Pacific Geotech
Consulting Geotechnical Engineers

GEOTECHNICAL REPORT: Proposed Residence

Lot 1 Spring Creek Estate

Spring Creek

Spring Creek Land Corporation Pty Ltd

October 2020

PG-5049

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Pacific Geotech
Consulting Geotechnical Engineers

Ref: PG-5049, 2020-10-27, LR VER 1
Author: Peter Elkington

28 October, 2020

Spring Creek Land Corporation Pty Ltd
c/- ADG Consulting Engineers
Email: mlepelaar@adgce.com

Dear Sir,

GEOTECHNICAL INVESTIGATION – PROPOSED RESIDENCE
LOT 1 SPRING CREEK ESTATE, SPRING CREEK

1.0 INTRODUCTION

This report contains the results of the geotechnical investigation and provides advice and recommendations relating to the following:

- Subsurface conditions in accordance with AS 1726
- Foundation Recommendations
- Characteristic ground surface movements
- Earthworks considerations
- Construction Considerations

Proposed Development

It is understood that the proposed development is to comprise the construction of a residential structure at the above site.

2.0 METHODOLOGY

The geotechnical investigation comprised the drilling and sampling of 2 boreholes to depths of 3m, using a Digga PDT1 drilling rig and 100mm solid flight augers. Dynamic Cone Penetrometer (DCP) testing was conducted adjacent to the boreholes.

The soil classification descriptions and field tests were carried out in general accordance with Australian Standards.

AS 1726	Geotechnical Site Investigations
AS 1289	Methods of Testing Soils for Engineering Purposes

Borehole records, Dynamic Cone Penetrometer test results and a site plan showing the test locations are appended to the report.

3.0 SITE DESCRIPTION

The site of the proposed development is located at Lot 1 Spring Creek Estate, Spring Creek.

At the time of the investigation, was vacant and vegetation comprised a short grass cover.

The site sloped gently towards the road and drainage was considered fair.

Refer following aerial and site photographs for typical site conditions.

AERIAL IMAGE

SITE PHOTOGRAPHS

4.0 GEOTECHNICAL MODEL

The subsurface profile encountered in the boreholes consisted of very stiff silty clay fill material to depths of 2.3m and 1.9m, overlying natural hard silty clay to testing termination. It is understood that the filling has been undertaken in a controlled manner and has been certified as such.

Detailed borehole record sheets are appended to this report.

Groundwater or subsurface seepage was not encountered in the boreholes at the time of drilling. Seepage could be expected through the surficial soils and along the fill/natural interface following periods of rainfall.

5.0 LABORATORY TESTING

Laboratory testing was conducted on selected samples recovered during the site investigation program and addressed the reactivity of the subsurface material.

The results of the laboratory testing are appended to this report.

6.0 POTENTIAL GROUND SURFACE MOVEMENTS

The investigation and laboratory test results indicate that the development site would be classified Class H2 in accordance with AS 2870-2011 'Residential Slabs and Footings' with a maximum potential ground surface movement (y_s) of up to 75mm. It is recommended that the readers satisfy themselves that the use of AS 2870-2011 is applicable for the proposed design.

7.0 BUILDING FOUNDATIONS

It is recommended that a high level footing system, founding into the controlled fill, be adopted for the support of the proposed building.

An allowable bearing capacity of 100kPa in the controlled and certified fill would be available, subject to inspection at the time of excavation.

If any uncontrolled fill is encountered, footings should be deepened to penetrate the uncontrolled fill material.

It is recommended that footing inspections be undertaken by Pacific Geotech, following excavation, to confirm the specified founding strata has been reached.

It is recommended that masonry walls supported on high level footings be suitably articulated.

Where footings are located adjacent to excavations such as underground service trenches, it is recommended that the footings be deepened to found at least 200mm below a line drawn up at 45 degrees from the base of the trench.

8.0 EARTHWORKS AND SITE PREPARATION CONSIDERATIONS

Earthworks are expected to comprise minor reprofiling of the block. It is recommended that the following site preparation and earthworks procedures be carried out as part of the earthworks procedures during development.

