FRED #1 LTD

10 SPRINGBURN PLACE, PŌKENO

GEOTECHNICAL ASSESSMENT FOR A PROPOSED SUBDIVISION: STAGE 2 (LOTS 13-53)

REFERENCE: R7615-1A
DATE: 03 NOVEMBER 2021

GCL
Ground Consulting Ltd

REPORT QUALITY CONTROL

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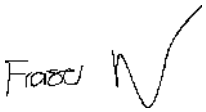
AUTHOR SIGNATURE			REVIEWER SIGNATURE	
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EXECUTIVE SUMMARY

SCOPE OF WORK		GCL has been engaged to conduct a geotechnical investigation for a proposed subdivision at 10 Springburn Place, Pokeno, and make appropriate recommendations for subdivision consent including, for foundations and earthworks.
DEVELOPMENT PROPOSAL		The proposed subdivision development of "stage 2" is anticipated to form a total of 41 Lots, consisting of the proposed Lots 13 – 53. The site has experienced significant modification via bulk cut and fill earthworks. The subdivisions bulk earthworks have been monitored and tested by GCL over the course of development.
GROUND CONDITIONS	PUBLISHED GEOLOGY	Kerikeri Volcanic Group of the south Auckland Volcanic field, comprising Lithic tuff, comprising comminuted pre-volcanic materials with basaltic fragments, and unconsolidated ash and lapilli deposits.
	PREVIOUS INVESTIGATIONS	GCL have undertaken a series of previous invesitgations, as detailed within Section 2.1 of this report.
	SITE GEOLOGY	Weathered volcanic ash consisting of very stiff hard clayey SILT.
	GROUND WATER	Generally depressed groundwater levels; however, a number of groundwater seeps have been identified through-out subdivision development.
	SURFACE WATER	A number of ground water seeps have been identified. A drainage reserve feature exists within the low-lying eastern portion of the subdivision.
NATURAL HAZARDS	LIQUEFACTION	Site investigations have proven fine grain soils not prone to liquefaction.
	ALLUVIAL LANDFORMS	Low-lying portions of the site, specifically at the toe of two gully land-forms contain shallow deposits of weak/compressible soils.
	SEISMIC CHARACTERISTICS	Seismic Soil Class C is considered appropriate. No active faults in proximity, but the design should be cognisant of NZS1170.5.
GEOTECHNICAL CONSIDERATIONS (PENDING A SPECIFIC ASSESSMENT)	SLOPE STABILITY	The proposed stage 2 subdivision development zone predominantly comprises gently sloping topography proving safe and stable building platforms. Other minor portions of the stage 2 subdivision contain moderately steep finished slopes which are considered to be susceptible to the affects of slope instability over the life of any given structuraly development within the slope's influence. The zone of influence is shown on the attached Drawings 002 and 003. Furthermore, a portion of the stage 2 development currently comprises unfinished moderately steep to steep slopes which are considered to be unstable. We understand this region of the subdivision will be modified via. bulk earthworks in order to form a continuous gentle graded topography. All aspects of slope stability are discussed in detail further within this report.
	BUILDING PLATFORM	Earthworks are required to form a level platform.
	BEARING CAPACITY	NZS3604 "good ground' present, which will provide an ultimate bearing capacity of 300kPa for traditional shallow foundations or waffle slab-on-ground solutions.
	SOIL EXPANSIVITY	Class M soil conditions.
	SETTLEMENT	Maximum 12kPa building load, 1.5m wide footing & 1.5m deep fill (in addition to subdivision filling).
	EARTHWORKS	Standard conditions apply to align with Earthworks Code of practice. The site won material is suitable for reuse subject to appropriate screening/testing.
STORMWATER DISPOSAL (PENDING A SPECIFIC ASSESSMENT)	Not assessed as part of this report.	
WASTEWATER DISPOSAL (PENDING A SPECIFIC ASSESSMENT)	Not assessed as part of this report.	

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PART A: SITE CONDITIONS

1 INTRODUCTION

1.1 PROJECT BRIEF

The client has requested GCL to provide a geotechnical assessment for a proposed subdivision of "stage two" which encompasses a total of 41 Lots (the "development") at 10 Springburn Place, Pokeno (the "site"). The site location is presented in Drawing 001.

This geotechnical report has been prepared for obtaining subdivision consent with Waikato District Council.

This report includes a summary of the investigations undertaken and provides an assessment of:

- ground conditions
- groundwater conditions
- natural hazards.
- building platform stability
- foundation conditions
- earthworks recommendations
- other pertinent constraints and issues identified with the site.

1.2 REPORT LAYOUT

This report is divided into three sections for convenience:

- Part A: Site conditions. This section provides a factual assessment of the proposed development, including a summary of the development, desktop study, site description, and sub-surface investigations undertaken.
- Part B: Geotechnical considerations. This section provides a geotechnical interpretative assessment of the proposed development, including site stability, foundation conditions, and site earthworks constraints pending a site-specific assessment for building consent.

1.3 PROPOSED SITE DEVELOPMENT

The proposed site development is anticipated to comprise the formation of a gently sloping building platform for a proposed dwelling within each of 41 proposed Lots of "stage 2".

The finished topography of each proposed Lot is anticipated to consist predominantly of gently sloping topography, with some minor portion of moderately steep slopes.

The proposed site development comprises bulk earthworks consisting of both cut and fill's of up to 5.0m and 8.0m respectively.

Suitable house site locations are presented on Drawing 002, as attached within the report appendices.

The proposed dwelling's are assumed to consist of a single storey light weight timber frame structures with weatherboard or brick cladding per NZS 3604:2011. It is anticipated that the structures will be founded on a reinforced concrete floor slab with shallow foundations

2 DESKTOP STUDY

2.1 PREVIOUS INVESTIGATIONS

GCL have previously undertaken a number of investigations and associated geotechnical assessments which relate to the proposed stage 2 subdivision development. The previous and associated reports have been reviewed and relied upon for the purposes of this report, and are summarised below:

- Geotechnical feasibility Assessment for a proposed subdivision; GCL report, R3463-2A (dated 12th September 2017).
    - Two "subdivision development zones" have been outlined in the GCL report and relate to the natural topographic profile and underlying geologic properties.
    - "Zone A" is land is considered to be suitable for residential development and should provide safe and stable conditions. Zone A land is typically associated with:
        - Gently sloping topography with slope angles of no steeper than 15° to the horizontal.
        - Topography which is not associated with high groundwater levels.
        - Topography which is not associated with surface water flows and/or ponding.
    - "Zone B" land is not suitable for residential development under existing conditions. Zone B land, however, can provide suitable subdivision development conditions with appropriate remedial measures. Zone B land is typically associated with:
        - Moderately steep to steep topography with slope angles of steeper than 15° to the horizontal.
        - Topography which is associated with high groundwater table levels.
        - Topography which is associated with surface water flows and/or ponding.
        - Topography which is associated with weak ground conditions.
    - Zone B land can provide suitable subdivision development conditions with appropriate remedial measures. Such measures include:
        - Structural in-filling or re-grading of steep slopes in order to provide acceptable overall slope grades, that being slope angles of <15° to the horizontal.
        - Engineered retaining along the edge of the gullies. This enables development to at least the edge of the gully features.
        - Structural in-filling and diversion of the site overland flowpaths.
        - Filling in the vicinity of the lower-lying areas combined with groundwater drainage in order to provide sufficient groundwater table clearances. Typically an all-season groundwater table clearance of at least 1m is sufficient for standard residential development works. Significant undercutting works, however, may be required in the vicinity of the low lying areas.
- Geotechnical feasibility Assessment for five proposed gully in-fills; GCL report, R3463-3A (dated 03 October 2018).
    - Three of the five assessed gully in-fill areas are situated within "stage 2" of the proposed subdivision development.
    - All unsuitables such as the weak gully alluvium and shallow soil creep should be undercut prior to filling.
    - The leading edge of the gully in-fill batters should be graded at no steeper than 1(v) on 4(h). Steeper fill batters may be feasible in some instances but should be specifically assessed by a suitably qualified person.
    - Groundwater drains should be constructed along the base of the gullies in order to prevent the development of significant groundwater heads within the fill.

- Geotechnical slope stability assessment for proposed permanent gully in-fill batters; GCL report R3463-7A (dated 09 February 2021).
    - The northern-most gully feature within "stage 2" of the proposed subdivision has been recently in-filled. The report conducted slope stability analysis in order to assess risk of slope instability to the upslope gentle topography and long-term stability of the gully in-fill batter.
    - The slope stability analysis provided the following conclusions and recommendations for permanent gully in-fill batter stability:
        - All unretained cut batters should be graded at no steeper than 1(v) on 2(h) / 26° to the horizontal and have a vertical height of no higher than 2.0m.
        - Batter profiles requiring a vertical height in excess of 2.0m must include a 1.5m width bench at each 2.0m height interval.
        - Where this slope profile specification results in the batters toe extending outside of usable land use boundaries, we recommend the batter to be structurally retained as shown on Drawing 002.
        - The batters should be planted with suitable varieties.

GCL has also previously conducted investigations throughout the local area and is therefore familiar with the local geology. Previous GCL reports containing pertinent information relevant to the current site have been reviewed and relied on where appropriate for the benefit of this current report.

2.2 NEW ZEALAND GEOTECHNICAL DATABASE

The New Zealand Geotechnical Database (NZGD) has been viewed, and no geotechnical investigations have been identified in the vicinity of the proposed development.

2.3 HISTORIC AERIAL PHOTOGRAPHS

Aerial photographs available from Google Earth dating from 2000 to 2021 were studied to observe the site over time and assess the geomorphological setting. The review of historical aerial photography provides a basic record for the significant landform modifications carried out across the proposed subdivision to date.

The review of historical aerial photography is summarised in the below table:

TABLE 1: HISTORIC AERIAL SUMMARY

YEAR:	SITE DESCRIPTION:
2000-2019	The site consists of open pastureland. Little to no modification from the original landforms are observable.
2020 (January)	Bulk cut earthworks have commenced in the northern region of the proposed subdivision development (predominantly within 'stage 1'). The northern-most gully landform has been in-filled utilising the bulk cut materials.
2020 (September)	Bulk cut to fill earthworks have continued and are largely completed within Lots 13-23 of Stage 2. The second gully in-fill works (immediately south of the first) has commenced.
2021 (July)	Further completion of earthworks has occurred within Lots 24-34 of stage 2. In-filling of the second gully continues. Earthwork developments within Lots 47-53 of stage 2 are now complete. Earthwork development within Lots 35-46 remain incomplete.

2.4 PUBLISHED GEOLOGY

The Geological Map of New Zealand provided on the New Zealand Geology Web Map at a scale of 1:250,000 maps the site as being underlain by the Kerikeri Volcanic Group of the South Auckland Volcanic Field. The South Auckland Volcanic Field consists of basalt lava, scoria, ash, lapilli, and lithic tuff.

2.5 SITE SERVICES

At the time of our site investigation, there was no evidence of any buried services in the vicinity of the proposed development; however, GCL has not undertaken a specific search of site utilities and services for this report.

3 SITE CONDITIONS

3.1 SITE DETAILS

The site comprises Lot 3 DP 547427at 10 Springburn Place, Pokeno.

The site is situated within Pokeno of the North Waikato region. The site is accessible off Helenvale Crescent. The site is currently surrounded by residential development.

3.2 SITE TOPOGRAPHY

The proposed stage 2 subdivision currently comprises a small array of differing topologies, as summarised below:

Lots 13-38, 47-48 & 50:

- The above Lots predominantly comprise gently sloping topography with measured slope angles no greater than 15° to the horizontal.
- The above lots are remote from steeper slopes and are presently grassed.

Lots 39-46:

- The above Lots contain unfinished earthwork developments, with continuation of a large scale gully in-fill still anticipated.
- The above lots predominantly comprise gentle to steeply sloping topography with measured slope angles of between 15° to 45° to the horizontal.
- The above lots are remote presently bare but do contain a number of fill stockpiles.

Lots 49 & 51-53:

- The above Lots contain gently sloping topography with measured slopes no greater than 15° to the horizontal.
- The eastern extent of gently sloping topography is delineated by a diffuse break of slope which transitions into moderately steep slopes with measured slope angles of between 26° to 30° to the horizontal.
- The above Lots are presently grassed.

3.3 EXISTING SITE DEVELOPMENT FEATURES

A significant volume of bulk cut and fill earthworks have been undertaken to date across the proposed subdivision of stage 2. These works predominantly comprise the cut/excavation within the subdivision's eastern-most portion and filling within the central and western portions. The depth and extent of recent cut/fill earthworks is shown on Drawings 003 and 004.

Unfinished earthworks are present within the south-western portion of the subdivision, as shown on Drawings 003 and 004.

3.4 SITE SURFACE WATER FEATURES

The original site topography comprised a number of overland flow paths, typically associated with the two gully features located within stage 2 of the proposed subdivision. Additionally, a ground spring has been identified within the north-eastern portion of the site.

The surface water features discussed above are shown on Drawing 002.

A specific assessment of surface water features has not been undertaken as part of this report.

3.5 SLOPE INSTABILITY FEATURES

The gently sloping portions of the site contain no observed slope instability features.

The pre-development steeper portions of the site contained shallow soil creep, however, upon recent earthworks modification (such as the two gully in-fill development), the shallow soil creep has been removed and reformed into a largely gently sloping landform. The steeper pre-development slopes do not contain any active deep-seated or large-scale slope instability features.

The existing steep to very steep (30° to 45° to the horizontal) 'unfinished' portions of subdivision development (Lots 39-46) contain slope instability largely in the form of soil creep. This instability is not considered a significant issue, given the 'unfinished' nature of earthworks within the region of the subdivision. We anticipate completion of these earthworks to provide a finished gradient of no steeper than 1(v) on 4(h) (<15° to the horizontal).

4 SUB SURFACE CONDITIONS

4.1 FIELD INVESTIGATIONS

Sub-surface investigations have been undertaken in the vicinity of the proposed development. The sub-surface investigations have comprised of:

- As part of recent stage 2 subdivision investigations, a total of 19 hand auger bores constructed to a maximum depth of 2.0m; augering ceased once geology had been established.
- Previous investigations have comprised eight hand auger bores within stage 2 of the proposed subdivision constructed to a maximum depth of 2.0m; augering ceased once geology had been established.
- Additionally, previous investigations have comprised a total of eleven cone penetrometer tests (CPTs) within stage 2 of the proposed subdivision, constructed to depths of between 5.5m and 20.5m, ceasing upon effective refusal.
- A series of nuclear densometer (NDM) testing has been undertaken through-out the processing of recent bulk fill earthworks. A total of 94 NDM tests have been undertaken over the period of 21/11/2019 and 03/05/2021.

The investigations were constructed to assess the sub-surface conditions in the vicinity of the development and were undertaken by a suitably qualified engineering geologist from GCL. The investigation locations were determined with a hand-held GPS device and Auckland Council GIS viewer/Waikato District Council GIS viewer/Queenstown Lakes District Council GIS viewer.

The approximate locations of the sub-surface investigations are shown in Drawings 003 and 004. Locations and results of NDM testing is presented within Appendix B of this report.

4.2 INVESTIGATION LOGGING

Soils recovered from the investigations have been logged and presented in Appendix A. Logging of the soil encountered has been undertaken according to NZ Geotechnical Society Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes.

Down-hole strength testing with a Pilcon shear vane has been undertaken within the hand auger bores at approximately 0.5m intervals. The readings provided on the logs are "shear vane strengths", which have been factored utilising "NZ Geotechnical Society Guideline for Handheld Shear Vane Tests". The logs are presented in Appendix A.

4.3 GROUND CONDITIONS

4.3.1 General

A summary of the sub-surface conditions identified in the investigations undertaken is presented below in depth from the ground surface. The sub-surface conditions have been extrapolated between the investigations undertaken. Whilst care has been taken to provide sufficient sub-surface information following best practices for the proposed development, no guarantee can be given on the validity of the inference made. As such, it should be appreciated that ground conditions may vary between the investigations undertaken.

Prior to subdivision earthwork development:

4.3.2 Holocene Alluvium

Recent alluvial soils underlie the lower lying portions of the site to a depth of at least 4.0m.

The alluvial soils typically consisted of clayey SILT and CLAY with minor sand to a sandy SILT with depth. The soil was firm to hard, wet to saturated (low recovery) with variable plasticity and sensitive to insensitive.

Down-hole shear strength testing undertaken provided an undrained shear strength of between 47kPa and >209kPa, with strengths generally increasing with depth.

Scala penetrometer testing undertaken within the non-cohesive soil provided blow counts between 7 – 10 (with effective refusal being met), indicating a dense to very dense soil at depth.

The Holocene alluvium has largely either been removed/excavated as part of the gully in-fill development or lies outside the influence of the proposed Lot's and associated suitable house sites.

4.3.3 Recent Colluvium

Recent colluvium mantles the steeper potions of the moderately steep to steep gully side slopes. The recent colluvium is typically associated with relic slips and soil creep with a maximum observed depth of 2.5m, but typically less than 0.5m.

The recent colluvium has largely been removed/excavated as part of the gully in-fill developments.

4.3.4 Weathered Volcanic Ash

Weathered volcanic ash soil associated with the South Auckland Volcanic Field underlies the site to a depth of at least 3.0m.

The soil typically consists of clayey SILT which is generally very stiff to hard, moist with low to moderate plasticity and insensitive.

Down-hole shear strength testing undertaken provided an undrained shear strength of between 110kPa and >211kPa.

4.3.5 Bedrock

Refusal was met in all CPT's undertaken on a competent layer at a depth of between 5.5m and 20.5m with the depth to refusal increasing relatively uniformly from west to east. The refusal layer likely consists of competent volcanic deposits such tuff rock which is common in the local area.

Post subdivision earthwork development (current):

4.3.6 Topsoil

Topsoil mantles the 'finished' portions of the stage 2 subdivision to measured depths of between 0.1m to 0.3m.

4.3.7 Engineered Fill

Engineered fill associated with the recent subdivision bulk fill earthworks has been identified and tested within recent hand auger bore investigations and through-out the numerous NDM tests.

The engineered Fill has been placed to depths of up to 8.0m from pre-development levels, as shown on the attached as-built cut to fill plans provided by The Surveying Company Ltd.

The engineered fill largely consists of site won materials, comprising clayey SILT which is generally very stiff to hard, moist with low to moderate plasticity.

Down-hole shear strength testing undertaken within recent hand auger bores provided an undrained shear strength between 76kPa and >203kPa, with only two recordeds strengths being less than 100kPa (being less than 95th percentile of all recorded strength) indicating a well compact and suitably engineered clay fill material.

Furthermore, the recent NDM testing has provided the following fill material properties:

ENGINEERED FILL PROPERTIES AS PER RECENT TESTING				
Description	Air voids (%)		Undrained Shear Strengths (kPa)	
	Maximum single value	Average value	Minimum single value	Average Value
General Fill	14.4 (second highest value: 9.8)	8	134	150

The NDM testing undertaken to date indicates a well compact and suitably engineered clay fill material.

4.3.8 Weathered Volcanic Ash

Weathered volcanic ash soil associated with the South Auckland Volcanic Field underlies the site to a depth of at least 3.0m.

The soil typically consists of clayey SILT, which is generally very stiff to hard, moist with low to moderate plasticity, and insensitive.

Down-hole shear strength testing undertaken provided an undrained shear strength between 103kPa and >203kPa, with strengths generally increasing with depth.

4.3.9 Bedrock

Refusal was met in all CPT's undertaken on a competent layer at a depth of between 5.5m and 20.5m with the depth to refusal increasing relatively uniformly from west to east. The refusal layer likely consists of competent volcanic deposits such tuff rock which is common in the local area.

4.4 GROUNDWATER CONDITIONS

Groundwater was not encountered within any of the investigations undertaken to a depth of at least 3.0m. Groundwater is susceptible to seasonal variation, and it should be noted that the investigations were undertaken during the Spring season.

Furthermore, sub-soil drains have been installed along the basal profile of the recent gully in-fill earthworks in order to provide a basal conduit and outlet to groundwater filtration. In addition, a subsoil drain has been installed along the north-eastern ground seep feature. The subsoil drains consist of a 110mm diameter socked nova-coil drain, back-filled with GAP 65 hardfill to at least 500mm above the pipe invert.

Given the nature and topography of the site, it is unlikely that a coherent groundwater table would rise significantly to the extent that it would interfere with shallow foundations.

PART B: GEOTECHNICAL CONSIDERATIONS

5 GROUND MODEL

5.1 GENERAL

We have developed a ground model for the site based on the investigations undertaken to date, including a desktop study, site mapping, and sub-surface tests. A summary of the ground model is provided as follows in the vicinity of the proposed development:

- The site has been modified by significant bulk cut to fill earthworks from late 2019 to the present. Ongoing earthwork developments are anticipated in order to form the proposed finished topographic grades.
- The pre-development topography comprised gentle slopes and two gully features consisting of moderately steep slopes containing shallow slope instability features.
- The moderately steep slopes and associated shallow slope instability features present in the pre-development topography have been removed and re-contoured via. the recent bulk fill earthworks.
- The pre-development and post-development gently sloping topography does not display any slope instability features.
- Recent bulk earthworks have formed finished areas of gently sloping topography. The finished portion of bulk fill earthworks is associated with the northern gully in-fill. The western batters of the northern gully in-fill contains moderately steep slopes which are considered to be safe and stable in regard to long-term instability.
- The finished portions of the stage 2 subdivision is underlain by competent ground conditions consisting of natural weathered volcanic ash and engineered fill. The competent ground conditions have been mantled with a topsoil layer.
- Unfinished portions of the stage 2 subdivision exists, comprising Lots 39-46. The unfinished portions of the subdivision contain areas of steep to very steep unfinished slopes providing unstable ground and non-engineered fill which have not as yet undergone the compaction process. We anticipate the finishing works of this area to comprise removal and compaction of the non-engineered fill to an engineered standard and finished slope gradients no steeper than 1(v) on 4(h) / <15° to the horizontal.
- The site is located on gently sloping topography, which does not display any slope instability features. In addition, the site is remote from steeper slopes and slopes prone to the development of slope instability features.
- The site does not contain any surface water features, and surface water on-site is considered via sheet flow only.

- The site contains depressed groundwater levels. Groundwater inflows identified during excavation of the gully in-fill developments have been controlled via the installation of sub-soil drains. Groundwater is susceptible to seasonal variations. It is feasible that groundwater levels may rise over that measured following a period of prolonged rainfall and during the winter months but not to the extent that it would interfere with the proposed development building platform stability or foundations.
- The site is not located near an active fault zone.

The ground model developed above has been utilised to consider the various geotechnical aspects of the proposed development, presented in Section 6 of this report.

5.2 GEOTECHNICAL RISK

The ground model presented in this report is based on the investigations undertaken to date. It should be appreciated that there is an inherent risk with the formulation of a ground model. In particular, we note the following:

- Ground conditions can vary between investigations undertaken, and there is always some natural variability in ground conditions.
- Discrete sub-surface investigations may not identify small-scale ground irregularities, particularly associated with human disturbance such as offal pits, drainage line back-fills, and landscaping works.
- Ground strength varies with changes in water content, soil type, and ground loading. As such, it should be appreciated that weaker ground conditions may develop over that measured due to periods of wet weather and during the winter months.
- The potential geotechnical effects of climate change are not well defined for New Zealand. Effects may include changes in groundwater levels, soil saturation, and surface water characteristics, affecting the proposed development.

Given the potential risk profile provided above, we have adopted a conservative approach when considering the geotechnical aspects of the proposed development.

6 SUBDIVISION DEVELOPMENT

The investigations undertaken for the proposed subdivision development are intended to assess the activity against Section 106 of the Resource Management Act for subdivision consent.

It should be appreciated that the proposed large scale subdivision earthwork development have not yet been completed and as such current landform's are not final.

However, a Geotechnical Compaction Report (GCR) will be required upon subdivision completion in order to confirm the following geotechnical aspects have been achieved:

- All building platform are provided with safe and stable conditions.
- All earthworks provide competent ground conditions.

We anticipate that the currently unfinished portions of the proposed stage 2 subdivision (comprising Lots 39-46) will be recontoured into gently sloping topography with gradients no steeper than 1(v) on 4(h) / <15° to the horizontal and consist of engineered fill. Furthermore, plans provided to us by The Surveying Company indicate this to be the intention of the proposed finished development.

7 BUILDING PLATFORM DEVELOPMENT

7.1 GENERAL

The proposed stage 2 subdivision development is anticipated to provide a suitable building platform located upon gently sloping topography within all 41 of the proposed Lots (13-53). The majority of the proposed Lots presently consist of gently sloping topography within the vicinity of the prescribed "suitable house sites", however a portion of the subdivision is presently unfinished (Lots 39-46).

The following sections in this report provide recommendations on forming the building platform concerning site stability, foundation conditions, site earthworks, and stormwater management pending a specific assessment as part of the future Geotechnical Completion Report (GCR).

8 BUILDING PLATFORM STABILITY

8.1 GENERAL

Lots 13-48 & 50:

The proposed "suitable house sites" within the above Lots are located upon (or are anticipated to be located upon) broad gently sloping topography underlain by competent ground conditions and remote from steeper slopes and slopes prone to slope instability features.

The low overall slope angles and underlying competent ground conditions in the vicinity of the proposed development should provide a safe and stable building platform concerning slope stability conditions.

A safe and stable building platform is defined as having a low to negligible risk of failure over the lifetime of the development. It is assessed as a factor of safety where a quantitative slope stability assessment is undertaken. Given the low slope angles in the vicinity of the "suitable house sites", we consider that a qualitative assessment of slope stability (as provided above) is acceptable for defining risk for this site, and a more rigorous quantitative analysis is not required.

Site earthworks are required to provide a suitable level building platform within the existing slopes. We consider that appropriate site development constraints are required to maintain safe and stable conditions. This is addressed in Section 12 of this report.

Lots 49 & 51-53:

The proposed "suitable house sites" within the above Lots are located upon broad, gently sloping topography, underlain by competent ground conditions. The low overall slope angles and underlying competent ground conditions in the vicinity of the proposed development should provide a safe and stable building platform concerning slope stability conditions.

However, the "suitable house sites" are located in the general vicinity of steeper slopes associated with the northern gully in-fill side-slope/batter. These steeper slopes may provide a risk to the proposed building platform over the lifetime of the development.

As such, we have undertaken a numerical slope stability assessment of the northern gully in-fill landform to determine the effect of the gully in-fill's global stabilty and associated side-slopes on the stability of the proposed building platform, which is provided below.

8.2 NUMERICAL SLOPE STABILITY ASSESSMENT

General:

As discussed above in regard to Lots 49 & 51-53, we have undertaken numerical slope stability analysis in order to assess the effect of the gully in-fill's global stabilty and associated side-slopes on the stability of the proposed building platform.

Ground Model Set-up:

The slope stability assessment has been undertaken using SLIDE, a 2-D slope stability model using the following set-up:

- Morgenstern-Price analysis method with a half-sine side function.
- Entry and exit method of analysis optimised for the critical slip surface location.
- The critical cross-section (A-A') in terms of slope stability in the vicinity of the northern gully in-fill development (Drawing 005). The critical cross-section comprises the finished gully in-fill landform and associated ground surcharge volume.
- Piezometric line pore water pressure conditions adopted from:
    - a "best estimate" groundwater condition, considered to be a coherent groundwater depth of generally between 6 and 12m through the profile of the northern gully in-fill.
    - an "extreme" groundwater condition (considered to be the "best estimate" coherent groundwater depth +2m). The "extreme" condition is only expected for short periods following very wet conditions and is considered to provide a conservative assessment of potential maximum groundwater levels. We note the presence of an existing subsoil drain through the base of the recent gully in-fill development which should provide a basal control on groundwater levels.
- Soil parameters as follows:
    - Engineered Fill: $c' = 5kPa$, $\phi' = 35°$ & $\gamma = 18kN/m^3$ (best estimate)
    - Alluvium: $c' = 1kPa$, $\phi' = 24°$ & $\gamma = 16kN/m^3$ (best estimate)
    - Weathered Volcanic Ash: $c' = 3kPa$, $\phi' = 28°$ & $\gamma = 18kN/m^3$ (best estimate).
    - Weathered bedrock: $c' = 10kPa$, $\phi' = 40°$ & $\gamma = 20kN/m^3$ (best estimate).

On model set-up, the slope stability analysis has been progressed using the following approach:

- Carry out a forward analysis of the proposed development utilising the above model set-up under static conditions.
- Carry out a forward analysis of the proposed development utilising the above model set-up under seismic conditions. A horizontal peak ground acceleration of 0.16g has been utilised based on a 1:1000 year ULS seismic event, and a site factor of 0.65, which considers the critical landmass, is unlikely to shake as a coherent body.

Factor of Safety Standards:

The results of the slope stability assessment are shown in the appendices and show "worst-case" potential failure surfaces for a variety of conditions. When assessing the factors of safety (FoS), we have adopted the following approach:

- A FoS of ≥ 1.5 is considered to provide acceptable long-term stability conditions for a building platform under static conditions.
- A FoS of ≥ 1.3 is considered to provide acceptable short-term stability conditions for a building platform under static conditions.
- A FoS of ≥ 1.0 is considered to provide acceptable stability conditions for a building platform under seismic conditions.

The assessment includes all failure surfaces which in totality or partly underlie the proposed development. All other failure surfaces have been ignored unless they provide a material impact on the development, such as failure surfaces which daylight up-slope of the development and may provide a slope debris issue.

The calculated FoS does not include the potential for slope failure outside of the building platform, altering the slope geometry and slope stability conditions. As such, any significant changes in the slope profile that develops in the building platform's vicinity should be immediately reported to a suitably qualified person.

Results:

According to the above standards, the numerical slope stability results (Appendix C) indicate that the proposed development and northern gully in-fill should provide a safe and stable building platform concerning overall stability conditions. However, the gully in-fill side-slopes are considered to be at risk from the regression of slope instability features over the lifetime of the development. As such, we recommend the following to provide safe and stable conditions:

- "Suitable house sites" within Lots 49 & 51-53 are located at least 5.0m back from the upper edge of the gully in-fill side-slope/batter. Should a 5.0m set-back be maintained break of slope between gentle and moderately steep to steep slopes, and as such are considered to be outside the influence of long-term slope regression (erosion and/or soil shrink/swell creep). \

Encroachments within the 5.0m set-back zone is feasible but requires specific geotechnical assessment, likely resulting in specific foundation design recommendations such as soil instability retention depths whereby the foundation line is founded below the depth of soil instability influence.

Further to the above discussions, the finished condition and stability of proposed "suitable house sites" is anticipated to be addressed in a final assessment as part of the subdivisions Geotechnical Completion Report (GCR). However, we anticipate the conclusions to largely be the same as that assessed above (should all recommendations of this report be followed).

9 BEARING CAPACITY

9.1 GENERAL

Bearing capacity is discussed in this report in terms of ultimate limit state design methods outlined in AS/NZS 1170. As such, per AS/NZS 1170, we have provided "ultimate" bearing capacity values and an appropriate "dependable" bearing capacity for foundation design pending a specific assessment as part of the subdivision's GCR. The dependable bearing capacity has been determined from a strength reduction factor of 0.5 (i.e., a factor of safety of 2), which is in general accordance with the requirements of AS/NZS 1170.

Our interpretation of the engineering description of the soil conditions and relative density and strength measurements based on the site-specific testing undertaken has determined the bearing capacity. The values presented consider natural variability of ground strength likely between investigations undertaken and potential strength reduction associated with saturated soil conditions.

It is also assumed that engineering fill will be placed to specification to provide an ultimate bearing capacity of 300kPa.

9.2 SHALLOW PAD/STRIP FOOTING AND SLAB FOUNDATION SOLUTION

Table 2 outlines design bearing capacities for a shallow pad/strip footing solution. The design capacities are based on a minimum foundation embedment depth of 450mm into competent ground.

TABLE 2: SHALLOW PAD/STRIP FOOTING DESIGN PARAMETERS

LOAD CASE	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	DEPENDABLE BEARING CAPACITY
Ultimate limit state design	300kPa	0.5	150kPa

The embedment depth of 450mm into competent ground provides sufficient bearing capacity, as outlined in the table above. The 450mm embedment depth may not adequately address soil expansivity issues (if any), and Section 10 of this report should be referred to with providing an appropriate embedment depth to mitigate expansive soil.

9.3 RIB-RAFT /WAFFLE SLAB SOLUTION

Table 3 outlines design bearing capacities for a rib-raft/waffle slab solution.

TABLE 3: RIB-RAFT/WAFFLE SLAB DESIGN PARAMETERS

LOAD CASE	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	DEPENDABLE BEARING CAPACITY
Ultimate limit state design	300kPa	0.5	150kPa

The rib-raft/waffle slab should also account for soil expansivity (if any), as outlined in Section 10 of this report.

9.4 SHALLOW PILE FOUNDATION

Table 4 outlines design bearing capacities for a shallow pile foundation solution for lightweight timber structures and appurtenant structures. The design capacities are based on a minimum foundation embedment depth of 450mm into competent ground.

TABLE 4: SHALLOW PILE FOUNDATION DESIGN PARAMETERS

END BEARING CASE			
LOAD CASE	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	END DEPENDABLE BEARING CAPACITY
Ultimate limit state design	300kPa	0.5	150kPa
AUGURED PILE SKIN FRICTION (FOR NON-EXPANSIVE SOIL)			
LOAD CASE	-	STRENGTH REDUCTION FACTOR	DEPENDABLE SKIN FRICTION
Ultimate limit state design	-	0.5	20kPa

The embedment depth of 450mm into competent ground provides sufficient bearing capacity, as outlined in the table above. The 450mm embedment depth may not adequately address soil expansivity issues (if any), and Section 10 of this report should be referred to with providing an appropriate embedment depth to mitigate expansive soil.

9.5 FOUNDATION SERVICE BRIDGING

We recommend that where a service line and associated backfilled trench are located within a 45° loading line taken from a load-bearing structure base, foundation bridging is required.

Service line trenching and backfilling should be per recommendations provided in Section 12 of the report.

The design bearing capacities for a bridging pile foundation solution can be taken from the above tables to the maximum depth of the investigations undertaken. Should deeper piles be required, specific investigations may be required as determined by a suitably qualified person. Skin friction should be ignored for the section of piles within the 45-degree zone of influence of the service line (projected from the pipe's invert to the ground surface).

The piles' clearance requirements and depths should be designed according to the council's construction clearance provisions.

9.6 RETAINING WALLS

Engineered retaining walls will be required on-site under the following circumstances:

- where the retention height is greater than 1.5m;
- where retaining wall supports any surcharged loads such as sloping ground and structure/traffic loads; and

- where retaining wall failure will affect the stability and integrity of adjacent structures and neighbouring properties.

Table 5 provides geotechnical parameters for the engineered retaining wall design as required:

TABLE 5: RETAINING WALL DESIGN PARAMETERS

COHESION (c')	FRICTION ANGLE (ϕ')	DESIGN c_u (COHESIVE SOIL)	ULTIMATE BEARING CAPACITY	UNIT WEIGHT (γ)
0kPa	32°	50kPa	300kPa	18kN/m^3

All retaining walls should be constructed with appropriate toe drainage and backfilled to their full height with lightly compacted free-draining granular material or other appropriate drainage solution. Toe drainage should be discharged at a point that will not impact or influence the construction works on-site or be connected to the reticulated stormwater system.

As usual, any building foundations laterally located within a 45-degree envelope of influence arising from the base of a batter or retaining wall should be subject to a specific design that does not induce unacceptable stresses in such batters or retaining walls. Clause 3.1.2 (b) of NZS3604:2011 also places restrictions on the proximity of building foundations from unretained batters. Where foundations will lie on the lower side of such walls, care should be taken to ensure that the active wedge behind any associated excavation does not remove support to the passive wedge supporting those walls. As such, foundations should be no closer than 'the height of the adjacent retaining wall plus the depth of foundation below ground level.

10 GROUND SETTLEMENT

10.1 GENERAL

The proposed development is underlain by competent ground conditions. The competent ground conditions are considered to be at least normally consolidated and should accommodate low to moderate loads without inducing significant ground consolidation and associated differential ground settlement within Building Code limits (a maximum differential settlement ratio of 1 in 240).

As a prudent measure, however, ground loading constraints are recommended as follows:

- A maximum building uniform distributed load (UDL) of 12kPa, including live + dead loads (limits overall building loads).
- A maximum footing width/diameter of 1.0m (limits the extent of high point, pad and line loads.
- A maximum fill depth of 1.5m (limits the load provided by fill soil).

