Multidisciplinary Expert Supplementary Report

Board of Inquiry into McCrae Landslide

Prepared for: Thomson Geer
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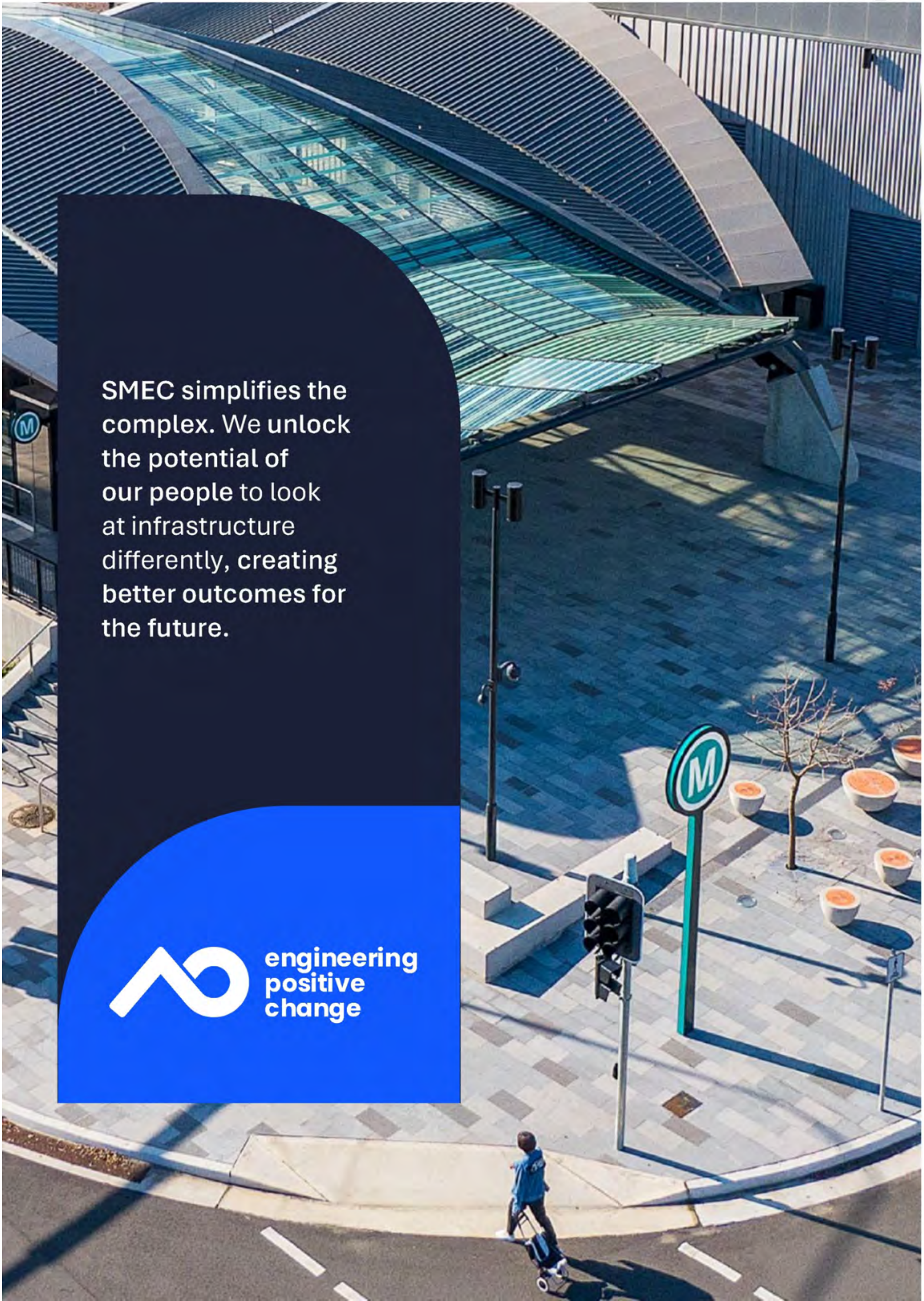

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Additional limitations relating specifically to geotechnical reports are presented in Appendix A.

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Executive Summary

Purpose

The purpose of this report is to provide engineering assessments of the:

- Possble sources of groundwater observed seeping from the failure scarp following the McCrae Landslide;
- Likelihood that South East Water (SEW) assets contributed to the McCrae Landslide, including a mains water leak, referred to as the 'Bayview Road leak';
- Amount of water from the Bayview Road leak that would have flowed into the natural geology and the stormwater system;
- Likely flow paths that mains water originating from the Bayview Road leak could have taken;
- Assess the susceptibility of the McCrae Landslide site to a landslide by assessing the volume of water that is likely required to cause a landslide.

This report supplements the Legally Privileged Multidisciplinary Expert Report issued on 5 May 2025 by SMEC, which is referred to as 'the preliminary assessment'.

Scope of Work

The scope of investigation, testing and assessment undertaken by various engineering disciplines to inform this report are detailed in the Appendices, and comprise:

- Site visits to the McCrae Landslide, Bayview Road leak and surrounds, to observe the current site condition, characteristics and extent of the landslide, and observe the characteristics of the area ;
- Geotechnical investigations to assess the subsurface geological conditions and engineering characteristics of the subsurface in the locality of the McCrae Landslide and the Bayview Road Leak ;
- Hydrogeological investigation and assessment to:
  - Characterise the movement and distribution of water within and through the site locality (within 500 m upslope of the landslide site); and
  - Assess chemistry of groundwater samples – particularly electrical conductivity (EC) – taken at various locations across the site at various points in time to:
    - Differentiate between background[1] groundwater and mains water on the basis of water chemistry - particularly EC (or the concentration of dissolved salts in the groundwater samples); and
    - Assess the degree to which the chemistry of mains water changes or mixes with background groundwater as it flows through natural soils and utilities trench embedment material.
- Geophysical surveying of roads and public land in the locality of the McCrae Landslde and the Bayview Road Leak to non-intrusively assess the variability of moisture content within underlying soils across the locality;
- Hydraulic modelling to estimate the proportion of flows from the Bayview Road leak which would have entered stormwater drains, some 30 m from the leak site;
- A slope stability analysis to quantitatively assess:
  - the susceptibility of slope failure at the site prior to the landslide (a.k.a Factor of Safety (FoS)); and

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[1] Background water quality refers to the natural or baseline condition of water quality – in this case without the influence of the Bayview Road Leak.

- the volume of additional water required to result in a slope failure similar to the 5 January 2025 landslide.

Site Surface Characteristics – Topography and Geomorphology

The terrain in the area slopes down toward the escarpment. The escarpment has been historically prone to landslides as documented in section 5.3.2 of this report. The topography of the escarpment features 'incisions' (linear surface depressions) in the surface which are likely to have established preferential water flow paths. Incisions can be observed near No. 10 – 12 View Point Road, No 4 View Point Road, and No. 12 Prospect Hill Road. The land behind the escarpment has a ground water profile that in general gets shallower towards the escarpment, but with springs observed at various locations and elevations.

The location of springs may be a result of the narrowing of surficial deposits, possibly including aeolian deposits, towards the escarpment crest. The locations of the springs do not appear to be related to known gullies or water courses, and anecdotal evidence suggests they may be ephemeral.

The above suggests that the terrain has adapted to the flow of water towards the escarpment and has developed some capacity to convey this flow in the form of the observed incisions.

Landscape works since 2016 within 10-12 View Point Road, specifically the creation of a raised vegatable garden bed bounded by a retaining wall, and another retaining wall that was built in front of the original, are considered to have modified the property's capacity to convey surface and subsurface water, and also adversley affected the stability of the slope.

Site Subsurface Characteristics

SMEC's model of the subsurface soil and rock has been developed based on investigations undertaken by SMEC and others. The ground model units are (in order of depth):

- Fill soil (anthropogenically deposited);
- Granular soil (sand and/or gravel) which varies in thickness and is not present across the whole site;
- Clay; and
- Weathered granite encountered at a typical depth of 6m to 7m below ground level.

This ground profile results in a shallow aquifer (underground body of water) which lies atop of the clay and weathered granite. The clay and weathered granite have relatively low permeability (capacity to transmit water).

A number of trenches have previously been excavated in the area to install underground services such as stormwater drainage, sewer pipes and gas mains. These trenches were backfilled with engineered soil material (embedment material), overlain with granular backfill. These embedment materials have a relatively large soil grain size and void space (the air space between individual soil particles).

Greater void space gives embedment material relatively high permeability when compared to the surrounding soil in which the trenches are constructed. Tests of water velocity in the embedment material – assuming a pressure head created by the Bayview Road leak – were in the order of <10 minutes per metre of travel. The water velocity through natural soil material should be considered as approximately 2 m per day, an order of magnitude slower (tens of times slower) than water flowing through trench embedment material.

Sources of Groundwater Seepage at the McCrae Landslide

The Bayview Road Leak

A longitudinal fracture is known to have affected a buried water main that is located within public land between Bayview Road, Outlook Road and the M11 Mornington Peninsula Freeway. The water main is an asset of South East Water (SEW). The location of the leak was approximately 450 m southwest of the landslide site. The leak was located on 31 December 2025 and repaired on 1 January 2025. The date that the water leak began is thought to be in early August 2024 according to a report from the University of Auckland (Appendix B Ref. 40). Residents began to report potential leaks at View Point Road, Charlesworth Street and Waller Place between 26 November 2024 and 1 January 2025. The University of Auckland report estimated, based on SEW raw data, that the volume of water that may have been lost through the leak was 40.3 ML.

Stormwater Capture of the Bayview Road Leak

Flow from the Bayview Road leak would have entered stormwater drains which pass underneath the Mornington Peninsula Freeway. This is supported by hydraulic modelling which indicates that the majority of flows would be captured in the stormwater drainage network, primarily through the stormwater drainage pit between the leak site and the Freeway.

Groundwater Interception by Subsurface Service Trenches

A portion of mains water flowing overland from the Bayview Road leak would have permeated into the surrounding soil, flowing toward the escarpment as groundwater. The two paths likely taken by the leak water to travel downslope as groundwater comprise:

- Flow through the shallow soil aquifer only (i.e. through natural soil and fill soil, excluding embedment material) following groundwater flow paths; and
- Flow through the shallow soil aquifer, then into utility trenches filled with embedment material and then flowing downhill to the sea.

While these two flow paths are not mutually exclusive, and Bayview Road leak water would likely have taken both paths, we assess that the majority of the mains water derived from the leak (that didn't enter the stormwater system) will have travelled downslope within existing services trenches. This is because the utility trenches – with relatively higher permeability than natural material – intercepts and absorbs the intercepted groundwater flowing through the shallow soil aquifer. Evidence for this includes:

- Site investigation results at NDT10 – investigation targeting stormwater drainage embedment material – encountered groundwater with EC values characteristic of background shallow perched groundwater. This is an example of a utility trench intercepting background groundwater.
- There is anecdotal evidence that the stormwater drain from Waller Place to Coburn Avenue has water flowing through it constantly, and the same is true of the Prospect Hill Road/ View Point Road system. This is evidence of groundwater sources constantly charging stormwater drains; and
- Geophysical survey indicates elevated soil moisture content along subsurface services trenches in the area. The moisture content is elevated relative to the surrounding soils in which the trenches were constructed. This indicates a tendency for permeable service trenches to draw groundwater from the surrounding soil.

Given that less than half of the Bayview Road leak water would have entered the shallow soil aquifer and given that, the time expected for water to travel through the natural geology without using service trenches would be expected to be over 200 days , SMEC assesses that it is unlikely that direct water from a Bayview Road leak contributed to trigger the 5 January 2025 landslide. SMEC considers it highly unlikely that the direct water from Bayview Road leak contributed to the McCrae Landslide.

It is estimated that between 2000 L and 2300 L was required to reduce the FoS of the slope at 10-12 View Point Road to less than 1.0. This volume of water may suggest sources of water that do not produce volumes in the tens of thousands of litres, may have contributed to the landslides.

Groundwater Chemistry of McCrae Landslide Seepage

SMEC assesses that the groundwater observed seeping from the failure scarp immediately following the landslide does not have the characteristics of mains water and was almost certainly background groundwater on the basis of groundwater chemistry.

The electrical conductivity (EC) of the sample taken at the landslide of 6 January 2025 was measured at 1600 µS/cm. The EC of background groundwater for the shallow perched aquifer has been measured at between 1,000 and 1,300 µS/cm. The typical EC for mains water is approximately 120 µS/cm, an order of magnitude less than that of background groundwater samples tested. The elevated EC observed in background groundwater is due to the groundwater flowing through the soil aquifer and dissolving soluble salts contained in the soil through which it flows.

High-Flow Groundwater Seepage at the McCrae Landslide Failure Scarp

Water in the shallow soil aquifer is assessed to flow through permeable surficial soils atop the underlying low permeability clay and granite materials. Water will tend to follow the path of least resistance. Prior to the landslide, the preferred path for groundwater was at or above the interface between the shallow aquifer and clay/bedrock until it reached the crest of the escarpment, where it permeated into the soil material covering the slope (colluvium). This colluvium forms a thin layer of soil over the underlying granite bedrock over a large area in which groundwater can permeate and disperse over an area of ground.

Following the 5 January 2025 landslide – and the consequent debris flow of surficial soil material from the top of the escarpment – a new low-pressure surface was established on the slope. The groundwater flow upslope of the escarpment crest would have flowed towards this new low-pressure point at the slope face. The sudden change in slope geometry is akin to the opening of a sink drain, pulling in water laterally from the upslope soil aquifer and concentrating the flow over a relatively small area as it temporarily became a shorter, and therefore preferred, pathway downslope. The short-term change to the groundwater flow regime would have naturally tended towards a new equilibrium.

Groundwater Seepage from the Escarpment is Characteristic of the Site

There is evidence to suggest that seepage down the gully downslope of 10-12 View Point Road was an established characteristic of the site prior to the 5 January 2025 landslide. This evidence is additional to the fact that the site comprises a gully which is very likely to have been formed by water flow down the slope.

An email from Mr. and Mrs. Wells (owners of 3 Penny Lane at the time) sent on 17 February 2023 noted water runoff from the slope originating from the top of the escarpment. It could be read that this email relates solely to the aftermath of the November 2022 landslide. However, given the extent of drainage works constructed at 3 Penny Lane, it is reasonable to presume that the drainage works for No. 3 Penny Lane are likely designed to manage seepage originating from the top of the escarpment directly above the property.

In addition, evidence of multiple perched water tables in PSM bores indicate springs must be present along the face of the escarpment. Furthermore, Coburn Creek is spring-fed towards its lower reach with evidence of seepage along the line of the escarpment.

Groundwater seepage down the escarpment slope is therefore characteristic of the site, rather than an aberration related to a landslide event. The large volume of seepage observed following the McCrae Landslide is assessed to be a realignment of preferential flow paths of the groundwater that would have characteristically flowed.

Landslide Susceptibility

Evidence suggests any heavy rainfall upslope of the escarpment is typically transported down slope by:

- Flowing in the vicinty of the historic course of Kings Creek (refer Figure 4); and

  - naturally infiltrating into the ground; or
  - spreading beneath the land between the historic course of Kings Creek and the gully at the road called 'The Eyrie'.
- Outfalling at springs uphill of the escarpment; or
- within seepages that would be expected within the 'incisions' that are located at No. 10 – 12 View Point Road, No 4 View Point Road, and No. 12 Prospect Hill Road.

SMEC has utilised previous analysis by others, on the landslide of November 2022, modelling the 5 January 2025 landslide. A slope stability assessment based on our model has been undertaken to assess:

- The susceptibility of the McCrae Landslide site prior to the landslide event; and
- The volume of water that would have been required to be introduced to the site in order to initiate a landslide event.

The slope stability analysis, coupled with assessment of photographs taken by others on 5 January 2025, suggests that the the McCrae Landslide site was highly susceptible to a slope failure of approximately 120 t of colluvial material flowing down the slope.

Prior to failure, the results of the analyses indicate that the slope had an FoS of 1.09 which implies that the forces resisting failure were only 9% higher than the forces driving failure. For context, an FoS of 1.5 is generally accepted as the minimum factor of safety for long-term global stability.

To back analyse the failure, a volume of saturated colluvial soil was incrementally increased until an FoS < 1.0 was achieved. To achieve this, the volume of water in this modelled soil block is assessed to be between 2000 L and 2300 L.

While the locality of the McCrae landslide site is susceptible to landslides (recorded in historical press cuttings, inferred in response to planning applications etc., it has at the same time demonstrated the ability to cope with influxes of water, as landslides have not occurred during or following every adverse weather event. No significant reports of movement or settlement of structures in the area due to the presence of shallow groundwater have been noted either.

Conclusions

Based on information reviewed to date, and analyses performed by SMEC, it is assessed that:

- The majority of the water originating from the Bayview Road leak would very likely have been intercepted by the stormwater drains grate approximately 30 m downslope of the leak locationand outfalled in Port Phillip Bay;
- The groundwater seepage observed in the failure scarp of the McCrae Landslide is highly unlikely to have been SEW mains water from the Bayview Road leak based on groundwater chemistry; and
- The high flow rate of groundwater seepage from the failure scarp immediately following the landslide is due to the disruption of the natural preferred flow path of groundwater down the escarpment. The change in the slope geometry likely resulted in a new short-term preferred groundwater flow path at the landslide itself, and transitioned toward a new equilibrium in the days and weeks following the landslide event.

While the existing locality has demonstrated some ability to cope with influxes of rainfall without resulting in a landslide, the McCrae landslide site is assessed to have had a high susceptibility to a landslide event occurring prior to the landslide event. Further, it was assessed that a relatively small amount of water (2000 L) was required to be introduced to the site in order to induce a landslide event.

1. Introduction

Two slope failures occurred on 5 January 2025 and 14 January 2025 within the property boundaries of 10-12 View Point Road, McCrae. The latter is referred to as the 'McCrae Landslide'. Approximately 20t of material slipped on 5 January 2025, with 120t slipping on 14 January 2025 (Appendix B Ref 23). Both landslides comprised downslope movements of material from the upper portion of a slope approximately 25 m high, within 10-12 View Point Road, towards 3 Penny Lane near the toe of the slope. The McCrae Landslide caused substantial damage to 3 Penny Lane and injured a person who was at the property at the time.

A longitudinal fracture is known to have affected a buried water main that is located within public land between Bayview Road, Outlook Road and the M11 Mornington Peninsula Freeway. The water main is an asset of South East Water (SEW). The location of the leak was approximately 460 m southwest of the landslide site and was identified on 31 December 2025 and repaired on 1 January 2025.

After the landslides occurring, a Board of Inquiry was established to investigate the nature of the landsides and their potential causes. The stated objectives of the Board of Inquiry are:

- Assess the cause(s) of the McCrae Landslide;
- Assess the adequacy of measures taken to address the risk of landslides and landslips in the McCrae area, including reviewing responses to the November 2022 and 5 January 2025 landslides and landslides in the area, to the extent that this information is relevant to the McCrae Landslide; and
- Identify measures to be undertaken for the prevention or mitigation of the risk of similar landslide events to the McCrae Landslide occurring in future in the McCrae area.

SMEC Australia Pty Ltd (SMEC) has been engaged by SEW c/o Thomson Geer to contribute to some of the objectives of the Board of Inquiry in order to:

- Provide an understanding of the sources of water that may have contributed to the landslide;
- Assess the impact of SEW assets on the landslide;
- Assess the amount of water from the Bayview Road leak that would have flowed into the natural geology and the stormwater system;
- Assess the likely flow paths that mains water originating from the Bayview Road leak could have taken; and
- Investigate how much water may have been needed to create a landslide at the site of the McCrae Landslide.

This revision includes a final Appendix D, of the Appendix D of this Report: Geotechnical Site Investigation Report, and an updated Appendix E: Hydrogeological Site Investigation Report. A further spell check and grammar check has been carried out on this revision, leading to some minor changes in the text.

2. Scope of this Report

SMEC has previously submitted to SEW c/o Thomson Geer a preliminary report assessing the likelihood of impact, and contribution of, the SEW assets on the McCrae Landslide (Appendix B, Ref. 24). Since this report was submitted, additional information relating to the landslide has been made available to SMEC. SMEC has also been instructed to scope and execute such site works we consider necessary to provide a greater understanding of the sources of water that could have impacted on the McCrae Landslide, and the impact of SEW assets on the McCrae Landslide.

The scope of this report is to:

- Document the findings of additional site investigations (including visual, and intrusive) that have been undertaken by SMEC in the general vicinity of the landslide site, and the subsequent monitoring programme and laboratory testing scheduled, to the extent that these have been completed up until 15 July 2025;
- Incorporate into the assessment additional information from other parties that has been made available to SMEC since the preliminary report was submitted;
- Assess the expected volume of water that entered a stormwater pit from a water mains leak, referred to as the 'Bayview Road Leak', identified on 31 December 2024 and repaired on 1 January 2025;
- Assess the volume of water necessary for the 5 January 2024 landslide to occur; and
- Provide an assessment of the sources of water that may have impacted on the McCrae landslide.

It is not the intention of this report to provide an exhaustive description or review of all known information relating to the landslides. The report focuses on events and data sources that SMEC considers most relevant to understanding the sources of water and particularly the influence of SEW assets on the landslide. It documents the several avenues of investigation followed by SMEC. The factual data of each avenue of investigation is presented in the appendices of this report. These appendices, combined with the preliminary SMEC report, are used to reach a conclusion on the sources of water and impact of SEW assets on the landslide.

3. Outline of Report

This report comprises a review of available data and investigations carried out to develop an understanding of the sources of water that may have impacted the McCrae Landslide and the 5 January 2025 landslide, and the impact of SEW assets. The assessment considers the following information sources:

- Information supplied by SEW c/o Thomson Geer as part of commissioning SMEC and issued as SEW conducted their own investigations;
- Information supplied by others and available to Thomson Geer, who have subsequently provided this information to SMEC. This is information that has either been provided to the Board of Inquiry and subsequently released by the Board following Thomson Geer's request or has been volunteered by others to the Expert Database set up by the Board;
- Information supplied by others and available to SMEC via the Expert Database. This is information that has been volunteered by others to the Expert Database set up by the Board;
- Information supplied by SEW c/o Thomson Geer that was requested by SMEC through a 'Request for Information' (RFI) process. This is information is included in the appendix of references for this report (Appendix B); and
- Information obtained from publicly available sources.

Due to the large amount of information that is available, a complete list of sources is not provided. However, the reader is referred to Appendix B which includes a tabulated summary of the metadata for key information sources that were referenced.

An outline of the content of each subsequent section of the report is provided below.

- **Section 4 Overview of 2025 Landslides**. This section provides a summary of the observations made by various parties following the landslides that occurred at 10-12 View Point Road on 5 January 2025 and 14 January 2025 (the McCrae Landslide);
- **Section 5 Desktop Study**. This section considers the information sources for the site, the local area and the region that are either publicly available, have been provided to SMEC by SEW c/o Thomson Geer, or have been submitted to the Board of Inquiry by others. The scope of the desktop review of the site and surrounding area was as follows:
  - Site location and description, including:
    - Topography;
    - Geomorphology;
    - Geology; and
    - Hydrology and hydrogeology.
  - Historic and recent development;
  - Susceptibility to landslides and evidence of previous failures;
  - Summary of known utilities; and
  - Apparent subsurface water issues.
- **Section 6 SMEC Site Investigations.** This section provides a summary of all site walkovers and physical site investigations undertaken by SMEC. The reader is referred to Appendix C, Appendix D, Appendix E and Appendix F for reports containing the findings of the investigations. The investigations undertaken to date are as follows:
  - Site walkover inspections to visually assess the characteristics and conditions of the site;
  - Geotechnical investigation comprising borehole drilling, sampling and laboratory testing;
  - Hydrogeological investigations comprising installation of piezometers to record groundwater conditions; and

  - Geophysical survey comprising frequency-domain electro-magnetic (FEM) surveying.
- **Section 7 Ground Model.** This section presents an interpretated ground model for the site and surrounding area that draws on available information and the investigations completed by SMEC. This section contains:
  - A description of the geological units encountered; and
  - An interpreted geotechnical and hydrogeological model for the site.
- **Section 8 Hydraulic Assessment.** This section presents a summary of a hydraulic assessment of the volume of water that flowed from the Bayview Road Leak to a nearby stormwater pit. Refer to Appendix G for a detailed description of the methodology and results of the hydraulic assessment;
- **Section 9 Assessment of Water Sources.** This section evaluates potential water sources that may have contributed to the McCrae Landslide and assesses their likelihood of influence;
- **Section 10 Slope Stability Assessment.** This section presents the findings of slope stability analysis that has been undertaken for the purpose of estimating the volume of water required to cause the landslides, specifically the 5 January 2025 landslide. Refer to Appendix H for a detailed description of the methodology and results of the slope stability analysis;
- **Section 11 Discussion**
- **Section 12 Conclusions.** This section contains a summary of the conclusions that SMEC has drawn regarding sources of water and their impact on the 2025 McCrae landslides. The conclusions are based on a review of the information from the site, interpretation of data from physical site investigations and analysis undertaken to date; and
- **Section 13 Outstanding Information.** This section provides a summary of works still to be completed at the time of issuing this report.

4. Overview of 2025 Landslides

4.1 Introduction

SMEC reviewed the information sources provided (up to 15 July 2025) and the observations recorded by various parties who visited the site during and after January 2025 to develop an understanding of the key events leading up to and following the landslide event. A description of the key events and observations is provided in this section.

4.2 Utility Leaks

A burst water main was identified near the intersection of Bayview Road and Outlook Road on 30 December 2024 and repaired on 1 January 2025. In the weeks prior to the identification of the water main leak, reports of water seepage through road pavement and verges were received from various residents residing to the southeast of the Site (Appendix B, Ref. 12,)

A leak from a private main at No. 5 Prospect Hill Road approximately 140 m east of the Site was identified by SEW in January 2025. The leak was located and repaired in April 2025. The landowner believes that the private agricultural (AG) drainage network of the property collected the leaking water. We understand the AG drain network flows into a roadside gully pit linked to the local stormwater drainage system. The volume of water leaked is not known.

More discussion on subsurface water issues is provided in Section 5.5.

4.3 Landslide at 10-12 View Point Road on 5 January 2025

A summary of SMEC's understanding of the key events and observations relating to this landslide is as follows:

- A landslide occurred within a gully or incision approximately mid-slope of a generally north-northwest facing escarpment slope, below the residence of 10-12 View Point Road;
- The landslide was first reported by the Emergency Management Co-ordinator at 21:14 on 5 January 2025 (Appendix B, Ref. 1);
- The head scarp presented approximately 6 m below the crest of the slope, downslope of a post and concrete sleeper retaining wall;
- The dimensions and volume of this landslide have been variously estimated by others as follows:
  - In email communications dated 7 January 2025 (Appendix B, Ref. 2), PSM noted 'A sub-vertical head scarp up to 1.5 m high' and 'volume in the range of 15 to 20 m^3'; and
  - In a report by GHD dated 22 January 2025 (Appendix B, Ref. 3,) GHD noted that the landslide is '...thought to be of limited size (estimated 3 x 5 m of unknown depth)'.
- Landslide debris appears to have moved downslope and piled up against the rear wall of 3 Penny Lane, which is located near the toe of the slope, to the north of 10-12 View Point Road;
- Rainfall data from weather stations at the Rosebud Country Club and Mornington (approximately 3.6 km and 17.9 km from the site respectively) indicate that no rainfall had occurred within eight days prior to the landslide;
- Site visits to observe conditions after the landslide were undertaken by:
  - PSM on 6 January 2025 (Appendix B, Ref. 2)
  - Civil Test on 6 January 2025 (Appendix B, Ref. 4)

- PSM noted during their site visit on 6 January 2025 a '… translational slide which has evacuated materials down to the natural granitic soils at the base of the landslide'. PSM noted that 'A significant portion of the head scarp was saturated and with measurable flow of water (0.15-0.2 L/s) flowing along the base and down the hill. The seepage was observed at the contact with surficial soils (fills/ancient landslide debris) and the underlying natural soils. 'Unstable zones' were also noted by PSM near the head scarp with volume in the order of '3 to 6 m^3';
- Civil Test noted during their site visit on 6 January 2025 that '…a steady stream of groundwater was observed to be emanating from the lower section of the head scarp, approximately 15-20 litres per minute (not directly measured) downstream flow…'. Civil Test notes that the base of the head scarp is approximately 4 m to 5 m below the ground surface level behind the retaining wall. It is therefore assumed that this depth approximately coincides with the point at which groundwater was observed to be seeping out of the slope. Civil Test notes that the material above this point was dry;
- Following their site visit on 6 January 2025, PSM provided a preliminary assessment of risk to life for the properties directly affected, with corresponding recommendations for actions to reduce risks to life to As Low As Reasonably Practicable (ALARP) (Appendix B, Ref. 2). The recommended actions were:
  - Monitoring slopes for signs of change and/or deterioration.
  - Diversion of surface water around the scarp and properties.
  - Installation of ballasted shipping containers between the downslope dwelling and the slope.

4.4 The McCrae Landslide (Landslide at 10-12 View Point Road on 14 January 2025)

A summary of SMEC's understanding of the key events and observations relating to this landslide is as follows:

- Landowners of 10-12 View Point Road note ravelling back of the backscarp towards the toe of the retaining wall between 6 January 2025 and 13 January 2025, culminating in the Municipal Building Surveyor (MBS) for Mornington Peninsula Shire Council (MPSC), visiting site on 13 January to investigate a void that had appeared beneath the toe of the wall;
- A second and larger landslide occurred at the site on 14 January 2025 that originated further up the slope from the 5 January 2025 landslide. The head scarp daylighted partially behind a steel post and concrete panel retaining wall that is located at the crest of the slope, damaging part of the wall;
- The landslide was first reported by MPSC at 09:30 on 14 January 2025 (Appendix B, Ref. 5);
- The width of this landslide is estimated to be 3 m to 5 m. The volume of dislodged material is thought to be 120 t (Appendix B Ref. 23 (Victoria Gazette, March 2025));
- Debris from this landslide travelled down the slope and effectively demolished the 3 Penny Lane property at the toe of the slope. Debris flow is understood to have reached as far as 2 Penny Lane;
- Rainfall data from nearby weather stations indicate approximately 8 mm to 9 mm of rain fell on 13 January 2025;
- Numerous site visits by various parties have been undertaken since the 14 January 2025 landslide. Key site visits and reports are:
  - Victorian State Emergency Services Authority (SES) on 14 to 15 January 2025;
  - GHD on 18 January 2025 (Appendix B, Ref. 3);
  - PSM between 15 and 17 January 2025 and 24 January 2025 (Appendix B, Ref. 14); and
  - CivilTest on 20 March 2025 (Appendix B, Ref, 4)
- During the site visit undertaken by GHD, subsurface water was noted to be emerging from numerous points in the backscarp that had been created. The seepage was observed to be approximately 3 m to 4 m below ground level at the crest of the slope. GHD's report (Appendix B, Ref. 3) states that no subsurface water was noted to be discharging from the slopes within the adjacent properties at the time of their site visit,

which was noted to be of limited duration. It is not clear if GHD obtained access to the other properties to undertake a detailed inspection;

- During the site visit undertaken by CivilTest (Appendix B, Ref. 4), the engineer noted that water seepage from the scarp that was observed immediately following the initial landslide was not observed on the day of the inspection (20 March 2025). During a site visit by SMEC on 13 June 2025, Mr. Borghesi informed SMEC's engineers that seepage stopped between 6 weeks and 2 months after the 14 January 2025 landslide. Mr Hutchings, the representative for the owner of No.6 View Point Road, informed SMEC engineers on 17 June 2025, that he believed that seepage was noted up to 3 months after 14 January 2025. Mr. Willigenburg's evidence was that he was prevented from entering his property at 607 Point Nepean Road in April due to water flowing through it. SMECs view is to suggest that Mr. Willigenburg's evidence should carry more weight that other evidence due to the likely higher accuracy of flow being through a property, rather than downslope of a vantage point;
- Actions taken by various parties in relation to and following the second landslide include:
  - Evacuation Order (EO) issued to directly affected property owners between 15 January 2025 and 17 January 2025 by the SES and MPSC. These EOs were updated on 14 and 20 February 2025;
  - GHD provided a quantitative landslide risk assessment for the area surrounding the landslide on 22 January 2025 to the SES (Appendix B, Ref. 3). The assessment considers the risk to road users and pedestrians waiting at bus stops on Nepean Point Road;
  - PSM undertook geotechnical investigation of the site between 21 January 2025 and 3 March 2025 as documented in the Geotechnical Factual Report (Appendix B, Ref. 6);
  - PSM commenced displacement monitoring of the site on 12 February 2025 (Appendix B, Ref. 7 to 10). Monitoring instruments installed comprise GPS sensors, tilt sensors, survey prisms, and radar monitoring;
  - CivilTest provided a landslide risk assessment to life for residents at 10-12 View Point Road on 26 March 2025 (Appendix B, Ref. 11);
  - PSM carried out a Non-Destructive Drilling regime (Appendix B, Ref. 43) to install vibrating wire piezometers and standpipe piezometers adjacent to stormwater and sewerage mains at locations in the locality of the landslides. This was observed by SEW representatives who took opportunistic disturbed samples for subsequent soil classification testing; and
  - WSP has carried out an intrusive investigation. The details of which have not been provided at the time of writing.

5. Desktop Study

5.1 Site Description

5.1.1 Site Location

The location of the 2025 McCrae landslides is within the suburb of McCrae on the Mornington Peninsula, Victoria approximately 90 km south of Melbourne City Centre.

The landslides originated within the property boundary of 10-12 View Point Road, McCrae. Debris flow from the landslides travelled downslope and demolished the property at 3 Penny Lane, immediately to the north. Together these two properties are considered to comprise the 'Site'.

An annotated plan showing the approximate location of the landslide within the Site is presented in Figure 1.

Figure 1: Annotated aerial photography showing the approximate location of the landslide and delineation of the Site (source: MetroMap; 2025-02-01. Annotation of site location added by SMEC)

5.1.2 Site Features and Topography

The house at 10-12 View Point Road is located at the southern end of the Site. It is positioned on top of an escarpment that is approximately 25 m to 30 m high, aligned roughly northeast to southwest. The escarpment slopes down relatively steeply towards the north end of the Site, which is currently occupied by the debris of the property at 3 Penny Lane.

The gradient of the escarpment slope is generally between 30° and 40°. However, there are localised steeper sections, particularly at residual spurs between the incised gullies that occur at regular intervals along the escarpment, at the location of natural drainage lines. The regularly incisional nature of the escarpment indicates evidence of historic landslides along the escarpment.

To the north of the Site are several residential properties located on a low-lying coastal zone along Point Nepean Road. A short distance further north is the Mornington Peninsula coastline. To the east and west the Site is bordered by other residential properties that are positioned either at the top or bottom of the escarpment.

Figure 2 below provides a cross section through the Site, based on the contour data illustrated in Figure 1.

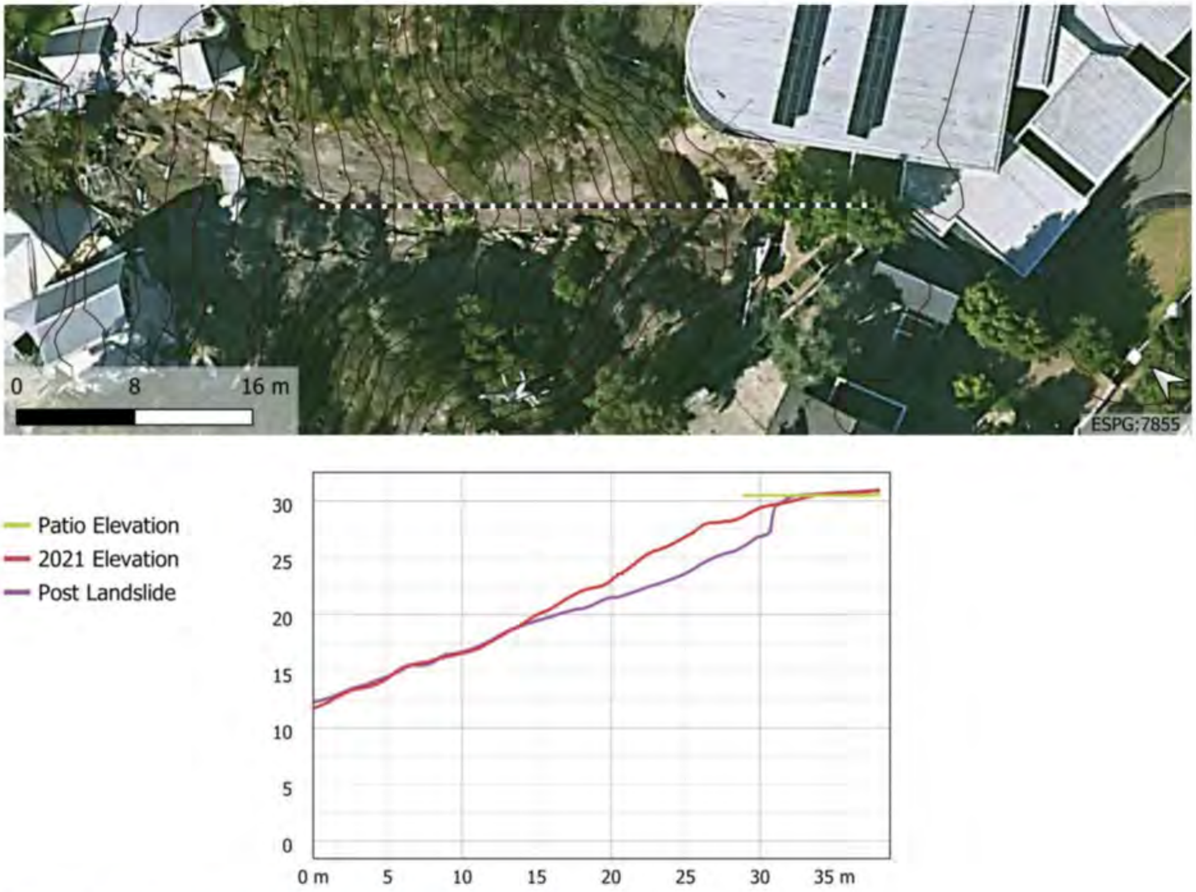


Figure 2: Drone footage illustrating the site features and topography

5.1.3 Regional Topography and Geomorphology

The region is dominated by the granitic intrusion of Arthurs Seat. The landform surrounding the summit falls in a generally conical shape, gently rising from sea level around Rosebud to the south west of the Site, and Dromana to the north east. In-between, the sloping topography is interrupted by an escarpment running approximately parallel to the coastline, abutting the sea at a minor promontory named Anthonys Nose. The slopes within approximately 1km of the coastline have been developed, which includes the construction of the M11 Mornington Peninsula Freeway. The freeway is aligned across the western slopes of Arthurs seat, in a series of cuttings and embankments.

A topographical map of the Mornington Peninsula is provided in Figure 3 below.

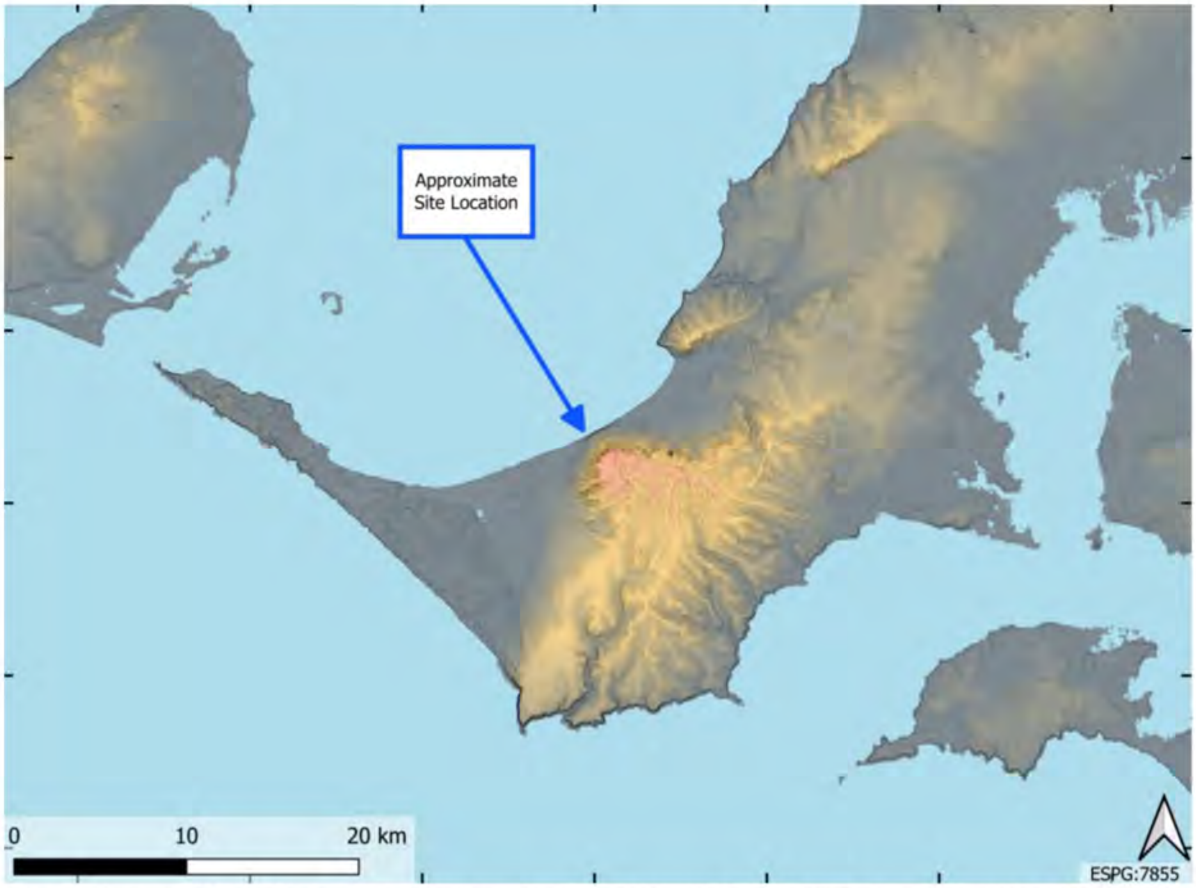


Figure 3: Topographical Map of Mornington Peninsula (elevation source: Geoscience Australia, SRTM-derived 1 Second Digital Elevation)

The lower slopes of the granite intrusion form a plateau above the escarpment. Various well-developed drainage channels drain in a north-northwest direction across this plateau, from Arthurs Seat towards the coast. Along the escarpment there are intermittent gullies that have been formed due to fluvial erosion from these drainage channels. The steep escarpment slopes, with intermittent gullies and streams, have been surveyed by the 1862 Coastal Survey – Port Phillip Martha Cliff to South Channel Map, which was available from the public records office of Victoria (refer Figure 4). This indicates the geomorphology of the McCrae area prior to any development.

Construction of the Mornington Peninsula Freeway has intersected drainage paths from Arthurs Seat to the coast, with significant filling and the construction of culverts to manage surface water.

Figure 4: Aerial photography from 1862 showing mapped drainage channels and annotated with the approximate location of the landslide and other features (source: PROV, Department of Crown Lands and Survey, VPRS 8168/P0002, CS21; PORT PHILLIP MARTHA CLIFF TO SOUTH CHANNEL; COX. Annotation of site location added by SMEC)

5.1.4 Ground Conditions

5.1.4.1 Regional Geology

Reference to the 1:63,360 Sorrento Geological Map (1967) (refer Figure 5) and the 1:250,000 seamless geology information from the GeoVIC online portal, indicates that the Site is underlain by:

- Devonian aged granodiorite and granite; and
- Quaternary aged coastal deposits, consisting of siliceous and calcareous sands, shell beds, and guano (Mud Islands).

The geological data sources also indicate that the inferred location of the Selwyn Fault is mapped near the Site. The Selwyn Fault is a reverse fault type, meaning that the ground on one side of the fault has been pushed up and over the ground on the other side. This fault forms part of the eastern highland fault system and runs from the Dandenong Ranges and extends towards the Mornington Peninsula (this subject area) and through to Cape Schanck (directly south of McCrae).

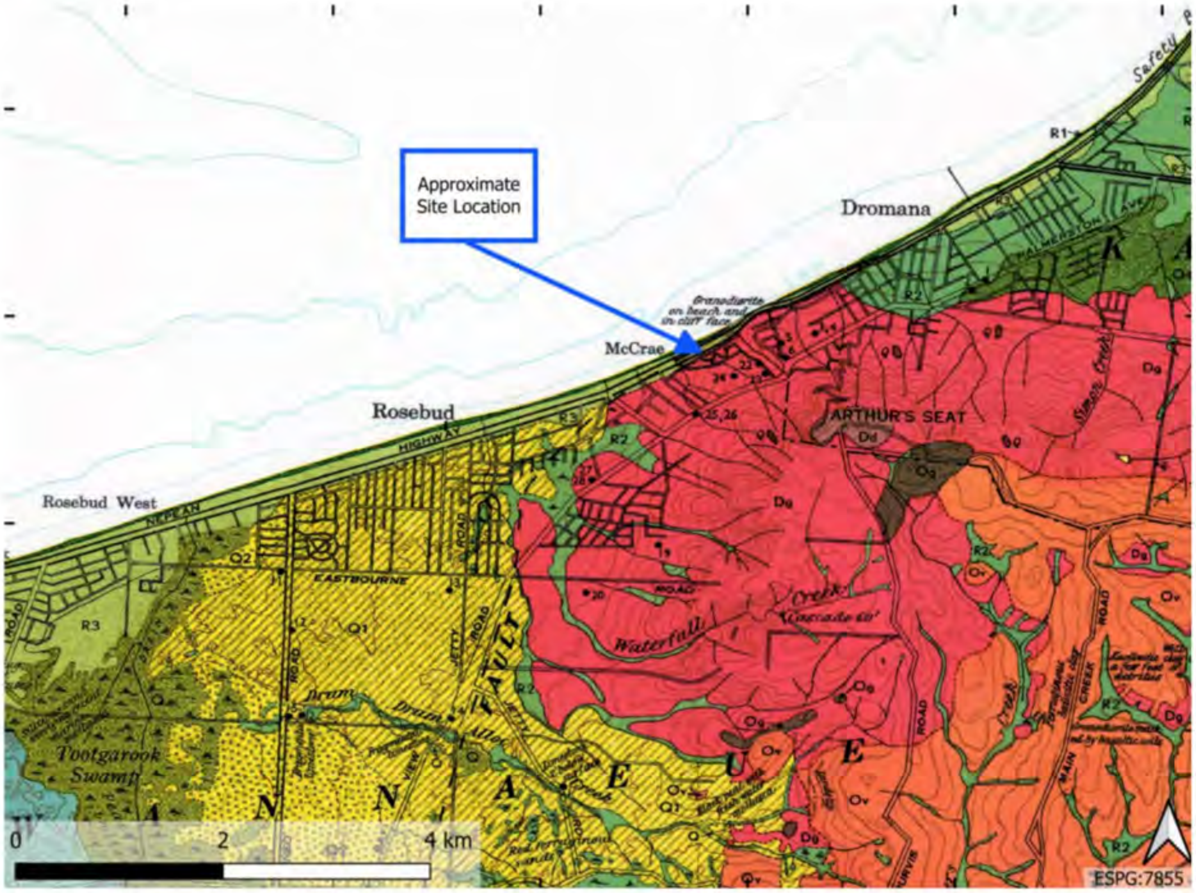


Figure 5: Regional Geology of the area, taken from Geological Survey of Victoria, Sorrento No. 867 Zone 7, Scale 1:63,360 1967. Approximate location of the Site annotated in blue.

5.1.4.2 Local Geology

Geotechnical investigations that have been carried out at the Site and surrounding areas are summarised in Section 6. The results of the investigations indicate that the materials within the vicinity of the Site typically comprise:

- **Topsoil** – Silts and sands encountered across the Site and surroundings, of variable thickness;
- **Aeolian and Marine soils** – Sandy deposits typically overlying the other units at the base of the escarpment and on the coastal flats. Some Aeolian soils encountered on the plateau above the escarpment;
- **Colluvium** – Sands and clays transported downslope. Typically encountered on the plateau as transported material from Arthurs Seat or around the escarpment as localised landslide and slope wash material;
- **Residual Soil** – Sands and clays derived from weathering of the granite bedrock. Typically encountered on the plateau, and to a lesser degree on the escarpment and coastal flats; and
- **Extremely Weathered Granite** – Deeply weathered bedrock profile with a rock strength typically less than very low, and therefore soil strength (sand and clay) material. Encountered across the region, typically underlying the other transported and residual soils on the coastal flats/plateau, sometimes exposed on the escarpment or beneath Colluvium.

Fill material associated with earthworks for residential developments and infrastructure is present across the area, as well as evidence of loosely end-tipped material over some parts of the escarpment. Fill is present at the Site in the form of backfill behind landscaping retaining walls near the top of the escarpment.

An interpreted geotechnical model for the Site is presented in Section 7.1.

5.1.5 Hydrology and Hydrogeology

5.1.5.1 Regional

The Mornington Peninsula region tends to experience moderate annual rainfall, with higher rainfall around Arthurs Seat (highest elevation levels). The region also tends to have short and steep catchments which drain directly into Port Philip Bay.

Development in the area such as roads and residential structures has increased the likelihood of surface water runoff and has altered drainage networks.

The granodiorite and granite form the underlying bedrock and are an important feature controlling the hydrogeology both locally and regionally. The regional water table would be expected to be found within or just above this geological feature. The Selwyn Fault is an important feature which is responsible for the escarpment and would be expected to be a major control on groundwater levels. The shallower deposits would blanket the underlying bedrock and would contain perched water tables which would be expected to discharge at surface to local water courses and as springs particularly where escarpments are located.

5.1.5.2 Site

The site conditions mirror the regional picture with the underlying granodiorite and granite forming the regional water table with the overlying soils containing shallow perched aquifer(s). Local water features, such as Coburn Creek, and other major topographic features, such as the escarpment, control both the regional and perched aquifers. Areas of anthropogenic fill have also been noted in the locality including cut/fill works associated with the M11 freeway, and private residence construction.

5.1.5.3 Rainfall

Rainfall data from the Bureau of Meteorology (BoM) weather station at Rosebud Country Club (approximately 3.5 km from McCrae) for 2024 is presented in Figure 6, which indicates:

- During a typical year, the median rainfall is generally highest during the winter and spring months, with up to 80mm of median total monthly rainfall anticipated in the area over this period
- During a typical year, median rainfall is generally lowest during summer and early autumn, with a minimum median monthly rainfall of approximately 40mm anticipated in the area during this period
- The total rainfall recorded during December 2024 – just prior to the McCrae Landslide – was atypically low compared to the median. Approximately 40mm of rainfall was recorded compared to the median of approximately 50mm.

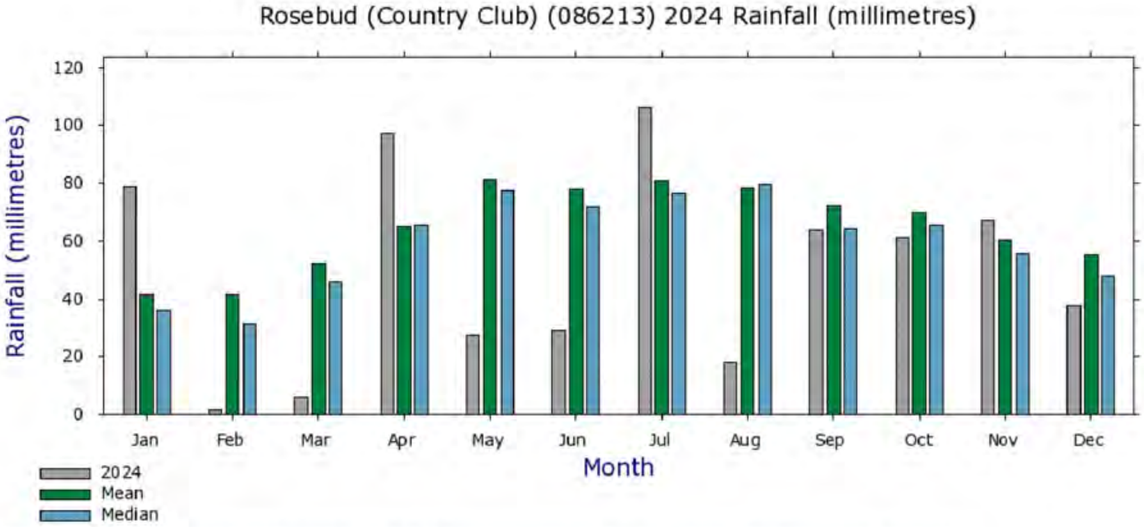


Figure 6: Median, mean and 2024 monthly rainfall at Rosebud weather station (source: http://www.bom.gov.au/)

A plot of daily rainfall in the months prior to the McCrae Landslide is presented in Figure 7. No significant rainfall was recorded prior to the initial landslide event on 5 January 2025. Rainfall at the site in the months prior to the landslide showed no great increase over the median.

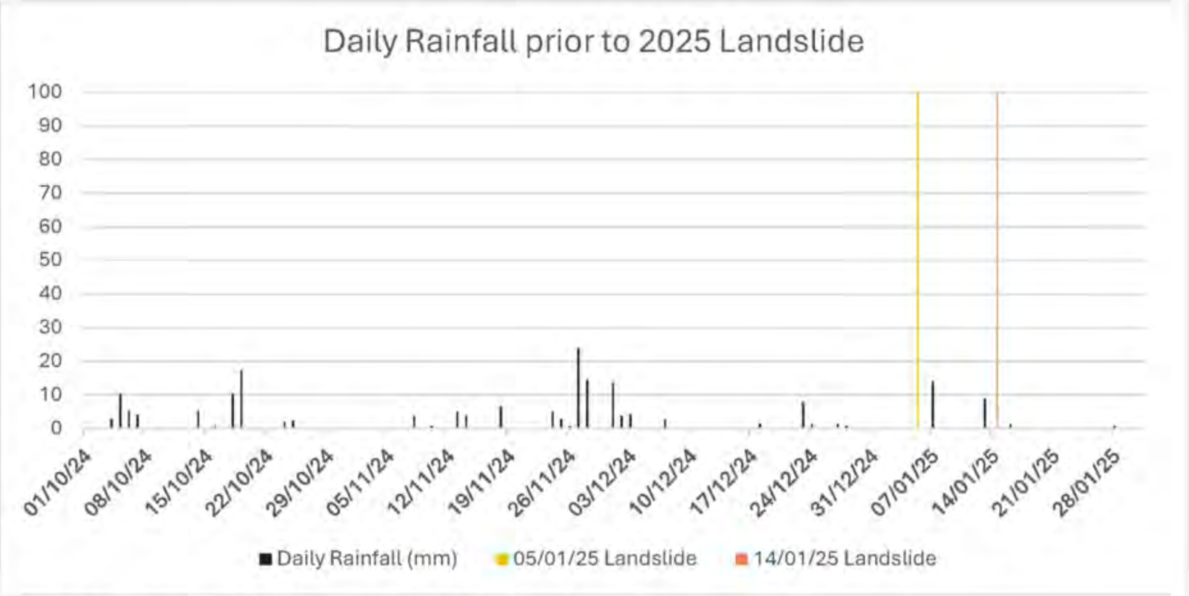


Figure 7: Daily rainfall prior to 2025 McCrae Landslide at 10-12 View Point Road

5.2 Site History

5.2.1 Historic Development

Historic plans of the local area accessed from the Public Records Office of Victoria, indicate that the area around the Site remained relatively undeveloped until at least the last decade of the 19th Century. A plan from 1890 (refer Figure 8) indicates that the area comprised 'open bush'. A road that follows the approximate alignment of the current Bayview Road appears to have been constructed by this time.

Figure 8: 1890 Plan of Site Locality (source: PROV, Department of Crown Lands and Survey, VPRS 8168/P0002, CS21; PORT PHILLIP MARTHA CLIFF TO SOUTH CHANNEL; COX;. Annotation of site location added by SMEC)

Aerial imagery from 1939 (refer Figure 9) presented in the report by PSM (Appendix B, Ref. 13) indicates that the area had been partially subdivided by this point and the house at 10-12 View Point Road had been constructed, indicating that the house is at least 86 years old. The aerial imagery indicates that the surrounding area was still relatively undeveloped at this time. Erosion appears to be evident along the escarpment to the east of the site.

Figure 9: 1939 Aerial Imagery of Site Locality (source: NAA: B5424, MAP3067/2705. Annotation of 10-12 View Point Road location added by SMEC)

Aerial imagery from 1951 (refer Figure 10) indicates that further development has occurred along Point Nepean Road and Coburn Avenue. There do not yet appear to be any other properties along the north side of View Point Road, although the resolution of the image is poor and vegetation may be obscuring some properties. Further clearing of vegetation has occurred since 1939.

Figure 10: 1951 Aerial Imagery of Site Locality (source: NAA: B5424, SVY1289/1339. Annotation of 10-12 View Point Road location added by SMEC)

By 1984 additional houses have been constructed along the north side of View Point Road, as well as across the suburb in general (refer Figure 11). Local roads have been upgraded, and considerable revegetation of the area has occurred after the original clearing of the native bush. Signs of erosion are no longer evident along the escarpment, although it may be obscured by vegetation.

Figure 11: 1984 Aerial Imagery of Site Locality (source: NAA: B6654, CAD/C2719/6710. Annotation of 10-12 View Point Road location added by SMEC)

5.2.2 Recent Development at the Site

5.2.2.1 Evidence of Property Alterations

A witness statement prepared by David Simon, Acting Director Planning and Environment, MPSC (Appendix B, Ref. 15) indicates that applications were submitted to MPSC for the following proposed property alterations for No. 10-12 View Point Road:

2015 to 2016 – applications were submitted for 10-12 View Point Road comprising alterations to the existing dwelling, extensions, a new outbuilding, retaining walls, hard paving, fences and gates. The submitted plan of the proposed alterations is presented in Figure 12. This plan indicates that new terraces were proposed either side of the house, and a new structure was proposed on the northeastern side of the house. The plans indicate an extension to the terrace on the north-eastern side of the house, requiring the construction of new retaining walls and placement of fill at the crest of the escarpment in the area that the 2025 landslides subsequently occurred.

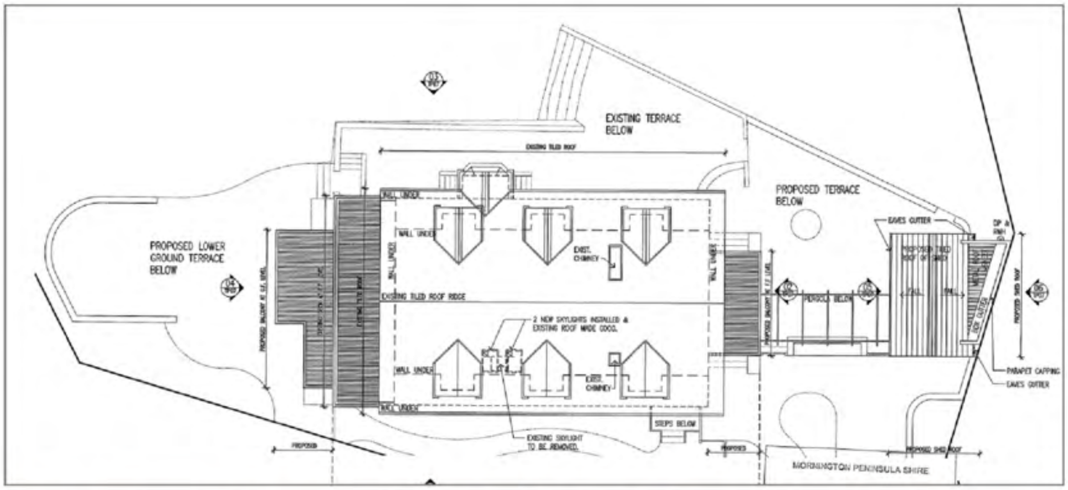


Figure 12: Plan of proposed development at 10-12 View Point Road (source: JDA Architects – Appendix B, Ref 16)

Aerial imagery from Metromap (refer Figure 13) indicates that this work was completed prior to 13 November 2017.

Figure 13: Aerial imagery of 10-12 View Point Road from 13 November 2017 (source: MetroMap accessed on 5 July 2025)

2020 to 2021 – applications were submitted for the installation of a deck and engineered handrail for the edge of a garden. The planning application appears to have been withdrawn at the request of the property owner (Appendix B, Ref. 17). Aerial imagery from Metromap (refer Figure 14) and available photographs indicate that a post and timber panel retaining wall with backfill was completed prior to 30 December 2021 and raised garden beds installed on the backfill by 21 July 2022.

Figure 14: Aerial imagery of 10-12 View Point Road from 21 July 2022 (source: MetroMap accessed on 5 July 2025. Annotation added by SMEC)

August 2022 – A letter was submitted to MPSC by the owner of 10-12 View Point Road requesting feedback on an attached proposal to construct a retaining wall and car/boat parking at the property. The letter noted that the *'proposal would require limited earthworks and vegetation removal on Penny Lane to enable a generally flat and level access from the West end of Penny Lane and would require a 1500mm retaining wall.'* Based on a review of aerial imagery and site photographs it does not appear that this development was undertaken.

Late 2022 – A steel post and timber plank retaining wall, understood from discussions with Mr. Borghesi during SMEC's site visit of 17 June 2025 (Appendix C) estimated to be up to 900 mm high was constructed, to create a flat area for raised vegetable garden beds behind and across the slope (refer Figure 15). Some fill would have been required to infill behind the wall (Appendix B, Ref 25).

Figure 15: Aerial imagery of 10-12 View Point Road from August 2023 (source: MetroMap accessed on 5 July 2025. Annotation added by SMEC)

January 2024 – A new steel post and concrete retaining wall was constructed in front of the wall supporting the raised garden beds that are shown in Figure 14. Invoices for the works, and photographic evidence of works in progress, and completed works have been submitted by the owner of 10-12 View Point Road, but no design drawings have been supplied.

5.2.2.2 Vegetation Changes

Vegetation plays an important role in slope stability and erosion in that it can absorb excess moisture from the ground, particularly during heavy rainfall events. It also provides a degree of physical reinforcement to the slope, binding the surficial soils together and breaking up the flow of water down the slope, which reduces erosion. Vegetation would not however, affect seepage along a geological boundary. Vegetation changes can occur due to human factors (e.g. removing trees) or natural factors (e.g. storm/fire damage, slope failures, or vegetation dying off).

A record of Inquiry by MPSC dated 17 August 2020 (Appendix B, Ref. 18) contains a complaint by the property owner of 27 Cook Street that the removal of vegetation from 37 Cook Street (approximately 1.5 km southeast of the Site) led to a mudslide that affected the properties at 27, 29 and 31 Cook Street. It is noted in the record that this occurred after a rainfall event that was described as 'not heavy'.

A review of available information including planning permit applications, aerial photography and site photos has been undertaken to gain an understanding of the recent vegetation changes that have occurred at the Site.

These observations indicate that there have been various instances of vegetation clearing at the Site between 2017 and 2023, including within the area that the 2025 landslide occurred. However, we are not aware of any evidence of significant changes between 2023 and the landslides in 2025. An example of an aerial image indicating removal of vegetation in 2018 is presented in Figure 16.

Figure 16: Aerial imagery of 10-12 View Point Road from September 2018 (source: MetroMap accessed on 5 July 2025. Annotation of vegetation clearing added by SMEC)

5.3 Landslide Susceptibility

5.3.1 Introduction

There are numerous sources of information available for the Site and the surrounding area that indicate:

- Past instances of slope failures along the escarpment;
- Concerns raised by residents regarding development in the vicinity of the escarpment, and the potential detrimental impact on stability of the slope above Penny Lane and Nepean Point Road. There appears to be an anecdotal understanding among some residents that the area is susceptible to landslides;
- Topographical maps showing coves, or incisions, the shape of which suggest landslide scarps (the rounded crest lines around No. 4 View Point Road (Figure 1); and
- Mapping of the Site as being vulnerable to landslides.

The following sections discuss these items further.

5.3.2 Past Occurrence of Landslides

As noted in the landslide risk assessment undertaken by GHD on 22 January 2025 (Appendix B, Ref. 3), there is anecdotal and historical record of previous landslides along the escarpment. These are as follows:

Early 1950s: Anecdotal information provided by SES and a homeowner at 4 View Point Road that a relatively large landslide occurred in the early 1950s below the current house at 4 View Point Road. The GHD report notes that this resulted in the transportation of a (collapsed) building downslope towards Point Nepean Road. It is noted that there does not appear to be a structure at the top of the escarpment in the aerial photograph of the Site from 1951 historical aerial imagery, where the current house at 4 View Point Road is located. Therefore, if this anecdotal record is accurate the landslide may either have occurred after 1951, or the house was destroyed and cleared prior to the 1951 photographic survey. Alternatively, it is possible that the detail regarding the destruction of a property is inaccurate.

The GHD report (Appendix B, Ref. 3) notes that evidence of a potential scarp from this landslide was observed below the house at 4 View Point Road during a site visit in 2025.

1952: Numerous newspaper articles from July 1952 reported a landslide that occurred in McCrae at some point along the escarpment adjacent to Point Nepean Road. The location is assumed in the GHD report to be near the point known as Anthony's Nose, which is approximately 2 km northeast of the Site. A report by PSM (Appendix B, Ref. 14) indicates that the landslide occurred on 14 July 1952 with the location likely to be between 563 and 577 Nepean Road. This landslide is understood to have been triggered by significant rainfall and destroyed eight holiday homes and a milk bar.

Between 1975 and 1977: It is inferred in a report by PSM (Appendix B, Ref. 14) that it is 'very probable' that a landslide occurred on a section of the escarpment below 10-12 View Point Road. This inference is based on a review of vegetation changes in aerial imagery between 1975 and 1977, supported by visual evidence of a head scarp and rotated tree observed during a site visit by PSM in January 2025.

Circa 2000: A letter submitted to MPSC by the property owner of 16 View Point Road in September 2002 (Appendix B, Ref. 19 and Section 5.3.3 of this report) made reference to a slippage or mudslide at the property next to 6 View Point Road two years earlier, as well as a general history of instability in the area.

2006: GHD noted in its report (Appendix B, Ref. 3) that the Department of Transport and Planning provided it with a 2006 report by Piper Associates for a geotechnical inspection of the cliff slopes at Anthonys Nose. SMEC has not seen this report and it is not clear if the inspection was in response to a particular failure event or a general inspection of the conditions in the area. GHD notes the following key points from the report:

- The escarpment was steepened in 1840 to construct a road (presumably Point Nepean Road). This steepening, combined with increased development in the area is thought to have led to erosion of the escarpment resulting in numerous shallow failures;
- Instability of the escarpment is thought to be the result of surface runoff and rainfall;
- There is no evidence of deeper-seated failures; and
- There is a significant deposit of colluvium at the base of the slope which is likely the result of a historical debris flow.

2007: A report by LanePiper dated 3 September 2007 (Appendix B, Ref. 20) contains a geotechnical assessment of the banks of a gully between 'The Eyrie' and Point Nepean Road, about 200 m northeast of the Site. A recent increase in runoff and erosion of the gully had caused instability of the gully banks and the collapse and closure of a walking path.

2022: There are numerous reports relating to a landslide that occurred at 10-12 View Point Road on 15 November 2022. The landslide was noted in a report by PSM (Appendix B, Ref. 14) to consist of two events – an initial translational slide followed by a debris flow. The landslide originated within a gully on the west side of the Site. The volume of transported material was estimated by PSM to be approximately 20 to 30 m^3. The landslide was preceded by approximately 80 mm of rainfall over a 24-hour period on 14 November 2022. Following the landslide various people, including the property owner, Mr Borghesi, and representatives of Stantec and PSM, noted that seepage was observed emanating from the slope within the area where the landslide had occurred. PSM (Appendix B, Ref. 14) note that groundwater was observed seeping from the head scarp in 'late 2023'.

Given the instances of previous landslides discussed above, it is considered likely that other landslides have occurred along the escarpment within the last 150 years or so, that have not been recorded.

5.3.3 Stability Concerns Raised by Residents

In September 2002 John d'Helin (property owner at 16 View Point Road) wrote to MPSC regarding some concerns he had with planning application P02/1833, which concerned proposed building alterations to 6 View Point Road (Appendix B, Ref. 19). The following concern relating to land stability was raised: *'This block & others in the* *immediate vicinity suffer from slippage & mudslides. The most recent occurred two years ago on the property next door to No. 6. Conventional wisdom in the area is that you disturb the dirt at your peril.'*

Details of the landslide that is mentioned in the letter as occurring around the year 2000 are not known. It is also not clear if the statement is referring to 4 View Point Road or 10-12 View Point Road.

The statement from Mr d'Helin indicates that there is a general understanding among some residents in the area that the escarpment has a history of, and is prone to, landslides.

5.3.4 Landslide Susceptibility Mapping

A report by Cardno LanePiper submitted to MPSC dated 1 February 2012 (Appendix B, Ref. 21) presents the results of a study of landslide susceptibility in the Mornington Peninsula Shire. This study resulted in the development of a landslide susceptibility map for the shire that classified landslide risk in terms of low (green), medium (yellow) or high (red). The classification was based primarily on slope grade/aspect and geology. Other more localised factors such as depth to groundwater, perched water tables, vegetation, and depth to rock were not considered. The study also included a review of aerial photography to identify previous landslides in the area, in order to inform the risk assessment.

MPSC has produced a map indicating the assessed landslide susceptibility risk level for the Site, which we understand is based on the 2012 Cardo LanePiper study. This map indicates that most of the Site is classed as 'high' (red) or 'medium' (yellow) risk level. The area where the 2025 landslides occurred is in the 'high' risk zone.

5.4 Subsurface Utilities

5.4.1 SEW Assets

SEW assets in the locality (that is, within 500 m) of the Site comprise buried gravity sewerage mains, pressurised water mains and mains water tanks. Buried water mains and sewerage mains are located along View Point Road. The nearest water tank is off Waller Place, some 300 m south east of the Site.

Plans showing the layout of the gravity sewer and pressurised water mains, assets are presented in Figure 17 and Figure 18.

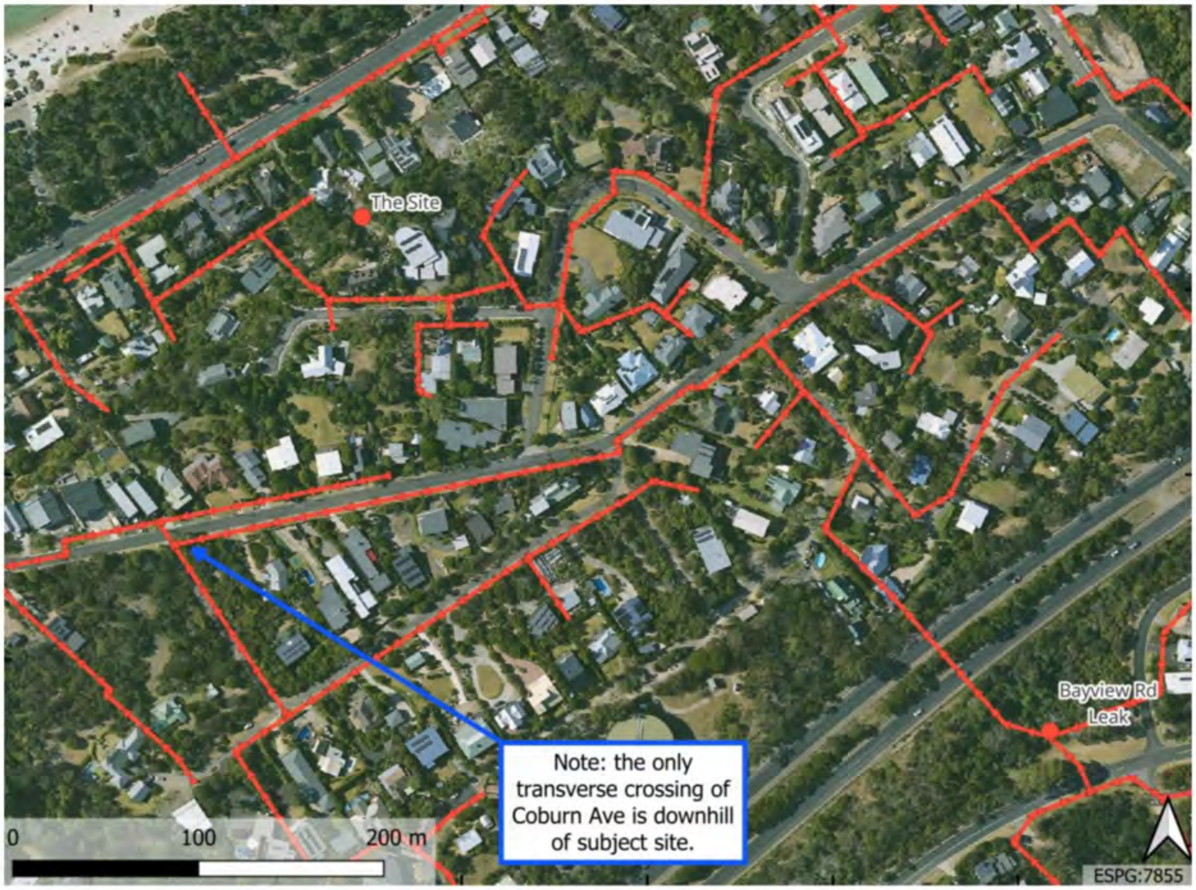


Figure 17: Plan showing sewerage network (red) around locality of View Point Road. Note that the leak near Bayview Road is on the south side of Mornington Freeway.

Figure 18: Plan showing water mains network (blue) around the locality of View Point Road

Figure 19 highlights the section of the sewer network between Bayview Road and Point Nepean Road. Chainages 217.75m to 298.25m are located along Charlesworth Street. The depth to invert along Charlesworth Street varies from 2.69m to 1.56m. It is noted that the invert depths along Charlesworth Street are not the shallowest inverts along the alignment.

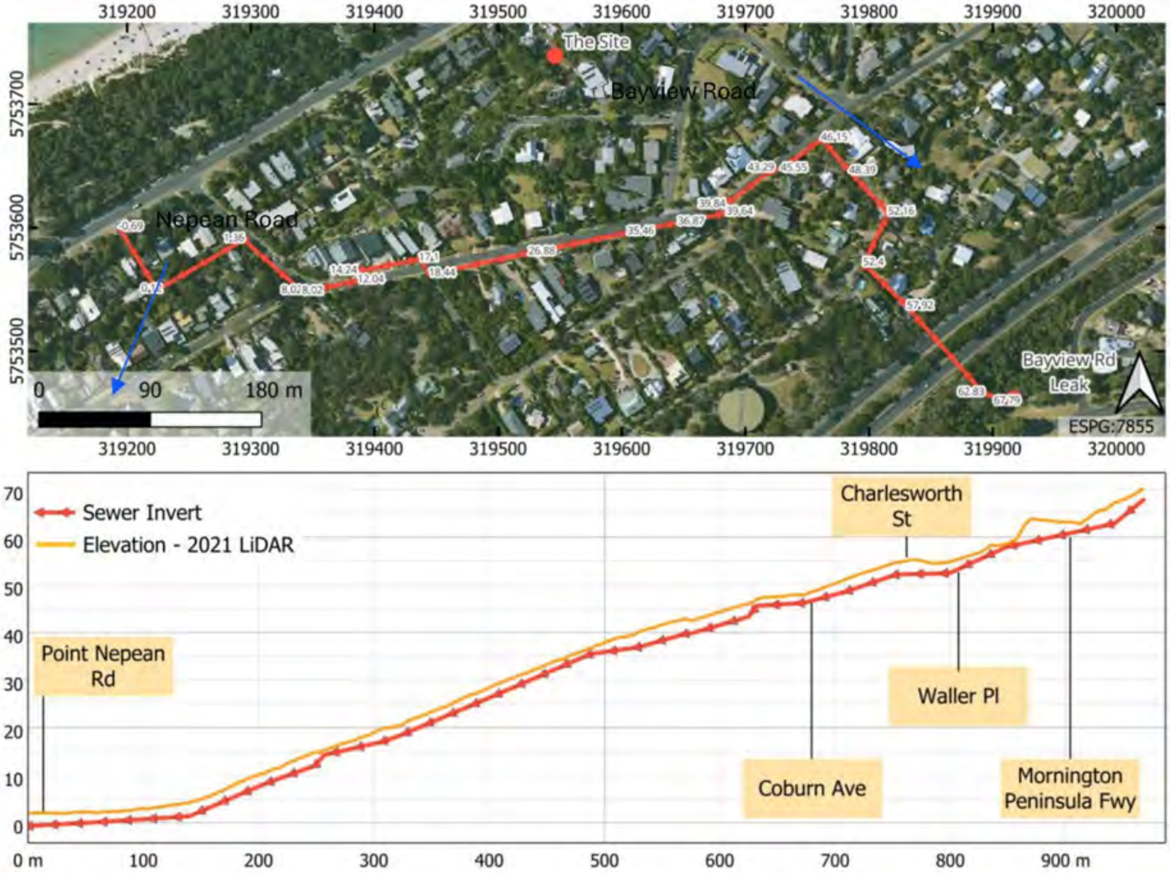


Figure 19: Graphical long section showing the ground level and invert levels of the sewer network between Bayview Road and Point Nepean Road.

Figure 20 below illustrates the sewer gradient through Prospect Hill Road into View Point Road. 10 View Point Road is at chainage 298.4m. These figures show a fall in invert level along the chainages, irrespective of the ground level. Chainages 83.9m to 93.7m is outside of 10 Prospect Hill Place.

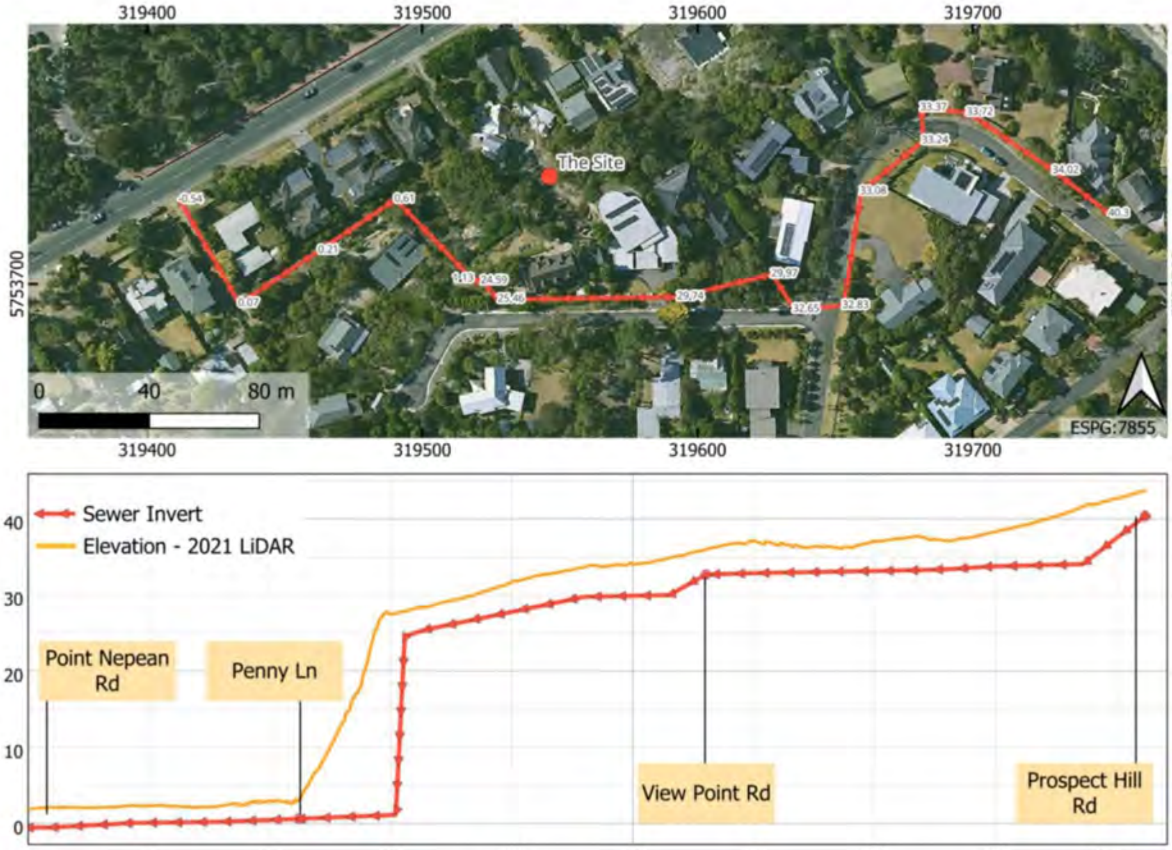


Figure 20: Graphical long section showing the ground level (CL) and invert levels (IL) of the sewer network between Prospect Hill Road and Point Nepean Road.

5.4.2 Stormwater

A plan of the stormwater network is presented in Figure 21. This plan has been annotated by SMEC to show the approximate location of known buried stormwater drainage that was installed along View Point Road in 2023. This figure is derived from Before You Dig Australia (BYDA) maps, which have been acknowledged to be incorrect by MPSC. No as-built drawings or site records of these construction works were available to SMEC at the time of writing this report. Based on conversations with MPSC, SMEC understands that the stormwater drainage flows from the front of No.4 to No.22 View Point Road. Drainage is located around the bend of Prospect Hill Road which SMEC understands connects to the newly installed drain along View Point Road.

Based on a memo from SEW, dated 15 May 2025, a separate 'spur' of the stormwater drainage system was identified and confirmed with MPSC on 15 May 2025. This spur is also shown in Figure 21, located near the Bayview Leak site. Given the likelihood that the construction of this spur is similar to other stormwater drainage lengths, it is reasonable to suggest that the embedment material of the spur comprises fine crushed rock or select fill. It is therefore reasonable to suggest that any perched water, or seepage from the Boulevard reserve may be in part, or in total be collected by the spur and the embedment material.

Figure 21: Map (not scaled) showing stormwater drainage network in the locality of the Site. Annotations have been added by SMEC of the stormwater drainage constructed in 2023 and known 'spur' confirmed by MPSC

Figure 22 below shows an annotated map showing depth to invert level at various locations of stormwater drains. These depths were provided by MPSC. These invert levels are based on address details provided by MPSC and have been annotated in the figure below. SMEC does not know the reason for there being more than one listed depth at multiple locations. However, this is potentially due to more than one pipe connecting into this pit.

