Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Peat Assessment

Bookaar Solar Farm
Meningoort Road, Bookaar

Prepared for
Bookaar Renewables Pty Ltd

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Peat Assessment
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1. Introduction

This report presents the results of a peat assessment undertaken for the proposed solar farm at Meningoort Road, Bookaar. The investigation was commissioned in an email dated 4 December 2019 by Richard Seymour for Bookaar Renewables Pty Ltd and was undertaken in accordance with Douglas Partners' proposal GGG190054 dated 30 September 2019 .

It is understood that the development of the site comprises a 200 MW solar farm with associated ancillary infrastructure including internal access tracks, a substation, battery storage area and operational buildings.

The aim of the investigation was to assess the likelihood of peat being present in the near surface soils at the Site. Peat has been known to cause underground fires in the wider area; therefore, the presence of peat beneath the proposed solar panels could potentially be hazardous.

In order to achieve the aims of the investigation, the following scope of work was undertaken:

- Preparation of Safe Work Method Statements (SWMSs);
- Review of site history and geology records;
- Drilling of six boreholes up to 2.4 m depth.
- Laboratory testing of selected samples;
- Preparation of this report; and
- Completion of all field work, laboratory testing, interpretation and reporting under a quality assurance system.

The details of the field work are presented in this report, together with findings and recommendations on the items listed above.

2. Site Description

The site is located approximately 8 km northwest of Camperdown in Victoria, on paddocks associated with the Meningoort Farm in Bookaar. The paddocks are mainly used for cropping and livestock production.

A site layout and location plan is shown on Drawing 1 in Appendix B. The proposed development plan supplied by the client is also attached.

The heritage listed Meningoort farmhouse is located approximately 1 km west of the proposed solar farm area. The farmhouse is built on the eastern side of Mount Meningoort, an extinct volcano comprising Newer Volcanic Group scoria deposits.

The proposed solar farm area is approximately 588 hectares.

A 220 kV transmission line crosses the site through its approximate centre, in a northeast to southwest direction.

Site levels range from RL 139 m AHD in the south to RL 148 m AHD in the northwest.

At the time of the investigation, extensive desiccation cracks and hummocky ground were noted in the northeast paddock where boreholes BH01 to BH03 were drilled. This paddock is referred to as Lower New by the farm.

The remaining paddocks where boreholes BH04 to BH06 are located were less hummocky than the Lower New paddock, although desiccation cracks were still visible.

Long grasses covered all of the paddocks in the proposed solar farm area, as shown in Figure 1 below.

Figure 1 – Typical long grasses over the site

Based on anecdotal evidence from farm workers obtained during the investigation, no evidence of peat or underground fires has been noted on the site.

3. Geological Setting

The online sources of geological mapping for the site (Geology Web Map Service Maintained by the Victorian Department of Primary Industries - Earth Resource Development Division) is shown on Drawing 1, Appendix B, and indicates that the proposed solar farm site is underlain by three geological units.

The majority of the site is underlain by Tertiary Hanson Plains Sands (referred to as Nb), also known as Brighton Group formation. These are indicated to comprise gravel, sand, silt: variably calcareous to ferruginous sandstones and coquinas; marine to non-marine.

Quaternary Newer Volcanic Group stony rises basalt (Neo2), tholeiitic to alkalic basalt and basanite are indicated along the western edge of the site, comprising youngest flows with little weathering or soil development (stony rises and hummocky lava flows).

Quaternary lake deposits (Ql2) comprising carbonaceous clay and silt, fine to coarse grained sand, gravel; poorly sorted, unconsolidated: lake floor and lake beach deposits are indicated beneath the southern end of the site.

An additional unit shown approximately 100 m beyond the north east corner of the site is indicated to potentially contain peat, with the materials referred to as Quaternary swamp and lake deposits (Qm1) comprising grey to black carbonaceous mud, silt, clay, minor peat: generally unconsolidated; rare dolomite.

It should be noted that the peat containing materials (Qm1) are not indicated to be present beneath the proposed solar farm site.

4. Historical Peat Fires

The following are summaries of recent documented underground fires that have occurred in the vicinity of the subject site.

Lake Cobrico, approximately 20 km southwest of the subject site. An underground fire started in the peat bog of Lake Cobrico on 17 March 2018 and was extinguished over a month later following construction of a pipeline to saturate the ground.

Lake Bullen Merri and Lake Elingamite, approximately 15 km south and 25 km south west of the subject site respectively, experienced similar underground peat fires in autumn 2018.

The online geological mapping for the historical peat fire sites indicates that they are all underlain by Quaternary swamp and lake deposits (Qm1). These deposits are indicated to potentially contain peat as discussed in Section 3. It should be noted that such deposits are not indicated to be present beneath the proposed solar farm site and occur beyond the site boundary to the north east of the site, as noted in Section 3.

5. Field Work Methods

The field work was undertaken on 19 December 2019 and involved the drilling of six boreholes (designated BH01 to BH06). The borehole locations are shown on Drawing 1 in Appendix B, and were set out by DP personnel using a hand-held GPS unit.

The borehole locations targeted the eastern edge of the site where the geological mapping indicates the highest risk of occurrence of peat beneath the site, and in particular at the following locations:

- along the north eastern boundary (boreholes BH01 to BH03) where a geological unit (Qm1) is described as containing "*minor peat*" by the geological mapping and occurs approximately 100 m beyond the site boundary outside the site; and
- along the central part of eastern boundary (BH04 to BH06) within an area of the site underlain by the geological unit (Ql2) that is not indicated to contain peat by the geological mapping but could be expected to contain some organic soils owing to its origin.

The investigation strategy was to undertake additional boreholes either between the initial six borehole locations or further to the west if peat was identified, with the aim of delineating the peat extent beneath the site if possible. As discussed below, peat was not identified in the initial six boreholes, therefore further additional boreholes were not required.

The boreholes were drilled using a push tube sampling rig, and were terminated at penetration depths of 2.4 m below the surface. Disturbed samples were collected in selected strata for logging purposes and laboratory testing.

On completion of drilling and after checking for groundwater inflows, the boreholes were backfilled with spoil and the surface tamped with hand tools.

Pocket penetrometer tests were undertaken on recovered samples to assist in the assessment of soil consistency.

Borehole co-ordinates and surface levels were recorded with a differential GPS unit, and the results are provided on the respective borehole logs in Appendix C.

All field work was undertaken by a geotechnical engineer who logged the boreholes and collected samples for visual and tactile assessment.

6. Field Work Results

6.1 Ground Conditions

Details of the conditions encountered in the boreholes are presented on the logs in Appendix C. Photographs of the recovered soil are also included in Appendix C. The logs should be read in conjunction with the explanatory notes in Appendix A. The strata are described in more detail below:

Unit 1: Topsoil - Silty Clay (Cl, Cl-CH) and Clayey Silt (ML-MH)
Natural soils typically comprised desiccated, hard, dark brown black and red brown, intermediate plasticity silty clay and clayey silt, with rootlets. The topsoil was between 0.05 m and 0.3 m thick.

Unit 2: Silty Clay (CH)
High plasticity silty clay was encountered beneath the topsoil to borehole termination depths of 2.4 m. The material was typically very stiff near the surface, reducing in strength to stiff and firm to stiff with depth.

The silty clay became mottled grey and grey brown with depth. Fine gravel was also encountered at depth.

