing records are presented in Appendix B.

The test pits have been located by hand held GPS and map estimates. Forestry Tasmania personnel surveyed the locations of the boreholes.

2.2 Monitoring Well Installation

Three ground water monitoring wells were installed in boreholes drilled between the 12th and 15th August. The wells are designated SMB1, SMB2 and SMB3 (see Figure 1).

All wells were constructed using machine slotted 3m PVC screen at the base of the hole and screw-jointed PVC casing to surface. Graded sand was used to backfill the boreholes around each monitoring well, with 0.5m of bentonite and 0.5m concrete comprising the final 1m below surface. All wells were completed with 100mm PVC casing covers and caps, standing approximately 1m above ground surface.

Soil and rock types encountered during drilling of the wells were described in the field and logs of boreholes are provided in Appendix A.

2.2.1 Well Development

Wells were developed on completion of each borehole. SMB1 failed to record a standing water level once installation was complete. Development of SMB2 and SMB3 continued until the bulk of drilling fines had been removed, or the water level was reduced to the base of the well.

A summary of conditions for each groundwater well is provided in Table 1.

2.2.2 Bore Survey

The completed monitoring wells (SMB1, SMB2 and SMB3) were surveyed to establish their respective locations and elevation. Survey locations were conducted by Forestry Tasmania and are presented on the logs in Appendix B.

2.2.3 Groundwater Sampling

Groundwater sampling was conducted by a Coffey scientist on 15th August 2002. Samples were taken to establish baseline information for the long-term monitoring of water quality. Prior to sampling, the water level at each bore was recorded and then each well was purged to standard environmental protocols, i.e. between 3 and 5 bore volumes were removed and field water quality parameters (pH, EC and temperature) were measured prior to sampling.

Groundwater samples were recovered from two of the three wells SMB2 and SMB3; with samples retaining the borehole nomenclature. Samples were decanted immediately into appropriate sample containers, then placed in eskies with ice, and dispatched to the designated laboratory (WSL) using standard environmental sample handling and chain of custody protocols.

All work was conducted in general accordance with standard Coffey environmental protocols with respect to sampling procedures.

Table 1: Summary of Monitoring Bore

Bore No.	Construction & Monitoring Date	Drill Depth	Screen Interval	Geology of the screened interval	Measured depth from water to top of PVC	Stick up of PVC	RL of natural surface	pH	EC (dS/m)
SMB1	14/08/02	31.5m	5.11-8.11m	Silty Sand	Dry well*	0.6m	103.55	NA	NA
SMB2	14/08/02	10.8m	6.85-9.85m	Silty Clay	3.42m	0.95m	93.68	3.89	0.08
SMB3	15/08/02	6.5m	3.7-6.7m	Sandy Clay	2.99m	0.55m		5.15	0.21

* Borehole water level measured at 16.5m when borehole depth at 31.5m. Well installed as temporary monitoring point to assess perched groundwater within influence of the development.

3. LABORATORY WORK

3.1 Geotechnical

For the test pits located at the footprints of the proposed structures, a set of CBR, Standard Compaction and Atterberg Limits testing was undertaken on three samples recovered from test pits STP2, STP3 and STP13, to assess the soil subgrade for design of pavements in the merchandising yard and access roads. In addition, two samples were selected from test pits STP6 and STP11 for laboratory permeability, Standard Compaction and Atterberg Limits testing to assess the properties of the soils and weathered rock for possible use as clay liner for proposed dams on the site.

Samples collected during previous fieldwork by GHD (Sample 1, MY1 and MY2) and tested by Coffey, are included in this report for completeness. The results of the laboratory testing are summarised in Table 2 and presented in Appendix C.

Table 2 Summary of Geotechnical Laboratory Test Results

Test Pit Location	Sample Depth	Atterberg Limits			Std Compaction		CBR (%)	Permeability (m/sec) *
		PI (%)	LL (%)	Linear Shrink (%)	Max Dry Density (t/m ³)	Optimum Moisture Cont (%)		
STP2	2.0-2.5m	10	35	6.5	1.64	19.0	13	
STP3	2.0-2.5m	18	36	7.5	1.90	13.0	11	
STP13	1.0-1.5m	6	27	3	1.73	18.0	20	
STP6	0.4-1.2m	26	55	10.5	1.44	30.5		3.5E - 9
STP11	0.4-1.2m	15	37	7.5	1.44	21.5		1.2E - 8
Sample#1 (existing gravel pit)	Surface	N.P	N.P	0	1.97	9.5	90	
MPY1	0.5-1.0m	9	28	6	1.71	19.5	20	
MPY2	>0.5m	11	37	8				

*compacted sample tested at MDD and OMC.

3.2 Water Quality

Water testing was undertaken on samples recovered from two of the three monitoring boreholes and sent to WSL laboratories in Melbourne, where the following tests were performed:

- Aromatic hydrocarbons (2 tests)
- TPH (2 tests)
- Total N (2 tests)
- Total P (2 tests)
- Anions content (Cl, PO₄, SO₄, CO₃, HCO₃) (2 tests)
- Cations content (Ca, Mg, Na, K, Al) (2 tests), and
- Faecal Coliforms & Streptococci (2 tests)

3.2.1 Groundwater Analytical Results

The analytical results are summarised in Table 3 and presented in Appendix D.

Table 3 Summary of Groundwater Analytical Results

Analysis	Monitoring Bore SMB2	Monitoring Bore SMB3
Faecal Coliforms	Absent	Detected
Faecal Strep.	Low levels present	Low levels present
Total N (mg/L)	2.5	3.9
Total P (mg/L)	0.21	0.52
Aromatic Hydrocarbons (mg/L)	<0.001	<0.001
TPH (mg/L)	<0.1	<0.1

Note: details of anions and cations are provided in the laboratory reports.

4. SITE CONDITIONS

4.1 Location & Existing Developments

The proposed development site occupies an area of about 40ha and is situated on a broad ridge, trending roughly north-south, bordered on 3 sides (west, south, east) by an incised meander of the Huon River, where the Arve River flows into the Huon.

Existing site development consists of the recently constructed Geeveston/Judbury Road, bridge over the Huon River, forestry tracks, as well as other excavated flat areas.

4.2 Geology

The Geological Atlas 1:250,000 digital series Geology of Southeast Tasmania produced by Mineral Resources Tasmania (1999 edition) indicates that the proposed development site is underlain by Permian Age siltstone and sandstone deposits.

Further geology and geomorphology information can be found in the report titled "Geomorphic Values Survey: Barnbaback Block, Huon Forest District prepared by Mr. C Sharples for Forestry Tasmania (Huon Forest District). This report indicates that the area is underlain by Permian marine siltstone and sandstone bedrock, with an erosion remnant of Quaternary glacio-fluvial material forming a 'cap' on the top of the high level terrace at the site.

Observations for this study include the following:

- Bedrock comprising Permian siltstone, mudstone and some sandstone beds exposed in road cuttings (see Figure 2) and sub crop around the site. Highly weathered, low to medium strength, bedding dip approximately 5° towards the SW (with potential for minor variations), sub vertical joint sets striking NW-SE and NE-SW, and sub vertical shear/fault zones (containing altered and weathered material) striking approximately N-S;
- Quaternary glacio-fluvial alluvium, exposed in road cuts across the site, comprising Silty Sand,

Sandy Clay and Silt with varying proportions of generally matrix supported, rounded gravel and cobbles (10 to 40%), and some Sandy Gravel lenses (clast supported). Sand and silt are generally fine grained, with low to medium plasticity clay and silt.

4.3 Geomorphology

4.3.1 General

The site is located on the crest and side slopes of a broad ridge with gentle upper slopes of approximately 5 to 10°, side slopes in the range of 10 to 20°, and locally 25 to 30° at the toe beside the Huon River (see Figure 2). The morphology is that of a remnant alluvial aggradation terrace at approximately RL100 to 106m that has been dissected by erosion of the Huon River (current approximate RL 40m) to produce lower degradation terraces and isolated remnants of alluvium (see Figures 2 to 4). Gullies and stream courses dissect the side slopes of the ridge, with head slopes in the region of 30°, discharge to the relatively narrow (<20m) modern floodplain of the Huon River. The Weld Plains to the west of the site represent a lower level (approximately RL 50m) alluvial terrace system that has also been mapped further downstream of this location.

Active natural erosion was not evident on any of the side slopes, which are blanketed with thick vegetation comprising button grass and heath on the terrace remnants and eucalypt forest on the slopes. The vegetation distribution reflects surface soil development, with a generally poorly drained peat sward occurring on the terrace remnants, and clay/silt colluvial soils developed over bedrock on side slopes.

Specific zones of groundwater seepage on side slopes were not observed during site walkovers due to the masking effects of persistent wet weather in recent months. However seepage is indicated towards the base of the alluvial terrace remnants and on the steeper lower bedrock slopes above the Weld Plains and the recent Huon River flood plain.

4.3.2 Landslides and Slope Stability

The previous work undertaken by Coffey (report ref HO53/1-AB, dated August 2000) had described a possible ancient landslide in bedrock on the side slopes at the SW end of the site (below the proposed power station and water pond). The geomorphology of this feature and 2 other possible large landslide features were confirmed by an overview of topographic maps and air photos for this study. The 3 possible landslide features are marked A, B and C on Figure 2.

A site walkover of the features has not revealed any field evidence to support the existence of landslides. If these features are landslides they are ancient failures that occurred in bedrock at a critical point in the down cutting of the Huon River, possibly several thousand years ago during rapid climate change at the end of the last glacial period.

Due to the age of features A, B and C, the degree of erosion and degradation, the absence of any evidence for recent or ongoing instability and the proposed location of development at least 50 to 100m from the crest of these features it is assessed that they do not pose a threat to site development.

Evidence of small scale recent and active slope instability, including in the heads of gullies, is absent. Soil creep is occurring on the bedrock and colluvium slopes along the Huon River, and there is potential for undercutting and local failures on these slopes. It is assessed that such failures would be very unlikely to undercut or otherwise affect the main upper terrace area.

4.4 Sub Surface Conditions

The information on sub surface conditions inferred from the test pits, boreholes and mapping observations that are to be encountered in the 2 main development areas is summarised in Tables 4 and 5 below. Natural scale cross sections presented in Figures 3 and 4 depict the main geological units, observed groundwater levels and extrapolated indicative bedrock structure.