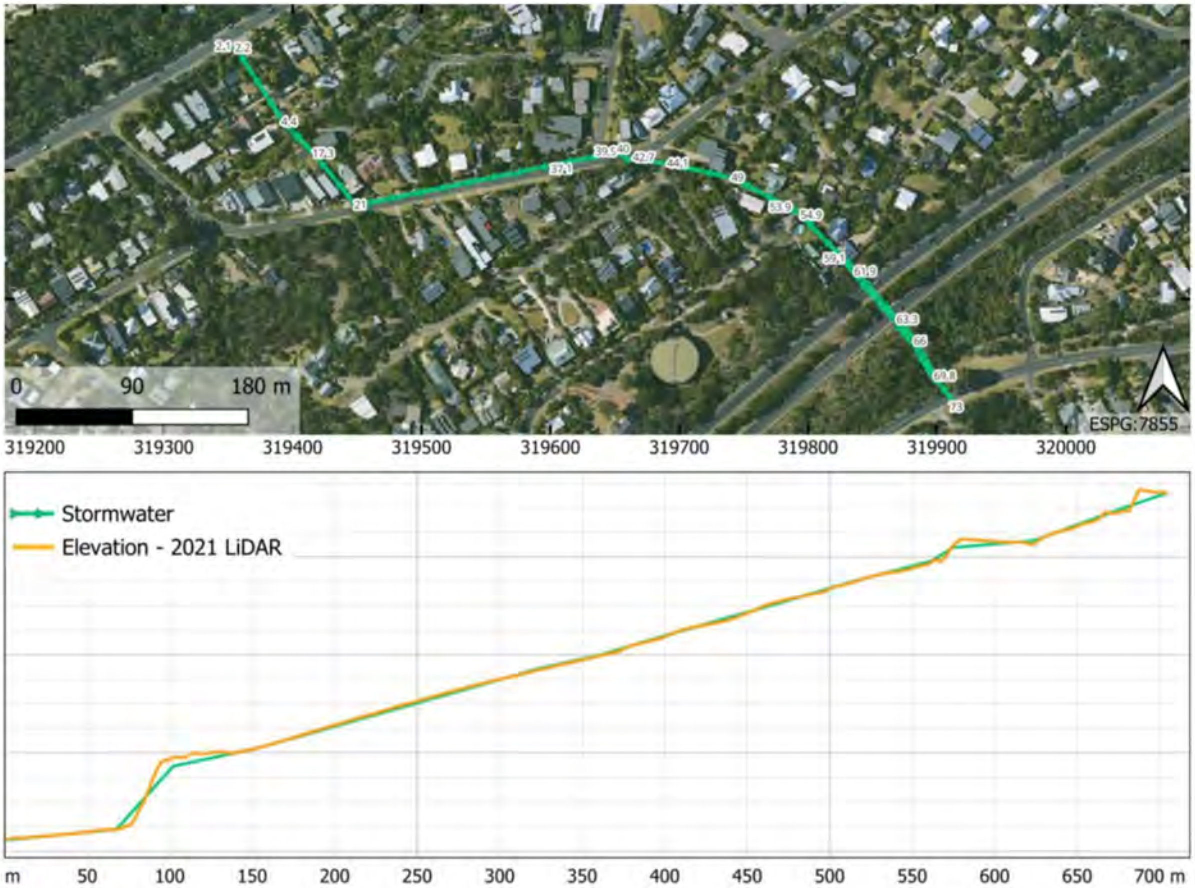
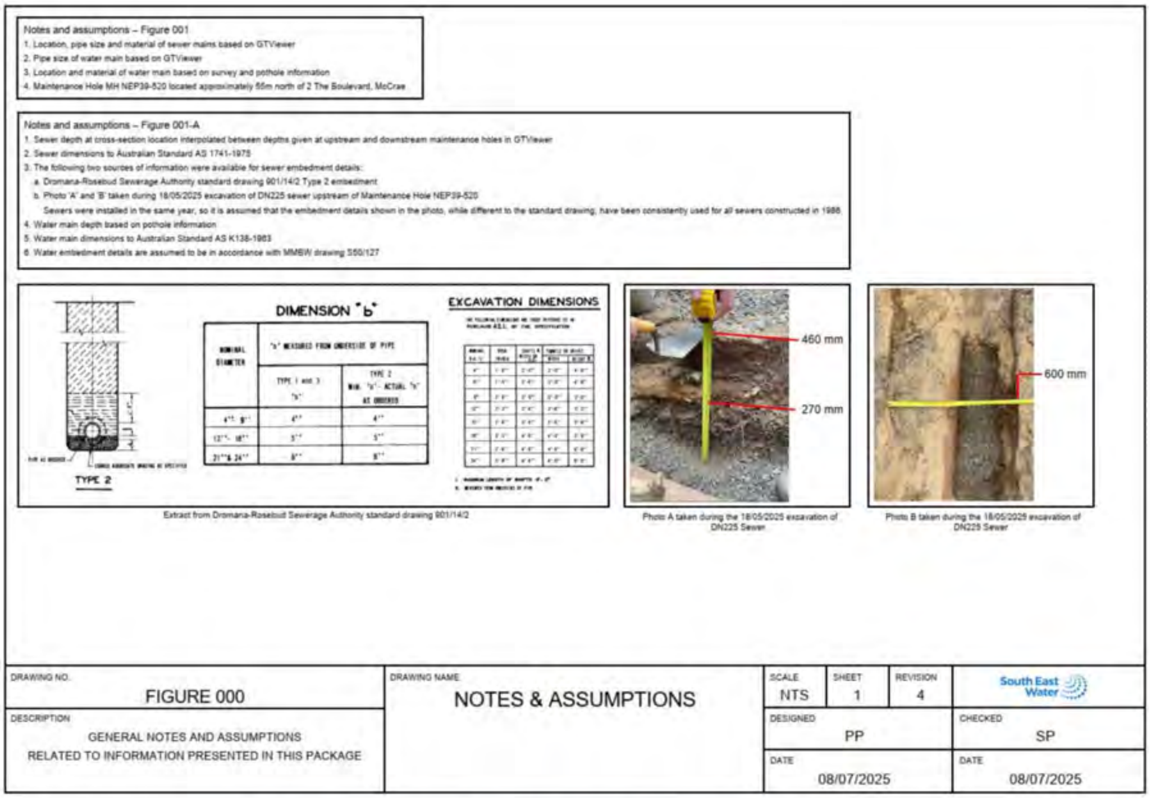


Figure 22: Graphical long section showing invert levels of stormwater drains at various locations as provided by MPSC

5.4.3 Utility Embedment Materials

Figure 23, Figure 24 and Figure 25 have been produced by SEW to describe the vicinity of the Bayview Road leak, with particular emphasis on pipe embedment. The figures note that the sewer bedding material, according to the standard drawing of a previous sewerage authority, comprises a coarse aggregate. SEW has confirmed the embedment material in recent excavation works. Above this material, the embedment material comprises sand. The mains pipe crossing over the sewerage also comprises sand embedment material.



Notes and assumptions – Figure 001
1. Location, pipe size and material of sewer mains based on GTViewer
2. Pipe size of water main based on GTViewer
3. Location and material of water main based on survey and pothole information
4. Maintenance Hole MH NEP39-520 located approximately 55m north of 2 The Boulevard, McCrae

Notes and assumptions – Figure 001-A
1. Sewer depth at cross-section location interpolated between depths given at upstream and downstream maintenance holes in GTViewer
2. Sewer dimensions to Australian Standard AS 1741-1975
3. The following two sources of information were available for sewer embedment details:
   a. Dromana-Rosebud Sewerage Authority standard drawing 901/14/2 Type 2 embedment
   b. Photo 'A' and 'B' taken during 18/05/2025 excavation of DN225 sewer upstream of Maintenance Hole NEP39-520
   Sewers were installed in the same year, so it is assumed that the embedment details shown in the photo, while different to the standard drawing, have been consistently used for all sewers constructed in 1986
4. Water main depth based on pothole information
5. Water main dimensions to Australian Standard AS K138-1963
6. Water embedment details are assumed to be in accordance with MMBW drawing S50/127

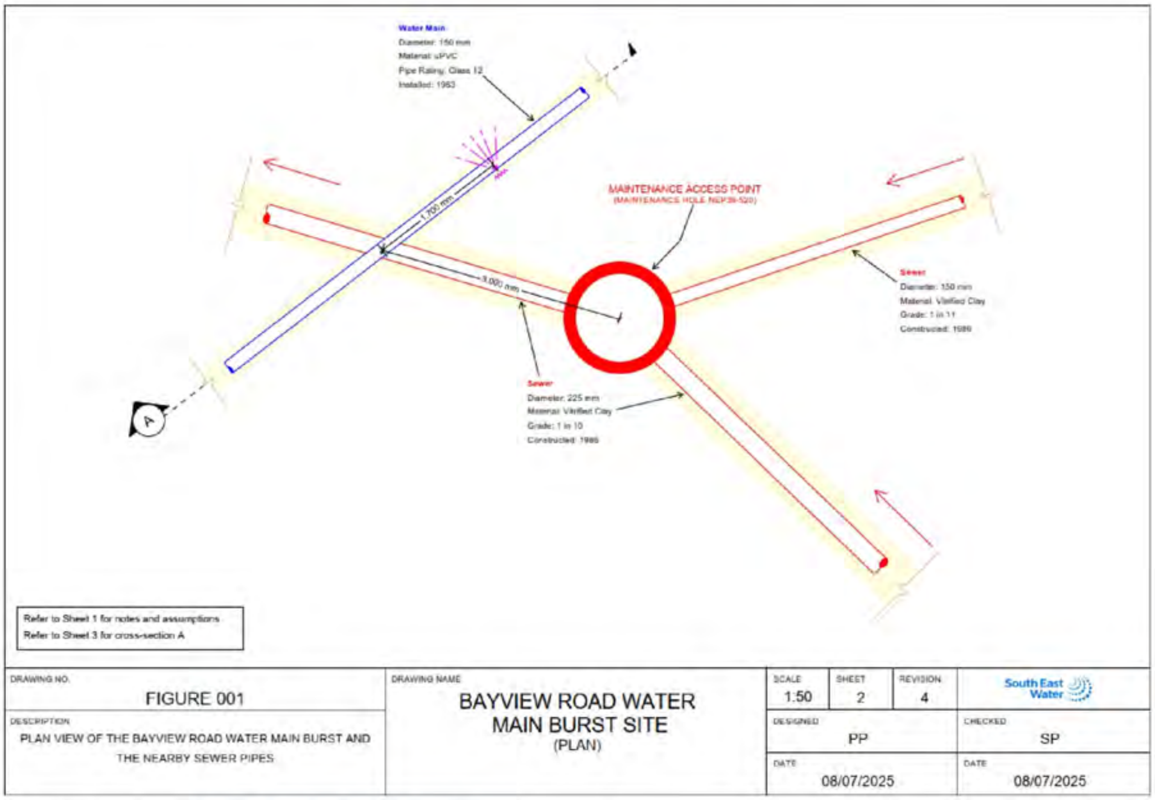
Extract from Dromana-Rosebud Sewerage Authority standard drawing 901/14/2

Photo A taken during the 18/05/2025 excavation of DN225 Sewer

Photo B taken during the 18/05/2025 excavation of DN225 Sewer

DRAWING NO. FIGURE 000
DRAWING NAME NOTES & ASSUMPTIONS
SCALE NTS
SHEET 1
REVISION 4
South East Water
DESCRIPTION GENERAL NOTES AND ASSUMPTIONS RELATED TO INFORMATION PRESENTED IN THIS PACKAGE
DESIGNED PP
CHECKED SP
DATE 08/07/2025
DATE 08/07/2025

Figure 23: Notes and assumptions relating to Bayview Road water main leak sketches by SEW



Refer to Sheet 1 for notes and assumptions
Refer to Sheet 3 for cross-section A

DRAWING NO. FIGURE 001
DRAWING NAME BAYVIEW ROAD WATER MAIN BURST SITE (PLAN)
SCALE 1:50
SHEET 2
REVISION 4
South East Water
DESCRIPTION PLAN VIEW OF THE BAYVIEW ROAD WATER MAIN BURST AND THE NEARBY SEWER PIPES
DESIGNED PP
CHECKED SP
DATE 08/07/2025
DATE 08/07/2025

Figure 24: Plan view of Bayview Road water main burst & nearby sewer pipes

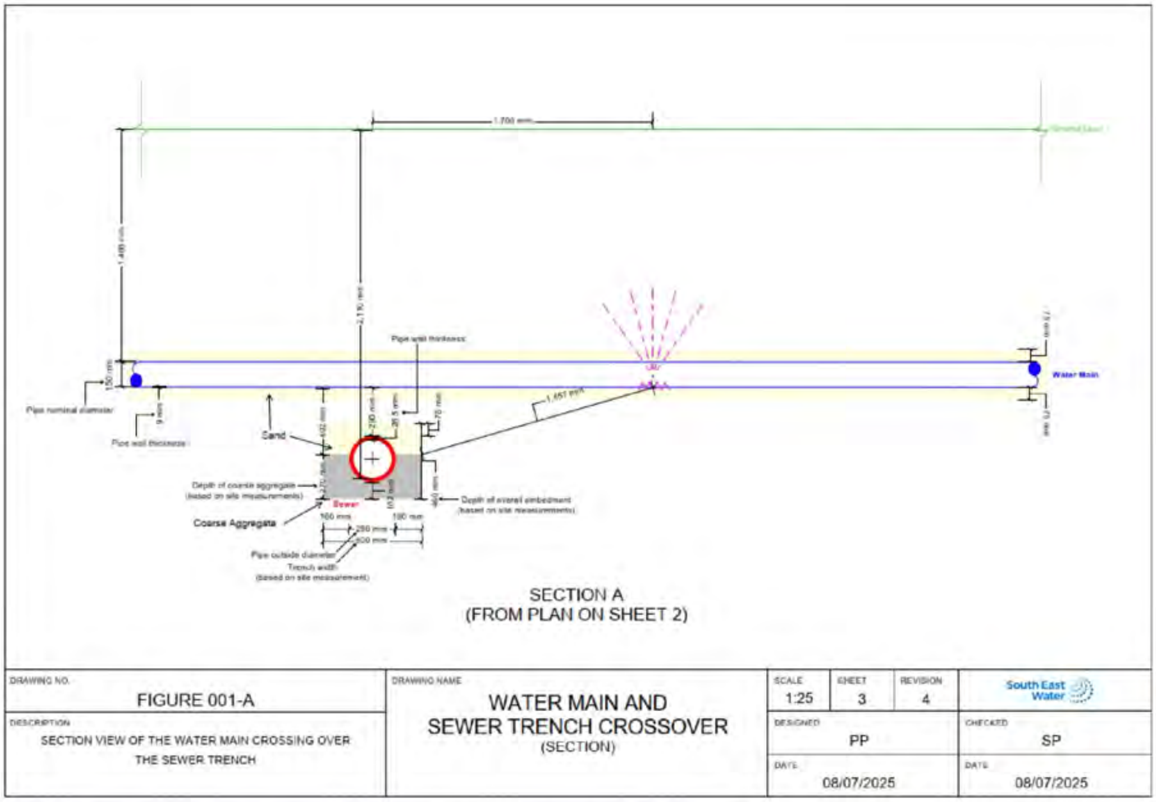


Figure 25: Section view of the Bayview Road water main crossing over sewer trench

Data supplied by MPSC indicates the embedment material of stormwater pipes comprises FCR (Fine Crushed Rock) or select fill (Appendix B, Ref. 33).

A ground investigation was carried out by PSM on behalf of MPSC (Appendix B, Ref. 6) which comprised non-destructive drilling works to install standpipe piezometers and vibrating wire piezometers with response zones within utility embedment zones. The works were observed by SEW personnel who took opportunistic samples from the excavations. Laboratory tests are being carried out to evaluate the characteristics of the samples. Results will be provided in an addendum once available.

Similar embedment material investigations were carried out by SMEC in June 2025 and are documented in our Geotechnical Factual Report (refer Appendix D). The coarse-grained characteristics of stormwater and sewerage embedment materials encountered in SMEC's investigation is generally consistent with the desktop sources discussed above.

5.4.4 Private Water Usage

SMEC has obtained quarterly meter readings since Quarter 3 of 2021 from SEW. Manual meter readings take place over days, and it is possible that lengths of quarters differ over time, and location. Meter readings do not provide data on specific uses of water within the property. However, analysis can indicate permanent occupancy. A pictorial presentation of the data is provided in Figure 26.

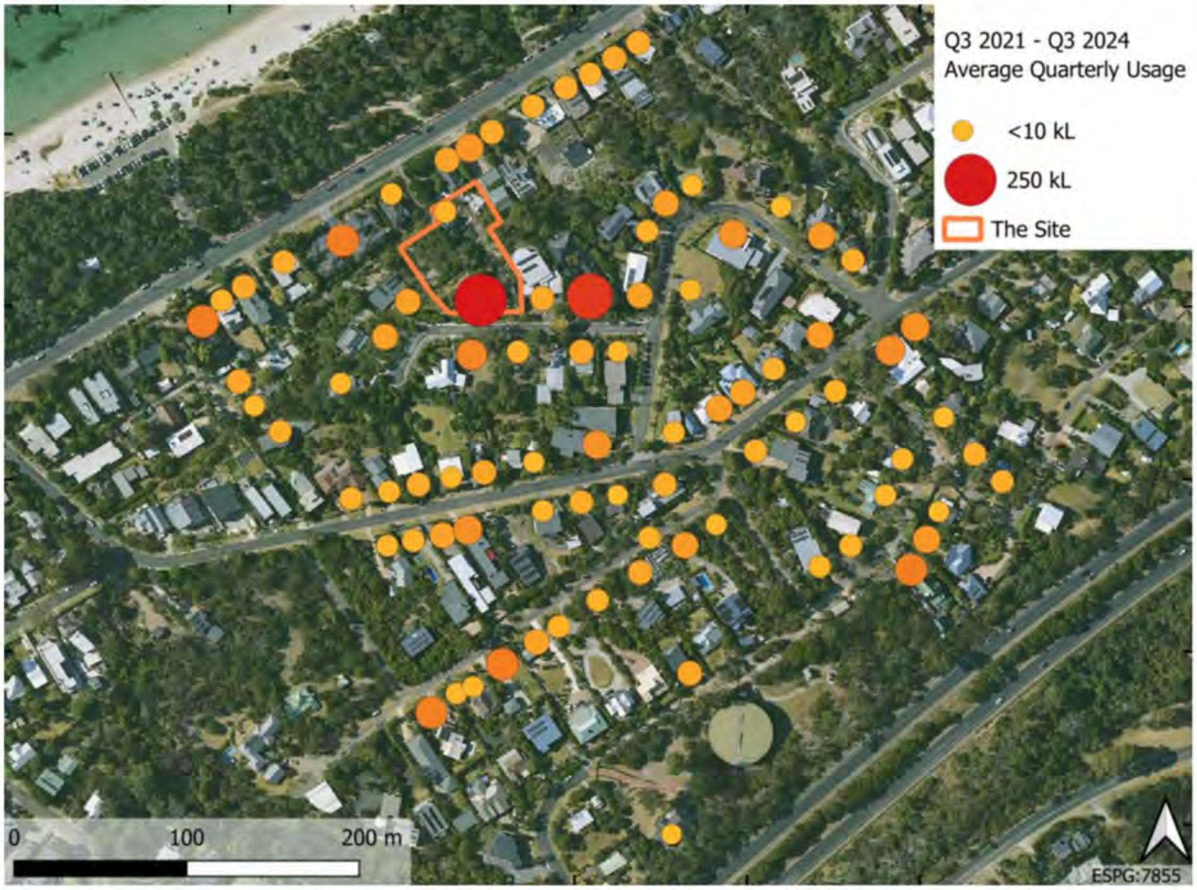


Figure 26: Private water usage of properties in the vicinity of the Site

Water usage of Nos 4 and -12 View Point Road is greater than the area average for permanent occupancy for all quarters since Q3 2021, up to, and including, Q4 2024. It was noted during the SMEC site visits, that there was a substantial irrigation system within the gardens of No. 10-12 View Point Road. SEW water understands that No. 4 View Point Road has an irrigation system installed.

Irrigation systems by their nature concentrate water at specific areas of ground at specific times. Therefore, it can be assumed that irrigation systems are more efficient than rainfall at directing water to plant root systems and maintain a desired moisture content of an area of land more efficiently than rainfall. With regards to slope stability, an irrigation system would potentially maintain near surface moisture content at a higher and more constant level during summer, than rainfall alone. The system would reduce the impact of dry weather spells but would not change the impact of significant rainfall.

No extensive examination has been carried out, of whether properties assessed as permanently occupied, also have irrigation systems. However, it is reasonable to conclude that the irrigation systems of both Nos. 4 and 10-12 View Point Road to have at least maintained moisture content in the properties at a higher level than surrounding properties without these systems. It is possible that near surface waterflow, and slope stability may have been affected by the usage of the systems.

SMEC understands that digital meters are being rolled out throughout McCrae, and further analysis of usage patterns and possible leaks in the future may be beneficial.

5.4.5 Other Utilities

SMEC understands that there is likely to be other subsurface utilities within the vicinity of the landslides, including but not limited to communication, electrical and gas services.

As these utilities do not carry water, they are unlikely to have contributed to the landslide events. The embedment materials around the services could act as preferential pathways for subsurface water, although these types of services do not require a consistent fall within trenches, as they are not governed by gravity.

5.5 Subsurface Water Issues

5.5.1 Potential Sources of Subsurface Water Impacting the Site

There have been various reports of water emanating from the ground in the vicinity of the Site. Groundwater was also typically encountered in boreholes undertaken as part of site investigations.

Sources of subsurface water, may include:

- Natural sources:
  - Direct rainfall infiltration;
  - Remote rainfall infiltration (i.e. rainfall on Arthurs Seat);
  - Re-entry of water into geology from springs; and
  - Other artesian groundwater conditions.
- Anthropogenic processes such as:
  - Leakage from utilities such as mains water or sewerage;
  - Leakage from stormwater drainage;
  - Leakage from 'on property leakage';
  - Transport of all sources from one location to another via the trenches of buried services; and
  - Leakage or intentional supply of mains water from private water usage such as fish ponds, swimming pools, water butts, irrigation systems, car washing, and window cleaning/ structural cleaning activities.

Natural sources of water are discussed are discussed further in the Hydrogeological Report (refer Appendix E) and Section 9 of this report. The following sections describe specific events or actions which suggest anthropogenic sources may have impacted on the Site.

5.5.2 Subsurface Water from Burst Water Main at Bayview Road

Numerous witness statements and SEW's own records detail a leak that occurred due to a fracture within a PVC water pipe near Bayview Road, approximately 450 m, south and upslope from the Site. SEW has advised that the fracture was located on 30 December 2024 and repaired on 1 January 2025. The date that the water leak began is thought to be in early August 2024 according to a report from the University of Auckland (Appendix B Ref. 40). Residents began to report potential leaks at Charlesworth Street and Waller Place between 26 November 2024 and 1 January 2025. The University of Auckland report estimated, based on SEW raw data, that the volume of water that may have been lost through the leak was 40.3 Ml.

A figure showing the location of the leak in relation to the Site is presented in Figure 27.

Figure 27: Plan showing the location of the water main leak at Bayview Road in relation to the Site

Resident statements to SEW personnel on 21 December 2024 and witness statements provided to the Board of Inquiry indicate that residents had observed a higher than usual flow rate of water through the stormwater drainage system around Waller Place (approximately 270 m southeast of the site). They also note water had been observed to be entering the stormwater system through a grated drain near Bayview Road Leak site.

Several instances of water appearing at ground surface level were documented in recorded communications with MPSC, SEW, and documented in Witness Statements. These observations included lifting of the pavement surface in some instances along Waller Place and Charlesworth Street during December 2024. Other observations comprised saturation of nature strips and inundation of gardens and properties.

SEW operative J. Marsh noted in his witness statement that on a visual walkover of the locality of the Site after the 5 January 2025 landslide wet verges were found in front of No. 34 Coburn Avenue and No. 1 Waller Place.

Numbered Item 49 of the Witness Statement by Brett Cooper, one of the registered owners of the property at 5 Waller Place, notes that the locations of water surfacing that he observed (approximately 265 m southeast of the Site) were dry by late March 2025. Repairs and investigations have been carried out in the area by both SEW and MPSC e.g. excavation works over the sewerage line on 24 January 2025, at Charlesworth Street.

In May 2025, a full depth pavement repair across Coburn Avenue at the junction with Charlesworth Street was carried out, as witnessed by Mr. Hutchings.

SMEC understands that no other mains leaks have been located or notified within the vicinity of the Site since 26 November 2024 (that is, leaks within 100 m of the Site).

5.5.3 Anomalous water seepage (5 Prospect Hill Road 2018)

The 2018 'Montage' document 764377 documents a call-out relating to a suspected leak on 16 October 2018 at 5 Prospect Hill Road (140 m east of the Site), prior to the construction of the house. The SEW operative recalls that a conversation with the landowner, supplemented with laboratory tests from water, suggested that there were traces of fluoride from seepage within the property. The test results indicated that a water main leak was running underground and into No. 5. The operative carried out leak detection of nearby services and no noises were detected.

The test results referred to by the landowner were taken on 25 September 2018, within boreholes Bore 3 and Bore 4 as shown in Figure 28. A control sample from Tap water was also taken. Fluoride levels of the samples taken from BGH3 and BH4 were 0.7 mg/l, and 0.6 mg/l compared to 0.5 mg/l for the tap water.

Similar leak detection tests with similar results were repeated on 19 October 2018. Ground water depth was measured within the boreholes.

Water samples were taken from borehole bore 4 and an area of seepage by SEW on 19 October 2018 and tested. Samples from Borehole BH4, returned an EC 1300 μS/cm, Fluoride 0.26 mg/l and Chloride of 260 mg/l.

Samples from the area of seepage returned an EC 450 μS/cm, Fluoride 0.10 mg/l and Chloride of 69 mg/l.

Contrasting these test results with the samples taken by SMEC during recent ground investigation works, the 2018 results compare well with test results for SMEC BH04 (Appendix E).

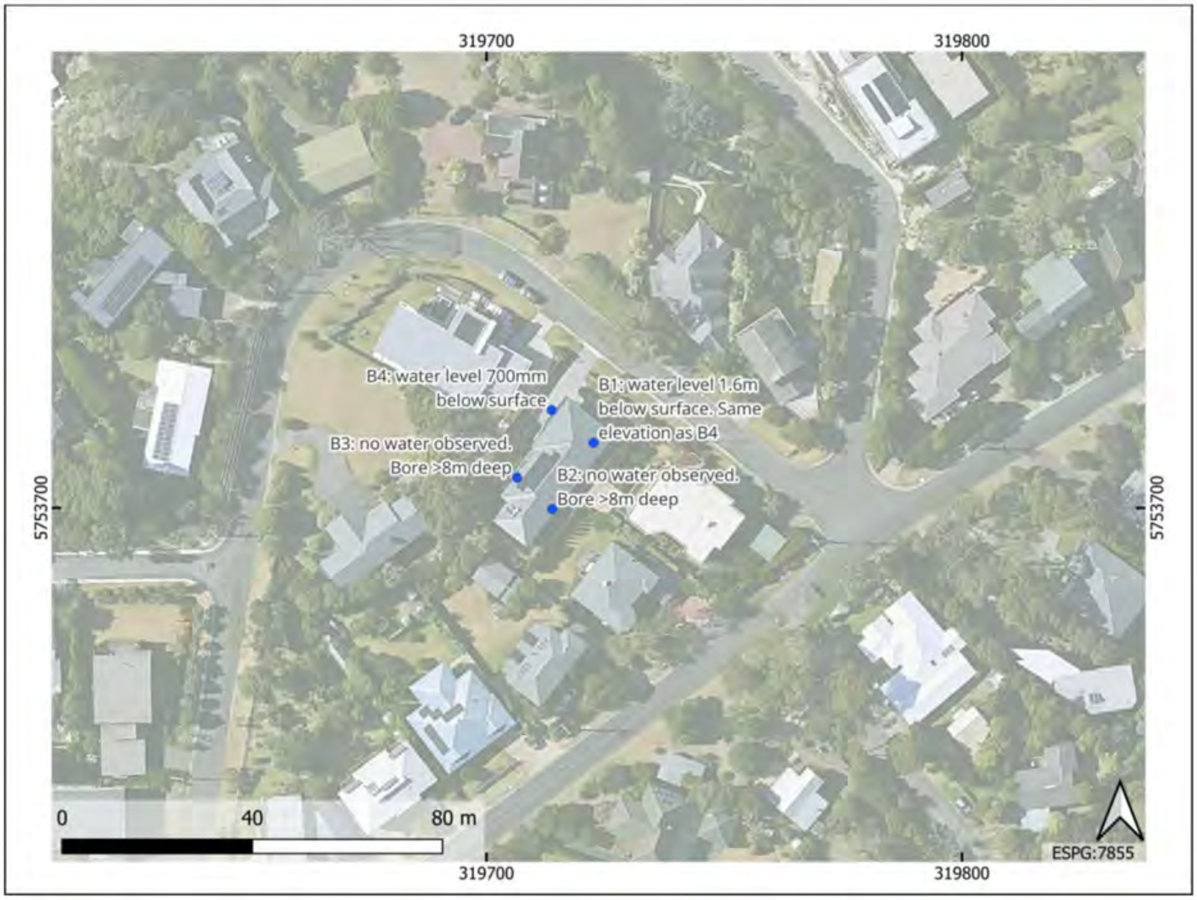


Figure 28: Locations of boreholes drilled in 2018 prior to the construction of No. 5 Prospect Hill Road, noting water level observations.

5.5.4 Other Mains Water Leak (5 Prospect Hill Road)

Section 7.6.3.4.4 of the Preliminary Assessment by SMEC notes that on the night of 5 January 2025 SEW personnel recorded that:

'[The owner of No. 5 Prospect Hill Road, 140m east of the Site] observed that the pump in his basement had started pumping more frequently as of around a month ago. The water from this pump discharges into the kerb

and channel in front of the property which connected into a closed stormwater drain that connects to the drain in View Point Rd.'

Further, SEW advised the owner that they had identified a leak on the property. This was found and repaired in April 2025. The owner has subsequently told SEW personnel that they believe the leak happened due to an electrician pushing an earthing rod through the pipe. The owner further suggests that his property is surrounded by AG drainage and that this picked up all the water that leaked from the burst water pipe. He does not therefore believe that the more frequent use of the pump that he has installed in his basement, as documented above was due to the burst main on his property.

5.5.5 Sewers

A small crack in the property branch of a sewer main (pipe from sewer main to 1m inside property boundary) was identified at 6 View Point Road in June 2023. The repair works were given low priority, and the damaged section of sewer was subsequently repaired in March 2025 from SEW's recollection.

5.5.6 Stormwater Drainage

We understand that a CCTV survey of the stormwater drainage network in the vicinity of the Site was undertaken by MPSC approximately one week after the 14 January 2025 landslide. We understand from Witness Statements from MPSC personnel, that no significant defects were identified in the stormwater drainage network in View Point Road. However, we are aware of a stormwater defect within Brown Street repaired in May 2025 from SEW recollections. It is typically expected that some leakage will occur from stormwater pipes. However, a substantial leak from a stormwater pipe would require a significant defect which would be expected to be apparent in a CCTV survey.

5.5.7 Condition of Road Pavements

A review of publicly available photographs from Google Streetview indicates that the condition of the local road pavements in the vicinity of the Site has deteriorated since at least 2013. Pavements typically deteriorate over their design life due to various reasons, but they may deteriorate faster than usual if the pavement layers and the subgrade upon which the pavement is constructed are frequently saturated or have elevated moisture content.

Deterioration of the pavements alone is not considered direct evidence of wet subgrades in the area. However, it is noted that the wet subgrade is a potential contributing factor and should be considered in the context of other observations and investigations of the long-term groundwater conditions in the area. The presence of cracking in the pavements would also lead to more infiltration of surface water into the ground through the cracked surface.

5.5.8 Other Subsurface Water Observations by Residents

Mr. Gerrard Borghesi's Board of Inquiry witness statement, numbered items 9 to 20 refer to past instances of subsurface water observed in the vicinity of the Site between May 2014 and January 2025. The Witness Statement makes references to the following:

- Regular observations by Mr Borghesi from 2014 (when he took ownership of the property), and particularly between December 2020 and May 2023, of a flow of water that appeared to originate from a spring under two properties located at 1 and 5 Prospect Hill Road. This water would flow into a stormwater drain and along a subsurface pipe beneath Prospect Hill Road. It would then enter a stormwater pit where the subsurface pipe terminated. This pit is noted by Mr Borghesi to be '...always and continuously overflowing...' and '...facilitated the flow of the spring water down the fractured and cracked northern kerb of View Point Road....';
- A general increase in saturation of the hillside on the Site, particularly at the location of the November 2022 landslide;
- Mr Borghesi notes that the flows and seepages noted above reduced, but did not stop, during dry periods of weather;
- There was a periodic build-up of moss and algae in the road gutter due to the continuous flow of water;

- Mr Borghesi installed subsoil drainage lines across the hillside pathway in July 2021 at the location of the November 2022 landslide to '...control erosion and make the pathway down to Penny Lane trafficable...';
- New kerbs and a subsurface stormwater drain were installed in May 2023 by MPSC. It is presumed that this was to manage the flow of water down View Point Road;
- Mr Borghesi states that after the stormwater upgrade works by MPSC the flow of water down the kerb and gutter in View Point Road stopped, and the slopes around the November 2022 landslide began to dry out. The seepages that he observed on the eastern and western flanks dried up completely;
- There was no visible saturation or water flow in the eastern gully area of the property until 5 January 2025 when '...a significant subterranean flow of water was uncovered by the landslide...'; and
- Numbered item 21 refers to numerous complaints made over many years about the water flow on View Point Road.

The observations by Mr Borghesi of a history of a spring in the vicinity of 1 and 5 Prospect Hill Road may indicate that there are potential instances of artesian groundwater in the area.

In an email from Mr. and Mrs. Wells (landowners of 3 Penny Lane at the time) sent on 17 February 2023 to MPSC (Code MSC. 5003.0001.7170), it was noted that runoff was occurring from the '*Hill at Penny Lane from View Point Road above*', and '*being collected in our drainage system*'. The email continues *'there has been continual run of water since November, and the swale drains have been holding that water since then. There are also signs that water is running off or under the soil on the block of land where the slip occurred'*. It appears that seepage was occurring in the area prior to the 2025 landslide.

6. SMEC Site Investigations

6.1 Site Walkovers

SMEC personnel have visited the Site several times, including on 3 March, 13 June, 17 June and 20 June 2025. The site visits were undertaken to observe the characteristics and conditions of the site and comprised visual walkover and photographic surveys. A report detailing site walkovers undertaken by SMEC is provided in Appendix C.

On 17 June and 20 June 2025, SMEC personnel observed the McCrae Landslide site from 10-12 View Point Road and 6 View Point Road respectively. Vantage points were limited to a safe distance behind and to the side of the backscarp of the landslide. Sketches and photographs of observations of interest were taken during the visit. These were reviewed and annotated as part of the report presented in Appendix C.

There has been some deterioration of the landslide since the significant movement on 14 January 2025. This includes some small zones of soil slipping downslope, and the foundation of a post of the post and sleeper retaining wall failing. Re-establishment of vegetation was noted to have begun on the exposed base on the landslide, particularly at approximately 2m below the toe of the previous retaining wall.

6.2 Geotechnical Investigation

A geotechnical investigation was undertaken by SMEC from 30 June 2025 to 9 July 2025 in order to provide information on the subsurface conditions between the Site and Bayview Road. The investigation comprised mechanical and manual borehole drilling, Non-Destructive Digging (NDD) and standpipe installation. The investigation methodology, engineering logs and encountered subsurface materials and groundwater conditions are presented in Appendix D.

Subsurface materials generally consisted of clayey/sandy material to depths of up to 1.8 m, underlain by Colluvium comprising sandy clay/clayey sand, and residual granitic soils to depths of about 15 m. Boreholes BH01 and BH02 (drilled at Bayview Rd and southern end of Charlesworth St, respectively) encountered extremely to slightly weathered granite from the base of residual soil to a termination depth of approximately 26 m.

Groundwater was encountered between 1.8 m and 6 m depth in boreholes BH03 (northern end of Charlesworth St) and BH04 (Prospect Hill Rd).

6.3 Hydrogeological Investigation

Hydrogeological investigations and findings are documented in the Hydrogeological Investigation Report (refer Appendix E). The scope of works undertaken for this investigation comprised:

- Site walkover inspection;
- Borehole drilling and in-situ testing;
- Physical aquifer parameter characterisation;
- Water chemistry characterisation; and
- Geochemical modelling.

A summary of the findings from the investigation is as follows:

- Water seeping from the January 2025 landslide site based on water quality testing results has a signature characteristic of groundwater derived from the shallow perched aquifer, and not mains water;
- Based on geochemical analysis from groundwater quality tests from water samples obtained and tested by SEW and PSM during January 2025, and by SMEC between May to July 2025 and site investigations carried out by SMEC water from the Bayview Road Leak was highly unlikely to have reached the Site;
- Water seeping from the Site on 6 January 2025, is of a similar quality to background water quality test results taken between May to July 2025 of what is considered to be water from a shallow perched aquifer; and
- The results of the investigation do not indicate a dilution of water from the shallow perched aquifer with mains water, as would be expected if water from the Bayview Road Leak was to have made it to the Site at the time of the landslide.

6.4 Geophysical Investigation

SMEC engaged Sub-Contractor MNG SubSpatial (MNG) to conduct a geophysical investigation to assist in assessing subsurface conditions in the locality of the Site. The objective of the survey was to characterise trench backfill, subsurface lithology, and soil moisture content distribution across multiple road corridors in an area underlain by deeply weathered granite. Refer to Appendix F for a detailed description of the investigation methodology and findings.

Surface conditions at the time of the investigations exhibit little indication of areas of moisture that were reported to have occurred during the leak. The main areas of evident surface water were relatively minor water at the intersection of Coburn Avenue and Charlesworth Street during November and December 2024, and water in the kerb channel emanating from 5 Prospect Hill observed on the night of 5 January 2025. It was also observed that the lower end of Coburn Creek, at Burrell Street, appears to be fed via spring seepage as water was observed to run in the creek even during periods of extended dry weather.

The investigation was conducted using Frequency-domain Electro-Magnetic (FEM) surveying, a non-intrusive geophysical technique sensitive to variations in subsurface EC. For example, High EC water will give higher reading responses within the geophysical survey results. The geophysical site work was carried out on 25, 27 and 30 June 2025 using a Profiler EMP-400 (GSSI) by a qualified Geophysicist from MNG.

The survey results indicate that there are localised regions of elevated subsurface moisture content. The area around 7 Prospect Hill Road generally shows a heightened response which may be related to anecdotal evidence of springs in the vicinity. High returns in the vicinity of the western T-junction of Prospect Hill Road with Coburn Avenue, 40 Coburn Avenue, 5 Coburn Avenue, and 3 Waller Place appear to coincide with historic course of Kings Creek. Kings Creek was the water course flowing from south of the Boulevard outfling at Margaret Street.

The results also indicate that the material in several of the service trenches in the area also show heightened moisture content as compared to the natural ground either side of the trenches.

7. Ground Model

7.1 Geotechnical/Geological

7.1.1 General

The ground models were developed based on geotechnical boreholes drilled by SMEC in June 2025, and investigation information by others supplied to the Board of Inquiry by witnesses, included within documents written by CivilTest (Appendix B, Ref. 28), PSM (Appendix B, Ref. 29) and intrusive investigation works carried out for development works at 3 Penny Lane (Appendix B, Ref. 22).

Geotechnical investigation information has been rationalised into project geotechnical units as presented in Table 1.

Table 1: Defined project geotechnical units

Project Geotechnical Unit	Description
Unit 1 – Fill/Topsoil	Silty SAND/Sandy SILT, brown, grey, dry to moist
Unit 2 – Aeolian Sand	SAND, Silty SAND, brown, pale grey, brown, inferred medium dense, moist to wet
Unit 3 – Inferred Colluvium	Clayey SAND, SAND/Sandy CLAY trace gravel, grey, brown, inferred medium dense/ very stiff
Unit 4 – Residual Granite	Variable material Sandy CLAY, Silty CLAY, Clayey SAND, paly grey, brown to mottled orange, grey-brown, typically very stiff to hard/medium dense to very dense
Unit 5 – Extremely Weathered (XW) Granite	Typically recovered as Gravelly SAND, Clayey SAND/Sandy CLAY, brown, grey, typically with rock strength less than very low

In general, the locality of the site is characterised by extremely weathered granite, encountered at depths between 6 and 7 m, typically deeper around Coburn Avenue. The material above the granite comprises a clayey layer, underlying more granular material of varying thickness. There are locations where no granular material was encountered Fill comprises a dense granular material. A cross-sectional sketch of the escarpment at the McCrae Landslide site indicating assessed distribution of geotechnical units beneath the ground surface is presented in Figure 29.

Further details relating to development of the geotechnical model of the site are provided in the Slope Stability Assessment (see Appendix F).

7.1.2 10-12 View Point Road

A shallow aquifer has developed in the ground profile. The shallow aquifer lies atop of the cohesive residual soil granite and weathered granite, which have relatively low permeability compared to the overlying sandy material. Groundwater was encountered in various boreholes at between 1.6 m and 4.5 m below ground during geotechnical investigation by SMEC.

A number of trenches have been excavated to install underground surfaces such as stormwater drainage, sewer pipes and gas mains. Following installation of these services, the trenches were backfilled with embedment material (typically select fill, an imported sand or fine crushed rock). The figure illustrates an interpretation of the borehole logs, and therefore question marks are placed over the strata boundaries as they are not confirmed within site works. The blue text within the slope profile reads 'possible pearched water'.

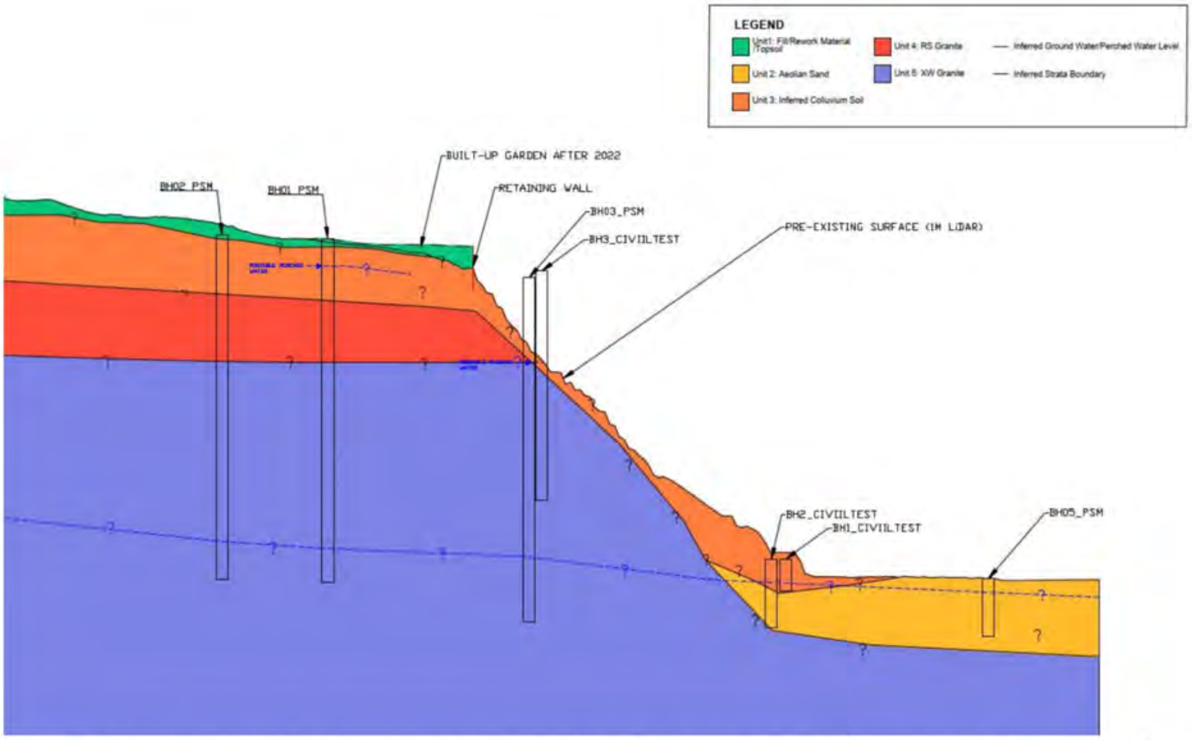


Figure 29: Cross-sectional sketch of the escarpment at the McCrae Landslide showing distribution of geotechnical units (not to scale). Note PSM BH03 is offset approximately 25m to west of cross-section.

The locality of the site

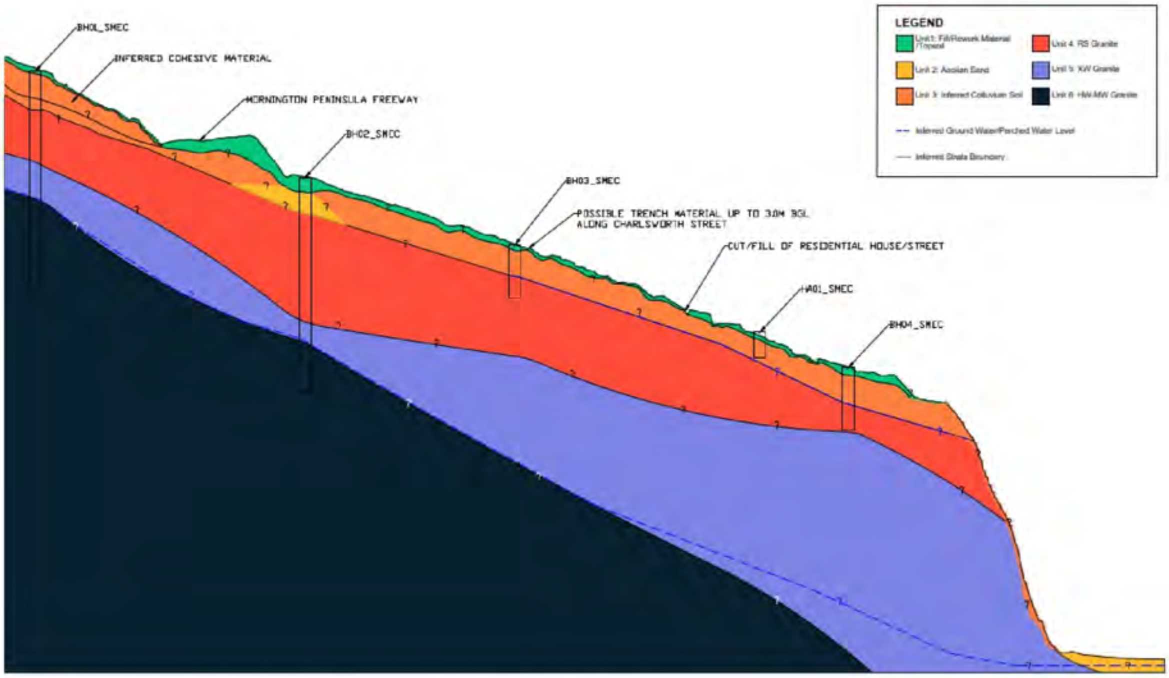


Figure 30: Cross-sectional sketch of the vicinity of the McCrae Landslide showing distribution of geotechnical units (not to scale).

7.2 Hydrogeology

7.2.1 Conceptual hydrogeological model

An understanding of the hydrogeology of the area has been developed through information gathered from the drilling programme. In addition, an understanding of the lithology and by extension the geology, has been developed using various tests such as permeameter, slug tests, tracer tests and lab testing. These tests have been used to understand the permeability of both the natural ground and fill material. It should be noted that some the tests were carried out on samples taken from service trench material in the area.

An interpretative hydrogeological cross section and a location plan with cross section line location are provided in Figure 32 and Figure 31 below. This shows the shallow perched aquifer and its relation to the geology, topography and underlying regional aquifer.

Figure 31: Location plan with cross section line

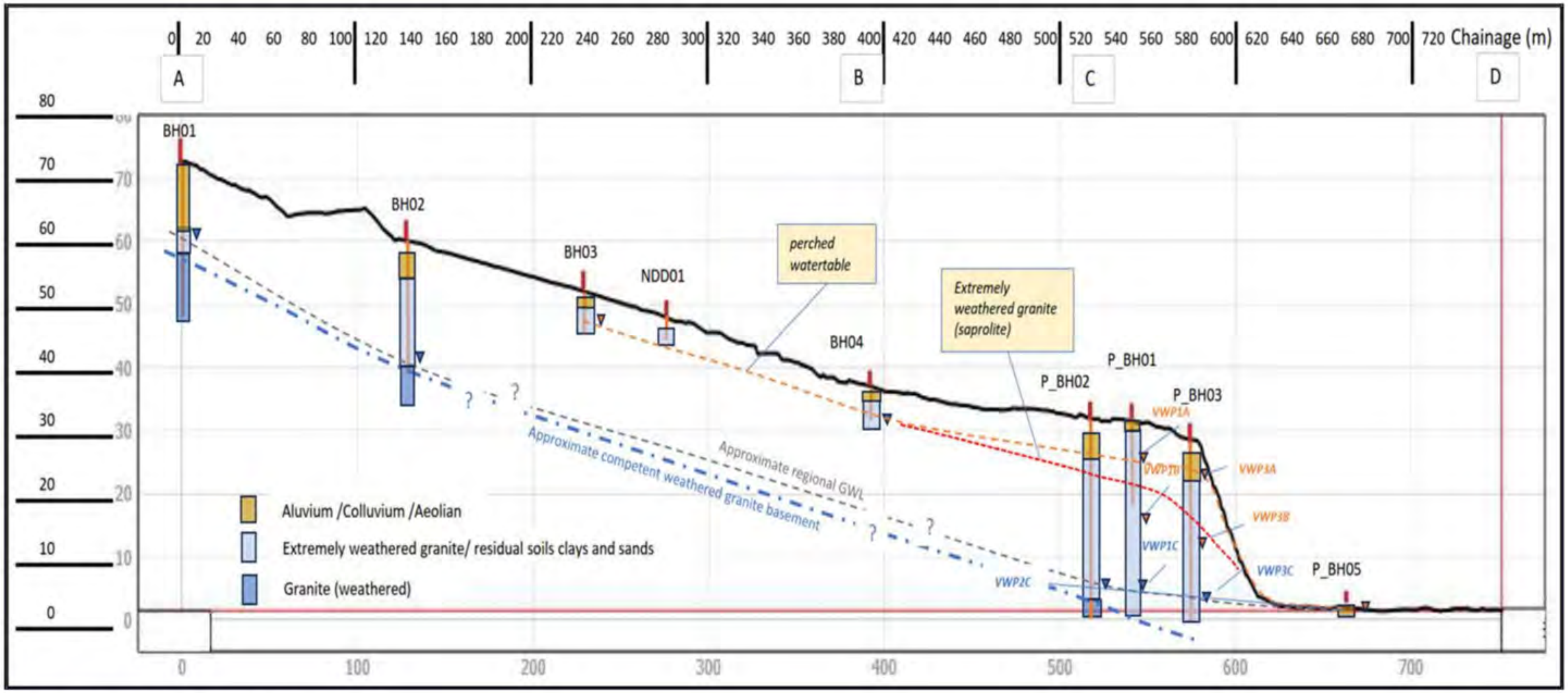


Figure 32: Interpretative hydrogeological cross section

7.2.2 Hydrological nature of flows from uphill of the Boulevard

Figure 33 presents a map showing the McCrae region using DEM modelling and LiDAR survey information. It shows that for most surface channels originating towards the summit of Arthurs Seat, the line and nature of the valleys formed is fairly straight and comprise fairly uniformly steep sides becoming more pronounced towards the shoreline. The exception is the area between the historic course of Kings Creek and the Eyrie. Taking account of development over the last two centuries, it is clear, that in contrast to Coburns Creek and the creek between Prospect Hill Road and The Eyrie, the historic course of Kings Creek;

- not only deviates from a straight path towards the shore, veering west to outfall at Margaret Street, but also
- flows down a shallow and relatively broad valley from Bayview Road north, to Margaret Street.

The lack of a discernible valley feature increases the likelihood of a flood even 'fanning out' from around the M11, outfalling throughout the escarpment between Margaret Street and The Eyrie.

SMEC would suggest updating to state that this landform is consistent with the 1860 contours and therefore unlikely to be due to any development including the construction of the M11 Mornington Peninsula Freeway.

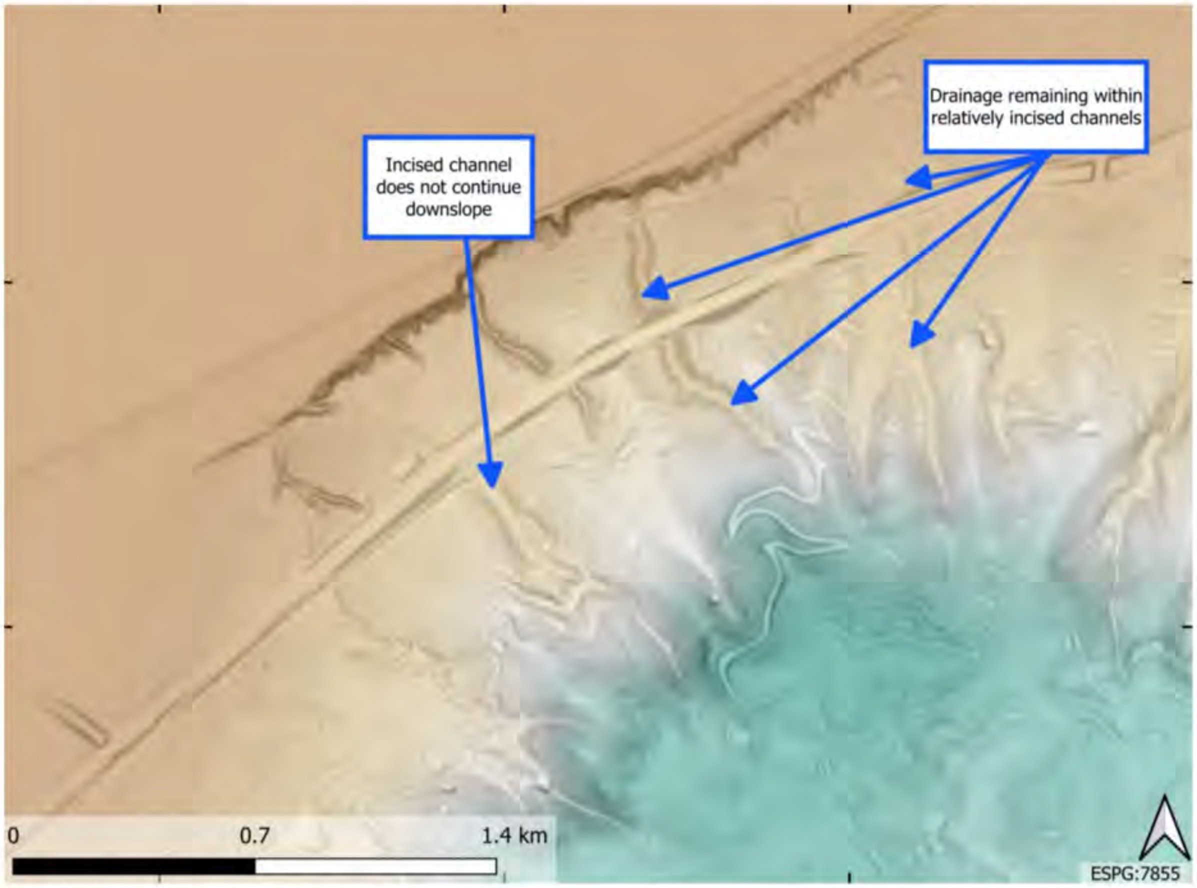


Figure 33: Plan showing DEM modelling and LiDAR survey information in the McCrae region (DEM source: Geoscience Australia, DEM of Australia derived from LiDAR 5 Metre Grid)

7.2.3 Interpretation of water flow from SEW burst

The use of geochemistry has been critical to understanding the impact and extent of the SEW burst. EC and chloride have proven to be simple yet useful chemical tracers to map the migration of the burst water.

Of importance, is the changes that occur to EC and chloride while the SEW burst water main is active. The progressive increase in EC and chloride levels following the repair of the burst as EC and chloride return to more elevated background levels.

The conceptual model indicates the following:

- A portion of the SEW mains water from the burst is considered to have made its way from Bayview Road using the sewer embedment material. This embedment material has allowed SEW mains water to migrate under the Mornington Peninsula Highway and makes it way to Waller Place. From here it is interpreted to follow the sewer trench down Waller Place to Charlesworth Street where it is interpreted to migrate to the intersection of Charlesworth Street and Coburn Avenue. This is based on observations the sewer embedment material is highly permeable, consisting of crushed granite aggregate and medium sand. The results of tracer testing have indicated a relatively rapid travel time at site DP1A / DP1B;
- The EC and chloride values post-water mains repair had risen over time to background levels. This is backed up by surface observations made during the burst of water coming to surface along this path (Refer to the appendices within Appendix E of this document);
- Further migration of a portion of the water is considered to have made its way towards 7 Prospect Hill Road based on changes to EC and chloride as observed at the sump collecting water from the building foundation drainage system for this property;
- Beyond this, comparison of background water quality data for the shallow perched aquifer to that of the Site indicate that is highly unlikely that water from the Bayview Road Leak made it to the Site. Water seeping from the Site on 6 January 2025, is of a similar quality to background water quality test results of what is considered to be water from a shallow perched aquifer. The results do not indicate a dilution of water from the shallow perched aquifer, with mains water as would be expected if water from the burst were to have made it to the Site.

8. Hydraulic Assessment

A hydraulic model of the Bayview Road leak site has been developed to estimate the proportion of the leakage flows that may have travelled overland and into a stormwater grate, some 30 m north of the location of the leak, as opposed to those that may have infiltrated into the soil subsurface over that distance. A report presenting the findings of the hydraulic assessment is presented in Appendix G.

A schematic illustration of the model shown in Figure 34 indicates:

- The assumed extent of surface flows based on the extent of surface sand presumed to be recently deposited during the leak (in red);
- Potential overland flow paths in blue, including flows toward the stormwater drainage pit via a surface drainage channel, and bypass flow which manages to bypass the surface channel towards the Mornington Peninsula Freeway; and
- Subsurface flows via the stormwater drainage pit and outlet pipe in yellow.

The hydraulic model was defined based on the topography of the site, a water source (the Bayview Road leak) with flow rate of between 10 L/s and 20 L/s. The results of hydraulic modelling indicate that the majority of flows would be captured in the stormwater drainage network. Flows captured by the drainage pit are 9.7 L/s and 19 L/s for the source flow rates, respectively, leaving 0.3 L/s and 1L/s of bypass flow of the original 10 L/s and 20 L/s source flow. In-situ infiltration tests suggest that a portion of the leak may have infiltrated the natural geology: these test results of the near surface material may have allowed for an infiltration flow of approximately 5 L/s over the area covered by the flow.

The figure notes a 'bypass flow' continuing north of the stormwater grate and down the cut slope of the M11. It should be noted that the model developed does not represent the channel running parallel to the direction of traffic along the M11, outfalling into the stormwater grate well. Therefore, the lack of visual confirmation that the Bypass flow happened is allowed for by the slight discrepancies of the model. The model outputs note that the Bypass flow accounts for only a small percentage (3% for the 10 L/s model, and 5% of the 20 L/s model) of the overall flow and it is very shallow.

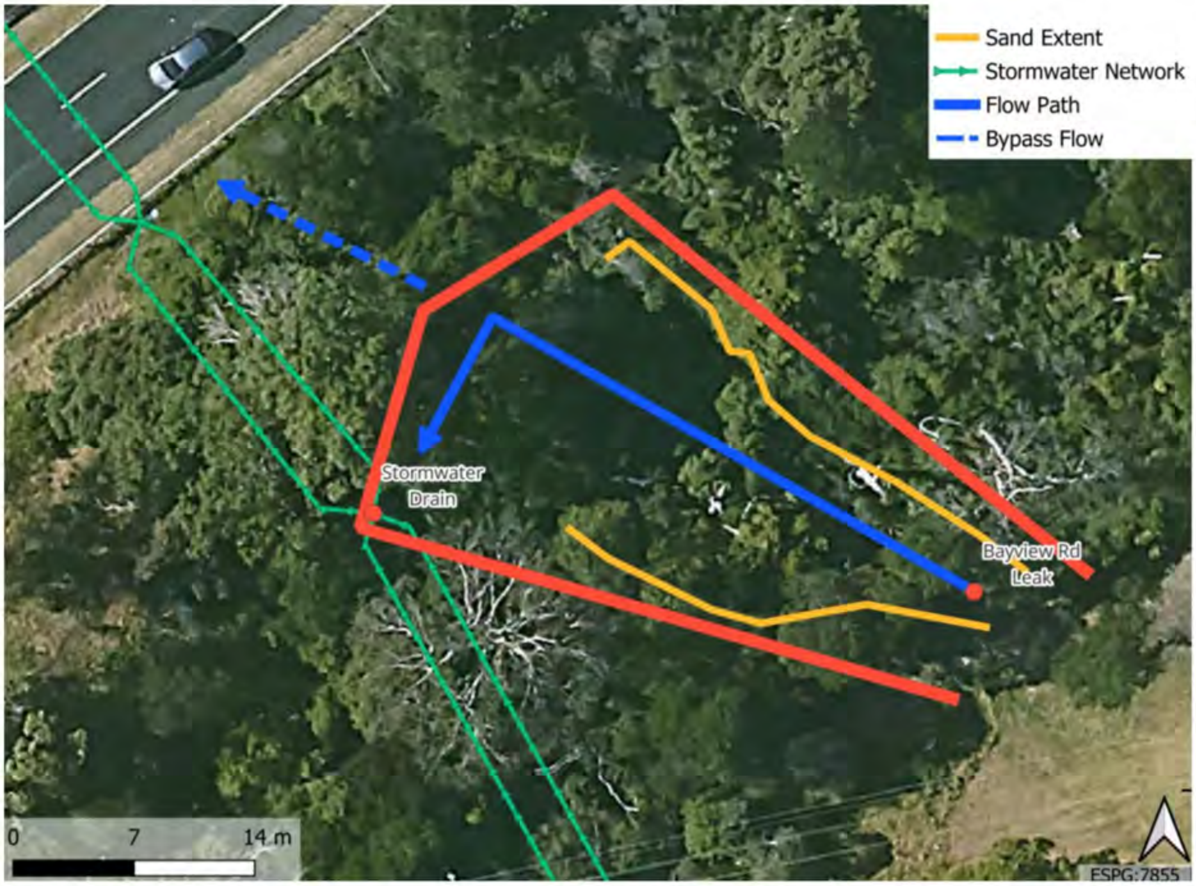


Figure 34: Schematic model of the Bayview Road leak showing surface extents and possible flow paths

9. Assessment of Water Sources

This section of the report evaluates potential water sources that may have contributed to the McCrae Landslide and assesses their likelihood of influence.

9.1 Site Rainfall Infiltration

The preliminary assessment details rainfall data near the site, obtained from the Bureau of Meteorology, and radar images of the region obtained from the online resource 'Weather Chaser'. This data was used to illustrate the rainfall conditions prior to and during the 5 January 2025 Landslide, and the McCrae Landslide, with consideration of the rainfall conditions prior to the November 2022 Landslide. The impact of direct rainfall on groundwater levels is considered low, and lower than historical impact due to the development of the site, with impermeable surfaces like roads, and stormwater drainage systems. It is theoretically possible that rainfall during the 24 hours before the McCrae landslide may have contributed to the slope movement, along with the ravelling back that landowners had noted since 5 January 2025.

9.2 Remote Rainfall Infiltration

DEM modelling and LiDAR survey information obtained by SMEC, has allowed us to model surface rainfall characteristics over Arthurs Seat. Our modelling enabled us to understand the flow down through Coburns Creek, the historic course of Kings Creek and others, and the land in between, in particular, the flow from the Boulevard downhill.

This understanding, when correlating with the Geophysical survey data provides an assessment of the near surface hydrology. Despite the stormwater drainage system, charging of a shallow perched aquifer system from uphill is considered a major contributor.

9.3 Re-entry of Spring Water into the Aquifer

In-situ infiltration tests, and laboratory permeability tests have given SMEC an understanding of the tendency for the surface geology to allow for infiltration or run off. Our conclusion is that the general characteristic of the natural ground is an impermeable nature, which promotes runoff rather than infiltration. Irrespective however, the tendency for springs throughout the locality of the site, to be present, but not result in permanent surface channels, may be in part due to an infiltration of this water downhill of any spring. This tendency is likely to be overshadowed by surface drainage works removing runoff into the stormwater drainage system initially. The impact of this mechanism is thought very low.

9.4 Leakages from Water Mains and Sewers

9.4.1 General

Prof. K van Zyl (Appendix B, Ref. 40) of the University of Auckland has carried out an analysis of the Bayview Road Leak following engagement by SEW. The results of the analysis have been viewed but not assessed by SMEC. The analysis suggests that after a period the majority of water flowed up to the surface and flowed over the surface downhill. The analysis suggests that during the first few weeks of the leak's existence, the fracture was small in dimension, the volume leaking was small compared to latter stages.

Montage records and statements made during hearings would suggest that identification of a mains leak and its repair happens in a short (e.g. 2 day) time frame. It is possible that leaks to date have been slowly charging a shallow perched aquifer with low leak volumes, which only become noticeable when the flow rate through the leak is such that it flows to the surface and then gets identified and repaired.

It is theoretically possible for leaked mains water to charge a shallow perched aquifer. The likelihood of mains water charging any perched aquifer is dependent on the relative permeability between embedment material and natural material. Additionally, the extent to which it charges any shallow perched aquifer is dependent on the location of the leak in relation to its proximity to a permeable natural material (in relation to the embedment material of the trench). The chemistry of the mains water would affect the chemistry of the groundwater. This hypothesis appears to provide the cause for the chemical results from samples taken from 7 Prospect Hill Road which returned EC levels which were too high for mains water, and too low for groundwater (as sampled by SMEC during June 2025).

9.4.2 Bayview Road Leak

With particular reference to the Bayview Road Leak, The report from Prof. K van Zyl (Appendix B, Ref. 40), provides estimates of maximum daily leakage volume (1.4 ML/day), total volume of water entering the embedment material of mains water and sewerage (11,000 L/day (0.011 ML/day)), and therefore the volume of leaked water that flowed to the surface (1.39 ML/day). The volume flowing to the surface increases with duration of leak.

Appendix H of this report estimates that the velocity of flow required to create the sand deposits downstream of the leak location is between 10 and 20 L/s (0.9 ML/day – 1.8 ML/day), with approximate infiltration of 5 L/s (0.4 ML/day).

The previous assessment (Appendix B, Ref. 24) suggested that the photo of the stormwater drain pit of Waller Place taken on 31 December 2024, suggests that the flow was approximately 9 L/s as confirmed by Mr. J. Tully's witness statement (Appendix B Ref. 42).

Given the ranges of values possible, it is theoretically possible for a volume of 0.4 – 0.5 ML/day to infiltrate the natural ground between the leak location and the stormwater pit.

The velocity of water through the natural material, estimated from in-situ infiltration tests and water velocity tests, is 2 m per day. Therefore, although the volume of water that infiltrates natural ground is significant, the velocity is too slow to be expected to impact on the landslide (which is 460 m from the leak site). A period of 230 days would be required for water from the leak to reach the Site, whereas the time between the estimated leak start date of early August and the 5 January failure is up to 157 days.

9.4.3 Sewers

Leaks from sewers are highly unlikely to affect any shallow perched aquifer due to the irregular frequency and low volume of sewer flow.

9.5 Leakages from stormwater drainage

Stormwater drains are typically made from pipe sections slotted together. Leaks from which are not uncommon. It is therefore theoretically possible for a leak to occur between pipe sections, with the water seeping into the surrounding embedment material. As noted, the embedment material of stormwater drains comprises Fine Crushed Rock or Select fill, material that is reasonably considered to have a higher permeability than surrounding natural material. Therefore, similar to arguments relating to water within service trenches infiltrating surrounds, the tendency would be for water within trenches to stay within trenches.

We understand that a CCTV survey of the stormwater drainage network in the vicinity of the Site was undertaken by MPSC approximately one week after the 14 January 2025 landslide. We understand from witness statements from the local authority, that no significant defects were identified in the stormwater drainage network. It is typically expected that some leakage will occur from stormwater pipes. However, a substantial leak from a stormwater pipe would require a significant defect which would be expected to be apparent in a CCTV survey.

In conclusion the likelihood of a defect within the stormwater drainage system from information available, is thought to be very low.

9.6 Leakages from Private Water Utilities

The arguments for public utilities are similar for private services. However, in addition, the roll out of digital meters has indicated several leaks in private property that remained unidentified prior to installation of the meters. The hearing statement from Mr. Forster-Knight included the statement:

'The data reveals that as at 6th June, a total of 57 leaks were identified on private property in the suburb of McCrae (representing a cumulative water loss of approximately 800,000 litres since digital meters began identifying leaks in the suburb). There have been 24 leaks over 1000 litres per day.'

The conclusion can be drawn that private leaks contribute to the local groundwater.

9.7 Water Flow in Permeable Service Trenches

Based on SEW records of excavations above sewer mains in Charlesworth Street in January 2025, and our Geophysical Survey results (see Section 6.4 and Appendix F), and the in-situ and laboratory data documented in our Hydrogeological report (see Appendix E), it is very likely that water from whatever source, can be intercepted by and travel through service trenches. Stormwater and sewerage trenches which require a gradient to utilise gravity to sustain flow. The level of impact on the perched water is based on the infiltration of water within the trench to the surrounds. This tendency would be based on the relative permeabilities of the embedment material and surrounds, as well as gradient. The characteristics that increase the likelihood of transportation therefore reduce the severity as the tendency would be for water within trenches to stay within trenches. In conclusion, where flow rate through trenches can be assessed to be low, with comparison to other lengths of the network, infiltration and impacting on the groundwater is more likely. This assumes that there is similar embedment material and surrounding natural material within the network.

9.8 Private Water Usage

Private water usage could include leakage or intentional supply of mains water from usages such as ponds, swimming pools, water butts, car washing, and window cleaning/ structural cleaning activities. The irregularity of most of these activities, the possible tendency for these to occur during summer months, and the relatively small volumes that these activities comprise, all indicate that the likelihood and severity of any influence is highly dependent on the hydrological, topographical and geotechnical characteristics of the locality of the activity.

Conversely, irrigation systems may be on timers, and therefore maybe regular, and of a volume of water comparatively greater than sources listed above.

Such activities use mains water, which as discussed has a low EC value (approximately 120 µS/cm compared to the 1600 µS/cm recorded on 6 January 2025. For such water to contribute to the landslides it would need to be within the colluvial layer over the surface of the slope within the site, raising the moisture content of this layer, but not infiltrate the underlying material.

In effect, the likelihood of such activities impacting groundwater levels and influencing the McCrae Landslide, albeit on a very localised scale, is considered slightly higher compared to other sources.

10. Slope Stability Assessment

A slope stability analysis has been undertaken in order to estimate the volume of water that would contribute to triggering the landslide that occurred at the Site on 5 January 2025. The objective of this assessment was to replicate the slope failure by saturating a section of the slope based on previous assessments and site observations. This then informed an estimate the possible volume of water that was required to trigger the landslide on 5 January 2025. Refer to Appendix H for detailed descriptions of the methodology and results of the slope stability assessment.

This analysis comprised a limit equilibrium slope stability analysis using the commercially available software GeoStudio Slope/W. The results of slope stability analysis are expressed in terms of the minimum Factor of Safety (FoS) which is the ratio of the total forces resisting failure to that driving failure. An FoS of less than 1.0 suggests imminent failure in a slope.

The slope geometry was based on available survey data. The ground model was developed based on the results from boreholes undertaken by PSM and CivilTest and is as described in Section 7.

Slope stability analysis was undertaken for two distinct cases:

- Unsaturated – no groundwater inflows to the site. This is an optimistic case given that groundwater seepage from the top of the escarpment is characteristic of the site; and
- Saturated – the unsaturated model was modified by increasing the degree of groundwater saturation in a block of colluvial soil on the slope.

The location of the saturated soil block was guided by recorded observations of the 5 January 2025 landslide. The volume of soil that was saturated was incrementally changed to result in a failure to assess the minimum saturated volume required to cause the 5 January 2025 landslide.

The unsaturated case had an FoS of 1.09 which implies that the forces resisting failure were only 9% higher than the forces driving failure for this optimistic assessment case. For context, a FoS of 1.5 is generally accepted as the minimum factor of safety for long-term global stability. The low factor of safety supports the site's existing susceptibility to landslide prior to the initial slope failure on 5 January 2025.

For the Saturated design case, a volume of saturated colluvial soil was incrementally increased until an FoS < 1.0 was achieved. The volume of water in this modelled soil block is assessed to be between 2000 L and 2300 L. This is the volume of water likely to have been required to be introduced to the McCrae Landslide site to trigger a landslide of similar scale to that observed on 5 January 2025.

11. Discussion

SMEC's objectives in carrying out investigative site work and analysis, documented in this report are to identify sources of water for the McCrae Landslide, and to estimate the impact of SEW assets on the landslide.

Our site investigation and subsequent testing and analysis, along with analysis of statements and supplied information from witnesses, and other consultant engineering firms provides the following points of note.

The Bayview Road Leak

SMEC understands that the Bayview Road leak, located approximately 460 m south east of the McCrae Landslide was located on 30 December 2024, and repaired on 1 January 2025.

Ground and hydrological model

Research on data made availably by MPSC and PSM indcates that the escarpment is prone to landslides (the 1952, 1970s, 2000, 2022, 2025 landslides and the incisioned nature of the escarpment are evidence (No. 10 – 12 View Point Road, No 4 View Point Road, and No. 12 Prospect Hill Road)), whilst the land behind it has a ground water profile that in general gets shallower towards the escarpment, but with springs at varied locations and elevations. The location of springs may be a result of the narrowing of superficial deposits, possibly including aeolian deposits, towards the escarpment crest. The locations of the springs do not appear to be related to known gullies or water courses, and anecdotal evidence suggests they may be ephemeral.

Geophysical survey results also suggest that the area, particularly the areas between Coburn Avenue and No. 7 Prospect Hill Road, may be an area of sustained, elevated moisture content.

Separately, water courses, with sources 'remote', that is beyond 500 m from the escarpment flowing from close to the summit of Arthurs seat, tend to have created incised valleys, which are typically straight. This is not the case for the historic course of Kings Creek, the watercourse that flows from south of the Boulevard, flowing to the sea around Margaret Street. Historical photographs illustrating the character of the locality do not suggest an incised valley between the current location of the M11, and Prospect Hill Road. Apparently unique to the area, the historic course of Kings Creek follows a very shallow valley, which flows westerly, flowing to the sea at an accute angle to the escarpment, rather than orthoganal to the cliff crest.

This may suggest a broadening of subsurface flow, which is indicated by the relatively high levels of responses of the geophysics survey around Coburn Avenue and the eastern limb of Prospect Hill Road. This may also coincide with an isolated area which may have the capability of storing more moisture than surrounds due to the relatively localised drop in the top of the regolith.

The boreholes drilled as part of the ground investigation indicate a clayey band of material around Bayview Road. Similar clayey material is at depth at the southern end of Charlesworth Road, clayey material is close to the surface towards the north end. At the mid point of Prospect Hill Road, the clayey material, (and groundwater) is close to 4 m below ground level. It is reaspnable to conclude that the encountering of a clay band at these locations would suggest a potential for a shallow perched aquifer, despite, BH01 at Bayview Road water seepage not being encountered at shallow depth.

Chemical analysis

The groundwater at BH04 has an EC of 1200 µS/cm. There are no samples of water within approximately 6 m of ground level (i.e. the elevation below ground level of seepage following the 5 January 2025 landslide), which can account for the EC of 1600 µS/cm from the sample taken at the landslide on 6 January 2025.

Laboratory samples, and the tendency for natural material of the locality of the site to be a low permeability may allow for slow moving water to flow through natural material and therefore pick up an elevated EC value. However, the likelihood of this slow moving water contributing to the 5 January 2025 landslide is considered much less than other possible causes.

Permeability

The embedment material of the sewers is typically a coarse aggregate, and can be expected to have a higher permeability than much of the surrounding natural material. Tests suggest a tendancy would be for water to flow down trenches, rather than through natural material. Geophysics survey results suggest trench backfill has a higher moisture content than surrounds. This is noticeable for sewers and stormwater drains as well as gas mains.

Groundwater flow

The vicinity of the McCrae landslide should cope with influxes of water. Although landslides have occured in the locality, they do not happen at every adverse weather event. Therefore, heavy rainfall leading to water flowing in the vicinty of the historic course of Kings Creek would naturally infiltrate, and perhaps spread beneath the land between the historic course of Kings Creek and the gully at the road called 'The Eyrie'. Outfalling at springs uphill of the escarpment, or seepages within the 'incisions' that are located at No. 10 – 12 View Point Road, No 4 View Point Road, and No. 12 Prospect Hill Road.

The lack of structural deformation that may be thought to be associated with such subsurface, and ephemoral groundwater flow is possibly due to the sandy nature of the material, and as indicated by a lack of damage to View Point Road from a leak in November 2024 from 9-11 View Point Road, daylighting in 18-20 View Point Road, seepage noted by the resident of the latter property on 12 October 2024.

This shallow perched aquifer is backed up by the clay material encountered in BH3 and BH4 drilled by SMEC, as well as BH1 drilled by PSM. The consistent water levels recorded in BH3 and BH4 at levels approximately 10 m shallower than the ground water levels recorded at PSMs boreholes and SMEC borehole BH1 and Douglas Partners borehole WR174.

SMEC estimate infiltration rates of up to 5 L/s across the area of innudation between the location of the Bayview Road Leak, and the stormwater drain grate (where sand was deposited on the surface). This should be compared to the 16.2 L/s estimated to have leaked from the pipe (peak flow) (Appendix B, Ref. 42).

The slope stability analysis, coupled with analysis of photographs taken by others on 5 January 2025, suggests that approximately 20 t of colluvial material, may have contained 2000 l of water..

SMEC concludes that the volume of water required to reduce the Factor of Safety of the slope to less than 1, is comparatively low compared to the volume that is expected to have infiltrated natural ground at the Bayview Road site. Therefore the landslide did not need a source of water of the scale of the Bayview Road leak for it to occur.

Slope stability

The behaviour of the vicinity of the McCrae Landslide in response to the volume of water from the leak is thought therefore to be in accordance with how the site facilities significant flow of water from Arthurs Seat. The 'fanning out' of water is likely to have increased the moisture content, or seepages within the slopes of incisions. Irrespective, the behaviour and the stability of the incisions would not be of concern, with the exception of 10 – 12 View Point Road, where it is thought that the 'fanning out' of water, led to a reimerging of an ephemeral spring, or increased level of existing seepage, the scale of which historically would not be unusual, but in this instance, led to a landslide.

Sources of water

It is therefore necessary to understand the activities in the vicinity of the McCrae Landslide that may have altered the hydrological character of the location.

The network of stormwater drains is such that it includes inlets of private AG drain systems into stormwater pits. Observed near 7 Prospect Hill Road, we noted constant flow from 7 Prospect Hill's private AG drain system into the stormwater drain. Irrespective, the stormwater drain from Waller Place to Coburn Avenue is anecdotally constantly running, and the same is true of the Prospect Hill Road/ View Point Road system. It would be reasonable to assume that the stormwater drainage embedment material picks up some of the same background water as indicated by NDT10 hitting water in the embedment material close to an old well, and known location of wet verge. Additionally, the redevelopment of properties is likely to have modified the behaviour and flow path of springs, as indicated by the AG drains required at the redeveloped Nos 5 and 7, and reasonably at No 7a Coburn Ave.

With regards to the chemical testing of water samples taken at borehole BH04 at 5 Prospect Hill Road in 2018 and contrasting these test results with the samples taken by SMEC during recent ground investigation works, the results compare well with test results for SMEC BH04. It is noted that the AG drainage system of 7 Prospect Hill Road which discharges to stormwater drains has a lower EC (refer to Appendix E) which is collecting both groundwater and other surficial water surrounding the property. This water from the AG drainage system of 7 Prospect Hill Road sample closely resembles characteristics of water from stormwater drains taken in June 2025.

It is notable that throughout the site, the permeability and insitu flow rate tests of embedment material and natural material suggest that the embedment material has a significantly higher permeability than surrounding material. The water velocity through the embedment material, assuming a pressure head created by the Bayview

Road leak, would be in the region of <10minutes per metre run. The water velocity through natural material should be considered as approximately 2 m per day. The tendency for water to stay in trenches rather than infiltrate surrounding material should be considered significant, although not exclusive.

Therefore it is theoretically possible for a fraction of trench bound water to seep into the natural material throughout the locality of the site. This includes the new length of stormwater drainage along View Point Road constructed in 2023. The rate of infiltration may be estimated to be similar to the 5 L/s estimated for infiltration of water downslope of the Bayview Road leak. For example, the invert of the sewer outside No. 10 – 12 View Point Road is understood to be between 3.00 m and 3.89 m deep. Acocoridn to the log of PSMs BH01, the material at that depth is likely to comprise a clayey sand. Therefore, under constant flow through the trench, water may infiltrate, at a rate where 2000 L of water may enter the localised geology. However, observations carried out by SMEC in June 2025, as well as ground water levels recorded in SMECs BH04 suggest that groundwater conditions around 7 View Point Road are such that the source of potential trench bound flow down View Point Road is currently present, and therefore can be assumed to be a characteristic of the area since construction of the stormwater drain in 2023, and construction of the house at 7 Prospect Hill Road for example. At the time of the 5 January 2025 landslide, ECs of water sampled from stormwater drains at 6 View Point Road on 8 January 2025 was 570 µS/cm whilst seepage at the Site had a EC of 1600 µS/cm. It is possible that the water taken from stormwater drains in part comprises mains water. Therefore it is similarly possible that at that time trench bound water comprised mains water. If that is the case, had it been tested for EC, it would return a similar value. Such a value is considered too low to contribute to groundwater whose chemistry comprises an EC of 1600 µS/cm, Therefore it is considered highly unlikely that trench bound water, and therefore water from the Bayview Road leak contributed to the 5 January 2025 landslide. Similarly, it is considered highly unlikely that this source of water contributed to the McCrae landslide.

It is estimated from the property owners of 10-12 View Point Road that the flow rate of seepage following the McCrae landslide was in litres per minute. Records of seepages appearing and disappearing at the site do contradict each other. However, explicit observations would suggest that seepage following the 5 January 2025 landslide and McCrae Landslide flowed down Penny Lane, and therefore the measured value of 200 mL/s is approximately suitable as an estimate of seepage rate immediately after both landslides. Records of seepage in 2023, and the prevention of residents entering 607 Point Nepean Road would suggest that seepage from the Site is not unusual and may be continuing.

The flow rate of 200 mL/s contrasts with the estimated water velocity through natural material of 1.5m/day. This contrast may be the result of the release of pressure by the landslide, the local water draining out at a new prefered pathway. This water is considered to be water that has been within the natural material for some time, which accounts for the reasonably high levels of EC. Tests indicate that a value of 1600 µS/cm is higher than other water samples except for the samples taken at depth (over 20 m deep).

It is unlikely that water from a mains source 'topped up' a localised ground water level within the Site.

Further, It is therefore unlikely that the sample and therefore the flow of water, had any if at all mains water.

It is highly unlikely that direct water infiltrating from the area of land between Bayview Road leak and near by Stormwater Drain reached the Site in the time needed to contribute to the landslide, without using subservice trenches, in which case the EC from the site at 6 January 2025 is not considered reasoanbly achievable if derived from mains water.

The removal of the slope's capability to maintain stability

At the site of the landslide significant alteration since 2016 has occurred within the extents of the natural gully:

- The removal of established vegetation at the crest and midslope of the escarpment;
- installation of hardstand from View Point Road to beyond the head of the gully reduced infiltration from rainfall, the backscarp of the failure revealed a relic topsoil layer with relic roots;
- A sophisticated irrigation system throughout the landscaped works, as well as noted in the front garden, and in the back garden to the west of the failure suggests the land has been subjected to artificially variable infiltration. We note that irrigation fountains, and outlets concentrate water flow and irrigation to a greater extent than rainfall – the ability of irrigation water to locally infiltrate at depth is greater than rainfall; and

- Significant irrigation activity 'upstream of the site', as possibly indicated by water usage data from uphill, and anecdotally from observation of lushness of vegetation (No 4 View Point Road), points to a localised hydrogeological character which differs to historical character.

All items have either increased the volume or number of sources of water towards the Site, or reduced the ability of the Site to cater for reasonable seepage down the gully within the Site, which after all should be considered to occur because it is a gully. Our slope stability analysis suggests that the slope stability of the site was precarious, when adopting geotechnical parameters determined by others.

12. Conclusions

Our assessment is therefore that the nature of the site, as with similar incisions in the escarpment between Margaret Street and The Eyrie is that it is one of a number of incisions caused by ephemeral spring locations close to, or at midslope of the escarpment, which are activated depending on the volume of water running over a clay lens within the superficial deposits of the area.

The ability of the site to cope with the flow from the Bayview Road Leak is thought to have been no greater or less than similar incisions. However, additional water sources such as irrigation measures, and the reduction of the site to uptake such water flow, from the removal of mature vegetation is thought to have been a signifincant contributor to the site, to the extent where only 2000 l would be needed for the 5 January 2025landslide to occur.