6.2 Groundwater

Groundwater was not observed between ground level and 2.4 m depth at any of the locations prior to backfilling, although the boreholes were only left open for a relatively short period of time which may not have been long enough for groundwater inflow to occur.

7. Laboratory Testing

Laboratory testing was undertaken on selected samples of the underlying natural material and comprised:

- 6 moisture content tests;
- 6 flashpoint tests; and
- 6 loss on ignition tests.

Detailed test report sheets are given in Appendix D and the results are summarised in Table 1.

Table 1: Results of Laboratory Tests

Location	Depth (m)	Sample Description	Moisture Content (%)	Flashpoint (°C)	Loss on Ignition at 550 °C (%)
BH01	0.2-0.5	Silty Clay	19	>65.0	7.5
BH02	0.4-0.7	Silty Clay	30	>65.0	6.2
BH03	0.0-0.2	Silty Clay	19	>65.0	8.5
BH04	0.5	Silty Clay	22	>65.0	7.4
BH05	0.3-0.5	Silty Clay	26	>65.0	5.1
BH06	0.6-0.9	Silty Clay	28	>65.0	6.8

Based on the above test results, the field moisture content is between 19% and 30%.

The loss on ignition test results indicate values of between 5.1% and 8.5% at 550 °C. Based on the Glossary section of the CSIRO Australian Soil Classification website (see References for website address), "*organic materials*" are those that are plant derived organic accumulations that are saturated with water for varying times and have between 12% and 20% of organic carbon, depending on the percentage of clay. The soils from the subject site are predominantly described as silty clays. For a clay content of greater than 60%, loss on ignition can be used to estimate organic carbon by dividing by a factor of 2.7, as detailed on the CSIRO website. Using this method gives a range of organic carbon values of between approximately 2% and 3%, i.e. well below the threshold of 12% that defines an organic soil.

Similarly, an organic soil is classified as "*peat*" in accordance with the Australian Standard 'AS1727-2017- Site Investigation' if the soil contains more than 25% of organic matter by mass.

Hence the samples tested can be considered to contain marginal amounts of organic carbon and by inference, could not be classified as peat.

8. Discussion

The process for field identification of peat in AS1726-2017 Site Investigation is defined as follows: "*Does the soil have a spongy feel or fibrous texture, with significant visible organic matter and an organic odour?*" Based on the field visual and olfactory evidence and the process in AS1726-2017, no peat was identified at the subject site.

In addition, based on the six laboratory test results indicating carbon matter at a maximum of 3.1%, the clays at the subject site are not considered to contain sufficient quantities of organic material to either be classified as peat or to present any risk of combustion.

Furthermore, the occurrence of historical peat fires in the vicinity of the site as discussed in Section 4 is not considered pose a risk to the subject site, as the underlying ground conditions are not the same.

Therefore, it can be concluded that based on the field observations and the laboratory tests undertaken, the risk of the soil at the subject site containing potentially flammable materials (i.e. peat) is considered to be negligible.

This assessment only presents discussion on the composition of the soil within the top 2.4 m at the six locations on the site and has not considered the combustibility of surface vegetation (e.g. weeds, grasses, trees etc.) nor the combustibility of the man-made infrastructure associated with the solar farm.

9. References

Geology Web Map Service Maintained by the Victorian Department of Primary Industries - Earth Resource Development Division http://dpsyddev01/#share=g-01d9a8b551dafbe422da47a15a1c9523

Visualising Victoria's Groundwater (VVG) website (http://www.vvg.org.au/)

Australian Standard AS1726-2017 Site Investigation, May 2017, Standards Australia

Glossary section of the CSIRO Australian Soil Classification website (https://www.clw.csiro.au/aclep/asc_re_on_line_V2/soilglos.htm),

Self-Ignition Temperature of Peat, Journal of Physics: Conference Series, A Taufik Arief et al 2019 J. Phys.: Conf. Ser. 1198 042021

10. Limitations

Douglas Partners (DP) has prepared this report for this project at Bookaar Solar Farm in accordance with DP's proposal GGG190054 dated 30 September 2019 and acceptance received from Richard Seymour dated 4 December 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Bookaar Renewables Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its

exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

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Appendix A

About This Report

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

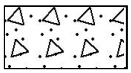
Symbols & Abbreviations

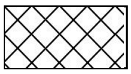
Graphic Symbols for Soil and Rock

General

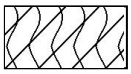

Asphalt

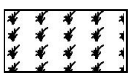

Road base

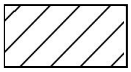

Concrete

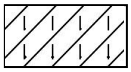

Filling

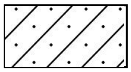
Soils


Topsoil

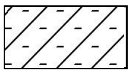

Peat

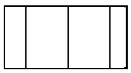

Clay

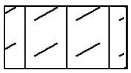

Silty clay

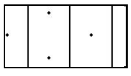

Sandy clay

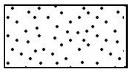

Gravelly clay

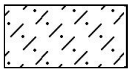

Shaly clay

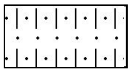

Silt


Clayey silt


Sandy silt

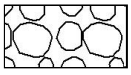

Sand

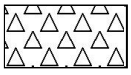

Clayey sand


Silty sand


Gravel

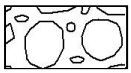

Sandy gravel


Cobbles, boulders

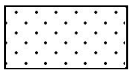

Talus

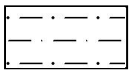
Sedimentary Rocks

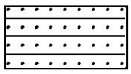

Boulder conglomerate

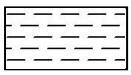

Conglomerate


Conglomeratic sandstone

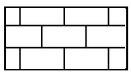

Sandstone


Siltstone

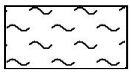

Laminite

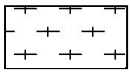

Mudstone, claystone, shale

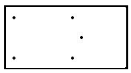

Coal


Limestone

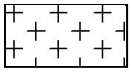
Metamorphic Rocks

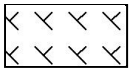

Slate, phyllite, schist

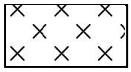

Gneiss

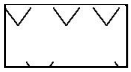

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Borehole Location Plan
Proposed Site Layout Plan

Quaternary swamp and lake deposits:

Grey to black carbonaceous mud, silt, clay, **minor peat**: generally unconsolidated; rare dolomite.

Meningoort

Tertiary Hanson Plains Sands / Brighton Group:

Gravel, sand, silt: variably calcareous to ferruginous sandstones and coquinas; marine to non-marine.

Quaternary Newer Volcanic Group:

Stony rises basalt, tholeiitic to alkalic basalt, basanite: youngest flows with little weathering or soil development (stony rises and hummocky lava flows).

Quaternary lake deposits:

Carbonaceous clay and silt, fine to coarse grained sand, gravel; poorly sorted, unconsolidated: lake floor and lake beach deposits.

