CMW Geosciences
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31 July 2025

Proposed Residential Subdivision

Milldale, Wainui East

FAST TRACK APPLICATION: SPECIALIST COMMENTS RESPONSE ADDENDUM

Fulton Hogan Land Development Limited

Job No. AKL2024-0257AE | Version 1

Auckland

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Version Control

Document version information	
Job number	AKL2024-0257AE
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For and on behalf of CMW Geosciences

Review and Update History

Version	Date	Comments
A	15 July 2025	Initial draft for internal review
0	16 July 2025	Final draft for client review
1	31 July 2025	Final for response to Auckland Council

CONTENTS

Appendices

1.0 INTRODUCTION

Section 53(2) of the Fast-track Approvals Act 2024 enables the Expert Consenting Panel to invite written comments on the application from specified persons and groups.

This memorandum has been prepared in response to the technical specialist memorandums issued by Auckland Council as part of their assessment of the Milldale Fast-Track Application. It specifically addresses the matters raised by Council and provides clarification, additional assessment, and updates where required.

In particular, this memo provides response to the following:

- Annexure 9: Geotechnical
- Memorandum of Planning Matters for Auckland Council (29 July 2025)

Since the initial lodgement of the Substantive Application with the Environmental Protection Authority (EPA), there has been ongoing engagement between the Applicant's expert team and Auckland Council specialists through meetings, design workshops, and site discussions.

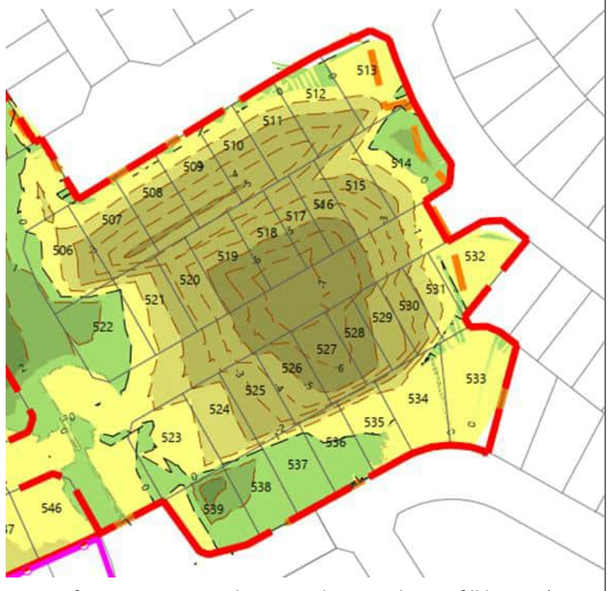
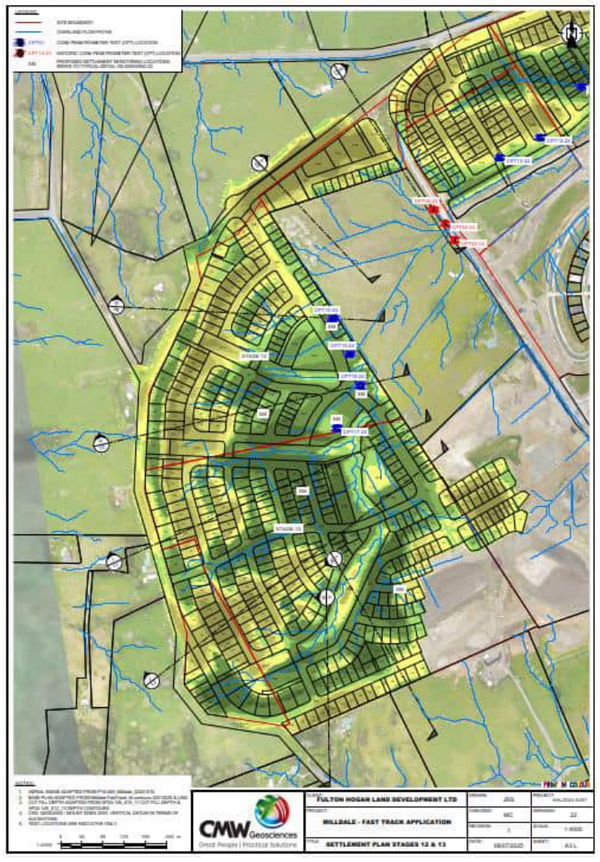
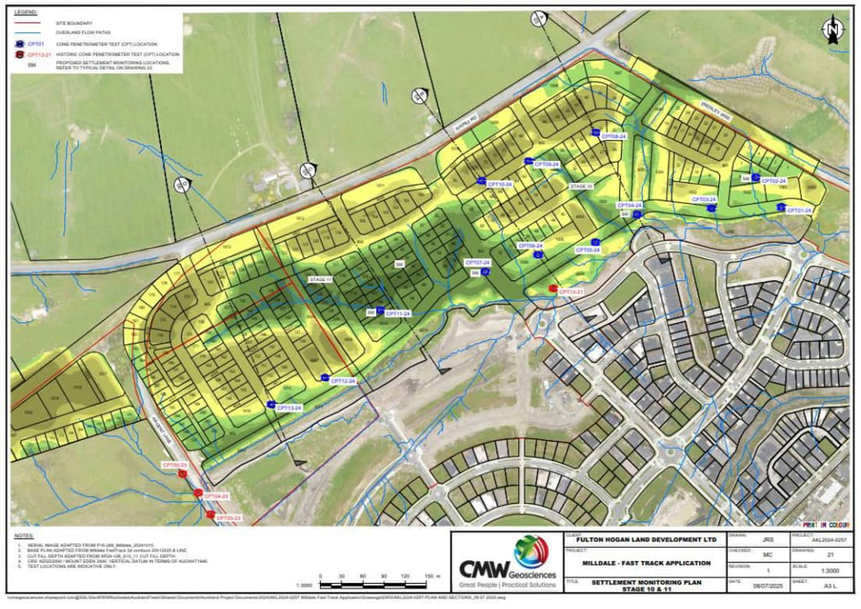
The following tables in ***Sections 2.0 to 4.0*** inclusive address geotechnical comments provided by Auckland Council in response to the Milldale Fast Track application for Stages 10 to 13, Stage 4C, and proposed Wastewater Treatment Plant, which are summarised in Annexure 9. Comments below should be read as an addendum to the following previously submitted reports:

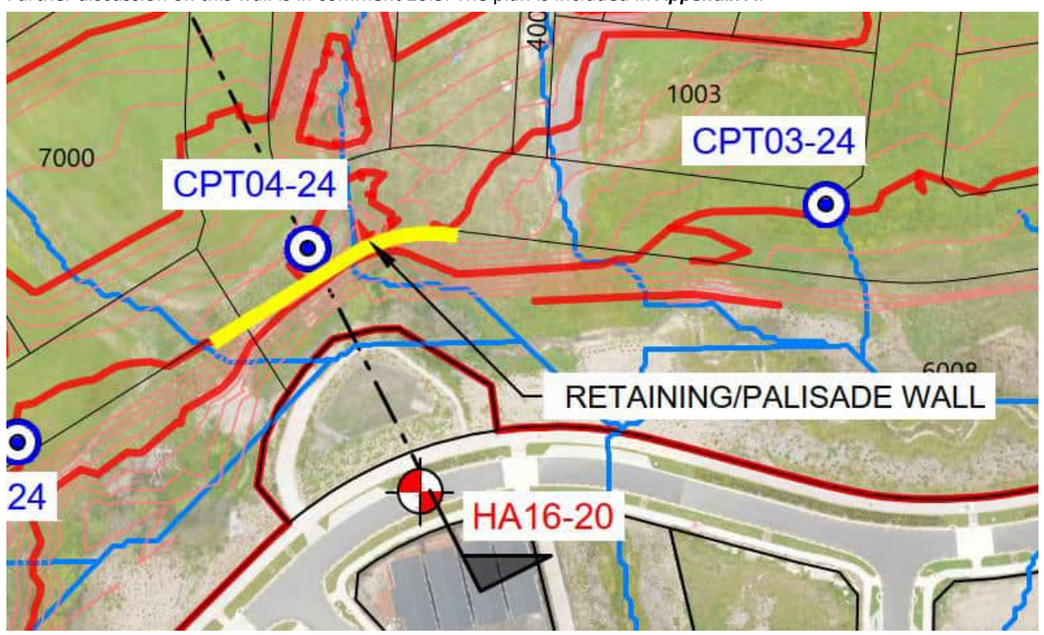
- CMW Geosciences' Milldale Fast Track Geotechnical Investigation Report (GIR) referenced AKL2024-0257AB, Rev 3, dated 24 March 2025
- CMW Geosciences' Milldale Stage 4C Geotechnical Assessment Report (GAR) referenced AKL2024-0257AD, Rev 1, dated 20 February 2025
- CMW Geosciences' Milldale WWTP Geotechnical Investigation Report (GIR) referenced AKL2024-0185AC, Rev 1, dated 26 February 2025

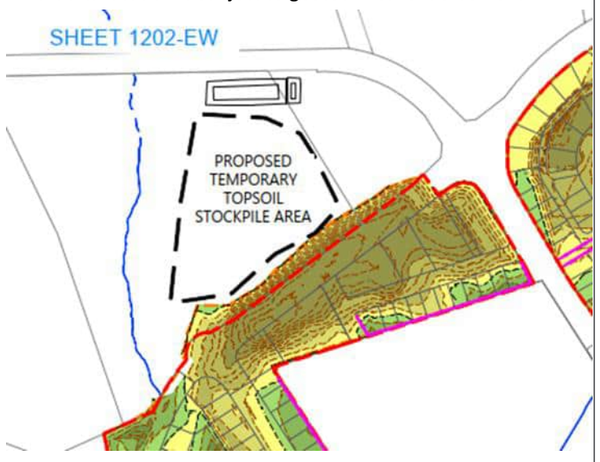
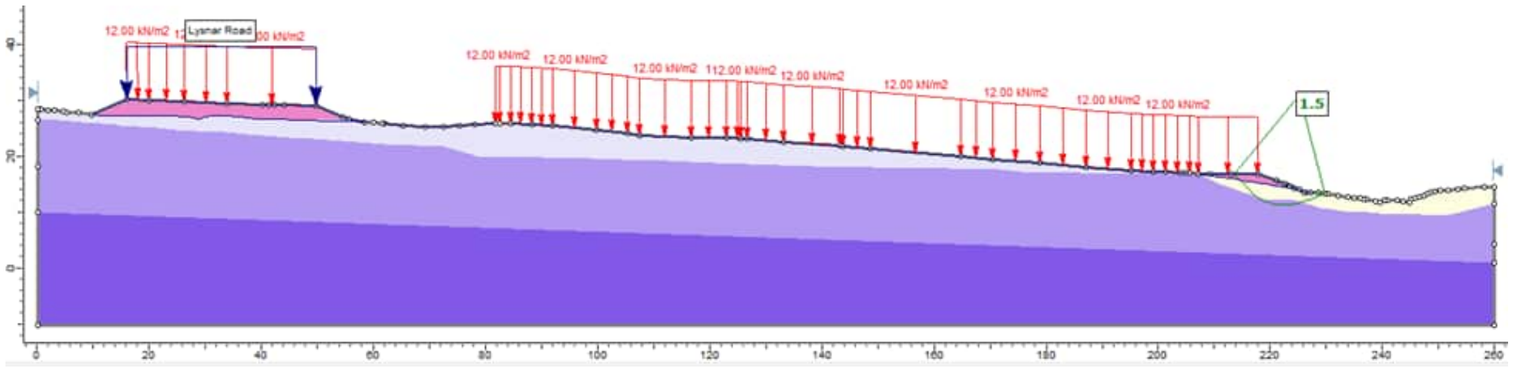
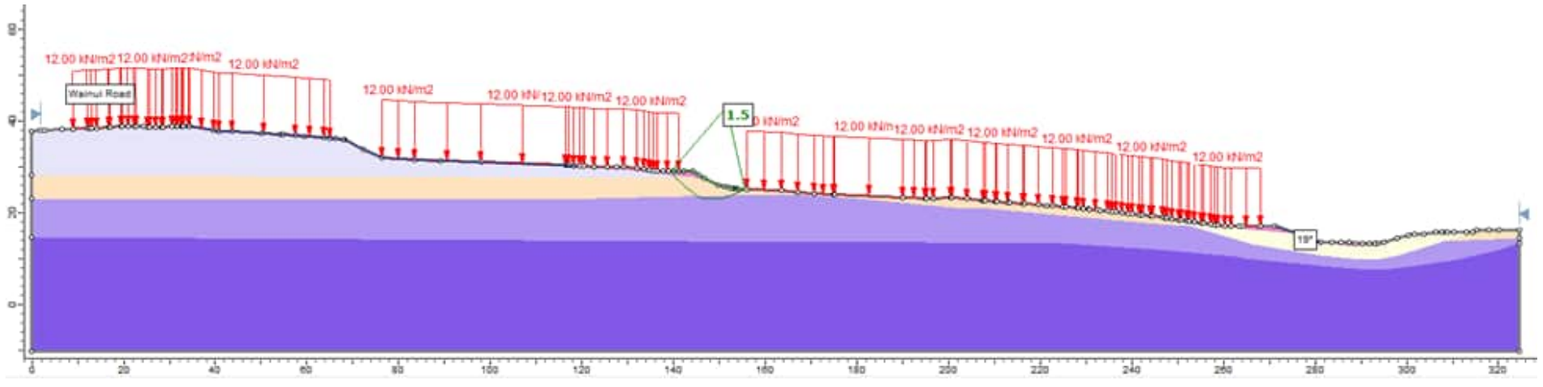
The table in ***Section 5.0*** responds to comments made in relation to the proposed Consent Conditions.

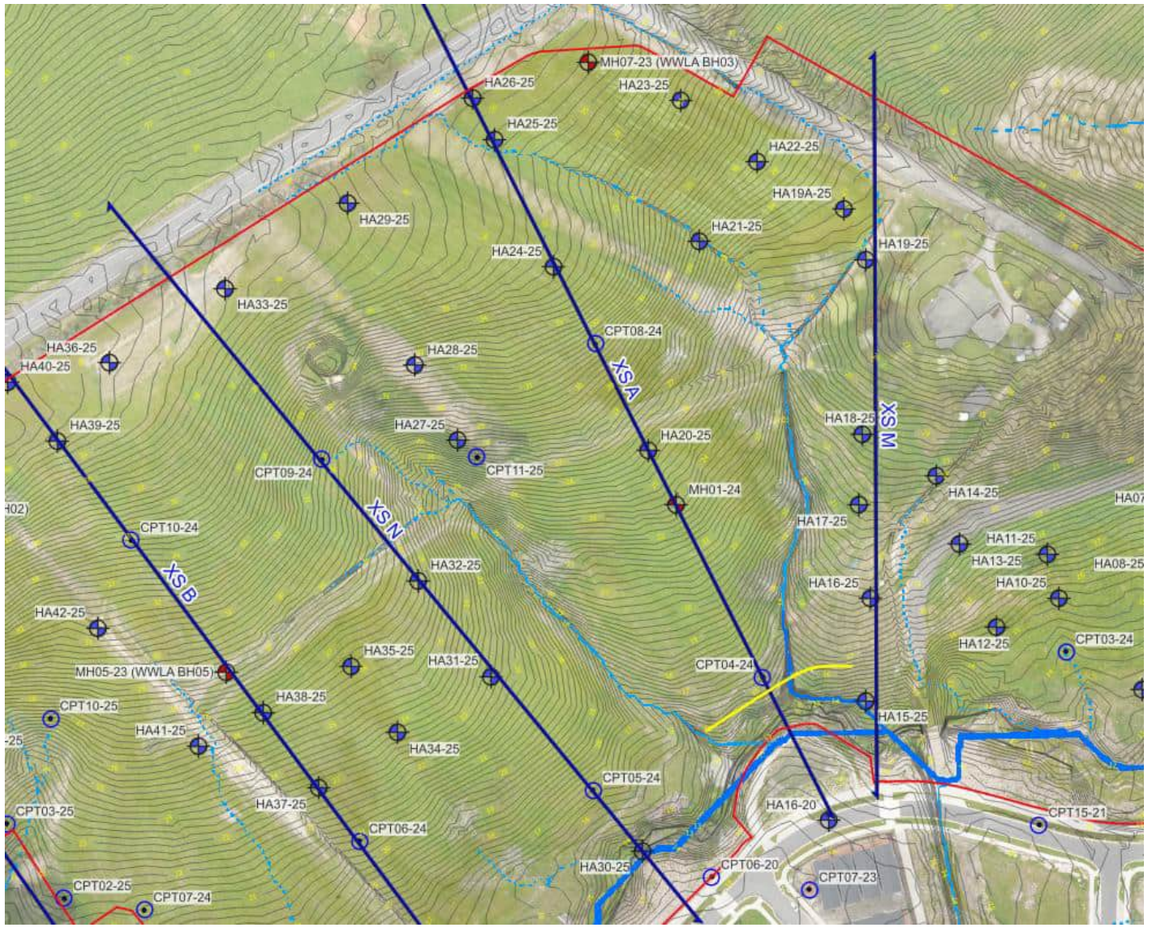
2.0 STAGES 10 TO 13

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
20.1	• Time to achieve estimated t90 settlement not stated, though this is partially addressed in the settlement memo where it stated previous stages observed time to t90 around 9 months to 1 year. We suggest that this be confirmed to aid in managing and controlling the effects of earthworks causing subsidence/instability onsite and ensure safe building platforms are achieved before 224(c) is issued following objectives and policies under E38 subdivision. We are agreeable that a settlement monitoring plan is required. • Note that the earthworks plan relied upon for the settlement monitoring plan in the Geotechnical Report does not align with the plan supplied by Milldale (drawings : P24-128-00-1202-EW and P24-128-00-1203-EW), a finalised settlement monitoring plan should be submitted.	• The timing between earthworks and civil works and therefore 224c typically exceeds 12 months at Milldale. We note earthworks are typically carried out across numerous stages, in most cases 1-2 years prior to civil works being undertaken. Settlement monitoring plans target critical areas (i.e. soft natural ground and deepest fills), and we generally observe the majority of settlement occurring prior to civil works commencing. Timeframes are based on previous monitoring observed over the last 7 years of the development – we believe that settlement data provides a much better estimate of timeframes than site investigation estimates (i.e. based on correlations in CPTs etc). • The Settlement Monitoring Plans have been updated and are at ***Appendix A***. (AKL2024-0257 DG21-22, Rev 1, 8/07/2025, shown below).

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
	 Extract of settlement monitoring plan from Geotech report – notice the difference in contours  Extract from Engineering drawings showing the cut fill layout (P24-128-00-1203	 
20.2	Inferred groundwater table nor proposed remedial works and Lot boundaries/accessways are presented on the geological cross sections. This should be shown to show underlying geological conditions and therefore ascertain expected geohazards which may be endured.	In stability modelling we use Ru values rather than a Ground Water Table as this is more appropriate for the geology. We also did not want to cause confusion between WWLA groundwater levels presented for consent. Therefore, we do not propose to update our sections with groundwater tables shown. We disagree that remediation should be shown on geological sections but will provide light hatching of this on relevant sections for information only to Council. Lot boundaries have been included on the cross sections, refer DG 05 to 16 at ***Appendix A***.

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
20.3	There are cut works proposed at the boundary of Stage 10-13, in which it does not seem to have commented on how the boundary stability will be achieved, this includes new retaining extending from Stage 13 connects to another retaining wall east of Stage 13 (Wall 22). This is necessary to assess against E12.6.2(2) and E12.8.2(1)(c). We suggest preliminary recommendations or methodologies be provided to manage the effects. 	Typically at Milldale, earthworks / retaining walls are constructed beyond stage boundaries where practical to avoid temporary works situations and where construction makes sense. In the event this does not occur, the following typical measures have been used at Milldale to control temporary stability. We typically would note these as part of the building consent design report for walls. • Leaving cut retaining wall locations at an appropriate temporary batter angle (typically shallower than 1V:3H) • Overfilling in areas of future fill retaining walls, batters at 1V:3H
20.4	There is discrepancy in the retaining wall plan where Woods Development does not show the full extent of the retaining wall in the Stage 10-11 works area where CMW considered it to be necessary and have modelled this in their slope stability outputs.  Site plan from geotechnical report	The CMW Remediation Plan, Stage 10 & 11 (DG 17) has been amended (ref. AKL2024-0257 DG17, Rev 1, shown below) so that the retaining wall shown is the same as that indicated on the Woods Retaining Wall Plan. The palisade wall location is based on the location of the retaining wall (culvert headwall) in Woods design, we have just noted that this retaining wall will require deeper piles due to global slope instability issues. Further discussion on this wall is in comment 20.5. The plan is included in ***Appendix A***. 

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
	 Retaining wall plan	
20.5	• No cross sections or slope stability analyses are provided along the existing overland flow path where the softened alluvium material is expected to be the deepest. • Further, the proposed stockpile area located above a gully feature and overland flow path (north of stage 12) may pose a risk of instability and the only reference in the reporting is for the locations to be approved by a geotechnical engineer prior to placement. We suggest that this be provided for review or an annotation provided on the plans to reinforce that its location is subject to geotechnical endorsement. 	• We have provided additional stability cross sections across the stream near the eastern end of the site to demonstrate approximate extents of the palisade action required beneath the culvert headwall shown on the Woods drawings. (XS M & XS N, locations shown below). Stability analyses of these new sections indicates that palisade action is not required at these locations to achieve the required global stability factors of safety. Further site specific investigation and design will be undertaken to inform the design of the proposed culvert headwall (marked in yellow below), including the extents of the required palisade component. Stability outputs for these sections are below and in ***Appendix C***. **Cross Section M**: - Proposed Slope, Transient Elevated Groundwater Condition:  **Cross Section N**: - Proposed Slope, Transient Elevated Groundwater Condition: 

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		Site Investigation Plan and Cross Section Locations (proposed culvert headwall location in yellow): 

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		• Annotation re topsoil stockpile area being subject to approval by Geotechnical Engineer has been included on plans, as shown below. The updated Woods plan (P24-128-00-1202-EW-CUT FILL PLAN) is at ***Appendix A***. 
20.6	With respect to the Earthworks Specification, it is stated that the reinforced slopes and retaining structures are excluded from this specification as it would be covered by Building Consent and specific structural specification. But there are still earthworks components for those works and it is not stated if that would be covered by the Structural specification as well.	The earthworks components of these structures will be referenced to the Earthworks Specification and any additional specification requirements will be in the design reports and drawings of specific structures. The specification specifically notes that reinforced earth slopes greater than 30 degrees are excluded; we do not have slopes greater than this in these stages of the development.
20.7	Table 4: Soil Fill Testing Requirements of the Earthworks Specification deviates from the minimum testing requirements recommended by NZS4431:2022, particularly the 'field water content and density' for all three types of soil fill and 'shear strength' for the fine grained and intermediate grained fill. Of note, while NZS4431 has acknowledged that the geotechnical designer can modify to suit project-specific requirements, evidence should be provided to demonstrate that the amended requirements will result in the same or better engineered fill. No evidence has been supplied to address this.	Density testing in site won fills is extremely difficult due to variability in natural soils and we do not believe that this would result in better engineered fill (MDD could change lower or higher in any given test). In terms of shear strength, we refer to NZS3604 requiring 300kPa geotechnical ultimate bearing capacity and also NZS 4431:2022 referring to plate load tests of the same bearing capacity. We note that this is approximately equal to a vane shear strength of 60kPa. Therefore, 140kPa is still well beyond the requirements here, and would result in the same engineered fill for this purpose.
20.8	Table outlining investigations in Section 5.1 references TP01-24 – TP32-24 however Appendix 2A Geotechnical Report Part 4 appears to omit TP04-24.	Test pit TP04 was not excavated (due to temporary stockpile construction in this location).
20.9	We note that Section 5.2 reports laboratory testing is still pending results that was tested for this stage of the investigation. These should be updated when available.	Section 5.2 of the GIR can now be updated as below. Test reports are included at ***Appendix B***.

<table>
<tr><th>Item #</th><th>Auckland Council Comments</th><th>Final Comment to Auckland Council in Response to Item</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th colspan="5">Laboratory Testing</th></tr>
<tr><th>Test ID/ Location</th><th>Type of Test</th><th>Test Method</th><th>Depth (m bgl)</th><th>Results</th></tr>
<tr><td>MH04-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>3.7 – 3.85</td><td>Φ′ = 30°
C′ = 39kPa</td></tr>
<tr><td>MH04-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>10.75 – 10.9</td><td>Φ′ = 27°
C′ = 51kPa</td></tr>
<tr><td>MH04-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>17.85 – 18.0</td><td>Not tested – sample fractured</td></tr>
<tr><td>MH05-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>10.25 – 10.5</td><td>Φ′ = 15°
C′ = 88kPa</td></tr>
<tr><td>MH10-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>6.45 – 6.7</td><td>Φ′ = 14°
C′ = 44kPa</td></tr>
<tr><td>MH11-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>5.4 – 5.65</td><td>Φ′ = 28°
C′ = 66kPa</td></tr>
<tr><td>MH13-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>11.8 – 12.0</td><td>Φ′ = 26°
C′ = 125kPa</td></tr>
<tr><td>MH13-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>14.6 – 14.85</td><td>Φ′ = 18°
C′ = 57kPa</td></tr>
<tr><td>MH14-24</td><td>Direct Shear Test (Shear Box) 3-Point Peak</td><td>BGL In-House Test Method #1</td><td>14.1 – 14.3</td><td>Φ′ = 28°
C′ = 84kPa</td></tr>
</table>
</td></tr>
<tr><td>20.10</td><td>We note that the design parameters presented in the Slope stability assessment appears to omit the previously identified softened base contact within the Mahurangi Limestone and the transitional Mahurangi Limestone referenced in Section 7.3 of the geotechnical reporting. This should be justified.

<table>
<tr><th colspan="5">Geotechnical Design Parameters</th></tr>
<tr><th>Unit Description</th><th>γ (kN/m³)</th><th>c′ (kPa)</th><th>ϕ′ (deg)</th><th>Su (kPa)</th></tr>
<tr><td>Engineered Fill (proposed)</td><td>18</td><td>8</td><td>28</td><td>100</td></tr>
<tr><td>Tauranga Group Alluvium (Stream)</td><td>17</td><td>5</td><td>26</td><td>60</td></tr>
<tr><td>Tauranga Group Alluvium (Ridge)</td><td>17</td><td>8</td><td>26</td><td>80</td></tr>
<tr><td>Residual Northland Allochthon</td><td>18</td><td>5</td><td>28</td><td>60</td></tr>
<tr><td>Transitional Hukerenui Mudstone</td><td>18</td><td>8</td><td>12</td><td>95</td></tr>
<tr><td>Hukerenui Mudstone</td><td>21</td><td>20</td><td>28</td><td>S-N Function*</td></tr>
<tr><td>Transitional Undifferentiated Mangakahia</td><td>18</td><td>8</td><td>21</td><td>55</td></tr>
<tr><td>Undifferentiated Mangakahia Rock Mass</td><td>21</td><td>20</td><td>28</td><td>S-N Function*</td></tr>
<tr><td>Mahurangi Limestone</td><td>19</td><td>10</td><td>40</td><td>-</td></tr>
</table>
Section 2 of slope stability assessment</td><td>The design parameters table presented in the slope stability assessment can be updated to match Section 7.3 of the GIR, shown below. These units were omitted from the stability cross-sections for clarity, as they were indiscernible at the scale of the sections and were not relevant to the lowest factors of safety returned.

<table>
<tr><th colspan="5">Geotechnical Design Parameters</th></tr>
<tr><th>Unit Description</th><th>γ (kN/m³)</th><th>c′ (kPa)</th><th>ϕ′ (deg)</th><th>Su (kPa)</th></tr>
<tr><td>Engineered Fill (proposed)</td><td>18</td><td>8</td><td>28</td><td>100</td></tr>
<tr><td>Tauranga Group Alluvium (Stream)</td><td>17</td><td>5</td><td>26</td><td>60</td></tr>
<tr><td>Tauranga Group Alluvium (Ridge)</td><td>17</td><td>8</td><td>26</td><td>80</td></tr>
<tr><td>Residual Northland Allochthon</td><td>18</td><td>5</td><td>28</td><td>60</td></tr>
<tr><td>Transitional Hukerenui Mudstone</td><td>18</td><td>8</td><td>12</td><td>95</td></tr>
<tr><td>Hukerenui Mudstone</td><td>21</td><td>20</td><td>28</td><td>S-N Function*</td></tr>
<tr><td>Transitional Undifferentiated Mangakahia</td><td>18</td><td>8</td><td>21</td><td>55</td></tr>
</table>
</td></tr>
</table>

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item

Geotechnical Design Parameters

Unit Description	Strength Range	γ (kN/m³)	c´ (kPa)	ϕ´ (deg)	S_u (kPa)
Proposed Engineered Fill	Vane Shear Strength >110kPa	18	8	28	100
Tauranga Group Alluvium (Stream)	CPT Qc < 1MPa	17	5	26	60
Tauranga Group Alluvium (Ridge)	SPT N values 1 to 8	17	8	26	80
Residual Northland Allochthon Soils	VSS 40 to >200kPa	18	5	28	60
Transitional Undifferentiated Mangakahia Complex	VSS 70 to >200kPa SPT N values 3 - 39	18	8	21	55*
Undifferentiated Mangakahia rock mass	SPT N values 40+	21	20	28	150**
Transitional Hukerenui Mudstone	SPT N values 12 -29	18	8	12	95
Hukerenui Mudstone	SPT N values 30+	21	20	28	150**
Mahurangi Limestone - softened base contact	***	18	5	26	50
Transitional Mahurangi Limestone	VSS >200kPa	19	3	40	-
Mahurangi Limestone	SPT N values 40+	19	10	40	-

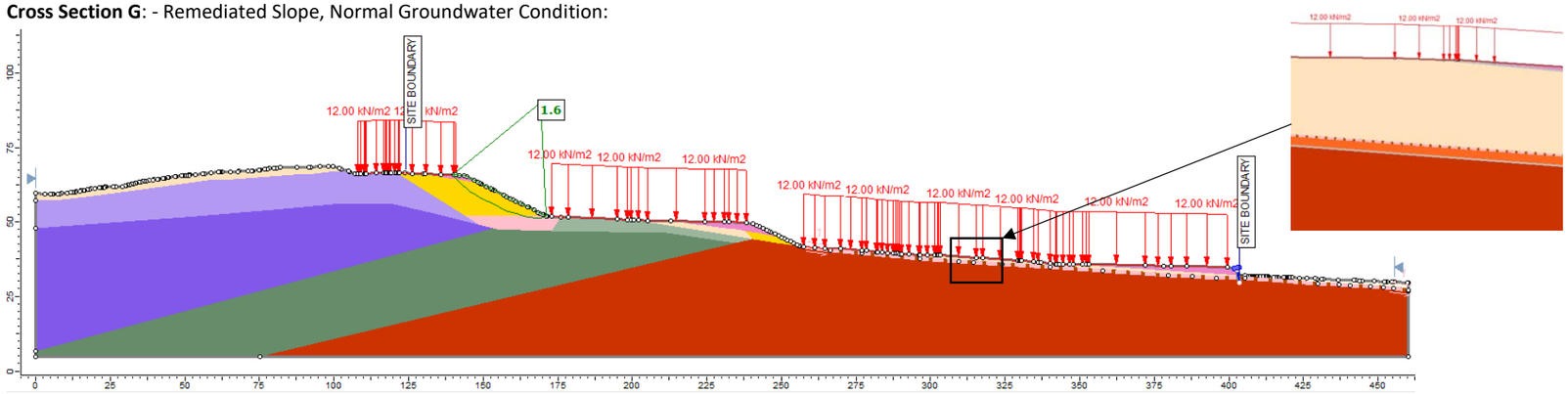
Section 7.3 of geotechnical report

Undifferentiated Mangakahia Rock Mass	21	20	28	S-N Function*
Mahurangi Limestone - softened base contact	18	5	26	50
Transitional Mahurangi Limestone	19	3	40	-
Mahurangi Limestone	19	10	40	-

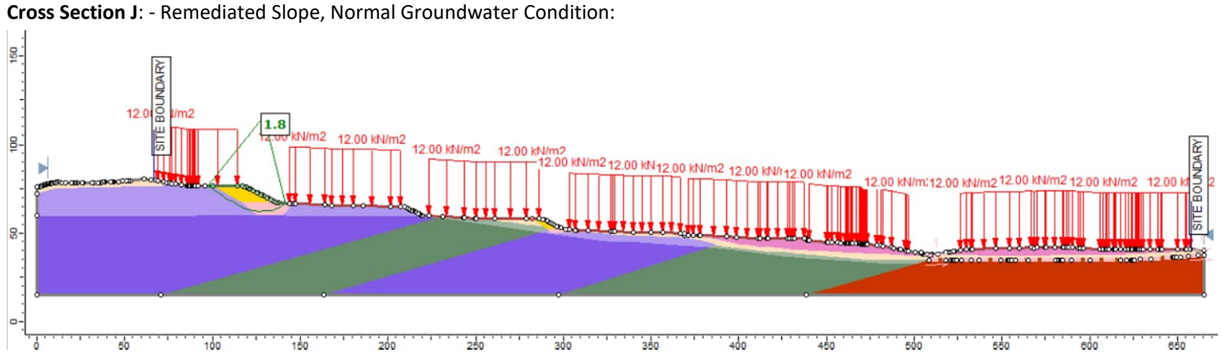
Notes: γ = soil unit weight (conservative value determined from CPT correlations / typical published values for similar soil types)
c´ = effective cohesion (conservative industry accepted value)
ϕ´ = effective friction angle (conservative industry accepted value/back analysis)
S_u = undrained shear strength
S-N Function* = Shear / Normal Function (Applied for Seismic Cases based on shear box results)

The affected sections G and J which contain Mahurangi Limestone have been updated to include the Mahurangi Limestone Transition Zone and Softened Base Contact, as shown below.