Table 4: Southern Area, Main High terrace, Power station, Fuel storage, Merchandising Yard

Geotechnical Unit	Thickness, m	Typical depth, m	Comments
Topsoil – Peat sward	0.2-0.5	0.3	Root zone & peat, generally wet, restricted drainage due to underlying coffee rock layer.
White Sand/Silt, or	0.3-0.4	0.6	STP1, STP3 & STP13; typically non-plastic silts and in a very loose state
Natural Clays	0.3-0.5	0.5	Occurs occasionally on the high level terrace in place of the white sand and coffee rock (e.g. STP1), typical pocket penetrometer tests range 170-300 kPa
Organic/Fe layer, partially cemented ('coffee rock')	0.05-0.2	0.7	Underlying the white sand silt layer (e.g. STP3 & STP13)
Alluvium (Glacio-fluvial)	5 to 25	6 to 26 Approx base RL 80m in the east to 90-100m in the west	Sand, silt and clay, fine grained, low to medium plasticity, with some gravel to gravelly. Some zones or lenses of sandy gravel (e.g. gravel pit in the NE of the terrace), medium dense to dense; soil matrix generally returned pocket penetrometer values of 300 to 600 kPa. Excavated in all test pits on the main terrace, except TP10 which encountered bedrock at 1m depth on the terrace margin.
Residual soils	0.5 to 2	6 to 28	1.5m of black high plasticity clay intercepted in SMB1, possible weathered carbonaceous mudstone or organic soil at the base of the alluvium?
Bedrock			Siltstone, mudstone and sandstone, extremely to highly weathered and very low to low strength for in the upper 1 to 5m (depending on lithology and presence of steep shear zones). The 50% core recovery from 27.2 to 31.5m in SMB1 was extremely weathered, and fractured.

Table 5 North West Area, Bedrock Slopes, Veneer Mill, Saw Mill, Woodfibre Mill & Dry Mill

Ground Unit	Thickness, m	Typical depth, m	Comments
Topsoil	0.05-0.5	0.3	Silt/Clay soil with root zone & peat, generally wet
Residual soils	0.4-0.7	0.9	Typically clayey silts and sandy silts (uncovered at STP4 to STP12 inclusive). The residual cohesive soils were typically stiff, but occasionally firm, while the non plastic soils ranged from loose to dense
Bedrock	Extremely weathered approx 0.5-2	Extremely weathered 2-3	Siltstone and sandstone, extremely to highly weathered, very low to low strength (rock ripper used from 0.5m depth at STP4, 2.2m at STP5 & from 2.6m at STP7). Steeply joints dipping to wards the west noted in some test pits.

4.5 Groundwater

Surface water and saturated topsoil conditions were prevalent at the time of the field work for this study. Ponded water in the soils on the main terrace and other remnants suggest that the drainage of the soil is impeded by the development of a thin partly cemented 'coffee rock' layer at about 1m depth..

The test pits generally did not encounter ground water, with the exception of the north-western corner of the site where some seepage was encountered in three of the test pits, as follows: STP6 (seepage from the southern side at 1.8m depth), STP10 (seepage at the northern corner at 0.9m depth), and STP12 (seepage at the southern side at 1.6m depth). This is the location of the proposed stormwater dam.

Standing water levels within two monitoring wells SMB2 and SMB3 were measured at 2.43m and 2.44m below ground level respectively. These water levels represent shallow groundwater within sandy aquifers overlying clayey alluvium. The monitoring well SMB1 is dry indicating that there is no perched aquifer at this location beneath the topsoil on the main terrace. The standing water level measured in the borehole before installing the well was 16.5m (with the hole collapsed back to 25m from 31m), suggesting that the silty sand and sandy clay materials are vertically well drained.

The results of hydraulic tests conducted in the monitoring wells (presented in Appendix B) indicate permeabilities in the order of 10^1 to 10^2 m/day for the perched sandy aquifers and approximately 10^{-3} m/day for the unsaturated silty sand materials in SMB1.

A conceptual model for the groundwater system based on site observations and investigations is presented in Figure 5. This model is considered appropriate for developing a groundwater impact risk assessment and using as the basis for establishing a long term groundwater monitoring network at the site, once development locations are finalised and access is available to suitable monitoring sites.

The major groundwater implication for development is that site earthworks that strip the upper layers of alluvium will be exposing the deeper alluvial aquifer to direct infiltration from site activities.

5. DISCUSSION AND RECOMMENDATIONS

5.1 Slope Stability

Natural slope stability is not considered to be a significant risk to the development provided standoffs of 100m from the potential ancient landslide features (Figure 2) and the crests of side slopes steeper than 20° are maintained. Any structures that are required inside the stand off zone will need a specific investigation to assess local subsurface conditions and risk of slope instability.

5.2 Earthworks for the Merchandising Yard

Site development will involve cuts up to 8 metres (as shown on Drawing 3210596-04, CH 100 at the location of the power station), and fills of up to about 7 metres (see CH 200 through the Fuel processing unit).

Excavation using ordinary earthworks machinery should be capable of excavating to the required foundation level, although ripping may be required on the western limit of the yard if siltstone and sandstone bedrock is encountered (will depend on final subgrade levels). The excavated materials should be suitable for usage to build up the formation levels for the foundations of the structures.

The general procedure recommended for engineered fill under roads and structures are as follows:

- Strip all existing fill, topsoil to spoil or stockpile for re-use as landscaping material only.
- Compact the exposed surface (upper 150mm) to a dry density ratio of 98% Standard Compaction (AS1289 54.1-1993). In any area where the above level of compaction cannot be achieved, excavate to a depth of 0.3 meters and fill with clean granular fill and compact as specified above.
- Place and compact clean fill in 150mm thick (compacted) layers to 95% Standard under roads and to 98% Standard under buildings and hard stand areas.
- The upper 150mm beneath road pavements should be compacted to 98% Standard Compaction.

Clay fill should be placed within +/- 2% of Standard Optimum Moisture Content. Where fill consists of clean sand and gravel, then it shall be compacted to a minimum 80% Density Index (AS1289 56.1-1993).

Where fill is placed on slopes in excess of 1V:8H (7°), a prepared surface should be benched/stepped into the natural slope. Proper sub-surface drainage should be provided beneath the new fill, as appropriate.

Based on the laboratory test results a subgrade CBR of 10 is recommended for the merchandising yard area.

5.3 Cut and Fill Batter Stability

Excavated slopes, not exceeding 8 metres height in natural ground areas should be constructed no steeper than the following:

- 1 V: 2H in alluvium, colluvium and residual soil;
- 1V:1.5H in extremely weathered rock;
- 1V:0.5H in highly weathered to fresh, sub-horizontally bedded rock.

Fill slopes constructed under engineering control should not be steeper than 1V:2H.

For all slopes:

- slope drainage should consist of catch drains
- erosion protection should be provided.

Support by retaining wall or specific investigation and design of slopes will be required if steeper slopes than those indicated above are required.

5.4 Foundations Of Structures

5.4.1 Shallow Foundations

Provided that the earthworks are undertaken in accordance with AS AS3798 "Guidelines on Earthworks for Commercial and Residential Developments", and the recommendations in Section 5.3, an allowable bearing capacity of 100 kPa should be available for the design of the foundations of new structures on fill.

Consideration should be given to the potential for differential settlement of foundations constructed partially on natural ground and partially on fill. Piled foundations for footings and slabs on fill may be appropriate for settlement sensitive structures.

Subject to inspection of all footings by a suitably qualified and experienced geotechnical engineer at the time of the foundation excavations, an allowable bearing capacity of 200 kPa should be available on alluvium and residual soils.

Shallow footings on weathered rock may have an allowable bearing capacity of 1000kPa, subject to inspection of all footings by a suitably qualified and experienced geotechnical engineer.

5.4.2 Deep Foundations

Piled foundations for heavily loaded structures on alluvium could include driven or bored piles. Preliminary estimates of allowable capacity are as follows:

- Driven or bored piles in very stiff clay, shaft resistance 20 to 25kPa;
- Driven piles in granular soils, shaft resistance 20kPa;
- Bored piles in granular soils, shaft resistance 10kPa;
- Driven piles end bearing capacity on extremely to highly weathered rock, 1000kPa;
- Bored piles end bearing capacity on extremely to highly weathered rock, 500kPa.

Note that large diameter bored piles may have advantages in terms of capacity achieved through large shaft surface area and stiffness of the pile for sensitive structures. Depending on the sensitivity of structures to settlement piles may have to be taken to rock. Further investigation will be required to assess site conditions sufficiently for detailed design and costing of foundations.

5.5 'Clay' Liner for Dams

Samples collected from residual soil and weathered rock in the NW area of the site are considered suitable for use as low permeability liner materials. The low plasticity, observed field moisture contents and compacted permeability values of 1×10^{-8} to 3×10^{-9} m/s indicate that design requirements required in the development approval can be achieved. Borrow would involve stripping of approximately 0.3m of top soil followed by excavation of 1 to 2m of suitable material. Further assessment and testing will be required when a clay borrow

area is finalised to ensure that the overall (bulk) natural properties will be suitable.

5.6 Construction Monitoring of Merchandising Yard

Variations in ground conditions may occur between test locations. If conditions other than those described are encountered, further advice should be sought without delay.

During excavation, site visits should be made by a Geotechnical Engineer or Engineering Geologist to ensure that the uncovered ground conditions are as those anticipated during the site investigation stage.

During the field compaction of the fill materials, layer thickness and coverages by the compactor should be carefully controlled and density in places and compaction tests taken as required for the relevant level of fill construction.

5.7 Further Investigations

Additional investigations will be required at the location of all structures to assess specific footing and foundation conditions. This work should be conducted in conjunction with detailed design studies when the location of structures has been finalised. The power station site in particular will require investigation to establish the parameters for the design of piled foundations. We recommend that at least 3 boreholes will need to be drilled to rock, with Standard Penetration Tests undertaken at 1.5 metre intervals. Coring of the rock should be conducted for at least 3m in at least 2 of the boreholes.

Further investigation and laboratory testing is also recommended on the foundations of and the materials to be used for the dam construction.

