

REPORT

Smiths Beach Development

Preliminary Geotechnical and Pavement Investigation

Submitted to:

Smiths 2014 Pty Ltd

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1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical and pavement investigation carried out by Golder Associates Pty Ltd (Golder) for the proposed development at Smiths Beach, Yallingup. The approximate location of the site in relation to the surrounding area is presented on Figure 1. The scope of work was outlined in Golder proposal P20435097-001-L-Rev1 and P20435097-002-L-Rev0, and authorised by Smiths 2014 Pty Ltd.

The proposed development will comprise tourism, community infrastructure and holiday homes. The development area is about 20 hectares in size and presently covered with variably dense remnant bushland, with firebreaks around the perimeter and on various alignments through the site. Regular rock outcrops occur near the western and eastern extents of the site (Area 1 and Area 7 as discussed in Section 6.2). Figure 2 provides aerial imagery of the site.

The ground surface level varies from about 5 m AHD close to the coast, to a maximum of about 60 m AHD near the southern extent.

2.0 OBJECTIVES

The objectives of the investigation were as follows:

Development Area

- Assess surface and subsurface conditions and soil profile, subsurface soil layer thicknesses, strength, and other geotechnical characteristics.
- Assess the preliminary site classification for the development.
- Provide earthworks recommendations working with *in situ* materials and imported material as appropriate.
- Assess suitability of excavated material for fill.
- Assess areas and depths of unsuitable material and possible reuse of this unsuitable material on site.
- Assess groundwater levels and any perched water table levels, including sub-surface flow paths.
- Assess soil permeability and potential for stormwater disposal by soakage.
- Provide earth pressure coefficients for granular backfill to earth retaining structures.
- Assess the pavement design CBR for the development.
- Assess the site suitability and foundation requirements for residential and commercial type development (noting building pad requirements) and recommendations of disposal of roof stormwater.
- Assess soil permeability and soil classification for design loading rate calculations, in accordance with AS/ANZ 1547, suitable for supporting approvals for on-site disposal of effluent generated from on-site ATU's.
- Provide recommendations for further work based on the outcomes of the investigation.

Smiths Beach Road Pavement

- Assess the existing pavement condition, profile, and deflection characteristics along Smiths Beach Road between Canal Rocks Road and the road termination.
- Provide pavement rehabilitation requirements if the existing pavement is considered inadequate for the expected traffic loading.

- Provide a design subgrade California Bearing Ratio (CBR) and pavement design for Smiths Beach Road.
- Provide comment on any other factors that may influence pavement construction or performance.

Rock Durability near the Coast Line

- Assess the surface level of the rock near the coastline that is considered to have sufficient durability to withstand the action of the ocean in the coming century.

3.0 PREVIOUS INVESTIGATIONS

Various reports containing relevant information have previously been undertaken at the site. The relevant test locations from these investigations are shown on Figure 2 and Figure 3.

The previous investigations comprise:

- Rock Exploration Drilling by MP Rogers & Associates (MRA) in May 2000.
- A geotechnical investigation by Douglas Partners in March 2001. The results are provided in report Ref: Project 22180 dated May 2001. The relevant work comprised excavation of ten test pits and associated laboratory testing. The test pit locations are shown on Figure 2 and Figure 3. Test pit reports and laboratory test results are provided in Appendix A.
- Permeability testing completed by hyd2o at four locations. The test locations and results are shown on Figure 2 and Figure 3.
- A Geophysical Investigation by GBG Maps in March 2019. The results are provided in report Ref: 70492 Rev1 dated 24 September 2020.

4.0 FIELDWORK

4.1 Geotechnical Investigation

The geotechnical investigation was completed between 10 December 2020 and 12 March 2021 and comprised:

- Drilling of hand auger boreholes at 32 locations, HA01 to HA32, extending to depths between 0.2 m and 3.0 m.
- Perth sand penetrometer (PSP) or dynamic cone penetrometer (DCP) testing adjacent to each hand auger borehole, extending to a depth of 2 m or shallower refusal.
- Diamond core boreholes at eight locations, BH1 to BH8, extending to depths of between 6.0 m and 16.5 m.
- *In situ* permeability testing at eight hand auger locations.
- Collection of samples for geotechnical laboratory testing.

The test positions were located using a hand-held GPS, typically accurate to within about 5 m. The test locations are shown on Figure 2 and Figure 3. A summary of the test locations is provided in Table 1.

Table 1: Summary of Geotechnical Investigation Test Locations

Test ID	Approximate Coordinates (GDA94)		Termination Depth (m)	Termination Remark	Inferred Refusal Material
	Easting (m)	Northing (m)			
Current Golder Investigation					
HA01	315991	6273479	0.50	Refusal	Gneiss
HA02	315991	6273397	0.65	Refusal	Gneiss

Test ID	Approximate Coordinates (GDA94)		Termination Depth (m)	Termination Remark	Inferred Refusal Material
	Easting (m)	Northing (m)			
HA03	316007	6273291	0.30	Refusal	Gneiss
HA04	315947	6273232	2.60	Refusal	Hard Clay
HA05	315912	6273317	1.30	Refusal	Gneiss
HA06	315909	6273413	3.0	Target Depth	-
HA07	315876	6273480	2.00	Refusal	Very dense Silty Sand
HA08	315833	6273396	3.00	Target Depth	-
HA09	315817	6273322	3.00	Target Depth	-
HA10	315852	6273231	1.30	Refusal	Hard Clay
HA11	315785	6273235	1.50	Refusal	Hard Clay
HA12	315738	6273338	3.00	Target Depth	-
HA13	315764	6273379	3.00	Target Depth	-
HA14	315792	6273477	3.00	Target Depth	-
HA15	315694	6273420	3.00	Target Depth	-
HA16	315694	6273355	3.00	Target Depth	-
HA17	315596	6273379	3.00	Target Depth	-
HA18	315568	6273453	3.00	Target Depth	-
HA19	315526	6273391	3.00	Target Depth	-
HA20	315430	6273397	1.90	Refusal	Gneiss
HA21	315440	6273464	1.10	Refusal	Gneiss
HA22	315529	6273515	1.00	Refusal	Gneiss
HA23	315460	6273520	0.90	Refusal	Gneiss
HA24	315517	6273591	0.40	Refusal	Gneiss
HA25	315536	6273661	0.20	Refusal	Gneiss
HA26	315505	6273696	0.80	Refusal	Hard Clay
HA27	315594	6273629	0.70	Refusal	Hard Clay
HA28	315595	6273557	1.00	Refusal	Hard Clay
HA29	315661	6273609	1.90	Refusal	Very dense Clayey Sand
HA30	315727	6273575	2.20	Refusal	Very dense Clayey Sand
HA31	315738	6273539	3.00	Target Depth	-
HA32	315252	6273212	3.00	Target Depth	-
BH1	315665	6273623	6.50	Target Depth	-
BH2	315702	6273613	7.50	Target Depth	-
BH3	315725	6273608	12.00	Target Depth	-
BH4	315765	6273585	16.50	Target Depth	-
BH5	315750	6273601	10.50	Target Depth	-
BH6	315761	6273634	6.0	Target Depth	-
BH7	315727	6273627	6.0	Target Depth	-
BH8	315740	6273614	10.5	Target Depth	-
Previous Douglas Partners Investigation					
TP1	-	-	1.1	Refusal	Granite boulders
TP2	-	-	1.2	Refusal	Granite
TP3	-	-	2.2	Target Depth	-
TP4	-	-	2.0	Target Depth	-
TP5	-	-	1.3	Refusal	Granite
TP6	-	-	1.4	Refusal	Granite
TP7	-	-	2.5	Target Depth	-
TP7A	-	-	0.6	Refusal	Calcarene
TP8	-	-	2.0	Target Depth	-
TP8A	-	-	1.2	Refusal	Granite

The hand auger borehole reports are provided in Appendix B along with a list of the notes and abbreviations used on the reports, and the method of soil description adopted.

PSP/DCP testing was conducted in accordance with AS 1289.6.2-1997 and 1289.6.3-1997. The results of the PSP/DCP tests are provided on the hand auger reports included in Appendix B.

The boreholes were drilled using HQ3 diamond core techniques by a GDR 650 truck mounted drill rig owned and operated by OzDrill. The borehole reports are presented in Appendix C along with a list of notes and abbreviations, and a method of soil description used on the reports.

The *in situ* permeability testing was carried out using the 'Talsma Hallam' method described in AS 1547:2012, Appendix G. In accordance with the standard, the test was conducted at 0.5 m depth. The test results are provided in Table 2.

Table 2: Permeability Test Results

Location	Area	Material Type	Permeability (m/day)
Current Golder Investigation			
HA2	Area 7	Silty Sand	3
HA4	Area 6	Sand/Silty Sand	7
HA8	Area 3	Sand	18
HA9	Area 3	Sand	17
HA16	Area 3	Sand	28
HA18	Area 3	Sand	23
HA25	Area 1	Rock – Gneiss	Shallow rock – unable to perform test
HA28	Area 2	Sandy Gravel over Sandy Clay	9
Previous hyd2o Investigation			
-	Area 5	Silty Sand	4
-	Area 5	Silty Sand	1
-	Area 3	Sand	64
-	Area 4	Sand/Silty Sand	3

Personnel from Golder selected the borehole locations, advanced the hand auger boreholes, carried out the DCP/PSP and permeability testing, logged the materials encountered, and collected samples for laboratory testing.

4.2 Pavement Investigation

The pavement investigation was completed between 18 and 22 December 2020 and comprised:

- Visual assessment of the pavement and surfacing condition.
- Pavement dippings at six locations, PD01 to PD06, extending to depths of between 0.41 m and 1.00 m.
- PSP/DCP testing at subgrade level within each dipping.
- Collection of samples for geotechnical laboratory testing.
- Falling Weight Deflectometer (FWD) testing on both lanes at intervals of 25 m along Smiths Beach Road between Canal Rocks Road and the road termination.

The pavement dipping positions were located using a hand-held GPS, typically accurate to within about 5 m. The test locations are shown on Figure 3. A summary of the test location is provided in Table 3.

Table 3: Summary of Pavement Dipping Locations

Test ID	Approximate Coordinates (GDA94)		Termination Depth (m)
	Easting (m)	Northing (m)	
PD01	316075	6273013	0.52
PD02	316075	6273130	0.41

Test ID	Approximate Coordinates (GDA94)		Termination Depth (m)
	Easting (m)	Northing (m)	
PD03	316074	6273292	0.49
PD04	316065	6273444	0.87
PD05	316063	6273536	1.00
PD06	315906	6273603	0.75

The visual assessment of the existing pavement and surfacing condition was undertaken during a walkover and is further discussed in Section 8.1.

The pavement dippings were excavated using a 150 mm diameter corer and jackhammer operated by Qualcon Laboratory. Pavement dipping logs are presented in Appendix D.

FWD testing was carried out by Specialist Testing and Technical Services (STATS). The results of the FWD testing are presented in Appendix E. The outcomes of the testing are further discussed in Section 8.3.

A geotechnical engineer from Golder undertook the visual assessment of the pavement condition, positioned the test locations, supervised the pavement dippings, conducted the PSP/DCP testing, logged the materials encountered, and collected the samples for laboratory testing. The pavement dipping holes were backfilled with basecourse material and the pavement surfacing was reinstated with compacted cold mix asphalt and the site left in a tidy condition.

5.0 LABORATORY TESTING

Samples were submitted for laboratory testing at Golder's NATA-accredited laboratory and Qualcon's NATA-accredited laboratory. The laboratory testing comprised:

- Moisture content on 13 samples
- Particle size distribution on 13 samples
- Atterberg limits and linear shrinkage on 13 samples
- Dry density/moisture content relationship on three samples
- Soaked CBR on three samples
- Point Load Index on 11 rock core samples.

The geotechnical laboratory test certificates are presented in Appendix F. The test methods followed are shown on the test reports. A summary of the laboratory test results is presented in Table 4 and Table 5.

Table 4: Summary of Laboratory Test Results – Soil

Test ID	Material Description	Depth (m)	Particle Size Distribution (% passing)			LL (%)	PI (%)	LS (%)	MC (%)	MMDD (t/m ³)	OMC (%)	CBR (%)	Swell (%)
			Gravel	Sand	Fines								
HA04	Sandy CLAY	1.4-1.8	0.7	62	37	75	58	12.0	19.1	-	-	-	-
HA05	Silty SAND	0.5-0.7	0.0	80	20	SIB	ND	NO	4.8	1.98	10.5	50	0.0
HA07	Silty SAND	1.8-2.0	4.3	79	16	SIB	ND	NO	6.9	-	-	-	-
HA19	SAND	1.8-2.0	0.0	95	5	SIB	ND	NO	2.6	-	-	-	-
HA21	Silty SAND	0.8-1.0	0.8	84	15	SIB	ND	NO	4.4	-	-	-	-
HA28	Sandy CLAY	0.6-1.0	6	52	42	50	29	9.5	25.4	-	-	-	-
HA30	Clayey SAND	2.0-2.2	0.0	82	18	27	15	3.0	12.5	-	-	-	-
PD01	Sandy GRAVEL	0.04-0.16	59	35	6	NO	NP	NO	5.6	-	-	-	-
PD02	Gravelly SAND	0.2-0.4	33	64	3	NO	NP	NO	6.9	1.93	11.0	13	0.0
PD03	Clayey Gravelly SAND	0.30-0.49	28	52	20	20	4	1.0	3.3	-	-	-	-
PD04	Clayey SAND	0.49-0.99	12	62	26	30	12	5.0	11.9	-	-	-	-
PD06	Clayey Sandy GRAVEL	0.03-0.29	54	31	15	21	5	2.5	8.0	-	-	-	-
PD06	SAND	0.1-0.3	2	95	3	NO	NP	NO	2.5	1.64	16.5	17	0.0

Notes: Gravel – material passing the 63 mm sieve and retained on the 2.36 mm sieve, Sand – material passing the 2.36 mm sieve and retained on the 0.075 mm sieve, Fines – material passing the 0.075 mm sieve, LL – liquid limit, PI – plasticity index, LS – linear shrinkage, MC – moisture content, OMC – optimum moisture content, MMDD – modified maximum dry density, CBR – soaked California bearing ratio, Swell – swell measured in CBR test, NP – non-plastic, ND – not determined, NO – not obtainable

Table 5: Summary of Laboratory Test Results – Rock Strength Testing

Test Location	Sample Depth	Test Direction	Point Load Test Results Is50 (MPa)	Inferred Strength (Approx.)
BH1	2.75	Axial	1.7	High
BH1	4.50	Diametral	9.8	Very High to Extremely High
BH2	3.40	Diametral	1.9	High
BH2	4.60	Axial	0.65	Medium
BH3	4.60	Axial	0.25	Low
BH3	6.15	Axial	0.47	Medium
BH3	8.60	Diametral	1.1	Medium to High
BH3	10.40	Axial	0.67	Medium
BH5	6.40	Diametral	0.2	Low
BH5	7.65	Axial	0.42	Medium
BH5	8.15	Diametral	4.8	Very High
BH6	4.80	Diametral	0.34	Medium
BH6	5.15	Axial	0.89	Medium
BH6	5.85	Axial	3.3	Very High
BH7	2.10	Diametral	0.87	Medium
BH7	3.25	Diametral	3.4	Very High
BH7	4.50	Diametral	2.1	High
BH8	6.05	Diametral	0.07	Very Low
BH8	7.45	Diametral	0.14	Low
BH8	8.55	Diametral	0.55	Medium
BH8	9.20	Diametral	0.18	Low
BH8	9.80	Axial	0.21	Low
BH8	10.10	Diametral	0.64	Medium

6.0 SITE CONDITIONS

6.1 Geological Setting

The Geological Survey of Western Australia 1:50,000 scale Geological Map of Yallingup is reproduced on Figure 4. The map indicates that the site is in an area underlain by the following geological units:

- SAND derived from Tamala Limestone – white to pale and olive-yellow, medium to coarse grained, sub-angular quartz; moderately sorted.
- GNEISS – medium grained mesocratic gneiss.

The results of the investigation suggest the geology map broadly represents conditions at the site, except that Gneiss also occurs along the eastern boundary of the site.

6.2 Subsurface Conditions – Development Area

The subsurface conditions across the area are relatively variable. Based on the investigation results and the site walkover, the site has been divided into areas of inferred similar subsurface conditions, as shown on Figure 5. The area boundaries must be considered preliminary and indicative only due to the variability of the conditions and the limitations of an investigation using hand techniques only.

The subsurface conditions in each area are discussed in the following sections.

6.2.1 Area 1 – Shallow Rock

The subsurface conditions encountered in this area may be generalised as comprising:

- Silty SAND (SM), fine to medium grained, generally about 15% low plasticity fines, generally loose becoming medium dense to dense with depth, brown becoming pale brown orange and pale brown grey, extending to depths of between about 0 m (rock outcrops) and 1.9 m, overlying
- Inferred GNEISS/GRANITE cobbles, boulders, or bedrock, causing refusal at depths between 0.2 m and 1.9 m.

6.2.2 Area 2 – Shallow Clay

The subsurface conditions encountered in this area may be generalised as comprising:

- Silty SAND (SM) or Sandy GRAVEL (GP), fine to medium grained sand, fine to coarse lateritised gneiss gravel, generally about 15% low plasticity fines, medium dense to dense with depth, brown, extending to depths of between about 0.4 m and 0.5 m, overlying
- Sandy CLAY(CI/CH), medium to high plasticity, very stiff to hard, brown, orange, and red, extending to the maximum depth investigated of 1.0 m.

6.2.3 Area 3 – Sand

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND (SP), fine to medium grained, with silt in parts, loose becoming medium dense to dense with depth, orange brown to red brown, extending to the maximum depth investigated of 3.0 m.

6.2.4 Area 4 – Sand over Clayey Sand

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND (SP), fine to medium grained, with silt, loose becoming medium dense to dense with depth, orange brown to grey brown, extending to depths of between about 1.5 m and 2.1 m, overlying
- Clayey SAND (SC), fine to coarse grained, about 15% to 25% low plasticity fines, dense to very dense, orange brown, orange yellow and yellow grey, containing a sand layer between 2.5 m and 3.0 m at HA31, extending to the maximum depth investigated of 3.0 m.

6.2.5 Area 5 – Silty Sand

The subsurface conditions encountered in this area may be generalised as comprising:

- Silty SAND (SP), fine to medium grained, about 10% to 20% low plasticity fines, loose becoming medium dense to dense with depth, red brown to brown, extending to the maximum depth investigated of 2.0 m.

6.2.6 Area 6 – Silty Sand over Clay

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND/Silty SAND (SP/SM), fine to medium grained, about 10% to 15% low plasticity fines, loose becoming medium dense to dense with depth, brown, extending to depths of between about 0.8 m and 1.4 m, overlying
- Clayey SAND/Sandy CLAY(SC/CI/CH), medium to high plasticity, very stiff to hard, brown, orange brown and grey, extremely weathered rock, extending to the maximum depth investigated of 2.6 m.

6.2.7 Area 7 – Shallow Rock

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND/Silty SAND/Silty Gravelly SAND (SM), fine to medium grained, generally about 15% to 20% low plasticity fines, generally loose becoming medium dense to dense with depth, brown and red brown, fine to coarse gneiss gravel and cobbles, extending to depths of between about 0 m (rock outcrops) and 1.1 m, overlying
- Inferred GNEISS/GRANITE cobbles, boulders, or bedrock, causing refusal at depths between 0.3 m and 1.3 m.

6.3 Subsurface Conditions – Foreshore Area

Figure 6 and Figure 7 provide a section showing the inferred subsurface conditions encountered within the boreholes located near the coastline on the northern edge of the proposed development. The subsurface conditions may be summarised as follows:

- SAND/Silty SAND/Clayey SAND (SP/SM/SC), fine to coarse grained sand, with some Gneiss boulders, extending to depths of between about 1.5 m and 7.2 m, overlying
- Clayey SAND/Sandy CLAY/CLAY (SC/CI), medium plasticity, very stiff to hard, variably cemented with iron cementation, encountered at BH4 and BH6 only, extending to a depth of 4.5 m at BH6 and the depth investigated of 16.5 m at BH4, overlying
- GNEISS, medium to coarse grained, mottled pale red, brown, grey, and pale blue, distinctly weathered and very low to low strength in parts near the surface of the unit, becoming slightly weathered to fresh and medium to very high strength, extending to the depths investigated of between 6.5 m and 12.0 m.

6.4 Existing Pavement Condition

The pavement profile encountered along Smiths Beach Road can be generalised as follows:

- **Asphalt** – thickness varies from 25 mm to 40 mm, overlying
- **Basecourse** – Sandy GRAVEL/Gravelly SAND (GP-SP), fine to medium grained, sub-rounded to sub-angular gravel, brown, fine to coarse grained sand, trace non plastic fines, thickness ranging from 120 mm to 270 mm, overlying
- **Subgrade** – SAND/Gravelly SAND (SP), fine to coarse grained, pale brown to brown, fine to medium gravel, trace non plastic fines.

A variation to the above profile was observed in pavement dipping PD01 located approximately 180 m south of Duddy Road where a gravelly sand limestone sub-base layer was encountered. Another variation was observed at pavement dipping PD05 located approximately 50 m north of the transition from granite to laterite asphalt surfacing, as follows:

- **Asphalt** – 30 mm thickness.
- **Basecourse** – Sandy GRAVEL (GP), fine to medium grained, sub-rounded to sub-angular gravel, brown, fine to coarse grained sand, trace fines, 190 mm thickness, overlying
- **Sub-base** – Sandy GRAVEL (GP), fine to medium grained, sub-rounded to sub-angular gravel, grey-brown, fine to coarse grained sand, trace fines, 70 mm thickness, overlying
- **Subgrade** – Silty SAND (SM), fine to medium grained, dark brown, trace fine to medium gravel. At 800 mm depth, the material transitions into a red brown Silty Clayey SAND (SM/SC) with low to medium plasticity fines.

6.5 Groundwater

During our investigation in December, groundwater was not encountered in the hand auger boreholes, although the groundwater level was considered to be close to the base of the hole at hand auger HA31.

During the previous investigation conducted by Douglas Partners in March 2001, groundwater was not encountered in any of the test pits. However, the groundwater level in the soak was about 2.5 m below the natural surface level.

During the previous investigation conducted by MRA in May 2000, groundwater was measured at about RL 4.1 m AHD near the soak, which was noted to be similar to the level in the soak.

Perched water may occur during wet periods. Stormwater will readily infiltrate into the surficial higher permeability materials (sandy soil and highly fractured rock) and more slowly into the underlying lower permeability materials (clayey soil and relatively unfractured rock). Depending upon the amount of rainfall, this may result in some water perching on the lower permeability soil, at relatively shallow depth over parts of the site.

Figure 8 to Figure 11 present inferred subsurface sections across the site, which show the boundary between the higher and lower permeability soils and the potential flow path for any perched water. They indicate that if present, any perched water will move towards the centre of the site from the east, west and south. In the centre of the site any perched water will move into the deep sand. In the northern parts of the site where lower permeability materials occur at shallower depth, any perched water will be directed towards the ocean through the area around the wetland. The artificial soak is considered to be a surface expression of perched water flowing towards the ocean.

7.0 DEVELOPMENT AREA DISCUSSION

7.1 Main Geotechnical Issues

The geotechnical issues requiring consideration include:

- *The variability in subsurface conditions.* Relatively variable subsurface conditions occur at the site due to:
 - the transition between geological units (sand derived from Tamala Limestone and Gneiss)
 - the presence of varying thicknesses of colluvial soil including large boulders
 - variable weathering of the bedrock, which sometimes occurs as extremely weathered rock (soil comprising medium to high plasticity sandy clay) and sometimes as shallow relatively fresh rock.
- *The shrink swell potential of the clayey soils within the zone of significant moisture fluctuation.* The presence of relatively shallow clayey soil in some areas will result in seasonal surface movement. Although the movement may be mitigated by placement of imported granular soil, this may not be appropriate at this site as sand pads may be undesirable.
- *Near surface soils with a relatively low permeability.* Although much of the site is overlain by a significant thickness of highly permeable sand, where shallow clayey soil or rock is present these will have a relatively low permeability and act as a barrier to stormwater and effluent infiltration. In addition, whilst not as impermeable as the clayey soil and rock discussed above, at some locations the silty sand will have a lower permeability compared to the free draining sand present over much of the site.

- *The presence of shallow rock in some areas.* Where shallow massive rock or large boulders occur, the material is often relatively fresh and will be difficult to excavate.
- *Relatively loose near-surface sand over parts of the site.* As for many typical sand sites, conventional proof rolling using a heavy vibratory roller is required to improve the density of the near surface sand/silty sand.

7.2 Preliminary Site Classification

AS 2870-2011 defines site classification on the basis of a characteristic surface movement associated with the surface movements of soils. At this site, the site classification is primarily influenced by:

- The presence of clayey soil within the depth of seasonal moisture variation over parts of the site.
- The shrink swell characteristics of the clayey soil.
- The thickness of inert *in situ* sand/silty sand, or imported fill sand (inert soil) overlying clayey soil.

We have assessed the classification for the site and consider that provided the site preparation measures provided in Section 7.3 are adopted, the preliminary site classifications discussed below are applicable:

- Area 1 and Area 7 – ‘Class S’ – While a ‘Class A’ may be applicable for much of these areas where silty sand overlies relatively shallow rock, a preliminary classification of ‘Class S’ is recommended due to the variable weathering characteristics of the rock and the presence of boulders which may appear as massive rock in the hand auger boreholes. These factors may result in relatively shallow medium to high plasticity clay being present in some areas. Should this occur a ‘Class M’ classification may be appropriate for isolated areas.
- Area 2 – ‘Class M’ – Based on the presence of relatively shallow medium to high plasticity sandy clay a ‘Class M’ is considered appropriate. The sandy clay may have varying shrink swell potential; however, based on the currently available information, a ‘Class H1’ may be appropriate if no inert soil is present over the clay, and where about 1.0 m of inert soil is present over clay a ‘Class S’ may be appropriate.
- Area 3 – ‘Class A’ – Based on the presence of deep sand a ‘Class A’ is considered appropriate.
- Area 4 – ‘Class S’ – Based on the presence of clayey sand within the depth of seasonal moisture variation, a ‘Class S’ is considered appropriate.
- Area 5 – ‘Class S’ – While a ‘Class A’ may be applicable for parts of this area where silty sand overlies relatively shallow rock, a preliminary classification of ‘Class S’ is recommended due to the variable ground conditions and the possible presence of clayey soil within the depth of seasonal moisture variation.
- Area 6 – ‘Class M’ – Based on the presence of relatively shallow high plasticity sandy clay a ‘Class M’ is considered appropriate, although other classifications may be applicable in some areas. The sandy clay may have varying shrink swell potential; however, based on the currently available information, if less than about 0.5 m of inert soil is present over the clay a ‘Class H1’ may be appropriate, and where about 1.2 m of inert soil is present over clay a ‘Class S’ may be appropriate.

7.3 Site Preparation Procedures

The site preparation requirements identified below are directed towards:

- Densification of loose surficial sand and silty sand zones that may occur across the site.
- Removal of rock relatively close to finished level to create a uniform bearing layer at least 0.3 m thick under footings and ground slabs. The presence of a variable mix of rock and soil below footings and ground slabs could otherwise create alternate 'hard' and 'soft' points below footings and ground slabs, which may lead to significant differential settlement and cracking or distortion of masonry structures. It may also be prudent to provide a blanket of soil, free of rock to improve drainage and into which footing excavations and service excavations can be made.
- Providing good drainage to reduce the risk of excessive seasonal movement associated with wetting of clayey soil.

The following site preparation procedures will be required to prepare the site for development:

- Remove any other trees not being retained as part of the development, including grubbing out roots.
- Remove all topsoil, roots and other unsuitable or deleterious material from the area. These materials should be stockpiled separately and are not suitable for re-use as structural fill in their current condition. Based on the findings of the site investigation, an average topsoil thickness of about 200 mm is present.
- If required, excavate to the required depth. Granular soils removed during this process should be stockpiled for later re-use as structural fill (refer Section 7.5).
- Where rock may be present within 0.3 m of footings and ground slabs, over-excavate to remove the rock within this zone. Deeper excavation of rock, or placement of structural fill may be desirable for non-geotechnical reasons.
- Proof-compact the exposed surface by moisture conditioning the soil well and applying at least eight overlapping passes with a minimum 10 tonne vibratory roller. Wetting of silty sand will be important prior to compaction to break soil bonds and allow re-orientation of the sand particles and densification of the soil.
- If clayey soils are present following excavation, measures must be undertaken to minimise any exposure of clayey soils to changes in moisture (rain, surface water run-off etc.) to reduce the risk of softening of the clayey soils during construction. Therefore, if excavations are proposed, earthworks should preferably be undertaken during dry periods, as the clayey soils present will be difficult to work when wet. Should the clayey soil become wet and soften it must be removed and replaced with compacted structural fill.
- Where clayey soils are present near surface below structures, the surface of the clayey soil will need to be graded to allow drainage to appropriately designed drains. The drains must be designed to collect water permeating through the granular fill and discharge it clear of the site.
- Where fill is required to achieve the required levels, place and compact approved free draining granular fill, as outlined in Section 7.5, in layers of no greater than 0.3 m loose thickness to the level of compaction specified in Section 7.4. The amount of granular fill required will be dependent on the desired site classification and drainage design.
- Confirm that the specified level of compaction has been achieved to a depth of 0.9 m by testing to the quantities required in AS 3798-2007.

Although the coverage of the site is reasonable on the basis of accepted field investigation practices, the occurrence of undetected unsuitable fill cannot be dismissed. Any deleterious material must be removed from beneath the site and replaced with compacted structural fill.

7.4 Compaction

The required level of compaction for fill and *in situ* soils is outlined below:

- Structural sand fill and *in situ* sand with less than about 5% fines should be compacted to achieve a Perth sand penetrometer (PSP) blow count of at least 8 blows per 300 mm in accordance with AS 1289 6.3.3. If difficulties are experienced with achieving this blow count, then *in situ* density testing may be required to confirm the correlation between Perth sand penetrometer blow count and relative density.
- Materials other than sand should be moisture conditioned and compacted to achieve a Modified dry density ratio of at least 95% in accordance with AS 1289 5.2.1. This is likely to apply where sandy/silty sand contains more than about 5% fines or where fill material comprising both sand and gravel to cobble size pieces is used.

Over excavation and replacement of loose or weak materials may be required where the minimum density cannot be achieved.

Care will need to be taken when compacting in the vicinity of existing buildings, roads, and underground services. This is particularly important if vibratory compaction is being carried out. Tynan (1973)¹ provides assistance with the selection of compaction equipment for use adjacent to structures.

7.5 Structural Fill

7.5.1 Imported Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments". The fill should comprise clean sand, with less than about 5% fines, that is free of deleterious materials and organic matter.

7.5.2 In Situ Soils

The *in situ* sand (other than the topsoil encountered at the surface) present across Area 3 is considered generally suitable for re-use as fill provided that any roots, organic matter and deleterious materials are removed.

The silty sand and gravelly silty sand present over the remainder of the site are considered suitable for re-use as fill provided it is recognised that these materials may not be free draining and the materials may be more difficult to compact as they may be more sensitive to moisture. These materials must not be used where free draining soil is required.

7.6 Excavations

Excavation above the hand auger borehole and test pit refusal depths (refer Table 1) should generally be achieved using standard earthmoving equipment such as a 20-tonne excavator. This is likely to be the case for excavations over most of the site, except in Area 1 and Area 7, and to a lesser extent Area 2, Area 5, and Area 6. Excavation of the relatively shallow granite/gneiss in these areas is expected to generally require a hydraulic rock breaker.

¹ Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11.

It is not possible to infer whether the rock is massive or a cobble/boulder from hand auger refusal, however at this stage it is recommended that where refusal has occurred it is assumed that massive rock, or large boulders requiring use of a rock breaker for excavation are present.

Excavations in sand and silty sand are particularly prone to instability. Care must be exercised in such excavations and appropriate safety measures adopted where necessary. A short-term excavation slope angle of 1V:1.5H is recommended provided there are no structures or surcharges located behind the slope crest.

Excavations along or close to boundaries may require installation of temporary retention structures to support the ground. It has been our experience that noticeable ground movements nearly always occur behind temporary and permanent retention structures, and care must be taken to ensure adjacent infrastructure or buried services are not damaged.

7.7 Earthwork Bulking Factors

Once excavated, the *in situ* materials are anticipated to bulk up and increase in volume. When placed and compacted the loose volume is anticipated to reduce. Indicative bulking factors are provided in Table 6.

Table 6: Bulking Factors

Soil Type	Bank (<i>In Situ</i> Soil)	Stockpiled Materials (Loose Condition)	Compacted Materials
Cohesive Soils	1.0	1.4	0.9
Silty Sand/Sand	1.0	1.2	0.8
Gravel	1.0	1.4	1.0
Rock	1.0	1.6	1.3

The bulking factors are approximate and will depend on the method of excavation and variations of grading of the materials.

7.8 Stormwater Disposal

In situ permeability testing was carried out at the site. The results are summarised in Table 2.

The results of the investigation indicate that across Area 3 the sand present is free draining and suitable for on-site disposal via soakwells or similar. The measured permeability varied between 17 m/day and 64 m/day, which will reduce following compaction due to earthworks or trafficking. For drainage design a permeability of 5 m/day to 10 m/day is considered appropriate for the sand in this area.

Across the remainder of site, the near surface sand/silty sand has a measured permeability of about 3 m/day to 7 m/day, which will reduce where trafficking or compaction occurs. For drainage design a permeability of 1 m/day is considered appropriate for the silty sand. The permeability of the underlying rock and clayey soil may be variable but should be considered to be relatively impermeable for stormwater disposal design, particularly for relatively small drainage features such as soakwells. Suitably designed on-site drainage may be appropriate depending upon the depth of sand/silty sand overlying rock or clayey soil.

Drainage design must allow for clogging of sands with fine particles through ongoing infiltration.

7.9 Pavements

Across Area 3, and also where at least 200 mm of imported sand fill forms the subgrade, a design CBR of 12% is considered appropriate. The sand subgrade in these areas should be compacted to a modified dry density ratio of at least 96% in accordance with AS 1289 5.2.1.

Across the remainder of the site where the *in situ* silty sand forms the subgrade a design CBR of 10% may be adopted. The silty sand subgrade should be compacted to a modified dry density ratio of at least 92% in accordance with AS 1289.5.2.1.

7.10 Effluent Disposal

In situ permeability testing in accordance with AS/ANZ 1547, was carried out at the site. The results are summarised in Table 2.

The results of the investigation indicate the following in accordance with Table 5.1 of AS/NZS 1547:2012:

- Area 3 – The soil in this area extends to significant depth and is considered to be ‘Category 1 – Gravels and sands – Structureless (Massive)’.
- Remainder of site – The near surface silty sand/sand across the remainder of the site is considered to be ‘Category 2 – Sandy loams – Massive’. The soil extends to varying depth as follows:
 - Area 1 and Area 7 – Rock outcrops occur regularly and at the test locations the silty sand extended to depths of between 0.2 m and 1.9 m. Design will need to consider the presence of relatively shallow rock in some areas that may be relatively impermeable.
 - Area 2 – Relatively shallow sandy clay occurs in this area. At the test locations the silty sand or sandy gravel extended to depths of between 0.4 m and 0.5 m. Design will need to consider the presence of relatively shallow sandy clay that is considered to be ‘Category 6 – Medium to heavy clays – Moderately structured’.
 - Area 4 – Relatively deep sand/silty sand occurs in this area. At the test locations the sand/silty sand extended to depths of between 1.5 m and 2.1 m. The underlying clayey sand is considered to be ‘Category 4 – Clay loam – Massive’.
 - Area 5 – At the test locations in this area the silty sand extended to depths of at least 1.3 m and 2.0 m.
 - Area 6 – At the test locations in this area the sand/silty sand extended to depths of between 0.8 m and 1.4 m. The underlying clayey sand/sandy clay is considered to be ‘Category 5 – Light clays – Massive’.

7.11 Retaining Structures

Retaining structures should be designed in accordance with AS 4678-2002 “Earth-Retaining Structures”. Backfill behind retaining structures should be free draining with a fines content of less than 5%. Where retaining structures are required at the site, the parameters provided in Table 7 can be used.

Table 7: Retaining Structure Parameters

Material Type	Unfactored Friction Angle ϕ	Coefficient of Earth Pressure at Rest, K_0	Coefficient of Drained Active Earth Pressure, K_a		Coefficient of Drained Passive Earth Pressure, K_p		Bulk Density kN/m^3
			Wall Friction = 0	Wall Friction = $0.5\phi'$	Wall Friction = 0	Wall Friction = $0.5\phi'$	
Medium dense SAND/Compacted SAND FILL	35°	0.43	0.27	0.24	3.7	6.1	18

Earth pressure coefficients are provided for conditions of zero friction between the wall and the soil. The retaining wall designer should make an independent assessment of the parameters appropriate to the construction method to be used, including alternative values of wall friction. A horizontal ground surface behind the wall has been assumed.

Compaction plant can increase the lateral earth pressures acting on retaining walls. Handheld compaction equipment is recommended within 2 m of any such walls to minimise compaction pressures.

8.0 PAVEMENT DISCUSSION

8.1 Visual Assessment

The existing pavement surfacing along Smiths Beach Road is observed to comprise two types:

- 10 mm laterite Dense Graded Asphalt (DGA) extending from the termination of the road to approximately 100 m south of the eastern carpark, transitioning to,
- 14 mm DGA thereafter until the intersection with Canal Rocks Road.

Deformation of the pavement surface is an important element of pavement condition due to the direct influence it has on the riding quality of a pavement and is often indicative of a pavement's underlying structural inadequacies. As such, surface shape typically governs the nature of the remediation required for a pavement, depending on the magnitude and frequency of estimated future traffic volumes. The shape of pavement along Smiths Beach Road was noted to be in satisfactory condition and no noticeable deformation or structural defects were recorded during the visual assessment.

Although the pavement appears structurally sound, defects relating to the surface texture of the pavement were observed during the visual assessment. Minor to moderate ravelling was recorded in both lanes, mainly outside the wheel paths and at proximity to joints, with a higher frequency of ravelling observed along the northbound lane. Pinhole sized defects are also generally widespread throughout the pavement, which suggests that aggregate has been plucked out of the asphalt surfacing by the traffic movement. The asphalt mix appears to be segregated, which indicates a lack of adhesion and insufficient mix temperature during the original construction. As the asphalt is observed to be relatively new (inferred around two years of age), the early ravelling and pinhole surface defects may also be associated with construction during wet or cold weather.