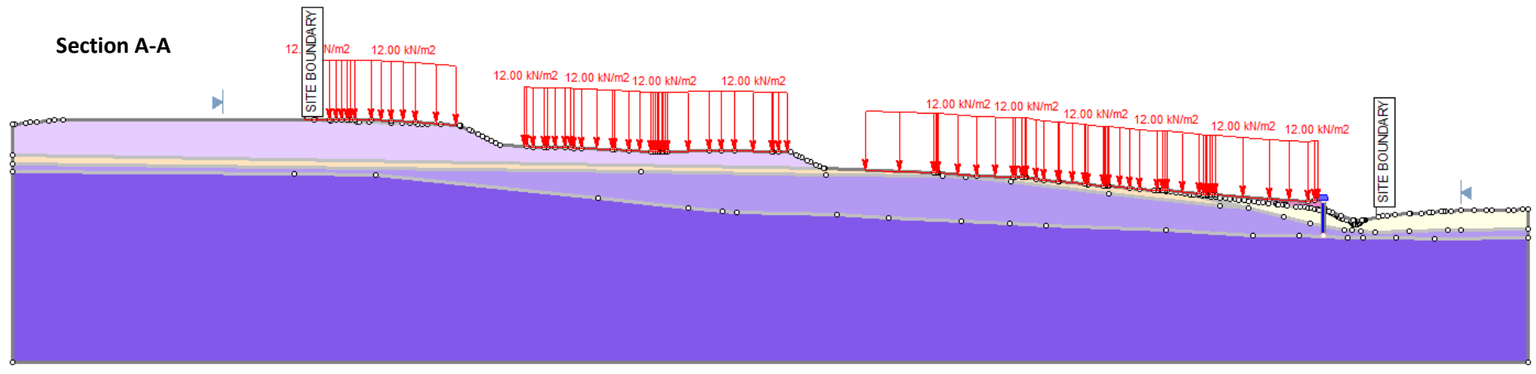
Cross Section G: - Remediated Slope, Normal Groundwater Condition:

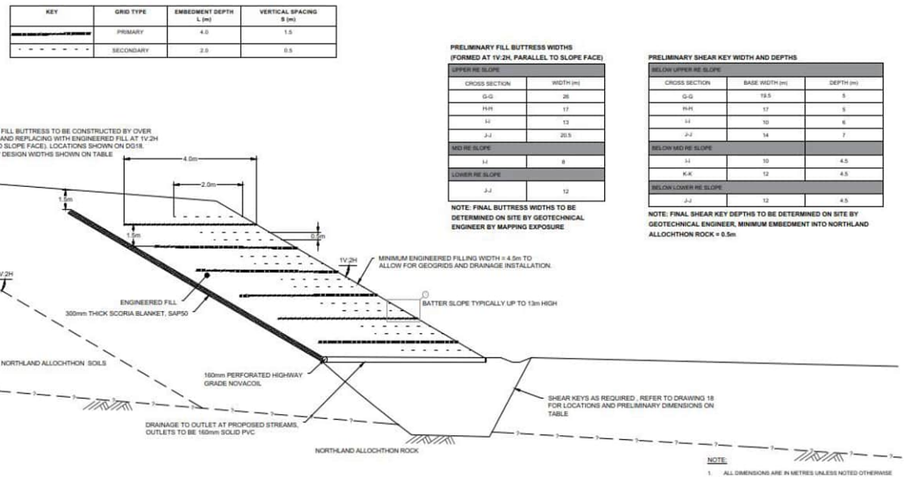


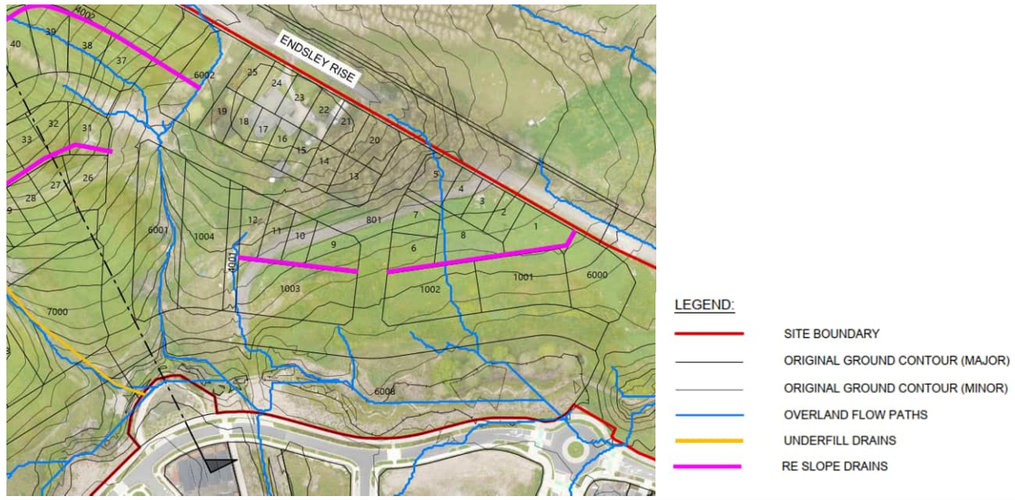
Cross Section J: - Remediated Slope, Normal Groundwater Condition:



<table>
<tr><th>Item #</th><th>Auckland Council Comments</th><th>Final Comment to Auckland Council in Response to Item</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Material Name</th><th>Color</th><th>Unit Weight (kN/m3)</th><th>Strength Type</th><th>Cohesion (kPa)</th><th>Phi (°)</th><th>Water Surface</th><th>Ru Value</th></tr>
<tr><td>Residual Northland Allocthon</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>5</td><td>28</td><td>None</td><td>0.2</td></tr>
<tr><td>Tauranga Group Alluvium (Stream)</td><td></td><td>17</td><td>Mohr-Coulomb</td><td>5</td><td>26</td><td>None</td><td>0.2</td></tr>
<tr><td>Transitional Hukerenui Mudstone</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>8</td><td>12</td><td>None</td><td>0.05</td></tr>
<tr><td>Hukerenui Mudstone</td><td></td><td>21</td><td>Mohr-Coulomb</td><td>20</td><td>28</td><td>None</td><td>0</td></tr>
<tr><td>Transitional Undifferentiated Mangakahia</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>8</td><td>21</td><td>None</td><td>0.05</td></tr>
<tr><td>Undifferentiated Mangakahia Rock Mass</td><td></td><td>21</td><td>Mohr-Coulomb</td><td>20</td><td>28</td><td>None</td><td>0</td></tr>
<tr><td>Mahurangi Limestone softened base contact</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>5</td><td>26</td><td>None</td><td>0.2</td></tr>
<tr><td>Transitional Mahurangi Limestone</td><td></td><td>19</td><td>Mohr-Coulomb</td><td>3</td><td>40</td><td>None</td><td>0</td></tr>
<tr><td>Mahurangi Limestone</td><td></td><td>19</td><td>Mohr-Coulomb</td><td>10</td><td>40</td><td>None</td><td>0</td></tr>
<tr><td>Proposed Engineered Fill</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>8</td><td>28</td><td>None</td><td>0</td></tr>
<tr><td>Shear Key</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>8</td><td>28</td><td>None</td><td>0</td></tr>
<tr><td>Buttress Fill</td><td></td><td>18</td><td>Mohr-Coulomb</td><td>8</td><td>28</td><td>None</td><td>0</td></tr>
</table>

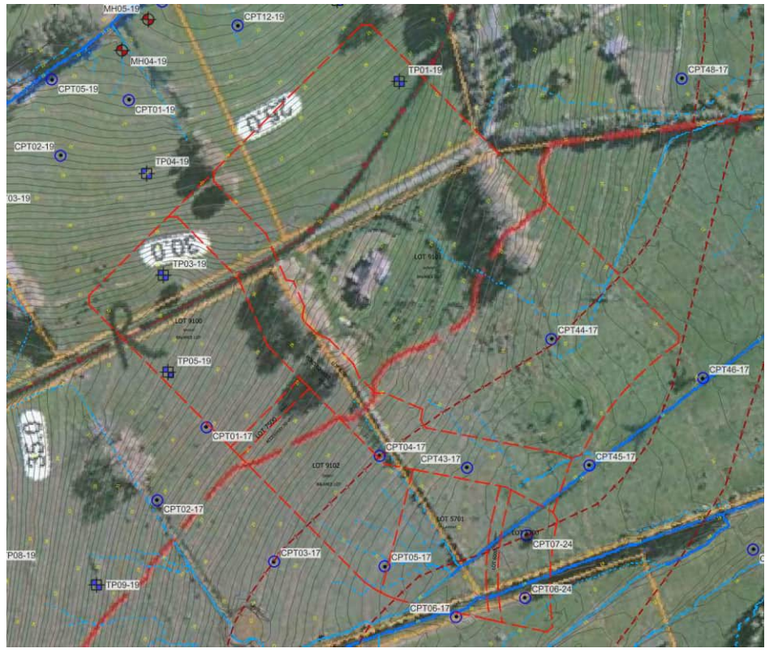
These sections were re-analysed to confirm that the minimum factors of safety returned for each case were still acceptable. On review, an error was noted in the sections included in the slope stability assessment – these pages have been updated and amended and are included in Appendix C. Minimum factors of safety in the remediated sections still meet ACCOPs requirements.
</td></tr>
<tr><td>20.11</td><td>Appendix F, Figure 3 of the slope stability assessment omits remediation outputs for Section A, which was identified as requiring remediation ‘retaining wall with palisade action’ in Section 5.</td><td>Figure 3, Section A-A, Proposed with Remediation model is shown below:
 
</td></tr>
<tr><td>20.12</td><td>Adopted parameters for the modelled retaining structures on the SLIDE outputs not shown e.g., Section A – Proposed with remediation (Retaining Walls), Section K- Proposed with Remediation (Shear Key and Retaining Wall).</td><td>This has been output again with the minimum pile shear strength parameters to achieve the global stability factor of safety requirements. We note that this wall will be subject to specific design. Pile parameters for Sections A and K are shown below. Updated outputs are in Appendix C.
Section A:
<table>
<tr><th>Support Name</th><th>Color</th><th>Type</th><th>Force Application</th><th>Out-Of-Plane Spacing (m)</th><th>Failure Mode</th><th>Pile Shear Strength (kN)</th><th>Force Orientation</th></tr>
<tr><td>Retaining Wall</td><td></td><td>Pile/ Micro Pile</td><td>Active (Method A)</td><td>1.2</td><td>Shear</td><td>50</td><td>Perpendicular to pile</td></tr>
</table>
</td></tr>
</table>

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		Section K: **Support Name** | **Color** | **Type** | **Force Application** | **Out-Of-Plane Spacing (m)** | **Failure Mode** | **Pile Shear Strength (kN)** | **Force Orientation** Palisade Wall (Retaining Wall) A | ■ | Pile/ Micro Pile | Active (Method A) | 1 | Shear | 90 | Perpendicular to pile
20.13	It is noted that restrictions are expected to be applied above and below the reinforced earth batters (from Section 8), an indicative plan should be provided to show the locations of development restriction zones as this may impact Lot placement and development yield.	We do not think this is appropriate to show at this stage, given there could be changes during construction. The developer is well versed in these limitations given the history of Milldale. These restriction zones will be clearly shown as part of the Geotechnical Completion Report (GCR) and applied as covenants on the record of title plans for each lot.
20.14	Reinforced slopes shown in the Milldale plans (e.g., P24-128-00-0013-SU) are not clearly shown in the remedial slope stability analyses e.g., Cross Section A and B etc. Are reinforced slopes still required in these areas or just drainage? We also note that Sections A and B has been excluded from drawing 25 by CMW for reinforced earth batter slopes. This creates inconsistency, may alter the ground profile and development restriction zones.  	Our typical reinforced earth slopes only require geogrids for face creep control, not for global stability so are not shown on stability models. All reinforced engineered fill batter slopes include a drainage blanket as shown in DG 25. Where further remediation is required to address global stability, shear keys (below the toe of the slope) and buttress fills (beyond the minimum 4m fill width required for the geogrid reinforcing) are proposed. Sections A & B do not require this remediation and as such are not listed in the tables provided in DG 25. DG 25 shown below for reference.  KEY / GRID TYPE / EMBEDMENT DEPTH L (m) / VERTICAL SPACING S (m) PRIMARY 4.0 1.5 SECONDARY 2.0 0.5 PRELIMINARY FILL BUTTRESS WIDTHS (FORMED AT 1V:2H, PARALLEL TO SLOPE FACE) UPPER RE SLOPE CROSS SECTION | WIDTH (m) G-G 26 H-H 17 I-I 13 J-J 20.5 MID RE SLOPE I-I 8 LOWER RE SLOPE J-J 12 NOTE: FINAL BUTTRESS WIDTHS TO BE DETERMINED ON SITE BY GEOTECHNICAL ENGINEER BY MAPPING EXPOSURE PRELIMINARY SHEAR KEY WIDTH AND DEPTHS BELOW UPPER RE SLOPE CROSS SECTION | BASE WIDTH (m) | DEPTH (m) G-G 19.5 5 H-H 17 5 I-I 10 6 J-J 14 7 BELOW MID RE SLOPE I-I 10 4.5 K-K 12 4.5 BELOW LOWER RE SLOPE J-J 12 4.5 NOTE: FINAL SHEAR KEY DEPTHS TO BE DETERMINED ON SITE BY GEOTECHNICAL ENGINEER, MINIMUM EMBEDMENT INTO NORTHLAND ALLOCHTHON ROCK = 0.5m ENGINEERED FILL BUTTRESS TO BE CONSTRUCTED BY OVER EXCAVATING AND REPLACING WITH ENGINEERED FILL AT 1V:2H (PARALLEL TO SLOPE FACE). LOCATIONS SHOWN ON DG18. PRELIMINARY DESIGN WIDTHS SHOWN ON TABLE 4.0m 2.0m 0.5m 1.5m 0.5m 1V:2H 1V:2H MINIMUM ENGINEERED FILLING WIDTH = 4.5m TO ALLOW FOR GEOGRIDS AND DRAINAGE INSTALLATION. ENGINEERED FILL 300mm THICK SCORIA BLANKET, SAP50 BATTER SLOPE TYPICALLY UP TO 13m HIGH NORTHLAND ALLOCHTHON SOILS 160mm PERFORATED HIGHWAY GRADE NOVACOIL SHEAR KEYS AS REQUIRED , REFER TO DRAWING 18 FOR LOCATIONS AND PRELIMINARY DIMENSIONS ON TABLE DRAINAGE TO OUTLET AT PROPOSED STREAMS. OUTLETS TO BE 160mm SOLID PVC NORTHLAND ALLOCHTHON ROCK NOTE: 1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE

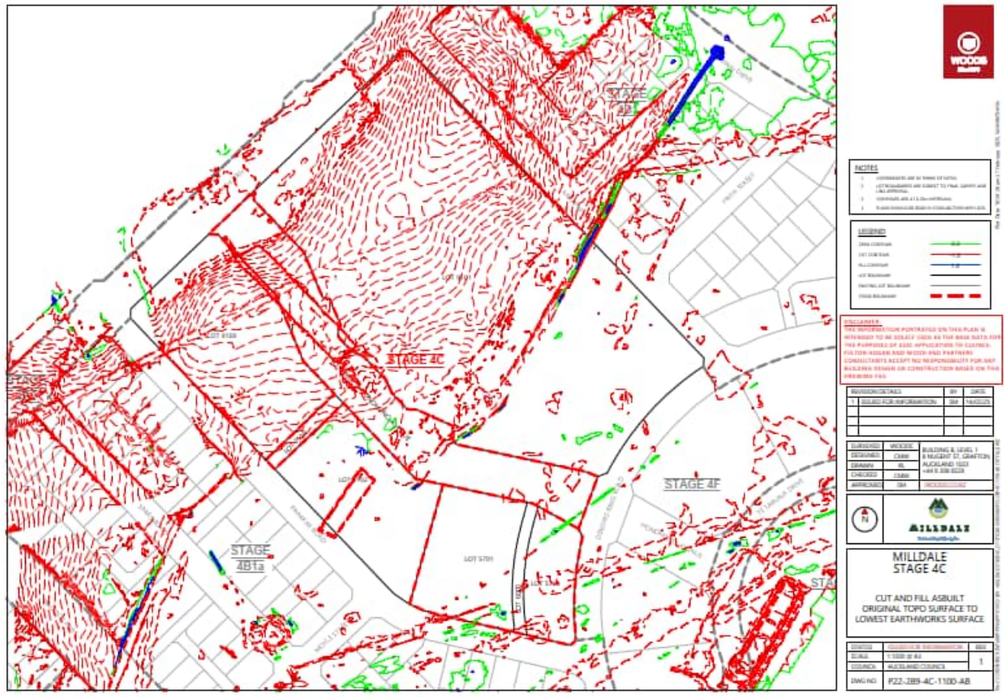
Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		The CMW Underfill Drain Plan – Stage 10 & 11 (DG 19) has been updated to include the RE slope drains in Stage 10, shown below, and included in ***Appendix A***. 
20.15	**(Comment to DE)** Considerations should be made to the potential migration of streams over the 100 year period for assessment under E36.9(2). Noting that streams can meander and therefore encroach on building platforms/access ways.	Council has indicated this is an internal comment for the development engineer in Council, not for CMW to respond to.
20.16	**Key concern:** Additional characterisation of geohazards required to inform consent sought including settlement monitoring of filling works and slope stability analyses (comment 5, 10, 12 and 14) would be required to inform on E12, E36 and E38 assessment.	Further site investigation and modelling has been undertaken to inform extents and design of the palisade wall required in Stage 10 (Item 20.5). Additionally, further explanation of expected settlement timeframes (Item 20.1), and laboratory testing undertaken which informed parameter selection (Item 20.9) has been provided. Clarification has been provided of the stability analyses undertaken (Items 20.5, 20.10, 20.12 & 20.14)

3.0 STAGE 4C

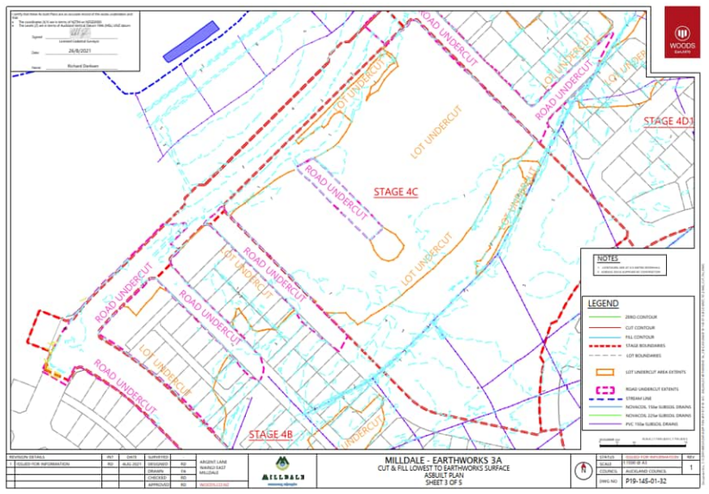
Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
20.17	The related documents in Section 4 of the report were not provided for review in this submission. There is no specific geotechnical site investigation provided for the site. The geotechnical model was based on existing site investigation data on the subject and adjacent sites. This poses a few risks: • Section 5 of the report refers to data presented in Geotechnical Investigation Reports for Stage 2, 3 and 4. These reports were not submitted as part of this consent for review. • Of the investigation shown on the site plan for the Stage 4C area, there are only 3 test pits that allows the visualisation of the subsurface material, which are concentrated at the northwest extent of the site. The rest of the investigation consists of CPT only. There is also a lack of investigation at the northern portion of the site. • No representative geological cross sections were provided.	The documents listed in Section 4 of the Stage 4C Geotechnical Assessment Report (listed below) have been provided for review. **Report** / **Reference and/or Comments** Geotechnical Investigation Report – Stages 2 & 3 / AKL2017_0069AC Rev.3, dated 18/09/2017 Stability Assessment / Appendix D to report AKL2017_0069AC Rev.3 Settlement Assessment / Appendix E to report AKL2017_0069AC Rev.3 Liquefaction Assessment / Appendix F to report AKL2017_0069AC Rev.3 Earthfill Completion Report – Earthworks 2 & 2A / AKL2017_0069BY Rev.0, dated 4/11/2019 Geotechnical Investigation Report – Earthworks 3A / AKL2019-0081AD Rev.1, dated 20/11/2019 Earthfills Completion Report – Earthworks 3A / AKL2019-0161CI Rev.0, dated 5/04/2022 Geotechnical Investigation Report – Subdivision Stage 4 / AKL2019-0238AD Rev.0, dated 3/08/2020 Geotechnical Letter – Stage 4C-1 Earthworks Consent / AKL2019-0161DJ Rev.1, dated 12/05/2023 In addition, Stage 4C-1 Geotechnical Completion Report, referenced AKL2019-0238AH, Rev 0, dated 13/03/2025 has been provided. Extensive earthworks have been undertaken and monitored by CMW across Stage 4C under previous consents, certified in the relevant completion reports;

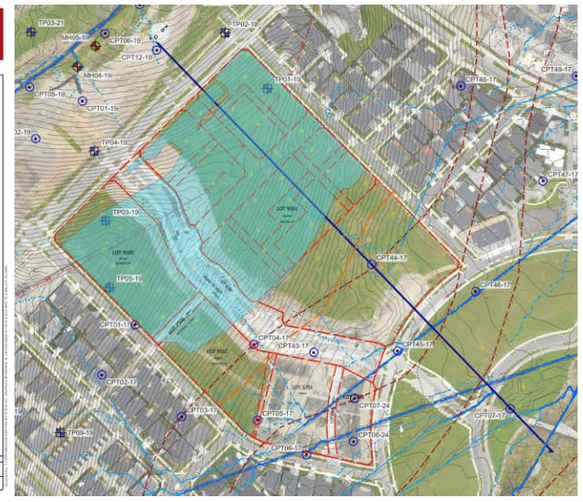
Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
	• It was not stated how the groundwater levels across the site were inferred.	• Earthfill Completion Report – Earthworks 2 & 2A, referenced AKL2017_0069BY Rev.0, dated 4/11/2019, • Earthfills Completion Report – Earthworks 3A, referenced AKL2019-0161CI Rev.0, dated 5/04/2022. These works included the placement of engineered filling across the lower portion of the slope, and cutting of the upper portion, including the ridgeline. Where Northland Allochthon rock mass or transitional materials were encountered, this was undercut by a minimum depth of 0.85m and replaced with engineered filling. The image below shows the original Stage 4C contour, with the ridgeline evident (labelled - R -) in the upper part of the site. The heavy dashed red line downslope / south of the dwelling in the central part of the site indicates the upslope / northern limit of the Earthworks 2 fills. As-built plans of these fills are appended to the Earthfill Completion Report – Earthworks 2 & 2A, referenced AKL2017_0069BY Rev.0, dated 4/11/2019).  Below shows the as-built extent of cuts (0.25m red contour) undertaken across the site (original to lowest surface comparison), appended to the Stage 4C-1 Geotechnical Completion Report, referenced AKL2019-0238AH, Rev 0, dated 13/03/2025.

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item



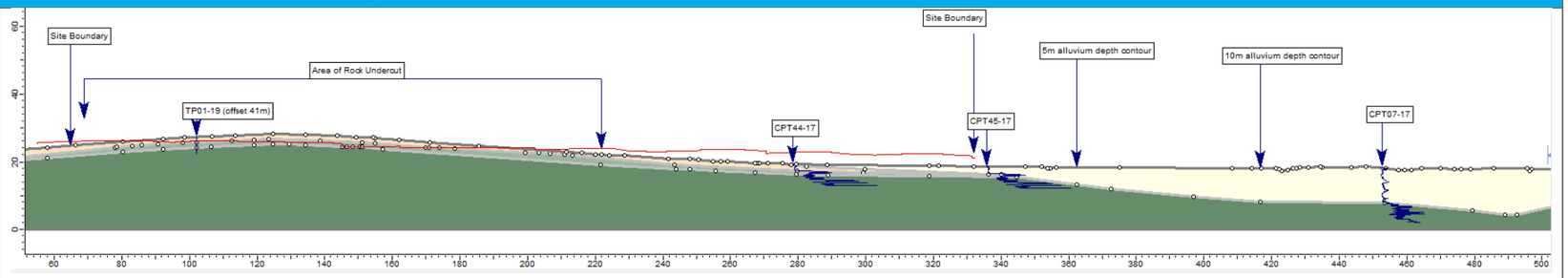
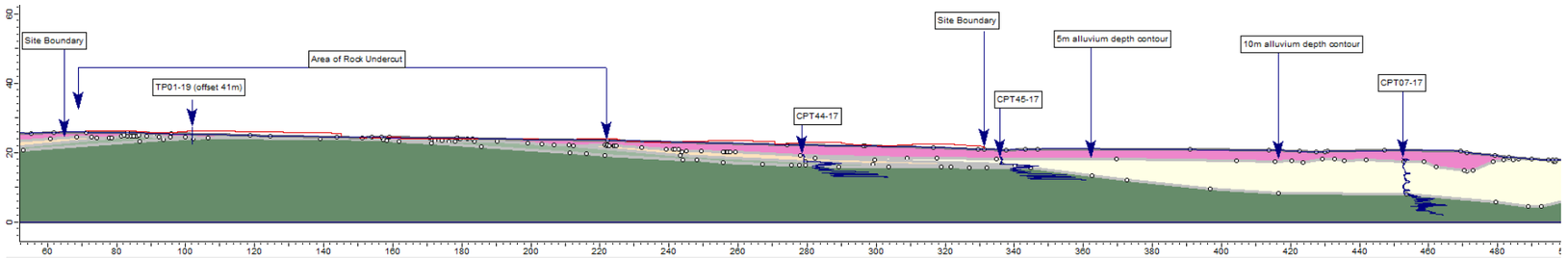
The as-built plan (below left) and site investigation plan (below right) show the extents of the rock undercut (in blue below right). Additionally, alluvium depth contours are shown (brown dash) below right on the site investigation plan – these have been compiled and updated by CMW from CPT and machine hole data since the earliest investigations at Milldale (refer Stage 2 & 3 GIR).



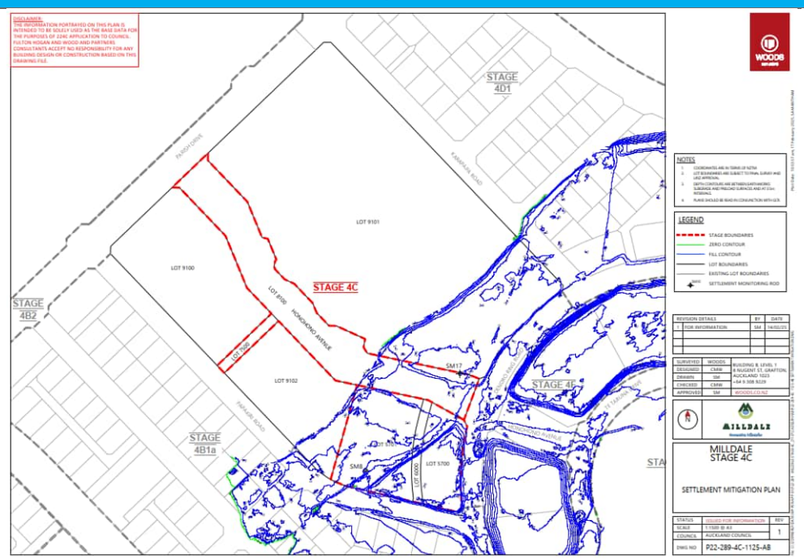
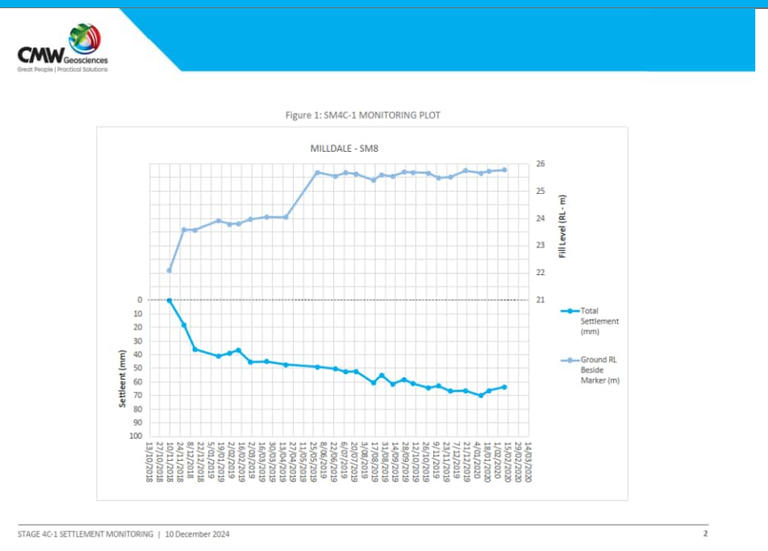


The cross section (XS Q) shown above right on the SI plan is below.

Original ground surface contour, with proposed (Stage 4C, Phase 2) contour in red:

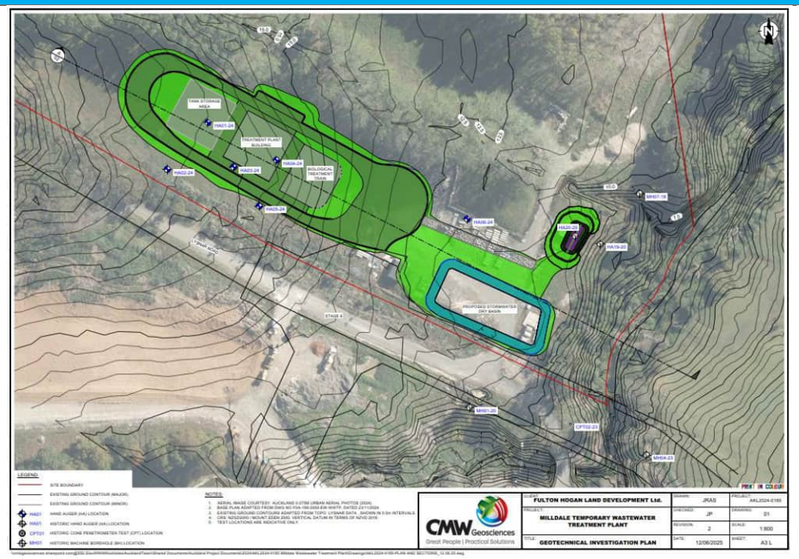
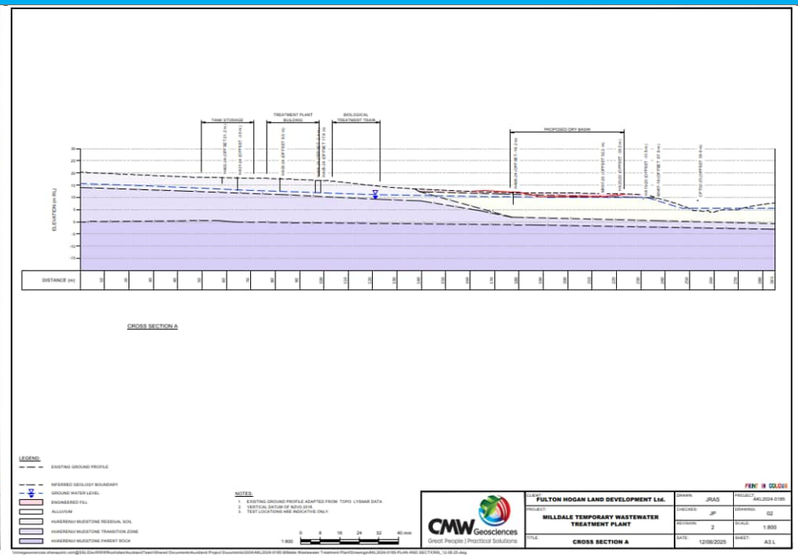
Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		 Current (post EW2 and EW3A) ground surface contour, with proposed (Stage 4C, Phase 2) contour in red. Areas of certified engineered filling are shown in pink.  Considering the very gentle to flat gradient shown above, we do not believe that assessment for global instability is required. A network of underfill drains, at a minimum of 50m spacing was installed beneath the fill areas; we expect that groundwater is typically found at the base of these engineered fills, and this has been confirmed as being the case on earlier stages of Milldale that were constructed in the same manner. Underfill drains are shown on the as-built plan above as purple lines.
20.18	While it is understood that slope stability analyses were not undertaken on the basis that the site is on a gentle landform, the proposed filling and retaining would result in level difference of up to 2m, where it would be appropriate to conduct slope stability analyses to confirm that global instability is not an issue.	As discussed in Item 20.17 above, we do not believe that global stability analyses are required. Local stability will be assessed during specific design of retaining walls. View west from eastern corner of site: 

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		View east from western corner of site: 
20.19	No recommendations or preliminary construction methodology were provided for the proposed retaining wall.	As in item 20.3 above, typically at Milldale, earthworks / retaining walls are constructed beyond stage boundaries where practical to avoid temporary works situations and where construction makes sense. In the event this does not occur, the following typical measures have been used at Milldale to control temporary stability. We typically would note these as part of the building consent design report for walls. • Leaving cut retaining walls at an appropriate temporary batter angle (typically shallower than 1V:3H) • Overfilling in areas of future fill retaining walls, batters at 1V:3H
20.20	Section 8.2 have mentioned that up to 50mm of post construction settlement may be expected for future development load of 10kPa, it has recommended if higher future development load is proposed, either further investigation and settlement monitoring should be undertaken during Phase 1 works, or additional settlement mitigation measures should be implemented during Phase 2 works. We suggest that be communicated to the applicant and included as an advice note or other similar approaches to ensure it is captured.	Noted. This will also be communicated in the relevant completion reports.
20.21	It is noted that earthworks and retaining are proposed to be staged, details should be provided to clarify how stability will be maintained between the substages of Stage 4C2 - 5 (particularly where earthworks and retaining are proposed at the stage boundaries).	Noted above in Item 20.19. Typically, earthworks fills will be placed beyond the proposed wall locations, to be cut back for the construction of the walls. Fills are typically battered to 1V:3H. Retaining walls in Stage 4C do not serve a global stability function.
20.22	Evidence of preloading, geotechnical supervision records etc., which was carried out during 'Earthworks 2' referenced in section 8.2 of should be provided for to support safe building platform and accessway as this impacts Stages 4C2 and 4.	The completion reports listed in Item 20.17 above contain summaries of the works observed and the results of geotechnical testing conducted by CMW. The Settlement Mitigation Plan from the Stage 4C-1 Geotechnical Completion Report (GCR), referenced AKL2019-0238AH, Rev 0, dated 13/03/2025 shows the preloads placed across the alluvial soils in the lower part of the site, and the locations of the settlement plates which were monitored. The plot of the SM8 monitoring data is shown below right.

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		 
20.23	**Key concern:** Lack of site investigations to support reporting, assessment and recommendations.	The accumulated knowledge of the ground conditions across this site is available from several previous reports which although referenced, were not originally supplied for information. (see Item 20.17 above). We do not believe that further site investigation is necessary given the consented works already undertaken across the site, much of which allowed for direct observation of the underlying rock mass. The engineered fills placed across the lower portion of the site have been preloaded where required, monitored for settlement over several years and subsequently certified in the supplied reports. The resultant landform is significantly gentler than the original.

4.0 WASTEWATER TREATMENT PLANT

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
20.24	The related documents in Section 4, in particular the Geotechnical Investigation Report for Milldale Stage 8, was not provided in this submission for our review. This is expected to include the previous investigation information that was referenced in Section 5.	The GIR for Stage 8 (referenced AKL2022-0029AE Rev.3, dated 4 September 2024) has been provided for information.
20.25	Site plan only showing locations of hand augers undertaken for this stage of the works, though Section 5.1 has stated previous investigation locations should also be shown on the site plan. It is unsure what deep investigation data was relied on to create the geological cross section as the hand augers are only 5m deep.	The CMW Geotechnical Investigation Plan and Cross Section A (WWTP DG 01 & 02) have been updated to include the mentioned previous investigations and are shown below, and included in ***Appendix A***. The related logs are in ***Appendix D***.

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
		 
20.26	Groundwater level and dry basin profile not shown on the geological cross section.	Drawing 02 (Geological Cross Section A) has been updated to include the groundwater level and dry basin profile, see 20.25 above.
20.27	No slope stability analyses were provided on the basis that the site is gently sloping and maximum cut and fill batter gradients of 1V:5H and 1V:3H respectively will be created. While the 1V:3H slopes made of engineering fill could normally considered conservative for stability, given the large surcharge loading and underlying 'problematic' Northland Allochthon residual soils, it would be more appropriate to undertake slope stability analyses to confirm the stability of the cut and fill slopes.	We have carried out the slope stability analysis for Section A. Please refer to ***Appendix C*** for the memo. The required factors of safety were met for all scenarios; no additional remediation is required.
20.275	Advice note is recommended for: • structural or civil engineer to confirm the estimated differential settlement of 25mm is acceptable for the proposed wastewater treatment plant. • settlement analysis to be reassessed if there is a change in the assumed loading.	The WWTP design was undertaken using advice from CMW that 25mm of differential settlement was anticipated. We have sought further confirmation from the WWTP designer that this is acceptable, to be provided separately in the form of an advice note. Reassessment of settlement will be undertaken if there is any change in the assumed loading.
20.28	Table 2: Testing Requirements of the Earthworks Specification deviates from the minimum testing requirements recommended by NZS4431:2022, particularly the 'field water content and density' for all three types of soil fill and 'shear strength' for the fine grained and intermediate grained fill. Of note, while NZS4431 has acknowledged that the geotechnical designer can modify to suit project-specific requirements, evidence should be provided to demonstrate that the amended requirements will result in the same or better engineered fill. No evidence has been supplied to address this.	Refer to comment 20.7 above.

5.0 CONDITIONS

Item #	Auckland Council Comments	Final Comment to Auckland Council in Response to Item
20.29	**Stage 10-13** • Condition 26, 43, 69, 86 refers to an outdated report (most up to date version is Rev3, dated 24 March 2025). (Please note that the groundwater conditions also feature this outdated report). • Condition 12 uses the word 'shall' when we should be using 'must' for the Settlement Monitoring Plan. SMP also appears to reference a site management plan and this may confuse the two plans. • Condition 43 and condition 44 appears to be in duplication and we recommend removing condition 43 in favour of Condition 44 to make it clear on expected completion documentation requirements. • Condition 44 for the geotechnical completion report should include a Statement of Professional Opinion (SOPO) and certified as-built plans.	• Conditions 26, 43, 69, 86: – these can be referenced to the latest Rev 3 report: ***Geotechnical Investigation Report, referenced AKL2024-0257AB, Rev. 3, prepared by CMW Geosciences, dated 24 March 2025***. • Condition 12 - Noted – to be amended in Conditions. • Condition 43 & 44 - agreed on removal of Condition 43 as Condition 44 is more suitable. • Condition 44 - agree on SOPO and certified as-builts. Additionally, restriction zones will be provided as part of the GCR.
20.30	**Stage 4C – Phases 1 & 2** • We agree that a condition for a settlement monitoring plan, supervision of works and geotechnical completion reporting is required. Condition 29 for the geotechnical completion report should include a Statement of Professional Opinion and certified as-built plans. • We suggest that condition 42 remain open for update noting the lack of site investigations undertaken may warrant a new report to be submitted and reviewed.	• Condition 14 – agreed on change from "shall" to "must" with regards to the Settlement Monitoring Plan. • Conditions 20 & 29 – agree on SOPO and certified as-builts. Additionally, restriction zones will be provided as part of the GCR. • Condition 42 – there will be specific reports for retaining walls for Building Consents under the standard process.
20.31	**WWTP** We agree with that supervision of works are required. Noting works are relatively smaller in scale, we suggest that the contents outlined in Condition 27 (GCR CONDITION) may not be warranted for the activity. We suggest that the condition be revised to be more akin to Condition 43 for the Stage 10 – 13.	• Agreed.

6.0 CLOSURE

Additional important information regarding the use of your CMW report is provided in the *'Using your CMW Report'* document attached to this report.