BH01
BH02
BH03
BH04
BH05
BH06

5778500
5778000
5777500
5777000
5776500
5776000
5775500
5775000
5774500
5774000
5773500
5773000

0 500 1000 1500 2000 2500 m

680000 680500 681000 681500 682000 682500 683000 683500 684000 684500

LOCALITY MAP

Legend

Bookaar Solar Farm Site Boundary

Borehole Locations

Google Satellite

GSV Geological Unit (250K)

Borehole	Eastings	Northings	Elevation (AHD)
BH01	683276.49	5778431.36	140.76
BH02	683321.44	5778113.13	140.84
BH03	683392.47	5777692.56	140.95
BH04	683339.16	5776909.21	139.9
BH05	683134.17	5775783.15	139.61
BH06	682633.29	5774456.87	139.13

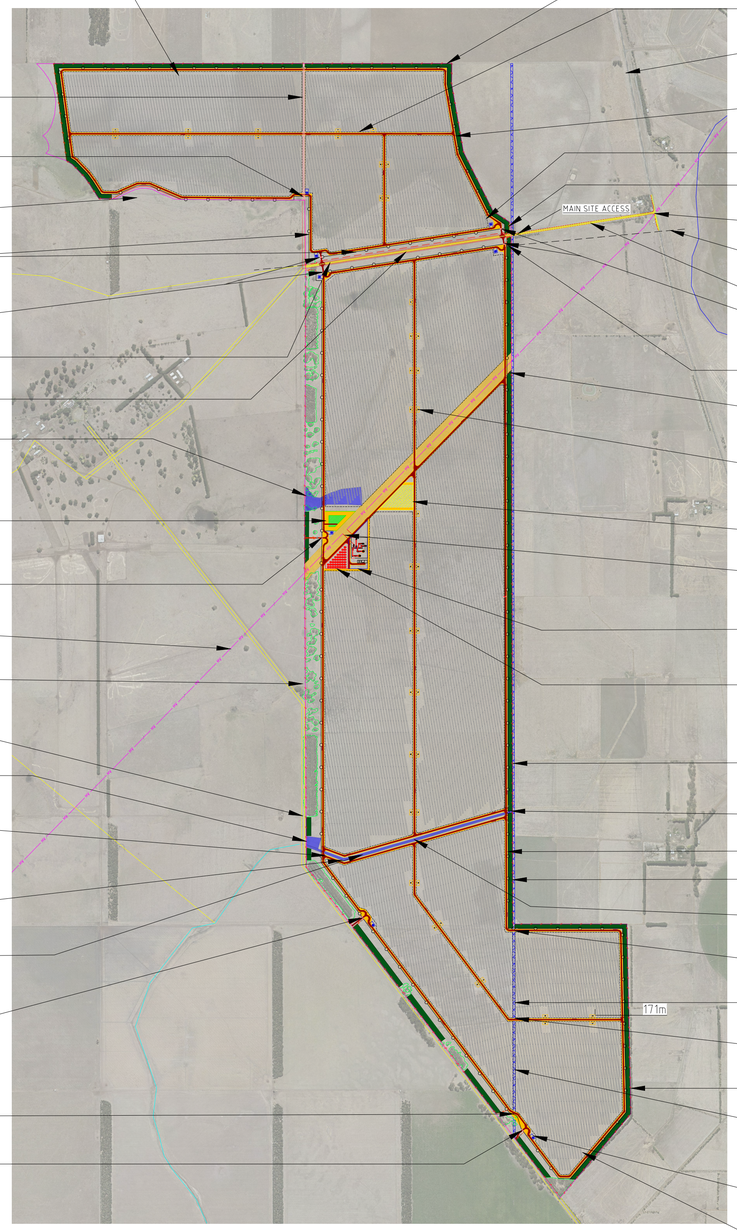
Douglas Partners
Geotechnics / Environment / Groundwater

Borehole Location Plan
Peat Assessment
Meningoort Road, Bookaar Solar Farm

N

OFFICE: Geelong
DRAWN BY: GSG
DATE: 30.01.2020

CLIENT: Bookaar Renewables Pty Ltd
PROJECT No: 87084.00
DRAWING No: 01
REVISION: 01
SCALE: 1:20000



DISTANCE BETWEEN ROWS (NORTHERN ARRAY)
13.00m PILE TO PILE

MENINGOORT RD
UNFORMED WITHIN SITE BOUNDARY

EMERGENCY ACCESS GATE '1' 8m WIDE

AREA OF ABORIGINAL LIKELIHOOD
EXCLUSION ZONE

20m OFFSET FROM EXISTING
ROAD TO FENCE BOUNDARY

MAIN ENTRY POINTS '3' AND '4' GATED 8m WIDE

PORTION OF EXISTING 11kV LINE
TO BE BURIED UNDERGROUND

UNDERGROUND CABLES TO BE INSTALLED UNDER MENINGOORT RD

FLOOD CONSTRAINT
INFRASTRUCTURE LIMITED TO FENCE, TRACK AND ARRAYS

OPERATIONS BUILDINGS
SEE 'APPENDIX D, OPERATIONS BUILDINGS PLAN' FOR DETAIL
118m FROM SITE BOUNDARY

EMERGENCY ACCESS GATE '2' 8m WIDE

220KV OVERHEAD TRANSMISSION LINE (EXISTING)

EXISTING VEGETATION
WITHIN THE PROJECT BOUNDARY

VEGETATION BUFFER
5m BETWEEN EXISTING AND VEGETATION SCREENS

FLOOD CONSTRAINT
INFRASTRUCTURE LIMITED TO TRACK AND FENCE

CULVERT (3 x 600mm PIPES) AT DRAIN CROSSING
SEDGE REMOVAL

15m FLOOD EXCLUSION ZONE
(7.5m EITHER SIDE OF THE CENTRE OF THE DRAIN)

EAST WEST DRAIN
CONTAINS NATIVE SEDGE

EMERGENCY ACCESS GATE '3' 8m WIDE

CULVERT (2 x 600mm PIPES) AT DRAIN CROSSING

EMERGENCY ACCESS GATE '4' 8m WIDE

VEGETATION SCREEN
20m WIDE

INTERNAL TRACK NETWORK

DARLINGTON CAMPERDOWN ROAD

ASSET PROTECTION ZONE (APZ)
10m WIDE APZ LOCATED AROUND THE INTERNAL
TRACK NETWORK INCLUDING THE PERIMETER
ACCESS TRACK

TRACKER LENGTH 56m

FARM ACCESS TO NORTH EAST FIELD OUTSIDE SITE

PROPOSED IMPROVEMENTS TO THE INTERSECTION OF
MENINGOORT ROAD AND DARLINGTON-CAMPERDOWN ROAD

11kV OVERHEAD LINE (EXISTING, CONT.)