Other localised defects were noted as follows:

- Minor ravelling observed at the intersection stub of Canal Rocks Road and Smiths Beach Road, on the wheel path of the left turning northbound lane.
- Minor pumping of fines at the joint along the sprayed seal widened edge of the intersection stub. Pumping of fines are generally associated with moisture ingress through cracking or poor joint sealing. No cracking was observed; however, waterproofing was not evident along the joints.
- Minor edge break/drop off on the spray sealed widened section of the intersection stub (northbound side). It was inferred that water drains towards the direction of the sealed section and as it sheds off the edge of pavement, a gradual erosion of the basecourse material causes the observed edge defects, particularly if the basecourse contains non plastic to low plasticity fines.
- Minor potholes on the outer wheel path and adjacent to the inner wheel path of the northbound lane approximately 210 north of the intersection with Canal Rocks Road, and on the edge of the northbound lane pavement approximately 270 m north of the intersection.
- Minor cracking at various locations (longitudinal, transverse, and meandering cracks).
- Minor flushing observed in the wheel paths, predominantly on the southbound lane along the bend of Smiths Beach Road. Despite the tendency for laterite asphalt to crack early during the design life (as the mix is generally stiffer than granite asphalt), minimal to no cracking was noted along the laterite asphalt section of Smiths Beach Road. This suggests that a higher binder content mix may have been used to compensate for the risk of early cracking. As such, the pavement is more prone to flushing, especially in sections of high traffic volume or high turning stresses such as that observed.

Selected photographs and a description of the observed defects are presented in Appendix G.

8.2 Design Traffic

The design traffic for Smiths Beach Road has been assessed using traffic count data supplied by Cardno. The data was collected by Matrix using tube counters installed at six locations along the road. It is noted that the data was collected during the peak holiday season between 16 December 2020 and 6 January 2021 when traffic volumes are higher than normal, and as such the traffic calculated is conservative.

The parameters used in the assessment are as follows:

- Percentage of heavy vehicle using the design lane – 100% (one lane each direction)
- Assumed linear traffic growth rate of 1%
- Pavement design life of 40 years for permanent subgrade deformation and 15 years for fatigue in thin asphalt surfacing in accordance with ERN9.

An axle equivalency factor for commercial vehicle by class was assumed based on available MRWA information for rural main and secondary roads and calculated against the distribution of heavy vehicles (Austroads Class 3 to Class 12 inclusive) provided with the traffic count data. The design traffic calculation can be referred to in Appendix H. We have not considered the carpark access data due to the anomaly in the heavy vehicle count, which may have been caused by an error in the classification of the larger vehicles accessing the carpark. The design traffic calculated from the supplied data has been adopted as follows:

- 1.22×10^5 ESAs for a 15-year design life
- 3.70×10^5 ESAs for a 40-year design life.

8.3 Subgrade Design CBR

Based on the geotechnical laboratory information and our experience with similar material, we consider that a subgrade design CBR value of 12% is appropriate for the existing road.

8.4 Falling Weight Deflectometer

Falling Weight Deflectometer (FWD) testing was carried out by Specialist Testing and Technical Services (STATS) using a trailer-mounted FWD at a target drop stress of 566 kPa. The results of the FWD testing are provided in Appendix E.

Deflection values were assessed using the method outlined in Austroads Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design (AGPT05). Due to the variance in the data and in accordance with the Austroads Guide, a selection of homogenous sections was conducted and summarised in Table 8.

Table 8: Falling Weight Deflectometer Results (566 kPa Drop Stress)

Section	No. Tests	Deflection ⁽¹⁾ (mm)		
		Mean	Std. Deviation	Characteristic
Northbound				
CH 0.0 – CH 0.527	22	0.398	0.09	0.521
CH 0.527 – CH 0.677	4	0.687	0.17	0.875 ⁽²⁾
CH 0.677 – CH 0.993	14	0.420	0.10	0.555
Southbound				
CH 0.990 – CH 0.665	13	0.286	0.07	0.376
CH 0.665 – CH 0.465	5	0.727	0.18	0.969 ⁽²⁾
CH 0.465 – CH 0.015	15	0.355	0.09	0.472

Notes: Chainage reference commences at CH 0.0 at the intersection of Smiths Beach Road and Canal Rocks Road

⁽¹⁾ Values include FWD deflection standardisation factor of 1.1. Outliers have been excluded from the assessment.

⁽²⁾ Characteristic deflection equals to maximum deflection as the section has less than 10 test points.

Based on the assessed design traffic volume in Section 8.2 and the Austroads criteria, a design deflection of 1.32 mm has been calculated. As the characteristic deflections within each section and lanes are less than the design deflection, an overlay is not required to strengthen the existing pavement.

8.5 Pavement Design (New and Existing Pavements)

An empirical and mechanistic assessment of the required pavement thickness for the design traffic loading has been conducted. The empirical design method followed Austroads Guidelines and assesses the required cover over the subgrade. The mechanistic design assesses the fatigue life of the asphalt surfacing. The mechanistic design was undertaken using the pavement design program CIRCLY 6.0. A posted speed of 40 km/h (design speed of 30 km/h) was assumed for the site. The asphalt fatigue life was assessed with the 15-year design traffic loading for the following surfacing type:

- 30 mm thickness – 10 mm Dense Graded Asphalt with C170 binder
- 40 mm thickness – 10 mm Dense Graded Asphalt with C170 binder.

The assumed flexible pavement and subgrade material properties are summarised in Table 9.

Table 9: Summary of Assumed Material Properties

Material	Vertical Modulus of Elasticity (MPa) at 29°C	Poisson's Ratio (ν)	Degree of Anisotropy
Dense graded asphalt ⁽¹⁾ (C170, 10 mm, 30 km/h)	2,310	0.40	1.0
Granular Basecourse	500	0.35	2.0
Granular Sub-base	250	0.35	2.0
Subgrade (CBR 12%)	120 (10 × CBR)	0.35	2.0

Notes: CBR – California Bearing Ratio

⁽¹⁾ to match the existing pavement, dense graded laterite asphalt may be used if preferred.

The mechanistic assessment indicated that a minimum granular pavement thickness of 140 mm is required to satisfy the asphalt fatigue requirements for the 30 mm thick surfacing option, which is already achieved by the existing pavement thickness. Where a 40 mm thick surfacing may be required to match existing pavement levels, a minimum granular thickness of 165 mm will be required, which is achieved at all pavement dipping locations except for PD02. The pavement design outputs are included in Appendix I.

The empirical design requires a minimum pavement thickness of 205 mm for the design traffic. The pavement dipping PD02 indicated a deficiency in the granular thickness of 55 mm (pavement thickness 150 mm). The empirical assessment was conducted using a subgrade design CBR of 12% and the soaked subgrade CBR measured during the laboratory testing varied between 13% to 17%, which indicates that the subgrade strength is higher than the design assumption. There is also a level of conservatism in the design traffic due to the availability of data and the expected significantly lower traffic outside of peak holiday season. On this basis and supported by the observed condition of the existing pavement, the deficiency in pavement thickness observed at pavement dipping PD02 is not considered to require remediation at this stage. It should be noted however that there is a higher risk of shape loss at this location especially if there is an increase in future traffic loading (such as during construction of the redevelopment).

As the existing pavement is observed to be structurally sound, a resurfacing design is presented as an option if a new pavement surfacing is preferred for the proposed development. It may also be necessary to provide new pavements to accommodate possible geometry changes during the proposed development. Due to the proposed development plan, we have not provided a design for the intersection of Smiths Beach Road and Canal Rocks Road. The recommended midblock granular pavement design is shown in Table 10.

Table 10: Summary of Granular Pavement Requirements

Layer	Pavement and Surfacing Requirement (mm)
New Pavement (In areas of new pavement and widening)	
10 mm dense graded asphalt ⁽²⁾ with C170 binder	30
Prime, 2 coat bitumen emulsion seal (CRS170/60, 10 mm/5 mm) or 7 mm emulsion seal	Nominal thickness
Granular Basecourse (Crushed Rock ⁽¹⁾ , Laterite Gravel or Bitumen Stabilised Limestone)	205
Resurfacing (Existing Pavements)	
10 mm dense graded asphalt ⁽²⁾ with C170 binder	30 or 40
Prime, 2 coat bitumen emulsion seal (CRS170/60, 10 mm/5 mm) or 7 mm emulsion seal (Where basecourse is exposed). or SAMI (where existing asphalt surfacing remains)	Nominal thickness
Existing Pavement	150 to greater than 480

Notes: ⁽¹⁾ It may be difficult to achieve the compaction requirements for placement of crushed rock directly on the subgrade. A sub-base layer may be required.

⁽²⁾ to match the existing pavement, dense graded laterite asphalt may be used if preferred.

8.6 Sealing

Preliminary seal application rates for the new pavement design are presented in Table 11. The preliminary rates will need to be adjusted to suit the aggregate used and site conditions. The seal should be applied in warm and dry weather with no cutter used in the binder. A 10/5 mm emulsion seal is recommended below asphalt. A 7 mm single coat emulsion seal could also be considered; however, a single coat seal will be more prone to damage from the paver during application of the asphalt. Any damage to the seal must be repaired during construction.

If due to traffic management requirements a cut back prime is not preferred, an emulsion prime such as Bioprime/Ecoprime or omission of the prime could be considered. The following should be noted however:

- Our experience is that emulsion primes may not penetrate as well as cut-back primes and the level of penetration will be highly dependent upon the basecourse material finish and basecourse type. Further information should be sought from the supplier on the selected emulsion prime's expected performance for the basecourse material proposed.
- The omission of the prime does increase the risk of an inadequate bond forming between the seal and basecourse. If this option is preferred the basecourse should be adequately swept to expose the gravel particles and the applied seal must be an emulsion seal. Each seal coat should receive a minimum of 15 roller passes to assist in bedding down the aggregate.

Emulsion primes should be cured in accordance with the manufacturer's instructions. We understand a curing period of about 24 hours is typical, depending on weather conditions. A cutback prime should be allowed to cure for a minimum period of three days of warm, dry weather prior to application of the seal.

Table 11: Preliminary Bituminous Surfacing Application Rates

Treatment Type	Binder Type	Aggregate Size	BAR/EAR (L/m ² at 15°C)	ASR ⁽²⁾ (m ² /m ³)
Prime	40/60 Bitumen (C170)/ Medium curing cutter <u>or</u> Bioprime/Ecoprime	Not Applicable	0.6 ⁽¹⁾ (total application rate)	Not Applicable
Single coat seal	CRS 170/60	7 mm	1.4	160-180
Double/double bitumen emulsion seal	CRS 170/60	1 st coat 10 mm	0.9	120-140
		2 nd coat 5 mm	1.1	200-250

Treatment Type	Binder Type	Aggregate Size	BAR/EAR (L/m ² at 15°C)	ASR ⁽²⁾ (m ² /m ³)
Strain Alleviating Membrane Interlayer	S20E	10 mm	1.5	120-160

Notes: BAR – binder application rate, ASR – aggregate spread rate, EAR – emulsion application rate (CRS170/60)

⁽¹⁾ The emulsion prime application rate should be confirmed with the supplier

⁽²⁾ Preliminary aggregate spread rates will need to be adjusted to suit aggregate properties

8.7 Pavement Joints

Pavement joints should be in accordance with standard MRWA joint drawings where applicable.

8.8 Pavement Rehabilitation

The pavement and surfacing condition on Smiths Beach Road were generally observed to be in satisfactory condition and relatively early in its design life. Based on the visual and FWD assessment, we anticipate the pavement to be in serviceable condition for about another five to ten years (or possibly longer with routine maintenance) under the current traffic loading. However, the pavement and surfacing will need to be monitored due to the anticipated increase in traffic loading during the construction of the development and provision for localised repairs should be made.

As discussed in Section 8.5, a section approximately 70 m south of Duddy Road is inferred to have insufficient granular thickness, as indicated by pavement dipping PD02. Monitoring of this section is recommended as there is a risk that the pavement will develop shape loss.

We further recommend that the observed surface defects such as cracking and potholes be repaired under the methods outlined in the following sub-sections. As discussed in Section 8.1, the observed edge break and drop-off along the sealed widening of the intersection is inferred to have occurred due to concentrated stormwater flow and the non-plastic to low plasticity of the basecourse gravel. We recommend a top up and rework of the unsealed basecourse in this section to prevent further erosion of the material.

8.8.1 Pothole and Small Defect Repair

It is our experience that potholes can deteriorate rapidly, requiring further repairs. As such, localised repairs may be required where potholes and small defects are observed.

The following methodology is recommended for potholes, particularly in areas subject to heavy vehicle movements:

- Cut the pavement outside the edges of the pothole to form a rectangular area with vertical sides.
- Remove loose material from the sides and base of the pothole to leave a flat base.
- Clean the pothole by sweeping, blowing with air or another suitable method to remove loose material that may affect adhesion of the asphalt.
- Apply a tack coat of bitumen emulsion to the base and sides of the pothole and allow to break (turn black).
- Backfill with hot mix (preferred) or high-quality cold-mix asphalt (such as Fulton Hogan EZ Street) and compact with appropriate plant. Our experience is that hand compacted asphalt can settle under traffic and therefore the repaired area should be left proud of the surrounding pavement to allow for this.

Thin layers of asphalt should not be used to make up minor level differences as they can delaminate, particularly if the surface is dusty.

8.8.2 Crack Sealing

A pavement work tip produced by Austroads outlines the recommended treatment for cracking and is included in Appendix J.

8.8.3 Edge and Shoulder Maintenance

The following methodology is recommended for the remediation of the observed edge defect at the Canal Rocks Road and Smiths Beach Road intersection stub.

- Clear vegetation from the existing shoulder if required.
- Scarify the existing shoulder material to at least 50 mm depth to facilitate bonding with the top-up material.
- Add basecourse material as required, and using a grader blade or similar, redistribute the shoulder material towards the existing seal and leave slightly proud of the existing seal level.
- Moisture condition and compact the shoulder. The final level of the shoulder should be approximately level with the existing seal level and provide crossfall for drainage. If the shoulder is proud of the seal it may restrict drainage or promote channelisation, leading to scour. In this case it should be graded flush with the seal, taking care not to damage the existing seal.

Our experience is that shoulder material with low fines content or low plasticity fines may be more susceptible to erosion. If available, a slightly higher-plasticity material should be used for these works.

9.0 PAVEMENT SPECIFICATIONS AND CONSTRUCTION

9.1 Specifications

The following MRWA specifications may be relevant for the design and rehabilitation options provided in this report. Alternatively, the City of Busselton may have specifications (such as WALGA Specifications) preferred for this project.

- Specification 501 – Pavements
- Specification 503 – Bituminous Surfacing
- Specification 504 – Asphalt Wearing Course
- Specification 508 – Cold Planing
- Specification 509 – Polymer Modified Bituminous Surfacing
- Specification 511 – Materials for Bituminous Treatments.

9.2 Compaction and Dryback

In areas of new pavement, it is essential that all granular pavement layers are well compacted and dried back prior to priming and sealing. It should be noted that failure to allow pavement layers to adequately dry back is a significant cause of pavement defects.

Minimum compaction and dryback requirements are presented in Table 12.

Table 12: Compaction and Dryback Requirements

Material Type	Density Specification Limit (%) [*]	Dry Back Moisture Ratio (%) [*]
Sub-base – Crushed Limestone	94	85
Granular Basecourse – Bitumen Stabilised Limestone or Natural Gravel	98	70
Granular Basecourse – Crushed Rock	99	60

Note: * Modified Compactive Effort

9.3 Asphalt

A nominal 30 mm thickness of 10 mm dense graded asphalt with C170 binder is recommended for Smiths Beach Road. Localised sections of the road more frequently exposed to turning vehicle movements (such as the bend, south of the public carpark) may experience earlier pavement defects compared to the remaining sections of the road. However, due to the relatively low heavy vehicle traffic and climate conditions at the site, we do not consider the use of a polymer modified binder such as A15E as necessary.

It is recommended that the MRWA Specification 504 be used as a basis for asphalt mix design. It is also recommended that approved asphalt mixes registered by MRWA be used if practicable.

9.4 Construction Advice

If it is anticipated that construction vehicles will be allowed to traffic Smiths Beach Road throughout the proposed development of the site, we highly recommend scheduling the pavement repairs and upgrades towards the end of construction. Excessive heavy vehicle use of the road must be avoided due to the high risk of shoving and rutting on a newly constructed or resurfaced pavement.

It is further recommended that pavement works be conducted in dry conditions to avoid complications with dry back and compaction. In situations where construction takes place over several days or if inclement weather is forecasted during construction, the construction should be staged as to minimise exposure to external moisture conditions.

9.5 Pavement Drainage

Performance of granular pavements is highly sensitive to the in-service moisture content. It is essential that adequate crossfall and drainage is provided to remove water from pavements, particularly in low-lying areas of the site.

10.0 ROCK DURABILITY DISCUSSION

The subsurface conditions encountered along the coastline on the northern edge of the proposed development are summarised in Section 6.3, and Figures 6 and 7 provide sections showing the inferred profile.

The section shows the thickness of soil and very low to low strength (weak) rock, overlying medium to high strength rock. The soil and weak rock are considered to be susceptible to erosion by the action of the ocean in the coming century, while the underlying medium to high strength rock is considered to have sufficient durability to withstand erosion.

As shown on Figure 6, the thickness of the soil and weak rock increases gradually towards the south-east, extending to between about RL 4.5 m AHD at BH1 and about RL -1 m AHD at BH5. Between BH5 and BH4 the underlying rock surface falls away significantly and soil extends to below RL -10 m AHD at BH4.

11.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled – “Important Information Relating to this Report”, which is included in Appendix K of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder has under the contract between it and its client.

Signature Page

Golder Associates Pty Ltd



Devina Gee
Geotechnical Engineer



Daniel Kain
Principal Geotechnical Engineer

DG-DJK/DMS/hn

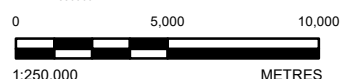
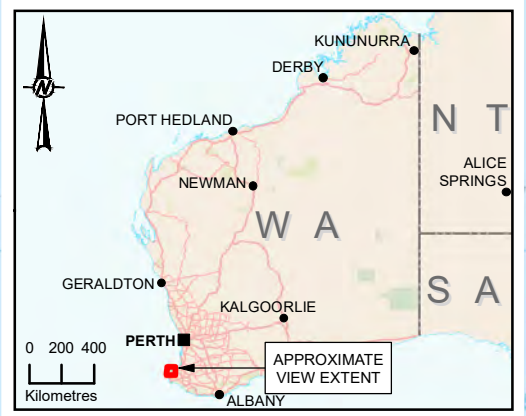
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APPROXIMATE
SITE LOCATION



1:250,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCE:
1. IMAGE SOURCED FROM GEOSCIENCE AUSTRALIA 1:250,000 TOPOGRAPHIC MAPPING.

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PROJECT
PROPOSED SMITHS BEACH DEVELOPMENT

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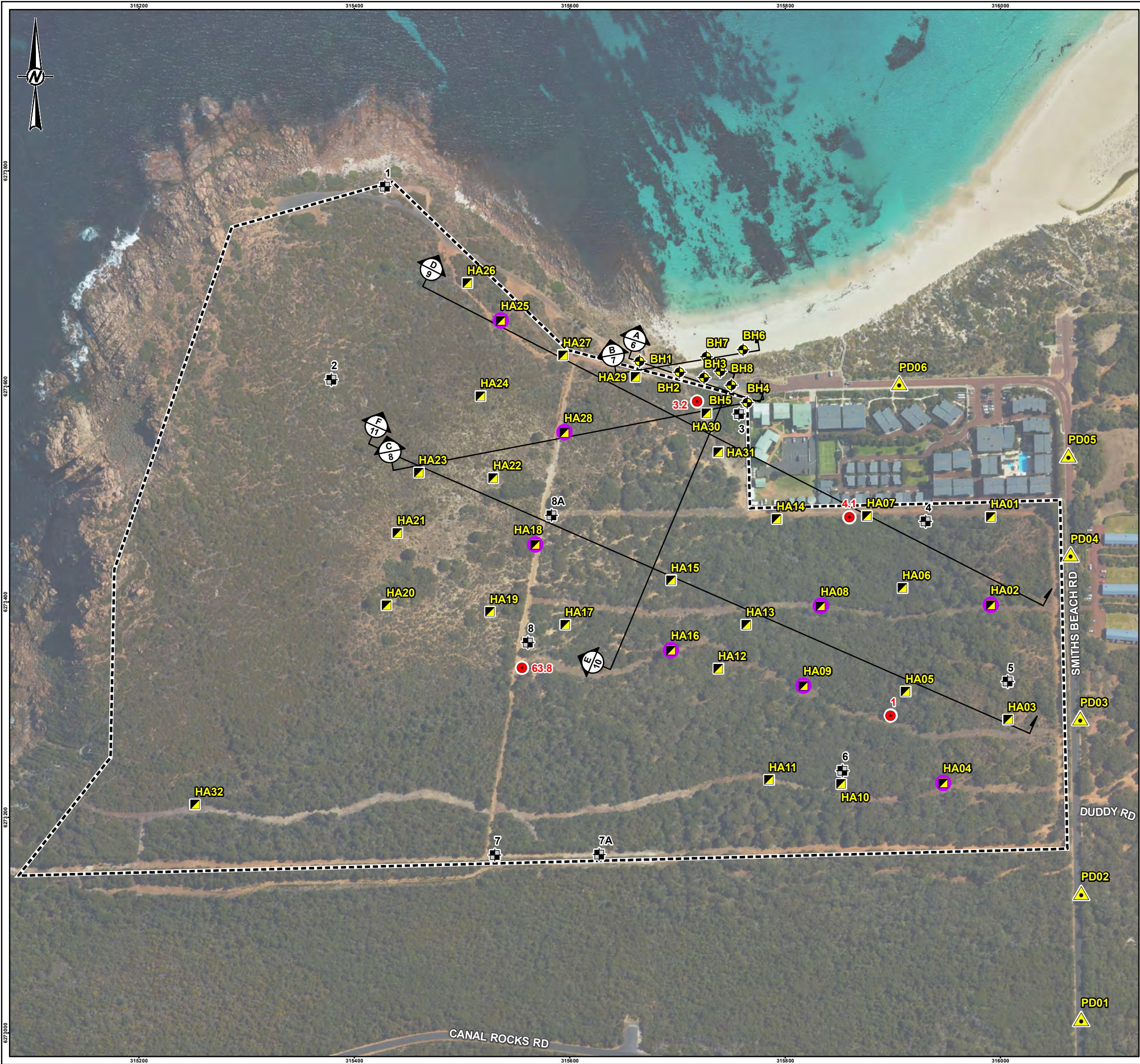


TITLE
LOCATION PLAN

PROJECT NO. 20435097 CONTROL 001 R REV. 0 FIGURE 1

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LEGEND

CADASTRE

APPROXIMATE SITE BOUNDARY

TEST INVESTIGATION

BOREHOLE LOCATION

HAND AUGER LOCATION

HAND AUGER AND PERMEABILITY TEST LOCATION

PAVEMENT DIPPING LOCATION

PREVIOUS INVESTIGATION

TEST PIT - DOUGLAS PARTNERS 2009

PERMEABILITY TEST LOCATION - hyd2o

4.1 PERMEABILITY (m/DAY)

0 500 1,000
Meters

0 100 200
METRES

1:3,500

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCE:
1. CADASTRE AND AERIAL IMAGERY BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2020).

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PROJECT
PROPOSED SMITHS BEACH DEVELOPMENT

TITLE
SITE PLAN

CONSULTANT	YYYY-MM-DD	2021-10-19
	DESIGNED	TC
	PREPARED	AM
	REVIEWED	DJK
	APPROVED	DJK

PROJECT NO. 20435097 CONTROL 001 R REV. 0

FIGURE 2

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LEGEND

CADASTRE

APPROXIMATE SITE BOUNDARY

TEST INVESTIGATION

BOREHOLE LOCATION

HAND AUGER LOCATION

HAND AUGER AND PERMEABILITY TEST LOCATION

INFILTRATION TEST

PAVEMENT DIPPING LOCATION

PREVIOUS INVESTIGATION

TEST PIT - DOUGLAS PARTNERS 2009

PERMEABILITY TEST LOCATION - hyd2o

4.1 PERMEABILITY (m/DAY)

0 10 20

1:500 METRES

NOTE:

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:

1. CADASTRE AND AERIAL IMAGERY BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2021).

2. SITE LAYOUT OVERLAY PROVIDED BY CLIENT (PDF FORMAT). DRAWING FILE: SMITHS DRAFT MASTERPLAN DECEMBER 2020.PDF

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PROJECT

PROPOSED SMITHS BEACH DEVELOPMENT

TITLE

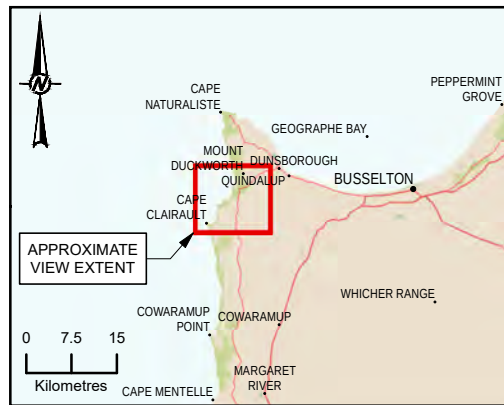
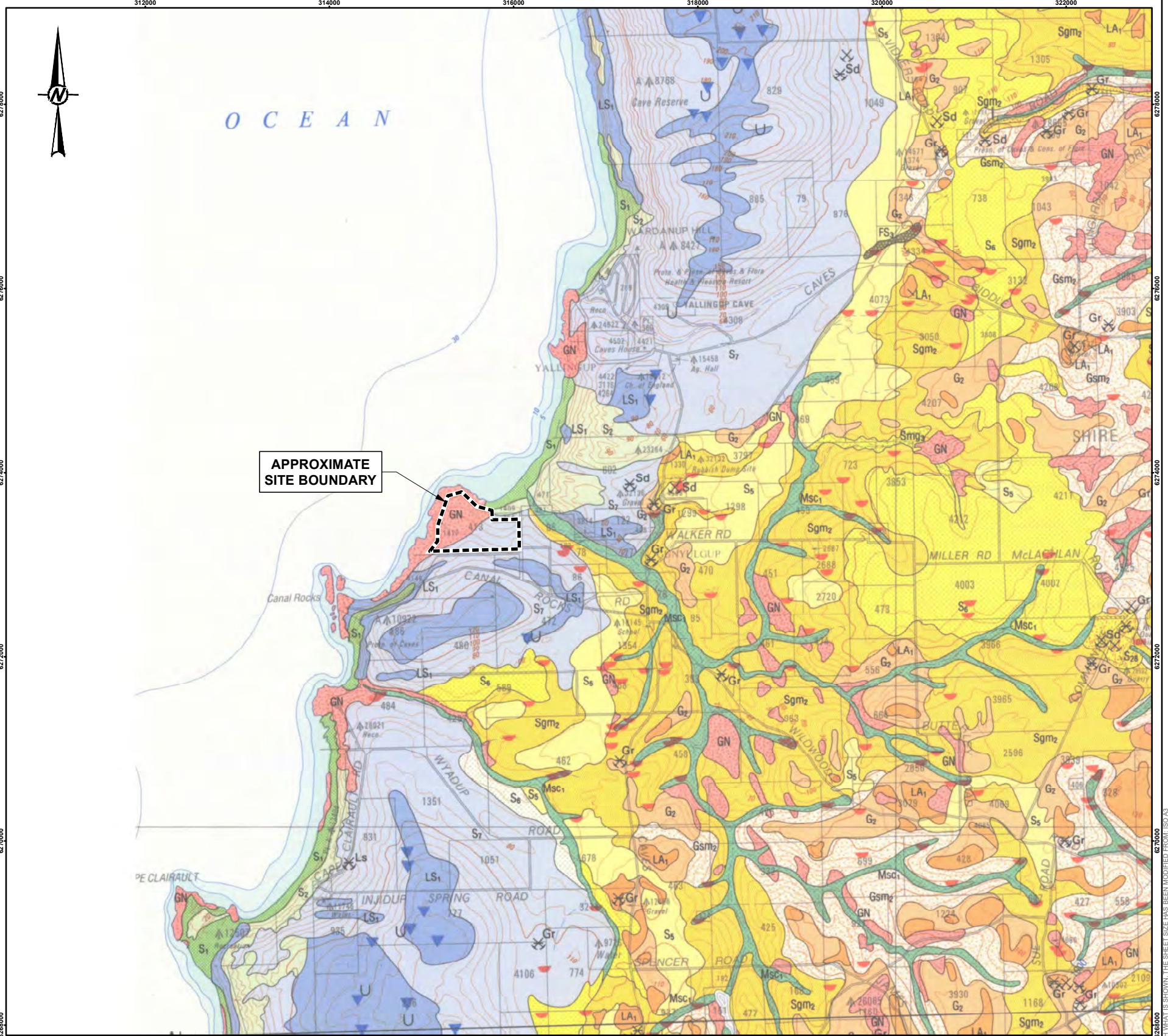
SITE PLAN – NORTH EAST CORNER

CONSULTANT	YYYY-MM-DD	2021-10-19
	DESIGNED	TC
	PREPARED	AM / JRP
	REVIEWED	DJK
	APPROVED	DJK

PROJECT NO.	CONTROL	REV.	FIGURE
20435097	001 R	0	3

GENERAL FEATURES:

Map unit ₁	Rock ₂	Description
Unconsolidated material ₃		
Spc ₁		CLAYEY PEATY SAND — grey to black quartz sand with variable organic content; minor clays
S ₁		CALCAREOUS SAND — white, fine- to coarse-grained, sub-rounded quartz and shell debris; also sub-rounded lithic pebbles
S ₂		CALCAREOUS SAND — white, fine- to medium-grained, sub-rounded quartz and shell debris
S ₁₃		CALCAREOUS SAND — white, medium-grained, rounded quartz and shell debris; well sorted
S ₂₆		CALCAREOUS SAND — as S ₁₃ , modified by estuarine and marine processes
S ₂₇		SAND — as S ₂₆ as a relatively thin layer of quartz and calcareous sand over variably thick estuarine silts and gley clays
M ₆		SILT — brownish grey, calcareous in part, soft; some fine sand and shell debris in places, minor clay content
M ₅		CALCAREOUS SILT — dark greyish brown silts and minor clays; some organic matter, shells and shell fragments and limestone are locally common
Sm ₁		SILTY SAND — strong brown to reddish brown, fine- to medium-grained quartz; variable silt content
Msc ₁		CLAYEY SANDY SILT — pale brown, angular to rounded sand; low cohesion; of alluvial origin
Sgm ₃		GRAVELLY SILTY SAND — very pale yellow to yellowish grey, mottled, fine- to medium-grained, quartz; locally high concentrations of pisoliths, variable silt content
G ₁		GRAVEL — red- brown gravels set in silty matrix overlying ironstones, cemented limonitic gravels, and coarse sands
FS ₁		IRONSTONE — red- brown limonitic gravel cemented in a limonite quartz-sand matrix
Sm ₁₂		SILTY SAND — yellowish brown to reddish brown, fine- to medium-grained quartz; some pisolithic gravels, variable silt content
Sgm ₄		GRAVELLY SILTY SAND — moderate brown to dark yellowish brown, fine- to coarse-grained, poorly sorted quartz variable silt content
S ₇		SAND — white to pale and olive-yellow, medium- to coarse-grained, sub-angular quartz; moderately sorted
LS ₂		LIMESTONE — light yellowish brown, fine- to coarse-grained, sub-angular to well-rounded quartz with shell, coral and, less commonly, crinoid debris; often overlain by S ₇
LS ₁		LIMESTONE — light yellowish brown, fine- to coarse-grained, sub-angular to well-rounded quartz, with shell debris and a trace of feldspar; kankar at surface common
S ₈		SAND — very light grey at surface, yellow at depth, fine- to medium-grained, sub-rounded quartz; moderately well sorted; local concentrations of heavy minerals, local development of coffee rock
S ₁₀		SAND over SILT and SANDY SILT — sand as S ₈ overlying Ms ₂
Ms ₂		SANDY SILT — strong brown to mid-grey, mottled, blocky, disseminated fine sand, hard when dry
Sm ₂		SILTY SAND — brown to yellow-grey, fine- to medium-grained quartz sand with variable silt content
S ₁₂		SAND — white, medium- to very coarse-grained, sub-rounded to rounded quartz; well sorted; local concentrations of heavy minerals
S ₅		SAND — very pale brown, medium- to coarse-grained, well sorted, sub-angular to rounded quartz and feldspar
S ₆		SAND — light grey, fine- to coarse-grained, angular to sub-rounded quartz with some feldspar; moderately sorted, loose
S ₂₈		SAND — white, coarse- to very coarse-grained, rounded quartz, occasional pebble and cobble beds
Sgm ₂		SILTY GRAVELLY SANDS — moderate brown to reddish brown, mottled, fine- to coarse-grained quartz; trace feldspar, pisolithic gravels, variable silt content
Gsm ₂		SILTY SANDY GRAVELS — moderate brown, mottled, pisolithic gravels and quartz; variable silt content, often thinly overlying gneiss (GN)
Sgm ₅		GRAVELLY SILTY SAND — dark reddish brown, mottled fine- to coarse-grained, quartz and feldspar and gneiss gravels; thinly developed over gneiss (GN)
G ₂		GRAVEL — brown to reddish brown, ferruginous, pisolithic; occasionally cemented in a clay-silt matrix, moderately sorted
LA ₁		LATERITE — massive and cemented, occasionally vesicular, up to 4m in thickness; overlies mottled and/or pallid clays, sometimes overlain by a ferruginous gravel set in a clay-sand matrix
LA ₃		LATERITE — massive, indurated, nodular and vesicular, iron-cemented, contains abundant fine- to medium-grained sub-angular quartz, developed over Leederville Formation
Dms ₁		SANDY SILTY CLAY — pale yellow to red, mottled; grades into weathered gneissic rock (GN) at depth, often overlain by pisolithic gravels
Smc ₃		CLAYEY SILTY SAND — off-white to brown, mottled, fine- to coarse-grained, sub-rounded sand with local concentrations of clay; variable silt content
GN		GNEISS — medium-grained mesocratic gneiss



NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCE:
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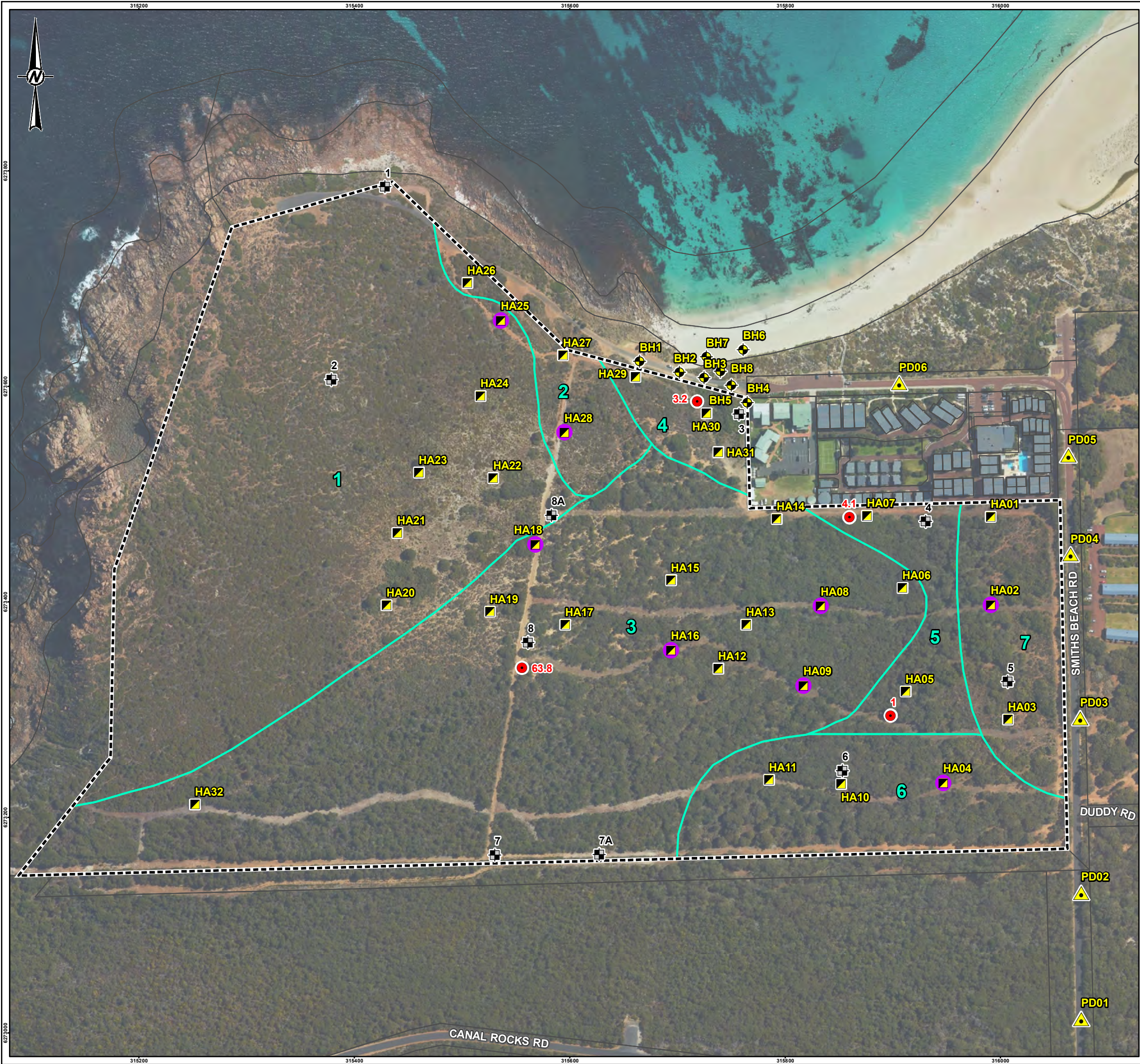


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PREPARED AM / JRP
REVIEWED DJK
APPROVED DJK

PROJECT
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TITLE
GEOLOGY MAP

PROJECT NO. 20435097 CONTROL 001 R REV. 0 FIGURE 4



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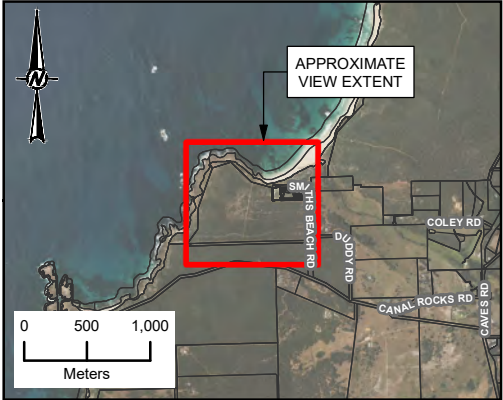
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- APPROXIMATE SITE BOUNDARY
- PRELIMINARY GEOTECHNICAL AREAS

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- BOREHOLE LOCATION
- HAND AUGER LOCATION
- HAND AUGER AND PERMEABILITY TEST LOCATION
- PAVEMENT DIPPING LOCATION

PREVIOUS INVESTIGATION

- TEST PIT - DOUGLAS PARTNERS 2009
- PERMEABILITY TEST LOCATION - hyd2o
- 4.1 PERMEABILITY (m/DAY)



0 100 200
1:3,500 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. CADASTRE AND AERIAL IMAGERY BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2020).
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PROJECT
PROPOSED SMITHS BEACH DEVELOPMENT