This report has been prepared for use by Fulton Hogan Land Development Limited in relation to the Fast Track Application, Milldale, Wainui East project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than Fulton Hogan Land Development Limited seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

Environmental Matters Are Not Covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

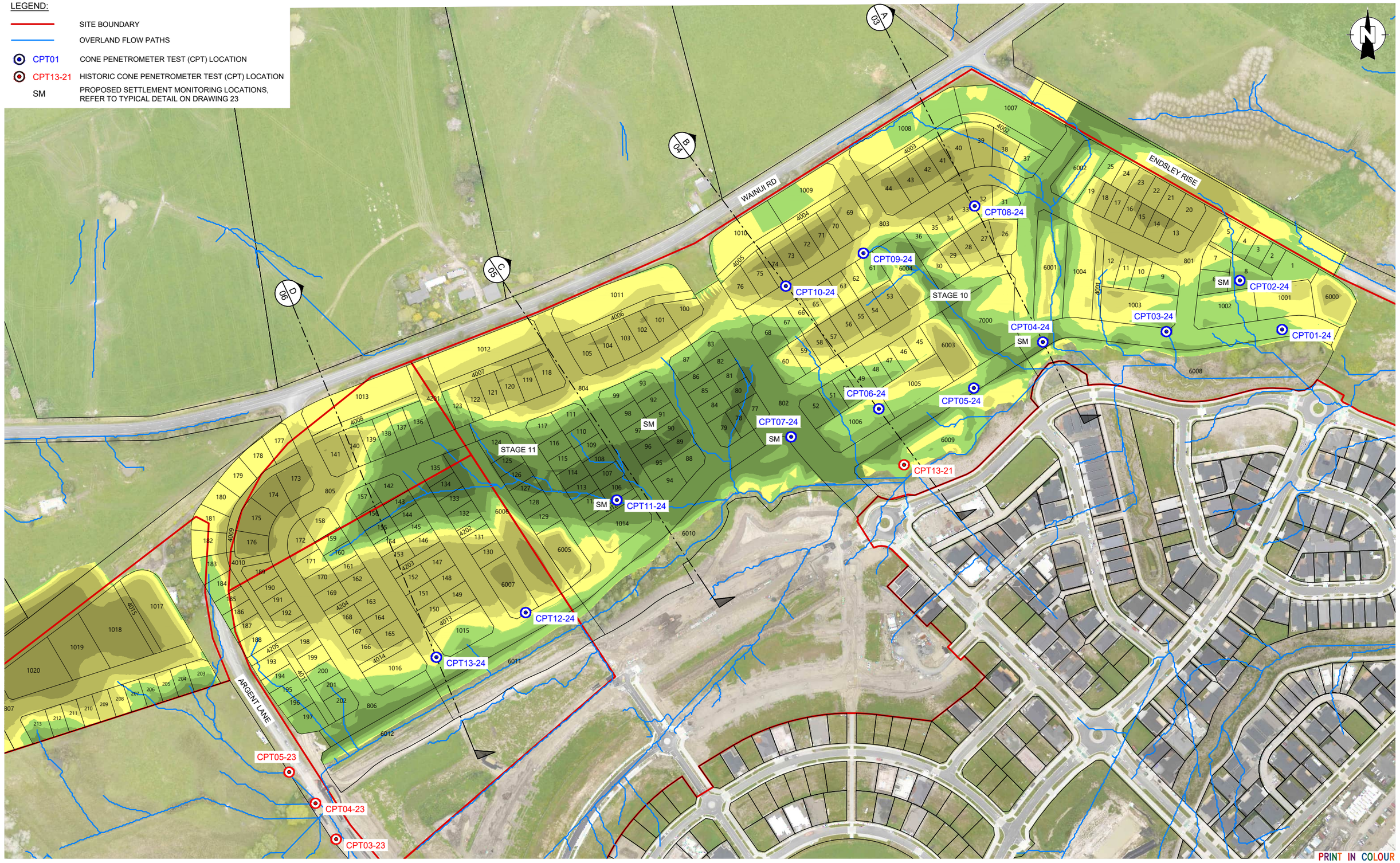
The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

APPENDIX A
Drawings

Item #	Title	Reference	Date	Revision
20.1	Settlement Monitoring Plans	AKL2024-0257 DG21-22	8/07/2025	1
20.2	Geological Cross Sections A to L	AKL2024-0257 DG05-16	17/07/2025	1
20.4	Remediation Plan Stage 10 & 11	AKL2024-0257 DG17	3/07/2025	1
20.5	Woods Cut-Fill Plan	P24-128-00-1202-EW	July 2025	2
20.14	Underfill Drain Plan – Stage 10 & 11	AKL2024-0257 DG19	9/07/2025	1
20.25	Geotechnical Investigation Plan and Cross Section A	AKL2024-0185 DG01 & 02	12/06/2025	2

LEGEND:

- SITE BOUNDARY
- OVERLAND FLOW PATHS
- CPT01 — CONE PENETROMETER TEST (CPT) LOCATION
- CPT13-21 — HISTORIC CONE PENETROMETER TEST (CPT) LOCATION
- SM — PROPOSED SETTLEMENT MONITORING LOCATIONS, REFER TO TYPICAL DETAIL ON DRAWING 23



NOTES:

1. AERIAL IMAGE ADAPTED FROM P16-269_Milldale_20241015.
2. BASE PLAN ADAPTED FROM Milldale FastTrack 3d contours 20012025 & LINZ.
3. CUT FILL DEPTH ADAPTED FROM XP24-128_S10_11 CUT FILL DEPTH
4. CRS: NZGD2000 / MOUNT EDEN 2000. VERTICAL DATUM IN TERMS OF AUCKHT1946.
5. TEST LOCATIONS ARE INDICATIVE ONLY.

1:3000 0 30 60 90 120 150 m

CMW Geosciences
Great People | Practical Solutions

CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 21
		REVISION: 1	SCALE: 1:3000
TITLE: SETTLEMENT MONITORING PLAN STAGE 10 & 11		DATE: 08/07/2025	SHEET: A3 L

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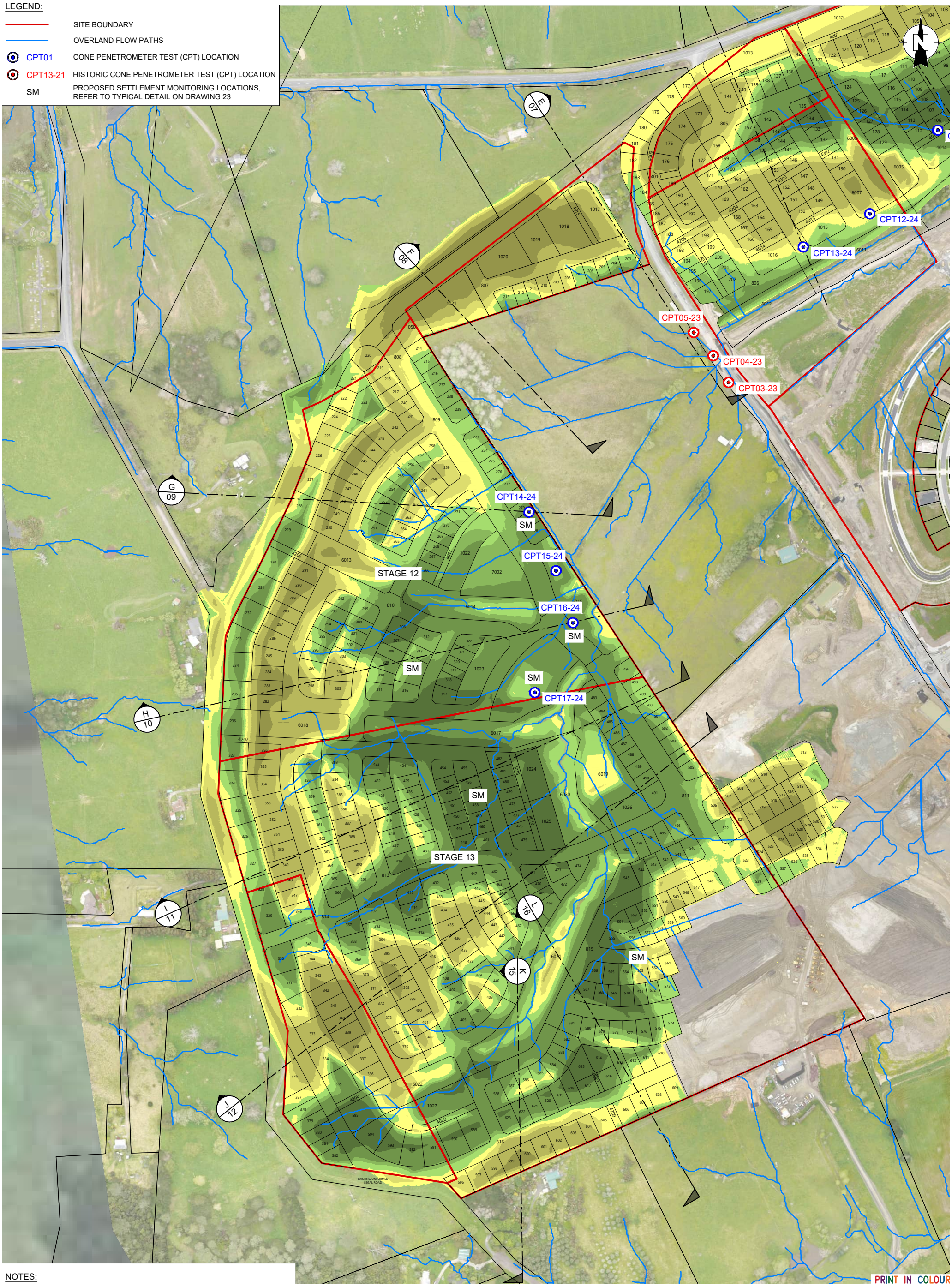
LEGEND:

- SITE BOUNDARY
- OVERLAND FLOW PATHS
- CPT01 — CONE PENETROMETER TEST (CPT) LOCATION
- CPT13-21 — HISTORIC CONE PENETROMETER TEST (CPT) LOCATION
- SM — PROPOSED SETTLEMENT MONITORING LOCATIONS, REFER TO TYPICAL DETAIL ON DRAWING 23



NOTES:

1. AERIAL IMAGE ADAPTED FROM P16-269_Milldale_20241015.
2. BASE PLAN ADAPTED FROM Milldale FastTrack 3d contours 20012025 & LINZ.
3. CUT FILL DEPTH ADAPTED FROM XP24-128_S10_11 CUT FILL DEPTH & XP24-128_S12_13 DEPTH CONTOURS
4. CRS: NZGD2000 / MOUNT EDEN 2000. VERTICAL DATUM IN TERMS OF AUCKHT1946.
5. TEST LOCATIONS ARE INDICATIVE ONLY.

1:4000 0 40 80 120 160 200 m

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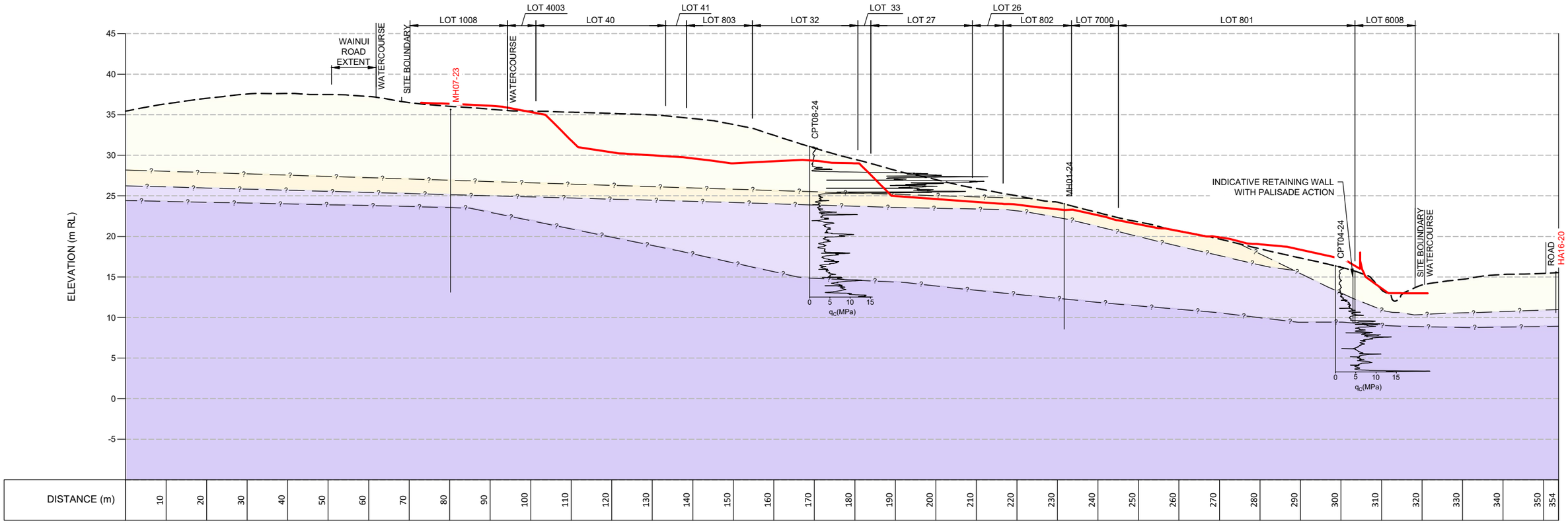
CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 22
		REVISION: 1	SCALE: 1:4000
TITLE: SETTLEMENT PLAN STAGES 12 & 13		DATE: 08/07/2025	SHEET: A3 L



CROSS SECTION A

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- TAURANGA GROUP ALLUVIUM
- RESIDUAL NORTHLAND ALLOCTHON
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1000 — 0 10 20 30 40 50 m

VERT. 1:500 — 0 5 10 15 20 25 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257	
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 05	
	REVISION: 1	SCALE: AS SHOWN	
TITLE: CROSS SECTION A	DATE: 17/07/2025	SHEET: A3 L	

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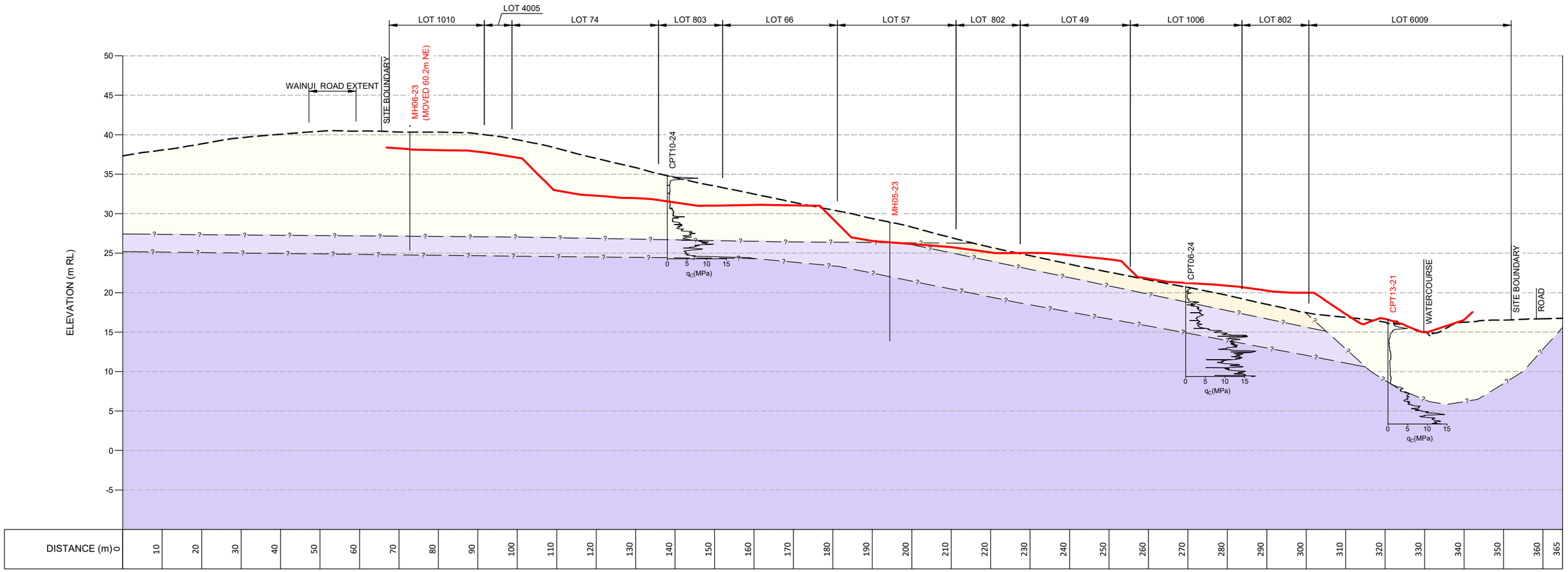

CROSS SECTION B

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- TAURANGA GROUP ALLUVIUM
- RESIDUAL NORTHLAND ALLOCTHON
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1000 — 0 10 20 30 40 50 m

VERT. 1:500 — 0 5 10 15 20 25 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257	
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 06	
	REVISION: 1	SCALE: AS SHOWN	
TITLE: CROSS SECTION B	DATE: 17/07/2025	SHEET: A3 L	

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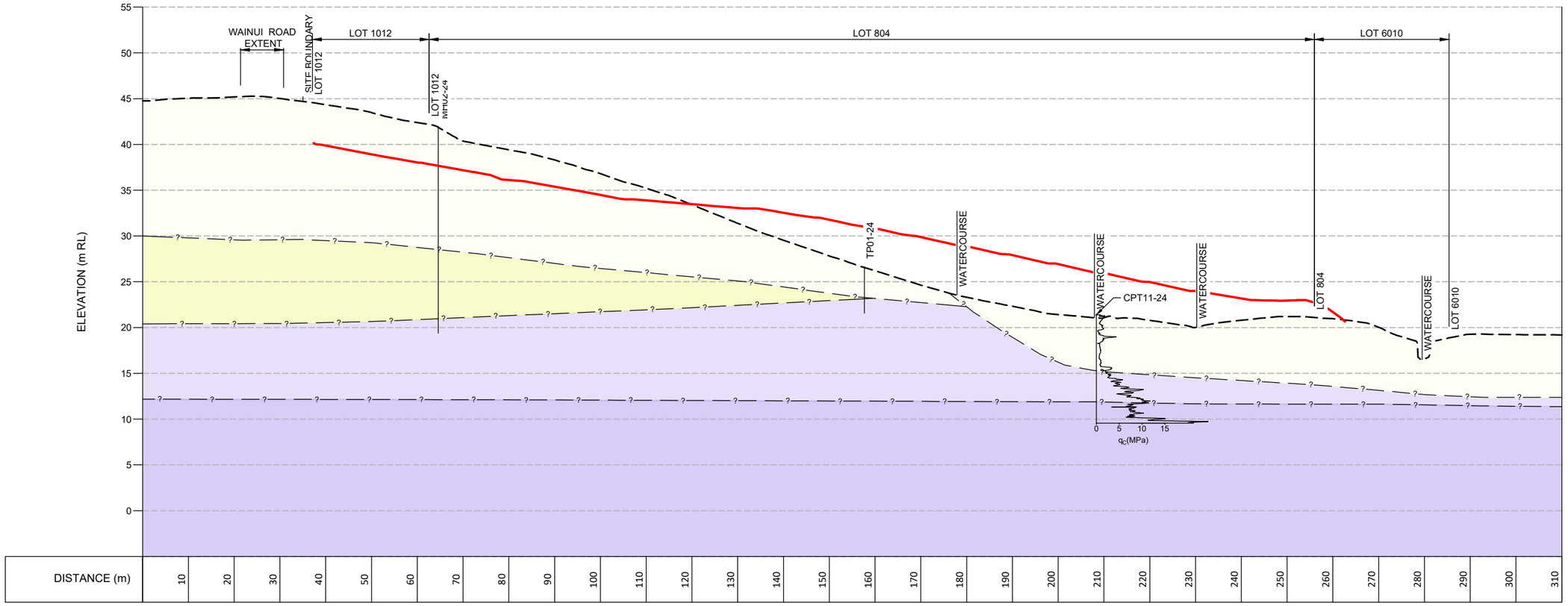

CROSS SECTION C

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- TAURANGA GROUP ALLUVIUM
- COLLUVIUM
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1000 — 0 10 20 30 40 50 m

VERT. 1:500 — 0 5 10 15 20 25 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 07
	REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION C	DATE: 17/07/2025	SHEET: A3 L

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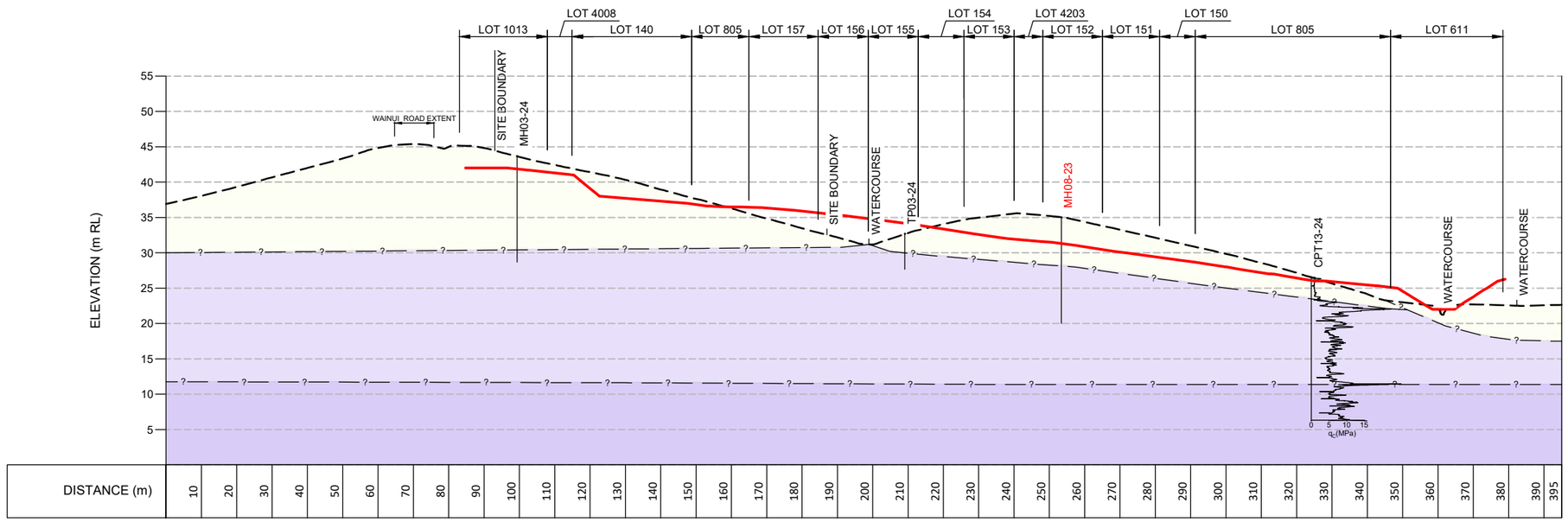

CROSS SECTION D

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- TAURANGA GROUP ALLUVIUM
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1500 — 0 15 30 45 60 75 m

VERT. 1:750 — 0 7.5 15 22.5 30 37.5 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 08
	REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION D	DATE: 17/07/2025	SHEET: A3 L

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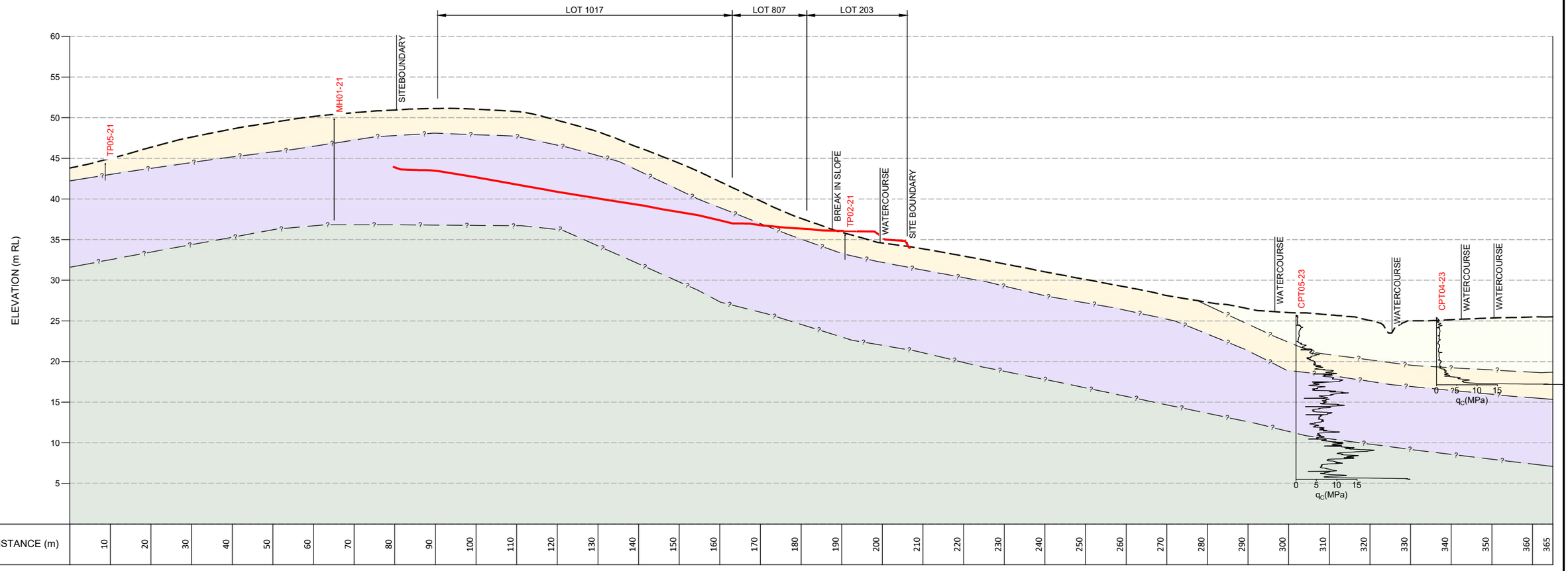

CROSS SECTION E

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- RESIDUAL NORTHLAND ALLOCTHON
- TAURANGA GROUP ALLUVIUM
- TRANSITIONAL HUKERENUI MUDSTONE
- TRANSITIONAL MANGAKAHIA

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1000 — 0 10 20 30 40 50 m

VERT. 1:500 — 0 5 10 15 20 25 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 09
	REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION E	DATE: 17/07/2025	SHEET: A3 L

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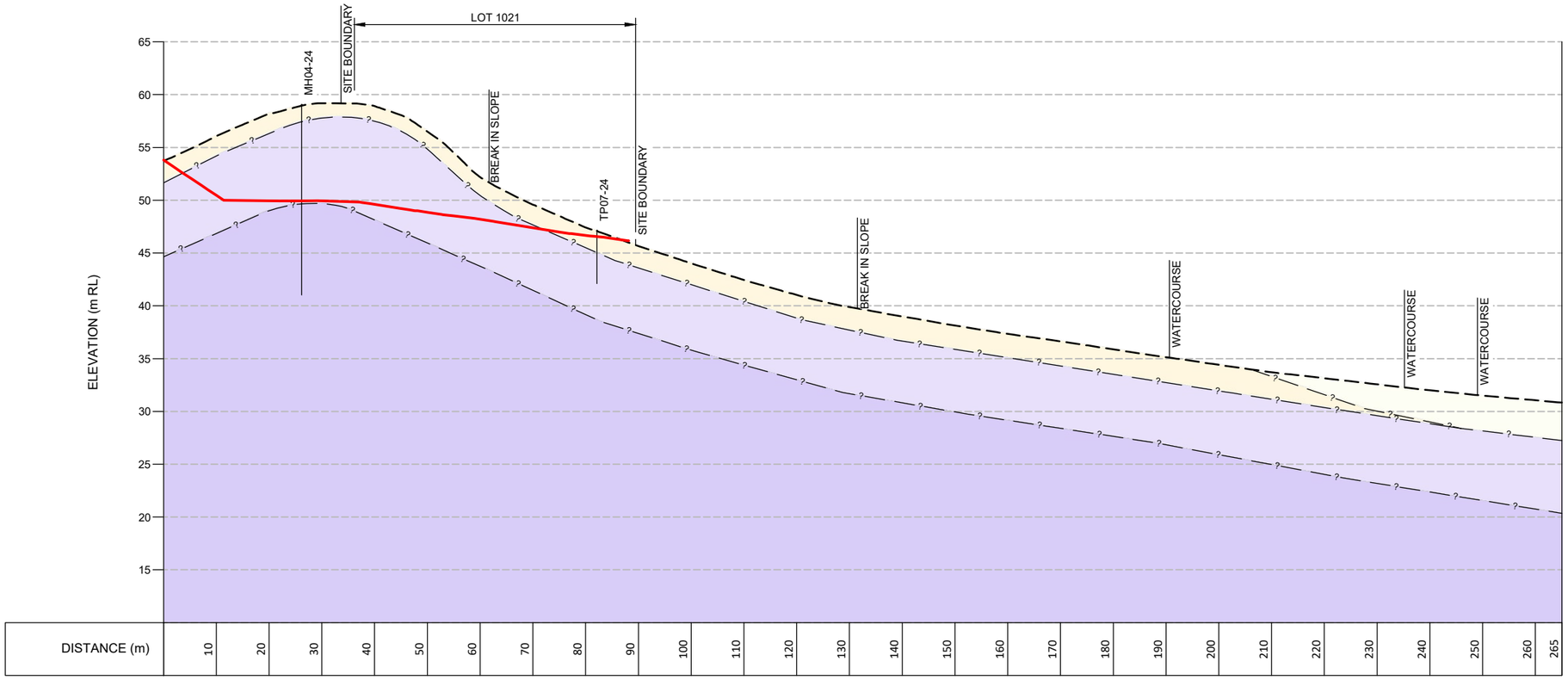

CROSS SECTION F

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- TAURANGA GROUP ALLUVIUM
- RESIDUAL NORTHLAND ALLOCTHON
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1000 — 0 10 20 30 40 50 m

VERT. 1:500 — 0 5 10 15 20 25 m

PRINT IN COLOUR

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 10
		REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION F		DATE: 17/07/2025	SHEET: A3 L

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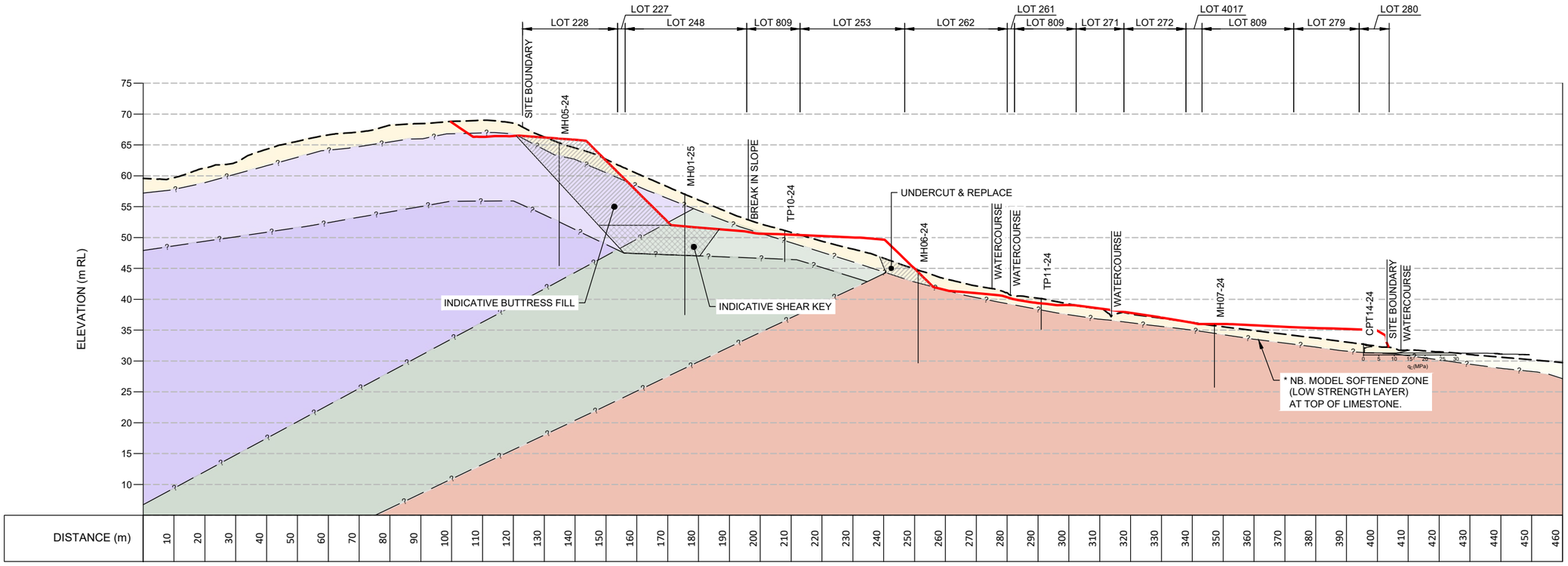

CROSS SECTION G

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- RESIDUAL NORTHLAND ALLOCTHON
- TAURANGA GROUP ALLUVIUM
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE
- TRANSITIONAL UNDIFFERENTIATED MANGAKAHIA
- UNDIFFERENTIATED MANGAKAHIA ROCK MASS
- MAHURANGI LIMESTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1500 — 0 15 30 45 60 75 m

VERT. 1:750 — 0 7.5 15 22.5 30 37.5 m

PRINT IN COLOUR

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 11
	REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION G	DATE: 17/07/2025	SHEET: A3 L

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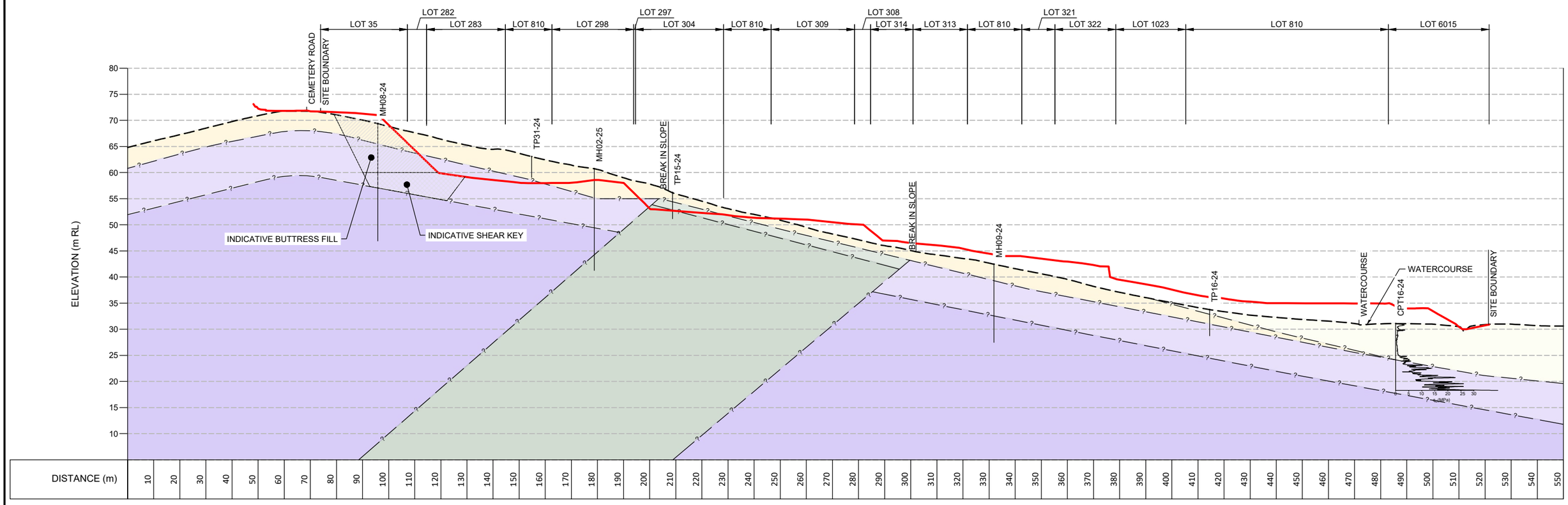

CROSS SECTION H

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- RESIDUAL NORTHLAND ALLOCTHON
- TAURANGA GROUP ALLUVIUM
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE
- TRANSITIONAL UNDIFFERENTIATED MANGAKAHIA
- UNDIFFERENTIATED MANGAKAHIA ROCK MASS

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:1500 — 0 15 30 45 60 75 m

VERT. 1:750 — 0 7.5 15 22.5 30 37.5 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 12
		REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION H		DATE: 17/07/2025	SHEET: A3 L