MENINGOORT ROAD (UPGRADE TO 7m WIDE)

MAIN ENTRY POINTS '1' AND '2' GATED 8m WIDE

6m GAP IN VEGETATION SCREENING

SITE ACCESS TO DRAIN
2 x 3m WIDE GATE ON EACH FENCE LINE

INVERTER STATION
CONTAINS 2 INVERTERS
INSTALLED ON 26x22m HARDSTAND

TEMPORARY CONSTRUCTION COMPOUND AND LAYDOWN AREA
1.44 ha WITH 10m APZ

POINT OF CONNECTION TO EXISTING TRANSMISSION LINE
186m FROM SITE BOUNDARY

SUBSTATION AREA
1.76 ha WITH 10m APZ
214m FROM SITE BOUNDARY

BATTERY AREA
0.91 ha WITH 10m APZ
102m FROM SITE BOUNDARY

NORTH SOUTH DRAIN
WITHIN DRAINAGE RESERVE 10m
OUTSIDE SITE BOUNDARY

CULVERT (12 x 300mm PIPES) AT DRAIN CROSSING
REMOVAL OF SEDGE

SECURITY FENCE (2.5m HIGH)
OFFSET 2m TO SCREEN

AGRICULTURAL FENCE (1.2m HIGH)

UNDERGROUND CABLE
HORIZONTAL BORE TO BE USED TO INSTALL CABLE
UNDERNEATH EXISTING DRAIN WITHOUT DISTURBING AREA

CULVERT (2 x 300mm PIPES) AT DRAIN CROSSING

NORTH SOUTH DRAIN
LOCATED WITHIN 10m WIDE DRAINAGE RESERVE

CULVERT (1 x 300mm PIPE) AT DRAIN CROSSING

SITE BOUNDARY

DRAINAGE RESERVE EXCLUSION ZONE (10m)
TRACK AND CABLES ONLY.
HORIZONTAL BORE TO BE USED TO INSTALL CABLE
UNDERNEATH DRAINAGE RESERVE WITHOUT DISTURBING AREA

WATER TANK
100kL
INSTALLED ON 16m x 26m HARDSTAND
WATER TANKS ARE LOCATED AT EACH ACCESS POINT

DISTANCE BETWEEN ROWS (SOUTHERN ARRAY)
12.75m PILE TO PILE

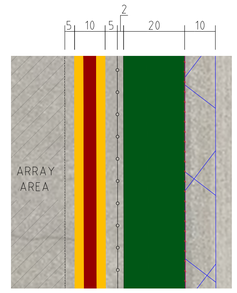
SITE PLAN VIEW
SCALE 1:15000

BILL OF MATERIALS (INDICATIVE)			
MATERIAL	DESCRIPTION	QUANTITY	UNITS
HV CABLE	240mm2 SINGLE CORE Al	285	km
DC CABLE	SUB-ARRAY (10mm2) TWIN Cu	120	km
DC CABLE	STRING (4mm2) TWIN Cu	3400	km
INVERTER STATIONS	SMA MVPS 5500-EV	41	EA
MODULES	TYPICAL 440W	641088	EA
TRACKERS	NEXTRACKER GEMINI 2P	5724	EA
COMBINER BOXES	1000V 32-INPUT COMBINER BOX (IP65)	954	EA
PIER	NEXTRACKER PIER, 4m DEEP	57240	EA

OVERALL SYSTEM SPECIFICATION		
MODULE	641088	TYPICAL 440W
INVERTER STATION	41	SMA MVPS 5500-EV (CONTAINING 2x 2750kVA INVERTERS)
INVERTER	82	SMA SUNNY CENTRAL 2750-EV
BATTERY	100	MWh
DC CAPACITY	282.08	MWp
AC CAPACITY	200.00	MVA (LIMITED FROM 225.5MVA)
DC/AC RATIO	1.41	

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN MILLIMETRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE BY CONTRACTOR.
2. PRINT IN COLOUR.
3. THIS DRAWING IS BASED ON THE INFORMATION SUPPLIED TO THE DESIGNER FROM ITS CLIENTS OR SUBCONTRACTORS AND HAS BEEN PROVIDED IN ACCORDANCE WITH GSES' TERMS AND CONDITIONS.
4. EXACT INVERTER LOCATION AND PIER HEIGHT TO BE CONFIRMED IN DETAILED DESIGN.

LEGEND:
- INVERTER STATION (ON HARDSTAND)
- WATER TANK WITH HARDSTAND
- SITE ACCESS GATE (MAIN & EMERGENCY)
- INTERNAL TRACK NETWORK
- ASSET PROTECTION ZONE (APZ)
- ACCESS ROAD (EXISTING)
- EXISTING VEGETATION
- PROPOSED VEGETATION
- OVERHEAD HV TRANSMISSION LINE
- OVERHEAD HV TRANSMISSION LINE (EXISTING)
- OVERHEAD 11kV LINE (EXISTING)
- UNDERGROUND 11kV LINE
- TRANSMISSION LINE EASEMENT
- SECURITY FENCE
- DRAINAGE RESERVE
- PROJECT BOUNDARY
- ARRAY AREA BOUNDARY
- LAYDOWN AREA
- OPERATIONS AREA
- BATTERY AREA
- SUBSTATION AREA
- 1.2m HIGH AGRICULTURAL-STYLE FENCE
- ACCESS GATE TO VEGETATION SCREEN & DRAIN (3m)



NOTE:
DO NOT MEASURE OR SCALE PLAN.
WRITTEN DIMENSIONS (METRES) TO TAKE PRECEDENCE

EASTERN BOUNDARY DETAIL (TYP)
1:1250

SITE PLAN APPENDIX LIST
- APPENDIX A: BATTERY AND SUBSTATION PLAN
- APPENDIX B: SUBSTATION ELEVATION
- APPENDIX C: BATTERY ELEVATION
- APPENDIX D: OPERATIONS BUILDINGS ELEVATION
- APPENDIX E: GATE ELEVATION
- APPENDIX F: TRACKER ELEVATION
- APPENDIX G: INVERTER ELEVATION
- APPENDIX H: INVERTER MAX. ELEVATION
- APPENDIX I: PILE EXAMPLE

NOT FOR CONSTRUCTION

REVISION PANEL				
REV	DATE	DRN	DETAILS	APR'D
7	13/10/20	H.S	ISSUED WITH DCA UPDATES	A.B
6	09/07/20	H.K	UPDATED AS PER CLIENT COMMENTS	A.B
5	01/07/20	H.S	UPDATED BASED ON CLIENT FEEDBACK	A.B
4	19/06/20	H.S	FINAL ISSUE FOR DEVELOPMENT APPROVAL	A.B
3	17/06/20	H.S	ADDED INVERTER NUMBERING	A.B

CURRENT REV CONTRACTOR: GSES CURRENT REV PROJECT:

CURRENT REV 13/10/2020
AUTHORISED
A.BONANNO
SIGNATURE

DESIGN PANEL			
DESIGNED	29/05/2020	AUTHORISED	29/05/2020
H.SMITH		A.BONANNO	
DRAWN	29/05/2020	SIGNATURE	
H.SMITH			
REVIEWED	29/05/2020		
B.COOK			

CONTRACTOR: GSES

ngse
NG ELECTRICAL PTY LTD

BOOKAAR 200MW SOLAR FARM
520 MENINGOORT ROAD, BOOKAR VIC 3260
SOLAR GENERATION
SITE PLAN VIEW

A1 SHT SIZE	TOTAL SHEETS:	7 REVISION
	PROJECT No: P1017	
	MAXIMO ID:	
	SUPERSEDES:	
	DRAWING NUMBER: P1017-01-001-01	

Appendix C

Borehole Logs
Soil Sample Photographs

BOREHOLE LOG

CLIENT: Bookaar Renewables Pty Ltd
PROJECT: Bookaar Solar Farm Peat Assessment
LOCATION: Meningoort Rad, Bookaar