The flow of water from the Bayview Road leak is thought to have followed pathways and characteristics similar to surface and near surface flows from upstream of the Boulevard. The water from the leak would have (in order of likelihood):

- Flowed from the surface breach at the leak location, into the stormwater drainage grate down hill of the leak;
- Infiltrated from initial surface flow, and from there:
  - Into the sewer and stormwater trenches (including those associated with the M11 freeway, following the trench system until out falling into Port Philip Bay; or
  - Into the perched water system, but taking over 200 days to cover the distance between leak and Site, which is too long to impact the 5 January 2025 or McCrae landslides.
- Kept within service trenches, probably transfering to the sewerage trench 3 m from the leak location, and staying within the trench system until out falling into Port Philip Bay;
- Followed the sewerage trench to Coburn Avenue, then infiltrating into natural ground as flow rate fell and then:
  - Continued in the trenches west and down hill along Coburn Avenue;
  - Flowed downhill through natural material towards 7 Prospect Hill Road, where either:
    - the AG drainage picked it up;
    - stormwater or sewerage trenches picked it up, where by it flowed down the trench, past View Point Road, and out falling at Port Philip Bay; or
    - It kept within the natural geology out falling within natural ephemoral seepages within incisions in the escarpment between The Eyrie, and 18-20 View Point Road. It should be noted that the EC test carried out on 6 January 2025 does not bear this scenario out.
- Seeping from surface breaches at Waller Place, Charlesworth St. and Coburn Avenue, and into the stormwater drainage system, outfalling into Port Philip Bay.

Test results do not indicate that mains water was within water seeping from the 5 January 2025 landslide. SMEC therfore concludes that water within the Site at the time of the landslides and which contributed to the landslide was not directly mains water, and that test results suggest a low level of likelihood that mains water contributed to a hydrological condition in a locality the character of which is defined by elevated ground water levels, springs, and an escarpment incised by gullies and characterised by historic landslide.

Therefore, our conclusions are:

1. Sources of water are:
    a. shallow pearched aquifer;
    b. Private usage;
    c. property leaks; and
    d. service leaks
2. The escarpment was marginally stable. Construction of the retaining wall above the landslide, devegetation and irrigation are factors that can reduce slope stability;
3. A relatively small increase of water could have triggered the landslide;
4. No evidence from chemical testing of water at the landslide to suggest SEW burst water contributed;
5. No evidence to show where any additional water came from;
6. The groundwater seepage observed in the failure scarp of the McCrae Landslide:
    a. is very likely to have been natural groundwater based on groundwater chemistry; and
    b. is very unlikely to have been SEW mains water from the Bayview Road leak based on groundwater chemistry.
7. SMEC would consider that it is highly likely that the 5 January 2025 landslide followed by the McCrae landslide would have occured without the leak at Bayview Road occuring.

13. Outstanding Information

This report was written considering information up to and including 15 July 2025. A report from Prof. van Zyl, University of Auckland (Appendix B, Ref. 40) was received on received on 18 July 2025 and viewed but not assessed in detail. Information that we expect to be received after this date include a final report from Douglas Partners.

At the time of compiling, permeability, porosity, dispersion tests and soil characteristic test result certificates as scheduled and documented within the Geotechnical Factual Report (Appendix D) had not been received. It is expected that these test results will provide further evidence to support the narrative detailed in this report. Once received, SMEC shall supply these within an addendum to this report.

Soil samples taken by SEW personnel during the PSM investigation works adjacent to services, can be expected to be presented within the same addendum.

Appendix A

Geotechnical Report Limitations

Issued: 11-Sep-24

Geotechnical Report Limitations

Important Notice

Headings in these Geotechnical Report Limitations are for ease of reference only and do not affect its construction or interpretation.

The meaning of general words is not limited by any specific examples, lists or the likes introduced by 'include' or 'including', or 'e.g.' or 'for example', or any similar expressions, and any such examples, lists or the likes are taken to be non-exhaustive.

References to a "party" may include an individual, body corporate (wherever incorporated), unincorporated association, trust or partnership (whether or not having separate legal personality), government, state or agency of a state, or two or more of the foregoing.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report.

The contents of the report are confidential and for the sole use of the party who commissioned SMEC for the work (the "Client"). No responsibility or liability will be accepted to any party other than the Client.

SMEC has prepared this report in accordance with the scope of work commissioned, under which SMEC undertook to perform a specific and limited task for the Client. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. Data or opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement with SMEC. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

Geotechnical Reports

Site subsurface conditions can cause design and construction technical challenges. Therefore, we have provided these notes to assist you in understanding your report.

The recommendations in this report are based on data observed and collected at specific locations using specific investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the scope of works and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the extrapolated model. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report.

If this report is reproduced, it must be in full. Investigation logs, laboratory test certificates, figures and drawings etc should not be extracted for use in other documents or separated from this report in any way.

Should there be any queries concerning this report please do not hesitate to contact SMEC.

Project Specific Criteria

Where the report has been prepared for a specific purpose (e.g. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (e.g. a four-storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC in the light of the new purpose.

Every care is taken with the report content. However, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount and distribution of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of consultants and contractors responding to commercial pressures.

If these occur, SMEC would be pleased to assist through further investigation, analysis or advice.

Understanding Ground Conditions

Introduction

The characteristics of any site (including small scale sites such as a small retaining wall up to large scale sites such as that material through which a tunnel is advanced) is spatially variable due to various processes. These processes could include natural processes, such as geological, chemical, physical, and thermal, and those of biological agents. Chemical and Biological issues are often due to the impacts imposed on the earth by humankind.

For the purposes of engineering design, a site is characterised by undertaking studies and investigations to gather data from the site. The site data is collected in accordance with accepted practices or in compliance with Guidelines and Standards, and provided to a Geologist or Engineer for interpretation and characterisation. The studies can include reviews of published literature, mapping, and test results, with site specific investigations. The site investigations can include intrusive works such as test pitting, trenching, and drilling, in addition to nonintrusive methods such as surveying (including LiDAR), imaging, geophysical profiling, surveying, and mapping. All of these items are combined to improve the data available for interpretation for its intended purpose.

Investigation Information

Logs of a borehole, recovered core, test pit, excavated face, or Cone Penetration Test (CPT) are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling/observation spacings, and the ground conditions. It is not always possible or economical to obtain continuous high-quality data. It should also be recognised that the volume of material observed or tested is only a small fraction of the total subsurface profile.

Factual Data

Factual data is material or information that has been observed or measured. It is, however, inherently limited with regard to the area, or volume, of the site it represents. For example, a single HMLC core measures 64 mm diameter, from a drill hole of 98 mm diameter. Within a cubic metre of material, the core represents just 0.3% of the volume, the drill hole 0.8%, and assuming the drill hole is imaged, the remaining 99.2% of the material is untested and requires interpretation. Across a site, the number of observation points from intrusive investigations versus the size of the site is a very small percentage. Thus, any model developed relies heavily on interpretation of this data.

Geological mapping and geophysical surveys improve the contextual understanding of intrusive investigation results and is strongly recommended as part of any investigative process.

Interpretation

For the development of the characteristics utilised in design, data may be sourced from many locations and weighted according to the source. In some cases, data may be skewed toward literature (technical papers) or sources in the public domain, and in others it may be predominantly site based.

Any engineering judgements, inputs sourced from the literature, or the experience of the person/s undertaking the interpretation will be documented so the reader is informed as to the limitations of the data utilised.

Interpretation of subsurface information and application to design and construction takes into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Further to the limitations associated with the data, the interpretation of the data can vary from person to person and team to team, based on the experience and knowledge of those undertaking the analysis and interpretation of the data. Whilst some interpretive methods follow procedures to reduce that variability, some elements may still provide decision points at which two or more paths may be selected for progression. Our advice is based on a process of internal, and sometimes external, review, drawing upon the experience of senior technical staff. Whilst the likely scenario may be explored and characterised, it is essential that the reader understands that other interpretations of the same database may be possible.

Certainty

Geotechnical interpretation relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than other disciplines such as Structural Engineering.

With all ground investigations and designs, there is no process that will provide one hundred percent certainty. As the database increases in size and different methods of investigation and analysis are employed, the uncertainty in the data can be reduced, increasing the reliability of the ground model and characteristics (as per Figure 1 and Table 1).

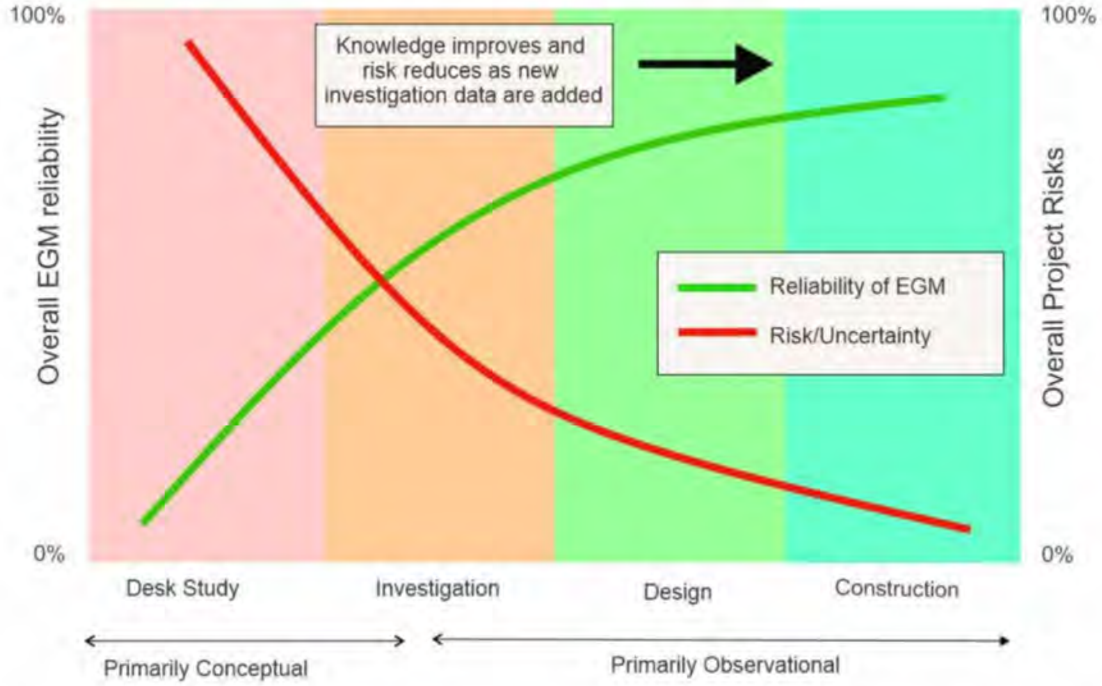


Figure 1: Idealised improvement in Engineering Ground Model (EGM) reliability as the project progresses (sourced from Baynes and Parry 2022)

Table 1: Stage, Geotechnical Uncertainty and Recommended Action (sourced from Baynes and Parry 2022)

Stage	Level of Geotechnical Uncertainty	Recommended Action (sourced from Baynes and Parry 2022)	Description of Geotechnical Model Development
Concept / Desk Study	Very High	Further investigation necessary	Typically based on desktop studies, literature reviews, open-source information, and experience of the team. Site visit.
Preliminary Design	High	Project future threatened but can be managed with additional investigation.	Addition of limited site-based works, some pitting, drilling or geophysics (surface and downhole), mapping, and review of client held core. Two-dimensional modelling. Material characterisation.
Detailed Design	Moderate	Identifiable risks to project that can be addressed with specific measures	Significant field investigation, pitting, trenching, drilling, geophysics (surface and downhole), three-dimensional modelling. Material characterisation.
Construction	Low	Risk management through procedures and involvement by geotechnical professional during construction	Site observation, high resolution mapping and other documentation.

The final investigation on any site is the construction phase. The Engineering Geologist or Geotechnical Engineer should remain involved, and the designer should communicate with the Engineering Geologist or Geotechnical Engineer, until all works are completed. Lastly, the ground model has been formulated using engineering judgement and experience. The process and background of the model formulation has been documented in the report to clearly show the limitations of the database.

Report Preparation

Geotechnical reports are prepared by qualified and experienced personnel using the information supplied or obtained and are based on current engineering and geological standards, methods, guidelines, or accepted industry practice of interpretation and analysis. These processes change with time and this report is limited to those in effect at the time of publication.

Changed Subsurface Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC should be notified immediately. Early identification of site anomalies generally results in problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

Subsurface conditions can change because of natural or anthropogenic processes. Fill can be placed on a site, contamination can migrate with time and water levels can vary with weather cycles or groundwater extraction. Such changes should be borne in mind, particularly if the findings and/or recommendations contained within this report are used after a delay.

Hydrogeology

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils, groundwater may not seep into an excavation or bore in the short time it is left open and local effects, through the excavation process, may alter the permeability of the material.
- A localised perched water table may not represent the true water table.
- Groundwater levels may vary according to rainfall events or season.
- Some drilling and testing procedures mask, prevent, or exacerbate groundwater inflow.
- The installation of piezometers and long-term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

This report is based on investigations and conditions that were observed at a specific time. Use of the information in this report should consider how the data and recommendations may have been affected by time, and activities on and off the site.

Contamination

This report has been prepared to address a geotechnical scope of work and unless requested by the Client, does not address Contamination issues. As such, it is unlikely to discuss investigations of the site for the presence of contaminants or hazardous materials, or provide discussions and recommendations about their presence or handling. The assessment of site contamination utilises specialist techniques and equipment under the direction of specialist, trained personnel. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact SMEC for information. On site contamination can create major safety, health and environmental risks to those on site or in the vicinity. SMEC can be contacted for advice regarding investigation of potential contamination or environmental issues at the site.

Use by Other Project Parties

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report (including any amendments or updates made to the same after the date of this report), or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any party other than the Client. Any other party who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that they acknowledge and accept that they may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

Geotechnical engineering is based on the interpretation and understanding of ground conditions using limited site-specific information, along with relevant experience, skill, and knowledge. To reduce the risk of inappropriate use of the data contained herein, it is strongly recommended that any plans and specifications prepared by others and relating to the content of this report, or any amendments to the original plans and specifications, are reviewed by SMEC to assess that the intent of the recommendations and advice contained herein are appropriately applied to, or reflected in, the design. If the encountered site conditions are assessed to vary significantly from the interpretation and model provided herein, SMEC is able to provide assistance or review the findings in combination with the investigation to more appropriately inform the design.

Subsurface conditions relevant to construction works should be assessed by Contractors who may make their own interpretation of the provided factual data, possibly provided under separate cover. The Contractor should undertake any additional tests as necessary for their own information and purposes.

Reference

Baynes, F. J. and Parry, S. 2022. Guidelines for the development and application of engineering geological models on projects. International Association for Engineering Geology and the Environment (IAEG) Commission 25 Publication No. 1, 129 pp.

Appendix B

Summary of Information Sources

SMEC Report Ref.	Originator	Reference Type	Title	Date	Document Ref.	MSC Ref.
1	Municipal Building Surveyor	Report	Significant Incident Notification Office of the MBS	7/01/2023	None	MSC.5003.0001.7156
2	PSM	Email	PSM5226-017E Preliminary landslide risk assessment 3 Penny Lane, McCrae, VIC	7/01/2023	None	MSC.5003.0001.7180
3	GHD	Report	Landslide Risk Assessment, View Point Road Landslide, McCrae	22/01/2025	12661110-REP-0_McCrae Landslide Risk Assessment.docx	MSC.5003.002.2627
4	CivilTest	Report	10-12 View Point Road MCCRAE	4/04/2025	1222044-15	RES.0001.0001.0001
5	Mornington Peninsula Shire Council	Report	McCrae Landslide 14 January 2025 Summary of Events	None	None	MSC.5003.002.2780
6	PSM	Report	Geotechnical Factual Report, McCrae Landslide - Evacuation Order Area	9/04/2025	PSM5665-GFR REV0	MSC.5007.0004.0078
7	PSM	Memorandum	McCrae Landslide Incident, Displacement Monitoring Update - 12 February 2025 to 28 February 2025	6/03/2025	PSM5665-050M	MSC.5000.0001.1505
8	PSM	Memorandum	McCrae Landslide Incident, Displacement Monitoring Update - 28 February 2025 to 6 March 2025	12/03/2025	PSM5665-052M	MSC.5016.0001.0205
9	PSM	Memorandum	McCrae Landslide Incident, Displacement Monitoring Update - 7 March 2025 to 13 March 2025	20/03/2025	PSM5665-054M	MSC.5020.0001.0385
10	PSM	Memorandum	McCrae Landslide Incident, Displacement Monitoring Update - 14 March 2025 to 27 March 2025	8/04/2025	PSM5665-056M	MSC.5020.0001.0453
11	CivilTest	Letter	10-12 View Point Road MCCRAE	26/03/2025	1222044-16	MSC.5016.0001.0996
12	South East Water	Report	South East Water Submission to the Board of Inquiry into the McCrae Landslide	April 2025	Legal/90953929	SEW.0001.0001.0111
13	PSM	Report	Expert Opinion Report - Landslide Assessment, 10-12 View Point Road, McCrae	11/06/2024	PSM5226-006R Rev0	MSC.5000.0001.0639
14	PSM	Report	McCrae Landslide, Evacuation Order Area - Landslide Risk Assessment	28/05/2025	PSM5665-LRA REV1	?
15	David Simon, Mornington Peninsula Shire Council	Witness Statement	David Simon Witness Statement, Board of Inquiry into the McCrae Landslide	11/04/2025	ME_952305884_1	MSC.9000.0001.0002
16	JDA Architects	Drawing	Alterations & Additions to Residence at 10-12 View Point Road	24/08/2015	214009 TP-04	MSC.5002.0001.0090
17	Mornington Peninsula Shire Council	Letter	Secondary Consent Application P15/1503.02, 10-12 View Point Road McCrae	10/08/2025	P15/1503.02	MSC.5014.0001.0103
18	Mornington Peninsula Shire Council	Enquiry	27 Cook Street Map 171 A1 Local Access C	17/08/2020	2229724	MSC.5012.0001.3414
19	John d'Helin	Letter	Planning application P02/1833	17/09/2002	None	MSC.5001.0001.4155
20	LanePiper	Report	Geotechnical Investigation of Stability of Gully Between The Eyrie and Point Nepean Road, McCrae	September 2007	207141Report01.1.doc	MSC.5012.0001.0123
21	Cardno LanePiper	Report	Landslide Susceptibility Assessment, Stage 2, Draft for Comment	1/02/2012	207166Report02.1	MSC.5012.0001.4440
22	CivilTest	Report	Geotechnical report for 3 Penny Lane, reference number RM0997-98, dated in 1998	1998	RM0997-98	MSC.5003.0001.7123
23	State of Victoria Government	Report	Victoria Government Gazette	18/03/2025	No. S111	MSC.5024.0001.0154
24	SMEC	Report	Legally Privilegdged Multidiscipline Expert Report	5/05/2025	SMEC 001 Rev 0	SEW.0001.0001.0142
25	Mr. G. Borghesi	Annexure to Witness Statement	Annenxure to Witness Statement of Gerrard Raymond Borghesi		None	RES.0001.0003.0001
26	Mr. J. Marsh	Witness Statement	Jason Marsh Witness Statement, Board of Inquiry into the McCrae Landslide	4/06/2025	None	SEW.0001.0001.4928
27	MBSC	LIDAR Digital Data	LIDAR digital data	2021	None	
28	CivilTest	Report	Land stability assessment at 10-12 View Point Road McCrae		1222044-3	SUB.0015.0001.0345_00
29	PSM	Report	McCrae Landslide - Evacuation Order Area Geotechnical Factual Report	9/04/2025	PSM5665-GFR Rev 0	MSC.5007.0004.0078
30	Douglas Partners	Report	Investigation Summary Report - DRAFT	18/07/2025	R.001.DFTA	
31	Stormwater drainage system Aerial View	Annotated aerial photograph	Stormwater drainage system Aerial View	22/05/2025	None	
32	Stormwater drainage system Pipes markup	Annotated pdf table	Stormwater drainage system Pipes markup	22/05/2025	None	
33	Stormwater drainage system Pipes	Annotated table	Stormwater drainage system Pipes	22/05/2025	None	
34	Stormwater driange stem Pits Markup	Annotated pdf table	Stormwater driange stem Pits Markup	22/05/2025	None	
35	Stormwater driange stem Pits	Annotated table	Stormwater driange stem Pits	22/05/2025	None	
36	Stormwater drainage system View Downstream Pits Pipes	Diagram	Stormwater drainage system View Downstream Pits Pipes	22/05/2025	None	
37	Stormwater drainage system View Techone asset IDS mar	Diagram	Stormwater drainage system View Techone asset IDS markup	22/05/2025	None	
38	Stormwater drainage system View Techone asset IDS mar	Diagram	Stormwater drainage system View Techone asset IDS markup	22/05/2025	None	
39	Stormwater drainage system View upstream Pits Pipes	Diagram	Stormwater drainage system View upstream Pits Pipes	22/05/2025	None	
40	University of Auckland	Report	Flow Rate from a Longitudinal Split in a PVC pipe, McCrae	18/07/2025	None	
41	SEW	Montage Report	Montage report	16/10/2018	764377	
42	SEW	Witness Statement	Julian Tully Witness Statement, Board of Inquiry into the McCrae Landslide	19/06/2025	None	SEW.0001.0001.5173
43	PSM	Report	McCrae Landslide - Stormwater and Sewer Investigation, Geotechnical Factual Report	13/06/2025	PSM5665-070R DRAFT REVA	
44	Geoscience Australia	Digital Elevation Model	Digital Elevation Model (DEM) of Australia derived from LIDAR 5 Metre Grid	9/04/2025	None	

Appendix C

Site Visit Report

Multidisciplinary Expert Supplementary Report

Board of Inquiry into the McCrae Landslide – Site Visit Report

Prepared for: Thomson Geer
21 July 2025
Client Reference No. SMEC Report 002 Appendix C

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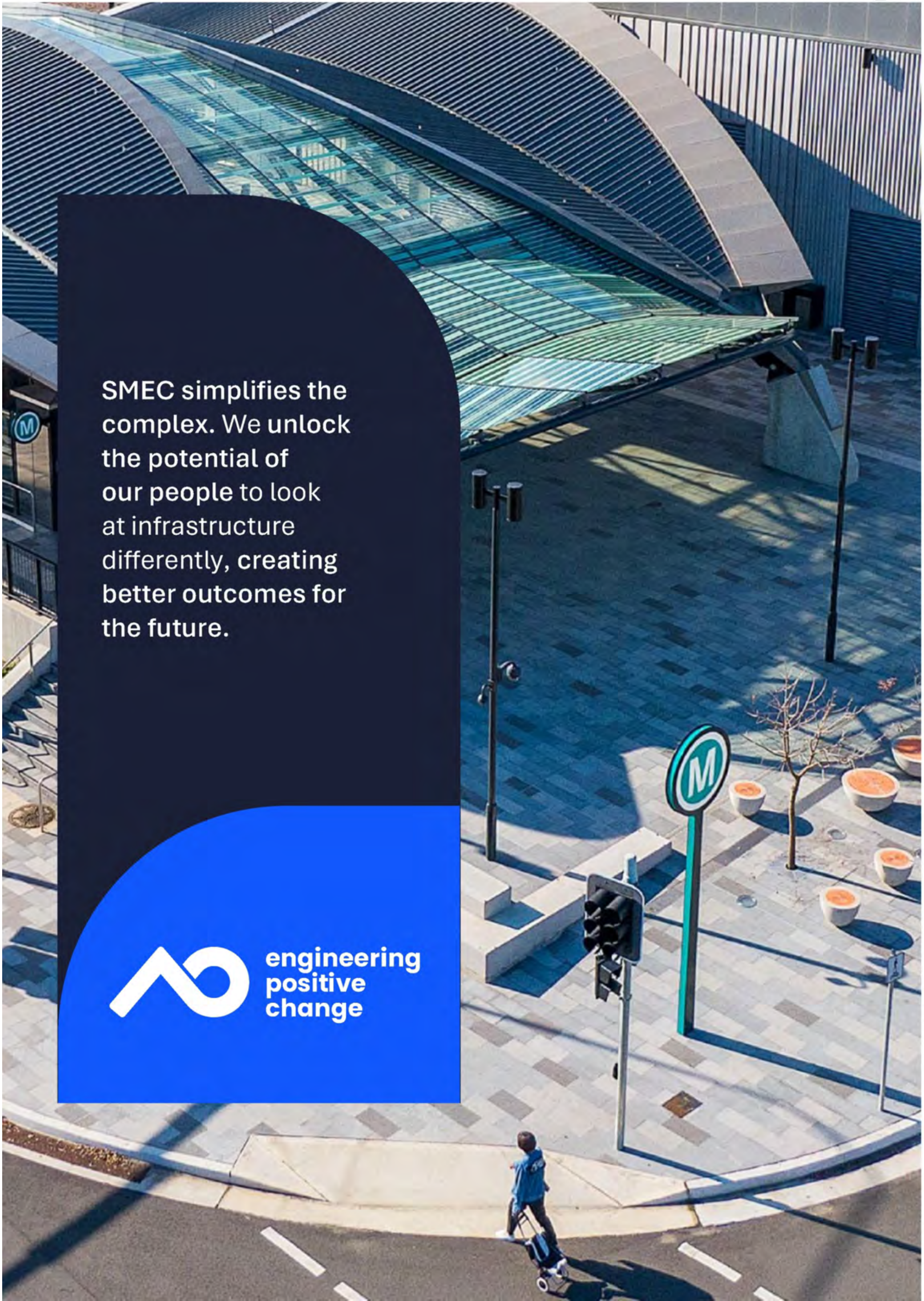

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Document Control

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Contents

Figures

Tables

1. Introduction

Two slope failures occurred on 5 January 2025 and 14 January 2025 within the property boundaries of 10-12 View Point Road, McCrae, Victoria. The latter is referred to as the McCrae Landslide. As part of investigation works to understand the possible impact of SEW assets on the landslides, SMEC Engineers have visited several specific locations in McCrae.

2. Scope of Works

Site visits were carried out by a SMEC Technical Principal Hydrogeologist and Senior Associate Geotechnical Engineer and comprised walkover and photographic surveys as summarised below:

Date	Location	Activities
03 March 2025	Charlesworth Street, Waller Place, Cornell Street, Henry Court, Coburn Avenue, Prospect Hill Road, The Eyrie, Bayview Road, M11 Mornington Peninsula Freeway, Margaret Street.	Drive through survey, enabling SMEC engineers to familiarise themselves with the site. Enabling some observations of site characteristics, such as pavement deformation, vergeside vegetation, and the topography near to the Bayside Road leak.
13 June 2025	Charlesworth Street, Waller Place, Henry Court, Coburn Avenue, Prospect Hill Road, The Eyrie, Bayview Road, M11 Mornington Peninsula Freeway, Margaret Street, View Point Road, Point Nepean Road.	Go Pro Stills photographic survey. Assessment of potential locations of intrusive investigation works. Assessment of potential extents of Geophysics Survey works
17 June 2025	McCrae Landslide from 10-12 View Point Road. Bayview Road, Point Nepean Road.	Photographic survey of McCrae Landslide. Go Pro video survey of Bayview Road leak and land between location and stormwater grate.
20 June 2025	McCrae Landslide from 6 View Point Road. Prospect Hill Road, Coburn Avenue. Point Nepean Road.	Photographic survey of McCrae Landslide. Walkover survey of Coburn Avenue at location of historical seepage. Walkover Survey of Prospect Hill Road and Coburn Avenue with Mr. Hutchings and MBS. Visit of outside of 595 Point Nepean Road with MBS.

3. Site visit records

3.1 3 March 2025

A drive through site visit was carried out by SMEC personnel accompanied by SEW personnel. Due to the sensitivity of the project, and the exclusion zone surrounding the subject site and adjacent properties, SMEC did not carry out a walkover survey of the subject site. During the site visit, walkover survey works were kept to areas to the south of the M11 Mornington Peninsula Freeway, and north of Point Nepean Road.

Records of the observations are available in the Legally Privileged Multidiscipline Expert Report for the McCrae Landslide, issued by SMEC dated 5 May 2025 (Appendix B, Ref 24).

3.2 13 June 2025

3.2.1 General

A Technical Principal Hydrogeologist and a Senior Associate Geotechnical Engineer from SMEC carried out a walkover survey, with Go Pro photographic survey of roads around the locality of the Site. The GoPro camera was mounted on a hard hat, with 360-degree photographs taken at 2 second intervals. An assessment of potential intrusive investigation locations, taking account of services as detailed in 'Before You Dig Australia' (BYDA) request returns, and the slope angle and width of the verges.

The weather was dry, visibility good, and underfoot conditions firm. Recent rainfall records are tabulated below:

Table 1: Rainfall data from 9 June to 13 June 2025 obtained from BOM online data.

Date	Rainfall (mm) (Rosebud Country Club weather station)
7 June 2025	0
8 June 2025	20.8
9 June 2025	14.0
10 June 2025	7.5
11 June 2025	10.6
12 June 2025	0
13 June 2025	0

The following observations were made during the walkover.

3.2.2 Bayview Road

The area is vegetated by mature trees, and scattered shrubs. Felled tree trunks with dislodged rootbowls were noted. Ferns and bracken were noted to the northeast of the leak site.

The land falls gently towards the verge of the M11 southbound carriageway. Ground conditions over an area between 0 m and 30 m north of the leak site were characterised by leaf litter, topsoil, with sporadic deposition of yellow brown sand. The sand was observed in the nooks created by tree roots, but also on bare ground. The nearby stormwater grate was observed. Vegetation surrounding the grate comprised felled tree trucks and shrubs, no sand deposition was observed.

The vegetation on the sloping ground towards the M11 typically comprised trees, with fewer shrubs and ferns than away from this sloping ground.

3.3 17 June 2025: 10-12 View Point Road

SMEC personnel were given access to 10 View Point Road. As arranged by the Board of Inquiry and SEW The visit was limited to viewing the landslide from the eastern part of the property. The visit was carried out in the presence of:

- The landowners of 10 View Point Road
- An observer from the Board of Inquiry
- A communications officer from SEW
- An officer from Mornington Peninsular Shire Council

During the visit, access to the landslip was restricted to 2 m from the backscarp. Access to slipped material was not permitted. Photographs were taken by personnel smart phone. The intention of each photograph was described to the landowner before it was taken and was shown to the landowners.

The weather was dry, visibility good, and underfoot conditions firm. Recent rainfall records are tabulated below:

Table 2: Rainfall data from 11 June 2025 to 17 June 2025 obtained from BOM online data.

Date	Rainfall (mm) (Rosebud Country Club weather station)
11 June 2025	10.6
12 June 2025	0
13 June 2025	0
14 June 2025	0
15 June 2025	0
16 June 2025	0
17 June 2025	3.6

The structure of the house, and outbuildings, along with the surface of the paving between the house and landslide did not exhibit signs of distress such as deformation, sheared down pipes, cracking etc.

A diagonal stepped crack was noted within a low stone wall adjacent to a footpath, based on our understanding of the site from the study of aerial photographs SMEC presumes allows access down to Penny Lane.

The exposed geology of the backscarp appeared to comprise a cohesive material, with some granular aspect, cohesive as it was near vertical, but there was no sign of slickensides, or other observations to suggest a pure cohesive material. Approximately 2m below ground level, over part of the backscarp is a lens, 300 mm thick of organic material, contaminated with plastic fragments.

There did not appear to be signs of further deterioration to the site when recollecting the drone footage taken during January 2025. However, on viewing the site from Point Nepean Road, SMEC suggests a minor slump has occurred since January 2025, on the western side of the failure.

The landowners answered questions SMEC personnel asked on site.

The landowners showed SMEC personnel a photograph taken before the retaining walls were constructed. The photograph showed a slightly sloping ground, dipping from the View Point Road (behind the photographer), to the crest of the escarpment. Figure 1 is a copy of GB-12, a photograph submitted as part of the annexure to the witness statement to the inquiry of Mr. Borghesi (Appendix B, Ref 25) . This figure shows the slope of the ground behind the original retaining wall, during construction works. The grassed topsoil, may be the material exposed by the backscarp of the McCrae landslide.

GB-12
Retaining Wall

Figure 1: GB-12, taken from Annexure of Witness Statement of G Borghesi, showing construction of original retaining wall,

The original retaining wall constructed of post and wooden sleepers, with tie backs comprising steel rods, with H-Section (assumed) into the natural material. The landowners described how the wall abutted the naturally steep gradient of the upper slopes of the escarpment. Forming a straight, or 'engineered' edge to the gently sloping surface behind the crest. It was noted on site that this surface, now paved, was approximately level.

The drainage measures behind the original wall SMEC understands to have comprised scoria only.

SMEC understands from the landowner that following some deformation of the wall along the line of the wall, a concrete panel and post wall was constructed, described during the site visit as 'an aesthetic wall'. The 'aesthetic' wall was designed for full lateral load. Which SMEC understood to mean the load of the retained soil.

The landowners recall that seepage was not noted on site before 5 January 2025, including out of the AG drain behind the 'aesthetic' wall.

Prior to 14 January 2025, the landowners recall a visit from the building surveyor, who was able to put his arm in the gap between the bottom sleeper and the dropped land in-front. The gap was dry, the drainage material above suspended by the geofabric.

Seepage continued from 14 January for between 6 weeks and 2 months, putting the last day of seepage between 25 February and 14 March 2025. This range of dates appears to be corroborated by the observation that no seepage was noted by CivilTest during their site visit of 20 March 2025, as documented in their letter of 4 April 2025, reference: 1222044-15 (Appendix B, Ref 4).

However, it is noted that available, safe locations to view possible seepage are approximately 6 m from the source of seepage, and as vegetation starts to recolonise the base of the landslip, it is reasonable to assume that seepage, minor comparison to the seepage following the landslides, does occur within the landslide.

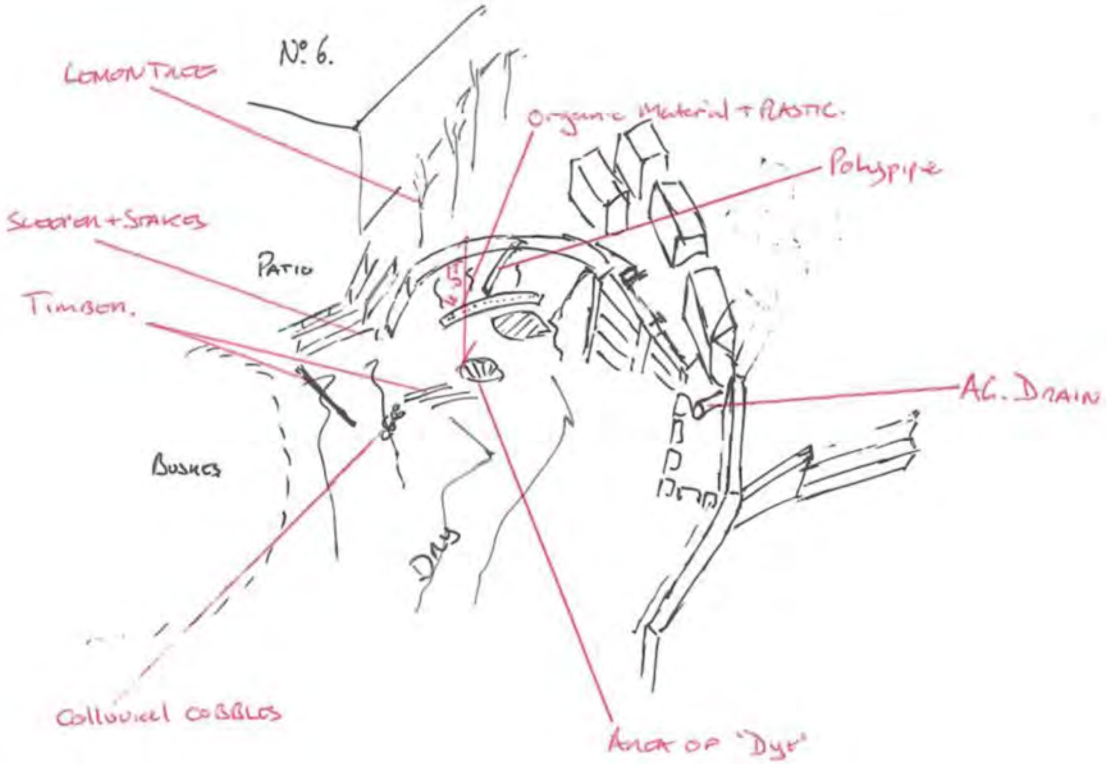

Figure 2: Sketch showing features noted by SMEC of the McCrae Landslip, from vantage points within 10-12 View Point Road property extents.

The owners of 10-12 View Point Road hypothesise that the remnant head of the gully used to head east, below the lemon tree (Figure 4).

Figure 3: Annotated aerial photograph showing approximate location and direction of photographs taken.

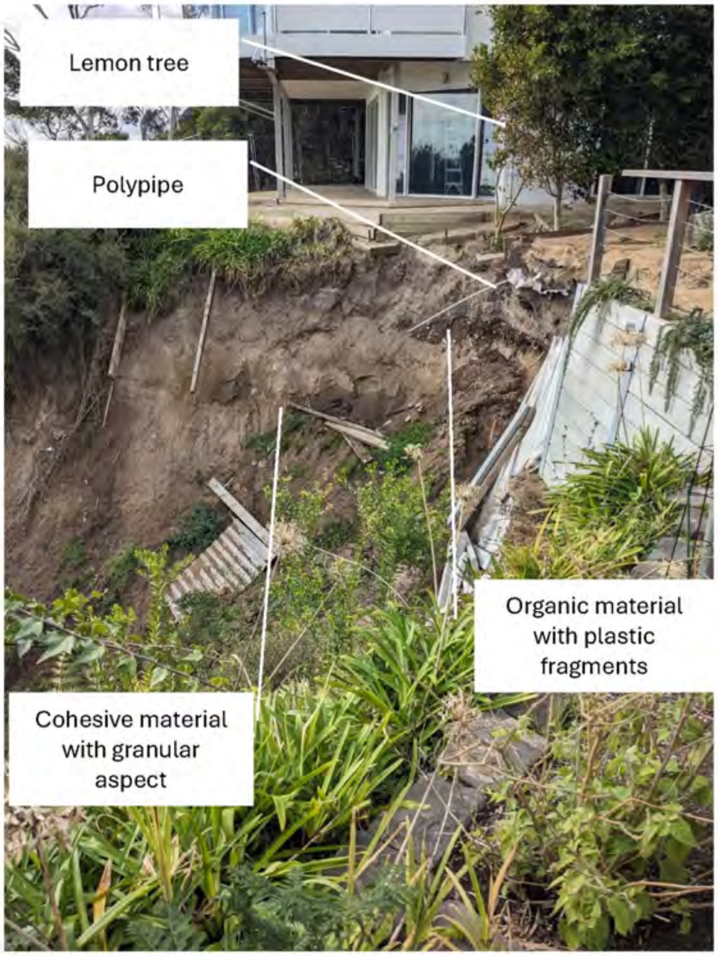

Figure 4: 17/6/25 Photo 01 Looking east showing the detail of the backscarp. Note the vertical nature of the backscarp, approximately 4.5m high.

Figure 5: 17/6/25 Photo 02 Looking north showing the extent of landslip

Figure 6: 17/6/25 Photo 03 Looking east showing the upper slope of the escarpment, and assumed extent of slip, showing debris downslope of the backscarp

Figure 7 is included to enable the reader to compare a photo taken by CivilTest on 20 March 2025, and included in the CivilTest letter to Mr. Borghesi on 4 April 2025 (Appendix B Ref 4), to Figure 6. Some deterioration appears to have occurred in the time between the two photographs.

Photograph 7: Site conditions on 20 March 2025

Figure 7: 20/3/25 taken from CivilTest Letter dated 4 April 2025 Reference 1222044-15.

Figure 8: 17/6/25 Photo 04 Looking east showing the detail of the backscarp. Note the vertical nature of the backscarp, approximately 4.5m high

Figure 9: 17/6/25 Photo 06 Looking north from behind the raised vegetable patch, towards the toe debris of the landslip. The tie back of the original retaining wall is visible, as is the white geofabric of the drainage measures of the 'aesthetic' wall

Figure 10: 17/6/25 Photo 07 Looking north, down the direction of the landslip

Figure 11: 17/6/25 Photo 08 Looking north over the vegetable garden, showing the crest of the backscarp

Figure 12: 17/6/25 Photo 09 Looking east showing the location of the seepage videoed by the landowners on 14 January 2025, and location of the dye that was seen daylighting through the backscarp after dye was poured into NDT01/02.

Figure 12 should be compared with Figure 13, which shows three panels of sleepers of the retaining wall still standing.

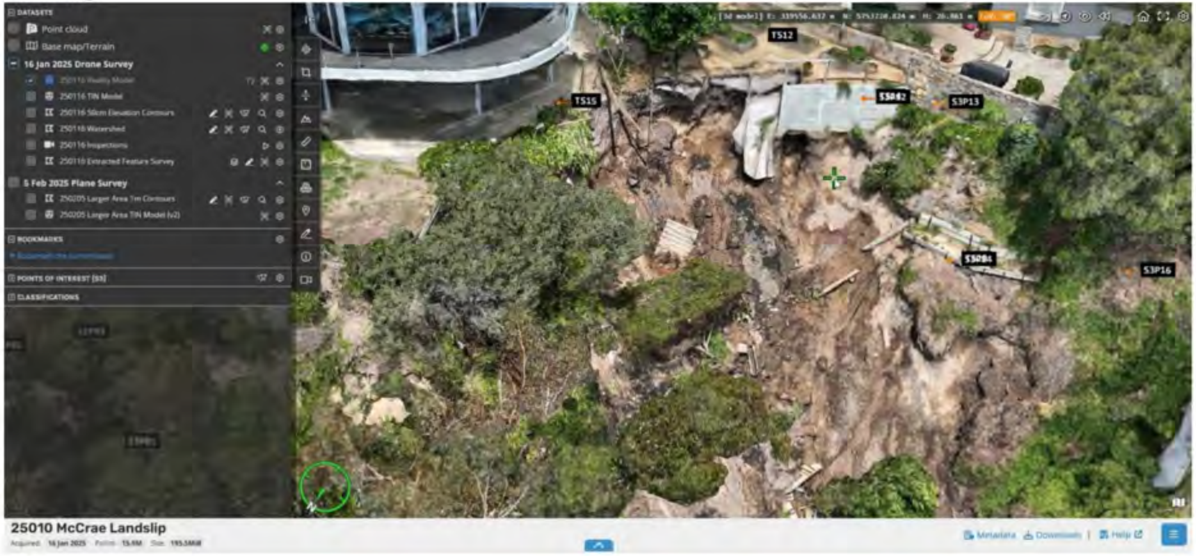

Figure 13: Detail of the landslip drone footage taken on 15/1/25.

3.4 20 June 2025

3.4.1 General

A Technical Principal Hydrogeologist and a Senior Associate Geotechnical Engineer from visited McCrae on 20 June 2025. A walkover of Coburn Avenue between 7A and 12 Coburn Avenue was carried out, followed by a site visit to No. 6 View Point Road, with the landowner's representatives, and then a walkover Coburn Avenue between each junction with Prospect Hill Road, and Prospect Hill Road.

The weather was dry, visibility good, and underfoot conditions firm. Recent rainfall records are tabulated below:

Table 3: Rainfall data from 14 June to 20 March 2025 obtained from BOM online data.

Date	Rainfall (mm) (Rosebud Country Club weather station)
14 June 2025	0
15 June 2025	0
16 June 2025	0
17 June 2025	3.6
18 June 2025	0
19 June 2025	0
20 June 2025	0

3.4.2 7A to 12 Coburn Avenue

Following a phone conversation with the owner of 12 Coburn Avenue on 19 June 2025, SMEC Geotechnical Engineer David Hartley visited the front of the property, where according to the landowner, bubbling of water within the verge close to his driveway in 2021 was observed. At the time of the site visit, the site was dry with some water from 18 Coburn Avenue, trickling along the kerb. The west bound lane of Coburn Avenue outside the driveway exhibited crocodile cracking.

Whilst photographing an area of crocodile cracking, and repaired pothole outside No. 9A Coburn Avenue, the owner of 7A Coburn Avenue chatted. At this location, the west bound lane of Coburn Avenue appears to be on a 2m approx. high embankment. The back garden of No. 7A abuts a steep (near vertical) slope downwards, the garden behind a post and panel retaining wall, perhaps 1m high.

The house appeared newly built. The owner said that 28 x 9m piles were installed, all were dry. However, the owner said that the verge in front of No. 7 was regularly saturated, and until recently there was a well in the front garden. It is noted that NDT10 (a Vibration Wire Piezometer) is installed in the verge outside No. 7.

It was noted the stormwater drain was flowing during the site visit.

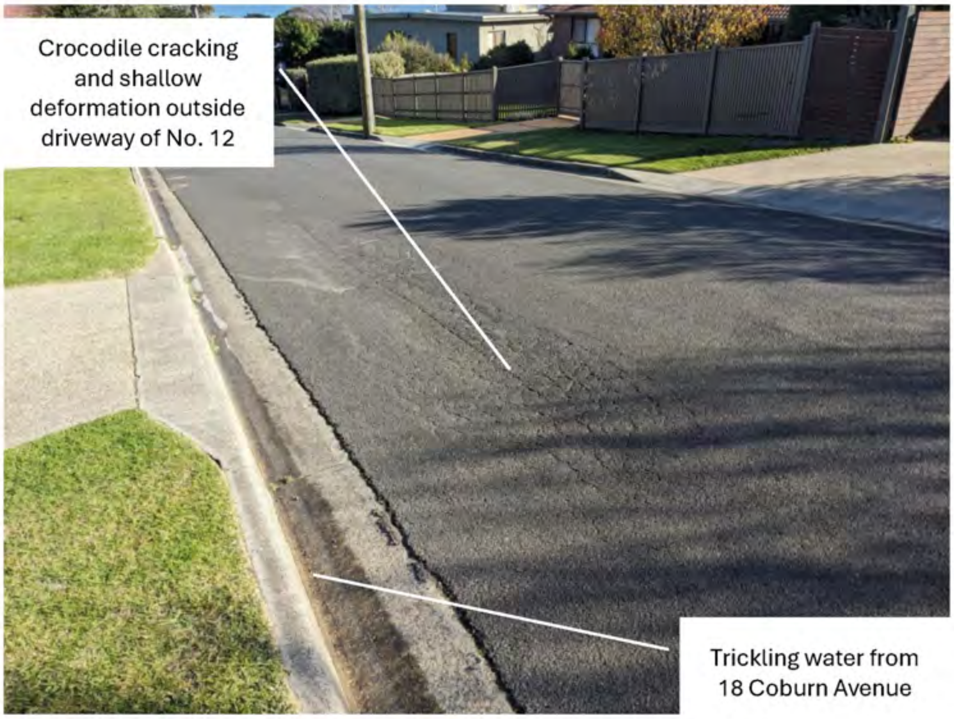

Figure 14: 20/6/25 12 Coburn Avenue, looking west showing condition of pavement

Figure 15: 20/6/25 Coburn Avenue looking east up hill towards NDT10, and location of locally saturated verge.

3.4.3 6 View Point Road

SMEC Geotechnical Engineer David Hartley and SMEC Hydrogeologist Hugo Bolton were given access to 6 View Point Road. As arranged by the Board of Inquiry and SEW. The visit was limited to keeping away from the dislodge patio tiles beneath the balcony of the property. The visit was carried out in the presence of:

- The representatives of the landowner of 6 View Point Road
- An observer from the Board of Inquiry
- A communications officer from SEW
- An officer from Mornington Peninsular Shire Council
- The Council Building surveyor.

Access to slipped material was not permitted. The structure of the house, and ground surface did not exhibit signs of distress such as deformation, except for:

- Dipping of the ground surface towards the landslip, west of the house.
- Some vertical displacement (10mm) within the tiled surface.
- Dilapidation of patio edging towards the failure.

The building was built in 2002, Mr. Hutchings (landowner's representative) said that he could not recall fill being placed as part of the works.

The exposed geology seemed to comprise a granular matrix with cobbles, overlying a greyish sandy material. The Council Building Surveyor pointed out suspected areas of 'piping' within the backscarp to SMEC personnel. The cause and exact nature of these areas were not confirmed by SMEC Engineers on site. Assessment of the dispersive nature of local geology is part of the scope of the SMEC intrusive investigation works, to be included in an addendum.

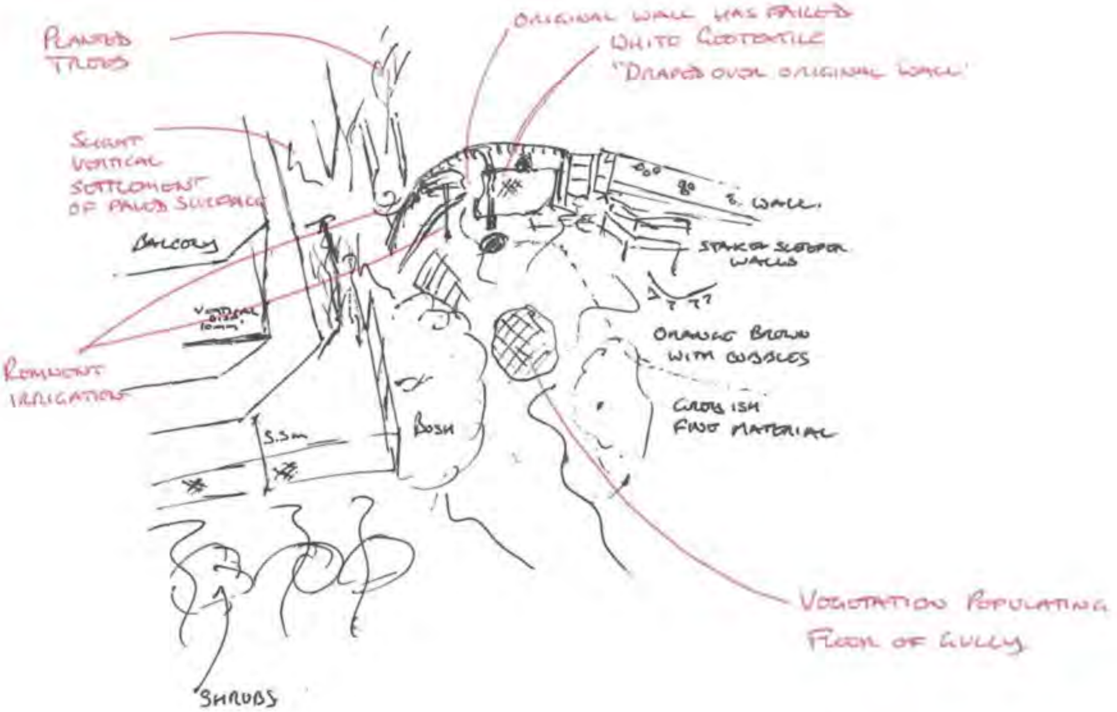

Figure 16: Sketch showing features noted by SMEC of the McCrae Landslip, from vantage points within 6 View Point Road property extents.

Mr. Hutchings suggested that seepage was noted until 3 months after the 14 January 2025. This is not consistent with the recollections of Mr. Borghesi. However, we note that in Mr. Willigenburg hearing, he recalls being told by the Municipal Building Surveyor during April that he and his wife were not permitted to walk through their property of 607 Point Nepean Road (north west of 3 Penny Lane), as 'there's water running through 607'.

The volume of this water is not known. It is possible that the landslide affected Penny Lane Stormwater Drainage, and therefore, if such volume was typical of seepage prior to the Landslides, it is reasonable to propose the pavement drainage would have the capacity for seepage flows at pre landslide volumes.

It can be concluded though that water flowing through 3 Penny Lane, could be sourced from the Site.

The inconsistencies between 3 statements would suggest that the locations for observations from both Mr. Hutchings and Mr. Borghesi may be too distant or too obscured to guarantee that the seepage stopped when they say it would. It is reasonable to assume that seepage, perhaps less than immediately after the landslide events continues from the property of 10-12 View Point Road, to Penny Lane.

Figure 17: 20/6/25 6 View Point Road, looking south note the disturbed paving, but the house does not show signs of movement.

Figure 18: 20/6/25 6 View Point Road looking west along line of retaining walls, showing tie backs, and several irrigation pipes

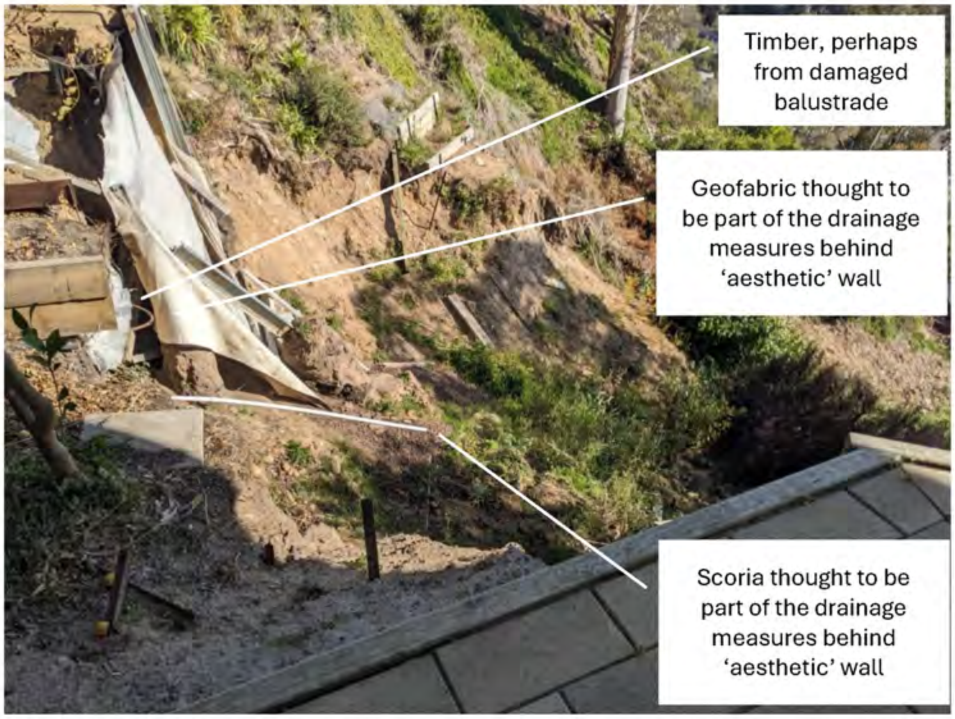

Figure 19: 20/6/25 Looking west showing failed slope material below retaining wall, note the vegetation at the floor of the failed material

Figure 20: 20/6/25 looking north west showing debris flow towards Penny Lane

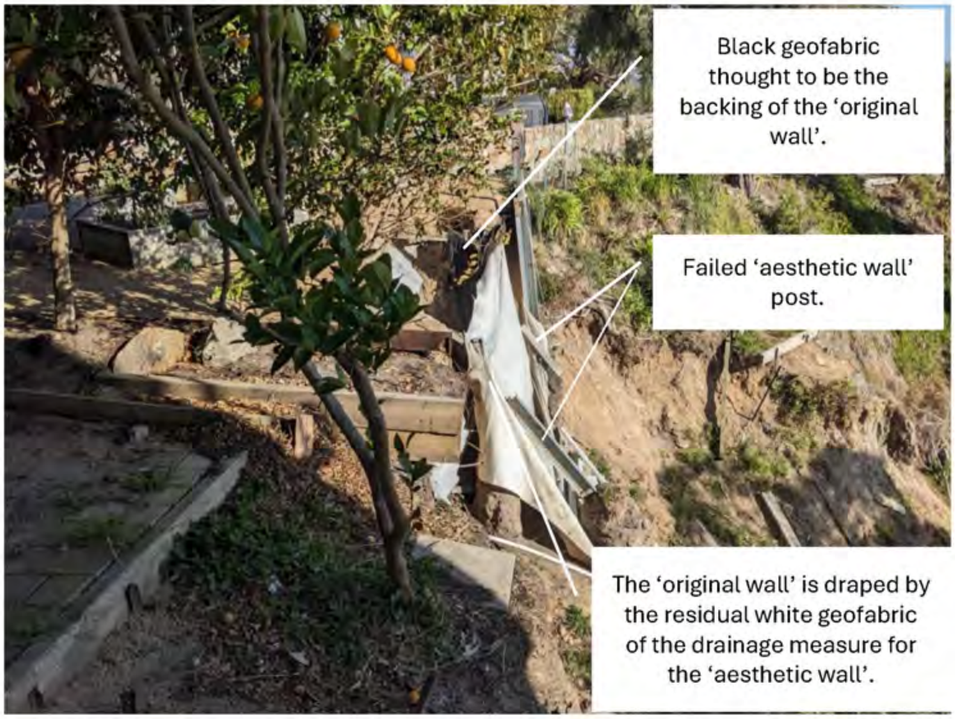

Figure 21: 20/6/25 looking west, showing lemo tree in the foreground, with colluvial material exposed in background.

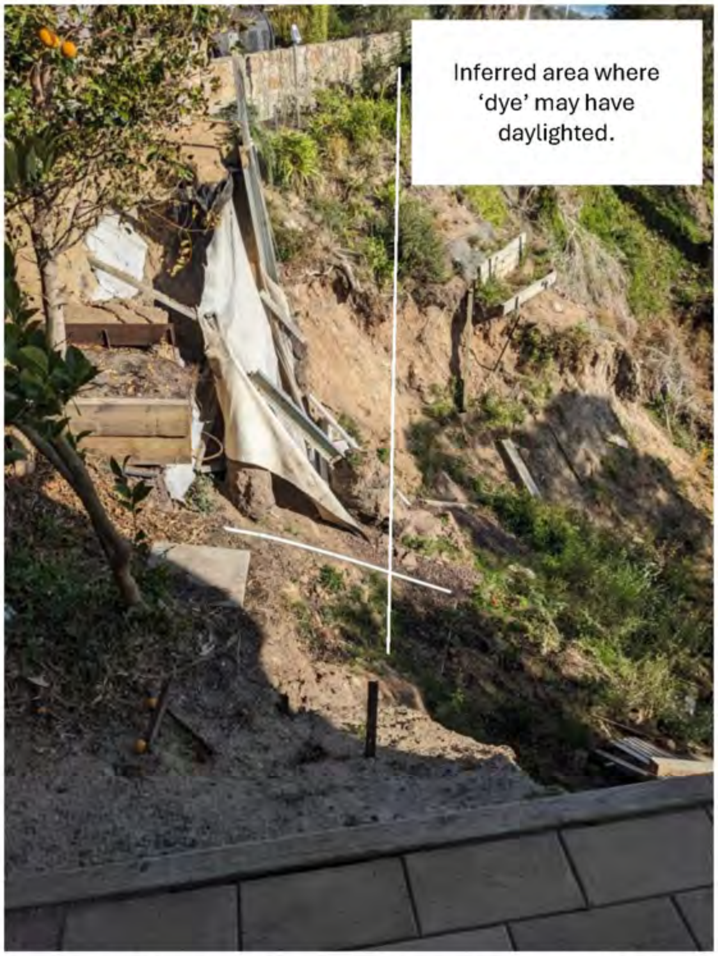

Figure 22: 20/6/25 looking west showing colluvial material exposed , note the geofabric behind the line of the retaining wall.

Figure 23: 20/6/25 Looking north west down the failure, showing depth of slope movement.

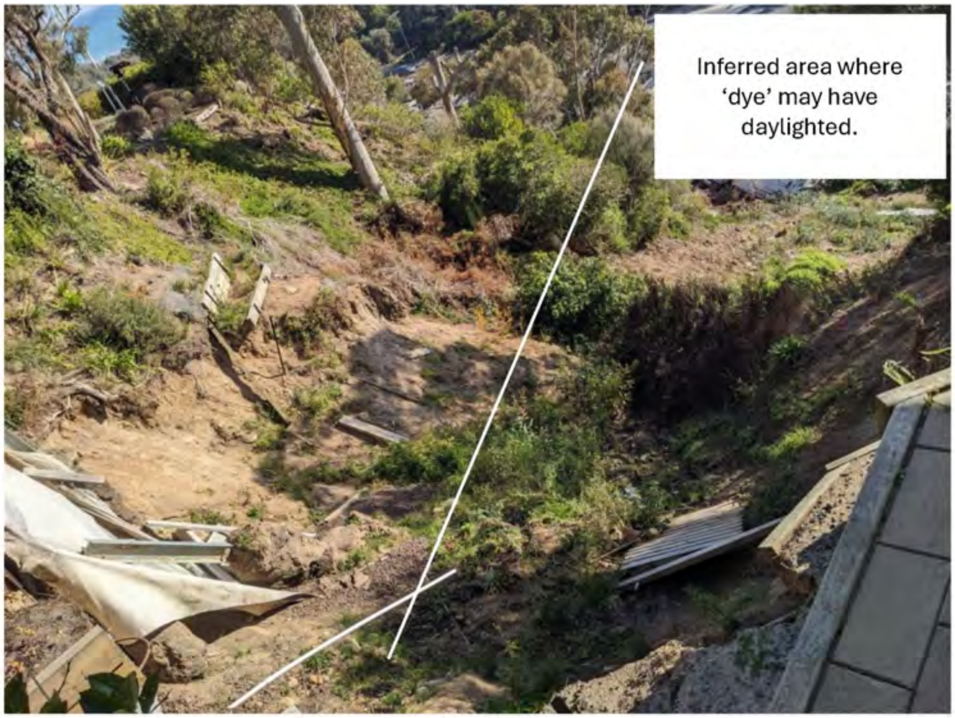

Figure 24: 20/6/25 6 View Point Road, looking north west showing path of landslip

Figure 25: 20/6/25 6 View Point Road, looking south towards fencing with No. 10, showing disturbed ground.

Figure 26: 20/6/25 Looking west from 6 View Point Road. Note the change in geology below the wooden sleepers.

Figure 27: 20/6/25 6 View Point Road, showing evidence of vegetation growth.

Figure 28: 20/6/25 6 View Point Road looking west. Note the leaning back of the retaining wall posts

Figure 29: 20/6/25 6 View Point Road looking north showing front gate which has had to be shaved due to toppling concrete pillar.

Figure 30: 20/6/25 6 View Point Road, Front Garden looking west showing platform 1m high where NDT 01 was drilled.

3.4.4 Walkover survey with landowner's representative of 6 View Point Road

Following the site visit of No. 6 View Point Road, Mr. Hutchings, SMEC personnel, the Board's observer and the SEW Communications Representative carried out a site visit.

Mr. Hutchings confirmed that he observed the subgrade at the T-Junction of Coburn Avenue and Charlesworth Street, during the full width repair in March 2025, was wet.

He has photographs of the back garden of No. 31B Coburn Avenue showing runoff flowing over the garden, in or around January 2025.

We note in Paragraph 22 of Mr. Jason Marsh's statement (Appendix B Ref. 26), that after the 5 January 2025 landslide, he walked the roads of the area and did not list No. 31b Coburn Avenue as a property where he noticed a wet nature strip.

Outside Nos. 5 and 7 Prospect Hill Road, the southbound kerb and edge repair edge was stained brownish red. SMEC notes that No. 5 Prospect Hill Road experienced a private water main leak, identified and repaired in April 2025, and recorded greater than usual requirements to pump water from the basement during January 2025. Mr. Hutchings said that he had seem water weep from the kerb edging and the edge of the edge repair earlier this year.

SMEC personnel observed a private gully pit, known to be the collection point of the AG drainage system for No. 7, recently rebuilt. This gully drains in to the stormwater pit outside No. 11. This stormwater pit is the head of a spur to the stormwater network flowing down View Point Road. The stormwater pit was flowing. It was known by Mr. Hutchings that the network of AG pipes was required because of spring(s) within the property.

Mr. Hutchings said that he noted runoff down the hill of the verge early in the year, where Prospect Hill Road backs on to No. 27 Coburn Avenue.

Figure 31: 20/6/25 5 Prospect Hill Road, looking south showing detail of staining flowing from the joint between asphalt and kerb

Figure 32: 20/6/25 Looking north form 6 Prospect Hill Road, showing cracking, and staining of kerb suggesting runoff has previously flowed over of kerb.

Figure 33: 20/6/25 7 Prospect Hill Road, looking east showing verge

Figure 34: 20/6/25 7 Prospect Hill Road looking east showing gully pot where AG pipes from the property meet, flowing to Stormwater Pit outside No. 11.

4. Limitations

This report has been prepared in general accordance with the objective detailed in our proposal (ref: 30043629 c.004 item 5), modified arrangements made by the client and SEW and others, leading up to site visits on 13, 17 and 20 June 2025.

The contents of the report are for the sole use of South East Water c/o Thomson Geer. No responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement with SMEC.

The observations in this report are based on data collected at specific locations using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific timeframe and technical requirements of the brief and this report does not purport to completely describe all the site characteristics and properties.

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Appendix D

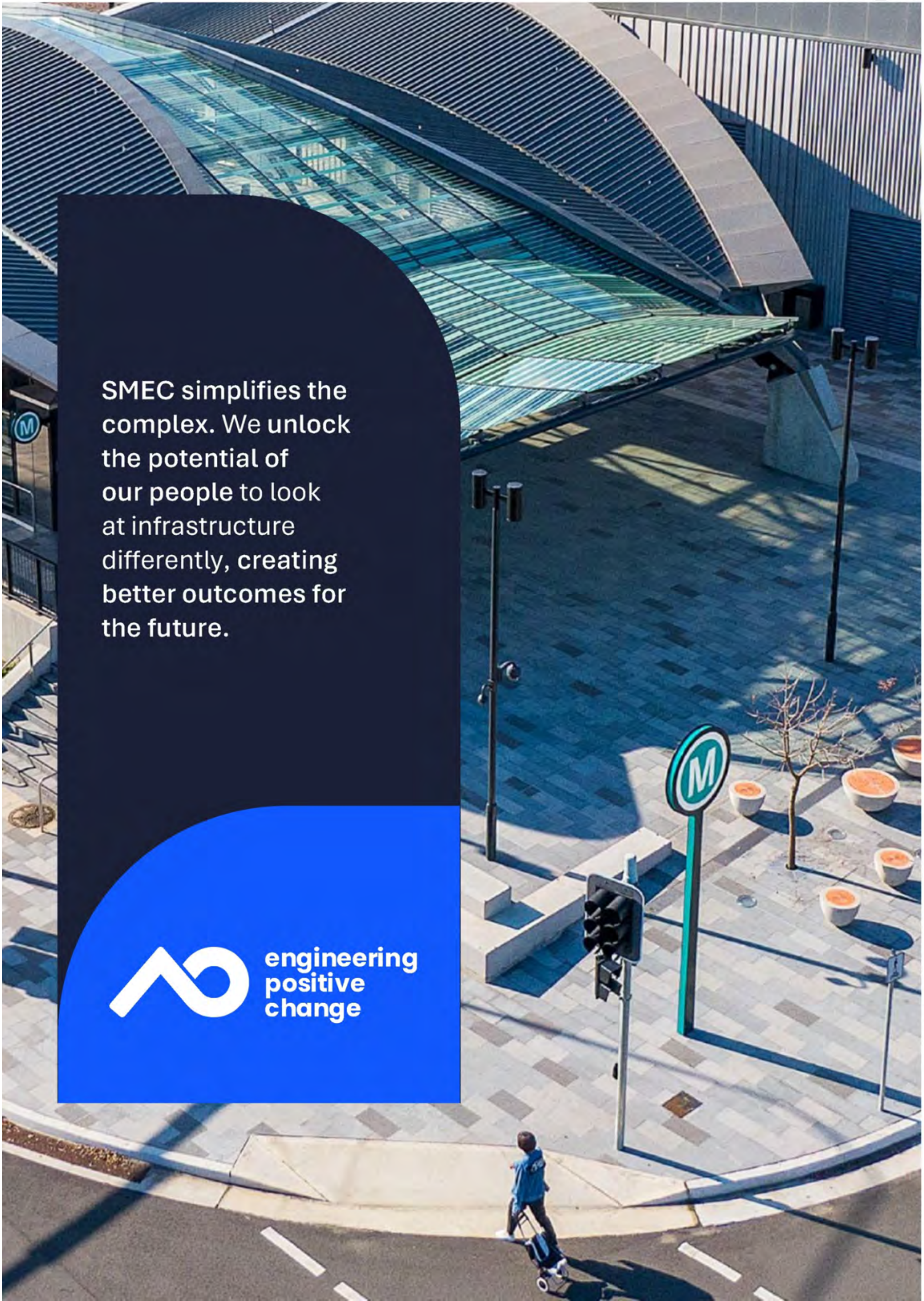
Geotechnical Site Investigation Report

Geotechnical Factual Report

McCrae Landslide Project

Prepared for: South East Water
30 July 2025
Client Reference No. SMEC Report 002 Appendix D

SMEC INTERNAL REF. 30043649



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South East Water

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Contents

Appendices

Figures

Tables

1. Introduction

Two slope failures occurred on 5 January 2025 and 14 January 2025 within the property boundaries of 10-12 View Point Road, McCrae, Victoria. The landslides comprised the downslope movement of a significant volume of material from the upper portion of the slope within the 10-12 View Point Road property. This material accumulated within the 3 Penny Lane property near the toe of the slope, causing substantial damage to the property and injury to a person who was inside the property at the time of the 14 January 2025 landslide.

SMEC Australia Pty Ltd has been engaged by SEW (c/o Thomson Geer) to provide technical advice relating to the 2025 landslides and the contribution that the water main leak may/may not have had in triggering the events. As part of this technical advice SMEC has undertaken limited geotechnical investigations in the locality upslope of the landslide site. A geotechnical investigation was previously completed by Douglas Partners in May to June 2025 surrounding McCrae's Low Level Storage Site (WR174) (Attached as Appendix D – ref: "235669.00.R.001.DFTA", note that at the time of writing only a Draft version was available). This report is referred to as Ref 30 within Appendix B of the supplementary expert report of which this report is also an appendix. SMEC was subsequently engaged to provide an additional geotechnical investigation for the purpose of obtaining information about the subsurface conditions to inform the formulation of the ground model for the area.

2. Aim of the investigation

The aims of the investigation were as follows:

- To provide SEW with geotechnical information to facilitate the causality and impact of the water main leak on the triggering landslide failures;
- To obtain subsurface conditions to help inform the formulation of the ground model;
- To obtain soil samples for laboratory testing;
- To assess the groundwater movement surrounding the site.

3. Scope of works

The completed scope of works is as follows:

- The drilling of four (4) no. boreholes inclusive of BH01, BH02, BH03 and BH04;
- The drilling of three (3) no. Hand Augers inclusive of HA01, HA02 and HA03;
- Non-Destructive Digging (NDD) of thirteen (13) no. locations next to existing assets with:
  - Installation of one (1) piezometer (standpipes) demarked as NDD01;
  - Installation of six (6) dual piezometers demarked as DP01A, DP01B, DP02A. DP02B, DP03A, DP03B, DP04A, DP04B, DP05A, DP05B, DP06A and DP06B;
- Installation and monitoring of groundwater water wells (piezometers) at specified locations;
- Sampling of soil and rock for classification testing in a NATA accredited geotechnical laboratory;
- Preparation of geotechnical investigation factual report (this report)

4. Methodology adopted for investigation

SMECs geotechnical team have carried out the geotechnical investigation at several locations in the vicinity of 10 View Point Road as detailed in the scope of works above. The investigation will provide an understanding of the storage capability of the geology along a possible route for water using SEW asset from Bayview Road to the McCrae landslip.

The fieldwork for the investigation was undertaken between 30 June 2025 and 9 July 2025 and has been summarised below. A test site location plan with all points is provided in Appendix A of this report.

To assess the effect of localised groundwater surrounding the site, all investigation locations (excluding hand augers) had groundwater monitoring wells (piezometers) installed at depth. The monitoring wells were installed by a licenced driller from QEST Infrastructure.

SMEC have obtained Before You Dig Australia (BYDA) plan prior to mobilisation to check the presence of underground services within the site extent. The BYDA enquiry indicated that there was a presence of underground assets within the investigation areas. Therefore, an accredited service locator was engaged to scan, clear and locate the proposed asset. QEST infrastructure was engaged to NDD the investigation locations wherever assets were identified nearby.

Fieldwork was conducted in the presence of a hydrogeologist/geotechnical engineer from SMEC who interpreted and logged the materials encountered, took samples and recorded results of in-situ testing. Relevant logs can be found in Appendix B.

4.1 Borehole investigation

The boreholes were drilled using a track mounted Boart Longyear LX6 drilling rig, owned and operated by QEST Infrastructure. A photo of the drilling rig is pictured in Figure 1 below.

All boreholes were advanced using a solid flight auguring (SFA) technique in soils until refusal or inferred groundwater was intercepted. Wash boring techniques were introduced in BH01 from 4.50m to 13.40m below ground level (bgl). The drilling was subsequently changed to a HQ coring technique in BH01 and BH02 at 13.40m and 15.10m, respectively, until borehole termination depth.

Soil samples, including undisturbed U63, were recovered for laboratory testing and logging purposes. Undisturbed tube samples (U63) collected within selective near surface cohesive layers, the tubes were subsequently sealed to preserve the in-situ moisture condition of the sample. Recovered rock cores were collected in the box and photographed on site and returned to our office for further testing and storage.

Standard Penetration Tests (SPTs) were performed at regular intervals of 1.0m to 1.5m when drilling in soils. In-situ pocket penetrometer testing was conducted on appropriate cohesive samples taken from SFA recovery and/or at the toe of U63 tubes.

Upon completion, all boreholes had monitoring wells installed. For accurate well construction details, refer to Appendix C.

The borehole investigation was undertaken in accordance with the guidelines outlined in AS1726-2017 Geotechnical Site Investigations and SMEC procedures for site investigation. The investigation was conducted under full time presence of one of SMEC's geotechnical engineers/hydrogeologists who supervised the drilling work, logged the boreholes and collected the samples.

All investigation locations were set out using a handheld GPS device, with a typical accuracy of ±5m. The coordinates relative to Geocentric Datum of Australia 2020 (GDA2020) Zone 55 are presented on the geotechnical engineering logs. Elevations of the ground level at investigation locations were surveyed by an SEW surveyor, the data supplied to SMEC.

A summary of the location and termination depth of each borehole is provided in Table 1. The borehole logs are presented in Appendix B-1 along with the core box photographs. The logs are preceded by summary sheets of providing explanation of the descriptive terms and symbols used in their preparation.

Figure 1: Boart Longyear LX6 drill rig setup

Table 1: Summary of borehole investigations

Test ID	Easting	Northing	RL (m AHD)	Termination Depth (m bgl)	Termination Remark	Construction depth of piezometer (m bgl)
BH01	319945.00	5753466.00	72.69	25.80	Target Depth	25.70
BH02	319860.00	5753565.00	59.79	25.90	Target Depth	25.60
BH03	319790.00	5753638.00	51.70	6.45	Target Depth	6.00
BH04	319668.00	5753744.00	36.82	7.50	Auger Refusal	7.50

4.2 Hand auger investigation

The hand augers were advanced using a manual hand auger tool, completed by one of SMEC experienced field engineers. Soil samples recovered from hand auger holes were used for logging and laboratory testing purposes. A typical hand auger tool has been pictured below in Figure 2.

Hand auger holes were advanced to a maximum depth of 3.10m bgl and a summary of the location and termination depth of each borehole is provided in Table 2. The hand auger logs are presented in Appendix B-2. The logs are preceded by summary sheets of providing explanation of the descriptive terms and symbols used in their preparation.

On completion of the hand auger holes, the hole was backfilled with cuttings then sand to match the existing surface level.

Figure 2: Typical Hand Auger sampling setup.

Table 2: Summary of Hand Auger locations

Test ID	Easting	Northing	RL (m AHD)	Termination Depth (m bgl)	Termination Remark
HA01	319726.80	5753742.70	41.10	3.10	Target Depth
HA02	319638.40	5753681.40	36.61	1.20	Target Depth
HA03	319400.30	5753549.70	15.41	1.80	Target Depth

4.3 Non-Destructive Digging investigation

Thirteen (13) locations were excavated using Non-Destructive Digging (NDD) techniques which involves a vacuum truck and pressure blasting the subgrade. NDD techniques were used to excavate holes to target depth. An NDD truck setup by QEST has been pictured below in Figure 3.

Where assets were identified, dual standpipe piezometers were installed directly adjacent to existing services, parallel to the direction of services and separated by two to three metres. These standpipe piezometers are labelled DP01A/B to DP06A/B. One (1) no. NDD was completed in natural material and a standpipe piezometer was installed accordingly and labelled as NDD01.

A summary of the locations and termination depths of each NDD location is provided below in Table 3 and the relevant logs are presented in Appendix B-3. The well construction details are presented in Appendix C.

Figure 3: Non-Destructive Digging vacuum truck

Table 3: Summary of NDD locations

Test ID	Easting	Northing	RL (m AHD)	Termination Depth (m bgl)	Termination Remark	Construction depth of piezometer (m bgl)
NDD01	319758.60	5753668.00	47.92	1.60	Refusal	2.50
DP01A	319783.70	5753646.00	50.78	2.70	Target Depth	2.70
DP01B	319782.60	5753647.00	50.65	2.60	Target Depth	2.60
DP02A	319756.30	5753684.00	46.90	1.60	Target Depth	1.60
DP02B	319755.70	5753684.00	46.87	1.60	Target Depth	1.60
DP03A	319728.10	5753740.00	41.36	0.70	Target Depth	0.70
DP03B	319727.20	5753741.00	41.23	0.70	Target Depth	0.70
DP04A	319654.70	5753689.00	37.65	1.70	Target Depth	1.70
DP04B	319653.40	5753690.00	37.45	1.90	Target Depth	1.90
DP05A	319634.90	5753693.00	35.82	1.00	Target Depth	1.00
DP05B	319633.70	5753693.00	35.73	1.00	Target Depth	1.00
DP06A	319631.60	5753696.00	35.43	1.60	Target Depth	1.60
DP06B	319629.90	5753696.00	35.30	1.60	Target Depth	1.60

5. Results of the investigation

5.1 Boreholes and hand augers

The subsurface conditions encountered during the investigation are presented in the reports of logs in Appendix B. Photographs of the recovered granite rock core recovered from BH01 is presented in Appendix B-1 along with the following information sheets relevant to the interpretation of the borehole reports.

- Explanation of Notes, Abbreviations and Terms.
- Method of Soil Description.
- Terms for Rock Material Strength and Weathering and Abbreviations for Defect Description.

In addition to the SMEC's completed investigation locations. WR174_BH01 was completed by Douglas Partners (DP), logs and relevant report is included in Appendix D of this report.

5.2 Well development

Groundwater monitoring bores were developed in selected locations between 30 June 2025 and 9 July 2025. Water levels were manually gauged using a water dipping tool during site investigation works. Measurements were taken from the top of the PVC casing and results have been tabulated below in Table 4 to Table 7, a typical finished well has also been provided in Figure 4.

Figure 4: Well installation at BH01

Table 4: Groundwater monitoring well measurements

Well ID	Surface RL (m AHD)	Casing RL (m AHD)*	Well Depth (m bgl)	3 July 2025		4 July 2025		6 July 2025	
				Depth (mbtc**)	Elevation RL (m AHD)	Depth (mbtc**)	Elevation RL (m AHD)	Depth (mbtc**)	Elevation RL (m AHD)
BH01	72.69	72.64	25.70	10.58	62.06	14.88	57.76	14.91	57.73
BH03	51.70	51.65	6.00	5.33	46.32	1.86	49.79	1.83	49.82
BH04	36.82	36.77	7.50	Not measured		Not measured		5.93	30.84
NDD01	47.92	47.87	2.50	2.24	45.68	2.44	45.43	DRY	-

*Casing is approximately 50mm below ground level.
**mbtc = metres below top of casing

Table 5: Groundwater monitoring well measurements

Well ID	Surface RL (m AHD)	Casing RL (m AHD)*	Well Depth (m bgl)	7 July 2025		8 July 2025	
				Depth (mbtc**)	Elevation RL (m AHD)	Depth (mbtc**)	Elevation RL (m AHD)
BH01	72.69	72.64	25.70	Not measured		13.81	58.83
BH03	51.70	51.65	6.00	Not measured		1.97	49.68
BH04	36.82	36.77	7.50	Not measured		5.82	30.95
NDD01	47.92	47.87	2.50	DRY	-	DRY	-
DP01A	50.78	50.73	2.70	DRY	-	Not measured	
DP01B	50.65	50.6	2.60	DRY	-	Not measured	
DP02A	46.90	46.85	1.60	DRY	-	Not measured	
DP02B	46.87	46.82	1.60	DRY	-	DRY	-
DP03A	41.36	41.31	0.70	0.55	40.76	0.68	40.63
DP03B	41.23	41.18	0.70	0.62	40.56	0.72	40.46
DP04A	37.65	37.6	1.70	DRY	-	DRY	-
DP04B	37.45	37.4	1.90	1.40	36.00	1.16	36.24
DP05A	35.82	35.77	1.00	Not measured		DRY	-
DP05B	35.73	35.68	1.00	Not measured		DRY	-

*Casing is approximately 50mm below ground level.
**mbtc = metres below top of casing

Table 6: Groundwater monitoring well measurements

Well ID	Surface RL (m AHD)	Casing RL (m AHD)*	Well Depth (m bgl)	10 July 2025		14 July 2025	
				Depth (mbtc**)	Elevation RL (m AHD)	Depth (mbtc**)	Elevation RL (m AHD)
BH01	72.69	72.64	25.70	Not measured		13.83	58.82
BH02	59.79	59.74	25.60	19.45	40.29	19.38	40.36
BH03	51.70	51.65	6.00	Not measured		2.13	49.52
BH04	36.82	36.77	7.50	Not measured		5.995	30.78
DP02B	46.87	46.82	1.60	Not measured		DRY	-
DP03A	41.36	41.31	0.70	Not measured		0.65	36.95

*Casing is approximately 50mm below ground level.
**mbtc = metres below top of casing

WR174_BH01 by DP was drilled and a standpipe was installed to a toe depth of 22.3m bgl. Figure 5 below shows the continuous monitoring of groundwater levels observed within this groundwater well. It is observed that the data logger was installed on 12 June 2025 and continuous measurements at 15-minute intervals until 27 June 2025.

Figure 5: WR174_BH01 groundwater level readings

5.3 Subsurface Conditions

Generalised subsurface conditions encountered across the site is summarised in Table 7. Full details of the subsurface conditions encountered in the boreholes are provided in attached logs in Appendix B along with the explanatory notes describing terms and symbols used in their preparation of the logs. NDD investigation locations were mainly excavated near existing assets in fill and has been omitted from this summary.

Table 7: Subsurface summary of borehole locations

Inferred Geological Unit	Material	Start Depth Range (m bgl)	End Depth Range (m bgl)	Borehole ID
Topsoil	-	0.00	0.05 - 0.30	BH01, BH02, BH03, BH04, HA01, HA02,
Fill	CLAY/ Sandy CLAY/ Silty CLAY	0.05 – 0.80	0.50 – 1.80	BH01, BH02, BH03, HA01
	SAND/Silty SAND	0.00 - 0.30	0.20 - 0.80	BH02, HA01, HA03, WR174_BH01
Inferred Colluvium	Sandy CLAY/ Silty CLAY	0.05 – 1.80	1.60 - 3.50	BH01, BH04
	SAND/ Clayey SAND/Silty SAND	0.20 - 1.80	1.00 - 4.30	BH02, BH04, HA02
Residual Soil	SAND/ Clayey SAND/ Silty SAND	0.20 – 7.90	1.80 – 15.00	BH01, BH02, BH03, BH04, HA01, WR174_BH01
	CLAY/Sandy CLAY/ Silty CLAY	1.00 – 7.50	1.60 - 11.00	BH01, BH02, BH03
Extremely Weathered Granite	SAND/Clayey SAND/Silty SAND	1.00 – 15.00	1.20** – 15.40	BH01, BH02, HA02, WR174_BH01
	Sandy CLAY/Silty CLAY	5.50 - 12.80	7.30 - 13.80	BH01, WR174_BH01
Palaeozoic Granodiorite/ Granite	HW - SW Granite*	7.30 - 15.40	End of Boreholes (22.30 – 25.90)	BH01, BH02, WR174_BH01

*Regular intervals of XW rock recovered within HW – SW Granite range
**End of HA02

6. Geotechnical laboratory testing

Geotechnical laboratory testing was undertaken on selected samples recovered from boreholes and hand auger investigations. Testing was undertaken in accordance with the relevant section AS1289 "Methods of Testing Soils for Engineering Purposes." The laboratory testing schedule is presented in Table 8. It is noted at the submission of this factual report, samples have been submitted to laboratory for testing and once received results will be provided in an addendum.

Selected soil and rock samples were collected and submitted to the NATA accredited laboratory for relevant geotechnical laboratory testing.