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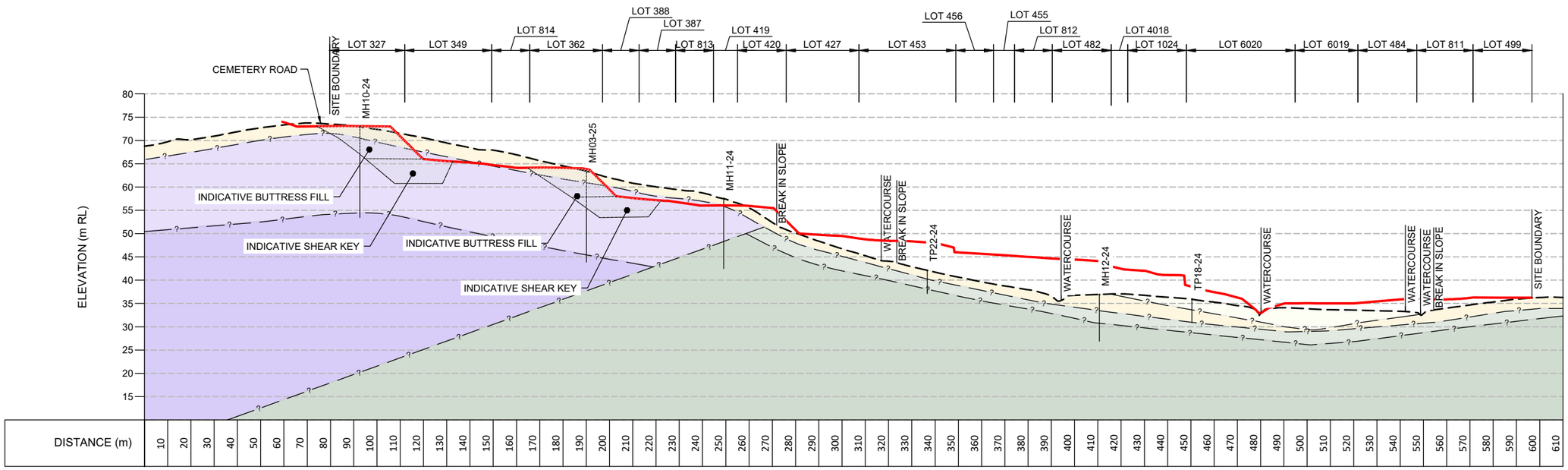

CROSS SECTION I

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- RESIDUAL NORTHLAND ALLOCTHON
- TAURANGA GROUP ALLUVIUM
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE
- TRANSITIONAL UNDIFFERENTIATED MANGAKAHIA
- UNDIFFERENTIATED MANGAKAHIA ROCK MASS

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:2000 — 0 20 40 60 80 100 m

VERT. 1:1000 — 0 10 20 30 40 50 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 13
		REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION I		DATE: 17/07/2025	SHEET: A3 L

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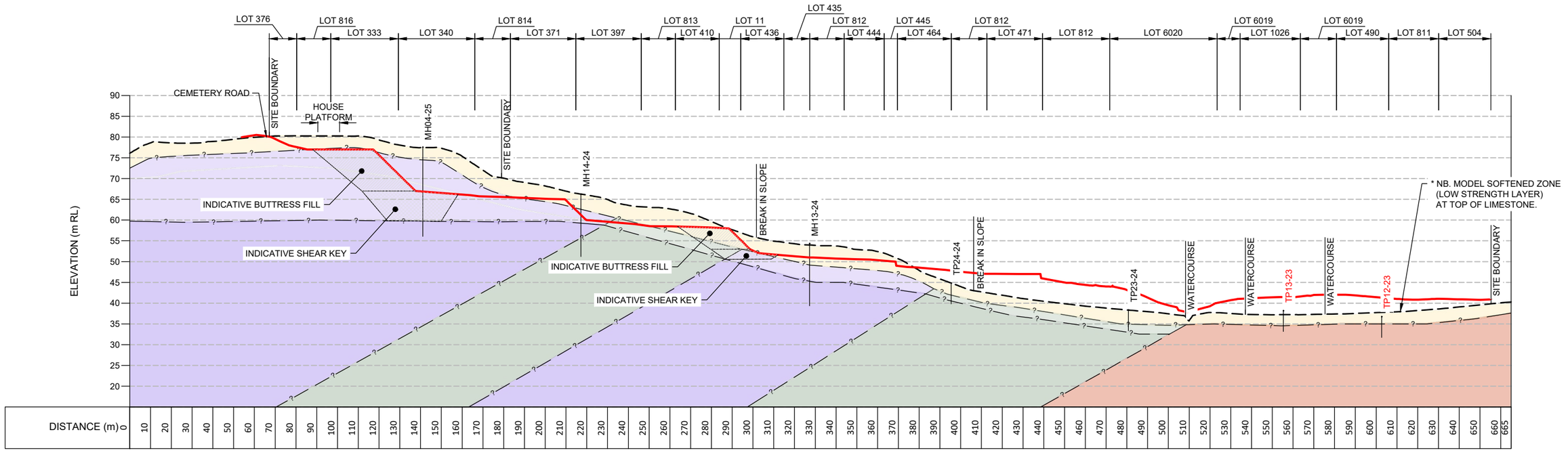

CROSS SECTION J

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- RESIDUAL NORTHLAND ALLOCTHON
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE
- TRANSITIONAL UNDIFFERENTIATED MANGAKAHIA
- UNDIFFERENTIATED MANGAKAHIA ROCK MASS
- MAHURANGI LIMESTONE

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

HORI. 1:2000 — 0 20 40 60 80 100 m

VERT. 1:1000 — 0 10 20 30 40 50 m

PRINT IN COLOUR

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 14
		REVISION: 1	SCALE: AS SHOWN
TITLE: CROSS SECTION J		DATE: 17/07/2025	SHEET: A3 L

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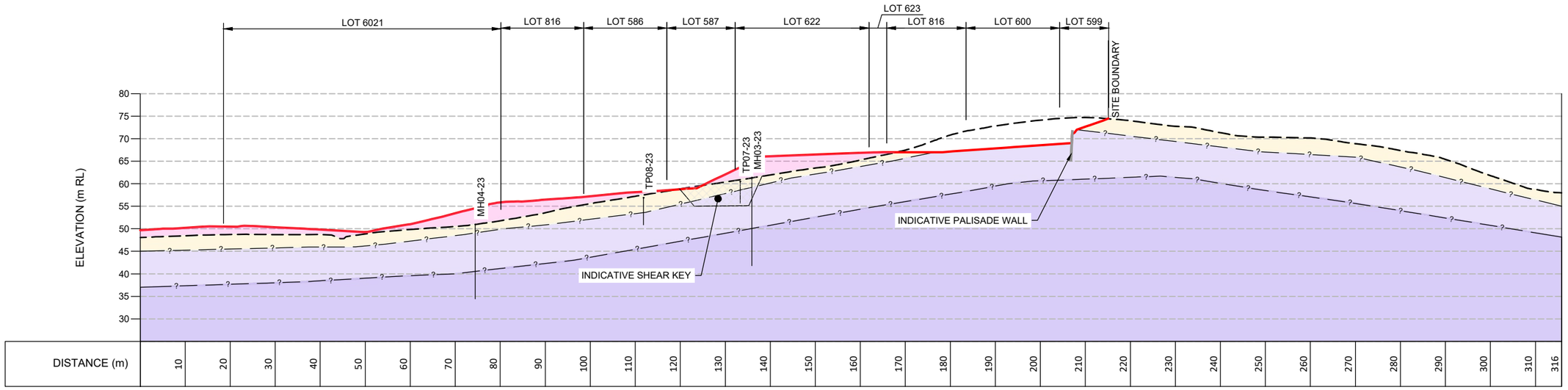

CROSS SECTION K (F STAGE 7)

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- PROPOSED ENGINEERED FILL
- RESIDUAL NORTHLAND ALLOCTHON
- TRANSITIONAL HUKERENUI MUDSTONE
- HUKERENUI MUDSTONE (NORTHLAND ALLOCHTHON ROCK)

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

1:1000 0 10 20 30 40 50 m

PRINT IN COLOUR

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 15
	REVISION: 1	SCALE: 1:1000
TITLE: CROSS SECTION K	DATE: 17/07/2025	SHEET: A3 L

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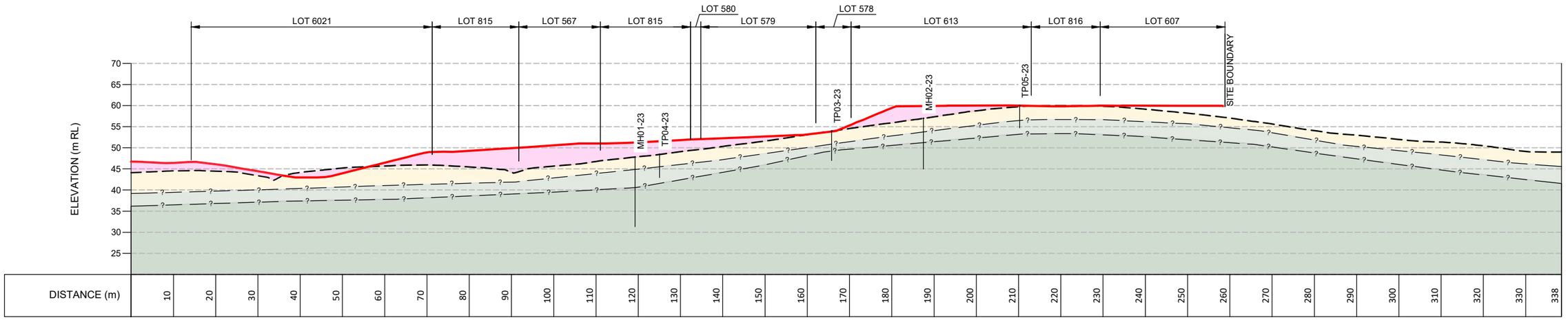

CROSS SECTION L (D STAGE 7)

LEGEND:

- EXISTING GROUND PROFILE
- DESIGN PROFILE
- INFERRED GEOLOGY BOUNDARY
- PROPOSED ENGINEERED FILL
- RESIDUAL NORTHLAND ALLOCTHON
- TRANSITIONAL UNDIFFERENTIATED MANGAKAHIA
- UNDIFFERENTIATED MANGAKAHIA (NORTHLAND ALLOCHTON ROCK)

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM xP24-128_Milldale Original Contours.
2. DESIGN PROFILE ADAPTED FROM Milldale FastTrack 3d contours 20012025.
3. VERTICAL DATUM IN TERMS OF AUCKHT1946.
4. TEST LOCATIONS ARE INDICATIVE ONLY.

1:1000 0 10 20 30 40 50 m

PRINT IN COLOUR

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 16
		REVISION: 1	SCALE: 1:1000
TITLE: CROSS SECTION L		DATE: 17/07/2025	SHEET: A3 L

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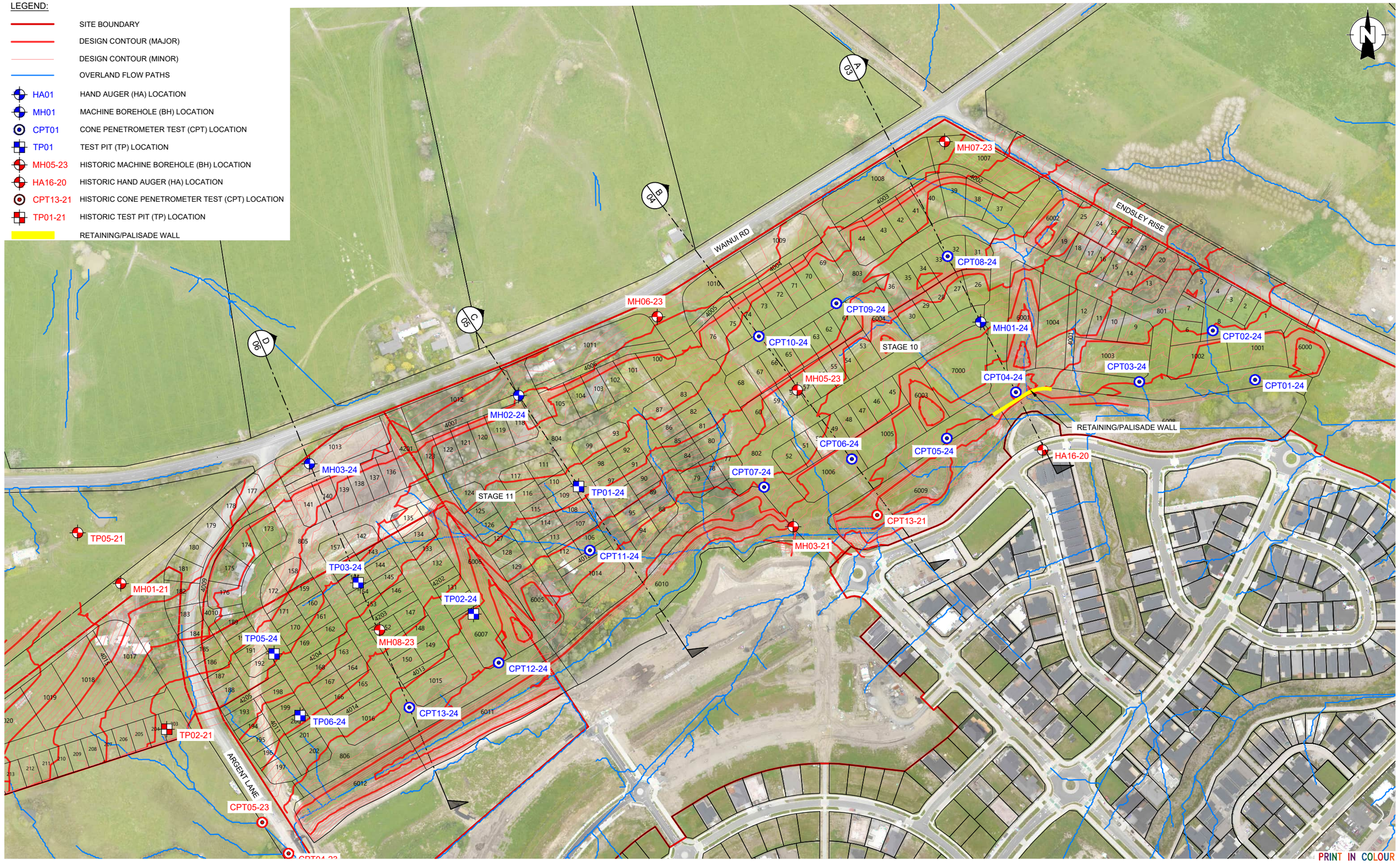
LEGEND:

- SITE BOUNDARY
- DESIGN CONTOUR (MAJOR)
- DESIGN CONTOUR (MINOR)
- OVERLAND FLOW PATHS
- HA01 — HAND AUGER (HA) LOCATION
- MH01 — MACHINE BOREHOLE (BH) LOCATION
- CPT01 — CONE PENETROMETER TEST (CPT) LOCATION
- TP01 — TEST PIT (TP) LOCATION
- MH05-23 — HISTORIC MACHINE BOREHOLE (BH) LOCATION
- HA16-20 — HISTORIC HAND AUGER (HA) LOCATION
- CPT13-21 — HISTORIC CONE PENETROMETER TEST (CPT) LOCATION
- TP01-21 — HISTORIC TEST PIT (TP) LOCATION
- RETAINING/PALISADE WALL



NOTES:

1. AERIAL IMAGE ADAPTED FROM P16-269_Milldale_20241015.
2. BASE PLAN ADAPTED FROM Milldale FastTrack 3d contours 20012025 & LINZ.
3. EXISTING GROUND CONTOURS ADAPTED FROM xP24-128_Milldale Original Contours,SHOWN IN 1.0m INTERVALS.
4. DESIGN CONTOURS ADAPTED FROM Milldale FastTrack 3d contours 20012025, SHOWN IN 0.5m INTERVALS.
5. CRS: NZGD2000 / MOUNT EDEN 2000. VERTICAL DATUM IN TERMS OF AUCKHT1946.
6. TEST LOCATIONS ARE INDICATIVE ONLY.

1:3000 0 30 60 90 120 150 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD		DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION		CHECKED: MC	DRAWING: 17
		REVISION: 1	SCALE: 1:3000
TITLE: REMEDIATION PLAN STAGE 10 & 11		DATE: 03/07/2025	SHEET: A3 L

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EXISTING SEDIMIENT AND EROSION CONTROL POND SIZED FOR 5ha (CONSTRUCTED UNDER BUN60425396)

PROPOSED TEMPORARY TOPSOIL STOCKPILE AREA. STOCKPILE LOCATION IS SUBJECT TO GEOTECHNICAL ENDORSEMENT

WAINUI ROAD

ARGENT LANE

9012 BALANCE PARCEL

SCALEBAR (m) 0 30 60 150

SCALE | 1:3000 @A3 | 1:1500 @A1|

LOCALITY PLAN
N.T.S

WOODS Est.1970

LEGEND

- EXTENTS OF FAST TRACK APPLICATION
- EXTENTS OF FAST TRACK APPLICATION EARTHWORKS
- CUT / FILL CONTOURS (1m)
- CUT / FILL LINE
- AREAS OF CUT
- AREAS OF FILL
- STREAM RETAINED AND ENHANCED
- PROPOSED RETAINING WALL

NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
2. ALL UNSUITABLE MATERIAL AS DEFINED IN THE SPECIFICATION IS TO BE REMOVED AND THE STRIPPED AREAS INSPECTED BY THE ENGINEER BEFORE FILL COMMENCES.
3. EARTHWORKS ARE NOT TO BE EXTENDED INTO ADJOINING SITES UNLESS THE ENGINEER HAS ISSUED SPECIFIC INSTRUCTIONS.
4. THE CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING AND PROTECTING EXISTING SERVICES AND DRAINAGE ON SITE.
5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

REVISION DETAILS		BY	DATE
1	FOR CONSENT	JW	FEB 25
2	FOR CONSENT	TB	JULY 25

SURVEYED	WOODS	SIDWELL ROAD WAINUI AUCKLAND
DESIGNED	WOODS	
DRAWN	FA	
CHECKED		
APPROVED	JW	WOODS.CO.NZ

N

MILLDALE
Connecting Lifestyles

MILLDALE FAST TRACK STAGES 10 - 13

CUT FILL LAYOUT SHEET 2

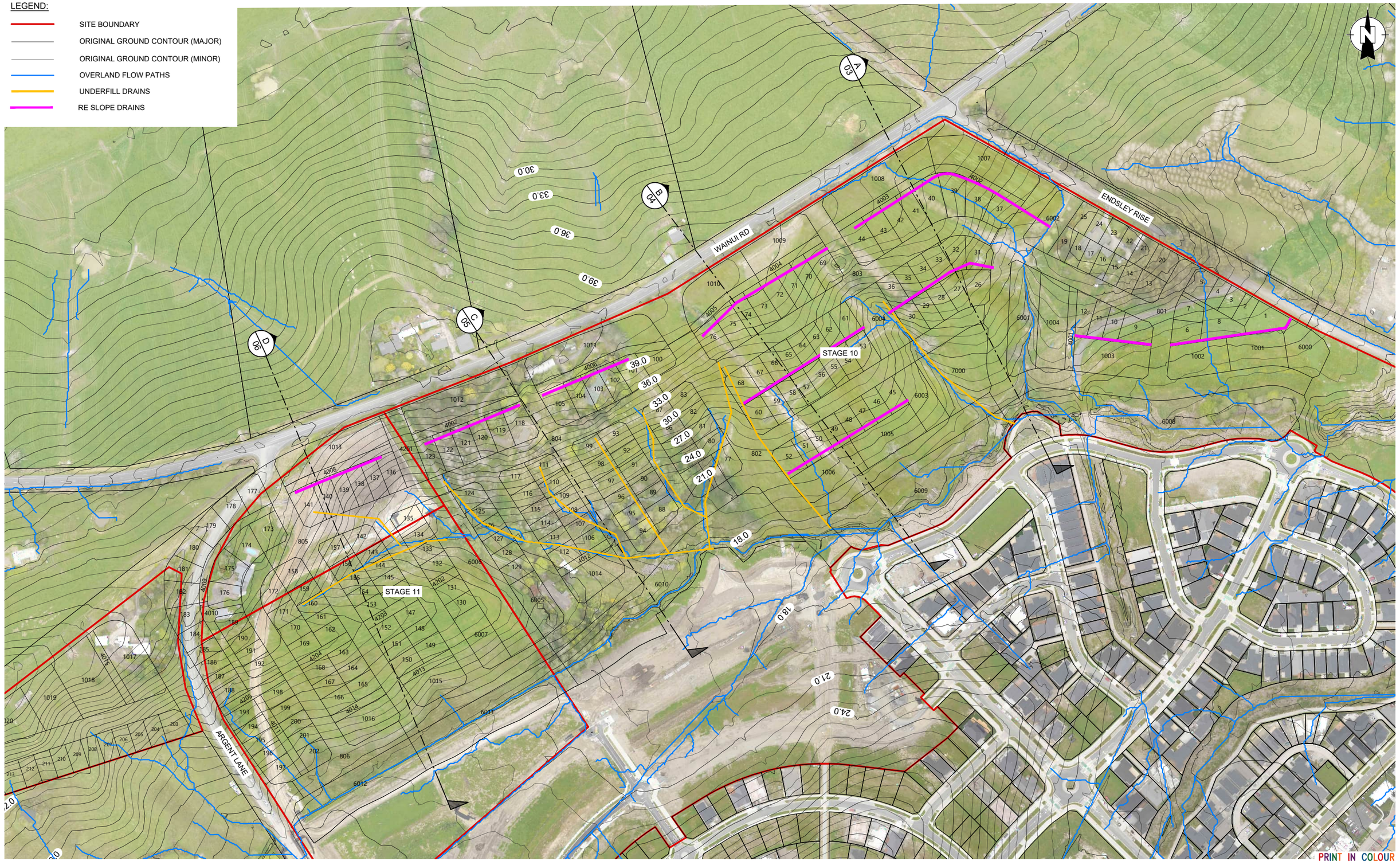
STATUS	ISSUED FOR CONSENT	REV
SCALE	1:3000 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-00-1202-EW	

Plot Date: 11:36:36 am,7 July 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-128 - MDL - FAST TRACK APPLICATION_21627\02 DRAWINGS\01 ENG\P24-128-00-1200-EW-CUT FILL PLAN .DWG

LEGEND:

- SITE BOUNDARY
- ORIGINAL GROUND CONTOUR (MAJOR)
- ORIGINAL GROUND CONTOUR (MINOR)
- OVERLAND FLOW PATHS
- UNDERFILL DRAINS
- RE SLOPE DRAINS



NOTES:

1. AERIAL IMAGE ADAPTED FROM P16-269_Milldale_20241015.
2. BASE PLAN ADAPTED FROM Milldale FastTrack 3d contours 20012025 & LINZ.
3. EXISTING GROUND CONTOURS ADAPTED FROM xP24-128_Milldale Original Contours,SHOWN IN 1.0m INTERVALS.
4. DESIGN CONTOURS ADAPTED FROM Milldale FastTrack 3d contours 20012025, SHOWN IN 0.5m INTERVALS.
5. CRS: NZGD2000 / MOUNT EDEN 2000. VERTICAL DATUM IN TERMS OF AUCKHT1946.
6. TEST LOCATIONS ARE INDICATIVE ONLY.

1:3000 0 30 60 90 120 150 m

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CLIENT: FULTON HOGAN LAND DEVELOPMENT LTD	DRAWN: JRS	PROJECT: AKL2024-0257
PROJECT: MILLDALE - FAST TRACK APPLICATION	CHECKED: MC	DRAWING: 19
	REVISION: 1	SCALE: 1:3000
TITLE: UNDERFILL DRAIN PLAN STAGE 10 & 11	DATE: 09/07/2025	SHEET: A3 L

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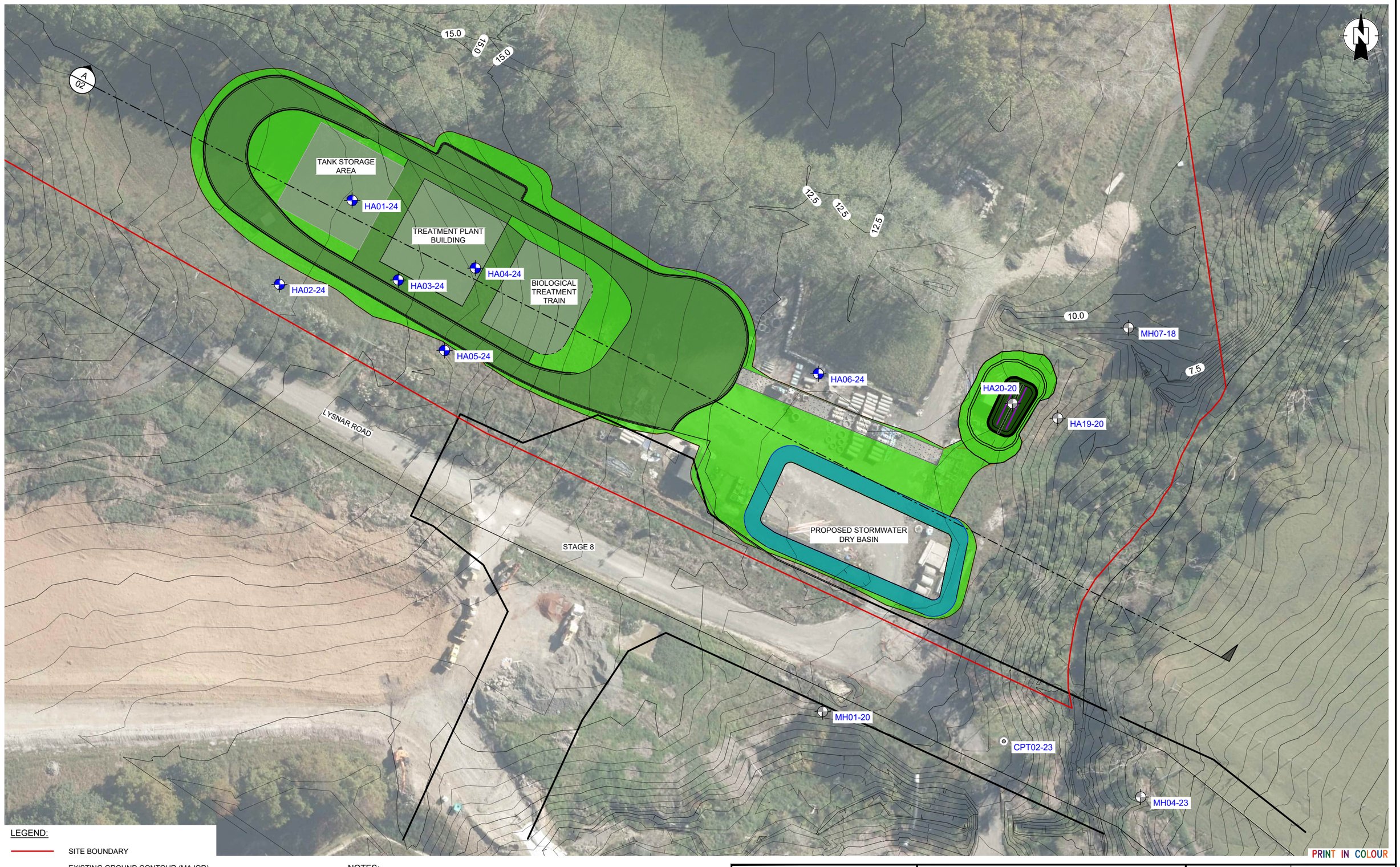

LEGEND:

- SITE BOUNDARY
- EXISTING GROUND CONTOUR (MAJOR)
- EXISTING GROUND CONTOUR (MINOR)
- HA01 — HAND AUGER (HA) LOCATION
- HA01 — HISTORIC HAND AUGER (HA) LOCATION
- CPT01 — HISTORIC CONE PENETROMETER TEST (CPT) LOCATION
- MH01 — HISTORIC MACHINE BOREHOLE (BH) LOCATION

NOTES:

1. AERIAL IMAGE COURTESY AUCKLAND 0.075M URBAN AERIAL PHOTOS (2024).
2. BASE PLAN ADAPTED FROM DWG NO P2A-189-2000-EW-WWTP, DATED 23/11/2024.
3. EXISTING GROUND CONTOURS ADAPTED FROM TOPO LYSNAR DATA , SHOWN IN 0.5m INTERVALS.
4. CRS: NZGD2000 / MOUNT EDEN 2000. VERTICAL DATUM IN TERMS OF NZVD 2016.
5. TEST LOCATIONS ARE INDICATIVE ONLY.

PRINT IN COLOUR

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Great People | Practical Solutions

CLIENT: **FULTON HOGAN LAND DEVELOPMENT Ltd.**	DRAWN: JRAS	PROJECT: AKL2024-0185
PROJECT: **MILLDALE TEMPORARY WASTEWATER TREATMENT PLANT**	CHECKED: JP	DRAWING: 01
	REVISION: 2	SCALE: 1:800
TITLE: **GEOTECHNICAL INVESTIGATION PLAN**	DATE: 12/06/2025	SHEET: A3 L

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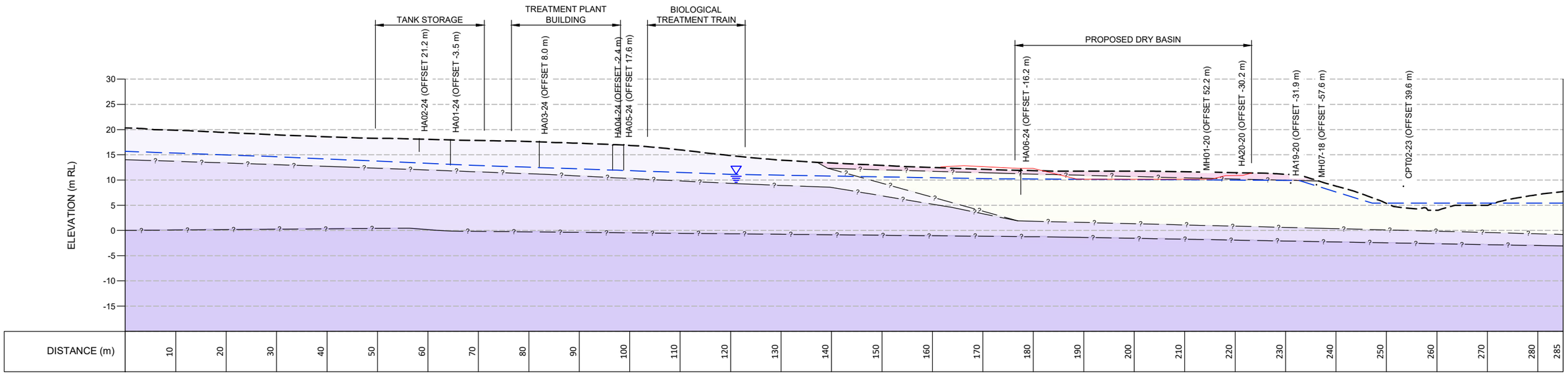

CROSS SECTION A

LEGEND:

- EXISTING GROUND PROFILE
- INFERRED GEOLOGY BOUNDARY
- GROUND WATER LEVEL
- ENGINEERED FILL
- ALLUVIUM
- HUKERENUI MUDSTONE RESIDUAL SOIL
- HUKERENUI MUDSTONE TRANSITION ZONE
- HUKERENUI MUDSTONE PARENT ROCK

NOTES:

1. EXISTING GROUND PROFILE ADAPTED FROM TOPO LYSNAR DATA.
2. VERTICAL DATUM OF NZVD 2016.
3. TEST LOCATIONS ARE INDICATIVE ONLY.

1:800 0 8 16 24 32 40 mm

PRINT IN COLOUR

CMW Geosciences
Great People | Practical Solutions

CLIENT: FULTON HOGAN LAND DEVELOPMENT Ltd.	DRAWN: JRAS	PROJECT: AKL2024-0185
PROJECT: MILLDALE TEMPORARY WASTEWATER TREATMENT PLANT	CHECKED: JP	DRAWING: 02
	REVISION: 2	SCALE: 1:800
TITLE: CROSS SECTION A	DATE: 12/06/2025	SHEET: A3 L

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APPENDIX B
Laboratory Test Results

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

24th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH04-24 3.70 – 3.85m

Borehole No: MH04-24 Sample No: Sample 7 Depth: 3.70 – 3.85m

The following report presents the results of Direct Shear Testing at BGL of a rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing used was determined from an estimation of the time at faliure, and an estimation of the displacement distance at failure.

The sample was then sheared at a set rate of 0.036mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.016mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.016mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

ACCREDITED
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TESTING LABORATORY
№ 126

All tests reported herein have been performed in accordance with the laboratory’s scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

Babbage Geotechnical Laboratory

Report Number:	63282#L/SB Milldale FTA MH04-24 3.70 - 3.85m		
Job Number:	63282#L	Reg. Number:	2766
PROJECT:	MILLDALE FAST TRACK APPLICATION		

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	Tested By:	WEC / JL / JF	February 2025
Version Date:	February 2025	Compiled By:	WEC	21/02/2025
Authorised By:	W. Campton	Checked By:	JF	24/02/2025

Borehole Number:	MH04-24	Sample Number:	Sample 7	Depth:	3.70 - 3.85m

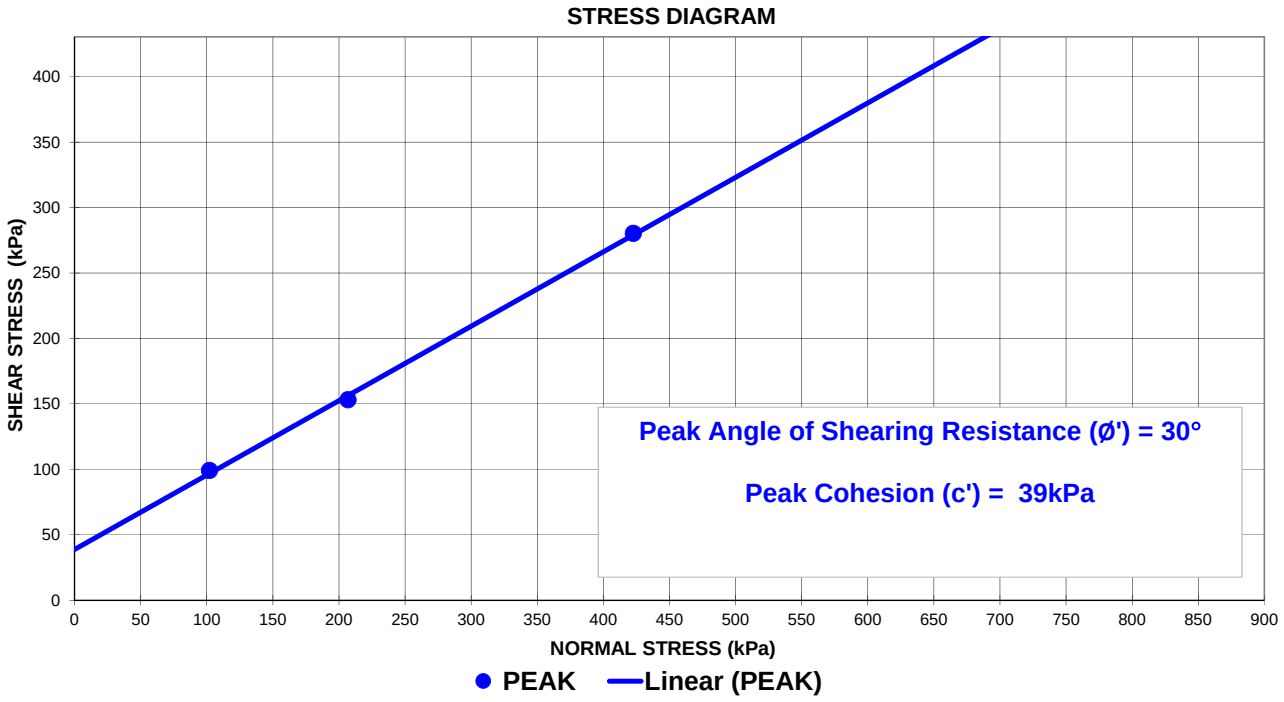
Sample History / Preparation: Rock core sample trimmed into 50mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, completely weathered, mottled light greenish grey, slightly moist.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.69	22.0	**102.2**	**0.133**	**99.1**	**1.166**	**0.026**
SHEAR CYCLE 2 - FAILURE VALUES						
1.68	22.0	**207.0**	**0.040**	**153.1**	**1.192**	**0.010**
SHEAR CYCLE 3 - FAILURE VALUES						
1.75	18.4	**422.8**	**0.137**	**280.2**	**2.012**	**0.010**



BGL Babbage Geotechnical Laboratory	**Report Number:**	**63282#L/SB Milldale FTA MH04-24 3.70 - 3.85m**			**Page 4 of 4**
	Job Number:	**63282#L**	**Reg. Number:**	**2766**	
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	**Tested By:**	WEC / JL / JF	February 2025
Version Date:	February 2025	**Compiled By:**	WEC	21/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	24/02/2025

Borehole Number:	**MH04-24**	**Sample Number:**	**Sample 7**	**Depth:**	**3.70 - 3.85m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	50.42	50.42	50.42
Thickness After Consolidation	(mm)	24.887	24.602	24.449
Height of Solids	(Hs)	15.926	15.832	16.530
Initial Water Content	(%)	22.0	22.0	18.4
Initial Bulk Density	(t/m^3)	2.06	2.05	2.08
Initial Dry Density	(t/m^3)	1.69	1.68	1.75
Dry Mass of sample	(g)	84.263	83.766	87.463
Initial Void Ratio	(e1)	0.570	0.579	0.512
Void Ratio after Consolidation	(e2)	0.563	0.554	0.479
Void Ratio after Shearing	(e3)	0.571	0.551	0.471

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.036	0.016	0.016
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.026	0.010	0.010
Ratio of Vertical Strain/Horizontal Strain			0.114	0.033	0.068
Vertical Deformation at Failure		(mm)	0.133	0.040	0.137
Horizontal Displacement		(mm)	**1.166**	**1.192**	**2.012**
Normal Stress		(kPa)	**102.2**	**207.0**	**422.8**
Peak Shear Stress		(kPa)	**99.1**	**153.1**	**280.2**

	PEAK
Angle of Shearing Resistance - ∅'	**30°**
Cohesion - c'	**39 kPa**

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

26th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH04-24 10.75 – 10.90m

Borehole No: MH04-24 Sample No: Sample 8 Depth: 10.75 – 10.90m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing used was determined from an estimation of the time at faliure, and an estimation of the displacement distance at failure.