SURFACE LEVEL: 140.76 m AHD **BORE No:** BH 01
EASTING: 683276.49 **PROJECT No:** 87084.00
NORTHING: 5778431.36 **DATE:** 19/12/2019
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	SILTY CLAY (CI): hard, dark brown, black, with abundant rootlets (topsoil).			0.1		pp >600		
		SILTY CLAY (CH): very stiff, dark brown black, M>Wp, with occasional rootlets. Swamp and lake deposits.			0.2				
				E		BH01-0.2-0.5			
					0.5		pp = 200-300		
140					0.8		pp = 310-340		
	1				1.0		pp = 300		1
		1.2 m: becoming stiff.			1.2				
				E		BH01-1.2-1.5			
					1.4		pp = 160-170		
					1.5				
139		1.7 m: becoming M>>Wp, firm to stiff.			1.7		pp = 110-130		
	2	2 m: mottled grey.							2
					2.1		pp = 70-90		
	2.4	Bore discontinued at 2.4m. Target depth met.			2.4		pp = 140-150		
138									

RIG: Christie Engineering **DRILLER:** DP **LOGGED:** AR / WB **CASING:** NA
TYPE OF BORING: Push Tube
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in WGS 84 Zone 54 H. Co-ordinates and RL's recorded with Altus NR3 dGPS unit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Bookaar Renewables Pty Ltd
PROJECT: Bookaar Solar Farm Peat Assessment
LOCATION: Meningoort Rad, Bookaar

SURFACE LEVEL: 140.84 m AHD **BORE No:** BH 02
EASTING: 683321.44 **PROJECT No:** 87084.00
NORTHING: 5778113.13 **DATE:** 19/12/2019
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
140		SILTY CLAY (CI): hard, dark brown, black, with abundant rootlets (topsoil).			0.1		pp >600		
	0.3	SILTY CLAY (CH): very stiff, dark brown black, M>Wp, with occasional rootlets to 0.8 m. Swamp and lake deposits.			0.4		pp = 330-390		
				E		BH02-0.4-0.7			
					0.7		pp = 210-240		
	1				1.0		pp = 195-200		1
		1.1 m: becoming M>>Wp, stiff.			1.3		pp = 110-130		
					1.45				
				E	1.6	BH02-1.45-1.8	pp = 140-170		
139					1.8				
	2				2.0		pp = 120-140		2
		2.2 m: becoming mottled grey.			2.2		pp = 120-130		
	2.4	Bore discontinued at 2.4m. Target depth met.							
138									

RIG: Christie Engineering **DRILLER:** DP **LOGGED:** AR / WB **CASING:** NA
TYPE OF BORING: Push Tube
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in WGS 84 Zone 54 H. Co-ordinates and RL's recorded with Altus NR3 dGPS unit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Bookaar Renewables Pty Ltd
PROJECT: Bookaar Solar Farm Peat Assessment
LOCATION: Meningoort Rad, Bookaar

SURFACE LEVEL: 140.95 m AHD **BORE No:** BH 03
EASTING: 683392.47 **PROJECT No:** 87084.00
NORTHING: 5777692.56 **DATE:** 19/12/2019
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
140	0.0	SILTY CLAY (CI-CH): hard, dark grey, desiccated, trace rootlets, M<Wp (topsoil).		E	0.0	BH03-0.0-0.2			
	0.2	SILTY CLAY (CH): stiff, dark grey, M>Wp, trace fine rootlets. Swamp and lake deposits.			0.2				
					0.3		pp = 110-140		
		0.6 m: becoming stiff to very stiff.			0.6		pp = 180-190		
					0.9		pp = 220-230		
	1								1
					1.2				
		1.3 m: brown grey, trace fine gravel.		E		BH03-1.2-1.4			
					1.4		pp = 160-180		
					1.7		pp = 170-210		
139	2				2.0		pp = 180-210		2
					2.3		pp = 160-200		
	2.4	Bore discontinued at 2.4m. Target depth met.							
138									

RIG: Christie Engineering **DRILLER:** DP **LOGGED:** AR / WB **CASING:** NA
TYPE OF BORING: Push Tube
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in WGS 84 Zone 54 H. Co-ordinates and RL's recorded with Altus NR3 dGPS unit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Bookaar Renewables Pty Ltd
PROJECT: Bookaar Solar Farm Peat Assessment
LOCATION: Meningoort Rad, Bookaar

SURFACE LEVEL: 139.90 m AHD **BORE No:** BH 04
EASTING: 683339.16 **PROJECT No:** 87084.00
NORTHING: 5776909.21 **DATE:** 19/12/2019
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	SILTY CLAY (CI-CH): hard, light brown, with rootlets, desiccated (topsoil).							
		SILTY CLAY (CH): dark grey, M>Wp, very stiff, trace fine rootlets to 0.8 m and fine sand and gravel. Lake deposits.		E	0.5	BH04-0.5	pp = 250-300		
139					0.9		pp = 200-200		
	1	1 m: becoming firm to stiff.			1.3		pp = 80-100		1
		1.6 m; becoming mottled brown grey.			1.6		pp = 80-90		
				E		BH04-1.6-1.8			
					1.8				
138					1.9		pp = 90-110		
	2								2
					2.2		pp = 90-100		
	2.4	Bore discontinued at 2.4m. Target depth met.							
137									

RIG: Christie Engineering **DRILLER:** DP **LOGGED:** AR / WB **CASING:** NA
TYPE OF BORING: Push Tube
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in WGS 84 Zone 54 H. Co-ordinates and RL's recorded with Altus NR3 dGPS unit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Bookaar Renewables Pty Ltd
PROJECT: Bookaar Solar Farm Peat Assessment
LOCATION: Meningoort Rad, Bookaar

SURFACE LEVEL: 139.61 m AHD **BORE No:** BH 05
EASTING: 683134.17 **PROJECT No:** 87084.00
NORTHING: 5775783.15 **DATE:** 19/12/2019
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
139	0.05	CLAYEY SILT (ML-MH): dark grey, moist, M<Wp, inferred stiff, with rootmat (topsoil).							
		SILTY CLAY (CH): very stiff, dark grey, moist, M>Wp, trace rootlets. Lake deposits.			0.2		pp = 300-300		
		0.3 m: becoming stiff.			0.3				
				E			BH05-0.3-0.5		
		0.45 m: grey, trace fine to medium gravel.			0.5		pp = 150-200		
					0.8		pp = 150-150		
		0.85 - 1 m: with medium to coarse sand, fine to medium gravel							
	1				1.0		pp = 130-160		1
		1.2 m: trace orange brown and grey mottling, trace pockets of fine to medium subangular basalt gravel.			1.3		pp = 120-150		
				E			BH05-1.3-1.6		
138					1.6		pp = 150-200		
		1.8 m; M>>Wp.			1.9		pp = 110-110		
	2								2
					2.1		pp = 130-150		
	2.4	Bore discontinued at 2.4m. Target depth met.							
137									

RIG: Christie Engineering **DRILLER:** DP **LOGGED:** AR / WB **CASING:** NA
TYPE OF BORING: Push Tube
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in WGS 84 Zone 54 H. Co-ordinates and RL's recorded with Altus NR3 dGPS unit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Bookaar Renewables Pty Ltd
PROJECT: Bookaar Solar Farm Peat Assessment
LOCATION: Meningoort Rad, Bookaar

SURFACE LEVEL: 139.13 m AHD **BORE No:** BH 06
EASTING: 682633.29 **PROJECT No:** 87084.00
NORTHING: 5774456.87 **DATE:** 19/12/2019
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
139	0.2	SILTY CLAY (CI-CH): red brown, with rootlets, desiccated (topsoil).							
		SILTY CLAY (CH): very stiff, dark grey, M=Wp, trace fine rootlets to 1.4 m. Lake deposits			0.3		pp = 340-340		
		0.6 m: becoming M>Wp, stiff to very stiff.			0.6				
				E	0.7	BH06-0.6-0.9	pp = 200-230		
		0.9 m: becoming grey brown.			0.9				
138	1				1.1		pp = 185-200		1
		1.4 m: trace fine to medium subangular calcareous gravel, becoming orange brown.			1.4		pp = 260-340		
				E		BH06-1.4-1.7			
					1.7		pp = 270-290		
137	2				2.0		pp = 230-250		2
	2.4	Bore discontinued at 2.4m. Target depth met.							