Should the proposed development exceed these constraints, we recommend that a specific settlement analysis be undertaken for the development and may require more extensive investigations than that undertaken to date.

Furthermore, recent bulk earthworks associated with the gully in-filling is considered to provide negligible levels of primary and secondary settlement in-line with code limits; this being due to weak/compressible soils being excavated as part of the gully in-fill development (as observed and inspected by GCL).

11 SOIL EXPANSIVITY

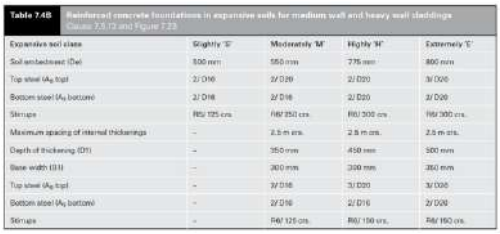
11.1 GENERAL

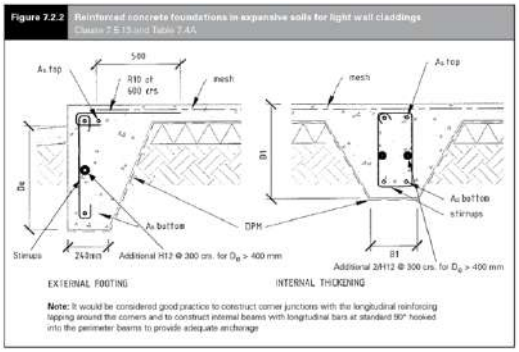
The site soil is considered to be susceptible to the development of soil shrink/swell associated with changes in soil moisture content. Based on the logging of recovered hand auger bore core samples, we consider the site soil to be moderately expansive (Class M) according to AS 2870.

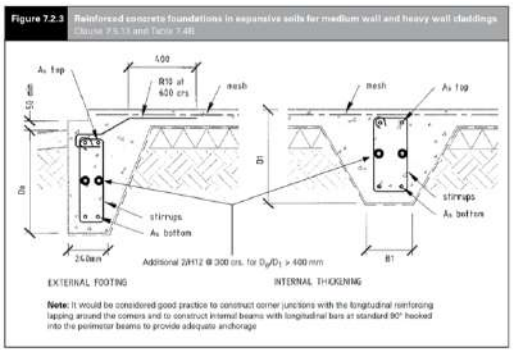
The soil expansivity class is based on our experience of the type of soils encountered on-site and is considered to provide a suitable qualitative assessment of soil shrink/swell.

The proposed development foundation design should resist shrink/swell associated with Class M soil according to AS 2870. This includes controls on foundation embedment depth, foundation reinforcing, slab thickening, and slab mesh determined from the building cladding and foundation type.

Alternatively, foundation design can adopt MBIE Acceptable Solution B1/AS1. Below are extracts from B1/AS1 for a conventional reinforced concrete floor slab and strip footings.







In addition to the above measures, it is recommended that the earthworks subgrade within the footprint of the development be maintained at or close to its natural water content to avoid drying out and associated shrinkage of the subgrade. As such, consideration should be given to wetting up the building platform before constructing the floor slab. In addition, the prepared building platform should be covered where the development will not be immediately constructed.

11.2 SPECIFIC TESTING

Specific testing of soil expansivity class will be undertaken as part of the final GCR.

12 SEISMIC CONSIDERATIONS

12.1 SEISMIC SOIL CLASS

Site investigations in the vicinity of the building platform have identified fine grain soils associated with the South Auckland Volcanic Field in addition to relatively shallow weathered bedrock profiles (of between

6.0m to 21.0m from pre-development levels). As such, we consider the site sub soil class C is appropriate according to NZS1170.5.

12.2 LIQUEFACTION

A specific assessment of site liquefaction based on the site CPT's carried out has not been undertaken as part of this report. This is due to the low to nil risk of liquefaction developing given the following:

- The soil profile is fine-grained in nature.
- The high strength/density soil profile including relatively shallow bedrock.
- Depressed groundwater regime.

13 SITE DEVELOPMENT CONSTRAINTS

13.1 GENERAL EARTHWORKS DISCUSSION

The proposed site development works will likely require excavation and or temporary batters before constructing formal retaining structures, building platforms, and access roads and driveways. There is the risk of collapse of soil batters during construction, especially if left unsupported for an extended period and or left exposed during a prolonged period of rainfall. Therefore, we recommend the following precautions:

- Cut faces should not be left unsupported for an extended period and may require additional protection with polythene sheeting during inclement weather.
- Where excavations are immediately adjacent to or situated on a property boundary, further precautions may be required to ensure stability through temporary buttressing. These works should be assessed and approved by a suitably qualified person.
- The contractor is expected to employ the appropriate plant and machinery to undertake the excavation and retaining wall construction.
- The contractor is responsible for ensuring that all necessary precautions are undertaken to protect exposed temporary batters.
- Appropriate silt and stormwater control measures should be employed.

The topsoil is considered unsuitable for reuse as engineered fill. The site won soil is likely to provide a source of material for fill placement subject to its performance per NZS 4431:1989.

13.2 SITE PREPARATION

During the earthworks operations, all topsoil and organic matter, and other unsuitable materials should be removed from the construction areas per the recommendations of NZS 4431:1989. The subgrade should be inspected before fill being placed and or foundations being constructed to establish it has a suitable bearing capacity and is clear of unsuitable materials.

Appropriate shallow graded sediment control measures should be installed during construction where rainwater and drainage run-off overexposed soils are likely. If slope gradients over 5% are proposed in soils, then the construction and lining of drainage channels are recommended, e.g., geotextile and suitably graded granular material, or similarly effective armouring.

Exposure to the elements should be limited for all soils, and covering the soils with polythene sheeting will reduce degradation due to wind, rain, and surface run-off. Under no circumstances should water be allowed to pond or collect near or under a foundation or slab. This can be avoided with the shaping of the subgrade to prevent water ingress or ponding.

If fill is utilised as bearing for foundations, it should be placed and compacted per the recommendations of NZS 4431:1989 and certification provided to that effect.

The upper soils present at the site are prone to erosion, both by wind and water, and should be protected by hardfill capping or re-topsoiled/mulched and re-vegetated as soon as the finished batter or subgrade levels are achieved.

Where the building platform has been rutted by heavy machinery or softened due to ponded rainwater, the platform should be trimmed back to competent ground and reinstated with compacted hardfill to design subgrade level before the commencement of building construction.

13.3 EXCAVATIONS

Recommendations for temporary and permanent slope batters are provided in Table 6 below. Slopes required to be steeper than those described below should be structurally retained or subject to specific geotechnical design.

All slopes should be periodically monitored during construction for signs of instability and excessive erosion, and, where necessary, corrective measures should be implemented to the satisfaction of a Geotechnical Engineer or Engineering Geologist. Should construction and earthworks be undertaken during the winter period, the frequency of the inspections should increase, with site inspections being made after any significant weather event.

Seepages are common in excavations completed in hillside areas, and drainage measures, such as horizontal drains may be required if excessive groundwater seepages are encountered during excavation. The final design and location of all sub-soil drainage works should be confirmed during construction by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist.

Recommended temporary and permanent batter angles for cut slopes up to a maximum of 3.0m in wet and dry conditions are presented below. The batters provided should be adhered to where more than one soil type is present within the slope or defaulted to the shallower angle where appropriate.

TABLE 6: BATTER ANGLES FOR SOIL SLOPES

MATERIAL TYPE	RECOMMENDED MAXIMUM BATTER ANGLES FOR TEMPORARY CUT SLOPES FORMED IN SOILS		RECOMMENDED MAXIMUM BATTER ANGLES FOR PERMANENT CUT SLOPES FORMED IN DRY (DRAINED) SLOPES
	WET GROUND	DRY GROUND	
Engineered Fill	2H:1V	1H:1V	2H:1V (unretained, drained)
Weathered Volcanic Ash	2H:1V	1H:1V	2H:1V (unretained, drained)

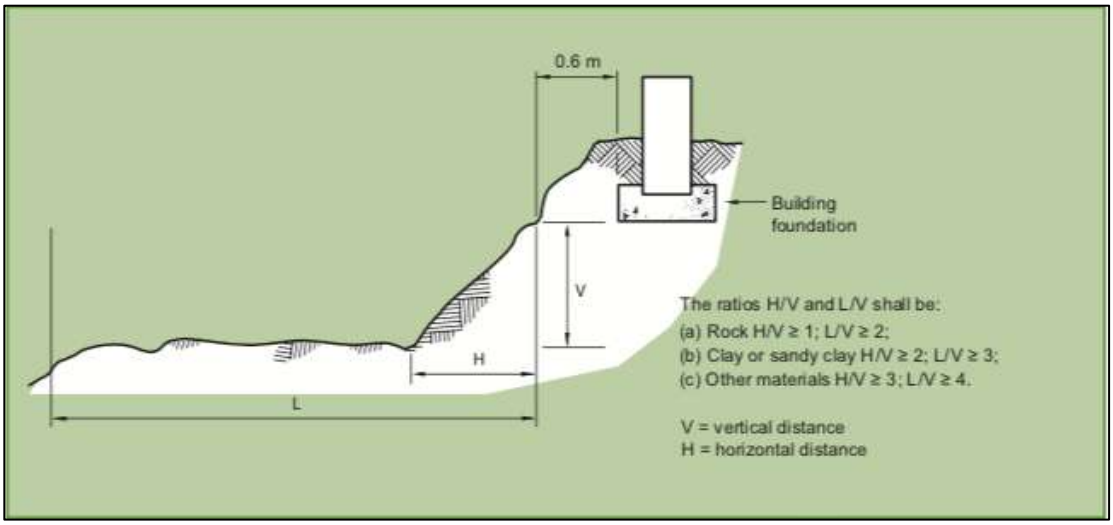
Inspections of soil cuts will be required during construction to confirm the above recommendations. Based on the site observations, a reduction in batter angles from those provided above may be required. Conversely, if materials are performing, they may be steepened if site conditions and construction sequencing/programme are favourable.

13.4 ENGINEERED FILL SLOPES

As recommended in Table 6 above, unretained engineered fill slopes should be formed at 2H:1V (or flatter), providing they are well-drained and compacted to the appropriate specification based on NZS 4431:1989. If steeper grades are required, the fill will require geogrid reinforcement to form slopes up to 45° but subject to specific engineering design from a chartered professional engineer.

13.5 FOUNDATION PROVISIONS (NZS 3604)

Regarding NZS 3604, Section 3.1.2 (b), any foundation for a building erected at the top of a bank shall be 600mm behind the ground line, as shown in the figure below. The horizontal distance (H) from top to bottom shall not exceed 3m. The slope beyond the bank shall not exceed 10° degrees for a distance of 10m.



Regarding NZS 3604, Section 3.1.2 (c) fill, including hard fill, placed over undisturbed ground or certified fill, shall not exceed 600mm in depth above natural ground level, if within 3m of a foundation. Where this condition cannot be met, the fill shall be tested and certified to be of appropriate density/strength.

13.6 CONSTRUCTION MONITORING AND CERTIFICATION

Given the extent of the earthworks and the volume of cut and fill required for the site, including the building platform, the earthworks, and placement of fill should be undertaken in general accordance with the council's Land Development Code of Practice (incorporating NZS 4404 and NZS 4431).

Of particular importance are the inspection and certification of the following:

- Subgrade inspection.
- Suitability of site won material for reuse and engineered fill.
- Performance of temporary cut batters.
- Foundation inspections.
- Hardfill >300mm depth or built as a slope >2H:1V.

13.7 SERVICES

We recommend that all underground services are backfilled with adequately compacted backfill to minimise significant trench consolidation and settlement risk.

Trench excavations should be shored or battered appropriately per the OSH/DOL Approved Code of Practice for Safety in Excavations and Shafts for Foundations (April 2000).

The contractor is expected to employ the appropriate plant and machinery to undertake the excavation and retaining wall construction.

13.8 UNSUITABLE MATERIALS

Recommendations for foundation design provided in Section 7 of this report are based on foundations embedded within "good ground" according to NZS 3604:2011. To achieve "good ground", we recommend the following:

- A suitably qualified person should inspect all foundation excavations.
- Care should be taken to ensure that all unsuitable material such as the topsoil layer, weak ground, areas of non-engineered fill, and or hard spots are removed from the building platform before building construction.

- The undercut for the building footprint should extend for a horizontal distance equivalent to the undercut depth beyond the footprint. The undercut should be backfilled with engineered fill up to the required formation-level unless specified otherwise by a suitably qualified person.

13.9 STORMWATER MANAGEMENT CONCERNING SLOPE STABILITY

A specific stormwater management assessment has not been undertaken as part of this report. However, we recommend that stormwater disposal should comply with the operative District/Regional Plans and the Building Code and, in particular, meet the following conditions:

- The disposal of stormwater should not provide a nuisance to neighbouring properties and public infrastructure.
- Stormwater should be managed in such a way as to avoid slope erosion, earthworks batters, retaining walls, building structures, and effluent disposal areas.
- Stormwater should be managed in such a way as to have no significant effect on overall slope stability conditions.
- Site development should be mindful of existing surface water features, including overland flow paths, and appropriate remedial measures should be provided where required.

14 NATURAL HAZARDS RISK ASSESSMENT

Per Section 106 of the Resource Management Act, we have undertaken a qualitative natural hazards risk assessment for the development. The natural hazard consequence and the likelihood of occurrence have been assessed using the overall risk matrix as shown in Table 7, with the risk classifications defined in Table 5.

TABLE 7: RISK MATRIX

POTENTIAL CONSEQUENCES	LIKELIHOOD				
	VERY UNLIKELY (0 – 5%)	UNLIKELY (5 – 45%)	POSSIBLE (45 – 55%)	LIKELY (55 – 95%)	ALMOST CERTAIN (95 – 100%)
SEVERE	Low	Low	Moderate	High	Very high
MODERATE	Negligible	Low	Moderate	Moderate	High
MINOR	Negligible	Low	Low	Moderate	Moderate
NEGLIGIBLE	Negligible	Negligible	Negligible	Low	Low

TABLE 8: SUMMARY OF RISK CLASSIFICATION

RATING SCALE	SECTION 106 COMLIANCE	DISCUSSION
VERY HIGH	Non-compliant	There is a high probability that severe damage to the proposed house site could arise from an identified source without appropriate remedial action
HIGH	Non-compliant	The proposed house site is likely to experience significant damage from an identified source without remedial action
MODERATE	Non-compliant	It is possible that damage could arise to the proposed house site, but it is unlikely that such damage would be significant

RATING SCALE	SECTION 106 COMLIANCE	DISCUSSION
LOW	Compliant	It is possible that damage could arise to the proposed house site from an identified source though this is likely to be mild or unlikely
NEGLIGIBLE	Compliant	The presence of the identified source does not give rise to the potential to cause significant damage to the proposed house site

Table 9 shows a risk register for the development and appropriate mitigation measures if applicable based on Tables 7 & 8.

TABLE 9: RISK REGISTER

RISK	POTENTIAL CONSEQUENCES	LIKELIHOOD	RISK CLASSIFICATION	COMMENT	MITIGATION MEASURES
SLOPE INSTABILITY	Severe	Very unlikely	Low	See Section 5.2	5m setback from moderately steep batter
GROUND SUBSIDENCE	Severe	Very unlikely	Low	See Section 6	n/a
SOIL SHRINK/SWELL	Moderate	Likely	Moderate	See Section 6.4	Engineered foundations designed for Class M soil expansivity
EARTHQUAKE/ LIQUEFACTION	Severe	Unlikely	Low	See Section 12.2	n/a
FLOODING	Minor	Very unlikely	Negligible	Elevated site remote from surface water features	n/a
TSUNAMI	Minor	Very unlikely	Negligible	Elevated site remote from the ocean	n/a
VOLCANIC ERUPTION/ASHFALL	Moderate	Unlikely	Low	Remote from active volcanic centre	n/a

Table 9 indicates the risk classification for the identified natural hazards is low to negligible for all risks apart from "soil shrink/swell", where appropriate mitigation measures can be reasonably provided. As such, we consider the development fulfils Section 106 of the Resource Management Act.

15 LIMITATIONS

15.1 GENERAL

Ground Consulting Ltd has undertaken this assessment per the brief as provided, based on the development location shown in Drawing 002. This report has been provided for the benefit of our client and for the authoritative council to rely on to process the consent for the specific project described herein. No liability

is accepted by this firm or any of its directors, servants, or agents in respect of its use by any other person, and any other person who relies upon the information contained herein does so entirely at their own risk.

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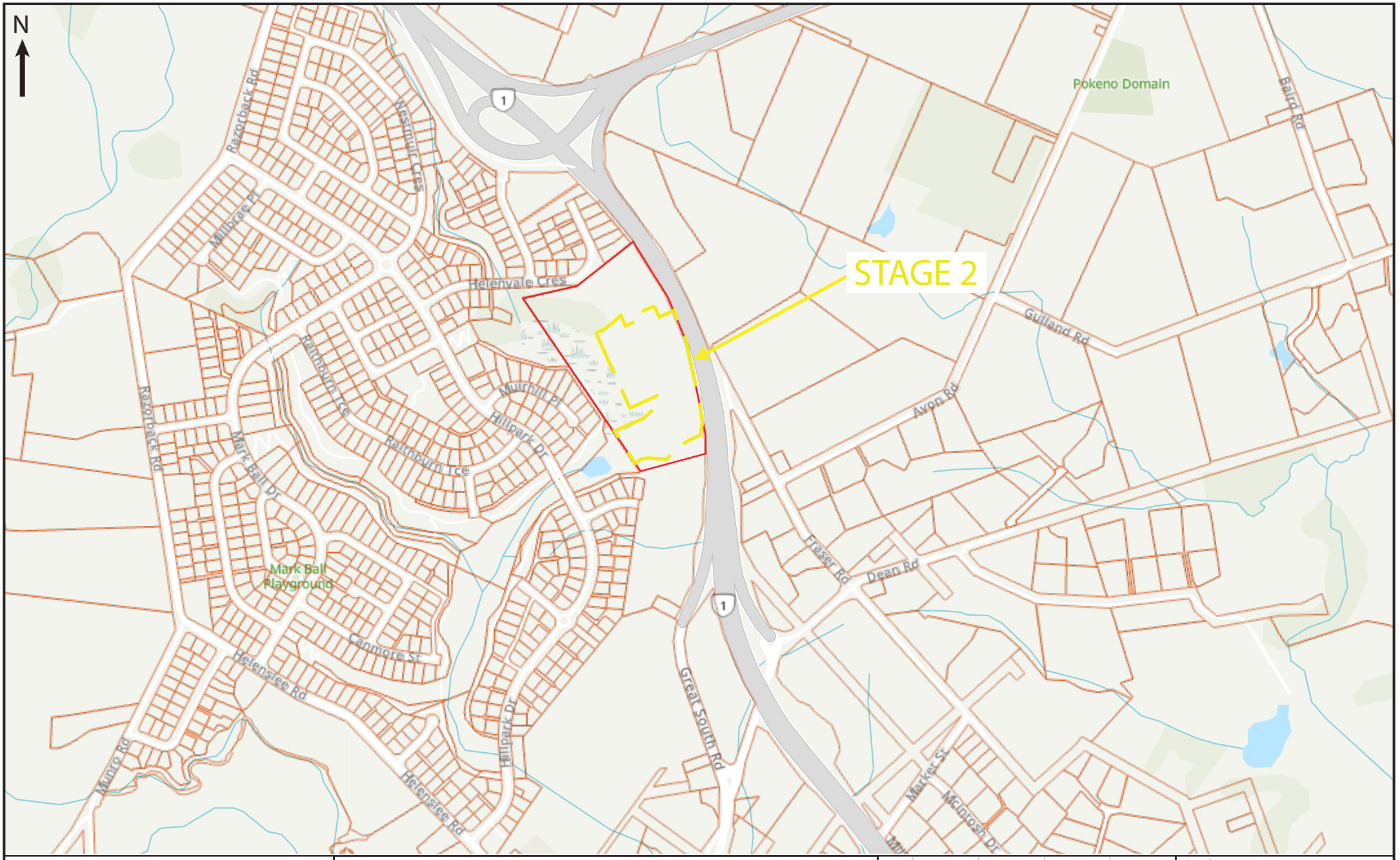
The sub-surface conditions have been extrapolated between the investigations undertaken. Whilst care has been taken to provide sufficient sub-surface information following best practice, no guarantee can be given on the validity of the inference made, and it must be appreciated that actual conditions could vary from the assumed model.

15.2 FURTHER INVESTIGATIONS REQUIRED

This assessment has been undertaken for the proposed site development to date. Any structural changes, alterations, and additions made to the proposed development should be checked by a suitably qualified person and may require further investigation and analysis.

Geotechnical inspections will be required during construction to assess site slopes, foundation excavations, retaining walls, and other geotechnical aspects of the development. This is to ensure ground conditions encountered are per the findings of this assessment. If ground conditions differ from those presented in this report, advice on design and construction modifications should be sought from a suitably qualified person.

DRAWINGS



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34 POKENO ROAD, POKENO, WAIKATO

SITE LOCATION PLAN

Rev	Date	Status	Drafted	Reviewer
A	01/11/2021	Issued	L.K	F.W

File Ref. MAC://Projects_7500/7615/R7615-1A/R7615-1A-DRW001.ai

Scale (A4) 1:9,000

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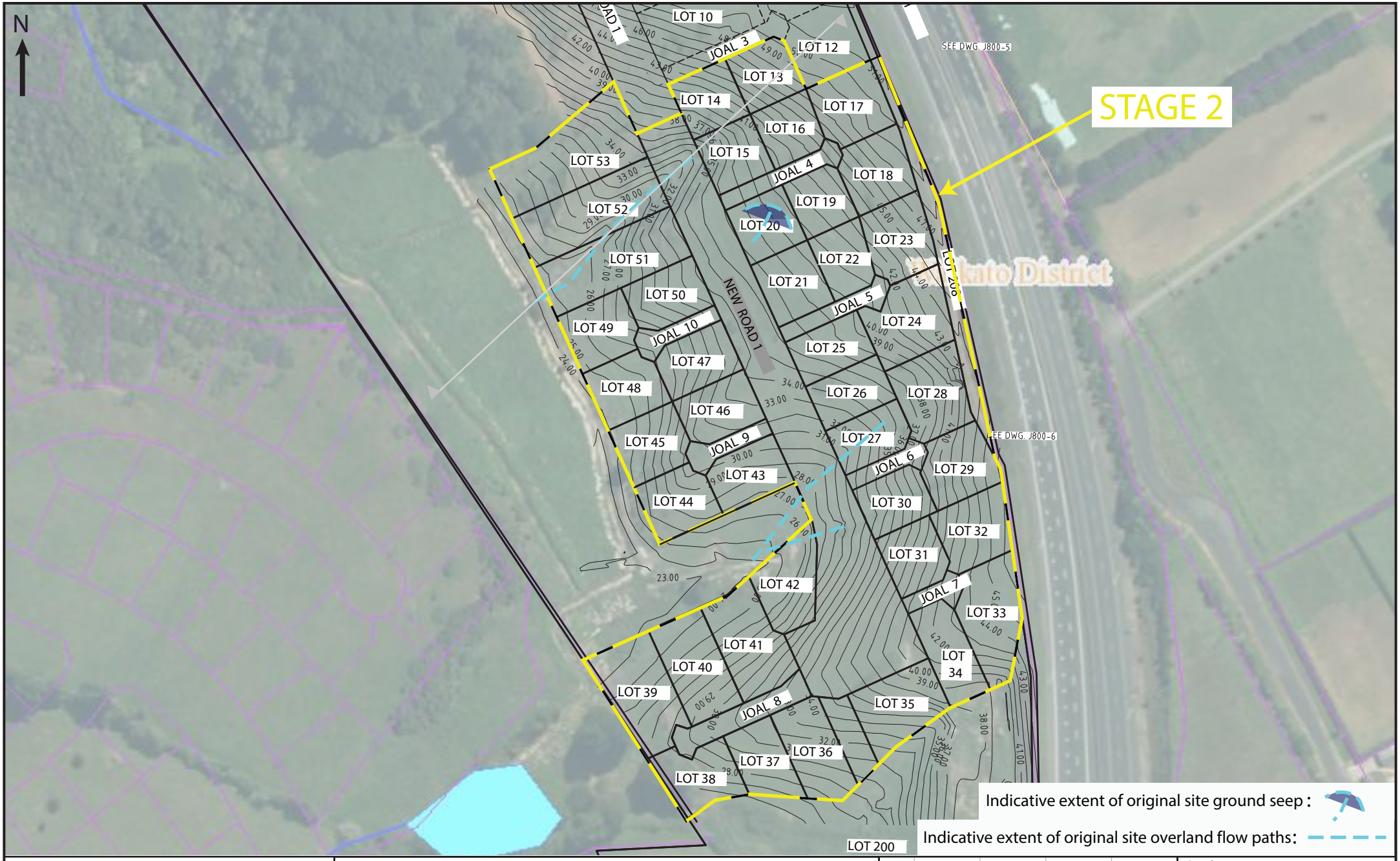
Project No. 7615

Report Ref. R7615-1A

Drawing No. 001



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34 POKENO ROAD, POKENO, WAIKATO

ORIGINAL TOPOGRAHPY - SUBDIVISION LAYOUT PLAN

Rev	Date	Status	Drafted	Reviewer
A	01/11/2021	Issued	L.K	F.W

File Ref. MAC://Projects_7500/7615/R7615-1A/R7615-1A-DRW002.ai

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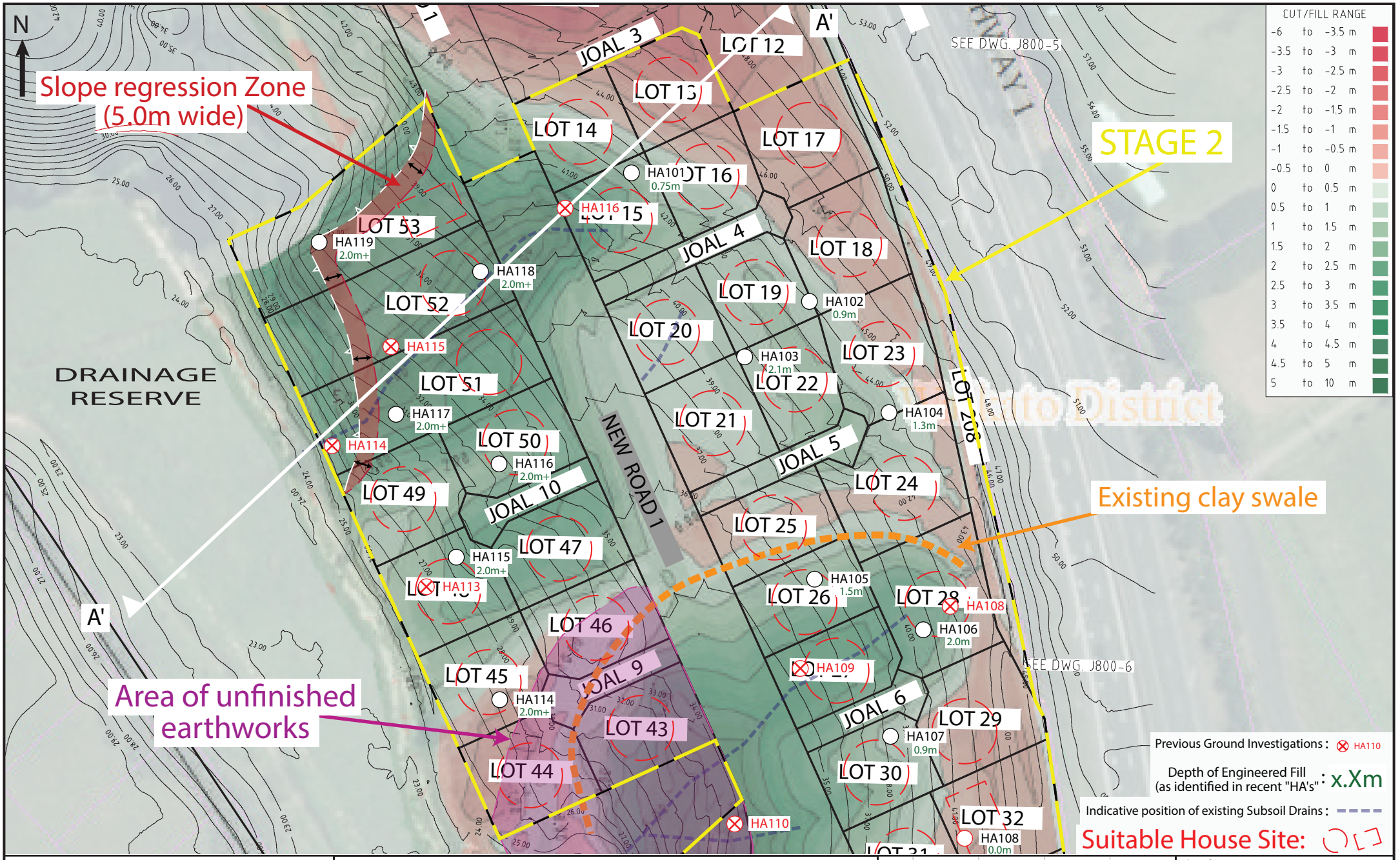
Project No. 7615

Report Ref. R7615-1A

Drawing No. 002



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34 POKENO ROAD, POKENO, WAIKATO

EXISTING TOPOGRAHPY - SUBDIVISION LAYOUT PLAN

Rev	Date	Status	Drafted	Reviewer
A	01/11/2021	Issued	L.K	F.W

File Ref. MAC://Projects_7500/7615/R7615-1A/R7615-1A-DRW003.ai

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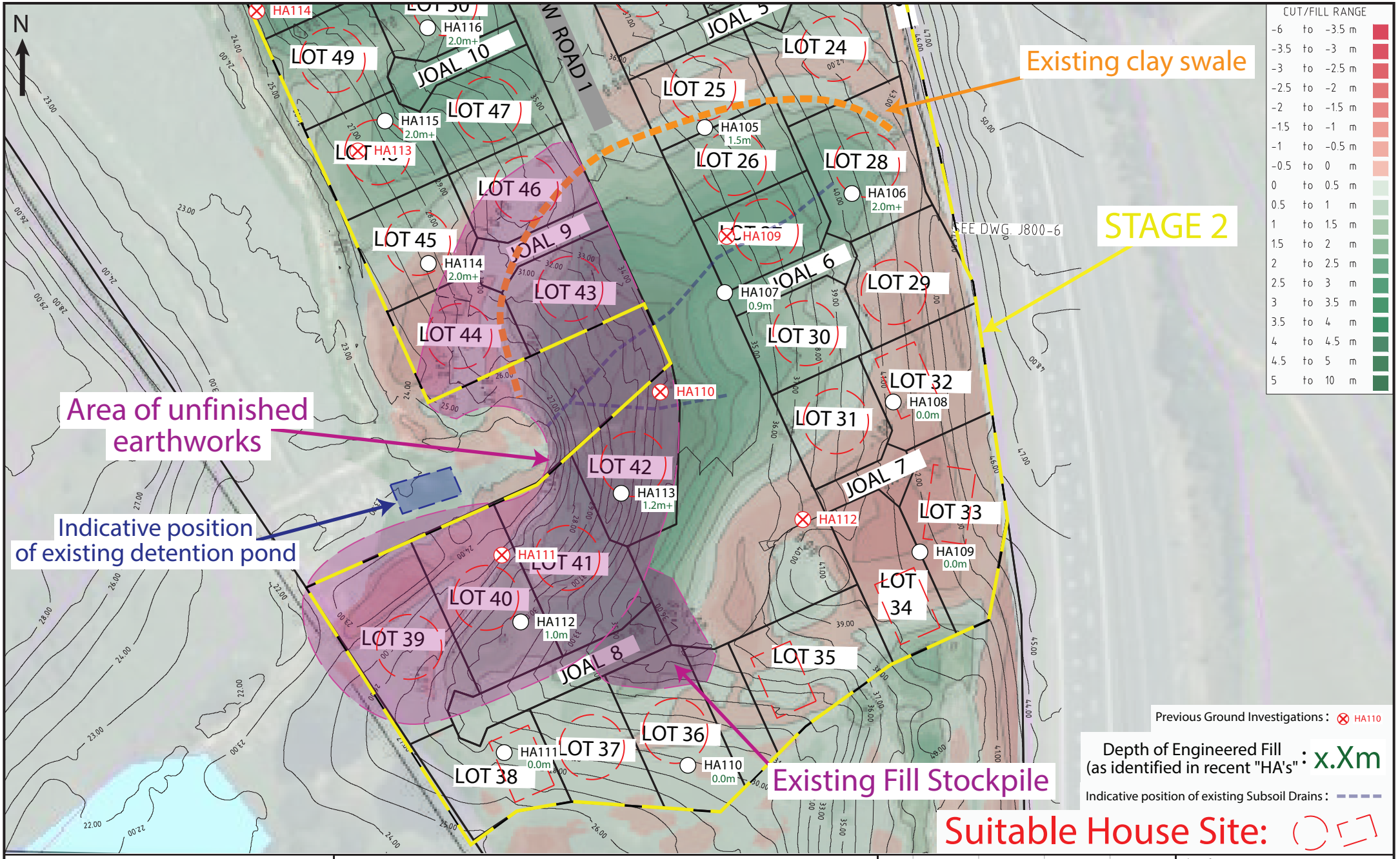
Project No. 7615

Report Ref. R7615-1A

Drawing No. 003



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34 POKENO ROAD, POKENO, WAIKATO

EXISTING TOPOGRAPHY - SUBDIVISION LAYOUT PLAN

Rev	Date	Status	Drafted	Reviewer
A	01/11/2021	Issued	L.K	F.W

File Ref. MAC://Projects_7500/7615/R7615-1A/R7615-1A-DRW004.ai

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Project No. 7615

Report Ref. R7615-1A

Drawing No. 004

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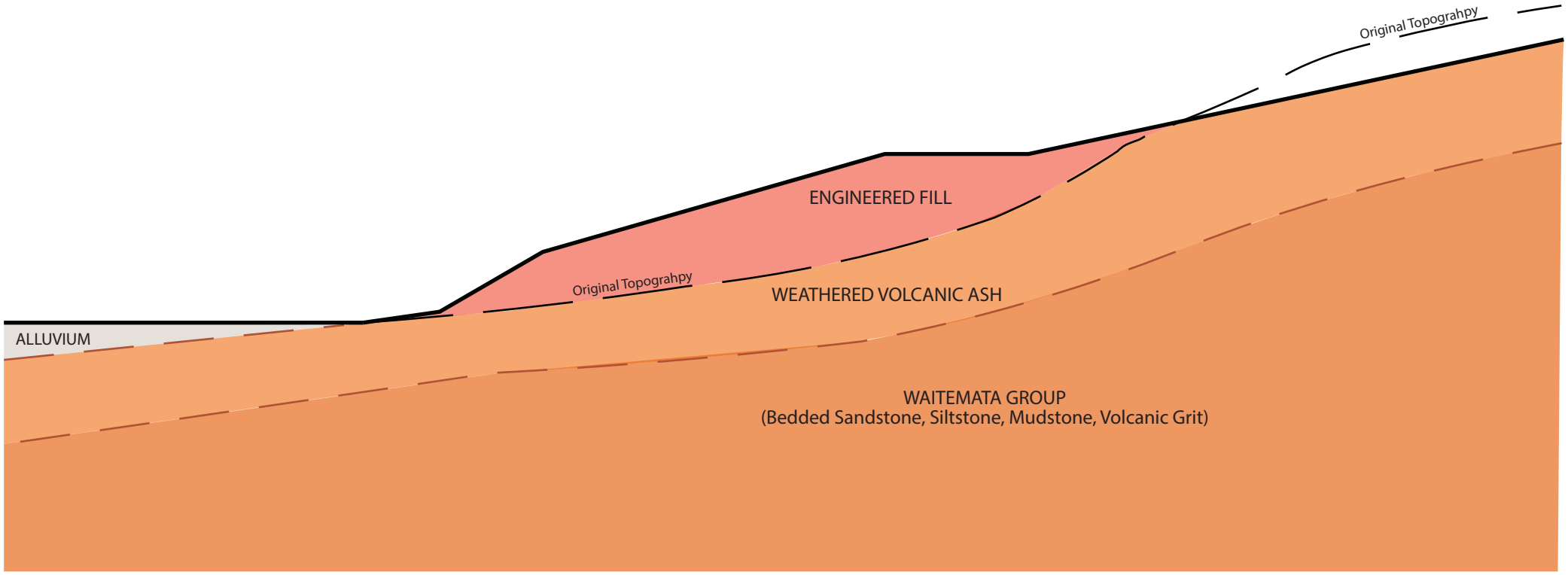