Establishment of a long term groundwater monitoring well system will be required once the location of structures is finalised and access is available to suitable long term monitoring sites. The long term monitoring system will need to be designed to allow monitoring of the major aquifer systems and associated contamination pathways identified in the conceptual groundwater model. At this stage we would envisage an additional 3 or 4 wells.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

APPENDIX A

Engineering Logs of Boreholes and Test Pits

APPENDIX B

Monitoring Bore Permeability Test Results

APPENDIX C

Laboratory Test Results – Soil

APPENDIX D

Laboratory Test Results – Groundwater

Borehole No. **SMB1**

Engineering Log - Borehole

Sheet 2 of 4

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **12.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance											
method	penetration			notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	hand penetrometer			structure and additional observations
	1	2	3									100 kPa	200 kPa	300 kPa	
W						9		SM	SILTY SAND: quartz sand particles, white, some to trace gravel and cobbles (<i>continued</i>)	M	MD/D				
						10									
						11									
						12		CL	Core Borehole. Clay with some quartzite gravel and cobbles. Recovery <20%		VS/H				
						13									
						14									
						15		CL	SANDY CLAY: medium plasticity, medium density, pink						becoming harder to drill
						16									

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE HO154-1-GR.J. COFFEY.GDT 28.08.02

Borehole No. **SMB1**

Engineering Log - Borehole

Sheet 3 of 4

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **12.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance											
method	penetration			notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	hand penetrometer			structure and additional observations
	1	2	3									100 kPa	200 kPa	300 kPa	
W						17	CL	SANDY CLAY: medium plasticity, medium density, pink (continued)	M	VS/H					
						18	SC	Possible Gravelly Sand layer, CLAYEY SAND: fine, harder, some quartz cobbles		MD/D					
						19									
						20	CL	SANDY CLAY: medium plasticity, brown, quartz and some gravel/cobbles		VS/H					
						21									
						22	SM	SILTY SAND: fine, brown, with some clay, some gravel/cobble layers		MD/D					
						23									
						24									

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE HO154-1-GRJ-COFFEY.GDT 28.08.02

Borehole No. **SMB1**

Engineering Log - Borehole

Sheet 4 of 4

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **12.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance											
method	penetration			notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	hand penetrometer			structure and additional observations
	1	2	3									100 kPa	200 kPa	300 kPa	
W						25		SM	SILTY SAND: fine, brown, with some clay, some gravel/cobble layers (continued)	M	MD/D				
						26		SM	SILTY SAND: black, some clay						
						26		CH	CLAY: high plasticity, black, weathered carbonateous mudstone? or organic soil?		H				Residual/EW rock
						27									
						28			Borehole SMB1 continued as cored hole						
						29									
						30									
						31									
						32									

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE HO154-1-IGR.J. COFFEY.GDT 28.08.02

Borehole No. **SMB1**

Engineering Log - Cored Borehole

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **12.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
hole diameter: bearing: datum:

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	Is ₍₅₀₎ MPa	defect spacing mm	defect description	
					rock type; grain characteristics, colour, structure, minor components					type, inclination, planarity, roughness, coating, thickness	
					Continued from non-cored borehole						
										particular	general
NQ				28	SILTSTONE: medium to high, black, highly weathered, moderately fractured <50mm core pieces						
				28	Core Loss 27.8-29.4m						
				29							
				30	SILTSTONE: extremely weathered, intense fracturing <50mm core pieces, clay along structures						
				30	SILTSTONE: extremely weathered, silicified.						
				31	Core Loss 30.5-31.5m						
				32	SMB1 terminated at 31.5m						
				33							
				34							
				35							

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	case-lift casing used barrel withdrawn graphic log/core recovery core recovered - hatching indicates material no core recovered	water 10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown	weathering/alteration (W/A) Fr fresh SW slightly MW moderately HW highly EW extremely	strength EL extremely low VL very low L low M medium H high VH very high EH extremely high	defects JT joint PT parting SM seam PL planar CV curved IR irregular RO rough SO smooth SL slickensided
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CORED BOREHOLE HO154-1.GPJ COFFEY.GDT 28.08.02

Borehole No. **SMB2**

Engineering Log - Borehole

Sheet 1 of 2

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance											
method	penetration			notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	hand penetrometer			structure and additional observations
	1	2	3									100 kPa	200 kPa	300 kPa	
W						1	[stippled]	SW	QUARTZ SAND: white/pink with quartz pebbles and chips, with some pale brown silt	W	D				Drill stalling on cobbles Harder drill area 3-3.5m, cobbles of quartzite
						2	[stippled]	SW	QUARTZ SAND: fine to medium, white/pink with pale brown silt						
						3	[stippled]	SW	QUARTZ SAND with dark brown silt, some cobbles						
						4	[stippled]	SW	QUARTZ SAND: fine, pale brown silt						
				SPT 1,2,2 N*=4		5	[hatched]	CH	SILTY CLAY: high plasticity, white	D	St/Vst				
						6	[hatched]								
						7	[hatched]								
						8	[hatched]								

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 [diagram] no resistance ranging to refusal water [diagram] 10/1/98 water level on date shown [diagram] water inflow [diagram] water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE HO154-1-GRJ-COFFEY.GDT 28.08.02

Borehole No. **SMB2**

Engineering Log - Borehole

Sheet 2 of 2

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance											
method	penetration			notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	hand penetrometer			structure and additional observations
	1	2	3									100 kPa	200 kPa	300 kPa	
W						9		CH	SILTY CLAY: high plasticity, white (continued)	D	St/Vst				
				SPT 2,4,6 N*=10		10			Borehole SMB2 terminated at 10.2m						
						11									
						12									
						13									
						14									
						15									
						16									

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE HO154-1-GRJ-COFFEY.GDT 28.08.02

Borehole No. **SMB3**

Engineering Log - Borehole

Sheet 1 of 1

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **15.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **15.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance											
method	penetration			notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material <small>soil type: plasticity or particle characteristics, colour, secondary and minor components.</small>	moisture condition	consistency/density index	hand penetrometer			structure and additional observations
	1	2	3									100 kPa	200 kPa	300 kPa	
W						1		SM	Road surface, siltstone and dolerite cobbles, with brown silt/clay	M	VD				Fill. Low water return to surface, water is moving thru road at ~500
						2		SM	SILTY SAND with some clay, fine, light brown		L/MD				
						3			2.3-3m log backfill						Old log at 2.3m
						4		CL	SANDY CLAY: medium plasticity, white, some silt		St/Vst				Alluvium
				SPT 4,4,4 N*=8		5									
						6									
						7			Borehole SMB3 terminated at 6.55m						
						8									

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE HO154-1-GRJ-COFFEY.GDT-28.08.02

Test pit No. **STP1**

Engineering log - Excavation

Sheet 1 of 2

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **ASAZ**

Test pit location: **Approximate GPS: 484840.00mE 5233285.00mN**

Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
 excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3			RL				soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N			0.0		TOPSOIL: peat sward		W			Topsoil
					0.5		ML SANDY SILT: pale grey		M	VL		
					0.8		OL ORGANIC SILT					
					1.0		CL SILTY CLAY: medium plasticity, light orange			St	X	Alluvium
					1.2		ML SANDY CLAYEY SILT: low to medium plasticity, light brown-light orange, ~10% to 15% subrounded gravels, gravels increase with depth up to 200mm			H/D	X	
					3.0						X	
					4.0							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP1**

Engineering log - Excavation

Sheet 2 of 2

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **ASAZ**

Test pit location: **Approximate GPS: 484840.00mE 5233285.00mN**

Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
 excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 kPa 200 kPa 300 kPa 400 kPa	
W		N			4.5 5.0 5.5 6.0 6.5			SANDY CLAYEY SILT: low to medium plasticity, light brown-light orange, ~10% to 15% subrounded gravels, gravels increase with depth up to 200mm (continued)	M	H/D		
					7.0 7.5 8.0			Test pit STP1 terminated at 6.7m				No refusal

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP2**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **See Figure 1**

Date started: **14.8.2002**
Date completed: **14.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance					
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
	1 2 3			RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			
W		N		0.5			TOPSOIL: peat sward	W		Topsoil
				1.0		ML	SANDY GRAVELLY SILT: low plasticity, pale orange to pale brown, with some clay, gravel becomes coarser with depth	M	D/St	Alluvium
			D	2.0						
				2.5						No refusal: groundwater not encountered during excavation
				3.0			Test pit STP2 terminated at 2.5m			
				3.5						
				4.0						

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP3**
 Sheet 1 of 1
 Office Job No.: **HO154/1**
 Date started: **14.8.2002**
 Date completed: **14.8.2002**
 Logged by: **ASAZ**
 Checked by: **BMcD**



Engineering log - Excavation

Client: **John Holland Pty Ltd**
 Principal: **John Holland Development & Investment Pty Ltd**
 Project: **Southwood Project**
 Test pit location: **Approximate GPS: 484720.00mE 5233312.00mN**

equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
 excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N						TOPSOIL: peat sward	W	VL		Topsoil
					0.5		SP	SAND: fine grained, pale grey	M			
							Pt	PEAT: ~50-100mm				
							ML	CLAYEY GRAVELLY SILT: fine to medium grained, pale orange, with some clay		St/VSt		Alluvium
					1.0		SM	SILTY SAND with some clay, light orange, dense		D		
				D								Bulk sample for CBR testing
												No refusal: Groundwater not encountered during excavation
								Test pit STP3 terminated at 2.6m				
					3.0							
					3.5							
					4.0							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP4**

Engineering log - Excavation

Sheet 1 of 2

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **ASAZ**

Test pit location: **Approximate GPS: 484561.00mE 5233418.00mN**

Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
 excavation dimensions: m long m wide datum:

excavation information					material substance									
method	penetration			notes samples, tests, etc	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			structure and additional observations
	1	2	3								100 kPa	200 kPa	300 kPa	
W					0.0		CL	TOPSOIL: organics	W					Topsoil
					0.5		CL	CLAYEY SILT: medium plasticity, pale orange to pale brown with some rootlet inclusions	M	St				Residual/Colluvial
					1.0			SILTSTONE: fine grained, pale cream, low to medium strength, extremely weathered						Rock, near vertical joints, iron stained, dipping westwards, <200mm spacing
					3.0									Rock ripper used from 3m

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP4**

Engineering log - Excavation

Sheet 2 of 2

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **ASAZ**

Test pit location: **Approximate GPS: 484561.00mE 5233418.00mN**

Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
 excavation dimensions: m long m wide datum:

excavation information					material substance						
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3			RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N		4.5			SILTSTONE: fine grained, pale cream, low to medium strength, extremely weathered (<i>continued</i>)				Rock, near vertical joints, iron stained, dipping westwards, <200mm spacing
				5.0			Test pit STP4 terminated at 4.7m				Close to refusal
				5.5							
				6.0							
				6.5							
				7.0							
				7.5							
				8.0							

Sketch

method N natural excavation X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP5**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484550.00mE 5233698.00mN**