The sample was then sheared at a set rate of 0.016mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.016mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.016mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

ACCREDITED
IANZ
TESTING LABORATORY
№ 126

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	Tested By:	WEC / JL / JF	February 2025
Version Date:	February 2025	Compiled By:	WEC	25/02/2025
Authorised By:	W. Campton	Checked By:	JF	26/02/2025

Borehole Number:	MH04-24	Sample Number:	Sample 8	Depth:	10.75 - 10.90m

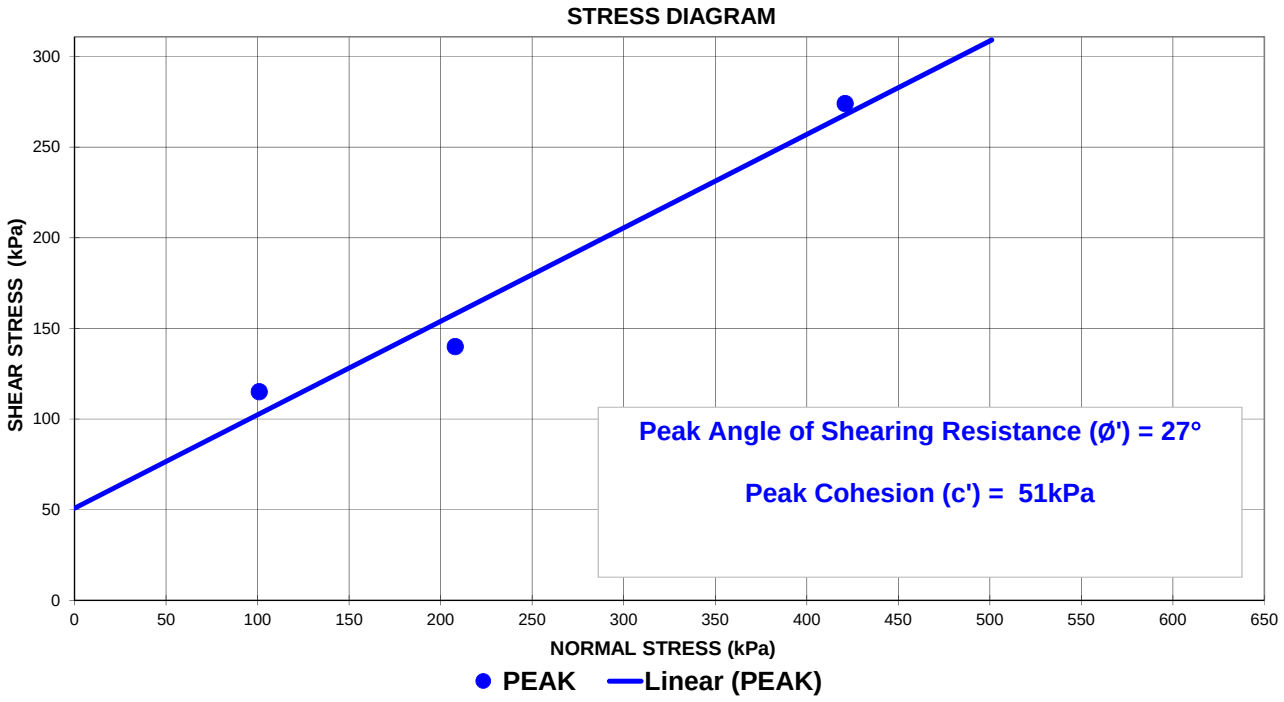
Sample History / Preparation: Rock core sample trimmed into 50mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, completely to highly weathered, mottled greenish grey & light grey, slightly moist.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.81	16.5	**101.0**	0.101	**114.9**	0.702	0.009
SHEAR CYCLE 2 - FAILURE VALUES						
1.80	17.0	**208.1**	0.089	**139.9**	1.398	0.011
SHEAR CYCLE 3 - FAILURE VALUES						
1.81	18.1	**421.0**	0.063	**274.0**	1.765	0.009



BGL Babbage Geotechnical Laboratory	**Report Number:**	**63282#L/SB Milldale FTA MH04-24 10.75 - 10.90m**			**Page 4 of 4**
	Job Number:	**63282#L**	**Reg. Number:**	**2766**	
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	**Tested By:**	WEC / JL / JF	February 2025
Version Date:	February 2025	**Compiled By:**	WEC	25/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	26/02/2025

Borehole Number:	**MH04-24**	**Sample Number:**	**Sample 8**	**Depth:**	**10.75 - 10.90m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	50.42	50.42	50.42
Thickness After Consolidation	(mm)	24.905	24.605	24.700
Height of Solids	(Hs)	17.109	17.014	17.094
Initial Water Content	(%)	16.5	17.0	18.1
Initial Bulk Density	(t/m^3)	2.11	2.11	2.14
Initial Dry Density	(t/m^3)	1.81	1.80	1.81
Dry Mass of sample	(g)	90.525	90.019	90.446
Initial Void Ratio	(e1)	0.461	0.469	0.462
Void Ratio after Consolidation	(e2)	0.456	0.446	0.445
Void Ratio after Shearing	(e3)	0.462	0.441	0.441

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.016	0.016	0.016
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.009	0.011	0.009
Ratio of Vertical Strain/Horizontal Strain			0.144	0.063	0.036
Vertical Deformation at Failure		(mm)	0.101	0.089	0.063
Horizontal Displacement		(mm)	**0.702**	**1.398**	**1.765**
Normal Stress		(kPa)	**101.0**	**208.1**	**421.0**
Peak Shear Stress		(kPa)	**114.9**	**139.9**	**274.0**

	PEAK
Angle of Shearing Resistance - ∅'	**27°**
Cohesion - c'	**51 kPa**

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

20th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH05-24 10.25 – 10.50m

Borehole No: MH05-24 Sample No: Sample 6 Depth: 10.25 – 10.50m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing used was determined from an estimation of the time at faliure, and an estimation of the displacement distance at failure.

The sample was then sheared at a set rate of 0.024mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

ACCREDITED
IANZ
TESTING LABORATORY
№ 126

All tests reported herein have been performed in accordance with the laboratory’s scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	Tested By:	WEC / JL / JF	February 2025
Version Date:	February 2025	Compiled By:	WEC	20/02/2025
Authorised By:	W. Campton	Checked By:	JF	20/02/2025

Borehole Number:	MH05-24	Sample Number:	Sample 6	Depth:	10.25 - 10.50m

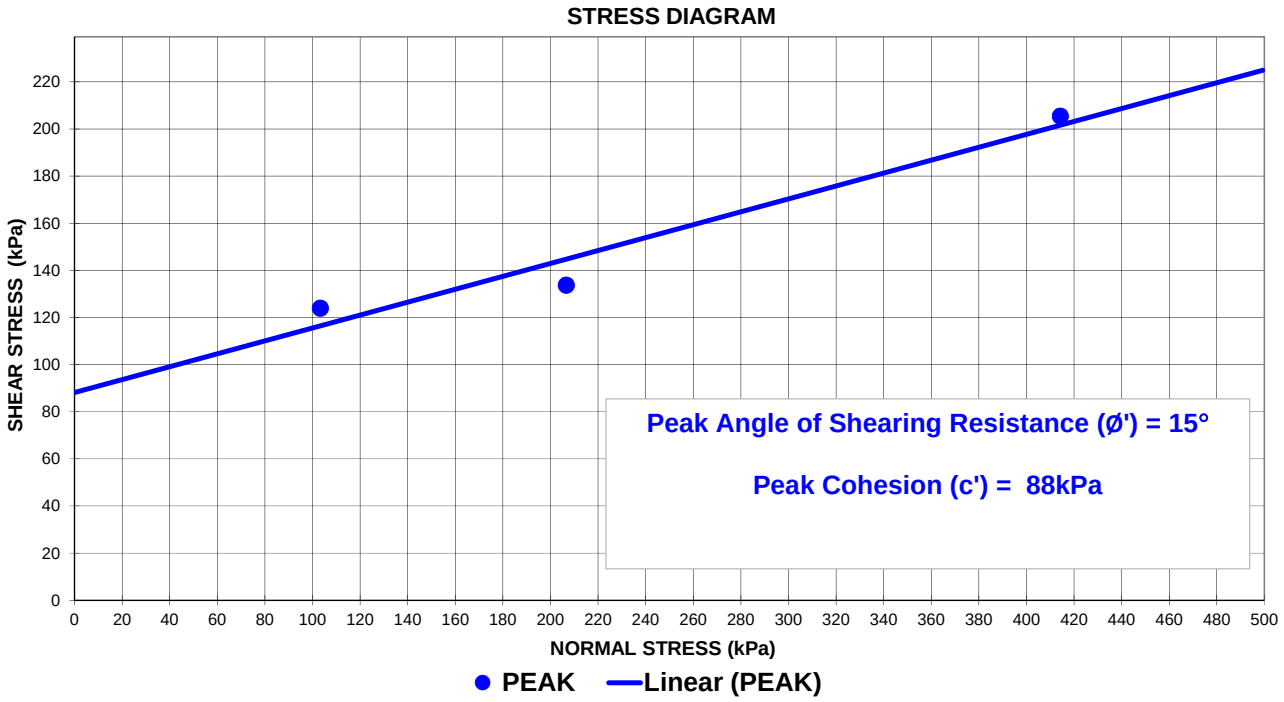
Sample History / Preparation: Rock core sample trimmed into 60mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, completely to highly weathered, extremely weak (very stiff to hard clay), light greenish grey with reddish veins & streaks, slightly moist.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
2.00	12.3	**103.3**	**0.154**	**123.9**	**1.228**	**0.014**
SHEAR CYCLE 2 - FAILURE VALUES						
1.99	13.0	**206.7**	**0.010**	**133.7**	**1.432**	**0.015**
SHEAR CYCLE 3 - FAILURE VALUES						
1.97	15.0	**414.4**	**0.105**	**205.3**	**1.633**	**0.013**



BGL Babbage Geotechnical Laboratory	**Report Number:**	**63282#L/SB Milldale FTA MH05-24 10.25 - 10.50m**			**Page 4 of 4**
	Job Number:	**63282#L**	**Reg. Number:**	**2766**	
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	**Tested By:**	WEC / JL / JF	February 2025
Version Date:	February 2025	**Compiled By:**	WEC	20/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	20/02/2025

Borehole Number:	**MH05-24**	**Sample Number:**	**Sample 6**	**Depth:**	**10.25 - 10.50m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	59.98	59.98	59.98
Thickness After Consolidation	(mm)	25.048	25.072	24.967
Height of Solids	(Hs)	18.897	18.753	18.551
Initial Water Content	(%)	12.3	13.0	15.0
Initial Bulk Density	(t/m^3)	2.25	2.25	2.26
Initial Dry Density	(t/m^3)	2.00	1.99	1.97
Dry Mass of sample	(g)	141.498	140.418	138.908
Initial Void Ratio	(e1)	0.323	0.333	0.348
Void Ratio after Consolidation	(e2)	0.325	0.337	0.346
Void Ratio after Shearing	(e3)	0.334	0.336	0.340

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.024	0.024	0.024
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.014	0.015	0.013
Ratio of Vertical Strain/Horizontal Strain			0.125	0.007	0.065
Vertical Deformation at Failure		(mm)	0.154	0.010	0.105
Horizontal Displacement		(mm)	**1.228**	**1.432**	**1.633**
Normal Stress		(kPa)	**103.3**	**206.7**	**414.4**
Peak Shear Stress		(kPa)	**123.9**	**133.7**	**205.3**

	PEAK
Angle of Shearing Resistance - ∅'	**15°**
Cohesion - c'	**88 kPa**

Babbage Geotechnical Laboratory
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Auckland 1010
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64-9-367 4954
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Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

17th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH10-24 6.45 – 6.70m

Borehole No: MH10-24 Sample No: Sample 5 Depth: 6.45 – 6.70m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing used was determined from an estimation of the time at faliure, and an estimation of the displacement distance at failure.

The sample was then sheared at a set rate of 0.024mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

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№ 126

All tests reported herein have been performed in accordance with the laboratory’s scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	Tested By:	WEC / JL / JF	February 2025
Version Date:	February 2025	Compiled By:	WEC	17/02/2025
Authorised By:	W. Campton	Checked By:	JF	17/02/2025

Borehole Number:	MH10-24	Sample Number:	Sample 5	Depth:	6.45 - 6.70m

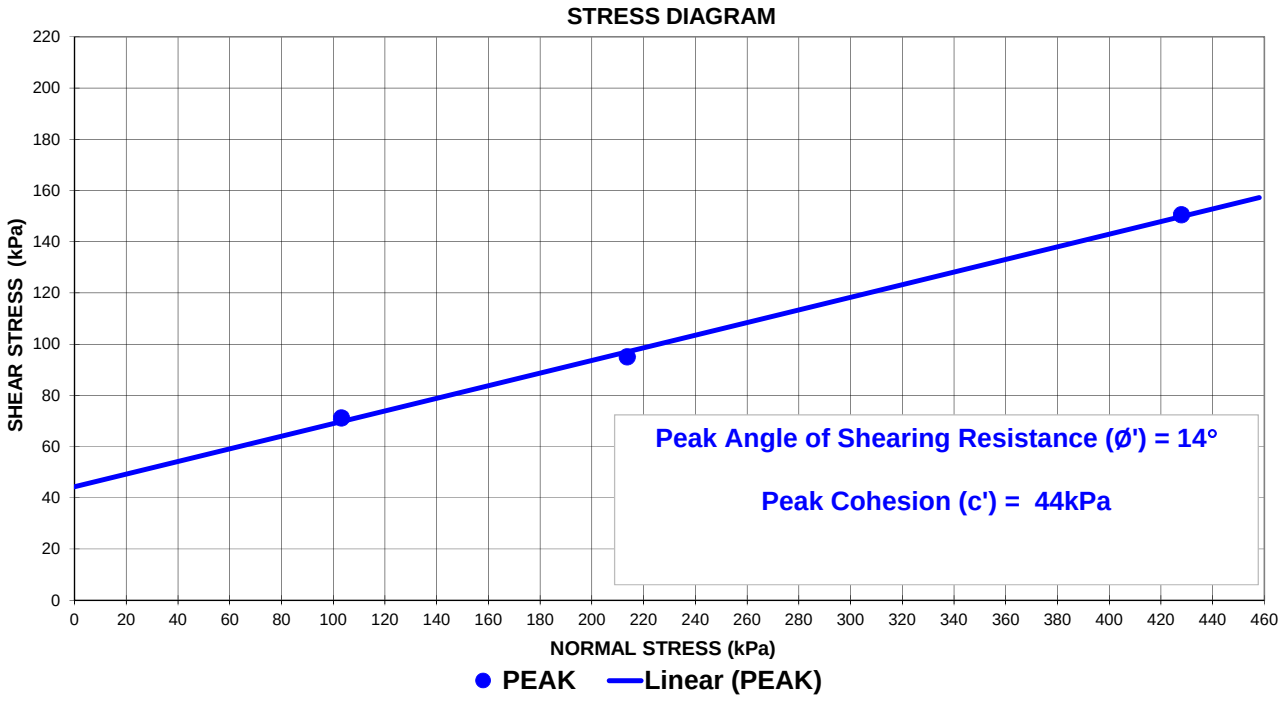
Sample History / Preparation: Rock core sample trimmed into 60mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, completely to highly weathered, grey, occasional well cemented fragments of siltstone.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.66	22.8	**103.3**	**0.028**	**71.1**	**1.189**	**0.017**
SHEAR CYCLE 2 - FAILURE VALUES						
1.68	22.1	**213.7**	**0.159**	**95.0**	**2.931**	**0.021**
SHEAR CYCLE 3 - FAILURE VALUES						
1.66	23.0	**428.0**	**0.299**	**150.5**	**3.081**	**0.019**



BGL Babbage Geotechnical Laboratory	**Report Number:**	**63282#L/SB Milldale FTA MH10-24 6.45 - 6.70m**			**Page 4 of 4**
	Job Number:	**63282#L**	**Reg. Number:**	**2766**	
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	**Tested By:**	WEC / JL / JF	February 2025
Version Date:	February 2025	**Compiled By:**	WEC	17/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	17/02/2025

Borehole Number:	**MH10-24**	**Sample Number:**	**Sample 5**	**Depth:**	**6.45 - 6.70m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	59.98	59.98	59.98
Thickness After Consolidation	(mm)	25.050	24.912	24.639
Height of Solids	(Hs)	15.688	15.851	15.647
Initial Water Content	(%)	22.8	22.1	23.0
Initial Bulk Density	(t/m^3)	2.04	2.05	2.04
Initial Dry Density	(t/m^3)	1.66	1.68	1.66
Dry Mass of sample	(g)	117.470	118.690	117.162
Initial Void Ratio	(e1)	0.594	0.577	0.598
Void Ratio after Consolidation	(e2)	0.597	0.572	0.575
Void Ratio after Shearing	(e3)	0.595	0.562	0.556

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.024	0.024	0.024
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.017	0.021	0.019
Ratio of Vertical Strain/Horizontal Strain			0.023	0.054	0.097
Vertical Deformation at Failure		(mm)	0.028	0.159	0.299
Horizontal Displacement		(mm)	**1.189**	**2.931**	**3.081**
Normal Stress		(kPa)	**103.3**	**213.7**	**428.0**
Peak Shear Stress		(kPa)	**71.1**	**95.0**	**150.5**

	PEAK
Angle of Shearing Resistance - ∅'	**14°**
Cohesion - c'	**44 kPa**

Babbage Geotechnical Laboratory
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68 Beach Road
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64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

17th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH11-24 5.40 – 5.65m

Borehole No: MH11-24 Sample No: Sample 4 Depth: 5.40 – 5.65m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing used was determined from an estimation of the time at faliure, and an estimation of the displacement distance at failure.

The sample was then sheared at a set rate of 0.024mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

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№ 126

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BGL Babbage Geotechnical Laboratory	Report Number:	63282#L/SB Milldale FTA MH11-24 5.40 - 5.65m			Page 3 of 4
	Job Number:	63282#L	Reg. Number:	2766	
	PROJECT:	MILLDALE FAST TRACK APPLICATION			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	Tested By:	WEC / JL / JF	February 2025
Version Date:	February 2025	Compiled By:	WEC	14/02/2025
Authorised By:	W. Campton	Checked By:	JF	17/02/2025

Borehole Number:	MH11-24	Sample Number:	Sample 4	Depth:	5.40 - 5.65m

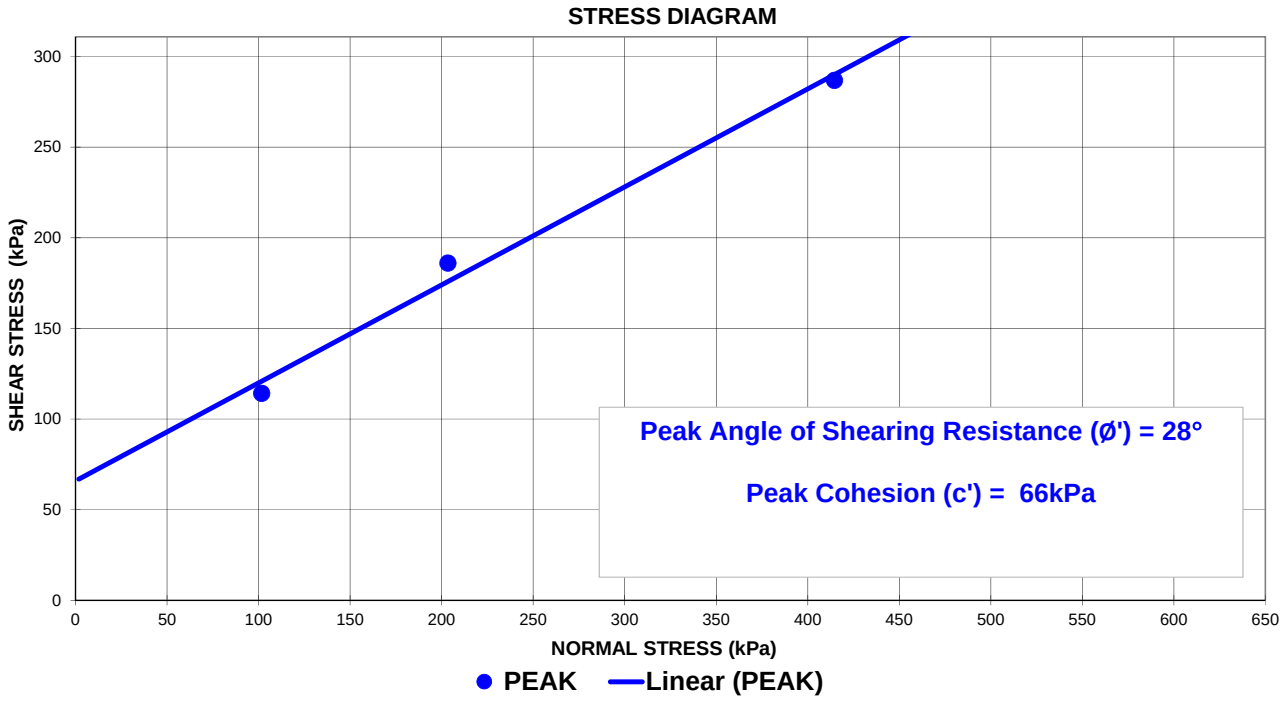
Sample History / Preparation: Rock core sample trimmed into 60mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, completely to highly weathered, greenish grey, slightly moist to dry.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.45	24.7	**101.8**	**0.061**	**114.1**	**0.534**	**0.010**
SHEAR CYCLE 2 - FAILURE VALUES						
1.51	24.4	**203.6**	**0.047**	**186.0**	**0.725**	**0.009**
SHEAR CYCLE 3 - FAILURE VALUES						
1.49	24.0	**414.7**	**0.059**	**286.8**	**1.668**	**0.011**



BGL Babbage Geotechnical Laboratory	**Report Number:**	**63282#L/SB Milldale FTA MH11-24 5.40 - 5.65m**			**Page 4 of 4**
	Job Number:	**63282#L**		**Reg. Number:**	**2766**
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	**Tested By:**	WEC / JL / JF	February 2025
Version Date:	February 2025	**Compiled By:**	WEC	14/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	17/02/2025

Borehole Number:	**MH11-24**	**Sample Number:**	**Sample 4**	**Depth:**	**5.40 - 5.65m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	59.98	59.98	59.98
Thickness After Consolidation	(mm)	25.161	24.842	24.953
Height of Solids	(Hs)	13.703	14.223	14.068
Initial Water Content	(%)	24.7	24.4	24.0
Initial Bulk Density	(t/m^3)	1.81	1.88	1.85
Initial Dry Density	(t/m^3)	1.45	1.51	1.49
Dry Mass of sample	(g)	102.606	106.496	105.334
Initial Void Ratio	(e1)	0.824	0.758	0.777
Void Ratio after Consolidation	(e2)	0.836	0.747	0.774
Void Ratio after Shearing	(e3)	0.841	0.750	0.770

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.024	0.024	0.024
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.010	0.009	0.011
Ratio of Vertical Strain/Horizontal Strain			0.115	0.065	0.035
Vertical Deformation at Failure		(mm)	0.061	0.047	0.059
Horizontal Displacement		(mm)	**0.534**	**0.725**	**1.668**
Normal Stress		(kPa)	**101.8**	**203.6**	**414.7**
Peak Shear Stress		(kPa)	**114.1**	**186.0**	**286.8**

	PEAK
Angle of Shearing Resistance - ∅'	**28°**
Cohesion - c'	**66 kPa**

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Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

13th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH13-24 11.80 – 12.00m

Borehole No: MH13-24 Sample No: Sample 3 Depth: 11.80 – 12.00m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing to use was determined from the equation: $t_f = 50t_{50}$ (where t_f = the total estimated elapsed time to failure in minutes and t_{50} = the time required in minutes for the sample to achieve 50% consolidation under the normal stress), and an estimation of the displacement distance to failure in mm. The sample was then sheared at a set rate of 0.024mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

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№ 126

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	Tested By:	WEC / JL	February 2025
Version Date:	February 2025	Compiled By:	WEC	13/02/2025
Authorised By:	W. Campton	Checked By:	JF	13/02/2025

Borehole Number:	MH13-24	Sample Number:	Sample 3	Depth:	11.80 - 12.00m

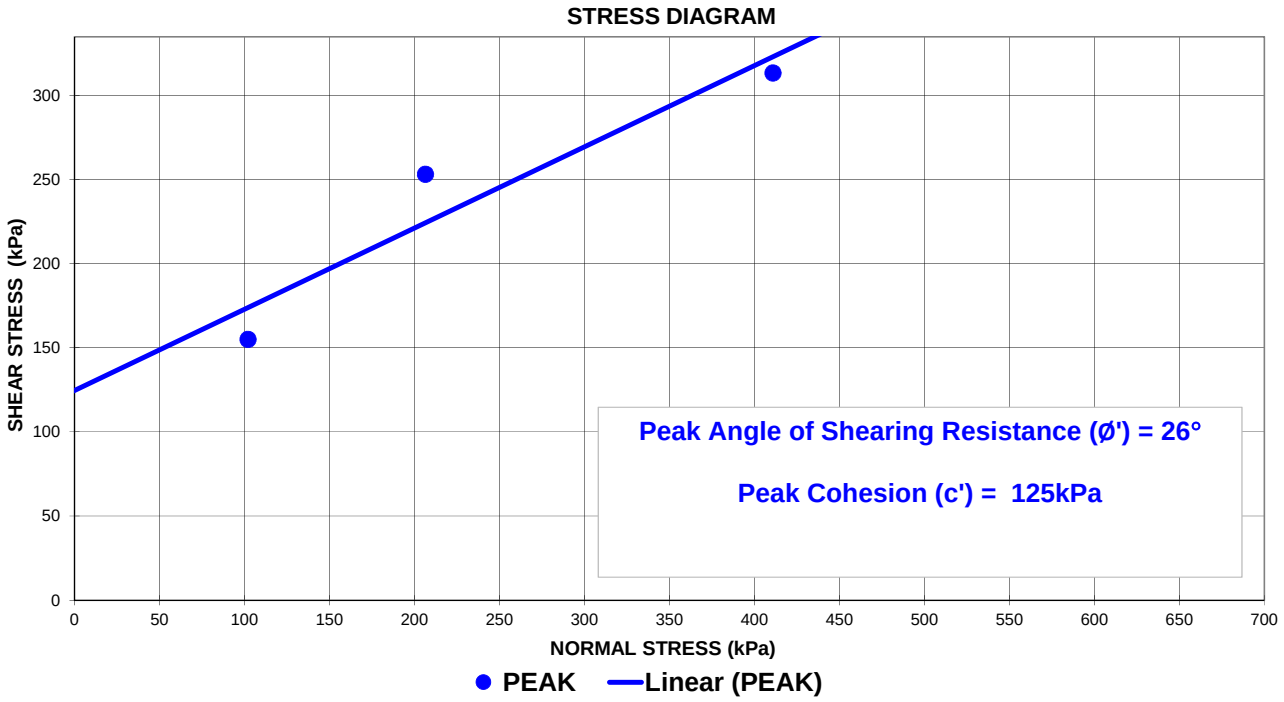
Sample History / Preparation: Rock core sample trimmed into 60mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, highly weathered, grey, highly shattered & sheared, numerous hard lumps, dry.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.60	21.6	**102.2**	**0.290**	**154.9**	**0.696**	**0.009**
SHEAR CYCLE 2 - FAILURE VALUES						
1.59	22.9	**206.6**	**0.271**	**253.0**	**1.393**	**0.011**
SHEAR CYCLE 3 - FAILURE VALUES						
1.52	25.1	**411.0**	**0.036**	**313.2**	**1.255**	**0.009**



BGL Babbage Geotechnical Laboratory	**Report Number:**	**63282#L/SB Milldale FTA MH13-24 11.80 - 12.00m**			**Page 4 of 4**
	Job Number:	**63282#L**	**Reg. Number:**	**2766**	
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	9 (circle)	**Tested By:**	WEC / JL	February 2025
Version Date:	February 2025	**Compiled By:**	WEC	13/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	13/02/2025

Borehole Number:	**MH13-24**	**Sample Number:**	**Sample 3**	**Depth:**	**11.80 - 12.00m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	59.98	59.98	59.98
Thickness After Consolidation	(mm)	25.221	24.969	24.954
Height of Solids	(Hs)	15.072	14.994	14.386
Initial Water Content	(%)	21.6	22.9	25.1
Initial Bulk Density	(t/m^3)	1.94	1.95	1.91
Initial Dry Density	(t/m^3)	1.60	1.59	1.52
Dry Mass of sample	(g)	112.854	112.268	107.715
Initial Void Ratio	(e1)	0.659	0.667	0.738
Void Ratio after Consolidation	(e2)	0.673	0.665	0.735
Void Ratio after Shearing	(e3)	0.693	0.683	0.737

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.024	0.024	0.024
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.009	0.011	0.009
Ratio of Vertical Strain/Horizontal Strain			0.416	0.195	0.029
Vertical Deformation at Failure		(mm)	0.290	0.271	0.036
Horizontal Displacement		(mm)	**0.696**	**1.393**	**1.255**
Normal Stress		(kPa)	**102.2**	**206.6**	**411.0**
Peak Shear Stress		(kPa)	**154.9**	**253.0**	**313.2**

	PEAK
Angle of Shearing Resistance - ∅'	**26°**
Cohesion - c'	**125 kPa**

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

12th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH13-24 14.60 – 14.85m

Borehole No: MH13-24 Sample No: Sample 2 Depth: 14.60 – 14.85m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing to use was determined from the equation: $t_f = 50t_{50}$ (where t_f = the total estimated elapsed time to failure in minutes and t_{50} = the time required in minutes for the sample to achieve 50% consolidation under the normal stress), and an estimation of the displacement distance to failure in mm. The sample was then sheared at a set rate of 0.024mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

ACCREDITED
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TESTING LABORATORY
№ 126

Babbage Geotechnical Laboratory

Job Number:	63282#L		
Reg. Number:	2766	Report Number:	63282#L/SB Milldale FTA MH13-24 14.60 - 14.85m
PROJECT:	MILLDALE FAST TRACK APPLICATION		

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	8	Tested By:	WEC / JL	February 2025
Version Date:	September 2024	Compiled By:	WEC	12/02/2025
Authorised By:	W. Campton	Checked By:	JF	12/02/2025

Borehole Number:	MH13-24	Sample Number:	Sample 2	Depth:	14.60 - 14.85m

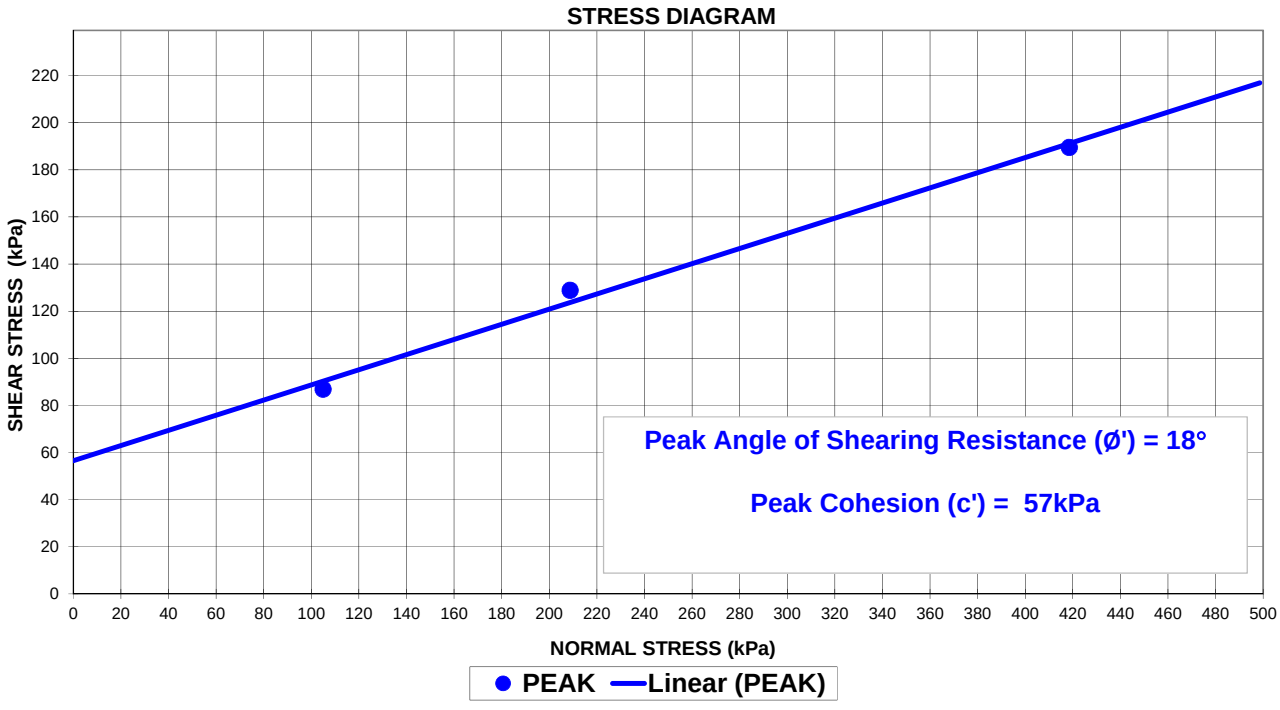
Sample History / Preparation: Rock core sample trimmed into 60mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, highly weathered, grey, highly shattered & sheared, softer patches.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.51	27.0	**105.0**	**0.031**	**86.8**	**1.938**	**0.019**
SHEAR CYCLE 2 - FAILURE VALUES						
1.57	25.3	**208.8**	**0.081**	**128.8**	**1.878**	**0.017**
SHEAR CYCLE 3 - FAILURE VALUES						
1.59	23.5	**418.6**	**0.119**	**189.4**	**2.088**	**0.015**



Babbage Geotechnical Laboratory

Job Number:	63282#L				
Reg. Number:	2766	Report Number:	63282#L/SB Milldale FTA MH13-24 14.60 - 14.85m		
PROJECT:	MILLDALE FAST TRACK APPLICATION				

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	8	Tested By:	WEC / JL	February 2025
Version Date:	September 2024	Compiled By:	WEC	12/02/2025
Authorised By:	W. Campton	Checked By:	JF	12/02/2025

Borehole Number:	MH13-24	Sample Number:	Sample 2	Depth:	14.60 - 14.85m

SHEAR CYCLES

		1	2	3
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	59.98	59.98	59.98
Thickness After Consolidation	(mm)	24.793	25.024	24.615
Height of Solids	(Hs)	14.286	14.854	15.029
Initial Water Content	(%)	27.0	25.3	23.5
Initial Bulk Density	(t/m^3)	1.92	1.97	1.97
Initial Dry Density	(t/m^3)	1.51	1.57	1.59
Dry Mass of sample	(g)	106.966	111.221	112.534
Initial Void Ratio	(e1)	0.750	0.683	0.663
Void Ratio after Consolidation	(e2)	0.736	0.685	0.638
Void Ratio after Shearing	(e3)	0.733	0.679	0.630

Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.024	0.024	0.024
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.019	0.017	0.015
Ratio of Vertical Strain/Horizontal Strain			0.016	0.043	0.057
Vertical Deformation at Failure		(mm)	0.031	0.081	0.119
Horizontal Displacement		(mm)	**1.938**	**1.878**	**2.088**
Normal Stress		(kPa)	**105.0**	**208.8**	**418.6**
Peak Shear Stress		(kPa)	**86.8**	**128.8**	**189.4**

	PEAK
Angle of Shearing Resistance - ∅'	**18°**
Cohesion - c'	**57 kPa**

Babbage Geotechnical Laboratory
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64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **MELISSA CAMPBELL**

Job Number: 63282#L
BGL Registration Number: 2766
Checked by: JF

7th February 2025

DIRECT SHEAR (SHEAR BOX) TESTING

Dear Melissa,

Re: MILLDALE FAST TRACK APPLICATION

Your Reference: AKL2024-0257
Report Number: 63282#L/SB Milldale FTA MH14-24 14.10 – 14.30m

Borehole No: MH14-24 Sample No: Sample 1 Depth: 14.10 – 14.30m

The following report presents the results of Direct Shear Testing at BGL of a 60mm diameter rock core sample delivered to this laboratory on the 16th of January 2025. Test results are summarised in the following pages.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Direct Shear Test of Soils Under Consolidated Drained Conditions:	ASTM D3080/3080M – 23

Three peak shear stress values were obtained from three separate samples taken from rock core sample. Each sample was subjected to a normal stress of either 100kPa, 200kPa or 400kPa when being sheared.