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34 POKENO ROAD, POKENO, WAIKATO

NORTHERN GULLY IN-FILL SLOPE STABILITY CROSS-SECTION

Rev	Date	Status	Drafted	Reviewer
A	01/11/2021	Issued	L.K	F.W

File Ref. MAC://Projects_7500/7615/R7615-1A/R7615-1A-DRW005.ai

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Project No. 7615

Report Ref. R7615-1A

Drawing No. 005

APPENDIX A: INVESTIGATION LOGS

INVESTIGATION LOG

HA101

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:3052, Vane Size: 19mm) Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.				
ENGINEERED FILL	Clayey SILT; orange mixed light brownish orange. Very stiff; moist; low to moderate plasticity.		136 74 133 90		
Weathered Ash	Clayey SILT; light brownish orange mottled orange. Very stiff; moist; Moderate plasticity.	1	>189 - >189 - >189 - 176 87 >189 -		
	End of Investigation: 2m Target depth	2	149 109		

Vane Shear Strength scale: 50 100 150 200

Scala Penetrometer scale (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA101

INVESTIGATION LOG

HA102

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Values (kPa)
Topsoil	TOPSOIL.		
ENGINEERED FILL	Clayey SILT; orange mixed light brownish orange. Very stiff; moist; low to moderate plasticity.		>189 - UTP - >189 87
	0.8m - 0.9m: With trace topsoil.		
Weathered Ash	Clayey SILT; light brownish orange mottled orange. Very stiff; moist; Moderate plasticity.	1	>189 87 >189 87 154 87 >189 109 >189 -
	1.8m: Becomes reddish orange.		
	End of Investigation: 2m Target depth	2	

Vane Shear Strength — Vane No:3052, Vane Size: 19mm (50, 100, 150, 200)

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA103

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			TS				
ENGINEERED FILL	Clayey SILT; orange mixed light brownish orange. Very stiff; moist; low to moderate plasticity.		1			>189 - >189 - >189 87 >189 87 >189 87 122 47 133 63 98 66		
	1.9m - 2.1m: With trace topsoil.		2					
ther ed	Clayey SILT; light brownish orange mottled orange. Very stiff; moist; Moderate plasticity.							
	End of Investigation: 2.2m Target depth							

Investigation Information

Depth	2.2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA104

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
ENGINEERED FILL	Clayey SILT, with minor sand; light brownish orange mixed light grey. Very stiff; dry to moist; moderate plasticity.	1		>189 47 >189 47 >189 47 154 122		
	1.2m - 1.3m: With trace topsoil.					
Weathered Ash	Clayey SILT; light brownish orange mottled orange. Very stiff; moist; Moderate plasticity.	2		109 63 >189 -		
	End of Investigation: 2m Target depth					

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA104

INVESTIGATION LOG

HA105

Report Ref R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			TS		>189		
ENGINEERED FILL	Clayey SILT, with trace sand; orange mixed light brownish orange. Very stiff; moist; moderate plasticity.		1			149 111 >189 >189		
	End of Investigation: 1.5m Effective refusal		2					

Investigation Information

Depth	1.5m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA106

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			>189		
				122		
ENGINEERED FILL	Clayey SILT; brownish orange mixed light grey and orange. Very stiff; moist; low to moderate plasticity.			>189		
				122		
				>189		
				122		
		1		176		
				141		
				122		
				58		
	End of Investigation: 2m Target depth	2		>189		
				-		

Vane Shear Strength: 50 100 150 200

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	ffective refus	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA107

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			TS				
ENGINEERED FILL	Clayey SILT; brownish orange mixed light grey and orange. Very stiff; moist; low to moderate plasticity.					>189 141 >189 141 >189 141		
Weathered Ash	Clayey SILT, with trace [set a composition]; brown . Very stiff; moist; moderate plasticity.		1			>189 -		
	End of Investigation: 2m Target depth		2			>189 -		

Vane Shear Strength: 50 100 150 200

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA107

INVESTIGATION LOG

HA108

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			TS				
Weathered Ash	Clayey SILT; reddish orange. Very stiff; moist; moderate plasticity.		1			141 98 149 114 138 87		
	End of Investigation: 2m Target depth		2			>189 -		

Vane Shear Strength: 50 100 150 200

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA108

INVESTIGATION LOG

HA109

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; orange brown. Stiff; moist; low to moderate plasticity, moderate sensitivity to insensitive.	
Weathered Ash	Clayey SILT; reddish brown. Stiff to very stiff; moist; moderate plasticity, insensitive.	1
	End of Investigation: 2m Target depth	2

Samples | Legend | Vane Shear Strength (Vane No:1938, Vane Size: 19mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater

Values (kPa)
180
67
160
105
163
119
125
67

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA109

INVESTIGATION LOG

HA110

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Values (kPa)
Topsoil	TOPSOIL.		
Weathered Ash	Clayey SILT; light brownish orange. Very stiff; moist; moderate plasticity; natural ground.		>189 -
		1	173 127
			130 71
	End of Investigation: 2m Target depth	2	176 92

Vane Shear Strength — Vane No:3052, Vane Size: 19mm (50, 100, 150, 200)

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA110

INVESTIGATION LOG

HA111

Report Ref R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No:3052, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			TS				
Weathered Ash	Clayey SILT; light brownish orange. Very stiff; moist; moderate plasticity; natural ground.		1			165 136 179 146 136 101		
	End of Investigation: 2m Target depth		2			149 103		

Vane Shear Strength: 50 100 150 200

Scala Penetrometer: 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

GCL Ground Consulting Ltd

HA112

Report Ref	
R7615-1A	

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

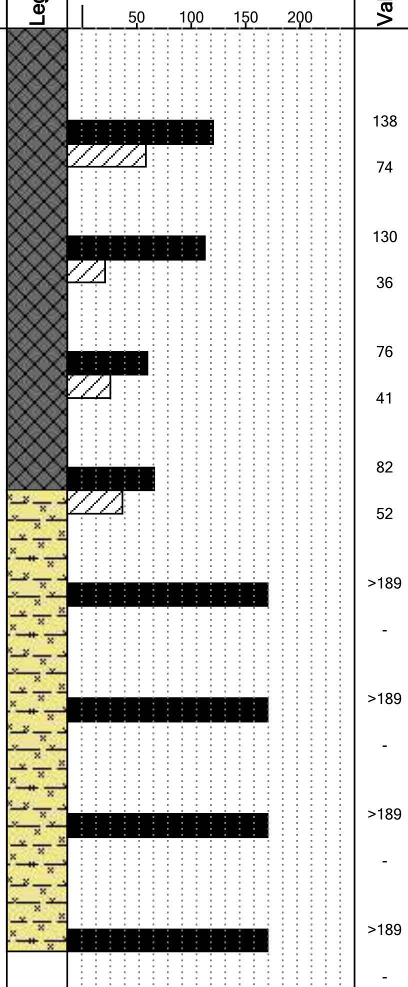
Location
Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Values (kPa)
FILL	Clayey SILT; brownish orange with mixed color mottles. Very stiff; moist; moderate plasticity.		0.0–1.0	138 / 74; 130 / 36; 76 / 41; 82 / 52
Weathered Ash	Clayey SILT; brownish orange. Very stiff; moist; Moderate plasticity.		1.0–2.0	>189 / -; >189 / -; >189 / -; >189 / -
	End of Investigation: 2m Target depth		2	

Vane Shear Strength — Vane No:3052 — Vane Size: 19mm

Scala Penetrometer (Blows / 100mm)

Groundwater



Investigation Information

Depth	2m	Logged By	Z.P	Start Date	07/10/21
Termination	Target depth	Checked By	F.W	End Date	07/10/21
Machine Used		Test Pit Dimensions		Logged Date	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA112

INVESTIGATION LOG

HA113

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Values (kPa)
ENGINEERED FILL	Clayey SILT, with minor gravel; brownish orange with mixed color mottles. Very stiff; wet; moderate plasticity.		>189 - >189 - >189 - UTP -
	End of Investigation: 1.2m Effective refusal	1 2	

Vane Shear Strength — Vane No:3052, Vane Size: 19mm (50, 100, 150, 200)

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	1.2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA113

INVESTIGATION LOG

HA114

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Values (kPa)
Topsoil	TOPSOIL.		
ENGINEERED FILL	Clayey SILT, with trace tuff; brownish orange. Very stiff; moist; moderate plasticity, insensitive.		143
	Clayey SILT, with trace tuff and sand; reddish orange with dark brown streaks and mottled white. Very stiff; moist; moderate plasticity.		99
	Clayey SILT, with trace tuff and sand; brown with dark brown, pink and white streaks. Very stiff to hard; moist; moderate plasticity.		>203
	Clayey SILT, with trace tuff and sand; brownish. Hard; dry to moist; low to moderate plasticity.	1	>203
	Clayey SILT, with some tuff; dark brown. Hard; moist; moderate plasticity.		>203
	Clayey SILT, with trace tuff and gravel; brown with pink and white streaks. Moist; gravel, angular; moderate to high plasticity.		>203
	End of Investigation: 2m Target depth	2	>203

Vane Shear Strength — Vane No:1938, Vane Size: 19mm (50, 100, 150, 200)

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	ffective refus	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA115

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:1938, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
ENGINEERED FILL	Clayey SILT, with trace tuff and sand; brown with grey streaks. Very stiff; low plasticity; dry; insensitive.			169 134 186 114 108 59 125 82 174 93		
	1.2m: Begin to see hints of creamy light brown	1				
	Clayey SILT, with trace tuff and sand; brown with creamy brown and reddish streaks. Very stiff to hard; moist; moderate plasticity, insensitive.			>203 - >203 - >203 -		
	End of Investigation: 2m Target depth	2				

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA116

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:1938, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
ENGINEERED FILL	Clayey SILT, with some sand; grey with mottled light brown, dark brown and red. Hard to stiff; dry to moist; low to moderate plasticity, moderate sensitivity to insensitive.			>203 62		
	Clayey SILT, with trace tuff and sand; orange brown with light brown streaks. Stiff to very stiff; moist; moderate plasticity.			186 62 105 56		
	Clayey SILT, with trace tuff and sand; brown with creamy light brown streaks. Stiff to hard; moist; moderate plasticity, moderate sensitivity to insensitive.	1		143 85 157 62 157 82		
	End of Investigation: 2m Target depth	2		>203 - >203 -		

Vane Shear Strength scale: 50 100 150 200

Scala Penetrometer scale: 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA116

INVESTIGATION LOG

HA117

Report Ref R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No:1938, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.			TS				
ENGINEERED FILL	Clayey SILT, with trace tuff and sand; brown with occasional light brown and reddish streaks. Very stiff to hard; moist; moderate plasticity, insensitive.		1			>203 102 >203 102 >203 102 166 102 174 119 174 119 >203 -		
	End of Investigation: 2m Target depth		2			>203 -		

Vane Shear Strength: 50 100 150 200

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA117

INVESTIGATION LOG

HA118

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:1938, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
ENGINEERED FILL	Clayey SILT, with trace tuff and sand; brownish. Hard; moist; low to moderate plasticity.			>203 70 >203 70		
	Clayey SILT, with trace tuff and sand; orange brown with mottled red. Hard to stiff; moist; moderate plasticity, insensitive to moderate sensitivity.	1		>203 70 154 70		
	Clayey SILT, with trace tuff and sand; brown with creamy brown streaks. Hard to very stiff; moist; moderate plasticity.			>203 93 163 93 157 88		
	Clayey SILT, with trace tuff and sand; dark brown with brown streaks. Very stiff to hard; moist; moderate to high plasticity.			>203		
	End of Investigation: 2m Target depth	2		-		

Vane Shear Strength: 50 100 150 200

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R7615-1A HA118

INVESTIGATION LOG

HA119

Report Ref: R7615-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd			

Location: Helenvale Crescent, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Values (kPa)
Topsoil	TOPSOIL.		
ENGINEERED FILL	Clayey SILT, with some gravel, with trace sand; brownish. Stiff to very stiff; moist; moderate plasticity, moderate sensitivity.		148 / 67
	Clayey SILT, with trace tuff and sand; brown with light brown streaks. Very stiff to hard; moist; moderate plasticity, moderate sensitivity to insensitive.	1	145 / 79
			160 / 105
			171 / 73
			171 / 96
			>203 / 154
	End of Investigation: 2m Target depth	2	>203 / 154
			197 / 154

Samples: TS

Vane Shear Strength — Vane No:1938, Vane Size: 19mm (50, 100, 150, 200)

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	2m	**Logged By**	Z.P	**Start Date**	07/10/21
Termination	Target depth	**Checked By**	F.W	**End Date**	07/10/21
Machine Used		**Test Pit Dimensions**		**Logged Date**	07/10/21

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA01

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,778,888.28m N 5,876,538.49m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Values (kPa)
Topsoil	TOPSOIL.		
Weathered Ash	Clayey SILT, with minor sand; light greyish orange. Very stiff; moist; mottled orange & light grey; low to moderate plasticity; insensitive.	1	169 105 134 81
Weathered Ash	Clayey SILT, with some sand; light grey. Moderate plasticity; moist; mottled dark purple & orange; very stiff to hard; insensitive.	2	170 115 >188 -
Topsoil	Oragnic SILT with some sand; Black; Moist: low plasticity; (relic topsoil layer).		
ALLUVIAL DEPOSITS	Sandy SILT, with some clay; greenish blue. Hard; low plasticity; moist to wet; sand, fine to medium.	3	>188 - UTP -
	End of Investigation: 3m Refusal	4	

Vane Shear Strength — Vane No:2088, Vane Size: 19mm (50, 100, 150, 200)

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater: SWL 1.80m

Investigation Information

Depth	3m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA01

INVESTIGATION LOG

HA02

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,778,913.77m N 5,876,560.37m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; brownish orange. Very stiff; moderate plasticity; moist; moderately sensitive.	
	Clayey SILT, with trace sand; brownish orange. Very stiff; moderate plasticity; moist; mottled brownish grey; moderately sensitive.	1
	Clayey SILT, with some sand; light bluish grey. Very stiff; moderate plasticity; mottled orange; moist to wet; moderately sensitive.	2
	CLAY, with some silt, with trace rootlets; light brownish grey. Hard; low plasticity; wet; moit to wet; moderate to high plasticity.	3
	3.2m: Becoming dark greyish brown.	
	End of Investigation: 4m Target depth	4

Vane Shear Strength — Vane No:2088, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
137
61
164
53
156
65
133
63
>188
-
>188
-
>188
-
>188
-

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater: SWL 2.60m

Investigation Information

Depth	4m	**Logged By**	K.H	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA03

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,778,967.91m N 5,876,629.71m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; light orange. Very stiff; moderate plasticity; moist; mottled white; insensitive.	
Weathered Ash	SILT; light orange. Very stiff; low plasticity; moist; mottled white; insensitive.	1
ALLUVIAL DEPOSITS	CLAY; light grey. High plasticity; moist; very stiff to hard; insensitive.	2
	2.4m: Low core recovery.	
	2.6m: Becoming dark blue.	
	End of Investigation: 3m Target depth	3
		4

Vane Shear Strength — Vane No:1859, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
169
97
139
71
120
85
108
69
196
-
196
-

Scala Penetrometer (Blows / 100mm) — 2 4 6 8 10 12 14 16 18

Groundwater — SWL 1.30m

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA03

INVESTIGATION LOG

HA04

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,088.41m N 5,876,709.69m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; light brown. Very stiff; low plasticity; moist; insensitive.	
	1.4m: Becoming light orange.	1
	2.2m: Becoming light orange mottled red.	2
	End of Investigation: 3m Target depth	3
		4

Vane Shear Strength — Vane No:1859, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
168
97
146
94
169
82
171
79
155
72
172
71

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA05

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,059.20m N 5,876,886.89m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2089, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
ps	TOPSOIL.					
Engineered Fill	Clayey SILT, with minor sand, with trace gravel; dark brownish grey. Mottled orange, brown; light grey & red; dry to moist; low to moderate plasticity; very stiff to hard.			>211 - 151 121		
	Clayey SILT, with trace sand and gravel; light greyish brown. Very stiff; moderate plasticity; mottled dark brown, brownish grey, red & orange; moist to wet; insensitive.	1		181 138 >211 - 163 129 138 99		
		2		198 149 181 167 144 105 135 91		
	End of Investigation: 3.2m Refusal	3		144 93		
		4				

Investigation Information

Depth	3.2m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA05

INVESTIGATION LOG

HA06

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,106.24m N 5,876,879.96m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	SILT; light brown. Very stiff; low plasticity; moist; insensitive.	
Weathered Ash	Clayey SILT; light orange. Very stiff; low plasticity; moist; mottled white; insensitive.	1
ALLUVIAL DEPOSITS	CLAY, with minor silt; light grey. Stiff; high plasticity; wet; moderately sensitive to sensitive.	
ALLUVIAL DEPOSITS	Clayey SILT, with some sand. Low plasticity; wet; stiff to very stiff; moderately sensitive to sensitive.	2
ALLUVIAL DEPOSITS	2.6m: Becoming dark blue. 2.7m: Low core recovery.	
ALLUVIAL DEPOSITS		3
ALLUVIAL DEPOSITS	**End of Investigation: 4m Target depth**	4

Vane Shear Strength (Vane No:1859, Vane Size: 19mm; 50 100 150 200) — Values (kPa): 146, 75, 93, 60, 86, 21, 70, 26, 69, 23, 140, 54, 130, 37, 141, 32

Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18)

Groundwater: SWL 1.50m

Investigation Information

Depth	4m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA06

INVESTIGATION LOG

HA07

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,149.29m N 5,876,887.25m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:1859, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
Weathered Ash	Clayey SILT; light orange. Very stiff; low plasticity; moist; insensitive.	0		153 113		
	Clayey SILT; light reddish orange. Very stiff; moderate plasticity; moist; insensitive.	1		141 111		
		2		122 101		
	Clayey SILT, with minor sand; light grey. Very stiff; low plasticity; moist; insensitive.			137 71		
	End of Investigation: 3m Target depth	3		140 93		
		4		168 97		

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA07

INVESTIGATION LOG

HA01

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,778,888.28m N 5,876,538.49m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2088, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)
Topsoil	TOPSOIL.				
Weathered Ash	Clayey SILT, with minor sand; light greyish orange. Very stiff; moist; mottled orange & light grey; low to moderate plasticity; insensitive.	1		169 105 134 81	
Weathered Ash	Clayey SILT, with some sand; light grey. Moderate plasticity; moist; mottled dark purple & orange; very stiff to hard; insensitive.	2		170 115	
Topsoil	Oragnic SILT with some sand; Black; Moist: low plasticity; (relic topsoil layer).			>188 -	
ALLUVIAL DEPOSITS	Sandy SILT, with some clay; greenish blue. Hard; low plasticity; moist to wet; sand, fine to medium.	3		>188 -	
	End of Investigation: 3m Refusal			UTP -	
		4			

Vane Shear Strength: 50 100 150 200

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Groundwater: SWL 1.80m

Investigation Information

Depth	3m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA02

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,778,913.77m N 5,876,560.37m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; brownish orange. Very stiff; moderate plasticity; moist; moderately sensitive.	
	Clayey SILT, with trace sand; brownish orange. Very stiff; moderate plasticity; moist; mottled brownish grey; moderately sensitive.	1
	Clayey SILT, with some sand; light bluish grey. Very stiff; moderate plasticity; mottled orange; moist to wet; moderately sensitive.	2
	CLAY, with some silt, with trace rootlets; light brownish grey. Hard; low plasticity; wet; moit to wet; moderate to high plasticity.	3
	3.2m: Becoming dark greyish brown.	
	End of Investigation: 4m Target depth	4

Samples | Legend: TS

Vane Shear Strength — Vane No:2088, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
137
61
164
53
156
65
133
63
>188
-
>188
-
>188
-
>188
-

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater: SWL 2.60m

Investigation Information

Depth	4m	**Logged By**	K.H	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA02

INVESTIGATION LOG

HA03

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,778,967.91m N 5,876,629.71m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; light orange. Very stiff; moderate plasticity; moist; mottled white; insensitive.	
Weathered Ash	SILT; light orange. Very stiff; low plasticity; moist; mottled white; insensitive.	1
ALLUVIAL DEPOSITS	CLAY; light grey. High plasticity; moist; very stiff to hard; insensitive.	2
	2.4m: Low core recovery.	
	2.6m: Becoming dark blue.	
	End of Investigation: 3m Target depth	3
		4

Vane Shear Strength — Vane No:1859, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
169
97
139
71
120
85
108
69
196
-
196
-

Scala Penetrometer (Blows / 100mm) — 2 4 6 8 10 12 14 16 18

Groundwater — SWL 1.30m

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA03

INVESTIGATION LOG

HA04

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,088.41m N 5,876,709.69m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT; light brown. Very stiff; low plasticity; moist; insensitive.	
	1.4m: Becoming light orange.	1
	2.2m: Becoming light orange mottled red.	2
	End of Investigation: 3m Target depth	3
		4

Vane Shear Strength — Vane No:1859, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
168
97
146
94
169
82
171
79
155
72
172
71

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

Groundwater

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA05

GCL Ground Consulting Ltd

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,059.20m N 5,876,886.89m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2089, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
ps	TOPSOIL.					
Engineered Fill	Clayey SILT, with minor sand, with trace gravel; dark brownish grey. Mottled orange, brown; light grey & red; dry to moist; low to moderate plasticity; very stiff to hard.	1		>211 - 151 121 181 138		
	Clayey SILT, with trace sand and gravel; light greyish brown. Very stiff; moderate plasticity; mottled dark brown, brownish grey, red & orange; moist to wet; insensitive.	2		>211 - 163 129 138 99 198 149 181 167 144 105 135 91		
	End of Investigation: 3.2m Refusal	3		144 93		
		4				

Investigation Information

Depth	3.2m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA05

INVESTIGATION LOG

HA06

GCL Ground Consulting Ltd

Report Ref	
R3463-1A	

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,106.24m N 5,876,879.96m		MAP

Location
34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:1859, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
Weathered Ash	SILT; light brown. Very stiff; low plasticity; moist; insensitive.			146 75		
	Clayey SILT; light orange. Very stiff; low plasticity; moist; mottled white; insensitive.	1		93 60		
ALLUVIAL DEPOSITS	CLAY, with minor silt; light grey. Stiff; high plasticity; wet; moderately sensitive to sensitive.			86 21		SWL 1.50m
	Clayey SILT, with some sand. Low plasticity; wet; stiff to very stiff; moderately sensitive to sensitive.	2		70 26		
	2.6m: Becoming dark blue. 2.7m: Low core recovery.			69 23		
		3		140 54		
				130 37		
	End of Investigation: 4m Target depth	4		141 32		

Investigation Information

Depth	4m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA07

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,149.29m N 5,876,887.25m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:1859, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
Weathered Ash	Clayey SILT; light orange. Very stiff; low plasticity; moist; insensitive.	0		153 113		
	Clayey SILT; light reddish orange. Very stiff; moderate plasticity; moist; insensitive.	1		141 111		
		2		122 101		
	Clayey SILT, with minor sand; light grey. Very stiff; low plasticity; moist; insensitive.			137 71		
	End of Investigation: 3m Target depth	3		140 93		
		4		168 97		

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA07

INVESTIGATION LOG

HA08

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,145.72m N 5,877,187.00m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
FILL	Clayey SILT, with some topsoil; dark brownish orange. Low plasticity; moist.	
Weathered Ash	Clayey SILT; light brown. Low plasticity; moist; very stiff to hard; insensitive.	1
	1.6m: Becoming red.	2
	2.4m: Becoming red mottled white.	
	End of Investigation: 3m Target depth	3
		4

Vane Shear Strength — Vane No:1859, Vane Size: 19mm (50 100 150 200)

Values (kPa)
109
71
115
86
>196
-
175
104
>196
-
>196
-
171
99

Scala Penetrometer (Blows / 100mm) (2 4 6 8 10 12 14 16 18)

Groundwater

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA09

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,111.89m N 5,877,179.34m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2088, Vane Size: 19mm) Values (kPa)	Scala Penetrometer (Blows / 100mm)
Topsoil	TOPSOIL.			
Weathered Ash	Clayey SILT; brownish orange. Hard; moderate plasticity; moist.		>188 -	
	Clayey SILT, with trace sand; yellowish orange. Very stiff; moderate plasticity; mottled reddish orange; moist to wet; insensitive.	1	169 132	
			145 111	
		2	134 88	
	Silty CLAY, with trace sand; light yellow. Very stiff; mottled brownish orange; moist to wet; moderate to high plasticity; insensitive.		153 120	
	End of Investigation: 3m Target depth	3	158 119	
		4		

Vane Shear Strength scale: 50 100 150 200

Scala Penetrometer scale: 2 4 6 8 10 12 14 16 18

Groundwater

Investigation Information

Depth	3m	**Logged By**	K.H	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA09

INVESTIGATION LOG

HA10

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,079.39m N 5,877,133.81m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
Weathered Ash	Clayey SILT, with some sand; brownish orange. Very stiff; moderate plasticity; moist; mottled greyish brown; insensitive.	
Weathered Ash	Silty CLAY, with some sand; greyish brown. Stiff; mottled red, orange & light grey; moist to wet; moderate to high plasticity; insensitive.	1
ALLUVIAL DEPOSITS	Silty sandy CLAY; grey. Firm; wet to saturated; low to high plasticity; insensitive.	
	1.8m: Low core recovery.	2
	Silty SAND, with minor clay; light bluish green. Low plasticity; very dense; fine to medium grained; well sorted.	
	End of Investigation: 2.7m Refusal	3
		4

Vane Shear Strength (Vane No:2089, Vane Size: 19mm)

Values (kPa)
157
84
97
61
61
34
47
42
UTP
-

Scala Penetrometer (Blows / 100mm)

24 >>

Groundwater

SWL 1.50m

Investigation Information

Depth	2.7m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R3463-1A HA10

INVESTIGATION LOG

HA11

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,003.01m N 5,877,079.71m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
FILL	clayey SILT with some intermixed topsoil; Brownish grey mottled dark brown; moist; low plasticity.	
ps	TOPSOIL.	
ALLUVIAL DEPOSITS	Silty CLAY, with some sand; grey. Firm; wet; mottled orange; moderate to high plasticity; moderately sensitive.	
	Sandy CLAY; grey. Stiff; high plasticity; mottled orange; wet to saturated; moderately sensitive.	1
	1.4m: Low core recovery.	
	gravelly SAND; black; wet; dense to very dense Sand, fine to medium Gravel, fine	2
	End of Investigation: 3m Refusal	3
		4

Vane Shear Strength — Vane No:2089, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
49
24
91
55
68
34
UTP
-

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

16
17
11
13
20

Groundwater

SWL 0.70m

Investigation Information

Depth	3m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA12

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,145.20m N 5,877,112.71m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2089, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
Weathered Ash	Clayey SILT, with trace sand; brownish orange. Very stiff; moist; mottled greyish brown; low to moderate plasticity; insensitive.	1		187 102 154 106		
	Clayey SILT, with minor sand; light red. Very stiff; moderate plasticity; mottled oramge & white; moist to wet; insensitive.	2		166 144 151 137		
	Silty CLAY, with some sand; brownish grey. Very stiff; high plasticity; mottled red; moist to wet; insensitive.					
	SILT, with some clay; dark red. Very stiff; low plasticity; wet; mottled dark brownish orange & black; insesnitive.	3		124 99		
	Clayey SILT; light red. Stiff; wet; moderate to high plasticity; low core recovery; insensitive.			76 69 136 81		
	Clayey SILT, with some sand; light red. Hard; moderate plasticity; wet; mottled light orange & white.	4		205 167		
	~~End of Investigation: 4m Target depth~~					

Investigation Information

Depth	4m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA13

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,023.25m N 5,877,167.08m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL comprising dark brown organic silt with trace rootlets.	
ALLUVIAL DEPOSITS	Clayey SILT, with minor sand; blue. Very stiff; moderate plasticity; wet.	1
Weathered Alluvium	SILT, with some sand, with minor clay, with trace gravel; orange. Low plasticity; mottled dark orange; moist to wet.	
	End of Investigation: 1.9m Refusal	2
		3
		4

Vane Shear Strength — Vane No:2088, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa): 54, 22, 86, 41, UTP, -

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18): 7, 20

Groundwater

Investigation Information

Depth	1.9m	**Logged By**	K.H	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA14

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,001.70m N 5,877,217.15m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL.	
ALLUVIAL DEPOSITS	Clayey SILT, with some sand; light orange. Very stiff; low plasticity; moist; insensitive.	
	CLAY, with minor silt; light orange. High plasticity; wet; stiff to very stiff; insensitive.	1
	2.8m: Low core recovery.	2
	3.0m: Thin hard sand layer.	3
	End of Investigation: 4m Target depth	4

Vane Shear Strength — Vane No:1859, Vane Size: 19mm (50, 100, 150, 200)

Values (kPa)
107
71
109
74
87
61
84
65
56
46
>196
-

Scala Penetrometer (Blows / 100mm) (2, 4, 6, 8, 10, 12, 14, 16, 18)

8
10
8
12
10

Groundwater SWL 1.00m

Investigation Information

Depth	4m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Refusal	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA15

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,034.37m N 5,877,254.39m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
Topsoil	TOPSOIL and colluvium intermixed; some mineralisation	
ALLUVIAL DEPOSITS	Clayey SILT, with some sand; light orange. Very stiff; low plasticity; moist; insensitive.	1
	CLAY, with minor silt; light orange. High plasticity; moist; very stiff; insensitive.	2
	2.4m: no/poor core recovery.	
	End of Investigation: 3m Target depth	3
		4

Vane Shear Strength
Vane No:1859
Vane Size: 19mm
50 100 150 200

Values (kPa)
126
93
122
92
133
85
140
57
120
71
115
78

Scala Penetrometer (Blows / 100mm)
2 4 6 8 10 12 14 16 18

Groundwater
SWL 2.20m

Investigation Information

Depth	3m	**Logged By**	S.W	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA17

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,018.90m N 5,877,367.08m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2088, Vane Size: 19mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.					
Weathered Ash	Clayey SILT; brownish orange. Moderate plasticity; moist; very stiff to hard; insensitive.	1		165 116 >188 -		
	SILT, with trace sand; red. Hard; low plasticity; moist; mottled brownish orange.	2		>188 -		
	End of Investigation: 2m Target depth	3		>188 -		
		4				

Investigation Information

Depth	2m	**Logged By**	K.H	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

INVESTIGATION LOG

HA18

Report Ref R3463-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
McRobbie Bros Ltd	E 1,779,031.58m N 5,877,406.92m		MAP

Location 34 Pokeno Road, Pokeno

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Vane Shear Strength (Vane No:2089, Vane Size: 19mm) Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
Topsoil	TOPSOIL.				
Weathered Ash	Clayey SILT, with trace sand; brownish orange. Very stiff; moderate plasticity; moist; mottled orange; moderately sensitive.		192, 96		
	Clayey SILT, with trace sand; light brownish orange. Very stiff; moist to wet; low to moderate plasticity.	1	169, 97		
			178, 137		
	SILT, with some clay, with minor sand; brownish orange. Very stiff; low plasticity; moist; insensitive.	2	181, 102		
	End of Investigation: 2m Target depth	3			
		4			

Investigation Information

Depth	2m	**Logged By**	H.P	**Start Date**	04/10/18
Termination	Target depth	**Checked By**	F.W	**End Date**	04/10/18
Machine Used		**Test Pit Dimensions**		**Logged Date**	04/10/18

Investigation Type

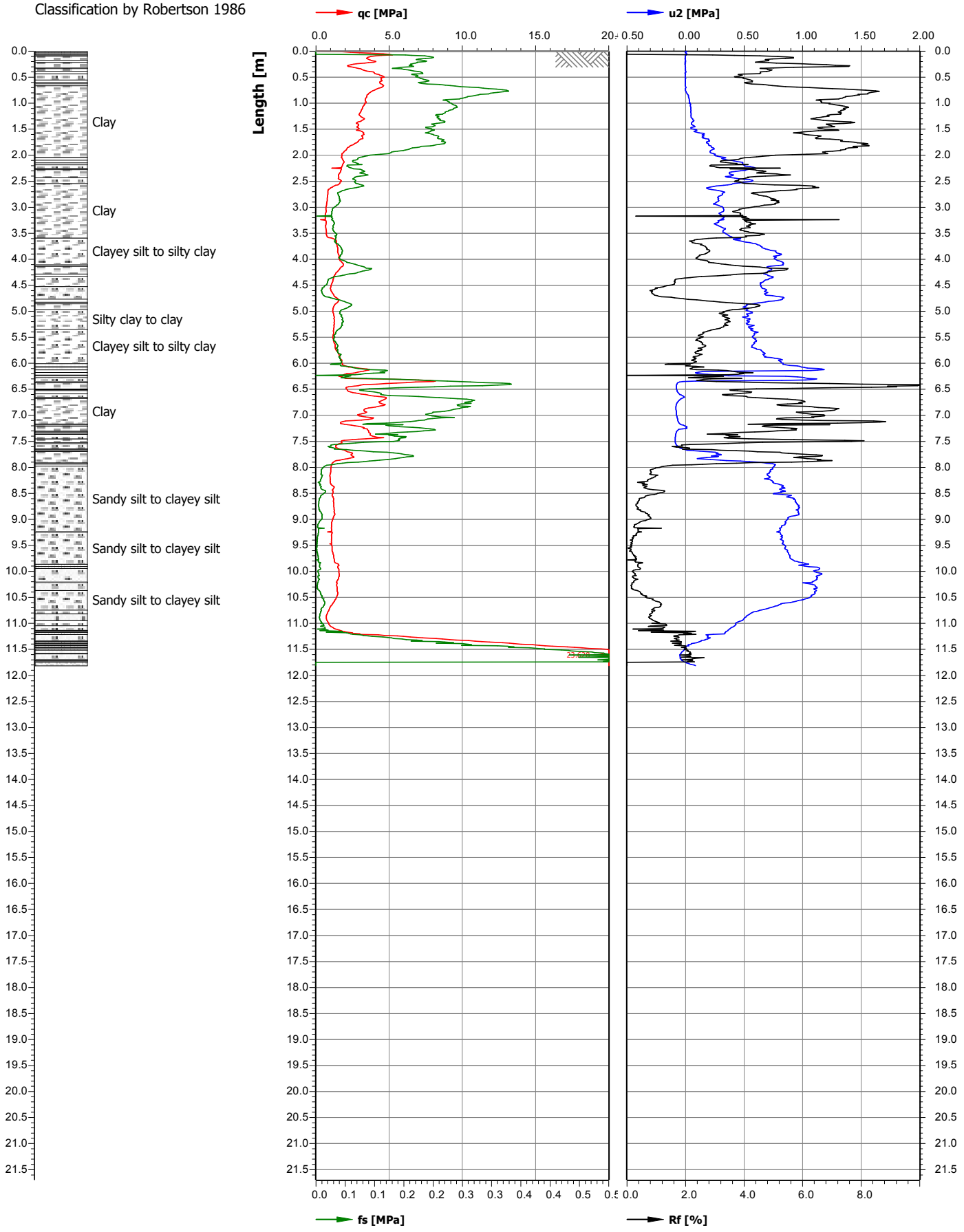
- [x] Hand Auger (50mm)
- [ ] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