TITLE
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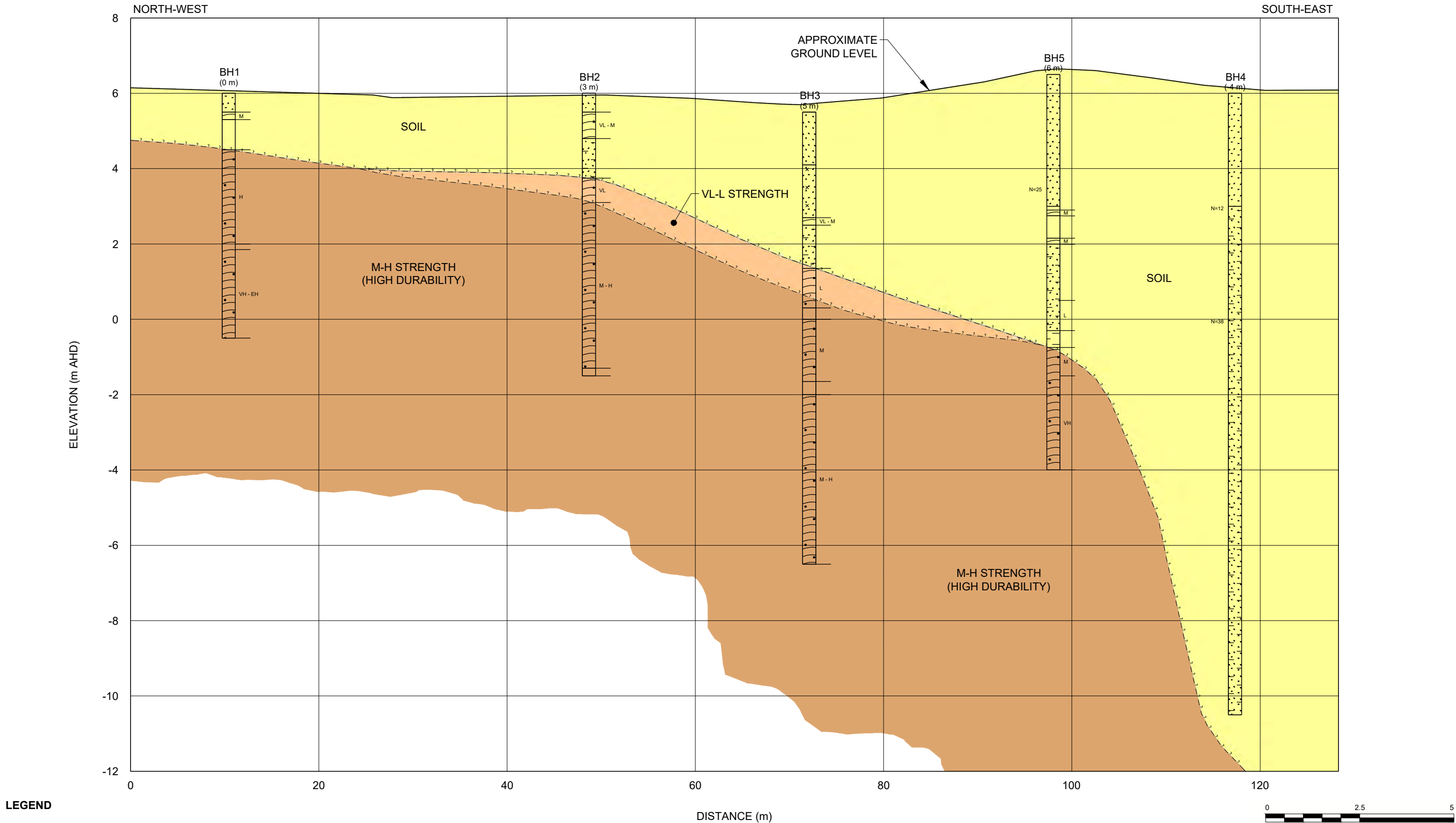
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	DESIGNED	TC
	PREPARED	AM
	REVIEWED	DJK
	APPROVED	DJK

PROJECT NO.	CONTROL	REV.	FIGURE
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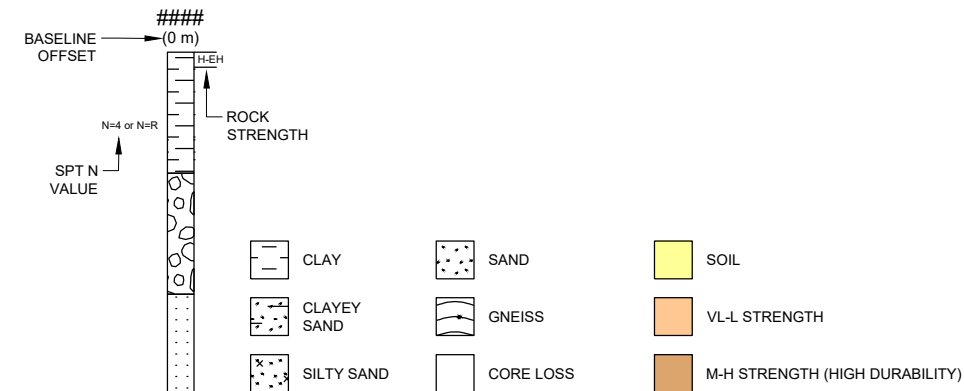
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NOTES

1. MATERIAL BOUNDARIES SHOWN ARE CONJECTURAL AND ARE BASED ON GEOLOGICAL INTERPRETATION.

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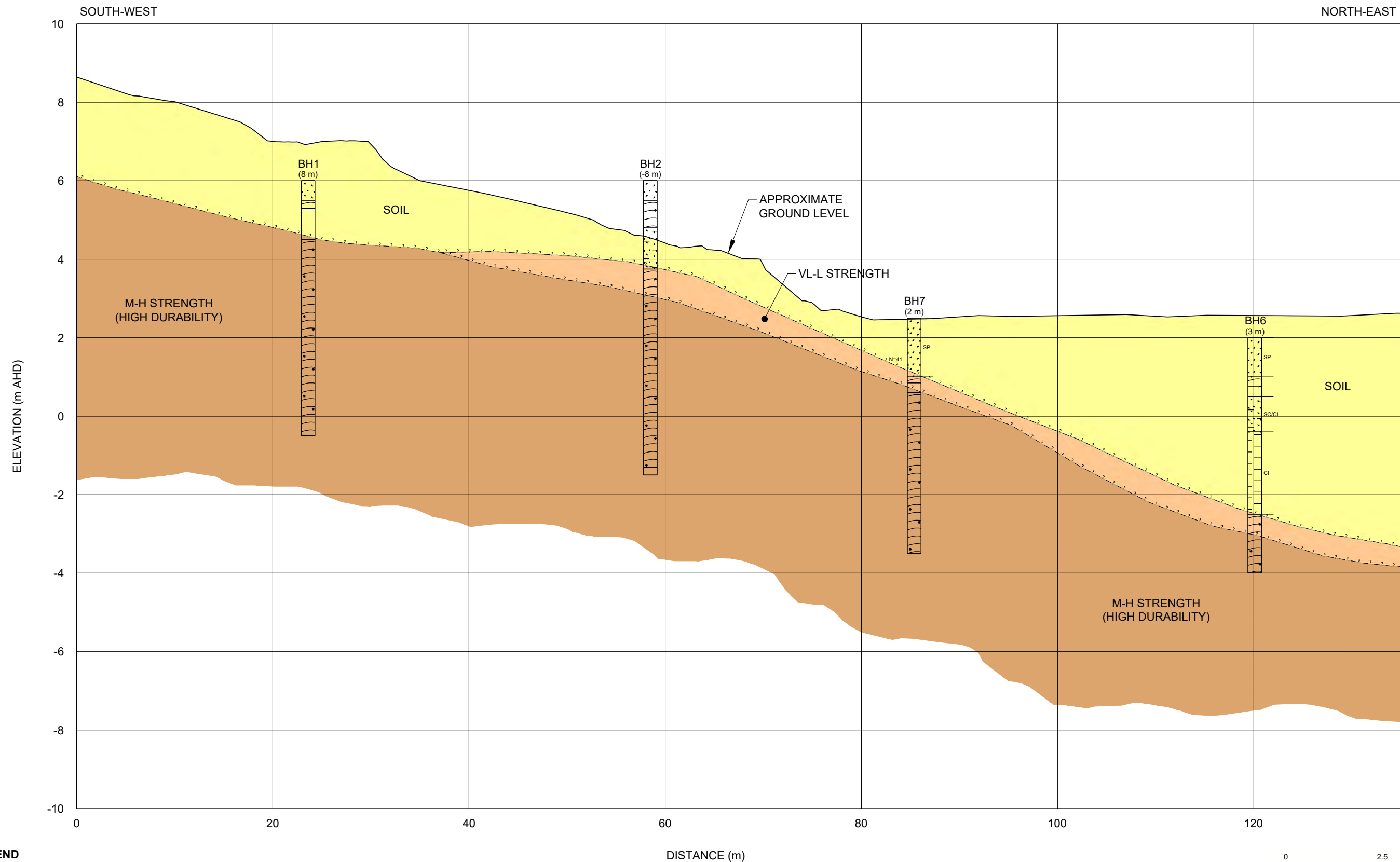
YYYY-MM-DD	2021-10-19
DESIGNED	TC
PREPARED	JRP
REVIEWED	DJK
APPROVED	DJK

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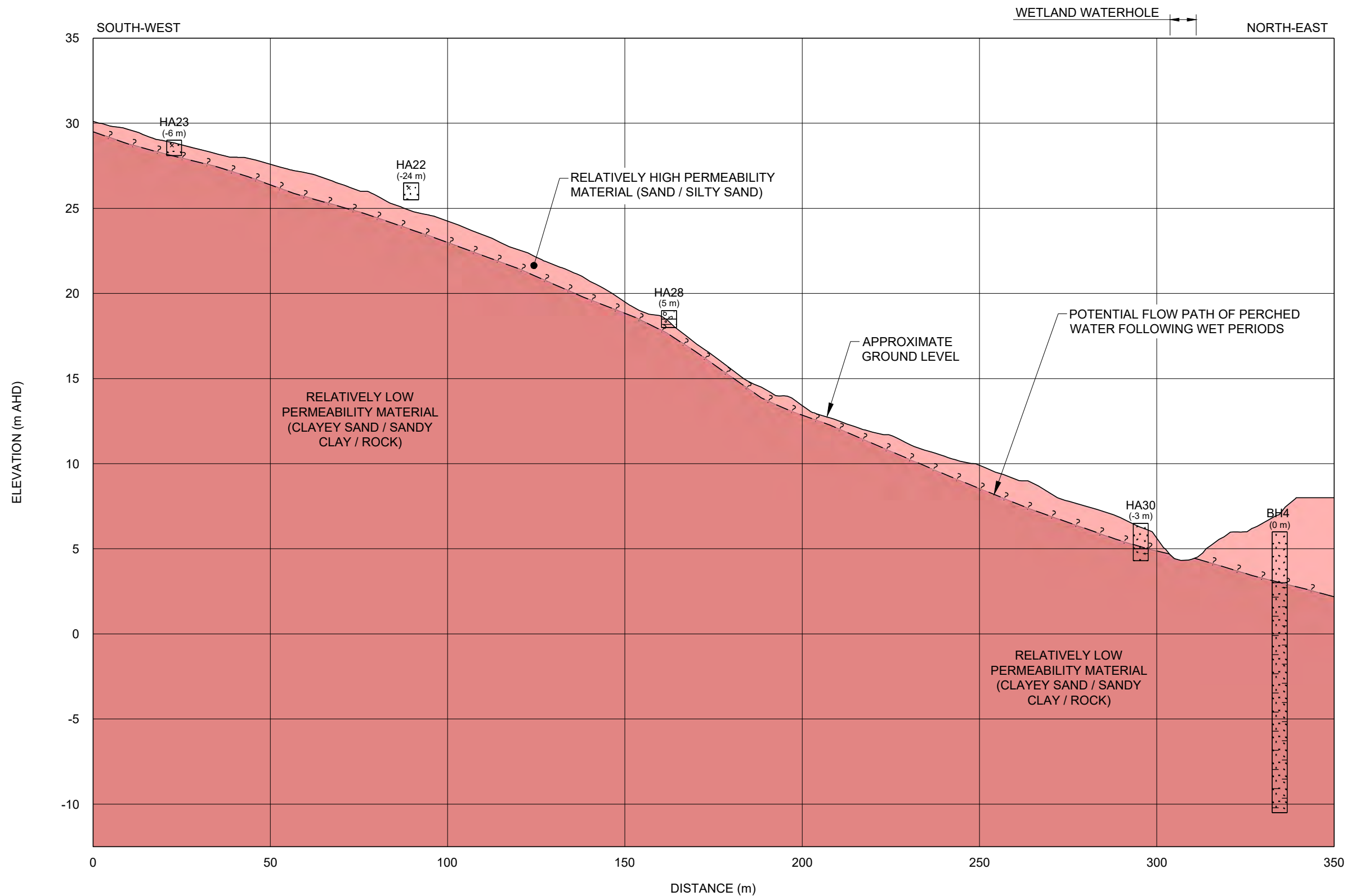
PROJECT NO.	CONTROL	REV.	FIGURE
20435097	001 R	0	6

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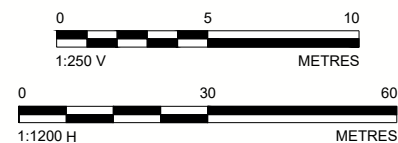
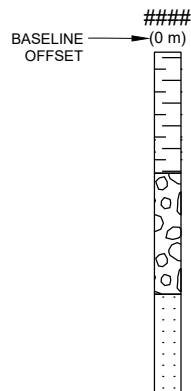
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PROPOSED SMITHS BEACH DEVELOPMENT

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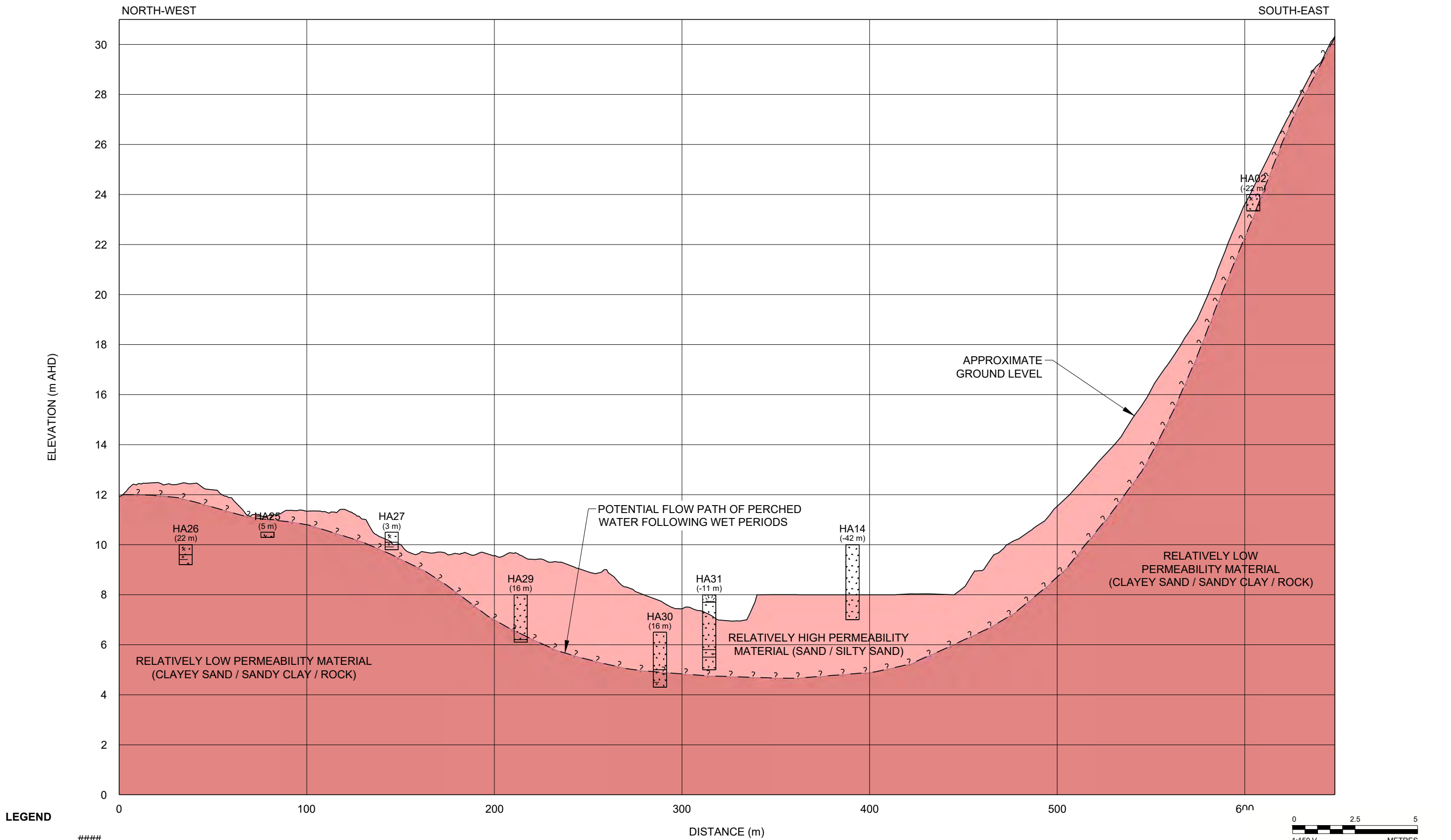
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DESIGNED	TC
PREPARED	JRP
REVIEWED	DJK
APPROVED	DJK

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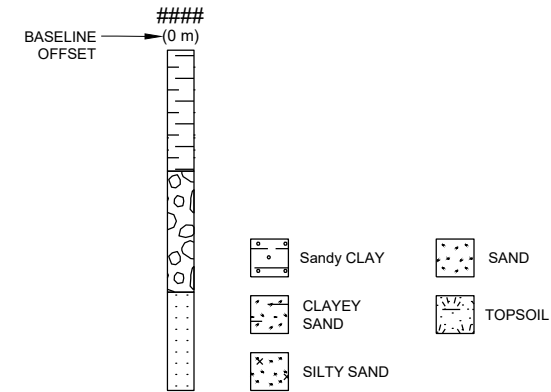
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20435097	001 R	0	8

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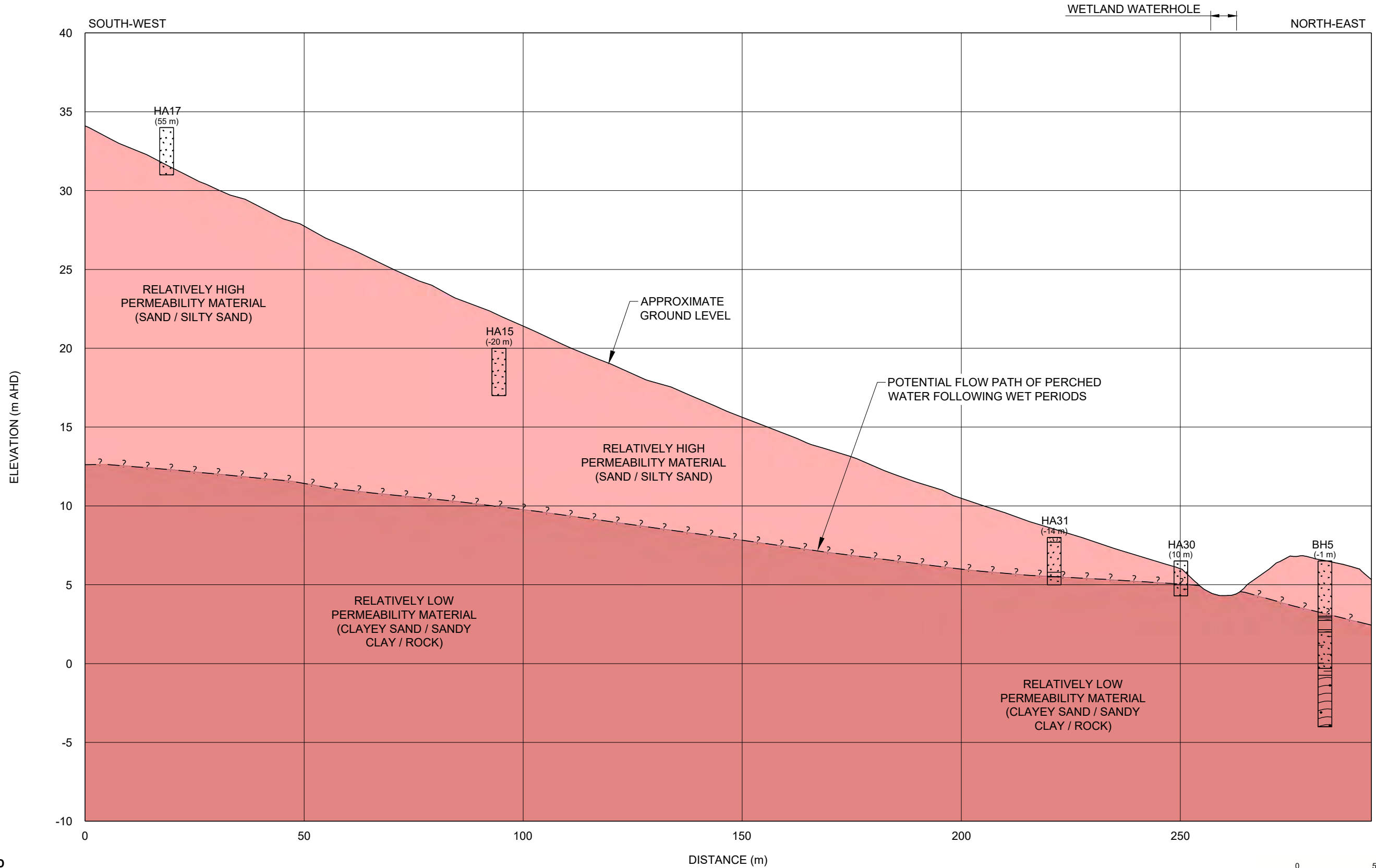
YYYY-MM-DD	2021-10-19
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PREPARED	JRP
REVIEWED	DJK
APPROVED	DJK

TITLE
INFERRED SUBSURFACE SECTION D

PROJECT NO.	CONTROL	REV.	FIGURE
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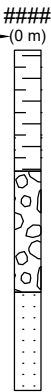
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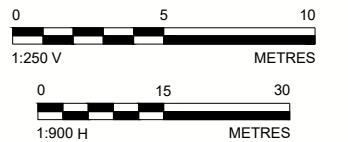
LEGEND

BASELINE
OFFSET



- CLAY
- CLAYEY SAND
- TOPSOIL
- SAND
- GNEISS
- CORE LOSS

- RELATIVELY HIGH PERMEABILITY MATERIAL (SAND / SILTY SAND)
- RELATIVELY LOW PERMEABILITY MATERIAL (CLAYEY SAND / SANDY CLAY / ROCK)



NOTES

1. MATERIAL BOUNDARIES SHOWN ARE CONJECTURAL AND ARE BASED ON GEOLOGICAL INTERPRETATION.

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PROJECT
PROPOSED SMITHS BEACH DEVELOPMENT

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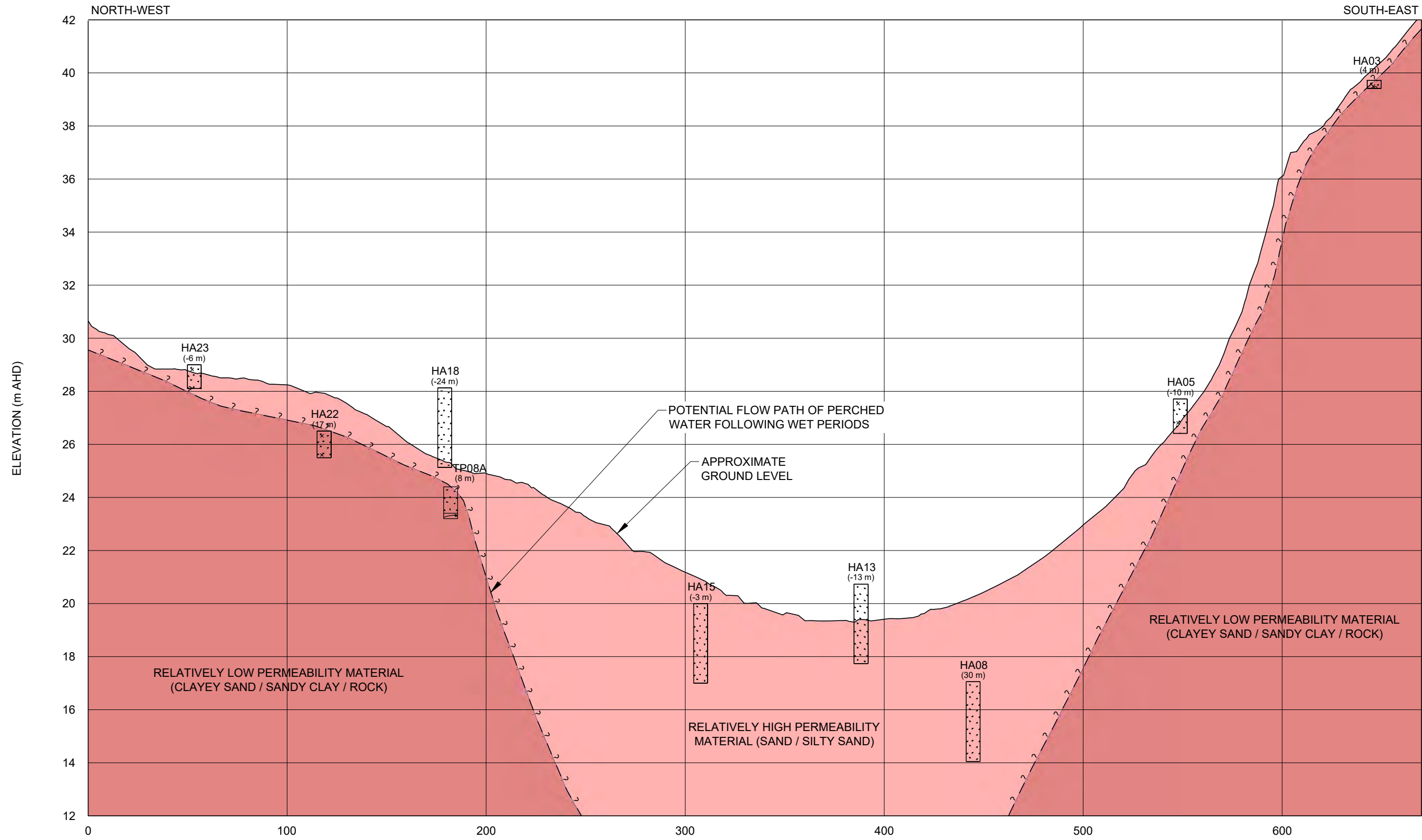
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PREPARED JRP
REVIEWED DJK
APPROVED DJK

TITLE
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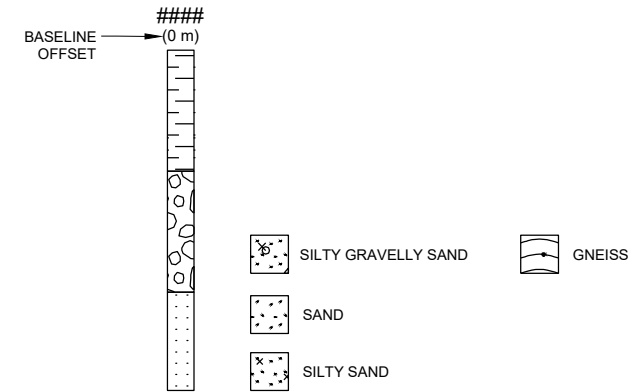
PROJECT NO. 20435097 CONTROL 001 R REV. 0 FIGURE 10

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LEGEND



- RELATIVELY HIGH PERMEABILITY MATERIAL (SAND / SILTY SAND)
- RELATIVELY LOW PERMEABILITY MATERIAL (CLAYEY SAND / SANDY CLAY / ROCK)

NOTES

1. MATERIAL BOUNDARIES SHOWN ARE CONJECTURAL AND ARE BASED ON GEOLOGICAL INTERPRETATION.

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PROPOSED SMITHS BEACH DEVELOPMENT

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APPROVED	DJK

TITLE
INFERRED SUBSURFACE SECTION F

PROJECT NO.	CONTROL	REV.	FIGURE
20435097	001 R	0	11

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

APPENDIX A

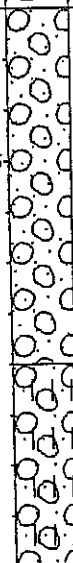
Previous Investigation Results – Douglas Partners

TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 5.3m

PIT No: 1
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
0.7	BOULDERS & SANDY GRAVEL - high strength granite boulders (30%) ranging from 200-500mm in a matrix of medium dense, dark brown, fine to medium grained, rounded sandy gravel (70%), containing roots to 0.15m.	4.6			0.7	%Fines = 17	
0.9	BOULDERS AND SILTY SAND - high strength granite boulders (30%) in a matrix of medium dense, light grey, fine to coarse grained silty sand.	4.2		D	0.9		
1.1	TEST PIT DISCONTINUED @ 1.1m due to refusal on granite boulders.	4.2					

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free ground water encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve. Location of soakage area B.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
W_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *af*

Date: 1/5/01



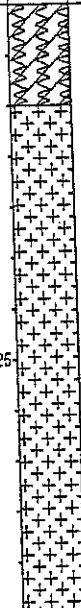
Douglas Partners
Geotechnics • Environment • Groundwater

TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 25.7m

PIT No: 2
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
0.2	TOPSOIL - loose, dark grey, fine grained sand containing shallow, minor roots.	25.5		D	0.5		
1.2	GRANITE - extremely low to very low strength, extremely weathered, mottled grey, white and brown, fine to coarse grained weathered <i>in situ</i> granite with zones of material excavated as sandy gravel.	24.5					
	TEST PIT DISCONTINUED @ 1.2m due to refusal.						

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve. Location of soakage area A.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
w_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *CP*

Date: 1/5/01



Douglas Partners
Geotechnics • Environment • Groundwater

TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 6.0m

PIT No: 3
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
0.1	FILL - loose, yellow, fine to medium grained sand with some gravel to 20mm.	5.9					
	SAND - loose to medium dense, light grey, fine to medium grained calcareous sand, containing minor roots.						
	becoming grey from 0.2m.						
	becoming light brown, damp and free of roots from 0.6m.			D	0.6		
					0.8		
1.7	CLAYEY SAND - medium dense, greenish brown, fine to medium grained, moist clayey sand.	4.3					
				D	2.0	%Fines = 20	
					2.1		
2.2	TEST PIT DISCONTINUED @ 2.2m	3.8					

Form No. 106-4

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve. Location of soakage area C.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
w_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *QW*

Date: 1/05/01



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TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 11.2m

PIT No: 4
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
	TOPSOIL - loose to medium dense, dark brown, fine grained silty sand containing roots to 30mm.						
0.4	SLIGHTLY CLAYEY SAND - medium dense, reddish brown, fine to coarse grained, damp, slightly clayey sand containing some fine gravel.	10.8					
					1.1	%Fines = 13	
				D	1.2		
2.0	TEST PIT DISCONTINUED @ 2.0m	9.2					

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
w_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *AG*

Date: 1/5/01



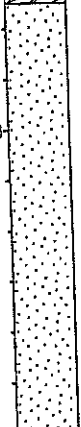
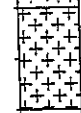
Douglas Partners
Geotechnics • Environment • Groundwater

TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 33.5m

PIT No: 5
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
0.25	TOPSOIL - medium dense, grey, fine grained sand, containing minor roots.	33.2					
	SAND - medium dense to dense, brown, fine to coarse grained sand containing some fine gravel	33					
	becoming reddish brown from 0.7m.						
1.1	GRANITE - very low strength, extremely weathered, mottled white, yellow brown, and grey, fine to coarse grained weathered <i>in situ</i> granite, with zones of material excavated as sandy gravel.	32.4					
1.3	TEST PIT DISCONTINUED @ 1.3m due to refusal	32.2					
		32					
		31					

Form No. 106-4

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free ground water encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
w_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials:

Date:



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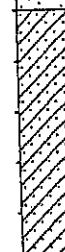
TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 33.7m

PIT No: 6

SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
	TOPSOIL - loose, dark brown, fine to medium grained sand containing roots ranging from 10-100mm.						
0.6	SAND - medium dense, reddish brown, fine to coarse grained sand containing a trace of gravel.	33.1					
0.9	GRANITE/SANDY CLAY - extremely weathered granite excavated as a stiff to hard, brown with grey, yellow and white mottling, sandy clay of medium plasticity and with fine to coarse grained sand.	32.8		D	1.1 1.3	I _p = 38% LS = 14%	
1.4	TEST PIT DISCONTINUED @ 1.4m due to refusal	32.3					

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve.

SAMPLING & IN SITU TESTING LEGEND

- | | | | |
|----------------|-------------------------|----------------|---------------------|
| D | disturbed soil sample | I _p | plasticity index |
| B | bulk sample | w _L | liquid limit |
| M | moisture content | LS | linear shrinkage |
| U _t | tube sample (x mm dia.) | pp | pocket penetrometer |

CHECKED

Initials:

Date: 1/5/20



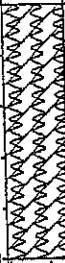
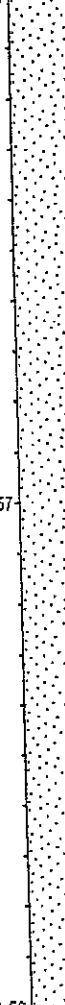
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Geotechnics • Environment • Groundwater

TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 58.5m

PIT No: 7
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
	TOPSOIL - loose, grey, fine to medium grained sand containing some minor roots.						
0.5	SAND - medium dense, yellow brown, fine to medium grained sand.	58.0 58					
1							
2	becoming yellow at 1.8m.						
	limestone cobbles from 2.3m.						
2.5	TEST PIT DISCONTINUED @ 2.5m	56.0 56					

Form No. LOG-4

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from countour plan supplied by Wood & Grieve.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
H moisture content
U_x tube sample (x mm dia.)
I_p plasticity Index
w_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *QW*

Date: 1/5/01



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TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 55.0m

PIT No: 7A
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
	TOPSOIL - loose, dark brown, fine to medium grained sand and gravel, containing some cobbles of limestone.	55					
0.3	CALCARENITE - very low to low strength, fine to medium grained, light brown calcarenite.	54.7					
0.6	TEST PIT DISCONTINUED @ 0.6m	54.4					
		54					
		53					

Form No. L00-4

EQUIPMENT: Case Turbo 580SK (500mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
w_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *CP*

Date: 1/5/01



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Geotechnics • Environment • Groundwater

TEST PIT REPORT

CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 38.0m

PIT No: 8
SHEET 1 of 1

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
0.2	TOPSOIL - loose, grey, fine to medium grained sand.	38.0					
	SAND - loose to medium dense, yellow, fine to medium grained sand.	37.8					
2.0	TEST PIT DISCONTINUED @ 2.0m	36.0					

Form No. 106-4

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Surface level interpolated from contour plan supplied by Wood & Grieve.

SAMPLING & IN SITU TESTING LEGEND

D disturbed soil sample
B bulk sample
M moisture content
U_x tube sample (x mm dia.)
I_p plasticity index
W_L liquid limit
LS linear shrinkage
pp pocket penetrometer

CHECKED

Initials: *CPW*

Date: 15/3/01



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TEST PIT REPORT

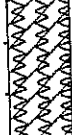
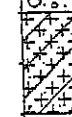
CLIENT: Canal Rocks Pty Ltd
PROJECT: Smith's Beach Development
LOCATION: Yallingup, WA

DATE: 15 March 2001
PROJECT No.: 22180
SURFACE LEVEL: 24.5m

PIT No: 8A

SHEET 1 of 1

LOCATION: Yallingup, WA

Depth (m)	Description of Strata	RL	Graphic Log	Sampling & Testing			Water
				Type	Depth (m)	Results	
0.3	TOPSOIL - loose to medium dense, grey, fine to medium grained sand.	24.2					
	light grey from 0.3m.	24					
0.6	SAND & GRAVEL - medium dense, brown, fine to medium grained sand and fine to coarse grained sub-rounded gravel.	23.9					
1.0	GRANITE - low strength, extremely weathered, mottled reddish brown, yellow brown, grey and white, fine to medium grained weathered <i>in situ</i> granite.	23.5					
1.2	TEST PIT DISCONTINUED @ 1.2m due to refusal.	23.3					
		23					
		22					

form No. 106-4

EQUIPMENT: Case Turbo 580SK (600mm Bucket)

LOGGED: A GANE

GROUND WATER OBSERVATIONS: No free groundwater encountered.

REMARKS: Steep inclination. Outcropping granite encountered 30m to north. Surface level interpolated from contour plan supplied by Wood & Greive.