Direct Shear Test Procedure

The rock core sample for the first cycle was trimmed into the shear box ring in small increments, until the sample protruded from both sides of the ring. A scalpel and straight edge were then used to trim the sample flat in the ring. The sample was next set up in the shear box machine.

Once set up in the shear box, the first sample was consolidated to approximately 100kPa normal stress. The rate of shearing to use was determined from the equation: $t_f = 50t_{50}$ (where t_f = the total estimated elapsed time to failure in minutes and t_{50} = the time required in minutes for the sample to achieve 50% consolidation under the normal stress), and an estimation of the displacement distance to failure in mm. The sample was then sheared at a set rate of 0.024mm/minute until a “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The sample for the second cycle was then prepared as in cycle 1 and set up in the shear box. This sample was consolidated to approximately 200kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 2 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

Finally, the sample for the third cycle was prepared and set up in the shear box as previously described. This sample was consolidated to approximately 400kPa normal stress and then sheared at a set rate of 0.024mm/minute until the cycle 3 “peak shear stress” value was obtained. Once complete, the sample was dried out in a soils drying oven to determine the water content.

The three peak values are plotted on a graph of shear stress vs. normal stress on page 3.

Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Key Technical Person
Laboratory Manager
Babbage Geotechnical Laboratory

ACCREDITED
IANZ
TESTING LABORATORY
№ 126

Babbage Geotechnical Laboratory

Job Number:	63282#L		
Reg. Number:	2766	Report Number:	63282#L/SB Milldale FTA MH14-24 14.10 - 14.30m
PROJECT:	MILLDALE FAST TRACK APPLICATION		

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	8	Tested By:	WEC	February 2025
Version Date:	September 2024	Compiled By:	JF	7/02/2025
Authorised By:	W. Campton	Checked By:	JF	7/02/2025

Borehole Number:	MH14-24	Sample Number:	Sample 1	Depth:	14.10 - 14.30m

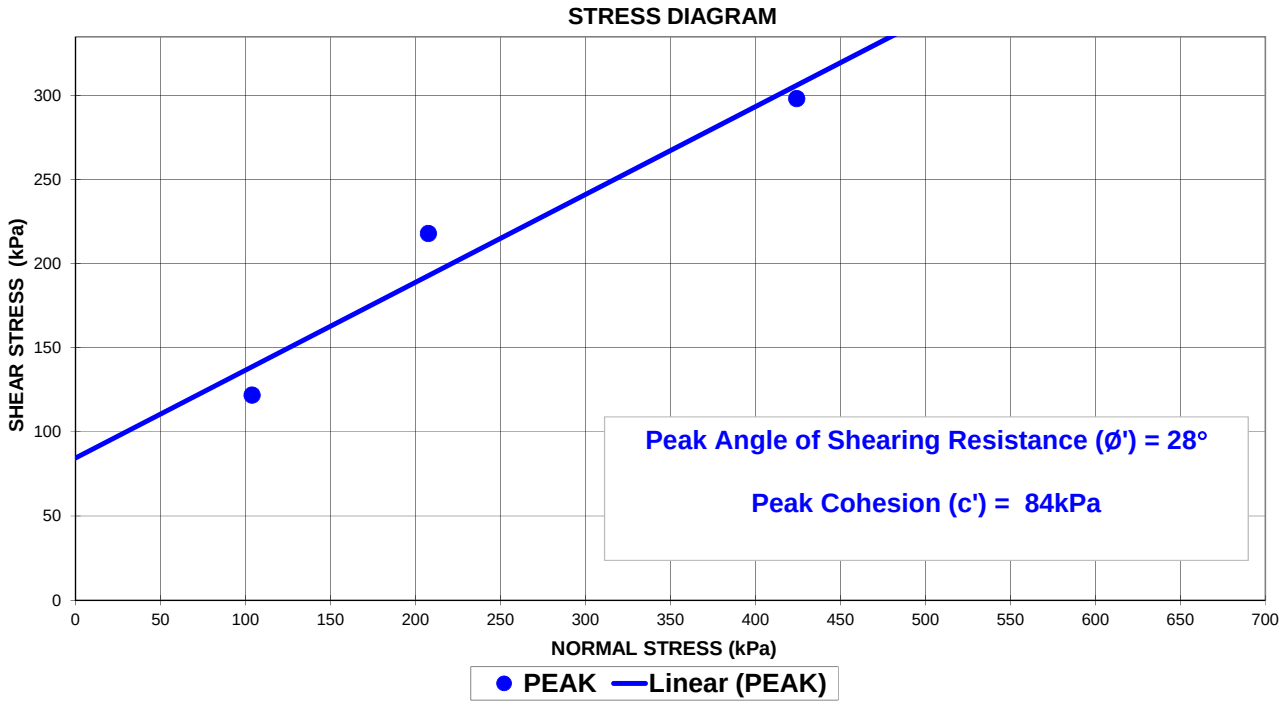
Sample History / Preparation: Rock core sample trimmed into 60mm diameter circular shear box ring in small increments.

Sample Type: ~~block / push-tube / recompacted /~~ rock core

Sample Description: (not IANZ endorsed)

SILTSTONE, extremely weak, highly to completely weathered, light greenish grey, highly sheared & shattered, slightly moist.

Initial Dry Density (t/m^3)	Initial Moisture Content (%)	Normal Stress (kPa)	Normal Displacement (mm)	PEAK Shear Stress (kPa)	Displacement at Failure (mm)	Average Rate of Displacement (mm/minute)
SHEAR CYCLE 1 - FAILURE VALUES						
1.85	14.1	**103.9**	**0.115**	**121.9**	**1.597**	**0.016**
SHEAR CYCLE 2 - FAILURE VALUES						
1.83	16.2	**207.7**	**0.031**	**217.8**	**1.632**	**0.013**
SHEAR CYCLE 3 - FAILURE VALUES						
1.87	15.4	**424.4**	**0.126**	**297.9**	**2.707**	**0.014**



BGL Babbage Geotechnical Laboratory	**Job Number:**	**63282#L**			**Page 4 of 4**
	Reg. Number:	**2766**	**Report Number:**	**63282#L/SB Milldale FTA MH14-24 14.10 - 14.30m**	
	PROJECT:	**MILLDALE FAST TRACK APPLICATION**			

SHEAR TEST SUMMARY

Test Method: ASTM D3080/D3080M - 23

Version Number:	8	**Tested By:**	WEC	February 2025
Version Date:	September 2024	**Compiled By:**	JF	7/02/2025
Authorised By:	W. Campton	**Checked By:**	JF	7/02/2025

Borehole Number:	**MH14-24**	**Sample Number:**	**Sample 1**	**Depth:**	**14.10 - 14.30m**

SHEAR CYCLES

		1	*2*	*3*
Solid Density of Soil Particles (assumed)	(t/m^3)	2.65	2.65	2.65
Initial Sample Thickness	(mm)	25.00	25.00	25.00
Initial Sample Diameter	(mm)	60.05	59.98	59.98
Thickness After Consolidation	(mm)	24.984	25.038	24.779
Height of Solids	(Hs)	17.431	17.234	17.659
Initial Water Content	(%)	14.1	16.2	15.4
Initial Bulk Density	(t/m^3)	2.11	2.12	2.16
Initial Dry Density	(t/m^3)	1.85	1.83	1.87
Dry Mass of sample	(g)	130.824	129.044	132.227
Initial Void Ratio	(e1)	0.434	0.451	0.416
Void Ratio after Consolidation	(e2)	0.433	0.453	0.403
Void Ratio after Shearing	(e3)	0.440	0.455	0.396

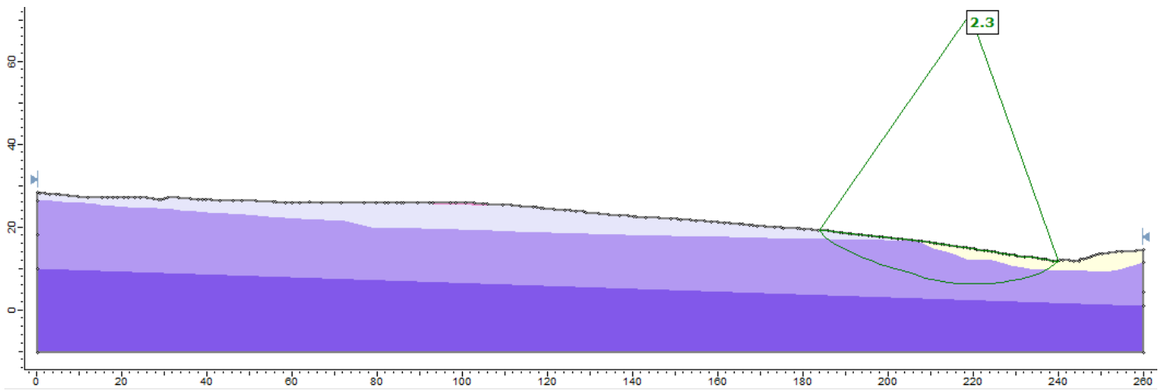
Peak Cycles - Failure Values

Rate of Strain	(set)	(mm/minute)	0.024	0.024	0.024
Mean Rate of Strain at Failure	(actual)	(mm/minute)	0.016	0.013	0.014
Ratio of Vertical Strain/Horizontal Strain			0.072	0.019	0.046
Vertical Deformation at Failure		(mm)	0.115	0.031	0.126
Horizontal Displacement		(mm)	**1.597**	**1.632**	**2.707**
Normal Stress		(kPa)	**103.9**	**207.7**	**424.4**
Peak Shear Stress		(kPa)	**121.9**	**217.8**	**297.9**

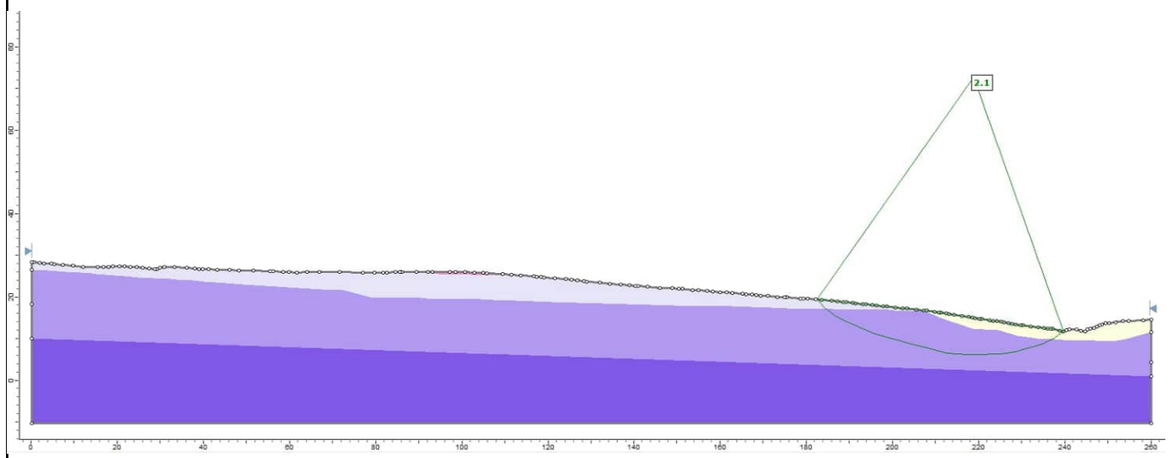
	PEAK
Angle of Shearing Resistance - ∅'	**28°**
Cohesion - c'	**84 kPa**

APPENDIX C
Stability Sections

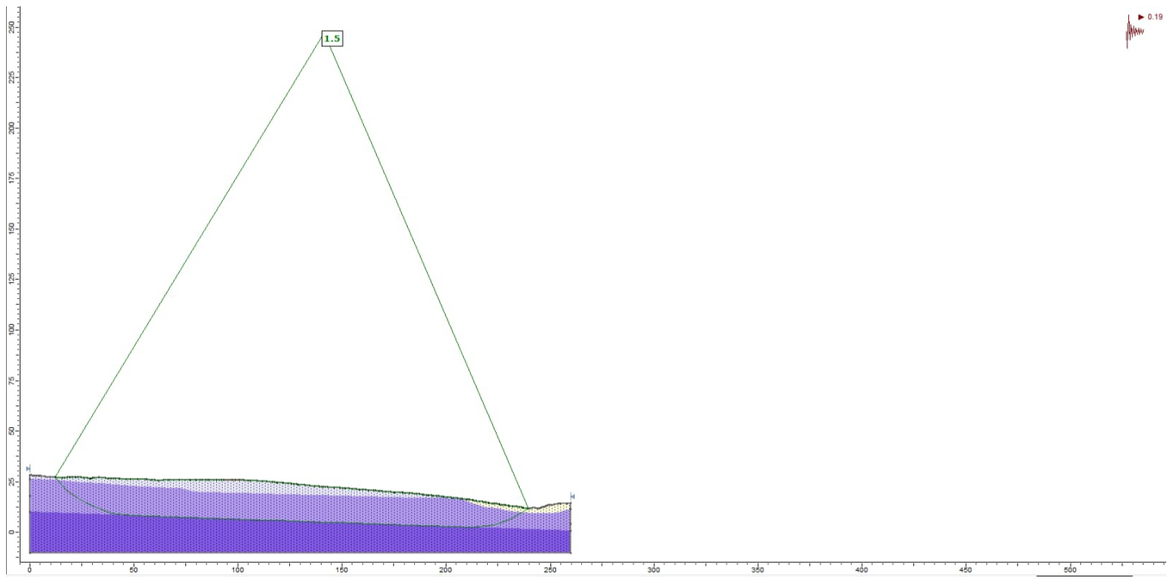
Item #	Title	Reference	Amendment	Date
20.5	Stability Sections M & N	AKL2024-0257 STAB 13 & 14	New sections	24/07/2025
20.10	Stability Sections G & J	AKL2024-0257 STAB 07 & 10	Mahurangi Limestone Transition Zone and Softened Base Contact units added to models	11/07/2025
20.12	Stability Sections A & K	AKL2024-0257 STAB 01 & 11	Pile parameters shown on outputs	10/07/2025
20.27	WWTP Stability Memo	AKL2024-0185AB – Stability Memo	New document	15/07/2025



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.2
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26			None	0.2
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None	0.2
Tauranga Group Alluvium (Ridge) UD		17	Undrained	80	0	Constant		None	0.2
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0.05
Hukerenui Mudstone UD		20.5	Shear/Normal Function				User Defined 1	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28			None	0

Parameters

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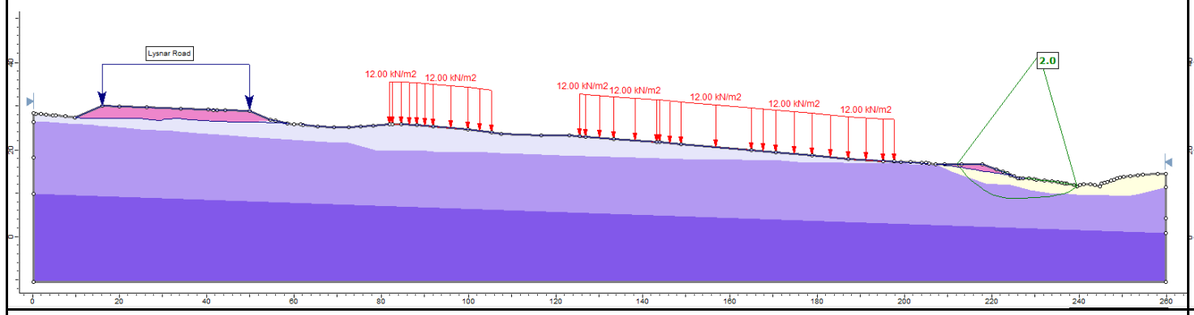
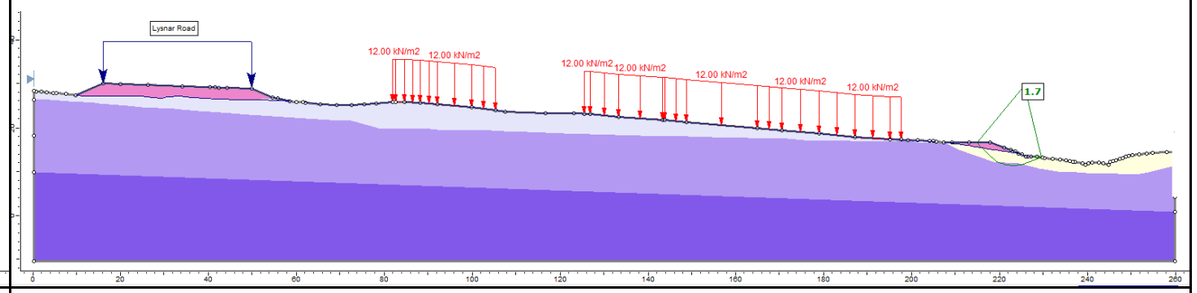
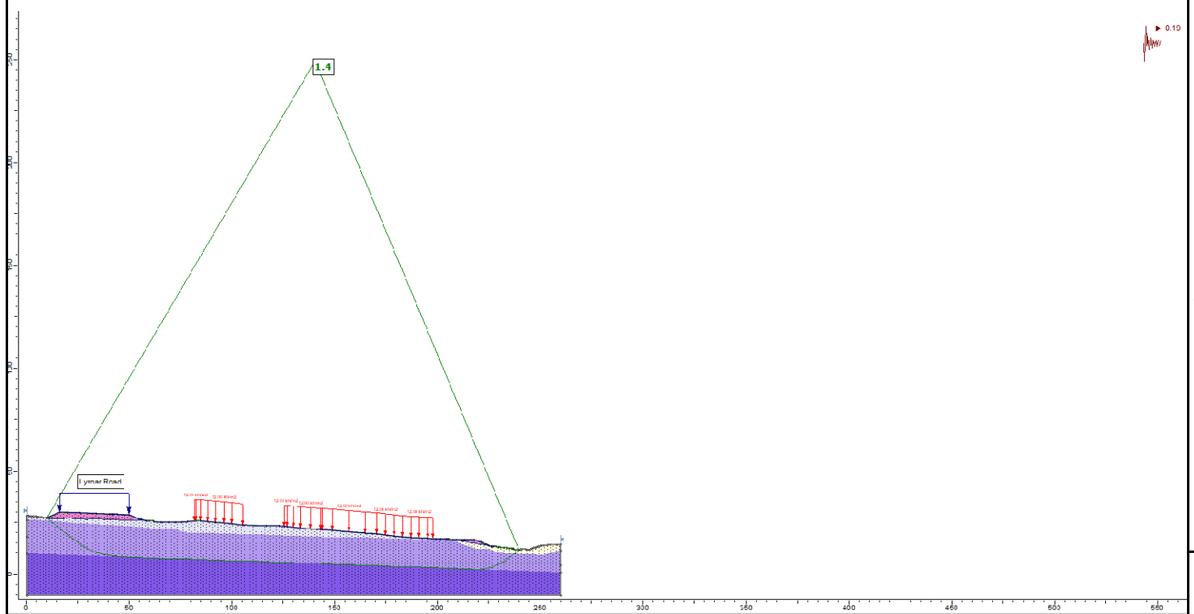
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section M - Existing	*Date* 24/07/2025	*Drawing* STAB 13



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.2
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2

Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface	Ru Value
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None	0.2
Tauranga Group Alluvium (Ridge) UD		17	Undrained	80	0	Constant		None	0.2
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0.05
Hukerenui Mudstone UD		20.5	Shear/Normal Function				User Defined 1	None	0
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None	0

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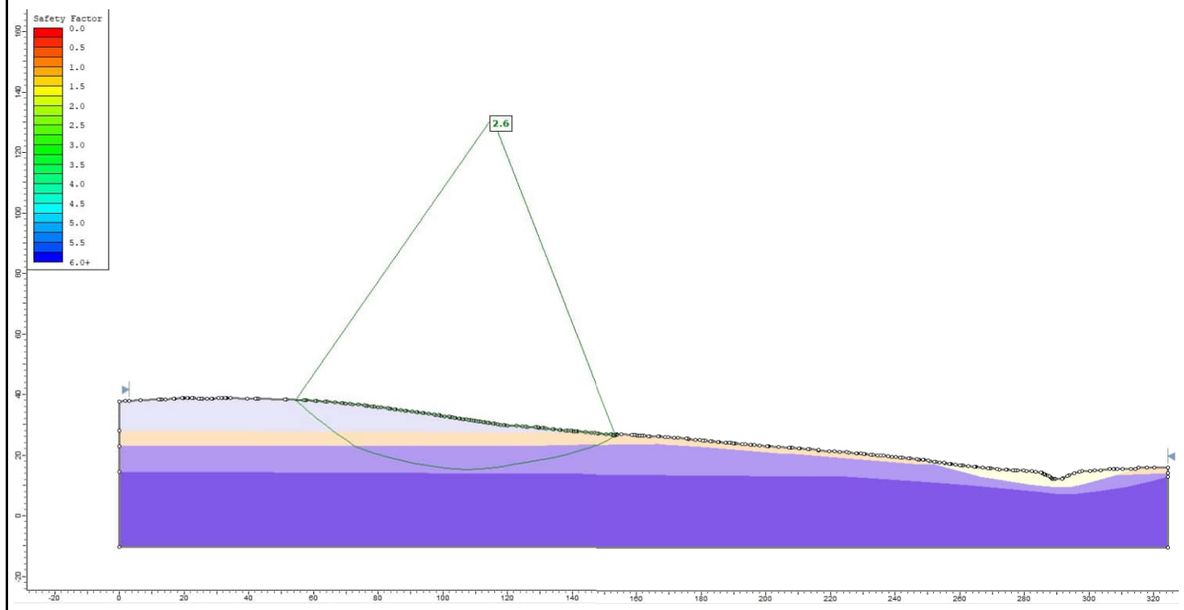
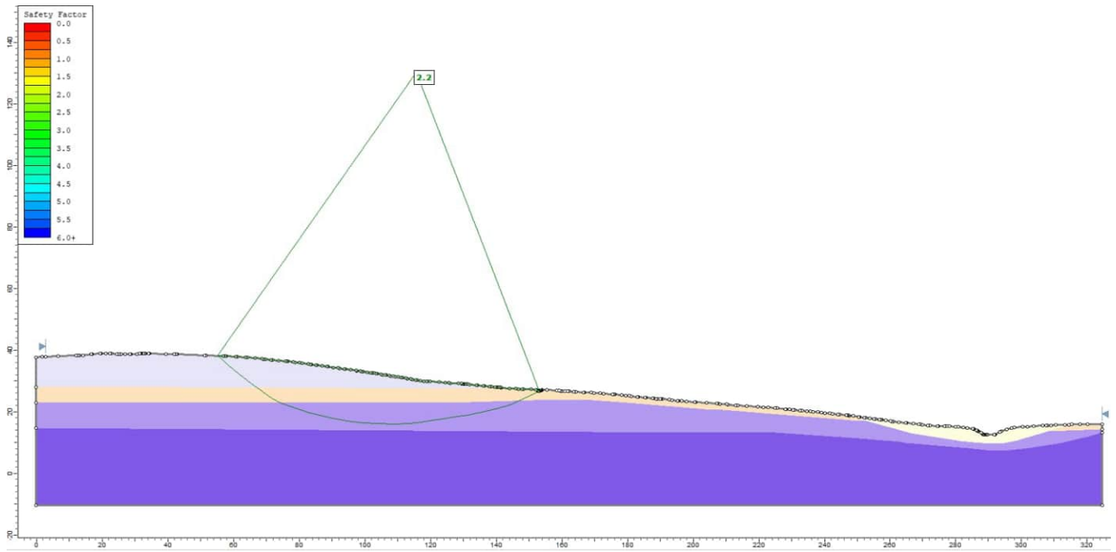
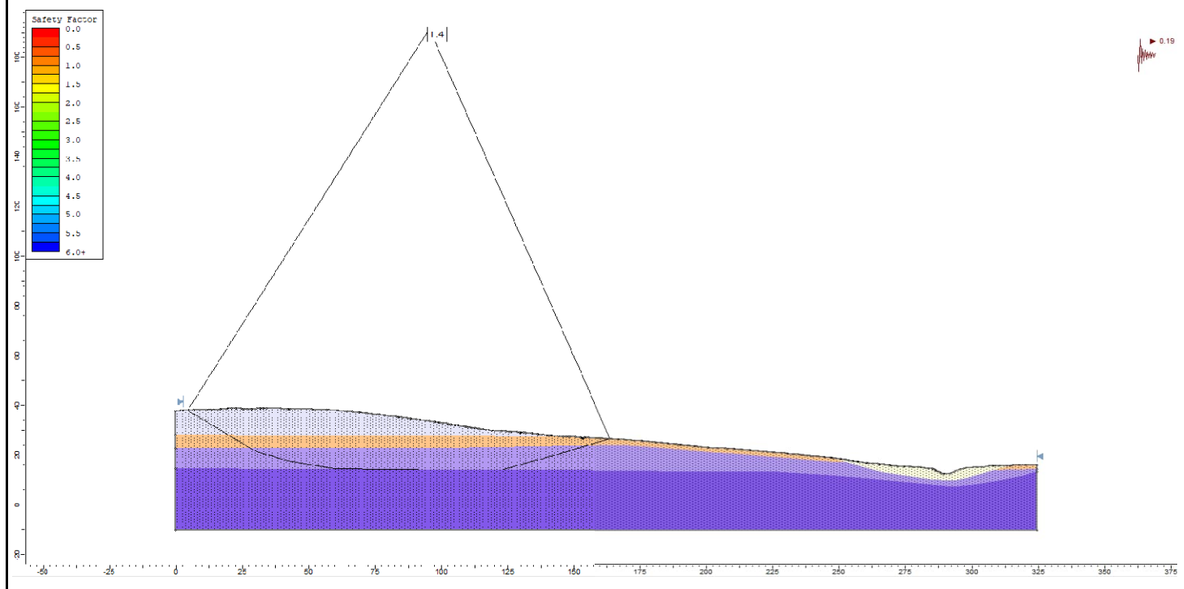
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section M - Proposed	*Date* 24/07/2025	*Drawing* STAB 13a



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.2
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.2
Residual Northland Allochthon		18	Mohr-Coulomb	5	28	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.4
Residual Northland Allochthon		18	Mohr-Coulomb	5	28	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface	Ru Value
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None	0.2
Tauranga Group Alluvium (Ridge) UD		17	Undrained	80	0	Constant		None	0
Residual Northland Allochthon UD		18	Undrained	60	0	Constant		None	0.2
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0.05
Hukerenui Mudstone UD		20.5	Shear/Normal Function				User Defined 1	None	0

Parameters

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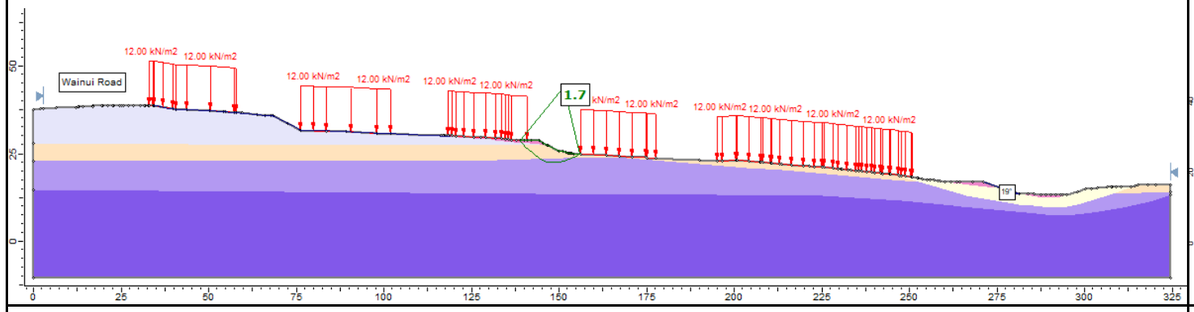
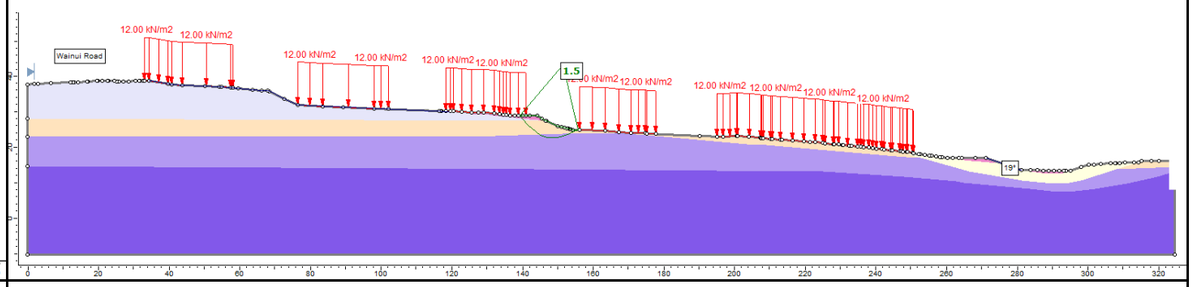
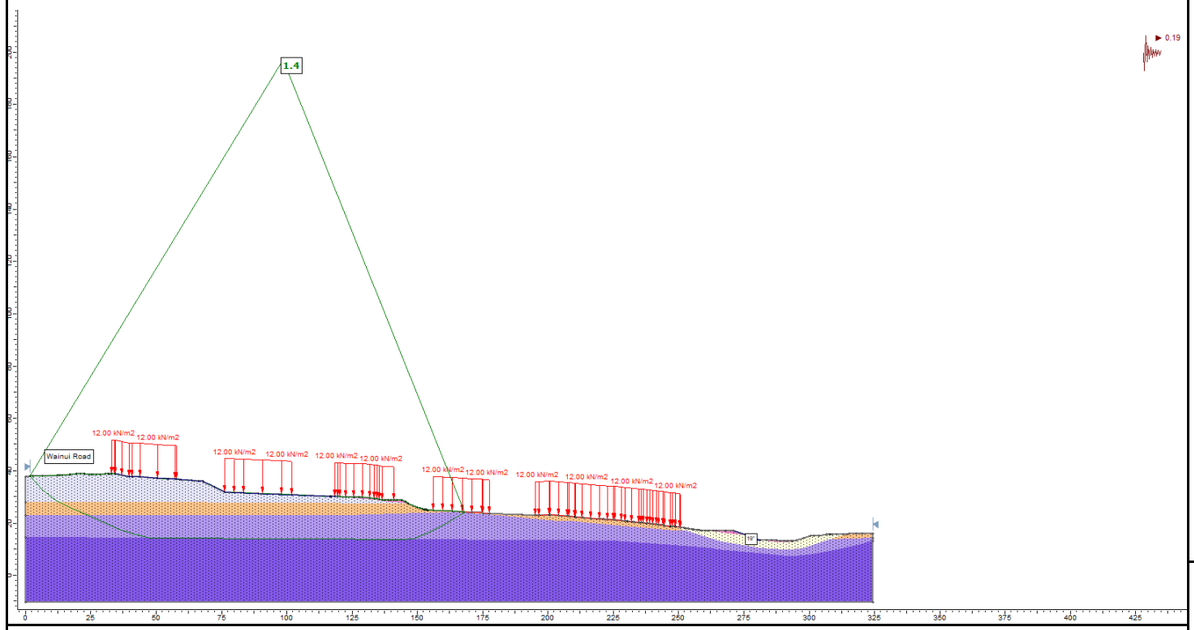
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257	
Title Section N - Existing	*Date* 24/07/2025	*Drawing* STAB 14	



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.2
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.2
Residual Northland Allochthon		18	Mohr-Coulomb	5	28	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.4
Residual Northland Allochthon		18	Mohr-Coulomb	5	28	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface	Ru Value
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None	0.2
Tauranga Group Alluvium (Ridge) UD		17	Undrained	80	0	Constant		None	0.2
Residual Northland Allochthon UD		18	Undrained	60	0	Constant		None	0.2
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0.05
Hukerenui Mudstone UD		20.5	Shear/Normal Function				User Defined 1	None	0
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None	0