Date started: **14.8.2002**
Date completed: **14.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance					
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
1 2 3			RL				soil type: plasticity or particle characteristics, colour, secondary and minor components.			
U		N		0.0			TOPSOIL: organics	M		
				0.5		CL	CLAYEY SILT: medium plasticity, pale brown, some rootlets		St	
				1.0			SILTSTONE: fine grained, cream, very low to low strength, extremely weathered			Rock joints dipping westwards, <200mm spacing, rock ripper used from 2.2m, ripping became very difficult at 3m
				2.0			SILTSTONE: fine grained, cream, medium strength, highly weathered			
				3.0			SILTSTONE: fine grained, cream, medium strength, highly weathered			
				3.5			Test pit STP5 terminated at 3.3m			Effective refusal; groundwater not encountered during excavation
				4.0						

Sketch

method N natural excavation X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY/GDT 28.08.02

Test pit No. **STP6**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484406.00mE 5233768.00mN**

Date started: **14.8.2002**
Date completed: **14.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N						TOPSOIL: organics, peat	W			Topsoil
				D	0.5		CH	SILTY CLAY: medium to high plasticity, pale brown to pale orange, some roots	M	F/St		Residual
					1.0		ML	SILT: slightly clayey, low to medium plasticity, orange stained cream,		H		
					1.5			SILTSTONE: fine grained, cream, low strength, extremely weathered, highly fractured				Rock
					2.0			Test pit STP6 terminated at 2m				Close to refusal
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method N natural excavation X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY/GDT 28.08.02

Test pit No. **STP7**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484463.00mE 5233870.00mN**

Date started: **14.8.2002**
Date completed: **14.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance				
method	penetration	support	water	notes samples, tests, etc	depth metres	material	moisture condition	consistency/density index	structure and additional observations
1 2 3				RL	graphic log	soil type: plasticity or particle characteristics, colour, secondary and minor components.		100 hand penetrometer	
W		N			0.0 - 0.5	TOPSOIL: organics	W		Topsoil
					0.5 - 1.0	ML/CL CLAYEY SILT: medium plasticity, pale brown to pale orange	M	St/VSt	Residual
					1.0 - 2.6	SILTSTONE: fine grained, cream, very low to low strength, highly weathered			Rock
					2.6 - 3.0	Test pit STP7 terminated at 2.6m			Groundwater not encountered during excavation Ripper used from 2.6m

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP8**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484513.00mE 5233847.00mN**

Date started: **15.8.2002**
Date completed: **15.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 kPa 200 kPa 300 kPa 400 kPa	
W		N			0.5			TOPSOIL and organics	M/W			Topsoil
					1.0			SILTSTONE: fine grained, cream, very low to low strength, extremely weathered				Rock
					1.5							
					2.0			Test pit STP8 terminated at 1.8m				Close to refusal: groundwater not encountered during excavation
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method N natural excavation X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP9**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484389.00mE 5233900.00mN**

Date started: **15.8.2002**
Date completed: **15.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N						TOPSOIL and organics	M			Topsoil
				D	0.5		MH	CLAYEY SILT: medium to high plasticity, pale brown/cream, friable, with some gravel		F/St		Residual
					1.0			SILTSTONE: fine grained, cream, very low to low strength, highly weathered				Rock
					2.0			Test pit STP9 terminated at 2m				No refusal; groundwater not encountered during excavation
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP10**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484303.00mE 5233898.00mN**

Date started: **15.8.2002**
Date completed: **15.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N						TOPSOIL: peat and organics	M/W			Topsoil
				D	0.5		ML	CLAYEY SILT: medium plasticity, orange stained grey	D	St/VSt		Residual/Colluvium
					1.0		SM	SILTY SAND: fine grained, pale gray	M			Seepage at 0.9m depth at Northern corner, ~0.5 liters per second
					1.5							
					2.0							
					2.1			Test pit STP10 terminated at 2.1m				No refusal
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **SPT11**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484267.00mE 5233840.00mN**

Date started: **15.8.2002**
Date completed: **15.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N						TOPSOIL	W			Topsoil, Vegetation and root zone
				D	0.5		MH	CLAYEY SILT: medium plasticity, orange stained, pale grey	M	St		Residual/Colluvium
					1.0							
					1.5		SM	SILTY SAND: fine grained, pale grey, silt decreasing with depth		MD		
					2.0							
					2.1			Test pit SPT11 terminated at 2.1m				No refusal: groundwater not encountered during excavation
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP12**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484290.00mE 5233752.00mN**

Date started: **15.8.2002**
Date completed: **15.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information				material substance								
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 kPa 200 kPa 300 kPa 400 kPa	
W		N						TOPSOIL and root zone	M/W	F/St		Topsoil
				D	0.5		CH	SILTY CLAY: medium to high plasticity, orange stained, cream,				Residual
					1.0		ML	SANDY CLAYEY SILT: low plasticity, pale grey	M	St		Extensive roots
					1.5		SM	SILTY SAND: with numerous quartzite rock pieces		MD		
					2.0			SILTSTONE: fine grained, pale grey, low to medium strength, extremely weathered, highly fractured				Rock; seepage from southern end at ~ 1.6m depth
					2.0			Test pit STP12 terminated at 1.8m				No refusal

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Test pit No. **STP13**

Engineering log - Excavation

Sheet 1 of 1
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**
Principal: **John Holland Development & Investment Pty Ltd**
Project: **Southwood Project**
Test pit location: **Approximate GPS: 484846.00mE 5233508.00mN**

Date started: **15.8.2002**
Date completed: **15.8.2002**
Logged by: **ASAZ**
Checked by: **BMcD**



equipment type and model: Excavator 20t, 0.75m bucket Pit Orientation: R.L. Surface: See plan for approximation
excavation dimensions: m long m wide datum:

excavation information					material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	hand penetrometer	structure and additional observations
	1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
W		N						TOPSOIL	W			Topsoil
					0.5		ML	GRAVELLY SILT: non plastic to low plasticity, pale grey, partly cemented		St		
							OL	ORGANIC SILT with some gravels		F		
				D	1.0		GW	Silty GRAVEL: medium to coarse grained, pale orange/pale brown; sub-rounded quartzite gravels of low to medium strength	M	MD		Alluvium
					1.5			Test pit STP13 terminated at 1.5m				gravels up to 150mm in size Close to refusal; groundwater not encountered during excavation
					2.0							
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator HA hand auger DT diatube	support T timbering N nil penetration 1 2 3 4 no ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT HO154-1.GPJ COFFEY.GDT 28.08.02

Borehole No. **SMB1A**

Engineering Log - Piezometer

Sheet 1 of 1

Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface:
 hole diameter: bearing: datum:

drilling information					material substance								
method	penetration			notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
	1	2	3										

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm dia D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement 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 WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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PIEZOMETER HO154-1-IGPJ-COFFEY.GDT 28.08.02

Borehole No. **SMB2**
 Sheet 1 of 2
 Office Job No.: **HO154/1**
 Date started: **14.8.2002**
 Date completed: **14.8.2002**
 Logged by: **AGG**
 Checked by: **BMcD**



Engineering Log - Piezometer

Client: **John Holland Pty Ltd**
 Principal: **John Holland Development & Investment Pty Ltd**
 Project: **Southwood Project**
 Borehole Location: **See Figure 1, TBA**

drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance									
method	penetration			notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	structure and additional observations
	1	2	3										
W							1		SW	QUARTZ SAND: white/pink with quartz pebbles and chips, with some pale brown silt	W	D	Drill stalling on cobbles
							2						
							3		SW	QUARTZ SAND: fine to medium, white/pink with pale brown silt			
							4		SW	QUARTZ SAND with dark brown silt, some cobbles			Harder drill area 3-3.5m, cobbles of quartzite
							5		SW	QUARTZ SAND: fine, pale brown silt			
				SPT 1,2,2 N*=4			6		CH	SILTY CLAY: high plasticity, white	D	St/Vst	
							7						
							8						

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm dia D ₅₀ disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement 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 WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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PIEZOMETER HO154-1.GPJ COFFEY.GDT 28.08.02

Borehole No. **SMB2**

Engineering Log - Piezometer

Sheet 2 of 2
Office Job No.: **HO154/1**

Client: **John Holland Pty Ltd**

Date started: **14.8.2002**

Principal: **John Holland Development & Investment Pty Ltd**

Date completed: **14.8.2002**

Project: **Southwood Project**

Logged by: **AGG**

Borehole Location: **See Figure 1, TBA**

Checked by: **BMcD**



drill model and mounting: slope: -90° R.L. Surface: TBA m
hole diameter: 100mm bearing: datum:

drilling information					material substance								
method	penetration	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
1 2 3										soil type: plasticity or particle characteristics, colour, secondary and minor components.			
W							9 10		CH	SILTY CLAY: high plasticity, white (continued)	D	St/Vst	
				SPT 2,4,6 N*=10			11 12 13 14 15 16			Borehole terminated at 10.2m			

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm dia D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement 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 WI 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
--	--	---	---	---

PIEZOMETER HO154-1-IGPJ-COFFEY.GDT 28.08.02

Borehole No. **SMB3**
 Sheet 1 of 1
 Office Job No.: **HO154/1**
 Date started: **15.8.2002**
 Date completed: **15.8.2002**
 Logged by: **AGG**
 Checked by: **BMcD**



Engineering Log - Piezometer

Client: **John Holland Pty Ltd**
 Principal: **John Holland Development & Investment Pty Ltd**
 Project: **Southwood Project**
 Borehole Location: **See Figure 1, TBA**

drill model and mounting: slope: -90° R.L. Surface: TBA m
 hole diameter: 100mm bearing: datum:

drilling information				material substance			
method	penetration	support	notes	well details	depth	material	structure and additional observations
1 2 3	1 2 3 4		samples, tests, etc	RL	metres	soil type: plasticity or particle characteristics, colour, secondary and minor components.	
W					0	Road surface, siltstone and dolerite cobbles, with brown silt/clay	Fill. Low water return to surface, water is moving thru road at -500
					1	SILTY SAND with some clay, fine, light brown	L/MD
					2		
					3	2.3-3m log backfill	Old log at 2.3m
					4	SANDY CLAY: medium plasticity, white, some silt	St/Vst
			SPT 4,4,4 N*=8		5		
					6		
					7	Borehole terminated at 6.55m	
					8		