SAMPLING & IN SITU TESTING LEGEND

D	disturbed soil sample	I _p	plasticity index
B	bulk sample	w _L	liquid limit
M	moisture content	LS	linear shrinkage
U _x	tube sample (x mm dia.)	pp	pocket penetrometer

CHECKED

Initials: *Q*

Date: 1/5/01



Douglas Partners
Geotechnics • Environment • Groundwater

TEST CERTIFICATE

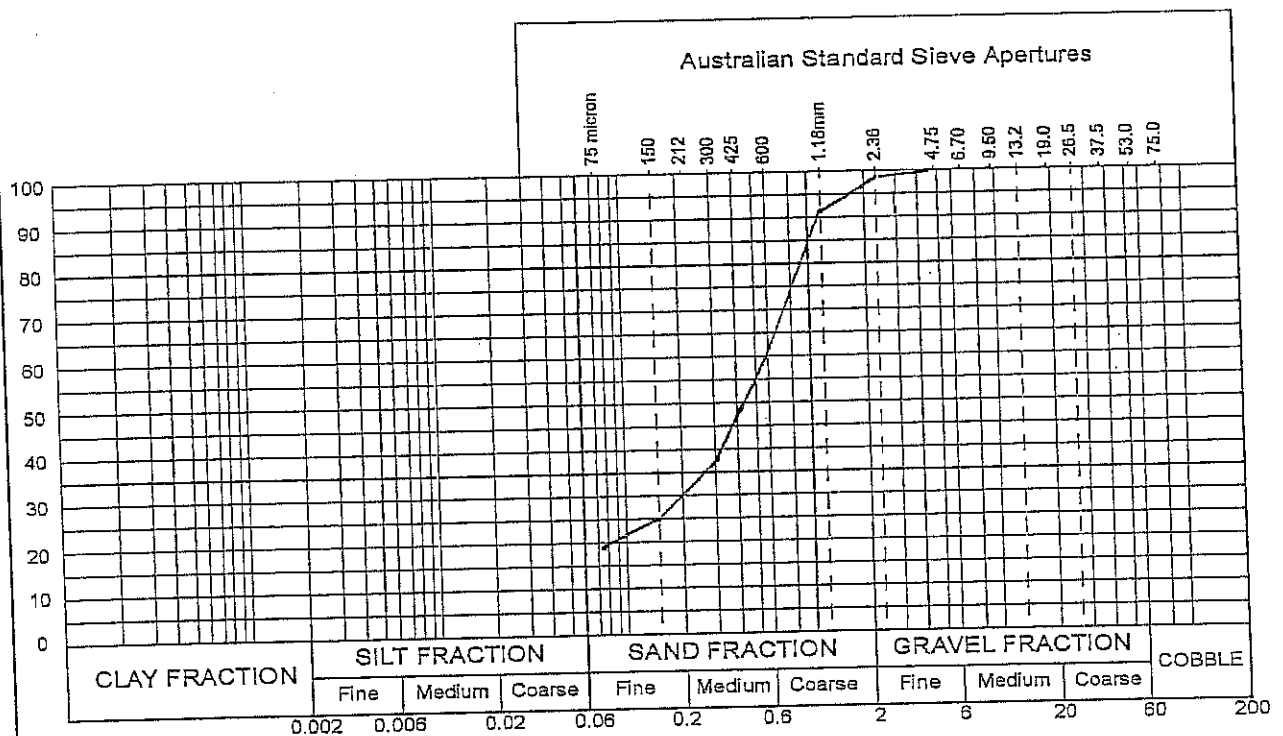
Client: DOUGLAS PARTNERS PTY LTD
 Project: SMITH'S BEACH, YALLINGUP WA - PROJECT NO. 22180
 Sample ID: 1, 0.7-0.9

Sheet No.: 2 OF 6
 Job No.: S8170
 Date Tested: 07.04.01

Particle Size Distribution of a Soil

Standard Method of Analysis by Sieving: AS 1289.3.6.1

Sieving				Sieving			
Sieve Size	% Passing	Sieve Size	% Passing	Sieve Size	% Passing	Sieve Size	% Passing
150.0mm		1.18 mm	91				
75.0mm		600 micron	62				
37.5 mm		425 micron	49				
19.0 mm		300 micron	38				
9.50 mm		150 micron	25				
4.75 mm	100	75 micron	19				
2.36mm	99						



Remarks: Sampling Method/s - Submitted by client



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Approved:



W Rozmianiec

Date: 23.04.01

TEST CERTIFICATE

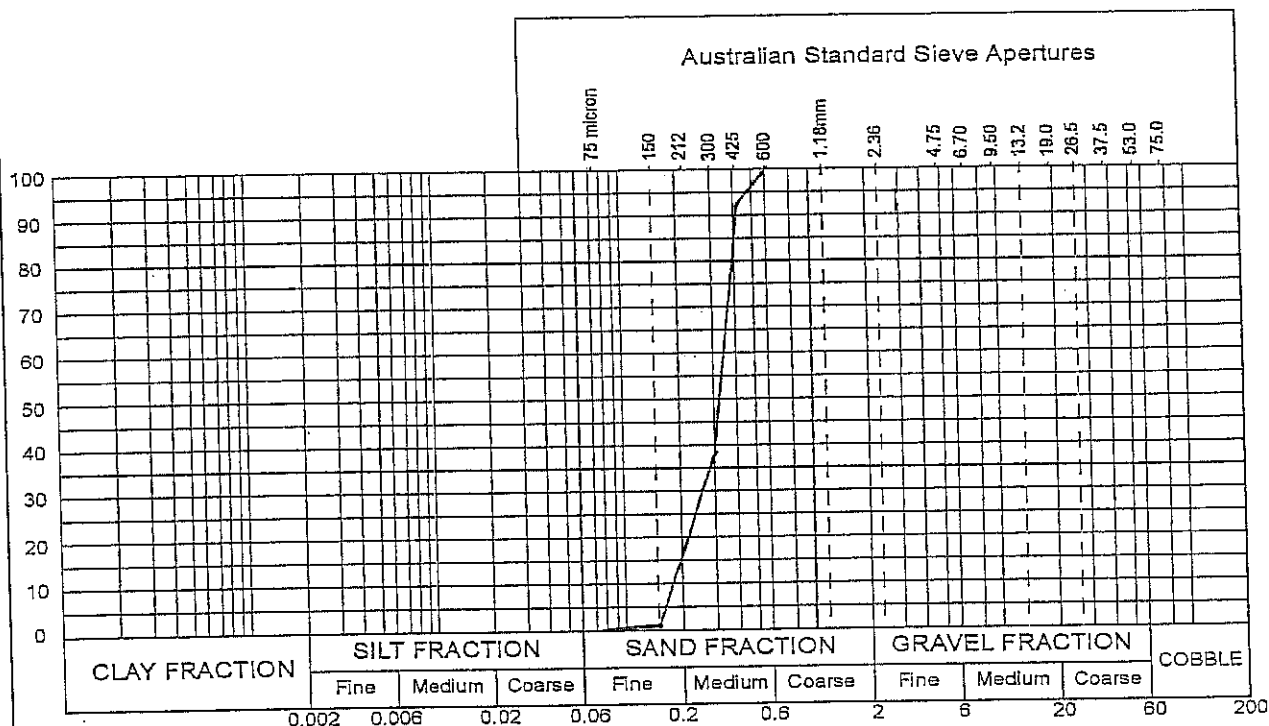
Client: DOUGLAS PARTNERS PTY LTD
Project: SMITH'S BEACH, YALLINGUP WA - PROJECT NO. 22180
Sample ID: 3, 0.6-0.8

Sheet No.: 3 OF 6
Job No.: S8170
Date Tested: 07.04.01

Particle Size Distribution of a Soil

Standard Method of Analysis by Sieving: AS 1289.3.6.1

Sieving				Sieving			
Sieve Size	% Passing	Sieve Size	% Passing	Sieve Size	% Passing	Sieve Size	% Passing
150.0mm		1.18 mm					
75.0mm		600 micron	100				
37.5 mm		425 micron	92				
19.0 mm		300 micron	38				
9.50 mm		150 micron	1				
4.75 mm		75 micron	0				
2.36mm							



Remarks: Sampling Method/s - Submitted by client



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Approved:



W Rozmianiec

Date: 23.04.01

TEST CERTIFICATE

Client: DOUGLAS PARTNERS PTY LTD
 Project: SMITH'S BEACH, YALLINGUP WA - PROJECT NO. 22180

Sheet No.: 4 OF 6
 Job No.: S8170
 Date Tested: 08.04.01

Plastic Properties - Casagrande Method

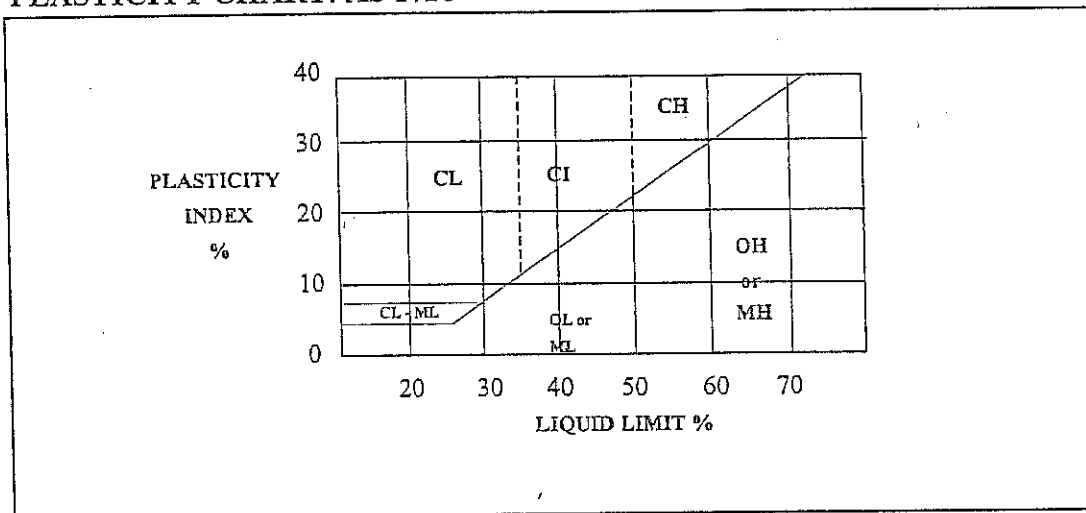
AS 1289.3.1.1, .3.2.1, .3.3.1, .3.4.1, .2.1.1

Test No.
 Sample ID

1
6
1.1-1.3
Liquid Limit % 63
Plastic Limit % 25
Plasticity Index % 38
Linear Shrinkage % 14.0

Liquid Limit
 Plastic Limit
 Plasticity Index
 Linear Shrinkage

PLASTICITY CHART: AS 1726



History of Sample: Cool Oven Dried
 Method of Preparation: Dry Sieved
 Remarks: Sampling Method/s - Submitted by client.

Length of Linear Shrinkage Mould: 250 mm
 Nature of Shrinkage: Normal



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Approved:



W Rozmianiec

Date: 23.04.01

TEST CERTIFICATE

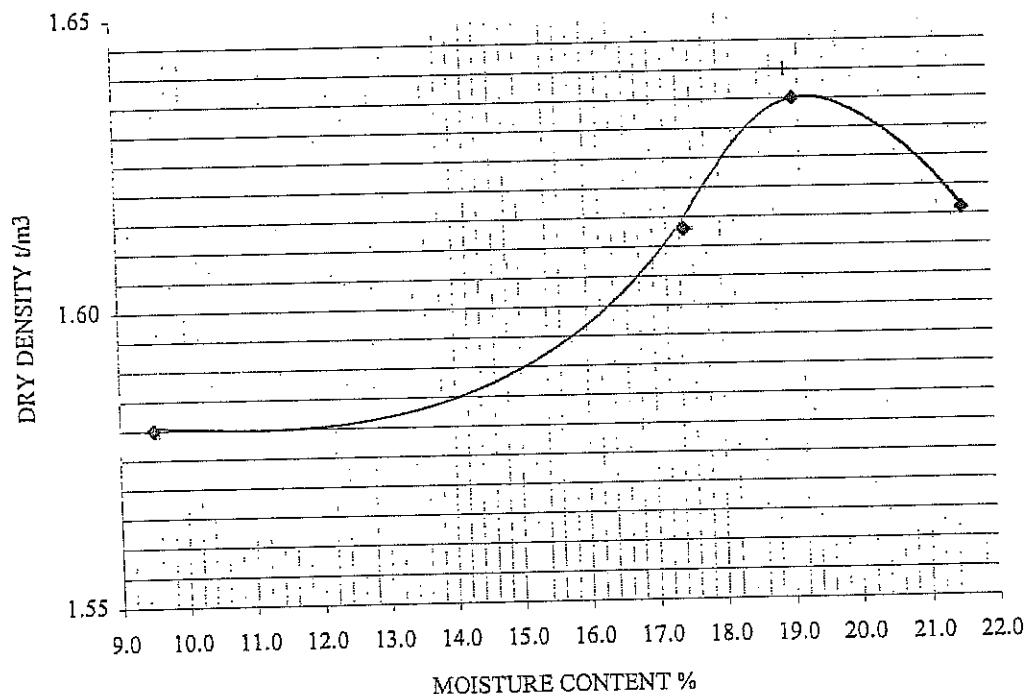
Client: DOUGLAS PARTNERS PTY LTD
 Project: SMITH'S BEACH, YALLINGUP WA - PROJECT NO. 22180
 Sample ID: 3, 0.6-0.8
 Description: SAND

Sheet No.: 5 OF 6
 Job No.: S8170
 Date Tested: 04.04.01

Dry Density / Moisture Content Relationship

AS 1289.5.1.1

Standard Maximum Dry Density	1.64	t/m ³
Optimum Moisture Content	19.0	%
Retained on 19.0mm Sieve	0	%
Retained on 37.5mm Sieve	N/A	%



Remarks: Sampling Method/s - Submitted by client



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

Approved:



W Rozmianiec

Date: 23.04.01



A Division of AMEC Engineering Pty Limited ABN 73 003 066 715
34 Walters Drive, Osborne Park WA 6017
Telephone: (08) 9244 1199 Facsimile: (08) 9244 1457
E-mail: src@amecaust.com.au

TEST CERTIFICATE

Client: DOUGLAS PARTNERS PTY LTD
Project: SMITH'S BEACH, YALLINGUP WA - PROJECT NO. 22180
Sample ID: 3, 0.6-0.8

Sheet No.: 6 OF 6
Job No.: S8170
Date Tested: 08.01.01

Falling Head Permeability

Laboratory Work in Soil Mechanics - Second Edition by Brian Vickers

Sample Preparation

Required Dry Density Ratio: 95 %
Required Moisture Content Ratio: 100 %

Maximum Dry Density: 1.64 t/m³
(AS 1289 .5.1.1 Standard)

Optimum Moisture Content: 19.0 %

Achieved Dry Density: 1.56 t/m³

Achieved Dry Density Ratio: 95 %

Achieved Moisture Content: 19.0 %
(AS 1289.2.1.1)

Achieved Moisture Content Ratio: 100 %

Average Coefficient of Permeability: 4.9×10^{-5} m/sec

Remarks: Sample submitted by client.

Approved:

W Rozmianiec

Date: 23.04.01

RESULTS OF MATERIALS FINER THAN 75µm

Sample Details:	Test No.	Test Pit	Depth (m)
	1	1	0.7 – 0.9
	2	3	2.0 – 2.1
	3	4	1.1 – 1.2

% passing 75µm:	Test No.	Result (%)
	1	17
	2	20
	3	13

Method of drying: Oven Dried

Client: Canal Rocks Pty Ltd
Project: Smith's Beach Development
Location: Yallingup, WA

Test Method: AS.1141.12 - 1996

Project No: 22180
Report No: -
Page: 1 of 1
Date Reported: 2 April 2001

Tested by: A. Gane
Checked by: C. Waterton

Laboratory: Perth

APPENDIX B

Hand Auger Borehole Report

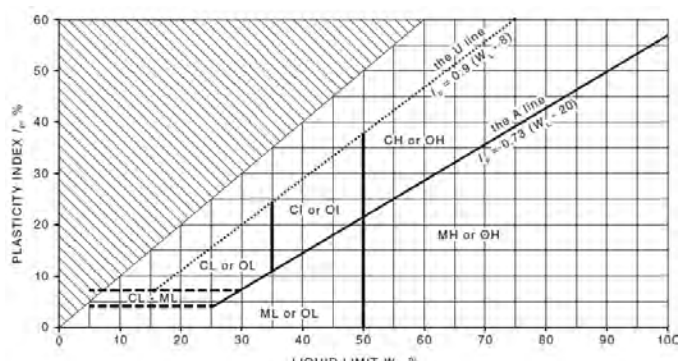
SYMBOLS

	FILL		CLAY (CL, CI or CH)
	GRAVEL (GW, GP, GM or GC)		ORGANIC SOILS (OL, OH or Pt)
	SAND (SW, SP, SM or SC)		COBBLES or BOULDERS
	SILT (ML or MH)		

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

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726-2017. The material properties are assessed in the field by visual/tactile methods.

Particle Size			Plasticity Properties
Soil Group	Sub Division	Particle Size	
BOULDERS		> 200 mm	
COBBLES		63 to 200 mm	
GRAVEL	Coarse	19 to 63 mm	
	Medium	6.7 to 19 mm	
	Fine	2.36 to 6.7 mm	
SAND	Coarse	0.6 to 2.36 mm	
	Medium	0.21 to 0.6 mm	
	Fine	0.075 to 0.21 mm	
SILT		0.002 to 0.075 mm	
CLAY		< 0.002 mm	

MOISTURE CONDITION

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

Moisture condition for fine grained soils is described relative to the plastic limit or liquid limit as specified in AS1726-2017.

CONSISTENCY AND DENSITY

Fine Grained Soils			Coarse Grained Soils			
Symbol	Term	Undrained Shear Strength	Symbol	Term	Density Index (%)	SPN "N" *
VS	Very Soft	0 to 12 kPa	VL	Very Loose	Less than 15	0 to 4
S	Soft	12 to 25 kPa	L	Loose	15 to 35	4 to 10
F	Firm	25 to 50 kPa	MD	Medium Dense	35 to 65	10 to 30
St	Stiff	50 to 100 kPa	D	Dense	65 to 85	30 to 50
VSt	Very Stiff	100 to 200 kPa	VD	Very Dense	Above 85	Above 50
H	Hard	Above 200 kPa				
Fr	Friable	-				

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

* SPT correlations are not stated in AS1726-2017, and may be subject to corrections for overburden pressure and equipment type.

CEMENTATION

Weakly Cemented	The soil may be easily disaggregated by hand in air or water.
Moderately Cemented	Effort is required to disaggregate the soil by hand in air or water.

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

DRILLING/EXCAVATION METHOD

ADH	Hollow auger drilling	EX	Excavator	PQ3	Diamond core - 83 mm
ADT	Auger drilling with tc-bit	HA	Hand auger	PT	Push tube sampling
ADV	Auger drilling with v-bit	HAND	Excavated by hand	RAB	Rotary air blast
AIRCORE	Aircore	HMLC	methods Diamond core - 63	RC	Reverse circulation
AT	Air track	HQ3	mm Diamond core - 61 mm	RT	Rock roller
BH	Backhoe bucket Cable	JET	Jetting	SONIC	Sonic drilling
CT	tool rig	MZ	Mazier tube sampling	SPT	Standard penetration
DTC	Diatube coring Existing	NDD	Non-destructive digging	U	testing Undisturbed tube
EE	excavation Extruded	NMLC	Diamond core - 52 mm	WB	sampling Washbore drilling
EPT	push tube	NQ3	Diamond core - 45 mm		

PENETRATION/EXCAVATION RESISTANCE

L	Low resistance. Rapid penetration possible with little effort from the equipment used.
M	Medium resistance. Excavation/possible at an acceptable rate with moderate effort from the equipment used.
H	High resistance to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.
R	Refusal or Practical Refusal. No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.
These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.	

WATER

	Water level at date shown		Partial water loss
	Water inflow		Complete water loss
GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.		
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.		

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80 mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (sv = peak value, sr = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure test
DCP	Dynamic cone penetration test
CPT	Cone penetration test
CPTu	Cone penetration test with pore pressure (u) measurement

RANKING OF VISUALLY OBSERVABLE CONTAMINATION AND ODOUR (for specific soil contamination assessment projects)

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

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)	RQD = Rock Quality Designation (%)	SCR = Solid Core Recovery (%)	F = Fracture Frequency
$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$	$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$	$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$	$= \frac{\text{No. of defects}}{\text{Length of zone (m)}}$

TERMS FOR ROCK MATERIAL STRENGTH & WEATHERING AND ABBREVIATIONS FOR DEFECT DESCRIPTIONS

STRENGTH

Symbol	Term	UCS (MPa)	Field Guide
VL	Very Low	0.6 to 2	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	2 to 6	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	6 to 20	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	20 to 60	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	60 to 200	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>200	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Material with strength less than 'Very Low' shall be described using soil characteristics. The presence of an original rock structure, fabric or texture should be noted, if relevant.

ROCK MATERIAL WEATHERING

Symbol	Term	Field Guide
RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering DW products in pores.
	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock.
SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes.

ABBREVIATIONS FOR DEFECT TYPES AND DESCRIPTIONS

Defect Type	Coating or Infilling	Roughness
P Parting	Cn Clean	VRo Very Rough
X Foliation	Sn Stain	Ro Rough
L Cleavage	Ve Veneer	Sm Smooth
C Contact	Ct Coating	Po Polished
J Joint	In Infill	Sl Slickensided
SSu Sheared Surface	Planarity	Vertical Boreholes – The dip (inclination from horizontal) of the defect is given. Inclined Boreholes – The inclination is measured as the acute angle between the core axis and the vertical direction.
SS Sheared Seam		
SZ Sheared Zone		
CS Crushed Seam		
IS Infilled Seam		
EWS Extremely Weathered Seam	PI Planar	
V Vein	Cv Curved	
	Un Undulating	
	St Stepped	
	Ir Irregular	



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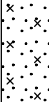
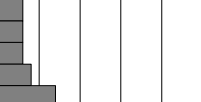
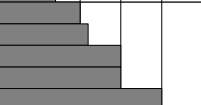
REPORT OF HAND AUGERED BOREHOLE: HA01

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315991 m E 6273479 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.50 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	L		0.0	0.30				SM	Silty SAND fine to medium grained, dark brown, about 15% silt, with rootlets	D	MD - D	Inferred refusal on Gneiss						
	M-H		fine to coarse grained, red brown, with fine gravel															
	R		0.5						END OF HAND AUGER @ 0.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED									
			1.0															
			1.5															
			2.0															
			2.5															
			3.0															

Sketch & Other Observations



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RL3



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REPORT OF HAND AUGERED BOREHOLE: HA02

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315991 m E 6273397 m N MGA94 50
SURFACE RL: 24.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.65 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	L		0.0	24.00				SM	Silty SAND fine to medium grained, brown, about 15-20% silt, with rootlets	D	L	About 200 mm of topsoil		SEAT				
			0.30 23.70	red brown, with gneiss gravel					MD - D									
	R		23.35						END OF HAND AUGER @ 0.65 m REFUSAL GROUNDWATER NOT ENCOUNTERED			Inferred refusal on Gneiss		Hammer Bounce				

Sketch & Other Observations



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REPORT OF HAND AUGERED BOREHOLE: HA03

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 316007 m E 6273291 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.30 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	L		0.0					SM	Silty Gravelly SAND fine to coarse grained, brown, about 30% fine to medium gravel, about 15% silt	D	MD - D	inferred extremely weathered gneiss						

Sketch & Other Observations



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RL3



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REPORT OF HAND AUGERED BOREHOLE: HA04

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315947 m E 6273232 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 2.60 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	L		0.0					SP / SM	SAND / Silty SAND fine to medium grained, brown	D	L	about 300 mm of topsoil						
			0.5					MD - D										
			1.0	1.00														
			1.20															
			1.40	DS 1.40-1.80 m Rec = 400/400 mm		SP	SAND fine to medium grained, pale grey brown, with clay/silt	VD										
	1.5		CH	Sandy CLAY high plasticity, orange brown and grey, about 60% fine to coarse sand		St												
	2.0					w ~ PL	VSt											
	2.5																	
R			3.0				END OF HAND AUGER @ 2.60 m REFUSAL GROUNDWATER NOT ENCOUNTERED				Refusal in hard CLAY							

Sketch & Other Observations



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RL3



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REPORT OF HAND AUGERED BOREHOLE: HA05

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315912 m E 6273317 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.30 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm						
													0	5	10	15	20	25	
HA	L		0.0	0.40				SM	Silty SAND fine to coarse grained, dark brown, about 20% silt		L	Likely refusal on cobble/boulder							
			0.5						red brown									D	MD
			1.0															D	
	R		1.5					END OF HAND AUGER @ 1.30 m REFUSAL GROUNDWATER NOT ENCOUNTERED											
			2.0																
			2.5																
			3.0																
			3.5																
			4.0																

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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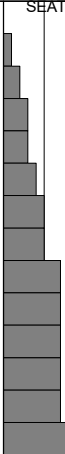
REPORT OF HAND AUGERED BOREHOLE: HA06

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315909 m E 6273413 m N MGA94 50
SURFACE RL: 16.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
														0	5	10	15	20	25
HA	L		0.0	16.00				SP	SAND fine to medium grained, brown, with silt red brown		L		about 300 mm of topsoil						
			MD																
	M		0.60	15.40						D	D								
			3.0	13.00					END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED										

Sketch & Other Observations



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RL3



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REPORT OF HAND AUGERED BOREHOLE: HA07

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315876 m E 6273480 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 2.00 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling			Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
													0	5	10	15	20	25
HA	L		0.0	0.60				SM	Silty SAND fine to medium grained, dark brown, about 15 to 20% silt	D	MD							
			0.5					SP	SAND fine to medium grained, brown, with silt/clay									
			1.0					M	D	1.30	SM							Silty SAND fine to coarse grained, brown orange, about 20% silt, trace gravel
	1.5																	
	H		2.0	DS 1.80-2.00 m Rec = 200/200 mm			END OF HAND AUGER @ 2.00 m REFUSAL GROUNDWATER NOT ENCOUNTERED											
R		2.0																
			2.5															
			3.0															
			3.5															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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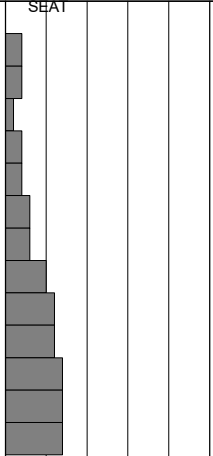
REPORT OF HAND AUGERED BOREHOLE: HA08

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315833 m E 6273396 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description														
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION		MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm						
														0	5	10	15	20	25	
HA	L		0.0					SP	SAND fine to medium grained, brown, with silt				About 250 mm of topsoil							
				0.80																
			0.5																	
			1.0						red brown											
			1.5																	
			2.0																	
			2.5																	
			3.0																	
			3.5						END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED											

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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REPORT OF HAND AUGERED BOREHOLE: HA09

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315817 m E 6273322 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
HA	L		0.0				SP	SAND fine to medium grained, orange brown			About 300 mm of topsoil	SEAT
			0.5							L		
			1.0									
			1.5							D		
			2.0							MD		
			2.5									
			3.0					END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED		D		
			3.5									

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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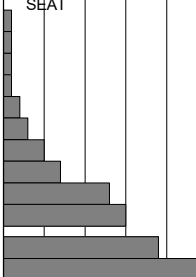
REPORT OF HAND AUGERED BOREHOLE: HA10

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315852 m E 6273231 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.30 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	L		0.0	0.80				SP / SM	SAND / Silty SAND fine to medium grained, brown	D	L	About 250 mm of topsoil						
			0.5					MD - D										
			1.0					H	Extremely weathered rock									
	R			Refusal on hard clay														
			1.5						END OF HAND AUGER @ 1.30 m REFUSAL GROUNDWATER NOT ENCOUNTERED									
			2.0															
			2.5															
			3.0															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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REPORT OF HAND AUGERED BOREHOLE: HA11

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315785 m E 6273235 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.50 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	L		0.0					SP / SM	SAND / Silty SAND fine to medium grained, brown, with fine to coarse gneiss gravel		L	About 200 mm of topsoil	SEAT					
	M		0.5	0.60			SP	Gravelly SAND fine to coarse grained, orange brown, fine to coarse gneiss gravel, with silt		MD								
	H		0.80				SC / CI	Clayey SAND / Sandy CLAY fine to coarse grained, pale grey and orange brown, about 25 to 60% medium plasticity fines in zones		VD								
				1.0						VD - H								
			1.5						END OF HAND AUGER @ 1.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED			Refusal on hard clay						
			2.0															
			2.5															
			3.0															
			3.5															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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REPORT OF HAND AUGERED BOREHOLE: HA12

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315738 m E 6273338 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: TC
CHECKED: DK
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
HA	L		0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5	0.80	DS 1.50-1.70 m Rec = 200/200 mm		SP	SAND fine to medium grained, brown brown orange becoming pale brown orange with depth	D MD M D			SEAT
								END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED				

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
MEMBER OF WSP

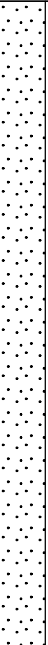
REPORT OF HAND AUGERED BOREHOLE: HA13

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315764 m E 6273379 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling			Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
													0	5	10	15	20	25
HA	L		0.0					SP	SAND fine to medium grained, orange brown	D	L - MD		SEAT					
	0.5																	
			1.0															
			1.5															
			2.0															
			2.5															
	M		3.0						END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED		D							
			3.5															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



SHEET: 1 OF 1

COORDS: 315792 m E 6273477 m N MGA94 50
SURFACE RL: 10.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: TC DATE: 10-12-20
CHECKED: DK DATE: 29-1-21

[illegible]

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
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REPORT OF HAND AUGERED BOREHOLE: HA15

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315694 m E 6273420 m N MGA94 50
SURFACE RL: 20.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
HA	L		0.0	20.00			SP	SAND fine to medium grained, orange brown		L		SEAT
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
	M		3.0	17.00				END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED				
			3.5									

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
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REPORT OF HAND AUGERED BOREHOLE: HA16

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315694 m E 6273355 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
			0.0				SP	SAND fine to medium grained, orange brown			About 200 mm of topsoil	0 5 10 15 20 25
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0					END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED				
			3.5									

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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REPORT OF HAND AUGERED BOREHOLE: HA17

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315596 m E 6273379 m N MGA94 50
SURFACE RL: 34.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description										
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
				0								0	5	10	15	20	25
HA	L		0.0	34.00			SP	SAND fine to medium grained, orange brown		L	About 150 mm of topsoil						
			MD														
	M		1.0						D								
			MD														
			2.0							D							
			D														
			2.5														
			3.0	31.00				END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED									
			3.5														

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
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REPORT OF HAND AUGERED BOREHOLE: HA18

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315568 m E 6273453 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
HA	L		0.0				SP	SAND fine to medium grained, orange brown			About 100 mm of topsoil	SEAT
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0					END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED				
			3.5									

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
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REPORT OF HAND AUGERED BOREHOLE: HA19

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315526 m E 6273391 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
HA	L		0.0 0.40 0.5 1.0 1.5 2.0 2.5 3.0 3.5		DS 1.80-2.00 m Rec = 200/200 mm		SP	SAND fine to medium grained, brown fine to coarse grained, pale brown orange END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED	D MD M D			SEAT

Sketch & Other Observations



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REPORT OF HAND AUGERED BOREHOLE: HA20

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315430 m E 6273397 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.90 m

LOGGED: TC
CHECKED: DK
DATE: 11-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
													0	5	10	15	20	25
HA	L		0.0					SM	Silty SAND fine to medium grained, dark brown, about 15% silt	D	L							
			0.40															
			0.5						pale brown orange		MD - D							
			1.0							M								
			1.5								D							
			2.0						END OF HAND AUGER @ 1.90 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED			Refusal on weathered rock						
			2.5															
			3.0															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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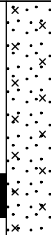
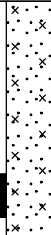
REPORT OF HAND AUGERED BOREHOLE: HA21

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315440 m E 6273464 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.10 m

LOGGED: TC
CHECKED: DK
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling			Field Material Description													
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION		MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
															0	5	10	15	20	25
HA	L		0.0	0.40	DS 0.80-1.00 m Rec = 200/200 mm			SM	Silty SAND fine to medium grained, dark brown, about 15% silt			L								
			pale brown orange																	
			R							1.0						END OF HAND AUGER @ 1.10 m REFUSAL GROUNDWATER NOT ENCOUNTERED				
			1.5																	
			2.0																	
			2.5																	
			3.0																	
			3.5																	

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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REPORT OF HAND AUGERED BOREHOLE: HA22

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315529 m E 6273515 m N MGA94 50
SURFACE RL: 26.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.00 m

LOGGED: TC
CHECKED: DK
DATE: 11-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
													0	5	10	15	20	25
HA	L		0.0	26.50				SM	Silty SAND fine to medium grained, brown, about 15% silt	D	MD							
			0.30	26.20														
			0.5						D									
			0.80	25.70					VD									
			1.0	25.50				END OF HAND AUGER @ 1.00 m REFUSAL GROUNDWATER NOT ENCOUNTERED			Refusal on inferred Gneiss							
			1.5															
			2.0															
			2.5															
			3.0															
			3.5															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
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REPORT OF HAND AUGERED BOREHOLE: HA23

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315460 m E 6273520 m N MGA94 50
SURFACE RL: 29.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.90 m

LOGGED: TC
CHECKED: DK
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling			Field Material Description										
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm				
				0	5	10	15	20	25								
HA	M		0.0	29.00			SM	Silty SAND	D	L	Some rock outcrops in the vicinity	SEAT					
			fine to medium grained, dark grey, about 15% silt														
			pale brown grey	MD - D													
	fine to coarse grained, pale grey, extremely weathered rock	VD															
H			0.30	28.70													
			0.5	0.70													
			28.30														
			1.0	28.10				END OF HAND AUGER @ 0.90 m			Inferred refusal on gneiss						

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



SHEET: 1 OF 1

COORDS: 315517 m E 6273591 m N MGA94 50
SURFACE RL: 20.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.40 m

LOGGED: TC DATE: 11-12-20
CHECKED: DK DATE: 29-1-21

[illegible]

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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REPORT OF HAND AUGERED BOREHOLE: HA25

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315536 m E 6273661 m N MGA94 50
SURFACE RL: 10.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.20 m

LOGGED: DK
CHECKED: TC
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling			Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
HA	M		0.0	10.50				SM	Silty SAND fine to coarse grained, brown, about 15-20% silt	D	L - MD	About 50 mm of topsoil Refusal on inferred Gneiss	SEAT					
			10.30						END OF HAND AUGER @ 0.20 m REFUSAL GROUNDWATER NOT ENCOUNTERED				Hammer	Bounce				
			0.5															
			1.0															
			1.5															
			2.0															
			2.5															
			3.0															
			3.5															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



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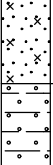
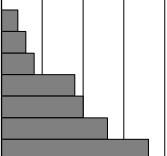
REPORT OF HAND AUGERED BOREHOLE: HA26

SHEET: 1 OF 1

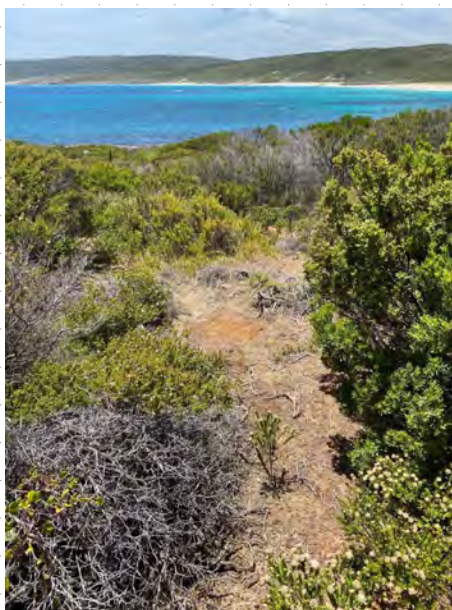
CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315505 m E 6273696 m N MGA94 50
SURFACE RL: 10.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.80 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	M		0.0	10.00				SM	Silty SAND fine to medium grained, dark brown, about 15% silt, with fine to medium gravel	D	MD - D	Refusal on hard clay	SEAT					
	H	0.5	0.40 9.60	CI				Sandy CLAY medium plasticity, brown orange red, about 40% fine to coarse sand	w < PL	H								
	R		0.5	9.20					END OF HAND AUGER @ 0.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED									
		1.0																
		1.5																
		2.0																
		2.5																
			3.0															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
MEMBER OF WSP

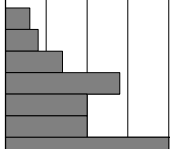
REPORT OF HAND AUGERED BOREHOLE: HA27

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315594 m E 6273629 m N MGA94 50
SURFACE RL: 10.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.70 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	M		0.0	10.50				SM	Silty SAND fine to medium grained, dark brown, about 15% silt, with fine to medium gravel	D	MD - D		SEAT					
	H		0.40	10.10				CI	Sandy CLAY medium plasticity, brown orange red, about 40% fine to coarse sand, trace gravel	w < PL	VSt - H							
	R		0.5	9.80					END OF HAND AUGER @ 0.70 m REFUSAL GROUNDWATER NOT ENCOUNTERED			Refusal on hard clay						
			1.0															
			1.5															
			2.0															
			2.5															
			3.0															
			3.5															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
MEMBER OF WSP

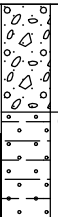
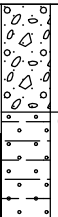
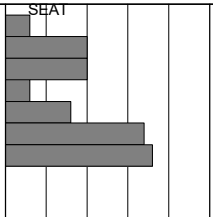
REPORT OF HAND AUGERED BOREHOLE: HA28

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315595 m E 6273557 m N MGA94 50
SURFACE RL: 19.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.00 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DCP TEST (AS1289.6.3.2) Blows per 100 mm					
													0	5	10	15	20	25
HA	M		0.0	19.00	DS 0.60-1.00 m Rec = 400/400 mm			GP	Sandy GRAVEL fine to coarse grained, lateritised gneiss, brown, fine to medium sand, with silt	D	MD	Refusal on hard clay						
			0.50	18.50					Cl / CH	Sandy CLAY medium to high plasticity, orange brown, red brown and pale grey, about 50% fine to coarse sand, trace gravel	M		VSt					
	H			1.0					18.00	END OF HAND AUGER @ 1.00 m REFUSAL GROUNDWATER NOT ENCOUNTERED	D		H					
	R		1.0	18.00					END OF HAND AUGER @ 1.00 m REFUSAL GROUNDWATER NOT ENCOUNTERED									
			1.5															
			2.0															
			2.5															
			3.0															
			3.5															
			4.0															
			4.5															
			5.0															

Sketch & Other Observations



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GAP gINT FN. F03h
RL3

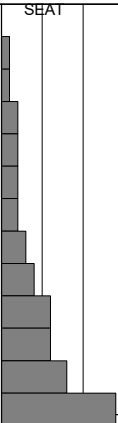
REPORT OF HAND AUGERED BOREHOLE: HA29

SHEET: 1 OF 1

 CLIENT: Smiths 2014 Pty Ltd
 PROJECT: Smiths Beach Development
 LOCATION: Yallingup
 JOB NO: 20435097

 COORDS: 315661 m E 6273609 m N MGA94 50
 SURFACE RL: 8.0 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 1.90 m

 LOGGED: TC
 CHECKED: DK
 DATE: 10-12-20
 DATE: 29-1-21

Drilling					Sampling		Field Material Description											
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
				0	5	10	15	20	25									
HA	L		0.0	8.00	DS 1.00-1.20 m Rec = 200/200 mm			SP	SAND fine to medium grained, dark brown, with silt	D	L							
			0.40	7.60					orange brown									
			0.5															
			1.0															
			1.40	6.60					pale grey brown, with clay									
			1.5															
			1.80															
			2.0	6.10					Clayey SAND fine to coarse grained, orange brown, about 15% to 20% low plasticity clay								M	D
			2.5						END OF HAND AUGER @ 1.90 m REFUSAL GROUNDWATER NOT ENCOUNTERED								VD	
			3.0															

Sketch & Other Observations



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 GAP gINT FN. F03h
 RL3



GOLDER
MEMBER OF WSP

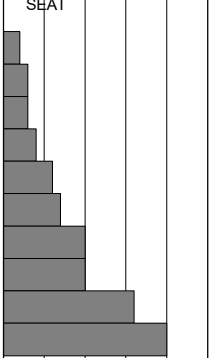
REPORT OF HAND AUGERED BOREHOLE: HA30

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315727 m E 6273575 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 2.20 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling					Sampling		Field Material Description															
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm									
				0	5	10	15	20	25													
L			0.0	6.50	DS 2.00-2.20 m Rec = 200/200 mm			SP	SAND fine to medium grained, black and grey, with fines, minor organic content	M	L, MD											
			0.5																			
			1.0																			
			1.20																			
			5.30																			
			1.50																			
			5.00																			
			2.00																			
			4.50																			
			M						2.0							4.50			SC	Clayey SAND fine to coarse grained, yellow grey, about 15% to 20% low plasticity clay	VD	
2.5																						
3.0																						
3.5																						
4.0																						
4.5																						
5.0																						
5.5																						
6.0																						
6.5																						
H			4.30					END OF HAND AUGER @ 2.20 m REFUSAL GROUNDWATER NOT ENCOUNTERED														
			4.5																			
			5.0																			
			5.5																			
			6.0																			
			6.5																			
			7.0																			
			7.5																			
			8.0																			
			8.5																			

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
MEMBER OF WSP

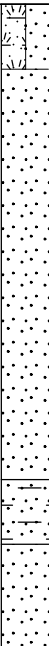
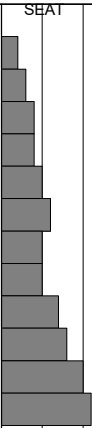
REPORT OF HAND AUGERED BOREHOLE: HA31

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315738 m E 6273539 m N MGA94 50
SURFACE RL: 8.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: TC
CHECKED: DK
DATE: 10-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description												
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm					
													0	5	10	15	20	25
HA	L		0.0	8.00				SP	SAND & TOPSOIL fine to medium grained, black and grey, with fines	M	L		SEAT					
			0.30	7.70				SP	SAND fine to medium grained, brown grey		MD							
			0.5						D									
			1.0															
			1.5															
			2.0															
			2.20	5.80				SC	Clayey SAND fine to medium grained, orange yellow, about 15% low plasticity clay		VD							
			2.50	5.50				SP	SAND fine to medium grained, pale grey		M - W							
			2.5															
			3.0	5.00											END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED			Water table close

Sketch & Other Observations



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GAP gINT FN. F03h
RL3



GOLDER
MEMBER OF WSP

REPORT OF HAND AUGERED BOREHOLE: HA32

SHEET: 1 OF 1

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315252 m E 6273212 m N MGA94 50
SURFACE RL: DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

LOGGED: DK
CHECKED: TC
DATE: 11-12-20
DATE: 29-1-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PERTH PENETROMETER TEST (AS1289.6.3.3) Blows per 150 mm
			0.0				SP	SAND fine to medium grained, dark brown, with silt, minor organic content		L		SEAT
	L		0.5									
			1.0	1.00				orange brown		D		
HA			1.5							D		
	M		2.0							VD		
			2.5									
			3.0					END OF HAND AUGER @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED				
			3.5									

Sketch & Other Observations



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GAP gINT FN. F03h
RL3

APPENDIX C

Borehole Report

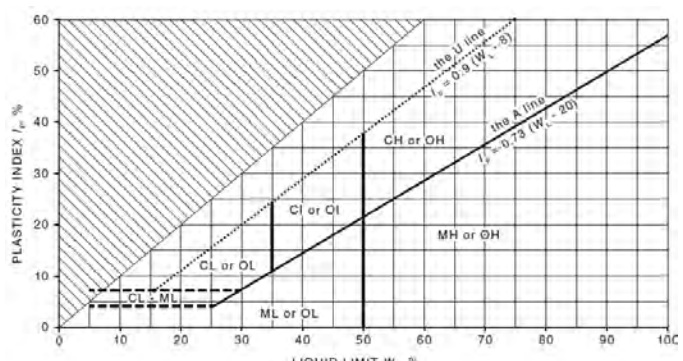
SYMBOLS

	FILL		CLAY (CL, CI or CH)
	GRAVEL (GW, GP, GM or GC)		ORGANIC SOILS (OL, OH or Pt)
	SAND (SW, SP, SM or SC)		COBBLES or BOULDERS
	SILT (ML or MH)		

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

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726-2017. The material properties are assessed in the field by visual/tactile methods.