RIG: Christie Engineering **DRILLER:** DP **LOGGED:** AR / WB **CASING:** NA
TYPE OF BORING: Push Tube
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in WGS 84 Zone 54 H. Co-ordinates and RL's recorded with Altus NR3 dGPS unit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

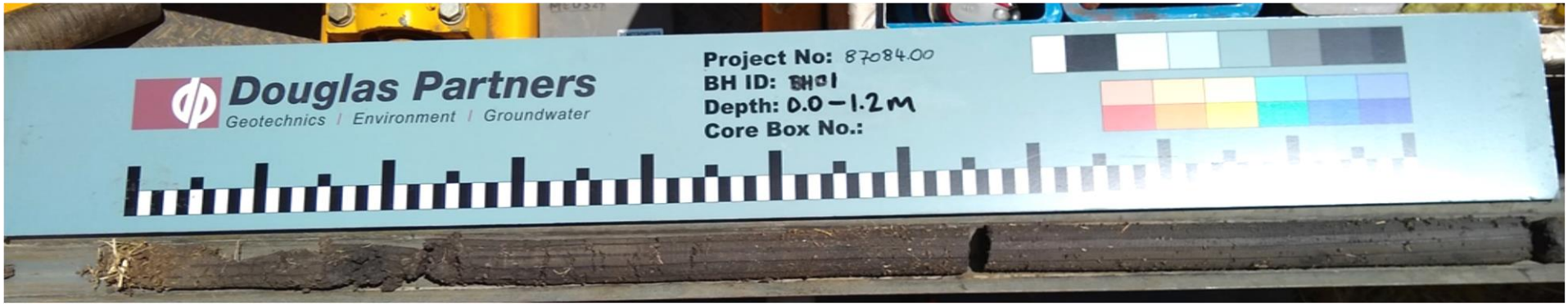


Photo 1 – Borehole BH01 Recovered Soil 0.0 to 1.2 m depth

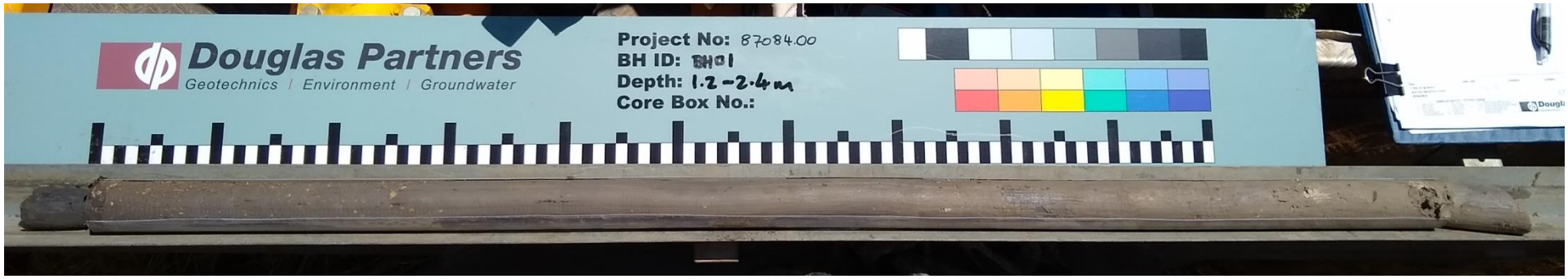


Photo 2 – Borehole BH01 Recovered Soil 1.2 to 2.4 m depth

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Bookaar Renewables Pty Ltd	**Recovered Soil Sample Photographs**	PROJECT No:	87084.00
	OFFICE:	Geelong	**Bookaar Solar Farm**	PLATE No:	1
	DATE:	19 December 2019	**Meningoort Road, Bookaar**	REVISION:	0

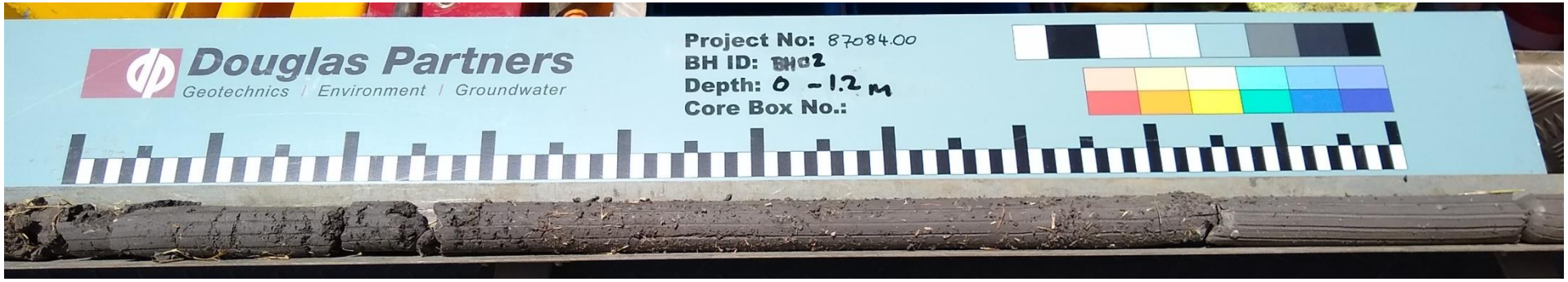


Photo 3 – Borehole BH02 Recovered Soil 0.0 to 1.2 m depth

Photo 4 – Borehole BH02 Recovered Soil 1.2 to 2.4 m depth

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Bookaar Renewables Pty Ltd	**Recovered Soil Sample Photographs**	PROJECT No:	87084.00
	OFFICE:	Geelong	**Bookaar Solar Farm**	PLATE No:	2
	DATE:	19 December 2019	**Meningoort Road, Bookaar**	REVISION:	0