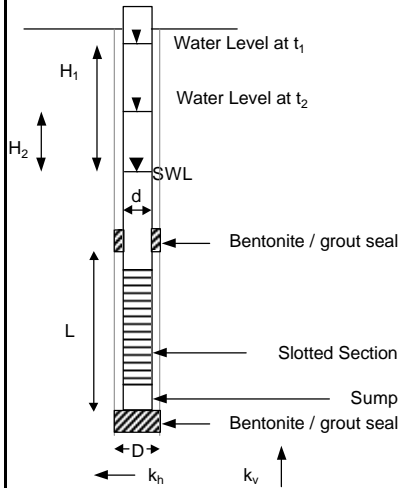
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support T timbering N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm dia D ₅₀ disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement 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 WI liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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PIEZOMETER HO154-1-IGPJ-COFFEY.GDT 28.08.02

FALLING HEAD TEST

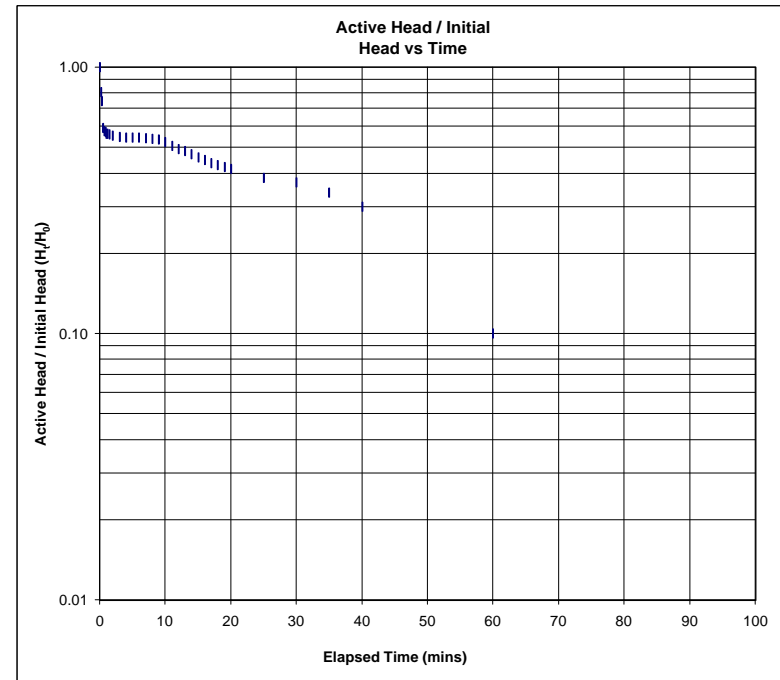
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	8.71
D = diameter of test section or ID of casing	m	0.100
d = diameter of standpipe	m	0.057
L = length of test section	m	8.71
estimated k_h/k_v	ratio	5.00
where k_v = vertical coefficient of permeability		
k_h = horizontal coefficient of permeability		
m = transformation ratio = $\sqrt{k_h/k_v}$	ratio	2.236
T = basic time lag = t when $(H_t/H_0 = 0.37)$	mins	1.1



Chosen time t_1	mins	10.0
Chosen time t_2	mins	40.0
H_1 = active Head at time t_1	m	4.56
H_2 = active Head at time t_2	m	2.60

		TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/ Initial Head			
0	0.00	8.71	1.00			
0.17	1.70	7.01	0.80			
0.33	2.20	6.51	0.75			
0.50	3.55	5.16	0.59			
0.67	3.71	5.00	0.57			
0.83	3.74	4.97	0.57			
1.00	3.80	4.91	0.56			
1.17	3.82	4.89	0.56			
1.50	3.84	4.87	0.56			
2.00	3.88	4.83	0.55			
3.00	3.94	4.77	0.55			
4.00	3.96	4.75	0.55			
5.00	3.97	4.74	0.54			
6.00	3.98	4.73	0.54			
7.00	4.00	4.71	0.54			
8.00	4.02	4.69	0.54			
9.00	4.05	4.66	0.54			
10.00	4.15	4.56	0.52			
11.00	4.29	4.42	0.51			
12.00	4.41	4.30	0.49			
13.00	4.50	4.21	0.48			
14.00	4.61	4.10	0.47			
15.00	4.72	3.99	0.46			
16.00	4.81	3.90	0.45			
17.00	4.91	3.80	0.44			
18.00	4.97	3.74	0.43			
19.00	5.04	3.67	0.42			
20.00	5.10	3.61	0.41			
25.00	5.36	3.35	0.38			
30.00	5.50	3.21	0.37			
35.00	5.76	2.95	0.34			
40.00	6.11	2.60	0.30			
60.00	7.84	0.87	0.10			
90.00	8.71	0.00	0.00			



k_h	k_v	k_{mean}	k_h	k_v	k_{mean}
$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
8.68E-08	1.74E-08	3.88E-08	7.50E-03	1.50E-03	3.35E-03
4.21E-06	8.43E-07	1.88E-06	3.64E-01	7.28E-02	1.63E-01

Coffey Geosciences

Drawn - AGG

Approved -

Date - Aug 2002

Scale - Not to Scale

John Holland Pty Ltd

Southwood Project

Hydrogeological Studies

Falling Head Test of Bore SMB#1

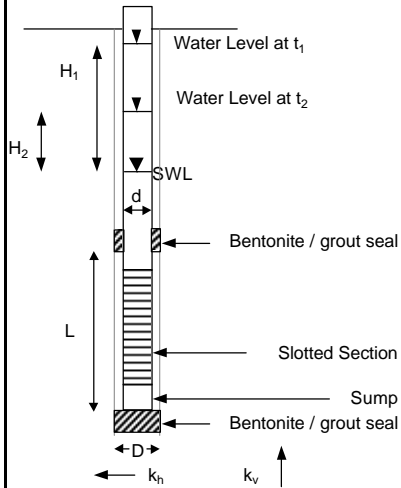
FIGURE B1

job no. Ho154/1

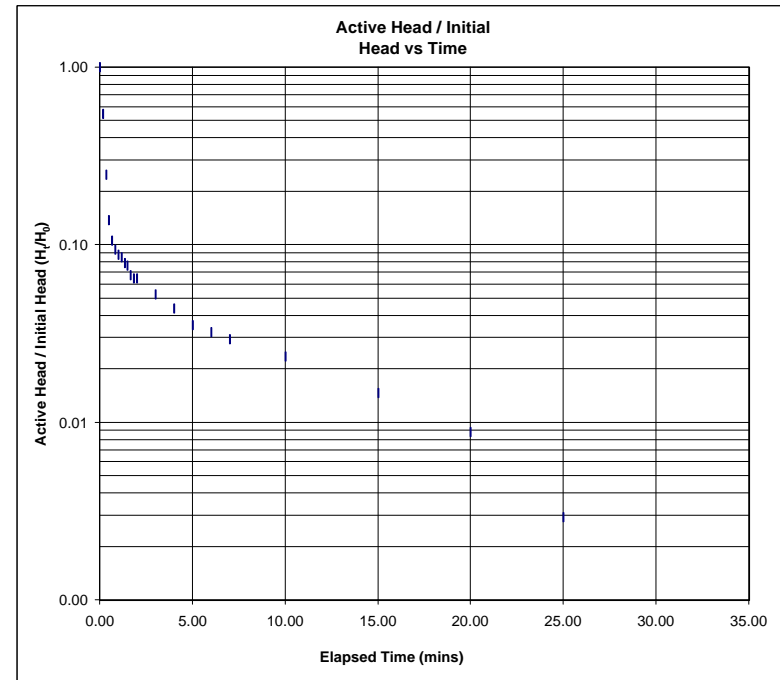
FALLING HEAD TEST

Hvorslev, 1951 - Well Point : Filter in Uniform Soil

			TEST DATA			
			Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/ Initial Head
Fixed Parameters	Unit	Value	0.00	0.00	3.42	1.00
SWL = Standing Water Level	m bGL	3.42	0.17	1.55	1.87	0.55
D = diameter of test section or ID of casing	m	0.100	0.33	2.57	0.85	0.25
d = diameter of standpipe	m	0.057	0.50	2.95	0.47	0.14
L = length of test section	m	10.80	0.66	3.06	0.36	0.11
estimated k_h/k_v	ratio	5.00	0.83	3.10	0.32	0.09
where k_v = vertical coefficient of permeability			1.00	3.12	0.30	0.09
k_h = horizontal coefficient of permeability			1.17	3.13	0.29	0.08
m = transformation ratio = $\sqrt{k_h/k_v}$	ratio	2.236	1.33	3.15	0.27	0.08
T = basic time lag = t when $(H_t/H_0 = 0.37)$	mins	1.1	1.50	3.16	0.26	0.08
			1.66	3.19	0.23	0.07
			1.83	3.20	0.22	0.06
			2.00	3.20	0.22	0.06
			3.00	3.24	0.18	0.05
			4.00	3.27	0.15	0.04
			5.00	3.30	0.12	0.04
			6.00	3.31	0.11	0.03
			7.00	3.32	0.10	0.03
			10.00	3.34	0.08	0.02
			15.00	3.37	0.05	0.01
			20.00	3.39	0.03	0.01
			25.00	3.41	0.01	0.00
			30.00	3.42	0.00	0.00



Chosen time t_1	mins	0.8
Chosen time t_2	mins	20.0
H_1 = active Head at time t_1	m	0.32
H_2 = active Head at time t_2	m	0.03



	k_h	k_v	k_{mean}	k_h	k_v	k_{mean}
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L} \ln(H_1/H_2)$	4.78E-07	9.57E-08	2.14E-07	4.13E-02	8.26E-03	1.85E-02
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	3.52E-06	7.04E-07	1.57E-06	3.04E-01	6.08E-02	1.36E-01