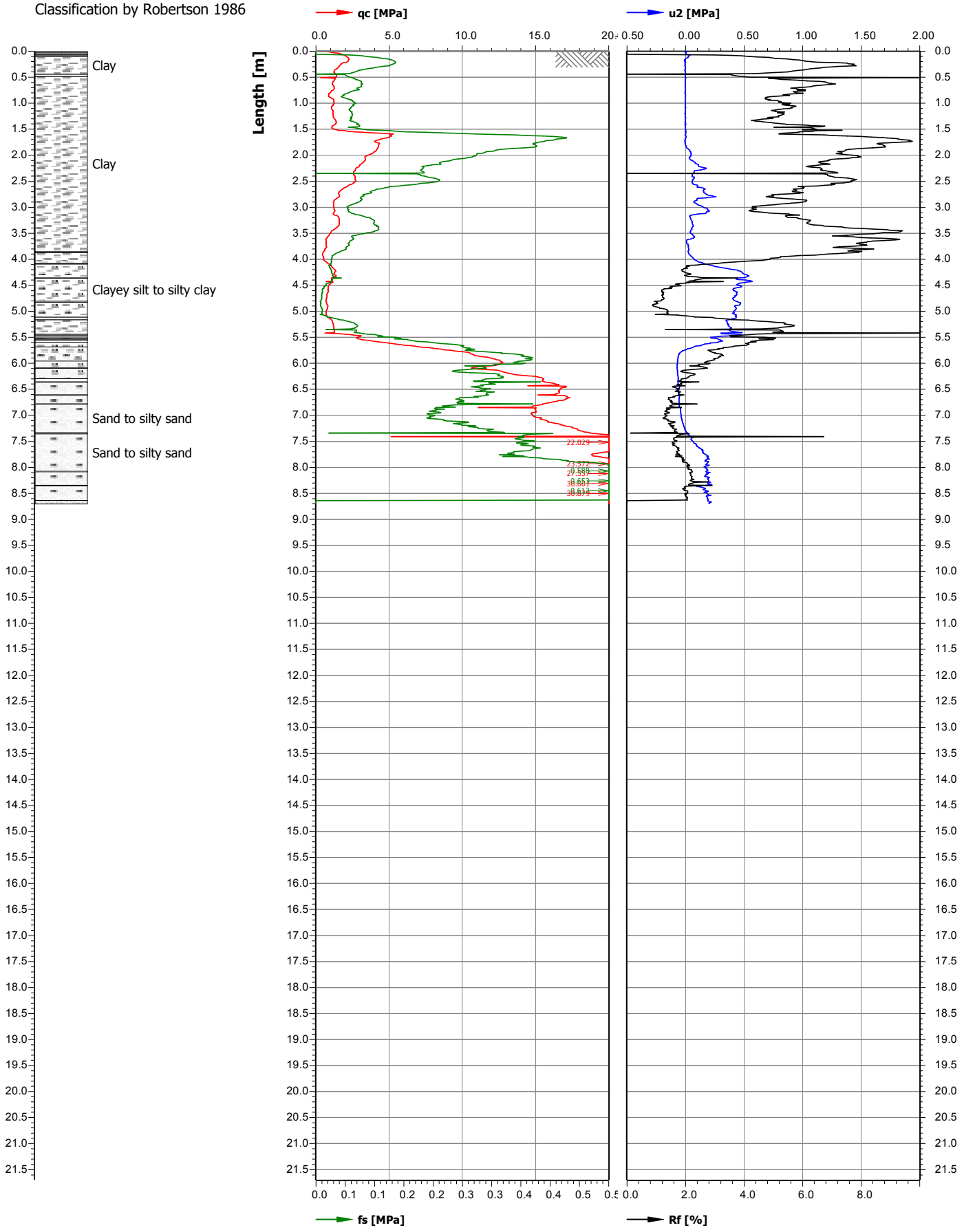
PRO-DRILL	Project name: GCLHelensvaleCrescent	Date investigation: 9/03/2020	
	Test name: CPT01a	Cone name: S10CFIIP.1734	
Test location name	Client: Ground Consulting LTD	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



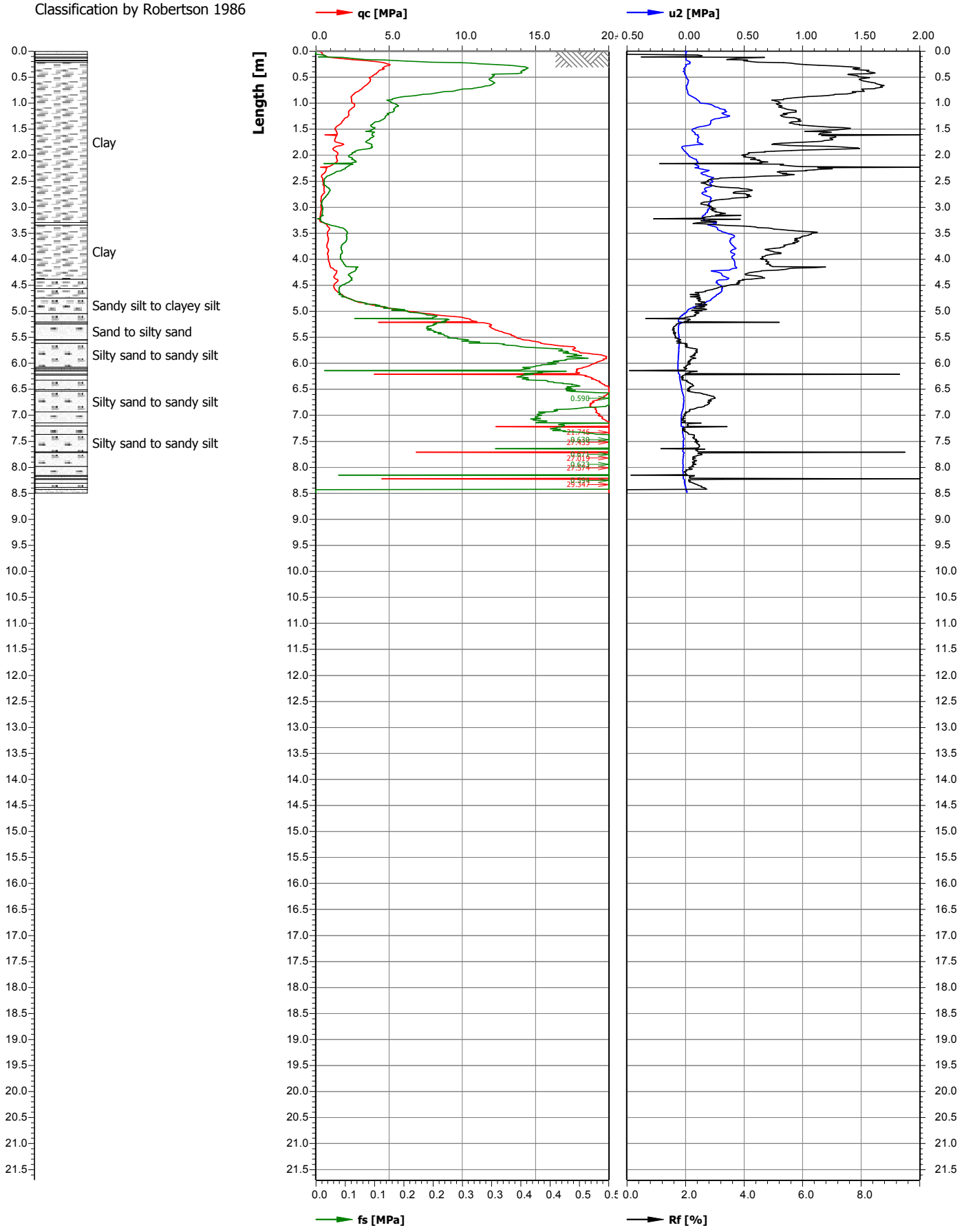
PRO-DRILL	Project name: GCLHelensvaleCrescent	Date investigation: 9/03/2020	
	Test name: CPT02	Cone name: S10CFIIP.1734	
Test location name	Client: Ground Consulting LTD	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



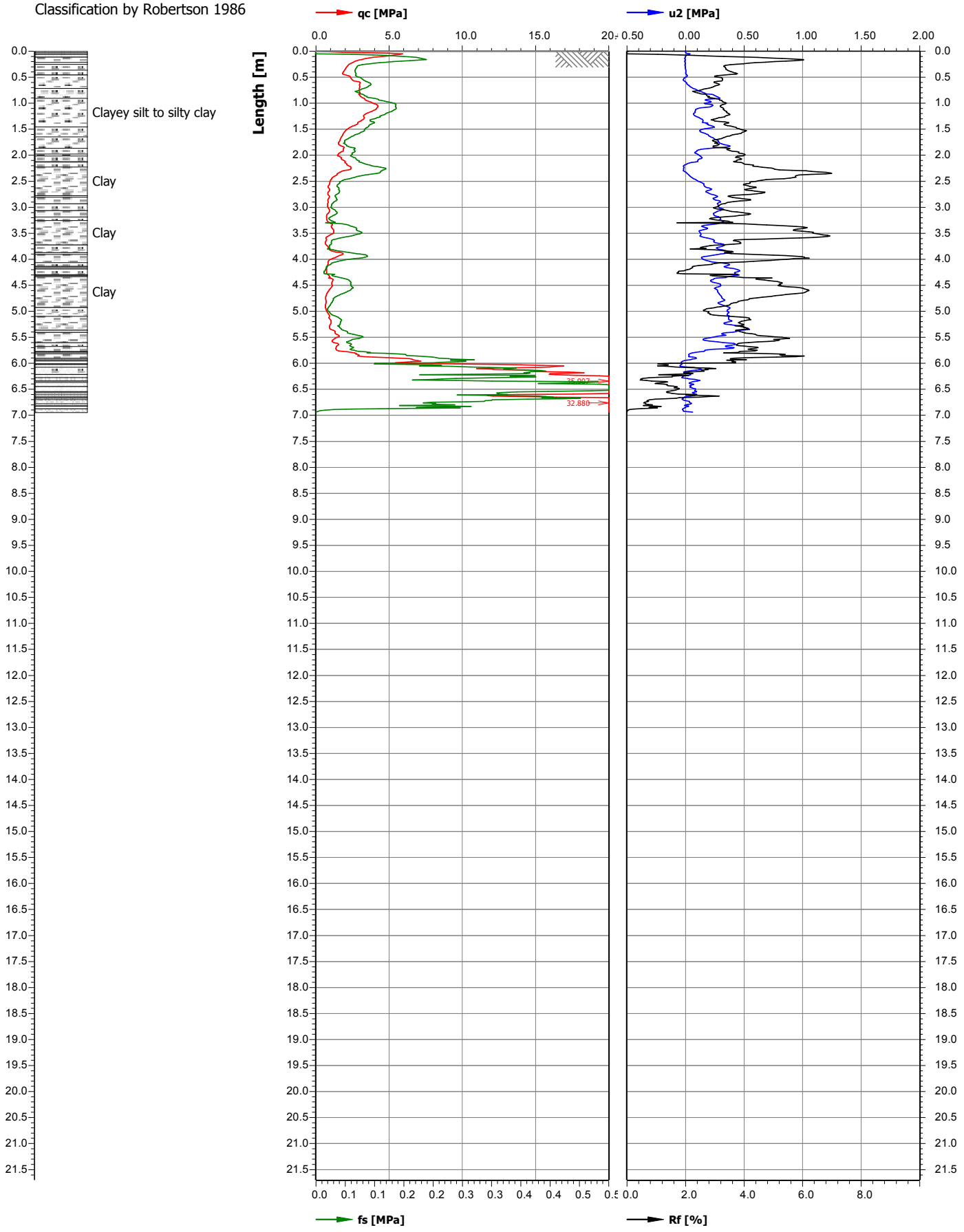
PRO-DRILL	Project name: GCLHelensvaleCrescent	Date investigation: 9/03/2020	
	Test name: CPT03	Cone name: S10CFIIP.1734	
Test location name	Client: Ground Consulting LTD	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



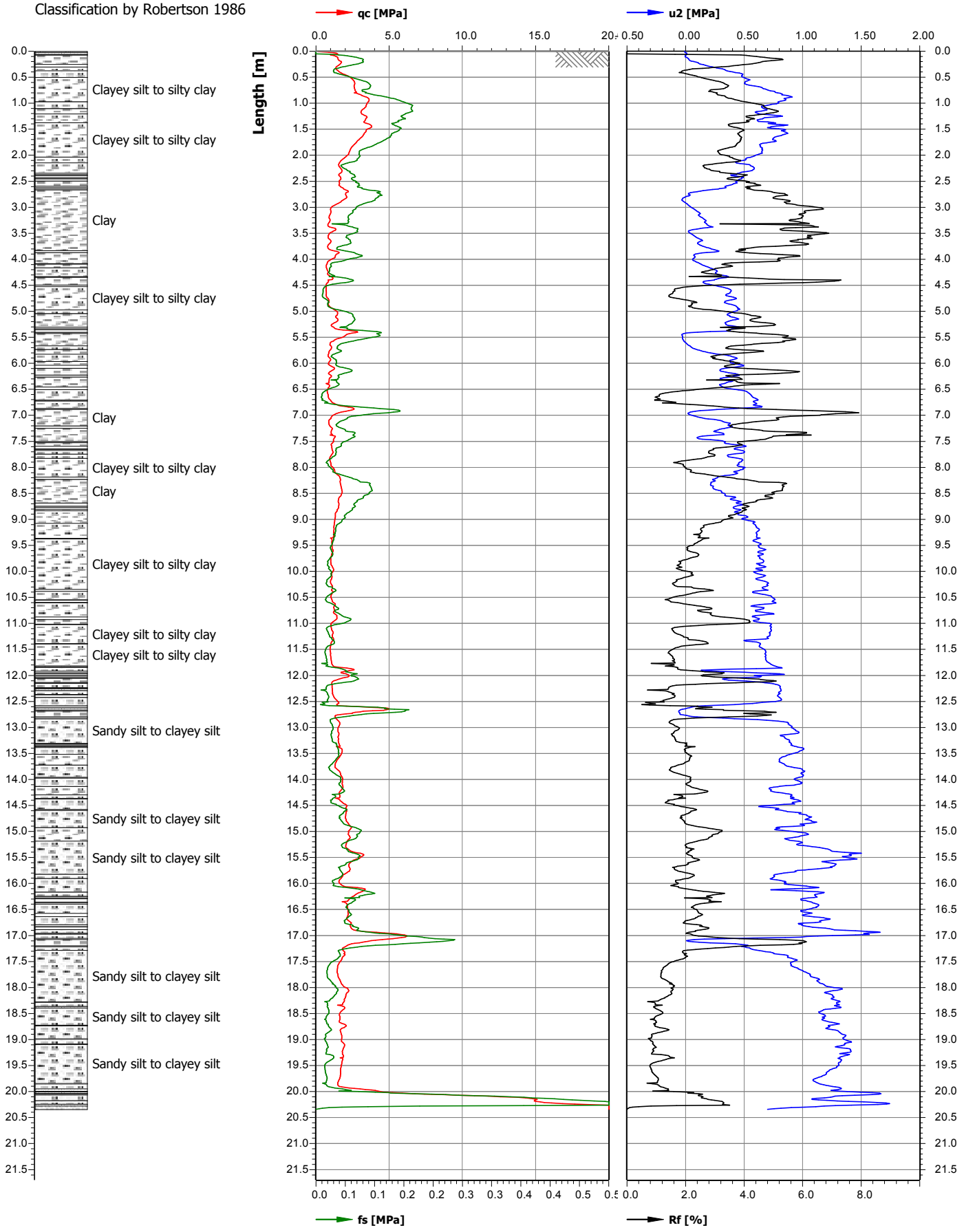
PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT01	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



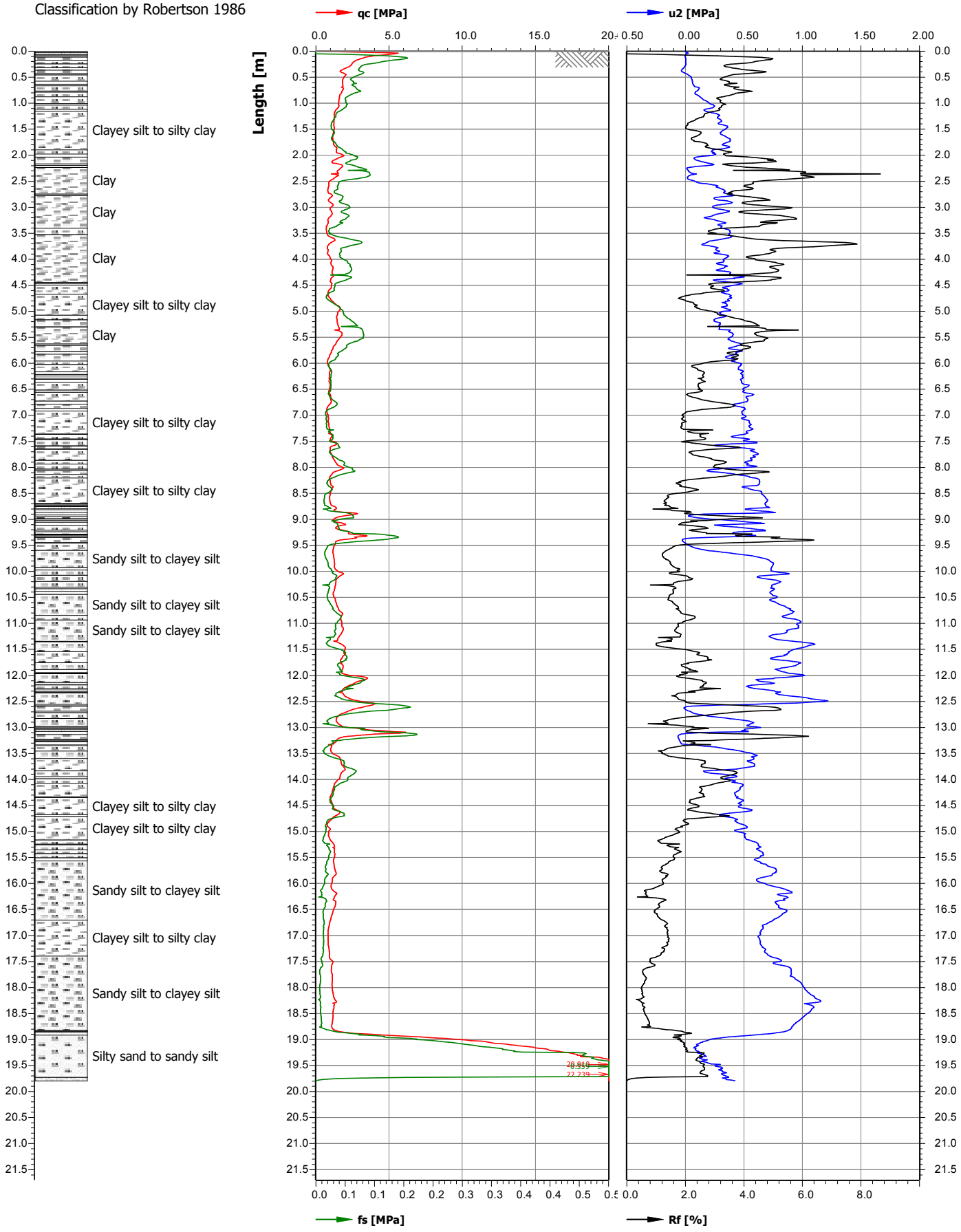
PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT02	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



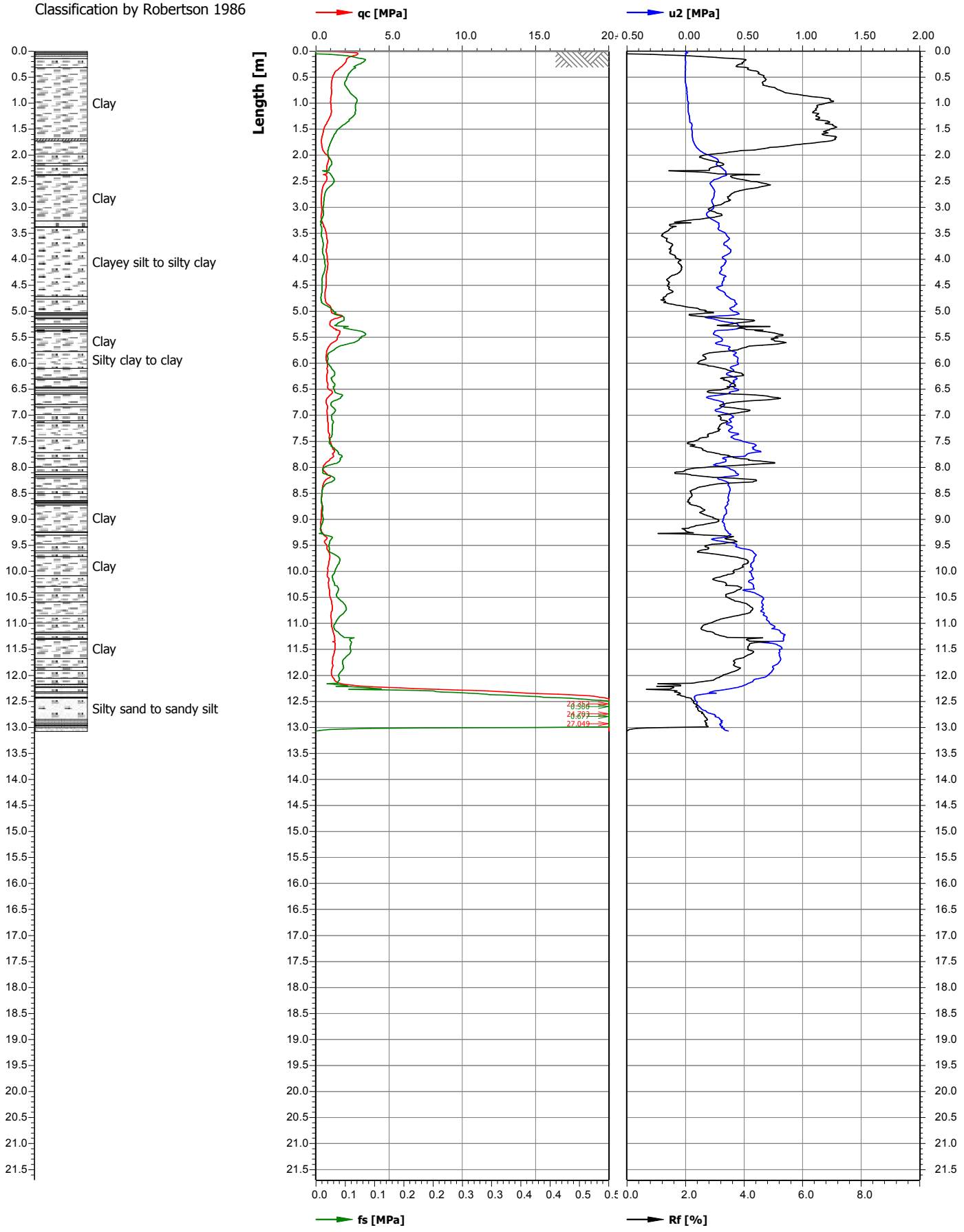
PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT03	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



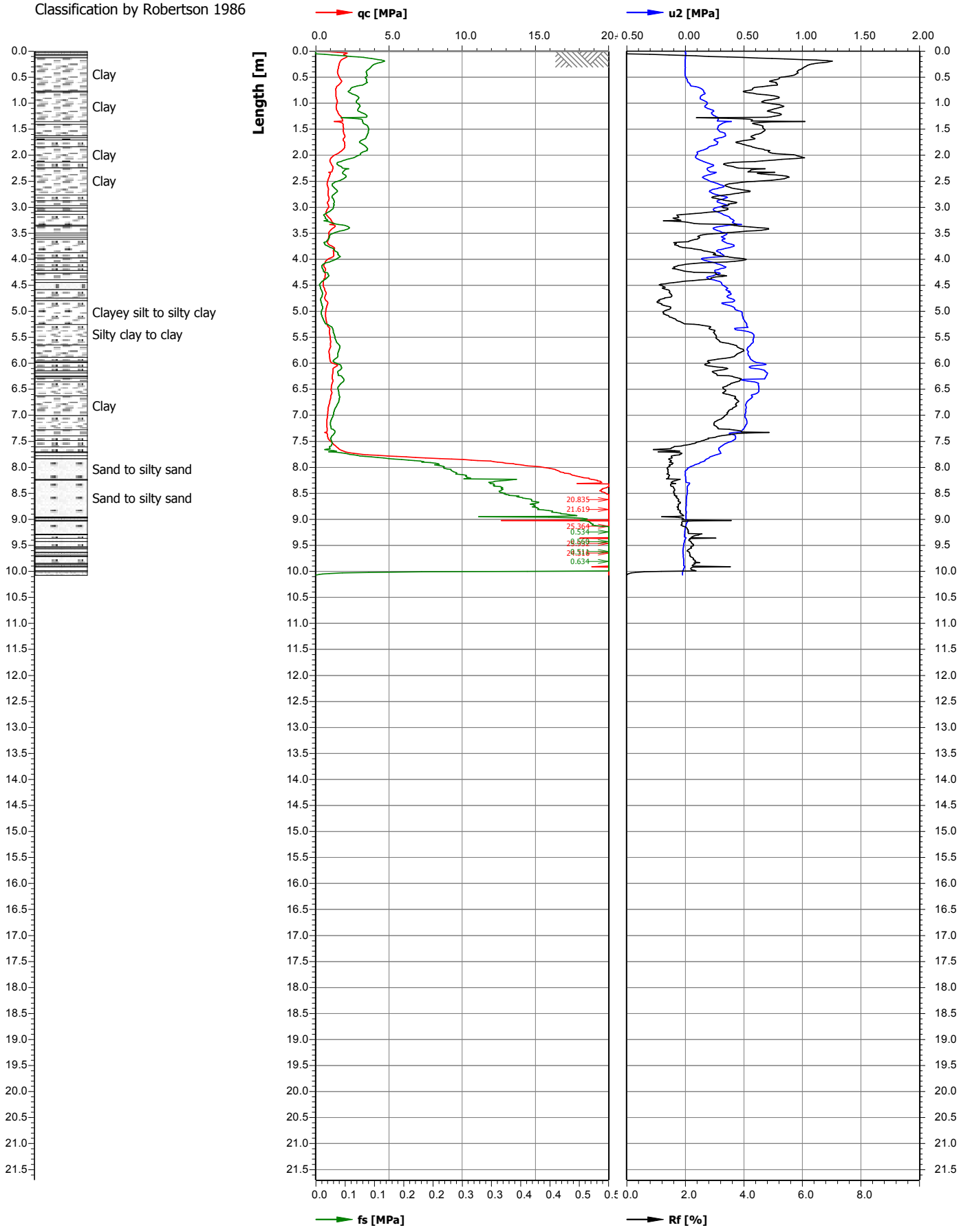
PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT04	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



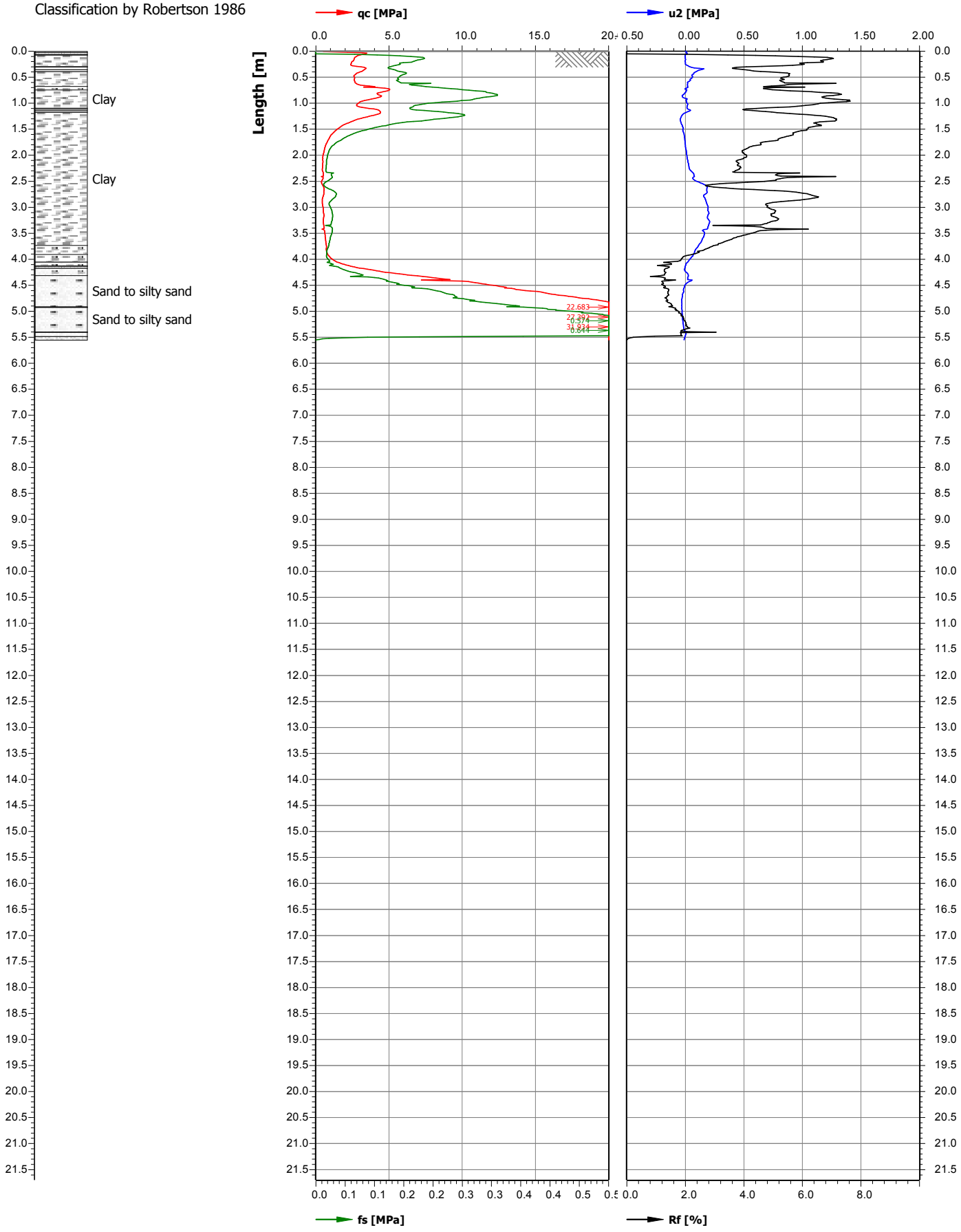
PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT05	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



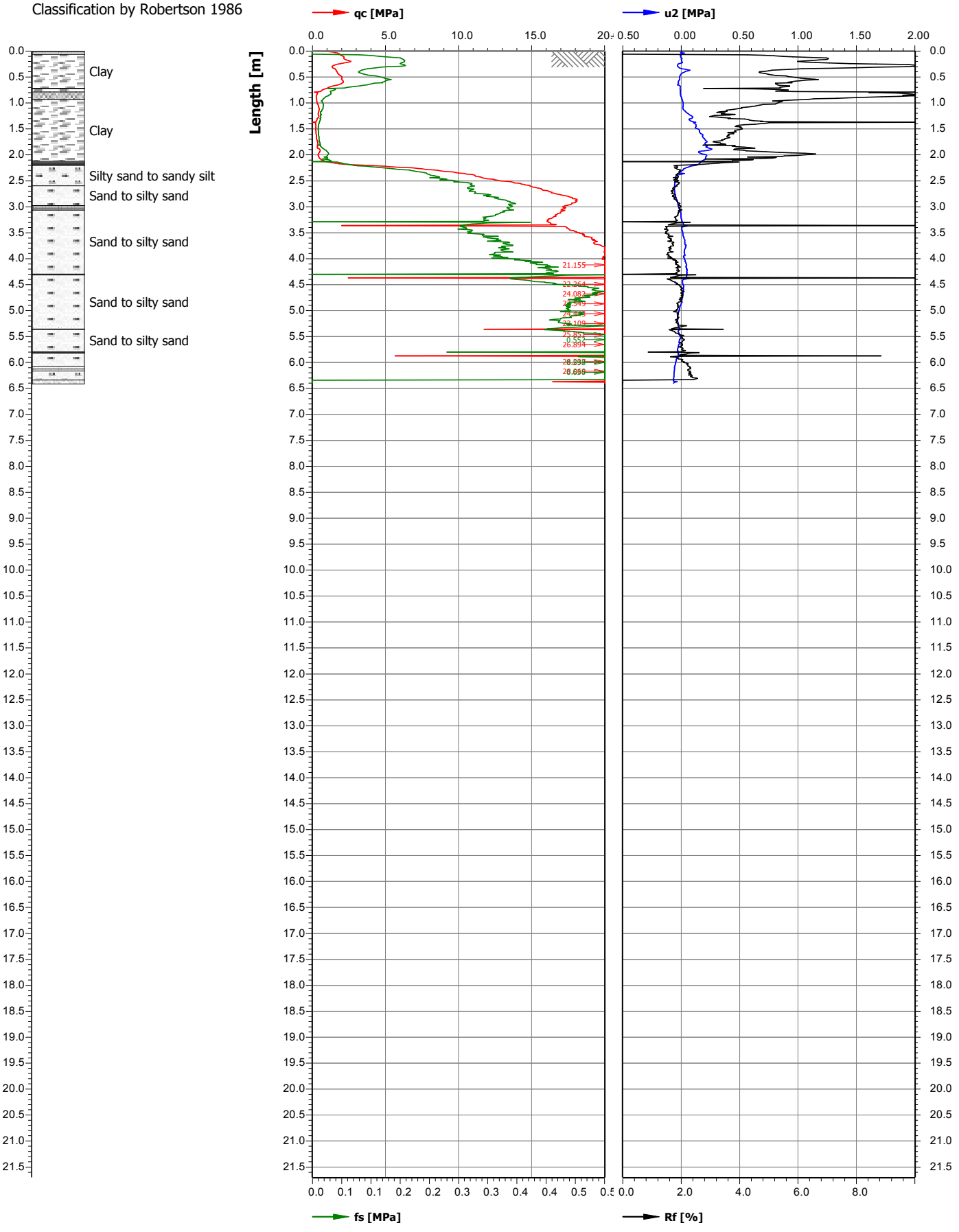
PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT06	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



PRO-DRILL	Project name: GCLHelenvaleCres	Date investigation: 22/11/2019	
	Test name: CPT07	Cone name: S10CFIIP.1754	
Test location name	Client: GCL	Net surface area quotient of ...: 0.850/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



APPENDIX B: FILL TESTING RESULTS

Our Ref: 1012885.0000.0.0/1
16 July 2020

McRobbie Brothers Ltd
Po Box 7
Pokeno 2440

Attention: James Mcobbie

Dear James

McRobbie Subdivision, Pokeno - Earthworks Testing 2019-2020.

Site Report

Customer's Instructions

We were instructed to:

Complete nuclear densometer and shear vane testing at the above mentioned site when requested and report the results.

Specifications

No formal specification was issued by the customer.

Dates of Procedures

Testing was carried out from the 21/11/2019 to the 18/05/2020.

Locations

Testing locations were selected on site by the Geotechnics technician on behalf of the customer.

The attached plans provide indicative locations only and are not to scale. All other information we provide regarding location should be referenced to the asset owner.

Samples

Samples taken for moisture content verification purposes were disposed of 24 hours after testing.

Methods

NZGS 8:2001 - Test method for determining the vane shear strength of a cohesive soil using a hand held shear vane.

NZS 4407:2015 Test 4.2 - Method using a nuclear surface moisture-density gauge (Direct Transmission Mode) – NDM

NZS 4402:1986 Test 2.1 - Determination of water content

Material Description

Material descriptions are provided in the attached results.

Results

The following is attached:

Earthworks testing summary and test location plans.

Test Remarks

NDM – Direct Transmission

The test method may not be appropriate for materials containing a nominal maximum particle size of >40 mm.

Nuclear densometers are calibrated for a bulk density range of 1,728 kg/m^3 to 2,756 kg/m^3. Test results outside of these bulk density limits are not covered under the IANZ endorsement of this report.

An assumed solid density value of 2.70 t/$m^3$was agreed with the customer. We do not take responsibility for misrepresentation or misinterpretation arising from the use of this assumed value to calculate air voids.

Oven calculated air voids (%) have been reported as zero if negative. The calculation of air voids is based on wet density, moisture content and the solid density. The wet density is measured by the nuclear densometer and the moisture content by oven drying.

Determination of Water Content

Samples used for the determination of the water content were taken in conjunction with nuclear densometer testing and disposed of after 24 hours.

General Remarks

This report has been prepared for the benefit of McRobbie Brothers Ltd, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

The inherent uncertainties of site investigation work, mean the nature and continuity of subsoil away from the test location could vary from the data logged.

Material descriptions are included for information only and are not covered under the IANZ endorsement of this report.

Sample(s) not destroyed during testing will be retained for one month from the date of this report before being discarded.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of the letterhead page.

GEOTECHNICS LTD

Report prepared by:

.....

Josh Allan
Projects Manager

Authorised for Geotechnics by:

.....

Steven Anderson
Project Director
Approved Signatory

Report checked by:

.....