- All earthworks operations should be carried out in general accordance with AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments".
- If significant rainfall events occur during the earthworks operation, some difficulties could be experienced in trafficing the exposed surface.
- All topsoil (i.e. soil containing organic matter) and soils containing deleterious matter should be stripped from the construction area at the commencement of the earthworks operation.
- The stripped surface should be proof rolled using a large vibrating roller to identify areas of weak surficial soils and to compact the upper level material.
- The majority of the soils on site will be suitable for re-use as structural fill, provided material is free of organic matter and deleterious material. It is likely that the soils will require conditioning to bring them to optimum moisture content. If the clays were overly moist, difficulty in achieving compaction of the materials will be encountered and moisture conditioning will be required.
- Imported fill should be of fair to good quality with a minimum Soaked CBR value of 10%, a maximum lss=1.0% and a maximum particle size of 75mm.
- All filling should be undertaken in layer thicknesses of approximately 250mm (or as appropriate for the compaction equipment being used). Fill should be compacted to a minimum dry density ratio of 95% Standard in accordance with AS1289 5.1.1.
- Field density testing should be carried out to check the standard of compaction achieved and the placement moisture content. The frequency and extent of testing should be as per guidelines in AS.3798-2007.
- On the basis of the field investigation undertaken, excavations should be able to be achieved with a small Dozer (say Cat D4 or Drott) or a backhoe or small excavator (say 5 to 10 tonne) to the borehole termination depths.
- All earthworks operations should be performed under Level 1 supervision, in general accordance with the requirements of AS3798 and should be certified as controlled fill by the testing authority.

9.0 SITE MANAGEMENT

To maintain the long term performance of the structure, good management of the soil conditions and the development is vital throughout the life of the development.

The following are some specific comments with respect to site management.

- The ground surface around the perimeter of the buildings should slope away from the structure and fall to the stormwater system. Water should not be allowed to pond adjacent to the buildings.
- Founding soils should not be allowed to become saturated.
- Service trenches under the buildings should be kept to a minimum. Saturation of the on-site material will result in an increase in potential ground surface movements.
- Footings should be poured immediately after excavation. If footings cannot be poured on the same day as excavation, a blinding layer of 50mm thickness is recommended.
- Trees, garden beds and other vegetation should be planted at a distance at least equivalent to their mature height away from the structures. This will assist in minimising shrinkage movements in the expansive on-soils.

10.0 LIMITATIONS

We have prepared this report for the Proposed Residence at Lot 1 Spring Creek Estate, Spring Creek. The report is provided for the exclusive use of Spring Creek Land Corporation Pty Ltd, for this project only and for the purposes outlined in the report. It should not be used by, or relied upon, for other projects on the same or different sites or by a third party. In preparing this report, we have relied upon information provided by the client or their agents.

The results are indicative of the subsurface conditions on site only at the specific testing locations. Subsurface conditions can change between test locations and the design and construction should take the spacing of the testing and testing methods adopted and the potential for variation between the test locations.

It is recommended that Pacific Geotech be engaged to provide advice and ensure the development is undertaken in accordance with the assumptions made in writing this report.

This is not to reduce the level of responsibility accepted by Pacific Geotech, but rather to ensure that the parties who may rely on the information contained in this report are aware of the responsibilities they assume in doing so.

P. ELKINGTON (RPEQ 7226)

For and on behalf of
PACIFIC GEOTECH PTY LTD

Attached
- Notes Relating to this Report
- Borehole Record Sheets
- Site Plan
- Laboratory Test Certificate

Notes Relating to this Report

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.

Every care has been taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical conditions and contains recommendations or suggestions for design and construction. However, unexpected variations in ground conditions will occur. The potential for this will depend partly on testing, spacing and sampling frequency.

If variations are identified, Pacific Geotech would be pleased to assist with additional investigations or advice to resolve the matter.

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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.

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.

Description and Classification Methods

The description and classification of soils and rocks used in this report are based on AS 1726.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the percent of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silty	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density which can be correlated from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very Loose	less than 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) and can be quantified by the Pocket Penetrometer test, Vane Shear test, laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 - 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 - 400
Hard	greater than 400
Friable	strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc.

Sampling

Sampling is undertaken during the fieldwork to allow examination of the soil or rock and to allow laboratory testing to be undertaken.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content and minor constituents. Bulk samples are similar but of greater volume

required for some test procedures such as CBR testing.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and collecting a sample of the soil contained 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.

Details of the type and method of sampling used are given on the attached logs.

Investigation Methods

Test Pits: These are typically undertaken with a backhoe or a tracked excavator, allowing examination of the insitu soils. Limitations of test pits are the problems associated with collapse of the pits, disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of typical diameter of between 50mm to 75mm advance manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as fill, gravel, hard clays and collapse of the borehole (typically in non-cohesive soil).

Continuous Spiral flight Augers: The borehole is advanced using 65mm to 100mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. Augers of up to 300mm in diameter are used to recover larger volumes of sample. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights. Samples can be disturbed and layers may become mixed. Augering below the groundwater table can be less reliable than augering above the water table.

A Tungsten Carbide (TC) bit for auger drilling into rock can be used to indicate rock strength and continuity by variation in drilling resistance and from examination of recovered rock fragments but provides only an indication of the likely rock strength. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is advanced by a bit attached to the end of a hollow rod string, with water being pumped down the drill rods and returned up the annulus of the borehole, carrying the drill cuttings. Changes in stratification can be determined from the return, together with information from "feel" and rate of penetration.