Particle Size			Plasticity Properties
Soil Group	Sub Division	Particle Size	
BOULDERS		> 200 mm	
COBBLES		63 to 200 mm	
GRAVEL	Coarse	19 to 63 mm	
	Medium	6.7 to 19 mm	
	Fine	2.36 to 6.7 mm	
SAND	Coarse	0.6 to 2.36 mm	
	Medium	0.21 to 0.6 mm	
	Fine	0.075 to 0.21 mm	
SILT		0.002 to 0.075 mm	
CLAY		< 0.002 mm	

MOISTURE CONDITION

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

Moisture condition for fine grained soils is described relative to the plastic limit or liquid limit as specified in AS1726-2017.

CONSISTENCY AND DENSITY

Fine Grained Soils			Coarse Grained Soils		
Symbol	Term	Undrained Shear Strength	Symbol	Term	Density Index (%)
VS	Very Soft	0 to 12 kPa	VL	Very Loose	Less than 15
S	Soft	12 to 25 kPa	L	Loose	15 to 35
F	Firm	25 to 50 kPa	MD	Medium Dense	35 to 65
St	Stiff	50 to 100 kPa	D	Dense	65 to 85
VSt	Very Stiff	100 to 200 kPa	VD	Very Dense	Above 85
H	Hard	Above 200 kPa			
Fr	Friable	-			

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

* SPT correlations are not stated in AS1726-2017, and may be subject to corrections for overburden pressure and equipment type.

CEMENTATION

Weakly Cemented	The soil may be easily disaggregated by hand in air or water.
Moderately Cemented	Effort is required to disaggregate the soil by hand in air or water.

DRILLING/EXCAVATION METHOD

ADH	Hollow auger drilling	EX	Excavator	PQ3	Diamond core - 83 mm
ADT	Auger drilling with tc-bit	HA	Hand auger	PT	Push tube sampling
ADV	Auger drilling with v-bit	HAND	Excavated by hand	RAB	Rotary air blast
AIRCORE	Aircore	HMLC	methods Diamond core - 63	RC	Reverse circulation
AT	Air track	HQ3	mm Diamond core - 61 mm	RT	Rock roller
BH	Backhoe bucket Cable	JET	Jetting	SONIC	Sonic drilling
CT	tool rig	MZ	Mazier tube sampling	SPT	Standard penetration
DTC	Diatube coring Existing	NDD	Non-destructive digging	U	testing Undisturbed tube
EE	excavation Extruded	NMLC	Diamond core - 52 mm	WB	sampling Washbore drilling
EPT	push tube	NQ3	Diamond core - 45 mm		

PENETRATION/EXCAVATION RESISTANCE

L	Low resistance. Rapid penetration possible with little effort from the equipment used.
M	Medium resistance. Excavation/possible at an acceptable rate with moderate effort from the equipment used.
H	High resistance to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.
R	Refusal or Practical Refusal. No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.
These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.	

WATER

	Water level at date shown		Partial water loss
	Water inflow		Complete water loss
GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.		
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.		

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80 mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (sv = peak value, sr = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure test
DCP	Dynamic cone penetration test
CPT	Cone penetration test
CPTu	Cone penetration test with pore pressure (u) measurement

RANKING OF VISUALLY OBSERVABLE CONTAMINATION AND ODOUR (for specific soil contamination assessment projects)

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

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)	RQD = Rock Quality Designation (%)	SCR = Solid Core Recovery (%)	F = Fracture Frequency
$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$	$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$	$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$	$= \frac{\text{No. of defects}}{\text{Length of zone (m)}}$

TERMS FOR ROCK MATERIAL STRENGTH & WEATHERING AND ABBREVIATIONS FOR DEFECT DESCRIPTIONS

STRENGTH

Symbol	Term	UCS (MPa)	Field Guide
VL	Very Low	0.6 to 2	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	2 to 6	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	6 to 20	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	20 to 60	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	60 to 200	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>200	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Material with strength less than 'Very Low' shall be described using soil characteristics. The presence of an original rock structure, fabric or texture should be noted, if relevant.

ROCK MATERIAL WEATHERING

Symbol	Term	Field Guide
RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering DW products in pores.
	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock.
SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes.

ABBREVIATIONS FOR DEFECT TYPES AND DESCRIPTIONS

Defect Type	Coating or Infilling	Roughness
P Parting	Cn Clean	VRo Very Rough
X Foliation	Sn Stain	Ro Rough
L Cleavage	Ve Veneer	Sm Smooth
C Contact	Ct Coating	Po Polished
J Joint	In Infill	Sl Slickensided
SSu Sheared Surface	Planarity	Vertical Boreholes – The dip (inclination from horizontal) of the defect is given. Inclined Boreholes – The inclination is measured as the acute angle between the core axis and the vertical direction.
SS Sheared Seam		
SZ Sheared Zone		
CS Crushed Seam		
IS Infilled Seam		
EWS Extremely Weathered Seam	PI Planar	
V Vein	Cv Curved	
	Un Undulating	
	St Stepped	
	Ir Irregular	



SHEET: 1 OF 1

DRILL RIG: GDR650

CONTRACTOR: OzDrill

LOGGED: TC

DATE: 15-1-21

CHECKED: DK

DATE: 29-1-21

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315665 m E 6273623 m N MGA94 50
SURFACE RL: 6.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.50 m

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GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315665 m E 6273623 m N MGA94 50
SURFACE RL: 6.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.50 m

SHEET: 1 OF 1
DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 15-1-21
CHECKED: DK DATE: 29-1-21



PointID : BH1 Depth Range: 0.00 - 5.00 m



PointID : BH1 Depth Range: 5.00 - 6.50 m

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SHEET: 1 OF 1

DRILL RIG: GDR650

CONTRACTOR: OzDrill

LOGGED: TC DATE: 15-1-21

CHECKED: DK DATE: 29-1-21

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315702 m E 6273613 m N MGA94 50
SURFACE RL: 6.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 7.50 m

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GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315702 m E 6273613 m N MGA94 50
SURFACE RL: 6.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 7.50 m

SHEET: 1 OF 1
DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 15-1-21
CHECKED: DK DATE: 29-1-21



PointID : BH2 Depth Range: 0.00 - 5.00 m



PointID : BH2 Depth Range: 5.00 - 7.50 m

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GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH3

SHEET: 1 OF 3

DRILL RIG: GDR650

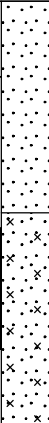
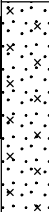
CONTRACTOR: OzDrill

LOGGED: TC DATE: 14-1-21

CHECKED: DK DATE: 29-1-21

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315725 m E 6273608 m N MGA94 50
SURFACE RL: 5.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 12.00 m

Drilling				Sampling		Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS			0	5.50	C 0.50-1.50 m Rec = 0/1000 mm			SP	SAND fine to medium grained, pale grey	D	MD		
			1										
HQ3			1.40	4.10	C 1.50-3.00 m Rec = 800/1500 mm			SM	Silty SAND fine to medium grained, dark grey black				
			2										
			3						For Continuation Refer to Sheet 2				
			4										
			5										
			6										
			7										
			8										
			9										
			10										

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GAP gINT FN. F01a
RL3



GOLDER

MEMBER OF WSP

REPORT OF BOREHOLE: BH3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315725 m E 6273608 m N MGA94 50
SURFACE RL: 5.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 12.00 m

SHEET: 2 OF 3

DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC
CHECKED: DK

DATE: 14-1-21
DATE: 29-1-21

Drilling					Field Material Description					Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	$I_{s(50)}$ MPa	D- diam- etral A- axial	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	
									EL 0.03 VL 0.1 L 0.3 M 1 VH 3 EH 10				10 30 100 300 1000 3000	
				0										
				1										
				2										
				2.80			Continuation of Sheet 1							
				2.70										
				3.00			GNEISS medium to coarse grained, mottled brown, pale red, dark grey, highly fractured, inferred boulder	MW						
				2.50			CLAYEY SAND fine to coarse grained, red brown and grey, weakly to moderately cemented with iron cementation							
			100	0										
				(0)										
			100	45										
				(45)										
			4											
				4.15			GNEISS medium to coarse grained, massive, mottled red brown and grey	DW						
				1.35										
			5											
				5.20			CORELOSS inferred weaker zone, extremely weathered							
				0.30										
			80	65										
				(80)										
			5											
				5.50			GNEISS medium to coarse grained, massive, mottled red brown and grey	MW						
				0.00										
			6											
				7.15										
				-1.65			CORELOSS inferred weaker zone, extremely weathered							
			55	25										
				(25)										
			7											
				7.50			GNEISS medium to coarse grained, massive, mottled red brown and grey	MW						
				-2.00										
			100	40										
				(30)										
			8											
				7.65										
				7.90										
				8.00-8.50										
			100	45										
				(65)										
			9											
				9.15										
				9.40										
			100	60										
				(70)										
			9											
				9.65										
				9.75										
			10											

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GAP gINT FN. F02a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315725 m E 6273608 m N MGA94 50
SURFACE RL: 5.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 12.00 m

SHEET: 3 OF 3
DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 14-1-21
CHECKED: DK DATE: 29-1-21

Drilling					Field Material Description					Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	$I_{s(50)}$ MPa	D- diam- etral A- axial	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	
HQ3				10			GNEISS medium to coarse grained, massive, mottled red brown and grey	SW			A 0.7	10.00-10.20 m: FZ		
		100	45 (80)	11	10.62 m: J, Pl, Ro, Cn 10.73 m: J, Pl, Ro, Cn 11.10 m: J, Pl, Ro, Cn 11.23 m: J, Pl, Ro, Cn 11.47 m: J, Pl, Ro, Cn 11.70 m: J, Pl, Ro, Cn									
			100	95 (95)	12	12.00 -6.50	END OF BOREHOLE @ 12.00 m TARGET DEPTH GROUNDWATER NOT OBSERVED							
				13										
				14										
				15										
				16										
				17										
				18										
				19										
				20										

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GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315725 m E 6273608 m N MGA94 50
SURFACE RL: 5.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 12.00 m

SHEET: 1 OF 1
DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 14-1-21
CHECKED: DK DATE: 29-1-21



PointID : BH3 Depth Range: 2.00 - 7.00 m



PointID : BH3 Depth Range: 7.00 - 12.00 m

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GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH4

SHEET: 1 OF 2

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315765 m E 6273585 m N MGA94 50
SURFACE RL: 6.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 16.50 m

DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 13-1-21
CHECKED: DK DATE: 29-1-21

Drilling					Sampling		Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS		
AS			0	6.00					SAND & GRAVEL					
			0.50	5.50				SP	SAND fine to medium grained, pale grey					
			1											
HA			2		Rec = 400/450 mm SPT 3.00-3.45 m 5, 4, 8 N=12		SC	Clayey SAND fine to coarse grained, pale brown, about 20-25% medium plasticity clay	D					
			3	3.00									3.00	
			4											
HQ3			5		Rec = 300/410 mm SPT 6.00-6.41 m 13, 18, 20/110mm N>38		SC / CI	Sandy CLAY medium plasticity, brown, grey, pale blue and pale red, fine to coarse sand, variable cementation, iron cemented		w < PL	Vst			
			6											
			7											
			8	7.50										
			9	-1.50										

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GAP gINT FN. F01a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH4

SHEET: 2 OF 2

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315765 m E 6273585 m N MGA94 50
SURFACE RL: 6.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 16.50 m

DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 13-1-21
CHECKED: DK DATE: 29-1-21

Drilling				Sampling			Field Material Description									
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS					
HQ3			10				SC / CI	Sandy CLAY medium plasticity, brown, grey, pale blue and pale red, fine to coarse sand, variable cementation, iron cemented	w < PL	VSt						
			11													
			12													
			13													
			14													
			15													
			16													
			17	-10.50									END OF BOREHOLE @ 16.50 m TARGET DEPTH GROUNDWATER NOT OBSERVED			
			18													
			19													

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GAP gINT FN. F01a
RL3

REPORT OF CORE PHOTOGRAPHS: BH4

CLIENT: Smiths 2014 Pty Ltd
 PROJECT: Smiths Beach Development
 LOCATION: Yallingup
 JOB NO: 20435097

COORDS: 315765 m E 6273585 m N MGA94 50
 SURFACE RL: 6.0 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 16.50 m

SHEET: 1 OF 1
 DRILL RIG: GDR650
 CONTRACTOR: OzDrill
 LOGGED: TC DATE: 13-1-21
 CHECKED: DK DATE: 29-1-21



PointID : BH4 Depth Range: 8.00 - 13.00 m



PointID : BH4 Depth Range: 13.00 - 16.50 m

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GOLDER
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REPORT OF BOREHOLE: BH5

SHEET: 1 OF 3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315750 m E 6273601 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 16-1-20
CHECKED: DK DATE: 29-1-21

Drilling					Sampling		Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION		MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS			0	6.50				SP	SAND & GRAVEL		D	MD		
			0.50	6.00					SAND fine to medium grained, pale grey					
HA			1											
HQ3			2											
			3		Rec = 300/450 mm SPT 3.00-3.45 m 8, 13, 12 N=25									
HQ3			4						For Continuation Refer to Sheet 2					
			5											
			6											
			7											
			8											
			9											
			10											

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GAP gINT FN. F01a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH5

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315750 m E 6273601 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

SHEET: 2 OF 3
DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 16-1-20
CHECKED: DK DATE: 29-1-21

Drilling					Field Material Description					Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH Is(50) MPa	Is(50) MPa D- diam- etral A- axial	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)		
									EL 0.03 VL 0.1 L 0.3 M 1 VH 3 EH 10			10 30 100 300 1000 3000		
				0										
				1										
				2										
				3										
				3.50			Continuation of Sheet 1							
				3.60										
				3.75			GNEISS	MW						
				2.75			medium to coarse grained, red brown, grey, inferred boulder							
				4			CORELOSS							
							inferred weak zone							
				4.35										
				4.50			GNEISS	MW						
				2.00			red brown, inferred boulder							
				5			CLAYEY SAND/ SANDY CLAY							
							brown, red, orange and grey, moderately cemented with iron cementation in parts							
				6										
				6.00										
				0.50			moderately to well cemented, variably cemented							
				6.80										
				-0.30			CLAY							
							mottled grey, blue and black, stiff to very stiff							
				7										
				7.25			GNEISS	SW						
				-0.75			medium to coarse grained, massive, mottled red brown, grey, pale red							
				8				FR						
				9										
				10										

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GAP gINT FN. F02a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH5

SHEET: 3 OF 3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315750 m E 6273601 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 16-1-20
CHECKED: DK DATE: 29-1-21

Drilling						Field Material Description					Defect Information			
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	$I_{s(50)}$ MPa D- diam- A- axial	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)		
			100 (100)	10	10.50 -4.00		GNEISS medium to coarse grained, massive, mottled red brown, grey, pale red	FR			10.00 m: J, Pl, Ro, Cn			
							END OF BOREHOLE @ 10.50 m TARGET DEPTH GROUNDWATER NOT OBSERVED							
				11										
				12										
				13										
				14										
				15										
				16										
				17										
				18										
				19										
				20										

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GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315750 m E 6273601 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

SHEET: 1 OF 1
DRILL RIG: GDR650
CONTRACTOR: OzDrill
LOGGED: TC DATE: 16-1-20
CHECKED: DK DATE: 29-1-21



PointID : BH5 Depth Range: 3.00 - 8.00 m



PointID : BH5 Depth Range: 8.00 - 10.50 m

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GOLDER
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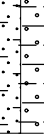
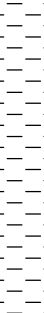
REPORT OF BOREHOLE: BH6

SHEET: 1 OF 2

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315761 m E 6273634 m N MGA94 50
SURFACE RL: 2.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.00 m

DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 10-3-21
CHECKED: DK DATE: 15-3-21

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HQ3			0	2.00				SP	SAND fine to medium grained, pale grey white, quartz and calcareous sand	D	L - MD	
			1	1.00					GNEISS fine to coarse grained, inferred boulder, mottled blue, grey and dark grey, slightly weathered, high strength			
				1.25					CORE LOSS			
				0.75				SC / CI	Clayey SAND /Sandy CLAY grey, brown, orange, red, fine to coarse grained sand, medium plasticity clay, variably cemented, moderately iron cemented in parts	M	VD - H	
				1.50								
				0.50								
			2	2.40				CI	CLAY medium plasticity, grey, red brown			
				-0.40								
			3							W ~ PL	VSt	
			4									
			5						For Continuation Refer to Sheet 2			
			6									
			7									
			8									
			9									
			10									

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GAP gINT FN. F01a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH6

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315761 m E 6273634 m N MGA94 50
SURFACE RL: 2.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.00 m

SHEET: 2 OF 2
DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 10-3-21
CHECKED: DK DATE: 15-3-21

Drilling						Field Material Description						Defect Information			
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH UCS MPa	LABORATORY STRENGTH (MPa)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)			
				0								10	20	100	300
				1								200	1000	3000	
				2											
				3											
				4											
				4.50			Continuation of Sheet 1								
				-2.50			GNEISS fine to coarse grained, massive, grey, brown, red	DW		PLI(D)=0.34					
				5				SW		PLI(A)=0.89					
				6.00			END OF BOREHOLE @ 6.00 m TARGET DEPTH GROUNDWATER NOT OBSERVED			PLI(A)=3.30					
				-4.00											
				7											
				8											
				9											
				10											

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GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315761 m E 6273634 m N MGA94 50
SURFACE RL: 2.0 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.00 m

SHEET: 1 OF 1
DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 10-3-21
CHECKED: DK DATE: 15-3-21



PointID : BH6 Depth Range: 1.00 - 6.00 m



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH7

SHEET: 1 OF 2

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315727 m E 6273627 m N MGA94 50
SURFACE RL: 2.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.00 m

DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 11-3-21
CHECKED: DK DATE: 15-3-21

Drilling					Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HQ3			0	2.50				SP	SAND fine to medium grained, pale grey white, quartz and calcareous sand	M	L - MD		
			1		Rec = 450/450 mm SPT 1.00-1.45 m 4, 13, 28 N=41						D		
			2						For Continuation Refer to Sheet 2				
			3										
			4										
			5										
			6										
			7										
			8										
			9										
			10										

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GAP gINT FN. F01a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH7

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315727 m E 6273627 m N MGA94 50
SURFACE RL: 2.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.00 m

SHEET: 2 OF 2

DRILL RIG: Jarco

CONTRACTOR: OzDrill

LOGGED: TC DATE: 11-3-21

CHECKED: DK DATE: 15-3-21

Drilling						Field Material Description						Defect Information			
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH UCS MPa	LABORATORY STRENGTH (MPa)		DEFECT DESCRIPTION & Additional Observations		AVERAGE DEFECT SPACING (mm)	
				0											
				1											
				1.50			Continuation of Sheet 1								
				1.65			GNEISS	SW							
				0.85			fine to coarse grained, dark blue, dark grey, possible boulder	FR							
				1.90											
				2			CORE LOSS	DW							
				0.60			GNEISS								
							fine to coarse grained, massive, brown, red, dark grey, fractured with clay/sand infill								
				3											
				3.50											
				1.00			blue, green, grey, red-brown, slightly fractured	SW							
				4											
				5											
				6.00			END OF BOREHOLE @ 6.00 m								
				3.50			TARGET DEPTH								
							GROUNDWATER NOT OBSERVED								
				7											
				8											
				9											
				10											

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GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315727 m E 6273627 m N MGA94 50
SURFACE RL: 2.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 6.00 m

SHEET: 1 OF 1
DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 11-3-21
CHECKED: DK DATE: 15-3-21



PointID : BH7 Depth Range: 1.00 - 6.00 m



REPORT OF BOREHOLE: BH8

SHEET: 1 OF 3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315740 m E 6273614 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 12-3-21
CHECKED: DK DATE: 15-3-21

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA			0	6.50			SP	SAND fine to medium grained, pale grey			
			1								
HQ3			2								
			3						M	MD	
			4								
			5								
			6								
			7								
			8								
			9								
			10								

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GAP gINT FN. F01a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH8

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315740 m E 6273614 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

SHEET: 2 OF 3
DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 12-3-21
CHECKED: DK DATE: 15-3-21

Drilling						Field Material Description					Defect Information		
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH UCS MPa	LABORATORY STRENGTH (MPa)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	
												10	20
												30	100
												300	1000
												3000	3000
				0									
				1									
				2									
				3									
				4									
				5									
				5.75									
				0.75			Continuation of Sheet 1						
				6			GNEISS fine to coarse grained, red brown, cemented clayey sand	XW			PLI(D)=0.07		
			100	0									
			(0)										
				7									
				8							PLI(D)=0.14		
			100	55									
			(55)										
				8.20									
				-1.70			GNEISS fine to coarse grained, massive, red brown and grey, slightly fractured	DW			PLI(D)=0.55		
				9							PLI(D)=0.18		
			100	95									
			(100)										
				10							PLI(A)=0.21		

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GAP gINT FN. F02a
RL3



GOLDER
MEMBER OF WSP

REPORT OF BOREHOLE: BH8

SHEET: 3 OF 3

DRILL RIG: Jarco

CONTRACTOR: OzDrill

LOGGED: TC DATE: 12-3-21

CHECKED: DK DATE: 15-3-21

CLIENT: Smiths 2014 Pty Ltd

COORDS: 315740 m E 6273614 m N MGA94 50

PROJECT: Smiths Beach Development

SURFACE RL: 6.5 m DATUM: AHD

LOCATION: Yallingup

INCLINATION: -90°

JOB NO: 20435097

HOLE DEPTH: 10.50 m

Drilling						Field Material Description						Defect Information			
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH UCS MPa	LABORATORY STRENGTH (MPa)		DEFECT DESCRIPTION & Additional Observations		AVERAGE DEFECT SPACING (mm)	
HQ3			100	95 (100)	10		GNEISS fine to coarse grained, massive, red brown and grey, slightly fractured	DW			PLI(D)=0.64				
					10.50 -4.00		END OF BOREHOLE @ 10.50 m TARGET DEPTH GROUNDWATER NOT OBSERVED								
					11										
					12										
					13										
					14										
					15										
					16										
					17										
					18										
					19										
					20										

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

GAP gINT FN. F02a
RL3

CLIENT: Smiths 2014 Pty Ltd
PROJECT: Smiths Beach Development
LOCATION: Yallingup
JOB NO: 20435097

COORDS: 315740 m E 6273614 m N MGA94 50
SURFACE RL: 6.5 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 10.50 m

SHEET: 1 OF 1
DRILL RIG: Jarco
CONTRACTOR: OzDrill
LOGGED: TC DATE: 12-3-21
CHECKED: DK DATE: 15-3-21



PointID : BH8 Depth Range: 5.00 - 10.00 m



PointID : BH8 Depth Range: 10.00 - 10.50 m

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

APPENDIX D

Pavement Dipping Report

Pavement Dipping Location	PD01	northbound lane, closest to Canal Rocks Rd	Approx. Coordinates: 316075 E 6273013 N Logged: DG	Datum: MGA zone 50J Date: 22/12/2020	Checked: DMS Date: 03-02-21
Pavement Thickness incl. Surfacing (mm)	>520		Samples		
End of Hole (mm)	520				
Surfacing	ASPHALT 14 mm DGA		1 x DS		
Thickness (mm)	40				
Comments	cored with water				
Basecourse	Sandy GRAVEL (GP) fine to coarse grained, sub-rounded to sub-angular, pale brown to brown, approximately 30-40% fine to coarse grained sand, trace non plastic fines		1 x DS		
Thickness (mm)	120				
Comments	dry				
Sub-base	Gravelly SAND (SP) fine to medium grained crushed limestone, pale yellow, fine to medium gravel (inferred fill)		1 x DS		
Thickness (mm)	>360				
Comments	dry, attempted hand augering to deeper depths but the material kept collapsing				
Subgrade					
Comments	Not encountered				
Pavement Conditions and General Comments			Asphalt surfacing looks relatively new. Shape of pavement is good, no significant defects observed.		

Pavement Dipping Location		PD02	southbound lane		Approx. Coordinates: 316075 E 6273130 N			Datum: MGA zone 50J				
					Logged: DG	Date: 22/12/2020	Checked: DMS	Date: 03-02-21				
Pavement Thickness incl. Surfacing (mm)		190		Samples								
End of Hole (mm)		410										
Surfacing		ASPHALT 14 mm DGA with inferred 10 mm seal										
Thickness (mm)		40										
Comments		cored with water										
Basecourse		Sandy GRAVEL (GP) fine to coarse grained, sub-rounded to sub-angular, brown, approximately 30-40% fine to coarse grained sand, trace non-plastic fines		1 x DS								
Thickness (mm)		150										
Comments		dry										
Subgrade		Gravelly SAND (SP) fine to coarse, pale brown, approximately 30% fine to medium gravel, trace fines		1 x BDS								
Comments		dry										
Pavement Conditions and General Comments		Asphalt surfacing looks relatively new. Shape of pavement is good, no significant defects observed.										
Perth Sands Penetrometer:		conducted at 410 mm depth										
Testing Increment (mm)		0-150	150-300	300-450	450-600							
Blow Count / 150 mm		8	7	7	7							

Pavement Dipping Location	PD03	southbound lane		Approx. Coordinates: 316074 E 6273292 N Datum: MGA zone 50J Logged: DG Date: 22/12/2020 Checked: DMS Date: 03-02-21			
Pavement Thickness incl. Surfacing (mm)	300		Samples				
End of Hole (mm)	490						
Surfacing	ASPHALT 14 mm DGA with inferred 10 mm seal						
Thickness (mm)	30						
Comments	cored with water						
Basecourse	Sandy GRAVEL/Gravelly SAND (GP-SP) fine to medium grained, sub-rounded to sub-angular gravel, brown, fine to coarse grained sand, trace fines						
Thickness (mm)	270						
Comments	dry						
Subgrade	Clayey Gravelly SAND (SP-SC) fine to coarse, brown-orange, with fine to medium, sub-rounded gravel, low plasticity fines (inferred fill)		1 x DS				
Comments	dry, similar material to basecourse - difficult to distinguish layer						
Pavement Conditions and General Comments		Asphalt surfacing looks relatively new. Shape of pavement is good, no significant defects observed.					
Dynamic Cone Penetrometer: conducted at 490 mm depth							
Testing Increment (mm)	0-100						
Blow Count / 100 mm	Refusal						

Pavement Dipping Location	PD04	northbound lane	Approx. Coordinates: 316065 E 6273444 N Datum: MGA zone 50J Logged: DG Date: 22/12/2020 Checked: DMS Date: 03-02-21
Pavement Thickness incl. Surfacing (mm)	260	Samples	
End of Hole (mm)	870		
Surfacing	ASPHALT 14 mm DGA		
Thickness (mm)	30		
Comments	cored with water		
Basecourse	Sandy GRAVEL/Gravelly SAND (GP/SP) fine to medium grained, sub-rounded to sub-angular gravel, brown, fine to coarse grained sand, trace fines	1 x DS	
Thickness (mm)	230		
Comments	dry		
Subgrade	SAND (SP) fine to coarse, pale brown, with fine to medium, sub-rounded gravel, trace fines different subgrade material from approx. 500 mm depth - Clayey SAND (SC), fine to coarse, low plasticity clay	1 x DS	
Comments	dry to moist		
Pavement Conditions and General Comments	Asphalt surfacing looks relatively new. Shape of pavement is good, no significant defects observed.		

Pavement Dipping Location		PD05	northbound lane	Approx. Coordinates: 316063 E 6273536 N		Datum: MGA zone 50J	
				Logged: DG	Date: 22/12/2020	Checked: DMS	Date: 03-02-21
Pavement Thickness incl. Surfacing (mm)		290	Samples				
End of Hole (mm)		1000					
Surfacing		ASPHALT 10 mm red laterite DGA with inferred 5 mm seal					
Thickness (mm)		30					
Comments		cored with water					
Basecourse		Sandy GRAVEL (GP) fine to medium grained, sub-rounded to sub-angular gravel, brown, fine to coarse grained sand, trace fines					
Thickness (mm)		190					
Comments		dry to moist					
Sub-base		Sandy GRAVEL (GP) fine to medium grained, sub-rounded to sub-angular gravel, grey-brown, fine to coarse grained sand, trace fines					
Thickness (mm)		70					
Comments		dry to moist					
Subgrade		Silty SAND(SM) fine to medium, dark brown, inferred low to medium plasticity silt, trace fine to medium sub-rounded gravel. at 800 mm depth material transitions to red brown, inferred medium plasticity silt/clayey fines					
Comments		moist					
Pavement Conditions and General Comments		Asphalt surfacing looks relatively new. Shape of pavement is good, minor flushing on the wheel paths further north, closer to the bend.					

Dynamic Cone Penetrometer: conducted at 450 mm depth

Testing Increment (mm)	0-100	100-200	200-300	300-400	400-500	500-600	
Blow Count / 100 mm	3	3	2	2	2	2	

Pavement Dipping Location		PD06	southbound lane		Approx. Coordinates: 315906 E 6273603 N			Datum: MGA zone 50J						
					Logged: DG		Date: 22/12/2020		Checked: DMS	Date: 03-02-21				
Pavement Thickness incl. Surfacing (mm)		290		Samples										
End of Hole (mm)		750												
Surfacing		ASPHALT 10 mm red laterite DGA with inferred 5 mm seal												
Thickness (mm)		30												
Comments		cored with water												
Basecourse		Clayey Sandy GRAVEL (GP-GC) fine to coarse grained, sub-rounded to sub-angular, brown, approximately 30% fine to coarse grained sand, low plasticity fines		1 x DS										
Thickness (mm)		260												
Comments		dry												
Subgrade		SAND (SP) fine to medium, brown to pale brown, trace non plastic fines		1 x BDS										
Comments		dry												
Pavement Conditions and General Comments		Asphalt surfacing looks relatively new. Shape of pavement is good, no significant defects observed. Minor flushing on the wheel paths closer to the bend - inferred due to turning stresses.												
Perth Sands Penetrometer:		conducted at 750 mm depth												
Testing Increment (mm)		0-150	150-300											
Blow Count / 150 mm		10	14											

APPENDIX E

Falling Weight Deflectometer Test Report



Client :	Golder Associates	Job No:	102162
Project Name:	FWD testing - Yallingup	File Name:	Beach Rd North
Road Name:	Smiths Beach Road - Starting form Canal Rock Road	Survey Date:	18/12/2020
Section / Lane:	Northbound L1	Tested By:	TM
Surface Tested:	Asphalt	Testing Interval:	25 m
Prepared By:	CK	Checked By:	TM

DYNATEST FWD (E- 044) TEST RESULTS TO WA:326.2

Normalised to (kPa)

566

Chainage (km)	Pavement Temp ^{tr} deg °C	Lane	FWD Stress (kPa)	Geophone Location (mm) and Deflections (micron)									Deflection (mm)	Curvature (mm)
				0	200	300	400	500	600	750	900	1500		
0.000	55.0	L1	548	389	228	157	100	91	61	53	39	15	0.401	0.166
0.025	55.0	L1	552	341	223	157	118	94	77	64	42	21	0.350	0.121
0.050	55.0	L1	548	377	244	180	139	117	101	83	57	32	0.389	0.137
0.076	55.0	L1	547	388	239	164	118	89	66	52	35	16	0.402	0.154
0.100	55.0	L1	550	238	123	84	61	48	47	34	22	11	0.245	0.119
0.125	55.0	L1	544	244	132	86	61	48	36	29	13	9	0.253	0.116
0.150	55.0	L1	541	220	121	86	65	50	41	29	19	11	0.231	0.104
0.175	55.0	L1	537	311	192	114	73	51	39	28	15	6	0.328	0.126
0.200	55.0	L1	534	338	202	137	97	72	63	47	36	16	0.358	0.145
0.226	55.0	L1	542	485	320	228	165	137	105	81	59	28	0.506	0.172
0.251	55.0	L1	539	455	290	196	137	104	86	60	35	18	0.478	0.174
0.275	55.0	L1	545	353	201	126	78	55	42	32	26	15	0.367	0.158
0.301	55.0	L1	541	346	199	124	78	56	42	33	25	14	0.361	0.153
0.326	55.0	L1	545	280	178	115	91	65	49	44	30	19	0.291	0.106
0.350	55.0	L1	540	488	261	161	100	77	58	48	36	16	0.511	0.238
0.375	55.0	L1	542	257	137	84	58	46	38	31	24	12	0.269	0.126
0.400	55.0	L1	537	329	214	146	102	78	59	41	29	11	0.347	0.122



Client :		Golder Associates							Job No:				102162	
Project Name:		FWD testing - Yallingup							File Name:				Beach Rd North	
Road Name:		Smiths Beach Road - Starting form Canal Rock Road							Survey Date:				18/12/2020	
Section / Lane:		Northbound L1							Tested By:				TM	
Surface Tested:		Asphalt							Testing Interval:				25 m	
Prepared By:		CK		Checked By:		TM								
DYNATEST FWD (E- 044) TEST RESULTS TO WA:326.2												Normalised to (kPa)		
												566		
Chainage (km)	Pavement Temp^{tr} deg °C	Lane	FWD Stress (kPa)	Geophone Location (mm) and Deflections (micron)									Deflection (mm)	Curvature (mm)
				0	200	300	400	500	600	750	900	1500		
0.425	56.0	L1	531	444	327	252	197	149	116	88	54	22	0.473	0.124
0.453	56.0	L1	537	244	168	127	96	83	59	44	27	19	0.257	0.079
0.475	56.0	L1	533	395	223	137	87	64	49	37	23	13	0.419	0.182
0.500	56.0	L1	532	283	147	77	46	40	36	25	17	6	0.302	0.145
0.527	56.0	L1	526	385	244	155	106	83	55	40	22	6	0.415	0.152
0.550	56.0	L1	527	527	347	229	150	105	80	58	34	15	0.566	0.193
0.576	56.0	L1	525	407	206	128	77	60	44	35	18	9	0.439	0.217
0.600	57.5	L1	524	885	563	373	241	162	107	70	38	21	0.956	0.348
0.625	57.5	L1	526	739	535	387	279	209	154	96	60	23	0.795	0.220
0.650	57.5	L1	527	922	648	459	334	253	186	126	80	24	0.991	0.295
0.677	57.5	L1	531	655	409	280	199	145	106	69	40	17	0.698	0.262
0.701	57.5	L1	537	270	156	111	88	70	62	45	30	15	0.284	0.119
0.726	57.5	L1	538	227	120	75	58	52	44	39	27	19	0.239	0.113
0.752	57.5	L1	535	366	182	107	76	65	57	49	40	25	0.387	0.195
0.755	57.5	L1	517	407	245	147	96	64	46	40	34	19	0.446	0.178
0.775	57.5	L1	539	331	195	114	74	63	49	42	30	21	0.347	0.142
0.800	57.5	L1	541	274	173	115	85	70	61	51	41	26	0.286	0.105