Seven Baker
CMT Field Technician

IANZ ACCREDITED LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

16-Jul-20

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GEOTECHNICS

Job: McRobbie Block, Pokeno

Client: McRobbie Bros Ltd

Job #	1012885.0000.0.0/1
Entered By	JRA
Checked By	FRHA
Approved By	SJA

URN	Tech.	Date	Location	Layer	Material	Test Type	NDM 0°			NDM 90°			AVERAGE NDM			Solid Density (t/m³) Assumed	Oven Moisture content (%)	Final Corrected		Average Air Voids (10 X Tests)	Shear Vane Reading (kPa)					Retest URN	PASS / FAIL	Comments
						NDM / SV	Wet Density (t/m³)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m³)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m³)	Moisture Content (%)	Air Voids (%)			Oven Dry Density (t/m³)	Average Air Voids (%)		Reading 1	Reading 2	Reading 3	Reading 4	Average SV (4 x Tests)		(P) Pass / (F) Fail
1.1	JRA	21/11/2019	Gully Fill	~ 1m - 1.5m Placed	Clay SILT	NDM / SV	1.63	56.4	2.9	1.64	53.0	3.6	**1.63**	**54.7**	**3.2**	2.70	58.9	1.03	**1.5**	-	187+	187+	187+	187	187	-	-	
1.2						NDM / SV	1.61	51.1	6.1	1.61	49.7	6.5	**1.61**	**50.4**	**6.3**	2.70	53.8	1.05	**4.8**	-	174	187+	187+	182	178	-	-	
1.3						NDM / SV	1.66	51.5	3.0	1.66	51.4	3.0	**1.66**	**51.5**	**3.0**	2.70	48.5	1.12	**4.4**	-	187+	187+	187+	184	184	-	-	
2.1	JRA	27/11/2019	Gully Fill	~ 3m Placed	Clay SILT	NDM / SV	1.60	53.9	5.5	1.60	50.1	7.4	**1.60**	**52.0**	**6.5**	2.70	47.4	1.08	**8.5**	-	187+	187+	187+	187+	187	-	-	
2.2						NDM / SV	1.68	55.0	0.2	1.68	51.2	1.8	**1.68**	**53.1**	**1.0**	2.70	58.8	1.06	**0.0**	-	187+	187+	187+	187+	187	-	-	
2.3						NDM / SV	1.59	49.6	8.0	1.62	46.7	7.8	**1.60**	**48.2**	**7.9**	2.70	46.7	1.09	**8.6**	-	187+	187+	187+	187+	187	-	-	
2.4						NDM / SV	1.60	48.6	7.9	1.59	49.1	8.3	**1.59**	**48.9**	**8.1**	2.70	47.2	1.08	**8.8**	-	187	187+	187+	187+	187	-	-	
3.1	JRA	6/12/2019	Gully Fill	~ 4m Placed	Clay SILT	NDM / SV	1.66	52.2	2.8	1.66	54.8	1.3	**1.66**	**53.5**	**2.0**	2.70	53.5	1.08	**2.0**	-	150	187+	163	160	158	-	-	
3.2						NDM / SV	1.60	66.1	0.4	1.60	60.9	2.6	**1.60**	**63.5**	**1.5**	2.70	66.1	0.96	**0.5**	-	187+	176	187+	187+	176	-	-	
3.3						NDM / SV	1.68	47.9	3.7	1.69	51.5	1.4	**1.68**	**49.7**	**2.5**	2.70	49.5	1.13	**2.6**	4.2	187+	187+	187+	182	182	-	-	
4.1	JRA	8/01/2020	Gully Fill	~ 5m Placed	Clay SILT	NDM / SV	1.65	51.9	3.3	1.65	51.4	3.6	**1.65**	**51.7**	**3.4**	2.70	54.3	1.07	**2.3**	4.3	187+	187+	187+	187+	187	-	-	
4.2						NDM / SV	1.57	55.0	6.8	1.57	52.9	7.5	**1.57**	**54.0**	**7.1**	2.70	52.9	1.03	**7.6**	4.5	187+	187+	187+	187+	187	-	-	
4.3			Fill Above Pond	~1.5m Below Pond Bund		NDM / SV	1.62	52.2	5.1	1.61	50.5	6.2	**1.62**	**51.4**	**5.7**	2.70	46.0	1.11	**8.1**	4.9	187+	187+	187+	187+	187	-	-	
4.4						NDM / SV	1.63	42.0	9.4	1.62	41.9	10.1	**1.62**	**42.0**	**9.8**	2.70	46.1	1.11	**7.7**	4.8	136	134	147	144	140	-	-	
5.1	JRA	15/01/2020	Future Road Fill Area	~0.5m below FL	Clay SILT	NDM / SV	1.67	47.6	4.2	1.67	47.1	4.3	**1.67**	**47.4**	**4.2**	2.70	52.5	1.10	**1.8**	5.0	160	150	166	158	159	-	-	
5.2				~1m below FL		NDM / SV	1.69	45.4	4.3	1.69	44.0	4.9	**1.69**	**44.7**	**0.0**	2.70	48.7	1.14	**0.0**	4.1	150	187+	163	174	162	-	-	
6.1	JRA	22/01/2020	Gully Fill	~ 6m Placed	Clay SILT	NDM / SV	1.64	42.8	8.3	1.65	43.2	7.8	**1.64**	**43.0**	**8.0**	2.70	46.3	1.12	**6.4**	3.9	187+	187+	187+	184	184	-	-	
6.2						NDM / SV	1.58	50.0	8.6	1.57	50.8	8.6	**1.57**	**50.4**	**8.6**	2.70	54.7	1.02	**6.8**	4.4	187+	187+	187+	187+	187	-	-	
6.3						NDM / SV	1.63	48.8	5.9	1.62	48.6	6.6	**1.63**	**48.7**	**6.3**	2.70	50.2	1.08	**5.6**	4.9	187+	187+	187+	187+	187	-	-	
7.1	JRA	31/01/2020	Future Road Fill Area	~FL	Clay SILT	NDM / SV	1.61	46.1	8.2	1.62	46.6	7.7	**1.62**	**46.4**	**8.0**	2.70	44.6	1.12	**8.8**	5.5	187+	187+	187+	184	184	-	-	
7.2			Fill to West of Road - Above Old Gully	~0.5m below FL		NDM / SV	1.59	50.3	7.8	1.59	50.5	7.3	**1.59**	**50.4**	**7.6**	2.70	54.2	1.03	**6.0**	5.9	168	150	187+	187+	173	-	-	
7.3				~1m below FL		NDM / SV	1.59	51.3	7.3	1.59	48.1	8.7	**1.59**	**49.7**	**8.0**	2.70	54.5	1.03	**5.9**	5.7	187+	187+	187+	187+	187	-	-	
8.1	JRA	5/02/2020	Fill to East of Road - Above Old Gully	~1m below FL	Clay SILT	NDM / SV	1.73	45.6	1.8	1.72	45.0	2.7	**1.73**	**45.3**	**2.2**	2.70	48.9	1.16	**0.4**	4.9	163	187+	187+	187+	163	-	-	
8.2						NDM / SV	1.75	39.8	4.0	1.75	39.6	3.9	**1.75**	**39.7**	**4.0**	2.70	43.9	1.22	**1.7**	4.3	131	187+	163	184	159	-	-	
8.3						NDM / SV	1.56	52.8	8.5	1.56	51.4	9.1	**1.56**	**52.1**	**8.8**	2.70	50.5	1.03	**9.4**	5.1	144	163	158	176	160	-	-	
9.1	JRA	17/02/2020	Fill to East of Road - Above Old Gully	~FL	Clay SILT	NDM / SV	1.66	39.7	8.8	1.66	40.5	8.4	**1.66**	**40.1**	**8.6**	2.70	40.2	1.18	**8.5**	6.0	187+	187+	187+	187+	187+	-	-	
9.2						NDM / SV	1.69	43.3	5.1	1.69	42.0	5.8	**1.69**	**42.7**	**5.5**	2.70	45.4	1.16	**4.0**	5.7	187+	187+	187+	187+	187+	-	-	
9.3			Future Road Fill Area			NDM / SV	1.61	49.2	7.0	1.62	45.2	8.0	**1.62**	**47.2**	**7.5**	2.70	53.4	1.05	**4.7**	5.5	160	166	187	184	174	-	-	
9.4			Fill to West of Road - Above Old Gully			NDM / SV	1.67	45.2	5.5	1.67	45.3	5.4	**1.67**	**45.3**	**5.4**	2.70	54.0	1.08	**1.3**	5.1	160	158	187	176	170	-	-	
10.1	JRA	20/02/2020	Fill Above Pond	~2m Below FL	Clay SILT	NDM / SV	1.62	44.6	8.5	1.62	44.7	8.8	**1.62**	**44.7**	**8.7**	2.70	46.4	1.10	**7.8**	5.0	187+	187+	187+	187+	187+	-	-	
10.2						NDM / SV	1.68	45.4	4.7	1.69	44.8	4.8	**1.68**	**45.1**	**4.7**	2.70	56.1	1.08	**0.0**	4.4	187+	187+	187+	187+	187+	-	-	
11.1	JRA	16/03/2020	South Gully	~1 -1 .5m Placed Above SPR	Clay SILT	NDM / SV	1.85	27.0	6.9	1.86	25.7	7.3	**1.85**	**26.4**	**7.1**	2.70	22.7	1.51	**9.8**	4.8	187+	187+	187+	187+	187+	-	-	
11.2						NDM / SV	1.87	27.1	5.6	1.88	27.1	5.2	**1.87**	**27.1**	**5.4**	2.70	23.4	1.52	**8.2**	5.5	187+	187+	187+	187+	187+	-	-	
12.1	JRA	28/04/2020	South Gully	~2.5-3m placed above SPR	Clay SILT	NDM / SV	1.80	34.5	4.0	1.82	34.3	3.6	**1.81**	**34.4**	**3.8**	2.70	32.6	1.36	**5.0**	5.9	160	187	131	187	166+	-	-	
12.2						NDM / SV	1.84	31.0	4.4	1.84	31.0	4.7	**1.84**	**31.0**	**4.6**	2.70	26.9	1.45	**7.4**	5.7	187+	187+	187+	187+	187+	-	-	
12.3						NDM / SV	1.62	50.2	5.7	1.63	46.6	6.9	**1.63**	**48.4**	**6.3**	2.70	44.2	1.13	**8.3**	5.7	187+	187+	187+	187+	187+	-	-	

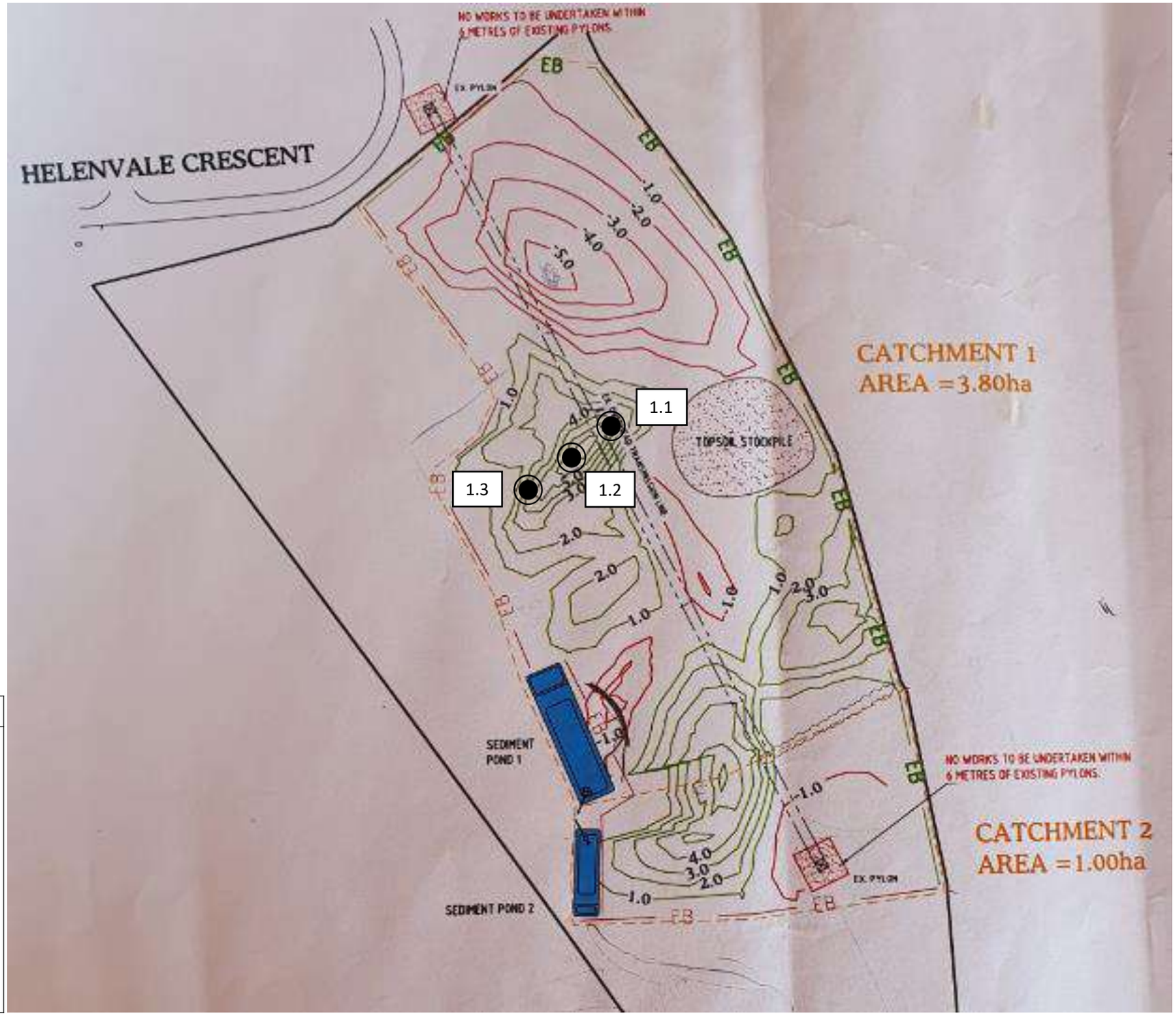
GEOTECHNICS

Job: McRobbie Block, Pokeno

Client: McRobbie Bros Ltd

Job #	1012885.0000.0.0/1
Entered By	JRA
Checked By	FRHA
Approved By	SJA

URN	Tech.	Date	Location	Layer	Material	Test Type	NDM 0^0			NDM 90^0			AVERAGE NDM			Solid Density (t/m^3) Assumed	Oven Moisture content (%)	Final Corrected		Average Air Voids (10 X Tests)	Shear Vane Reading (kPa)					Retest URN	PASS / FAIL	Comments
						NDM / SV	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)			Oven Dry Density (t/m^3)	Average Air Voids (%)		Reading 1	Reading 2	Reading 3	Reading 4	Average SV (4 x Tests)		(P) Pass / (F) Fail
13.1	JRA	8/05/2020	South Gully	~3.5 - 4m placed above SPR	Clay SILT	NDM / SV	1.87	28.0	5.2	1.87	28.0	5.1	**1.87**	**28.0**	**5.2**	2.70	27.9	1.46	**5.2**	5.8	187+	187+	187+	187+	187+	-	-	
13.2						NDM / SV	1.86	28.4	5.3	1.87	28.1	5.1	**1.86**	**28.3**	**5.2**	2.70	26.0	1.48	**6.8**	6.0	187+	187+	187+	187+	187+	-	-	
13.3						NDM / SV	1.85	30.7	4.2	1.85	31.2	3.8	**1.85**	**31.0**	**4.0**	2.70	30.2	1.42	**4.5**	6.3	187+	187+	187+	187+	187+	-	-	
14.1	JRA	18/05/2020	South Gully	~Road Subgrade Level	Clay SILT	NDM / SV	1.86	29.5	4.7	1.85	28.8	5.4	**1.85**	**29.2**	**5.0**	2.70	26.5	1.46	**6.9**	6.2	187+	187+	187+	187+	187+	-	-	
14.2						NDM / SV	1.82	33.2	3.9	1.82	32.4	4.8	**1.82**	**32.8**	**4.3**	2.70	32.3	1.38	**4.6**	6.7	187+	187+	187+	187+	187+	-	-	
14.3				~5m Placed aove SPR		NDM / SV	1.89	32.5	1.1	1.89	31.6	1.4	**1.89**	**32.1**	**1.2**	2.70	31.2	1.44	**1.8**	5.9	171	176	187+	187+	180+	-	-	



Legend:

- Impact Hammer
- NDM & SV Set
- Shear Vane
- Scala
- Hand Auger

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	21/11/19
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	1	Date:	21/11/19
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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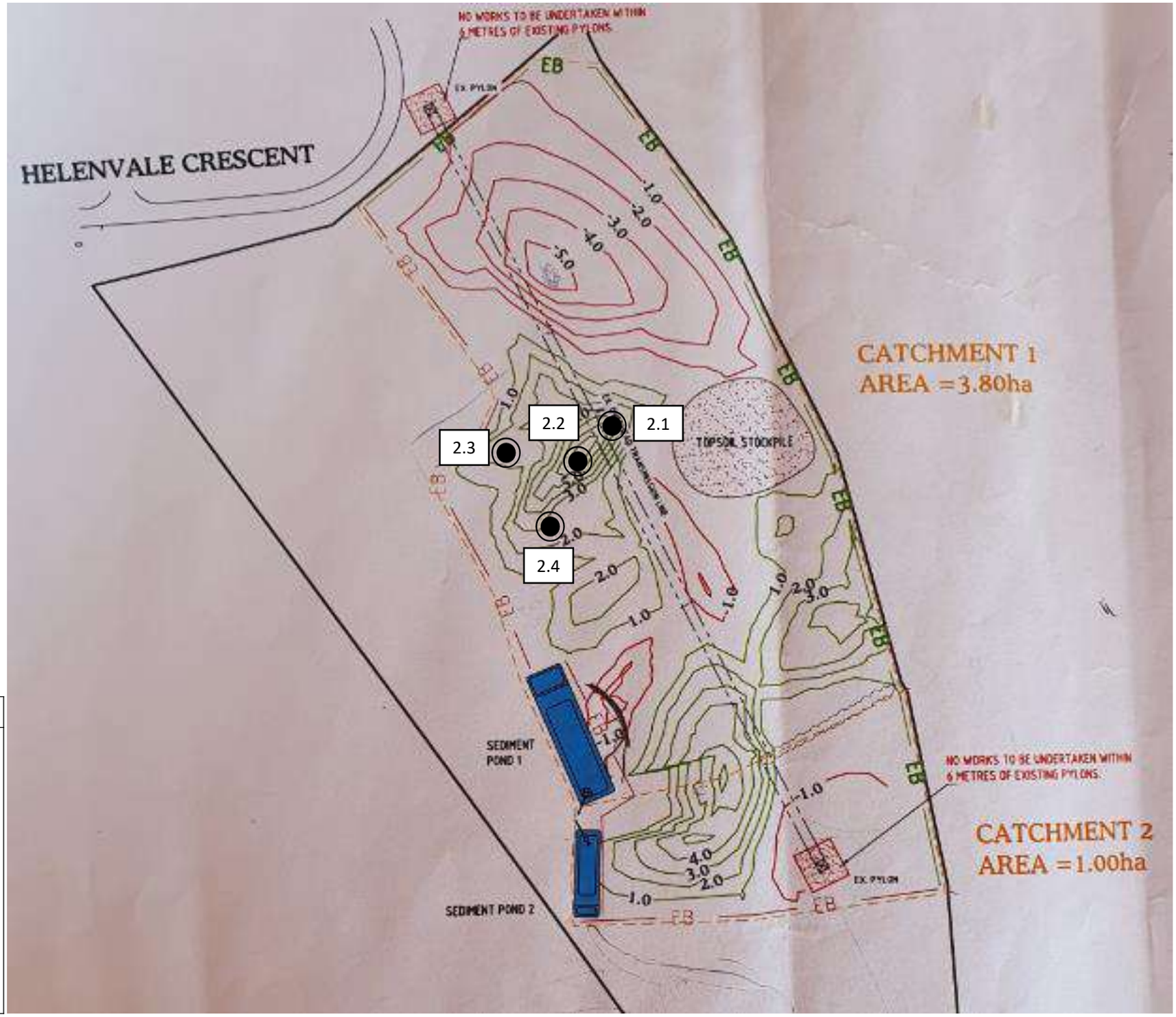

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	27/11/19
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	2	Date:	27/11/19
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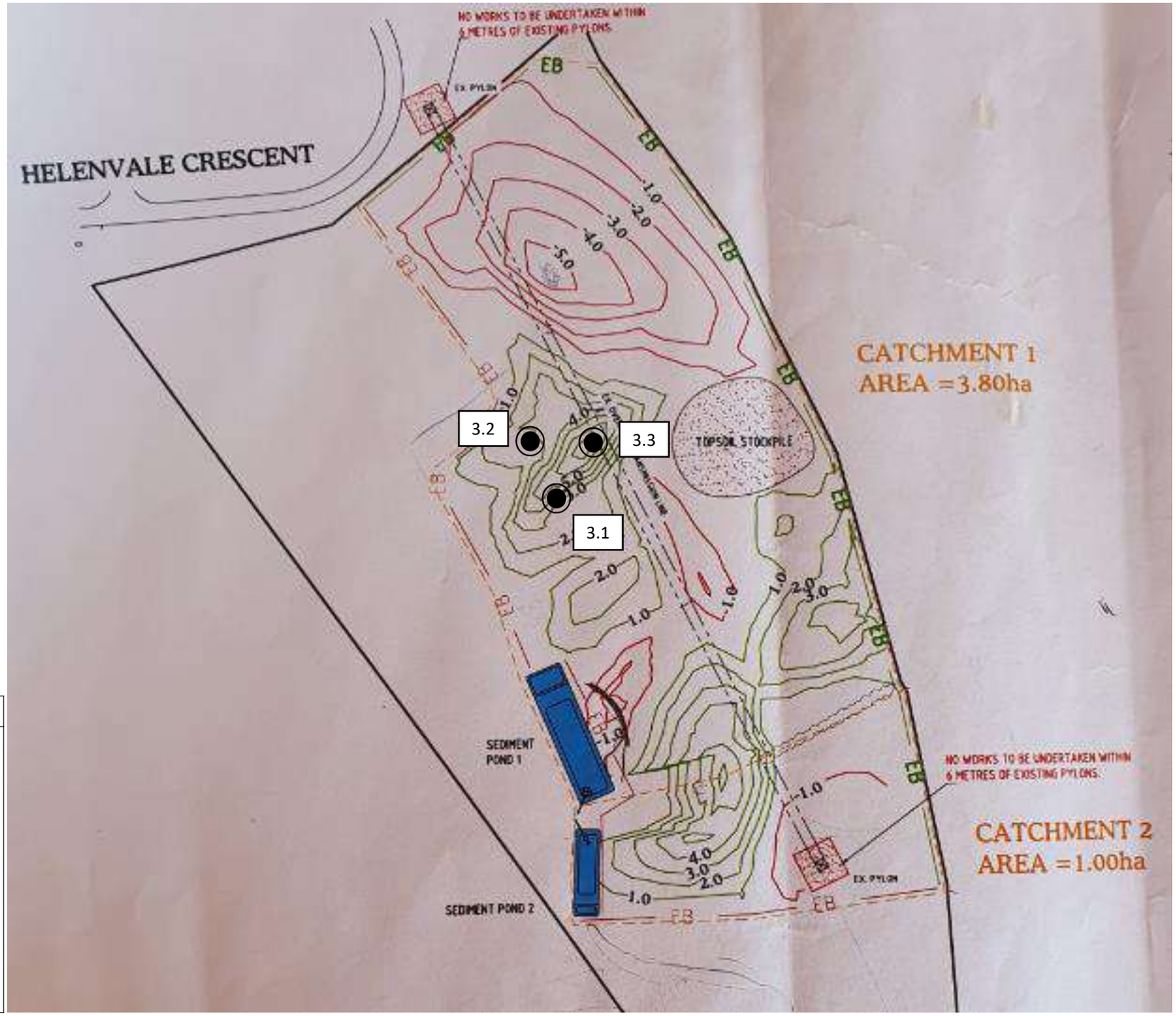

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	6/12/19
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	3	Date:	6/12/19
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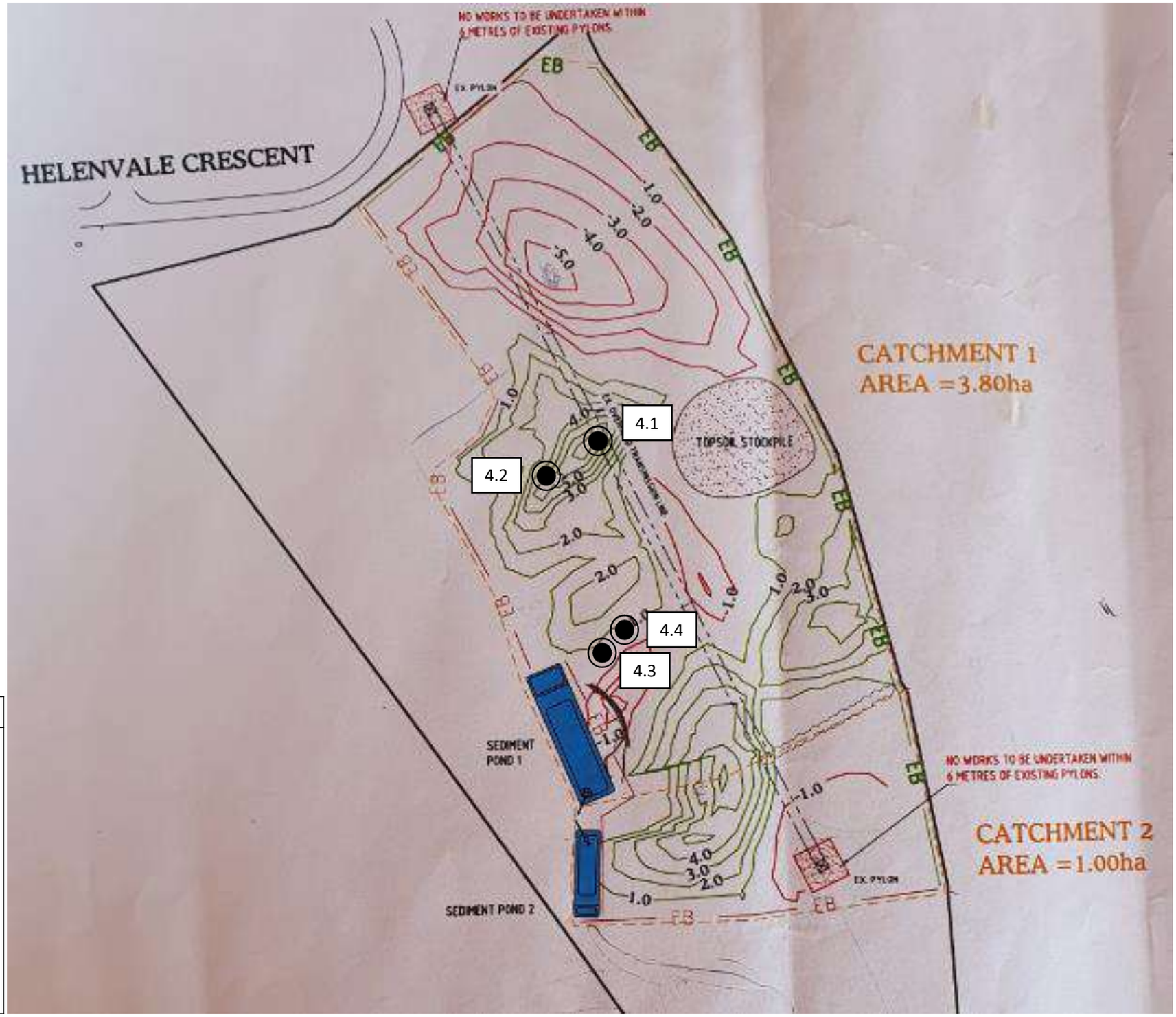

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	8/1/20
Location:	Gully & Pond Fill	Job No.:	1012885.0000.0.0/1	URN:	4	Date:	8/1/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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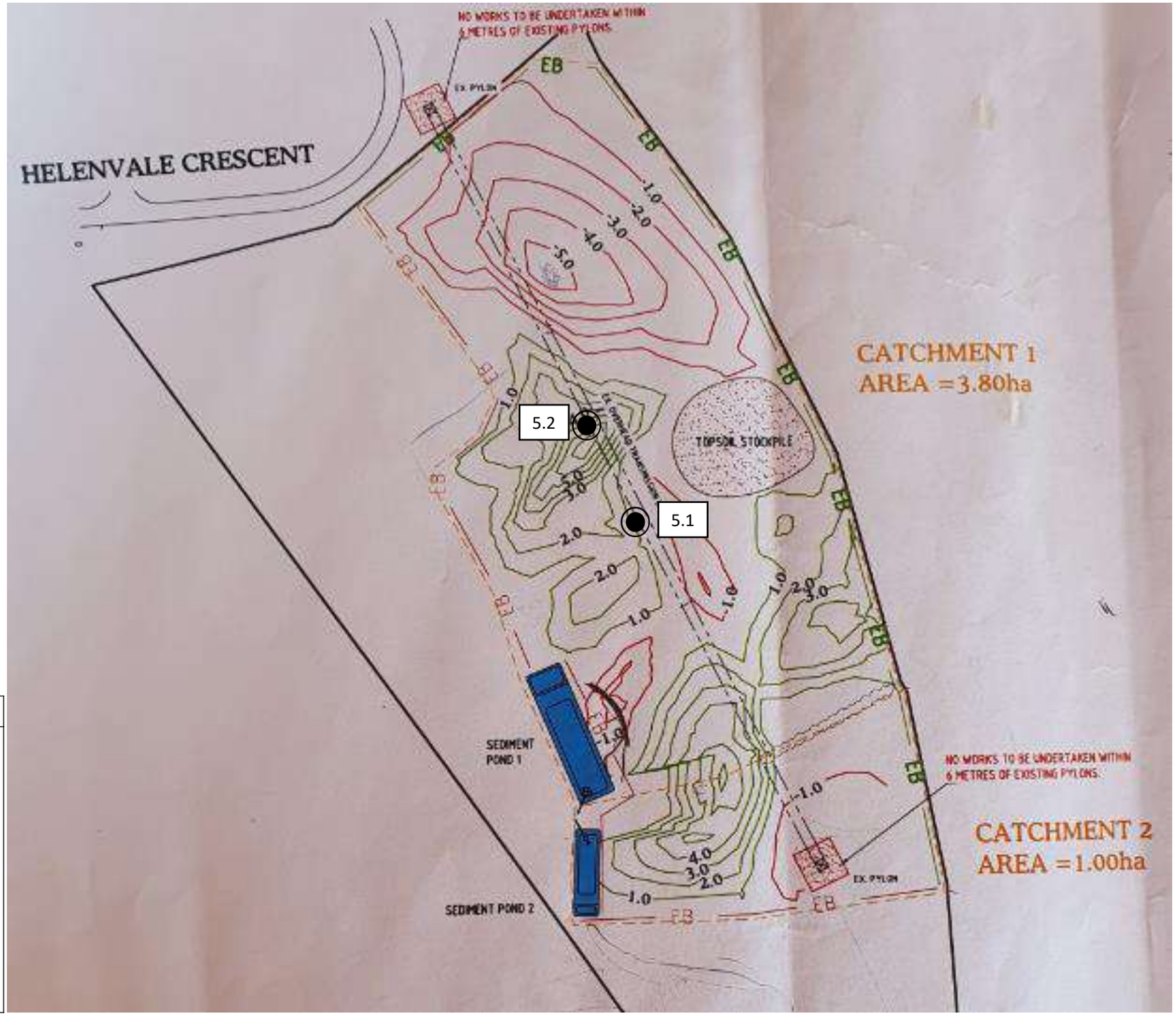

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	15/1/20
Location:	Road Fill Area	Job No.:	1012885.0000.0.0/1	URN:	5	Date:	15/1/20
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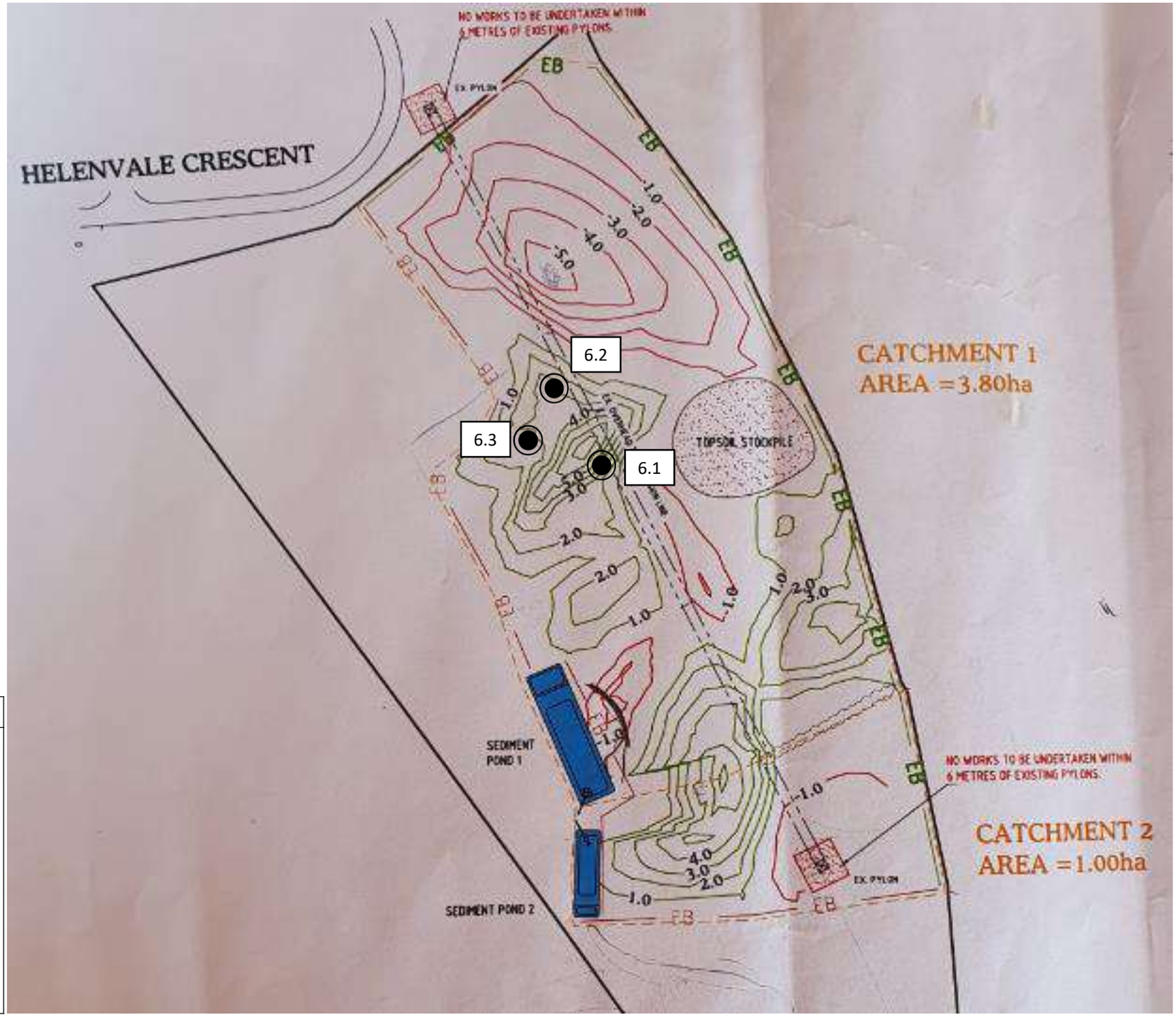