Coffey Geosciences

Drawn - AGG

Approved -

Date - Aug 2002

Scale - Not to Scale

John Holland Pty Ltd

Southwood Project

Hydrogeological Studies

Falling Head Test of Bore SMB#2

FIGURE B2

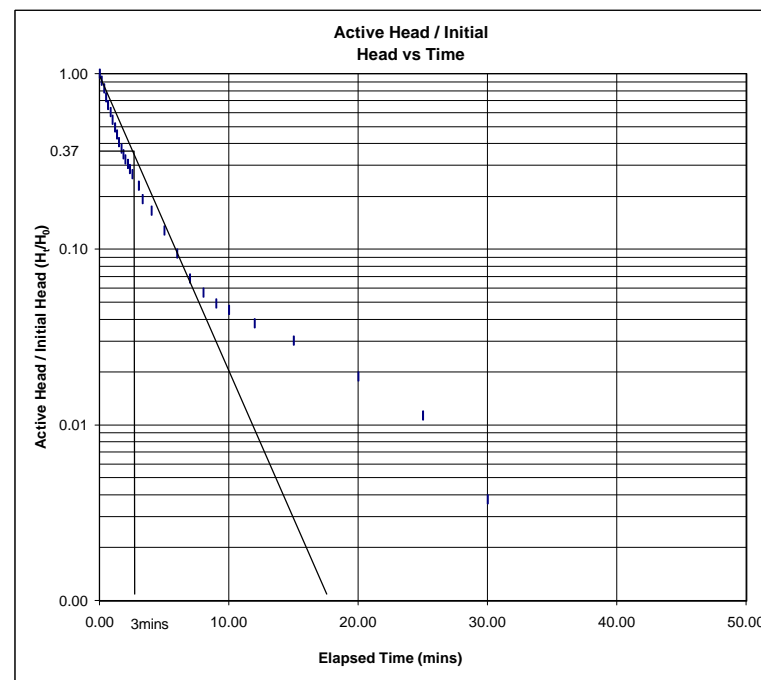
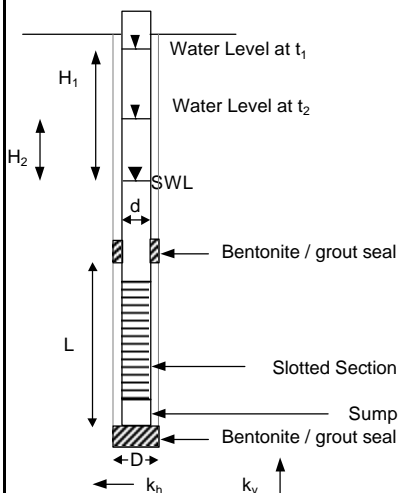
job no. Ho154/1

BASIC TIME LAG SLUG OUT TEST

Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	2.99
D = diameter of test section or ID of casing	m	0.100
d = diameter of standpipe	m	0.057
L = length of test section	m	7.25
R = radius of standpipe	m	0.05
r = radius of test section	m	0.03
T = basic time lag = t when (H _t /H ₀ = 0.37)	mins	3.0
	secs	180

		TEST DATA			
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/ Initial Head		
0.00	5.64	-2.65	1.00		
0.17	5.41	-2.42	0.91		
0.33	5.17	-2.18	0.82		
0.50	4.94	-1.95	0.74		
0.66	4.75	-1.76	0.66		
0.83	4.59	-1.60	0.60		
1.00	4.44	-1.45	0.55		
1.17	4.30	-1.31	0.49		
1.33	4.18	-1.19	0.45		
1.50	4.07	-1.08	0.41		
1.66	3.98	-0.99	0.37		
1.83	3.91	-0.92	0.35		
2.00	3.85	-0.86	0.32		
2.17	3.80	-0.81	0.31		
2.33	3.75	-0.76	0.29		
2.50	3.70	-0.71	0.27		
3.00	3.60	-0.61	0.23		
3.30	3.50	-0.51	0.19		
4.00	3.43	-0.44	0.17		
5.00	3.33	-0.34	0.13		
6.00	3.24	-0.25	0.09		
7.00	3.17	-0.18	0.07		
8.00	3.14	-0.15	0.06		
9.00	3.12	-0.13	0.05		
10.00	3.11	-0.12	0.05		
12.00	3.09	-0.10	0.04		
15.00	3.07	-0.08	0.03		
20.00	3.04	-0.05	0.02		
25.00	3.02	-0.03	0.01		
30.00	3.00	-0.01	0.00		
35.00	2.99	0.00	0.00		



	K m/s	m/day
Basic Time Lag Determination $K = \frac{r^2 \ln(L/R)}{2LT_0}$	1.5E-06	9.66E-02

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Drawn - AGG

Approved -

Date - August 2002

Scale - Not to Scale

John Holland Pty Ltd

Southwood Project

Hydrogeological Studies

Rising Head Test - Bore SMB#3

FIGURE B3

job no. Ho154/1



california bearing ratio test results

client : **JOHN HOLLAND CONSTRUCTIONS PTY LTD**
principal :
project : **SOUTHWOOD**
location : **TASMANIA**

job no : **H0154/1**
laboratory : **MELBOURNE**
date : **27/08/02**
test report : **AA**

test procedure :		AS1289 6.1.1			
laboratory compaction method :		AS1289 5.1.1			
sample number :		TP 2	TP 3	TP 13	
depth: m		2.0 - 2.5m	2.0 - 2.5m	1.0 - 1.5m	
location:		REFER TO FIGURE 1	REFER TO FIGURE 1	REFER TO FIGURE 1	
date sampled:		N.A	N.A	N.A	
date tested:		26-Aug-02	26-Aug-02	26-Aug-02	
sample description:		GRAVELLY SILTY CLAY, medium plasticity, orange brown, fine to coarse gravel	SANDY CLAY / CLAYEY SAND, fine to coarse, orange brown, low plasticity, some gravel	clayey GRAVELLY SAND, orange brown, fine to coarse, gravel fine to coarse, low plasticity.	
maximum dry density: t/m ³		1.64	1.90	1.73	
optimum moisture content: %		19.0	13.0	18.0	
field moisture content: %		17.4	13.0	15.0	
% retained on 19mm:		4.8	0	8.2	
C.B.R. test	dry density t/m ³	before soaking	1.60	1.86	1.70
		after soaking	1.59	1.85	1.70
	density ratio:	98	98	98	
	moisture ratio:	105	100	97	
	number of days soaked:	4	4	4	
	surcharge: kg	4.5	4.5	4.5	
	moisture content % top 30mm	24.1	15.4	21.4	
	moisture content % remaining sample	23.4	13.9	18.1	
	swell after soaking: %	0.0	0.5	0.0	
	penetration: mm	5.0	5.0	5.0	
C.B.R. value: %	13	11	20		
remarks :					

Form Number L2.BR1 Version 4.1

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Authorised Signature
NATA No 1040
Ernie Gmeiling
Ernie Gmeiling

test results

client : **JOHN HOLLAND CONSTRUCTIONS PTY LTD**
principal :
project : **SOUTHWOOD**
location : **TASMANIA**

job no : **H0154/1**
laboratory : **MELBOURNE**
date : **28/08/02**
test report : **AB**

test procedure : **AS1289 3.1.2 - 3.2.1 - 3.3.1 - 3.4.1**
Preparation method : oven dried, dry sieved

test data : **various**

Location		TP 2	TP 3	TP 6	TP 11
Depth m		2.0 - 2.5	2.0 - 2.5	0.4 - 1.2	0.4 - 1.2
Liquid limit	WL	35	36	55	37
Plastic limit	Wp	25	18	29	22
Plasticity Index	Ip	10	18	26	15
Linear Shrinkage	L.S.	6.5	7.5	10.5	7.5
curling / crumbling		crumbling	neither	neither	crumbling

remarks : Notes 1. sampled by B McDowell, tested "as received"
2. curling / crumbling refers to the condition of the linear shrinkage sample after constant drying



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Authorised Signature
NATA No 431
Ernie Amehling
Ernie Amehling

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test results

client : **JOHN HOLLAND CONSTRUCTIONS PTY LTD**
principal :
project : **SOUTHWOOD**
location : **TASMANIA**

job no : **H0154/1**
laboratory : **MELBOURNE**
date : **28/08/02**
test report : **AC**

test procedure : **AS1289 3.1.2 - 3.2.1 - 3.3.1 - 3.4.1**
Preparation method : oven dried, dry sieved

test date : **various**

Location	TP 13	
Depth m	1.0 - 1.5	
Liquid limit	WL	27
Plastic limit	Wp	21
Plasticity Index	Ip	6
Linear Shrinkage	L.S.	3
curling / crumbling		crumbling

remarks : *Notes 1. sampled by B McDowell, tested "as received"*
2. curling / crumbling refers to the condition of the linear shrinkage sample after constant drying



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Authorised Signature

NATA No 431

Ernie Gmehling
Ernie Gmehling

test results

client : JOHN HOLLAND CONSTRUCTIONS PTY LTD	job no : H0164/1
principal :	laboratory : MELBOURNE
project : SOUTHWOOD	date : 28/08/02
location : TASMANIA	test report : AD

test procedure : AS1289 6.7.3 (Triaxial Permeability) AS1289 5.1.1	test date : 22/08/02
---	-----------------------------

Identification		TP 6	TP 11
depth m		0.4 - 1.2	0.4 - 1.2
Maximum Dry Density	t/m ³	1.44	1.60
Optimum Moisture Content	%	30.5	21.5
Bulk wet Density of test specimen	t/m ³	1.839	1.908
Natural Moisture Content of test specimen	%	32.4	22.6
Dry Density of test specimen	t/m ³	1.41	1.56
Density Ratio	%	98	98
Moisture Ratio	%	97	103
Percentage oversize	%	0	0
PERMEABILITY m/sec		3.5E - 9	1.2 E - 8
Water Type		distilled	distilled
Description		TP 6 SILTY CLAY, medium to high plasticity, mottled grey yellow brown TP 11 SILTY CLAY, medium to high plasticity, mottled grey yellow brown	
Notes:		The sample was remoulded in five layers at 98% SMDD @ OMC	

remarks :



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 Authorised Signature
 NATA No 431 **Ernie Smehling**



california bearing ratio test results

client : **GHD PTY LTD**
 principal :
 project : **SOUTHWOOD**
 location : **TASMANIA**

job no : **H0142/1**
 laboratory : **MELBOURNE**
 date : **01 May 02**
 test report : **AB**

test procedure :		AS1289 6.1.1		
laboratory compaction method :		AS1289 5.1.1		
sample number :		# 1		
depth: m		-		
location:		REFER TO FIGURE 1		
date sampled:		18-Apr-02		
date tested:		30-Apr-02		
sample description:		SANDY GRAVEL, fine to coarse, light grey white, fine to coarse sand		
maximum dry density: t/m ³		1.97		
optimum moisture content: %		9.5		
field moisture content: %		2.7		
% retained on 19mm:		34		
C.B.R. test	dry density before soaking	1.93		
	t/m ³ after soaking	1.94		
	density ratio:	98		
	moisture ratio:	101		
	number of days soaked:	4		
	surcharge: kg	9.0		
	moisture content % top 30mm	11.0		
	moisture content % remaining sample	9.8		
	swell after soaking: %	0.0		
	penetration: mm	2.5		
C.B.R. value: %	90			
remarks : <i>sampled by B Mc Dowell, tested " as received"</i>				

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Authorised Signature
 NATA No 1040