Client :		Golder Associates							Job No:				102162	
Project Name:		FWD testing - Yallingup							File Name:				Beach Rd North	
Road Name:		Smiths Beach Road - Starting form Canal Rock Road							Survey Date:				18/12/2020	
Section / Lane:		Northbound L1							Tested By:				TM	
Surface Tested:		Asphalt							Testing Interval:				25 m	
Prepared By:		CK	Checked By:		TM									
DYNATEST FWD (E- 044) TEST RESULTS TO WA:326.2												Normalised to (kPa)		
												566		
Chainage (km)	Pavement Temp'tr deg °C	Lane	FWD Stress (kPa)	Geophone Location (mm) and Deflections (micron)									Deflection (mm)	Curvature (mm)
				0	200	300	400	500	600	750	900	1500		
0.825	57.5	L1	537	529	298	172	105	69	48	34	30	18	0.557	0.243
0.851	57.5	L1	539	398	214	131	87	65	52	42	32	17	0.417	0.193
0.875	56.5	L1	563	337	195	128	94	71	57	46	36	17	0.339	0.143
0.901	56.5	L1	559	510	274	174	130	90	67	50	41	17	0.516	0.239
0.924	55.2	L1	562	432	234	147	91	66	56	37	27	14	0.435	0.200
0.950	55.2	L1	553	383	228	144	109	76	61	50	33	16	0.392	0.159
0.976	55.2	L1	552	394	218	137	89	67	52	38	27	16	0.404	0.180
0.993	55.2	L1	556	285	183	129	90	69	52	39	29	15	0.290	0.103
Redoxide Asphalt Surface														
Mean			540	402	244	161	112	85	66	50	34	17	0.422	0.166
SDEV			11	158	114	83	60	44	31	21	13	6	0.17	0.06
COVR, %			2	39	47	51	53	51	48	42	39	34	40.7	33.9
97.5 Percentile													0.952	
95 Percentile													0.790	



Client :		Golder Associates							Job No:				102162																																																																																																																																																																																																																																																																										
Project Name:		FWD testing - Yallingup							File Name:				Beach Rd South																																																																																																																																																																																																																																																																										
Road Name:		Smiths Beach Road - Starting from the Carpark							Survey Date:				18/12/2020																																																																																																																																																																																																																																																																										
Section / Lane:		Southbound - R1							Tested By:				TM																																																																																																																																																																																																																																																																										
Surface Tested:		Asphalt							Testing Interval:				25 m																																																																																																																																																																																																																																																																										
Prepared By:		CK	Checked By:		TM																																																																																																																																																																																																																																																																																		
DYNATEST FWD (E- 044) TEST RESULTS TO WA:326.2												Normalised to (kPa)																																																																																																																																																																																																																																																																											
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Chainage (km)	Pavement Temp <tr><td rowspan="2">Lane</td><td rowspan="2">FWD Stress (kPa)</td><td colspan="10">Geophone Location (mm) and Deflections (micron)</td><td rowspan="2">Deflection (mm)</td><td rowspan="2">Curvature (mm)</td></tr> <tr><td>0</td><td>200</td><td>300</td><td>400</td><td>500</td><td>600</td><td>750</td><td>900</td><td>1500</td></tr> <tr><td>0.990</td><td>55.2</td><td>R1</td><td>547</td><td>299</td><td>182</td><td>123</td><td>90</td><td>69</td><td>58</td><td>47</td><td>39</td><td>22</td><td>0.309</td><td>0.121</td></tr> <tr><td>0.965</td><td>55.2</td><td>R1</td><td>546</td><td>283</td><td>170</td><td>112</td><td>82</td><td>62</td><td>51</td><td>39</td><td>30</td><td>15</td><td>0.293</td><td>0.117</td></tr> <tr><td>0.940</td><td>55.2</td><td>R1</td><td>550</td><td>216</td><td>142</td><td>96</td><td>69</td><td>53</td><td>44</td><td>35</td><td>27</td><td>14</td><td>0.222</td><td>0.076</td></tr> <tr><td>0.921</td><td>55.2</td><td>R1</td><td>555</td><td>168</td><td>121</td><td>87</td><td>67</td><td>54</td><td>45</td><td>37</td><td>27</td><td>14</td><td>0.171</td><td>0.047</td></tr> <tr><td>0.890</td><td>54.5</td><td>R1</td><td>548</td><td>210</td><td>139</td><td>97</td><td>74</td><td>58</td><td>50</td><td>40</td><td>30</td><td>19</td><td>0.217</td><td>0.074</td></tr> <tr><td>0.865</td><td>54.5</td><td>R1</td><td>547</td><td>219</td><td>123</td><td>81</td><td>65</td><td>45</td><td>43</td><td>33</td><td>28</td><td>15</td><td>0.226</td><td>0.099</td></tr> <tr><td>0.840</td><td>54.5</td><td>R1</td><td>551</td><td>149</td><td>109</td><td>68</td><td>58</td><td>45</td><td>40</td><td>30</td><td>23</td><td>14</td><td>0.153</td><td>0.041</td></tr> <tr><td>0.816</td><td>54.5</td><td>R1</td><td>547</td><td>250</td><td>160</td><td>104</td><td>74</td><td>59</td><td>50</td><td>38</td><td>29</td><td>15</td><td>0.259</td><td>0.093</td></tr> <tr><td>0.790</td><td>54.5</td><td>R1</td><td>545</td><td>306</td><td>161</td><td>105</td><td>75</td><td>62</td><td>50</td><td>41</td><td>34</td><td>19</td><td>0.318</td><td>0.151</td></tr> <tr><td>0.765</td><td>54.5</td><td>R1</td><td>543</td><td>311</td><td>182</td><td>120</td><td>87</td><td>70</td><td>60</td><td>48</td><td>42</td><td>28</td><td>0.324</td><td>0.134</td></tr> <tr><td>0.740</td><td>54.5</td><td>R1</td><td>539</td><td>318</td><td>177</td><td>116</td><td>79</td><td>61</td><td>48</td><td>38</td><td>31</td><td>15</td><td>0.334</td><td>0.148</td></tr> <tr><td>0.715</td><td>54.5</td><td>R1</td><td>538</td><td>230</td><td>114</td><td>82</td><td>64</td><td>54</td><td>44</td><td>38</td><td>33</td><td>21</td><td>0.242</td><td>0.122</td></tr> <tr><td>0.690</td><td>55.9</td><td>R1</td><td>538</td><td>101</td><td>82</td><td>57</td><td>45</td><td>39</td><td>35</td><td>28</td><td>23</td><td>11</td><td>0.106</td><td>0.020</td></tr> <tr><td>0.665</td><td>55.9</td><td>R1</td><td>538</td><td>298</td><td>195</td><td>133</td><td>98</td><td>71</td><td>52</td><td>37</td><td>26</td><td>10</td><td>0.314</td><td>0.109</td></tr> <tr><td>0.640</td><td>55.9</td><td>R1</td><td>525</td><td>1024</td><td>649</td><td>427</td><td>270</td><td>175</td><td>109</td><td>61</td><td>37</td><td>17</td><td>1.104</td><td>0.405</td></tr> <tr><td>0.615</td><td>55.9</td><td>R1</td><td>521</td><td>1226</td><td>846</td><td>587</td><td>405</td><td>282</td><td>189</td><td>104</td><td>57</td><td>16</td><td>1.332</td><td>0.413</td></tr> <tr><td>0.590</td><td>58.0</td><td>R1</td><td>524</td><td>816</td><td>505</td><td>355</td><td>252</td><td>163</td><td>118</td><td>78</td><td>42</td><td>17</td><td>0.881</td><td>0.335</td></tr>	Lane	FWD Stress (kPa)	Geophone Location (mm) and Deflections (micron)										Deflection (mm)	Curvature (mm)	0	200	300	400	500	600	750	900	1500	0.990	55.2	R1	547	299	182	123	90	69	58	47	39	22	0.309	0.121	0.965	55.2	R1	546	283	170	112	82	62	51	39	30	15	0.293	0.117	0.940	55.2	R1	550	216	142	96	69	53	44	35	27	14	0.222	0.076	0.921	55.2	R1	555	168	121	87	67	54	45	37	27	14	0.171	0.047	0.890	54.5	R1	548	210	139	97	74	58	50	40	30	19	0.217	0.074	0.865	54.5	R1	547	219	123	81	65	45	43	33	28	15	0.226	0.099	0.840	54.5	R1	551	149	109	68	58	45	40	30	23	14	0.153	0.041	0.816	54.5	R1	547	250	160	104	74	59	50	38	29	15	0.259	0.093	0.790	54.5	R1	545	306	161	105	75	62	50	41	34	19	0.318	0.151	0.765	54.5	R1	543	311	182	120	87	70	60	48	42	28	0.324	0.134	0.740	54.5	R1	539	318	177	116	79	61	48	38	31	15	0.334	0.148	0.715	54.5	R1	538	230	114	82	64	54	44	38	33	21	0.242	0.122	0.690	55.9	R1	538	101	82	57	45	39	35	28	23	11	0.106	0.020	0.665	55.9	R1	538	298	195	133	98	71	52	37	26	10	0.314	0.109	0.640	55.9	R1	525	1024	649	427	270	175	109	61	37	17	1.104	0.405	0.615	55.9	R1	521	1226	846	587	405	282	189	104	57	16	1.332	0.413	0.590	58.0	R1	524	816	505	355	252	163	118	78	42	17	0.881	0.335
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0.590	58.0	R1	524	816	505	355	252	163	118	78	42	17	0.881	0.335																																																																																																																																																																																																																																																																									



Client :	Golder Associates	Job No:	102162
Project Name:	FWD testing - Yallingup	File Name:	Beach Rd South
Road Name:	Smiths Beach Road - Starting from the Carpark	Survey Date:	18/12/2020
Section / Lane:	Southbound - R1	Tested By:	TM
Surface Tested:	Asphalt	Testing Interval:	25 m
Prepared By:	CK	Checked By:	TM

DYNATEST FWD (E- 044) TEST RESULTS TO WA:326.2

Normalised to (kPa)

566

Chainage (km)	Pavement Temp ^{tr} deg °C	Lane	FWD Stress (kPa)	Geophone Location (mm) and Deflections (micron)									Deflection (mm)	Curvature (mm)
				0	200	300	400	500	600	750	900	1500		
0.564	58.0	R1	522	605	345	229	139	99	76	52	33	16	0.656	0.283
0.540	58.0	R1	525	438	191	103	67	47	34	24	18	7	0.473	0.267
0.515	58.0	R1	526	250	126	78	46	38	32	19	9	4	0.269	0.133
0.490	58.0	R1	518	502	319	221	153	114	84	54	30	8	0.548	0.199
0.465	58.0	R1	521	689	411	279	194	129	82	40	22	11	0.748	0.302
0.440	56.5	R1	526	377	208	139	97	70	52	38	21	7	0.405	0.181
0.415	56.5	R1	531	220	122	86	68	48	41	32	24	10	0.234	0.104
0.390	56.5	R1	527	547	337	224	166	100	76	54	31	10	0.588	0.225
0.365	56.5	R1	532	303	146	80	61	41	38	28	16	12	0.322	0.167
0.340	56.5	R1	532	235	133	97	68	52	44	33	23	10	0.250	0.109
0.315	56.5	R1	533	279	165	109	74	54	44	33	26	10	0.297	0.121
0.295	56.5	R1	537	310	173	109	73	54	43	36	27	12	0.326	0.144
0.265	56.5	R1	538	306	173	110	74	54	43	35	27	12	0.322	0.141
0.240	56.5	R1	532	440	226	120	76	49	46	33	25	12	0.468	0.229
0.215	56.5	R1	536	403	245	177	133	101	80	58	46	19	0.426	0.167
0.195	56.5	R1	528	495	309	213	157	123	101	85	59	27	0.531	0.200
0.165	56.5	R1	526	352	198	132	95	75	56	47	26	10	0.379	0.165



Client :		Golder Associates							Job No:				102162	
Project Name:		FWD testing - Yallingup							File Name:				Beach Rd South	
Road Name:		Smiths Beach Road - Starting from the Carpark							Survey Date:				18/12/2020	
Section / Lane:		Southbound - R1							Tested By:				TM	
Surface Tested:		Asphalt							Testing Interval:				25 m	
Prepared By:		CK		Checked By:		TM								
DYNATEST FWD (E- 044) TEST RESULTS TO WA:326.2												Normalised to (kPa)		
												566		
Chainage (km)	Pavement Temp'tr deg °C	Lane	FWD Stress (kPa)	Geophone Location (mm) and Deflections (micron)									Deflection (mm)	Curvature (mm)
				0	200	300	400	500	600	750	900	1500		
0.140	56.5	R1	528	300	139	83	57	47	38	23	13	8	0.321	0.172
0.115	56.5	R1	533	194	102	63	50	39	36	25	20	8	0.206	0.098
0.090	56.5	R1	537	192	90	45	42	27	26	18	15	8	0.202	0.108
0.065	56.5	R1	535	169	89	62	49	39	36	27	19	9	0.179	0.085
0.040	56.5	R1	533	358	212	146	111	87	72	56	42	18	0.380	0.155
0.015	56.5	R1	531	283	164	129	106	89	80	69	53	27	0.301	0.127
Redoxide Asphalt Surface														
Mean			535	367	217	145	103	75	59	42	29	14	0.391	0.160
SDEV			9	231	154	107	72	47	30	18	11	6	0.25	0.09
COVR, %			2	63	71	74	70	63	52	43	38	41	64.6	56.1
97.5 Percentile													1.110	
95 Percentile													0.892	

APPENDIX F

Laboratory Test Certificates

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

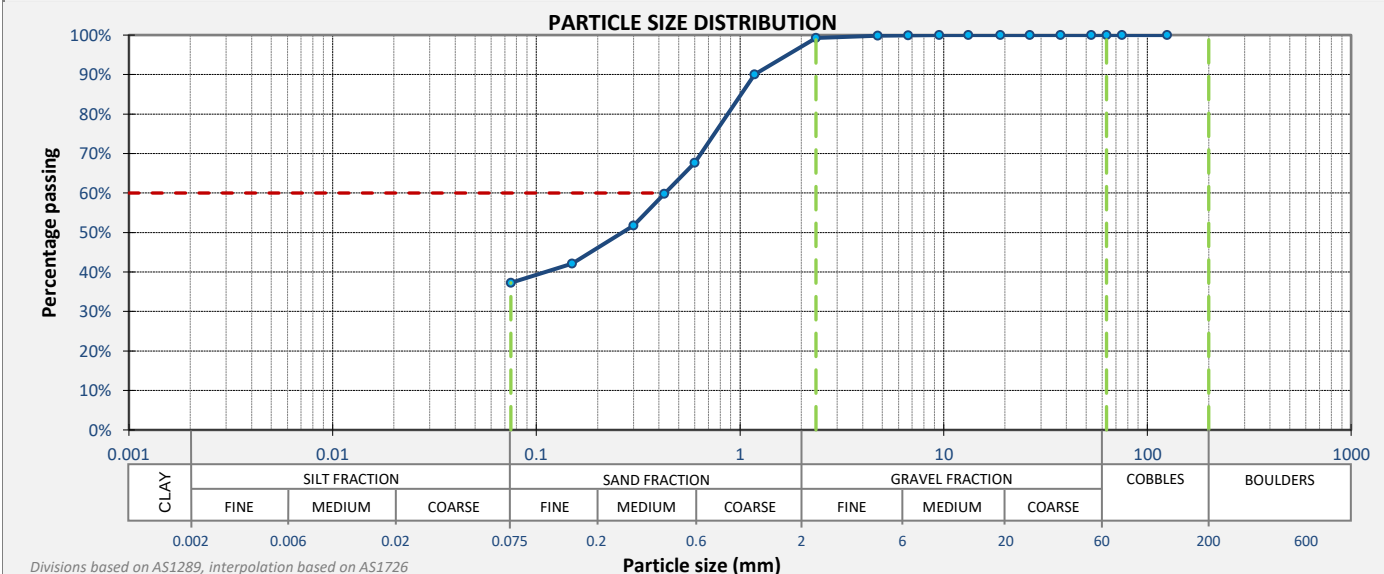


GOLDER

Test request #: TRP20-0279		Lab sample ID: LPER202012150		Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017	
Client: Smiths 2014 Pty Ltd					
Client address: Level 3/338 Barker Road, Subiaco WA 6008					
Project ID: 20435097		Lab report ref.: LPER_21061399			
Project name: Smith's Beach Redevelopment			Exploratory Hole HA04	Sample depth (m): 1.40 - 1.80	
				Client sample ref:	
Project reference:			Loc. ref.: Yallingup		

Specimen description:								Sampling:	Tested as received					
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1				(CH) Sandy CLAY, high plasticity, grey & brown, fine to coarse grained		Easting (m)	Northing (m)	Level (m)		
Sieve Size	Passing	LB S	UB S											
125 mm	100%			Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1					
75 mm	100%				Moisture content	1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking				
63 mm	100%			Result:	19.1% As Rcvd.	75%	17%	58%	12.0%	Curling				
53 mm	100%				LB S: UB S:						- -			
37.5 mm	100%			Att. preparation method:		Dry sieved		LSM length (mm):		125				
26.5 mm	100%			Specimen history/notes:	Preparation of specimen and testing performed on sample supplied to the laboratory									
19 mm	100%				LB S = Lower bound specification		N/A = Not applicable							
13.2 mm	100%			Definitions:	LSM = Linear shrinkage mould		ND = Not determined; SIB = Slip in bowl							
9.5 mm	100%				UB S = Upper bound specification		NO = Not obtainable; NP = Non plastic							
6.7 mm	100%			GRADING SUMMARY										
4.75 mm	100%			Fines		Sand*		Gravel*			Cobbles*			
2.36 mm	99%			(<75 µm)		(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)			(>63mm - <200 mm)			
1.18 mm	90%			37.3%		62.0%		0.7%			0.0%			
600 µm	68%													
425 µm	60%													
300 µm	52%													
150 µm	42%													
75 µm	37%													

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	PK	Dates:	21/12/20 - 14/01/21	Results reviewed by:	SLenihan	Date reported:	18/01/2021
Cert. ref.:	20435097_HA04_TRP20-0279_PSD_2012150_Rep21061399					Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing					Sean Lenihan	
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL					Sean Lenihan - Laboratory Technician	

Phone: +61 (0)8 9441 0700

Fax: +61 (0)8 9441 0701

E-mail: perthlab@golder.com.au

Web: www.golder.com.au

These tests were carried out in accordance with the Australian standards identified in this certificate.
Test results relate only to the specimens tested.

Rep AS1289.3.6.1 - RL44

Soils testing - Determination of the California Bearing Ratio of a soil

Standard laboratory method for a remoulded specimen (Soaked)

AS 1289.6.1.1-2014



Test request #:	TRP21-0007	Lab sample ID:	LPER202101180	Golder Associates Pty Ltd
Client:	Smiths 2014 Pty Ltd	PERTH GEOTECHNICAL LABORATORY		
Client address:	Level 3/338 Barker Road, Subiaco WA 6008	84 Guthrie Street, Osborne Park, Western Australia 6017		
Project ID:	20435097	Lab report ref.:	LPER_21061778	
Lab project name:	Smith's Beach Redevelopment	Exploratory Hole	HA05	Sample depth (m): 0.50 - 0.70
Project reference:	Smith's Beach -	Loc. ref.:	-	Client sample ref.:
Specimen description:	(SM) Silty SAND, fine to coarse grained, red brown, non-plastic fines			Sampled by:
(Based on visual and tactile assessment)				Sampled type: D

SPECIMEN PREPARATION - SUMMARY OF COMPACTION AND MOISTURE CONTENT TEST RESULTS

Initial moisture content:	4.8% As rcvd.
Compaction method:	AS1289.5.2.1-2017 Modified
Maximum dry density (t/m ³):	1.98
Optimum moisture content:	10.5%
Oversize material (>19mm):	-
Compaction moisture content:	10.6%

Note on compaction:

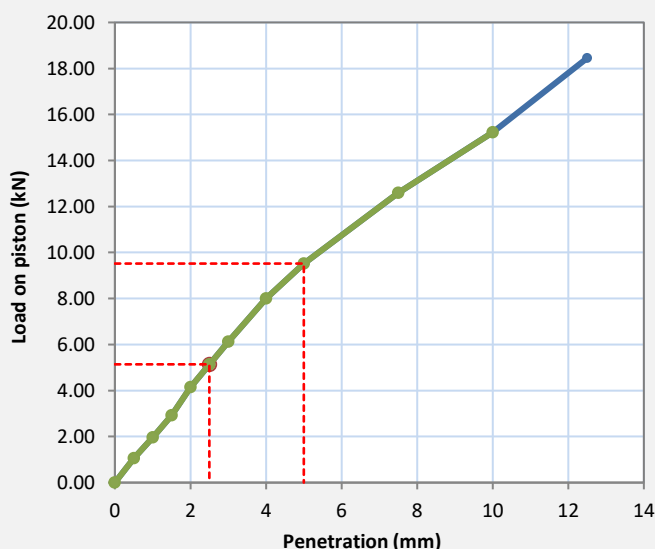
No oversize material was retained on the 19mm sieve

Notes on test:

Notes on compaction test

SUMMARY OF CALIFORNIA BEARING RATIO TEST RESULT

Penetration (mm):	0.0	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.5	10.0	12.5	Correction:
Load (kN)	0.00	1.06	1.96	2.93	4.15	5.14	6.12	8.01	9.52	12.59	15.22	18.45	
	0.00	1.06	1.96	2.93	4.15	5.14	6.12	8.01	9.52	12.59	15.22		



Dry density t/m ³	before soaking:	1.88
	after soaking	1.88
Density ratio	before soaking	95.0%
	after soaking	95.0%
Moisture ratio at compaction:		100.5%
Duration of soaking (days):		4
Surcharge applied (kg):		7.0
Moisture content top 30mm:		13.3%
Moisture content remainder:		11.6%
Swell after soaking:		NIL
Bearing ratio at 2.5mm penetration:		40.0%
Bearing ratio at 5.0mm penetration:		50.0%

Penetration (mm) 5.0 CBR Value 50%

Definitions: Specimen prepared by: sl Tested by: sl On: 26/01/21
ND = Not determined Results reviewed by: SLenihan Date reported: 27/01/21

Cert. ref.:	20435097_HA05_TRP21-0007_CBRS_2101180_Rep-21061778	Approved signatory:
	NATA accreditation number: 1961 - Site:1598 - Perth	
	Accredited for compliance with ISO/IEC 17025 - Testing	
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	

Sean Lenihan - Laboratory Technician

Phone: +61 (0)8 9441 0700

Fax: +61 (0)8 9441 0701

E-mail: perthlab@golder.com.au

Web: www.golder.com.au

Soils testing - Determination of the dry density moisture relationship

Modified compaction method

AS 1289.5.2.1-2017

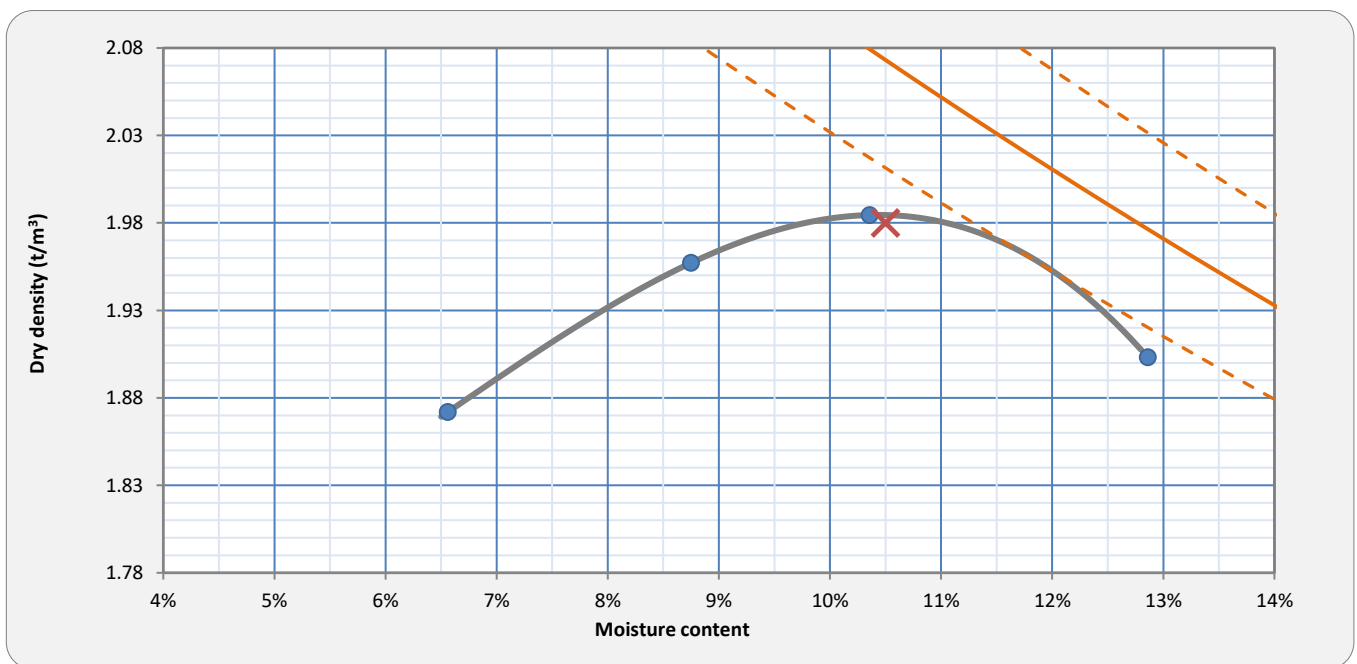


GOLDER

Test request ID: TRP21-0007	Lab sample ID: LPER202101180	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017
Client: Smiths 2014 Pty Ltd		
Client address: Level 3/338 Barker Road, Subiaco WA 6008		
Project ID: 20435097	Lab report ref.: LPER_21061777	
Project name: Smith's Beach Redevelopment	Exploratory Hole HA05	Sample depth (m): 0.50 - 0.70 Client sample ref:
Location: Yallingup	Project reference: Smith's Beach -	
Specimen description: (Based on visual and tactile assessment) (SM) Silty SAND, fine to coarse grained, red brown, non-plastic fines		Sampling co-ordinates Easting (m) Northing (m) Reduced Level
Curing compliance:	Liquid Limit	Moisture content: <i>AS 1289 2.1.1-2005</i> Portion test performed on: -19 mm
Material type	Measured: Assumed: Adopted:	
Granular	Curing times are compliant Cure: 2 Hrs	

TEST REPORT - COMPACTION RESULTS

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Oversize material - (by dry mass) No oversize correction required +19 mm: +37.5 mm: <i>No oversize material present</i>
Dry density (t/m³):	1.98	1.90	1.96	1.87			
Moisture content:	10.4%	12.9%	8.7%	6.6%			



Notes:

Modified maximum dry density (t/m³):

Modified optimum moisture content:

Result	Adjusted for oversize
1.98	
10.5%	

Specimens prepared by: gm	Tests performed by: gm	Date tested: 20/01/2021
Definition: ND = Not Determined	Results reviewed by: SWai	Date reported: 27/01/2021

Cert. ref.: 20435097_HA05_TRP21-0007_ModComp_s2101180_Rep21061777	Approved signatory:	
NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing		
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Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

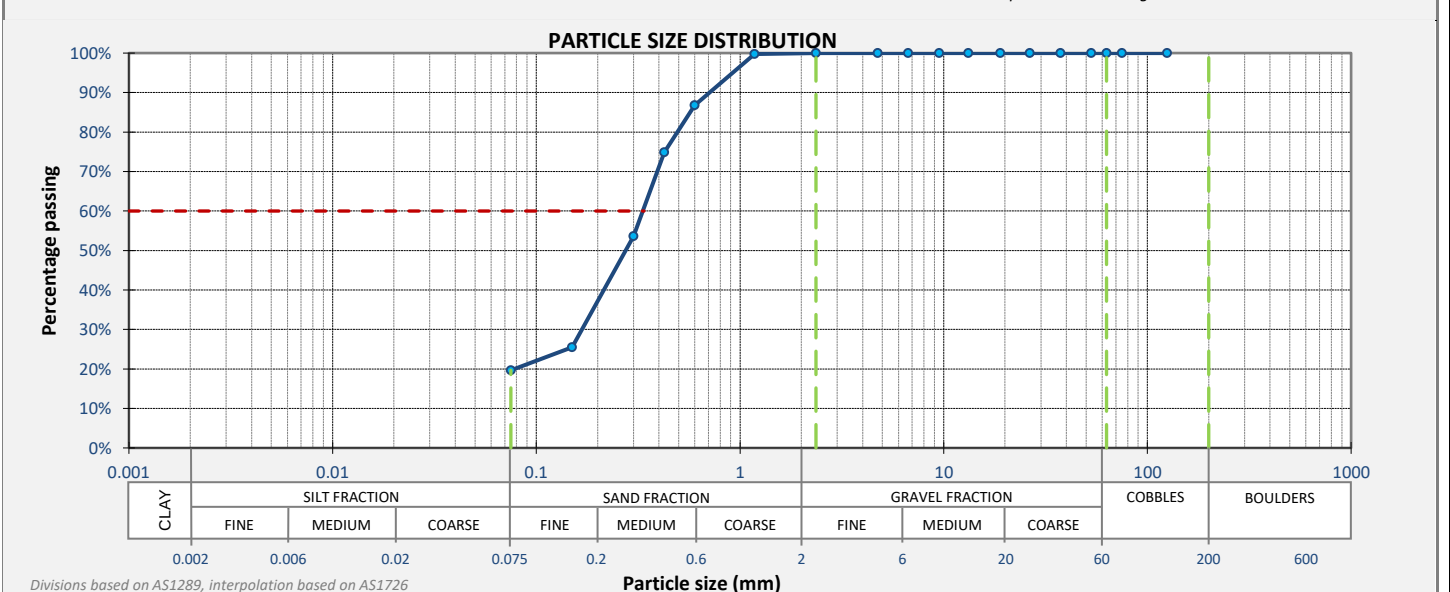


GOLDER

Test request #:	TRP21-0007	Lab sample ID:	LPER202101180	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017		
Client:	Smiths 2014 Pty Ltd					
Client address:	Level 3/338 Barker Road, Subiaco WA 6008					
Project ID:	20435097	Lab report ref.: LPER_21061776				
Project name:	Smith's Beach Redevelopment		Exploratory Hole HA05	Sample depth (m): 0.50 - 0.70 Client sample ref:		
Project reference:	Smith's Beach -		Loc. ref.:	Yallingup		

Specimen description:				Sampling:				Tested as received				
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1				(SM) Silty SAND, fine to coarse grained, red brown, non-plastic fines		Easting (m)	Northing (m)	Level (m)
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%											
75 mm	100%											
63 mm	100%											
53 mm	100%											
37.5 mm	100%											
26.5 mm	100%											
19 mm	100%											
13.2 mm	100%											
9.5 mm	100%											
6.7 mm	100%											
4.75 mm	100%											
2.36 mm	100%											
1.18 mm	100%											
600 µm	87%											
425 µm	75%											
300 µm	54%											
150 µm	26%											
75 µm	20%											
						</						

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	SL	Dates:	21/01/21 - 27/01/21	Results reviewed by:	SWai	Date reported:	27/01/2021
Cert. ref.:	20435097_HA05_TRP21-0007_PSD_2101180_Rep21061776					Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing					Sean Lenihan	
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Rep AS1289.3.6.1 - RL44

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

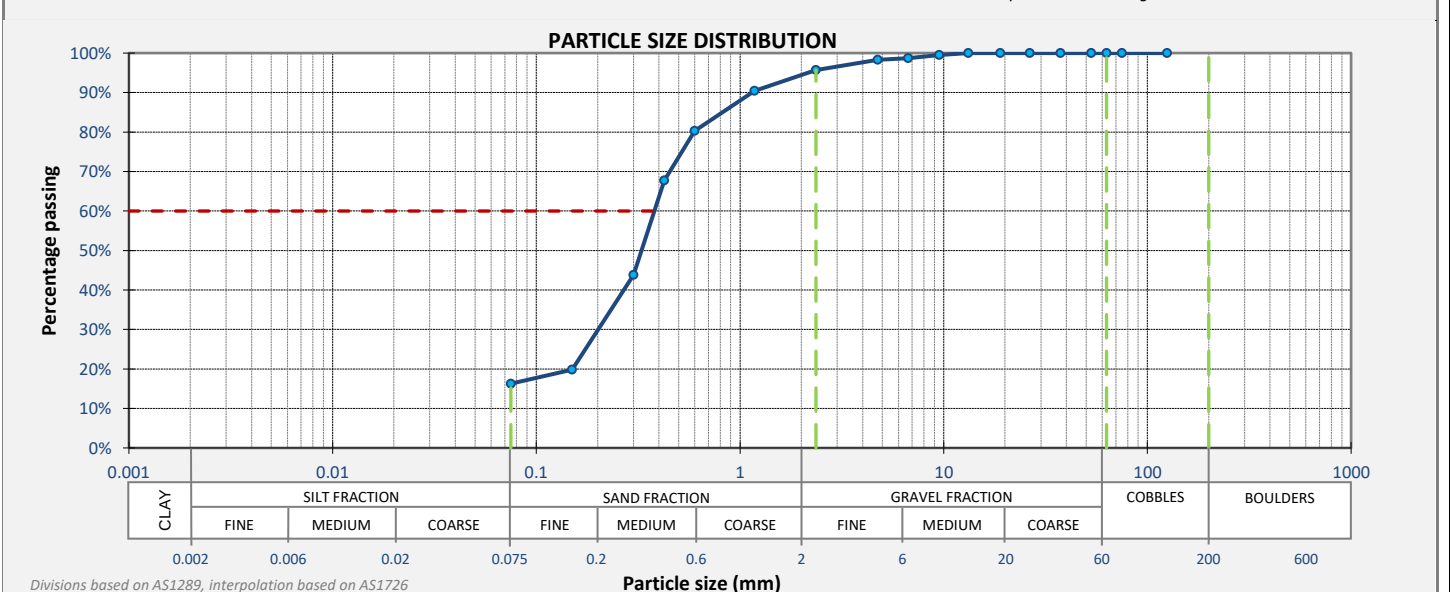


GOLDER

Test request #:	TRP20-0279	Lab sample ID:	LPER202012151	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017		
Client:	Smiths 2014 Pty Ltd					
Client address:	Level 3/338 Barker Road, Subiaco WA 6008					
Project ID:	20435097	Lab report ref.:		LPER_21061400		
Project name:	Smith's Beach Redevelopment		Exploratory Hole	Sample depth (m):	1.80	- 2.00
			HA07	Client sample ref:		
Project reference:			Loc. ref.:	Yallingup		

Specimen description:				Sampling:		Tested as received							
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1		(SM) Silty SAND, trace of gravel, fine to coarse grained, brown, non-plastic fines,		Easting (m)		Northing (m)		Level (m)	
Sieve Size	Passing	LB S	UB S	Method:		AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%												
75 mm	100%												
63 mm	100%												
53 mm	100%												
37.5 mm	100%												
26.5 mm	100%												
19 mm	100%												
13.2 mm	100%												
9.5 mm	99%												
6.7 mm	99%												
4.75 mm	98%												
2.36 mm	96%												
1.18 mm	90%												
600 µm	80%												
425 µm	68%												
300 µm	44%												
150 µm	20%												
75 µm	16%												
				Result:		6.9% As Rcvd.	SIB	NP	ND				
				LB S:									-
				UB S:									-
				Att. preparation method:		Dry sieved			LSM length (mm):				
				Specimen history/notes:		Preparation of specimen and testing performed on sample supplied to the laboratory							
				Definitions:		LB S = Lower bound specification LSM = Linear shrinkage mould UB S = Upper bound specification			N/A = Not applicable ND = Not determined; SIB = Slip in bowl NO = Not obtainable; NP = Non plastic				
GRADING SUMMARY													
Fines		Sand*		Gravel*		Cobbles*							
(<75 µm)		(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)		(>63mm - <200 mm)							
16.3%		79.4%		4.3%		0.0%							

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	pk	Dates:	23/12/20 - 14/01/21	Results reviewed by:	SWai	Date reported:	18/01/2021
Cert. ref.:	20435097_HA07_TRP20-0279_PSD_2012151_Rep21061400					Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing					Sean Lenihan	
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Test results relate only to the specimens tested.