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	22/1/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	6	Date:	22/1/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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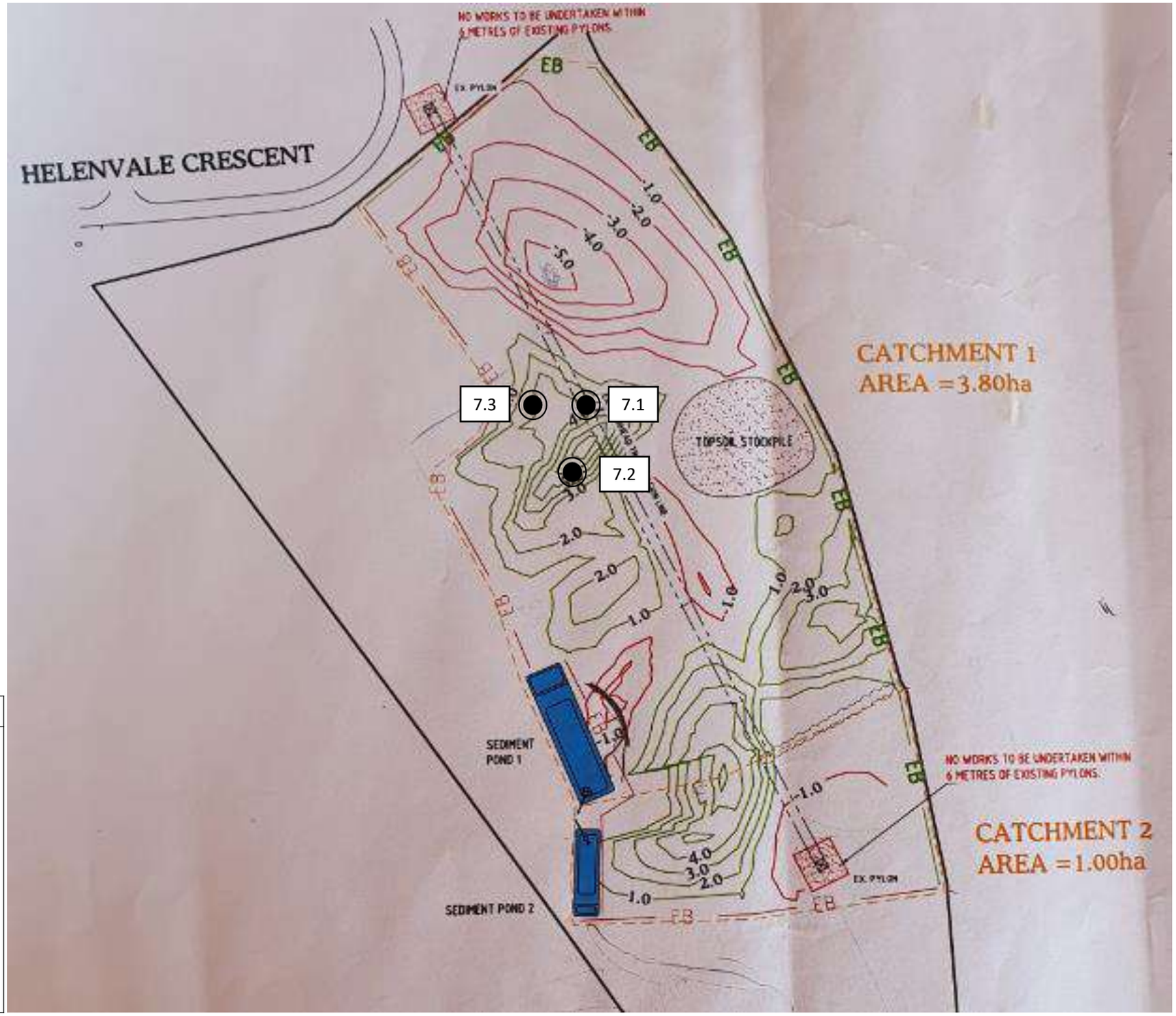

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	31/1/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	7	Date:	31/1/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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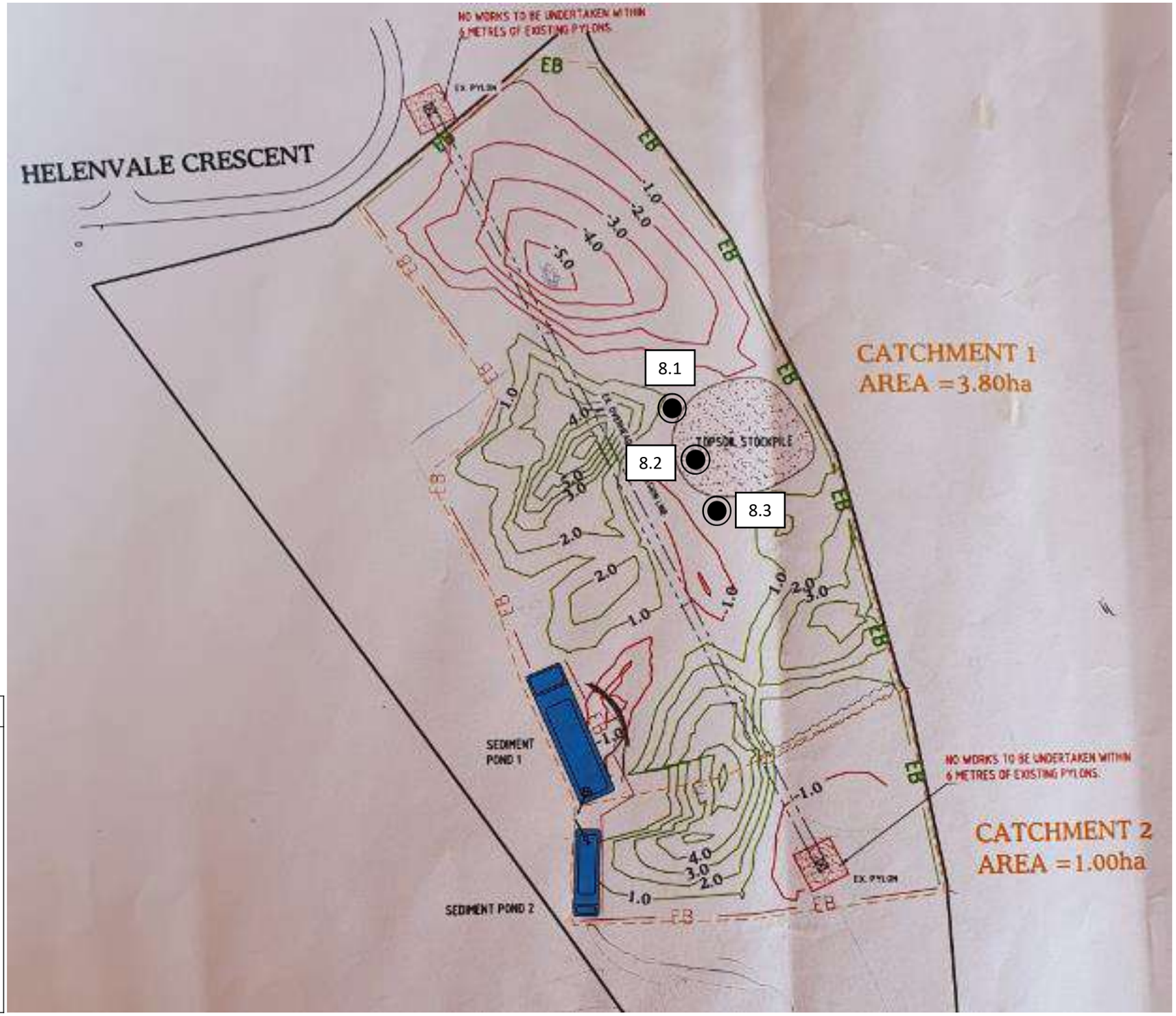

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	5/2/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	8	Date:	5/2/20
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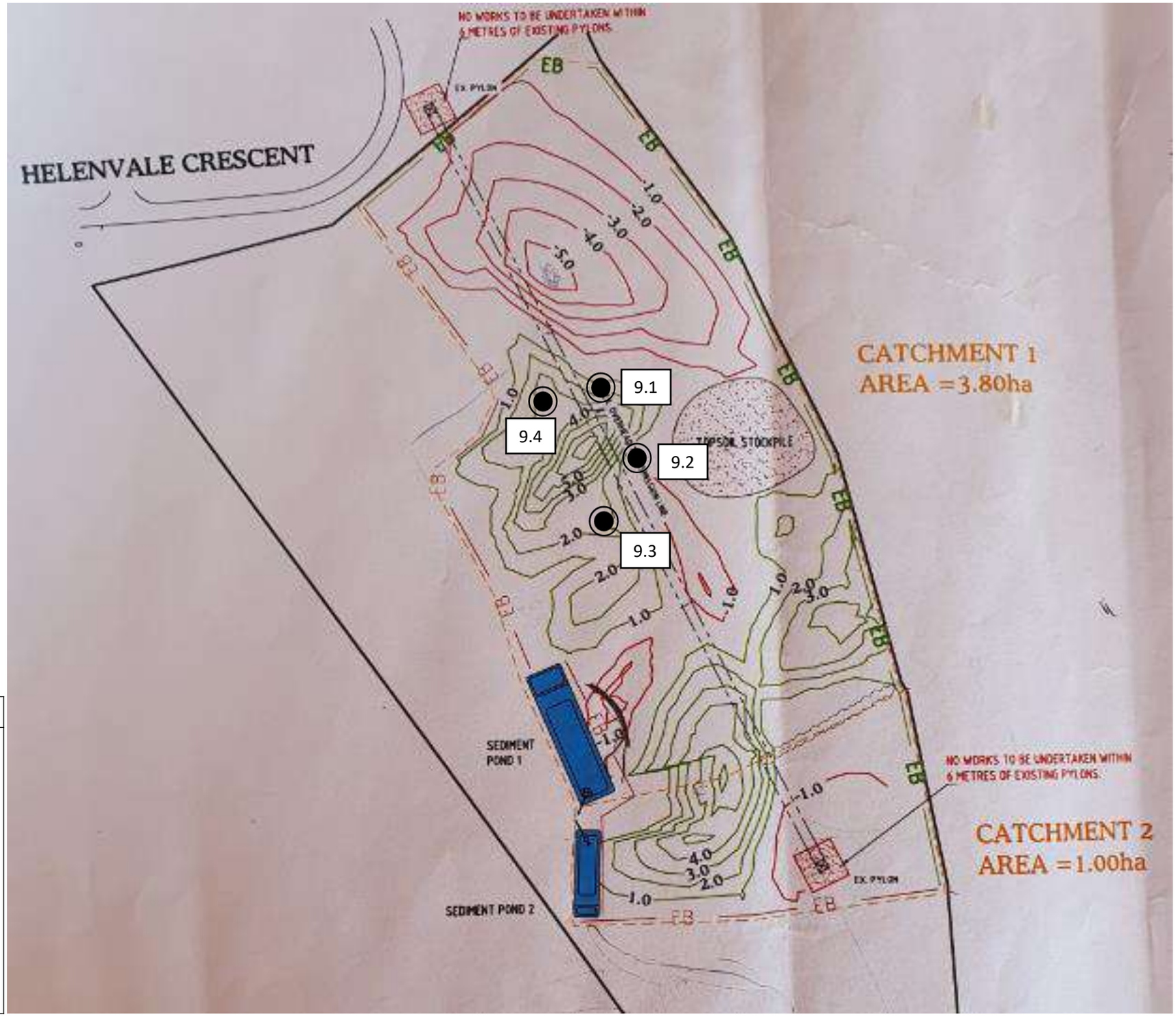

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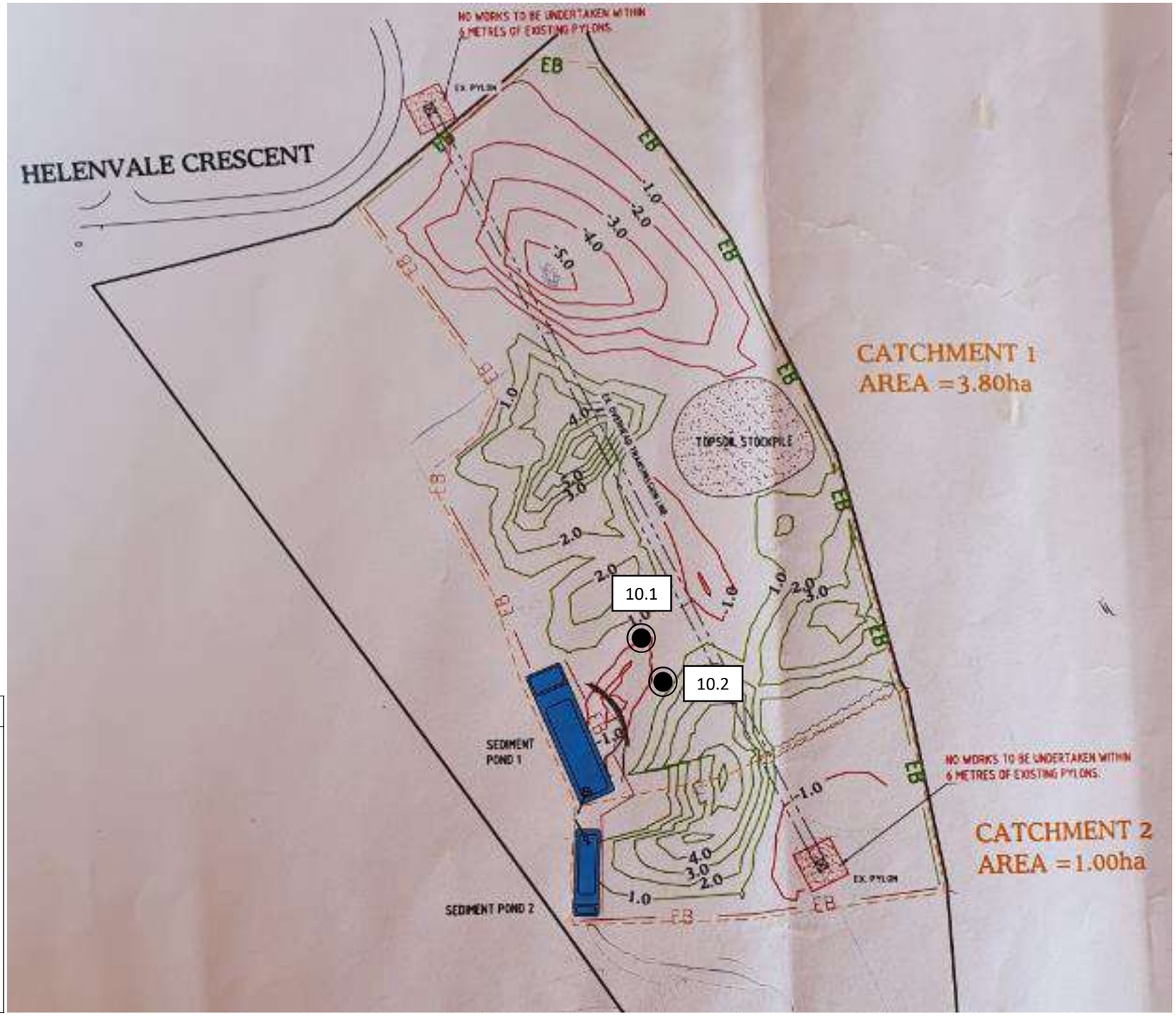
Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	17/2/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	9	Date:	17/2/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

N



Legend:

- Impact Hammer
- NDM & SV Set
- Shear Vane
- Scala
- Hand Auger

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e. enquiry@geotechnics.co.nz
w. www.geotechnics.co.nz

Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	20/2/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	10	Date:	20/2/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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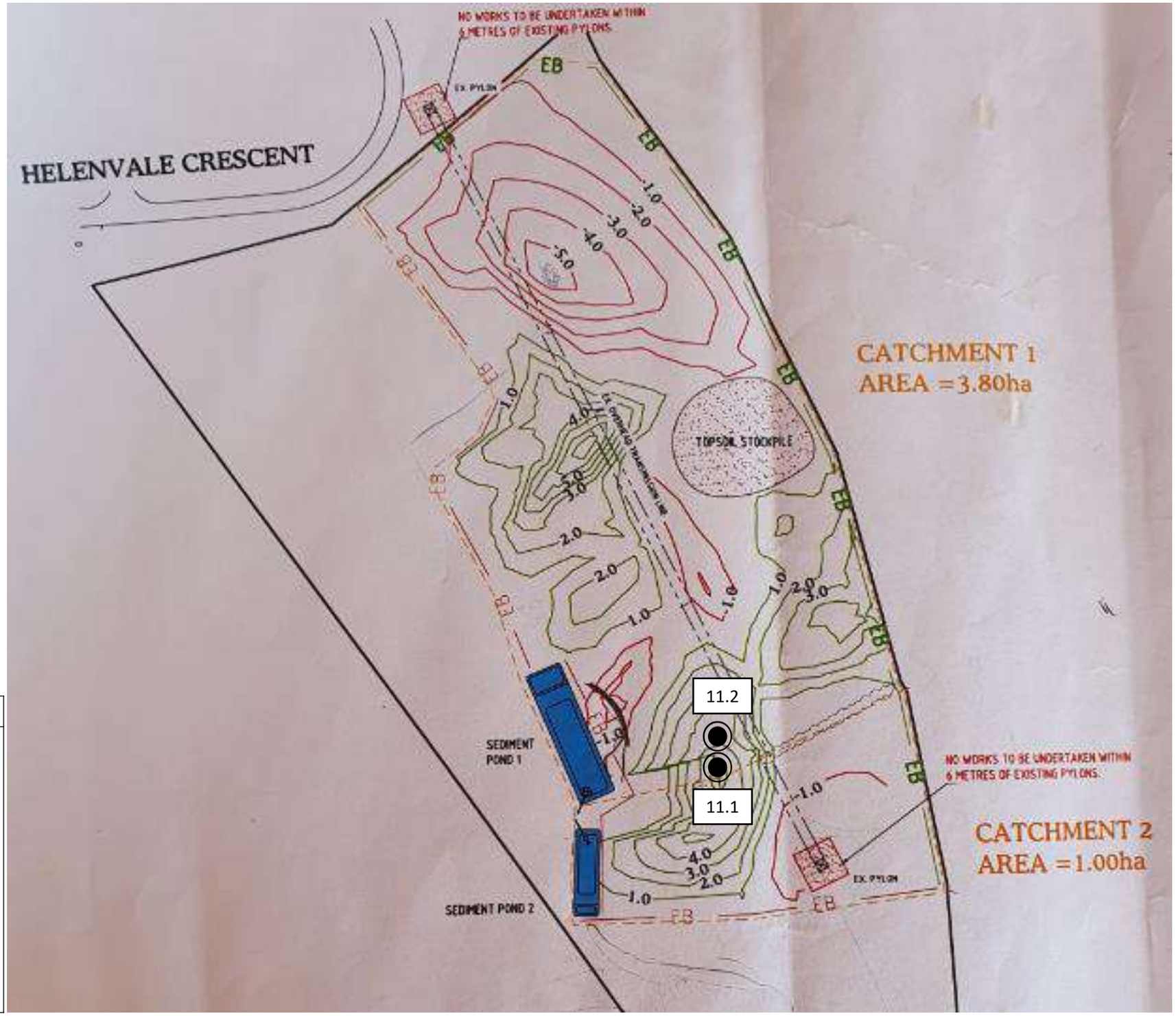

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	16/3/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	11	Date:	16/3/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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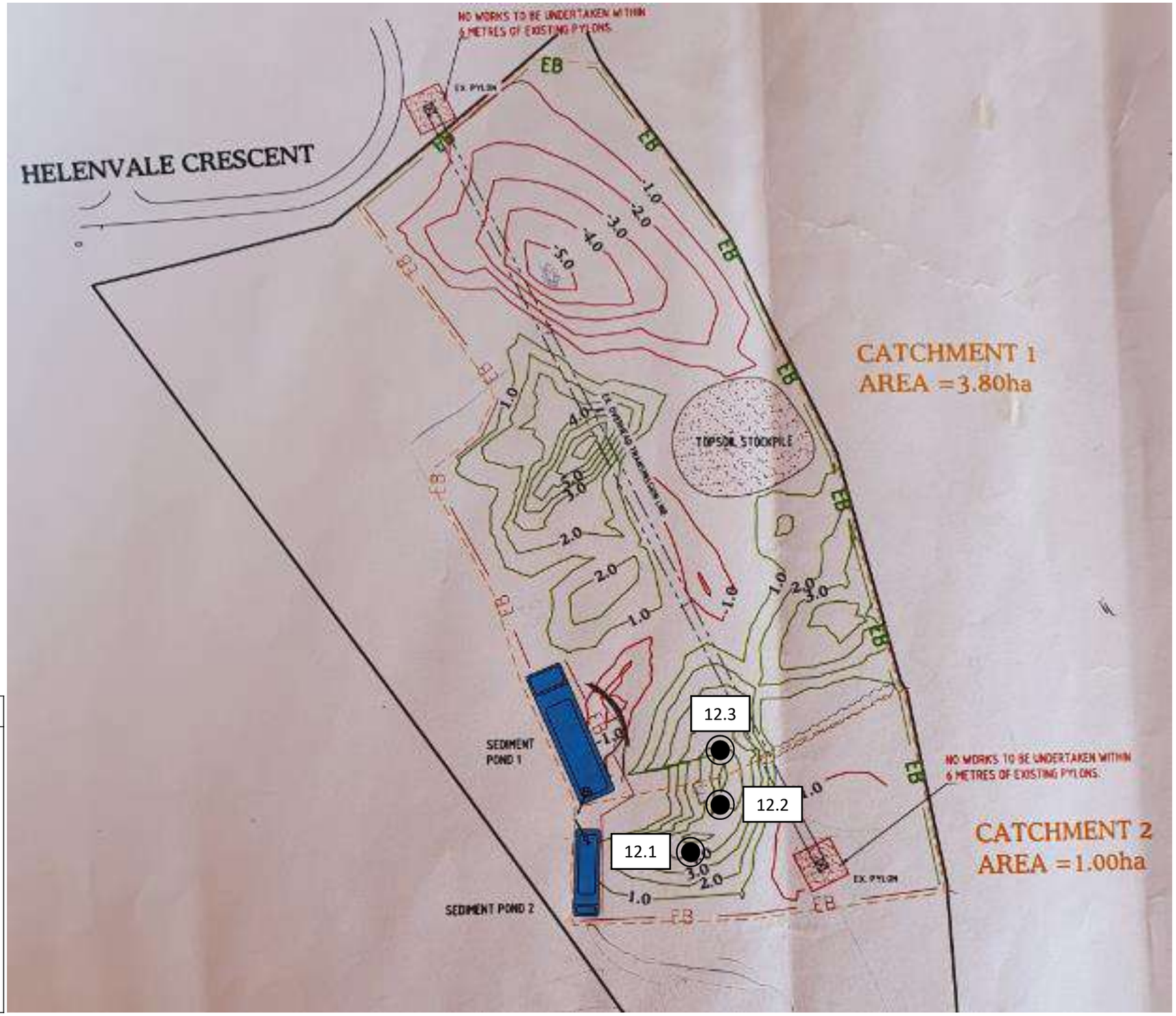

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	28/4/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	12	Date:	28/4/20
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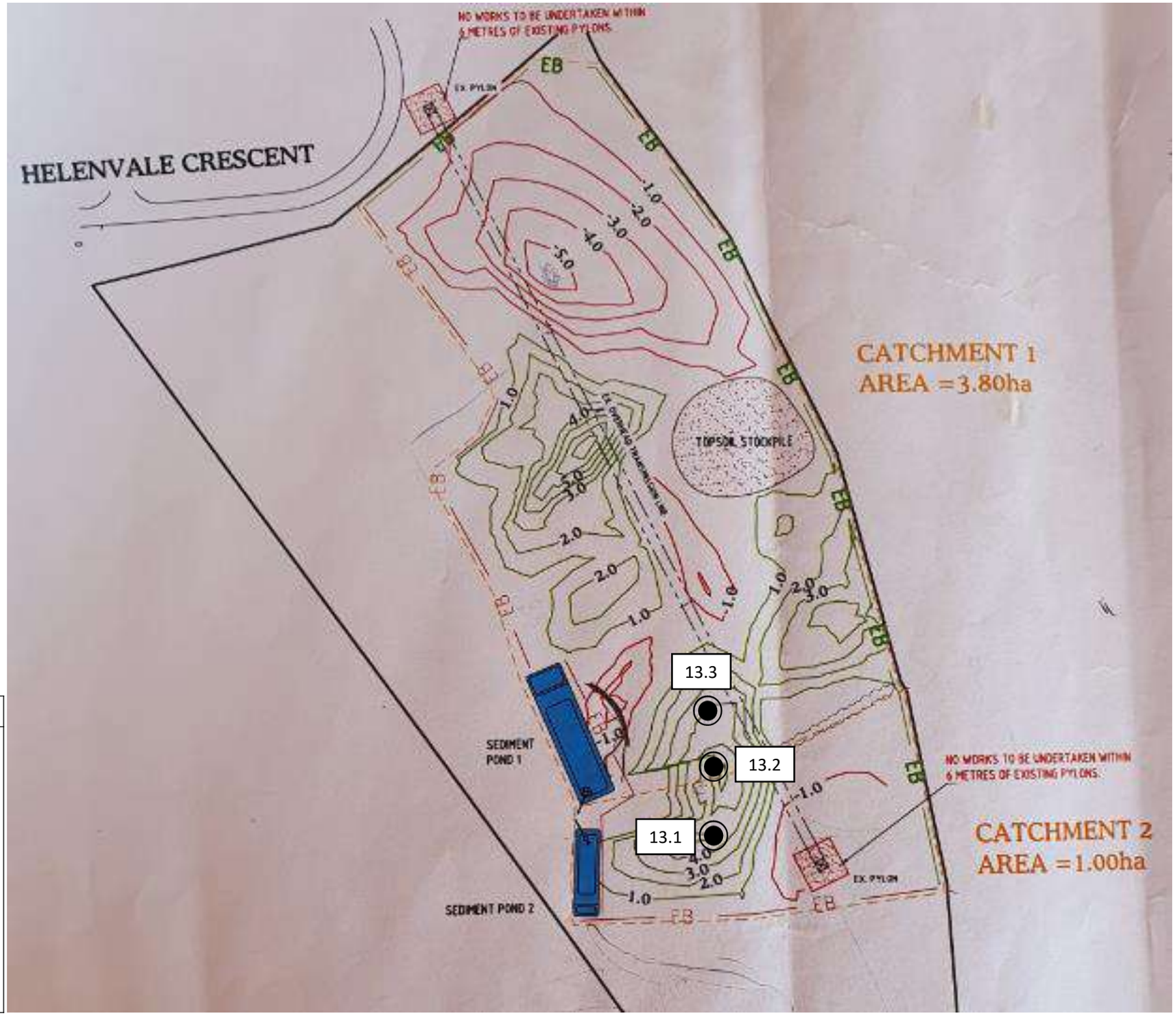

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	8/5/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	13	Date:	8/5/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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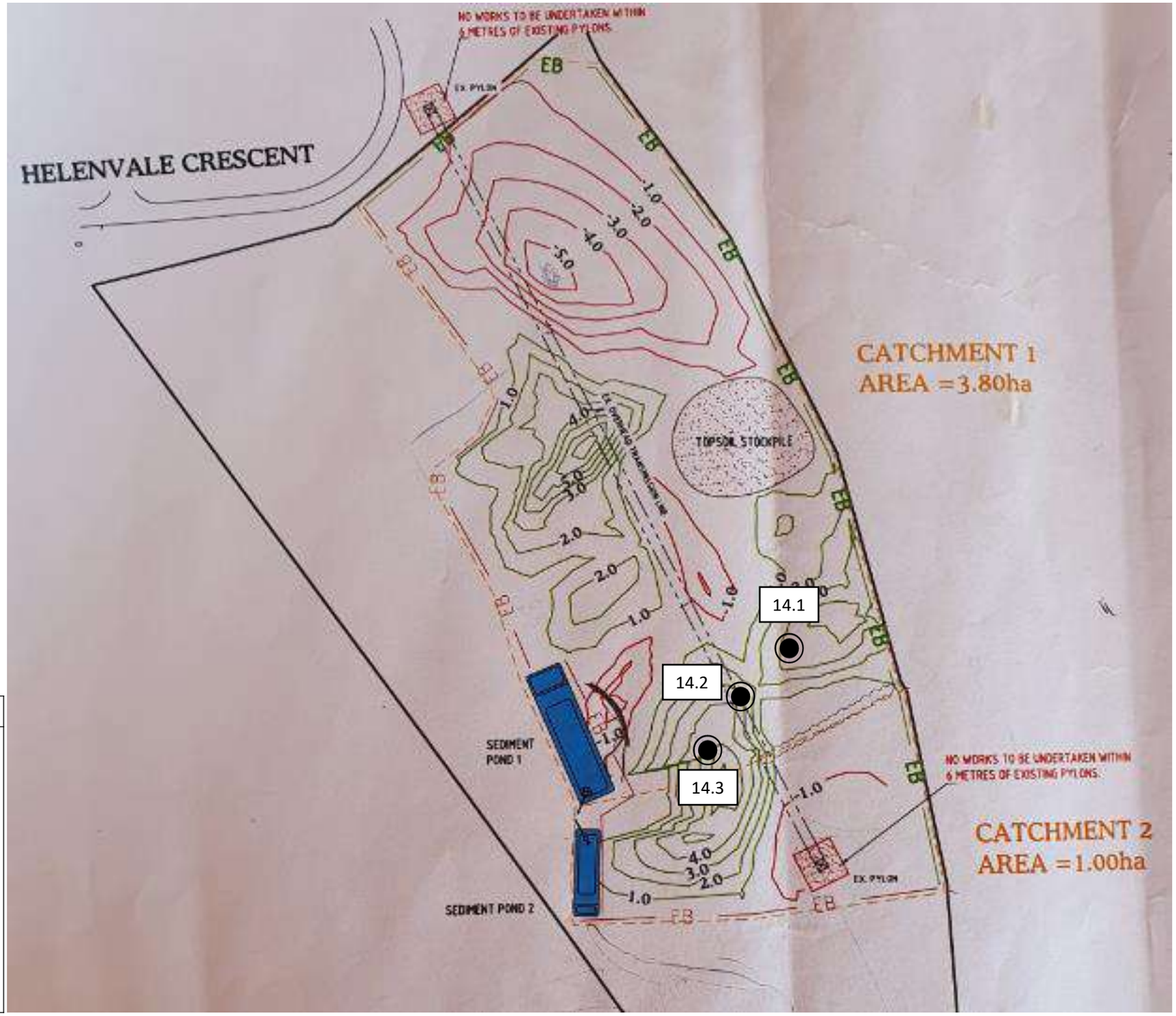

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	18/5/20
Location:	Gully Fill	Job No.:	1012885.0000.0.0/1	URN:	14	Date:	18/5/20
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

N

Our Ref: 1012885.0000.0.0/2
15 February 2021

McRobbie Brothers Ltd
PO Box 7
Pokeno 2440

Attention: James McRobbie

Dear James

McRobbie Subdivison, Pokeno - Earthworks Testing 2020-2021

Site Report

Customer's Instructions

We were instructed to:

Complete nuclear densometer and shear vane testing at the above mentioned site when requested and report the results.

Specifications

No formal specification was issued by the customer.

Dates of Procedures

Testing was carried out from the 21/9/2020 to the 22/12/2020.

Locations

Testing locations were selected on site by the Geotechnics technician on behalf of the customer.

The attached plans provide indicative locations only and are not to scale. All other information we provide regarding location should be referenced to the asset owner.

Samples

Samples taken for moisture content verification purposes were disposed of 24 hours after testing.

Methods

NZGS 8:2001 - Test method for determining the vane shear strength of a cohesive soil using a hand held shear vane.

NZS 4407:2015 Test 4.2 - Method using a nuclear surface moisture-density gauge (Direct Transmission Mode) – NDM

NZS 4407:2015 Test 3.1 - Determination of water content

Material Description

Material descriptions are provided in the attached results. All descriptions were provided by the customer.

Results

The following is attached:

Earthworks Results and Test Location Plans.

Test Remarks

Shear Vane

Shear Vane tests are potentially unsuitable for material described in the earthworks summary as 'Clay SILT w Gravels'. Tests in these materials may not be compliant with the stated test method and results are therefore not covered under the IANZ endorsement of this report.

NDM – Direct Transmission

The test method may not be appropriate for materials containing a nominal maximum particle size of >40 mm.

Nuclear densometers are calibrated for a bulk density range of 1,728 kg/m^3 to 2,756 kg/m^3. Test results outside of these bulk density limits are not covered under the IANZ endorsement of this report.

An assumed solid density value of 2.70 t/m^3 was agreed with the customer. We do not take responsibility for misrepresentation or misinterpretation arising from the use of this assumed value to calculate air voids.

Where oven calculated air voids are negatives, these have been reported as zero.

The calculation of air voids is based on wet density (measured by the nuclear densometer), moisture content (measured by oven drying) and solid density (either assumed or measured by laboratory testing). Negative air voids may be caused by incorrect assumed solid density or due to the variability of onsite material when compared to that tested in a laboratory.

Determination of Water Content

Samples used for the determination of the water content were sampled in conjunction with nuclear densometer testing and disposed of after 24 hours.

General Remarks

This report has been prepared for the benefit of McRobbie Brothers Ltd, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

The inherent uncertainties of site investigation work, mean the nature and continuity of subsoil away from the test location could vary from the data logged.

Material descriptions are included for information only and are not covered under the IANZ endorsement of this report.

Sample(s) not destroyed during testing will be retained for one month from the date of this report before being discarded.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of the letterhead page.