 Ernie Brehling

test results

client : **GHD PTY LTD**
principal :
project : **SOUTHWOOD**
location : **TASMANIA**

job no : **H0142/1**
laboratory : **MELBOURNE**
date : **1/05/02**
test report : **AC**

test procedure : **AS1289 3.1.2 - 3.2.1 - 3.3.1 - 3.4.1**
Preparation method : oven dried, dry sieved

test date : **30/04/02**

Sample identification	ATTERBERG LIMITS		
	sample 1	MPY1	MPY 2
Liquid limit WL	N.P	28	37
Plastic limit Wp	N.P	19	26
Plasticity Index Ip	N.P	9	11
Linear Shrinkage L.S.	0	6	8
curling / cracking	none	crumbling	crumbling
Note	N.P refers to non plastic fines		

remarks : Notes 1. sampled by B M cDowell, tested "as received"
2. curling / cracking refers to the condition of the linear shrinkage sample after constant drying

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Authorised Signature
NATA No 431

Ernie Gmehling

california bearing ratio test results

client : **GHD PTY LTD**
principal :
project : **SOUTHWOOD**
location : **TASMANIA**

job no : **H0142/1**
laboratory : **MELBOURNE**
report date : **06 May 02**
test report : **AF**

test procedure : **AS1289 6.1.1**
laboratory compaction method : **AS1289 5.1.1**

sample number :	MPY 1			
depth: m				
location:	REFER TO FIGURE 1			
date sampled:	18-Apr-02			
date tested:	3-May-02			
sample description:	GRAVELY SAND, fine to coarse, brown, fine to coarse gravel, fines of low plasticity.			
maximum dry density: t/m ³	1.71			
optimum moisture content: %	19.5			
field moisture content: %	19.3			
% retained on 19mm:	5.2			
C.B.R. test	dry density t/m ³	before soaking	1.68	
		after soaking	1.70	
	density ratio:	99		
	moisture ratio:	98		
	number of days soaked:	4		
	surcharge: kg	4.5		
	moisture content % top 30mm	21.0		
	moisture content % remaining sample	20.0		
	swell after soaking: %	0.0		
	penetration: mm	5.0		
C.B.R. value: %	20			

remarks :
sampled by B McDowell, tested " as received"



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NATA No 431

Ernie Gmehling
Ernie Gmehling

MICROBIOLOGICAL RESULTS FORM Water (2002)

Report No: **W484/02**
 Order No: **H0102**
 Page: 1 of 1
 Submitted by: **B McDowell**
 Date report issued: **22/08/02**
 SIGNED: *[Signature]*
 (M Sharpe, Microbiologist)

Coffey Geosciences

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 Hobart TAS 7000
 Phone: (03) 6234 9955
 Fax: (03) 6234 9577



National Association of Testing
 Authorities, Australia

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Sample Number	Lab. Number	Sample Description	Sample Site	Date Collected	Time Collected	Date Received	Date Tested	Tests Required *	FC /100mL	E.coli /100mL	FS /100mL
H0154/1 SMB#2	02/W8/243	Water	Southwood bore	15/08/02	nr	16/08/02	16/08/02	FC, E.coli, FS	<10	<10	20 (est)
H01541 SMB#3	02/W8/244	"	Southwood bore	"	"	"	"	"	10 (est)	10 (est)	10 (est)

*tests were performed on samples as received est = estimate nr = not recorded

Test Methods

FC (Faecal Coliforms), E.coli, AS4276.7-1995; FS (Faecal Streptococci), AS4276.9-1995.



WSL Consultants™
 Enviroscience

WSL Consultants Pty. Ltd.
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 2-8 Harvey Street, Richmond, Victoria 3121, Australia
 Telephone: +61 3 9429 4666 Facsimile: +61 3 9429 2294
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Date: 28-Aug-2002
 WSL Report No: 481486
 WSL Job Number: 18572 Client: Coffey Hobart Job Reference: H0154/1

LAB NUM	Received	Sample	POTASSIUM	SODIUM	CALCIUM	MAGNESIUM	ALKALINITY as CaCO3	BI- CARBONATE as CaCO3	CARBONATE as CaCO3	HYDROXIDE as CaCO3	CHLORIDE	SULPHATE	Al	PHOSPHORUS	TOTAL NITROGEN
481486	19-Aug-2002	SMB#2	2.4	6.1	0.51	1.5	8	8	<2	<2	13	<1	45	0.21	2.5
481487	19-Aug-2002	SMB#3	9.2	18	7.2	13	90	90	<2	<2	22	<1	340	0.52	3.9

A blank space indicates no test performed

Results expressed as mg/L where applicable





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Date: 28-Aug-2002

WSL Report No: 481486

WSL JobNumber: 18572 Client: Coffey Hobart Job Reference: H0154/1

LAB NUM	Received	Sample	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
481486	19-Aug-2002	SMB#2	<0.1	<0.1	<0.1	<0.1	<0.001	<0.001	<0.001	<0.001
481487	19-Aug-2002	SMB#3	<0.1	0.1	0.6	<0.1	<0.001	0.001	<0.001	<0.001

A blank space indicates no test performed

Results expressed as mg/L





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28-AUG-2002 12:57

WSL CONSULTANTS - TP

61 3 9429 2294 P.04/04

date: 18-Aug-2002
SL Report No: 481486
SL Job Number: 18572 Client: Coffey Habitat Job Reference: H0154/1

LAB NUM	Received	Sample	NAP	ACY	ACE	FLU	PHE	ANT	FLA	PYR	BAA	CHR	BBF	BKF	BAP	DBA	BGP	IPY	TOTAL* PAH
481486	19-Aug-2002	SMB#2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
481487	19-Aug-2002	SMB#3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

TOTAL P.04

* Total PAH's refers only to the sum of individual PAH's tested above.

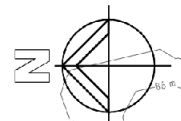
Blank space indicates no test performed

Results expressed as mg/L

Page 4 of 4



DO NOT SCALE

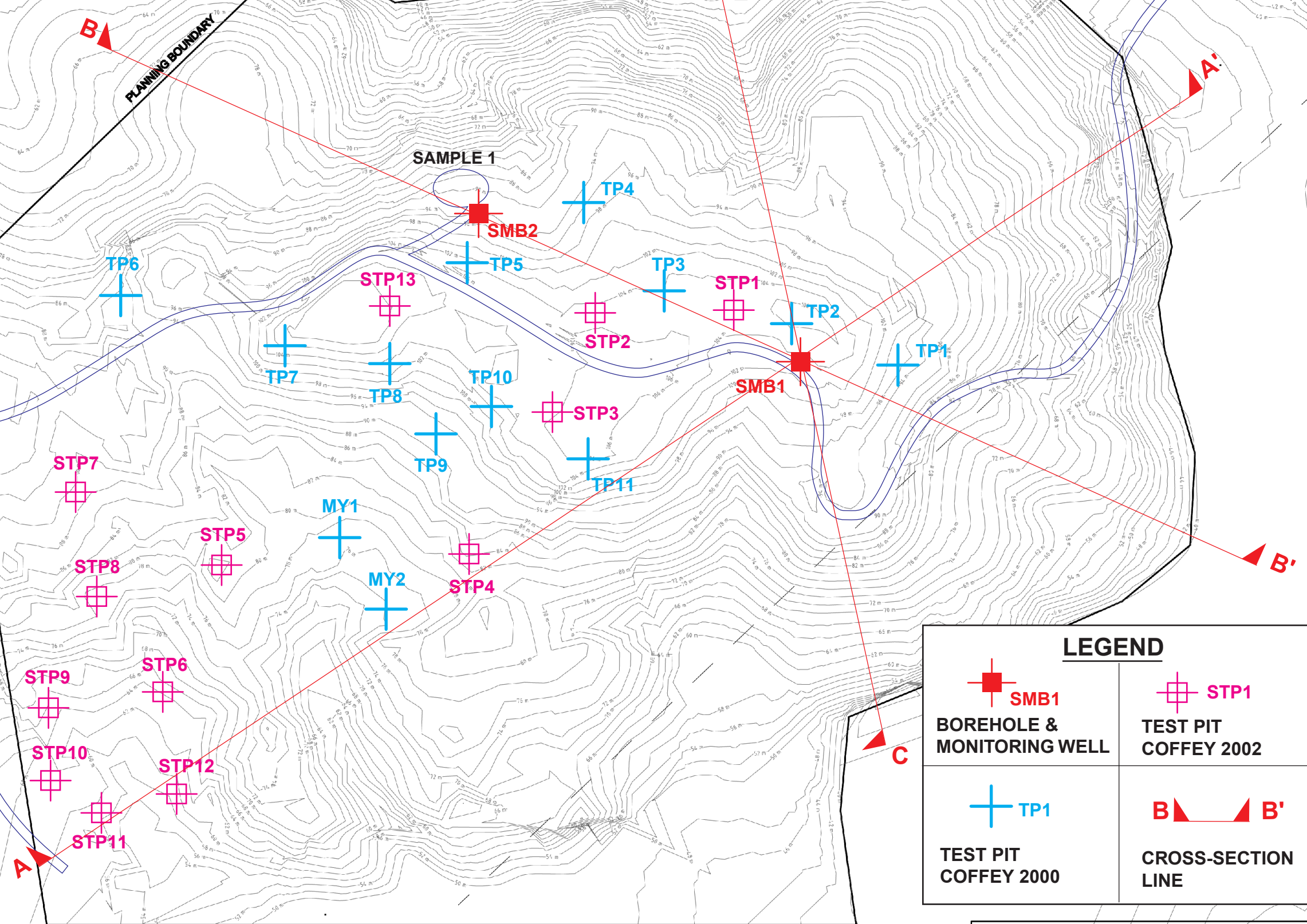


Geeveston

Coffey

Judbury

Eddy Road



LEGEND

SMB1	STP1
BOREHOLE & MONITORING WELL	TEST PIT COFFEY 2002
TP1	B B'
TEST PIT COFFEY 2000	CROSS-SECTION LINE

IMPORTANT NOTE
 DATA WITHIN THE DETAILED PERIMETER HAS BEEN OBTAINED FROM GPS SURVEY AND IS ACCURATE TO +/- 1 METRE. DATA OUTSIDE THE DETAILED PERIMETER HAS BEEN SOURCED FROM DPIWF DATA SETS AND SHOULD BE CONSIDERED INDICATIVE ONLY.
 PRIOR TO ANY EXCAVATION OR CONSTRUCTION COMMENCING ON THE SITE, MORE INTENSIVE DETAIL SURVEY WORK SHOULD BE CARRIED OUT TO ASCERTAIN ACCURATE LEVELS. THIS NOTE IS AN INTEGRAL PART OF THE PLAN.