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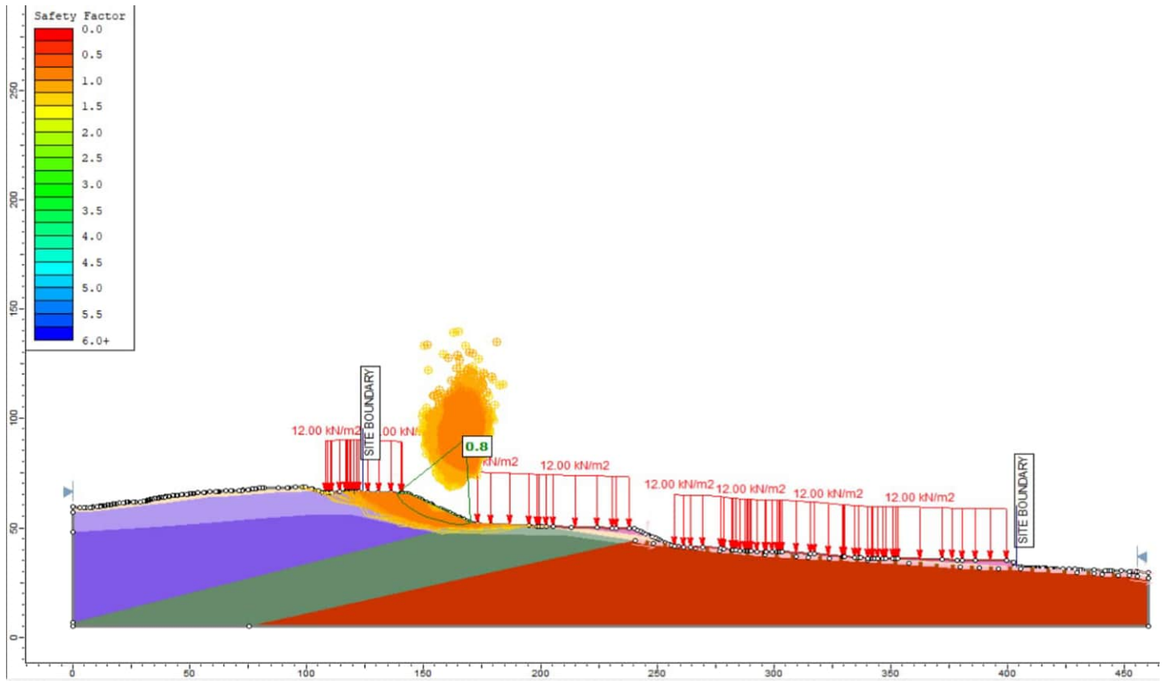
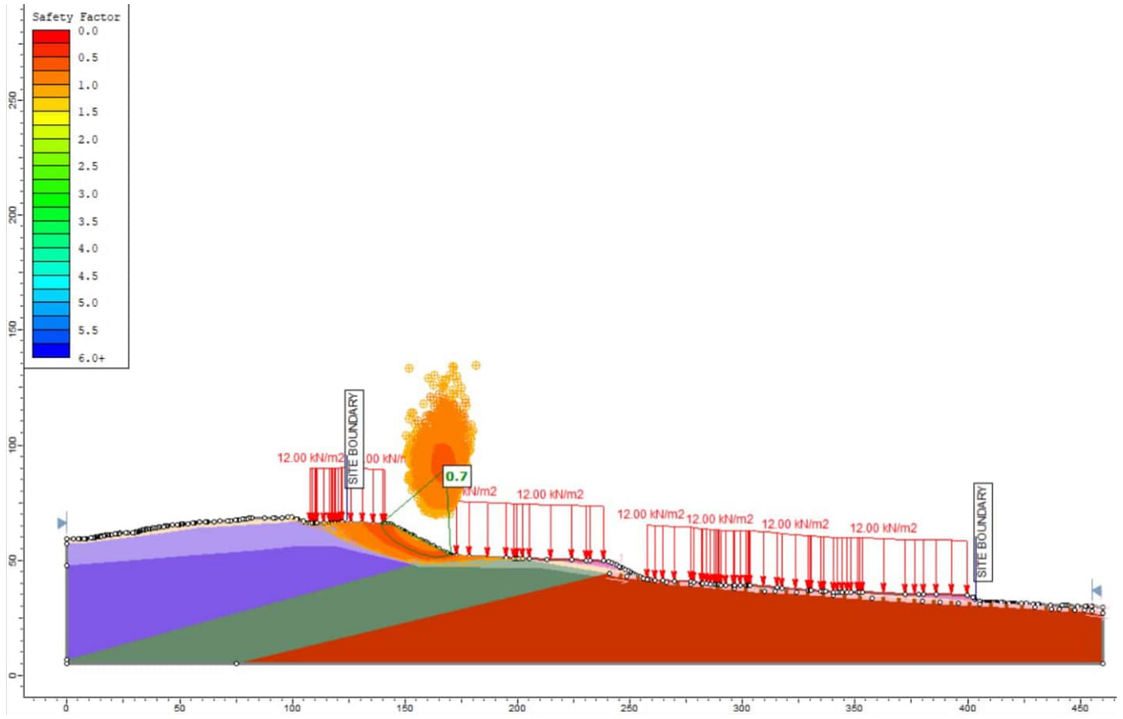
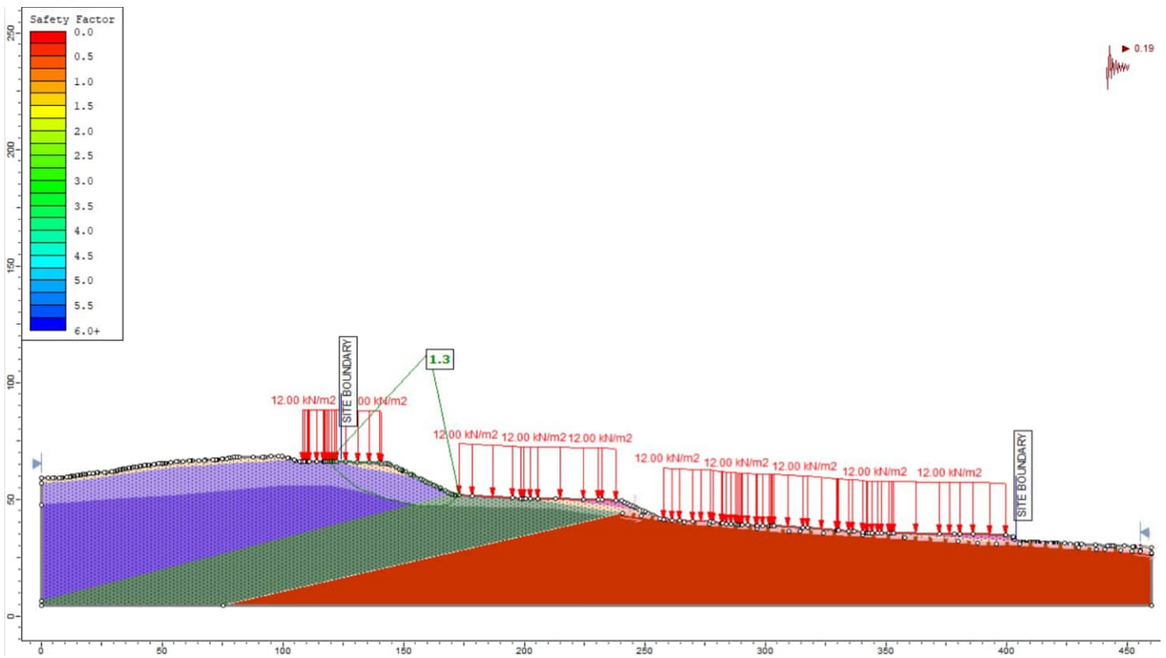
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section N - Proposed	*Date* 24/07/2025	*Drawing* STAB 14a



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr Coulomb	5	28	None	0.2
Tauranga Group Alluvium (Stream)		17	Mohr Coulomb	5	26	None	0.2
Transitional Hukerenui Mudstone		18	Mohr Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr Coulomb	8	21	None	0.05
Undifferentiated Mangakahia Rock Mass		21	Mohr Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr Coulomb	8	28	None	0
TZ Mahurangi Limestone		19	Mohr Coulomb	3	40	None	0
Mahurangi Limestone softened base contact		18	Mohr Coulomb	5	26	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.4
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr-Coulomb	8	21	None	0.2
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2
TZ Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone softened basecontact		18	Mohr-Coulomb	5	26	None	0.4

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface
Mahurangi Limestone		19	Mohr Coulomb	10	40			None
Residual Northland Allocthon UD		18	Undrained	60	0	Constant		None
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None
Hukerenui Mudstone UD		18	Shear/Normal Function				User Defined 1	None
Mangakahia Transitional UD		18	Undrained	55	0	Constant		None
Undifferentiated Mangakahia Rock Mass UD		21	Shear/Normal Function				User Defined 1	None
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None
TZ Mahurangi Limestone (UD*)		19	Mohr Coulomb	3	40			None
Mahurangi Limestone softened base contact (UD)		18	Undrained	50	0	Constant		None

Parameters

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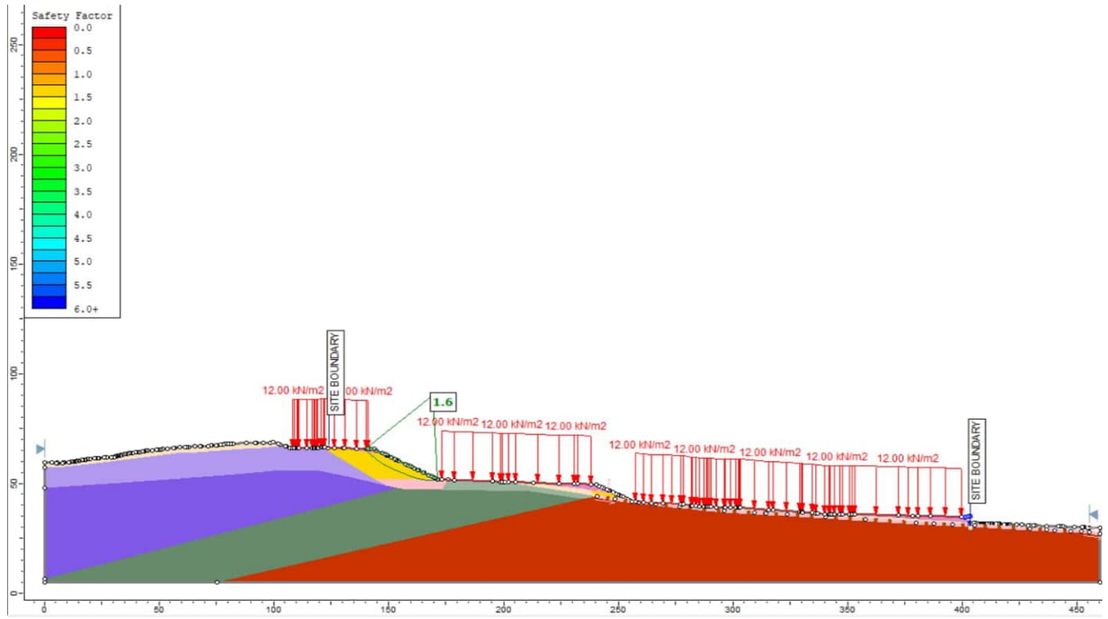
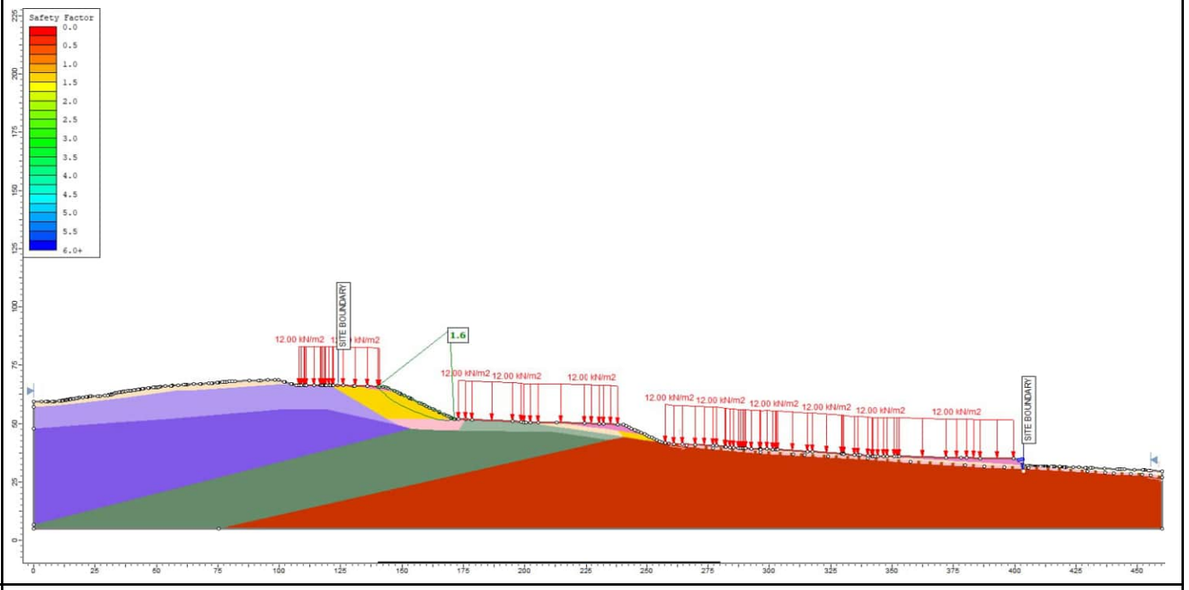
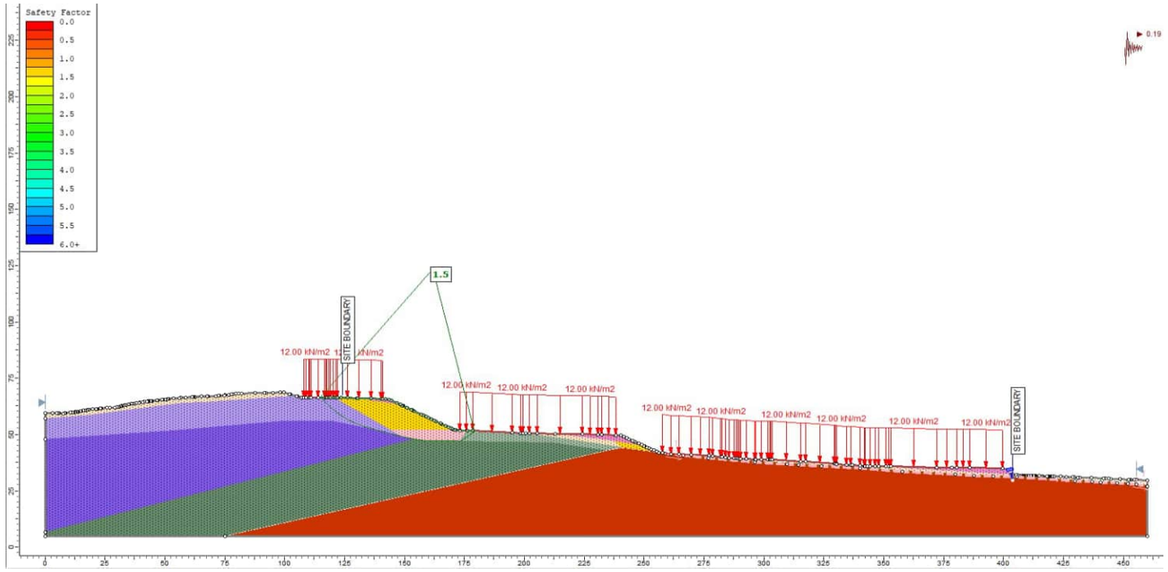
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section G - Proposed	*Date* 11/07/2025	*Drawing* STAB 07



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.2
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
MangakahiaTransitional		18	Mohr-Coulomb	8	21	None	0.05
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0
Shear Key		18	Mohr-Coulomb	8	28	None	0
Buttress Fill		18	Mohr-Coulomb	8	28	None	0
TZ Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone softened base contact		18	Mohr-Coulomb	5	26	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.4
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr-Coulomb	8	21	None	0.2
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2
Shear Key		18	Mohr-Coulomb	8	28	None	0
Buttress Fill		18	Mohr-Coulomb	8	28	None	0
TZ Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone softened base contact		18	Mohr-Coulomb	5	26	None	0.4

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface
Mahurangi Limestone		19	Mohr-Coulomb	10	40			None
Residual Northland Allocthon UD		18	Undrained	60	0	Constant		None
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None
Hukerenui Mudstone UD		18	Shear/Normal Function				User Defined 1	None
Mangakahia Transitional UD		18	Undrained	55	0	Constant		None
Undifferentiated Mangakahia Rock Mass UD		21	Shear/Normal Function				User Defined 1	None
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None
Shear Key_UD		18	Undrained	100	0	Constant		None
Buttress Fill_UD		18	Undrained	100	0	Constant		None
TZ Mahurangi Limestone(UD *)		19	Mohr-Coulomb	3	40			None
Mahurangi Limestone softened base contact (UD)		18	Undrained	50	0	Constant		None

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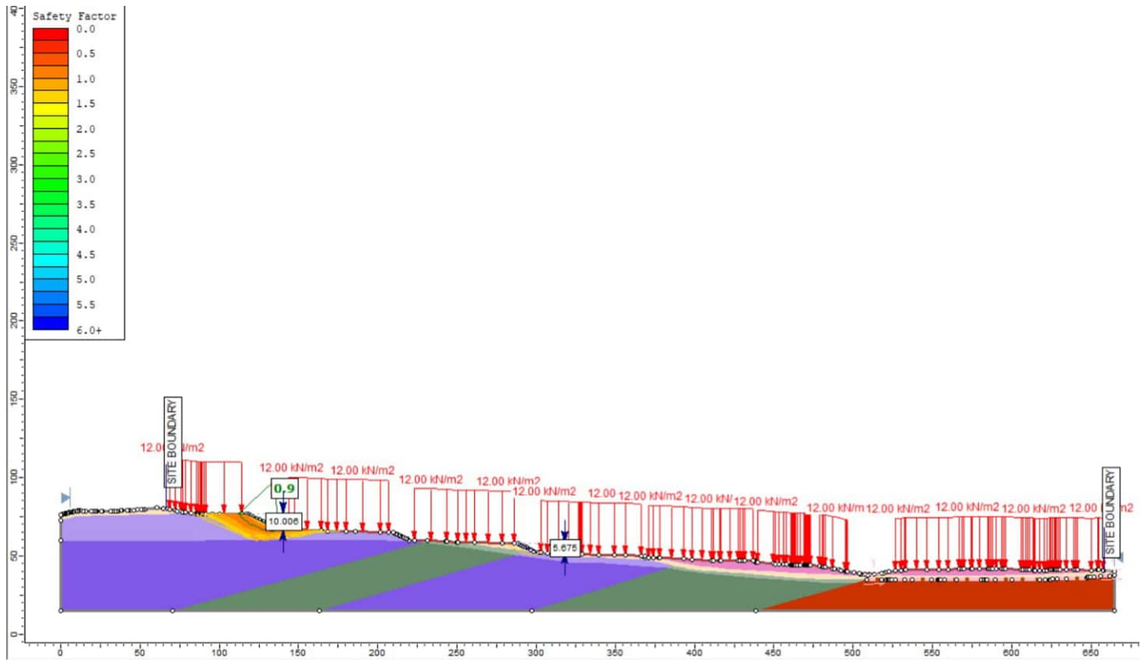
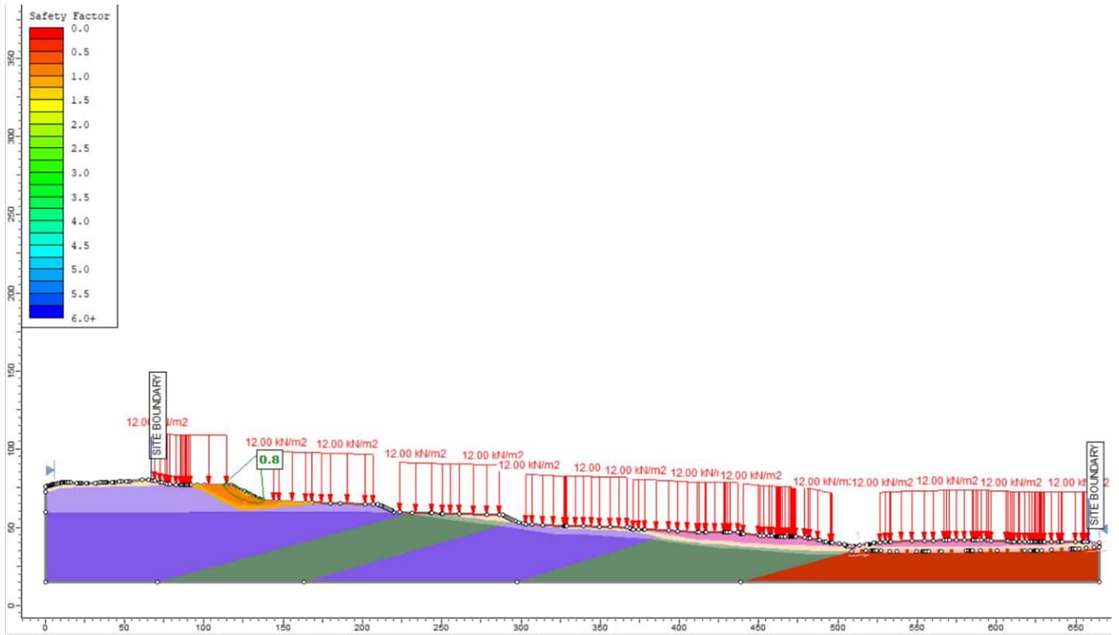
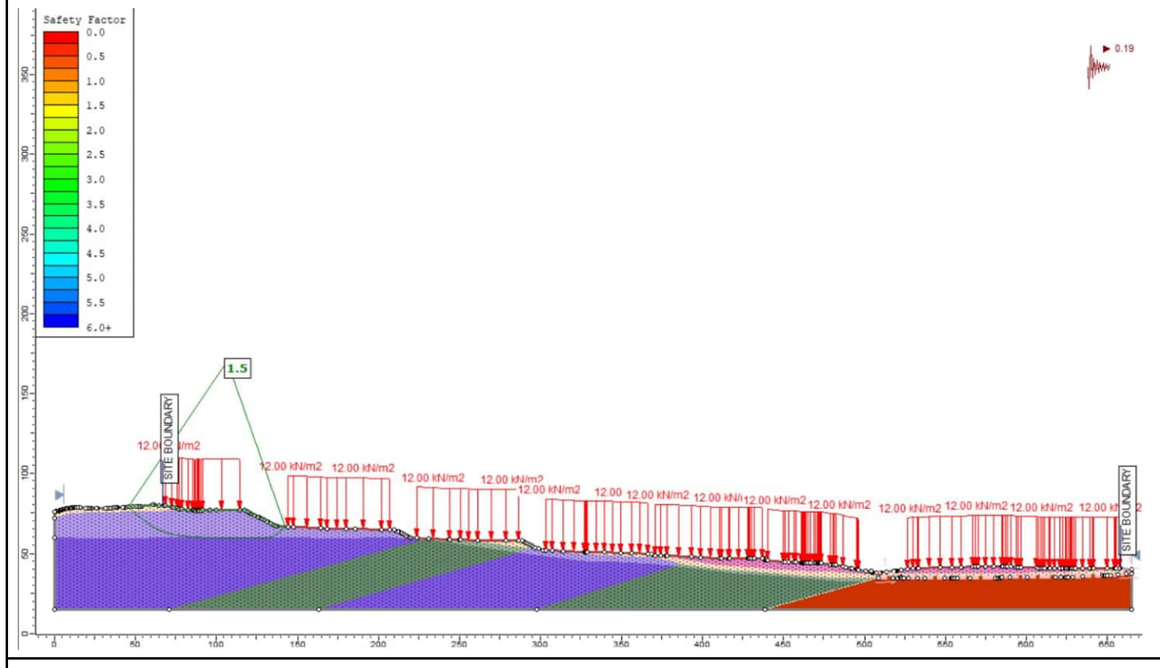
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section G - Proposed with Remediation (Shear Key & Buttress fill)	*Date* 11/07/2025	*Drawing* STAB 07a



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr-Coulomb	8	21	None	0.05
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0
Transitional Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone - softened base contact		18	Mohr-Coulomb	5	26	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr-Coulomb	8	21	None	0.2
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2
Transitional Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone - softened base contact		18	Mohr-Coulomb	5	26	None	0.4

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface	Ru Value
Mahurangi Limestone		19	Mohr-Coulomb	10	40			None	0
Residual Northland Allocthon UD		18	Undrained	60	0	Constant		None	0
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0
Hukerenui Mudstone UD		18	Shear/Normal Function				User Defined 1	None	0
Mangakahia Transitional UD		18	Undrained	55	0	Constant		None	0
Undifferentiated Mangakahia Rock Mass UD		21	Shear/Normal Function				User Defined 1	None	0
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None	0
TZ Mahurangi Limestone (UD*)		19	Mohr-Coulomb	3	40			None	0
Mahurangi Limestone - softened base contact (UD)		18	Undrained	50	0	Constant		None	0

Parameters

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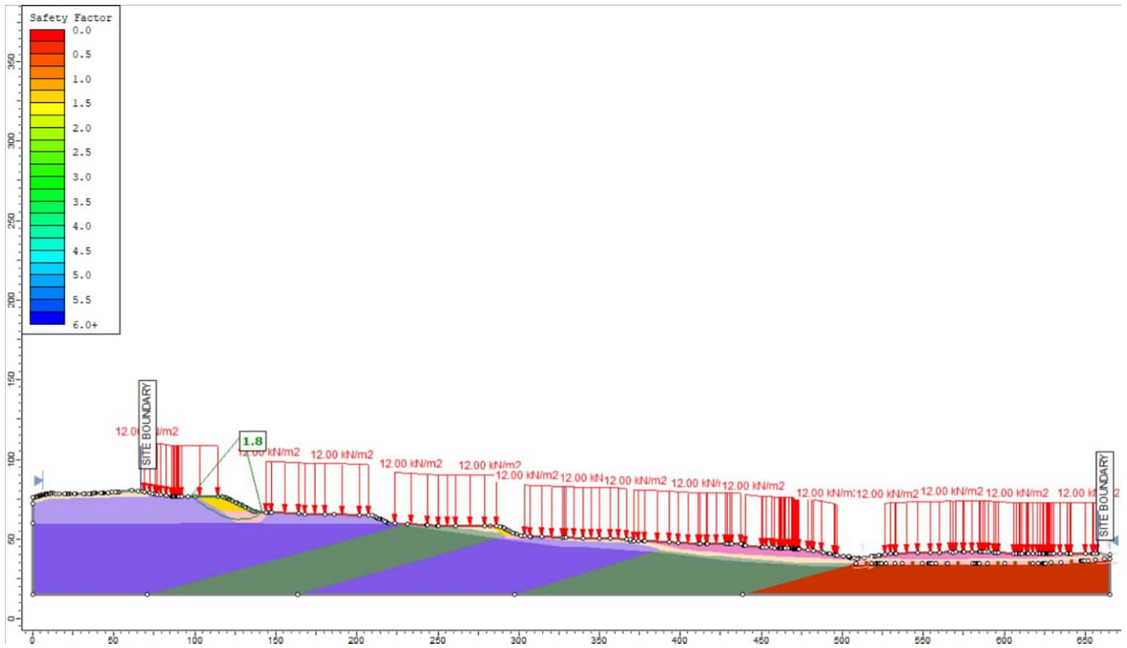
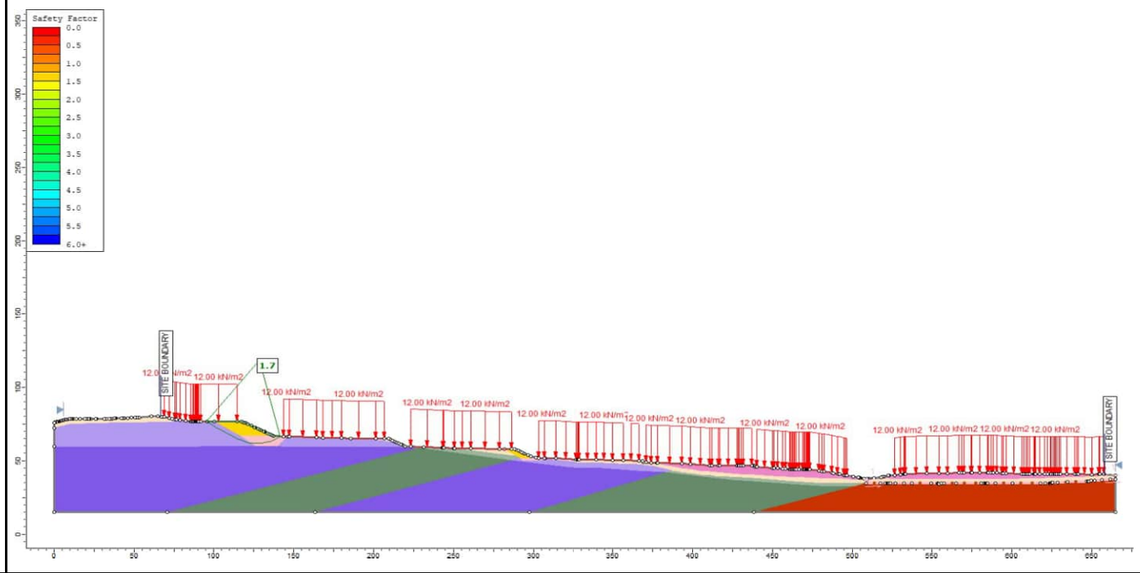
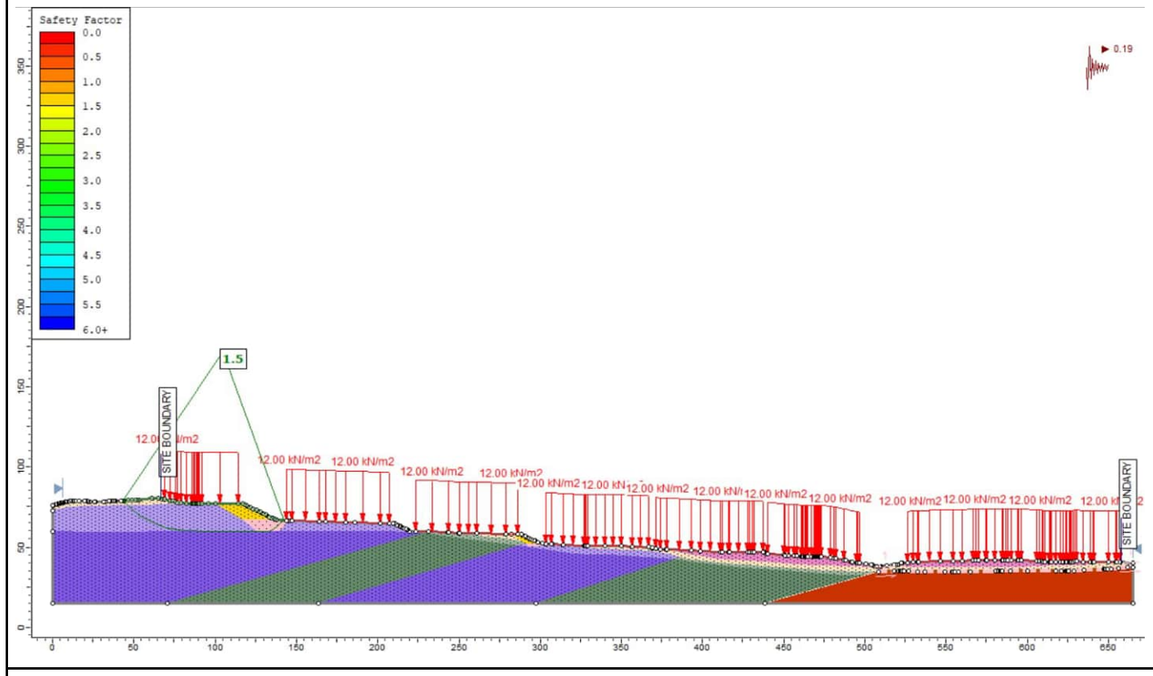
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section J - Proposed	*Date* 11/07/2025	*Drawing* STAB 10



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr-Coulomb	8	21	None	0.05
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0
Shear Key		18	Mohr-Coulomb	8	28	None	0
Buttress Fill		18	Mohr-Coulomb	8	28	None	0
Transitional Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone - softened base contact		18	Mohr-Coulomb	5	26	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Mangakahia Transitional		18	Mohr-Coulomb	8	21	None	0.2
Undifferentiated Mangakahia Rock Mass		21	Mohr-Coulomb	20	28	None	0
Mahurangi Limestone		19	Mohr-Coulomb	10	40	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2
Shear Key		18	Mohr-Coulomb	8	28	None	0
Buttress Fill		18	Mohr-Coulomb	8	28	None	0
Transitional Mahurangi Limestone		19	Mohr-Coulomb	3	40	None	0
Mahurangi Limestone - softened base contact		18	Mohr-Coulomb	5	26	None	0.4

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/Normal Function	Water Surface	Ru Value
Mahurangi Limestone		19	Mohr-Coulomb	10	40			None	0
Residual Northland Allocthon UD		18	Undrained	60	0	Constant		None	0
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0
Hukerenui Mudstone UD		18	Shear/Normal Function				User Defined 1	None	0
Mangakahia Transitional UD		18	Undrained	55	0	Constant		None	0
Undifferentiated Mangakahia Rock Mass UD		21	Shear/Normal Function				User Defined 1	None	0
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None	0
Shear Key UD		18	Undrained	100	0	Constant		None	0
Buttress Fill UD		18	Undrained	100	0	Constant		None	0
TZ Mahurangi Limestone (UD*)		19	Mohr-Coulomb	3	40			None	0
Mahurangi Limestone - softened base contact (UD)		18	Undrained	50	0	Constant		None	0

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Project
MILLDALE FAST TRACK APPLICATION

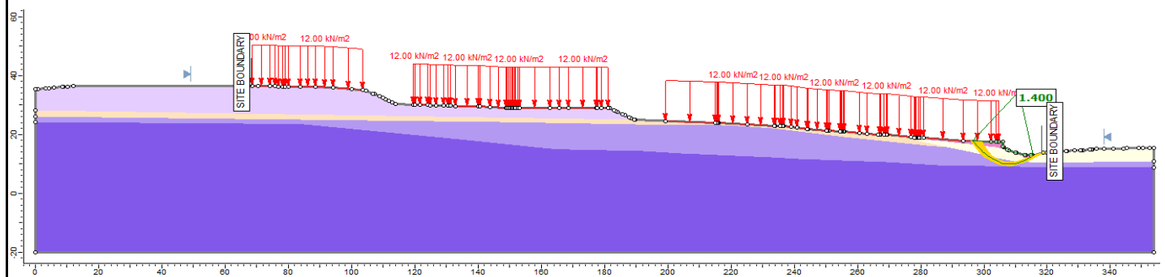
Analysis
Non-Circular

Project No.
AKL2024-0257

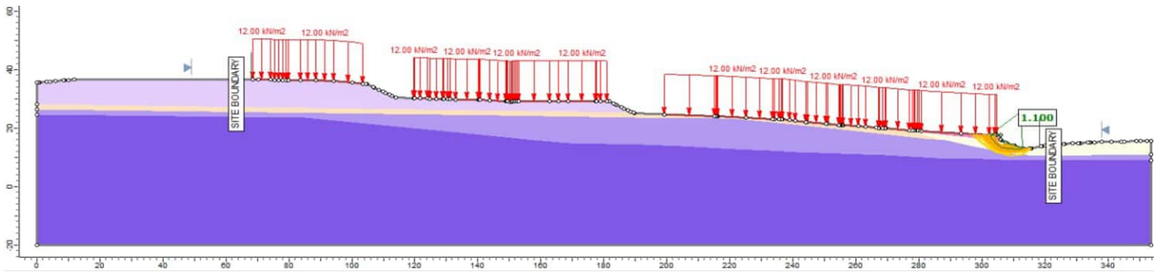
Title
Section J - Proposed with Remediation
Proposed with Remediation (Shear Key & Buttress fill)

Date
11/07/2025

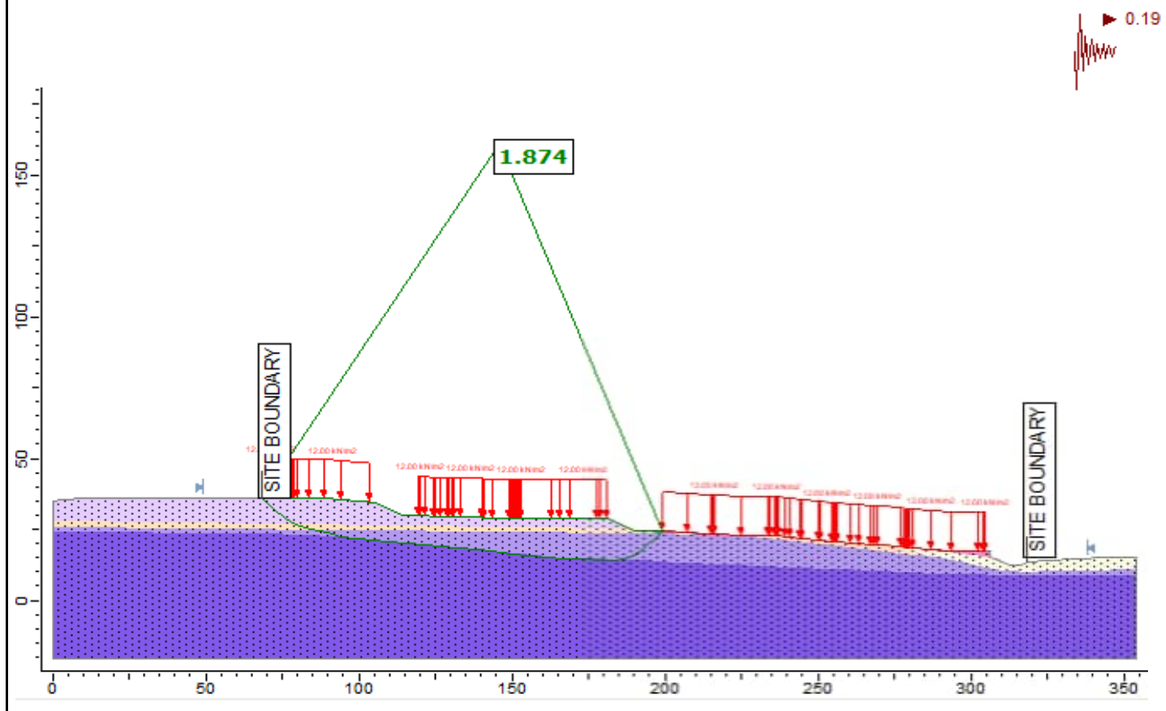
Drawing
STAB 10a



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.2
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.2
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.2
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.05
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Tauranga Group Alluvium (Stream)		17	Mohr-Coulomb	5	26	None	0.4
Residual Northland Allocthon		18	Mohr-Coulomb	5	28	None	0.4
Tauranga Group Alluvium (Ridge)		17	Mohr-Coulomb	8	26	None	0.4
Transitional Hukerenui Mudstone		18	Mohr-Coulomb	8	12	None	0.2
Hukerenui Mudstone		21	Mohr-Coulomb	20	28	None	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	None	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/ Normal Function	Water Surface	Ru Value
Tauranga Group Alluvium (Stream) UD		17	Undrained	60	0	Constant		None	0
Residual Northland Allocthon UD		18	Undrained	60	0	Constant		None	0
Tauranga Group Alluvium (Ridge) UD		17	Undrained	80	0	Constant		None	0
Transitional Hukerenui Mudstone UD		18	Undrained	95	0	Constant		None	0
Hukerenui Mudstone UD		21	Shear/ Normal Function				User Defined 1	None	0
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		None	0