The borehole can be stabilised through the use of drilling mud as a circulating fluid. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. This technique provides a reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel is used, which gives a core of about 50mm diameter. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a disturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposed", Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer, with a free fall of 760mm. The sample is driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense soils, hard clays or weak rock, the full 450mm 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 150mm of , say, 4, 6 and 7 blows, as
  N = 13
  4, 6, 7
- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as
  N > 30
  15, 30/40mm

Cone Penetrometer Testing (CPT): Cone Penetrometer Testing with or without pore pressure measurement (CPTu) is carried out using a Cone Penetrometer in general accordance with AS 1289 6.5.1, 1999.

In the tests, a 36mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the fractional resistance on a separate 135mm long sleeve, immediately behind the cone. Pore Pressure is recovered through a pore ring located either within, or more usually immediately behind the cone/tip.

As penetration occurs (at a rate of approximately 20mm per second) and data is recorded every 20mm of penetration, the results are presented graphically.

The information provided on the plot comprises:

- Cone resistance – expressed in mPa
- Sleeve friction – expressed in kPa
- Friction ratio – the ratio of sleeve friction to cone resistance expressed as a percentage.
- Pore pressure in kPa
- Tilt of probe (in degrees).

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and rising to 2% to as high as 8%, and higher in organic soils. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes, etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive.

Dynamic Cone Penetrometers:

Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod into the ground with a 9kg sliding hammer dropping 510mm and counting the blows for successive 100mm increments of penetration.

Logs

The borehole or test pit logs are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of the boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

Groundwater

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.

- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be flushed from the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes from which ongoing monitoring can be undertaken.

Fill

The present of fill materials can often be determined only by the inclusion of foreign objects (e.g. bricks, steel ,etc.) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult to reliably determine the extent of the fill.

Laboratory Testing

Laboratory testing is carried out in general accordance with Australian Standard 1289 'Methods of Testing Soil for Engineering Purposes'.

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, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage.

Review of Design

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a design review.

Site Inspection

Pacific Geotech would be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related:

Requirements could range from:

i. a site visit to confirm that conditions exposed are no worse than those interpreted, to
ii. a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
iii. full time engineering present on site.

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Borehole No.
BH 01
Page 1 of 1

Project No.: PG-5049

Client:	Spring Creek Land Corporation Pty Ltd	Commenced:	24/10/2020
Project Name:	Soil Classification	Logged By:	RE
Hole Location:	Lot 1 Spring Creek Estate, Spring Creek	Checked By:	
Hole Position:			
Drill Model and Mounting:	Digga PDT 1	RL Surface:	No survey
Hole Diameter:		Datum:	AHD Operator: RE

Drilling Information							Soil Description			DCP
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	0 5 10 15 20 25
AD/T			U50 0.70-0.85 m			1		CH	FILL Silty CLAY (CH): Very stiff, high plasticity, brown mottled pale red brown, moist.	
						2				
						2.30		CH	NATURAL Silty CLAY (CH): Hard, high plasticity, brown, moist.	
						3				
						3.00			Hole Terminated at 3.00 m	
						4				

Method
AS - Auger
RR - Rock Roller
WB - Washbore

Support
C - Casing

Water
Level (Date)
Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Remarks
1. Groundwater not encountered.

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Borehole No.
BH 02
Page 1 of 1

Project No.: PG-5049

Client:	Spring Creek Land Corporation Pty Ltd	Commenced:	24/10/2020
Project Name:	Soil Classification	Logged By:	RE
Hole Location:	Lot 1 Spring Creek Estate, Spring Creek	Checked By:	
Hole Position:			
Drill Model and Mounting:	Digga PDT 1	RL Surface:	No survey
Hole Diameter:		Datum:	AHD Operator: RE

Drilling Information							Soil Description			DCP
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	0 5 10 15 20 25
AD/T			D 2.60-3.00 m			1 2 1.90 3 3.00 4		CH CH	FILL Silty CLAY (CH): Very stiff, high plasticity, pale red brown and pale light grey, moist. NATURAL Silty CLAY (CH): Hard, high plasticity, brown, moist. Hole Terminated at 3.00 m	