Table 8: Summary of laboratory testing

Laboratory Test	Test Method	Quantity
Moisture Content	AS1289.2.1.1	18
4-Point Atterberg Limits with Linear Shrinkage	AS1289.3.1.1, 3.2.1, 3.3.1, 3.4.1	9
Particle Size Distribution (19mm)	AS1289.3.6.1	11
Emerson Classification	AS1289.3.8.1	10
Permeability	AS1289.6.7.1, 6.7.2, 6.7.3	6
Porosity	AS1289.5.1.1	6

7. Limitations

This report has been prepared in general accordance with the objective detailed in our proposal (ref: 30043629 c.004 item 4), modified following the walkover survey of 13 June 2025, a briefing meeting with our geochemist subcontractor on 19 June, and service clearance works on 27 June 2025.

The contents of the report are for the sole use of South East Water c/o Thomson Geer. No responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement with SMEC.

The recommendations in this report are based on data collected at specific locations using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific timeframe and technical requirements of the brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the extrapolated model.

The information provided in logs of boreholes, hand augers and NDD locations are limited to their locality, the logs do not provide or include an interpretation of geotechnical information between these locations. The reliability of the logged information depends on the drilling/testing method, sampling/observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high-quality data. It should also be recognised that the volume of material observed or tested is only a fraction of the total subsurface profile.

Subsurface conditions, such as groundwater levels, can change over time and this should be borne in mind, particularly if the findings and/or recommendations contained within this report are used after a protracted delay.

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Appendix A Test Site Location Plan

FIGURE TITLE Test Site Location Plan

PROJECT TITLE McCrae Landslide

PROJECT NO. 30043649

DATE 11-07-2025

DRAWING NO. SK001

DATUM/CRS GDA2020/MGA Z55

20 0 20 40 60 80 100 m

PAGE SIZE A3

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FIGURE TITLE Test Site Location Plan

PROJECT TITLE McCrae Landslide

PROJECT NO. 30043649

DATE 11-07-2025

DRAWING NO. SK002

DATUM/CRS GDA2020/MGA Z55

9 0 9 18 27 36 45 m

PAGE SIZE A3

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FIGURE TITLE Test Site Location Plan

PROJECT TITLE McCrae Landslide

PROJECT NO. 30043649

DATE 11-07-2025

DRAWING NO. SK003

DATUM/CRS GDA2020/MGA Z55

10 0 10 20 30 40 50 m

PAGE SIZE A3

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FIGURE TITLE Test Site Location Plan
PROJECT TITLE McCrae Landslide
PROJECT NO. 30043649

DATE 11-07-2025
DRAWING NO. SK004
DATUM/CRS GDA2020/MGA Z55

9 0 9 18 27 36 45 m

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Appendix B Explanatory Notes and Logs

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Explanatory Notes of Abbreviations and Terms

Used on Borehole and Excavation Logs

General

The "Geological and Engineering Log" presents data from drilling or excavation operations where material recovery is soil and or rock. Data presented is a combination of material recovered, regular sampling and insitu testing. Excavations may present data obtained on the subsurface profile from observations of natural or man-made excavations. Logs may contain scaled graphical presentations, photography, or downhole imagery results. Logs may not contain all data types presented in these notes.

The "Non Core Drill Hole Engineering Log" presents data from drilling operations where a core barrel has not been used. The material is penetrated using methods other than those designed to recover core and is commonly soil or extremely to highly weathered. The "Cored Drill Hole Engineering Log" presents data from drilling operations where a core barrel has been used. The "Excavation - Geological Log" presents data obtained on the subsurface profile from observations of excavations, either natural or anthropogenic. As far as is practicable, the data contained on the log sheet is factual. Some interpretation is inevitable with respect to the: assessment of material boundaries in areas of partial sampling and recovery,

a. location of areas of core loss,
b. description and classification of material,
c. estimate of field strength, and
d. identification of drilling induced fractures.

Material description and classification is generally based on AS1726-2017 (as amended).

Drilling Method

Code	**Description**
AD/T	Auger drilling with TC-bit
AD/V	Auger drilling V-bit
AS	Auger screwing
AT	Air track
CA	Casing advancer
CC	Concrete core
CT	Cable tool rig
DB	Wash bore drag bit
HA	Hand auger
HAND	Hand methods
HSA	Hollow flight auger
HMLC	Diamond core 64mm diameter
HQ	Wireline, 64mm core diameter
HQ3	Wireline, triple tube, 61mm core diameter
NDD	Non destructive drilling
NMLC	Diamond core 52mm diameter
NQ	Wireline, 48mm core diameter
NQ3	Wireline, triple tube, 45mm core diameter
PT	Continuous push tube
PQ	Wireline, 85mm core diameter
PQ3	Wireline, triple tube, 83mm core diameter
RAB	Rotary air blast
RC	Reverse circulation
RD	Rotary blade or drag bit
RR	Rock roller
RT	Rotary tricone bit
S	Sonic drilling
SFA	Solid flight auger
TBX	Tube-X
VC	Vibro-core drilling
VE	Vaccume Excavation
WB	Wash bore drilling

Casing

Code	**Outside Diameter**
AW	57.1 mm
BW	73 mm
HW / HWT	114.3 mm
NW / NWT	89.9 mm
PW / PWT	139.7 mm
PVC90	90 mm
PVC150	150 mm

Defect Spacing

The average distance between defects is measured parallel to the core axis in mm and may be expressed as a range or average.

Borehole angle and Azimuth

Angle from horizontal where a positive angle is above horizontal, and a negative angle is below horizontal. Azimuth is to magnetic north and in degrees.

Defect Orientation

For vertical boreholes, the dip of the defect is measured relative to core normal (unless specified otherwise). The dip direction can not be ascertained for vertical holes. For inclined boreholes, the Alpha angle is recorded relative to the core axis and where core orientation has been undertaken (with appropriate reference line), a Beta angle can be measured clockwise from the reference line looking down the core axis in the direction of drilling. The alpha and beta angles can be converted to dip and dip direction if the position of the reference line relative the hole is known, and the borehole angle and azimuth is known.

Excavation Method

N	Natural exposure
X	Existing excavation
BH	Tractor mounted backhoe bucket
E	Hydraulic excavator
EH	Hydraulic excavator with hammer
B	Bulldozer blade
R	Ripper

Water / Drilling Fluid

The drilling fluid used is identified and loss of return to the surface is estimated as a percentage, generally of each core lift.

Symbol	**Description**
▶——	Water inflow
▷——	Water inflow partial
——◀	Water outflow
——◁	Water outflow partial
▽	Water level: during drilling or immediately after completion of drilling

Groundwater

Symbol	**Description**
▼	Groundwater level with date observed prior to introduction of fluids or after standpipe construction
Not observed	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole / test pit.
Not en-countered	The borehole / test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole / test pit been left open for a longer period.

Core Run

Core lifts are identified by a line and depth. The run number may be shown and total core recovery is shown as a percentage in brackets followed by the RQD percentage unless otherwise indicated.

Colour

The colour of a soil or rock is described in a moist/wet condition using simple terms, such as black, white, grey, red, brown, orange, yellow green or blue. These are modified as necessary by 'pale', 'dark' or 'mottled'. Borderline colours are described as a combination of these colours (e.g. orange-brown). Where a soil or rock consists of a primary colour with a secondary mottling it is described as (primary colour) mottled (first colour) and (secondary colour).

Description of Soil

- **i.** Soil name
- **ii.** Plasticity or particle size of soil
- **iii.** Colour
- **iv.** Secondary soil components names & estimated proportions including their plasticity / particle characteristics, colour
- **v.** Minor soil components name, estimated proportions, including their plasticity / particle characteristics, colour
- **vi.** Other minor soil components
- **vii.** Structure of soil including zoning, defects & cementing
- **viii.** Additional observations including odour & staining

The origin of soil, soil classification, consistency / density & soil moisture condition are presented separately from the material description.

Particle Size

Term		**Grain Size**
Clay		< 2 µm
Silt		2 – 75 µm
Sand	Fine	0.075 – 0.21 mm
	Medium	0.21 – 0.6 mm
	Coarse	0.6 – 2.36 mm
Gravel	Fine	2.36 – 6.7 mm
	Medium	6.7 – 19 mm
	Coarse	19 – 63 mm
Cobbles		63 – 200 mm
Boulders		> 200 mm

Fine Grained and Coarse Grained Soils

Term	**Description**
Fine Grained Soil (cohesive)	More than 35% of the material less than 63 mm is smaller than 0.075 mm (silts and clays)
Coarse Grained Soil	More than 65% of the material less than 63 mm is larger than 0.075 mm (sands, gravels and cobbles)

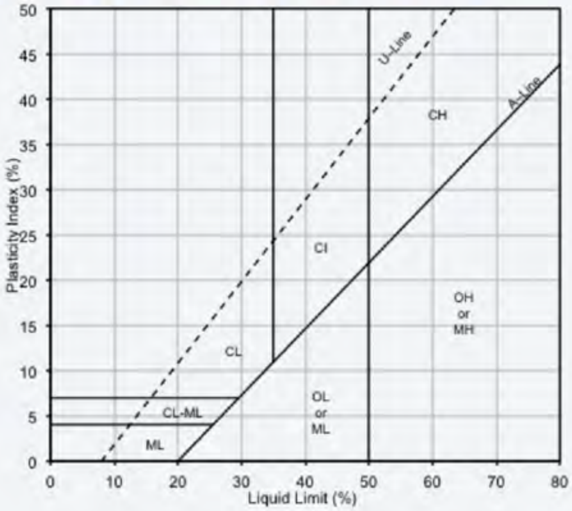
Descriptive Terms for Secondary and Minor Components

Designation of Components	**In coarse grained soils**				**In fine grained soils**	
	% Fines	**Terminology**	**% Accessory coarse fraction**	**Terminology**	**% Sand / Gravel**	**Terminology**
Minor	≤5	trace	≤15	trace	≤15	trace
	>5, ≤12	with	>15, ≤30	with	>15, ≤30	with
Secondary	>12	prefix	>30	prefix	>30	prefix

Plasticity – Fine Grained Soils

Liquid Limit (LL) %	**Description**
≤ 35	Low plasticity
>35 to ≤ 50	Medium plasticity
> 50	High plasticity

Plasticity Chart– Fine Grained Soils



Consistency Terms – Fine Grained Soils

Term	Undrained shear strength (kPa)	Indicative SPT (N) Blow Count	Field Guide to Consistency
Very Soft (VS)	<12	0 – 2	Easily penetrated several centimetres by fist, exudes between fingers when squeezed in fist
Soft (S)	12 – 25	2 – 4	Easily penetrated several centimetres by thumb, easily moulded by light finger pressure
Firm (F)	25 – 50	4 – 8	Can be penetrated several centimetres by thumb with moderate effort, and moulded between the fingers by strong pressure
Stiff (St)	50 – 100	8 – 15	Readily indented by thumb but penetrated only with difficultly. Cannot be moulded by fingers
Very Stiff (VSt)	100 – 200	15 –30	Readily indented by thumb nail, still very tough
Hard (H)	>200	>30	Indented with difficulty by thumb nail, brittle
Friable (Fr)	-		Can be easily crumbled or broken into small pieces

Density Terms – Coarse Grained Soils

Term	Density Index (%)	SPT (N) Blow Count
Very Loose (VL)	< 15	0 – 4
Loose (L)	15 – 35	4 – 10
Medium Dense (MD)	35 – 65	10 – 30
Dense (D)	65 – 85	30 – 50
Very Dense (VD)	> 85	>50

Particle Characteristics – Coarse Grained Soils

Term	Description
Well Graded	Having good representation of all particle sizes
Poorly graded	With one or more intermediate size poorly represented
Gap graded	With one or more intermediate sizes absent
Uniform	Essentially of one size

Angularity – Coarse Grained Soils

	Rounded
	Sub-rounded
	Angular
	Sub-angular

Origin of Soil

Fill	Formed by humans
Aeolian	Formed by wind
Alluvial	Formed by streams and rivers
Colluvial	Formed on slopes (talus)
Estuarine	Formed in marine environments
Lacustrine	Formed in lakes
Residual	Formed by weathering insitu

Soil Moisture

	Term	Code	Description
Coarse Grained	Dry	D	Looks and feels dry and free running
	Moist	M	Soil feels cool, darkened in colour, soils tend to stick together, soil grains do not run freely through fingers and no visible free water
	Wet	W	Soil feels cool, darkened in colour, soils tend to stick together, free water on remoulding
Fine Grained	Moist, Less than Plastic Limit	W < PL	Hard and friable or powdery, moisture content well below Plastic Limit
	Moist, Near Plastic Limit	W ≈ PL	Soil feels cool, darkened in colour, can be moulded, near Plastic Limit
	Moist, Wet of Plastic Limit	W > PL	Soil feels cool, dark, usually weakened, free water, moisture content well above Plastic Limit
	Wet, Near Liquid Limit	W ≈ LL	Soil exudes easily
	Wet, Wet of Liquid Limit	W > LL	Soil behaves as a liquid

Boundary Classifications

Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.

Graphic Symbols

■	Asphalt	▒	MH
▥	CH	▤	ML
▨	CI	▒	OH
▤	CL	▒	OL
▦	Concrete	▒	PT
▩	Fill	▨	SC
▒	GC	▨	SM
▒	GM	░	SP
▒	GP	░	SW
▒	GW		

Description of Rock

i. Rock name
ii. Grain size and mineralogy
iii. Colour
iv. Fabric, bedding and texture
v. Features, inclusions, minor components, moisture condition and durability
vi. Rock mass properties - discontinuities and structure of rock
vii. Additional observations including odour & staining

The origin of rock, interpreted stratigraphic unit, strength weathering and alteration are presented separately from the material description.

Simple rock names are used to provide a reasonable engineering description, rather than a precise geological classification. The rock name is chosen by considering the nature and shape of the grains or crystals, the texture and fabric of the rock material, the geological structure and setting, and information from the geological map of the area. Further guidance on the naming of rocks can be found in AS1726-2017, Tables 15, 16, 17 and 18. Typical rock types are described below, though subject to site specific variations.

Rock Type	Description	Example of Rock Name
Sedimentary	Formed by deposited beds of sediments, have grains that are cemented together and often rounded. Significant porosity	COMMON: Conglomerate, Breccia, Sandstone, Mudstone, Siltstone, Claystone ≥90% CARBONATE: Limestone, Dolomite, Calcirudite, Calcarenite, Calcisiltite, Calcilutite PYROCLASTIC: Agglomerate, Volcanic Breccia, Tuff
Igneous	Formed from molten rock and have a crystalline texture. Typically massive and low porosity. Rock types are from coarse to fine grained.	HIGH QUARTZ CONTENT: Granite, Microgranite, Rhyolite MODERATE QUARTZ CONTENT: Diorite, Microdiorite, Andesite LOW QUARTZ CONTENT: Gabbro, Dolerite, Basalt
Metamorphic	Formed when rocks are subject to heat and/or pressure and have typically have directional fabric. Typically have low porosity and crystalline structure. Rock types are from coarse to fine grained	FOLIATED: Gneiss, Schist, Phyllite, Slate NON-FOLIATED: Marble, Quartzite, Serpentinite, Hornfels
Duricrust	Formed as part of a weathering profile and show evidence of being cemented in situ. Cementation is typically irregular and exhibits replacement textures.	Ferricrete (Iron oxides and hydroxides) Silicrete (Silica) Calcrete (Calcium carbonate) Gypcrete (Gypsum)

Note: ( ) denotes dominant cementing mineralogy

Grain Size

Terms describing dominate grain size in sedimentary rocks.

Term	Grain size
Coarse	Mainly 0.6 mm to 2 mm
Medium	Mainly 0.2 mm to 0.6 mm
Fine	Mainly 0.06 mm (just visible)

Terms describing dominate grain size in igneous and metamorphic rocks

Term	Grain size
Coarse	Mainly greater than 2 mm
Medium	0.06 mm to 2 mm
Fine	Mainly less than 0.06 mm (just visible)

Texture and Fabric

Sedimentary rocks

Thickness	Bedding Term
< 6 mm	Thinly laminated
6 – 20 mm	Laminated
20 – 60 mm	Very thinly bedded
60 – 200 mm	Thinly bedded
0.2 – 0.6 m	Medium bedding
0.6 – 2 m	Thickly bedded
> 2 m	Very thickly bedded

Igneous rocks

Term	Definition
Amorphous	Indicates that the rock has no obvious crystalline structure
Crystalline	A regular molecular structure, showing crystal structure and symmetry.
Cryptocrystalline	The texture comprises crystals that are too small to recognise under an ordinary microscope. Indistinctly crystalline.
Porphyritic	Indicates the presence of phenocrysts (relatively large crystals in a fine grained ground mass) in igneous rocks.
Flow banded	Indicates visible flow lines in volcanic rocks and some intrusive rocks
Glassy	Entirely glass like. No crystalline units and without crystalline structure.
Vesicular	A texture of volcanic rocks that indicates the presence of vesicles (small gas bubbles). Where the vesicles are filled with a mineral substance they are termed Amygdales and the texture is Amygdaloidal.

Metamorphic

Term	Definition
Foliation	The parallel arrangement of minerals due to metamorphic process, which shall be defined by the terms in weak, moderate and strongly foliated.
Porphyroblastic	A texture indicating the presence of porphyroblasts (larger crystals formed by recrystallization during metamorphism, such as garnet or staurolite in a mica schist).
Cleavage	A type of foliation developed in fine grained metamorphic rocks such as slates.

Bedding and Fabric Development

Type	Definition
Massive	No obvious development of bedding – rock appears homogeneous
Poorly Developed	Bedding is barely obvious as faint mineralogical layering or grain size banding, but bedding planes are poorly defined.
Well Developed	Bedding is apparent in outcrops or drill core as distinct layers or lines marked by mineralogical or grain size layering.
Very Well Developed	Bedding is often marked by a distinct colour banding as well as by mineralogical or grain size layering.
Indistinct fabric	There is little effect on strength properties
Distinct Fabric	The rock may break more easily parallel to the fabric

Rock Strength

Term (Code)	UCS (MPa)	$Is_{(50)}$ (MPa)	Field Guide to Strength
Soil Strength (SS)	<0.6	<0.03	Soil strength materials, formerly classified as Extremely Low Strength rock, as to be assigned a soil strength based on the soil characteristics: granular or cohesive. Where strength ranges between soil and Very Low Strength rock, Soil Strength may be used for transitional strengths.
Very Low (VL)	0.6 – 2	> 0.03 to ≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3 cm thick can be broken by finger pressure.
Low (L)	2 - 6	> 0.1 to ≤ 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blow of the pick point; has dull sound under hammer. A piece of core 150 mm long 50 mm in diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium (M)	6 - 20	> 0.3 to ≤ 1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm in diameter can be broken by hand with difficulty.
High (H)	20 - 60	> 1 to ≤ 3	A piece of core 150 mm long by 50 mm in diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High (VH)	60 -200	> 3 to ≤ 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High (EH)	>200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Rock strength is assessed by laboratory Uniaxial Compressive Strength (UCS) testing and/or Point Load Strength Index (PLT) testing to obtain the $Is_{(50)}$ the strength table implies a 20 times correlation between $Is_{(50)}$ and UCS used for classification. Note however, multiplier may range from 4 (e.g. some carbonated and low strength rocks) to 40 (e.g. some igneous rocks and/or some high strength rocks). A site specific correlation based on testing, previous investigation or literature may be used where available. These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considered weaker due to the effect of rock defects. Material with strength less than Very Low are described using soil characteristics including consistency / density as detailed on page 4.

Visual Log

A detailed core photo or diagrammatic plot of defects showing type, spacing and orientation in relation to the core axis.

———	Defects open in-situ or clay sealed
--------	Defects closed in-situ
············	Drill induced fractures or handling breaks
▬	Infilled seam

Rock Weathering and Alteration Classification

<table>
<tr><th colspan="2">Term (Code)</th><th colspan="2">Definition</th></tr>
<tr><td colspan="2">Residual soil (RS)</td><td colspan="2">Soil developed on extremely weathered rock. The rock mass structure and substance fabric are no longer evident but the soil has not been significantly transported.</td></tr>
<tr><td colspan="2">Extremely weathered (XW)
Extremely altered (XA)</td><td colspan="2">Rock is weathered to such an extent that it has 'soil' properties, i.e, it either disintegrates or can be remoulded in water, but the texture of original rock is still evident.</td></tr>
<tr><td>Highly weathered (HW)
Highly Altered (HA)</td><td rowspan="2">Distinctly weathered (DW)*
Distinctly Altered (DA)</td><td>Whole rock material is discoloured usually by extent that iron staining or bleaching and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original rock substance is no longer recognisable</td><td rowspan="2">*Where is it not practical to distinguish between 'HW' and MW'. Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores</td></tr>
<tr><td>Moderately weathered (MW)
Moderately Altered (MA)</td><td>Whole rock material is discoloured usually by staining that original colour of the fresh rock is no longer recognisable</td></tr>
<tr><td colspan="2">Slightly weathered (SW)
Slightly altered (SA)</td><td colspan="2">Rock is slightly discoloured but shows little or no change of strength from fresh rock</td></tr>
<tr><td colspan="2">Fresh rock (FR)</td><td colspan="2">Rock shows no sign of decomposition or staining.</td></tr>
</table>

Rock Core Recovery

TCR = Total Core Recovery (%)

$$\frac{\textbf{Length of Core Recovered}}{\textbf{Length of Core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$\frac{\textbf{Sum Length of Cylindrical Core Recovered}}{\textbf{Length of Core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$\frac{\textbf{Sum Length of Sound Core Pieces > 100mm in length}}{\textbf{Length of Core run}} \times 100$$

Types of Defects

Term		Code	Description
Parting		P	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (i.e. cleavage). May be opened or closed.
Joint		J	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or sub-parallel to layering or to planar anisotropy in the rock material. May be open or closed.
Sheared Surface		S	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.
Sheared Zone		SZ	Zone of rock material with roughly parallel, near planar, curved, or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.
Crushed Zone[a]		CZ	A zone of broken and disturbed ground containing more than one identifiable Crushed Seam.
Fracture Zone[a]		FZ	A zone of broken ground with parallel to opposing boundaries dominated by abundant, extremely closely to closely spaced defects, which may be intact or open, and planar, curved, undulating, irregular, or stepped, resulting in a dissected rock mass of angular trapezoidal, triangular or rectangular fragments.
Seam (SE)	Sheared Seam	SS	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.
	Crushed Seam	CS	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.
	Infilled Seam	IS	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.
	Extremely Weathered Seam	EW	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.
Fault [b]		FT	A fracture (defect) or fracture zone along which there has been an observable amount of displacement.
Vein [c]		VE	Any fracture that contains mineralized material. Veins can display either crack-normal extension or shear displacement coupled with crack-normal extension.
Vugh [a]		VG	An open void with secondary crystallisation which may be coated, partly or nearly completely filled.
Void [a]		VO	An open space created through natural or anthropogenic processes, including, but not limited to, caves, kettles, tunnels, mines, pipes, piping, landslides, faulting, shearing, dissolution, & erosion.
Mechanical Break		MB	A fracture or break induced or created by the sampling process (i.e. drilling (DB) handling (HB), drill lift (DL), excavation, or blasting).

All definitions as per AS1726-2017 except: a) SMEC Field Manual, b) British Standard BS 5930:2015 and
c) Glossary of Geology (Fifth Edition - revised 2011) American Geosciences Institute.

Discontinuity Planarity

Code	Description
CU	Curved – A defect with a gradual change in orientation
IR	Irregular – A defect with many sharp changes in orientation
PR	Planar – Defect forms a continuous plane without variation in orientation
ST	Stepped – A defect with distinct sharp steps or step
UN	Undulose – A defect with undulations

Discontinuity Roughness

Code	Description
VR	Very rough – many large surface irregularities, amplitude generally more than 1mm
RF	Rough – Many small surface irregularities generally related to the grain size of the parent rock
SM	Smooth – Few or no surface irregularities related to the grain size of the parent rock
PO	Polished – Planes have a distinct sheen or a smoothness
SL	Slickensided – Planes have a polished, grooved or striated surface consistent with differential movement of the parent rocs along the plane

Type of Structures

Term	Code	Description
Bedding	BD	A layered arrangement of minerals parallel to the surface of deposition which has caused planar anisotropy in the rock substance.
Cleavage	CV	An alignment of fine grained minerals caused by deformation.
Fold Axis	FX	The orientation of a line representing the location of greatest curvature of a fold
Schistosity	SH	A layered arrangement of minerals to each other
Foliation	FL	A planar alignment of minerals caused by deformation.
Void	VO	A completely empty space
Dyke	DK	Sheet-like bodies of igneous rock that cut across sedimentary bedding or foliations in rocks. They may be single or multiple in nature
Sill	SI	A sill is an intrusion of magma that spreads underground between the layers of another kind of rock
Contact	CX	A contact between intrusive and stratigraphic units.
Boundary	BN	A distinct boundary between two stratigraphic units

Note: Drill breaks (DB) and handling breaks (HB) are not included as natural discontinuity.

Discontinuity Spacing

Spacing (mm)	Description
>6000	Extremely Widely Spaced
2000 - 6000	Very Widely Spaced
600 - 2000	Widely Spaced
200 - 600	Moderately Widely Spaced
60 - 200	Closely Spaced
20 - 60	Very Closely Spaced
<20	Extremely Closely Spaced

Discontinuity Aperture Openness

Code	Description
tight	Nil, Closed
very narrow	>0-2 mm, Closed
narrow	2-6 mm, Closed
moderately narrow	6-20 mm, Gapped
moderately wide	20-60 mm, Open
wide	60-200 mm, Open
very wide	>200 mm, Open

Infill Material

Code	Name	Code	Name
AM	Azurite / Malachite	Gp	Gypsum
Ap	Apatite	He	Hematite
Ca	Calcite	Is	Ironstone
Co	Coal	Mn	Manganese
Ch	Chlorite	Pl	Pyrolusite
Cp	Chalcopyrite	Py	Pyrite
Cy	Chalcedony	Sd	Siderite
Ep	Epidote	Se	Serpentine minerals
Fe	Limonite/Goethite	Sp	Sphalerite
FeO	Iron oxide	Um	Unidentified mineral
Fs	Feldspar (K)	Qz	Quartz
FsC	Feldspar (Ca/Na)	X	Carbonaceous
Ga	Galena	Ze	Zeolite

Discontinuity Observation

Term	Code	Description
Clean	CN	No visible coating or infill
Stain	SN	No visible coating or infill but surfaces are discoloured by mineral staining
Veneer	VN	A visible coating or soil or mineral substance but usually unable to be measured. If discontinuous over the plane, patchy veneer.
Coating	CT	A visible coating up to 1mm thick. Thicker soil material shall be described using defect terms (e.g. infilled seam). Thicker rock strength material shall be described as a vein.

Discontinuity Nature

Code	Description
C	Crushed
DL	Dilated
DS	Displaced
HL	Hairline
HE	Healed
IF	Infilled
IT	Intact

Samples

Code	Description
B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample
ES	Soil sample for environmental testing
EW	Water sample for environmental testing
G	Gas sample
LB	Large bulk disturbed sample
P	Piston sample
SPTLS	Standard penetration test liner sample
U	Undisturbed push in sample
U50	Undisturbed tube sample (50 mm diameter)
U75	Undisturbed tube sample (75 mm diameter)
CONCC	Concrete core
M	Mazier type sample

Field Tests

Code	Description
DCP	Dynamic Cone Penetration test
H	Hydraulic fracturing
HB	Hammer bouncing
PP	Hand penetrometer test
$Is_{(50)}$	Point Load Index
K	Permeability
N	Standard penetration test result
REC	Recovered length of SPT
PID	Photoionisation detector reading in ppm
R	Refusal
SPT	Standard penetration test
VS	Vane shear test
FP	Pressuremeter
● (A)	Axial Test
○ (D)	Diametral Test
□	Irregular Lump test
uL	Lugeon value

Laboratory Tests

Code	Description
ACM	Asbestos Containing Material
AT+MC	Atterberg Limits + moisture content
CD	Consolidated Drained
CBR	California Bearing Ratio (4 day, 4.5kg, 98%)
Cerchar	Cerchar Abrasivity
CU	Consolidated Undrained
DS	Direct shear along defect
DSI	Direct shear through intact rock
DTd	Direct Tensile - defect
DTr	Direct Tensile - rock
EC	Emerson Class
HELD	Sample held at this time for possible later testing
LL	Liquid Limit
LS	Linear Shrinkage
MC	Moisture Content
MDD	Maximum Dry Density
MSD	Modified slake durability
NAGC	Nett Acid Generating Capacity
OMC	Optimum Moisture Content
PBT	Plate Bearing Test
PET	Petrography
PHD	Pinhole dispersion
PI	Plasticity Index
PL	Plastic Limit
PSD	Particle Size Distribution
PSD+	PSD + hydrometer
ρ_b	Bulk Density
ρ_p	Particle Density
ρ_d	Dry Density
UCS+	Unconfined Compressive Strength + Youngs Modulus + Poisson's Ratio (rock) + Moisture content + wet density
UU	Undrained Unconsolidated
TXL	Triaxial (rock)
TX	Triaxial (soil)
CHEM	Geochemical Testing
■	UCS Test

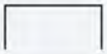
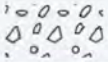
Types fo Defects - Televiewer logging

Type	Description
BD	Bedding, a depositional fabric in the rock, that is not considered a geotechnical defect as it is closed at the location in which it was observed
BN	A distinct boundary between two stratigraphic units
BSH	Bedding Shear, a shear connecting bedding surfaces or shearing along a bedding surface
CX	A contact between intrusive and stratigraphic units
CS	Crush seam, typically sub-horizontal seam with soft infill and possible rock fragments showing evidence of localised crushing at the location in which it was observed
CV	Cleavage, a secondary deformation fabric, not inherently part of the deposition fabric of the rock that presents as a surface of weakness or defect
FX	Fold axis, not dip and dip direction of a plane but trend and plunge of a line that represents the axis of the folded limbs
FT	Fault, a fracture, similar to a joint, but where defined displacement is observed (e.g. through mismatching of bedding across the structure)
FT/FZ	A fault or group of closely spaced faults with cumulative defined displacement observed
J	Joint, a fracture in the rock with little to no tensile strength
P	Parting, as per bedding but forms a defect in the rock as the two sides are separated at the location in which it was observed
SM	Clay seam, typically sub-horizontal seam with clay and no evidence of shearing at the location in which it was observed
SR	Shear, deformation feature with evidence of movement within the infill zone at the location in which it was observed. Often bounded by discreet structures
SR/ SZ	Shear zone, multiple shear features making up a wider zone of deformation
SS	Sheared seam, typically sub-horizontal with evidence of movement within the infill zone at the location in which it was observed
VE	Vein, open bounding surfaces or vuginess at the location in which it was observed
Vc	Vein with closed bounding surfaces at the location i n which it was observed

Concrete Bond Logging

Type	Description
BLJ	Bonded Lift Joint
ULJ	Unbonded Lift Joint
LJ	Lift Joint

Backfill / Standpipe Detail

Symbol	Description
	Cement seal
	Grout backfill
	Blank pipe
	Slotted pipe
	Surface Completion: Monument Above Ground
	Filter pack: sand filter
	Filter pack: gravel filter
	Bentonite seal
	Cutting – excavated material backfill
	Surface Completion: Gatic Ground Monument

Completion Details

Type	Description
Collapse	Exploratory hole collapsed before reaching planned depth
Equipment Failure	Boring or excavator equipment operational failure
Flooding	Flooding of excavation
Machine Limit	Limit of machine capability reached
Obstruction in the hole	Obstruction preventing further advancement
Possible services	Indication of possible services below
Services present	Services encountered during exploratory hole
Squeezing	Hole squeezing boring equipment
Target Depth	Depth reached as planned
Target Depth Instrumentation Installed	Depth reached as planned instrumentation installed
Target Depth Standpipe Installed	Depth reached as planned open standpipe constructed
Refusal	Material preventing further advancement

Status

Code	Description
-2	Historic
-1	For information
0	Preliminary
1	Checked
2	Draft
3	Final

B-1 Borehole logs

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **BH01_SMEC**
FILE / JOB NO : 30043649
SHEET : 1 OF 5

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319945.0, N: 5753466.0 (MGA2020-55)
SURFACE ELEVATION : 72.69 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 1/7/2025
DATE COMPLETED : 2/7/2025
DATE LOGGED : 2/7/2025
LOGGED BY : SC
CHECKED BY : PE

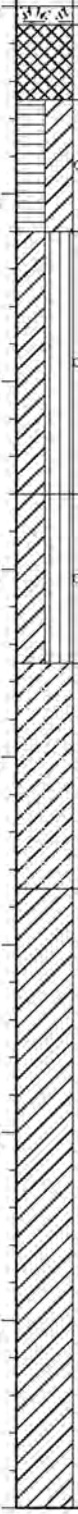
DRILLING

PROGRESS – DRILLING & CASING: SFA (0.0–4.50), WB (4.50–8.0)
PROGRESS – DRILLING & CASING: PWT (0.0–6.0), HQ (6.0–8.0)
GROUND WATER LEVELS: Not Observed

SAMPLES & FIELD TESTS
0.10m B 0.50m
0.50m SPT 8,9,12 N=21 (0.45m REC) 0.95m
1.50m SPT 8,9,10 N=19 (0.45m REC) 1.95m
2.50m U 2.70m
2.70m SPT 9,14,17 N=31 (0.45m REC) 3.15m
3.50m U 3.76m
3.76m SPT 10,18,25 N=41 (0.45m REC) 4.20m
4.50m SPT 25/140mm HB N=R (0.14m REC) 4.64m
5.70m SPT 9,11,10 N=21 (0.45m REC) 6.15m
7.20m SPT 11,9,8 N=17 (0.45m REC) 7.65m

DEPTH (m)	RL (m AHD)
0.0	72.7
1.0	71.7
2.0	70.7
3.0	69.7
4.0	68.7
5.0	67.7
6.0	66.7
7.0	65.7
8.0	64.7

MATERIAL



Depth	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.10m		TOPSOIL Sandy CLAY: low plasticity, brown, with grass rootlets	w>PL		TOPSOIL 0.00: grass reserve with gum trees nearby
0.50m		FILL CLAY: low to medium plasticity, brown, with fine to coarse grained sand, trace gravel	w<PL	Fr	FILL 0.10-0.50: root and wood inclusions
1.20m	CL-CI	Sandy CLAY: low to medium plasticity, pale grey, sand is fine grained.	w<PL	VSt	INFERRED COLLUVIUM SOIL
2.60m	CI-CH	Silty CLAY: medium to high plasticity, brown, orange, grey, trace fine grained sand	w≈PL		1.64: PP >400 kPa 2.00: inferred minor perched water
3.50m	CI-CH	Sandy CLAY: medium to high plasticity, grey, orange, brown, sand is fine to coarse grained	w>PL		
4.70m	SM	Clayey Silty SAND: fine grained, grey, brown, silt is low plasticity	M	D	RESIDUAL SOIL 4.50-13.50: moisture inferred from SPT sampling
	CI	Sandy CLAY: medium plasticity, grey, brown, sand is fine to coarse grained; trace fine grained subangular to angular gravel 7.20-7.50: sand content increasing	w>PL	VSt	

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **BH01_SMEC**
FILE / JOB NO : 30043649
SHEET : 2 OF 5

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319945.0, N: 5753466.0 (MGA2020-55)
SURFACE ELEVATION : 72.69 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 1/7/2025
DATE COMPLETED : 2/7/2025
DATE LOGGED : 2/7/2025
LOGGED BY : SC
CHECKED BY : PE

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
WB HQ			Not Observed		8.0 64.7	▨	CI	Sandy CLAY: medium plasticity, grey, brown, sand is fine to coarse grained; trace fine grained subangular to angular gravel. *(continued)*	w>PL	VSt	RESIDUAL SOIL
				8.70m SPT 7,10,12 N=22 (0.45m REC) 9.15m	9.0 63.7						
					10.0 62.7						
				10.70m SPT 12,18,25 N=45 (0.45m REC) 11.15m							
					11.0 61.7	▨	SC	11.00m Clayey SAND: fine to coarse grained, poorly graded, grey, brown, clay is low to medium plasticity; trace fine to coarse grained subangular to angular gravel. (Extremely Weathered granite)	M	D - VD	EXTREMELY WEATHERED MATERIAL 11.00: inferred extremely weathered granite. Quartz gravel recovered
					12.0 60.7						
				12.20m SPT 11,14,30 N=44 (0.45m REC) 12.65m							
						▤	CL-CI	12.80m Sandy CLAY: low to medium plasticity, grey, brown, black, sand is fine to coarse grained; trace fine to coarse grained gravel. (Extremely Weathered granite)	w>PL	H	12.70: hole paused for day (5pm 1/07 to 7am 2/07). Water level at 5.10pm 1/7 1.9 mbgl and 2.73 mbgl at 7:15am 2/7. After bailing, water level at 7.3 mbgl and remained at this level for 15 minutes, indicating no, or extremely slow, groundwater recharge
					13.0 59.7						
▼	▼			13.20m SPT 14,15/110mm HB N=R (0.20m REC) 13.40m				13.40m			
								Continued as Cored Drill Hole			
					14.0 58.7						
					15.0 57.7						
					16.0 56.7						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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CORED DRILL HOLE LOG

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

HOLE NO : BH01_SMEC
FILE / JOB NO : 30043649
SHEET : 3 OF 5

POSITION : E: 319945.0, N: 5753466.0 (MGA2020-55)
SURFACE ELEVATION : 72.69 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 1/7/2025
DATE COMPLETED : 2/7/2025
DATE LOGGED : 2/7/2025
LOGGED BY : SC
CHECKED BY : PE
CASING DIAMETER : 88.9/139.7
BARREL (Length) :
BIT :
BIT CONDITION :

DRILLING						MATERIAL					FRACTURES		
PROGRESS: DRILLING & CASING	PROGRESS: WATER	(CORE LOSS RUN %) DRILL DEPTH	RQD (%)	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG		DESCRIPTION ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable)	WEATHERING	Inferred Rock Strength UCS ■ Is(50) ● - Axial O - Diametral VL L M H VH EH	NATURAL FRACTURE (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
					8.0 64.7								
					9.0 63.7								
					10.0 62.7								
					11.0 61.7								
					12.0 60.7								
					13.0 59.7								
							13.40m	START CORING AT 13.40m					
HQ		0% LOSS	0	SPT 14,15/110mm HB N=R (0.20m REC) 13.40m				CL-CI Sandy CLAY: low to medium plasticity, grey, brown, black, sand is fine to coarse grained; trace fine to coarse grained gravel; (Extremely Weathered), hard; Moist, wet of plastic limit					13.50: feldspathic gravel
					14.0 58.7		13.80m	SC Clayey SAND: medium to coarse grained, poorly graded, dark grey, red-brown, clay is low to medium plasticity; with medium to coarse grained subangular to angular gravel; (Extremely Weathered granite), very dense; moist.					
		14.90											
		0% LOSS	0		15.0 57.7								
							15.40m	GRANITE: medium to coarse grained, red-brown, grey, massive.	HW				15.40-16.00: granite 15.50: J, 20°, CT, CU, RF 15.58: J, 20°, CN, PR, SM 15.70-15.75: CZ, 5°, VN, IR, RF
					16.0 56.7		16.00m						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

CORED DRILL HOLE LOG

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

HOLE NO : BH01_SMEC
FILE / JOB NO : 30043649
SHEET : 4 OF 5

POSITION : E: 319945.0, N: 5753466.0 (MGA2020-55)
SURFACE ELEVATION : 72.69 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 1/7/2025
DATE COMPLETED : 2/7/2025
DATE LOGGED : 2/7/2025
LOGGED BY : SC
CHECKED BY : PE
CASING DIAMETER : 88.9/139.7
BARREL (Length) :
BIT :
BIT CONDITION :

DRILLING

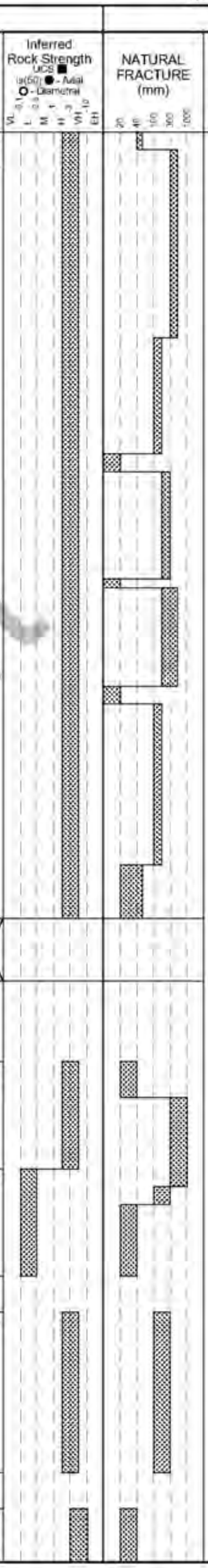
Drilling & Casing: HQ

DRILL DEPTH	(CORE LOSS) RUN %	RQD (%)
16.10	0% LOSS	87
17.60	0% LOSS	61
19.40	21% LOSS	44
21.10	0% LOSS	27
22.60	0% LOSS	27
23.70	0% LOSS	27

DEPTH (m)	RL (m AHD)
16.0	56.7
17.0	55.7
18.0	54.7
19.0	53.7
20.0	52.7
21.0	51.7
22.0	50.7
23.0	49.7
24.0	48.7

MATERIAL

Depth to	DESCRIPTION ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable)	WEATHERING
20.40m	GRANITE: medium to coarse grained, dark grey, grey, spotted black, massive.	MW - SW
20.75m	NO CORE 0.35m (20.40-20.75)	
21.20m	CI Silty CLAY: grey/pale grey, silt is low plasticity; with fine to coarse grained sand; with medium to coarse grained, angular gravel; (Extremely Weathered granite), hard.	
22.40m	GRANITE: medium to coarse grained, grey, dark grey, black and white spotted, massive.	MW HW
22.60m	SC Clayey SAND: fine to coarse grained, grey, dark grey, clay is low plasticity; with medium to coarse grained grained gravel; (Extremely Weathered granite), very dense.	
23.50m	GRANITE: medium to coarse grained, grey, brown, black spotted, massive.	MW
23.70m	SP Gravelly SAND: medium to coarse grained, dark grey, brown, gravel is fine to coarse; with clay; (Extremely Weathered granite), very dense.	
	GRANITE: medium to coarse grained, dark grey, brown, black spotted, massive.	MW - SW



FRACTURES

ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other

- 15.90: J, 80°, VN, UN, SM, clay veneer
- 16.00-20.40: granite
- 16.30: J, 70°, VN, UN
- 16.65: J, 75°, SN, PR, SM
- 17.15: J, 0 - 5°, VN, PR, SM clay veneer
- 17.40: J, 60°, VN, PR, SM, clay veneer
- 17.50: J, 5°, CT, ST, RF, clay coating
- 17.65: J, 60°, VN, IR, RF, clay veneer
- 17.80-17.90: CZ, 10°, CT, C, RF
- 18.10: J, 80°, VN, PR, SM
- 18.50-18.55: CS, VN, ST, RF
- 18.70: J, 30°, SN, PR, SM
- 19.10-19.20: CZ, 30°, CN, IR, RF
- 19.30: J, 85°, SN, UN, SM
- 19.60: J, 60°, SN, ST, SM
- 19.75: J, 70°, SN, PR, RF
- 19.65: J, 30°, SN, PR, SM
- 20.00: Jx2, 80°, CT, PR, SM, very widely spaced, clay veneer
- 20.10-20.40: Jx3, 10°, CN, IR, SM
- 21.20-21.40: CZ, 10°, CN, IR, RF
- 21.90: CS, Clay
- 22.00-22.40: CZ, CT, IR, RF, clay coating
- 22.95: J, 30°, CT, PR, RF, clay coating
- 23.10: J, 75°, SN, UN, SM
- 23.20: J, 10°, CN, ST, RF

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

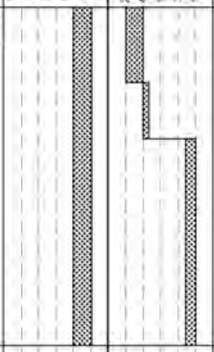
CORED DRILL HOLE LOG

HOLE NO : BH01_SMEC
FILE / JOB NO : 30043649
SHEET : 5 OF 5

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319945.0, N: 5753466.0 (MGA2020-55)   SURFACE ELEVATION : 72.69 (AHD)   INCLINATION : -90°   AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6   MOUNTING : Track   CONTRACTOR : QEST   DRILLER : QEST
DATE STARTED : 1/7/2025   DATE COMPLETED : 2/7/2025   DATE LOGGED : 2/7/2025   LOGGED BY : SC   CHECKED BY : PE
CASING DIAMETER : 88.9/139.7   BARREL (Length) :   BIT :   BIT CONDITION :

DRILLING						MATERIAL				FRACTURES		
PROGRESS												ADDITIONAL DATA
DRILLING & CASING	WATER	(CORE LOSS RUN %) DRILL DEPTH	RQD (%)	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	DESCRIPTION ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable)	WEATHERING	Inferred Rock Strength UCS ■ Is(50) ● - Axial O - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	NATURAL FRACTURE (mm) 20 40 100 300 1000	VISUAL	(joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
HQ		0% LOSS	27		24.0 *48.7*	+ +	GRANITE: medium to coarse grained, dark grey, brown, black spotted, massive. *(continued)*	MW - SW				23.80-24.40: Jx4, 10 - 60°, SN, UN, SM closely spaced
						+ +						24.45: J, 15°, SN, ST, SM 24.50: J, 60°, SN, IR, RF 24.55: J, 85°, VN, PR, SM, clay veneer 24.60: J, 60°, SN, PR, SM 24.70: Jx2, 10°, CN, ST, SM
		24.80				+ +						
		0% LOSS	100			+ +						
					25.0 *47.7*	+ +						
						+ +						25.50: J, 85°, SN, PR, SM
		25.80				+ +	25.80m					
							BH Terminated at 25.80 m Target Depth Monitoring Bore Installed					
					26.0 *46.7*							
					27.0 *45.7*							
					28.0 *44.7*							
					29.0 *43.7*							
					30.0 *42.7*							
					31.0 *41.7*							
					32.0 *40.7*							



See Explanatory Notes for details of abbreviations & basis of descriptions.

BH01: 13.70 – 16.40m

McCrae Landslide Project **Rock Core Photographs**	PROJECT NO.:	30043649
CLIENT: SOUTH EAST WATER	DATE TAKEN:	02/07/2025

BH01: 16.40 – 20.40m

smec	McCrae Landslide Project **Rock Core Photographs**	PROJECT NO.:	30043649
	CLIENT: SOUTH EAST WATER	DATE TAKEN:	02/07/2025

BH01: 20.40 – 24.40m

McCrae Landslide Project Rock Core Photographs	PROJECT NO.:	30043649
CLIENT: SOUTH EAST WATER	DATE TAKEN:	02/07/2025

BH01: 24.40 – 25.80m

smec	McCrae Landslide Project Rock Core Photographs	PROJECT NO.:	30043649
	CLIENT: SOUTH EAST WATER	DATE TAKEN:	02/07/2025

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH02_SMEC
FILE / JOB NO : 30043649
SHEET : 1 OF 5

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319860.0, N: 5753565.0 (MGA2020-55)   SURFACE ELEVATION : 59.79 (AHD)   INCLINATION : -90°   AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6   MOUNTING : Track   CONTRACTOR : QEST   DRILLER : QEST
DATE STARTED : 4/7/2025   DATE COMPLETED : 9/7/2025   DATE LOGGED : 4/7/2025   LOGGED BY : SC   CHECKED BY : PE

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
SFA			Not Encountered		0.0 59.8			0.10m TOPSOIL Sandy CLAY: low plasticity, brown, sand is fine to medium grained; with rootlets.			TOPSOIL 0.00: grass nature strip beside driveway. Small trees nearby
								FILL Silty SAND: fine to medium grained, brown, silt is low plasticity.	D	MD	FILL
				1.00m SPT 11,22,30/130mm N=R (0.42m REC) 1.43m	1.0 58.8			0.80m FILL Sandy CLAY: low to medium plasticity, grey, white speckled, sand is fine to coarse grained. 1.60: becoming fine to medium grained, grey/brown		H	
				2.00m B 2.50m SPT 11,15,13 N=28 (0.45m REC) 2.95m 3.50m B 4.00m SPT 5,7,11 N=18 (0.45m REC)	2.0 57.8 3.0 56.8 4.0 55.8		SP	1.80m SAND: fine to medium grained, uniform, grey, brown, with clay.	M	MD	INFERRED COLLUVIUM SOIL
				4.45m 5.00m B 5.50m SPT 8,10,13 N=23 (0.45m REC) 5.95m 7.00m B	5.0 54.8 6.0 53.8 7.0 52.8		SC	4.30m Clayey SAND: fine to coarse grained, grey, brown, clay is low to medium plasticity; trace subangular to angular quartz gravel.	M	MD	RESIDUAL SOIL
				7.50m SPT 5,7,10 N=17 (0.45m REC)			CL-CI	7.50m Sandy CLAY: low to medium plasticity, grey, brown, white speckled, sand is fine to coarse grained.	w≈PL	VSt	
				7.95m	8.0 51.8		SC	7.90m Clayey SAND: fine to medium grained, grey, brown, clay is low plasticity.	M	MD	

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **BH02_SMEC**
FILE / JOB NO : 30043649
SHEET : 2 OF 5

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319860.0, N: 5753565.0 (MGA2020-55)
SURFACE ELEVATION : 59.79 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 4/7/2025
DATE COMPLETED : 9/7/2025
DATE LOGGED : 4/7/2025
LOGGED BY : SC
CHECKED BY : PE

DRILLING						MATERIAL					
PROGRESS DRILLING & CASING	PROGRESS WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
SFA			Not Encountered		8.0 *51.8*			Clayey SAND: fine to medium grained, grey, brown, clay is low plasticity. *(continued)*			RESIDUAL SOIL
									M	MD	
				9.00m SPT 9,11,11 N=22 (0.45m REC) 9.45m	9.0 *50.8*			9.10-9.40: clayey band, low to medium plasticity	w≈PL	VSt	
								9.50: sand becoming orange, trace fine to coarse grained quartz gravel			
				10.00m B	10.0 *49.8*			10.20-10.30: white quartz vein			
				10.50m SPT 14,17,20 N=37 (0.45m REC) 10.95m							
					11.0 *48.8*		SC				
					12.0 *47.8*				M	MD	
					13.0 *46.8*			13.00: sand becoming fine to coarse grained			
					14.0 *45.8*						
				15.00m SPT 14,15/50mm HB N=R (0.24m REC)	15.0 *44.8*		SC	15.00m 15.10m Clayey SAND: fine to coarse grained, grey, orange-brown, clay is low plasticity; (Extremely Weathered granite). Continued as Cored Drill Hole		VD	EXTREMELY WEATHERED MATERIAL
					16.0 *43.8*						

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

CORED DRILL HOLE LOG

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

HOLE NO : BH02_SMEC
FILE / JOB NO : 30043649
SHEET : 3 OF 5

POSITION : E: 319860.0, N: 5753565.0 (MGA2020-55) SURFACE ELEVATION : 59.79 (AHD) INCLINATION : -90° AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6 MOUNTING : Track CONTRACTOR : QEST DRILLER : QEST
DATE STARTED : 4/7/2025 DATE COMPLETED : 9/7/2025 DATE LOGGED : 4/7/2025 LOGGED BY : SC CHECKED BY : PE
CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING						MATERIAL				FRACTURES		
PROGRESS DRILLING & CASING	PROGRESS WATER	(CORE LOSS RUN %) DRILL DEPTH	RQD (%)	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	DESCRIPTION ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable)	WEATHERING	Inferred Rock Strength UCS ■ Is(50) ● - Axial O - Diametral VL L M H VH EH	NATURAL FRACTURE (mm) 20 40 100 300 1000	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
					8.0 51.8							
					9.0 50.8							
					10.0 49.8							
					11.0 48.8							
					12.0 47.8							
					13.0 46.8							
					14.0 45.8							
					15.0 44.8			START CORING AT 15.10m				
HQ				SPT 14,15/90mm HB N=R (0.24m REC) 15.24m		▨	SC Clayey SAND: fine to coarse grained, grey, orange-brown, clay is low plasticity; (Extremely Weathered granite), very dense; moist. *(continued)*					15.25: Auger refusal in extremely weathered granite. Borehole terminated on Friday 4th July with standpipe to be installed on Monday 7th July.
					15.60m	☒	NO CORE 0.84m (15.60-16.44)	☒				
					16.0 43.8							

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

CORED DRILL HOLE LOG

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

HOLE NO : BH02_SMEC
FILE / JOB NO : 30043649
SHEET : 4 OF 5

POSITION : E: 319860.0, N: 5753565.0 (MGA2020-55)
SURFACE ELEVATION : 59.79 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 4/7/2025
DATE COMPLETED : 9/7/2025
DATE LOGGED : 4/7/2025
LOGGED BY : SC
CHECKED BY : PE
CASING DIAMETER :
BARREL (Length) :
BIT :
BIT CONDITION :

DRILLING

PROGRESS: DRILLING & CASING | WATER | (CORE LOSS RUN %) DRILL DEPTH | RQD (%) | SAMPLES & FIELD TESTS

DRILLING & CASING: HQ

DEPTH (m)	RL (m AHD)
16.0	43.8
17.0	42.8
18.0	41.8
19.0	40.8
20.0	39.8
21.0	38.8
22.0	37.8
23.0	36.8
24.0	35.8

MATERIAL

GRAPHIC LOG | Inferred Rock Strength: UCS ■, Is(50) ● - Axial, O - Diametral; VL 0.1 L 0.3 M 1 H 3 VH 10 EH

DESCRIPTION ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable)	WEATHERING
NO CORE 0.84m (15.60-16.44) *(continued)*	
16.44m	
SP SAND: fine to coarse grained, grey, orange-brown, with clay, (Extremely Weathered granite), very dense; moist.	
16.90m	
NO CORE 0.77m (16.90-17.67)	
17.67m	
SP SAND: fine to coarse grained, grey, orange-brown, (Extremely Weathered granite), very dense; moist.	XW - HW
18.40m	
NO CORE 0.48m (18.40-18.88)	
18.88m	
GRANITE: medium to coarse grained, grey brown.	HW XW - HW
19.90m	
NO CORE 0.05m (19.90-19.95)	
19.95m	
GRANITE: medium grained, grey.	XW - HW HW - MW
23.90m	
GRANITE: medium to coarse grained, grey blue.	MW

FRACTURES

NATURAL FRACTURE (mm): 20 | 40 | 100 | 300 | 1000

VISUAL

ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other

- 18.88-18.91: CZ
- 18.96-19.00: CZ
- 19.03: J, 80°, CN, PR, SM
- 19.07-19.09: CZ
- 19.10: J, 80°, CN, PR, SM
- 19.19: J, 30°, VN, ST, SM
- 19.28: J, 80°, VN, IR, SM
- 19.30: J, 80°, VN, IR, SM
- 19.36-19.40: CS
- 19.63: J, 0°, SN, PR, SM
- 19.67: Jx3, 60 - 75°, VN, PR, SM
- 19.79-19.90: CZ
- 20.21: J, 10 - 15°, CN, ST, RF
- 20.50: Jx2, 75 - 80°, VN, IR, RF
- 20.60-21.36: FZ
- 21.37: J, 15°, CN, CU, RF
- 21.40: J, 75°, VN, IR, RF
- 21.40: J, 0 - 10°, CN, IR, RF
- 21.52-21.56: CZ
- 21.58: J, 15°, CN, CU, RF
- 21.73: J, 15°, CN, UN, RF
- 21.76: J, 30°, CN, PR, SM
- 21.80-21.83: IS, 30°, Clay CT, PR, RF
- 21.90: J, 0 - 10°, VN, IR, RF
- 21.93: J, 0 - 10°, VN, IR, RF
- 22.00: J, 0 - 10°, VN, IR, RF
- 22.18: J, 0 - 10°, CN, PR, RF
- 22.31: J, 0 - 10°, CN, IR, RF
- 22.60: J, 0 - 10°, VN, CU, RF
- 22.65: J, 0 - 10°, VN, IR, RF
- 22.68-22.70: CZ
- 22.70: HB
- 22.90: J, 0 - 10°, CN, UN, RF
- 23.50: Jx2, 45°, SN, PR, RF
- 23.59: J, 10°, SN, CU, RF
- 23.61: J, 15°, CN, UN, RF
- 23.90: Jx2, 45°, SN, PR, RF

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

CORED DRILL HOLE LOG

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

HOLE NO : BH02_SMEC
FILE / JOB NO : 30043649
SHEET : 5 OF 5

POSITION : E: 319860.0, N: 5753565.0 (MGA2020-55)
SURFACE ELEVATION : 59.79 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 4/7/2025
DATE COMPLETED : 9/7/2025
DATE LOGGED : 4/7/2025
LOGGED BY : SC
CHECKED BY : PE
CASING DIAMETER :
BARREL (Length) :
BIT :
BIT CONDITION :

DRILLING						MATERIAL				FRACTURES		
PROGRESS		(CORE LOSS RUN %) DRILL DEPTH	RQD (%)	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	DESCRIPTION ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable)	WEATHERING	Inferred Rock Strength UCS ■ Is(50) ● - Axial O - Diametral VL L M H VH EH	NATURAL FRACTURE (mm) 25 40 100 300 1000	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
DRILLING & CASING	WATER											
HQ					24.0 *35.8* 25.0 *34.8*	+ + +	GRANITE, medium to coarse grained, grey blue *(continued)* 25.90m	MW				24.05: J, 15°, VN, UN, RF 24.21: J, 30°, VN, IR, RF 24.23: J, 10°, SN, IR, RF 24.29: J, 10°, SN, IR, RF 24.32: J, 10°, SN, IR, RF 24.40: J, 10°, SN, PR, RF 24.54: J, 0°, CN, IR, RF 24.58: J, 15°, CN, CU, RF 24.72-24.85: FZ 25.00: J, 30°, VN, IR, RF 25.08: J, 45°, CT, IR, RF 25.16: J, 45°, VN, IR, RF 25.20: J, 45°, VN, IR, RF 25.28: J, 20°, CN, IR, RF 25.44: J, 10°, CN, PR, SM 25.52: Jx7, 10 - 30°, CN, IR, RF 25.60-25.65: CZ 25.72: Jx2, 0 - 10°, VN, IR, RF 25.80: Jx2, 45°, VN, IR, RF 25.85: J, 30°, SN, IR, RF
					26.0 *33.8* 27.0 *32.8* 28.0 *31.8* 29.0 *30.8* 30.0 *29.8* 31.0 *28.8* 32.0 *27.8*		BH Terminated at 25.90 m Target Depth Monitoring Bore Installed					

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

BH02: 15.10 – 19.40m

	McCrae Landslide Project Rock Core Photographs	PROJECT NO.: 30043649
	CLIENT: SOUTH EAST WATER	DATE TAKEN: 07/07/2025

BH02: 19.40 – 23.40m

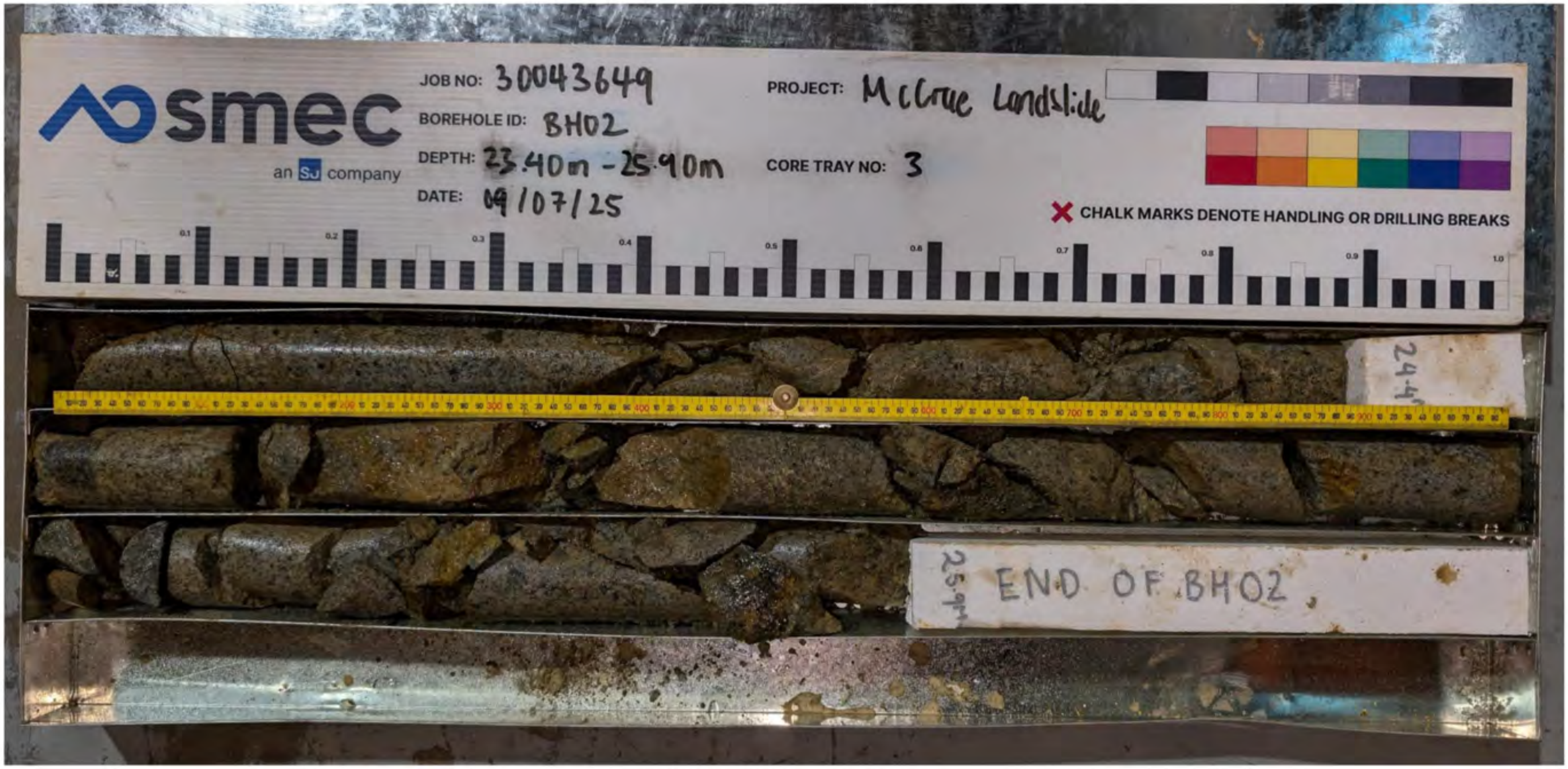
McCrae Landslide Project

Rock Core Photographs

PROJECT NO.: 30043649

CLIENT: SOUTH EAST WATER

DATE TAKEN: 08/07/2025



BH02: 19.40 – 25.90m

McCrae Landslide Project

Rock Core Photographs

PROJECT NO.: 30043649

CLIENT: SOUTH EAST WATER

DATE TAKEN: 09/07/2025

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **BH03_SMEC**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319790.0, N: 5753638.0 (MGA2020-55)
SURFACE ELEVATION : 51.70 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 3/7/2025
DATE COMPLETED : 3/7/2025
DATE LOGGED : 3/7/2025
LOGGED BY : SC
CHECKED BY : PE

DRILLING & CASING	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	RL (m AHD)	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
SFA			0.0	51.7		0.10m TOPSOIL Sandy CLAY: low to medium plasticity, dark brown, sand is fine to medium grained; with grass rootlets.	w<PL		TOPSOIL
		0.10m B 0.50m 0.50m SPT 4,5,5 N=10 (0.45m REC) 0.95m				FILL Sandy CLAY: low to medium plasticity, dark brown; sand is fine to medium grained.		St	FILL
			1.0	50.7		0.70m FILL Silty CLAY: low to medium plasticity, dark brown			
		1.20m D 1.50m 1.50m SPT 4,2,1 N=[illegible] (0.45m REC)				1.20m FILL Sandy CLAY: medium plasticity, orange, brown, grey, sand is fine to medium grained.			
	3/7/2025 ▽	1.70m B 1.95m 2.00m U	2.0	49.7		1.70m Clayey SAND: fine to coarse grained, brown, grey; clay is low to medium plasticity.	W	VL	RESIDUAL SOIL 1.70: groundwater recovered during drilling
		2.50m SPT 3,14,10 N=24 (0.45m REC) 2.95m 3.00m U 3.50m SPT 0,9,8 N=17 (0.45m REC) 3.95m	3.0	48.7	SC		M	MD	
			4.0	47.7	CI	3.70m Silty CLAY: medium plasticity, grey, orange, with fine to medium grained sand.	w>PL	VSt	
						4.20m Sandy CLAY: medium plasticity, orange, brown, grey, sand is fine to medium grained; with silt; trace fine to medium grained gravel			
		4.50m SPT 12,19/100mm HB N=R (0.25m REC) 4.75m				4.50-5.00: white speckled		H	
		6.00m SPT 8,13,13 N=26 (0.45m REC) 6.45m	5.0 6.0	46.7 45.7	CI			VSt	
						6.45m BH Terminated at 6.45 m Target Depth Monitoring Bore Installed			
			7.0	44.7					
			8.0	43.7					

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

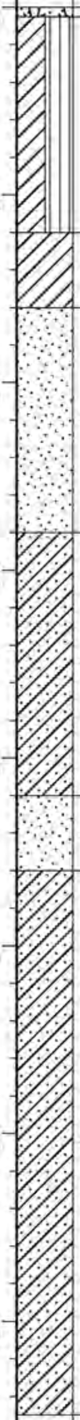
smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **BH04_SMEC**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319668.0, N: 5753744.0 (MGA2020-55)
SURFACE ELEVATION : 36.82 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Boart Longyear LX6
MOUNTING : Track
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 4/7/2025
DATE COMPLETED : 4/7/2025
DATE LOGGED :
LOGGED BY : SC
CHECKED BY : PE



DRILLING						MATERIAL				
PROGRESS: DRILLING & CASING	PROGRESS: WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
SFA (0.0–7.50)					0.0 36.8		0.05m TOPSOIL Sandy CLAY: medium plasticity, dark brown, sand is fine to medium grained; with rootlets.			TOPSOIL 0.00: grassed nature strip
				0.50m B 1.00m U	1.0 35.8		Silty CLAY: medium to high plasticity, dark brown 0.30: becoming grey, mottled orange-brown	w≈PL	VSt - H	INFERRED COLLUVIUM SOIL 0.70: PP =200 - 250 kPa
				1.50m SPT 8,9,9 N=18 (0.45m REC) 1.95m			1.20m Sandy CLAY: medium plasticity, grey, white speckled, sand is fine to coarse grained; with silt.			1.20: PP >400 kPa
				2.00m B 2.50m SPT 11,16,17 N=33 (0.45m REC) 2.95m	2.0 34.8	SP	1.60m SAND: fine to medium grained, grey, with low plasticity clay			
				4.00m U	3.0 33.8 4.0 32.8	SC	2.80m Clayey SAND: fine to medium grained, grey,brown, clay is low plasticity	M	D	RESIDUAL SOIL
			▽ 4/7/2025 10:20	4.40m SPT 11,18,18 N=36 (0.45m REC) 4.85m		SP	4.20m SAND: coarse grained, grey, with low plasticity clay	W		4.20-4.60: wet sand at 4.2m
				5.50m B 6.00m SPT 9,15,14 N=29 (0.45m REC) 6.45m	5.0 31.8 6.0 30.8	SC	4.60m Clayey SAND: fine to medium grained, grey, brown, clay is low plasticity; with silt.	M	MD	
					7.0 29.8		7.00-7.50: sand becoming coarse grained	W	D - VD	7.00: water recovery
					8.0 28.8		7.50m BH Terminated at 7.50 m Target Depth Monitoring Bore Installed			7.50: near auger refusal at base of hole on inferred extremely weathered grainte

See Explanatory Notes for details of abbreviations & basis of descriptions.

B-2 Hand auger logs

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : HA01
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319726.8, N: 5753742.7 (MGA2020-55) SURFACE ELEVATION : 41.10 (AHD) INCLINATION : -90° AZIMUTH : 360°
RIG TYPE : MOUNTING : CONTRACTOR : DRILLER :
DATE STARTED : 4/7/2025 DATE COMPLETED : 4/7/2025 DATE LOGGED : 4/7/2025 LOGGED BY : JH CHECKED BY : PE

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA			Not Encountered	0.30m	0.0 41.1			TOPSOIL SAND: fine to coarse grained, dark grey, brown. 0.30m	w<PL		TOPSOIL
				D 0.50m				FILL SAND: fine to coarse grained, grey. 0.55m	D		FILL
				D				FILL CLAY: high plasticity, dark grey. 1.00m	w<PL		
				1.00m 1.10m D	1.0 40.1		CH	CLAY: high plasticity, grey mottled yellow brown. 1.25m	w<PL	F - St	RESIDUAL SOIL
				1.50m D			CH	Sandy CLAY: high plasticity, grey mottled yellow brown. 1.60m 1.50-1.60: becoming trace fine grained gravel			
							SC	Clayey SAND: fine to coarse grained, grey mottled yellow brown. 2.00m	D - M	MD	
				2.00m D	2.0 39.1		SP	SAND: fine to coarse grained, grey.		MD	
					3.0 38.1			3.10m			
								HA Terminated at 3.10 m Target Depth			
					4.0 37.1						
					5.0 36.1						
					6.0 35.1						
					7.0 34.1						
					8.0 33.1						

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : HA02
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319638.4, N: 5753681.4 (MGA2020-55)
SURFACE ELEVATION : 36.61 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE :
MOUNTING :
CONTRACTOR :
DRILLER :
DATE STARTED : 4/7/2025
DATE COMPLETED : 4/7/2025
DATE LOGGED : 4/7/2025
LOGGED BY : JH
CHECKED BY : PE

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA			Not Encountered		0.0 *36.6*			TOPSOIL Sandy CLAY: dark grey, brown, sand is fine to coarse grained.	w>PL	F	TOPSOIL
				0.25m D		▨	SM	0.20m Silty SAND: fine to medium grained, grey	M D	MD	INFERRED COLLUVIUM SOIL
				1.00m D	1.0 *35.6*		SP	1.00m SAND: fine to coarse grained, pale yellow brown, grey. (Extremely Weathered granite).	w<PL	D - VD	EXTREMELY WEATHERED MATERIAL
								1.20m HA Terminated at 1.20 m Refusal			
					2.0 *34.6*						
					3.0 *33.6*						
					4.0 *32.6*						
					5.0 *31.6*						
					6.0 *30.6*						
					7.0 *29.6*						
					8.0 *28.6*						

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : HA03

FILE / JOB NO : 30043649

SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319400.3, N: 5753549.7 (MGA2020-55)
SURFACE ELEVATION : 15.41 (AHD)
INCLINATION : -90°
AZIMUTH : 360°

RIG TYPE :
MOUNTING :
CONTRACTOR :
DRILLER :

DATE STARTED : 4/7/2025
DATE COMPLETED : 4/7/2025
DATE LOGGED : 4/7/2025
LOGGED BY : JH
CHECKED BY : PE

DRILLING						MATERIAL					
PROGRESS		DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
DRILLING & CASING	WATER										
HA			Not Encountered	D	0.0 *15.4*			FILL SAND: fine to coarse grained, dark grey, brown.			FILL
				0.40m D							
								0.80m			
							SP	SAND: fine to coarse grained, grey mottled yellow brown.	D	MD	RESIDUAL SOIL
					1.0 *14.4*						
				1.10m D				1.10m			
							SP	SAND: fine to coarse grained, grey. 1.30-1.80: trace sub-angular gravel			
				1.50m D							
								1.80m			
								HA Terminated at 1.80 m Refusal			
					2.0 *13.4*						
					3.0 *12.4*						
					4.0 *11.4*						
					5.0 *10.4*						
					6.0 *9.4*						
					7.0 *8.4*						
					8.0 *7.4*						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

B-3 Non-Destructive Digging logs

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **DP01A**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
PROJECT : McCrae Landslide
LOCATION : McCrae

POSITION : E: 319783.7, N: 5753646.3 (MGA2020-55)
SURFACE ELEVATION : 50.78 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 30/6/2025
DATE COMPLETED : 30/6/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 *50.8*	▨		FILL SAND: fine to coarse grained, dark grey, brown			FILL
						▨		0.50m FILL SAND: yellow brown			
					1.0 *49.8*	▨					
					2.0 *48.8*	▨		2.00m FILL CLAY: high plasticity			
								2.70m VE Terminated at 2.70 m Target Depth Groundwater monitoring well installed			
					3.0 *47.8*						
					4.0 *46.8*						
					5.0 *45.8*						
					6.0 *44.8*						
					7.0 *43.8*						
					8.0 *42.8*						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP01B

FILE / JOB NO : 30043649

SHEET : 1 OF 1

CLIENT : South East Water
PROJECT : McCrae Landslide
LOCATION : McCrae

POSITION : E: 319782.6, N: 5753647.4 (MGA2020-55)
SURFACE ELEVATION : 50.65 (AHD)
INCLINATION : -90°
AZIMUTH : 360°

RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST

DATE STARTED : 30/6/2025
DATE COMPLETED : 30/6/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD ↓			Not Encountered		0.0 *50.7*	▨		FILL SAND: yellow brown, grey, with clay, trace gravel.			FILL
					1.0 *49.7*	▨					
					2.0 *48.7*	▨					
						○	2.40m	GRAVEL: fine grained, sub-angular to angular			
							2.60m	VE Terminated at 2.60 m Target Depth Groundwater monitoring well installed			
					3.0 *47.7*						
					4.0 *46.7*						
					5.0 *45.7*						
					6.0 *44.7*						
					7.0 *43.7*						
					8.0 *42.7*						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **DP02A**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
PROJECT : McCrae Landslide
LOCATION : McCrae

POSITION : E: 319756.3, N: 5753683.8 (MGA2020-55)
SURFACE ELEVATION : 41.36 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 1/7/2025
DATE COMPLETED : 1/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS		DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
DRILLING & CASING	WATER										
NDD			Not Encountered		0.0 41.4	▩		Clayey SAND: dark grey , brown			
					1.0 40.4	▥		1.00m Sandy CLAY: grey.			
								1.60m VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
					2.0 39.4						
					3.0 38.4						
					4.0 37.4						
					5.0 36.4						
					6.0 35.4						
					7.0 34.4						
					8.0 33.4						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP02B
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319755.7, N: 5753684.4 (MGA2020-55)   SURFACE ELEVATION : 41.23 (AHD)   INCLINATION : -90°   AZIMUTH : 360°
RIG TYPE : Vaccum Truck   MOUNTING : Truck   CONTRACTOR : QEST   DRILLER : QEST
DATE STARTED : 1/7/2025   DATE COMPLETED : 1/7/2025   DATE LOGGED :   LOGGED BY : JH   CHECKED BY :

DRILLING						MATERIAL					
PROGRESS		DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
DRILLING & CASING	WATER										
NDD			Not Encountered		0.0 41.2			0.10m Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.			
								Sandy CLAY: high plasticity, grey, brown.			
					1.0 40.2						
								1.60m			
								VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
					2.0 39.2						
					3.0 38.2						
					4.0 37.2						
					5.0 36.2						
					6.0 35.2						
					7.0 34.2						
					8.0 33.2						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **DP03A**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
PROJECT : McCrae Landslide
LOCATION : McCrae

POSITION : E: 319728.1, N: 5753740.3 (MGA2020-55)
SURFACE ELEVATION : 37.65 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 2/7/2025
DATE COMPLETED : 2/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 37.7	▨		FILL Sandy CLAY: high plasticity, dark grey			FILL
							0.70m	VE Terminated at 0.70 m Target Depth Groundwater monitoring well installed			
					1.0 36.7						
					2.0 35.7						
					3.0 34.7						
					4.0 33.7						
					5.0 32.7						
					6.0 31.7						
					7.0 30.7						
					8.0 29.7						

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP03B
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
PROJECT : McCrae Landslide
LOCATION : McCrae

POSITION : E: 319727.2, N: 5753741.0 (MGA2020-55)
SURFACE ELEVATION : 37.45 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 2/7/2025
DATE COMPLETED : 2/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 37.5	▨		FILL Sandy CLAY: high plasticity, dark grey			FILL
							0.70m	VE Terminated at 0.70 m Target Depth Groundwater monitoring well installed			
					1.0 36.5						
					2.0 35.5						
					3.0 34.5						
					4.0 33.5						
					5.0 32.5						
					6.0 31.5						
					7.0 30.5						
					8.0 29.5						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **DP04A**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319654.7, N: 5753689.3 (MGA2020-55)
SURFACE ELEVATION : 35.82 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 3/7/2025
DATE COMPLETED : 3/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 35.8			0.10m TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.			TOPSOIL
								FILL Clayey GRAVEL: fine to medium grained, dark grey.			FILL 0.10: crush rock 0.50: pipeline embedment material
					1.0 34.8						
								1.60m			
								1.70m FILL GRAVEL: fine grained.			
								VE Terminated at 1.70 m Target Depth Groundwater monitoring well installed			
					2.0 33.8						
					3.0 32.8						
					4.0 31.8						
					5.0 30.8						
					6.0 29.8						
					7.0 28.8						
					8.0 27.8						

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP04B
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319653.4, N: 5753690.0 (MGA2020-55)
SURFACE ELEVATION : 35.73 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 3/7/2025
DATE COMPLETED : 3/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 35.7	⁂		0.10m TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.			TOPSOIL
						▨		FILL Clayey GRAVEL: fine to medium grained, dark grey.			FILL 0.10: crush rock 0.50: pipeline embedment material
					1.0 34.7	▨					
						▨		1.60m			
						▨		1.90m FILL GRAVEL: fine grained.			
								VE Terminated at 1.90 m Target Depth Groundwater monitoring well installed			
					2.0 33.7						
					3.0 32.7						
					4.0 31.7						
					5.0 30.7						
					6.0 29.7						
					7.0 28.7						
					8.0 27.7						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP05A
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319634.9, N: 5753693.5 (MGA2020-55)
SURFACE ELEVATION : 46.90 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 3/7/2025
DATE COMPLETED : 3/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 46.9			0.10m TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.			TOPSOIL
						▨		FILL Clayey SAND: fine to coarse grained, dark grey			FILL
								1.00m			
					1.0 45.9			VE Terminated at 1.00 m Target Depth Groundwater monitoring well installed			
					2.0 44.9						
					3.0 43.9						
					4.0 42.9						
					5.0 41.9						
					6.0 40.9						
					7.0 39.9						
					8.0 38.9						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP05B
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319633.7, N: 5753693.5 (MGA2020-55)
SURFACE ELEVATION : 46.87 (AHD)
INCLINATION : -90°
AZIMUTH : 360°
RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST
DATE STARTED : 3/7/2025
DATE COMPLETED : 3/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Encountered		0.0 46.9			0.10m TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown			TOPSOIL
						▨		FILL Clayey SAND: fine to coarse grained, dark grey 1.00m			FILL
					1.0 45.9			VE Terminated at 1.00 m Target Depth Groundwater monitoring well installed			
					2.0 44.9						
					3.0 43.9						
					4.0 42.9						
					5.0 41.9						
					6.0 40.9						
					7.0 39.9						
					8.0 38.9						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : DP06A

FILE / JOB NO : 30043649

SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319631.6, N: 5753696.4 (MGA2020-55)
SURFACE ELEVATION : 35.43 (AHD)
INCLINATION : -90°
AZIMUTH : 360°

RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST

DATE STARTED : 3/7/2025
DATE COMPLETED : 3/7/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			Not Encountered		0.0 35.4			0.10m Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.			
						▨		Clayey SAND: fine to coarse grained, grey, brown.			
					1.0 34.4						
								1.60m			
								VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
					2.0 33.4						
					3.0 32.4						
					4.0 31.4						
					5.0 30.4						
					6.0 29.4						
					7.0 28.4						
					8.0 27.4						

See Explanatory Notes for details of abbreviations & basis of descriptions.