Photo 5 – Borehole BH03 Recovered Soil 0.0 to 1.2 m depth

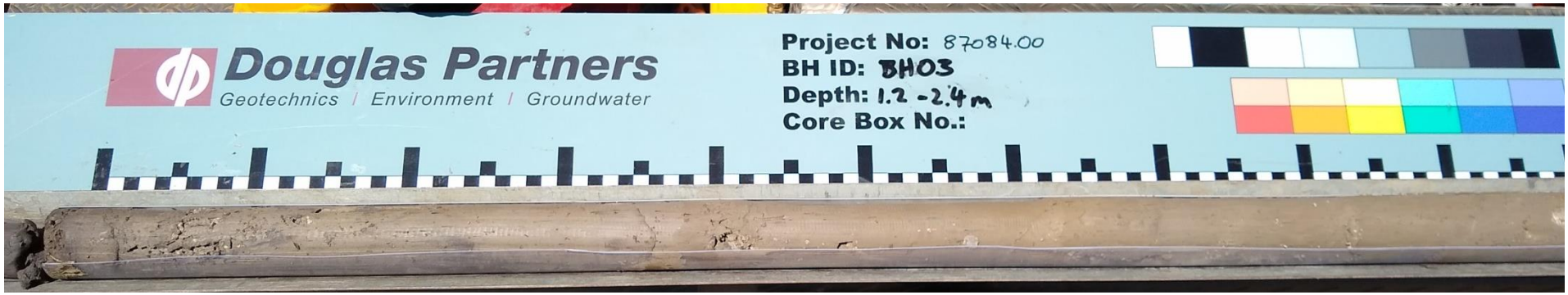


Photo 6 – Borehole BH03 Recovered Soil 1.2 to 2.4 m depth

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Bookaar Renewables Pty Ltd	**Recovered Soil Sample Photographs**	PROJECT No:	87084.00
	OFFICE:	Geelong	**Bookaar Solar Farm**	PLATE No:	3
	DATE:	19 December 2019	**Meningoort Road, Bookaar**	REVISION:	0

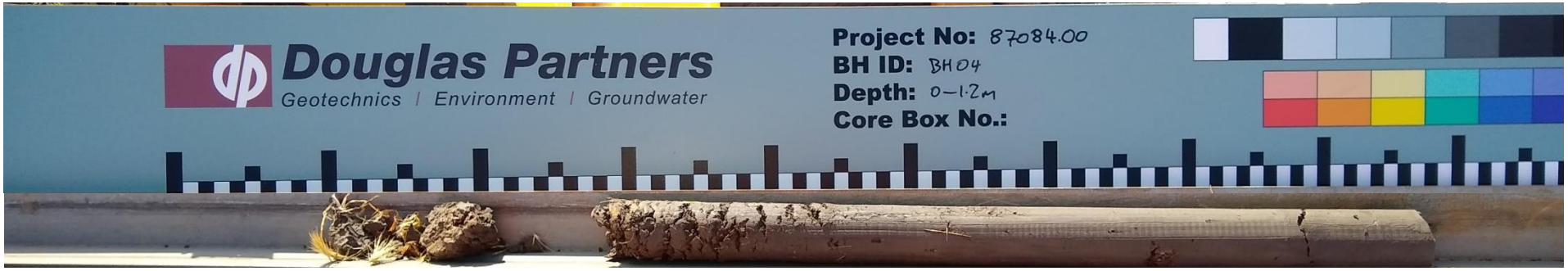


Photo 7 – Borehole BH04 Recovered Soil 0.0 to 1.2 m depth

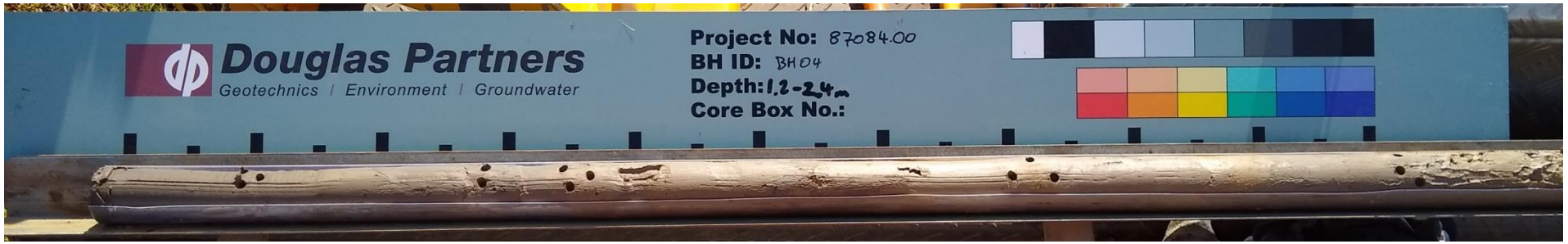


Photo 8 – Borehole BH04 Recovered Soil 1.2 to 2.4 m depth

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Bookaar Renewables Pty Ltd	**Recovered Soil Sample Photographs**	PROJECT No:	87084.00
	OFFICE:	Geelong	**Bookaar Solar Farm**	PLATE No:	4
	DATE:	19 December 2019	**Meningoort Road, Bookaar**	REVISION:	0

Photo 9 – Borehole BH05 Recovered Soil 0.0 to 1.2 m depth

Photo 10 – Borehole BH05 Recovered Soil 1.2 to 2.4 m depth

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Bookaar Renewables Pty Ltd	**Recovered Soil Sample Photographs**	PROJECT No:	87084.00
	OFFICE:	Geelong	**Bookaar Solar Farm**	PLATE No:	5
	DATE:	19 December 2019	**Meningoort Road, Bookaar**	REVISION:	0

Photo 11 – Borehole BH06 Recovered Soil 0.0 to 1.2 m depth

Photo 12 – Borehole BH06 Recovered Soil 1.2 to 2.4 m depth

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Bookaar Renewables Pty Ltd	**Recovered Soil Sample Photographs**	PROJECT No:	87084.00
	OFFICE:	Geelong	**Bookaar Solar Farm**	PLATE No:	6
	DATE:	19 December 2019	**Meningoort Road, Bookaar**	REVISION:	0

Appendix D

Laboratory Test Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1922119**	Page	: 1 of 4
Client	: **ALS WATER RESOURCES GROUP**	Laboratory	: Environmental Division Melbourne
Contact	: TUYEN NGUYEN	Contact	: Customer Services EM
Address	: CARIBBEAN BUSINESS PARK 22 DALMORE DRIVE SCORESBY VIC, AUSTRALIA 3179	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 8756 8000	Telephone	: +61-3-8549 9600
Project	: DOUGLAS (1958784)	Date Samples Received	: 23-Dec-2019 16:10
Order number	: 111595	Date Analysis Commenced	: 27-Dec-2019
C-O-C number	: ----	Issue Date	: 08-Jan-2020 11:32
Sampler	: ----		
Site	: ----		
Quote number	: EN/109/18 Scoresby for EM batches		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC

General Comments

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

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

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

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

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)				Client sample ID	6389174	6389176	6389178	6389180	6389182
				Client sampling date / time	19-Dec-2019 00:00	19-Dec-2019 00:00	19-Dec-2019 00:00	19-Dec-2019 00:00	19-Dec-2019 00:00
Compound	*CAS Number*	*LOR*	*Unit*		**EM1922119-001**	**EM1922119-002**	**EM1922119-003**	**EM1922119-004**	**EM1922119-005**
					Result	Result	Result	Result	Result
EA101: Loss on Ignition									
Loss on Ignition @ 550°C	----	0.1	%		**7.5**	**6.2**	**8.5**	**7.4**	**5.1**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	6389184	----	----	----	----
				Client sampling date / time	19-Dec-2019 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1922119-006	--------	--------	--------	--------	
				Result	----	----	----	----	
EA101: Loss on Ignition									
Loss on Ignition @ 550°C	----	0.1	%	**6.8**	**----**	**----**	**----**	**----**	

CERTIFICATE OF ANALYSIS

Batch No:	**19-58784**	*Page*	Page 1 of 4
Replacement Report	811855	*Laboratory*	Scoresby Laboratory
This report replaces Report Number:	**800941**	*Address*	Caribbean Business Park, 22 Dalmore Drive, Scoresby, VIC 3179
Client:	**Douglas Partners Pty Ltd**	*Phone*	03 8756 8000
		Fax	03 9763 1862
Contact:	**Arthur Rowling**	Contact:	Tuyen Nguyen Client Manager Tuyen.Nguyen@alsglobal.com
Address:	231 Normanby Road SOUTH MELBOURNE VIC 3205 AUSTRALIA		
Client Program Ref:	**87084-00 Bookaar**	Date Sampled:	19-Dec-2019
ALS Program Ref:	**DOUGLAS**	Date Samples Received:	20-Dec-2019
PO No:	**144167**	*Date Issued:*	**04-Mar-2020**

The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Moisture	WA055	Scoresby	**Checktest**	# External laboratory as listed.	Scoresby	**Flashpoint**	Outsourced	Intertek

Loss on Ignition analysis conducted at ALS Springvale. 4 Westall Rd Springvale VIC 3170. The results may be found in their Work Order: EM1922119. NATA Accredited Laboratory Number: 825.