GEOTECHNICS LTD

Report prepared by:

.....
Josh Allan
Projects Manager
Approved Signatory

Authorised for Geotechnics by:

.....
Steven Anderson
Project Director

Report checked by:

.....
Seven Baker
CMT Field Technician

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

15-Feb-21

t:\geotechnicsgroup\projects\1009213\1009213.0683 - stage 5b, 125 murphys road\issueddocuments\report\20210126 jra rpt1.docx

GEOTECHNICS

Job: McRobbie Block, Pokeno

Client: McRobbie Bros Ltd

Job #	1012885.0000.0.0/2
Entered By	JRA
Checked By	SEBA / DASA
Approved By	SJA

URN	Tech.	Date	Location	Layer	Material	Test Type	NDM 0⁰			NDM 90⁰			AVERAGE NDM			Solid Density (t/m³) Assumed	Oven Moisture content (%)	Final Corrected		Average Air Voids (10 X Tests)	Shear Vane Reading (kPa)					Retest URN	PASS / FAIL	Comments
						NDM / SV	Wet Density (t/m³)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m³)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m³)	Moisture Content (%)	Air Voids (%)			Oven Dry Density (t/m³)	Average Air Voids (%)		Reading 1	Reading 2	Reading 3	Reading 4	Average SV (4 x Tests)		(P) Pass / (F) Fail	
15.1	JRA	21/09/2020	South Gully	~Road Subgrade Level	Clay SILT	NDM / SV	1.87	33.6	0.9	1.87	34.2	0.8	**1.87**	**33.9**	**0.8**	2.70	33.6	1.40	**1.0**	5.2	187+	136	147	176	162+	-	-	
15.2						NDM / SV	1.81	31.6	5.7	1.82	33.2	4.2	**1.81**	**32.4**	**5.0**	2.70	31.3	1.38	**5.7**	5.2	187+	187+	187+	187+	187+	-	-	
15.3						NDM / SV	1.85	30.2	4.7	1.83	30.9	4.9	**1.84**	**30.6**	**4.8**	2.70	33.1	1.38	**3.1**	4.8	187+	187+	187+	187+	187+	-	-	
15.4						NDM / SV	1.78	34.3	5.5	1.79	35.6	4.3	**1.78**	**35.0**	**4.9**	2.70	31.6	1.35	**7.0**	4.7	150	187+	176	174	172+	-	-	
16.1	JRA	23/09/2020	South Gully Area	~4-5m Placed above SPR	Clay SILT	NDM / SV	1.79	30.3	7.7	1.80	31.2	6.4	**1.79**	**30.8**	**7.0**	2.70	32.8	1.35	**5.7**	4.7	160	144	131	147	146	-	-	
16.2						NDM / SV	1.73	36.5	7.0	1.85	32.6	3.0	**1.79**	**34.6**	**5.0**	2.70	31.6	1.36	**6.8**	4.7	187	176	187	187	184	-	-	
16.3						NDM / SV	1.84	31.9	3.7	1.85	32.5	3.1	**1.84**	**32.2**	**3.4**	2.70	33.9	1.38	**2.3**	4.5	176	158	134	131	150	-	-	
16.4						NDM / SV	1.77	33.5	6.2	1.77	31.2	7.9	**1.77**	**32.4**	**7.0**	2.70	29.7	1.37	**8.8**	4.7	176	171	160	150	164	-	-	
17.1	SEBA	6/10/2020	South Gully Area	~1m placed since last layer	Clay SILT	NDM / SV	1.85	30.0	4.4	1.85	33.0	2.4	**1.85**	**31.5**	**3.4**	2.70	25.0	1.48	**8.0**	5.0	189	189	189	189	189	-	-	
17.2						NDM / SV	1.92	32.6	0.0	1.91	31.4	0.8	**1.91**	**32.0**	**0.0**	2.70	30.4	1.47	**1.1**	5.0	162	175	189	189	178	-	-	
17.3						NDM / SV	1.70	44.4	4.2	1.70	42.6	5.1	**1.70**	**43.5**	**4.6**	2.70	41.6	1.20	**5.6**	5.4	162	164	189	189	176	-	-	
17.4						NDM / SV	1.72	47.9	1.3	1.76	45.0	0.7	**1.74**	**46.5**	**1.0**	2.70	38.5	1.25	**5.3**	5.4	189	189	189	189	189	-	-	
17.5						NDM / SV	1.76	38.7	4.1	1.76	39.9	3.1	**1.76**	**39.3**	**3.6**	2.70	37.3	1.28	**4.8**	5.5	148	162	167	186	166	-	-	
17.6						NDM / SV	1.77	46.0	0.0	1.77	39.9	2.7	**1.77**	**43.0**	**1.0**	2.70	33.0	1.33	**6.8**	5.5	148	162	186	186	170	-	-	
17.7						NDM / SV	1.80	39.8	1.0	1.80	41.6	0.0	**1.80**	**40.7**	**0.4**	2.70	40.4	1.28	**0.6**	5.0	121	135	162	162	145	-	-	
17.8						NDM / SV	1.74	53.0	0.0	1.71	56.8	0.0	**1.73**	**54.9**	**0.0**	2.70	47.1	1.17	**1.3**	4.5	189	189	189	189	189	-	-	
17.9						NDM / SV	1.61	47.5	7.9	1.65	43.4	7.6	**1.63**	**45.5**	**7.7**	2.70	41.1	1.15	**9.9**	5.2	162	186	186	186	180	-	-	
18.1	JRA	20/10/2020	South Gully Area	~2m Below FL	Clay SILT	NDM / SV	1.80	42.3	0.0	1.80	42.3	0.0	**1.80**	**42.3**	**0.0**	2.70	39.5	1.29	**1.3**	4.5	123	147	131	144	136	-	-	
18.2						NDM / SV	1.77	41.7	1.7	1.77	42.7	0.9	**1.77**	**42.2**	**1.3**	2.70	46.8	1.21	**0.0**	3.7	126	123	139	147	134	-	-	
18.3						NDM / SV	1.79	35.9	3.7	1.79	35.0	4.2	**1.79**	**35.5**	**4.0**	2.70	34.1	1.34	**4.8**	4.0	126	131	136	128	130	-	-	
18.4						NDM / SV	1.87	27.7	5.2	1.88	27.9	4.8	**1.87**	**27.8**	**5.0**	2.70	27.4	1.47	**5.3**	4.0	171	187	176	150	171	-	-	
19.1	JRA	3/11/2020	South Gully Area	~FL	Clay SILT	NDM / SV	1.81	31.1	6.0	1.81	29.6	6.9	**1.81**	**30.4**	**6.5**	2.70	28.7	1.41	**7.6**	4.2	187+	187+	UTP	UTP	187+	-	-	
19.2						NDM / SV	1.97	25.2	2.3	1.97	24.5	2.7	**1.97**	**24.9**	**2.5**	2.70	25.4	1.57	**2.1**	4.0	187+	187+	187+	UTP	187+	-	-	
19.3						NDM / SV	1.68	43.4	5.9	1.68	42.9	5.8	**1.68**	**43.2**	**5.9**	2.70	43.1	1.17	**5.9**	3.9	187+	187+	179	174	182+	-	-	
19.4						NDM / SV	1.68	40.2	7.3	1.68	42.9	6.0	**1.68**	**41.6**	**6.7**	2.70	44.1	1.17	**5.3**	4.4	158	144	163	160	156	-	-	
19.5				~1.5m below FL		NDM / SV	1.64	45.5	6.9	1.64	49.2	5.3	**1.64**	**47.4**	**6.1**	2.70	48.7	1.10	**5.5**	4.8	187+	187+	187+	187+	187+	-	-	
20.1	JRA	16/11/2020	South Gully Area	~FL	Clay SILT	NDM / SV	1.72	37.4	7.0	1.73	35.1	7.7	**1.72**	**36.3**	**7.3**	2.70	32.9	1.30	**9.4**	4.7	216+	216+	216+	216+	216+	-	-	
20.2						NDM / SV	1.70	34.1	9.9	1.70	33.5	10.2	**1.70**	**33.8**	**10.1**	2.70	42.2	1.19	**5.3**	5.1	216+	216+	216+	216+	216+	-	-	
20.3					Clay SILT w Gravels	NDM / SV	1.97	22.7	4.1	1.98	21.3	4.6	**1.98**	**22.0**	**4.4**	2.70	22.6	1.61	**3.9**	5.5	UTP	UTP	UTP	UTP	UTP	-	-	
20.4				~1m below FL		NDM / SV	1.82	33.2	4.0	1.83	34.5	2.9	**1.82**	**33.9**	**3.5**	2.70	34.1	1.36	**3.3**	5.4	173	185	151	139	162	-	-	
21.1	JRA	7/12/2020	South Gully Area	~FL	Clay SILT w Gravels	NDM / SV	1.88	29.0	3.5	1.89	29.9	2.5	**1.89**	**29.5**	**3.0**	2.70	28.3	1.47	**3.8**	5.2	199+	199+	199+	199+	199+	-	-	
21.2						NDM / SV	1.79	29.2	8.1	1.78	30.4	7.9	**1.79**	**29.8**	**8.0**	2.70	31.9	1.35	**6.6**	5.1	170	196	199+	184	187+	-	-	
21.3				~1-2m below FL		NDM / SV	1.84	32.4	3.7	1.84	32.5	3.4	**1.84**	**32.5**	**3.6**	2.70	31.4	1.40	**4.3**	5.3	153	183	199+	199+	184+	-	-	
21.4						NDM / SV	1.87	31.1	2.7	1.87	30.7	2.9	**1.87**	**30.9**	**2.8**	2.70	29.1	1.45	**4.1**	5.2	150	153	199	176	170	-	-	

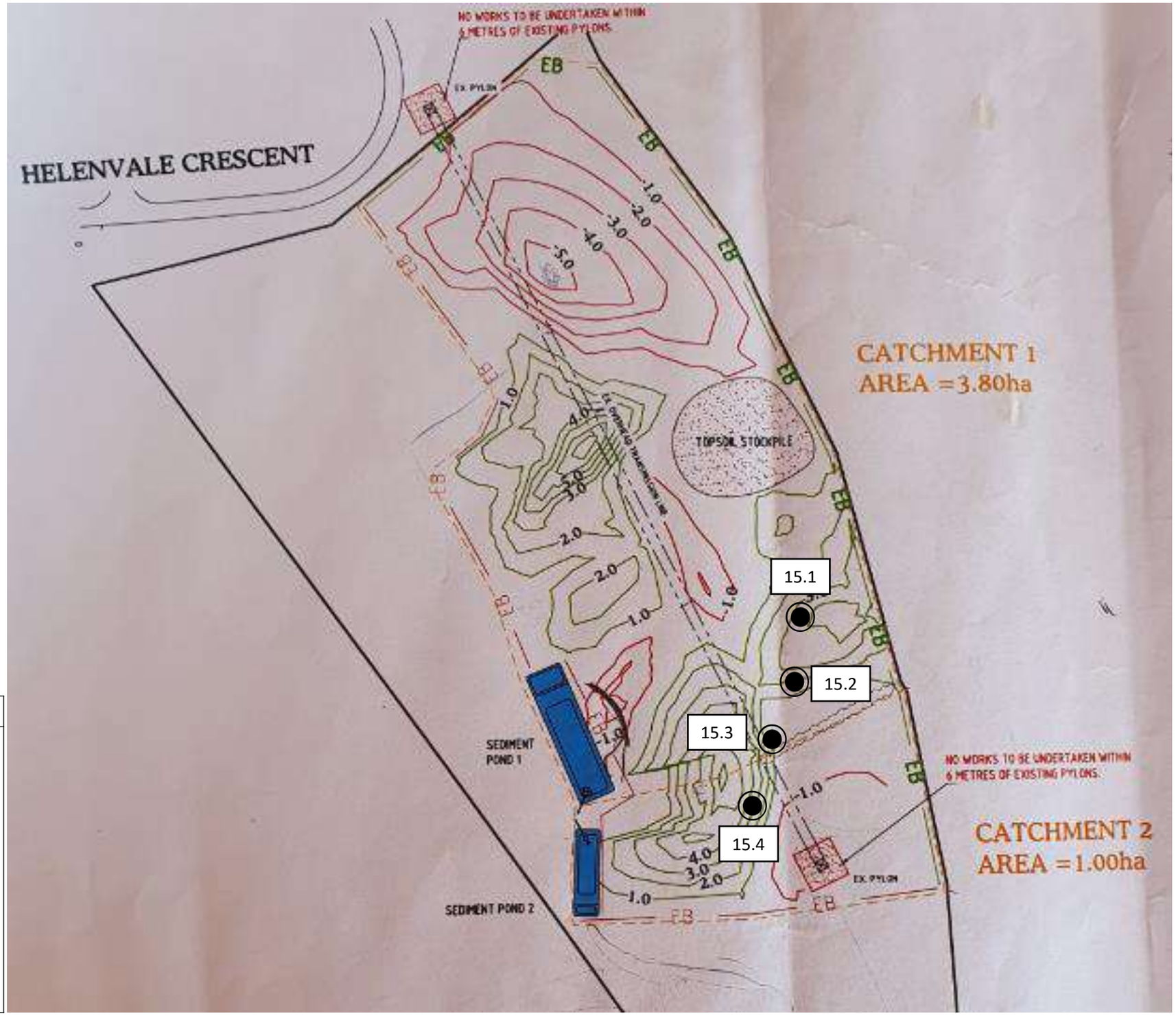
GEOTECHNICS

Job: McRobbie Block, Pokeno

Client: McRobbie Bros Ltd

Job #	1012885.0000.0.0/2
Entered By	JRA
Checked By	SEBA / DASA
Approved By	SJA

URN	Tech.	Date	Location	Layer	Material	Test Type	NDM 0^0			NDM 90^0			AVERAGE NDM			Solid Density (t/m^3) Assumed	Oven Moisture content (%)	Final Corrected		Average Air Voids (10 X Tests)	Shear Vane Reading (kPa)					Retest URN	PASS / FAIL	Comments
						NDM / SV	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)			Oven Dry Density (t/m^3)	Average Air Voids (%)		Reading 1	Reading 2	Reading 3	Reading 4	Average SV (4 x Tests)		(P) Pass / (F) Fail	
22.1	JRA	22/12/2020	South Gully Area	~FL	Clay SILT	NDM / SV	1.85	30.0	4.4	1.86	29.1	4.8	**1.86**	**29.6**	**4.6**	2.70	25.9	1.47	**7.2**	5.3	199+	199+	199+	199+	199+	-	-	
22.2						NDM / SV	1.80	30.8	6.6	1.78	32.2	7.0	**1.79**	**31.5**	**6.8**	2.70	30.0	1.38	**7.8**	5.6	199+	184	187	199+	192+	-	-	
22.3						NDM / SV	1.69	30.2	12.6	1.66	28.4	15.4	**1.68**	**29.3**	**14.0**	2.70	28.7	1.30	**14.4**	6.1	199+	199+	199+	199+	199+	-	-	
22.4						NDM / SV	1.82	28.5	7.2	1.82	27.5	7.9	**1.82**	**28.0**	**7.6**	2.70	26.9	1.43	**8.3**	6.4	199+	199+	199+	199+	199+	-	-	



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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	21/9/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	15	Date:	21/9/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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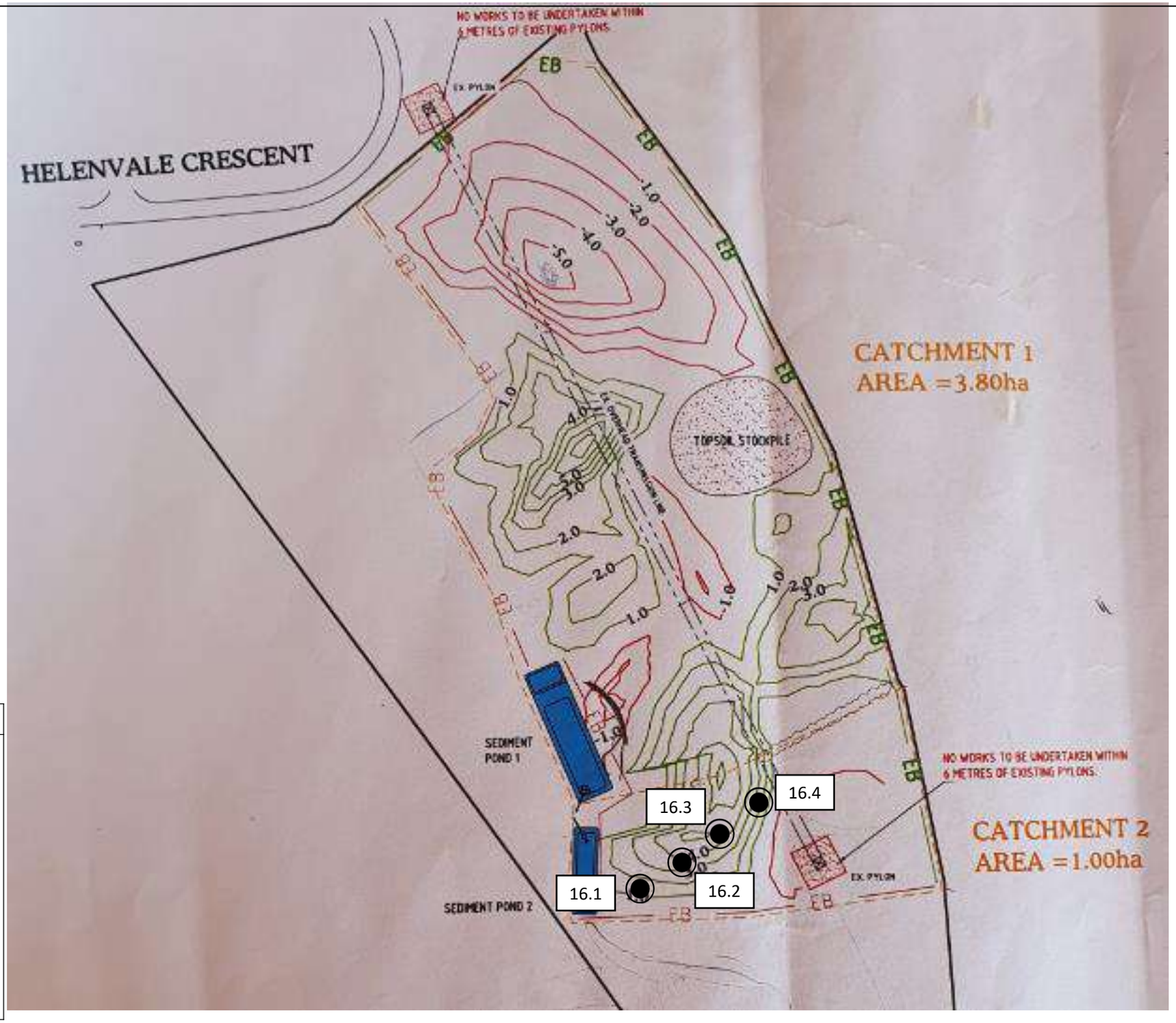

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	23/9/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	16	Date:	23/9/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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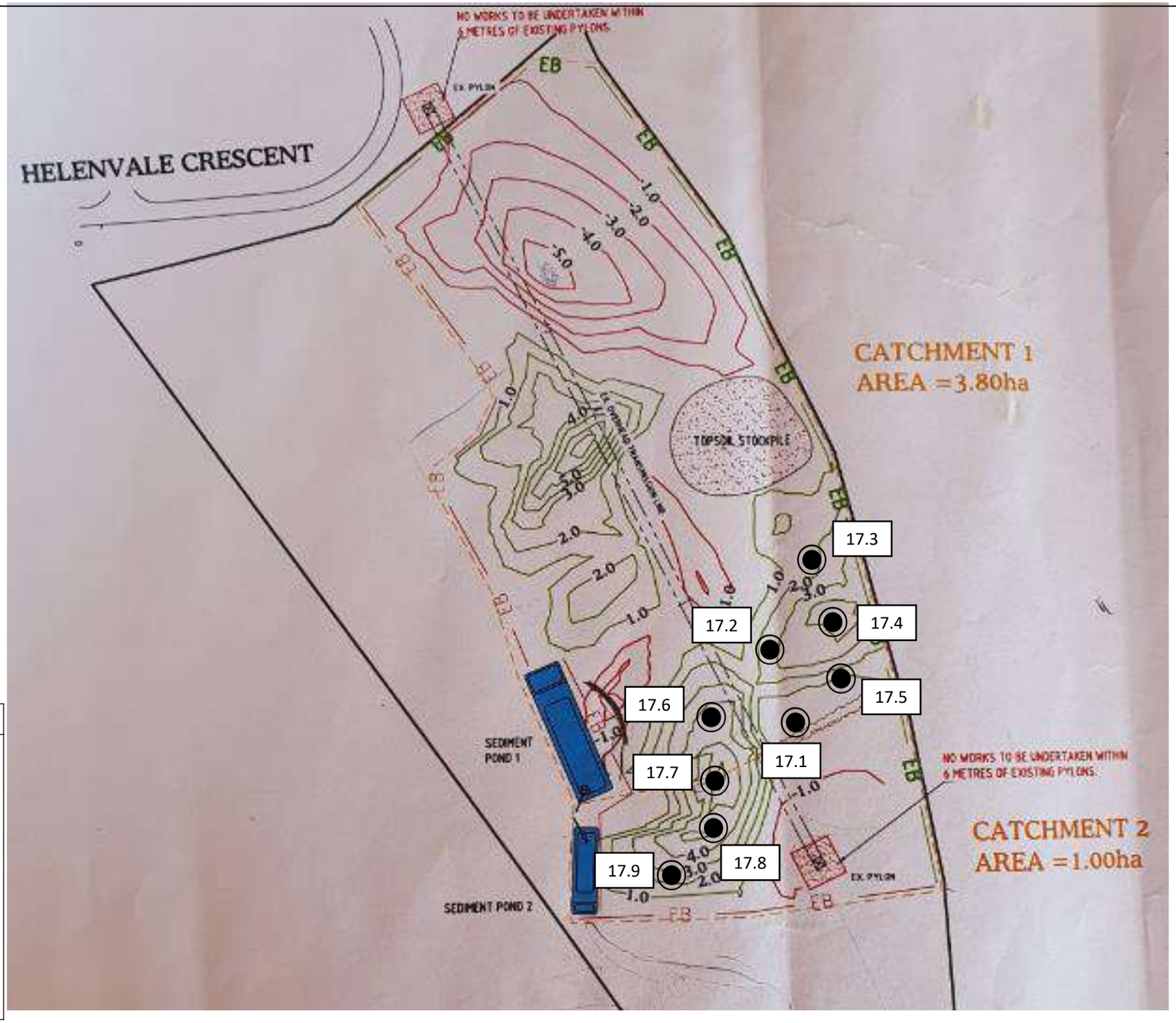

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	SEBA	Date:	06/10/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	17	Date:	06/10/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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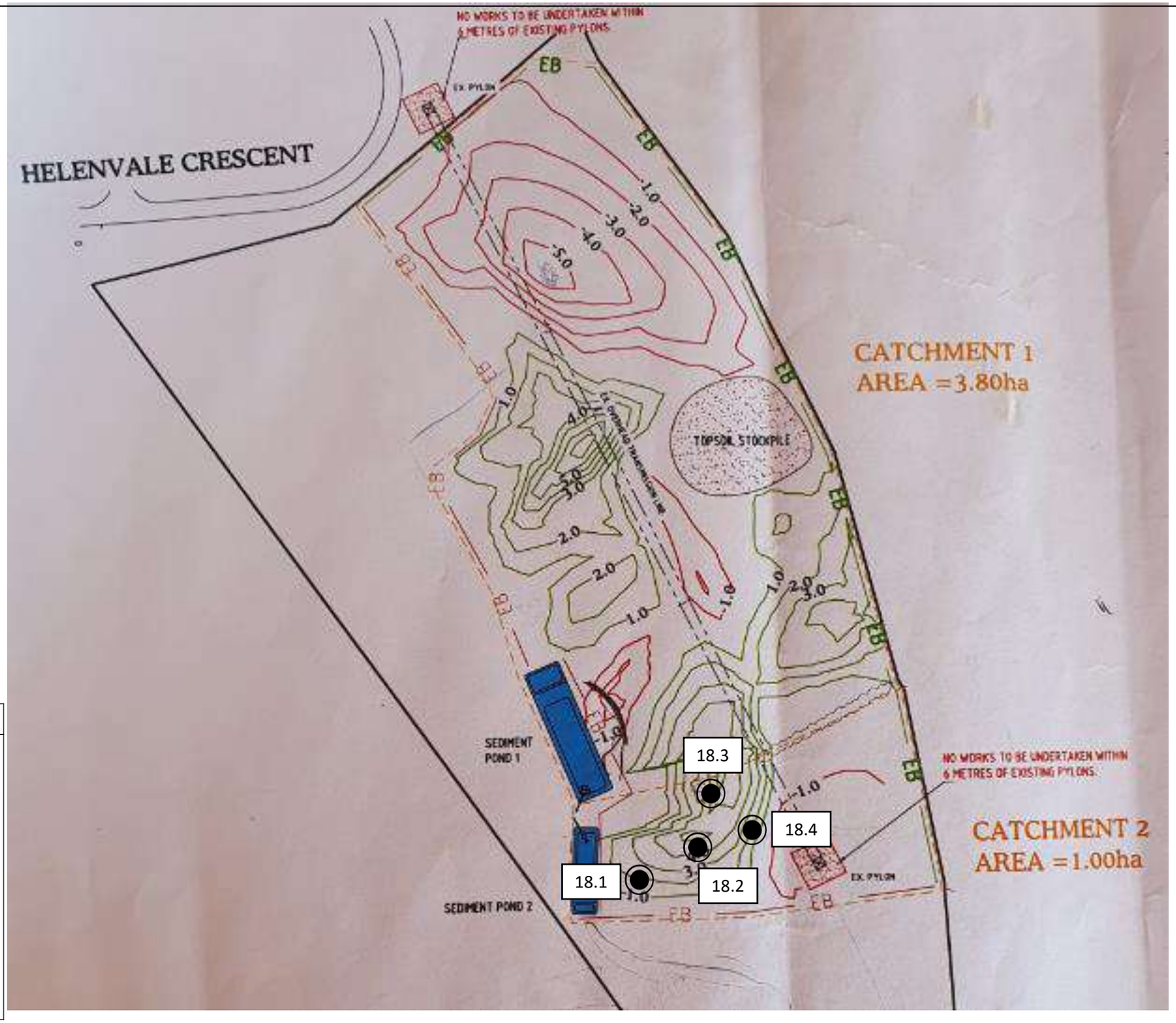

Legend:

- Impact Hammer
- NDM & SV Set
- Shear Vane
- Scala
- Hand Auger

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	20/10/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	18	Date:	20/10/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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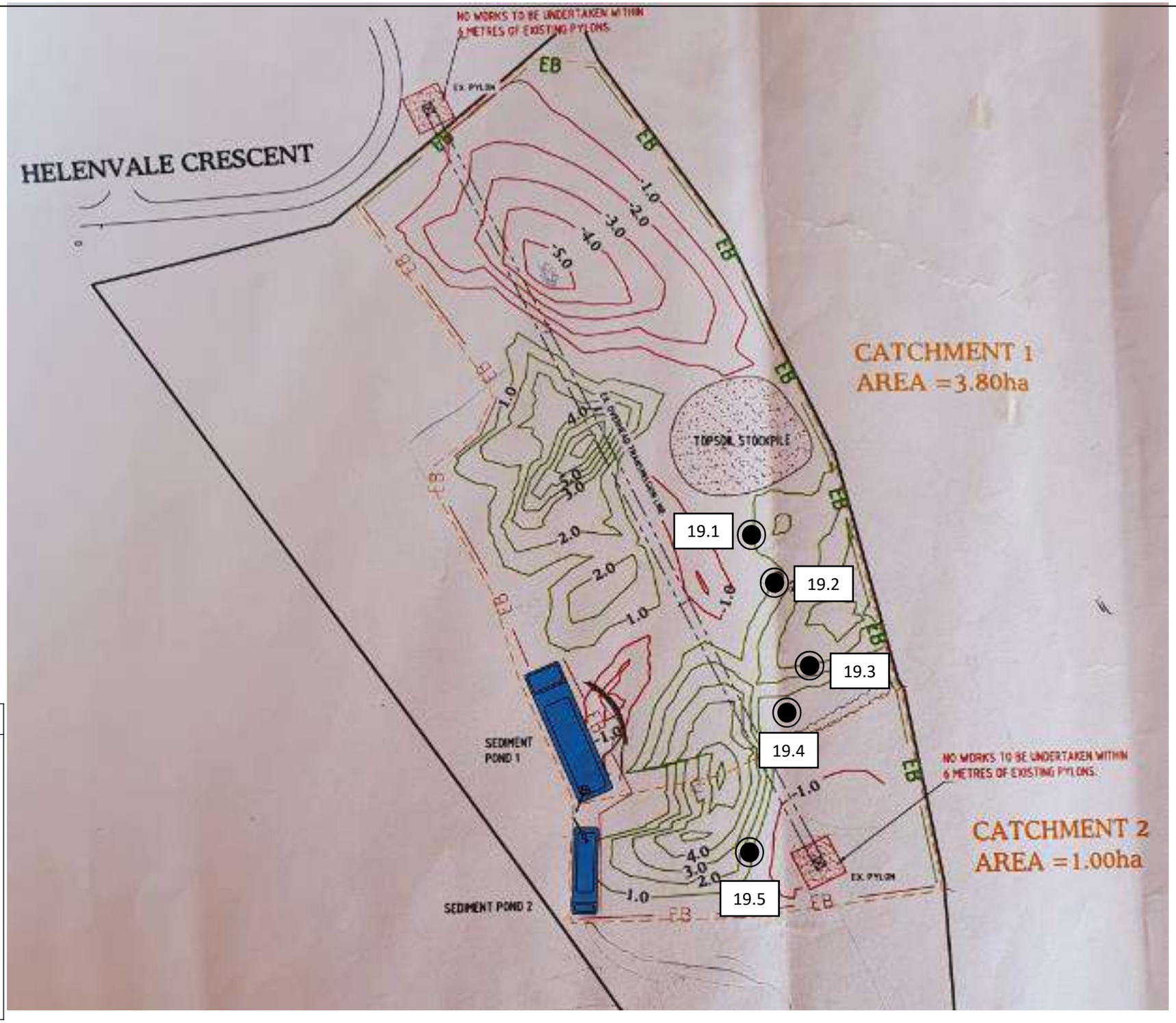

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	3/11/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	19	Date:	3/11/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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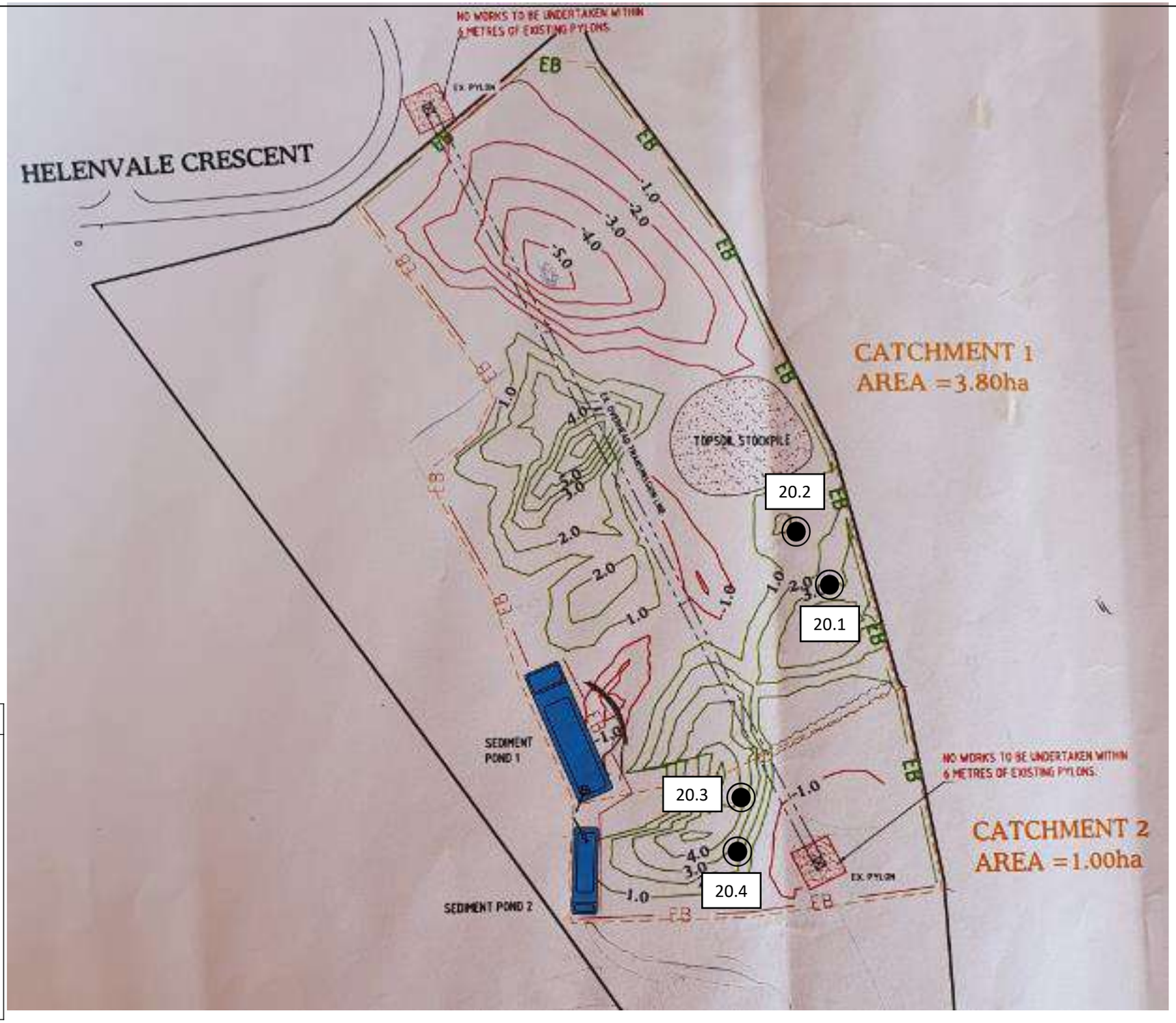

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	16/11/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	20	Date:	16/11/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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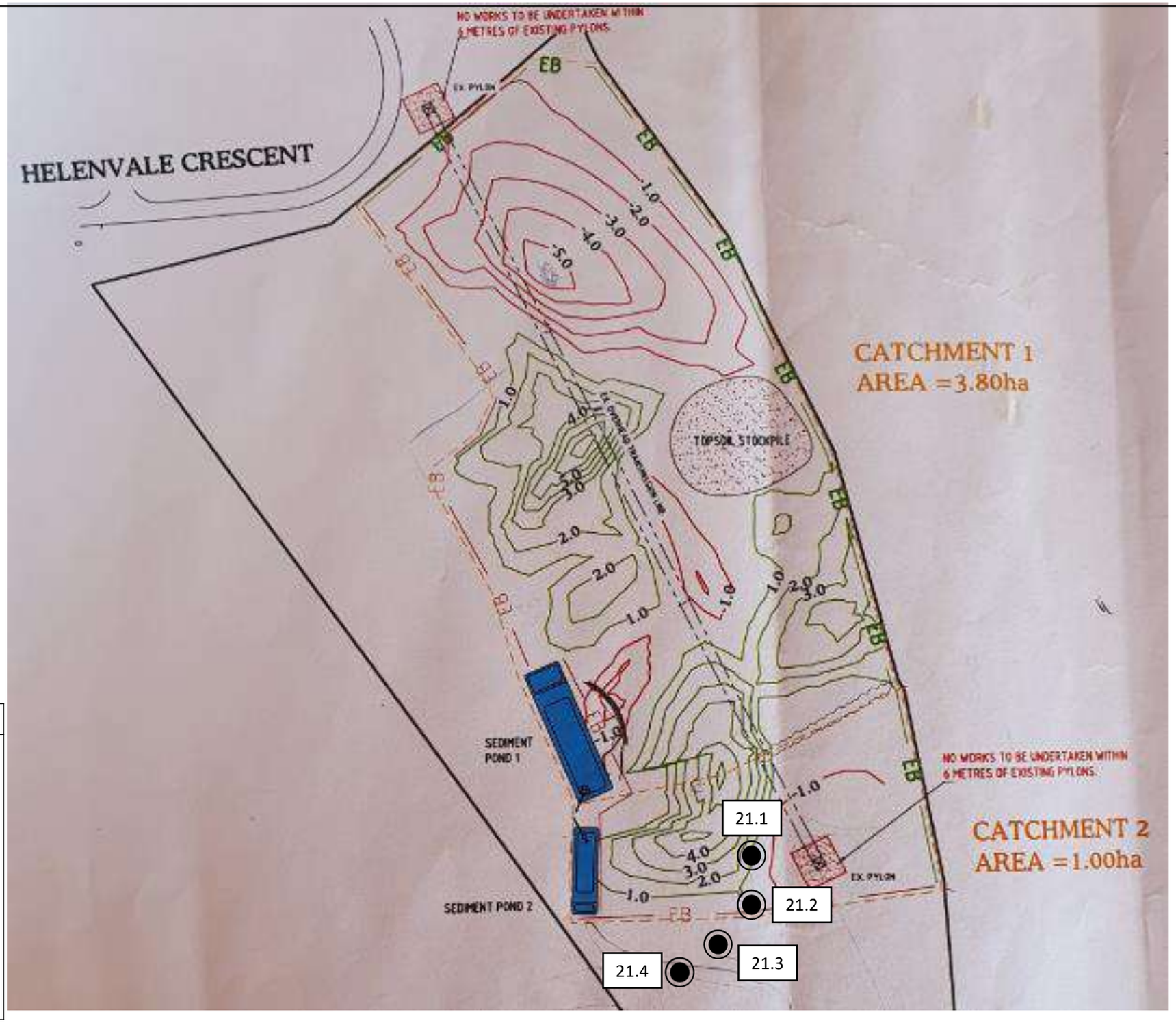

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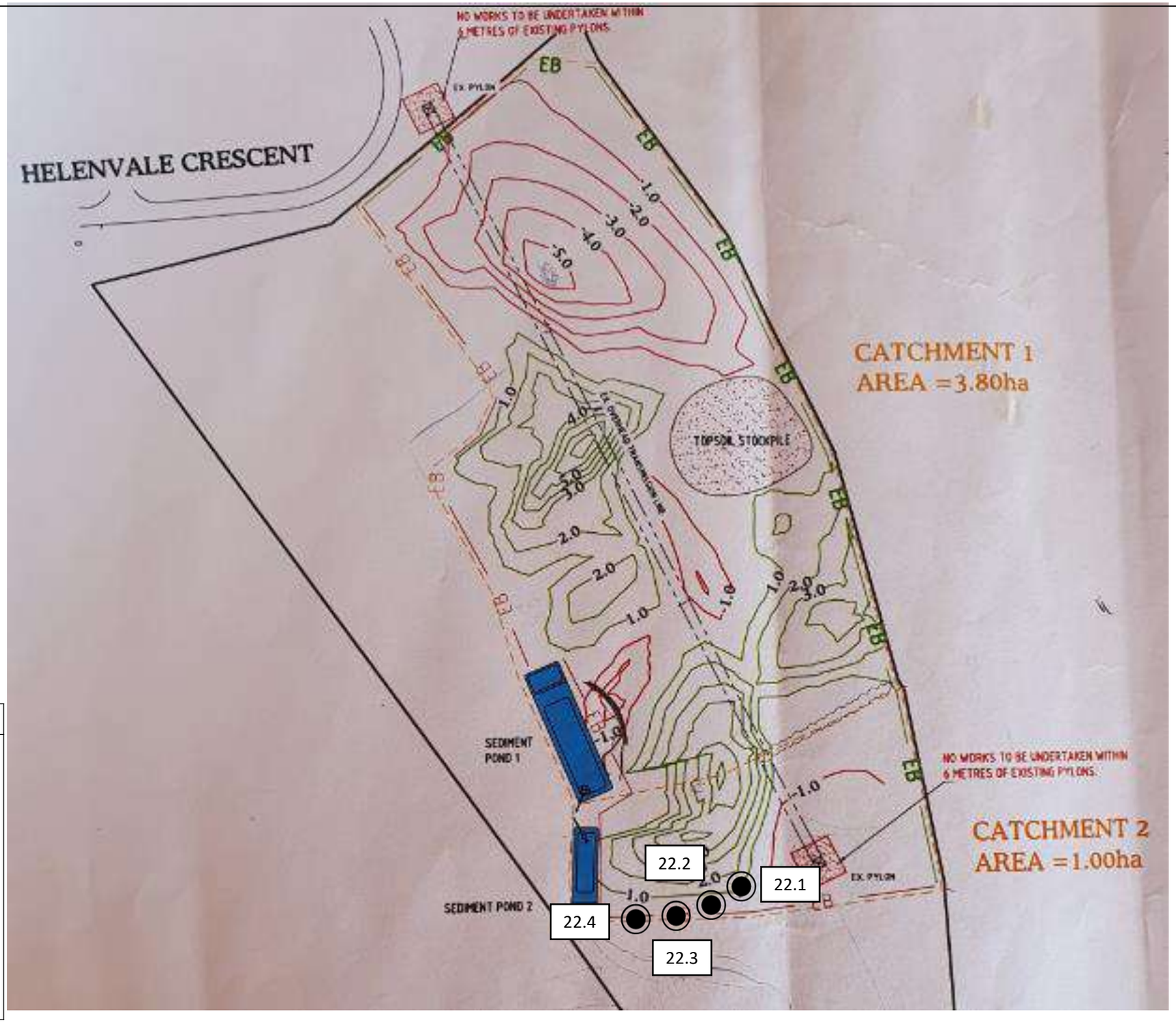
Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	7/12/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	21	Date:	7/12/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

N



Legend:

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- Scala
- Hand Auger

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	22/12/2020
Location:	Gully Fill	Job No.:	1012885.0000.0.0/2	URN:	22	Date:	22/12/2020
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

N

Our Ref: 1012885.0000.0.0/3
Client Ref: -
23 September 2021

McRobbie Brothers Ltd
PO Box 7
Pokeno 2440

Attention: James McRobbie

Dear James,

McRobbie Subdivision, Pokeno - Earthworks Testing

2021 Site Report

Customer's Instructions

We were instructed to:

Complete nuclear densometer and shear vane testing at the above mentioned site when requested and report the results.