Method
AS - Auger
RR - Rock Roller
WB - Washbore

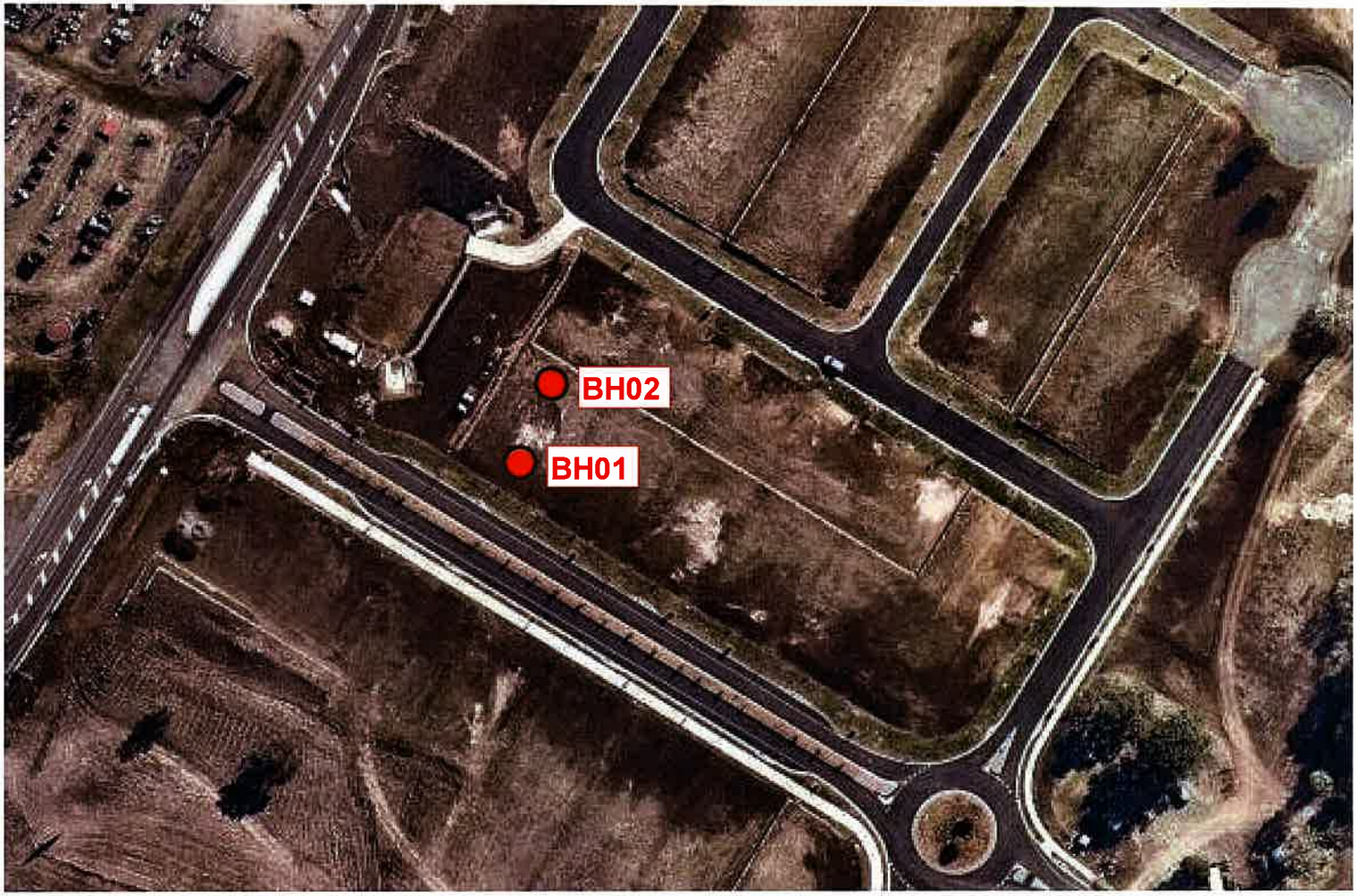
Support
C - Casing

Water
Level (Date)
Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Remarks
1. Groundwater not encountered.
2. DCP refusal met at 1.0m.



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Drawn KM	Project:	Soil Classification	Drawing No. PG-5049-01	A4
Date Oct. 2020	Location:	Lot 1 Spring Creek Estate, Spring Creek		
Checked	Client:	Spring Creek Land Corporation Pty Ltd		

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SHRINK SWELL INDEX REPORT

CLIENT:	Spring Creek Land Corporation Pty Ltd	PROJECT NUMBER:	PG-5049
ADDRESS:	Lot 1 Spring Creek Estate, Beaudesert	REPORT NUMBER:	PG-5049-SS-01
PROJECT NAME:	Soil Classification	REPORT DATE:	27/10/2020
		TEST METHOD:	AS 1289.7.1.1

SAMPLE LOCATION:	**BH01 @ 0.7m**
SAMPLING METHOD:	U50
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	24/10/2020
DATE TESTED:	26/10/2020
MATERIAL TYPE:	Sandy Clay

SHRINKAGE MOISTURE CONTENT (%):	17.5
SHRINKAGE (%):	3.4
SWELL MOISTURE CONTENT INITIAL (%):	17.2
SWELL MOISTURE CONTENT FINAL (%):	29.6
SWELL (%):	7.4
UNIT WEIGHT (t/m³):	1.85
SHRINK SWELL INDEX Iss (%):	**3.8**
CRACKING:	slight
CRUMBLING:	no

REMARKS:

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