Rep AS1289.3.6.1 - RL44

For Issue

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

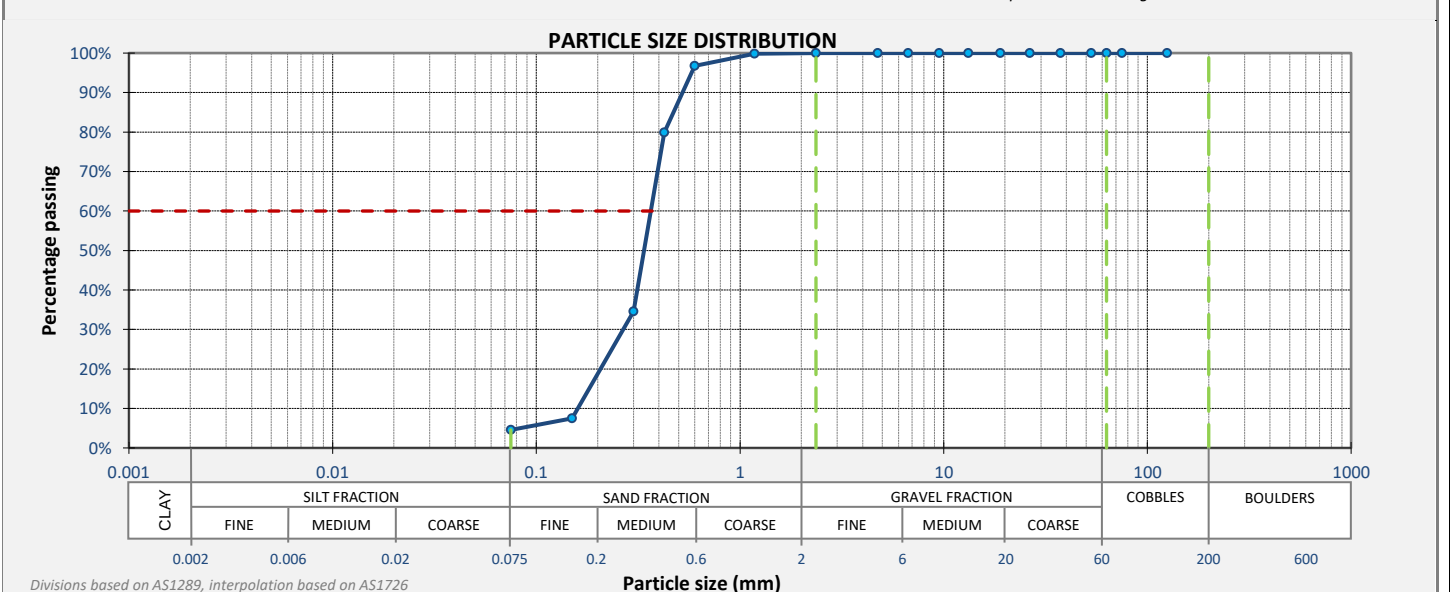


GOLDER

Test request #:	TRP20-0279	Lab sample ID:	LPER202012155	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017		
Client:	Smiths 2014 Pty Ltd					
Client address:	Level 3/338 Barker Road, Subiaco WA 6008					
Project ID:	20435097	Lab report ref.:		LPER_21061401		
Project name:	Smith's Beach Redevelopment		Exploratory Hole	Sample depth (m):	1.80	- 2.00
			HA19	Client sample ref:		
Project reference:			Loc. ref.:	Yallingup		

Specimen description:				Sampling:		Tested as received							
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1		(SP) SAND, trace of silt, fine to coarse grained, brown, non-plastic fines		Easting (m)		Northing (m)		Level (m)	
Sieve Size	Passing	LB S	UB S	Method:		AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%												
75 mm	100%												
63 mm	100%												
53 mm	100%												
37.5 mm	100%												
26.5 mm	100%												
19 mm	100%												
13.2 mm	100%												
9.5 mm	100%												
6.7 mm	100%												
4.75 mm	100%												
2.36 mm	100%												
1.18 mm	100%												
600 µm	97%												
425 µm	80%												
300 µm	35%												
150 µm	7%												
75 µm	5%												
				Result:		2.6% As Rcvd.	SIB	NP	ND				
				LB S:								-	
				UB S:								-	
				Att. preparation method:		Dry sieved			LSM length (mm):				
				Specimen history/notes:		Preparation of specimen and testing performed on sample supplied to the laboratory							
				Definitions:		LB S = Lower bound specification			N/A = Not applicable				
						LSM = Linear shrinkage mould			ND = Not determined; SIB = Slip in bowl				
						UB S = Upper bound specification			NO = Not obtainable; NP = Non plastic				
GRADING SUMMARY													
Fines		Sand*		Gravel*		Cobbles*							
(<75 µm)		(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)		(>63mm - <200 mm)							
4.6%		95.4%		0.0%		0.0%							

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	PK	Dates:	18/12/20 - 14/01/21	Results reviewed by:	SWai	Date reported:	18/01/2021
Cert. ref.:	20435097_HA19_TRP20-0279_PSD_2012155_Rep21061401					Approved signatory:	
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Rep AS1289.3.6.1 - RL44

For Issue

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

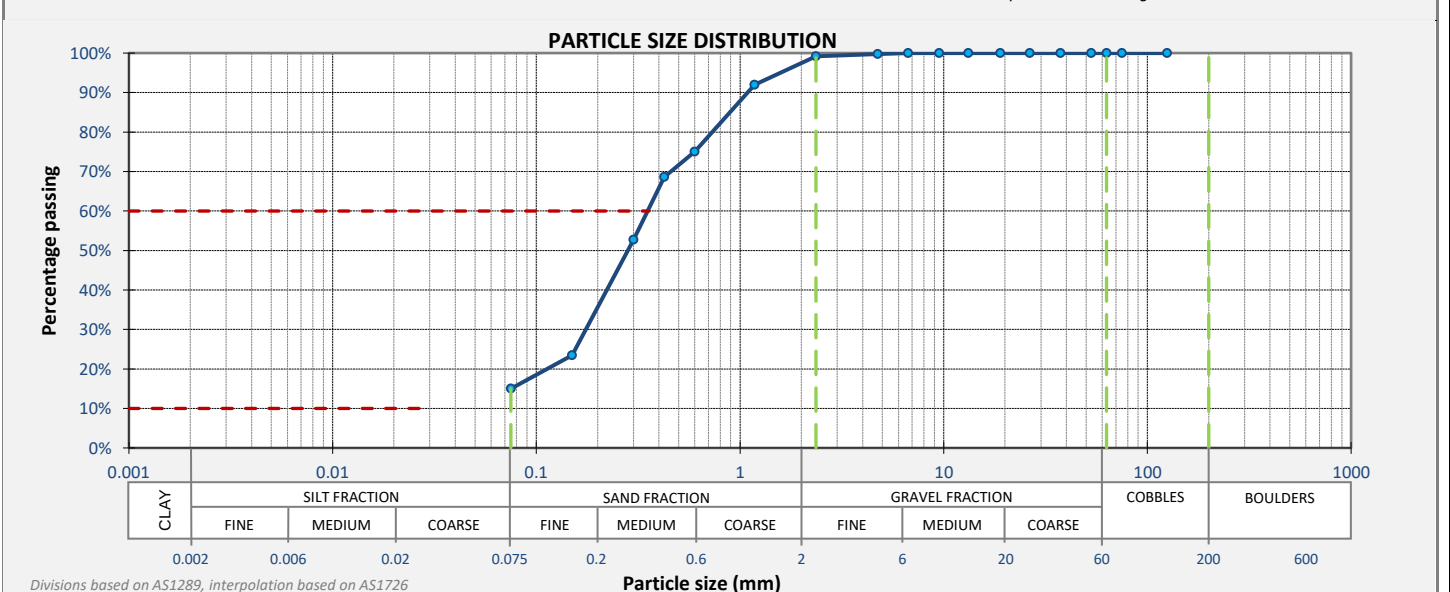


GOLDER

Test request #: TRP20-0279		Lab sample ID: LPER202012152		Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017		
Client: Smiths 2014 Pty Ltd						
Client address: Level 3/338 Barker Road, Subiaco WA 6008						
Project ID: 20435097		Lab report ref.: LPER_21061402				
Project name: Smith's Beach Redevelopment		Exploratory Hole HA21		Sample depth (m): 0.80 - 1.00		
				Client sample ref:		
Project reference:		Loc. ref.:		Yallingup		

Specimen description:				Sampling:		Tested as received															
PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1				(SM) Silty SAND, fine to coarse grained, brown, non-plastic fines				Easting (m)		Northing (m)		Level (m)									
Sieve Size		Passing		LB S		UB S															
125 mm		100%						Method:		AS 1289.2.1.1		AS 1289.3.1.2		AS 1289.3.2.1		AS 1289.3.3.1		AS 1289.3.4.1			
75 mm		100%								Moisture content		1 point Liquid limit		Plastic limit		Plasticity index		Linear shrinkage		Curling/ Crumbling/ Cracking	
63 mm		100%										SIB		NP		ND					
53 mm		100%																			
37.5 mm		100%																			
26.5 mm		100%																			
19 mm		100%																			
13.2 mm		100%																			
9.5 mm		100%																			
6.7 mm		100%																			
4.75 mm		100%																			
2.36 mm		99%																			
1.18 mm		92%																			
600 µm		75%																			
425 µm		69%																			
300 µm		53%																			
150 µm		23%																			
75 µm		15%																			

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	PK	Dates:	18/12/20 - 14/01/21	Results reviewed by:	SWai	Date reported:	18/01/2021
Cert. ref.:	20435097_HA21_TRP20-0279_PSD_2012152_Rep21061402					Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing					Sean Lenihan	
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Rep AS1289.3.6.1 - RL44

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

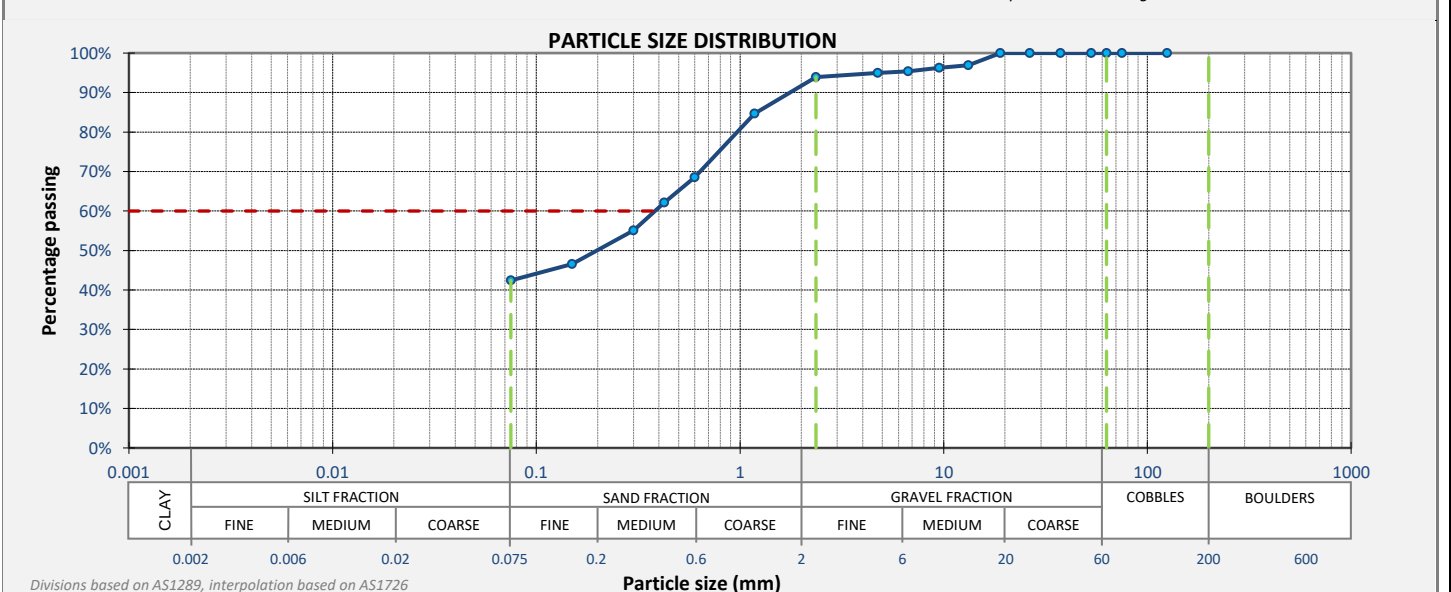


GOLDER

Test request #:	TRP20-0279	Lab sample ID:	LPER202012153	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017		
Client:	Smiths 2014 Pty Ltd					
Client address:	Level 3/338 Barker Road, Subiaco WA 6008					
Project ID:	20435097	Lab report ref.:		LPER_21061403		
Project name:	Smith's Beach Redevelopment		Exploratory Hole	Sample depth (m):	0.60	- 1.00
			HA28	Client sample ref:		
Project reference:			Loc. ref.:	Yallingup		

Specimen description:				Sampling:		Tested as received				
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1		(CI) Sandy CLAY, trace of gravel, medium plasticity, brown, fine to coarse grained		Easting (m)	Northing (m)	Level (m)
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
125 mm	100%									
75 mm	100%									
63 mm	100%									
53 mm	100%									
37.5 mm	100%									
26.5 mm	100%									
19 mm	100%									
13.2 mm	97%									
9.5 mm	96%									
6.7 mm	95%									
4.75 mm	95%									
2.36 mm	94%									
1.18 mm	85%									
600 µm	69%									
425 µm	62%									
300 µm	55%									
150 µm	47%									
75 µm	42%									

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	PK	Dates:	12/01/21 - 14/01/21	Results reviewed by:	SLenihan	Date reported:	18/01/2021
Cert. ref.:	20435097_HA28_TRP20-0279_PSD_2012153_Rep21061403					Approved signatory:	
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Rep AS1289.3.6.1 - RL44

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 & 3.4.1

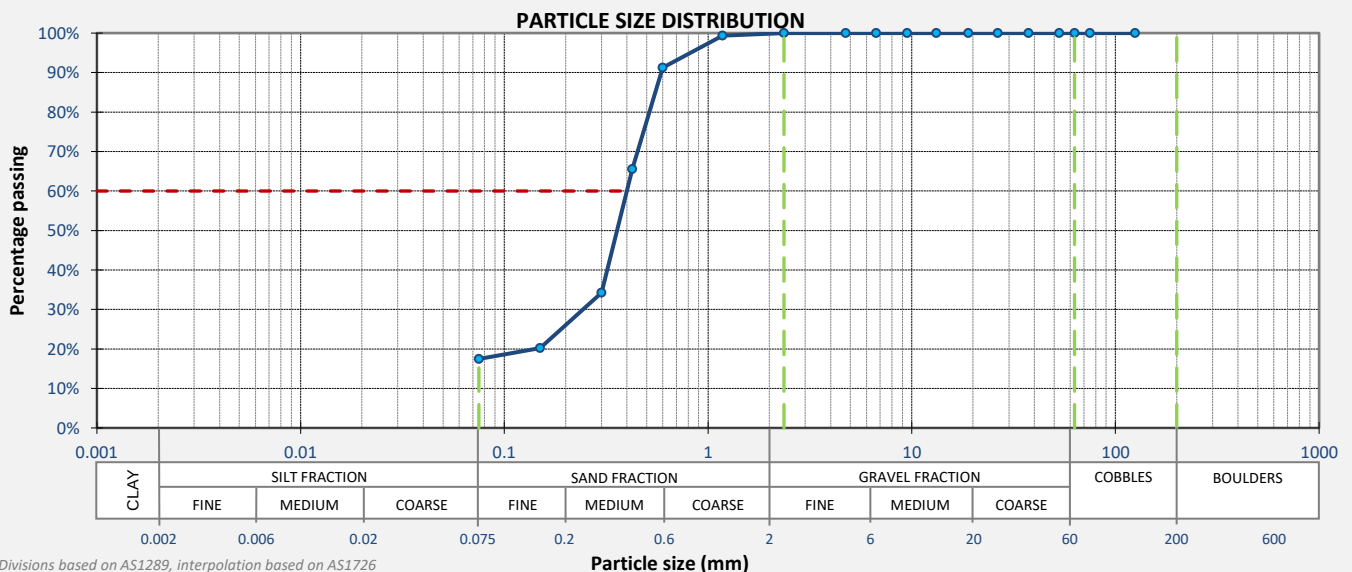


GOLDER

Test request #:	TRP20-0279	Lab sample ID:	LPER202012154	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017		
Client:	Smiths 2014 Pty Ltd					
Client address:	Level 3/338 Barker Road, Subiaco WA 6008					
Project ID:	20435097	Lab report ref.:		LPER_21061404		
Project name:	Smith's Beach Redevelopment		Exploratory Hole	Sample depth (m):	2.00	- 2.20
			HA30	Client sample ref:		
Project reference:			Loc. ref.:	Yallingup		

Specimen description:				Sampling:				Tested as received				
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1				(SC) Clayey SAND, fine to coarse grained, grey & brown, low plasticity		Easting (m)	Northing (m)	Level (m)
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%					Moisture content	1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking	
75 mm	100%											
63 mm	100%											
53 mm	100%											
37.5 mm	100%											
26.5 mm	100%											
19 mm	100%											
13.2 mm	100%											
9.5 mm	100%											
6.7 mm	100%											
4.75 mm	100%											
2.36 mm	100%											
1.18 mm	99%											
600 µm	91%											
425 µm	66%											
300 µm	34%											
150 µm	20%											
75 µm	17%											

*Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing by:	PK	Dates:	21/12/20 - 14/01/21	Results reviewed by:	SLenihan	Date reported:	18/01/2021
Cert. ref.:	20435097_HA30_TRP20-0279_PSD_2012154_Rep21061404					Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing					Sean Lenihan	
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Test results relate only to the specimens tested.

Rep AS1289.3.6.1 - RL44

Rocks testing - Determination of point load strength index

Including tests on; Axial (A), Diametral (D) or irregular Lump (L) specimens

AS 4133.4.1-2007

TEST REPORT - SUMMARY OF ANALYSIS



Test request ID:	TRP21-0007	Lab sample IDs:	2101181 - 2101182	Lab report ref.:	LPER_21061770
Client:	Smiths 2014 Pty Ltd	Project reference:	Smith's Beach -		
Client address:	Level 3/338 Barker Road, Subiaco WA 6008	Location:	Yallingup		
Project ID:	20435097	Project name:	Smith's Beach Redevelopment		

Golder Associates Pty Ltd
PERTH GEOTECHNICAL LABORATORY
 84 Guthrie Street,
 Osborne Park,
 Western Australia 6017

Exploratory hole reference		Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory	
BH1		2.75		Test type: **Compliant test: Failure mode Failure load [kN] Defect orientation Is [MPa] Is ₍₅₀₎ [MPa]	A											Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method		
					Yes													
Lab sample ID		LPER202101181			M											Axial	Diametral	Irregular
By		Date:			4.9											4.9		
Sampling			Method:		-	90°										-	-	-
					1.6											1.6		
Moisture content				1.7											1.7			
Moisture content type:																		
Density (t/m ³)		As received	Dry	Lithological description	GNEISS								History:		Test performed on samples submitted to the laboratory.			
		ND	ND										Client ref.:					
Exploratory hole reference		Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory	
BH1		4.50		Test type: **Compliant test: Failure mode Failure load [kN] Defect orientation Is [MPa] Is ₍₅₀₎ [MPa]	D											Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method		
					Yes													
Lab sample ID		LPER202101182			M											Axial	Diametral	Irregular
By		Date:			24												24	
Sampling			Method:		-	180°										-	-	-
					9.8												9.8	
Moisture content				9.8												9.8		
Moisture content type:																		
Density (t/m ³)		As received	Dry	Lithological description	GNEISS								History:		Test performed on samples submitted to the laboratory.			
		ND	ND										Client ref.:					

Definitions: Test types: A = Axial, D = Diametral, L = Lump / Irregular n/a = Not applicable, ND = Not determined ** A non compliant test = platen gap at failure being outside of the tolerance of the method
 Failure modes: B = Along bedding plane, M = Through rock matrix, J = Along joint, W = Along a plane of weakness, DF = Didn't Fail

Cert. ref.:	20435097_TRP21-0007_PtLd_2101181 - 2101182_Rep-21061770	Specimens prepared by:	SL	Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth	Tests performed by:	SL 27/01/21		
	Accredited for compliance with ISO/IEC 17025 - Testing	Results reviewed by:	SLenihan		
THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL		Date reported:	27/01/2021	Sean Lenihan - Laboratory Technician	

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Rocks testing - Determination of point load strength index

Including tests on; Axial (A), Diametral (D) or irregular Lump (L) specimens

AS 4133.4.1-2007

TEST REPORT - SUMMARY OF ANALYSIS



Test request ID:	TRP21-0007	Lab sample IDs:	2101183 - 2101184	Lab report ref.:	LPER_21061771	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017
Client:	Smiths 2014 Pty Ltd		Project reference:		Smith's Beach -	
Client address:	Level 3/338 Barker Road, Subiaco WA 6008		Location:		Yallingup	
Project ID:	20435097	Project name:		Smith's Beach Redevelopment		

Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory
BH2	3.40		Test type:	D										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method		
			**Compliant test:	Yes												
Lab sample ID	LPER202101183		Failure mode	M										Axial	Diametral	Irregular
By	Date:	-	Failure load [kN]	5.4											5.4	
Sampling			Method:	Defect orientation	180°										-	-
Moisture content			Is [MPa]	1.9											1.9	
Moisture content type:			Is ₍₅₀₎ [MPa]	1.9											1.9	
Density (t/m ³)	As received	Dry	Lithological description									History:	Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:				
Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory
BH2	4.60		Test type:	A										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method		
			**Compliant test:	Yes												
Lab sample ID	LPER202101184		Failure mode	M										Axial	Diametral	Irregular
By	Date:	-	Failure load [kN]	1.9										1.9		
Sampling			Method:	Defect orientation	90°										-	-
Moisture content			Is [MPa]	0.62										0.62		
Moisture content type:			Is ₍₅₀₎ [MPa]	0.65										0.65		
Density (t/m ³)	As received	Dry	Lithological description	GNEISS								History:	Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:				

Definitions: Test types: A = Axial, D = Diametral, L = Lump / Irregular n/a = Not applicable, ND = Not determined ** A non compliant test = platen gap at failure being outside of the tolerance of the method
Failure modes: B = Along bedding plane, M = Through rock matrix, J = Along joint, W = Along a plane of weakness, DF = Didn't Fail

Cert. ref.:	20435097_TRP21-0007_PtLd_2101183 - 2101184_Rep-21061771	Specimens prepared by:	SL	Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth	Tests performed by:	SL 27/01/21		
	Accredited for compliance with ISO/IEC 17025 - Testing	Results reviewed by:	SLenihan		
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	Date reported:	27/01/2021	Sean Lenihan - Laboratory Technician	

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Rocks testing - Determination of point load strength index

Including tests on; Axial (A), Diametral (D) or irregular Lump (L) specimens

AS 4133.4.1-2007

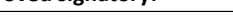
TEST REPORT - SUMMARY OF ANALYSIS



Test request ID:	TRP21-0007	Lab sample IDs:	2101185 - 2101186	Lab report ref.:	LPER_21061772	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017
Client:	Smiths 2014 Pty Ltd		Project reference:		Smith's Beach -	
Client address:	Level 3/338 Barker Road, Subiaco WA 6008		Location:		Yallingup	
Project ID:	20435097	Project name:		Smith's Beach Redevelopment		

Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory	
BH3	4.60		Test type:	A										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method			
			**Compliant test:	Yes													
Lab sample ID	LPER202101185		Failure mode	M										Axial		Diametral	Irregular
Sampling By	Date:	-	Failure load [kN]	0.78										0.78			
	Method:		Defect orientation	90°											-		-
Moisture content			Is [MPa]	0.24										0.24			
Moisture content type:			Is ₍₅₀₎ [MPa]	0.25											0.25		
Density (t/m ³)	As received	Dry	Lithological description	GNEISS								History:		Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:					
Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory	
BH3	6.15		Test type:	A										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method			
			**Compliant test:	Yes													
Lab sample ID	LPER202101186		Failure mode	M										Axial		Diametral	Irregular
Sampling By	Date:	-	Failure load [kN]	1.4										1.4			
	Method:		Defect orientation	90°											-		-
Moisture content			Is [MPa]	0.45										0.45			
Moisture content type:			Is ₍₅₀₎ [MPa]	0.47											0.47		
Density (t/m ³)	As received	Dry	Lithological description	GNEISS								History:		Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:					

Definitions: Test types: A = Axial, D = Diametral, L = Lump / Irregular n/a = Not applicable, ND = Not determined ** A non compliant test = platen gap at failure being outside of the tolerance of the method
Failure modes: B = Along bedding plane, M = Through rock matrix, J = Along joint, W = Along a plane of weakness, DF = Didn't Fail

Cert. ref.:	20435097_TRP21-0007_PtLd_2101185 - 2101186_Rep-21061772	Specimens prepared by:	SL	Approved signatory:
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing	Tests performed by:	SL 27/01/21	
		Results reviewed by:	SLenihan	
		THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	Date reported:	27/01/2021

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Rocks testing - Determination of point load strength index

Including tests on; Axial (A), Diametral (D) or irregular Lump (L) specimens

AS 4133.4.1-2007

TEST REPORT - SUMMARY OF ANALYSIS



Test request ID:	TRP21-0007	Lab sample IDs:	2101187 - 2101188	Lab report ref.:	LPER_21061773	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017
Client:	Smiths 2014 Pty Ltd	Project reference:		Smith's Beach -		
Client address:	Level 3/338 Barker Road, Subiaco WA 6008		Location:		Yallingup	
Project ID:	20435097	Project name:		Smith's Beach Redevelopment		

Exploratory hole reference		Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory		
BH3		8.60		Test type: **Compliant test: Failure mode Failure load [kN] Defect orientation Is [MPa] Is ₍₅₀₎ [MPa]	D											Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method			
					Yes														
Lab sample ID		LPER202101187			M												Axial	Diametral	Irregular
By		Date:			3													3	
Sampling			Method:			45°											-	-	-
						1.1												1.1	
Moisture content					1.1												1.1		
Moisture content type:																			
Density (t/m³)		As received	Dry	Lithological description	GNEISS							History:		Test performed on samples submitted to the laboratory.					
		ND	ND									Client ref.:							
Exploratory hole reference		Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory		
BH3		10.40		Test type: **Compliant test: Failure mode Failure load [kN] Defect orientation Is [MPa] Is ₍₅₀₎ [MPa]	A											Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method			
					Yes														
Lab sample ID		LPER202101188			M												Axial	Diametral	Irregular
By		Date:			2												2		
Sampling			Method:			90°											-	-	-
						0.64											0.64		
Moisture content					0.67											0.67			
Moisture content type:																			
Density (t/m³)		As received	Dry	Lithological description	GNEISS							History:		Test performed on samples submitted to the laboratory. Soaked for at least 24 hours.					
		ND	ND									Client ref.:							

Definitions: Test types: A = Axial, D = Diametral, L = Lump / Irregular n/a = Not applicable, ND = Not determined ** A non compliant test = platen gap at failure being outside of the tolerance of the method
Failure modes: B = Along bedding plane, M = Through rock matrix, J = Along joint, W = Along a plane of weakness, DF = Didn't Fail

Cert. ref.:	20435097_TRP21-0007_PtLd_2101187 - 2101188_Rep-21061773	Specimens prepared by:	SL	Approved signatory:
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing	Tests performed by:	SL 27/01/21	
		Results reviewed by:	SLenihan	
		THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	Date reported:	27/01/2021

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Rocks testing - Determination of point load strength index

Including tests on; Axial (A), Diametral (D) or irregular Lump (L) specimens

AS 4133.4.1-2007

TEST REPORT - SUMMARY OF ANALYSIS



Test request ID:	TRP21-0007	Lab sample IDs:	2101189 - 21011810	Lab report ref.:	LPER_21061774	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017
Client:	Smiths 2014 Pty Ltd		Project reference:		Smith's Beach -	
Client address:	Level 3/338 Barker Road, Subiaco WA 6008		Location:		Yallingup	
Project ID:	20435097	Project name:		Smith's Beach Redevelopment		

Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory	
BHS	6.40		Test type:	D										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method			
			**Compliant test:	Yes													
Lab sample ID	LPER202101189		Failure mode	M										Axial		Diametral	Irregular
By	Date:	-	Failure load [kN]	0.59												0.59	
Sampling			Method:	Defect orientation	180°										-	-	-
Moisture content			Is [MPa]	0.2												0.2	
Moisture content type:			Is ₍₅₀₎ [MPa]	0.2												0.2	
Density (t/m ³)	As received	Dry	Lithological description	GNEISS								History:		Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:					
Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory	
BHS	7.65		Test type:	A										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method			
			**Compliant test:	Yes													
Lab sample ID	LPER2021011810		Failure mode	M										Axial		Diametral	Irregular
By	Date:	-	Failure load [kN]	1.3											1.3		
Sampling			Method:	Defect orientation	90°										-	-	-
Moisture content			Is [MPa]	0.4											0.4		
Moisture content type:			Is ₍₅₀₎ [MPa]	0.42											0.42		
Density (t/m ³)	As received	Dry	Lithological description	GNEISS								History:		Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:					

Definitions: Test types: A = Axial, D = Diametral, L = Lump / Irregular n/a = Not applicable, ND = Not determined ** A non compliant test = platen gap at failure being outside of the tolerance of the method
Failure modes: B = Along bedding plane, M = Through rock matrix, J = Along joint, W = Along a plane of weakness, DF = Didn't Fail

Cert. ref.:	20435097_TRP21-0007_PtLd_2101189 - 21011810_Rep-21061774	Specimens prepared by:	SL	Approved signatory:	
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing	Tests performed by:	SL 27/01/21		
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	Results reviewed by:	SLenihan		
		Date reported:	27/01/2021	Sean Lenihan - Laboratory Technician	

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Rocks testing - Determination of point load strength index

Including tests on; Axial (A), Diametral (D) or irregular Lump (L) specimens

AS 4133.4.1-2007

TEST REPORT - SUMMARY OF ANALYSIS



Test request ID:	TRP21-0007	Lab sample ID:	21011811	Lab report ref.:	LPER_21061775	Golder Associates Pty Ltd PERTH GEOTECHNICAL LABORATORY 84 Guthrie Street, Osborne Park, Western Australia 6017
Client:	Smiths 2014 Pty Ltd	Project reference:		Smith's Beach -		
Client address:	Level 3/338 Barker Road, Subiaco WA 6008		Location:		Yallingup	
Project ID:	20435097	Project name:		Smith's Beach Redevelopment		

Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		Laboratory
BH5	8.15		Test type:	D										Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method		
			**Compliant test:	Yes												
Lab sample ID	LPER2021011811		Failure mode	M										Axial	Diametral	Irregular
Sampling	By	Date:	Failure load [kN]	12											12	
		Method:	Defect orientation	180°										-	-	-
Moisture content			Is [MPa]	4.8											4.8	
Moisture content type:			Is ₍₅₀₎ [MPa]	4.8											4.8	
Density (t/m ³)	As received	Dry	Lithological description	GNEISS								History:	Test performed on samples submitted to the laboratory.			
	ND	ND										Client ref.:				
Exploratory hole reference	Sample depth (m)	Specimen reference	Sub-specimen:	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	Location test conducted:		
			Test type:											Mean values: Calculation excludes specimens which are not compliant with the tolerances specified in the test method		
			**Compliant test:													
Lab sample ID			Failure mode											Axial	Diametral	Irregular
Sampling	By	Date:	Failure load [kN]													
		Method:	Defect orientation											-	-	-
Moisture content			Is [MPa]													
Moisture content type:			Is ₍₅₀₎ [MPa]													
Density (t/m ³)	As received	Dry	Lithological description									History:				
												Client ref.:				

Definitions: Test types: A = Axial, D = Diametral, L = Lump / Irregular n/a = Not applicable, ND = Not determined ** A non compliant test = platen gap at failure being outside of the tolerance of the method
Failure modes: B = Along bedding plane, M = Through rock matrix, J = Along joint, W = Along a plane of weakness, DF = Didn't Fail

Cert. ref.:	20435097_TRP21-0007_PtLd_21011811_Rep-21061775	Specimen prepared by:	SL	Approved signatory:
	NATA accreditation number: 1961 - Site:1598 - Perth Accredited for compliance with ISO/IEC 17025 - Testing	Test performed by:	SL 27/01/21	
		Result reviewed by:	SLenihan	
		THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	Date reported:	27/01/2021

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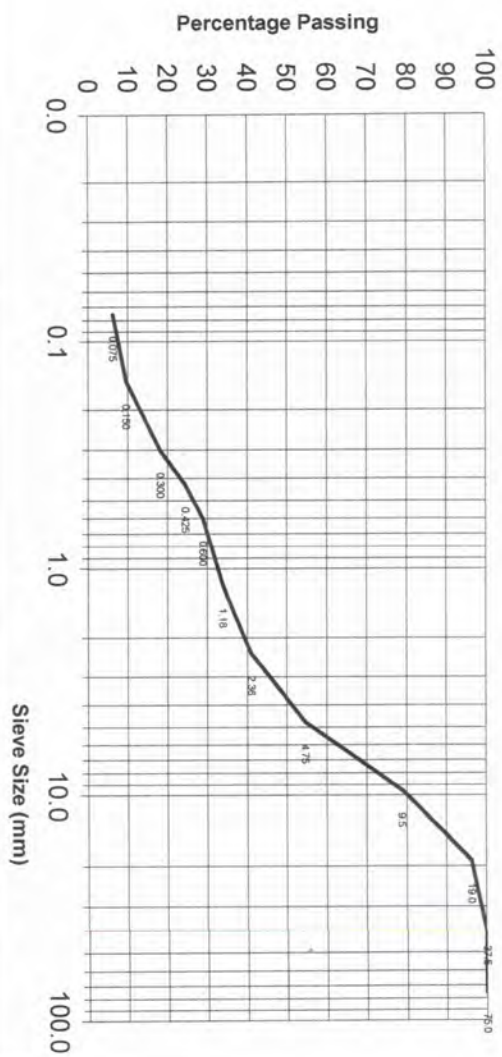
Web: www.golder.com.au

PARTICLE SIZE DISTRIBUTION REPORT

Client	Goldier Associates Pty Ltd	Report Number	QL3698-21
Location	Smiths Beach Road, Yallingup (PD1 - 0.04m to 0.16m)	Date of Report	13-Jan-21
Sampled By	C Prince	Test Number	7381
Sample Date	22-Dec-20 (Ex Pavement)	Sample Description	Sandy Gravel - Base
Test Method	AS1289.3.6.1, AS1289.1.2.1 - 6.4(b)	Moisture Content (%)	5.6

Sieve Size (mm)	Percentage Passing
75.0	100
37.5	100
19.0	96
9.5	79
4.75	55
2.36	41
1.18	34
0.600	29
0.425	24
0.300	18
0.150	10
0.075	6

GRADING CURVE



Authorised Signatory: *G J Donatti*

G J Donatti

Page _1_ of _2_

CASAGRANDE REPORT

Report Number	QL3698-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD1 - 0.04m to 0.16m)		
Test Methods	AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1		
Material Description	Sandy Gravel - Base (Ex Pavement)		

Test Number	7381			
Material Status	Air Dried			
Preparation Method	Dry Sieved			
Liquid Limit (w_L) (%)	NO			
Plastic Limit (w_P) (%)	ND			
Plasticity Index (I_P) (%)	NP			
Linear Shrinkage (LS) (%)	NO			
Cracking	-			
Crumbling	-			
Curling	-			

Notes on Test:

Liquid Limit = (NO)	Not Obtainable, material slips in cup, test is not applicable.
Plastic Limit = (ND)	Not Determined, material can not be rolled.
Plasticity Index = (NP)	Non Plastic, when neither the liquid limit or Plastic Limit can be determined.
Linear Shrinkage = (NO)	Not Obtainable, material slips in cup, test is not applicable.

Authorised Signatory



G.J. Donatti

Page

2 of 2

AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1.REP.JAN2021

Approved By: G. Donatti



N.A.T.A. Accreditation Number: 10731

Unit 2/2 Lorries Court, MALAGA. W.A. 6090.

as trustee for Qualcon Unit Trust (ABN: 34 736 601 547 ACN: 068 691 369)

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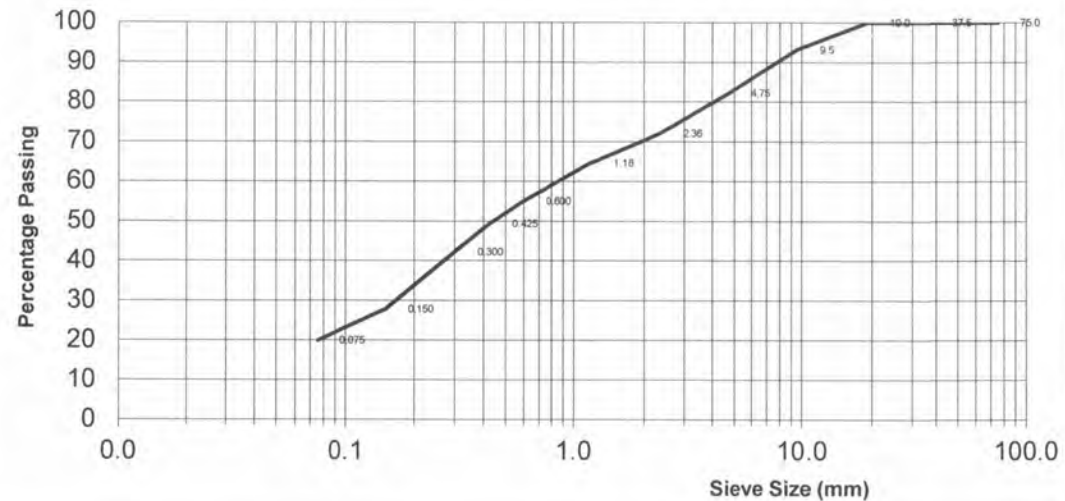
Email: qualcon@inet.net.au

PARTICLE SIZE DISTRIBUTION REPORT

Client	Golder Associates Pty Ltd	Report Number	QL3699-21
Location	Smiths Beach Road, Yallingup (PD3 - 0.30m to 0.49m)	Date of Report	13-Jan-21
Sampled By	C Prince	Test Number	7382
Sample Date	22-Dec-20 (Ex Pavement)	Sample Description	Clayey Gravelly Sand
Test Method	AS1289.3.6.1, AS1289.1.2.1 - 6.4(b)	Moisture Content (%)	3.3 (Subgrade)

Sieve Size (mm)	Percentage Passing
75.0	100
37.5	100
19.0	100
9.5	93
4.75	82
2.36	72
1.18	65
0.600	55
0.425	49
0.300	42
0.150	28
0.075	20

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with ISO/IEC 17025 - Testing

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Page _1_ of _2_

AS1289.3.6.1.REP.JAN2021

Approved by : G Donatti



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as trustee for Qualcon Unit Trust
ABN: 34 736 601 547 ACN: 068 691 369

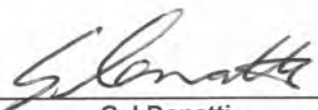
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Email: qualcon@inet.net.au

CASAGRANDE REPORT

Report Number	QL3699-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD3 - 0.30m to 0.49m)		
Test Methods	AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1		
Material Description	Clayey Gravelly Sand - Subgrade (Ex Pavement)		

Test Number	7382			
Material Status	Air Dried			
Preparation Method	Dry Sieved			
Liquid Limit (w_L) (%)	20			
Plastic Limit (w_P) (%)	16			
Plasticity Index (I_P) (%)	4			
Linear Shrinkage (LS) (%)	1.0			
Cracking	Yes			
Crumbling	-			
Curling	-			

Authorised Signatory


G.J. Donatti

Page

2 of 2

AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1.REP.JAN2021

Approved By: G. Donatti



N.A.T.A. Accreditation Number: 10731

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as trustee for Qualcon Unit Trust (ABN: 34 736 601 547 ACN: 068 691 369)

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PARTICLE SIZE DISTRIBUTION REPORT

Client

Golder Associates Pty Ltd

Location

Smiths Beach Road, Yallingup (PD4 - 0.49m to 0.99m)

Sampled By

C Prince

Sample Date

22-Dec-20 (Ex Pavement)

Test Method

AS1289.3.6.1, AS1289.1.2.1 - 6.4(b)

Report Number

QL3700-21

Date of Report

13-Jan-21

Test Number

7383

Sample Description

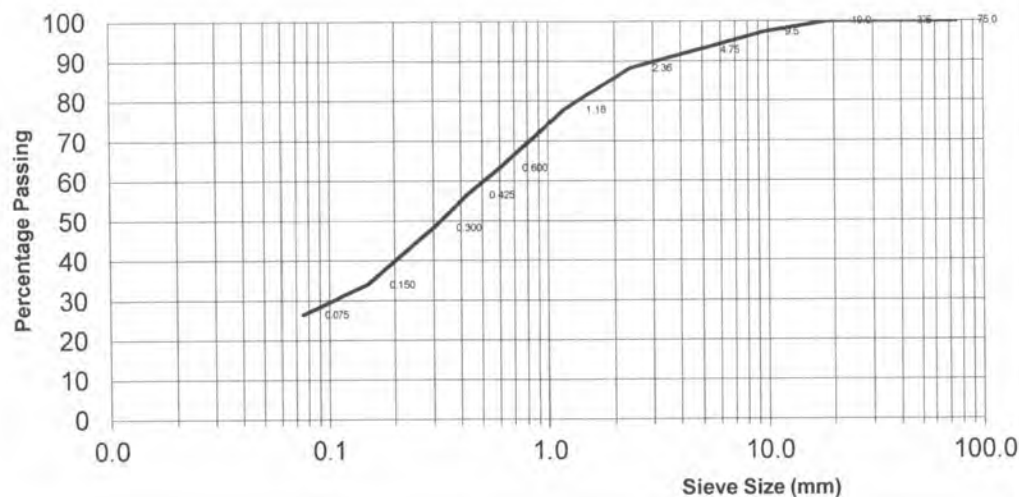
Gravelly Clayey Sand

Moisture Content (%)

11.9 (Below Subgrade)

Sieve Size (mm)	Percentage Passing
75.0	100
37.5	100
19.0	100
9.5	97
4.75	93
2.36	88
1.18	78
0.600	63
0.425	57
0.300	48
0.150	34
0.075	26

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Authorised Signatory:

G J Donatti

Page 1_ of 2_

AS1289.3.6.1 R1P JAN2021

Approved by: G Donatti



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Email: qualcon@inet.net.au

CASAGRANDE REPORT

Report Number	QL3700-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD4 - 0.49m to 0.99m)		
Test Methods	AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1		
Material Description	Gravelly Clayey Sand - Below Subgrade (Ex Pavement)		

Test Number		7383			
Material Status		Air Dried			
Preparation Method		Dry Sieved			
Liquid Limit (w_L)	(%)	30			
Plastic Limit (w_P)	(%)	18			
Plasticity Index (I_P)	(%)	12			
Linear Shrinkage (LS)	(%)	5.0			
Cracking		Yes			
Crumbling		-			
Curling		-			

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G.J. Donatti

Page

2 of 2

AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1.REP.JAN2021

Approved By: G. Donatti



N.A.T.A. Accreditation Number: 10731

Unit 2/2 Lorries Court, MALAGA. W.A. 6090.

as trustee for Qualcon Unit Trust (ABN: 34 736 601 547 ACN: 068 691 369)

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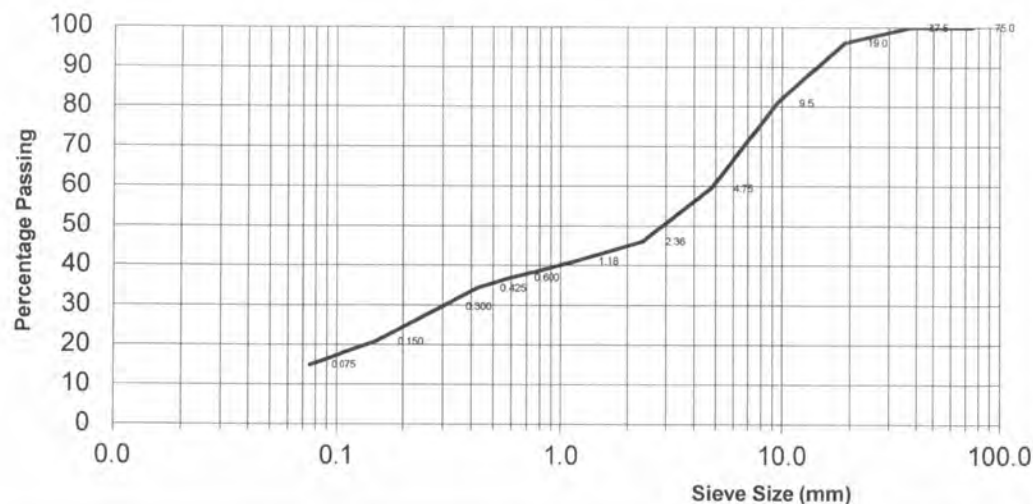
Email: qualcon@inet.net.au

PARTICLE SIZE DISTRIBUTION REPORT

Client	Golder Associates Pty Ltd	Report Number	QL3701-21
Location	Smiths Beach Road, Yallingup (PD6 - 0.03m to 0.29m)	Date of Report	13-Jan-21
Sampled By	C Prince	Test Number	7384
Sample Date	22-Dec-20 (Ex Pavement)	Sample Description	Clayey Sandy Gravel - Base
Test Method	AS1289.3.6.1, AS1289.1.2.1 - 6.4(b)	Moisture Content (%)	8.0

Sieve Size (mm)	Percentage Passing
75.0	100
37.5	100
19.0	96
9.5	81
4.75	60
2.36	46
1.18	41
0.600	37
0.425	34
0.300	30
0.150	21
0.075	15

GRADING CURVE



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Page 1_ of 2_

AS1289.3.6.1 REP JAN2021

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CASAGRANDE REPORT

Report Number	QL3701-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD6 - 0.03m to 0.29m)		
Test Methods	AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1		
Material Description	Clayey Sandy Gravel - Base (Ex Pavement)		

Test Number	7384			
Material Status	Air Dried			
Preparation Method	Dry Sieved			
Liquid Limit (w_L) (%)	21			
Plastic Limit (w_P) (%)	16			
Plasticity Index (I_P) (%)	5			
Linear Shrinkage (LS) (%)	2.5			
Cracking	Yes			
Crumbling	-			
Curling	-			

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Page

2 of 2

AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1.REP.JAN2021

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PARTICLE SIZE DISTRIBUTION REPORT

Client

Location

Sampled By

Sample Date

Test Method

Golder Associates Pty Ltd

Smiths Beach Road, Yallingup (PD2 - 0.20m to 0.40m)

C Prince

22-Dec-20 (Ex Verge)

AS1289.3.6.1, AS1289.1.2.1 - 6.5.1

Report Number

QL3702-21

Date of Report

13-Jan-21

Test Number

7376

Sample Description

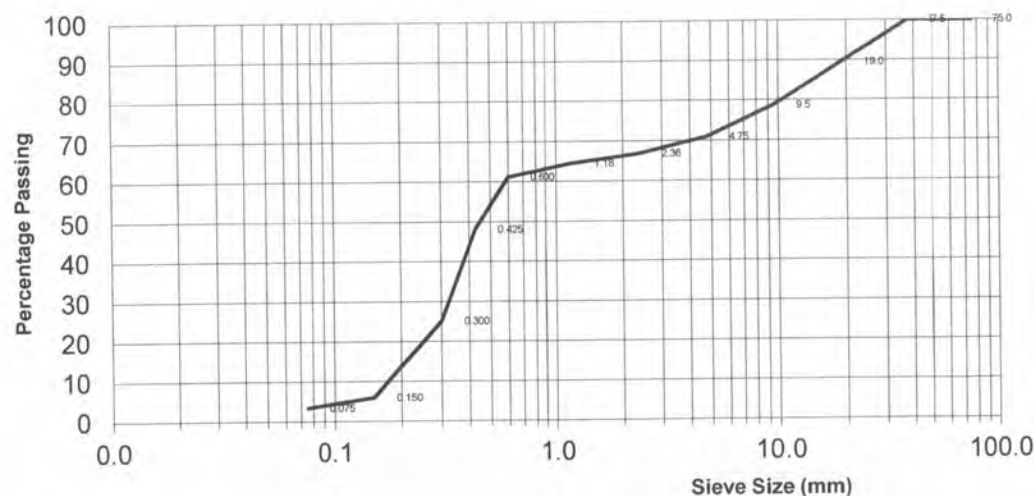
Gravelly Sand

Moisture Content (%)

6.9

Sieve Size (mm)	Percentage Passing
75.0	100
37.5	100
19.0	90
9.5	79
4.75	71
2.36	67
1.18	65
0.600	61
0.425	48
0.300	25
0.150	6
0.075	3

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Page 1 of 5

AS1289.3.6.1 REP. JAN2021

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CASAGRANDE REPORT

Report Number	QL3702-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD2 - 0.20m to 0.40m)		
Test Methods	AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1		
Material Description	Gravelly Sand (Ex Verge)		

Test Number	7376			
Material Status	Air Dried			
Preparation Method	Dry Sieved			
Liquid Limit (w_L) (%)	NO			
Plastic Limit (w_P) (%)	ND			
Plasticity Index (I_P) (%)	NP			
Linear Shrinkage (LS) (%)	NO			
Cracking	-			
Crumbling	-			
Curling	-			

Notes on Test:

Liquid Limit = (NO)	Not Obtainable, material slips in cup, test is not applicable.
Plastic Limit = (ND)	Not Determined, material can not be rolled.
Plasticity Index = (NP)	Non Plastic, when neither the liquid limit or Plastic Limit can be determined.
Linear Shrinkage = (NO)	Not Obtainable, material slips in cup, test is not applicable.

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Page

2 of 5

AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1.REP.JAN2021

Approved By: G. Donatti



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Email: qualcon@iinet.net.au

CALIFORNIAN BEARING RATIO OF REMOULDED SPECIMEN REPORT

Report Number	QL3702-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD2 - 0.20m to 0.40m)		
Test Methods	AS1289.6.1.1, AS1289.5.2.1, AS1289.2.1.1		
Sampling Method	AS1289.1.2.1 - 6.5.1	Date Sampled	22-Dec-20
Date Tested	11-Jan-21	Test Number	7376
Material Description	Gravelly Sand (Ex Verge)		

LABORATORY COMPACTION DETAILS

Maximum Dry Density (t/m^3)	1.93
Optimum Moisture Content (%)	11.0

TEST CONDITIONS OF SPECIMEN

Condition of Specimen	Soaked
Soaking Period	4 Days
Surcharge Mass (kg)	6.75
Dry Density Ratio of Specimen (%)	95
Compactive Effort Used in Remoulding Specimen (mass of rammer (kg)/drop of rammer (mm)/no. of layers/blows per layer)	4.9/450/5/10

TEST RESULTS

Dry Density (t/m^3)	
Specimen after Compaction	1.84
Specimen after Soaking	1.84
Dry Density Ratio (%)	
Specimen after Compaction	95
Specimen after Soaking	96
Moisture Content (%)	
Specimen at Compaction	10
Specimen after Soaking	12
Top 30mm Layer of Specimen after Penetration	14
Entire Depth of Specimen after Penetration	15
Moisture Ratio (%)	
Specimen at Compaction	95
Specimen after Soaking	115
Top 30mm Layer of Specimen after Penetration	132
Entire Depth of Specimen after Penetration	142
Specimen Swell (%)	0.0
CALIFORNIAN BEARING RATIO (%)	13
PENETRATION (mm)	5.0

Note 1 MDD/OMC figures were obtained from Qualcon Laboratories Pty Ltd Report No. QL3702-21, Page 5 of 5.

Note 2 Percentage of material retained on 19.0mm sieve size was 10.

Note 3: The sample was cured for a minimum of 2 Hours.

Note 4: The liquid limit as determined by Actual (Not Obtainable - Non Plastic).

Authorised Signatory :

G. J. Donatti

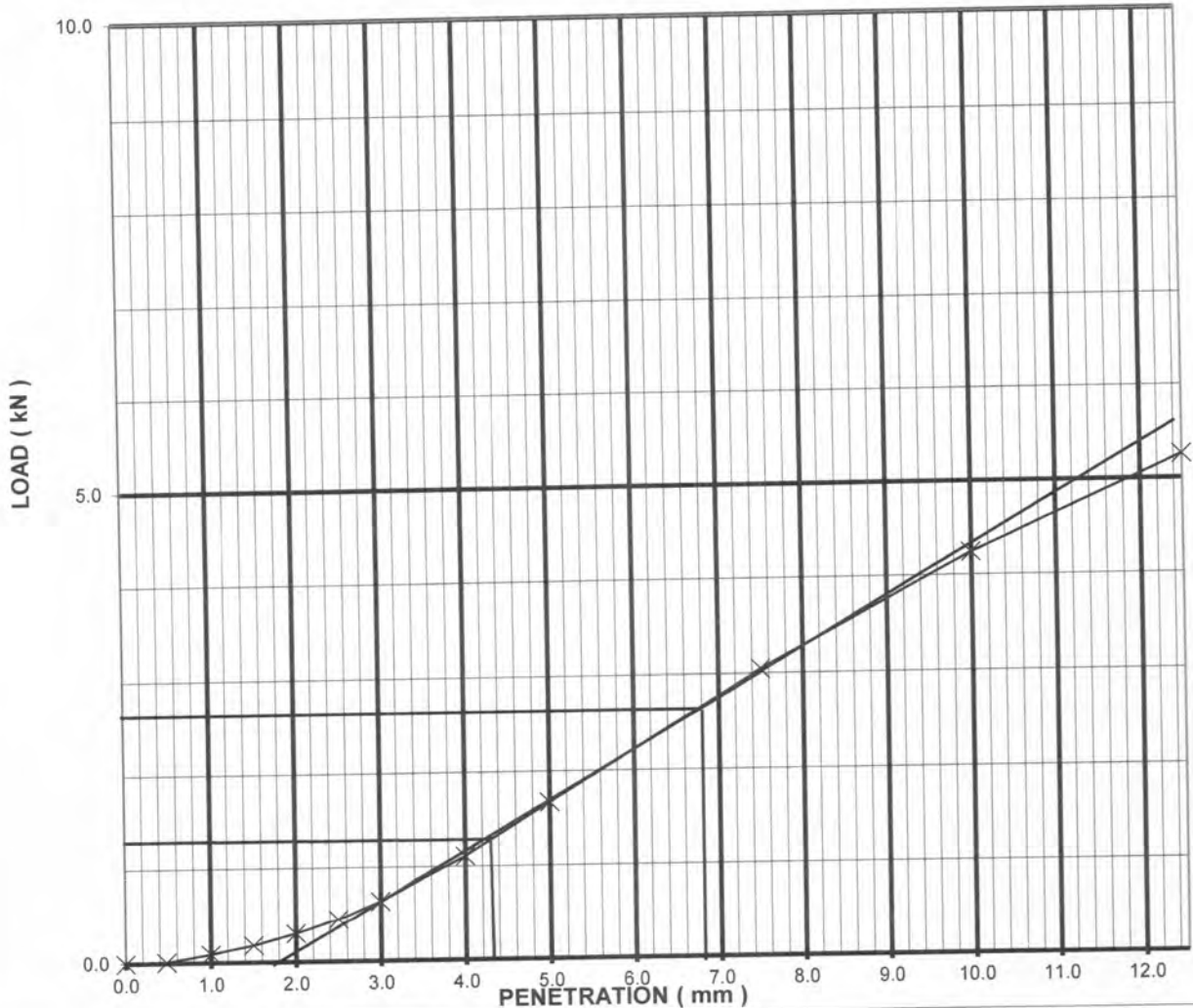
Page 3 of 5

AS1289.6.1.1.REP.JAN2021

Approved by : G Donatti

LABORATORY C.B.R. PLOT SHEET

Client Golder Associates Pty Ltd Report No : QL3702-21
 Location Smiths Beach Road, Yallingup (PD2 - 0.20m to 0.40m) Test No : 7376
 Material Description Gravelly Sand (Ex Verge - 22-Dec-20)
 Date Tested: 11-Jan-21 By: C Prince Checked By: G Donatti Date: 13-Jan-21

C.B.R CalculationsS. LOAD AT CORRECTED 2.5mm PENETRATION = 1.300 kNT. C.B.R. = 2.5 S = 9.85 %U. LOAD AT CORRECTED 5.0mm PENETRATION = 2.650 kNV. C.B.R. = 5.0 U = 13.38 %REPORTED C.B.R. = 13 @ 5.0 mm PENETRATION.CBR REPORTING

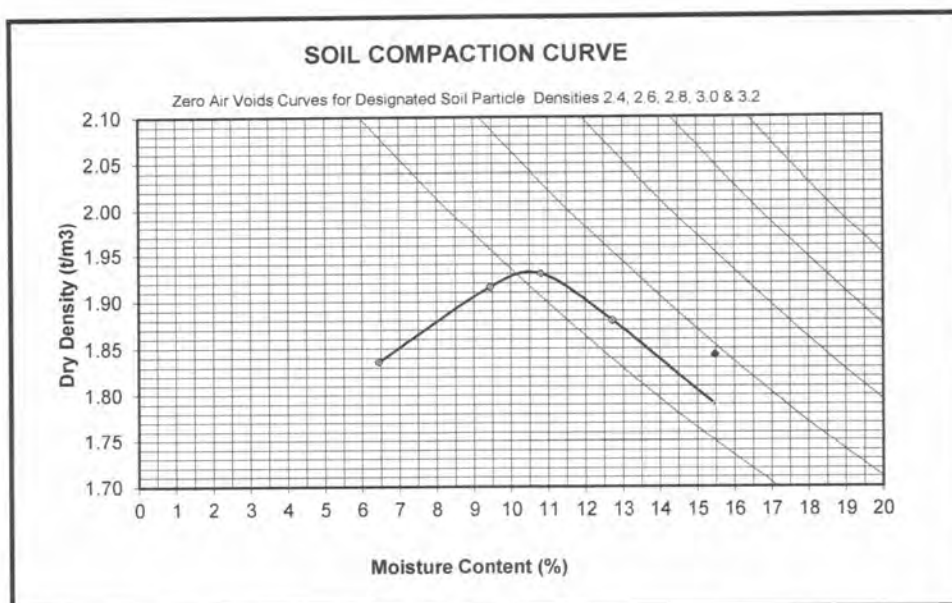
<5	0.5
5 - 20	1
20 - 50	5
>50	10

Page 4 of 5

SOIL COMPACTION REPORT

Report Number	QL3702-21	Date of Report	13-Jan-21
Client	Golders & Associates Pty Ltd	Test Number	7376
Location	Smiths Beach Road, Yallingup (PD2 - 0.20m to 0.40m)		
Test Methods	AS1289.1.1, AS1289.2.1.1, AS1289.5.2.1, AS1289.1.2.1.6.4(b)		
Material Type	Gravelly Sand (Ex Verge - 22-Dec-20)		
Compaction Type	Modified (Small Mould)	Minimum Curing Time	2hrs
Liquid Limit Method	AS1289.3.1.2		
Liquid Limit Value	Sands and granular material		

Maximum Dry Density (t/m^3)	1.93
Optimum Moisture Content(%)	11.0
Percent Retained on 19.0mm sieve	10
Percent Retained on 37.5mm sieve	0



Notes:

Authorised Signatory: _____


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Page: 5 of 5

AS1289.5.2.1, .5.1.1.REP.JAN2020

Approved By: G. Donatti



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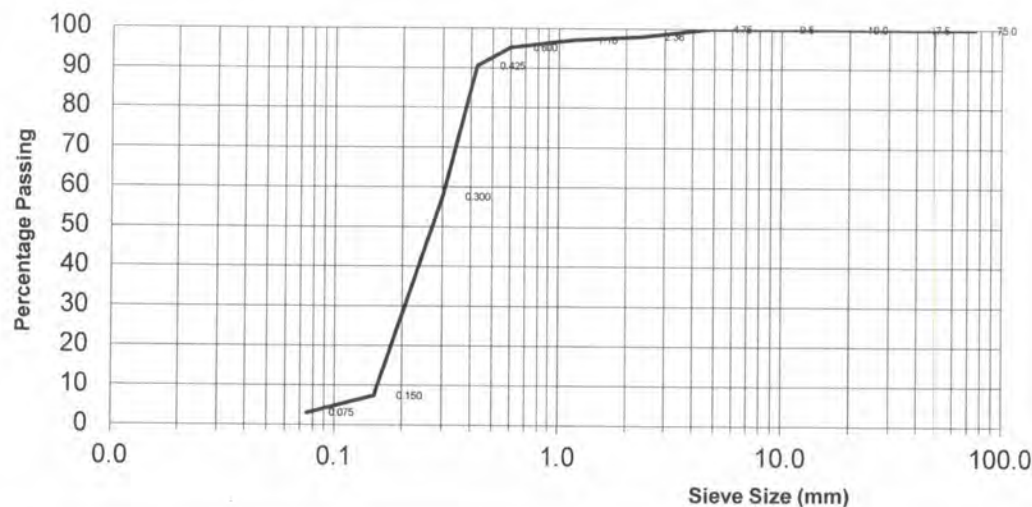
Email: qualcon@iinet.net.au

PARTICLE SIZE DISTRIBUTION REPORT

Client	Golder Associates Pty Ltd	Report Number	QL3703-21
Location	Smiths Beach Road, Yallingup (PD6 - 0.10m to 0.30m)	Date of Report	13-Jan-21
Sampled By	C Prince	Test Number	7377
Sample Date	22-Dec-20 (Ex Verge)	Sample Description	Sand
Test Method	AS1289.3.6.1, AS1289.1.2.1 - 6.5.1	Moisture Content (%)	2.5

Sieve Size (mm)	Percentage Passing
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	98
1.18	97
0.600	95
0.425	91
0.300	58
0.150	7
0.075	3

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AS1289.3.6.1.REP JAN2021

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CASAGRANDE REPORT

Report Number	QL3707-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD6 - 0.10m to 0.30m)		
Test Methods	AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1. AS1289.3.4.1		
Material Description	Sand (Ex Verge)		

Test Number	7377			
Material Status	Air Dried			
Preparation Method	Dry Sieved			
Liquid Limit (w_L) (%)	NO			
Plastic Limit (w_P) (%)	ND			
Plasticity Index (I_P) (%)	NP			
Linear Shrinkage (LS) (%)	NO			
Cracking	-			
Crumbling	-			
Curling	-			

Notes on Test:

Liquid Limit = (NO)	Not Obtainable, material slips in cup, test is not applicable.
Plastic Limit = (ND)	Not Determined, material can not be rolled.
Plasticity Index = (NP)	Non Plastic, when neither the liquid limit or Plastic Limit can be determined.
Linear Shrinkage = (NO)	Not Obtainable, material slips in cup, test is not applicable.

Authorised Signatory


G.J. Donatti

Page

2 of 4

AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1.REP.JAN2021

Approved By: G. Donatti

CALIFORNIAN BEARING RATIO OF REMOULDED SPECIMEN REPORT

Report Number	QL3703-21	Date of Report	13-Jan-21
Client	Golder Associates Pty Ltd		
Location	Smiths Beach Road, Yallingup (PD6 - 0.10m to 0.30m)		
Test Methods	AS1289.6.1.1, AS1289.5.2.1, AS1289.2.1.1		
Sampling Method	AS1289.1.2.1 - 6.5.1	Date Sampled	22-Dec-20
Date Tested	11-Jan-21	Test Number	7377
Material Description	Sand (Ex Verge)		

LABORATORY COMPACTION DETAILS

Maximum Dry Density (t/m ³)	1.64
Optimum Moisture Content (%)	16.5

TEST CONDITIONS OF SPECIMEN

Condition of Specimen	Soaked
Soaking Period	4 Days
Surcharge Mass (kg)	6.75
Dry Density Ratio of Specimen (%)	95
Compactive Effort Used in Remoulding Specimen (mass of rammer (kg)/drop of rammer (mm)/no. of layers/blows per layer)	4.9/450/5/11

TEST RESULTS

Dry Density (t/m³)	
Specimen after Compaction	1.56
Specimen after Soaking	1.57
Dry Density Ratio (%)	
Specimen after Compaction	95
Specimen after Soaking	95
Moisture Content (%)	
Specimen at Compaction	16
Specimen after Soaking	21
Top 30mm Layer of Specimen after Penetration	23
Entire Depth of Specimen after Penetration	23
Moisture Ratio (%)	
Specimen at Compaction	99
Specimen after Soaking	129
Top 30mm Layer of Specimen after Penetration	143
Entire Depth of Specimen after Penetration	140
Specimen Swell (%)	0.0
CALIFORNIAN BEARING RATIO (%)	17
PENETRATION (mm)	2.5

Note 1 MDD/OMC figures were obtained from Qualcon Laboratories Pty Ltd Report No. QL3703-21, Page 4 of 4.

Note 2 Percentage of material retained on 19.0mm sieve size was 0.

Note 3 : The sample was cured for a minimum of 2 Hours.

Note 4 : The liquid limit as determined by Actual (Not Obtainable - Non Plastic).

Authorised Signatory :


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Page 3 of 4

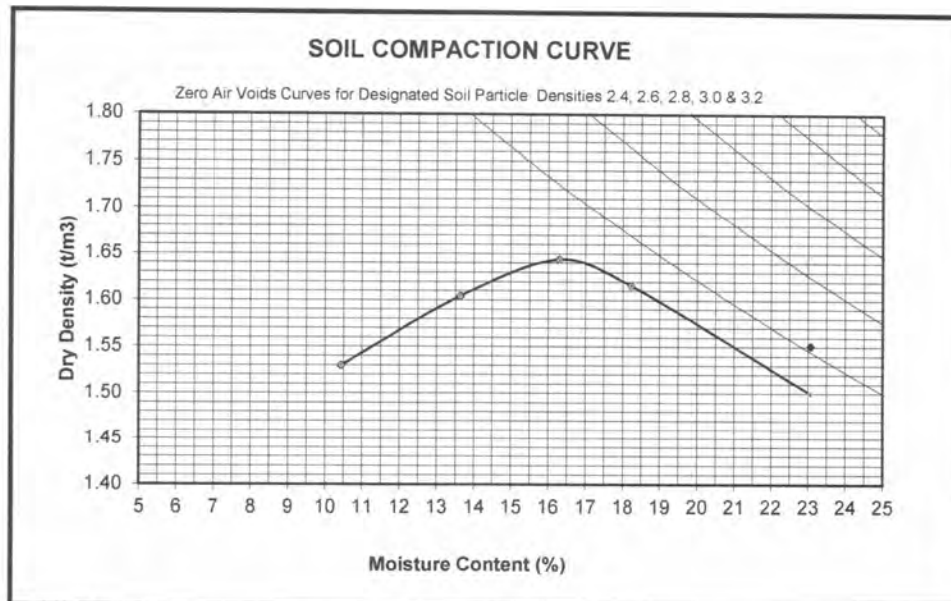
AS1289.6.1.1 REP JAN2021

Approved by : G Donatti

SOIL COMPACTION REPORT

Report Number	QL3703-21	Date of Report	13-Jan-21
Client	Golders & Associates Pty Ltd	Test Number	7377
Location	Smiths Beach Road, Yallingup (PD6 - 0.10m to 0.30m)		
Test Methods	AS1289.1.1, AS1289.2.1.1, AS1289.5.2.1, AS1289.1.2.1.6.4(b)		
Material Type	Sand (Ex Verge - 22-Dec-20)		
Compaction Type	Modified (Small Mould)	Minimum Curing Time	2hrs
Liquid Limit Method	AS1289.3.1.2		
Liquid Limit Value	Sands and granular material		

Maximum Dry Density (t/m ³)	1.64
Optimum Moisture Content(%)	16.5
Percent Retained on 19.0mm sieve	0
Percent Retained on 37.5mm sieve	0



Notes:

Authorised Signatory:

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Page: 4 of 4

AS1289.5.2.1, .5.1.1.REP.JAN2020

Approved By: G. Donatti

APPENDIX G

Pavement Visual Assessment

Photograph		Location/Description of Defect
		Minor potholes on the outer wheel path and outside of the inner wheel path of the northbound lane (approx. 210 m north of the intersection with Canal Rocks Road)
		Observed minor to moderate ravelling in both lanes, pinhole defects suggest that aggregate have been plucked out by the traffic movement. As the asphalt looks relatively new (inferred age around 2 years), the early ravelling may have been caused by temperature of the mix/temperature during construction.

Photograph		Location/Description of Defect
		Minor ravelling along the longitudinal joint, could be due to construction practices. Pinholes observed across both lanes.
		Longitudinal and transverse cracking between the two lanes

Photograph		Location/Description of Defect	
		Minor to moderate ravelling on both lanes	
		Small localised potholes along the edge of pavement (associated with edge break)	

Photograph		Location/Description of Defect	
		Observed minor ravelling outside the wheel path and along the joint on the northbound lane.	
		Longitudinal crack along the edge of pavement at localised areas	

Photograph	Location/Description of Defect
	Pavement shape along the investigated extent of road is good, no crocodile cracking or rutting observed.
	Ravelling on the inner wheel path of the northbound lane

Photograph		Location/Description of Defect	
		Localised longitudinal cracking – southbound lane	
		Transverse and longitudinal cracking between the lanes. Minor ravelling observed.	

Photograph		Location/Description of Defect	
		Minor flushing observed on the wheel paths, predominantly on the southbound lane along the bend of the road. Increased turning stresses may have contributed to the observed flushing around the bend.	
		As above	

Photograph	Location/Description of Defect
	Some minor cracking along the joints and pumping of fines. Minor ravelling within the turning pocket.
	Close up of pavement – small pin holes were generally observed on the pavement surface, as well as minor ravelling at localised spots, between wheel paths. Pavement may have been constructed during wet or cold weather.

Photograph	Location/Description of Defect
	Intersection stub of Canal Rocks Road and Smiths Beach Road – the asphalt surfacing joins to a spray sealed through lane and the joint sealing is relatively poor. Spray sealed shoulder on the left turn heading north widens the intersection stub, some minor stripping observed on the sealed surface.

Photograph	Location/Description of Defect
	Edge break and drop off along the edge of the northbound lane (spray seal) and pumping of fines along the joint. Some ravelling was also observed on the wheel path of the turning lane (asphalt surfacing).

APPENDIX H

Design Traffic Calculation

Site	Location on Smiths Beach Rd	Direction	AADT (1-dir)	Year	Growth Rate	Design AADT (1-dir)	Lane Factor	Heavy Vehicle Composition												%HV	R				Design Traffic (ESAs)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Year (assumed)	2021
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ESAs per Heavy Vehicle (Rural Main and Secondary)									
C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
0.23	1.09	3.24	0.96	0.6	2.9	3.13	5.64	7.26	7.87

APPENDIX I

Pavement Design

GRANULAR PAVEMENT THICKNESS DESIGN (ERN 9, April 2009)

PROJECT TITLE Smiths Beach Development

DESIGNED BY DG

DATE 29-01-21

PROJECT DETAIL Empirical Pavement Design

SUBGRADE CBR

Input CBR (%)

Mean CBR (%) k value

Standard Deviation

Design CBR (%) 12

DESIGN TRAFFIC

1. Initial number of vehicles (AADT) daily in one direction	n	0
2. Percentage of heavy vehicles	c (%)	0
3. Annual heavy traffic growth rate r1 for the first Q years, and traffic growth rate r2 for the remainder of the design life P years	r ₁ Q r ₂	0 0 0
4. Percentage of vehicles using design lane	d (%)	0
5. Equivalent number of standard axles per heavy vehicle	F	0
6. Pavement design life	P (year)	0
7. Cumulative Growth Factor	R	0.00
8. Design Traffic	ESA	3.70E+05
9. Design Traffic at roundabouts or small radius curves	ESA	1.11E+06

GRANULAR PAVEMENT THICKNESS

Calculated Rounded to

1. Minimum Thickness of All Granular Material (mm)	205	205
2. Minimum Thickness of Basecourse Material (mm)	118	120

CIRCLY Pro - Version 6.0 (20 February 2019)

Job Title: 20435097 Smiths Beach Development

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	1.22E+05

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:

Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: trial1 Title: trial

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	115003B-02	Iso.	2.31E+03	0.40			
2	rough	Gran 500	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	Sub_CBR12	Aniso.	1.20E+02	0.35	8.89E+01	6.00E+01	0.35

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	115003B-02	ETH	0.004759	5.000	1.130
3	top	Sub_CBR12	EZZ	0.009300	7.000	1.530

Reliability Factors:

Project Reliability: Austroads 95%

Layer Reliability Material

Layer No.	Factor	Type
1	1.00	Asphalt
3	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:

Layer no. 2: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	30.00	115003B-02	ESA750-Full	-4.45E-04	9.82E-01
2	139.00	Gran_500	n/a		n/a
3	0.00	Sub_CBR12	ESA750-Full	1.60E-03	8.29E-01

CIRCLY Pro - Version 6.0 (20 February 2019)

Job Title: 20435097 Smiths Beach Development

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Fulll	1.22E+05

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/Ref. stress	Exponent
1	ESA750-Fulll	ESA750-Fulll	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Fulll	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Fulll	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Fulll	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Fulll	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:

Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: trial1 Title: trial

Layer No.	Lower I/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvvh)	F	Eh	vh
1	rough	115003B-02	Iso.	2.31E+03	0.40			
2	rough	Gran_500	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	Sub_CBR12	Aniso.	1.20E+02	0.35	8.89E+01	6.00E+01	0.35

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	115003B-02	ETH	0.004759	5.000	1.130
3	top	Sub_CBR12	EZZ	0.009300	7.000	1.530

Reliability Factors:

Project Reliability: Austroads 95%

Layer Reliability Material

Layer No.	Factor	Type
1	1.00	Asphalt
3	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:

Layer no. 2: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	115003B-02	ESA750-Fulll	-4.47E-04	1.00E+00
2	165.00	Gran_500	n/a	n/a	n/a
3	0.00	Sub_CBR12	ESA750-Fulll	1.17E-03	9.20E-02

APPENDIX J

Pavement Work Tip – Treatment of Cracks

Treatment of Cracks in Flexible Pavements

pavement work tips — no. 8

May 1998

INTRODUCTION

Pavement cracking may occur as the result of a wide variety of causes, but regardless of the cause, the outcome is a path for the entry of moisture. Unless treated, this will result in the accelerated deterioration of the pavement. Treatment will stop or slow down the rate of deterioration and improve the effectiveness of subsequent surfacing treatments.

This Work Tip provides advice on the treatment of cracks in flexible pavements surfaced with asphalt, sprayed seals or slurry surfacing. Treatment can be applied:

- directly to individual cracks
- as a complete surfacing of the affected area
- as a combination of the two.

The severity and extent of the cracks, as well as the underlying causes, will influence choice and effectiveness of the treatment.

TREATING INDIVIDUAL CRACKS

General

Filling of individual cracks is often regarded as being tedious and time consuming. However, when done correctly, it often provides the most effective treatment in terms of waterproofing and extending the life of the pavement.

Crack Filling

This involves cleaning the cracks and filling with an appropriate crack sealant, and is suitable for all cracks from about 2 - 10mm wide.

Overbanding

This involves cleaning the surface around the cracks and applying a "band-aid" of sealant over the top of the crack. A band of material about 50 to 100mm wide, 2 to 3mm thick, is applied over the crack using a special applicator. Suitable for cracks from about 5-15mm wide.

If it is intended to overlay the area with dense graded asphalt, overbanding may also be applied in the form of a proprietary, pre-formed strip of binder, highly modified and/or reinforced, about 250 to 300mm wide. A tack coat is sprayed and the strip placed centrally over the crack and rolled, just prior to placing the asphalt. Suitable for cracks from about 5-15 mm width.

Overbanding would be used in preference to filling cracks if crack movement is relatively large and/or cracks to be treated are deep or difficult to clean out.

Routing and Filling

This involves routing the crack and filling with a thick "plug" of joint sealant material. Width to depth ratio should be about 1:2 to minimise tension at the interface at the walls of the crack, and optimise its performance. This is most suitable for use with cracks that are reasonably straight e.g. joints in aged asphalt, or concrete pavements.

Suitable for medium to large cracks. Maximum recommended routing width is about 15mm.

This method may be used to treat cracks in the existing surface or with a dense graded asphalt overlay the routing and filling can be applied in the new asphalt directly over the cracks. It is essential that the location of cracks can be accurately marked prior to placing the overlay. This has been found to be a most cost effective treatment when asphaltting over cracked concrete pavements.

CRACK AND JOINT SEALANTS

General

The material must be able to fill and/or seal the cracks to prevent water entering the pavement at the surface. A typical problem is the thermal contraction and expansion of the pavements with seasonal and/or diurnal temperature variations. This movement can exceed the resilience of normal bitumen when used as a crack sealant, allowing the cracks to reopen. Polymer modified bitumen is often used to address this problem because it has improved cohesive (internal) strength, and is usually more elastic, at normal road surface temperatures.

The practitioner must assess whether the enhanced properties are required, and if modified sealant provides an economic solution.

The following, generally in order of performance and cost, provides a brief description of the materials commonly used:

- Bitumen emulsion can be poured into the cracks, or sprayed or spread onto the surface

continued on reverse

Key Summary

This issue of 'pavement work tips' provides advice on treating cracks in flexible pavements to stop or slow down deterioration and improve future surfacing treatments

with a broom or squeegee, and covered with grit or clean sand. Generally most suitable for small cracks, less than 2mm, with little movement.

- Bitumen emulsion modified with natural rubber, or polymers, provides improved performance over standard emulsions. Suitable for small to medium cracks, 2 - 5mm, with little movement.
- Hot poured modified bitumen, usually with a high polymer content, is generally used as a sealant in overbanding, and routing and filling treatments. These treatments are suitable for medium to large cracks, about 5 - 15mm with larger movement.

PROCEDURES FOR CRACK FILLING

- Cracks must be cleaned out, generally to a depth of about twice the width. Any greater depth may affect the ability of the sealant to remain bonded to the sides if the crack width increases due to any movement in the pavement.
- Compressed air is the most common method of cleaning out cracks, but this may be supplemented by wire brushes etc.
- The cracks should be filled level, or just below the surface, to prevent pick-up and minimise potential bleeding in subsequent reseals.
- If possible, treat cracks when, environmentally, they are at their widest, such as at the end of a long dry spell.
- When applying grit or sand, take care not to fill the full depth of the crack as this will reduce the effectiveness and life of the sealant.
- Bonding of the sealant to the sides of the crack may be a problem when using hot pour sealant. When this occurs, the crack may need to be dried out using a blower, or a primer applied to the sides.

TREATING THE ENTIRE SURFACE

General

It is generally more cost effective to treat the entire surface by applying a sprayed seal if cracking

is extensive and treating cracks individually would be labour intensive and time consuming.

Sprayed Seals

These may be either single or two coat seals, with normal binder. Suitable for untreated small cracks, less than 2mm, with very small movement, or over all sizes of treated cracks.

Stress Alleviating Membrane (SAM)

These are sprayed seals using a polymer modified binder to provide a thicker and more elastic film of binder, thereby giving improved waterproofing properties. Suitable for small to medium cracks, about 2-5mm.

Strain Alleviating Membrane Interlayer (SAMI)

These are similar to SAM's, but generally with a more highly modified binder at higher rates of application, used over a cracked pavement prior to placing an asphalt overlay. Suitable for small to medium cracks, about 2-5mm.

Reinforced Seals

These are sprayed seals reinforced with glass fibres, or geotextile fabric, to provide an extremely strong and waterproof membrane.

In areas where the cracking or loading is extreme, the performance may be further improved by using a two coat seal, with modified binder.

Suitable for medium to large cracks, about 5-15mm, but has been successfully used in treating larger cracks.

Choice of Polymer Modified Binder (PMB)

The widths of the cracks and amount/cause of any movement influence the choice of a suitable polymer modified binder. The movement is usually defined in terms of being due to environmental causes or traffic (load) induced. If movement exceeds about 0.5 to 1mm, it is doubtful that a PMB alone will provide a long term solution and it should be used in conjunction with a geotextile. APRG Report No 19 provides guidance as to the selection of a suitable grade of PMB to use.

SAFETY ASPECTS

Where cracks are evident as crocodile crazing/cracking, and the pattern is closely spaced, overbanding may cause problems due to water ponding, which may cause loss of skid resistance and a rough ride.

For more information on any of the construction practices discussed in "pavement work tips", please contact either your local AUSTROADS Pavement Research Group representative or AAPA — tel (03) 9853 3595; fax (03) 9853 3484; e-mail: info@aapa.asn.au

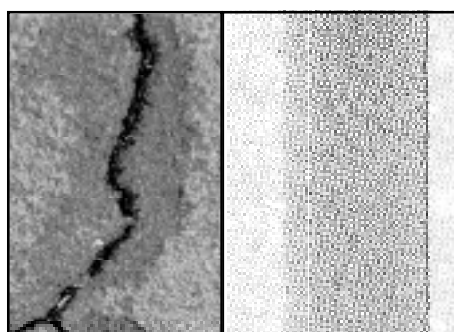
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This edition was prepared by Ian Cossens and Walter Holtrop, in consultation with members of the National Bituminous Surfacing Research Group (NaBSuRG).



Crack filling with insulated hand lance



Overbanding before (left) and after (right)



Filling and sanding cracks after routing

APPENDIX K

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