PRELIMINARY - REDUCED COPY
 UNCONTROLLED DRAWING - SUBJECT TO CHANGE

BASE MAP FROM GHD. (DRAWING NO. 3210596-01)

No.	Description	Drawn	Approved	Date
0	Issued for Tender	SB	B McD	29/8/02

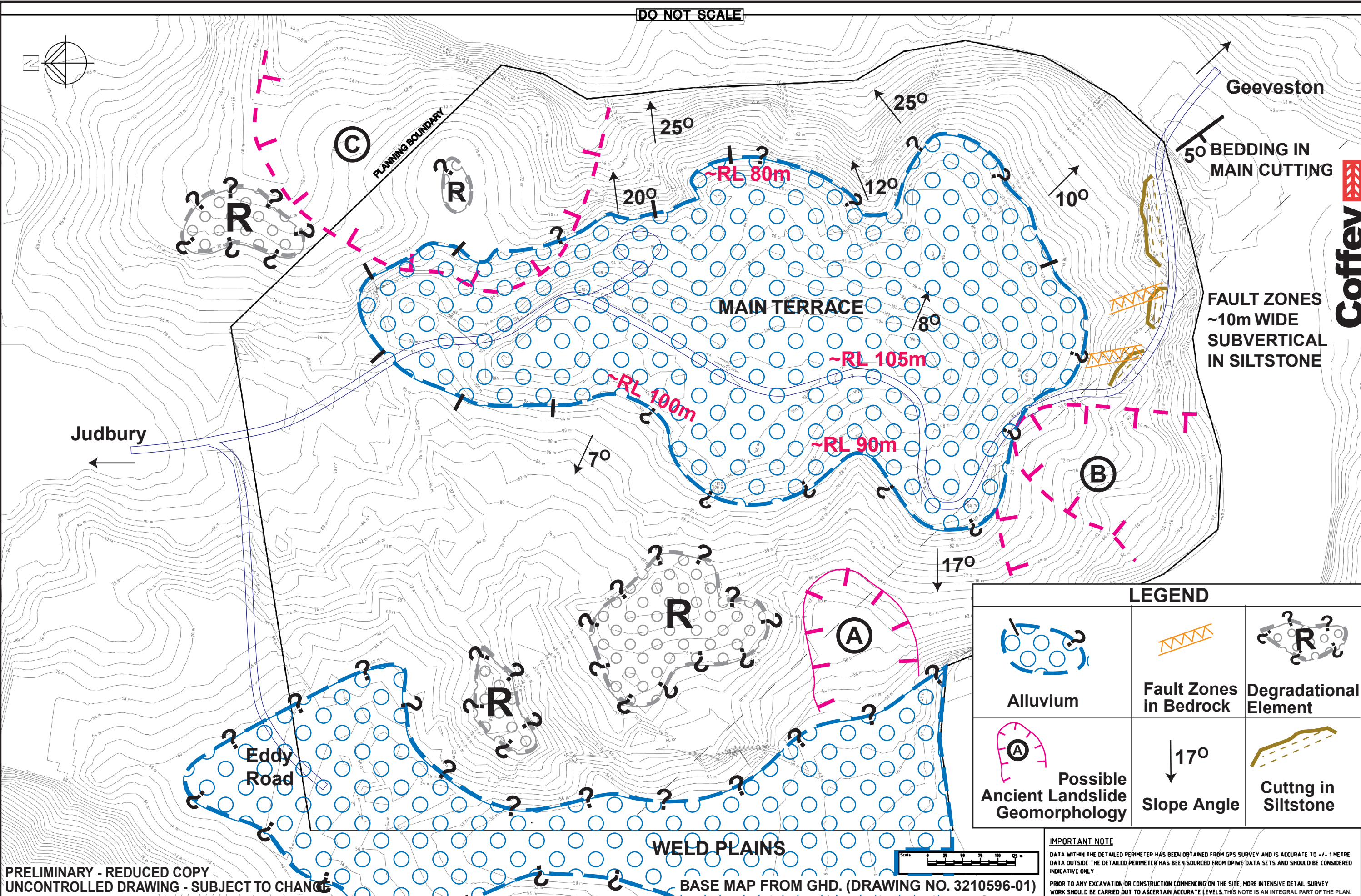
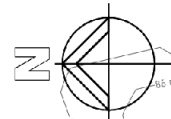
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JOHN HOLLAND PTY LTD - SOUTHWOOD PROJECT
 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS
 LOCATION PLAN OF TEST PITS AND BOREHOLES

Drawing No. :
 FIGURE 1

Job No. : HO154/1-AE

DO NOT SCALE



Geeveston

50 BEDDING IN MAIN CUTTING

FAULT ZONES ~10m WIDE SUBVERTICAL IN SILTSTONE

MAIN TERRACE

WELD PLAINS

Judbury

Eddy Road

LEGEND

Alluvium	Fault Zones in Bedrock	Degradational Element
Possible Ancient Landslide Geomorphology	Slope Angle	Cutting in Siltstone

IMPORTANT NOTE
 DATA WITHIN THE DETAILED PERIMETER HAS BEEN OBTAINED FROM GPS SURVEY AND IS ACCURATE TO +/- 1 METRE. DATA OUTSIDE THE DETAILED PERIMETER HAS BEEN SOURCED FROM DPIWE DATA SETS AND SHOULD BE CONSIDERED INDICATIVE ONLY.
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BASE MAP FROM GHD. (DRAWING NO. 3210596-01)

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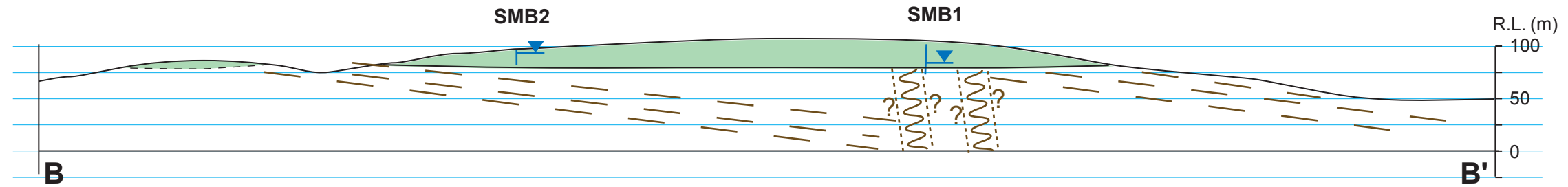
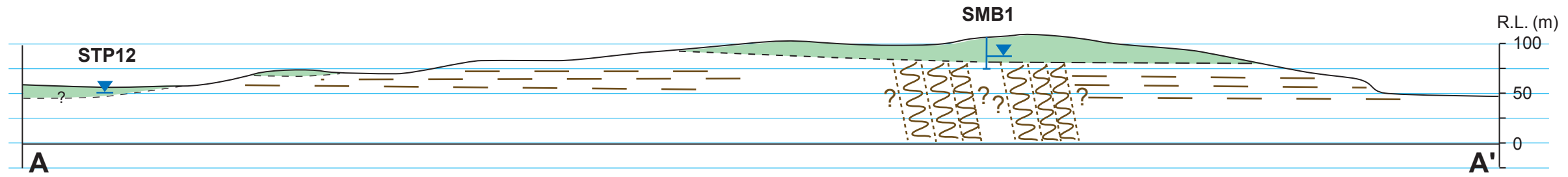
No.	Description	Drawn	Approved	Date
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Drawn	SB
Approved	B McD
Date	AUG' 2002
Scale	1:5000





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 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS
 SKETCH PLAN OF GEOLOGY AND GEOMORPHOLOGY

Drawing No. :
 FIGURE 2
 Job No. : HO154/1-AE

Coffey



LEGEND

-  Borehole with Groundwater level
-  Quaternary Alluvium
-  Permian Sedimentary Rocks (apparent dip in section)
-  Shear Zone, Projection of mapped, others will be present

REVISION	No.	Description	Drawn	Approved	Date
	0	Issued for Tender	SB	B McD	29/8/02

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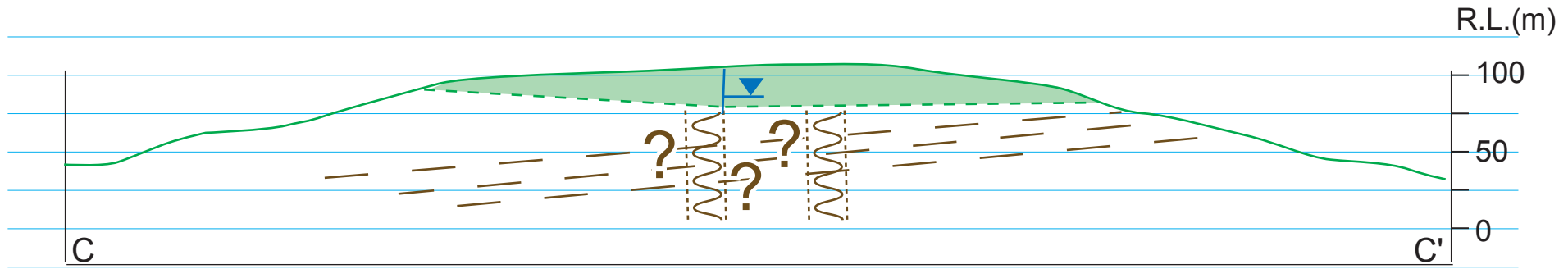
Drawn	SB
Approved	B McD
Date	AUG' 2002
Scale	NTS

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 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS
 CROSS-SECTION A - A' & B - B'

Drawing No. :
 FIGURE 3

Job No. : HO154/1-AE

SMB1



Poor Rock In Borehole
possible Shear Zone

LEGEND



Borehole with Groundwater level



Quaternary Alluvium



Permian Sedimentary Rocks (apparent dip in section)



Shear Zone, Projection of mapped, others will be present

REVISION	No.	Description	Drawn	Approved	Date	Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical	Resources	Environmental	Technical	Project Management
							Drawn	SB	JOHN HOLLAND PTY LTD - SOUTHWOOD PROJECT GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS CROSS-SECTION C - C'			
					Approved	B McD	Drawing No. : FIGURE 4					
					Date	AUG' 2002	Job No. : HO154/1AE					
					Scale	NTS	Job No. : HO154/1AE					
	0	Issued for Tender	SB	B McD	29/8/02							