Specifications

No formal specification was provided for nuclear densometer or shear vane testing, results were passed onto the customer for approval.

Dates of Procedures

Testing was carried out from the 25/2/2021 to the 3/5/2021.

Locations

Testing locations were selected on site by the Geotechnics technician on behalf of the customer.

The attached plans provide indicative locations only and are not to scale. All other information we provide regarding location should be referenced to the asset owner.

Samples

Samples taken for moisture content verification purposes were disposed of 24 hours after testing.

Methods

NZGS 8:2001 - Test method for determining the vane shear strength of a cohesive soil using a hand held shear vane.

NZS 4407:2015 Test 4.2 - Method using a nuclear surface moisture-density gauge (Direct Transmission Mode) – NDM

NZS 4407:2015 Test 3.1 - Determination of water content

Material Description

Material descriptions are provided in the attached results. All descriptions were provided by the customer.

Results

The following is attached:

Earthworks testing results and test location plans.

Test Remarks

NDM – Direct Transmission

The test method may not be appropriate for materials containing a nominal maximum particle size of >40 mm.

Nuclear densometers are calibrated for a bulk density range of 1,728 kg/m^3 to 2,756 kg/m^3. Test results outside of these bulk density limits are not covered under the IANZ endorsement of this report.

An assumed solid density value of 2.70 t/m^3 was agreed with the customer. We do not take responsibility for misrepresentation or misinterpretation arising from the use of this assumed value to calculate air voids.

Where oven calculated air voids are negatives, these have been reported as zero.

The calculation of air voids is based on wet density (measured by the nuclear densometer), moisture content (measured by oven drying) and solid density (either assumed or measured by laboratory testing). Negative air voids may be caused by incorrect assumed solid density or due to the variability of onsite material when compared to that tested in a laboratory.

Determination of Water Content

Samples used for the determination of the water content were sampled in conjunction with nuclear densometer testing and disposed of after 24 hours.

General Remarks

This report has been prepared for the benefit of McRobbie Brothers Ltd, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

The inherent uncertainties of site investigation work, mean the nature and continuity of subsoil away from the test location could vary from the data logged.

Material descriptions are included for information only and are not covered under the IANZ endorsement of this report.

Sample(s) not destroyed during testing will be retained for one month from the date of this report before being discarded.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of the letterhead page.

GEOTECHNICS LTD

Report prepared by:

.....
David Sayers
CMT Field Technician

Authorised for Geotechnics by:

.....
Steven Anderson
Project Director

Report checked by:

.....
Seven Baker
South Auckland Field Coordinator

ACCREDITED TESTING LABORATORY

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

23-Sep-21

t:\geotechnicsgroup\projects\1012885\issueddocuments\report 3\20210923 mcrobbie block, pokeno report 3.docx

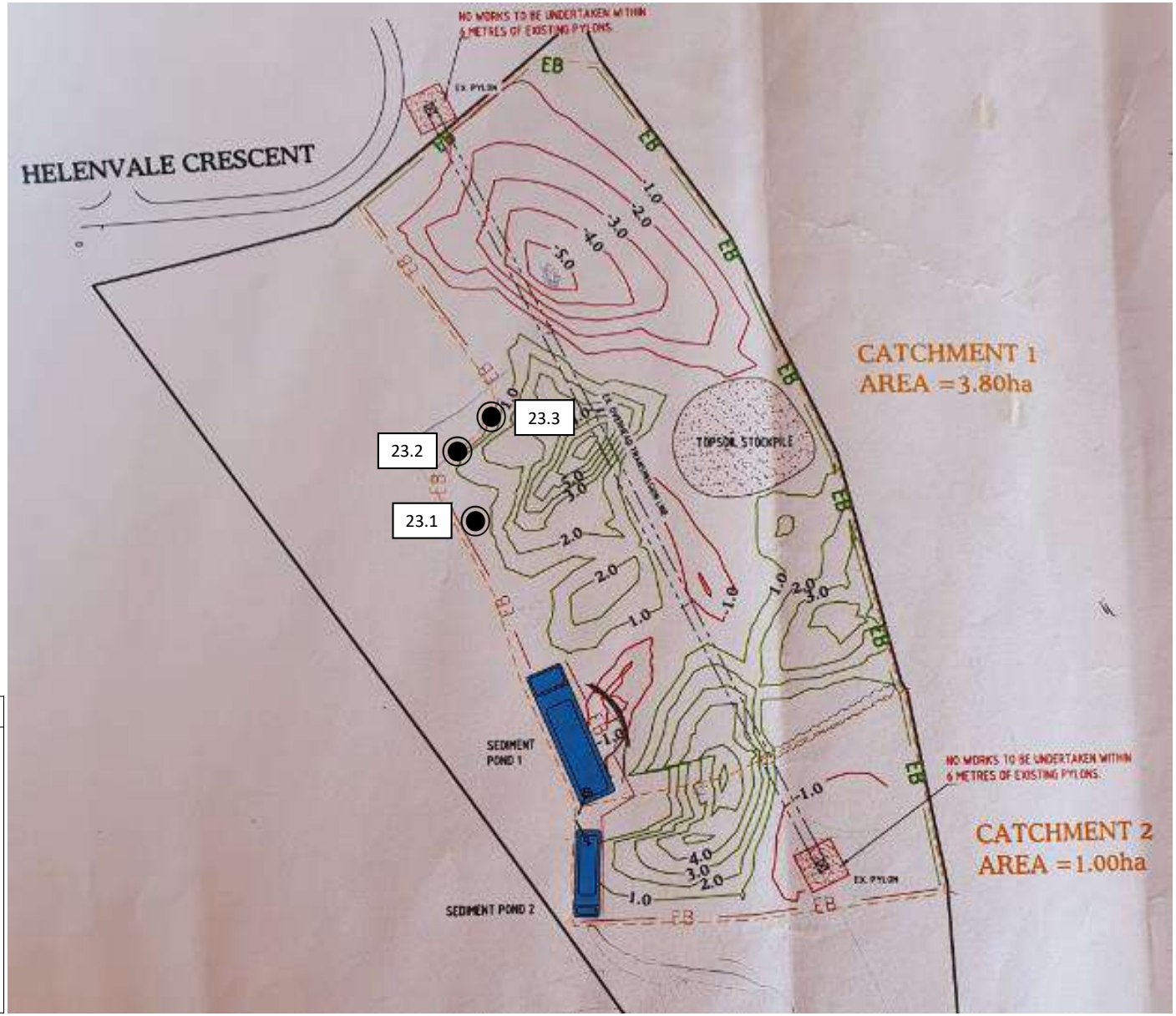
GEOTECHNICS

Job: McRobbie Block, Pokeno

Client: McRobbie Bros Ltd

Job #	1012885.0000.0.0/3
Entered By	JRA
Checked By	SEBA
Approved By	SJA

URN	Tech.	Date	Location	Layer	Material	Test Type	NDM 0°			NDM 90°			AVERAGE NDM			Solid Density (t/m^3) Assumed	Oven Moisture content (%)	Final Corrected		Average Air Voids (10 X Tests)	Shear Vane Reading (kPa)					Retest URN	PASS / FAIL	Comments
						NDM / SV	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)	Wet Density (t/m^3)	Moisture Content (%)	Air Voids (%)			Oven Dry Density (t/m^3)	Average Air Voids (%)		Reading 1	Reading 2	Reading 3	Reading 4	Average SV (4 x Tests)		(P) Pass / (F) Fail	
23.1	JRA	25/02/2021	Batter Slope - See Site Plan	~FL	Clay SILT	NDM / SV	1.71	45.2	3.3	1.71	43.8	4.1	**1.71**	**44.5**	**3.7**	2.70	43.0	1.19	**4.5**	6.4	199+	199+	139	199+	184+	-	-	
23.2						NDM / SV	1.69	46.9	3.7	1.69	46.4	3.8	**1.69**	**46.7**	**3.8**	2.70	47.3	1.14	**3.5**	6.5	173	199+	199+	176	187+	-	-	
23.3						NDM / SV	1.63	49.8	5.6	1.63	47.0	6.8	**1.63**	**48.4**	**6.2**	2.70	48.5	1.10	**6.2**	6.7	153	142	139	145	145	-	-	
24.1	JRA	9/04/2021	SILT Pond Fill - See Site Plan	~1m placed above hardfill	Clay SILT	NDM / SV	1.87	26.0	6.5	1.87	26.6	6.2	**1.87**	**26.3**	**6.4**	2.70	25.8	1.48	**6.8**	6.7	199+	199+	199+	199+	199+	-	-	
24.2						NDM / SV	1.87	29.5	3.8	1.88	28.1	4.6	**1.87**	**28.8**	**4.2**	2.70	24.6	1.50	**7.3**	7.0	199+	199+	199+	199+	199+	-	-	
24.3						NDM / SV	1.84	40.6	0.0	1.83	41.4	0.0	**1.83**	**41.0**	**0.0**	2.70	38.6	1.32	**0.0**	6.6	199+	199+	199+	199+	199+	-	-	
25.1	JRA	30/04/2021	SILT Pond Fill - See Site Plan	~1.5m below FL	Clay SILT	NDM / SV	1.62	59.4	1.9	1.62	58.6	2.5	**1.62**	**59.0**	**2.2**	2.70	52.6	1.06	**4.9**	6.4	199+	199+	199+	199+	199+	-	-	
25.2						NDM / SV	1.59	63.6	2.5	1.59	64.4	2.0	**1.59**	**64.0**	**2.2**	2.70	57.0	1.01	**4.9**	6.1	173	199	184	199	189+	-	-	
26.1	JRA	3/05/2021	SILT Pond Fill - See Site Plan	~0.5m below FL	Clay SILT	NDM / SV	1.64	50.2	4.6	1.64	50.3	4.5	**1.64**	**50.3**	**4.6**	2.70	50.0	1.10	**4.7**	5.1	199+	199+	199+	199+	199+	-	-	
26.2						NDM / SV	1.59	62.2	2.6	1.59	59.5	4.0	**1.59**	**60.9**	**3.3**	2.70	54.9	1.03	**5.7**	4.9	167	196	176	187	182	-	-	



Legend:

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	25/2/2021
Location:	Batter Slope Area	Job No.:	1012885.0000.0.0/3	URN:	23	Date:	25/2/2021
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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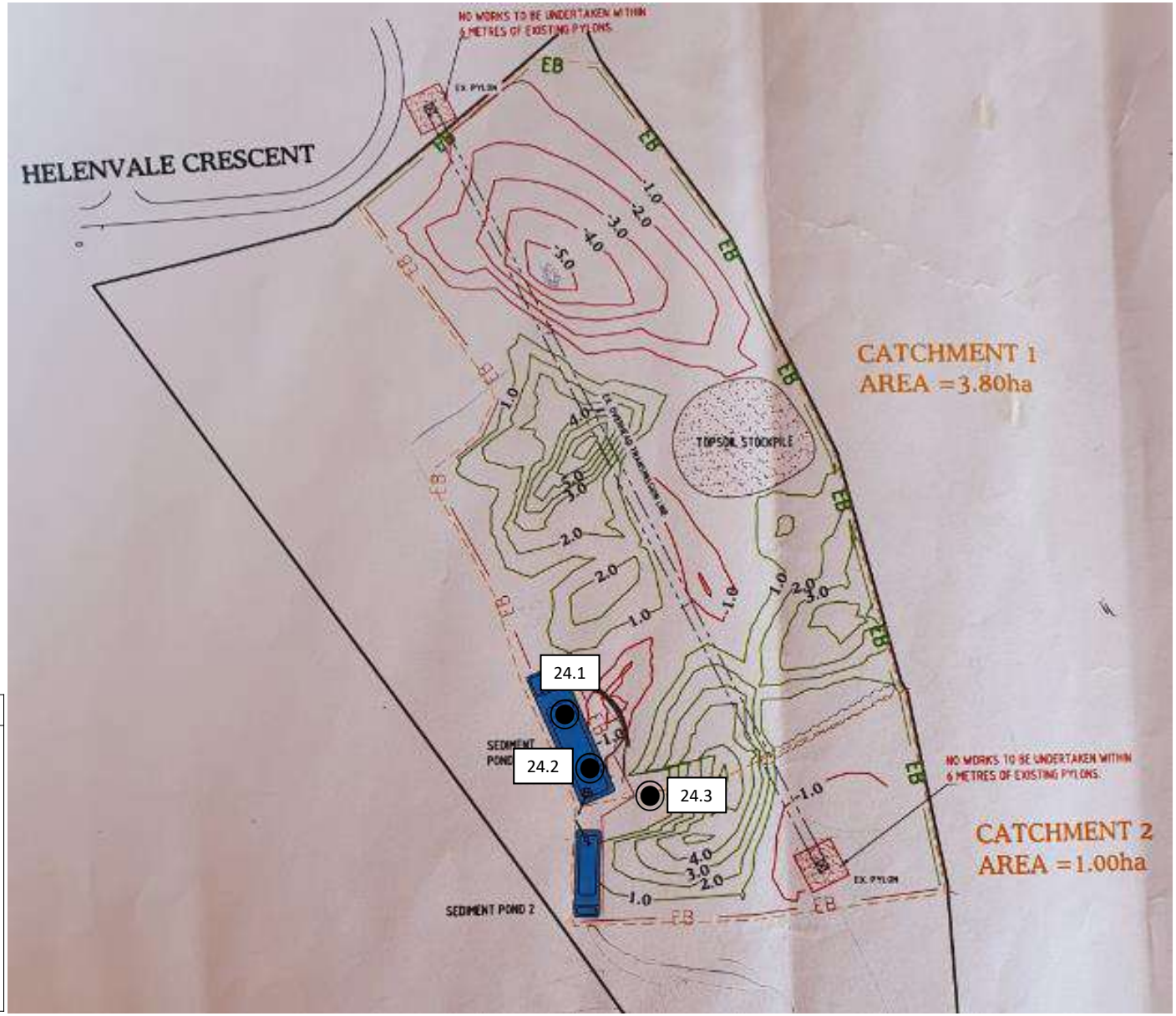

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	9/4/2021
Location:	Silt Pond Backfill	Job No.:	1012885.0000.0.0/3	URN:	24	Date:	9/4/2021
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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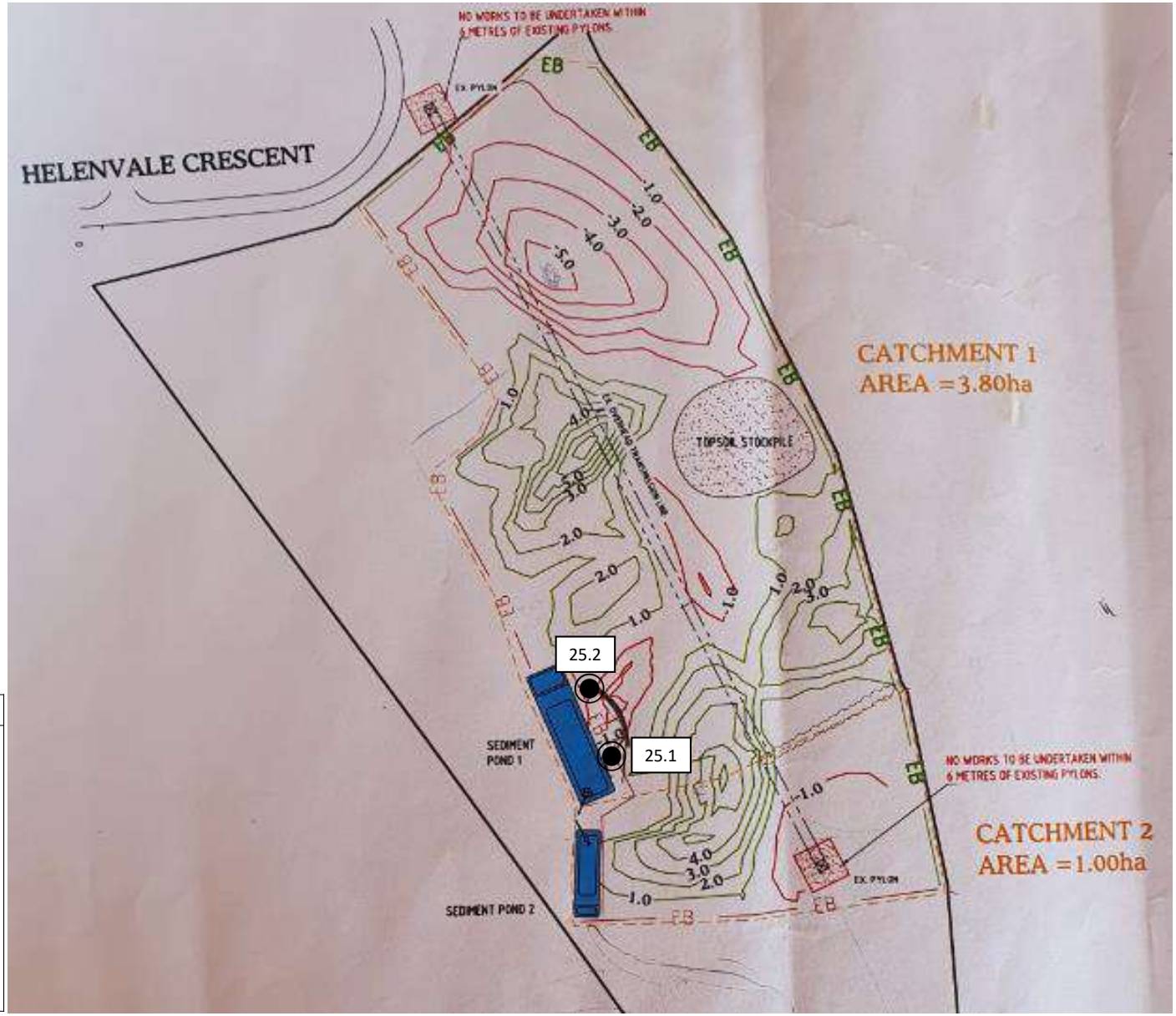

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Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	30/4/2021
Location:	Silt Pond Backfill	Job No.:	1012885.0000.0.0/3	URN:	25	Date:	30/4/2021
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

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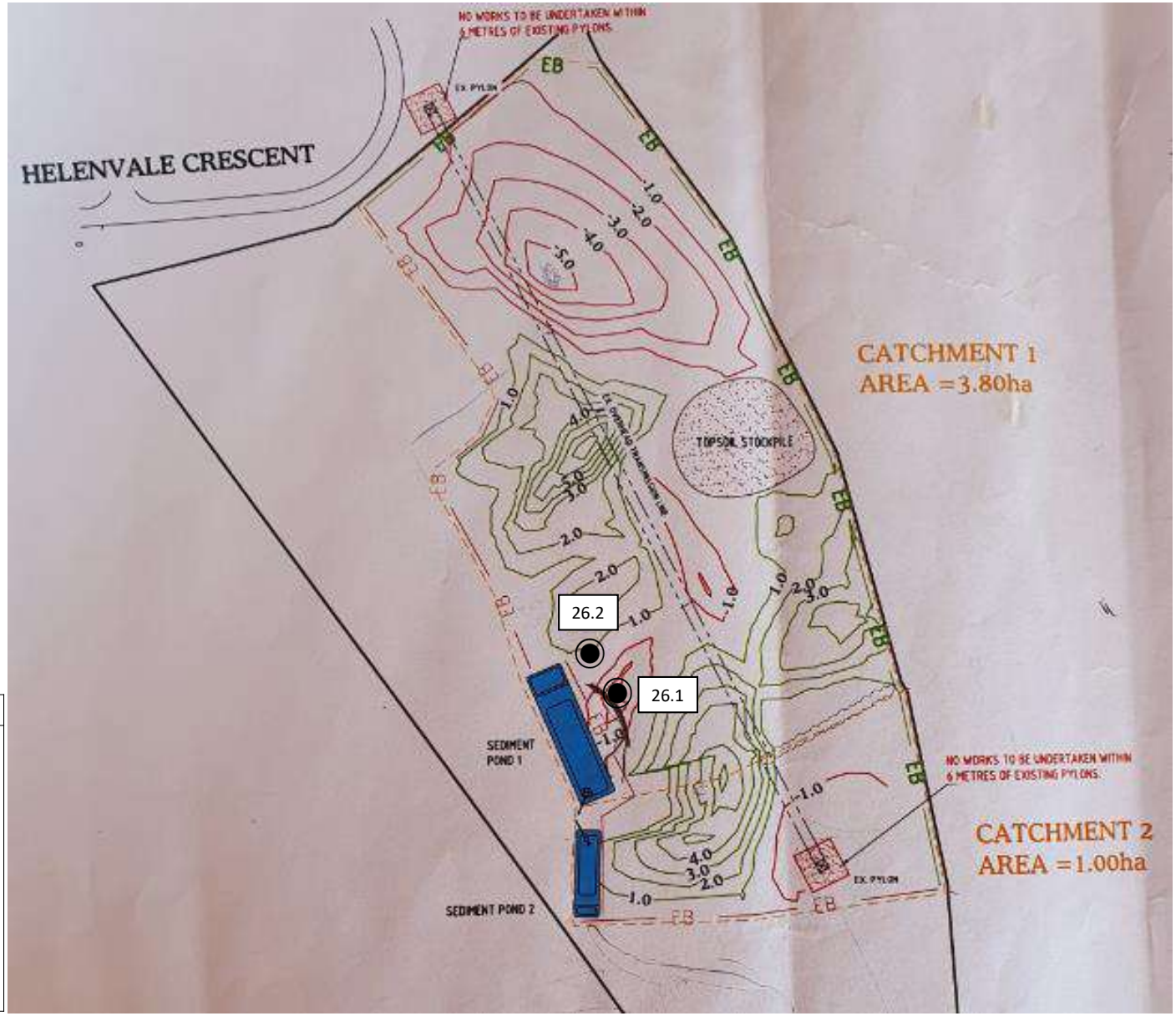

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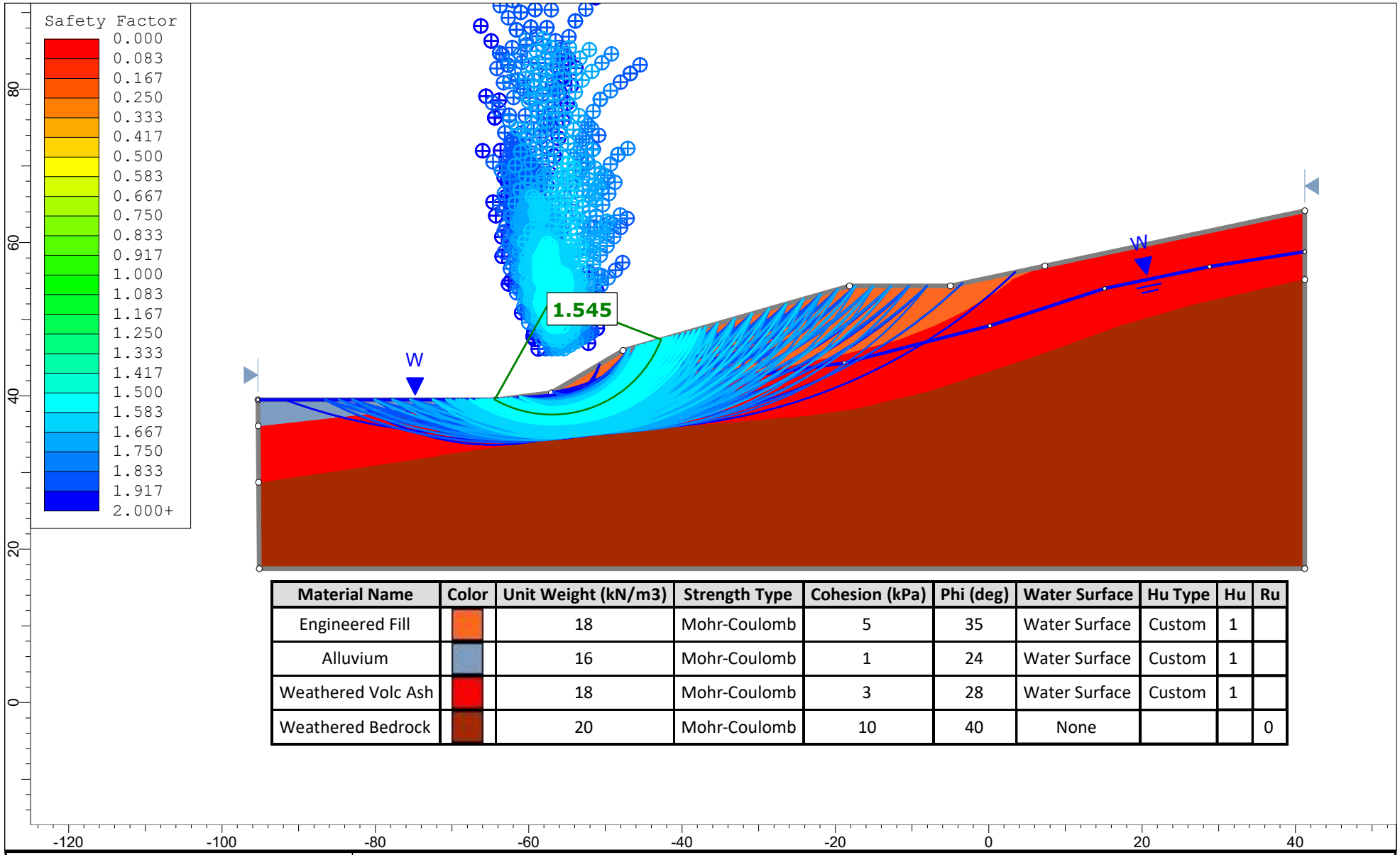
Test Location Plan

Site:	McRobbie Block, Pokeno	Job Name:	McRobbie Block, Pokeno	Drawn:	JRA	Date:	3/5/2021
Location:	Silt Pond Backfill	Job No.:	1012885.0000.0.0/3	URN:	26	Date:	3/5/2021
		Lab Ref:	- N/A	Scale:	Not to Scale	Rev.:	1

N

APPENDIX C: SLIDE RESULTS

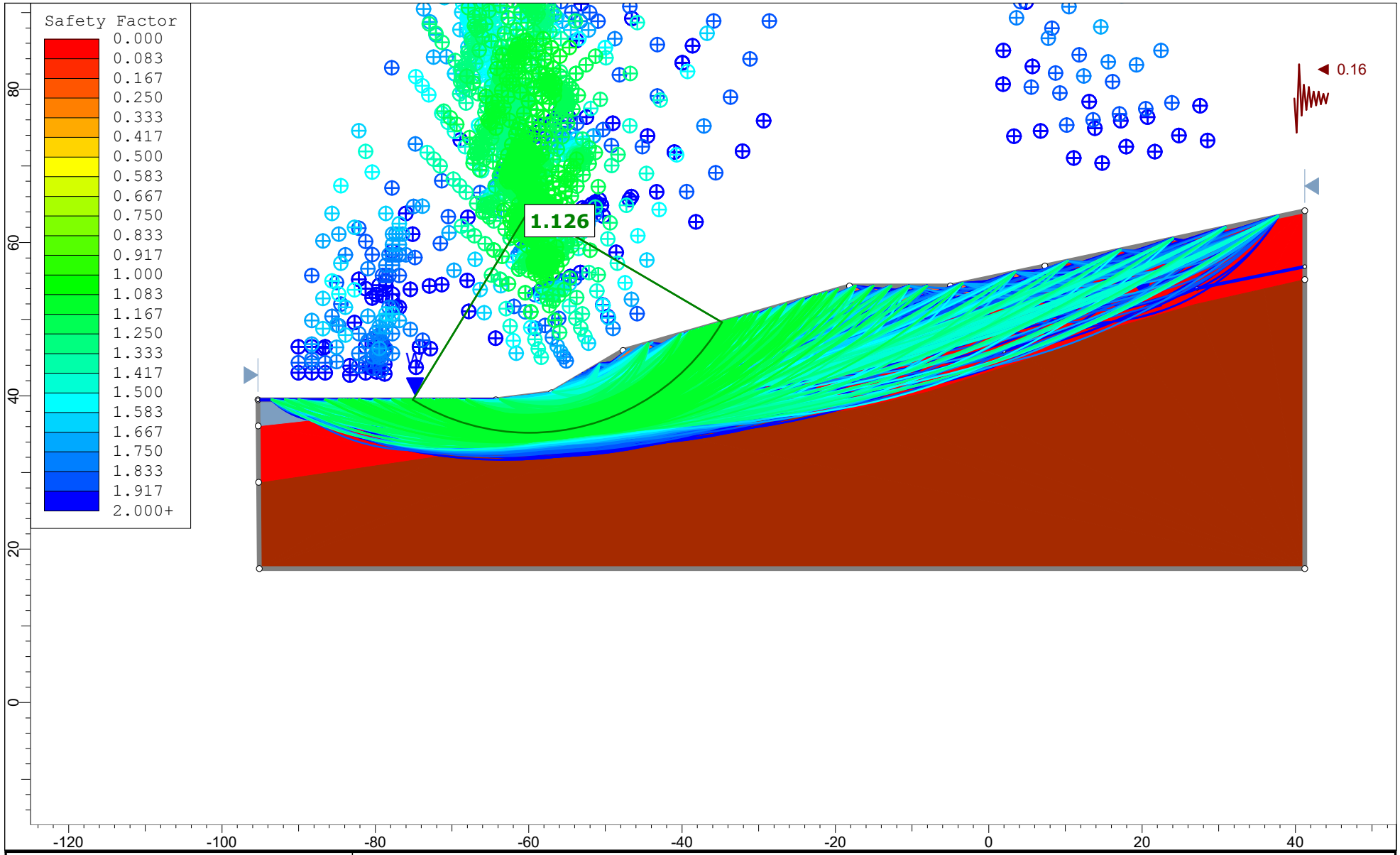


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Engineered Fill		18	Mohr-Coulomb	5	35	Water Surface	Custom	1	
Alluvium		16	Mohr-Coulomb	1	24	Water Surface	Custom	1	
Weathered Volc Ash		18	Mohr-Coulomb	3	28	Water Surface	Custom	1	
Weathered Bedrock		20	Mohr-Coulomb	10	40	None			0

GCL Ground Consulting Ltd

SLIDEINTERPRET 9.019

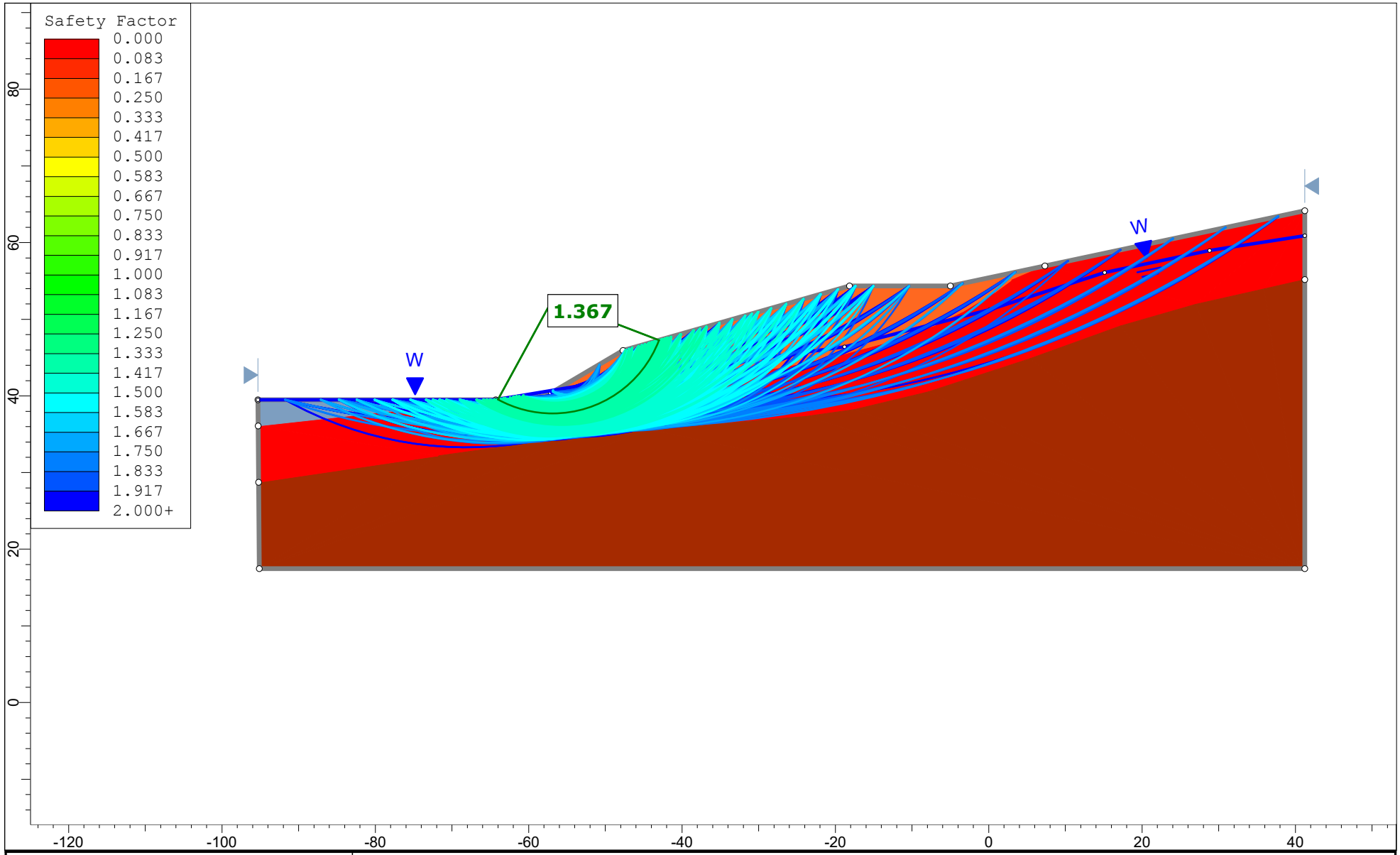
Project	R7615-1A Cross-Section A-A'		
Group	Proposed Subdivision Profile	*Scenario*	Winter Groundwater Condition
Drawn By	LK	*Company*	GCL
Date	17/11/2021, 9:06:17 AM	*File Name*	R7615-1A-Cross-section A.slmd



GCL Ground Consulting Ltd

SLIDEINTERPRET 9.019

Project	R7615-1A Cross-Section A-A'		
Group	Proposed Subdivision Profile	*Scenario*	Seismic Condition
Drawn By	LK	*Company*	GCL
Date	17/11/2021, 9:06:17 AM	*File Name*	R7615-1A-Cross-section A.slmd



GCL Ground Consulting Ltd

SLIDEINTERPRET 9.019

Project	R7615-1A Cross-Section A-A'		
Group	Proposed Subdivision Profile	*Scenario*	Extreme Groundwater Condition
Drawn By	LK	*Company*	GCL
Date	17/11/2021, 9:06:17 AM	*File Name*	R7615-1A-Cross-section A.slmd

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