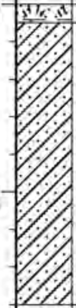
smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **DP06B**
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319629.9, N: 5753696.4 (MGA2020-55) SURFACE ELEVATION : 35.30 (AHD) INCLINATION : -90° AZIMUTH : 360°
RIG TYPE : Vaccum Truck MOUNTING : Truck CONTRACTOR : QEST DRILLER : QEST
DATE STARTED : 3/7/2025 DATE COMPLETED : 3/7/2025 DATE LOGGED : LOGGED BY : JH CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			Not Encountered		0.0 35.3			0.10m Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.			
								Clayey SAND: fine to coarse grained, grey, brown			
					1.0 34.3						
								1.60m			
								VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
					2.0 33.3						
					3.0 32.3						
					4.0 31.3						
					5.0 30.3						
					6.0 29.3						
					7.0 28.3						
					8.0 27.3						

See Explanatory Notes for details of abbreviations & basis of descriptions.

smec

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : NDD01
FILE / JOB NO : 30043649
SHEET : 1 OF 1

CLIENT : South East Water
LOCATION : McCrae
PROJECT : McCrae Landslide

POSITION : E: 319758.6, N: 5753668.3 (MGA2020-55)
SURFACE ELEVATION : 47.92 (AHD)
INCLINATION : -90°
AZIMUTH : 360°

RIG TYPE : Vaccum Truck
MOUNTING : Truck
CONTRACTOR : QEST
DRILLER : QEST

DATE STARTED : 30/6/2025
DATE COMPLETED : 30/6/2025
DATE LOGGED :
LOGGED BY : JH
CHECKED BY :

DRILLING						MATERIAL					
PROGRESS											
DRILLING & CASING	WATER	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) *RL (m AHD)*	GRAPHIC LOG	SOIL CODE	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
NDD			Not Observec		0.0 47.9 1.0 46.9	▨	SC	SAND: fine to coarse grained, dark grey, brown 0.50: very dry possibly due to tree nearby 1.50m	D	MD	
						▥	CH	CLAY: medium plasticity, grey. 1.60m		St - VSt	
					2.0 45.9	▨	SC	GRANITE RECOVERED AS CLAYEY SAND: medium to coarse grained, sub-angular to sub-rounded 2.30: becoming trace fine grained gravel, sub-angular 2.50m		D	
					3.0 44.9			VE Terminated at 2.50 m Refusal This borehole was undertaken with Non-Distructive Drilling method. The encountered material was only assessed visually			
					4.0 43.9						
					5.0 42.9						
					6.0 41.9						
					7.0 40.9						
					8.0 39.9						

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

Appendix C Well construction details

smec

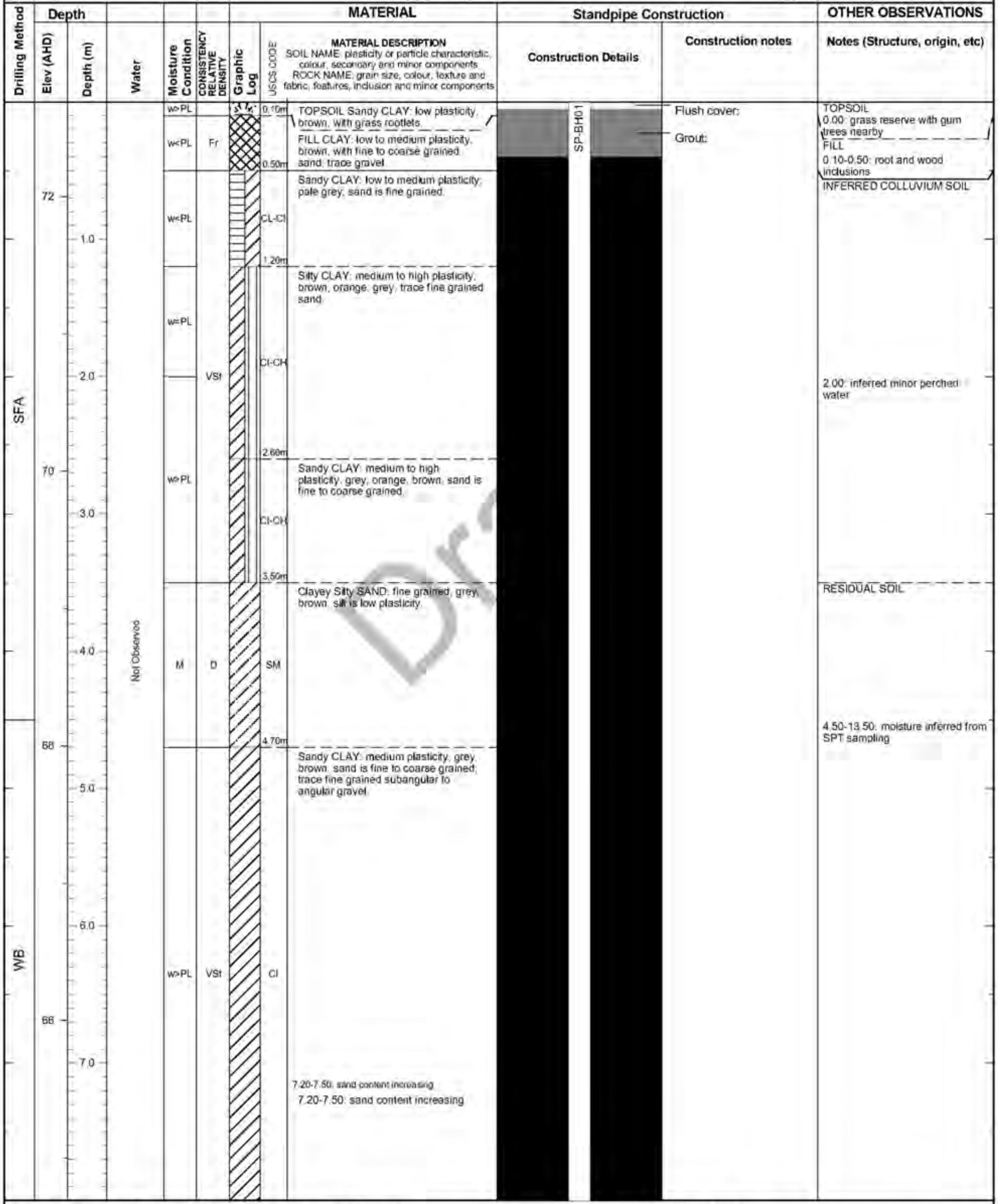
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: **BH01_SMEC**
SHEET No: 1 of 4
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319945.0, N: 5753466.0 (MGA2020-55)"
FINAL DEPTH: 25.8m

SURFACE ELEVATION : 72.690 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°



Drilling Method	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Depth	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction notes	Notes (Structure, origin, etc)
SFA	Not Observed	w>PL		0.10m		TOPSOIL Sandy CLAY: low plasticity, brown, with grass rootlets.	Flush cover: Grout:	TOPSOIL 0.00: grass reserve with gum trees nearby
		w<PL	Fr	0.50m		FILL CLAY: low to medium plasticity, brown, with fine to coarse grained sand; trace gravel		FILL 0.10-0.50: root and wood inclusions
		w<PL	VSt	1.20m	CL-CI	Sandy CLAY: low to medium plasticity; pale grey; sand is fine grained.		INFERRED COLLUVIUM SOIL
		w=PL w>PL		2.60m	CI-CH	Silty CLAY: medium to high plasticity, brown, orange, grey, trace fine grained sand.		2.00: inferred minor perched water
		w>PL		3.50m	CI-CH	Sandy CLAY: medium to high plasticity, grey, orange, brown, sand is fine to coarse grained.		
		M	D	4.70m	SM	Clayey Silty SAND: fine grained, grey, brown, silt is low plasticity.		RESIDUAL SOIL 4.50-13.50: moisture inferred from SPT sampling
WB		w>PL	VSt		CI	Sandy CLAY: medium plasticity, grey, brown, sand is fine to coarse grained; trace fine grained subangular to angular gravel. 7.20-7.50: sand content increasing 7.20-7.50: sand content increasing		

Notes: ▶—Inflow —◀Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6

COMMENCED: 1/07/2025 11:00:00 AM
COMPLETED: 2/07/2025 10:00:00 AM

LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: BH01_SMEC
SHEET No: 2 of 4
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319945.0, N: 5753466.0 (MGA2020-55)"
FINAL DEPTH: 25.8m
SURFACE ELEVATION : 72.690 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Depth Elev (AHD)	Depth Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL **MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Standpipe Construction **Construction Details**	Standpipe Construction **Construction notes**	OTHER OBSERVATIONS **Notes (Structure, origin, etc)**
WB	64 62	9.0 10.0		w>PL	VSt		CI 11.00m	Sandy CLAY: medium plasticity, grey, brown, sand is fine to coarse grained, trace fine grained subangular to angular gravel. *(continued)*		Bentonite:	RESIDUAL SOIL
	60	11.0 12.0	Not Observed	M	D - VD		SC 12.60m	Clayey SAND: fine to coarse grained, poorly graded, grey, brown, clay is low to medium plasticity; trace fine to coarse grained subangular to angular gravel; (Extremely Weathered granite)			EXTREMELY WEATHERED MATERIAL 11.00: inferred extremely weathered granite. Quartz gravel recovered
		13.0		w>PL	H		CL-CI 13.40m	Sandy CLAY: low to medium plasticity grey, brown, black, sand is fine to coarse grained; trace fine to coarse grained gravel; (Extremely Weathered granite)			12.70: hole paused for day (5pm 1/07 to 7am 2/07). Water level at 5.10pm 1/7: 1.9 mbgl and 2.73 mbgl at 7:15am 2/7. After bailing, water level at 7.3 mbgl and remained at this level for 15 minutes, indicating no, or extremely slow, groundwater recharge.
HQ				w>PL	H		CL-CI 13.80m	Sandy CLAY: low to medium plasticity; grey, brown, black, sand is fine to coarse grained; trace fine to coarse grained gravel. (Extremely Weathered).			13.50: feldspathic gravel
	58	14.0 15.0		M	VD		SC 15.40m	Clayey SAND: medium to coarse grained, poorly graded, dark grey red-brown, clay is low to medium plasticity, with medium to coarse grained subangular to angular gravel; (Extremely Weathered granite).			
							16.00m	GRANITE: medium to coarse grained, red-brown, grey, massive			15.40-16.00: granite

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level   Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST   COMMENCED: 1/07/2025 11:00:00 AM   LOGGED BY: SC
EQUIPMENT: Boart Longyear LX6   COMPLETED: 2/07/2025 10:00:00 AM   CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: BH01_SMEC
SHEET No: 3 of 4
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

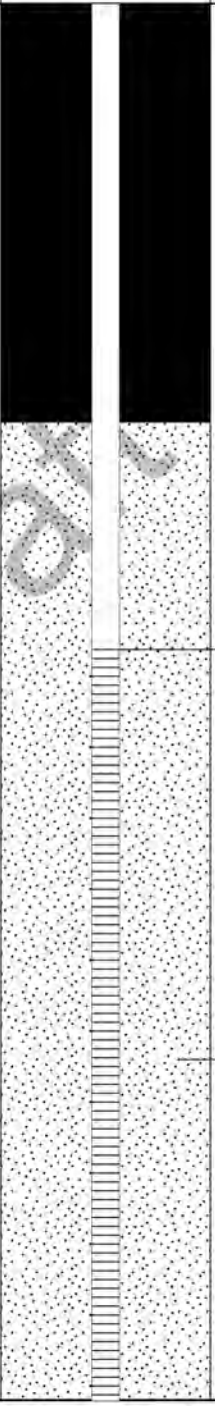
POSITION : "E: 319945.0, N: 5753466.0 (MGA2020-55)"
FINAL DEPTH: 25.8m

SURFACE ELEVATION : 72.690 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Elev (AHD): 56, 54, 52, 50
Depth (m): 17.0, 18.0, 19.0, 20.0, 21.0, 22.0, 23.0

Drilling Method	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction notes	Notes (Structure, origin, etc)
HQ	20.40m	Not Observed				GRANITE: medium to coarse grained, dark grey, grey, spotted black, massive.	Start Slotted 19.7m	16.00-20.40: granite
	20.75m					CORE LOSS 0.35m (20.40-20.75)		
	21.20m			H	CI	Silty CLAY: grey/pale grey, silt is low plasticity; with fine to coarse grained sand; with medium to coarse grained, angular gravel. (Extremely Weathered granite).		EXTREMELY WEATHERED MATERIAL
	22.40m					GRANITE: medium to coarse grained, grey, dark grey, black and white spotted, massive	Sand:	
	22.60m			VD	SC	Clayey SAND: fine to coarse grained, grey, dark grey, clay is low plasticity; with medium to coarse grained grained gravel. (Extremely Weathered granite).		EXTREMELY WEATHERED MATERIAL
	23.50m					GRANITE: medium to coarse grained, grey, brown, black spotted, massive.		
	23.70m			VD	SP	Gravelly SAND: medium to coarse grained, dark grey, brown, gravel is fine to coarse; with clay. (Extremely Weathered granite).		EXTREMELY WEATHERED MATERIAL

Standpipe Construction — Construction Details



Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

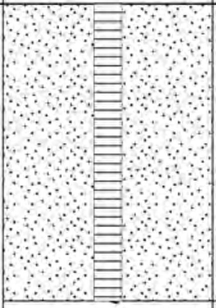
CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6
COMMENCED: 1/07/2025 11:00:00 AM
COMPLETED: 2/07/2025 10:00:00 AM
LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: **BH01_SMEC**
SHEET No: 4 of 4
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319945.0, N: 5753466.0 (MGA2020-55)"
FINAL DEPTH: 25.8m
SURFACE ELEVATION : 72.690 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

	Depth					**MATERIAL**			**Standpipe Construction**		**OTHER OBSERVATIONS**
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
HQ	48	25.0	Not Observed			+ + +	25.80m	GRANITE, medium to coarse grained, dark grey, brown, black spotted, massive. *(continued)*		End Slotted 25.7m	
		26.0						BH Terminated at 25.80 m Target Depth Monitoring Bore Installed			
	46	27.0									
		28.0									
	44	29.0									
		30.0									
	42	31.0									

Notes: ▶— Inflow —◀ Outflow ▼ Standing Water Level   Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6
COMMENCED: 1/07/2025 11:00:00 AM
COMPLETED: 2/07/2025 10:00:00 AM
LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: BH02_SMEC
SHEET No: 1 of 4
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319860.0, N: 5753565.0 (MGA2020-55)"
FINAL DEPTH: 25.9m
SURFACE ELEVATION : 59.790 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Elev (AHD): 58, 56, 54, 52
Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

Drilling Method	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Depth	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction notes	Notes (Structure, origin, etc)
SFA	Not Encountered	D		0.10m		TOPSOIL Sandy CLAY: low plasticity, brown, sand is fine to medium grained, with rootlets.	Flush cover: Grout:	TOPSOIL 0.00: grass nature strip beside driveway, Small trees nearby
			MD	0.60m		FILL Silty SAND: fine to medium grained, brown, silt is low plasticity		FILL
			H	1.80m		FILL Sandy CLAY: low to medium plasticity, grey, white speckled, sand is fine to coarse grained. 1.60: becoming fine to medium grained, grey/brow 1.60: becoming fine to medium grained, grey/brown		
		M	MD	4.30m	SP	SAND: fine to medium grained, uniform, grey, brown, with clay		INFERRED COLLUVIUM SOIL
		M	MD	7.50m	SC	Clayey SAND: fine to coarse grained, grey, brown, clay is low to medium plasticity; trace subangular to angular quartz gravel.		RESIDUAL SOIL
		w=PL	VSt	7.90m	CL-CI	Sandy CLAY: low to medium plasticity, grey, brown, white speckled, sand is fine to coarse grained.		
		M	MD		SC			

Standpipe Construction — Construction Details

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level
Pipe Description:
Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6
COMMENCED: 4/07/2025 12:30:00 PM
COMPLETED: 9/07/2025 4:35:00 PM
LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: **BH02_SMEC**
SHEET No: 2 of 4
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319860.0, N: 5753565.0 (MGA2020-55)"
FINAL DEPTH: 25.9m

SURFACE ELEVATION : 59.790 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Elev (AHD)	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction Details	Construction notes	Notes (Structure, origin, etc)
SFA			Not Encountered	M	MD	SC	Clayey SAND: fine to medium grained, grey, brown, clay is low plasticity. *(continued)*			RESIDUAL SOIL
		9.0		w=PL	VSt		9.10-9.40: clayey band, low to medium plasticity 9.10-9.40: clayey band, low to medium plasticity			
				M	MD		9.50: sand becoming orange, trace fine to coarse 9.50: sand becoming orange, trace fine to coarse grained quartz gravel			
	50	10.0					10.20-10.30: white quartz vein 10.20-10.30: white quartz vein			
		11.0							Bentonite:	
	48	12.0								
		13.0					13.00: sand becoming fine to coarse grained 13.00: sand becoming fine to coarse grained			
	46	14.0								
		15.0			VD		15.00m			EXTREMELY WEATHERED MATERIAL
HQ				M	VD	SC	15.30m Clayey SAND: fine to coarse grained, grey, orange-brown, clay is low plasticity; (Extremely Weathered granite).			15.25: Auger refusal in extremely weathered granite. Borehole terminated on Friday 4th July with standpipe to be installed on Monday 7th July.
							Clayey SAND: fine to coarse grained, grey, orange-brown, clay is low plasticity; (Extremely Weathered granite).			
	44						15.60m CORE LOSS 0.84m (15.60-16.44)			

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6

COMMENCED: 4/07/2025 12:30:00 PM
COMPLETED: 9/07/2025 4:35:00 PM

LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: BH02_SMEC
SHEET No: 3 of 4
PROJECT No: *30043649*

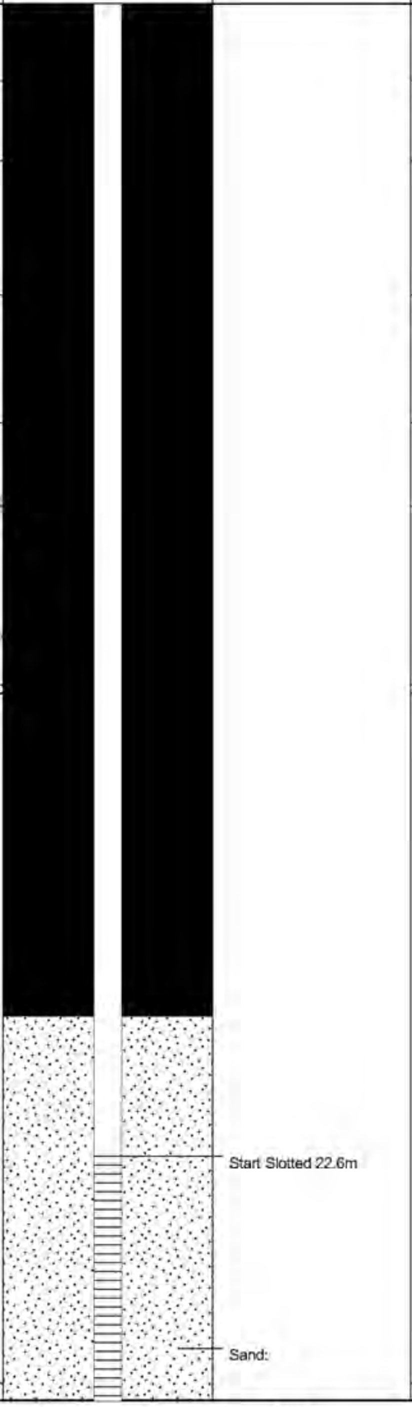
PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319860.0, N: 5753565.0 (MGA2020-55)"
FINAL DEPTH: 25.9m

SURFACE ELEVATION : 59.790 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Elev (AHD)	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Notes (Structure, origin, etc)
HQ			Not Encountered				16.44m	CORE LOSS 0.84m (15.60-16.44) *(continued)*	
				M	VD		SP 16.90m	SAND: fine to coarse grained, grey, orange-brown, with clay; (Extremely Weathered granite).	EXTREMELY WEATHERED MATERIAL
		17.0					17.67m	CORE LOSS 0.77m (16.90-17.67)	
	42	18.0		M	VD		SP 18.40m	SAND: fine to coarse grained, grey, orange-brown. (Extremely Weathered granite).	EXTREMELY WEATHERED MATERIAL
							18.88m	CORE LOSS 0.48m (18.40-18.88)	
	40	19.0					19.90m	GRANITE: medium to coarse grained, grey brown.	
							19.95m	CORE LOSS 0.05m (19.90-19.95)	
	38 36	20.0 21.0 22.0 23.0					23.90m	GRANITE: medium grained, grey.	

Standpipe Construction



Notes: Inflow Outflow Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6
COMMENCED: 4/07/2025 12:30:00 PM
COMPLETED: 9/07/2025 4:35:00 PM
LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

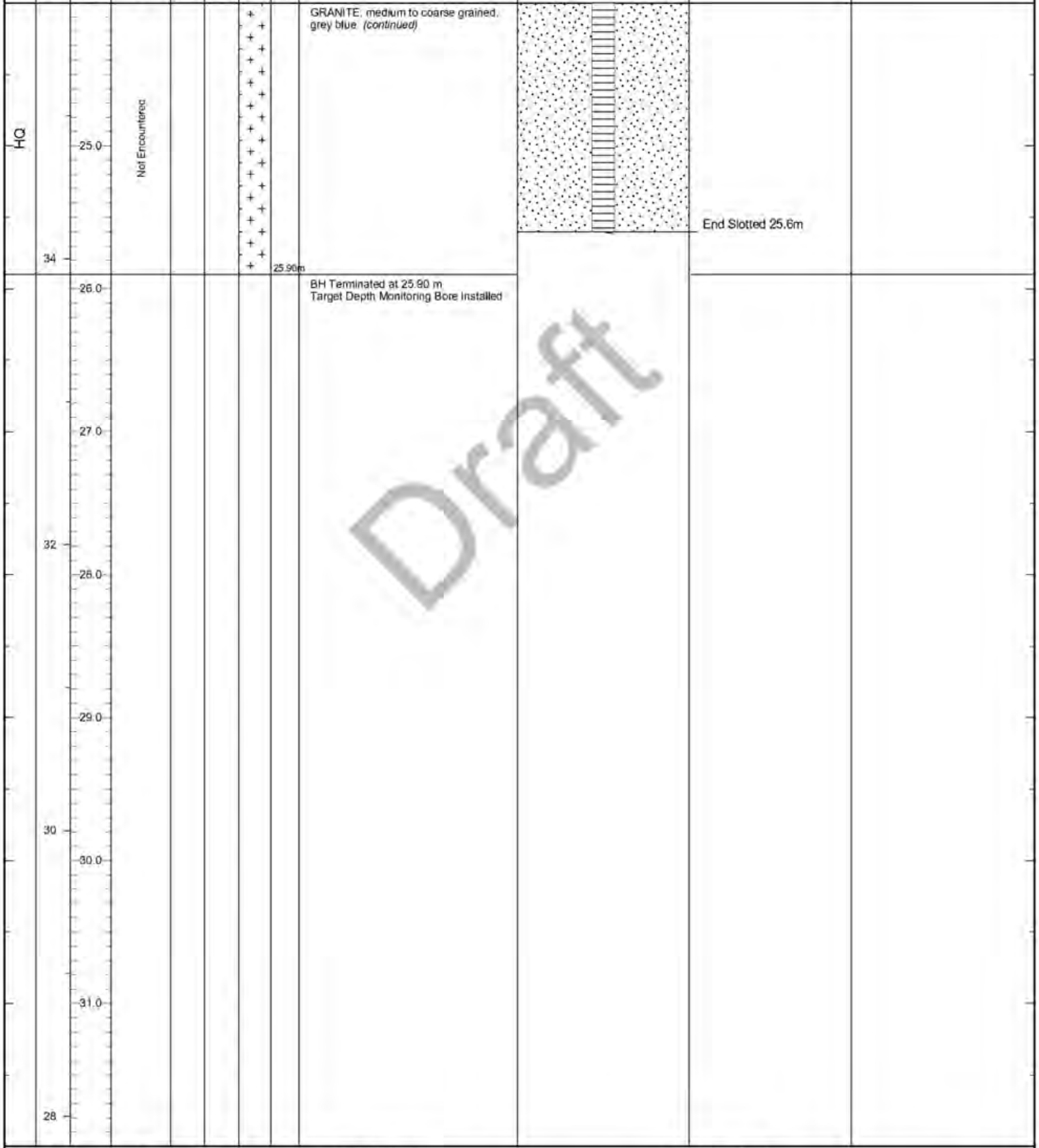
HOLE No:	**BH02_SMEC**
SHEET No:	4 of 4
PROJECT No:	*30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319860.0, N: 5753565.0 (MGA2020-55)"
FINAL DEPTH: 25.9m

SURFACE ELEVATION : 59.790 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Depth: Elev (AHD)	Depth: Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Standpipe Construction: Construction Details	Construction notes	OTHER OBSERVATIONS: Notes (Structure, origin, etc)
HQ			Not Encountered					GRANITE: medium to coarse grained, grey blue. *(continued)*		End Slotted 25.6m	
							25.90m	BH Terminated at 25.90 m Target Depth Monitoring Bore Installed			



Notes: Inflow Outflow Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6

COMMENCED: 4/07/2025 12:30:00 PM
COMPLETED: 9/07/2025 4:35:00 PM

LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: BH03_SMEC
SHEET No: 1 of 1
PROJECT No: 30043649

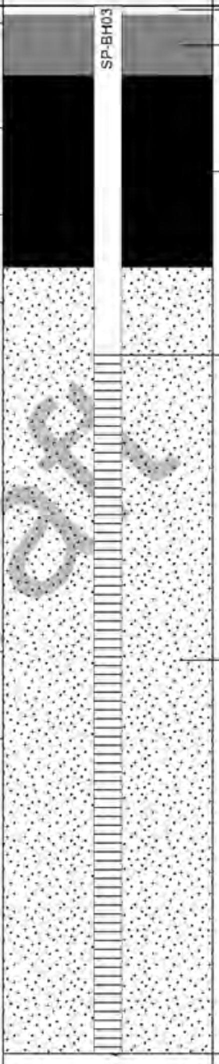
PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319790.0, N: 5753638.0 (MGA2020-55)"
FINAL DEPTH: 6.45m

SURFACE ELEVATION : 51.700 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Notes (Structure, origin, etc)
SFA	0.10m		w<PL			TOPSOIL Sandy CLAY: low to medium plasticity, dark brown, sand is fine to medium grained; with grass rootlets	TOPSOIL
	0.70m			St		FILL Sandy CLAY: low to medium plasticity, dark brown, sand is fine to medium grained.	FILL
	1.20m					FILL Silty CLAY: low to medium plasticity, dark brown.	
	1.70m					FILL Sandy CLAY: medium plasticity, orange, brown, grey, sand is fine to medium grained.	
	3.70m		W M	VL MD	SC	Clayey SAND: fine to coarse grained, brown, grey, clay is low to medium plasticity.	RESIDUAL SOIL 1.70: groundwater recovered during drilling
	4.20m		w>PL	VSt	CI	Silty CLAY: medium plasticity, grey, orange, with fine to medium grained sand.	
	6.45m			VSt H VSt	CI	Sandy CLAY: medium plasticity, orange, brown, grey, sand is fine to medium grained; with silt, trace fine to medium grained gravel. 4.50-5.00: white speckled	
						BH Terminated at 6.45 m Target Depth Monitoring Bore Installed	

Standpipe Construction



Construction notes:
- Flush cover:
- Grout:
- Bentonite:
- Start Slotted 2m
- Sand:
- End Slotted 6m

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level

Pipe Description:

Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6

COMMENCED: 3/07/2025 8:32:00 AM
COMPLETED: 3/07/2025 8:33:00 AM

LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

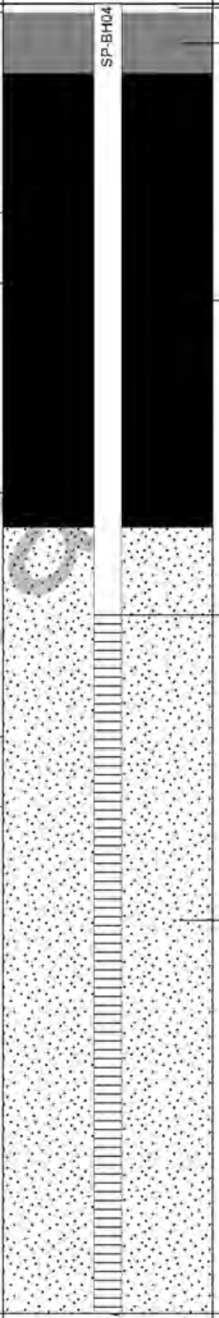
HOLE No: BH04_SMEC
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319668.0, N: 5753744.0 (MGA2020-55)"
FINAL DEPTH: 7.5m
SURFACE ELEVATION : 36.820 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method: SFA

Depth (m)	Moisture Condition	Consistency / Relative Density	USCS Code	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Notes (Structure, origin, etc)
0.05m	w=PL	VSt - H		TOPSOIL Sandy CLAY: medium plasticity, dark brown, sand is fine to medium grained; with rootlets	TOPSOIL 0.00: grassed nature strip
1.20m	w=PL	VSt - H		0.30: becoming grey, mottled orange-brown Silty CLAY: medium to high plasticity, dark brown. 0.30: becoming grey, mottled orange-brown	INFERRED COLLUVIUM SOIL
1.60m	w=PL	VSt - H		Sandy CLAY: medium plasticity, grey, white speckled, sand is fine to coarse grained; with silt.	
2.60m	M	D	SP	SAND: fine to medium grained, grey, with low plasticity clay.	
4.20m	M	D	SC	Clayey SAND: fine to medium grained, grey,brown, clay is low plasticity.	RESIDUAL SOIL
4.60m	W	D	SP	SAND: coarse grained, grey, with low plasticity clay.	4.20-4.60: wet sand at 4.2m
7.50m	M W	D MD D - VD	SC	Clayey SAND: fine to medium grained, grey, brown, clay is low plasticity; with silt. 7.00-7.50: sand becoming coarse grained 7.00-7.50: sand becoming coarse grained	7.00: water recovery
				BH Terminated at 7.50 m Target Depth Monitoring Bore Installed	7.50: near auger refusal at base of hole on inferred extremely weathered grainte

Standpipe Construction



Construction notes:
- Flush cover:
- Grout:
- Bentonite:
- Start Slotted 3.5m
- Sand:
- End Slotted 7.5m

Notes: Inflow — Outflow — Standing Water Level
Pipe Description:
Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Boart Longyear LX6
COMMENCED: 4/07/2025 9:00:00 AM
COMPLETED: 4/07/2025 12:37:00 PM
LOGGED BY: SC
CHECKED BY: PE

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP01A
SHEET No: 1 of 1
PROJECT No: 30043649

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319783.7, N: 5753646.3 (MGA2020-55)"
FINAL DEPTH: 2.7m
SURFACE ELEVATION : 50.780 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Elev (AHD)	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction notes	Notes (Structure, origin, etc)
NDD			Not Encountered			▨		FILL SAND: fine to coarse grained, dark grey, brown	Flush cover: Grout:	FILL
		0.50m				▨		FILL SAND: yellow brown	Bentonite:	
		2.00m				▨		FILL CLAY: high plasticity	Start Slotted 2.2m Sand: End Slotted 2.7m	
		2.70m						VE Terminated at 2.70 m Target Depth Groundwater monitoring well installed		

Elev (AHD): 50, 48, 46, 44
Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

Standpipe Construction – Construction Details

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level
Pipe Description:
Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck
COMMENCED: 30/06/2025
COMPLETED: 30/06/2025
LOGGED BY: JH
CHECKED BY:

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP01B
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319782.6, N: 5753647.4 (MGA2020-55)"
FINAL DEPTH: 2.6m

SURFACE ELEVATION : 50.650 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Elev (AHD)	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction Details	Construction notes	Notes (Structure, origin, etc)
NDD			Not Encountered					FILL SAND: yellow brown, grey, with clay, trace gravel.	DP01B	Flush cover: Grout: Bentonite: Start Slotted 2.1m Sand:	FILL
		2.40m						GRAVEL: fine grained, sub-angular to angular.		End Slotted 2.6m	
		2.60m						VE Terminated at 2.60 m Target Depth Groundwater monitoring well installed			

Notes: ▶— Inflow —◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck
COMMENCED: 30/06/2025
COMPLETED: 30/06/2025
LOGGED BY: JH
CHECKED BY:

smec

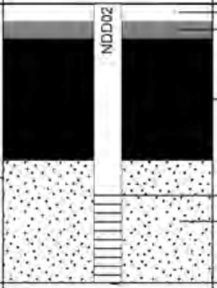
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP02A
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319756.3, N: 5753683.8 (MGA2020-55)"
FINAL DEPTH: 1.6m

SURFACE ELEVATION : 41.360 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

	Depth					MATERIAL			Standpipe Construction		OTHER OBSERVATIONS
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD			Not Encountered			▨	1.00m	Clayey SAND: dark grey , brown.		Flush cover: Grout: Bentonite:	
	40	1.0				▥	1.60m	Sandy CLAY: grey.		Start Slotted 1.1m Sand: End Slotted 1.6m	
		2.0						VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
	38	3.0									
		4.0									
	36	5.0									
		6.0									
	34	7.0									

Notes: ▶— Inflow —◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck

COMMENCED: 1/07/2025
COMPLETED: 1/07/2025

LOGGED BY: JH
CHECKED BY:

smec

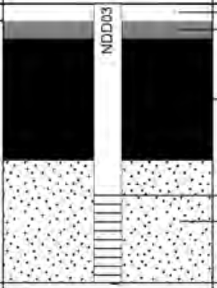
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP02B
SHEET No: 1 of 1
PROJECT No: 30043649

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319755.7, N: 5753684.4 (MGA2020-55)"
FINAL DEPTH: 1.6m

SURFACE ELEVATION : 41.230 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

	Depth			MATERIAL					Standpipe Construction		OTHER OBSERVATIONS
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD	40	1.0	Not Encountered					Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets Sandy CLAY: high plasticity, grey, brown	 NDD03	Flush cover: Grout: Bentonite: Start Slotted 1.1m Sand: End Slotted 1.6m	
		2.0						VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
	38	3.0									
		4.0									
	36	5.0									
		6.0									
	34	7.0									

Notes: ▶— Inflow —◀ Outflow ▼ Standing Water Level   Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST   COMMENCED: 1/07/2025   LOGGED BY: JH
EQUIPMENT: Vaccum Truck   COMPLETED: 1/07/2025   CHECKED BY:

osmec

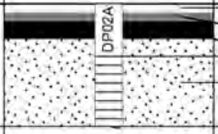
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP03A
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319728.1, N: 5753740.3 (MGA2020-55)"
FINAL DEPTH: 0.7m

SURFACE ELEVATION : 37.650 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

	Depth					**MATERIAL**			**Standpipe Construction**		**OTHER OBSERVATIONS**
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD			Not Encountered			▨	0.70m	FILL Sandy CLAY: high plasticity, dark grey.	 DP02A	Flush cover: Grout: Bentonite: Start Slotted 0.3m Sand: End Slotted 0.7m	FILL
								VE Terminated at 0.70 m Target Depth Groundwater monitoring well installed			
		1.0									
	36										
		2.0									
		3.0									
	34										
		4.0									
		5.0									
	32										
		6.0									
		7.0									
	30										

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck

COMMENCED: 2/07/2025
COMPLETED: 2/07/2025

LOGGED BY: JH
CHECKED BY:

smec

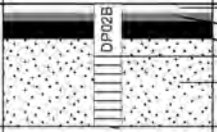
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP03B
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319727.2, N: 5753741.0 (MGA2020-55)"
FINAL DEPTH: 0.7m

SURFACE ELEVATION : 37.450 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Depth						MATERIAL			Standpipe Construction		OTHER OBSERVATIONS
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD			Not Encountered			▨	0.70m	FILL Sandy CLAY: high plasticity, dark grey.		Flush cover: Grout: Bentonite: Start Slotted 0.3m Sand: End Slotted 0.7m	FILL
	36 34 32 30	1.0 2.0 3.0 4.0 5.0 6.0 7.0						VE Terminated at 0.70 m Target Depth Groundwater monitoring well installed			

Draft

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck

COMMENCED: 2/07/2025
COMPLETED: 2/07/2025

LOGGED BY: JH
CHECKED BY:

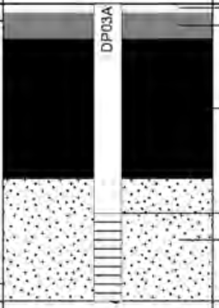
smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP04A
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319654.7, N: 5753689.3 (MGA2020-55)"
FINAL DEPTH: 1.7m
SURFACE ELEVATION : 35.820 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	**Depth**		**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL**	**Standpipe Construction**		**OTHER OBSERVATIONS**
	Elev (AHD)	**Depth (m)**						**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD			Not Encountered				0.10m	TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets	DP03A	Flush cover: Grout:	TOPSOIL
		1.0						FILL Clayey GRAVEL: fine to medium grained, dark grey.		Bentonite: Start Slotted 1.2m Sand:	FILL 0.10: crush rock 0.50: pipeline embedment material
							1.60m 1.70m	FILL GRAVEL: fine grained		End Slotted 1.7m	
	34	2.0						VE Terminated at 1.70 m Target Depth Groundwater monitoring well installed			
		3.0									
	32	4.0									
		5.0									
	30	6.0									
		7.0									
	28										



Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level   Pipe Description: Pipe Screen Details:

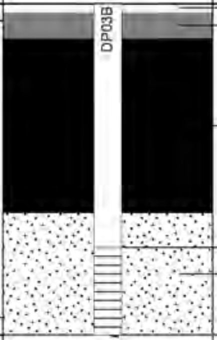
CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck
COMMENCED: 3/07/2025
COMPLETED: 3/07/2025
LOGGED BY: JH
CHECKED BY:

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP04B
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319653.4, N: 5753690.0 (MGA2020-55)"
FINAL DEPTH: 1.9m
SURFACE ELEVATION : 35.730 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

	Depth					MATERIAL			Standpipe Construction		OTHER OBSERVATIONS
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD			Not Encountered				0.10m	TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets		Flush cover: Grout:	TOPSOIL
	34	1.0				▨	1.60m	FILL Clayey GRAVEL: fine to medium grained, dark grey.		Bentonite: Start Slotted 1.4m Sand:	FILL 0.10: crush rock 0.50: pipeline embedment material
						▨	1.90m	FILL GRAVEL: fine grained		End Slotted 1.9m	
		2.0						VE Terminated at 1.90 m Target Depth Groundwater monitoring well installed			
		3.0									
	32	4.0									
		5.0									
	30	6.0									
		7.0									
	28										

Draft

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck
COMMENCED: 3/07/2025
COMPLETED: 3/07/2025
LOGGED BY: JH
CHECKED BY:

smec

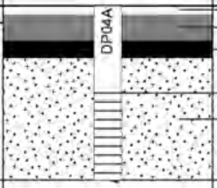
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP05A
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319634.9, N: 5753693.5 (MGA2020-55)"
FINAL DEPTH: 1m

SURFACE ELEVATION : 46.900 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

	Depth					MATERIAL			Standpipe Construction		OTHER OBSERVATIONS
Drilling Method	**Elev (AHD)**	**Depth (m)**	**Water**	**Moisture Condition**	**CONSISTENCY RELATIVE DENSITY**	**Graphic Log**	USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	**Construction Details**	**Construction notes**	**Notes (Structure, origin, etc)**
NDD	46	1.0	Not Encountered				0.10m 1.00m	TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets FILL Clayey SAND: fine to coarse grained, dark grey.	 DP04A	Flush cover: Grout: Bentonite: Start Slotted 0.5m Sand: End Slotted 1m	TOPSOIL FILL
								VE Terminated at 1.00 m Target Depth Groundwater monitoring well installed			
		2.0									
	44	3.0									
		4.0									
	42	5.0									
		6.0									
	40	7.0									

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck

COMMENCED: 3/07/2025
COMPLETED: 3/07/2025

LOGGED BY: JH
CHECKED BY:

smec

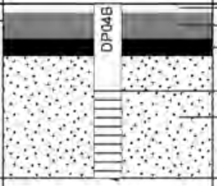
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP05B
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319633.7, N: 5753693.5 (MGA2020-55)"
FINAL DEPTH: 1m

SURFACE ELEVATION : 46.870 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Depth: Elev (AHD)	Depth: Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	MATERIAL: Graphic Log	MATERIAL: USCS CODE	**MATERIAL DESCRIPTION** SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Standpipe Construction: Construction Details	Standpipe Construction: Construction notes	OTHER OBSERVATIONS: Notes (Structure, origin, etc)
NDD			Not Encountered				0.10m	TOPSOIL Clayey SAND: fine to coarse grained, dark grey, brown.		Flush cover: Grout: Bentonite:	TOPSOIL
								FILL Clayey SAND: fine to coarse grained, dark grey.		Start Slotted 0.5m Sand: End Slotted 1m	FILL
	46						1.00m				
		1.0						VE Terminated at 1.00 m Target Depth Groundwater monitoring well installed			
		2.0									
	44	3.0									
		4.0									
	42	5.0									
		6.0									
	40	7.0									

Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck

COMMENCED: 3/07/2025
COMPLETED: 3/07/2025

LOGGED BY: JH
CHECKED BY:

osmec

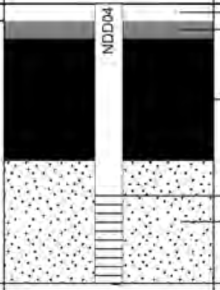
GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP06A
SHEET No: 1 of 1
PROJECT No: 30043649

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319631.6, N: 5753696.4 (MGA2020-55)"
FINAL DEPTH: 1.6m

SURFACE ELEVATION : 35.430 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Depth Elev (AHD)	Depth Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	MATERIAL Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Standpipe Construction Construction Details	Construction notes	OTHER OBSERVATIONS Notes (Structure, origin, etc)
			Not Encountered				0.10m	Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets		Flush cover: Grout:	
		1.0					1.60m	Clayey SAND: fine to coarse grained, grey, brown		Bentonite: Start Slotted 1.1m Sand: End Slotted 1.6m	
	34										
								VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
		2.0									
		3.0									
	32										
		4.0									
		5.0									
	30										
		6.0									
		7.0									
	28										

Notes: ▶— Inflow —◀ Outflow ▼ Standing Water Level   Pipe Description: Pipe Screen Details:

CONTRACTOR: QEST   COMMENCED: 3/07/2025   LOGGED BY: JH
EQUIPMENT: Vaccum Truck   COMPLETED: 3/07/2025   CHECKED BY:

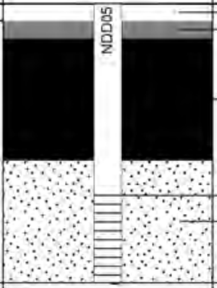
smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: DP06B
SHEET No: 1 of 1
PROJECT No: *30043649*

PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :
POSITION : "E: 319629.9, N: 5753696.4 (MGA2020-55)"
FINAL DEPTH: 1.6m
SURFACE ELEVATION : 35.300 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Elev (AHD)	Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	Construction Details	Construction notes	Notes (Structure, origin, etc)
		0.10m	Not Encountered					Clayey SAND: fine to coarse grained, dark grey, brown, trace rootlets.		Flush cover: Grout:	
								Clayey SAND: fine to coarse grained, grey, brown		Bentonite:	
		1.0								Start Slotted 1.1m	
	34									Sand:	
		1.60m								End Slotted 1.6m	
								VE Terminated at 1.60 m Target Depth Groundwater monitoring well installed			
		2.0									
		3.0									
	32										
		4.0									
		5.0									
	30										
		6.0									
		7.0									
	28										



Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level
Pipe Description:
Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck
COMMENCED: 3/07/2025
COMPLETED: 3/07/2025
LOGGED BY: JH
CHECKED BY:

smec

GEOLOGICAL LOG BORE HOLE WITH STANDPIPE / PIEZOMETER

HOLE No: NDD01
SHEET No: 1 of 1
PROJECT No: *30043649*

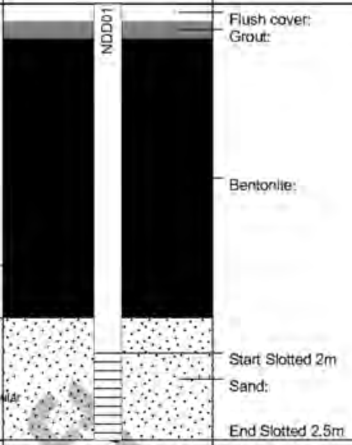
PROJECT : McCrae Landslide
CLIENT : South East Water
PURPOSE :
LOCATION :

POSITION : "E: 319758.6, N: 5753668.3 (MGA2020-55)"
FINAL DEPTH: 2.5m

SURFACE ELEVATION : 47.920 (AHD)
TOP OF CASING:
ANGLE FROM HORIZONTAL : -90°

Drilling Method	Depth: Elev (AHD)	Depth: Depth (m)	Water	Moisture Condition	CONSISTENCY RELATIVE DENSITY	Graphic Log	USCS CODE	MATERIAL DESCRIPTION SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components ROCK NAME: grain size, colour, texture and fabric, features, inclusion and minor components	OTHER OBSERVATIONS Notes (Structure, origin, etc)
NDD		1.0	Not Observed	D	MD		SC 1.50m	SAND: fine to coarse grained, dark grey, brown 0.50: very dry possibly due to tree nearby 0.50: very dry possibly due to tree nearby	
					St - VSt		CH 1.60m	CLAY: medium plasticity, grey	
	46	2.0			D		SC 2.50m	GRANITE RECOVERED AS CLAYEY SAND: medium to coarse grained, sub-angular to sub-rounded. 2.30: becoming trace fine grained gravel, sub-angular 2.30: becoming trace fine grained gravel, sub-angular	
		3.0						VE Terminated at 2.50 m Refusal This borehole was undertaken with Non-Distructive Drilling method. The encountered material was only assessed visually.	
	44	4.0							
		5.0							
	42	6.0							
		7.0							
	40								

Standpipe Construction



Notes: ▶ Inflow ◀ Outflow ▼ Standing Water Level

Pipe Description:

Pipe Screen Details:

CONTRACTOR: QEST
EQUIPMENT: Vaccum Truck

COMMENCED: 30/06/2025
COMPLETED: 30/06/2025

LOGGED BY: JH
CHECKED BY:

Appendix D Douglas Partners Investigation Report

Douglas PARTNERS | GROUNDED EXPERTISE

Investigation Summary Report

To:	Land Engineering for South East Water	Date:	29 July 2025
Attention:	Saleh Ramezani	Project No.:	235669.00
Email:	saleh.ramezani@landengineering.net.au	Reference:	R.001.Rev0
Subject:	Geotechnical Investigation & Monitoring Bore Installation - McCrae Low Level Storage Site (WR174)		

1. Introduction

Douglas Partners Pty Ltd (Douglas) was commissioned to undertake the geotechnical site investigation and monitoring bore installation in McCrae at McCrae's Low Level Storage Site (WR174) for Land Engineering on behalf of South East Water. The site location is shown in Figure 1.

Figure 1: Site Location

A track mounted drill rig supplied and operated by Gem Drilling was mobilised on 27 May 2025 and then subsequently on 5 June 2025 to complete the works. A geotechnical engineer from Douglas supervised the drilling rig on both occasions.

Land Engineering facilitated clearance of underground service assets and also undertook non destructive digging (NDD) to prove services prior to the borehole being drilled.

A geotechnical engineer and hydrogeologist from SMEC directed the required scope of works.

2. Scope of Works

The scope of works completed by Douglas comprised the following:

- Drill one borehole to 22.3 m and within the weathered granite rock;
- Recover soil and rock sub-samples for laboratory testing at Douglas' South Melbourne NATA accredited laboratory; and
- Install a groundwater monitoring standpipe.

Douglas facilitated the process of obtaining a bore construction licence for the installation of the groundwater monitoring standpipe. A copy of the licence was sent directly to Lucas Krutop of South East Water by Southern Rural Water.

3. Summary of Subsurface Conditions

The subsurface conditions encountered within the borehole were as follows:

- Fill to 0.2 m: Silty sand, with gravel;
- Possibly Residual to 3.1 m: Silty sand, with extremely weathered granite gravel inclusions, trace clay;
- Extremely weathered granite to 5.5 m: Recovered as Silty sand, with clay and gravel inclusions;
- Residual to 7.3 m: Recovered as Silty clay, trace gravel;
- Granite rock to 8.8 m: Extremely to highly weathered (very low to low strength) with possible shear zone;
- Granite rock to 22.3 m: Highly weathered (medium strength) to 17.9 m and moderately weathered (high strength) to 22.3 m.

The borehole location plan and borehole log can be found within the attachments.

Following drilling of the borehole to 22.3 m on 27 May 2025, the borehole was left open for measurements of groundwater level to determine whether the regional groundwater level was encountered to facilitate decisions around the installation of the groundwater monitoring standpipe.

Two further groundwater measurements were taken by a Douglas Geotechnical Engineer on 30 May and 3 June 2025. The purpose of a Douglas Geotechnical Engineer attending site on 3 June 2025 was to assess the recharge rate of the groundwater level once purged to facilitate decisions around whether the borehole needed to be deeper in order to reach the regional groundwater level. About 70 L of water was purged from the borehole prior to undertaking groundwater level readings at regular intervals. With the latter achieved, we mobilised to site on 5 June 2025 to install a groundwater monitoring standpipe for monitoring groundwater levels. The standpipe construction details can be found within the attachments. The groundwater level readings taken on the various occasions can be found within the attachments.

4. Laboratory Testing

A selection of laboratory tests have been scheduled from the recovered soil and weathered rock samples in Douglas' NATA accredited laboratory. The following tests are scheduled:

- Atterberg limits;
- Moisture content;
- Particle size distribution;
- Permeability; and
- Porosity.

Table 1 to Table 4 summarise the laboratory test results. Accompanying NATA accredited test certificates are within the attachments. It is to be noted that the porosity testing undertaken is not a NATA accredited test and hence test certificates are not provided.

Table 1: Results of Laboratory Testing - Atterberg Limits

Bore	Depth (m)	Description	FMC (%)	LL (%)	PL (%)	PI (%)	LS (%)
BH01	5.7-6.0	Silty CLAY trace gravel	42.8	126	20	106	10
BH01	6.4-6.7	Silty CLAY trace gravel	22.5	51	18	33	9.5
BH01	7.1-7.4	Silty CLAY trace gravel	26.8	51	21	30	12

Notes:
FMC - Field Moisture Content
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
LS - Linear Shrinkage

Table 2: Results of Laboratory Testing - Gradings

Bore	Depth (m)	Description	Gravel (%)	Sand (%)	Silt and clay (%)
BH01	1.00-1.35	Silty SAND trace gravel	1	60	39
BH01	1.5-1.9	Silty SAND trace gravel	2	77	21
BH01	2.0-2.35	Silty SAND trace gravel	4	70	26
BH01	2.5-2.6	Silty SAND trace gravel	6	66	28
BH01	3.0-3.15	Silty SAND trace gravel	8	66	26
BH01	3.7-3.95	Silty SAND trace gravel	5	65	30
BH01	4.0-4.2	Silty SAND	0	60	40
BH01	4.45-4.75	Sandy silty CLAY	0	53	47
BH01	5-5.3	Clayey SAND trace gravel	2	65	33

Table 3: Results of Laboratory Testing – Porosity

Location	Depth (m)	Material	Volume of Perm Specimen post testing (cm3)	Mass of Moisture post testing (g)	Porosity (%)
BH01	1.00-1.35	Sandy SILT trace gravel	225	78	35
BH01	3.7-3.95	Silty SAND trace gravel	116	42	37
BH01	4.0-4.2	Silty SAND	118	46	39
BH01	4.45-4.75	Sandy silty CLAY	108	41	38
BH01	5-5.3	Clayey SAND trace gravel	126	46	36
BH01	5.7-6.0	Silty CLAY trace gravel	116	64	55
BH01	6.4-6.7	Silty CLAY trace gravel	129	54	42
BH01	7.1-7.4	Silty CLAY trace gravel	107	44	41

Table 4: Results of Laboratory Testing – Permeability

Location	Depth (m)	Material	Moisture Content (%)	Coefficient of Permeability (m/s)
BH01	1.00-1.35	Sandy SILT trace gravel	11.7	2×10^{-9}
BH01	1.50-1.90	Sandy SILT trace gravel	12.5	3×10^{-10}
BH01	2.0-2.35	Silty SAND trace gravel	12.7	1×10^{-10}
BH01	2.5-2.60	Silty SAND trace gravel	12.6	3×10^{-10}
BH01	3.0-3.15	Silty SAND trace gravel	16.3	2×10^{-10}
BH01	3.7-3.95	Silty SAND trace gravel and clay	19.0	1×10^{-9}
BH01	4.0-4.2	Silty SAND with gravel trace clay	21.9	1×10^{-10}
BH01	4.45-4.75	Silty SAND with gravel trace clay	21.9	3×10^{-10}
BH01	5.0-5.3	Silty SAND with gravel trace clay	20.1	4×10^{-10}
BH01	5.7-6.0	Silty CLAY trace gravel	42.8	1×10^{-10}
BH01	6.4-6.7	Silty CLAY trace gravel	22.5	8×10^{-11}
BH01	7.1-7.4	Silty CLAY trace gravel	26.8	1×10^{-10}

5. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at Waller Place, McCrae in line with Douglas' email proposal dated 11 April 2025. The work was carried out under Douglas's Terms and Conditions. This report is provided for the exclusive use of Land Engineering (for South East Water) for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

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

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

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

Douglas Partners Pty Ltd

PI

Avi Poonyth
Associate / Geotechnical Engineer

Reviewed by

PI

Chris Crowe
Principal

Attachments:	About This Report
	Terminology, Symbols and Abbreviations
	Borehole Location Plan
	Borehole Log
	Photos – U_{63} and Recovered Rock Cores
	Standpipe Construction Detail
	Groundwater Level Measurement
	Laboratory Test Certificates

About this Report

October 2024

Introduction

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

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

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Engagement Terms for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

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Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style `XW`. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	`KL`
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	`UK`
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	`ND`
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	`NA`

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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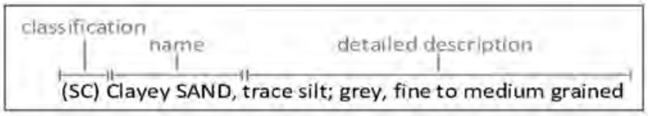
Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:



The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	**Particle Size (mm)**	**Behaviour Model**	
		Behaviour	**Approximate Dry Mass**
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	**Definition[1]**	**Relative Proportion**	
		In Fine Grained Soil	**In Coarse Grained Soil**
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component[1]	**Prominence in Soil Name**
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	**Relative Proportion**	
	In Fine Grained Soil	**In Coarse Grained Soil**
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	**Laboratory liquid limit range**	
	Silt	**Clay**
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		**Particle size (mm)**
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	**Particle size (mm)**
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Descriptions

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Soil Descriptions

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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Rock Descriptions

Terminology
Symbols
Abbreviations

March 2024

Rock Strength

Rock strength is defined by the unconfined compressive strength, and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $I_{s(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Unconfined Compressive Strength (MPa)	Point Load Index[1] $I_{s(50)}$ MPa	Abbreviation Code
Very low	0.6 - 2	0.03 - 0.1	VL
Low	2 - 6	0.1 - 0.3	L
Medium	6 - 20	0.3 - 1.0	M
High	20 - 60	1 - 3	H
Very high	60 - 200	3 - 10	VH
Extremely high	>200	>10	EH

[1] Rock strength classification is based on UCS. The UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site. The point load index ranges shown above are as suggested in AS1726 and should not be relied upon without supporting evidence.

The following abbreviation codes are used for soil layers or seams of material "within rock" but for which the equivalent UCS strength is less than 0.6 MPa.

Scenario	Abbreviation Code
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the "Description of Strata" and soil properties columns.	SOIL
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column.	SEAM

Degree of Weathering

The degree of weathering of rock is classified as follows:

Weathering Term	Description	Abbreviation Code
Residual Soil[1]	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.	RS
Extremely weathered[1]	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible	XW
Highly weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.	HW
Moderately weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MW
Slightly weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	SW
Fresh	No signs of decomposition or staining.	FR
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.	DW

[1] The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

Rock Descriptions

Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

Term	Description	Abbreviation Code
Extremely altered	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.	XA
Highly altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching or may be decreased due to precipitation of secondary materials in pores.	HA
Moderately altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MA
Slightly altered	Rock is slightly discoloured but shows little or no change of strength from fresh rock	SA
Note: If HA and MA cannot be differentiated use DA (see below)		
Distinctly altered	Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching or may be decreased due to precipitation of secondary minerals in pores.	DA

Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} > 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e., drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Rock Descriptions

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Cleavage	CL
Crushed seam	CS
Crushed zone	CZ
Drilling break	DB
Decomposed seam	DS
Drill lift	DL
Extremely Weathered seam	EW
Fault	F
Fracture	FC
Fragmented	FG
Handling break	HB
Infilled seam	IS
Joint	JT
Lamination	LAM
Shear seam	SS
Shear zone	SZ
Vein	VN
Mechanical break	MB
Parting	P
Sheared Surface	S

Rock Defect Orientation

Term	Abbreviation Code
Horizontal	H
Vertical	V
Sub-horizontal	SH
Sub-vertical	SV

Rock Defect Coating

Term	Abbreviation Code
Clean	CN
Coating	CT
Healed	HE
Infilled	INF
Stained	SN
Tight	TI
Veneer	VNR

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLAY
Iron oxide	FE
Manganese	MN
Pyrite	Py
Secondary material	MS
Silt	M
Quartz	Qz
Unidentified material	MU

Rock Defect Shape/Planarity

Term	Abbreviation Code
Curved	CU
Discontinuous	DIS
Irregular	IR
Planar	PR
Stepped	ST
Undulating	UN

Rock Defect Roughness

Term	Abbreviation Code
Polished	PO
Rough	RF
Smooth	SM
Slickensided	SL
Very rough	VR

Defect Orientation

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

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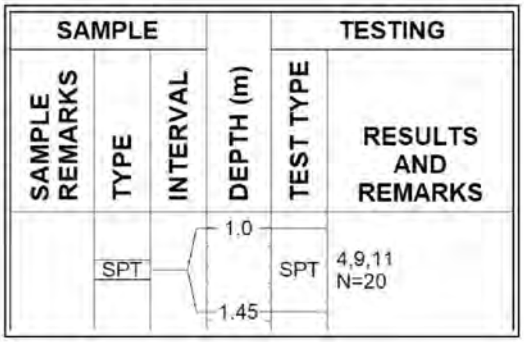
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

October 2024

Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Driven Tube sample	DT
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y = x blows for y mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP9/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

Site Location

Legend

⯐ Borehole

— Site Boundary

0 5 10 15 20 m

NOTE:
1. Drawing adapted from aerial imagery from "MetroMap" dated 30.05.2025.
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage (handheld GPS, measured off site features)

Douglas PARTNERS

CLIENT: Land Engineering for South East Water		TITLE:	**Borehole Location Plan** **McCrae, Waller Place** **2 Cornell Street, McCrae VIC 3938**
OFFICE: Melbourne	DRAWN BY: NW		
SCALE: 1:400 @A3	DATE: 10.June.2025		

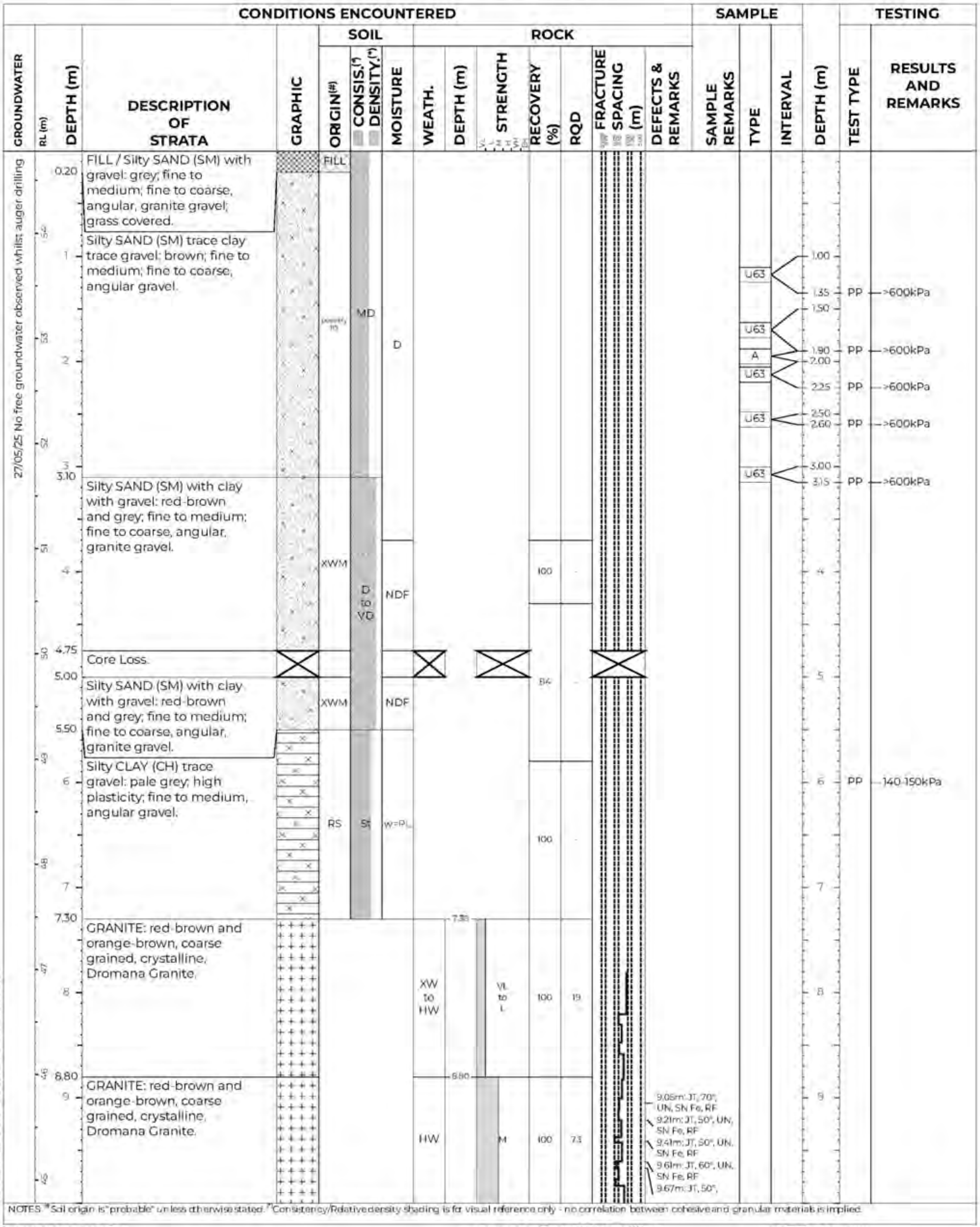
Project: 235669.00
DRAWING No: 1
REVISION: 0

BOREHOLE LOG

CLIENT: Land Engineering Pty Ltd
PROJECT: McCrae Low Level Storage Site (WR174)
LOCATION: Waller Place, McCrae, VIC 3938

SURFACE LEVEL: 54.8 AHD
COORDINATE: E:319730.4, N:5753465.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: MW0227 (WR174)
PROJECT No: 235669.00
DATE: 27/05/25
SHEET: 1 of 3



DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN	CONSIS./DENSITY	MOISTURE	WEATH.	STRENGTH	RECOVERY (%)	RQD	DEFECTS & REMARKS	TYPE	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
0.20	FILL / Silty SAND (SM) with gravel: grey; fine to medium; fine to coarse, angular, granite gravel; grass covered.	FILL											
3.10	Silty SAND (SM) trace clay trace gravel: brown; fine to medium; fine to coarse, angular gravel.	possibly TO	MD	D						U63	1.00 – 1.35	PP	>600kPa
										U63	1.50 – 1.90	PP	>600kPa
										A	2.00		
										U63	2.00 – 2.25	PP	>600kPa
										U63	2.50 – 2.60	PP	>600kPa
										U63	3.00 – 3.15	PP	>600kPa
4.75	Silty SAND (SM) with clay with gravel: red-brown and grey; fine to medium; fine to coarse, angular, granite gravel.	XWM	D to VD	NDF			100	-					
5.00	Core Loss.						84	-					
5.50	Silty SAND (SM) with clay with gravel: red-brown and grey; fine to medium; fine to coarse, angular, granite gravel.	XWM		NDF									
7.30	Silty CLAY (CH) trace gravel: pale grey; high plasticity; fine to medium, angular gravel.	RS	St	w=PL			100	-			6	PP	140-150kPa
8.80	GRANITE: red-brown and orange-brown, coarse grained, crystalline, Dromana Granite.				XW to HW	VL to L	100	19					
	GRANITE: red-brown and orange-brown, coarse grained, crystalline, Dromana Granite.				HW	M	100	73	9.05m: JT, 70°, UN, SN Fe, RF 9.21m: JT, 50°, UN, SN Fe, RF 9.41m: JT, 50°, UN, SN Fe, RF 9.61m: JT, 60°, UN, SN Fe, RF 9.67m: JT, 50°,				

GROUNDWATER: 27/05/25 No free groundwater observed whilst auger drilling

NOTES: # Soil origin is "probable" unless otherwise stated. * Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Combined Log

PLANT: MDR 2.4
METHOD: AD/T to 3.7m, then NMLC to 22.3m
REMARKS:

OPERATOR: GEM Drilling

LOGGED: NW
CASING: HQ to 3.5m

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: Land Engineering Pty Ltd
PROJECT: McCrae Low Level Storage Site (WR174)
LOCATION: Waller Place, McCrae, VIC 3938

SURFACE LEVEL: 54.8 AHD
COORDINATE: E:319730.4, N:5753465.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: MW0227 (WR174)
PROJECT No: 235669.00
DATE: 27/05/25
SHEET: 2 of 3

CONDITIONS ENCOUNTERED															SAMPLE				TESTING	
					SOIL			ROCK												
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			[CONT] GRANITE: red-brown and orange-brown, coarse grained, crystalline. Dromana Granite.								100	73		UN, SN Fe, RF						
	44 43	11									100	90		10.30-11.89m: JT, 70°, UN, SN Fe, SM				11		
	42	12 13									100	94		11.89-13.35m: JT, 90°, UN, SN Fe, SM				12 13		
	41 40	14						HW			100	34		13.41-13.55m: DS, approx. 30mm 13.72m: DS, approx. 20mm 13.87m: DS, approx. 20mm 14.50m: JT, 60°, UN, CN, SM 14.55m: JT, 90°, IR, SN Fe, RF				14		
	39	15 16								M	100	43		14.66m: JT, 70°, UN, SN Fe, RF 14.97m: DS, approx. 50mm 15.07m: JT, 50°, IR, SN Fe, SM 15.60-15.80m: JT, 60°, UN, RF, DS: approx. 30mm				15 16		
	38 37	17									100	50		16.30m: JT, 80°, UN, SN Fe, RF 16.38m: JT, 60°, IR, SN Fe, RF 16.58m: JT, 70°, CU, RF, DS approx. 20mm 16.82-17.88m: JT, 70°, CU, SN Fe, RF				17		
	36	18 19	17.90m: grey brown					MW	17.90		100	83		18.68m: JT, 70°, IR, SN Fe, RF 19.20m: JT, 60°, UN, SN Fe, RF				18 19		
	35								19.70	H	100	56								

NOTES: # Soil origin is "probable" unless otherwise stated. * Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Combined Log

PLANT: MDR 2.4
METHOD: AD/T to 3.7m, then NMLC to 22.3m
REMARKS:

OPERATOR: GEM Drilling

LOGGED: NW
CASING: HQ to 3.5m

Refer to explanatory notes for symbol and abbreviation definitions

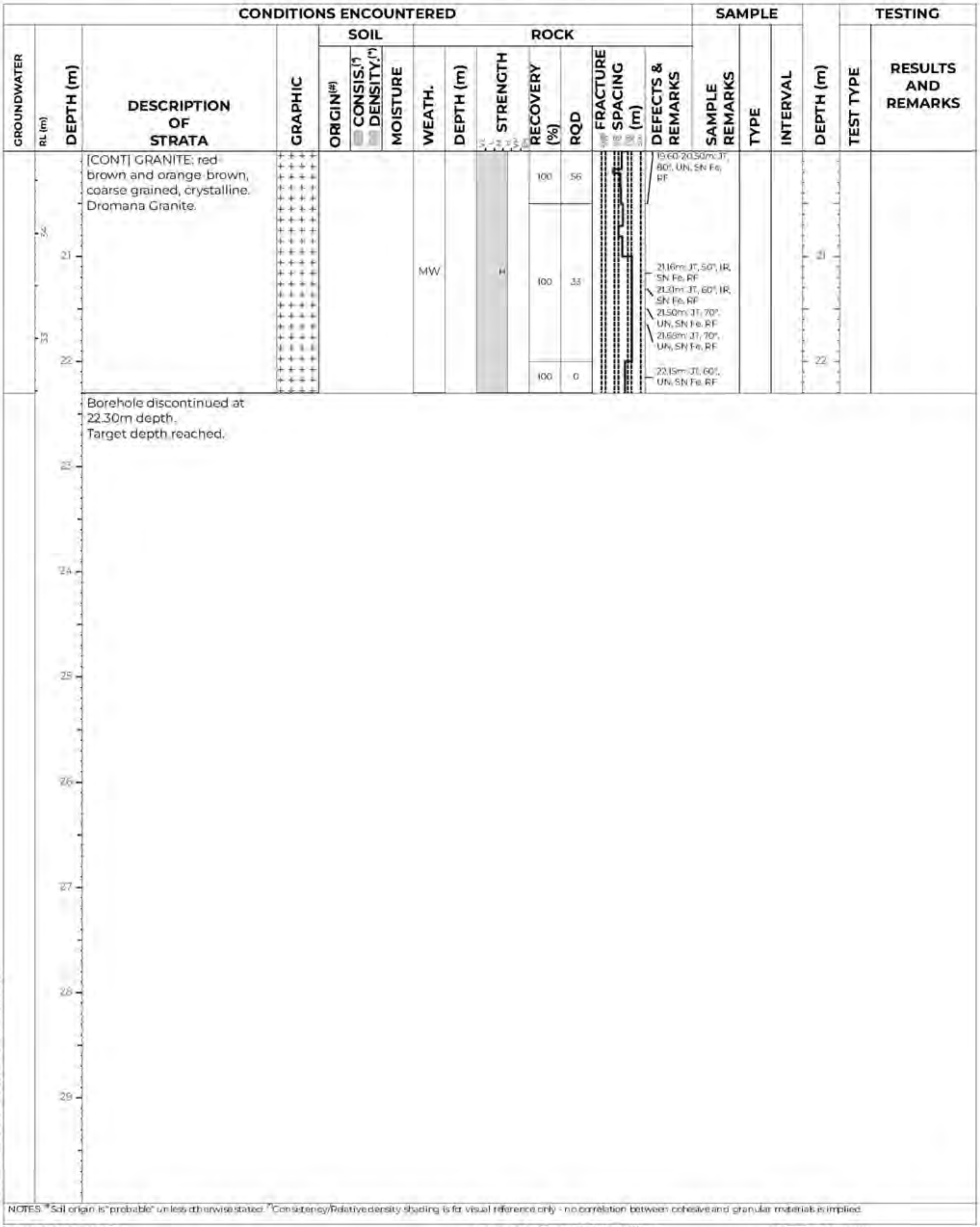
Douglas PARTNERS

BOREHOLE LOG

CLIENT: Land Engineering Pty Ltd
PROJECT: McCrae Low Level Storage Site (WR174)
LOCATION: Waller Place, McCrae, VIC 3938

SURFACE LEVEL: 54.8 AHD
COORDINATE: E:319730.4, N:5753465.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: MW0227 (WR174)
PROJECT No: 235669.00
DATE: 27/05/25
SHEET: 3 of 3



CONDITIONS ENCOUNTERED					SOIL			ROCK							SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	34		[CONT] GRANITE: red brown and orange brown, coarse grained, crystalline. Dromana Granite.	+ + + +				MW		H	100	56		19.60-20.50m: JT, 80°, UN, SN Fe, RF						
	33	21									100	33		21.16m: JT, 50°, IR, SN Fe, RF 21.30m: JT, 60°, IR, SN Fe, RF 21.50m: JT, 70°, UN, SN Fe, RF 21.68m: JT, 70°, UN, SN Fe, RF				21		
		22									100	0		22.15m: JT, 60°, UN, SN Fe, RF				22		
			Borehole discontinued at 22.30m depth. Target depth reached.																	

NOTES: #Soil origin is "probable" unless otherwise stated. *Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Combined Log

PLANT: MDR 2.4
METHOD: AD/T to 3.7m, then NMLC to 22.3m
REMARKS:

OPERATOR: GEM Drilling

LOGGED: NW
CASING: HQ to 3.5m

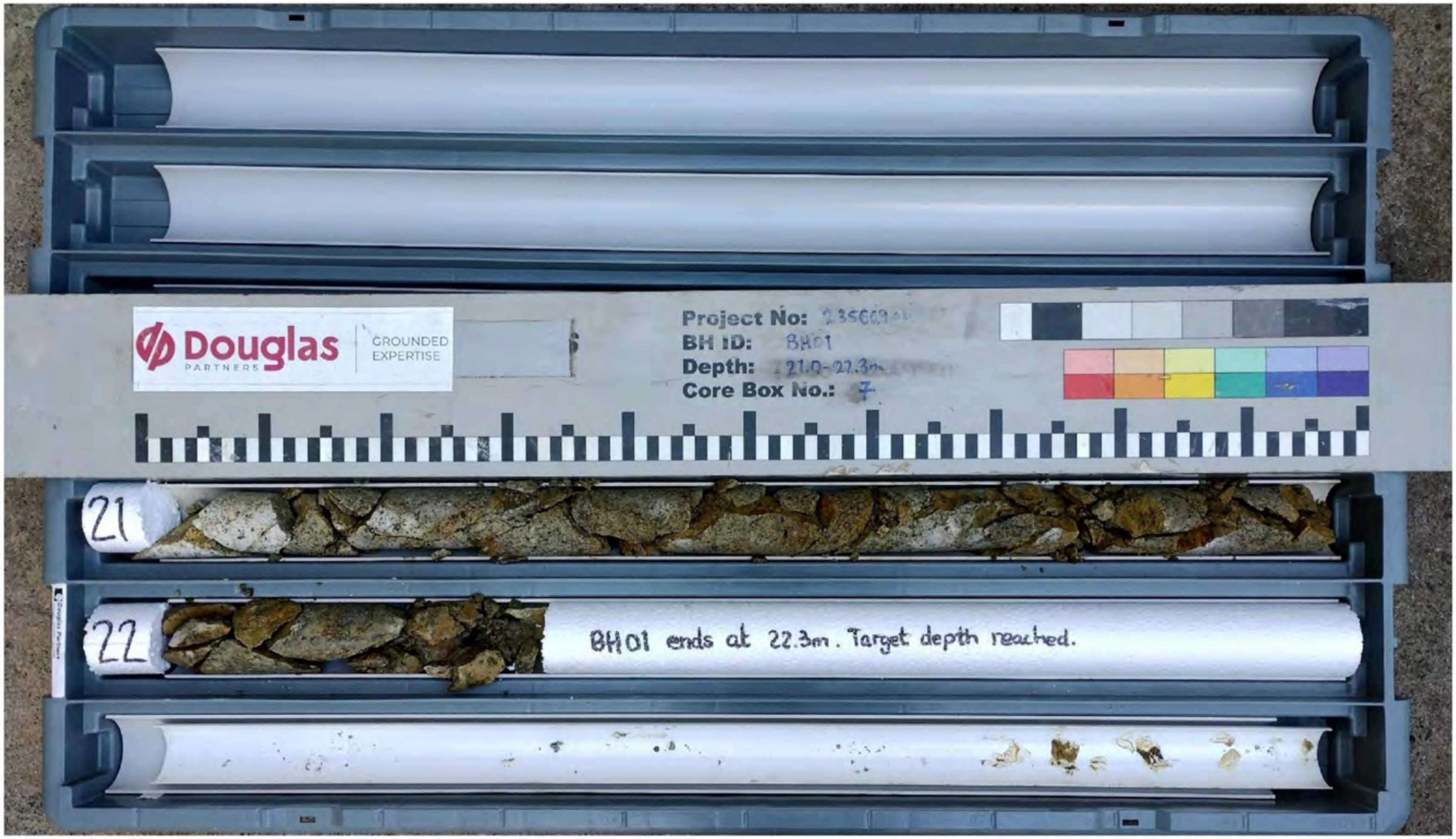
Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

GROUNDED EXPERTISE	CLIENT:	Land Engineering for South East Water	**Core Photographs**	PROJECT:	235669.00
	OFFICE:	Melbourne	**MW0227: 3.7 m – 9.0 m**	REVISION	0
	DATE:	June 2025	**McCrae, Waller Place**		

GROUNDED EXPERTISE	CLIENT:	Land Engineering for South East Water	**Core Photographs**	PROJECT:	235669.00
	OFFICE:	Melbourne	**MW0227: 9.0 m – 15.0 m**	REVISION	0
	DATE:	June 2025	**McCrae, Waller Place**		

GROUNDED EXPERTISE	CLIENT:	Land Engineering for South East Water	**Core Photographs**	PROJECT:	235669.00
	OFFICE:	Melbourne	**MW0227: 15.0 m – 21.0 m**	REVISION	0
	DATE:	June 2025	**McCrae, Waller Place**		



Douglas PARTNERS GROUNDED EXPERTISE	CLIENT:	Land Engineering for South East Water	**Core Photographs**	PROJECT:	235669.00
	OFFICE:	Melbourne	**MW0227: 21.0 m – 22.3 m**	REVISION	0
	DATE:	June 2025	**McCrae, Waller Place**		

Douglas PARTNERS GROUNDED EXPERTISE	CLIENT: Land Engineering for South East Water	**Sample Photographs**	PROJECT:	235669.00
	OFFICE: Melbourne	**MW0227: U63 samples**	REVISION:	0
	DATE: June 2025	**McCrae, Waller Place**	PLATE No.	1

Douglas Partners
Geotechnics / Environment / Groundwater

JOB No: 235669.00
DATE: 27/5/25
ROJECT/LOCATION: McCrae
MPLE TYPE: U63
PROJ MGR: AP
DEPTH: 2.0-2.35m
ENG: NW
BORE/TEST PIT/SAMPLE No: BH01
REMARKS: 250mm rec., 600+pp

Douglas Partners
Geotechnics / Environment / Groundwater

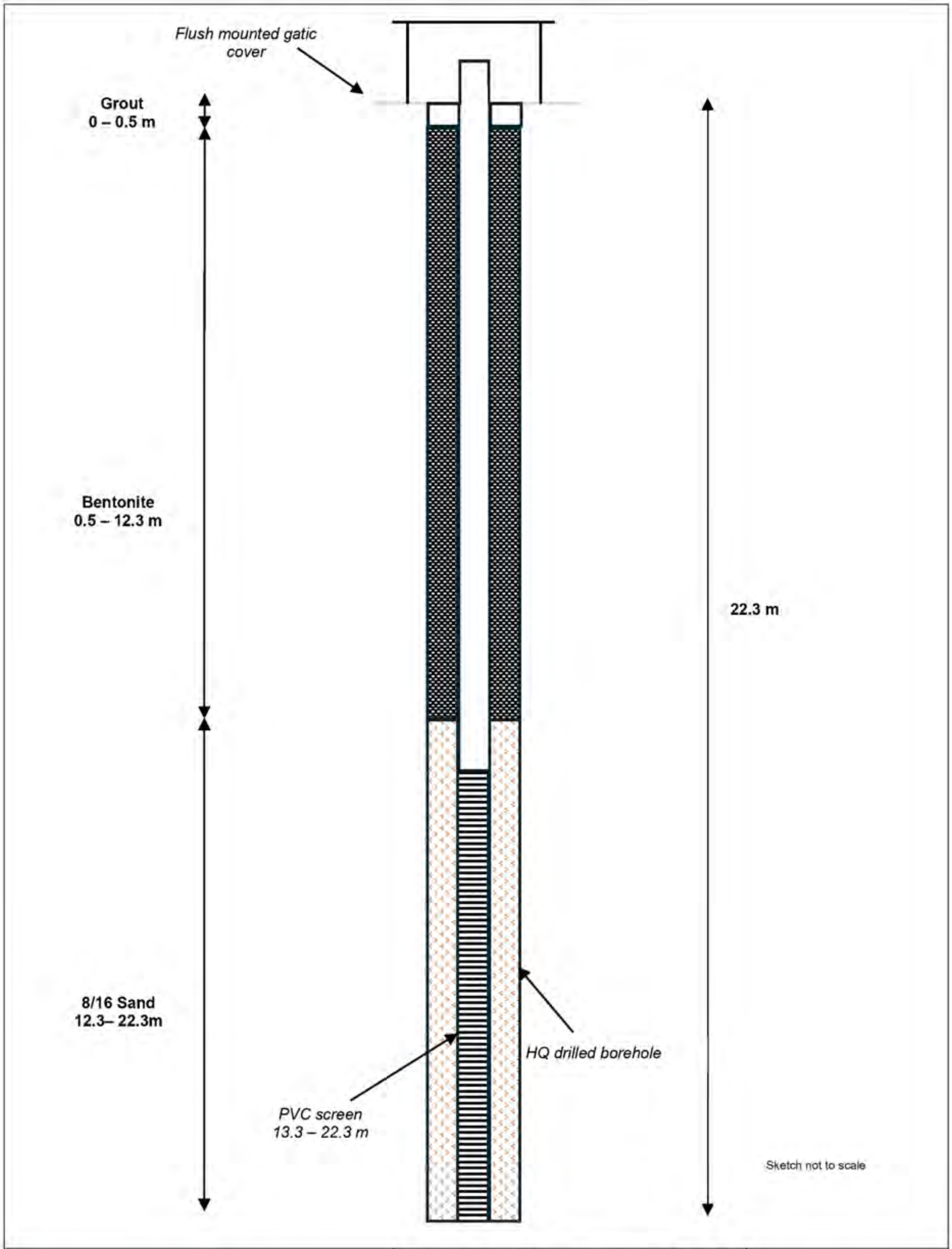
JOB No: McCrae
DATE: 27/5/25
PROJECT/LOCATION: 235669.00
SAMPLE TYPE: U63
PROJ MGR: AP
H: 2.5-2.6m
ENG: MW
E/TEST PIT/SAMPLE No: BH01
REMARKS: Refusal, 100mm rec.

Douglas PARTNERS GROUNDED EXPERTISE	CLIENT:	Land Engineering for South East Water	**Sample Photographs**	PROJECT:	235669.00
	OFFICE:	Melbourne	**MW0227: U63 samples**	REVISION:	0
	DATE:	June 2025	**McCrae, Waller Place**	PLATE No.	2

Douglas Partners
Geotechnics / Environment / Groundwater

JOB No: 235669.00 DATE: 27/5/25
PROJECT/LOCATION: McCrae
SAMPLE TYPE: U63 PROJ MGR: AP
EPTH: 3.0-3.15m ENG: MW
BORE/TEST PIT/SAMPLE No: BH01
REMARKS: 150mm rec., 600+

GROUNDED EXPERTISE	CLIENT: Land Engineering for South East Water	**Sample Photographs**	PROJECT:	235669.00
	OFFICE: Melbourne	**MW0227: U63 samples**	REVISION:	0
	DATE: June 2025	**McCrae, Waller Place**	PLATE No.	3



Douglas PARTNERS | GROUNDED EXPERTISE

Standpipe Construction Detail
MW0227
McCrae, Waller Place
2 Cornell Street, McCrae

PROJECT:
235669.00

CLIENT: Land Engineering for South East Water

DATE: June 2025

GROUNDWATER LEVEL MEASUREMENTS – MW0227

PROJECT: McCrae, Waller Pl	**PROJECT NO:** 235669.00
LOCATION: 2 Cornell Street, McCrae VIC 3938	**CLIENT:** Land Engineering for South East Water

DATE	TIME	BORE ID No.	DIPMETER READING (m)	STICK-UP (m)	DEPTH TO SWL (m)	COMMENTS (OPERATOR, METHOD, WATER PURGED, ETC.)
27.5.25	16:30	BH01	7.00	0.4	**6.60**	NW. Dipmeter, open bore, no standpipe.
30.5.25	9:40	BH01	9.90	0.4	**9.50**	NW. Dipmeter, open bore, no standpipe.
3.6.25	9:00	BH01	10.54	0.4	**10.14**	DL. Dipmeter, open bore, no standpipe.
3.6.25	9:50	BH01	19.00	0.4	**18.60**	DL. Dipmeter, open bore, no standpipe. After purging about 70L of water.
3.6.25	9:51	BH01	18.88	0.4	**18.48**	DL. Dipmeter, open bore, no standpipe.
3.6.25	9:53	BH01	18.60	0.4	**18.20**	DL. Dipmeter, open bore, no standpipe.
3.6.25	9:56	BH01	18.47	0.4	**18.07**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:00	BH01	18.37	0.4	**17.97**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:05	BH01	18.25	0.4	**17.85**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:10	BH01	18.11	0.4	**17.71**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:15	BH01	17.99	0.4	**17.59**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:20	BH01	17.86	0.4	**17.46**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:25	BH01	17.72	0.4	**17.32**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:30	BH01	17.62	0.4	**17.22**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:35	BH01	17.50	0.4	**17.10**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:40	BH01	17.42	0.4	**17.02**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:45	BH01	17.36	0.4	**16.96**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:50	BH01	17.27	0.4	**16.87**	DL. Dipmeter, open bore, no standpipe.
3.6.25	10:55	BH01	17.18	0.4	**16.78**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:00	BH01	17.09	0.4	**16.69**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:05	BH01	17.00	0.4	**16.60**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:10	BH01	16.92	0.4	**16.52**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:15	BH01	16.86	0.4	**16.46**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:20	BH01	16.78	0.4	**16.38**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:25	BH01	16.70	0.4	**16.30**	DL. Dipmeter, open bore, no standpipe.

3.6.25	11:30	BH01	16.63	0.4	**16.23**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:35	BH01	16.56	0.4	**16.16**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:40	BH01	16.50	0.4	**16.10**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:45	BH01	16.44	0.4	**16.04**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:50	BH01	16.38	0.4	**15.98**	DL. Dipmeter, open bore, no standpipe.
3.6.25	11:55	BH01	16.32	0.4	**15.92**	DL. Dipmeter, open bore, no standpipe.
3.6.25	12:00	BH01	16.27	0.4	**15.87**	Stopped measuring at 12:00pm as discussed with Hugo
5.6.25	8:30	BH01	14.7	0.4	**14.3**	NW. Dipmeter, open bore, no standpipe
5.6.25	12:00	BH01	16.2	0	**16.2**	NW. Well developed (~15L purged). Standpipe completed to 22.3m.

Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911A
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 20/06/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 1.00-1.35m**
Material: Silty SAND trace gravel

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Melbourne Laboratory
231 Normanby Road South Melbourne Vic 3205
Phone: (03) 9673 3500
Email: Peter.Chan@douglaspartners.com.au

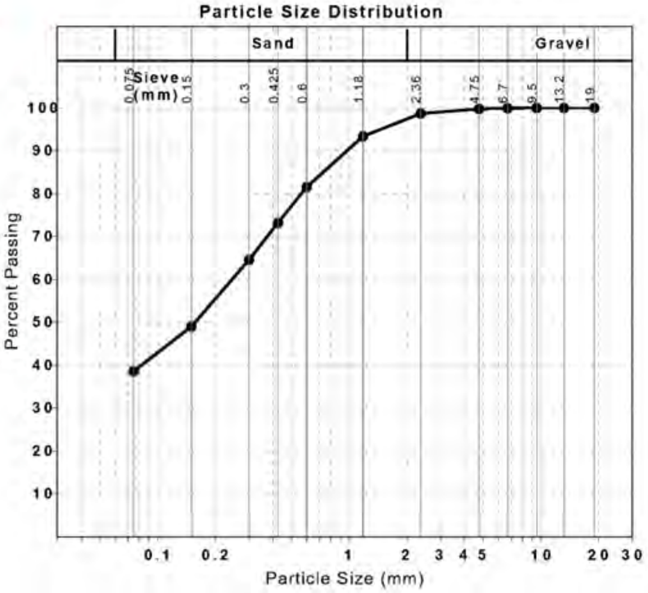
Accredited for compliance with ISO/IEC 17025 - Testing

PI

Approved Signatory: Peter Chan
Senior Associate
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**99**			1		
1.18 mm	**93**			5		
0.6 mm	**82**			12		
0.425 mm	**73**			8		
0.3 mm	**65**			9		
0.15 mm	**49**			16		
0.075 mm	**39**			10		



Material Test Report

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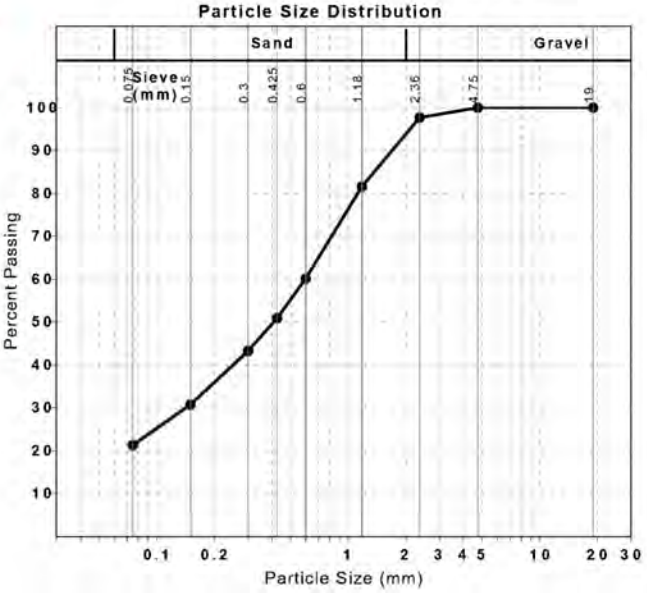
Approved Signatory: Peter Chan
Senior Associate
Laboratory Accreditation Number: 828

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911B
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 04/07/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 1.5-1.9m**
Material: Silty SAND trace gravel

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**98**			2		
1.18 mm	**82**			16		
0.6 mm	**60**			21		
0.425 mm	**51**			9		
0.3 mm	**43**			8		
0.15 mm	**31**			13		
0.075 mm	**21**			9		



Material Test Report

Report Number:	**235669.00-1A**
Issue Number:	1
Date Issued:	04/07/2025
Client:	Land Engineering Pty Ltd PO Box 108, Hastings VIC
Project Number:	235669.00
Project Name:	Geotechnical Investigation & Monitoring Bore Installation
Project Location:	Waller Place, McCrae VIC
Work Request:	7911
Sample Number:	ME-7911C
Date Sampled:	27/05/2025
Dates Tested:	06/06/2025 - 04/07/2025
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**BH01, Depth: 2.0-2.35m**
Material:	Silty SAND trace gravel

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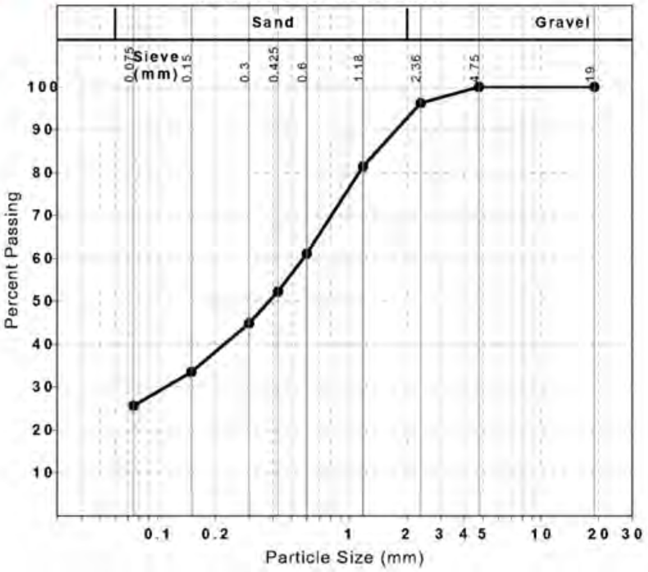
Senior Associate
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**96**			4		
1.18 mm	**81**			15		
0.6 mm	**61**			20		
0.425 mm	**52**			9		
0.3 mm	**45**			7		
0.15 mm	**33**			11		
0.075 mm	**26**			8		

Particle Size Distribution



Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911D
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 04/07/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 2.5-2.6m**
Material: Silty SAND trace gravel

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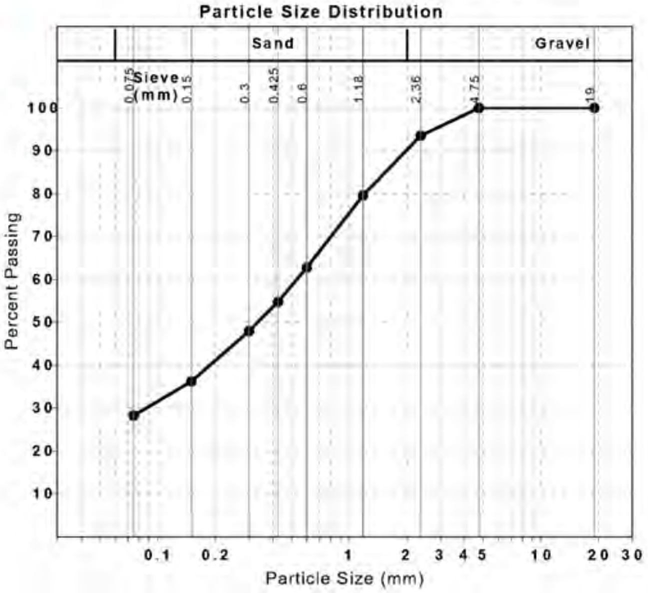
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**94**			6		
1.18 mm	**80**			14		
0.6 mm	**63**			17		
0.425 mm	**55**			8		
0.3 mm	**48**			7		
0.15 mm	**36**			12		
0.075 mm	**28**			8		



Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911E
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 04/07/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 3.0-3.15m**
Material: Silty SAND trace gravel

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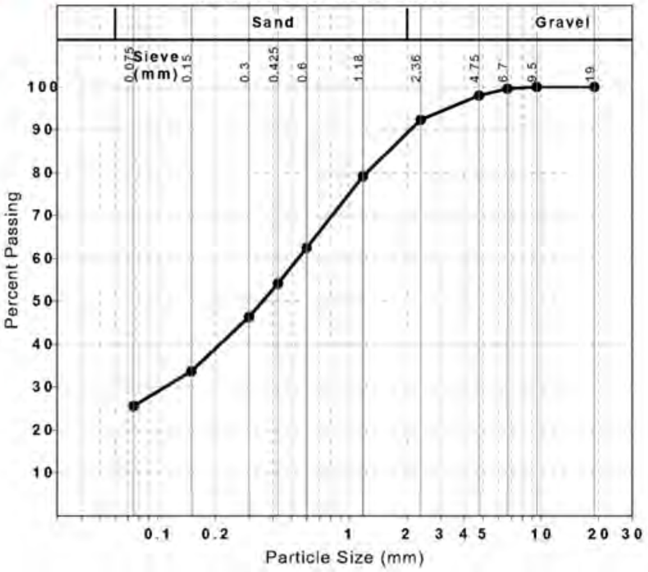
Senior Associate
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**98**			2		
2.36 mm	**92**			6		
1.18 mm	**79**			13		
0.6 mm	**62**			17		
0.425 mm	**54**			8		
0.3 mm	**46**			8		
0.15 mm	**34**			13		
0.075 mm	**26**			8		

Particle Size Distribution



Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911F
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 13/06/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 3.7-3.95m**
Material: Silty SAND trace gravel

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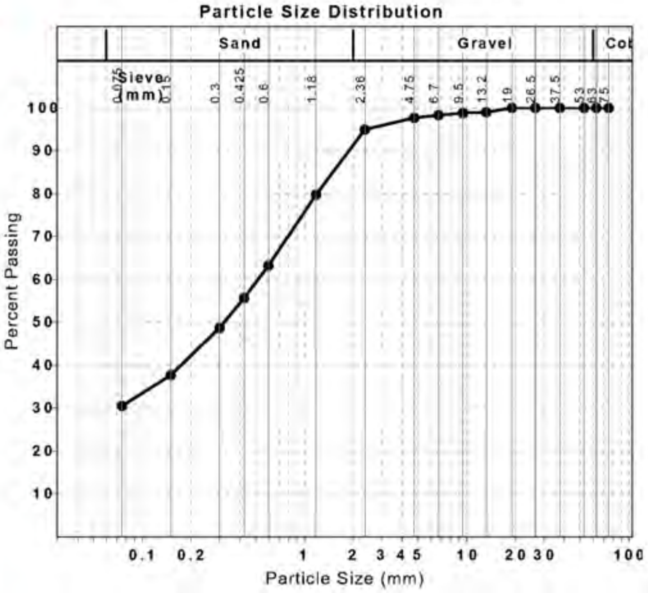
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**99**			1		
9.5 mm	**99**			0		
6.7 mm	**98**			1		
4.75 mm	**98**			1		
2.36 mm	**95**			3		
1.18 mm	**80**			15		
0.6 mm	**63**			17		
0.425 mm	**56**			8		
0.3 mm	**49**			7		
0.15 mm	**38**			11		
0.075 mm	**30**			7		


Particle Size Distribution

Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911G
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 13/06/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 4.0-4.2m**
Material: Silty SAND

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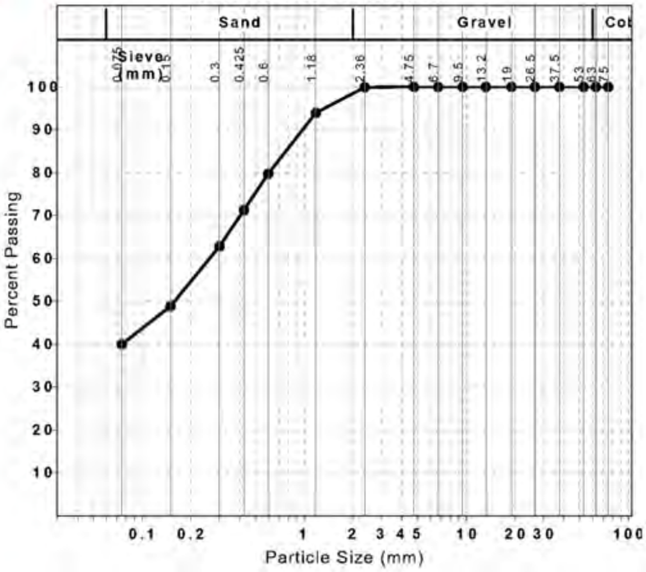
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**94**			6		
0.6 mm	**80**			14		
0.425 mm	**71**			9		
0.3 mm	**63**			8		
0.15 mm	**49**			14		
0.075 mm	**40**			9		

Particle Size Distribution



Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911I
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 13/06/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 4.45-4.75m**
Material: Sandy silty CLAY

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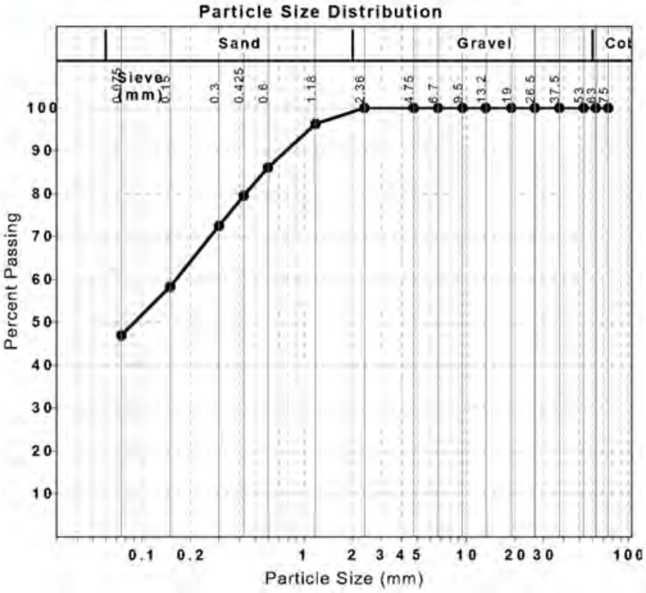
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**96**			4		
0.6 mm	**86**			10		
0.425 mm	**80**			7		
0.3 mm	**73**			7		
0.15 mm	**58**			14		
0.075 mm	**47**			11		



Material Test Report

Report Number: **235669.00-1A**
Issue Number: 1
Date Issued: 04/07/2025
Client: Land Engineering Pty Ltd
PO Box 108, Hastings VIC
Project Number: 235669.00
Project Name: Geotechnical Investigation & Monitoring Bore Installation
Project Location: Waller Place, McCrae VIC
Work Request: 7911
Sample Number: ME-7911J
Date Sampled: 27/05/2025
Dates Tested: 06/06/2025 - 13/06/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01, Depth: 5-5.3m**
Material: Clayey SAND trace gravel

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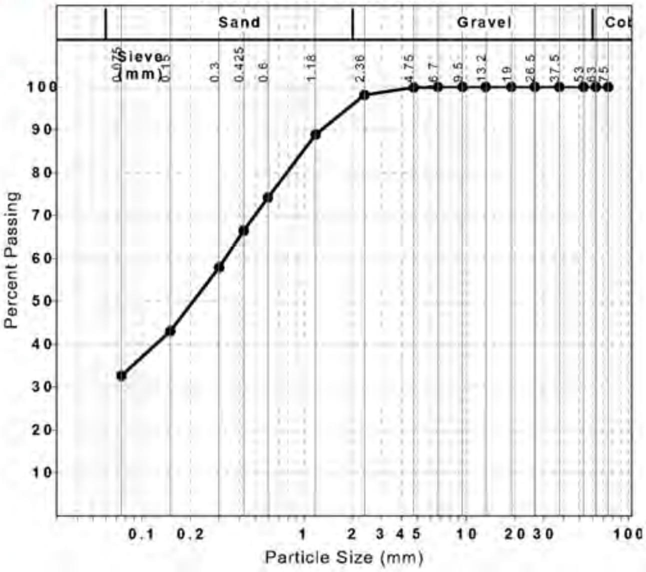
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**98**			2		
1.18 mm	**89**			9		
0.6 mm	**74**			15		
0.425 mm	**66**			8		
0.3 mm	**58**			9		
0.15 mm	**43**			15		
0.075 mm	**33**			10		

Particle Size Distribution



Material Test Report

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Approved Signatory: Peter Chan
Senior Associate
Laboratory Accreditation Number: 828

Report Number:	**235669.00-1A**
Issue Number:	1
Date Issued:	04/07/2025
Client:	Land Engineering Pty Ltd PO Box 108, Hastings VIC
Project Number:	235669.00
Project Name:	Geotechnical Investigation & Monitoring Bore Installation
Project Location:	Waller Place, McCrae VIC
Work Request:	7911
Sample Number:	ME-7911K
Date Sampled:	27/05/2025
Dates Tested:	06/06/2025 - 13/06/2025
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**BH01, Depth: 5.7-6.0m**
Material:	Silty CLAY trace gravel

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried / Air Dried / Natural / Unknown		
Preparation Method			
Liquid Limit (%)	126		
Plastic Limit (%)	20		
Plasticity Index (%)	**106**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	**10.0**		
Cracking Crumbling Curling	Cracking & Crumbling		

Material Test Report

Report Number:	**235669.00-1A**
Issue Number:	1
Date Issued:	04/07/2025
Client:	Land Engineering Pty Ltd PO Box 108, Hastings VIC
Project Number:	235669.00
Project Name:	Geotechnical Investigation & Monitoring Bore Installation
Project Location:	Waller Place, McCrae VIC
Work Request:	7911
Sample Number:	ME-7911L
Date Sampled:	27/05/2025
Dates Tested:	06/06/2025 - 13/06/2025
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**BH01, Depth: 6.4-6.7m**
Material:	Silty CLAY trace gravel

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Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	51		
Plastic Limit (%)	18		
Plasticity Index (%)	**33**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	**9.5**		
Cracking Crumbling Curling	Cracking & Curling		

Material Test Report

Report Number:	**235669.00-1A**
Issue Number:	1
Date Issued:	04/07/2025
Client:	Land Engineering Pty Ltd PO Box 108, Hastings VIC
Project Number:	235669.00
Project Name:	Geotechnical Investigation & Monitoring Bore Installation
Project Location:	Waller Place, McCrae VIC
Work Request:	7911
Sample Number:	ME-7911M
Date Sampled:	27/05/2025
Dates Tested:	06/06/2025 - 16/06/2025
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**BH01, Depth: 7.1-7.4m**
Material:	Silty CLAY trace gravel

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Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	51		
Plastic Limit (%)	21		
Plasticity Index (%)	**30**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	Curling		

Material Test Report

Report Number:	**235669.00-1A**
Issue Number:	1
Date Issued:	04/07/2025
Client:	Land Engineering Pty Ltd PO Box 108, Hastings VIC
Project Number:	235669.00
Project Name:	Geotechnical Investigation & Monitoring Bore Installation
Project Location:	Waller Place, McCrae VIC
Work Request:	7911
Date Sampled:	27/05/2025
Dates Tested:	06/06/2025 - 27/06/2025
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*

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Moisture Content AS 1289 2.1.1

Sample Number	Sample Location	Moisture Content (%)	Min	Max	Material
ME-7911A	BH01, Depth: 1.00-1.35m	11.7 %	**	**	Silty SAND trace gravel
ME-7911B	BH01, Depth: 1.5-1.9m	12.5 %	**	**	Silty SAND trace gravel
ME-7911C	BH01, Depth: 2.0-2.35m	12.7 %	**	**	Silty SAND trace gravel
ME-7911D	BH01, Depth: 2.5-2.6m	12.6 %	**	**	Silty SAND trace gravel
ME-7911E	BH01, Depth: 3.0-3.15m	16.3 %	**	**	Silty SAND trace gravel
ME-7911F	BH01, Depth: 3.7-3.95m	19.0 %	**	**	Silty SAND trace gravel
ME-7911G	BH01, Depth: 4.0-4.2m	21.9 %	**	**	Silty SAND
ME-7911I	BH01, Depth: 4.45-4.75m	21.9 %	**	**	Sandy silty CLAY
ME-7911J	BH01, Depth: 5-5.3m	20.1 %	**	**	Clayey SAND trace gravel
ME-7911K	BH01, Depth: 5.7-6.0m	42.8 %	**	**	Silty CLAY trace gravel
ME-7911L	BH01, Depth: 6.4-6.7m	22.5 %	**	**	Silty CLAY trace gravel
ME-7911M	BH01, Depth: 7.1-7.4m	26.8 %	**	**	Silty CLAY trace gravel

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd
Project : Geotechnical Investigation & Monitoring Bore Installation
Location : Waller Place, McCrae VIC
Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-2
Report Date : 29 Jun 2025
Date Sampled: 27 May 2025
Dates of Test: 22/06/2025-26/06/2025
Geotester Ref: ME-7911A

Location:	BH01	
Depth / Layer:	1.00-1.35(m)	
Sample Description:	Sandy SILT trace gravel	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	70	mm
Averaged Sample Diameter:	64	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	20.0	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**2×10^{-9}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1
Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.
Remarks:

NATA Accredited Laboratory No 828
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Tested: TH
Checked: SB

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd
Project : Geotechnical Investigation & Monitoring Bore Installation
Location : Waller Place, McCrae VIC
Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-3
Report Date : 08 Jul 2025
Date Sampled: 27 May 2025
Dates of Test: 30/06/2025-04/07/2025
Geotester Ref: ME-7911B

Location:	BH01	
Depth / Layer:	1.5-1.9(m)	
Sample Description:	Silty SAND trace gravel	
Sample Preparation:	Remoulded	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	0% on 4.7mm Sieve (Excluded)	
Averaged Sample Length:	55	mm
Averaged Sample Diameter:	51	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	21.3	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**3×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Client's representative requested samples to be remoulded to 1.7t/m3 (Dry Density). Achieved Dry Density = 1.70, Remould Moisture Content = 12.5%.

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Tested: TH
Checked: SB

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Land Engineering Pty Ltd	**Project No. :**	235669.00
		Report No. :	235669.00-4
Project :	Geotechnical Investigation & Monitoring Bore Installation	**Report Date :**	08 Jul 2025
		Date Sampled:	27 May 2025
Location :	Waller Place, McCrae VIC	**Dates of Test:**	30/06/2025-04/07/2025
Page : 1 of 1		**Geotester Ref:**	ME-7911C

Location:	BH01	
Depth / Layer:	2.0-2.35(m)	
Sample Description:	Silty SAND trace gravel	
Sample Preparation:	Remoulded	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	0% on 4.75mm Sieve (Excluded)	
Averaged Sample Length:	55	mm
Averaged Sample Diameter:	51	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	20.4	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**1×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Client's representative requested samples to be remoulded to 1.7t/m3 (Dry Density). Achieved Dry Density = 1.71, Remould Moisture Content = 12.4%.

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Tested: TH
Checked: SB

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd

Project : Geotechnical Investigation & Monitoring Bore Installation

Location : Waller Place, McCrae VIC

Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-5
Report Date : 08 Jul 2025
Date Sampled: 27 May 2025
Dates of Test: 30/06/2025-04/07/2025
Geotester Ref: ME-7911D

Location:	BH01	
Depth / Layer:	2.5-2.6(m)	
Sample Description:	Silty SAND trace gravel	
Sample Preparation:	Remoulded	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	0% on 6.7mm Sieve (Excluded)	
Averaged Sample Length:	66	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	20.6	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**3×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Client's representative requested samples to be remoulded to 1.7t/m3 (Dry Density). Achieved Dry Density = 1.71, Remould Moisture Content = 12.4%.

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Checked: SB

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Land Engineering Pty Ltd	**Project No. :**	235669.00
		Report No. :	235669.00-6
Project :	Geotechnical Investigation & Monitoring Bore Installation	**Report Date :**	08 Jul 2025
		Date Sampled:	27 May 2025
Location :	Waller Place, McCrae VIC	**Dates of Test:**	30/06/2025-04/07/2025
Page : 1 of 1		**Geotester Ref:**	ME-7911E

Location:	BH01	
Depth / Layer:	3.0-3.15(m)	
Sample Description:	Silty SAND trace gravel	
Sample Preparation:	Remoulded	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	0% on 6.7mm Sieve (Excluded)	
Averaged Sample Length:	66	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	20.5	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**2×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Client's representative requested samples to be remoulded to 1.7t/m3 (Dry Density). Achieved Dry Density = 1.71, Remould Moisture Content = 16.2%.

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Checked: SB

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd

Project : Geotechnical Investigation & Monitoring Bore Installation

Location : Waller Place, McCrae VIC

Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-7
Report Date : 29 Jun 2025
Date Sampled: 27 May 2025
Dates of Test: 20/06/2025-25/06/2025
Geotester Ref: ME-7911F

Location:	BH01	
Depth / Layer:	3.7-3.95(m)	
Sample Description:	Silty SAND trace gravel and clay	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	55	mm
Averaged Sample Diameter:	53	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	21.8	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**1×10^{-9}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd
Project : Geotechnical Investigation & Monitoring Bore Installation
Location : Waller Place, McCrae VIC
Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-8
Report Date : 29 Jun 2025
Date Sampled: 27 May 2025
Dates of Test: 22/06/2025-26/06/2025
Geotester Ref: ME-7911G

Location:	BH01	
Depth / Layer:	4.0-4.2(m)	
Sample Description:	Silty SAND with gravel trace clay	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	58	mm
Averaged Sample Diameter:	51	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	23.9	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**1×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Land Engineering Pty Ltd	**Project No. :**	235669.00
		Report No. :	235669.00-9
Project :	Geotechnical Investigation & Monitoring Bore Installation	**Report Date :**	29 Jun 2025
		Date Sampled:	27 May 2025
Location :	Waller Place, McCrae VIC	**Dates of Test:**	21/06/2025-26/06/2025
Page :	1 of 1	**Geotester Ref:**	ME-7911I

Location:	BH01	
Depth / Layer:	4.45-4.75(m)	
Sample Description:	Silty SAND with gravel trace clay	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	54	mm
Averaged Sample Diameter:	51	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	23.5	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**3 x 10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

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Tested: TH
Checked: SB

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Land Engineering Pty Ltd	**Project No. :**	235669.00
		Report No. :	235669.00-10
Project :	Geotechnical Investigation & Monitoring Bore Installation	**Report Date :**	29 Jun 2025
		Date Sampled:	27 May 2025
Location :	Waller Place, McCrae VIC	**Dates of Test:**	11/06/2025- 14/06/2025
Page : 1 of 1		**Geotester Ref:**	ME-7911J

Location:	BH01	
Depth / Layer:	5-5.3(m)	
Sample Description:	Silty SAND with gravel trace clay	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	59	mm
Averaged Sample Diameter:	53	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	21.3	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**4×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd
Project : Geotechnical Investigation & Monitoring Bore Installation
Location : Waller Place, McCrae VIC
Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-11
Report Date : 29 Jun 2025
Date Sampled: 27 May 2025
Dates of Test: 8/06/2025-12/06/2025
Geotester Ref: ME-7911K

Location:	BH01	
Depth / Layer:	5.7-6.0(m)	
Sample Description:	Silty CLAY trace gravel	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	53	mm
Averaged Sample Diameter:	53	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	46.2	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**1×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

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Tested: TH
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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Land Engineering Pty Ltd	**Project No. :**	235669.00
		Report No. :	235669.00-12
Project :	Geotechnical Investigation & Monitoring Bore Installation	**Report Date :**	29 Jun 2025
		Date Sampled:	27 May 2025
Location :	Waller Place, McCrae VIC	**Dates of Test:**	6/06/2025-10/06/2025
Page : 1 of 1		**Geotester Ref:**	ME-7911L

Location:	BH01	
Depth / Layer:	6.4-6.7(m)	
Sample Description:	Silty CLAY trace gravel	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	59	mm
Averaged Sample Diameter:	53	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	27.5	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**8×10^{-11}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

NATA Accredited Laboratory No 828
Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

[redacted]
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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client : Land Engineering Pty Ltd

Project : Geotechnical Investigation & Monitoring Bore Installation

Location : Waller Place, McCrae VIC

Page : 1 of 1

Project No. : 235669.00
Report No. : 235669.00-13
Report Date : 29 Jun 2025
Date Sampled: 27 May 2025
Dates of Test: 05/06/2025-09/06/2025
Geotester Ref: ME-7911M

Location:	BH01	
Depth / Layer:	7.1-7.4(m)	
Sample Description:	Silty CLAY trace gravel	
Sample Preparation:	Undisturbed	
Density Ratio:	N/A	%
Moisture Ratio:	N/A	%
Compactive Effort:	N/A	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	53	mm
Averaged Sample Diameter:	51	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	25.7	%
Permeant Used:	Potable Water	
Mean Effective Stress:	100	kPa
Coefficient of Permeability:	**1×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks:

NATA Accredited Laboratory No 828
Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

PI

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Laboratory Manager

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Appendix E

Hydrogeological Site Investigation Report

Legally Privileged Multidisciplinary Expert Supplementary Report

Board of Inquiry into the McCrae Landslide

Prepared for: Thomson Geer
30 July 2025
Client Reference No. SMEC Report 002 Appendix E

SMEC INTERNAL REF. 30043649

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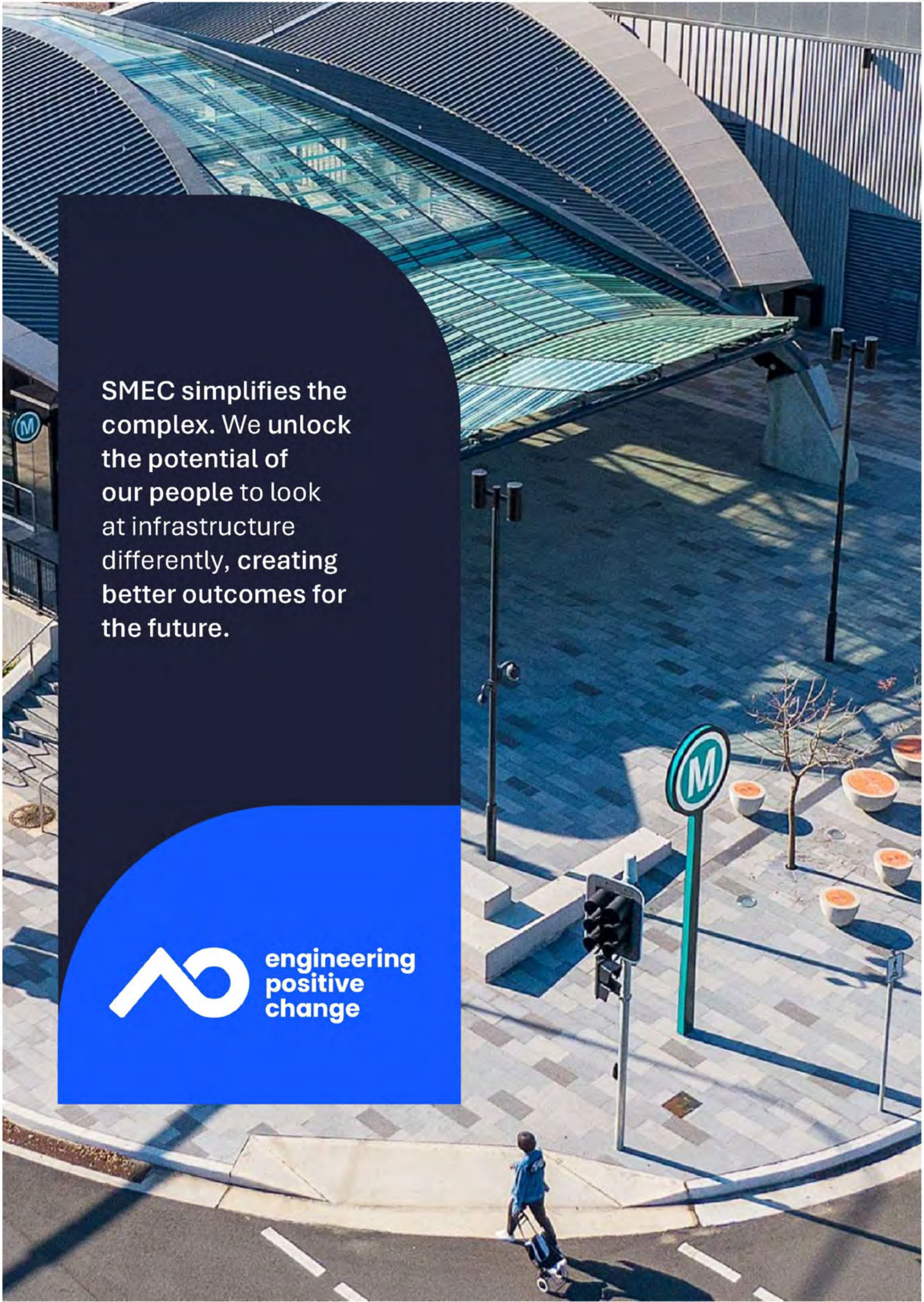

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Document Control

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Important Notice

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Executive Summary

Two slope failures occurred on 5 January 2025 and 14 January 2025 within the property boundaries of 10-12 View Point Road, damaging 3 Penny Lane McCrae, Victoria. The landslides comprised the downslope movement of a significant volume of material from the upper portion of the slope within 10-12 View Point Road. This material accumulated within the 3 Penny Lane property near the toe of the slope, causing substantial damage to the property and injury to a person who was at the property at the time of the 14 January 2025 landslide.

SMEC Australia Pty Ltd (SMEC) has been engaged by South East Water (SEW) c/o Thompson Geer to provide technical advice relating to the 2025 landslides and assess the contribution that a water main leak may or may not have had in triggering the events. As part of this technical advice SMEC has undertaken limited geotechnical investigations in the locality upslope of the landslide. The purpose of the geotechnical investigations was to obtain information about the subsurface conditions to inform the formulation of the ground model for the area.

As part of these investigations SMEC has undertaken hydrogeological investigations which are outlined in this report. This information together with the investigations by others has been used to assess the hydrogeological characteristics of the area and potential sources of water.

Hydrogeological investigations comprised:

- Site surface walkovers;
- Drilling program;
- Physical aquifer parameter characterisation;
- Water chemistry characterisation;
- Geochemical modelling.

Based on the scope of work presented in this report:

- Water seeping from the 6 January 2025 landslide site has a signature characteristic of background[1] groundwater derived from the shallow perched aquifer.
- Based on geochemical analysis of groundwater and data from water samples obtained and tested by SEW and PSM[2] during January 2025, and by SMEC during June to July 2025, there is no indication that that water from the Bayview Road Leak made it to the Site. Water seeping from the Site on 6 January 2025, is of a similar water quality to background water quality test results and is considered to be water from a shallow perched aquifer.
- The results of water quality testing at the Site do not indicate dilution of the shallow perched aquifer by mains water as would be expected if water from the Bayview Road Leak were to have made it to the Site.

Please note there is a need to provide an addendum to this report. This addendum will include information on triaxial permeability, porosity and geochemical modelling. This addendum will provide additional insights and may lead to adjustment of the interpretation and conclusions provided in this report.

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[1] Background water quality refers to the natural or baseline condition of water quality – in this case without the influence of the Bayview Road Leak.

[2] PSM are consultants who represent the Mornington Peninsula Shire Council

1. Introduction

Two slope failures occurred on 5 January 2025 and 14 January 2025 within the property boundaries of 10-12 View Point Road, damaging 3 Penny Lane, McCrae, Victoria. The landslides comprised the downslope movement of a significant volume of material from the upper portion of the slope within 10-12 View Point Road. This material accumulated within the 3 Penny Lane property near the toe of the slope, causing substantial damage to the property and injury to a person who was at the property at the time of the 14 January 2025 landslide.

SMEC Australia Pty Ltd (SMEC) has been engaged by South East Water (SEW) c/o Thompson Geer to provide technical advice relating to the 2025 landslides and assess the contribution that the water main leak at Bayview Road may/may not have had in triggering the events. As part of this technical advice, SMEC has undertaken limited geotechnical investigations in the locality upslope of the landslide. The purpose of the geotechnical investigations was to obtain information about the subsurface conditions to inform the formulation of the ground model for the area.

As part of these investigations SMEC has undertaken hydrogeological investigations which are outlined in this report. This information together with the PSM investigations has been used to assess the hydrogeological characteristics of the area and potential sources of water.

The technical report has been compiled by the following project team:

- Lead Author: Hugo Bolton, Technical Principal – Hydrogeology;
- Support Team member: Alan Bull, Technical Principal – Environment, Stella Smallman, Scientist Contaminated Land, Environment and Steve Feiss, Principal – Hydrogeology.

2. Scope of Works

The scope of hydrogeological investigations was formulated to develop a hydrogeological model of the site. Physical and chemical data was analysed to understand whether, or to what degree, the burst water mains uphill from the landslide area contributed to the landslide. The location of the burst water main in Bayview Road is approximately located near "BH01" as shown in Figure 1, and it is located approximately 465 m from the two slope failures noted in Section 1.

The methodology of the works undertaken and documented in this report is described in Section 3.

Hydrogeological investigations comprised the following:

- Site Surface walkovers;
- Drilling program;
- Physical aquifer parameter characterisation;
- Water chemistry characterisation;
- Geochemical modelling.

3. Methodology

3.1 Site Surface Walkovers

A Technical Principal Hydrogeologist undertook site walkovers on several occasions during field visits during March, May, June and July 2025. During the site walkovers, observations were made of the surface conditions in publicly accessible areas upslope of the landslide. Discussions with local residents occurred during the site walkovers to obtain information about their observation of groundwater events and issues.

3.2 Drilling Program

The drilling program supervised by SMEC took place over the period 30/6/2025 to 4/7/2025 and was comprised of:

- The drilling of boreholes using a drill rig or non-destructive digging (NDD). A drilling rig was used to drill the 'BH' prefix boreholes and single standalone monitoring standpipe were installed. NDD was used to install the 'DP' (Dual Piezometer) and 'NDD' prefix boreholes. The 'DP' prefix boreholes were installed in pairs to allow tracer testing to be performed.
- Hand auger ('HA' prefix) bores were drilled to only collect lithology data. No monitoring installation was constructed.

The installations are shown in Figure 1. The SMEC borehole and construction details are presented in Table 1.

Figure 1 Location of bore sites

Table 1: Bore details with monitoring equipment and monitoring data available

Bore Hole Id	Easting	Northing	Location Description	GL Elevation (mAHD)	Total Bore Depth (m)	Piezometer (installed or not)	Screen interval (m depth)	Drilling date	Purpose
WR174 BH01	319730	5753465	SEW Water Reservoir WR174, Waller Place	55.04	22.3	Yes	13.3-22.3	27/05/2025	Geotech & groundwater
BH01	319945	5753466	Cnr Bayview Rd and Outlook Rd	72.69	25.8	Yes	19.7 -25.7	02/07/2025	Geotech & groundwater
BH02	319860	5753565	15 Charlesworth St	59.79	25.9	Yes	19.9 – 25.9	04/07/2025	Geotech & groundwater
BH03	319790	5753638	On Charlesworth St, halfway between Coburn and Waller	51.70	6.45	Yes	2.0- 6 0	03/07/2025	Geotech & groundwater
BH04	319668	5753744	7 Prospect Hill Rd	36.82	7.5	Yes	3.5 – 7.5	04/07/2025	Geotech & groundwater
HA01	319726	5753742	4 -6 Prospect Hill Rd	41.10	3.1	No	NA	04/07/2025	Geotech & groundwater
HA02	319638	5753681	1 View Point Rd (cnr View Point Rd and Prospect Hill Rd)	36.61	1.2	No	NA	04/07/2025	Geotech & groundwater
HA03	319400	5753549	6 Coburn Ave	15.41	1.8	No	NA	04/07/2025	Geotech & groundwater
NDD01	319759	5753668	Cnr Charlesworth St and Coburn Ave (south side)	47.92	2.5	Yes	2.0 – 2.5	30/06/2025	Geotech & groundwater
DP01A	319784	5753646	On Charlesworth St, halfway between Coburn and Waller	50.78	2.7	Yes	2.2 – 2.7	30/06/2025	Groundwater (tracer testing)
DP01B	319783	5753647	On Charlesworth St, halfway between Coburn and Waller	50.65	2.6	Yes	2.1 – 2.6	30/06/2025	Groundwater (tracer testing)
DP02A	319728	5753740	33 Coburn Ave (near cnr Coburn and Prospect Hill Rd	41.36	1.6	Yes	1.1 – 1.6	01/07/2025	Groundwater (tracer testing)
DP02B	319727	5753741	33 Coburn Ave (near cnr Coburn and Prospect Hill Rd	41.23	1.6	Yes	1.1 – 1.6	01/07/2025	Groundwater (tracer testing)
DP03A	319655	5753689	4 -6 Prospect Hill Rd	37.65	0.7	Yes	0.3 – 0.7	02/07/2025	Groundwater (tracer testing)
DP03B	319653	5753690	4 -6 Prospect Hill Rd	37.45	0.7	Yes	0.3 – 0.7	02/07/2025	Groundwater (tracer testing)
DP04A	319635	5753693	11 Prospect Hill Rd (cnr Prospect Hill Rd and View Point Rd)	35.82	1.7	Yes	1.2 – 1.7	03/07/2025	Groundwater (tracer testing)

Bore Hole Id	Easting	Northing	Location Description	GL Elevation (mAHD)	Total Bore Depth (m)	Piezometer (installed or not)	Screen interval (m depth)	Drilling date	Purpose
DP04B	319634	5753693	11 Prospect Hill Rd (cnr Prospect Hill Rd and View Point Rd, south side)	35.73	1.9	Yes	1.4 – 1.9	03/07/2025	Groundwater (tracer testing)
DP05A	319635	5753693	2 View Point Rd (cnr Prospect Hill Rd and View Point Rd, north side)	35.82	1.0	Yes	0.5 – 1.0	03/07/2025	Groundwater (tracer testing)
DP05B	319634	5753693	2 View Point Rd (cnr Prospect Hill Rd and View Point Rd, north side)	35.73	1.0	Yes	0.5 – 1.0	03/07/2025	Groundwater (tracer testing)
DP06A	319632	5753696	2 – 4 View Point Rd	35.43	1.6	Yes	1.1 – 1.6	03/07/2025	Groundwater (tracer testing)
DP06B	319630	5753696	2 – 4 View Point Rd	35.30	1.6	Yes	1.1 – 1.6	03/07/2025	Groundwater (tracer testing)

3.3 Physical Aquifer Parameter Characterisation

Physical aquifer parameter characterisation was undertaken including:

- Laboratory testing (triaxial permeability and porosity testing);
- Field testing (slug testing, permeameter testing, tracer testing and water level monitoring).

3.4 Water Chemistry Characterisation

Water physicochemical parameters were tested to gain an understanding of the water chemistry.

Water in its natural occurrence will have a compositional signature specific to the formation in which it is found, that is, its water chemistry reflects an equilibrium, or trend towards equilibrium, between the groundwater and its host geological formation (Stum & Morgan, 1996). As such, the first step in the water chemistry characterisation sought to distinguish potential differences in water sampled from different locations/ sources by its physicochemical parameters.

SMEC also relied on water chemistry analysis conducted by third parties. Where these have been relied upon, reference to source is provided. It is noted that SMEC has taken the third-party water chemistry results as valid and reliable for the purposes of this water characterization.

3.4.1 Water Laboratory Chemical Analysis

The laboratory chemical analysis of the water samples, tested for the analytes listed in Table 2.

Table 2: Chemical parameters analysed

Chemical Parameters	
EC - Electrical Conductivity @ 25C (µS/cm)	Nitrite, as N
pH (pH units)	Ferric iron, as Fe - Soluble (by Difference)
Turbidity (NTU)	Ferrous iron, as Fe
Fluoride, as F	Bromide
Chloride, as Cl	Boron
Sulphate, as SO_4	Total iron, as Fe
Bicarbonate Alkalinity as $CaCO_3$	Strontium
Carbonate Alkalinity as $CaCO_3$	Calcium
Hydroxide Alkalinity as $CaCO_3$	Magnesium
Total Alkalinity as $CaCO_3$	Potassium
Ammonia, as N	Sodium
Nitrate, as N	Iodide, as I

3.4.2 Water Sampling Events

This section provides a summary of the water sampling events conducted by SMEC for this assessment. All water samples collected by SMEC were taken according to SMEC's Standard Operating Procedures (SOP) which follows current guidance and industry practices for water sampling. All laboratories selected for water sampling analysis were NATA accredited for the method used. The laboratory Certificate of Analysis (COA) including sample results are enclosed in Appendix A.

Soil sample characterisation was also conducted, and these are discussed in Section 3.5. A summary table of water samples and sample analytes are presented in Appendix A.

3.4.2.1 Groundwater

Groundwater sampling locations are shown in Figure 1. The locations were selected to provide samples that were characteristic of the water source and compare to chemical signatures from other water samples.

Groundwater boreholes were sampled on the following dates and with sample IDs as follows:

- 12/06/2025 – WR174-BH01;
- 17/06/2025 – WR174-BH01;
- 06/07/2025 – BH01, BH03;
- 07/07/2025 – BH04;
- 10/07/2025 – BH02.

3.4.2.2 Surface Water and Drinking Water

Surface water sample locations are shown in Figure 1. The samples were taken to determine the characteristics of the water source and compare them to chemical signatures from other water samples.

Surface water locations were sampled from Coburn Creek (sample ID Sample 4 and Sample 5) on 25th March 2025 and 6th May.

3.4.2.3 Building Foundation Drainage System Water

A water sample was taken from the building foundation drainage system from a residential property at 7 Prospect Hill Road. The building foundation drainage system is understood to consist of a network of perforated pipes or drainage boards placed beneath the slab, often within gravel-filled trenches. These systems are designed to direct water to a sump pit or a gravity outlet. The sump pit for 7 Prospect Hill Road is visible from the road just outside the boundary fence. Water entering the sump pit gravity feeds by being discharged via an underground pipe to the stormwater pit just outside 9 Prospect Hill Road. Stormwater then flows underneath the road and eventually along the stormwater system towards View Point Road.

This water sample has been labelled as '7 PROSPECT HILL'.

Similar to 7 Prospect Hill Road, the property at 5 Prospect Hill Road also has a building foundation drainage system. Unlike 7 Prospect Hill Road, where the house is entirely above ground level, 5 Prospect Hill Road has an underground garage which has a building foundation drainage system. Being underground, a sump pump is utilised to discharge water to the curb gutter which then flows down to the stormwater pit just outside 9 Prospect Hill Road. Up until approximately the end of April 2025, water was seen to discharge to the curb gutter. A leaking customer side pipe at this property was repaired at this time. Once fixed, the discharge of water to the curb gutter was not observed. Water collected prior to the end of April 2025 from the curb gutter outside 5 Prospect Hill Road had a geochemical signature indicating SEW water mains origin.

Sample were taken on the following dates and sample IDs:

- 27/06/2025 – 7 Prospect Hill;
- 07/07/2025 – 7 Prospect Hill;
- 13/07/2025 – 5 Prospect Hill (sump from building foundation drainage system).

3.4.3 Third Party Water Results

This section provides a summary of water sample results which SMEC relied upon for the water chemistry characterisation assessment. The summary is provided in Table 3. A preceding letter added to the sample location ID (e.g. P_ to indicate PSM) is only for internal differentiator for the source of the sample location description.

Table 3: Water Chemistry from Third Party Reports

Sample ID	Approximate Location	Source Document
P_SW01, P_SW02, P_SW03, P_SW04	Taken on Penny Lane, slightly contaminated with mains water.	Geotech Report (PSM 2025)
5 The Eyrie	At 5 The Eyrie	SEW (15/04/2025)
16 Arthurs Avenue	At 16 Arthurs Avenue	SEW (15/04/2025)
3 Flinders Street	At 3 Flinders Street	SEW (15/04/2025)
A	Upwelling within pothole at junction of Waller Pl and Charlesworth St.	SEW (2025)
B	Within stormwater drain in front of 6 View Point Rd	SEW (2025)
C	Seepage within landslide material	SEW (2025)
D	Pavement around Coburn & Charlesworth	SEW (2025)
E	Verge in front of 34 Coburn Ave	SEW (2025)
F	Verge opposite 5 Waller Place	SEW (2025)
G	Within stormwater drain in front of 11 Prospect Hill Rd	SEW (2025)
H	Kerb in front of 5 Prospect Hill Rd	SEW (2025)
Sample 1	Gutter of 5 Prospect Hill Rd 'storm pipe'	SEW (2025)
Sample 2	11 Prospect Hill Rd Stormwater Pit	SEW (2025)
Sample 3	10 View Point Rd Storm Pit	SEW (2025)
Sample 4 (Creek)	29 Browne St Coburn Creek (25th March 2025)	SEW (2025)
Sample 5 (Creek)	1-3 Burrell St (25th March 2025) / 2 Burrell St (6th May 2025), Coburn Creek	SEW (2025)

Selected sample locations, as described in Table 4, are shown in Figure 2.

Figure 2: Approximate Sample Locations by SEW 2025 (SMEC, 2025)

The summary of laboratory results for the water samples relied as part of this review are presented in Appendix A.

3.5 Soil Physicochemical Assessment

Characterisation testing of the soil samples was undertaken for:

- CEC (Cation Exchange Capacity);
- XRD to assess mineralogy of soils and sewer embedment materials;
- Soil column leachability tests.

3.5.1 Cation Exchange Capacity

CEC was conducted to measure the soil's ability to hold and exchange positively charged ions. This is important in understanding the ability of a soil to interact with water that flows through it. The samples that were submitted are presented in Table 4.

Table 4: CEC samples submitted

Bore Hole ID	Depth sampled (m BTOC)
BH01	1.50 – 1.95
BH01	3.75 – 4.20
BH01	5.70 – 6.15
BH01	8.70 – 9.20
BH01	12.20 – 12.65
BH02	1.00 – 1.45
BH02	3.50 – 4.00
BH02	5.00 – 5.50
BH02	7.00 – 7.50
BH02	10.00 – 10.50
BH03	1.50 – 1.95
BH03	3.50 – 3.95
BH03	6.00 – 6.45
BH04	0.50 – 1.00
BH04	2.00 – 2.50
BH04	4.40 – 4.85
BH04	5.50 – 6.00
BH04	6.00 – 6.95

CEC results are provided in Section 6.3 of this report.

3.5.2 X-Ray Diffraction

An X-ray Diffraction (XRD) analysis was conducted on the following soil samples that were named:

- Bayview Hand Auger – native soil located approximately 2m downhill of the Bayview Road Leak.
- Bayview Sewer Dig – native soil from excavation located 4 m uphill from l Bayview Road Leak.
- Bayview Sewer Sand – sewer embedment sand from excavation located 4 m uphill from l Bayview Road Leak.

- Bayview 7 March, 2025 – native soil from excavation of a mains water leak located 15m towards Outlook Road from the Bayview Road Leak.
- Bayview Sewer Gravel – sewer embedment aggregate from excavation located 4 m uphill from l Bayview Road Leak.

The XRD results are discussed further in Section 6.6.

3.5.3 Soil Column Leachability Test

Soil column leachability tests are laboratory experiments that assess water chemistry changes as water moves through a soil medium. The testing in a controlled environment aims to simulate environmental conditions more closely than batch tests. These tests involve passing water through a soil sample contained in a column and collecting the outflow (eluate) for analysis.

Column tests are designed to mimic, to the extent possible, how water flows through soil in the field, allowing for the observation of time-dependent chemical changes and the influence of factors like contact time and liquid-to-solid ratios on leaching behaviour.

The Column Tests were carried out on the following six samples that we named:

- Sewer Embedment Sand – sewer embedment sand from excavation located 4 m uphill from l Bayview Road Leak..
- Sewer Coarse Aggregate – sewer embedment aggregate from excavation located 4 m uphill from l Bayview Road Leak.
- Bayview 7 March 2025 – native soil from excavation of a mains water leak located 15m towards Outlook Road from the Bayview Road Leak.
- NDT14 1.2 m Deep
- Bayview Hand Auger Composite – native soil located approximately 2m downhill of the Bayview Road Leak.
- WR174 BH1 Composite – native soil located from WR174 BH1

The column test method used was as follows:

- Modified Leaching Environmental Assessment Framework (LEAF) test which has been designed to simulate leaching from a soil material by a fluid (eluent) under environmental conditions.
- The eluent used for the LEAF test was SEW's drinking water. The default LEAF test uses deionised water. However, for the purpose of this investigation it was decided to use SEW's drinking water as it would best represent potential changes to water quality that may have occurred on the site.
- Each of the samples noted above was packed into a column at the Laboratory. The SEW drinking water was then pumped into the column in an "up-flow" direction to reduce any air entrapment (EPA US, 2017), with a volume of 600 mL being passed for each trial.
- The flow was maintained at a constant rate and the outflow (eluate) was then collected and analysed for the chemical constituents of interest.
- For the purpose of this assessment, each fraction of eluate sampled was labelled as T1, T2 up to T5. For each test a "blank" – a sample of the input eluent - was analysed.

Results of the soil column leachability tests are discussed in Section 5.3.

3.6 Geochemical Modelling

Geochemical modelling was undertaken using Geochemist's Workbench (GWB): Groundwater Mixing Model.

The purpose of the geochemical modelling was to understand changes to water chemistry that may occur as SEW water enters and flows through the ground. The geochemical modelling builds on the results of the soil column leachability tests to allow observation on a larger scale. The objective was to replicate observations from water chemistry sampling and thus understand the geochemical processes at play.

4. Site Information

4.1 Surface Conditions

Surface conditions at the time of the investigations in March to July 2025 exhibited little indication of the areas of moisture that were reported to have occurred in November 2024 to January 2025. The main areas of evident surface water in March 2025 were relatively minor water at the intersection of Coburn Avenue and Charlesworth Street and water in the curb gutter emanating from 5 Prospect Hill Road.

Discussions with local residents indicated that springs have historically existed in the area. These were mainly located within the area bounded by Prospect Hill Road and Coburn Road. However, with relatively recent building of residences at 5 and 7 Prospect Hill Road, which have building foundation drainage systems, it appears that the area has dried out, because water that would in the past have seeped at the surface is now being collected and discharged to the stormwater system.

It was also observed that the lower end of Coburn Creek, at Burrell Street, appears to be fed via spring seepage. Water was observed to run in the creek even during periods of extended dry weather.

4.2 Subsurface Conditions

The 250k seamless geology information from the GeoVIC online portal indicates that the locality is underlain by two geological units, as shown on the map reproduced in Figure 3):

- G262 (red): Dromana Granite, consisting of Devonian-aged granite
- Qdl1 (yellow): Coastal Dune Deposits, consisting of Holocene-aged sands, silts and clays that are well sorted, poorly consolidated coastal dune and beach deposits with some swamp deposits.

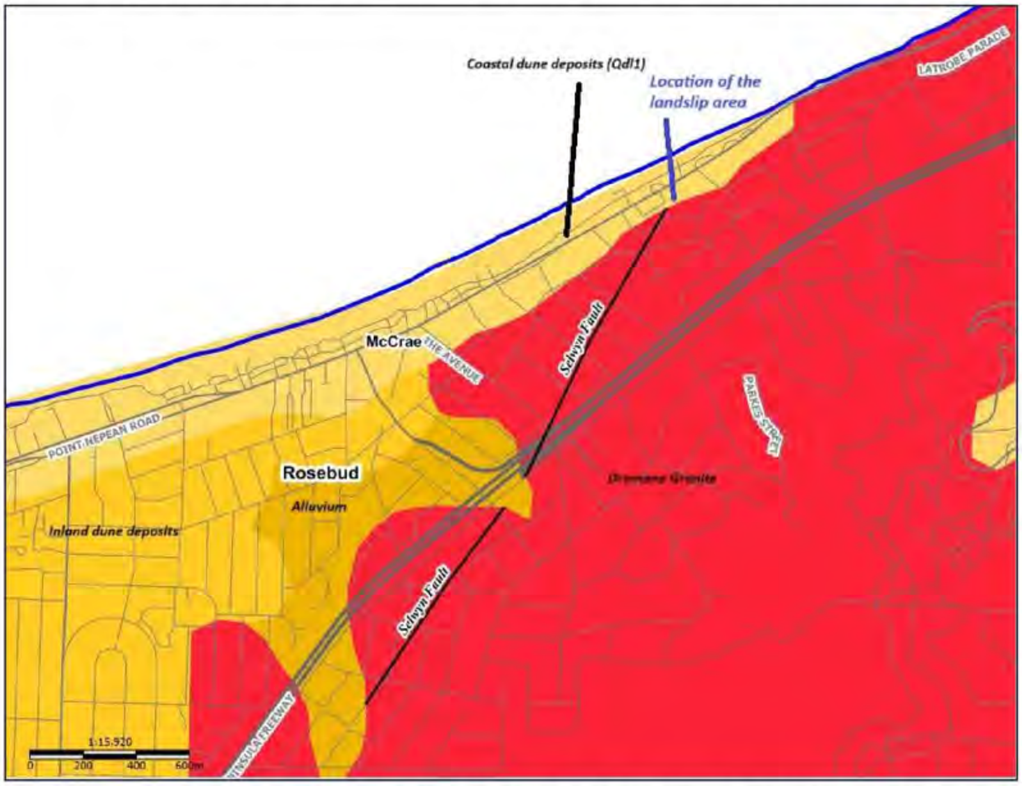


Figure 3: Surface Geology of the locality of the subject site (GeoVic 1:250,000 seamless geology) (Accessed 9th July 2025)

The figure above also indicates the inferred location of the Selwyn Fault within the area of investigation.

The Selwyn Fault is a reverse fault type, meaning that the ground on one side of the fault has been pushed up and over the ground on the other side (i.e. it is a compressional structure). This fault forms part of the eastern highland fault system and runs from the Dandenong Ranges and extends towards the Mornington Peninsula (this subject area) and through to Cape Schanck (directly south of McCrae)

The geological characteristics of the locality can be summarised as residual soils comprising sandy clay grading to sands, overlying weathered granite. The depth of the sand may vary across the site. Quaternary Sands deposits include alluvial gravels, sands and silt from fluvial processes and are mapped (Figure 3) as Alluvium. These are of Pleistocene to Holocene age. Coastal dune deposits of silt, sand and gravel (Quaternary - Holocene age) have formed along the coastal zone.

The soil landscape of the Mornington Peninsula is shaped by the climatic conditions, the geological history and general topography of the area. The soils are derived from but not limited to coastal sands, granite derived profiles as well as volcanic soils. The Mornington Peninsula's landscape has also been shaped by the Selwyn Fault line.

In the vicinity of the landslide, the area is characterised by a near continuous coastal escarpment with the base of the escarpment lying in coastal deposits comprising siliceous and calcareous sands and mud islands. These sandy soils would be prone to erosion, especially when located along steep slopes or at the location of the escarpment. The top of the escarpment is generally defined as elevated terrain consisting of granodiorite and granite, as well as granite derived soils such as clays.

Areas of anthropogenic fill have also been noted in the locality. These are associated with retaining walls, services trenches and roads.

Drilling indicated the granite is deeply weathered, with zones of clay and extremely weathered bedrock. The more competent weathered rock is overlain by a granite-derived saprolite. This is often logged as a mix of sand, clay and gravel, but core photos show the material has bedrock texture, and appears more competent. The regional groundwater table lies within this zone.

Above the saprolite is a zone of mostly sandy clays and clayey sands that is likely colluvial material derived from weathered granite. Aeolian deposits may be present.

Figure 4 below is a summary of aquifer zones intercepted by the drilling in the area and the groundwater levels.

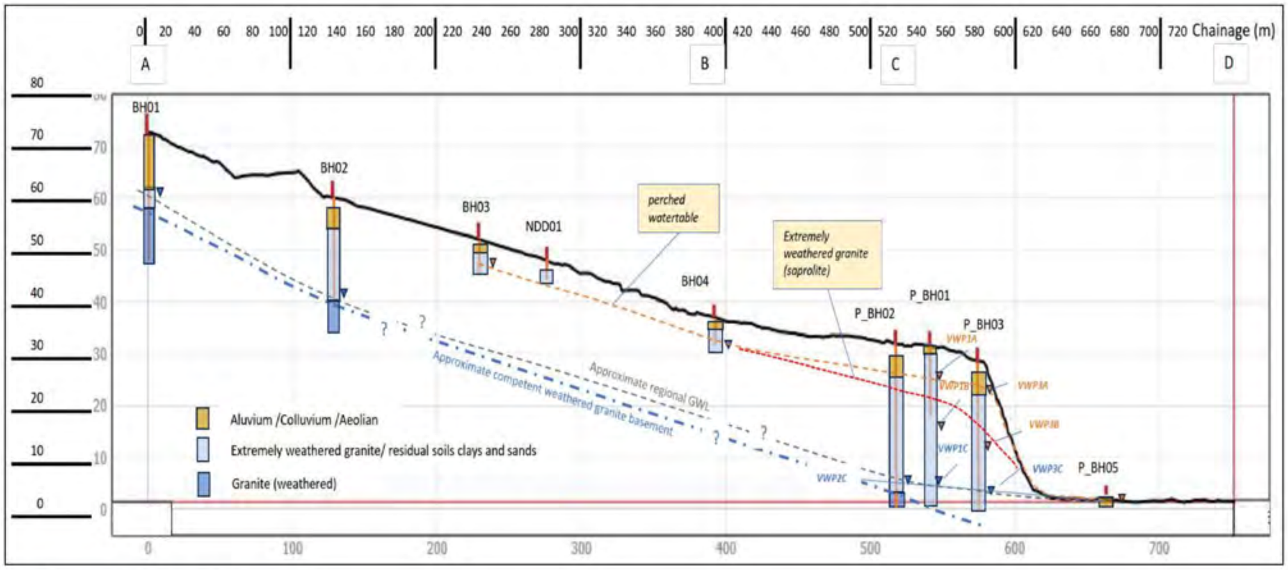


Figure 4: Interpretative hydrogeological cross section

Figure 5: Location plan with cross section line

4.3 Climatic Conditions

At the time of the site investigations, the weather was variable. Rainfall data for the investigation period is shown in Figure 6.

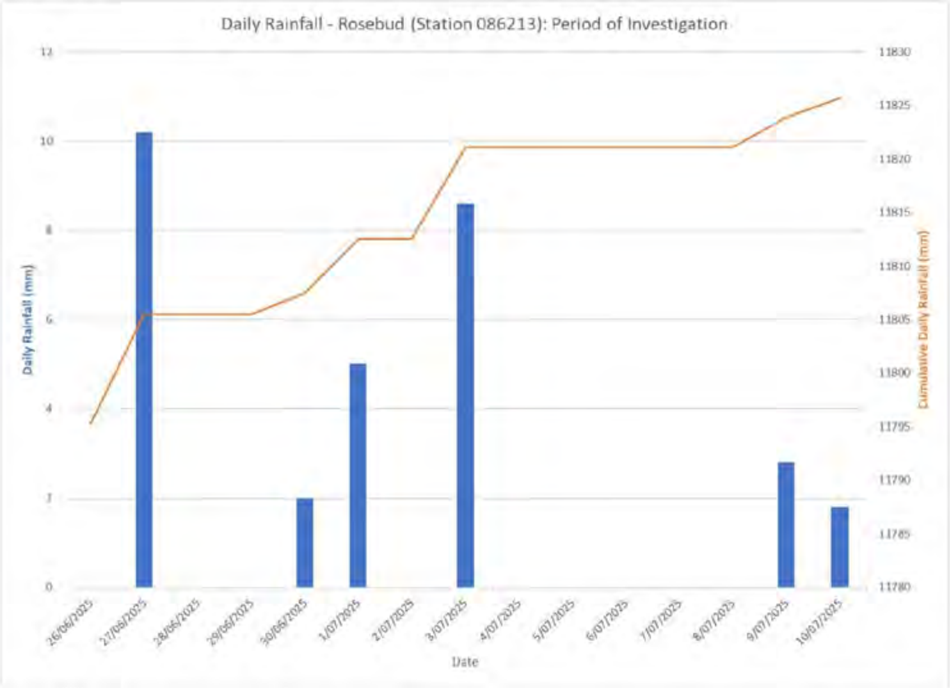


Figure 6 Rainfall over the period of investigation

Daily rainfall data and the accumulated daily rainfall around the time of the landslips is presented in Figure 7.

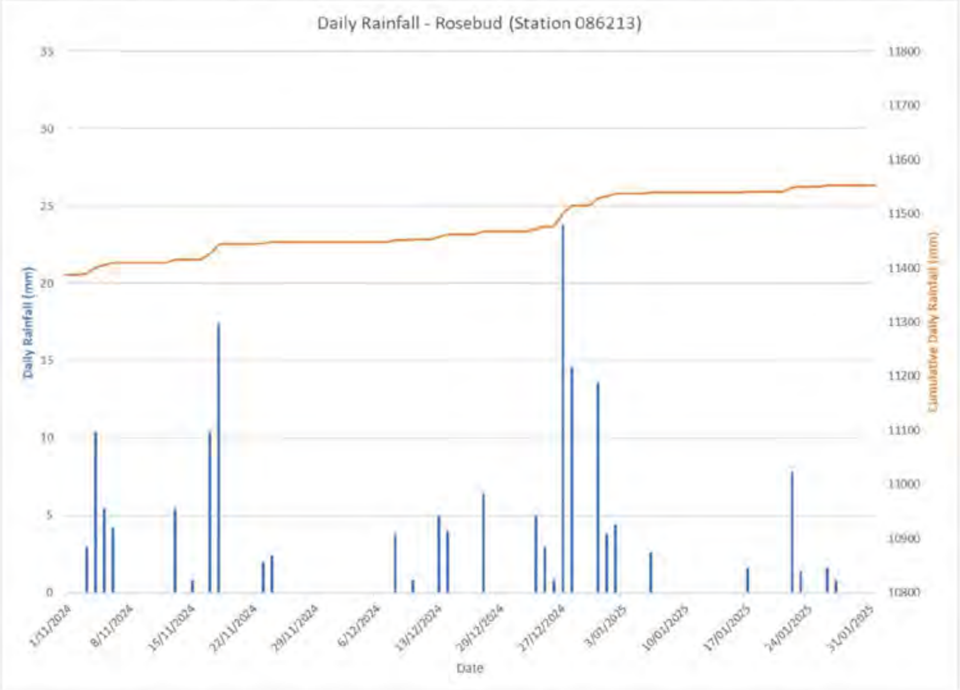


Figure 7: Daily Rainfall for Rosebud monitoring station 086213 for the period 1/11/24 to 31/1/25

The rainfall event preceding the 5 January 2025 landslip included a total of 60.2 mm of rain over a 7-day period from 27 November 2024 to 3 December 2024. The maximum rainfall occurred on 27 November 2024 (23.8mm). Another rain event of 21.8mm over 3 days (1st to 3rd January 2025) added moisture to already wet conditions.

Very little rain fell between the 5 January and 14 January 2025 (2.6mm on the 7 January 2025).

The cumulative daily rainfall plot demonstrates the rising rainfall trend in late November to early December 2024. Monthly rainfall statistics for the Rosebud rainfall station is shown in Figure 7.

The average monthly rainfall statistics are presented below in Table 5.

Table 5: Monthly rainfall statistics for full history of recording at Rosebud rainfall station (086213)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	41.7	41.6	52.3	64.9	81.4	78	80.8	78.2	72.2	69.9	60.2	55.1	780.5
Lowest	2	0	6.2	14.8	15.7	18.7	23.2	18	22.7	7.9	9.6	7.1	453.8
5th %ile	6.2	3	13.5	23.4	30.2	29	34.7	31.9	32.5	21.1	22.2	13.9	508.4
10th %ile	8	6.1	16.8	24.5	33.8	34.2	41.3	34.6	39.2	30.5	25.2	20	605.5
Median	36	31.3	45.8	65.6	77.5	72	76.8	79.8	64.2	65.4	55.5	48.1	803.6
90th %ile	78.6	83.4	100.2	108.9	124.8	124.2	126.6	118	121.4	116.2	98.3	104.8	951.4
95th %ile	94.3	101.9	110.7	121.2	140.4	141.8	133.5	123.4	130	124.3	113.6	119.7	998
Highest	135.8	238	176.1	207.4	216.5	169.8	176.2	129.8	148.2	140.2	163	137.8	1099.4

The November 2024 monthly rainfall of 67.2mm is slightly higher than average monthly rainfall (60.2mm). However, is not outside the normal range of November rainfall events for the area. The cumulative residual monthly rainfall data from July 2024 to November 2024 in the lead up to the landslide shows a falling trend. Cumulative residual rainfall is a consecutive monthly accumulation of the deviation from average monthly rainfall. Therefore, a rising trend indicates a wetter period and a falling trend indicates a drying trend.

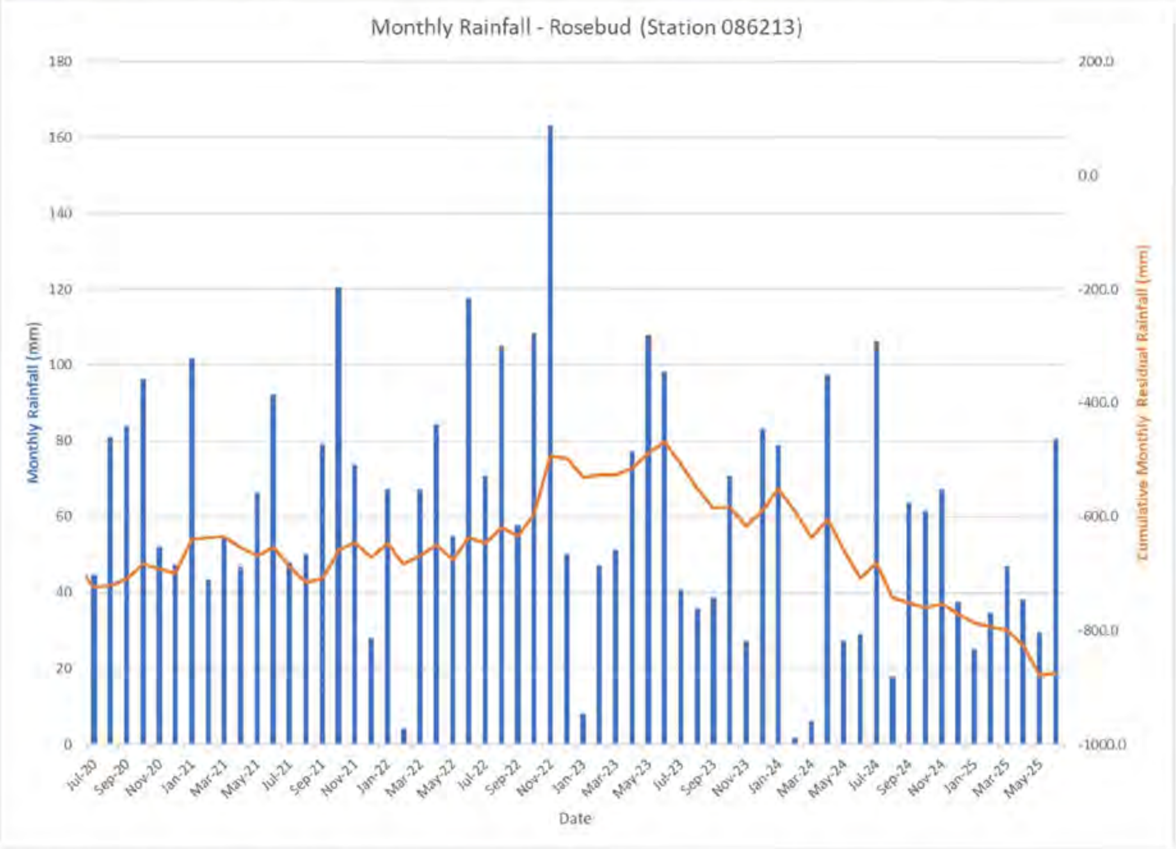


Figure 8: Cumulative Residual Monthly Rainfall for Rosebud rainfall station

5. Investigation Results

5.1 Surface Observations

Surface conditions at the time of the investigations exhibit little indication of areas of moisture that were reported to have occurred during the leak. The main areas of evident surface water in March 2025 were relatively minor water at the intersection of Coburn Avenue and Charlesworth Street and water in the curb channel emanating from 5 Prospect Hill Road.

Discussions with local residents does indicate that springs have historically existed in the area. These have mainly been located within the area bound by Prospect Hill Road and Coburn Avenue. However, with relatively recent (circa 2021) building of residences at 5 and 7 Prospect Hill Road which have building foundation drainage system, it appears that the area has dried out with water that would have in the past seeped at the surface now being collected and discharged to the stormwater system.

It was also observed that the lower end of Coburn Creek, at Burrell Street, appears to be fed via spring seepage. Water was observed to run in the creek even during periods of extended dry weather.

Springs are expected to occur along the escarpment due to the sharp topographic gradient change which would likely result in groundwater daylighting at escarpment slope.

5.2 Subsurface Conditions

Previous drilling undertaken in February 2025 (PSM, 9 April 2025) included eight bores shown in Table 6 below. The locations are shown in Figure 1. The geological logs from the PSM report (PSM5665-07R, 13 June 2025) have been reviewed.

Table 6: Boreholes drilled by PSM

Bore ID#	Easting	Northing	Location Description	Depth (mBGL)
P_BH01	319565.8	5753704.4	6 View Point Rd	31.57
P_BH01A	319565.7	5753704.3	6 View Point Rd	31.69
P_BH02	319562.3	5753681.9	11 View Point Rd	31.87
P_BH03	319533	5753715.6	12 View Point Rd	28.62
P_BH03A	319533.7	5753716.7	12 View Point Rd	28.7
P_BH04	319498.1	5753665.8	20 View Point Rd	26.82
P_BH04A	319499.2	5753666	20 View Point Rd	26.86
P_BH05	319500.7	5753775.2	2 Penny Lane	1.98

#Note: Bore hole names have had "P_" pre-fix here to denote bores related to work by PSM to differentiate SMEC bores

5.2.1 Regional Geology

The main granitic bedrock observed in the Arthurs Seat area is the Dromana Granite, defined in the 1:250,000 scale Queenscliff Geology Map as an 'I-type' granite of Upper Devonian age. I-type granites are biotite-hornblende granites with relatively high Na/Al ratios. The Dromana Granite has also been described as an Oligoclase-Orthoclase-Biotite Granite (quartz assumed). The granite is flanked to the southwest by a northwest – southeast trending regional fault named the Flinders Fault. The northeast edge of the granite is a northeast trending regional fault called the Selwyn Fault. Quaternary sediments of Pleistocene age (Qpd) lie to the west of the granitoid with younger Pleistocene to Holocene aged sediments (Qrd) closer to the coast.

The younger Quaternary sediments (Qrd) nearer the coast are described as aeolian coastal and inland dunes, dune sand, and some swamp deposits. The older Quaternary sediments are also aeolian type deposits of sand, clay, and calcareous sand.

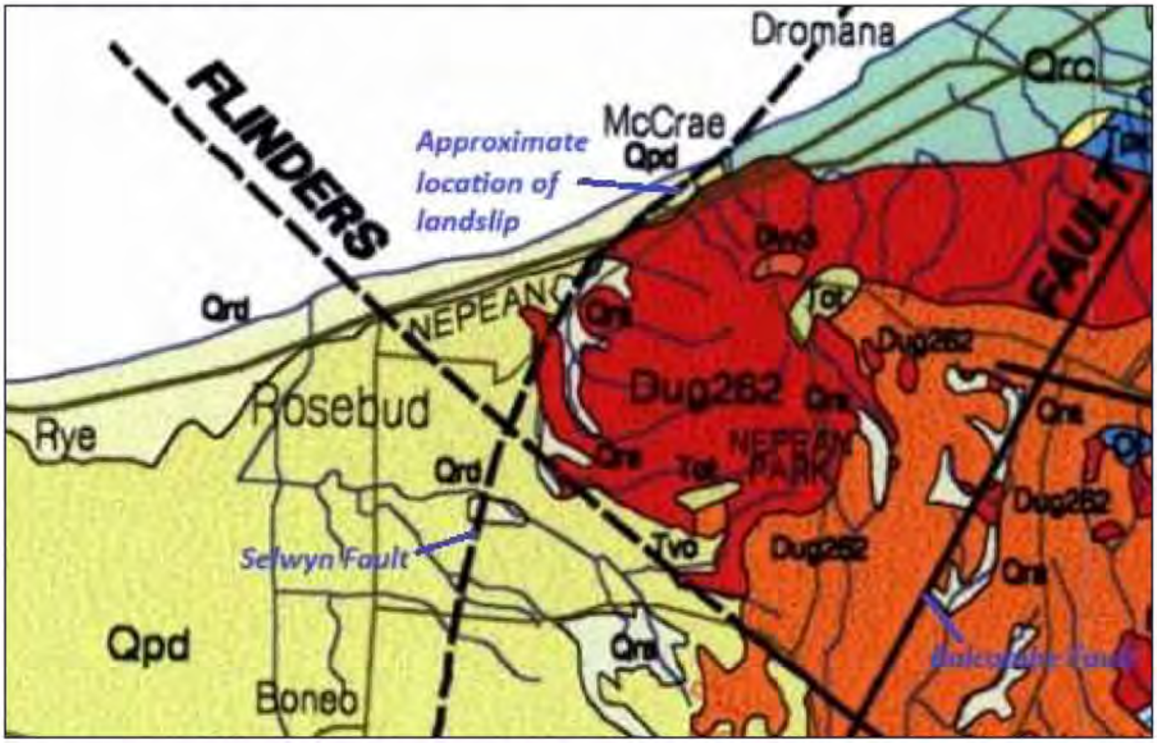


Figure 9: Regional Geology (Extract from the Queenscliff 1:250,000 Geological map, VANDENBERG, A.H.M., 1997 source GeoVic)

5.2.2 Site Geology

Detailed borehole logs have been compiled for bores of the 'BH', 'DP', 'HA' and 'NDD' series. Construction details and bore logs for the standpipe bores are located in the Appendix D of the Supplementary Expert Report of which this is another appendix.

5.2.2.1 Bedrock

Deeper bores BH01 and BH02 in the upper part of the landscape were drilled into, and screened in the weathered, fractured granite bedrock. Overlying the weathered, competent bedrock material is the extremely weathered granite or saprolite represented by zones of sandy clay, clayey sand and some gravel size material. Above the saprolite zone, is a residual soil including sandy clay and clayey sand, likely derived from granite. Overlying the residual soil layer is a transition from colluvial soil to soil fill and topsoil.

The top of the weathered granite is competent enough to resist auger drilling as noted in BH04. The weathered bedrock surface is interpreted to have an undulating profile as shown in Figure 4. BH04 reached the top of the weathered granite and terminated due to resistance. Bore logs from the PSM drilling were used to understand the subsurface geology profile in the escarpment and lower coastal area.

5.2.2.2 Shallow Soils

Mid-slope, the bores drilled were shallower in depth targeting the upper profile for groundwater monitoring. Bores in the mid-slope are screened in the fill or shallow clay and sand layers.

5.2.3 Groundwater Level

The regional water table lies in the extremely weathered granite, immediately above the more competent weathered rock zone.

A shallow perched watertable exists around 2 to 6 m depth below ground level within the saprolitic or colluvial soils which are composed of sands, clays and gravel.

The groundwater hydraulic gradient generally follows the topographic gradient, with the regional groundwater level following the bedrock surface. The perched watertable, where present, essentially mimics the current ground surface topography. No perched watertable was found at BH01 (SMEC), BH02 (SMEC) or WR174-BH01 (SMEC).

A perched shallow watertable was observed in boreholes BH03 (SMEC), BH04 (SMEC) and P_BH03 (PSM).

6. Laboratory Test Results

This section provides a summary of the laboratory and test results\. These are:

- Water quality tests
- Column tests
- CEC for soil samples
- Triaxial Permeability tests
- Porosity tests
- XRD on soil samples and sewer embedment

6.1 Water Quality Results

This section provides a summary of the laboratory chemical analysis for the water samples for the chemical constituents analysed. A summary of the water quality results is provided in Table 7. The laboratory results relied upon for this assessment are summarized in Appendix A.

In addition, water quality results are referred to from Table 12 of the 5 May 2025 SMEC report titled McCrae Landslip Project, Reference No. SMEC 001 Rev 0.

Table 7: Water Chemical Laboratory Results Summary (Units mg/L)

Chemical Parameter	Drinking Water	Surface Water	Landslide Seepage	Dewatering System	Groundwater (Aquifer Units)	
					Colluvium	Granite
Ammonia	<0.002	<0.1 – 0.6	-[#]	<0.1	<0.1 – 0.2	<0.1 – 0.1
TDS	78 – 85	330 – 430	-	320 – 370	630 – 990	920 – 3,300
EC (µS/cm)	120	420 – 630	1,600	740 – 770	1,000 – 1,300	1,700 – 5,200
Fluoride	0.76 – 0.81	0.15 – 0.19	0.15	0.14	0.34 – 0.59	0.25 – 0.88
Chloride	19 – 20	88 – 100	330	120 – 180	100 – 170	420 – 1,600
Sulphate as SO_4	2.0 – 3.0	<5.0 – 43	-	44 – 50	43 – 48	52 – 250
Alkalinity ($CaCO_3$)	23 – 26	38 – 170	-	88 – 110	370 – 440	83 – 160
Nitrate (as N)	0.21 – 0.22	<0.01 – 0.24	-	0.53 – 0.59	0.04 – 0.25	<0.01 – 0.11
Boron	0.05 – 0.06	0.08 – 0.11	-	0.01 – 0.09	0.11 – 0.12	0.03 – 0.07
Strontium	0.028	0.081 – 0.27	-	0.13 – 0.14	0.41 – 0.57	0.25 – 0.62
Calcium	8.4 – 8.9	16 – 49	-	16 – 19	58 – 69	44 – 90
Magnesium	1.6 – 1.7	6.2 – 20	-	15 – 17	34 – 40	34 – 160
Potassium	1.2 – 1.3	3.0 – 4.8	-	4.0 – 4.3	5.1 – 6.0	6.0 – 18
Sodium	9.1 – 9.7	54 – 57	-	90 – 100	120 – 130	120 – 750
Iodine	-	-	-	-	0.01	0.03 – 0.19

-Note:

[#] - no data reviewed or available at the time of writing of report

Surface Water refers to samples for Coburn Creek

Landslide Seepage refers to the sample collected on January 6, 2025 from the landslide face

Dewatering System refers to samples collected from 7 Prospect Hill Road building foundation drainage system in June/July 2025

Colluvium refers to samples collected from BH03 (SMEC), BH04 (SMEC) and a 2018 sample collected from 5 Prospect Hill Road BH04

Granite refers to samples collected from BH01 (SMEC), BH02 (SMEC) and WR174 BH01 (SMEC).

A review of the above water quality results indicates that a pattern in EC and chloride values can be seen. A map is provided below indicates the locations of:

- Bayview Road Leak
- A – Waller Place and Charlesworth Street intersection where upwelling occurred
- B – Coburn Avenue and Charlesworth Street intersection where upwelling occurred
- C – 7 Prospect Hill where samples collected from building foundation drainage system
- D – Location of landslide where a water quality sample was taken on 6 January 2025

All of these sampling locations are for groundwater associated with the shallow aquifer system.

Figure 10 Location of sample sites referred to in Figure 11 and Figure 12

Water sample data prior to / shortly after repairing the SEW burst and post repair used are as follows:

- A –Waller Place and Charlesworth Street intersection from as per Table 12 of the 5 May 2025 SMEC report titled McCrae Landslip Project, Reference No. SMEC 001 Rev 0
- B – Coburn Avenue and Charlesworth Street intersection as per Table 12 of the 5 May 2025 SMEC report titled McCrae Landslip Project, Reference No. SMEC 001 Rev 0
- C – 7 Prospect Hill samples collected from building foundation drainage system as as per SW2 from PSM report MSC.5007.0004.0219 and samples collected by SMEC
- D – Location of landslide where a water quality sample was taken on 6 January 2025 as per Table 12 of the 5 May 2025 SMEC report titled McCrae Landslip Project, Reference No. SMEC 001 Rev 0

Figure 11 shows EC changes for the selected sample location shown in Figure 10 for EC values prior to / shortly after repairing the SEW burst compared to EC values post repair, which show a substantial increase in EC levels as groundwater quality in the shallow perched aquifer returns to background water quality. In fact, it can be seen that in each case, the post-repair EC is almost exactly double the pre-repair value.

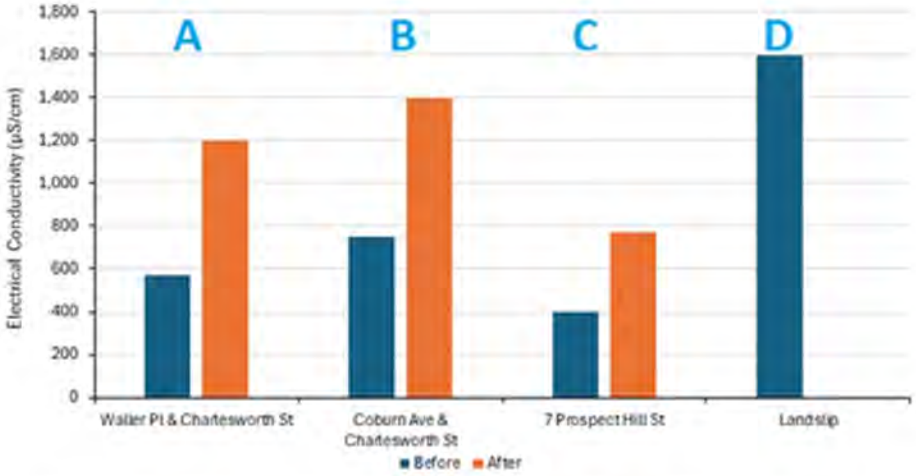


Figure 11: Summary of EC for selected sample locations showing Before and After Fix of Burst Pipe area

A similar proportionate change in concentrations is also observed for chloride, as shown in Figure 12.

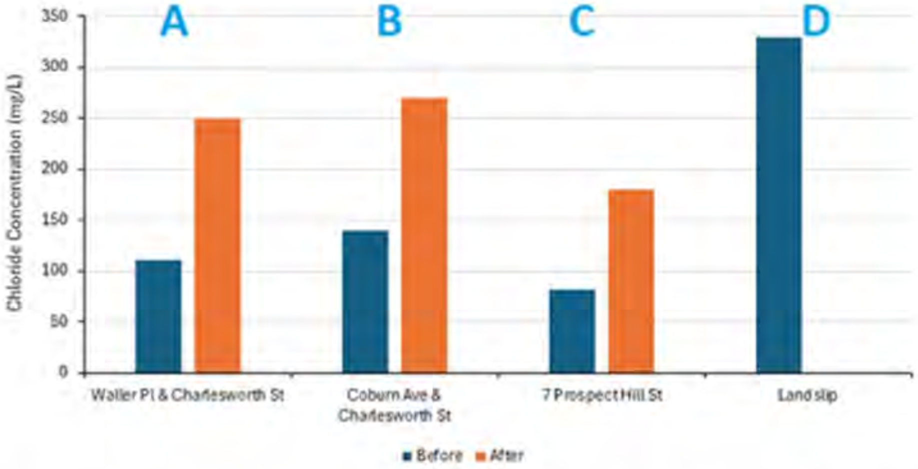


Figure 12: Summary of Chloride Concentration for selected sample locations showing Before and After Fix of Burst Pipe

Overall, the increase in EC, and chloride, post repair of the burst pipe shows similar ratios.