Flashpoint analysis conducted at Intertek Testing Services (Australia) Pty Ltd. 218 Lorimer Street, Port Melbourne, Vic 3207. The results may be found in their job No. 2020-PTML-000266. NATA Accredited Laboratory Number: 890.

Please note:

			Flashpoint °C
6389174	19-12-19	BH01-0.2-0.5m is the same as #6389186	>65.0
6389176	19-12-19	BH02-0.4-0.7m is the same as #6389188	>65.0
6389178	19-12-19	BH03-0.0-0.2m is the same as #6389190	>65.0
6389180	19-12-19	BH04-0.5m is the same as #6389192	>65.0
6389182	19-12-19	BH05-0.3-0.5m is the same as #6389194	>99.5
6389184	19-12-19	BH06-0.6-0.9m is the same as #6389196	>65.0

Please note that this is an amended report replacing the one originally sent on 08/01/2020. The amendment involves amended results for flash point. The amendments were made by Tuyen Nguyen on 04/03/2020.

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Signatories

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Name	*Title*	*Name*	*Title*
Brad Snibson	**Client Manager**	**Chatura Perera**	**Team Leader Nutrients**
Ximena Iglesias	**Client Manager**		

Batch No: **19-58784**
Report Number: **811855**
Client: **Douglas Partners Pty Ltd**
Client Program Ref: **87084-00 Bookaar**

LOR = Limit of reporting. When a reported LOR is higher than the standard LOR, this may be due to high moisture content, insufficient sample or matrix interference.
CAS Number = Chemistry Abstract Services Number. The analytical procedures in this report (including in house methods) are developed from internationally recognised procedures such as those published by USEPA, APHA and NEPM.

				Sample No.	6389174	6389176	6389178	6389180	6389182	6389184
				Client Sample ID	BH01-0.2-0.5m	BH02-0.4-0.7m	BH03-0.0-0.2m	BH04-0.5m	BH05-0.3-0.5m	BH06-0.6-0.9m
				Sample Date	19/12/19	19/12/19	19/12/19	19/12/19	19/12/19	19/12/19
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Analysis	**Analyte**	**CAS #**	**LOR**							
Checktest	Checktest				Refer WO:EM1922119	Refer WO:EM1922119	Refer WO:EM1922119	Refer WO:EM1922119	Refer WO:EM1922119	Refer WO:EM1922119
Analysis	**Analyte**	**CAS #**	**LOR**							
Moisture	Moisture %	MOISTCONTE	<2	% w/wet w	19	30	19	22	26	28
Analysis	**Analyte**	**CAS #**	**LOR**							
Flashpoint	Flashpoint °C	FLASHPOINT		°C	>65.0	>65.0	>65.0	>65.0	>99.5	>65.0

Samples not collected by ALS and are tested as received.

A blank space indicates no test performed. Soil microbiological testing was commenced within 4 days from the day collected unless otherwise stated.
Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.
MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.
MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.
Calculated results are based on raw data.

QUALITY CONTROL - DUPLICATES

QC Data for duplicates is calculated on raw 'unrounded' values. Laboratory duplicates are randomly selected samples tested by the laboratory to maintain method precision and provide information on sample homogeniety.
RPD = Relative Percentage Difference for duplicate determinations. RPD's that fall outside the general acceptance criteria will be attributed to non-homogeneity of samples or results of low magnitudes.

					Sample Value	Duplicate Value	% RPD
Lab Sample ID	**Client Sample ID**	**Analysis**	**Analyte**				
6391608	NCP	Moisture	Moisture %	% w/wet w	20	20	0.4

Samples not collected by ALS and are tested as received.

A blank space indicates no test performed. Soil microbiological testing was commenced within 4 days from the day collected unless otherwise stated.
Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.
MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.
MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.
Calculated results are based on raw data.

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	87084.00	**Suburb:**	Bookaar	**To:**	ALS Scoresby
Project Name:	BOOKAAR, Meningoort Road - Peat	**Order Number**	144167		22 Dalmore Drive, Scoresby, Victoria 3179
Project Manager:	Arthur Rowling	**Sampler:**	AR/WB	**Attn:**	Tuyen Nguyen
Emails:	Arthur.Rowling@douglaspartners.com.au			**Phone:**	03 8756 8116
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ✓			**Email:**	tuyen.nguyen@alsglobal.com

Prior Storage: ☐ Esky ☐ Fridge ☐ Shelved — Do samples contain 'potential' HBM? Yes ☐ No ☐ (If YES, then handle, transport and store in accordance with FPM HAZID)

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: Moisture Content	Loss on Ignition	Flashpoint							Notes/preservation
BH01-0.2-0.5m		19/12/19	S	G	✓	✓	✓							Flashpoint sample in second jar
BH01-1.2-1.5m		19/12/19	S	G										Flashpoint sample in second jar
BH02-0.4-0.7m		19/12/19	S	G	✓	✓	✓							Flashpoint sample in second jar
BH02-1.45-1.8m		19/12/19	S	G										Flashpoint sample in second jar
BH03-0.0-0.2m		19/12/19	S	G	✓	✓	✓							Flashpoint sample in second jar
BH03-1.2-1.4m		19/12/19	S	G										Flashpoint sample in second jar
BH04-0.5m		19/12/19	S	G	✓	✓	✓							Flashpoint sample in second jar
BH04-1.6-1.8m		19/12/19	S	G										Flashpoint sample in second jar
BH05-0.3-0.5m		19/12/19	S	G	✓	✓	✓							Flashpoint sample in second jar
BH05-1.3-1.6m		19/12/19	S	G										Flashpoint sample in second jar
BH06-0.6-0.9m		19/12/19	S	G	✓	✓	✓							Flashpoint sample in second jar
BH06-1.4-1.7m		19/12/19	S	G										Flashpoint sample in second jar
PQL (S) mg/kg														**ANZECC PQLs req'd for all water analytes** ☐

ALS DOUGLAS
DOUGLAS 19-58784
MEL-C-04 Due Date: 31/12/2019

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No: 19-58784

Total number of samples in container: **Relinquished by:** **Transported to laboratory by:**

Send Results to: Douglas Partners Pty Ltd **Address:** **Phone:** **Fax:**

Signed: **Received by:** D. Curtis ALS **Date & Time:** 23/12 1500