This change in both EC and chloride indicates that a portion of the SEW mains water from the Bayview Road Leak is considered to have made its way from Bayview Road to Waller Place, along Charlesworth Street to the intersection of Charlesworth Street and Coburn Avenue. Further migration of a portion of the water is considered to have occurred towards 7 Prospect Hill Road. This conclusion is based on changes to EC and chloride as observed at the sump collecting water from the building foundation drainage system for this property.

Water seeping from the landslide on 6 January 2025, was of a similar quality to background water quality considered to be water from a shallow perched aquifer. The results do not indicate a dilution of water from the shallow perched aquifer with mains water as would be expected if water from the burst were to have made it to the Site of the 5 January 2025 landslide.

In subsequent sections of this report, further supporting evidence is given regarding the sewer embedment material permeability which provided the pathway for SEW mains water to migrate from the Bayview Road Leak under the Mornington Peninsula Highway and make its way to Waller Place, Charlesworth Street and Coburn Avenue. This is backed up by surface observations made during the Bayview Road Leak of water coming to surface along this path.

6.2 Soil Column Leachability Test Results

This section provides a summary of the column test results. As noted in Section 3.5.3, the targeted chemical analysis for the column test eluent shows that, for some physicochemical parameters there is an increase in concentration of a chemical or parameter compared to the blank sample. It is noted that, for most parameters assessed, the "blank" eluent had a similar initial concentration to the five subsequent eluents measured. The laboratory results for the column test for EC is provided in Figure 13.

From Figure 13, the following observations are provided:

- Highest EC contribution is shown for the composite soils sample collected from WR174 BH1 Composite. That is, the initial eluent flush (i.e., T1) shows the largest change in EC with subsequent eluent analysis being relatively consistent at approximately 250 µS/cm to the final eluent measured at T5. It is understood that this sample was crushed and grounds to a powder form which would increase the surface area of the soil particles (in comparison to their condition in the ground), this increasing the availability of soluble ions.
- Samples for the Sewer coarse aggregate and Sewer embedment sand showed an increase in EC concentrations in the initial eluent compared to the blank concentration. However, the concentrations in the subsequent samples remained relatively constant. While the increase in EC is noticeably less than WR174 BH01 Composite, the sewer bed aggregate material shows some increase in EC.
- The eluent from the native soil samples (i.e., Bayview) showed no significant changes in EC concentrations relative to their respective blanks.

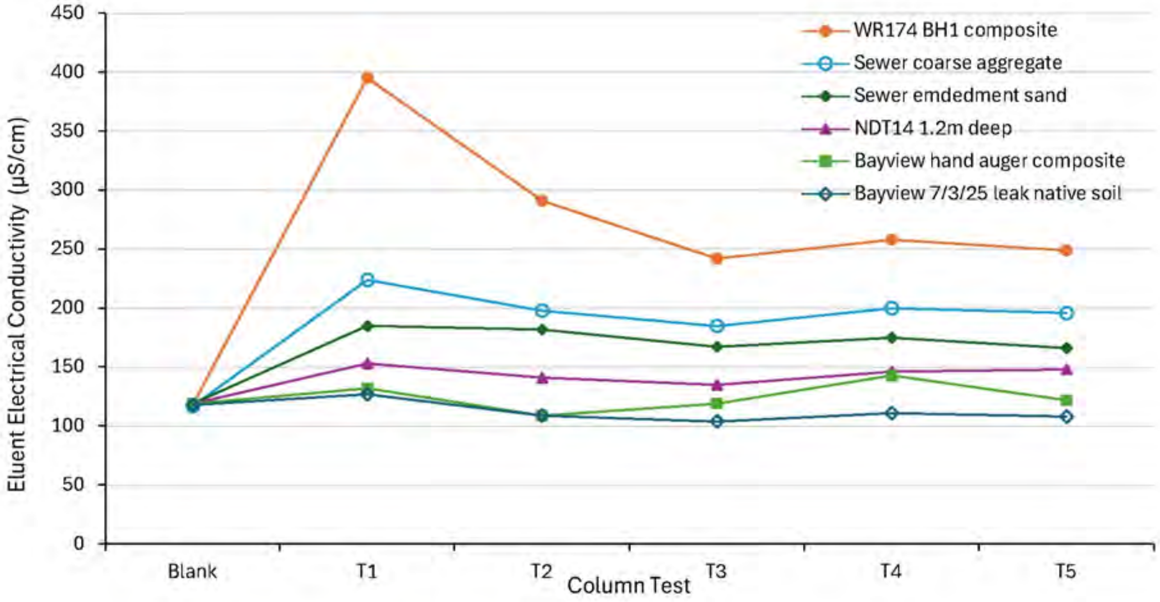


Figure 13: Electrical Conductivity Column Test Eluent Concentrations

Fluoride was considered as a potential chemical to compare the SEW drinking water sample with groundwater or seepage sample at the site. However, Fluoride is known to be present at high concentrations in groundwater within granitic geology (see fluoride results for Table 7 for Granite Aquifer water results) and as such it was not considered to be a suitable tracer chemical. Also, fluoride tends to attenuate, as it is shown in the column test results. That is, all of the T5 fluoride concentration results were lower than the blank sample concentration for the natural soils assessed (i.e., Bayview soils). That shows potential adsorption of fluoride onto the soil profile.

Chloride can also be considered as a tracer chemical (because it is very soluble and does not readily adsorb to mineral surfaces or exchange onto charged clay particles), and the data obtained from the column tests does support this conclusion. That is, while chloride is also present in the background water samples the column tests did not show a significant difference in changes of chloride concentrations for all the different matrices assessed. As such, should there be any change in chloride concentrations along a pathway, it is expected that it would be reflected across different profiles in a similar ratio. This is shown in Figure 14, as there is a close profile correlation in chloride concentrations across all different samples assessed. It is noted that the T1 sample for WR174 BH1 composite showed an increase in concentration; however, overall it followed a similar trend compared to all other samples.

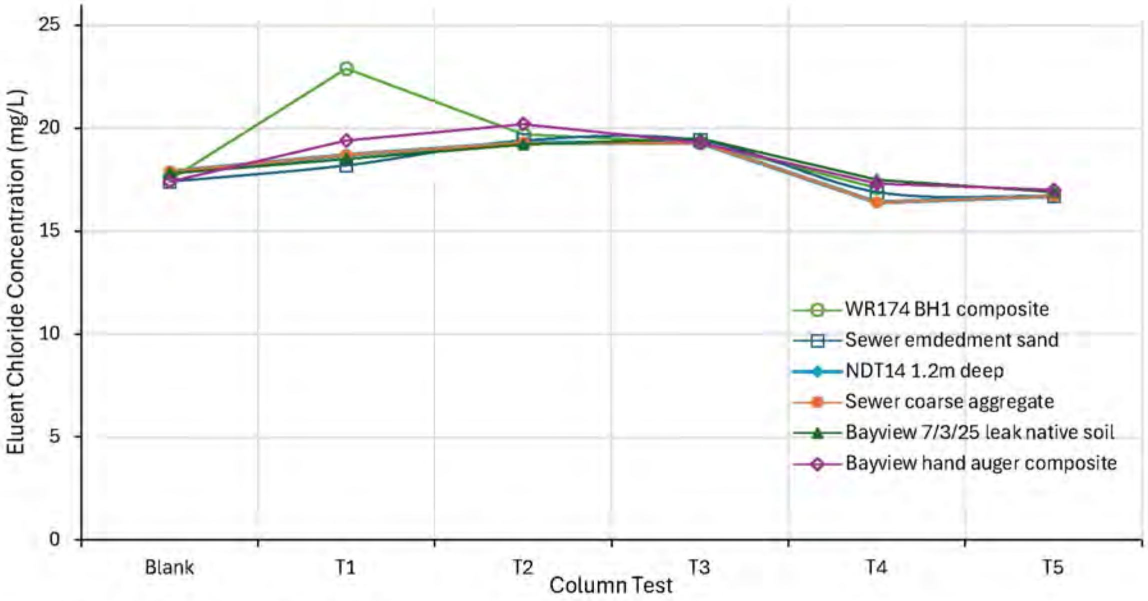


Figure 14: Chloride Eluent Column Test Eluent Concentrations

The column test data is consistent with the groundwater results assessed for the project. That is, the lower geological unit, represented by the sample ID WR174 BH1 composite showed the most significant changes in EC which is consistent with the EC measured at this location as part of the groundwater sampling event (e.g., EC maximum of 5,200 µS/cm).

The column test for the native soil's samples, represented by sample IDs NDT14 and Bayview, shows that while there is a potential increase in EC concentrations due to soil characteristics, the total mass change is not significant compared to the blank sample and there is a ready stabilisation with following eluent samples.

The column testing is used to inform the geochemical modelling. The geochemical modelling builds on the results of the column tests to allow observation on a larger scale.

6.3 Cation Exchange Capacity for soil samples

CEC was measured to determine the ability of the soil to hold and exchange positively charged ions. This is important in understanding the ability of a soil to interact with water that flows through it. The CEC is used as input to inform the geochemical modelling. CEC results are presented in Table 8.

Table 8: CEC Results

Bore Hole ID	Depth sampled (m BTOC)	CEC (meq/100g)
BH01	1.50 – 1.95	8.5
BH01	3.75 – 4.20	5.2
BH01	5.70 – 6.15	12
BH01	8.70 – 9.20	9.1
BH01	12.20 – 12.65	8.1
BH02	1.00 – 1.45	5.9
BH02	3.50 – 4.00	2.5
BH02	5.00 – 5.50	4.4
BH02	7.00 – 7.50	6.7
BH02	10.00 – 10.50	6.4
BH03	1.50 – 1.95	6.8
BH03	3.50 – 3.95	4
BH03	6.00 – 6.45	13
BH04	0.50 – 1.00	18
BH04	2.00 – 2.50	3.8
BH04	4.40 – 4.85	3.3
BH04	5.50 – 6.00	4.3
BH04	6.00 – 6.95	4.7

6.4 Triaxial Permeability tests

No triaxial permeability test results were available at the time of writing this report.

6.5 Porosity tests

No porosity test results were available at the time of writing this report.

6.6 XRD

The XRD results are summarized in Table 9. The XRD laboratory results are provided in Appendix C.

Table 9: XRD Summary of Results (Units – Percentum of weight, wt%)

	Calcite	Chlorite Group	Kaolinite Subgroup	Mica Group	K-Feldspar#	Quartz	Na-Plagioclase##
Bayview Hand Auger.			1		30	54	15
Bayview Sewer Dig.			5		20	59	15
Bayview Sewer Sand.	14	2	2	5	9	60	8

	Calcite	Chlorite Group	Kaolinite Subgroup	Mica Group	K-Feldspar#	Quartz	Na-Plagioclase##
Bayview 7 March.			2	3	16	69	10
Bayview Sewer Gravel.	<1	4		5	23	50	17

Notes:

\# - Potassium Feldspar.

\#\# - Sodium Plagioclase.

The data reported in in Table 9 for the XRD results is consistent with the limited published information concerning the mineralogy of the Dromana Granite and granitic derived soils, based on the ratio of Potassium-Feldspar, Plagioclase (Oligoclase) and Quartz percentage reported.

The XRD results are used as input to inform the geochemical modelling.

7. Field Test Results

This section provides a summary of the field testing. These are:

- Permeameter tests;
- Slug tests;
- Tracer tests.

7.1 Permeameter tests

A permeameter test is conducted on a borehole that is augered to a specified depth using a hand auger. A field instrument called a Talsma permeameter is used to measure the rate of infiltration into the bottom of the borehole at a constant head of water equal to 20mm. This test allows the saturated infiltration or permeability of a soil to be calculated. Permeameter test results are present in Table 10.

Table 10: Permeameter test results

Test	Location	Depth (m)	Infiltration / Permeability (m/d)	Infiltration / Permeability (mm/h)	Material
TP1	Bayview - 2m south of leak site	0.27	1.2	52	Silty Fine Sand
TP2	WR174 BH01	0.31	< 0.008	0.3	Extremely weathered Granite (Saprolite)
TP3	Charlesworth Street (opposite street side from BH03)	0.5	1.3	56	Silty Fine Sand
TP4	BH02	0.5	1.1	44	Silty Fine Sand
TP5	BH03 Charlesworth (above sewer)	0.5	< 0.01	0.5	Clay Fill
TP6	BH03 Charlesworth (3m away)	0.5	1.6	66	Silty Fine Sand
TP7	Coburn at Charlesworth DP2a DP2b	0.5	6.1	255	Silty Fine to Medium Sand Fill
TP8	Prospect Hill near DP3a DP3b	0.5	0.1	4	Silty Fine Sand with Clay at base
TP9	View Point DP6a DP6b	0.5	0.8	33	Silty Fine Sand

The permeameter results indicate the range of infiltration / permeability values. Generally, the infiltration or permeability values range between 0.8 and 1.6 m/d. Values below this range are associated with areas that appear to have been cut (i.e. TP2 at WR174 BH01) or filled (i.e. TP5). Values above this range are also associated with fill material such as TP7 which has silty fine to medium sand fill.

7.2 Slug tests

Slug tests are used to calculate the saturated permeability (also referred as hydraulic conductivity) of an aquifer or other saturated soil or rock. The test involves a sudden change in water level within a bore and the monitoring of the water level recovery to the original static water level. Analysing the recovery curves allows the permeability to be calculated. Slug test results are present in Table 11.

Table 11: Slug test results

Test	Date	Screen Interval Depth (m)	Filter Pack Interval Depth (m)	Static Water Level Depth (m)	Permeability or Hydraulic Conductivity (m/d)	Screened Material
BH01	8/7/25	19.7 to 25.7	18.4 to 25.7	13.805	0.007	Extremely Weathered (XW) Granite
BH02	9/7/25	22.6 to 25.6	21.8 to 25.9	19.383	0.2	XW Granite
BH03	8/7/25	2 to 6	1.5 to 6	1.967	6	Clayey Fine to Coarse Sand, Clay Low to Medium Plasticity. Below 3.7m Silt Clay to 4.2m then Fine to Medium Sandy Clay
BH04	8/7/25	3.5 to 7.5	3 to 7.5	5.82	0.3	Clayey Fine to Medium Sand, Clay Low Plasticity with silt
WR174 BH01	12/6/25	13.3 to 22.3	12.3-22.3	14.217	0.02	XW Granite

For the granite the range of permeability calculated varied from 0.007 to 0.2 m/d. The variation seen is attributable to the degree of fracturing present and how connected the fractures are.

For the shallow perched aquifer the range of permeability is from 0.3 to 6 m/d.

7.3 Tracer tests

Tracer test results are present in Table 12 and graphically in Figure 15. Both DP1A/DP1B and DP5A/DP5B show clear responses indicating the ability of the embedment material to transmit water. It should be noted that the head differences that occurred during the test are higher than what would be experienced in reality therefore the travel times should treated with this in mind.

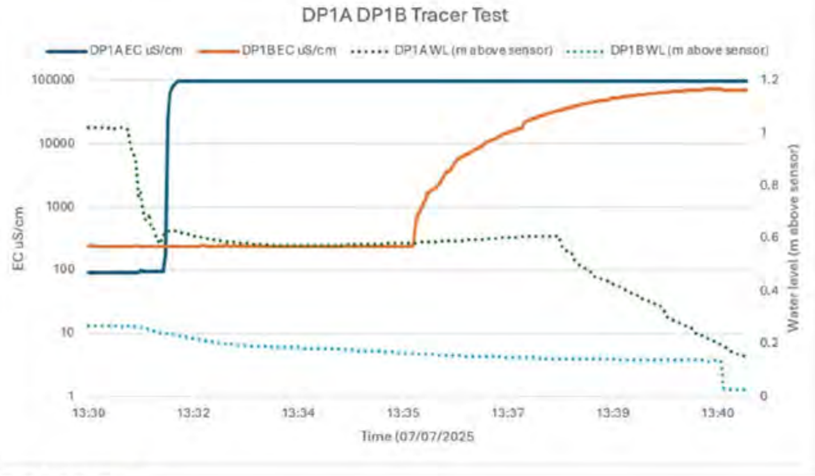
An analysis of the tracer test data for DP1A/DP1B and DP5A/DP5B was undertaken giving permeability values of 900 and 220 m/d respectively.

The results of the tracer tests indicate that the sewer embedment material is very permeable, consisting of crushed granite aggregate and medium sand.

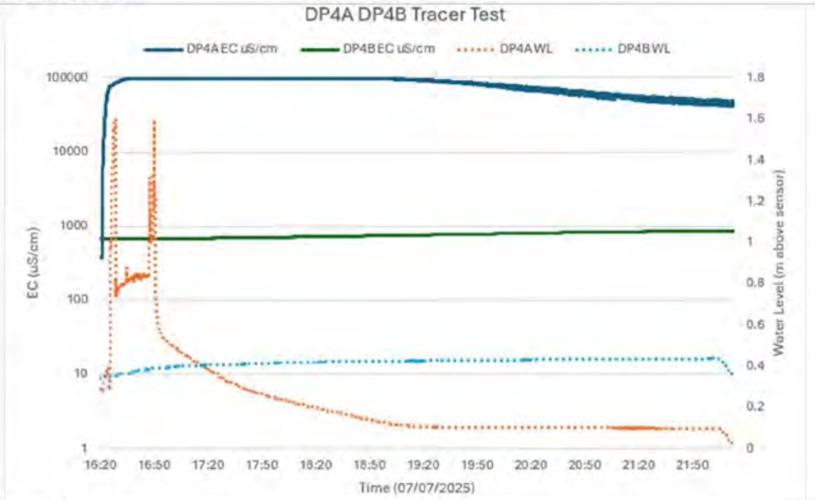
Table 12: Tracer test results

Test	Screen Depth/Bore Depth A (m)	Screen Depth/Bore Depth B (m)	Distance Travelled (m)	Travel Time (minutes) (ermeability (m/d)	Material
DP1A/DP1B	2.472	2.094	1.970	4 minutes 900 m/d	Sewer Embedment Aggregate & Sand
DP2A/DP2B	2.400	1.220	0.720	no response	Silty Fine to Medium Sand Fill
DP3A/DP3B	0.800	0.830	1.255	no response	Water Mains Embedment
DP4A/DP4B	1.620	1.480	2.080	Some response but difficult to determine time – at least 1 hour	Sewer Embedment Aggregate & Sand
DP5A/DP5B	0.930	0.985	1.310	6 minutes 220 m/d	Water Mains Embedment
DP6A/DP6B	1.680	1.270	1.820	no response	Silty Fine Sand

DP1A/DP1B



DP4A/DP4B



DP5A/DP5B

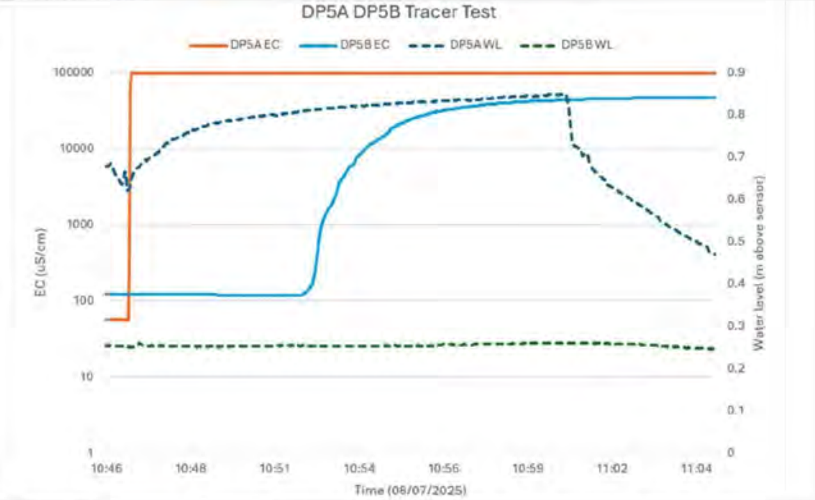


Figure 15: Tracer Test Plots

8. Geochemical Modelling Results

The results to date indicate that SEW water can be expected to cause change to the overall water quality as it mixes with and dilutes the higher EC natural background groundwater.

This indicated is a progressive increase in EC relative to the SEW water as the water migrates along its flow path as a result of the SEW water diluting the background ground water quality.

Geochemical modelling will be completed and provided as an addendum to this report.

9. Ground Model

The ground model or commonly referred to by hydrogeologists as a hydrogeological conceptual model, is presented here.

9.1 Hydrogeology

An understanding of the hydrogeology of the area has been developed through information gathered from the drilling program. In addition, an understanding of the lithology and by extension the geology, has been developed. Various tests such permeameter measurements, slug tests, tracer tests and lab testing have been used to understand the permeability of both the natural ground and fill material. This includes testing of water and sewer service trench material in the area.

9.2 Geochemistry

The use of geochemistry has been critical to understanding the impact and extent of the SEW burst. In particular, EC and chloride have proven to be simple yet useful chemical tracers to map the migration of the burst water.

Of importance, are the changes that are likely to have occurred to EC and chloride while the SEW burst water main was active. The progressive increase in EC and chloride levels following the repair of the burst main, as EC and chloride return to more elevated background levels, was observed.

9.3 Conceptual Model

The conceptual model indicates the following:

- A portion of the SEW mains water from the burst is considered to have made its way from Bayview Road using the sewer embedment material. This embedment material has allowed SEW mains water to migrate under the Mornington Peninsula Highway and make its way to Waller Place. From here it followed the sewer trench down Waller Place to Charlesworth Street where it migrated to the intersection of Charlesworth Street and Coburn Avenue. This interpretation is based on observations that the sewer embedment material is very permeable, consisting of crushed granite aggregate and medium sand. The results of tracer testing have indicated a relatively rapid travel time to site DP1A / DP1B. The EC and chloride values indicated that, post-water mains repair, these have risen, returning to background levels. This is backed up by surface observations made during the burst of water coming to surface along this path.
- Further migration of a portion of the water is considered to have occurred towards 7 Prospect Hill Road. This conclusion is based on changes to EC and chloride as observed at the sump collecting water from the building foundation drainage system for this property.
- Beyond this, comparison of background water quality data for the shallow perched aquifer to that of the Site indicate that is highly unlikely that water from the Bayview Road Leak made it to the Site. Water seeping from the Site on 6 January 2025, is of a similar quality to background water quality test results of what is considered to be water from a shallow perched aquifer. The results do not indicate a dilution of water from the shallow perched aquifer, with mains water as would be expected if water from the burst were to have made it to the Site.

10. Conclusions

Based on the observations, investigation, laboratory test results and analysis presented in this report, conclusions have been drawn as follows:

- Water seeping from the 6 January 2025 landslide site has a signature characteristic of background groundwater derived from the shallow perched aquifer.
- Based on geochemical analysis of groundwater and data from water samples obtained and tested by SEW and PSM during January 2025, and by SMEC during June to July 2025, there is no indication that that water from the Bayview Road Leak made it to the Site. Water seeping from the Site on 6 January 2025, is of a similar water quality to background water quality test results and is considered to be water from a shallow perched aquifer.
- The results of water quality testing at the Site do not indicate dilution of the shallow perched aquifer by mains water as would be expected if water from the Bayview Road Leak were to have made it to the Site.

Please note there is a need to provide an addendum to this report. This addendum will include information on triaxial permeability, porosity and geochemical modelling. This addendum will provide additional insights and may lead to adjustment of the interpretation and conclusions provided in this report.

11. Limitations

The contents of the report are for the sole use of South East Water c/o Thomson Geer. No responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement with SMEC.

The recommendations in this report are based on data collected at specific locations using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific timeframe and technical requirements of the brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the extrapolated model.

The information provided in logs of boreholes, hand augers and NDD locations are limited to their locality, the logs do not provide or include an interpretation of geotechnical information between these locations. The reliability of the logged information depends on the drilling/testing method, sampling/observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high-quality data. It should also be recognised that the volume of material observed or tested is only a fraction of the total subsurface profile.

Subsurface conditions, such as groundwater levels, can change over time and this should be borne in mind, particularly if the findings and/or recommendations contained within this report are used after a protracted delay.

If this report is reproduced, it must be in full. Should there be any queries concerning this report please do not hesitate to contact the author.

12. References

Appelo and Postma, 2010. Geochemistry, Groundwater and Pollution, 2nd Ed. Appelo, C. A. J., and Postma, D. CRC Press, 2010.

Beck and Howard, 1986. The Significance of Iodide and Fluoride in Groundwater from Surficial Sediments of Southern Ontario. IAH, April 1986.

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US EPA, 2017. Liquid-Solid Partitioning as a Function of Liquid-Solid Ratio for Constituents in Soild Materials Using an Up-Flow Percolation Column Procedure – Method 1314. Leaching Environmental Assessment Framework (LEAF) Methods and Guidance. United States Environmental Protection Agency (US EPA), Hazardous Waste Test Methods, 2017.

Appendix A
Water Chemistry Data

Sample Ref.	Location of sample	Notes	Sample Date	Distance from Leakage	Description	Sampled By	Sample Type (Tap water, Mains Water, SW, GW)	Sample Matrix	Sample ID	Lab Report Number	Easting	Northing	SO_4	NH_3	pH - pH, units	BOD5 Day	COD
													(mg/l)	(mg/l)	Units	mg/L	mg/L
4	29 Browne St Coburn Creek	Along the same water course	25/3/25	470.00	Creek	SEW	Creek - Sample 4	Water	4 NONE	25-22598				<0.1	7.3		
5	1-3 Burrell St	Along the same water course	25/3/25	580.00	Creek	SEW	Creek - Sample 5	Water	5 NONE	25-22598				0.6	6.8	7	38
A	Upwelling within pothole at junction of Waller Pl and Charlesworth St		24/12/24	195.00	Exc. W&C - Pre	SEW	Excavation	Water	SEW01 - Road damage NONE	**24-74742**				N/A	N/A		
A	Upwelling within pothole at junction of Waller Pl and Charlesworth St		30/12/24	195.00	Exc. W&C - Pre	SEW	Excavation	Water	SEW02 - Road damage NONE	24-74742				N/A	N/A		
A	Upwelling within pothole at junction of Waller Pl and Charlesworth St	Following 5 January 2025 landslide	6/1/25	195.00	Exc. W&C - Pre	SEW	Excavation	Water	2 Waller place road NONE	25-05645				N/A	N/A		
A	Upwelling within pothole at junction of Waller Pl and Charlesworth St	After 14 January 2025 landslide and Council excavation at site	16/1/25	195.00	Exc. W&C - Post	SEW	Excavation	Water						N/A	N/A		
D	Upwelling within pothole at junction of Coburn Ave and Charlesworth St	Following 5 January 2025 landslide	6/1/25	195.00	Exc. C&C - Pre	SEW	Excavation	Water	3 Waller place road 2 NONE	25-05645				N/A	N/A		
D	Upwelling within pothole at junction of Coburn Ave and Charlesworth St		22/1/25	195.00	Exc. C&C - Post	SEW	Excavation	Water	SEW01-P2 NONE	25-09278				<0.1	7.1		
D	Pavement around Coburn & Charlesworth		22/1/25		Exc. C&C - Post	SEW	Excavation	Water	SEW01-P1 NONE	25-09278				0.1	7.2		
Sample 11233984	WR174 BH01	After airlift development	5/6/25	170.00	GW - W. Granite	SMEC - HB	Groundwater	Water	11233984		319730	5753465			7.7	13	420
Sample 25-38718	WR174 BH01	Low flow sampling	12/6/25	170.00	GW - W. Granite	SMEC - SS	Groundwater	Water		25-38718	319730	5753465		<0.1	5.8	6	55
25-42089	WR174 BH01	Low flow sampling	27/6/25	170.00	GW - W. Granite	SMEC - SS	Groundwater	Water	11316870	25-42089	319730	5753465		<0.1	6	11	24
BH01	BH01	Low flow sampling	6/7/25		GW - W. Granite	SMEC - SS	Groundwater	Water	11350037	25-43934	319945	5753466		<0.1	7.4		<5.0
BH02	BH02	Low flow sampling	10/7/25		GW - W. Granite	SMEC - HB	Groundwater	Water	11372681	25-45052	319860	5753565		0.1	7.4		<5.0
BH03	BH03	Low flow sampling	6/7/25		GW - Colluvium	SMEC - HB SS	Groundwater	Water	11350039	25-43934	319790	5753638		<0.1	8.2		15
BH04	BH04	Low flow sampling	7/7/25		GW - Colluvium	SMEC - HB SS	Groundwater	Water	11353965	25-44152	319668	5753744		0.2	6.9		320
Sample 25-38718	WR174 BH01 QA1A		12/6/25		GW - W. Granite						319730	5753465		<0.1	5.9	2	32
Sample MGF0253-01	WR174 BH01 QA1B	Low flow sampling	12/6/25	170.00	GW - W. Granite	SMEC - SS	Groundwater	Water	MGF0253-01		319730	5753465			5.8	<5.0	180
Sample MGF0253-01	WR174 BH01 QA1B - internal duplicate	Not used	12/6/25		GW - W. Granite						319730	5753465					
5 The Eyrie	300 m ENE of subject site	SEW Drinking Water	15/4/25	300.00	Drinking Water	SEW	Mains Water	Water	11045899	269398				<0.002	7.7		
16 Arthurs Avenue	760 m SE of subject site	SEW Drinking Water	15/4/25	760.00	Drinking Water	SEW	Mains Water	Water	11045900	269398				<0.002	7.7		
2 Flinders Street	630 m SSE of subject site	SEW Drinking Water	15/4/25	630.00	Drinking Water	SEW	Mains Water	Water	11045901	269398				<0.002	7.7		
B	Within stormwater drain in front of 6 View Point Rd	Following 5 January 2025 landslide	8/1/25	410.00	Stormwater	SEW	Stormwater	Water	SEW01 NONE	25-06135				N/A	N/A		
C	Seepage within landslide material	Following 5 January 2025 landslide	6/01/2025	462.00	Seepage	SEW	Slope Seepage	Water						N/A	N/A		
PSM SW05	Taken on Peny Lane, slightly contaminated with mains water.	Source: Geotech Report (PSM 2025)	20/01/2025		Seepage	PSM /JBS&G	Slope Seepage	Water	SW05	1179041-W					8.0		
E	Verge in front of 34 Coburn Ave		22/1/25	270.00	Stormwater	SEW	Stormwater	Water	SEW01-NS NONE	25-06135				<0.1	6.7		
F	Within stormwater drain in front Waller Place		30/12/24	410.00	Stormwater	SEW	Stormwater	Water	[illegible]	24-74742				N/A	N/A		
F	Verge opposite 5 Waller Place		22/1/25	160.00	Stormwater	SEW	Stormwater	Water	SEW-SW NONE	25-09278				<0.1	8.2		
G	Within stormwater drain in front of 11 Prospect Hill Rd	Investigating high result at Point B	3/2/25	360.00	Stormwater	SEW	Stormwater	Water		25-11902_10787181				<0.1	7.1		
H	Kerb in front of 5 Prospect Hill Rd		3/2/25	340.00	Stormwater	SEW	Stormwater	Water		25-11902_10787182				0.1	7.7		
1	Gutter of 5 Prospect Hill Rd 'storm pipe'	Taken on the same day, along the same 'stormwater flow' (Note location B is along the same flow).	25/3/25	340.00	Stormwater	SEW	Stormwater	Water	1 NONE	25-22598				<0.1	7.1		
2	11 Prospect Hill Rd Stormwater Pit		25/3/25	360.00	Stormwater	SEW	Stormwater	Water	2 NONE	25-22598				<0.1	7.0		
3	10 View Point Rd Storm Pit	11 Prospect Hill Road is 'halfway' along.	25/3/25	430.00	Stormwater	SEW	Stormwater	Water	3 NONE	25-22598				<0.1	7.6		
Sample 11233985	Waller Place Stormwater Pit opposite 5 Waller Place	5 Waller Place	5/6/25	160.00	Stormwater	SEW	Stormwater	Water	11233984	25-37204					8.3	2	16
PSM SW01	Flowing water from 5 Prospect Hill Road into gutter	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	PSM /JBS&G	SW	Water	SW01	1179041-W					6.8		
PSM SW02	Flowing water from 7 Prospect Hill Road into private stormwater pit	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	PSM /JBS&G	SW	Water	SW02	1179041-W					6.9		
PSM SW03	Flowing drain around 4 View Point Road	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	PSM /JBS&G	SW	Water	SW03	1179041-W					7.2		
PSM SW04	Flowing drain at View Point Road Cul-de-sac	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	PSM /JBS&G	SW	Water	SW04	1179041-W					7.4		
McCrae LL Tank	McCrae LL Tank	SMEC 2025	23/6/25		Tank Water	SMEC - SS	Tank	Water	11290315	25-40631				<0.1	7.50	1.20	<5.0
7 PROSPECT HILL	7 PROSPECT HILL	SMEC 2025	27-Jun-25		Dewatering	SMEC - SS	Dewatering	Water	11316874	25-42089				<0.1	7.70	<2.0	11.00
7 Prospect Hill	**7 Prospect Hill**	SMEC2025	07-Jul-25			SMEC - HB	SW	Water	11353966	25-44152				<0.1	8.00		13.00
WSP_BH04	WSP_BH04	WSP 2025	18/6/25		Groundwater	WSP	Groundwater	Water	EM2510957-003	2510957					6.65		
SEW_BH4	SEW_BH4	SEW 2025	19/10/18		Groundwater	SEW	Groundwater	Water		718472					7.00		
Column Test Water	Drinking Water	SMEC2025	23/6/25		Drinking Water	SEW	Drinking Water	Water	11290666	ES2519058				<0.01	7.22	<2	<10
5PH	5 Prospect Hill	SMEC 2025	13/07/2025		Dewatering	SMEC	Dewatering	Water	11383542	25-45779				<0.1	7.3		40
QA1	5 Prospect Hill	SMEC 2025	13/07/2025		Dewatering	SMEC	Dewatering	Water	11383543	25-45779				<0.1	7.5		42
Bayview Rd. Pit	Bayview Rd. Pit	SEW 2025	18/06/2025		Stormwater	SEW	Stormwater	Water	11277975	25-40037				<0.1	6.9	4	14
Waller A	Stormwater Pit Waller St opposite 6 Walle	SEW 2025	6/05/2025		Stormwater	SEW	Stormwater	Water	11117649	25-30795				<0.1	8.4	<2	13
Waller B	Stormwater Pit Waller St opposite 6 Walle	SEW 2025	6/05/2025		Stormwater	SEW	Stormwater	Water	11117650	25-30795				<0.1	8.4	2	13
Burell	Burell Creek	SEW 2025	6/05/2025		Creek	SEW	Creek	Water	11117651	25-30795				<0.1	8.3	2	56

Location of sample	Notes	Sample Date	Distance from Leakage	Description	TKN/TP (HL) - Phosphorus, total as P	Total Organic Carbon	Dissolved Organic Carbon	SS at 104+/- 2°C - Suspended Solids	TDS at 180°C +/- 5°C - Total Dissolved Solids	EC - Electrical Conductivity @ 25C	Turbidity, NTU	Fluoride, as F	Chloride, as Cl	Sulphate, as SO4	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Alkalinity as CaCO3	Ferric Sol Diff - Ferric - Soluble (by Difference)	Ferrous Fe - Ferrous iron, as Fe	Bromide
					mg P / L	mg/L	mg/L	mg/L	mg/L	uS/cm	NTU	mg/L	mg/L	mg/L	ng CaCO3 /	ng CaCO3 /	ng CaCO3 /	ng CaCO3 /	mg/L	mg/L	mg/L
29 Browne St Coburn Creek	Along the same water course	25/3/25	470.00	Creek					330	420	46	0.19	100	<5	38			38			
1-3 Burrell St	Along the same water course	25/3/25	580.00	Creek					430	620	39	0.15	85	43	170			170		12	
Upwelling within pothole at junction of Waller Pl and Charlesworth St		24/12/24	195.00	Exc. W&C - Pre						670		0.29	120	N/A							
Upwelling within pothole at junction of Waller Pl and Charlesworth St		30/12/24	195.00	Exc. W&C - Pre						640		0.27	120	N/A							
Upwelling within pothole at junction of Waller Pl and Charlesworth St	Following 5 January 2025 landslide	6/1/25	195.00	Exc. W&C - Pre						570		0.14	110	N/A							
Upwelling within pothole at junction of Waller Pl and Charlesworth St	After 14 January 2025 landslide and Council excavation at site	16/1/25	195.00	Exc. W&C - Post						1200		0.28	250	N/A							
Upwelling within pothole at junction of Coburn Ave and Charlesworth St	Following 5 January 2025 landslide	6/1/25	195.00	Exc. C&C - Pre						750		0.3	140	N/A							
Upwelling within pothole at junction of Coburn Ave and Charlesworth St		22/1/25	195.00	Exc. C&C - Post						1000		0.32	210	<10 LINT							
Pavement around Coburn & Charlesworth		22/1/25		Exc. C&C - Post						1400		0.22	270	95							
WR174 BH01	After airlift development	5/6/25	170.00	GW - W. Granite	6.2	NR INAP	NR INAP	11000	2300	3700	>1000	0.88	1300	210	90	<2	<2	90	NR	20	3.7
WR174 BH01	Low flow sampling	12/6/25	170.00	GW - W. Granite		7.1	6.8	140	2900	4900	100	0.78	1600	240	120	<2	<2	120	4.2	0.9	4.9
WR174 BH01	Low flow sampling	27/6/25	170.00	GW - W. Granite		8	7.9	180	3300	5200	110	0.53	1500	250	160			160	5.7	0.2	
BH01	Low flow sampling	6/7/25		GW - W. Granite				93	1000	1700	160	0.48	420	62	84			84	7	0.2	1.2
BH02	Low flow sampling	10/7/25		GW - W. Granite		3.4	3.3	3000	920	1800	120	0.25	480	52	83			83	<0.2	3.8	
BH03	Low flow sampling	6/7/25		GW - Colluvium				320	630	1000	82	0.59	100	43	370			370	<0.2	<0.1	0.69
BH04	Low flow sampling	7/7/25		GW - Colluvium			11	20000	990	1200	>600	0.34	170	48	440			440	<0.2	<0.1	
WR174 BH01 QA1A		12/6/25		GW - W. Granite		7.6	7.1	100	2800	4900	70	0.79	1600	240	120	<2	<2	120		1	
WR174 BH01 QA1B	Low flow sampling	12/6/25	170.00	GW - W. Granite	0.21	46	25	74	2900	4800	100	0.79	1400	220	140	<5.0	<5.0	140	<0.050	1.0	<10
WR174 BH01 QA1B - internal duplicate	Not used	12/6/25		GW - W. Granite																	
300 m ENE of subject site	SEW Drinking Water	15/4/25	300.00	Drinking Water					85	120	0.2	0.76	20	2	23	<2	<2	23			
760 m SE of subject site	SEW Drinking Water	15/4/25	760.00	Drinking Water					78	120	0.2	0.81	19	2	26	<2	<2	26			
630 m SSE of subject site	SEW Drinking Water	15/4/25	630.00	Drinking Water					62	120	0.2	0.79	20	3	25	<2	<2	25			
Within stormwater drain in front of 6 View Point Rd	Following 5 January 2025 landslide	8/1/25	410.00	Stormwater						570.00		0.13	82	N/A							
Seepage within landslide material	Following 5 January 2025 landslide	6/01/2025	462.00	Seepage						1600.00		0.16	330	N/A							
Taken on Peny Lane, slightly contaminated with mains water.	Source: Geotech Report (PSM 2025)	20/01/2025		Seepage					640	1200.00		0.15	240	100	190	<10		190			
Verge in front of 34 Coburn Ave		22/1/25	270.00	Stormwater						880.00		0.31	150	<20 LINT							
Within stormwater drain in front Waller Place		30/12/24	410.00	Stormwater						160.00		0.8	29	N/A							
Verge opposite 5 Waller Place		22/1/25	160.00	Stormwater						600.00		0.18	120	29							
Within stormwater drain in front of 11 Prospect Hill Rd	Investigating high result at Point B	3/2/25	360.00	Stormwater						400.00		0.14	63	14							
Kerb in front of 5 Prospect Hill Rd		3/2/25	340.00	Stormwater						140		0.86	20	5							
Gutter of 5 Prospect Hill Rd 'storm pipe'	Taken on the same day, along the same 'stormwater flow' (Note location B is along the same flow).	25/3/25	340.00	Stormwater					12	120	5.5	0.71	117	2	26			26	0.28		
11 Prospect Hill Rd Stormwater Pit		25/3/25	360.00	Stormwater					1100	440	380	0.13	100	17	62			62	16		
10 View Point Rd Storm Pit	11 Prospect Hill Road is 'halfway' along.	25/3/25	430.00	Stormwater					1000	450	370	0.16	99	22	64			64	15		
Waller Place Stormwater Pit opposite 5 Waller Place	5 Waller Place	5/6/25	160.00	Stormwater	<0.05	4.5	4.5	6	300	510	5	0.1	81	27	110	<2	<2	110	0.9	<0.1	0.36
Flowing water from 5 Prospect Hill Road into gutter	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water					100	140		<0.5	19	<5	41	<10		41			
Flowing water from 7 Prospect Hill Road into private stormwater pit	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water					1400	400		<0.5	81	19	79	<10		79			
Flowing drain around 4 View Point Road	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water					1400	480		<0.5	90	27	95	<10		95			
Flowing drain at View Point Road Cul-de-sac	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water					1100	440		<0.5	89	20	93	<10		93			
McCrae LL Tank	SMEC 2025	23/6/25		Tank Water		1.60	1.50	<2.0	80.00	110.00		0.83	19.00	2.00	23.00			23.00			
7 PROSPECT HILL	SMEC 2025	27-Jun-25		Dewatering			4.80	<2.0	320.00	740.00	15.00	0.14	120.00	44.00	110.00			110.00	0.50	<0.1	
7 Prospect Hill	SMEC2025	07-Jul-25				5.80	5.80	2.00	370.00	770.00	12.00	0.14	180.00	50.00	88.00			88.00			0.54
WSP_BH04	WSP 2025	18/6/25		Groundwater					5800.00	9800.00		0.30									5.91
SEW_BH4	SEW 2025	19/10/18		Groundwater						1300.00		0.26	260.00	53.00							
Drinking Water	SMEC2025	23/6/25		Drinking Water		2.00		<5	74.00	118.00		0.90	17.00	<1	27.00	<1	<1	27.00	<0.05	<0.05	<0.1
5 Prospect Hill	SMEC 2025	13/07/2025		Dewatering		7	5.3	850	210	250	170	0.16	39	42	42	<2	<2	42	5.2	<0.1	0.12
5 Prospect Hill	SMEC 2025	13/07/2025		Dewatering		5.6	5.3	320	200	260	120	0.13	35	37	43	<2	<2	43	6	<0.1	0.13
Bayview Rd. Pit	SEW 2025	18/06/2025		Stormwater		4.2	4.1	<2	190	490	3.8	0.09	82	24	100	<2	<2	100	0.6	0.1	0.33
Stormwater Pit Waller St opposite 6 Walle	SEW 2025	6/05/2025		Stormwater		5.3	5.3	16	240	530	6.2	0.11	77	31	110	<2	<2	110	1.9	<0.1	
Stormwater Pit Waller St opposite 6 Walle	SEW 2025	6/05/2025		Stormwater		5.3	5.2	26	340	530	7.1	0.11	77	31	110	<2	<2	110	3.2	<0.1	
Burell Creek	SEW 2025	6/05/2025		Creek		18	18	4	390	570	3.8	0.19	74	<5	170	<2	<2	170	1.2	<0.1	

Location of sample	Notes	Sample Date	Distance from Leakage	Description	Ammonia, as N	Nitrate, as N	Nitrite, as N	Boron	Iron	Strontium	Hardness, as CaCO3	Calcium	Magnesium	Potassium	Sodium	Iodine - Iodine
					mg N / L	mg N / L	mg N / L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
29 Browne St Coburn Creek	Along the same water course	25/3/25	470.00	Creek		0.24	<0.01	0.11	0.6	0.081		16	6.2	3	54	
1-3 Burrell St	Along the same water course	25/3/25	580.00	Creek	0.6	0.005	<0.01	0.08	1.2	0.27		49	20	4.8	57	
Upwelling within pothole at junction of Waller Pl and Charlesworth St		24/12/24	195.00	Exc. W&C - Pre												
Upwelling within pothole at junction of Waller Pl and Charlesworth St		30/12/24	195.00	Exc. W&C - Pre												
Upwelling within pothole at junction of Waller Pl and Charlesworth St	Following 5 January 2025 landslide	6/1/25	195.00	Exc. W&C - Pre												
Upwelling within pothole at junction of Waller Pl and Charlesworth St	After 14 January 2025 landslide and Council excavation at site	16/1/25	195.00	Exc. W&C - Post												
Upwelling within pothole at junction of Coburn Ave and Charlesworth St	Following 5 January 2025 landslide	6/1/25	195.00	Exc. C&C - Pre												
Upwelling within pothole at junction of Coburn Ave and Charlesworth St		22/1/25	195.00	Exc. C&C - Post												
Pavement around Coburn & Charlesworth		22/1/25		Exc. C&C - Post												
WR174 BH01	After airlift development	5/6/25	170.00	GW - W. Granite	<0.1	0.03	0.04	0.07	0.02	0.4	580	56	110	17	580	0.14
WR174 BH01	Low flow sampling	12/6/25	170.00	GW - W. Granite	<0.1	0.005	<0.01	0.06	5.1	0.54		80	140	18	690	0.17
WR174 BH01	Low flow sampling	27/6/25	170.00	GW - W. Granite	<0.1	0.005	<0.01	0.06	5.9	0.62	890	90	160	17	750	
BH01	Low flow sampling	6/7/25		GW - W. Granite	<0.1	0.01	0.12	0.04	6.6	0.25	290	58	34	6	120	0.03
BH02	Low flow sampling	10/7/25		GW - W. Granite	0.1	0.11	0.08	0.07	3.8	0.25	280	44	41	9.1	250	
BH03	Low flow sampling	6/7/25		GW - Colluvium	<0.1	0.04	0.35	0.11	<0.01	0.52	290	58	34	6	120	0.01
BH04	Low flow sampling	7/7/25		GW - Colluvium	0.2	0.25	<0.01	0.12	0.21	0.41	340	69	40	5.1	130	
WR174 BH01 QA1A		12/6/25		GW - W. Granite				0.06	4.3	0.62		89	160	20	770	0.19
WR174 BH01 QA1B	Low flow sampling	12/6/25	170.00	GW - W. Granite	0.024	<0.0050	0.030	0.063	0.72	0.55	720	74	130	24	660	0.14
WR174 BH01 QA1B - internal duplicate	Not used	12/6/25		GW - W. Granite												
300 m ENE of subject site	SEW Drinking Water	15/4/25	300.00	Drinking Water	<0.002	0.22	<0.002	0.05	<0.01	0.028		8.9	1.6	1.3	9.7	
760 m SE of subject site	SEW Drinking Water	15/4/25	760.00	Drinking Water	<0.002	0.21	<0.002	0.06	<0.01	0.028		8.5	1.6	1.2	9.1	
630 m SSE of subject site	SEW Drinking Water	15/4/25	630.00	Drinking Water	<0.002	0.22	<0.002	0.06	<0.01	0.028		8.4	1.7	1.2	9.4	
Within stormwater drain in front of 6 View Point Rd	Following 5 January 2025 landslide	8/1/25	410.00	Stormwater												
Seepage within landslide material	Following 5 January 2025 landslide	6/01/2025	462.00	Seepage												
Taken on Peny Lane, slightly contaminated with mains water.	Source: Geotech Report (PSM 2025)	20/01/2025		Seepage	0.42	0.2						41	21	14	160	
Verge in front of 34 Coburn Ave		22/1/25	270.00	Stormwater												
Within stormwater drain in front Waller Place		30/12/24	410.00	Stormwater												
Verge opposite 5 Waller Place		22/1/25	160.00	Stormwater												
Within stormwater drain in front of 11 Prospect Hill Rd	Investigating high result at Point B	3/2/25	360.00	Stormwater												
Kerb in front of 5 Prospect Hill Rd		3/2/25	340.00	Stormwater												
Gutter of 5 Prospect Hill Rd 'storm pipe'	Taken on the same day, along the same 'stormwater flow' (Note location B is along the same flow).	25/3/25	340.00	Stormwater	<0.1	0.27	<0.01	0.08	0.02	0.032		10	1.6	1.2	11	
11 Prospect Hill Rd Stormwater Pit		25/3/25	360.00	Stormwater		0.37	<0.01	0.08	1.2	0.065		13	12	4.9	63	
10 View Point Rd Storm Pit	11 Prospect Hill Road is 'halfway' along.	25/3/25	430.00	Stormwater		0.3	<0.01	0.07	1.1	0.069		15	12	5.1	62	
Waller Place Stormwater Pit opposite 5 Waller Place	5 Waller Place	5/6/25	160.00	Stormwater	<0.1	0.88	0.01	0.07	0.88	0.13	110	15	18	3.7	63	<0.05
Flowing water from 5 Prospect Hill Road into gutter	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	0.02	0.27						9.6	1.6	1.2	11	
Flowing water from 7 Prospect Hill Road into private stormwater pit	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	0.79	0.01						8.4	7.7	2.5	55	
Flowing drain around 4 View Point Road	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	0.48	0.2						11	8.2	3.3	64	
Flowing drain at View Point Road Cul-de-sac	Source: Geotech Report (PSM 2025)	20/1/25		Surface Water	0.62	0.2						10	7.6	2.8	57	
McCrae LL Tank	SMEC 2025	23/6/25		Tank Water	<0.1	0.22	<0.01	0.04	0.04	0.03	28.00	8.20	1.90	1.40	10.00	<0.01
7 PROSPECT HILL	SMEC 2025	27-Jun-25		Dewatering	<0.1	0.53	<0.01	0.01	0.10	0.14	100.00	16.00	15.00	4.00	90.00	
7 Prospect Hill	SMEC2025	07-Jul-25			<0.1	0.69	0.02	0.09	0.09	0.13	120.00	19.00	17.00	4.30	100.00	
WSP_BH04	WSP 2025	18/6/25		Groundwater		2.42	0.02	0.06	<0.05			118.00	330.00	21.00	1460.00	
SEW_BH4	SEW 2025	19/10/18		Groundwater	0.10											
Drinking Water	SMEC2025	23/6/25		Drinking Water	<0.01	0.23	<0.01	<0.05	<0.05	0.02		9.00	2.00	2.00	12.00	<0.01
5 Prospect Hill	SMEC 2025	13/07/2025		Dewatering	<0.1	0.65	<0.01	0.03	0.04	0.05	46	12	4	3.9	41	<0.05
5 Prospect Hill	SMEC 2025	13/07/2025		Dewatering	<0.1	0.78	<0.01	0.03	0.03	0.046	39	10	3.4	3.4	33	<0.05
Bayview Rd. Pit	SEW 2025	18/06/2025		Stormwater	<0.1	1.7	0.02	0.06	0.53	0.14	110	13	18	3.7	55	
Stormwater Pit Waller St opposite 6 Walle	SEW 2025	6/05/2025		Stormwater	<0.1	1	0.01				95	12	16	3.5	60	
Stormwater Pit Waller St opposite 6 Walle	SEW 2025	6/05/2025		Stormwater	<0.1	1	0.01				100	13	16	3.4	59	
Burell Creek	SEW 2025	6/05/2025		Creek	<0.1	0.02	<0.01				140	37	11	4.4	53	

Appendix B

LEAF Column Test Result

CERTIFICATE OF ANALYSIS

Work Order	: **ES2519076**	Page	: 1 of 26
Amendment	: **3**		
Client	: **ALS WATER AND HYDROGRAPHICS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ACCOUNTS PAYABLE	Contact	: Customer Services ES
Address	: 22 DALMORE DRIVE SCORESBY VIC, AUSTRALIA 3179	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 07 4944 0177	Telephone	: +61 2 8784 8555
Project	: 25-40631	Date Samples Received	: 24-Jun-2025 13:35
Order number	: ----	Date Analysis Commenced	: 25-Jun-2025
C-O-C number	: ----	Issue Date	: 29-Jul-2025 16:35
Sampler	: ----		
Site	: ----		
Quote number	: EM25ECOENV0002		
No. of samples received	: 36		
No. of samples analysed	: 36		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- Poor spike recovery for (Iodide) due to matrix interferences.
- Ed009x: Poor spike recovery for (Iodide) due to matrix interferences.
- EK059G/55G: LOR raised for NOx& Ammonia on sample no.31 due to sample matrix.
- EK057G/EK059G: Sample 31 is confirmed for NOX/Nitrite by re-analysis
- ED093: Positive results for samples ES2519076-#006, #012, #018, #024, #030 and #036 have been confirmed by reanalysis.
- TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Amendment (10/07/2025): This report has been amended and re-released to allow the reporting of additional analytical data, specifically method ED093F and ED009X for all samples.
- Amendment (16/07/2025): This report has been amended and re-released to allow the reporting of additional analytical data, specifically method ED009X (Cl and SO4) ED093F (Na, K, Ca, Mg), for All samples on this work order.
- Amendment (29/07/2025): This report has been amended and re-released to allow the reporting of additional analytical data, specifically method ED037P: Alkalinity for all samples.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	Sewer emdedment sand T01	Sewer emdedment sand T02	Sewer emdedment sand T03	Sewer emdedment sand T04	Sewer emdedment sand T05
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00
Compound	CAS Number	LOR	Unit	**ES2519076-001**	**ES2519076-002**	**ES2519076-003**	**ES2519076-004**	**ES2519076-005**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.88**	**7.17**	**7.15**	**7.78**	**7.84**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**185**	**182**	**167**	**175**	**166**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**149**	**139**	**108**	**112**	**101**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**6**	<5	<5	<5	<5
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**182**	**124**	**135**	**154**	**163**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**18.2**	**19.4**	**19.4**	**16.9**	**16.7**
Fluoride	16984-48-8	0.010	mg/L	**1.17**	**1.39**	**1.22**	**1.06**	**1.08**
Iodide	20461-54-5	0.010	mg/L	**0.010**	<0.010	**0.013**	**0.014**	**0.013**
Sulfate	14808-79-8	0.100	mg/L	**3.18**	**2.00**	**1.90**	**1.96**	**1.80**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**72**	**67**	**57**	**54**	**48**
Total Alkalinity as CaCO3	----	1	mg/L	**72**	**67**	**57**	**54**	**48**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**28**	**27**	**23**	**22**	**19**
Magnesium	7439-95-4	1	mg/L	**3**	**2**	**2**	**2**	**1**
Sodium	7440-23-5	1	mg/L	**10**	**10**	**11**	**11**	**11**
Potassium	7440-09-7	1	mg/L	<1	<1	**2**	**2**	**1**
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**1.0**	**1.4**	**0.6**	**0.3**	**0.3**

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER)**

			Sample ID	Sewer emdedment sand T01	Sewer emdedment sand T02	Sewer emdedment sand T03	Sewer emdedment sand T04	Sewer emdedment sand T05
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00
Compound	CAS Number	LOR	Unit	ES2519076-001	ES2519076-002	ES2519076-003	ES2519076-004	ES2519076-005
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	1.1	1.5	0.6	0.2	0.2
Strontium	7440-24-6	0.1	mg/L	0.2	0.2	0.1	0.1	0.1
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	0.67	0.17	0.22	0.24	0.17
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	0.17	<0.05	<0.05	0.09	<0.05
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	0.50	0.17	0.22	0.15	0.17
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.02	0.02	0.01	0.04
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	0.02	<0.01	<0.01	<0.01	0.01
Nitrite as NO2	14797-65-0	0.05	mg/L	0.06	<0.05	<0.05	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.25	<0.01	<0.01	0.06	0.05
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.27	<0.01	<0.01	0.06	0.06
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	0.4	0.4	0.2	0.3
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	4	6	5	4	4

Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)			Sample ID	**Sewer emdedment sand Blank**	**Sewer coarse aggregate T01**	**Sewer coarse aggregate T02**	**Sewer coarse aggregate T03**	**Sewer coarse aggregate T04**
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00
Compound	CAS Number	LOR	Unit	**ES2519076-006**	**ES2519076-007**	**ES2519076-008**	**ES2519076-009**	**ES2519076-010**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.38**	**7.94**	**7.24**	**7.25**	**7.85**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**119**	**224**	**198**	**185**	**200**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**83**	**211**	**188**	**190**	**172**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	**9**	**6**	<5	<5
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**331**	**190**	**138**	**135**	**168**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**17.4**	**18.7**	**19.3**	**19.3**	**16.4**
Fluoride	16984-48-8	0.010	mg/L	**1.00**	**1.18**	**1.25**	**1.15**	**1.07**
Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	**0.010**	<0.010	<0.010
Sulfate	14808-79-8	0.100	mg/L	**1.58**	**4.11**	**2.29**	**2.07**	**2.28**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**26**	**84**	**74**	**68**	**68**
Total Alkalinity as CaCO3	----	1	mg/L	**26**	**84**	**74**	**68**	**68**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**8**	**31**	**27**	**25**	**25**
Magnesium	7439-95-4	1	mg/L	**2**	**4**	**3**	**3**	**3**
Sodium	7440-23-5	1	mg/L	**11**	**12**	**11**	**11**	**11**
Potassium	7440-09-7	1	mg/L	**1**	**2**	**2**	**1**	**2**
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1	**5.1**	**6.8**	**5.4**	**3.5**

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	**Sewer emdedment sand Blank**	**Sewer coarse aggregate T01**	**Sewer coarse aggregate T02**	**Sewer coarse aggregate T03**	**Sewer coarse aggregate T04**
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-006**	**ES2519076-007**	**ES2519076-008**	**ES2519076-009**	**ES2519076-010**
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	<0.1	**5.5**	**6.8**	**5.2**	**3.3**
Strontium	7440-24-6	0.1	mg/L	<0.1	**0.2**	**0.2**	**0.2**	**0.1**
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	<0.05	**0.30**	**0.19**	**0.63**	**0.39**
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	**0.08**	<0.05	<0.05	**0.22**
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	<0.05	**0.22**	**0.19**	**0.63**	**0.17**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.04**	**0.10**	**0.03**	**0.04**	**0.02**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	**0.09**	<0.01	**0.01**	<0.01
Nitrite as NO2	14797-65-0	0.05	mg/L	<0.05	**0.30**	<0.05	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.37**	**0.13**	**0.01**	**0.01**	**0.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.37**	**0.22**	**0.01**	**0.02**	**0.02**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.1**	**0.8**	**0.5**	**0.7**	**0.4**
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**2**	**8**	**7**	**5**	**6**

Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)			*Sample ID*	Sewer coarse aggregate T05	Sewer coarse aggregate Blank	Bayview 7/3/25 leak native soil T01	Bayview 7/3/25 leak native soil T02	Bayview 7/3/25 leak native soil T03
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	ES2519076-011	ES2519076-012	ES2519076-013	ES2519076-014	ES2519076-015
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.96**	**7.44**	**7.19**	**6.75**	**6.69**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**196**	**117**	**127**	**109**	**104**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**148**	**88**	**125**	**82**	**56**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**180**	**333**	**193**	**147**	**152**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**16.7**	**17.9**	**18.5**	**19.2**	**19.5**
Fluoride	16984-48-8	0.010	mg/L	**1.09**	**0.947**	**0.531**	**0.636**	**0.636**
Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	<0.010	**0.012**	<0.010
Sulfate	14808-79-8	0.100	mg/L	**2.02**	**1.48**	**6.54**	**2.37**	**2.05**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**66**	**27**	**22**	**20**	**18**
Total Alkalinity as CaCO3	----	1	mg/L	**66**	**27**	**22**	**20**	**18**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**24**	**8**	**13**	**10**	**9**
Magnesium	7439-95-4	1	mg/L	**3**	**2**	**2**	**1**	**1**
Sodium	7440-23-5	1	mg/L	**11**	**11**	**10**	**10**	**10**
Potassium	7440-09-7	1	mg/L	**1**	**1**	**2**	**1**	**1**
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**2.4**	<0.1	**0.5**	**0.4**	**0.4**

Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER)**			*Sample ID*	**Sewer coarse aggregate T05**	**Sewer coarse aggregate Blank**	**Bayview 7/3/25 leak native soil T01**	**Bayview 7/3/25 leak native soil T02**	**Bayview 7/3/25 leak native soil T03**
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-011**	**ES2519076-012**	**ES2519076-013**	**ES2519076-014**	**ES2519076-015**
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	**2.3**	<0.1	**0.1**	**0.1**	<0.1
Strontium	7440-24-6	0.1	mg/L	**0.1**	<0.1	<0.1	<0.1	<0.1
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	**0.63**	<0.05	**0.08**	**0.05**	<0.05
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	**0.12**	<0.05	<0.05
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	**0.63**	<0.05	<0.05	**0.05**	<0.05
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.03**	**0.04**	<0.01	**0.01**	**0.02**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	**0.01**	**0.01**	**0.01**
Nitrite as NO2	14797-65-0	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	**0.37**	**0.27**	**0.05**	**0.07**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.04**	**0.37**	**0.28**	**0.06**	**0.08**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.9**	**0.1**	**0.5**	**0.5**	**0.2**
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**5**	**2**	**10**	**10**	**8**

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	**Bayview 7/3/25 leak native soil T04**	**Bayview 7/3/25 leak native soil T05**	**Bayview 7/3/25 leak native soil Blank**	**NDT14 1.2m deep T01**	**NDT14 1.2m deep T02**
			Sampling date / time	07-Mar-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-016**	**ES2519076-017**	**ES2519076-018**	**ES2519076-019**	**ES2519076-020**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.94**	**6.82**	**7.45**	**7.66**	**6.98**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**111**	**108**	**118**	**153**	**141**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**73**	**78**	**88**	**336**	**327**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**157**	**170**	**484**	**213**	**156**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**17.5**	**16.9**	**17.8**	**18.2**	**19.1**
Fluoride	16984-48-8	0.010	mg/L	**0.616**	**0.588**	**0.937**	**0.904**	**0.938**
Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	14808-79-8	0.100	mg/L	**2.14**	**2.00**	**1.50**	**3.55**	**2.12**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**16**	**15**	**26**	**41**	**42**
Total Alkalinity as CaCO3	----	1	mg/L	**16**	**15**	**26**	**41**	**42**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**8**	<1	**9**	**19**	**17**
Magnesium	7439-95-4	1	mg/L	**1**	<1	**2**	**3**	**2**
Sodium	7440-23-5	1	mg/L	**10**	<1	**11**	**11**	**11**
Potassium	7440-09-7	1	mg/L	**1**	<1	**1**	**2**	**2**
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**0.3**	**0.3**	<0.1	**12.5**	**17.8**
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)			Sample ID	**Bayview 7/3/25 leak native soil T04**	**Bayview 7/3/25 leak native soil T05**	**Bayview 7/3/25 leak native soil Blank**	**NDT14 1.2m deep T01**	**NDT14 1.2m deep T02**
			Sampling date / time	07-Mar-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00
Compound	CAS Number	LOR	Unit	**ES2519076-016**	**ES2519076-017**	**ES2519076-018**	**ES2519076-019**	**ES2519076-020**
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	<0.1	**9.6**	**14.7**
Strontium	7440-24-6	0.1	mg/L	<0.1	<0.1	<0.1	**0.1**	**0.1**
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	**0.06**	**0.05**	<0.05	**0.40**	**0.41**
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	**0.13**	<0.05	<0.05	**0.19**	**0.09**
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	<0.05	**0.05**	<0.05	**0.21**	**0.32**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.04**	<0.01	<0.01	**0.01**	**0.01**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.01**
Nitrite as NO2	14797-65-0	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.05**	**0.08**	**0.37**	**0.98**	**0.05**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.05**	**0.08**	**0.37**	**0.98**	**0.06**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.3**	**0.2**	**0.2**	**0.3**	**1.2**
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**7**	**7**	**2**	**5**	**6**

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Sample ID	NDT14 1.2m deep T03	NDT14 1.2m deep T04	NDT14 1.2m deep T05	NDT14 1.2m deep Blank	Bayview hand auger composite T01
			Sampling date / time	29-Apr-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00	27-May-2025 00:00
Compound	CAS Number	LOR	Unit	ES2519076-021	ES2519076-022	ES2519076-023	ES2519076-024	ES2519076-025
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.98**	**7.56**	**7.67**	**7.46**	**6.99**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**135**	**146**	**148**	**119**	**132**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**288**	**238**	**208**	**81**	**402**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	**8**
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**157**	**192**	**197**	**480**	**220**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**19.9**	**16.7**	**17.4**	**18.0**	**19.4**
Fluoride	16984-48-8	0.010	mg/L	**0.979**	**0.856**	**0.900**	**0.972**	**0.329**
Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	14808-79-8	0.100	mg/L	**1.96**	**1.90**	**1.91**	**1.60**	**6.42**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**40**	**41**	**40**	**27**	**26**
Total Alkalinity as CaCO3	----	1	mg/L	**40**	**41**	**40**	**27**	**26**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**16**	**16**	**16**	**9**	**10**
Magnesium	7439-95-4	1	mg/L	**2**	**2**	**2**	**2**	**3**
Sodium	7440-23-5	1	mg/L	**11**	**11**	**11**	**11**	**15**
Potassium	7440-09-7	1	mg/L	**2**	**2**	**2**	**1**	**3**
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**10.1**	**3.0**	**1.8**	<0.1	**21.1**
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER)**

			Sample ID	**NDT14 1.2m deep T03**	**NDT14 1.2m deep T04**	**NDT14 1.2m deep T05**	**NDT14 1.2m deep Blank**	**Bayview hand auger composite T01**
			Sampling date / time	29-Apr-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00	27-May-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-021**	**ES2519076-022**	**ES2519076-023**	**ES2519076-024**	**ES2519076-025**
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Iron	7439-89-6	0.1	mg/L	**7.7**	**2.0**	**1.1**	<0.1	**20.3**
Strontium	7440-24-6	0.1	mg/L	**0.1**	<0.1	**0.1**	<0.1	<0.1
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	**0.41**	**0.79**	**1.01**	<0.05	**0.52**
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	**0.08**	**0.12**	<0.05	**0.46**
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	**0.41**	**0.71**	**0.89**	<0.05	**0.06**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	**0.01**	**0.04**	**0.06**	**0.22**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	**0.01**
Nitrite as NO2	14797-65-0	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.07**	**0.04**	**0.04**	**0.38**	**0.34**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.08**	**0.04**	**0.04**	**0.38**	**0.35**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.9**	**0.6**	**0.6**	**0.2**	**1.6**
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**11**	**6**	**7**	**2**	**11**

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	Bayview hand auger composite T02	Bayview hand auger composite T03	Bayview hand auger composite T04	Bayview hand auger composite T05	Bayview hand auger composite Blank
			Sampling date / time	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-026**	**ES2519076-027**	**ES2519076-028**	**ES2519076-029**	**ES2519076-030**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.67**	**6.75**	**7.19**	**7.02**	**7.46**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**109**	**119**	**143**	**122**	**119**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**202**	**231**	**209**	**144**	**73**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**157**	**157**	**200**	**208**	**510**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**20.2**	**19.3**	**17.3**	**17.0**	**17.4**
Fluoride	16984-48-8	0.010	mg/L	**0.611**	**0.630**	**0.556**	**0.707**	**0.946**
Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	14808-79-8	0.100	mg/L	**2.54**	**2.31**	**2.43**	**1.85**	**1.57**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**20**	**29**	**38**	**25**	**26**
Total Alkalinity as CaCO3	----	1	mg/L	**20**	**29**	**38**	**25**	**26**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**7**	**10**	**12**	**9**	**9**
Magnesium	7439-95-4	1	mg/L	**2**	**3**	**3**	**2**	**2**
Sodium	7440-23-5	1	mg/L	**12**	**12**	**12**	**12**	**11**
Potassium	7440-09-7	1	mg/L	**2**	**3**	**2**	**2**	**1**
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**7.9**	**9.3**	**3.4**	**0.8**	<0.1

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	Bayview hand auger composite T02	Bayview hand auger composite T03	Bayview hand auger composite T04	Bayview hand auger composite T05	Bayview hand auger composite Blank
			Sampling date / time	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00
Compound	CAS Number	LOR	Unit	ES2519076-026	ES2519076-027	ES2519076-028	ES2519076-029	ES2519076-030
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	**7.7**	**8.5**	**2.9**	**2.3**	<0.1
Strontium	7440-24-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	**0.24**	**0.27**	**0.63**	**1.46**	<0.05
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	**0.06**	**0.06**	**0.08**	**0.08**	<0.05
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	**0.18**	**0.21**	**0.55**	**1.38**	<0.05
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.11**	**0.09**	**0.02**	**0.02**	**0.06**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.02**	**0.02**	<0.01	<0.01	<0.01
Nitrite as NO2	14797-65-0	0.05	mg/L	**0.06**	**0.06**	<0.05	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.13**	**0.10**	**0.03**	**0.13**	**0.36**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.15**	**0.12**	**0.03**	**0.13**	**0.36**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.3**	**0.9**	**0.8**	**0.5**	**0.2**
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**5**	**8**	**13**	**9**	**2**

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	WR174 BH1 composite T01	WR174 BH1 composite T02	WR174 BH1 composite T03	WR174 BH1 composite T04	WR174 BH1 composite T05
			Sampling date / time	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-031**	**ES2519076-032**	**ES2519076-033**	**ES2519076-034**	**ES2519076-035**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.33**	**8.22**	**8.53**	**8.69**	**8.68**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**395**	**291**	**242**	**258**	**249**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**4560**	**1040**	**788**	**506**	**198**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**42**	**34**	**24**	<5	<5
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**190**	**129**	**121**	**177**	**178**
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**22.9**	**19.7**	**19.3**	**17.1**	**16.3**
Fluoride	16984-48-8	0.010	mg/L	**7.45**	**5.07**	**3.21**	**2.70**	**1.93**
Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	**0.011**	**0.013**	**0.015**
Sulfate	14808-79-8	0.100	mg/L	**10.9**	**4.73**	**3.46**	**3.28**	**2.88**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**3**	<1	**7**	**7**	**6**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**148**	**121**	**90**	**90**	**86**
Total Alkalinity as CaCO3	----	1	mg/L	**151**	**121**	**98**	**97**	**93**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**14**	**4**	**4**	**2**	<1
Magnesium	7439-95-4	1	mg/L	**24**	**6**	**6**	**2**	<1
Sodium	7440-23-5	1	mg/L	**135**	**78**	**61**	**54**	**55**
Potassium	7440-09-7	1	mg/L	**6**	**2**	**2**	**1**	<1
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**207**	**56.5**	**143**	**15.9**	**14.2**

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER)**

			Sample ID	**WR174 BH1 composite T01**	**WR174 BH1 composite T02**	**WR174 BH1 composite T03**	**WR174 BH1 composite T04**	**WR174 BH1 composite T05**
			Sampling date / time	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-031**	**ES2519076-032**	**ES2519076-033**	**ES2519076-034**	**ES2519076-035**
				Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	**458**	**112**	**265**	**35.4**	**29.6**
Strontium	7440-24-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	**2.41**	**1.05**	**2.49**	**0.70**	**0.59**
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	**1.15**	**0.30**	**0.22**	**0.34**	**0.10**
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	**1.26**	**0.75**	**2.27**	**0.36**	**0.49**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	**0.06**	**0.09**	**0.03**	**0.01**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.16**	<0.01	**0.02**	<0.01	<0.01
Nitrite as NO2	14797-65-0	0.05	mg/L	**0.52**	<0.05	**0.06**	<0.05	<0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.10	<0.01	**0.05**	<0.01	**0.04**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.10	<0.01	**0.07**	<0.01	**0.04**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.2**	**1.7**	**1.5**	**0.1**	<0.1
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**8**	**8**	**7**	**5**	**4**

Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)			Sample ID	**WR174 BH1 composite Blank**	----	----	----	----
			Sampling date / time	27-May-2025 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-036**	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.47**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**118**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**70**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	----	----	----	----
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**502**	----	----	----	----
ED009: Anions								
Chloride	16887-00-6	0.100	mg/L	**17.5**	----	----	----	----
Fluoride	16984-48-8	0.010	mg/L	**0.928**	----	----	----	----
Iodide	20461-54-5	0.010	mg/L	<0.010	----	----	----	----
Sulfate	14808-79-8	0.100	mg/L	**1.61**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**26**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**26**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**9**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**2**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**11**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**1**	----	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1	----	----	----	----
Boron	7440-42-8	0.1	mg/L	<0.1	----	----	----	----

Analytical Results

Sub-Matrix: **LEACHATE**
(Matrix: **WATER**)

			Sample ID	**WR174 BH1 composite Blank**	----	----	----	----
			Sampling date / time	27-May-2025 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-036**	--------	--------	--------	--------
				Result	----	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Iron	7439-89-6	0.1	mg/L	<0.1	----	----	----	----
Strontium	7440-24-6	0.1	mg/L	<0.1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	----	----	----	----
EG053FG-MS: Dissolved Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	<0.05	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
Nitrite as NO2	14797-65-0	0.05	mg/L	<0.05	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.37**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.37**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.2**	----	----	----	----
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**2**	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL)**

			Sample ID	**Sewer emdedment sand T01**	**Sewer emdedment sand T02**	**Sewer emdedment sand T03**	**Sewer emdedment sand T04**	**Sewer emdedment sand T05**
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00
Compound	CAS Number	LOR	Unit	**ES2519076-001**	**ES2519076-002**	**ES2519076-003**	**ES2519076-004**	**ES2519076-005**
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**489**	**489**	**489**	**489**	**489**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**702**	**651**	**621**	**610**	**653**
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**1.4**	**1.3**	**1.3**	**1.2**	**1.3**

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Sample ID*	**Sewer emdedment sand Blank**	**Sewer coarse aggregate T01**	**Sewer coarse aggregate T02**	**Sewer coarse aggregate T03**	**Sewer coarse aggregate T04**
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-006**	**ES2519076-007**	**ES2519076-008**	**ES2519076-009**	**ES2519076-010**
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**2.1**	**4.2**	**4.2**	**4.2**	**4.2**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**489**	**431**	**431**	**431**	**431**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**----**	**655**	**663**	**625**	**636**
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.3**	**1.5**	**1.5**	**1.5**	**1.5**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**----**	**1.5**	**1.5**	**1.4**	**1.5**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Sample ID	Sewer coarse aggregate T05	Sewer coarse aggregate Blank	Bayview 7/3/25 leak native soil T01	Bayview 7/3/25 leak native soil T02	Bayview 7/3/25 leak native soil T03
			Sampling date / time	18-Jun-2025 00:00	18-Jun-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00
Compound	CAS Number	LOR	Unit	ES2519076-011	ES2519076-012	ES2519076-013	ES2519076-014	ES2519076-015
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**4.2**	**4.2**	**2.0**	**2.0**	**2.0**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**431**	**431**	**392**	**392**	**392**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**650**	----	**755**	**664**	**604**
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.5**	**1.5**	**1.7**	**1.7**	**1.7**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**1.5**	----	**1.9**	**1.7**	**1.5**

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Sample ID*	**Bayview 7/3/25 leak native soil T04**	**Bayview 7/3/25 leak native soil T05**	**Bayview 7/3/25 leak native soil Blank**	**NDT14 1.2m deep T01**	**NDT14 1.2m deep T02**
			Sampling date / time	07-Mar-2025 00:00	07-Mar-2025 00:00	07-Mar-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-016**	**ES2519076-017**	**ES2519076-018**	**ES2519076-019**	**ES2519076-020**
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**2.0**	**2.0**	**2.0**	**4.9**	**4.9**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**392**	**392**	**392**	**380**	**380**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**672**	**640**	**----**	**747**	**684**
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**1.7**	**1.6**	**----**	**2.0**	**1.8**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Sample ID	**NDT14 1.2m deep T03**	**NDT14 1.2m deep T04**	**NDT14 1.2m deep T05**	**NDT14 1.2m deep Blank**	**Bayview hand auger composite T01**
			Sampling date / time	29-Apr-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00	29-Apr-2025 00:00	27-May-2025 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-021**	**ES2519076-022**	**ES2519076-023**	**ES2519076-024**	**ES2519076-025**
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**4.9**	**4.9**	**4.9**	**4.9**	**5.0**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**380**	**380**	**380**	**380**	**380**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**687**	**934**	**744**	**----**	**675**
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**1.8**	**2.4**	**2.0**	**----**	**1.8**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Sample ID	Bayview hand auger composite T02	Bayview hand auger composite T03	Bayview hand auger composite T04	Bayview hand auger composite T05	Bayview hand auger composite Blank
			Sampling date / time	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00
Compound	CAS Number	LOR	Unit	ES2519076-026	ES2519076-027	ES2519076-028	ES2519076-029	ES2519076-030
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**380**	**380**	**380**	**380**	**380**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**738**	**677**	**659**	**781**	----
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**1.9**	**1.8**	**1.7**	**2.0**	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Sample ID	WR174 BH1 composite T01	WR174 BH1 composite T02	WR174 BH1 composite T03	WR174 BH1 composite T04	WR174 BH1 composite T05
			Sampling date / time	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00	27-May-2025 00:00
Compound	CAS Number	LOR	Unit	ES2519076-031	ES2519076-032	ES2519076-033	ES2519076-034	ES2519076-035
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**8.6**	**8.6**	**8.6**	**8.6**	**8.6**
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	**2**	**2**	**2**	**2**
ø Dry mass of sample in column packing	----	0.1	g	**366**	**366**	**366**	**366**	**366**
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**	**4.8 cm (ID) x 30 cm (L)**
ø Eluate Fraction Volume	----	0.1	mL	**670**	**668**	**740**	**700**	**584**
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**
ø Actual Fraction L/S ratio	----	0.1	mL/g-dry	**1.8**	**1.8**	**2.0**	**1.9**	**1.6**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL)**

			Sample ID	**WR174 BH1 composite Blank**	-----	-----	-----	-----
			Sampling date / time	27-May-2025 00:00	-----	-----	-----	-----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2519076-036**	--------	--------	--------	--------
				Result	-----	-----	-----	-----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**8.6**	----	----	----	----
EN58-3: Leaching Environmental Assessment Framework (LEAF) Method 1314								
ø Particle Size (>85 wt% passing through)	----	0.1	mm	**2**	----	----	----	----
ø Dry mass of sample in column packing	----	0.1	g	**366**	----	----	----	----
ø Column ID and Length	----	-	cm	**4.8 cm (ID) x 30 cm (L)**	----	----	----	----
ø Target Fraction L/S ratio	----	0.1	mL/g-dry	**1.8**	----	----	----	----

Appendix C

XRD Report

[redacted]

Laboratory Report

Client: SMEC Australia
Client address: Level 14/109 St Georges Terrace, Perth, WA, 6000
Job ID: 25_1226
Lab ID: See results table
Client ID: See results table
Comments: -

Date received: 2/07/2025
Date analysed: 7/07/2025
Date reported: 7/07/2025
Revision no.: 0

Analysis: Semi-quantitative X-ray diffraction (XRD) analysis

Sample preparation

Representative sub-samples were removed and lightly ground. Each specimen was packed and presented as a powder mount of the total sample.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non-crystalline) material will normally add to the background. The search/match software used was Eva 5.2. An up-to-date ICDD database was used. The X-ray source was cobalt radiation.

No standards were used in the quantification process. The concentrations were calculated using the normalized reference intensity ratio method, where the intensity of the 100% peak divided by the published I/Ic value for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for slight attention to be paid to preferred orientation but is limited in considering other factors including but not limited to; variable crystallinity, alteration, substitution, and crystallite size and microstrain.

No chemical assay data (XRF/ICP) was supplied by the client as an elemental relative abundance/concentration indicator. Phase identification and quantification is subject to change should such information be provided.

It should be noted that there is a higher level of uncertainty in the results due to preferred orientation in the platy minerals for this sample.

Results summary

The phases are listed in alphabetical order in the 'Results' tab of this spreadsheet (25_1226 Semi-quantitative XRD analysis Report [FINAL].xlsx).

The results table represents the normalised concentration, as weight percent, of each phase without considering the contribution of any amorphous, or non-crystalline, material.

The ICDD match is a subjective measure of the confidence in which the identified phase matches the peak positions and intensities in each diffraction pattern.

Analysed by: Jarvis Lawson, B.Sc.(Chemistry)
Reported by: Jarvis Lawson, B.Sc.(Chemistry)
Approved by: Rick Hughes, B.Sc.(Hons)Physics, MAIP

Table 1: Results.

	Phase	Calcite	Chlorite group	Expanding clay	Hematite	Kaolinite subgroup	Mica group	Potassium Feldspar	Quartz	Sodium Plagioclase	Grand Total
	Formula	$CaCO_3$	$(Fe,Al,Mg,Li,Ni)_6(Si,Al)_4O_{10}(OH)_8$		Fe_2O_3	$Al_2Si_2O_5(OH)_4$	$(K,Ca,Na,Li)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	$KAlSi_3O_8$	SiO_2	$NaAlSi_3O_8$	
Lab ID	Client ID / Units	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
25_1226_001	Bayview Hand Auger					1		30	54	15	100
25_1226_002	Bayview Sewer Dig			1		5		20	59	15	100
25_1226_003	Bayview Sewer Sand	14	2		1	2	5	9	60	8	101
25_1226_004	Bayview 7 March					2	3	16	69	10	100
25_1226_005	Bayview Sewer Gravel	< 1	4				5	23	50	17	99

Table 2: ICDD match confidence.

	Phase	Calcite	Chlorite group	Expanding clay	Hematite	Kaolinite subgroup	Mica group	Potassium Feldspar	Quartz	Sodium Plagioclase
	Formula	$CaCO_3$	$(Fe,Al,Mg,Li,Ni)_6(Si,Al)_4O_{10}(OH)_8$		Fe_2O_3	$Al_2Si_2O_5(OH)_4$	$(K,Ca,Na,Li)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	$KAlSi_3O_8$	SiO_2	$NaAlSi_3O_8$
Lab ID	Client ID / Units	ICDD match	ICDD match	ICDD match	ICDD match	ICDD match	ICDD match	ICDD match	ICDD match	ICDD match
25_1226_001	Bayview Hand Auger					Low		Medium	High	Medium
25_1226_002	Bayview Sewer Dig			Low		Medium		Medium	High	Medium
25_1226_003	Bayview Sewer Sand	High	Low		Low	Low	Low	Medium	High	Medium
25_1226_004	Bayview 7 March					Low	Low	Medium	High	Medium
25_1226_005	Bayview Sewer Gravel	Low	Medium				Medium	Medium	High	Medium

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engineering positive change

SMEC simplifies the complex. We unlock the potential of our people to look at infrastructure differently, creating better outcomes for the future.

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Appendix F

Geophysical Investigation Report

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REPORT:

GEOPHYSICAL INVESTIGATION TO CHARACTERISE TRENCH BACKFILL, LITHOLOGY AND SUBSURFACE MOISTURE CONDITIONS ACROSS MULTIPLE ROAD CORRIDORS IN McCRAE, VIC

Date: 11th July 2025

MNG Ref: 80823

Melbourne Level 1, 5 Queens Road, Melbourne VIC 3004
Phone 03 7002 2200 **Email** info@mngsurvey.com.au
McMullen Nolan Group Pty Ltd **ABN** 90 009 363 311
Perth | Brisbane | Melbourne | Sydney | Broome | South West WA

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TEAMWORK. INNOVATION. KNOWLEDGE.

DOCUMENT INFORMATION

DETAILS

Project number	80823
Document Title	Geophysical Investigation to Characterise Trench Backfill, Lithology and Subsurface Moisture Conditions Across Multiple Road Corridors in Mcrae, VIC
Site Address	McCrae, Victoria
Report prepared for	SMEC

STATUS AND REVIEW

Revision	Prepared by	Reviewed by	Date issued
A	Prudence Warner	Tavis Lavell	11/07/2025

DISTRIBUTION

Revision	Electronic	Paper	Issued to
A	1	0	Hugo Bolton, SMEC

COMPANY DETAILS

Business name	McMullen Nolan Group Pty Ltd (MNG) - SubSpatial
ABN	90 009 363 311
Business address	Level 1, 5 Queens Road, Melbourne VIC 3004
Phone	03 7002 2207
Email	Prudence.warner@mngsubspatial.com.au

CONTENTS

1. INTRODUCTION

SMEC engaged MNG SubSpatial (MNG) to conduct a geophysical investigation at McCrae, Victoria, to assist in assessing subsurface conditions following a landslip event in January 2025. The objective of the survey was to characterise trench backfill, subsurface lithology, and moisture distribution across multiple road corridors in an area underlain by deeply weathered granite. These data will inform SMEC's broader geotechnical and environmental assessments.

The investigation was conducted using Frequency-domain Electro-Magnetic (FEM) surveying, a non-intrusive geophysical technique sensitive to variations in subsurface conductivity. FEM data were acquired, processed, and interpreted by a qualified Geophysicist from MNG SubSpatial in May and June 2025.

2. GEOPHYSICAL INVESTIGATION SITE

The survey area included a mix of surface conditions including asphalt roads, grassed verges, footpaths, and landscaped parks. Data acquisition was feasible in most areas; however, access was restricted in some zones due to dense vegetation, steep slopes, and obstructions such as fences, street signage, and buried infrastructure.

Electromagnetic interference from manholes, steel-reinforced driveways, signage, and other urban elements was present and required mitigation during data filtering and interpretation.

3. GEOPHYSICAL DATA ACQUISITION

3.1 INVESTIGATION LOGISTICS

The geophysical site work was carried out on the 25th, 27th and 30th of June 2025 by a qualified Geophysicist from MNG SubSpatial. During the investigation FEM was utilised to obtain electrical conductivity distribution of the subsurface material.

3.2 FEM DATA ACQUISITION

FEM data was acquired using a Profiler EMP-400 (GSSI), displayed in Figure 1. The system allows for the recording of three (3) multiple frequency responses simultaneously corresponding to increasing depths of influence. Acquisition parameters are provided in Table 1.

Data acquisition involved carrying the equipment consisting of transmitting and receiving coils as a series of transects over accessible areas of the site. Data was not acquired where surface obstructions prevented the free movement of personnel such as thick vegetation, existing infrastructure and steeply dipping terrain.

Figure 1: FEM collection using the GSSI Profiler EM400 during a similar survey

Table 1 – FEM Acquisition Parameters

Acquisition Parameter	Specification
Operating Frequencies	1000 Hz / 5000 Hz / 12000 Hz
Sample rate	1 Hz
Stacks	2
Dipole orientation	Inline Vertical Dipole Moment
Nominal transect spacing	1

3.4 LOCATING AND POSITIONING

Positioning of geophysical measurements acquired during the investigation was achieved using Navcom Global Positioning System (GPS). The GPS receiver was linked to the CORS Network to provide the following accuracies:

- ± 100mm Horizontal Accuracy
- ± 200mm Vertical Accuracy

Horizontal positions are given in GDA2020 MGA Zone 50, whilst elevations are given in Australian Height Datum (AHD).

4. GEOPHYSICAL DATA PROCESSING

The acquired FEM data was processed using the following software packages:

1. **Excel** (Microsoft) for data processing including applying:
   a. Custom filtering algorithms to remove spurious results and outliers
   b. Numerical differentiation to calculate the rate of change of ground conductivity
2. **Surfer** (Golden Software) for gridding and contouring to produce EM conductivity maps for the various frequencies responses and components.

The resultant grids were contoured to produce colour contour plots of the three transmit frequencies in both quadrature and in-phase components.

The generated conductivity plots are presented in **Appendix A** as colour contours showing the value of the measured EM field strength against the transmitted EM field strength in parts per million (ppm).

Details on the two components of measured EM field strength are provided below and indicate why the quadrature component delineated the buried uncontrolled fill more accurately:

- **Quadrature component** refers to the part of the measured signal that is 90 degrees out of phase with the transmit signal. It is related to the apparent conductivity and is influenced by subsurface variations causing bulk changes in conductivity such as porosity and permeability, degree of saturation, and fluid type.
- **In-phase component** refers to the part of the measured signal that is in phase with the transmit signal. It is most influenced by discrete packages of high conductivity material and as such is a good indicator of buried ferrous material.

5. RESULTS

The results of the geophysical investigation carried out in McCrea Victoria are provided in PDF format in the appendices of this report.

Appendix A – Geophysical Investigation Site Plan

- **80823-01 –** Site Plan

Appendix B – FEM Conductivity Maps

- **80823-02 –** FEM Data 1,000Hz Inphase
- **80823-03 –** FEM Data 1,000Hz Quadrature
- **80823-04 –** FEM Data 5,000Hz Inphase
- **80823-05 –** FEM Data 5,000Hz Quadrature
- **80823-06 –** FEM Data 12,000Hz Inphase
- **80823-07 –** FEM Data 12,000Hz Quadrature

6. GEOPHYSICAL INTERPRETATION

The in-phase component of the electromagnetic response is highly sensitive to discrete conductive targets, particularly those associated with ferrous or metallic infrastructure such as manhole covers, buried services, reinforced concrete, signage, and other urban elements. These features often generate sharp, high-amplitude anomalies and were filtered or excluded from interpretation where clearly attributable to known surface structures. Across the McCrae site, elevated in-phase values were consistently observed in areas with confirmed infrastructure, most notably along Colton Street, within footpaths, driveways and adjacent to utility assets.

The abrupt lateral gradients, often transitioning from low to high values over just a few metres, support the interpretation of narrow, disturbed features such as service trenches or isolated metal objects, rather than laterally extensive geological layers. In contrast, consistently low in-phase values are representative of resistive background soils, likely corresponding to dry, unmodified weathered granite or colluvial overburden.

The quadrature component reflects bulk ground conductivity and is less influenced by localised metallic interference. It is more sensitive to subsurface parameters such as moisture content, clay fraction, porosity and the continuity of conductive pathways. Of the two components, quadrature data provided the most stable and spatially coherent depiction of subsurface conductivity conditions across the site.

Elevated quadrature responses were observed in broader, less sharply defined zones that are interpreted as areas of reworked or moisture-retaining material; potentially trench backfill, fine-grained soils or disturbed zones from historical excavation. These zones may indicate areas with increased moisture retention, poor drainage or textural contrasts, all of which could influence water movement and contribute to local instability.

Notably, the quadrature data consistently exhibited low conductivity values within the elevated southern parkland areas, corresponding with well-drained terrain and the absence of urban infrastructure. These results suggest resistive soils, minimal retained moisture and an overall lack of conductive fill or disturbance, further supporting the interpretation of this area as relatively undisturbed natural ground.

Overall, both components highlight lateral variations in conductivity across the site, with in-phase anomalies closely linked to metallic infrastructure and quadrature anomalies more aligned with natural or reworked materials potentially influencing subsurface moisture pathways and hydrogeological behaviour in the context of the landslip.

7. INVESTIGATION SUMMARY

MNG SubSpatial has completed a Frequency-domain Electro-Magnetic (FEM) survey at McCrae, Victoria, on behalf of SMEC, following a landslip event in January 2025. The purpose of the investigation was to assess shallow subsurface conditions, characterise trench backfill materials and evaluate potential lithological or anthropogenic factors contributing to subsurface water movement in the affected area.

FEM data was collected across accessible zones surrounding the landslip site, using a multi-frequency approach to resolve conductivity variations at differing depths. Interpretation of both in-phase and quadrature components has revealed multiple lateral conductivity contrasts across the site.

The observed conductivity responses suggest that subsurface water movement may be locally influenced by historical disturbance, poorly drained fill or contrasting materials within the trench alignments. The quadrature response, in particular, highlights zones with increased moisture retention or fine-grained material, conditions that may exacerbate instability during periods of high rainfall.

The methods used during the investigation are geophysical and as such the results are based on indirect measurements and the processing and interpretation of electrical signals. The findings in this report represent the professional opinions of the authors, based on experience gained during previous similar surveys and with correlation to known and assumed subsurface ground conditions at the site.

MNG trust that this report and the attached drawings provide you with the information required. If you require clarification on any points arising from this geophysical investigation, please do not hesitate to contact the undersigned on (03) 7002 2207.

For and on behalf of
MNG SubSpatial

PRUDENCE WARNER
Geophysicist

APPENDIX A – FEM RESULTS

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

SITE MAP

LEGEND:

🟦	FEM Coverage Area (Acquired by MNG June 2025)

The contents of this drawing are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should ensure this is the most up to date version, by contacting McMullen Nolan Group.

A	Initial Issue	PWA	10/07/2025	TLA
Rev.	Description	Drawn	Date	Checked

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Sydney | Broome | Bunbury
ABN: 90 009 363 311

Title:
GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

Client: SMEC

Proj. Mngr.	PWA	Datum	MGA2020 / AHD

Drawing: 80823-01

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

1000Hz InPhase

LEGEND:

InPhase RESPONSE (ppm)

0 500 1250 2000 2750 3500 4000+

Rev.	Description	Drawn	Date	Checked
A	Initial Issue	PWA	10/07/2025	TLA

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Title:
GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

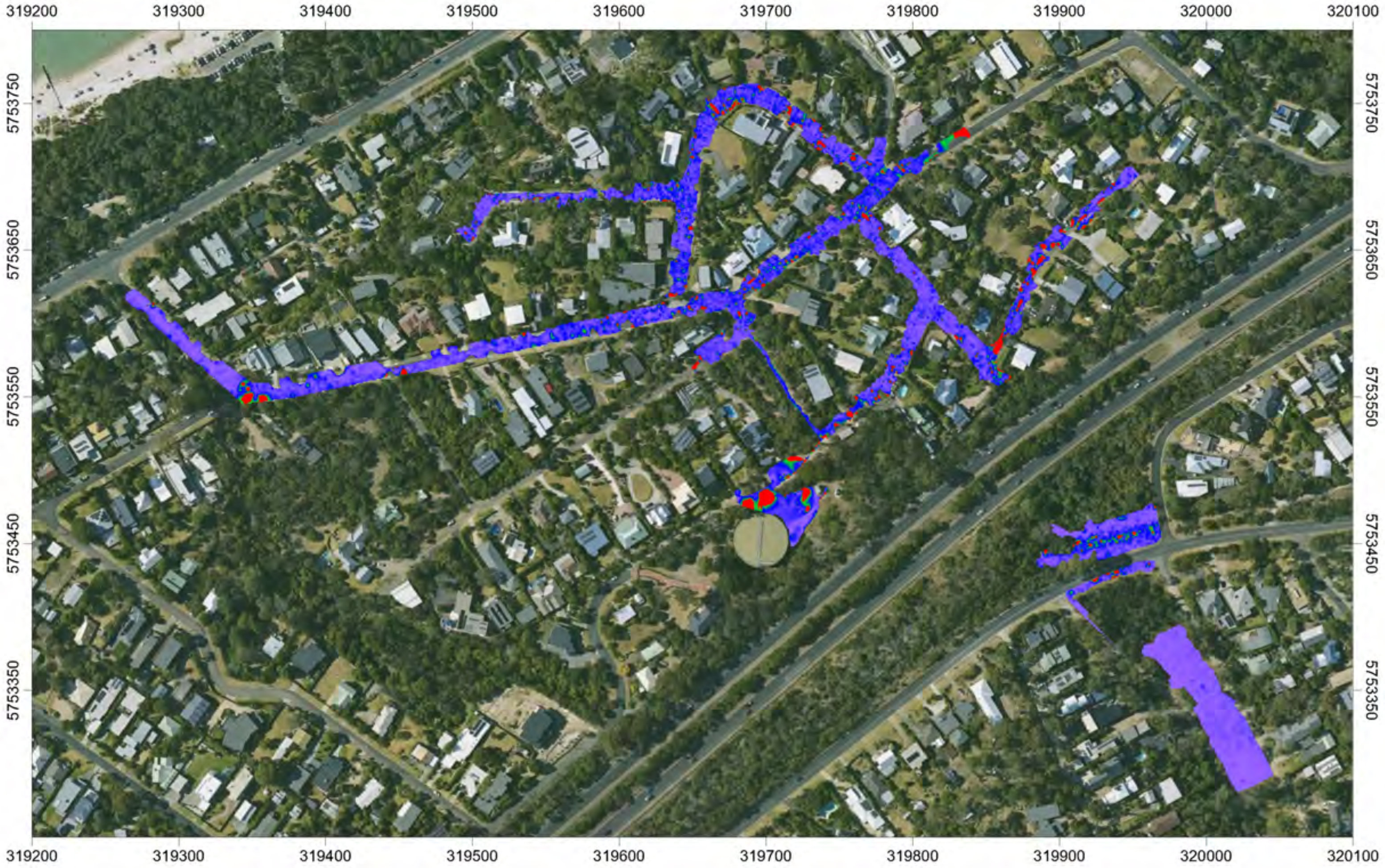
Client:
SMEC

Proj. Mngr.	PWA	Datum	MGA2020 / AHD

Drawing:
80823-02

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

1000Hz Quadrature



LEGEND:

InPhase RESPONSE (ppm)

0 500 1250 2000 2750 3500 4000+

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A	Initial Issue	PWA	10/07/2025	TLA
Rev.	Description	Drawn	Date	Checked

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Title:
GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

Client:
SMEC

Proj. Mngr.	PWA	Datum	MGA2020 / AHD

Drawing:
80823-03

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

5000Hz InPhase

LEGEND:

InPhase RESPONSE (ppm)

0 500 1250 2000 2750 3500 4000+

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A	Initial Issue	PWA	10/07/2025	TLA
Rev.	Description	Drawn	Date	Checked

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Title: GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

Client: SMEC

Proj. Mngr.	PWA	Datum	MGA2020 / AHD

Drawing: 80823-04

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

5000Hz Quadrature

LEGEND:

InPhase RESPONSE (ppm)

0 500 1250 2000 2750 3500 4000+

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A	Initial Issue	PWA	10/07/2025	TLA
Rev.	Description	Drawn	Date	Checked

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Title:
GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

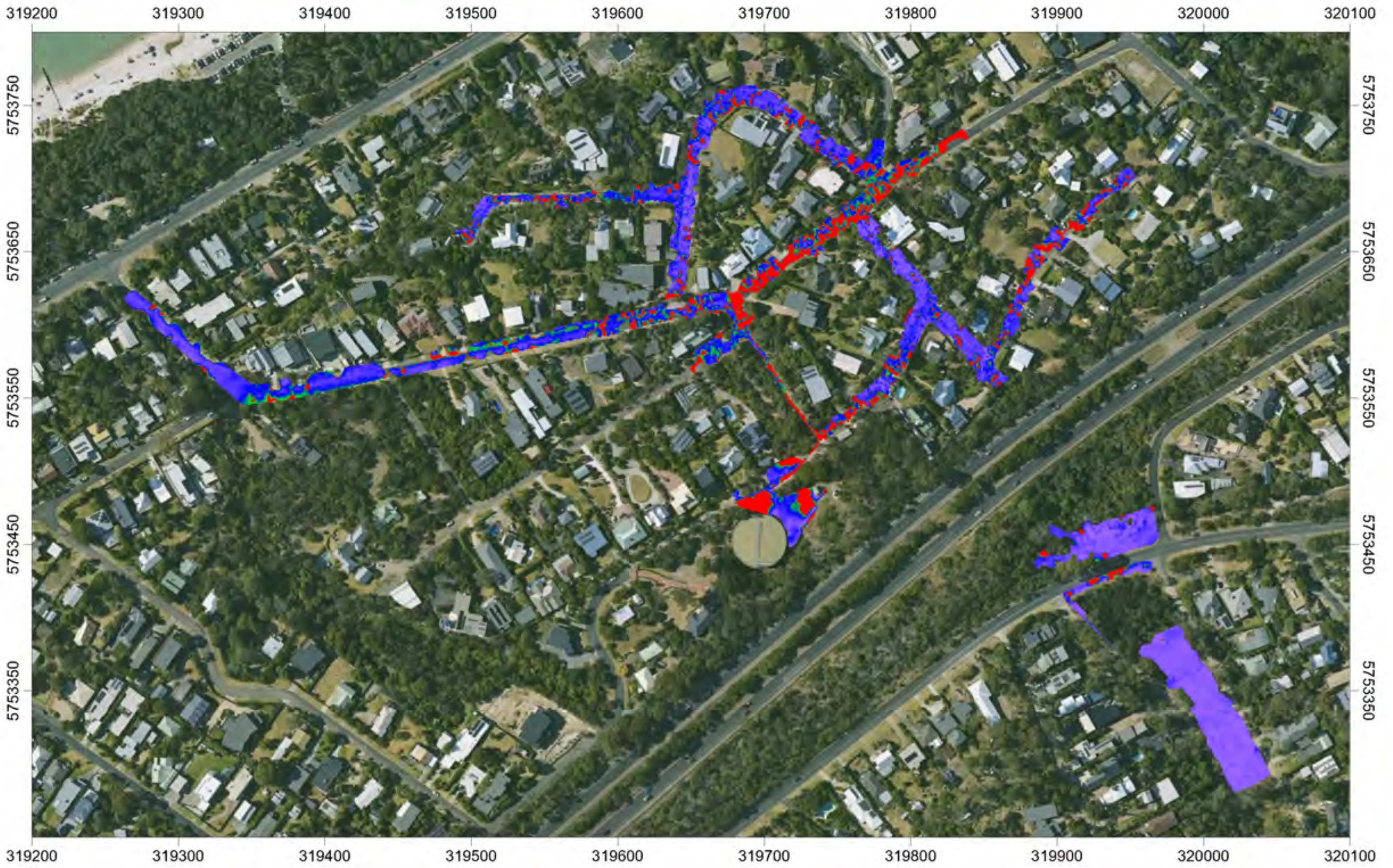
Client:
SMEC

Proj. Mngr.	PWA	Datum	MGA2020 / AHD

Drawing:
80823-05

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

12000Hz InPhase



LEGEND:

InPhase RESPONSE (ppm)

0 500 1250 2000 2750 3500 4000+

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Rev.	Description	Drawn	Date	Checked
A	Initial Issue	PWA	10/07/2025	TLA

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Title: GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

Client: SMEC

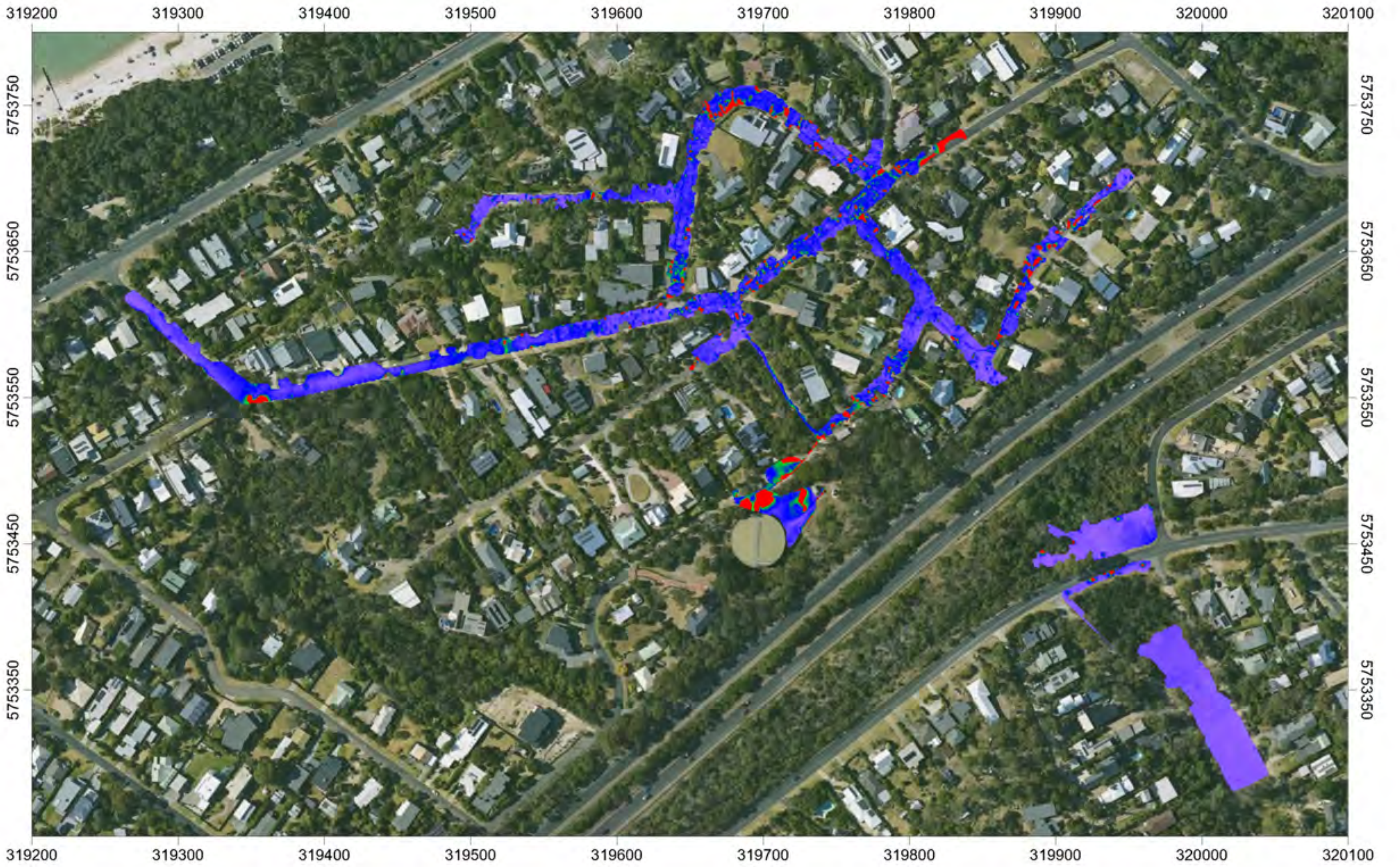
Proj. Mngr.: PWA

Datum: MGA2020 / AHD

Drawing: 80823-06

GEOPHYSICAL INVESTIGATION - McCRAE LANDSLIP

12000Hz Quadrature



LEGEND:

InPhase RESPONSE (ppm)

0 500 1250 2000 2750 3500 4000+

The contents of this drawing are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should ensure this is the most up to date version, by contacting McMullen Nolan Group.

Rev.	Description	Drawn	Date	Checked
A	Initial Issue	PWA	10/07/2025	TLA

Scale: 1:3000

Metres (m)

0 50 100 150

Paper Size: A3

Drawing to be used in conjunction with Report 80823.
Image Source: MetroMap 01/02/2025

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Title: GEOPHYSICAL INVESTIGATION TO DETERMINE SUBSURFACE PROPERTIES AT McCRAE VICTORIA

Client: SMEC

Proj. Mngr.: PWA

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Appendix G

Hydraulic Assessment

Multidisciplinary Expert Supplementary Report

Board of Inquiry into the McCrae Landslide – Hydraulic Modelling

Prepared for: Thomson Geer
21 July 2025
Client Reference No. SMEC Report 002 Appendix G

SMEC INTERNAL REF. 30043649

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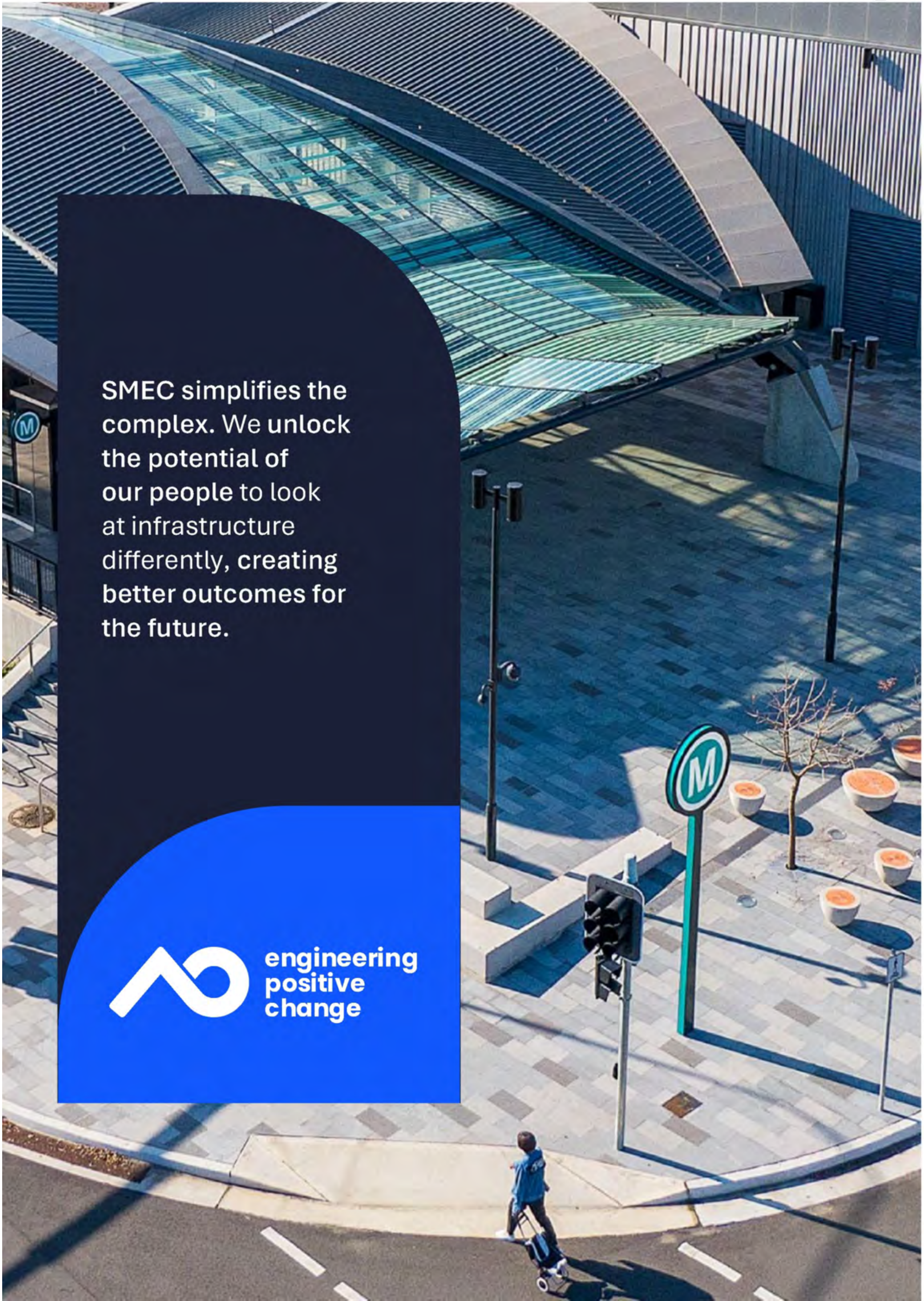

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1. Introduction

As part of the project works, an investigation has been undertaken to estimate the proportion of the leakage flows that may have travelled overland as opposed to those that may have passed into the soil sub surface. The investigation has been completed utilising a 2 dimensional hydraulic model that simulates flows across the terrain between the leak location on Bayview Road and a drainage line passing underneath the Mornington Peninsula Freeway.

The model has been run with an estimate of the seepage flow and the outputs have been used to estimate extent of surface inundation. The estimated width has been compared against the evidence from site of the same extent. This has been used as a basis for estimating the proportion of flows which travelled across the surface.

2. Site description

The occurred through dense vegetation between Bayview Road and the Mornington Peninsula Freeway. The flows appear to have progressed downhill towards a shallow unlined surface drain running parallel to the Mornington Peninsula Freeway and terminating at an open grated pit. The pit is connected to a drainage line running underneath the freeway. Any flows which are not captured by the surface drain and pit would bypass the surface drain and continue downhill to the freeway.

The extent of the surface flows is estimated to be delineated by the extent of sandy materials deposited across the surface downstream of the leak location. The key features are shown on Figure 1.

Figure 1: Estimated Sand Deposition Extent

The extent of sand deposition is delineated by the red lines in the above image. An example of the sand deposition area as viewed on the ground is presented in Figure 2.

Figure 2: Example of Sand Deposition

The image presented above shows that the sand depositions area has a characteristic colour, overlies leaf litter is largely free of vegetation. The appearance is different to that of adjoining regions which are characterised by a greater vegetative coverage, darker colour and a greater depth of leaf litter across the surface.

3. Available Data

A range of data was made available for the analysis as follows:

- Surface survey – Surface elevations from a site feature survey made available from SEW personnel.
- LiDAR – Local lidar of the surface was obtained, although the coverage is limited by the presence of dense vegetation (Appendix B, Ref 27)
- An estimate of the maximum leakage flows at the leak location – 16 L/s
- An estimate of the flow in the pipe discharging from the pit during the course of the leakage event. 10-20 L/s.
- The hydrogeological analysis discussed in Section 7 describes a permeameter test at Bayview Road (TP1) indicating that the soil infiltration rate is around 50 mm/hr.

4. Model Setup

The waterway was modelled using the TUFLOW software package, version no. 2025.0.3, HPC solution scheme and a cell size of 1 m. A uniform mannings n was applied across the modelled domain which is shown in Figure 3. The inflow point to the model is shown as a green square and the outlet pit is represented as a red circle.

Figure 3: Modelled Domain

A single inlet pit and pipe was incorporated into the model to capture flows entering the drainage network.

The various estimates of leakage outflow indicate that the range of potential outflows would be in the range of 10 L/s – 20 L/s. A variety of model runs were completed as follows:

- 10 L/s steady state inflow with a mannings n of 0.6.
- 10 L/s steady state inflow with a mannings n of 0.8.
- 20 L/s steady state inflow with a mannings n of 0.6.
- 20 L/s steady state inflow with a mannings n of 0.8.

Each run was undertaken in the model for a period of 10 hours to ensure that steady state conditions are achieved.

5. Analysis outcomes

The analysis outcomes in terms of quantitative measures are presented in Table 1:

Table 1 Modelled Outcomes

Scenario	Inflow (L/s)	Mannings n	Pit Flow (L/s)	Bypass Flow (L/s)
1	10	0.6	10	0.3
2	10	0.8	10	0.3
3	20	0.6	19	1
4	20	0.8	19	1

The results indicate that the majority of flows would be captured in the pipe drainage network. Any bypass is negligible and further, the outcomes are insensitive to the roughness.

The inundation extents for 10 L/s and 20 L/s are shown in Figure 4 and Figure 5 respectively. All depths greater than 2 mm are presented on the outputs.

Figure 4: 10 l/s inundation extents

Figure 5: 20l/s inundation extents

The outcomes indicate that the flood extent is similar to the observed extent of sediment deposition (red line). The outcomes indicate that the majority of the estimated outflow of 16 L/s would have travelled across the surface.

The surface area of the inundation extent is estimated to be around 400 m^2. Applying an infiltration rate of 50 mm/hr suggests that an infiltration into the subsoil of up to 5 L/s could have occurred.

It is judged that the majority, or all, of the estimated peak leakage flow would be required to produce a sediment deposition pattern consistent with that observed at the site. The infiltration estimate indicates that around 25% of the 20 L/s flow could have entered the subsoils.

A plot of velocities for the 20 L/s flow is presented in Figure 6.

Figure 6: 20 l/s maximum velocities

Note that the velocities in the above figure cover a broader extent than that shown in the flood maps because velocities are shown for all depths, while the flood maps do not show depths less than 2 mm. The maximum velocities are around 0.5 m/s. This is consistent with a maximum diameter of around 1 mm for transported sediments.

6. Limitations

This report has been prepared in general accordance with the objective detailed in our proposal (ref: 30043629 c.004 item 6), modified following the walkover surveys of 13, 17 and 20 June 2025.

The contents of the report are for the sole use of South East Water c/o Thomson Geer. No responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement with SMEC.

The recommendations in this report are based on data collected at specific locations using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific timeframe and technical requirements of the brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the extrapolated model.

The information provided from in-situ tests are limited to their locality, results do not provide or include an interpretation of hydrological information between these locations. The reliability of the information depends on the testing method, sampling/observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high-quality data. It should also be recognised that the volume of material observed or tested is only a fraction of the total subsurface profile.

Subsurface conditions, such as groundwater levels, can change over time and this should be borne in mind, particularly if the findings and/or recommendations contained within this report are used after a protracted delay.

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Appendix H

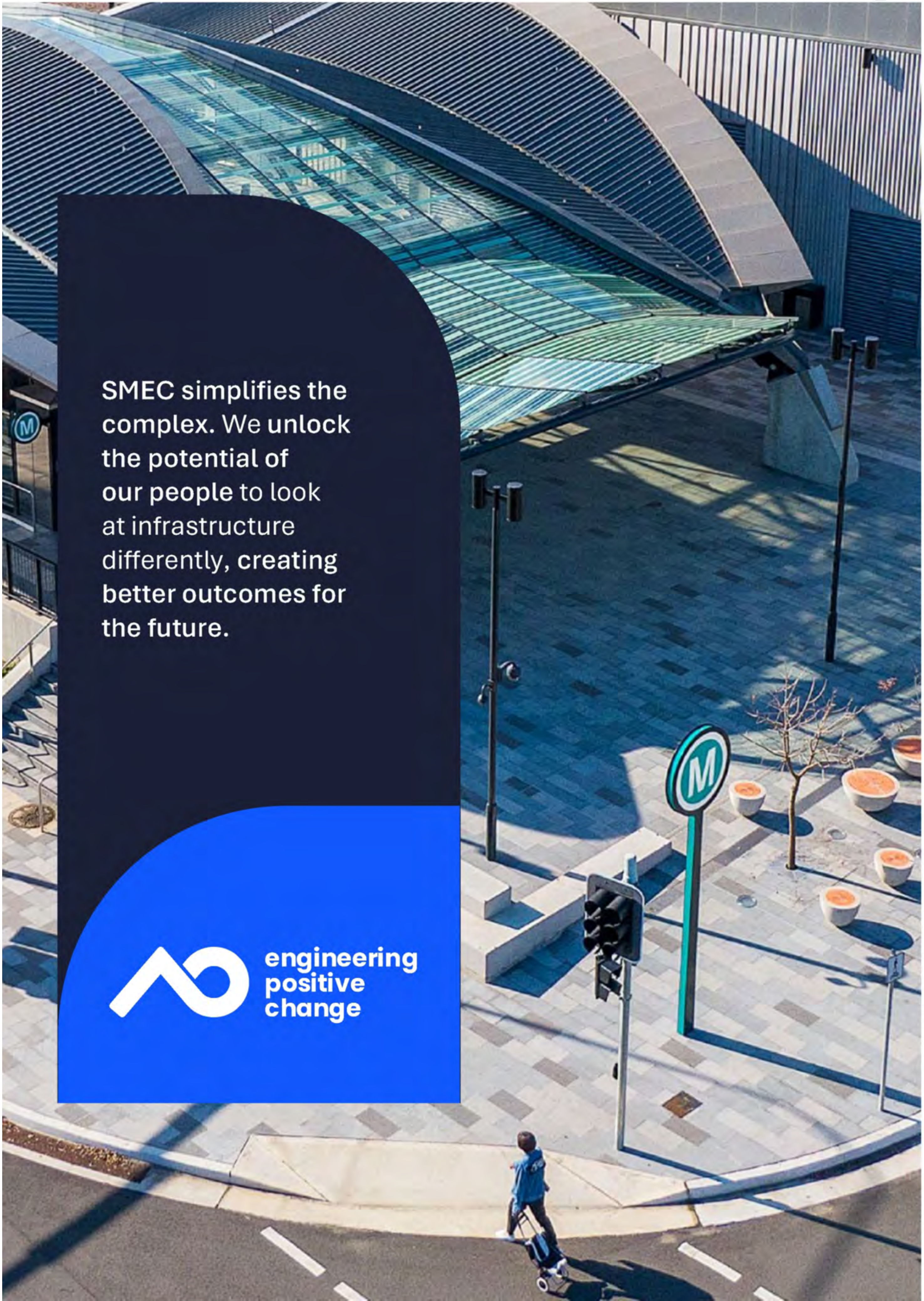
Slope Stability Assessment

Ground Model Slope Stability Assessment Report

McCrae Landslide

Prepared for: Thomson Geer
21 July 2025
Client Reference No. SMEC Report 002 Appendix H

SMEC INTERNAL REF. 30043649



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Important Notice

This report is confidential and is provided solely for the purposes of documenting the result of a slope stability assessment to estimate the required volume of water to replicate the 5 January 2025 slope failure at 10-12 View Point Road. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Thomson Geer or SEW, under which SMEC undertook to perform a specific and limited task for Thomson Geer or SEW. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

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1. Introduction

Landslides occurred on 5 January 2025 and 14 January 2025 within the property boundaries of 10-12 View Point Road, the debris effectively demolishing 3 Penny Lane in McCrae, Victoria. The landslides comprised the downslope movement of initially an estimated 20 m^3 of material, with the McCrae landslide (dated 14 January 2025) comprising an estimated 120m^3 of material from the upper portion of the escarpment within the 10-12 View Point Road property. This material accumulated within the 3 Penny Lane property near the toe of the slope, causing substantial damage to the property and injury to a person who was inside the property at the time of the 14 January 2025 landslide.

SMEC Australia Pty Ltd has been engaged by South East Water (SEW) c/o Thomson Geer to provide technical advice relating to the McCrae landslide and the impact of SEW asset on the landslide. As part of this technical advice, SMEC has undertaken exercises to create ground models of:

- The locality of the Site, based on logs of boreholes drilled by subcontractors engaged by SMEC, and
- of the McCrae landslide site, to model the volume of water required to reduce the Factor of Safety of the slope. The purpose of this analysis was to replicate the failure occurred on 5 January 2025 and estimate the possibly volume of water required to trigger this landslide event.

2. References

References had been made to the document/data listed in Table 1. Note the reference numbers refer to Appendix B.

Table 1: Referenced documents

SMEC Ref. No.	Name	Owner	Description
22	Geotechnical report for 3 Penny Lane, reference number RM0997-98, dated in 1998	CivilTest	Geotechnical report to inform the proposed additional construction of the existing dwelling at 3 Penny Lane, McCrae. A total of 4 shallow boreholes were drilled.
20	Geotechnical Investigation of Stability of Gully between the Eyrie & Point Nepean Road, reference number 207141Report01.1, dated September 2007	LanePiper	Geotechnical report to assess the stability of the existing banks of a gully between The Eyrie and Point Nepean Road, McCrae and to recommend remedial actions to stabilise the banks of the gully. A total of 4 boreholes to 10-20m and 7 hand auger holes to 1.0-1.5m were drilled. A set of geotechnical parameters were provided.
4	Land Stability Assessment at 10-12 View Point Road McCrae, reference number 1222044-3 Issue 5, date unknown	CivilTest	CivilTest undertook a geotechnical investigation following a landslip event on 15 November 2022. The investigation comprised: • 3 No. boreholes to maximum depth of 20.0m below ground level (bgl); • Soil classification tests on selected samples. Slope stability modelling and landslide risk assessment were also conducted based on the findings of the investigation.

SMEC Ref. No.	Name	Owner	Description
13	Expert Opinion Report – Landslide Assessment, reference number PSM5226-006 Rev0, date 11 June 2024	Dane Pope (PSM Consulting Service)	Mr D. Pope from PSM was engaged by Ms Leesa Hovenden of Harwood Andrews who acts for Mornington Peninsula Shire Council to prepare an independent report for their opinion on the cause of the November 2022 landslide. The report comprised geotechnical assessment based on the 2022 investigation by CivilTest, with interpreted geotechnical parameters provided.
3	View Point Road Landslide, McCrae – Landslide Risk Assessment Draft A, reference number 12661110, dated 22 January 2025	GHD	Requested by the State Emergency Service Authority (SES), GHD understood a landslide risk assessment following the 14 January 2025 landslide.
23	Victoria Government Gazette, No. S111, dated 18 March 2025	State of Victoria	Board inquiry document by the state of Victoria government.
6	McCrae Landslide – Evacuation Oder Area – Geotechnical Factual Report, reference number PSM5665-GFR REV0, dated 9 April 2025	PSM Consulting Service	PSM was engaged by the State Emergency Services (SES) and MPSC to undertake a geotechnical investigation, after two major landslide events occurred in the same area on 5 January 2025 and 14 January 2025. The investigation comprised: • 8 No. boreholes to maximum depth of 30m bgl with standpipes installed and Vibrating Wire Piezometer (VWP); • 2 No. Non-Destructive Testing (NDT) holes with standpipes installed to 3.5 to 5.0 m bgl; • 2 No. hand auger holes to 0.7 to 0.9m bgl; • 7 No. Cone Penetrometer Tests (CPTs) with dissipation testings to 15.0m bgl; and Soil classification tests on selected samples. Factual information only.
14	McCrae Landslide – Evacuation Oder Area – Landslide Risk Assessment, reference number PSM5665-LRA REV1, dated 28 May 2025	PSM Consulting Service	Commissioned by the Mornington Peninsula Shire Council, PSM undertook a landslide risk assessment of the site region following the January 2025 landslides.
-	LiDAR	Mornington Peninsula Shire Council	LiDAR survey from 2021 provided via a Freedom of Information request from SEW

3. Site Description

3.1 10-12 View Point Road

It is understood from the hearing statement from Mr. Borghesi, that works to the west and east of the house at No. 10 – 12 View Point Road between 2015 and 2018. A retaining wall less than 1m was constructed at the 'crest' of the slope, to the northeast of the property. The retaining wall was constructed using steel posts tied back with steel 'I' section beams and wooden sleepers. In early 2024, a 1.9 m high wall, constructed using steel posts and concrete sleepers was installed in front of the original wall after the latter started showing signs of deformation. The slope below the retaining wall was terraced, using stakes and wooden planks.

With reference to the draft landslide risk assessment report by GHD (Appendix B, ref. No.3), an initial landslide occurred below this retaining wall with estimated size of 3m (wide) x 5m (long) (depth unknown). Mr. Borghesi recollected during the hearing of how the backscarp of this failure, ravelled back, and on 14 January 2025, the 'McCrae Landslide' occurred during which both retaining walls were substantially damaged, and the debris of which partially destroyed the dwelling on 3 Penny Lane at the toe of the slope.

Figure 1 to Figure 5 show the site prior and after the 2025 landslide events. It can be seen that the retaining wall was not affected in the 5 January landslide (Figure 2), and the backscarp of this failure was approximately 3 m to 5 m below the toe of the retaining wall.

In carrying out the slope stability assessment, we have assumed the 2021 LiDAR data made available from MPSC provides a reasonably accurate model of the site geometry prior to the 5 January 2025 landslip, with the exception of the retaining walls, which have been added to our cross sections.

Figure 1: Aerial photo on 15 February 2024 (Nearmap 2024)

Figure 2: Looking at 5 January 2025 failure, taken on 7 January 2025 by Kevin Hutchings

Figure 3: Photo taken by SEW personnel 6 January 2025 showing landslide from midslope of 10-12 View Point Road

Figure 4: Photo taken by SEW personnel on 6 January 2025 showing detail of backscarp of landslide

Figure 5: Drone footage of the retaining wall on 16 January 2025

3.2 The Locality of 10-12 View Point Road

The locality of the Site is located on the lower slopes of Arthurs Seat, a hill dominating the local area, overlooking the southeastern shoreline of Port Philip Bay. The slopes are gentle, approximately 1v:10h in gradient, up to an escarpment slope up to 35 m high, steep (approximately 1v:1.5h in places) slope, incised by gullies occasionally related to streams fed from uphill towards the summit of Arthurs Seat.

The slopes have been developed, and the surface is characterised by residential housing, paved roads, occasional mature eucalyptus trees. The M11 Mornington Peninsula Freeway crosses the site in a northeasterly south-westerly orientation, within a cut fill cross sectional profile. The cut slopes are vegetated by scrub and woodland.

4. Ground Models

4.1 10-12 View Point Road

A ground model was developed for the slope stability analysis based on the listed boreholes below:

- BH1 to BH4 by CivilTest in 1998 (Appendix B, ref. No.22);
- BH1, BH2 and BH3 by CivilTest in 2024 (Appendix B, ref. No.4);
- BH01, BH02, BH03 and BH05 by PSM in 2025 (Appendix B, ref. No.6).

Figure 6 shows the assessed boreholes and the location of the assessed section.

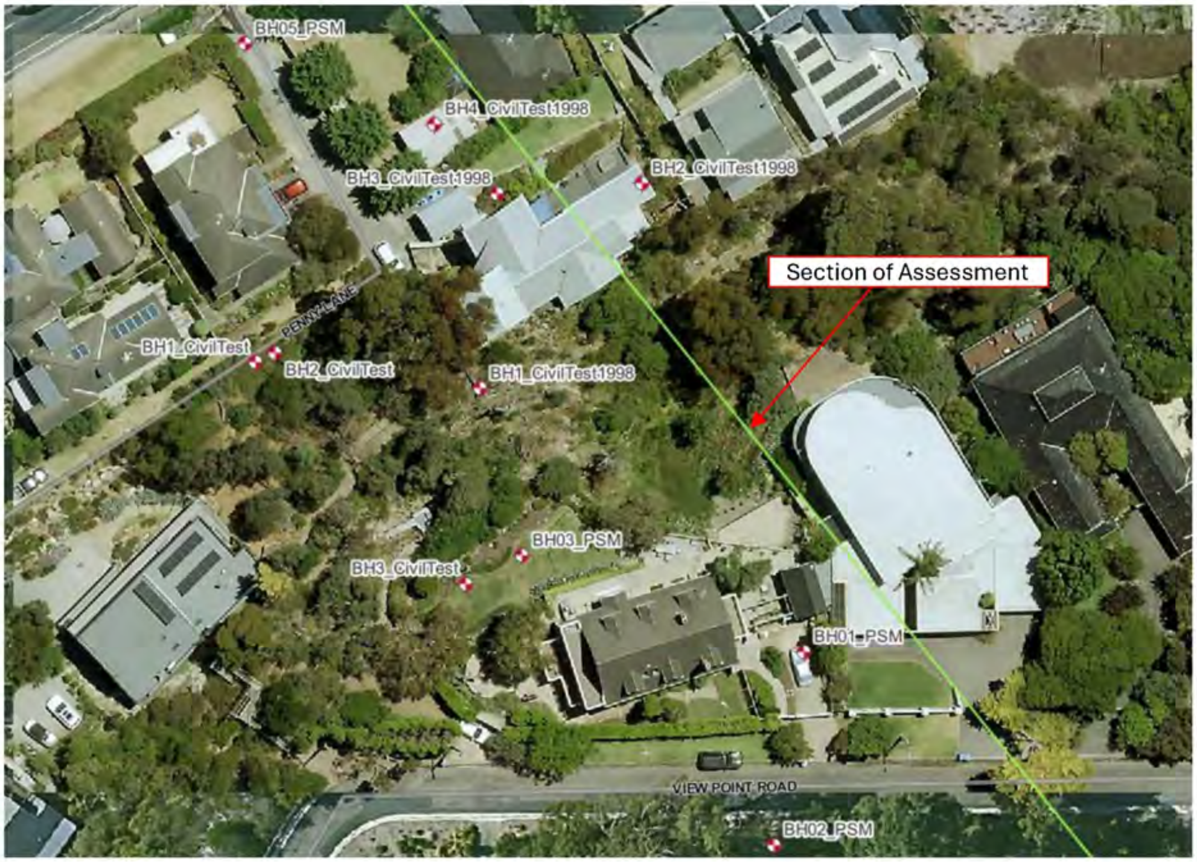

Figure 6: Layout of assessed boreholes

With reference to previous assessments by PSM and CivilTest, the encountered materials within the site extent are summarised in Table 2.

Table 2: Defined project units

Project Unit	Description
Unit 1 – Fill/Topsoil	Silty SAND/Sandy SILT, brown, grey, dry to moist
Unit 2 – Aeolian Sand	SAND, Silty SAND, brown, pale grey, brown, inferred medium dense, moist to wet
Unit 3 – Inferred Colluvium	Clayey SAND, SAND/Sandy CLAY trace gravel, grey, brown, inferred medium dense/ very stiff
Unit 4 – Residual (RS) Granite	Variable material Sandy CLAY, Silty CLAY, Clayey SAND, paly grey, brown to mottled orange grey brown, typically very stiff to hard/medium dense to very dense
Unit 5 – Extremely Weathered (XW) Granite	Typically recovered as Gravelly SAND, Clayey SAND/Sandy CLAY, brown, grey, typically with rock strength less than very low

Based on BH01 and BH02 by PSM, the ground at 10 View Point Road comprised granular fill material overlying inferred granular colluvium material, underlain by residual granite recovered as Clayey SAND or Sandy CLAY and grading into XW granite as depth increases. Figure 7 and Figure 8 shows the post-failure condition of the slope. It can be seen that as surficial material (inferred colluvium soil) slipped down along the slope, weathered rock was daylighted under the retaining wall. Based on Figure 8 and site observations, the thickness of the inferred colluvium soil above weathered rock was approximately 1-2m.

BH05 by PSM showed the ground at the toe of the slope comprised aeolian soil overlying possible residual granite.

Groundwater was logged at BH01 and BH03 at 4.5m below ground level (bgl) and 2.5m bgl respectively, and BH05 at 1.6m bgl. However, from site photographs and site observations, only minor seepage on the slope was identified based on damped debris and recent grown vegetation.

Figure 7: Site photograph looking at backscarp facing 6 View Point Road

Figure 8: Site photograph looking at backscarp from 6 View Point Road

Based on assessments above, a ground model was developed for the replication of the slope failure.

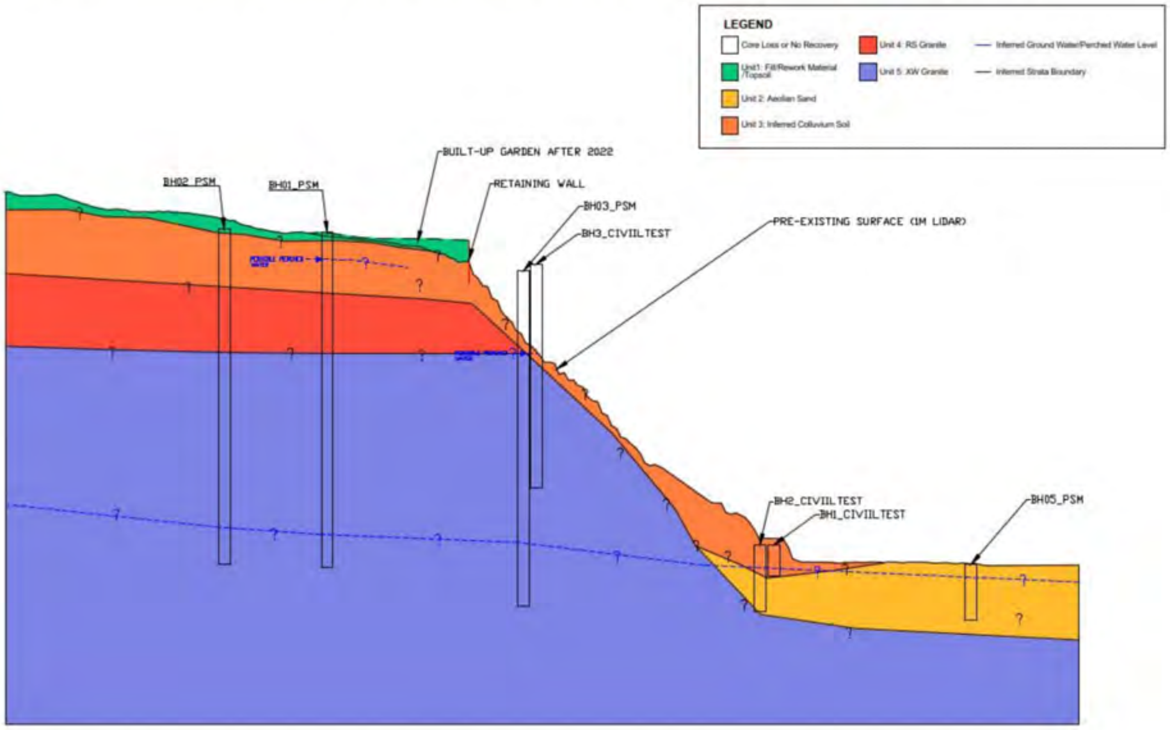

Figure 9: Ground model of assessed section (not to scale)

4.2 Locality of 10-12 View Point Road

A ground model was developed for the slope stability analysis based on BH1 to BH4, HA01 and HA02 by SMEC in 2025.

Figure 10 shows the locations of all works carried out by SMEC in June 2025, including the locations of the boreholes the logs of which are used to create this cross section.

Figure 10: Layout of SMEC boreholes (taken from Geotechnical Factual Report and therefore includes intrusive holes not used in developing this ground model

The geological strata units that were used in developing the model are provide in Table 2.

The ground model below was developed to illustrate our understanding of the geological characteristics of the locality of the Site.

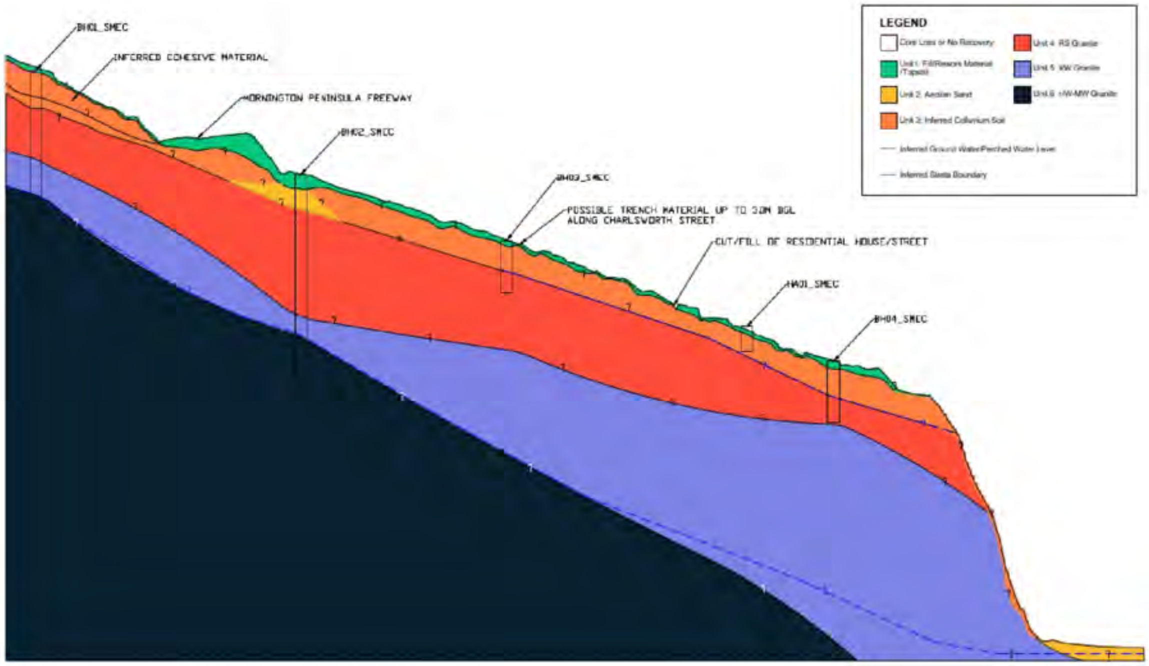

Figure 11: Ground model of site locality (not to scale)

4.3 Assessment of Data

Limited data was collected from PSM (Appendix B, ref. No.6) and CivilTest (Appendix B, ref. No.4), investigations for allocating consistency or density to the units within the ground model for the slope stability assessment.

Assessments of moisture content of Unit 2 material, Pocket Penetrometer (PP) tests and Standard Penetration Test (SPT) are presented below. This data is presented, with the design parameters used by PSM (Appendix B, ref. No.13). SMEC do not see merit in revising the parameters put forward by PSM.

It should be noted that PSM may take the opportunity to revise parameters as part of their interpretive activities following investigation works of February 2025. SMEC does not consider it very likely that such revision to significantly affect the conclusions of the slope stability analysis.

4.3.1 Moisture Content Test of Unit 3 and Unit 4 Material

Unit 3 – Inferred Colluvium Soil

Only two moisture content tests were performed on Unit 3 materials, showing in Figure 12. It can be seen that the results of the tested samples had less than 5% moisture content. Note that material in BH03_PSM at 2.7 m was logged as wet soil.

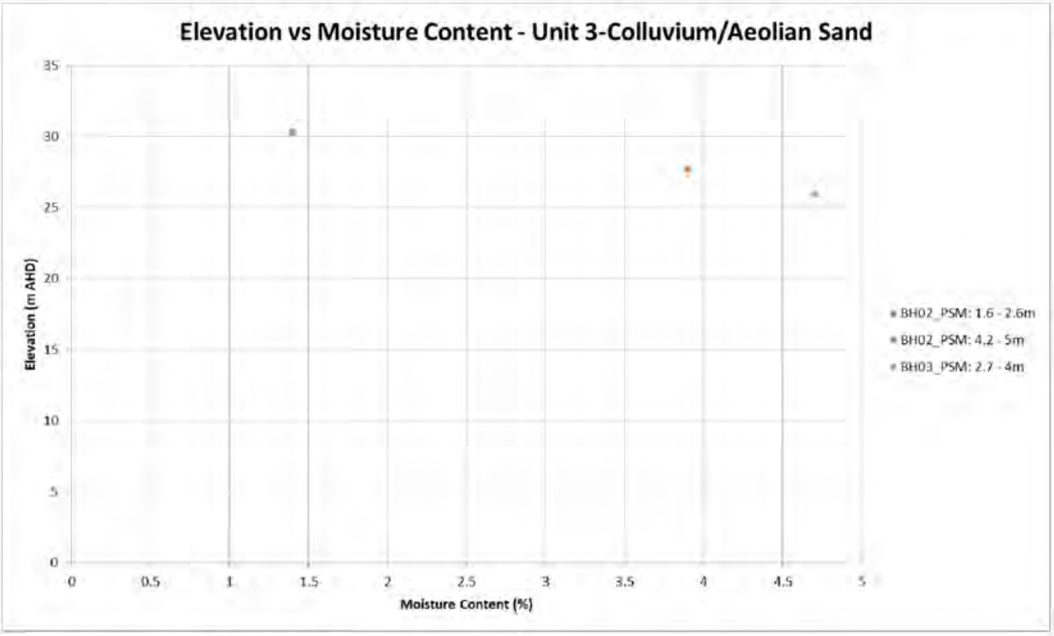

Figure 12: Unit 3 moisture content plot

Unit 4 – Residual Granite

Only two moisture content tests were performed on Unit 4 materials, showing in Figure 13. It can be seen that the tested Unit 4 materials had less than 11.5% moisture content.

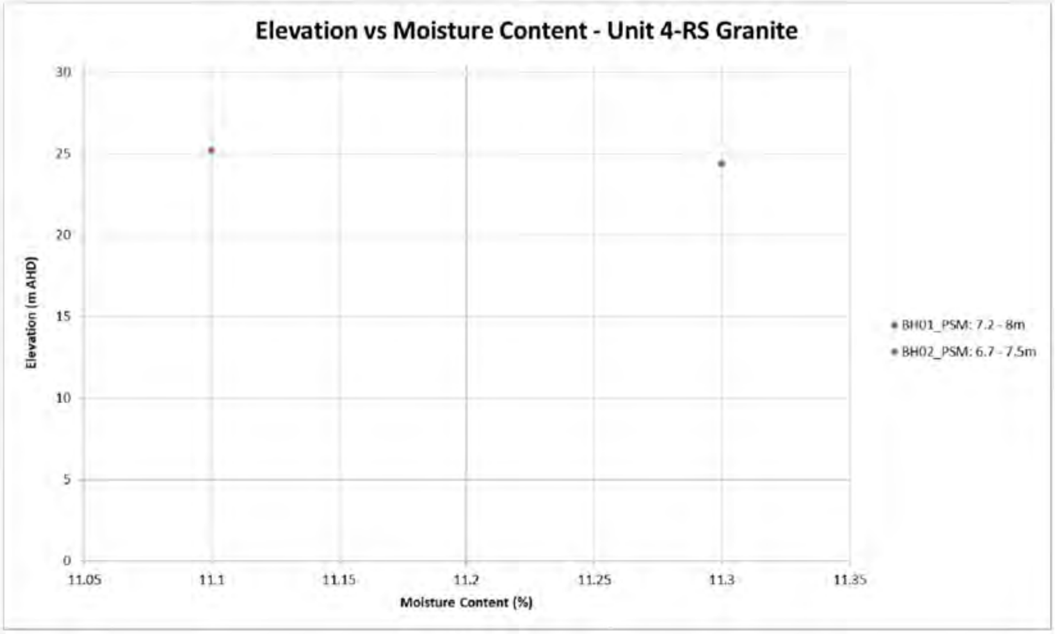

Figure 13: Unit 4 moisture content plot

4.3.2 Pocket Penetrometer test by PSM

A total of 68 No. in-situ PP tests were conducted on selected samples by PSM, and the uncorrected readings of the test were recorded. The undrained shear strengths (c_u) of the tested soils were calculated based on correlation of:

$$c_u = PP\ reading\ uncorrected\ /\ 2,$$

which was plotted against the test elevation as shown in Figure 14.

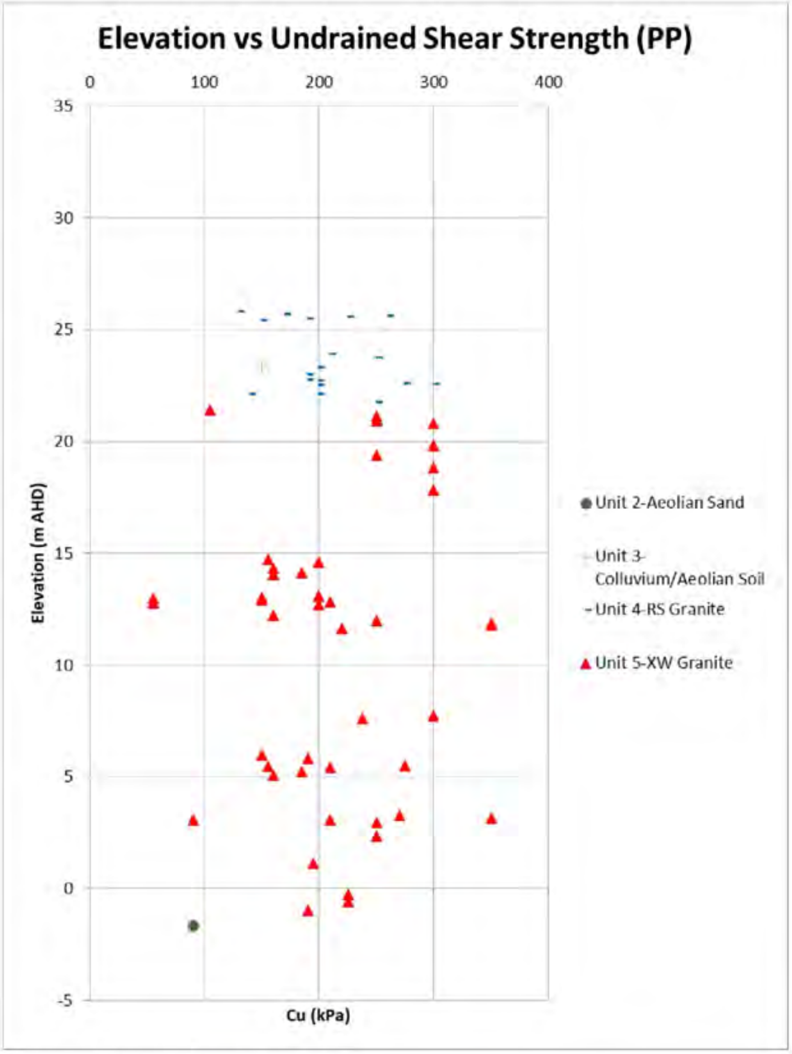

Figure 14: Pocket penetrometer result plot

The statistic of the undrained shear strength results is shown in Table 3.

Table 3: Statistic of undrained shear strength from pocket penetrometer tests

Unit*	Undrained Shear Strength derived from Pocket Penetrometer Test (kPa)			
	Min	Max	Average	25th Percentile
Unit 4-RS Granite	130	300	210	190
Unit 5-XW Granite	55	350	213	160

*Only Unit 2 and Unit 3 statistic was presented as other units had too small sample size

4.3.3 Standard Penetration Tests

A total of 8 No. Standard Penetration Tests were conducted by PSM in 2025 and CivilTest in 2022. The results of SPT in Unit 3 and Unit 4 soil are presented in Figure 15 and Figure 16. Note that SPT N value of 50 represents refusal. The key findings of the SPT tests were as follows:

- All SPT in Unit 3 soil were conducted within granular material. SPT in BH02_PSM refused which was potentially due to the presence of gravel;
- Only one SPT in Unit 4 soil was conducted within cohesive material which had SPT N value of 12 indicating consistency of stiff. All other SPTs had N value of 25 to 33, indicating relative density of medium dense to dense;
- Due to the limited amount of data, it is difficult to derive soil parameters from SPT results.

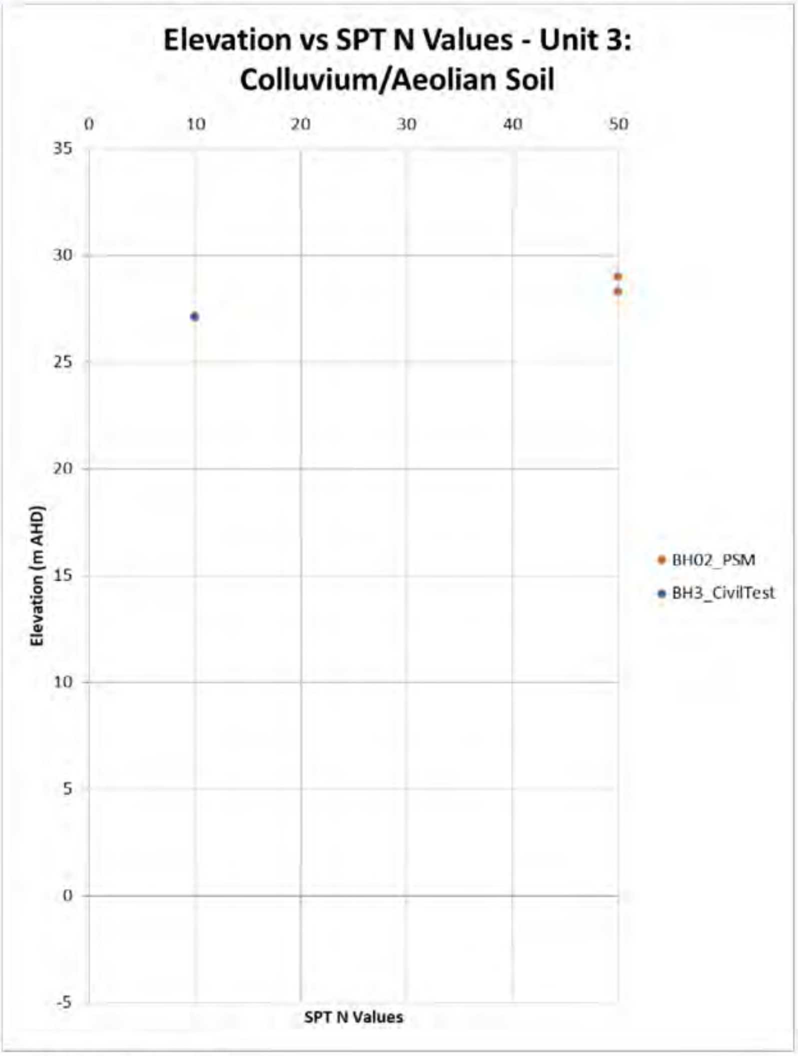

Figure 15: Unit 3 SPT plot

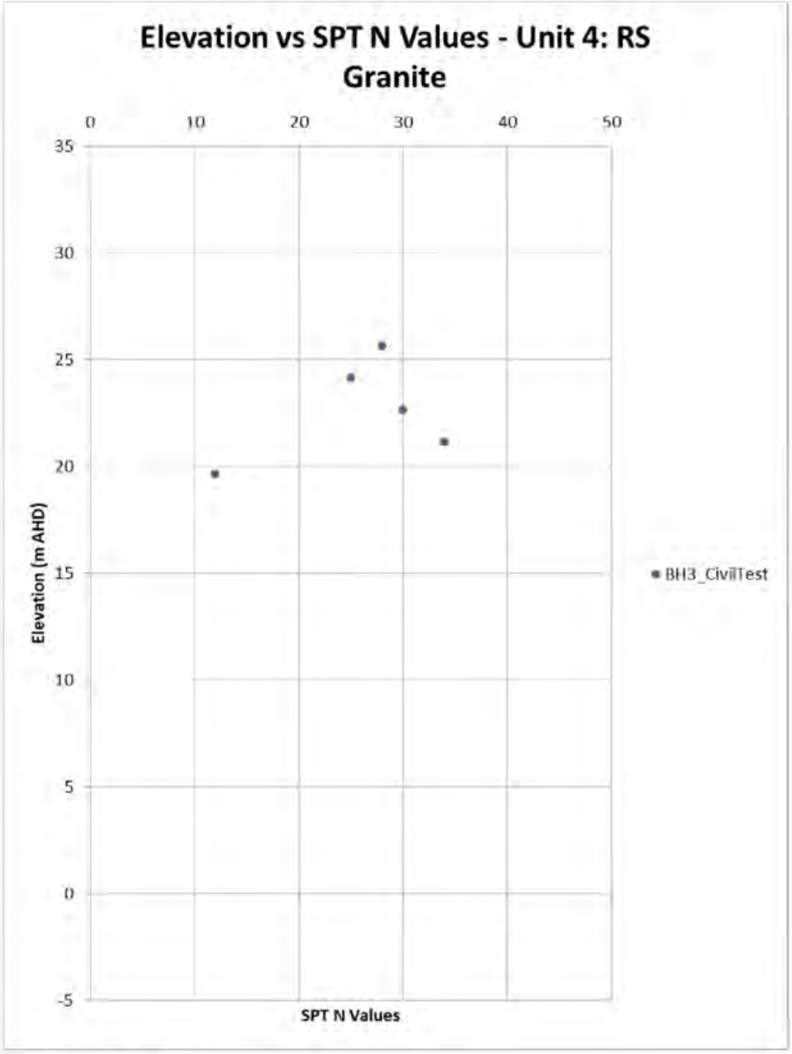

Figure 16: Unit 4 SPT plot

4.4 Design Parameters

According to PSM report (Appendix B, ref. No.13), the geotechnical parameters presented in Table 4 were adopted by PSM to replicate the November 2022 landslide.

It should be noted that another set of geotechnical parameters was provided by LanePiper (Appendix B, ref. No.20) to assess the slope stability of the banks of a gully approximate 150m away from the project site. However, this set of parameters were considered not representative of the project site. The subject site in the LanePiper report was a pre-existing gully with steep slopes on both sides, where colluvium material was not identified. Based on site observations by SMEC Engineers (see Appendix C), and borehole logs presented in the PSM Geotechnical Factual Report, the PSM parameters were considered representative, and it is reasonable that these are used for the slope analysis for the 5 January 2026 landslide.

Table 4: Previously adopted geotechnical parameters by PSM

Unit	Relative Density	Unit Weight γ (kN/m^3)	Effective Cohesion c' (kPa)	Effective Friction Angle ϕ' (°)
SURFICIAL SAND (Unit 2 – Aeolian Sand)	Inferred medium dense	18	0	34
COLLUVIUM (Unit 3 – Inferred Colluvium)	Medium dense to dense	18	2	30
RESIDUAL (Unit 4 – RS Granite)	Inferred dense to very dense	20	20	30

5. Slope Stability Analysis

5.1 Methodology

The slope stability assessment was conducted by the Slope/W analysis in GeoStudio software 2024.1. It is difficult to replicate the pre-failure hydrological condition of the site, as the moisture condition of the soil and location of the possible seepage on the slope previously are unknown. Two scenarios were proposed for the replication of the failure:

1. A localised area on the slope was saturated by possible concentrated seepage flow, while other areas was dry;
2. A section of the slope was saturated by possible seepage flow, with the downslope area continued to be saturated by the residual flow and the remaining of the slope being dry.

The following cases were analysed:

- Case 0.0: Factor of safety under dry (pore water pressure ratio (r_u) = 0, no phreatic surface) condition to validate ground model and geometry;
- Case 1.0: A portion of the colluvium material within the midslope, 5 m to 6 m below the retaining wall was modelled as saturated by introducing a r_u to the soil unit, to obtain a slip surface that is similar to the 5 January landslide. Note that r_u is defined by:

$$r_u = \frac{u}{\gamma_t H_s},$$

$$where\ u = pore - water\ pressure = \gamma_w H_w$$

$$\gamma_t = total\ unit\ weight$$

$$\gamma_w = unit\ weight\ of\ water$$

$$H_s = height\ of\ the\ soil\ column$$

$$H_w = equivalent\ height\ of\ water$$

An initial r_u ratio of 0.3 was applied to a limited zone of colluvium. The analysis was repeated, increasing the height of the zone of saturated colluvium, until a Factor of Safety (FoS) of less than 1.0 was achieved, with a slip circle representative of the conditions of the site immediately after the 5 January 2025 landslip;

- Case 2.0: A portion of the colluvium material within the midslope, 5 m to 6 m below the retaining wall was modelled as wetter than surrounding surface material (r_u maximum of 0.3), which was itself subjected to a r_u value of 0.1.

5.2 Assumptions

The assumptions of the Slope/W analysis are as follows:

- The height of retaining wall was 1.9m above ground level. It is assumed that the embedment depth of the retaining wall was 2m;
- The analysis modified hydraulic conditions to result in a critical circular slip failure similar to the estimated scale of the 5 January 2025, and as illustrated by photos taken shortly after the landslide.
- It is assumed that the fill material behind the retaining wall has similar property as the Unit 2 material;
- It is assumed that the soil within the saturation zone was fully saturated within the height of water;
- It is assumed that the maximum porosity of the Unit 3 soil was 0.3;
- Based on photographs taken shortly after the 5 January 2025 landslide, it is assumed that the breadth of the landslide was approximately 3.0m;

5.3 Results

Table 5 presents the FoS of the assessed scenarios. The graphical results of the analysis are provided in Attachment A.

Table 5: Slope/W results

Case	Description	FoS
0	Assuming dry soil condition in the slope	1.088
1	Applying r_u of 0.3 to approximately 6 m below the toe of retaining wall	0.995
2	Applying maximum r_u of 0.3 to a larger extent than Case 1, with a nominal r_u down the slope	0.998

The modelled slope has a low FoS of 1.088 under dry condition, which indicates the slope was susceptible even when there was no groundwater, seepage or other water source saturating the soil on slope. Both assessed scenarios provided FoS just less than 1.0.

We estimate that for a landslide 3 m wide, with a localised area with a pore-water pressure of 0.3, the equivalent approximate volume of water in the range of 2000 litres to 2300 litres. A flow rate of approximately 0.02 to 0.03 l/s can achieve this volume over a 24 hour period.

Attachment A

Slope/W Outputs

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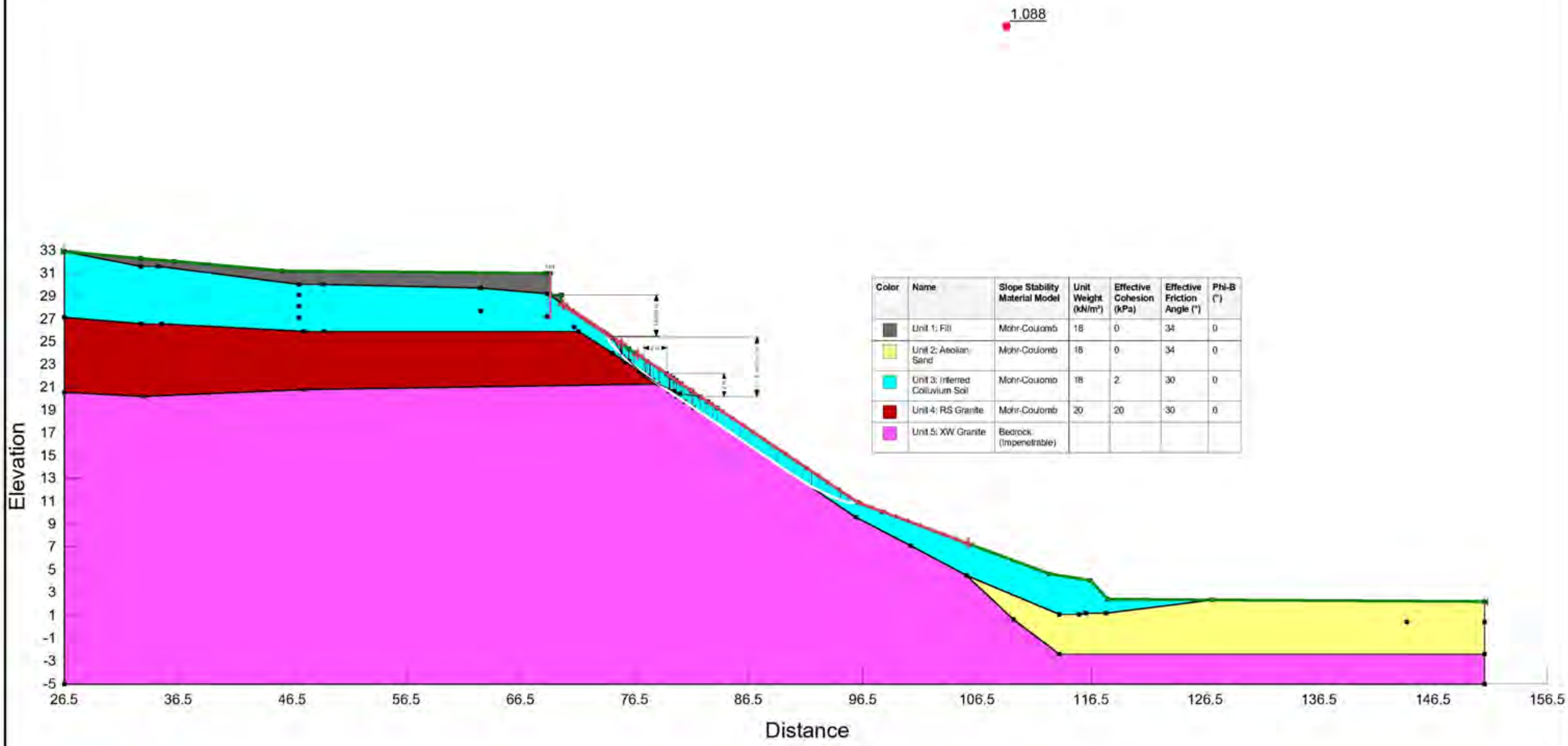
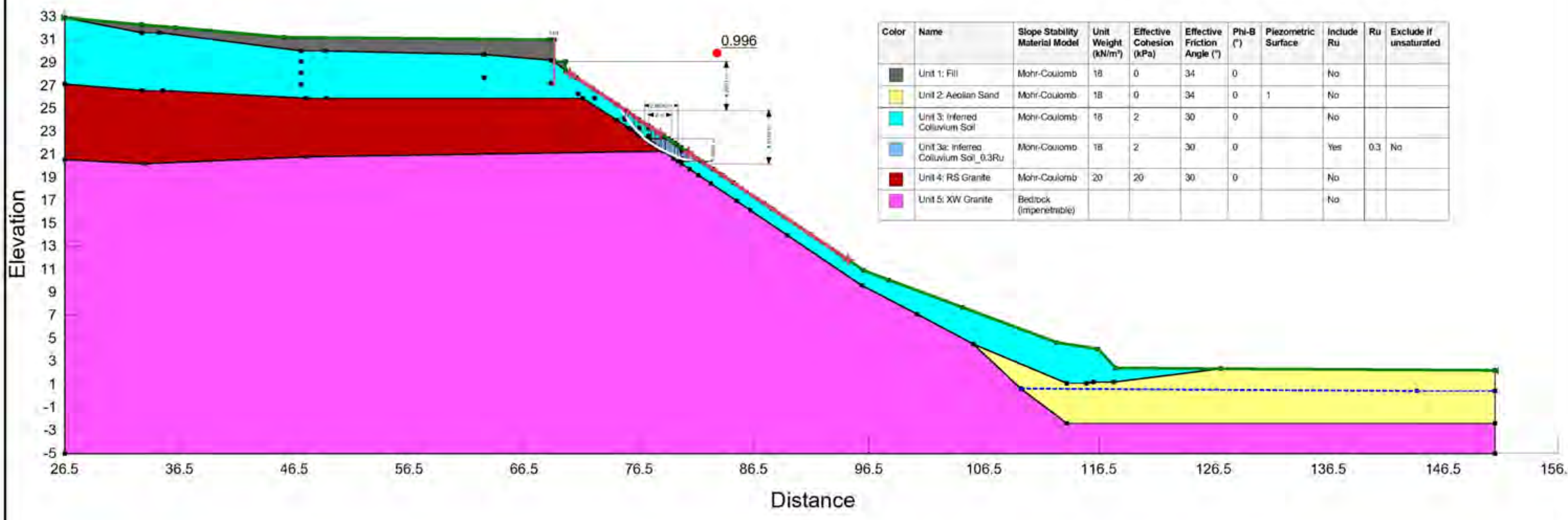


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
■	Unit 1: Fill	Mohr-Coulomb	18	0	34	0
■	Unit 2: Aeolian Sand	Mohr-Coulomb	18	0	34	0
■	Unit 3: Inferred Colluvium Soil	Mohr-Coulomb	18	2	30	0
■	Unit 4: RS Granite	Mohr-Coulomb	20	20	30	0
■	Unit 5: XW Granite	Bedrock (Impenetrable)				

1.0 Pre-failure_Dry	
McCrae Landslide_RevB.gsz	
15/07/2025	1:352



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface	Include Ru	Ru	Exclude if unsaturated
■	Unit 1: Fill	Mohr-Coulomb	18	0	34	0		No		
■	Unit 2: Aeolian Sand	Mohr-Coulomb	18	0	34	0	1	No		
■	Unit 3: Inferred Colluvium Soil	Mohr-Coulomb	18	2	30	0		No		
■	Unit 3a: Inferred Colluvium Soil_0.3Ru	Mohr-Coulomb	18	2	30	0		Yes	0.3	No
■	Unit 4: RS Granite	Mohr-Coulomb	20	20	30	0		No		
■	Unit 5: XW Granite	Bedrock (Impenetrable)						No		

2.0 Failure_Ru0.3

McCrae Landslide_RevB.gsz

16/07/2025 1:352

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Annexure A:

Corrections to SMEC Preliminary Report

The following corrections are advised to the text of the SMEC preliminary report (Ref. SMEC 001 Rev0, dated 5 May 2025):

Section 4.1 Principal events (part of) (page 9):

The last three paragraphs of this section shall be replaced with the following:

It is noted that there have been no significant rainfall events recorded by near-by weather stations during the period of time of interest (Table 16, Appendix A, from 26 November 2024).

In SMEC's experience of slope failure projects where we have been informed of the time scale, where rainfall is identified as a primary cause of failure, the landslip happens within approximately 24 hours of a rainfall event. Antecedent rainfall may also impact on slope stability.

The heaviest rainfall event appears to have taken place between 27 and 28 November 2024, where 38.4 mm fell over a 48 hour period. This should be compared to the heaviest rainfall recorded at Rosebud Community Club for 2024, which was on 2 April, where 48.8 mm was recorded over 24 hours (Table 9).

Analysis of daily rainfall data listed in Table 16 of Appendix A indicates the cumulative rainfall of the 4 weeks prior to the landslide of 15 November 2022 was 130.2 mm, whilst the cumulative rainfall of the 4 weeks prior to the 5 January 2025 slope failure was 13.8 mm.

It is therefore considered that rainfall did not fall directly on the subject site and therefore it is not the primary cause of the 5 January 2025 slope failure. However, rainfall occurring prior to the 14 January 2025 slope failure may have contributed to that slope failure.

Section 7.3.2.1 Records (part of) (page 36-37)

The following figures below shall be included:

Figure 24: Photograph from email of 22 November 2022, looking north from Coburn Avenue towards Prospect Hill Road showing undulating concrete pavement construction.

Figure 25: Photograph from email of 22 November 2022, showing detail of sinkhole repair within private land.

Figure 26: Photograph from email of 22 November 2022, showing detail of sinkhole repair adjacent to a kerb.

Figure 27: Photograph from SEW taken on 15 November 2022 (approximately), looking west along Coburn Avenue from junction with Prospect Hill Road showing completed mains repair works.

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