Parameters

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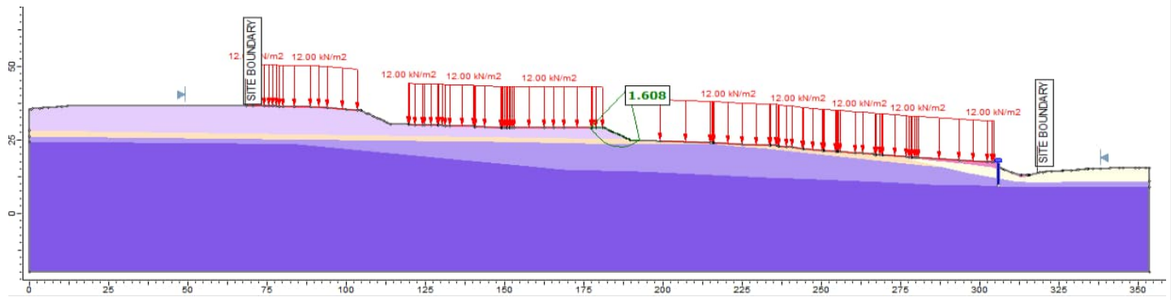
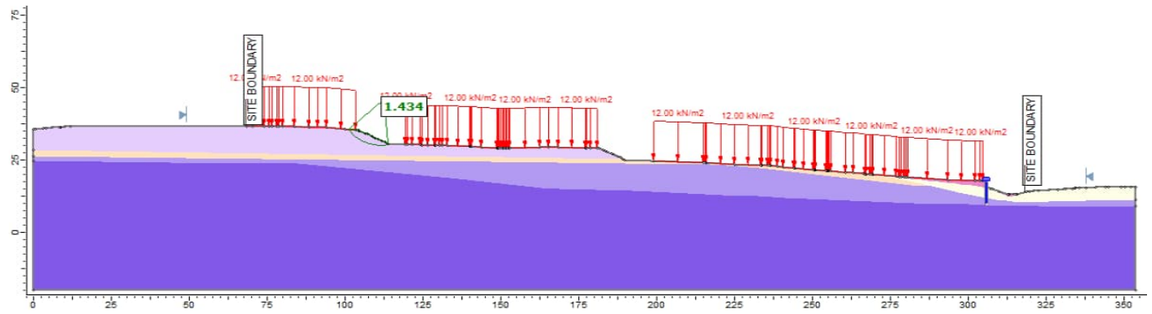
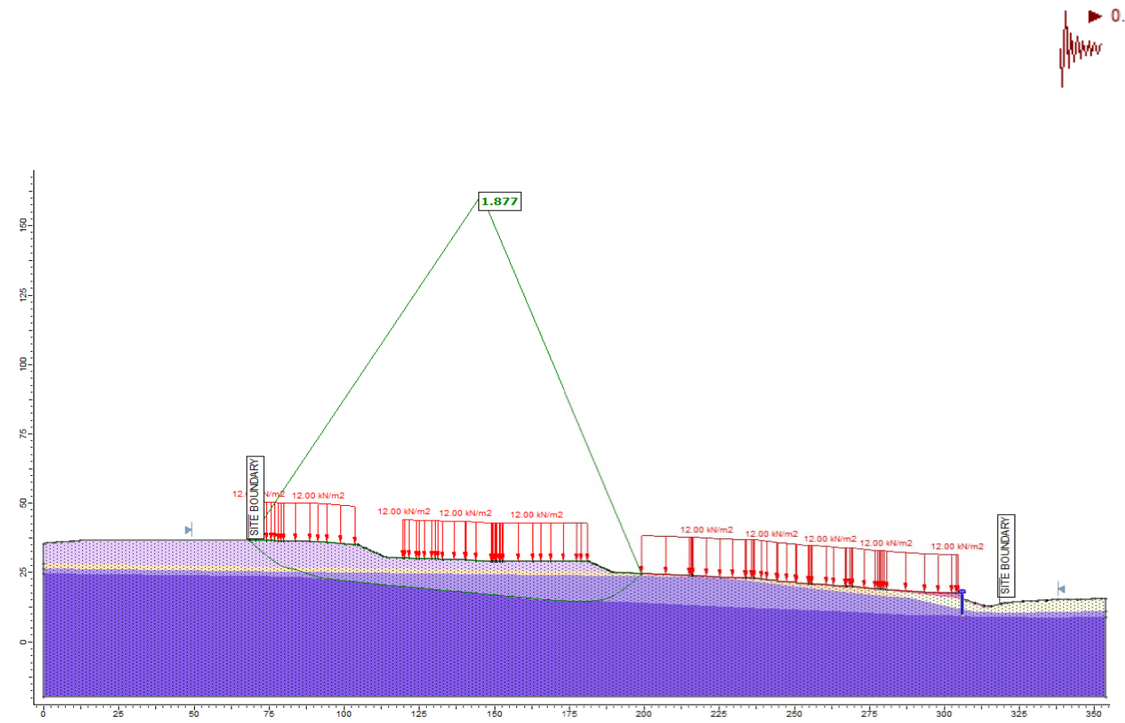
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section A - Proposed	*Date* 10/07/2025	*Drawing* STAB 01



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (m)	Failure Mode	Pile Shear Strength (kN)	Force Orientation
Retaining Wall		Pile/ Micro Pile	Active (Method A)	1.2	Shear	50	Perpendicular to pile

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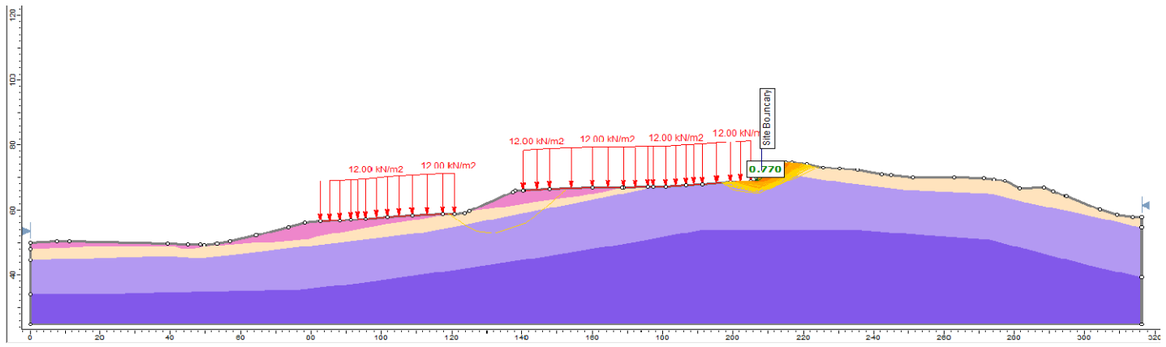
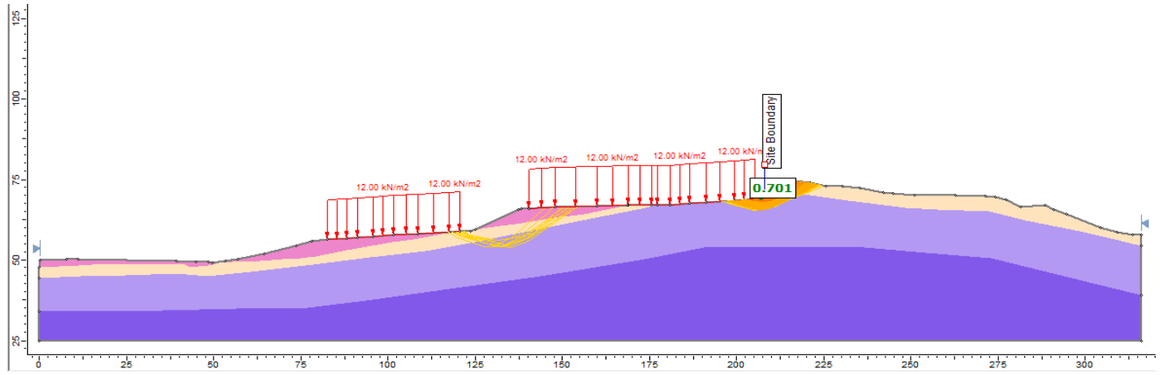
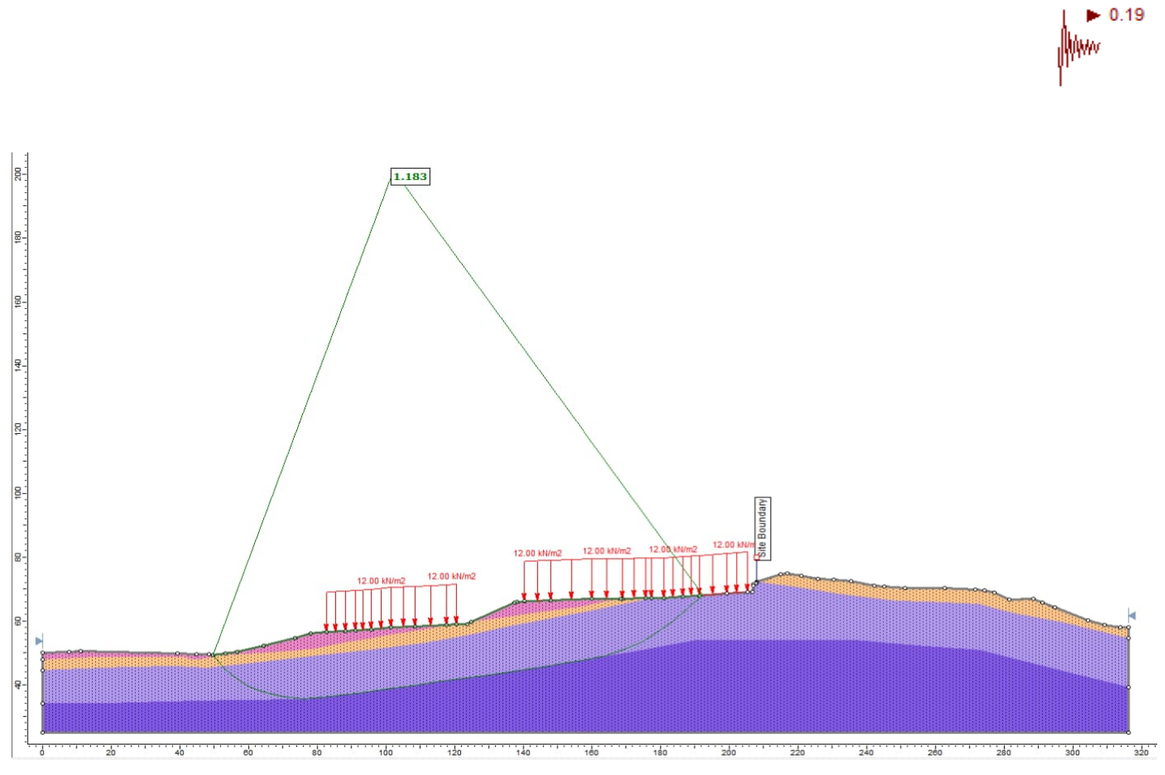
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2021-0161
Title Section A - Proposed with Remediation (Retaining Walls)	*Date* 10/07/2025	*Drawing* STAB 01a



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Ru Value
Residual Northland Allochthon		18	Mohr-Coulomb	5	28	0.2
Transitional Hukereui Mudstone		18	Mohr-Coulomb	8	12	0.05
Hukernui Mudstone		21	Mohr-Coulomb	20	28	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	0

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Ru Value
Residual Northland Allochthon		18	Mohr-Coulomb	5	28	0.4
Transitional Hukereui Mudstone		18	Mohr-Coulomb	8	12	0.2
Hukernui Mudstone		21	Mohr-Coulomb	20	28	0
Proposed Engineered Fill		18	Mohr-Coulomb	8	28	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/ Normal Function	Ru Value
Proposed Engineered Fill		18	Mohr-Coulomb	8	28			0.2
Proposed Engineered Fill UD		18	Undrained	100	0	Constant		0
Residual Northland Allochthon UD		18	Undrained	60	0	Constant		0
Transitional Hukereui Mudstone UD		18	Undrained	95	0	Constant		0
Hukernui Mudstone UD		20.5	Shear/ Normal Function				User Defined 1	0

Parameters

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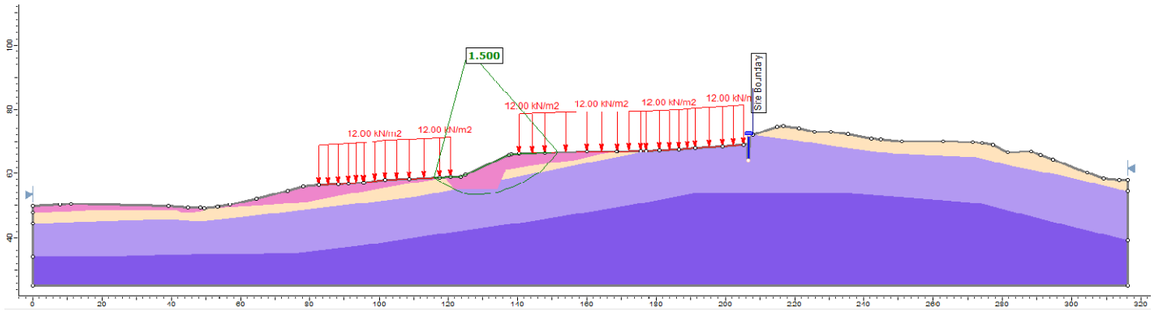
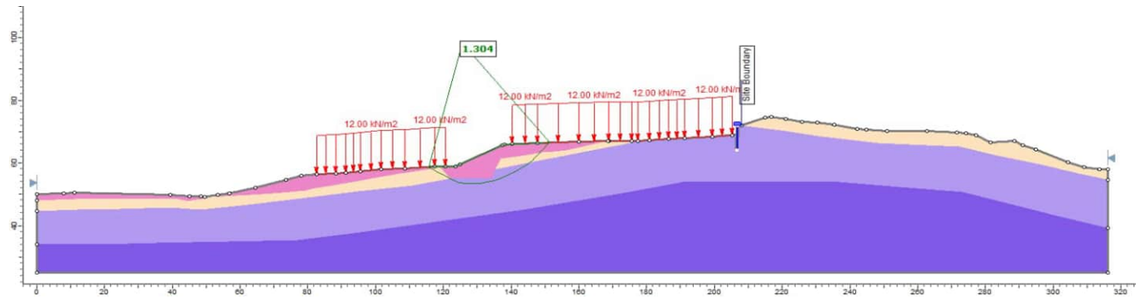
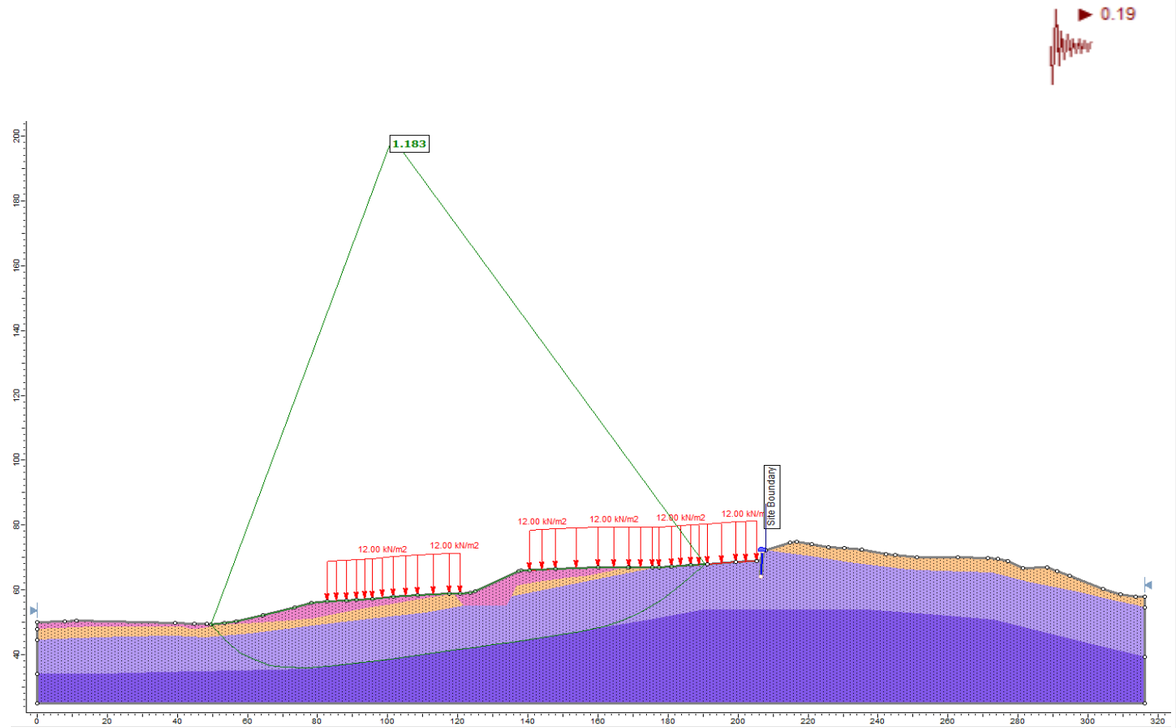
Project MILLDALE FAST TRACK APPLICATION	*Analysis* Non-Circular	*Project No.* AKL2024-0257
Title Section K - Proposed	*Date* 10/07/2025	*Drawing* STAB 11



Normal Groundwater Conditions



Transient Groundwater Conditions



Seismic Event

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (m)	Failure Mode	Pile Shear Strength (kN)	Force Orientation
Palisade Wall (Retaining Wall) A		Pile/ Micro Pile	Active (Method A)	1	Shear	90	Perpendicular to pile

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Project MILLDALE FAST TRACK APPLICATION	*Analysis* Circular	*Project No.* AKL2021-0161
Title Section K - Proposed with Remediation (Shear Key and Retaining Wall)	*Date* 10/07/2025	*Drawing* STAB 11a

Slope Stability

Site Address	Milldale Temporary Wastewater Treatment Facility	Report Number	AKL2024-0185AB
Client	FHLDL	Date	15 July 2025
Prepared by	Jenna Pallarca		
Reviewed & Authorised by	Gaurav Mathur		

1.0 DESIGN CRITERIA

The stability of cut batters and fill embankments under a range of design conditions is expressed in terms of a factor of safety, which is defined as the ratio of forces resisting failure to the forces causing failure. The following performance standards are recommended for slope stability assessment:

Table 1: Slope Stability Factor of Safety Criteria

Condition	Required Factor of Safety
Normal Groundwater Condition	1.5
Extreme (worst credible) groundwater condition	1.3
Seismic condition for ULS PGA (calculated as 0.19g)	1.0

2.0 DESIGN PARAMETERS

The design parameters adopted were according to Table 7.2 of the GIR.

Table 2: Geotechnical Design Parameter

Unit Description	Typical Thickness (m)	Strength Range (kPa)	γ (kN/m3)	c´ (kPa)	ϕ´ (deg)	Su (kPa)
Engineered Fill	1	100 – 200	17.5	8	28	100
Alluvium	10	35 – 145	18	5	26	50
Northland Allochthon - Hukerenui Residual Soils	6	89 – 200	17	5	28	60
Northland Allochthon - Hukerenui Transitional Zone	12	15 – 20 blows / mm	18	6	12	130
Northland Allochthon - Hukerenui Parent Rock		> 40 blows / mm	20.5	20	28	150

3.0 METHODOLOGY

- Slope stability analyses were undertaken using the Morgenstern-Price method of slices under translational failure mechanisms (Cuckoo Search) using the proprietary software SLIDE2 Version 6.
- A load of 12kPa was applied for the Treatment Plant Building and roads, 40kPa for the biological reactor, and 20kPa for tank storage area.
- A shear/normal function was applied to Hukerenui Mudstone Parent Rock (Northland Allochthon) in seismic cases to approximately model its in-situ behaviour.
- A groundwater table of 2m below ground level (bgl) was modelled for normal loading conditions and 1m bgl for the transient case.

4.0 RESULTS

Slope stability analyses were undertaken on Section A-A' (refer to Drawing 01).

Results are appended to this memo and are summarised below for the proposed landform.

Table 3: Slope Stability Analysis Results (Minimum Factor of Safety Obtained)

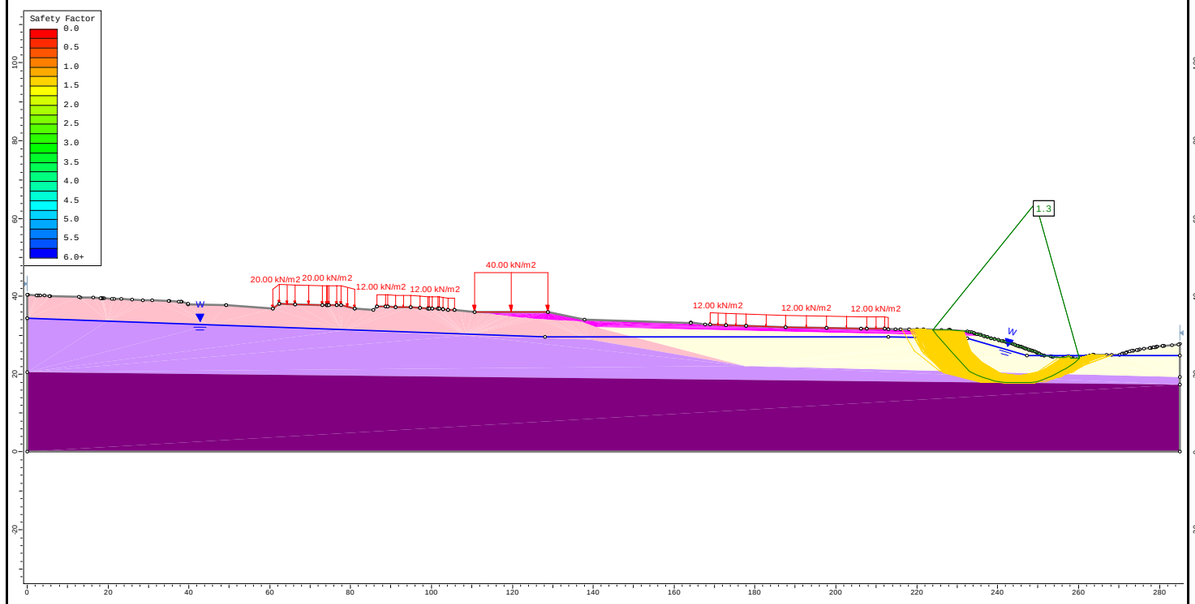
Section	Prevailing	Transient	Seismic
A-A'	> 1.5 at slopes within facility	1.3	1.0

Based on the slope stability analysis, required factors of safety were met for all scenarios. No remediation required. It should be noted that FoS <1.3 can potentially occur at the existing slopes of Waterloo Stream. However, the slip circles are outside the work extents.

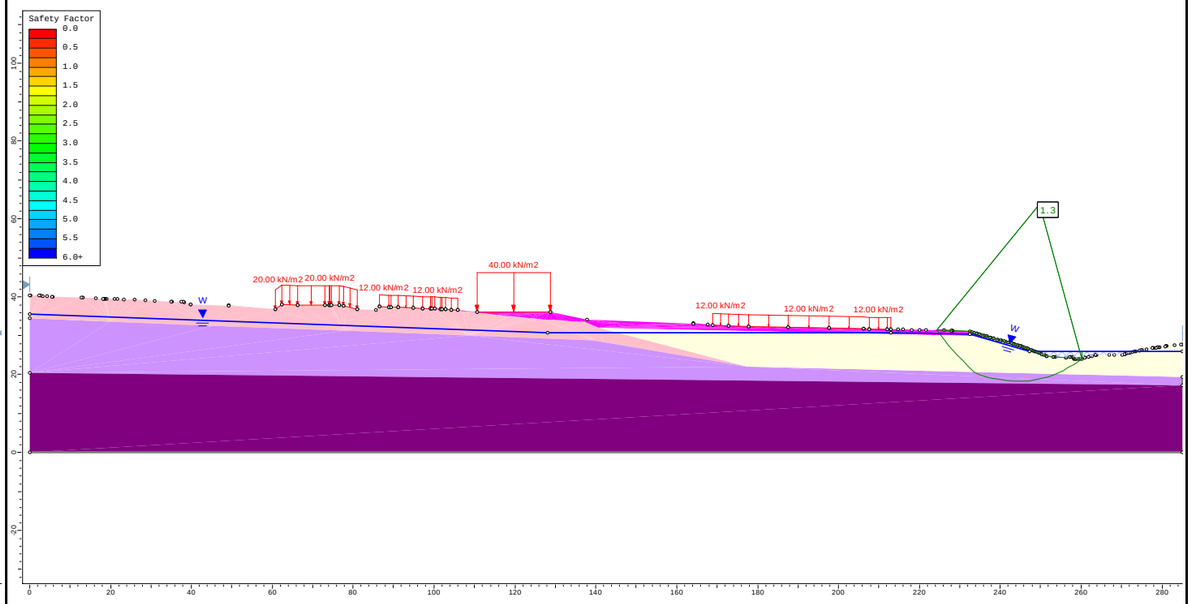
Stability Analysis Summary Table

Client:	FHLDL
Project:	Milldale Temporary Wastewater Treatment Plant
Project Number	AKL2024-0185
Date:	28/05/2025
Notes:	NGW = Normal Groundwater — Target minimum FoS = 1.5
	HGW = High Groundwater (worst credible) — Target minimum FoS = 1.2
	SEIS = Seismic — Target minimum FoS = 1.0

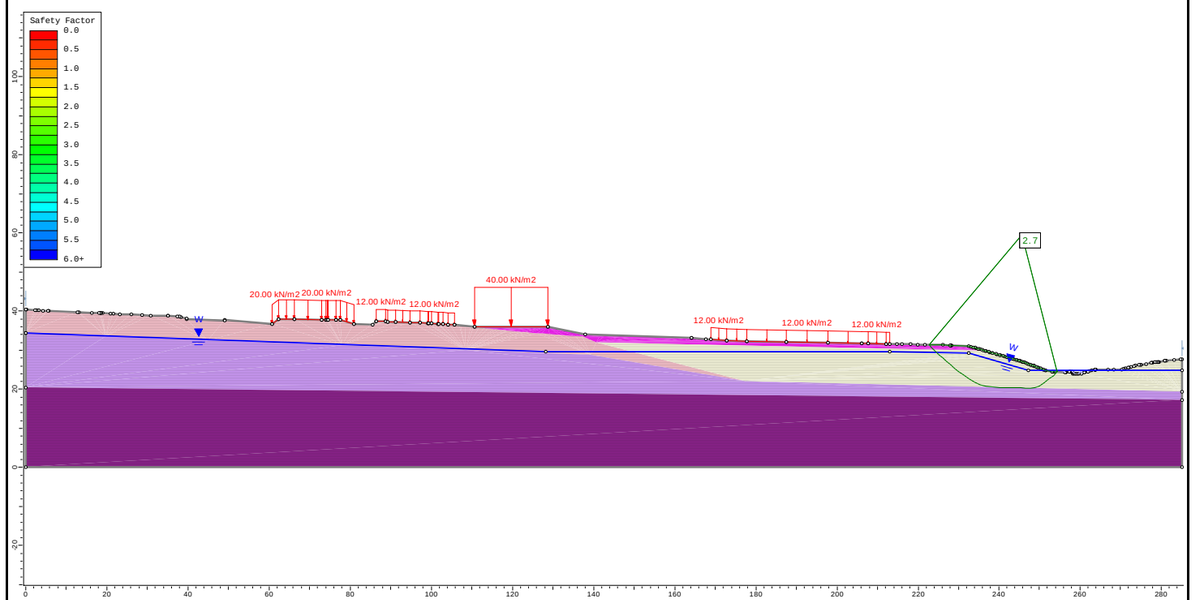
Cross Section	Profile	Design Case	Analysis Type	Factor of Safety	Printout Included	Additional Comments
Section A	Proposed	NGW	Non-circular	> 1.5	✓	FoS < 1.5 limited to the existing slope outside the WWTP
		HGW	Non-circular	1.3	✓	GWT at 1m below ground level
		SEIS	Non-circular	2.7	✓	PGA = 0.19g



Proposed Profile - Normal Groundwater Conditions



Proposed Profile - Worst Credible Groundwater Conditions



Proposed Profile - Seismic Event

Material Name	Color	Unit Weight (kN/m3)	Saturated U.W. (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type
Uncontrolled Fill		17.5	19.5	Mohr-Coulomb	8	28	Water Table	Automatically Calculated
Alluvium		18	20	Mohr-Coulomb	5	26	Water Table	Automatically Calculated
NA Hukerenui Residual Soil		17	19	Mohr-Coulomb	5	28	Water Table	Automatically Calculated
NA Hukerenui Transition		18	20	Mohr-Coulomb	6	12	Water Table	Automatically Calculated
NA Hukerenui Parent Rock		20.5	21	Mohr-Coulomb	20	28	Water Table	Automatically Calculated

Material Name	Color	Unit Weight (kN/m3)	Saturated U.W. (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Shear/Normal Function	Water Surface	Hu Type
UD Uncontrolled Fill		17.5	19.5	Mohr-Coulomb	100	0		Water Table	Automatically Calculated
UD Alluvium		18	20	Mohr-Coulomb	50	0		Water Table	Automatically Calculated
UD NA Hukerenui Residual Soil		17	19	Mohr-Coulomb	60	0		Water Table	Automatically Calculated
UD NA Hukerenui Transition		18	20	Mohr-Coulomb	130	0		Water Table	Automatically Calculated
UD NA Hukerenui Parent Rock		20.5	21	Shear/Normal Function			20	Water Table	Automatically Calculated

Parameters

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Project Milldale Temporary Wastewater Treatment Plant	*Analysis* Cuckoo	*Project No.* AKL2024-0185	
Title Section A - Proposed	*Date* 28/05/2025	*Drawing* STAB 01	

APPENDIX D

Investigation Logs

HAND AUGER BOREHOLE LOG - HA01-24

Client: Fulton Hogan Land Development Ltd
Project: Milldale Wastewater Treatment Plant
Site Location: Milldale
Project No.: AKL2024-0185
Date: 30/10/2024
Borehole Location: Refer to Site Plan Logged by: JH Checked by: JP Scale: 1:25 Sheet 1 of 1

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Position: 1747627.2mE; 5947814.1mN Projection: NZTM
Elevation: 18.10m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			18.1			OL: Organic SILT: Dark brown. Low plasticity. Trace rootlets. (Topsoil)			
			18.0			CH: Silty CLAY: Yellowish brown mottled greyish brown. High plasticity. Moderately sensitive. (Hukerenui Mudstone)			
	0.4	Peak = 153kPa Residual = 65kPa							
						... at 0.60m, Becoming yellowish brown streaked orange and light grey.			
	0.8	Peak = 136kPa Residual = 59kPa							
						... at 0.90m, Minor limonite staining.			
				1					
	1.2	Peak = 124kPa Residual = 59kPa				*... at 1.20m, Becoming light whitish grey streaked light yellowish brown.*			
	1.6	Peak = 139kPa Residual = 91kPa							
	2.0	Peak = 139kPa Residual = 65kPa		2					
			15.9			ML: Clayey SILT: Yellowish brown. Low plasticity. Insensitive. (Hukerenui Mudstone)			
	2.4	Peak = 106kPa Residual = 65kPa					M	VSt	
	2.8	Peak = 106kPa Residual = 74kPa	15.3			ML: SILT: Bluish grey. Low plasticity. Moderately sensitive. (Hukerenui Mudstone)			
						... from 2.80m to 3.60m, Insensitive.			
				3					
	3.2	Peak = 124kPa Residual = 65kPa							
	3.6	Peak = 118kPa Residual = 65kPa							
	4.0	Peak = 148kPa Residual = 71kPa		4					
	4.4	Peak = 198kPa Residual = 77kPa							
	4.8	Peak = 192kPa Residual = 74kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1603 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA02-24

Client: Fulton Hogan Land Development Ltd
Project: Milldale Wastewater Treatment Plant
Site Location: Milldale
Project No.: AKL2024-0185
Date: 30/10/2024
Borehole Location: Refer to Site Plan Logged by: JH Checked by: JP Scale: 1:25 Sheet 1 of 1

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Position: 1747610.2mE; 5947795.5mN Projection: NZTM
Elevation: 17.90m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			17.9			ML: Organic SILT: Dark brown. Low plasticity. Trace rootlets. (Topsoil)			
			17.7			ML: Clayey SILT: Greyish brown mottled orange. Low plasticity. Moderately sensitive. (Hukerenui Mudstone)			
	0.4	Peak = 148kPa Residual = 50kPa							
	0.8	Peak = 148kPa Residual = 47kPa		1				VSt	
	1.2	Peak = 136kPa Residual = 74kPa				*... from 1.20m to 1.60m, Insensitive.*	M		
	1.6	Peak = 136kPa Residual = 65kPa							
			16.1			ML: SILT with trace sand: Grey mottled trace light yellowish brown. Low plasticity. Moderately sensitive. Minor limonite staining. (Hukerenui Mudstone)			
	2.0	Peak = > 207 kPa		2				H	
	2.4	Peak = UTP							
						Borehole terminated at 2.5 m			15, 18, 20
				3					
				4					
				5					

Termination Reason: Refusal on Hard Ground
Shear Vane No: 1603 DCP No: 05
Remarks: Groundwater not encountered. DCP conducted from 2.5 to 2.7m. Refusal on hard ground at 2.7m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA03-24

Client: Fulton Hogan Land Development Ltd
Project: Milldale Wastewater Treatment Plant
Site Location: Milldale
Project No.: AKL2024-0185
Date: 30/10/2024
Borehole Location: Refer to Site Plan Logged by: JH Checked by: JP Scale: 1:25 Sheet 1 of 1

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Position: 1747637.4mE; 5947796.0mN Projection: NZTM
Elevation: 17.60m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			17.6			OL: Organic SILT: Dark brown. Low plasticity. Trace rootlets.			
			17.5			(Topsoil)			
						CH: Silty CLAY: Yellowish brown streaked greyish brown. High plasticity. Insensitive. (Hukerenui Mudstone)			
	0.4	Peak = 171kPa Residual = 65kPa				... from 0.40m to 0.80m, Moderately sensitive.			
	0.8	Peak = 118kPa Residual = 65kPa		1					
	1.2	Peak = UTP	16.4			ML: Clayey SILT: Yellowish brown. Low plasticity. Insensitive. (Hukerenui Mudstone)	M		
						... at 1.20m, Thin lens of limonite nodules, medium gravel sized, angular.			
	1.6	Peak = 121kPa Residual = 74kPa	16.0			CH: Silty CLAY: Yellowish brown streaked light grey. High plasticity. Insensitive. (Hukerenui Mudstone)		VSt	
30-10-2024	2.0	Peak = 153kPa Residual = 89kPa		2					
			15.3			ML: SILT: Light bluish grey. Low plasticity. Insensitive. (Hukerenui Mudstone)			
	2.4	Peak = 150kPa Residual = 80kPa							
	2.8	Peak = 121kPa Residual = 71kPa				... at 2.80m, Becoming bluish grey.			
				3					
	3.2	Peak = 100kPa Residual = 71kPa							
	3.6	Peak = 103kPa Residual = 62kPa				... at 3.60m, With trace fine sand.	M to W		
	4.0	Peak = 89kPa Residual = 47kPa		4				St	
	4.4	Peak = > 207 kPa				... at 4.40m, Becoming hard.		H	
	4.8	Peak = > 207 kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1603 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA04-24

Client: Fulton Hogan Land Development Ltd
Project: Milldale Wastewater Treatment Plant
Site Location: Milldale
Project No.: AKL2024-0185
Date: 31/10/2024
Borehole Location: Refer to Site Plan Logged by: JH Checked by: JP Scale: 1:25 Sheet 1 of 1

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Position: 1747655.1mE; 5947798.4mN Projection: NZTM
Elevation: 17.00m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			17.0			OL: Organic SILT: Dark brown. Low plasticity. Trace rootlets. (Topsoil)			
			16.8			CH: CLAY with minor silt: Greyish brown streaked yellowish brown. High plasticity. Moderately sensitive. (Alluvium)			
	0.4	Peak = 118kPa Residual = 30kPa							
	0.8	Peak = 121kPa Residual = 56kPa				... at 0.70m, Becoming light whitish grey streaked light yellowish brown. Trace limonite staining.			
				1			M	VSt	
	1.2	Peak = 118kPa Residual = 89kPa				... at 1.20m, Becoming insensitive.			
	1.6	Peak = 130kPa Residual = 86kPa							
31-10-2024	2.0	Peak = 124kPa Residual = 83kPa		2		... at 2.00m, Trace decomposing tree roots.			
	2.4	Peak = 80kPa Residual = 47kPa							
	2.8	Peak = 106kPa Residual = 56kPa						St	
				3			M to W		
	3.2	Peak = 62kPa Residual = 32kPa							
			13.5			MH: Clayey SILT: Light whitish grey streaked trace light yellowish brown. Low plasticity. Insensitive. (Alluvium)			
	3.6	Peak = 62kPa Residual = 38kPa						F	
	4.0	Peak = 47kPa Residual = 30kPa		4		... at 4.00m, Becoming light bluish grey.			
						... from 4.20m to 4.80m, Poor recovery.			
	4.4	Peak = 59kPa Residual = 30kPa					W to S	St	
	4.8	Peak = 89kPa Residual = 46kPa				... at 4.80m, With trace fine sand. Yellowish brown.			
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1603 DCP No:
Remarks: Groundwater encountered at 2.4m. Poor recovery from 4.2 to 4.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA05-24

Client: Fulton Hogan Land Development Ltd
Project: Milldale Wastewater Treatment Plant
Site Location: Milldale
Project No.: AKL2024-0185
Date: 30/10/2024
Borehole Location: Refer to Site Plan Logged by: JH Checked by: JP Scale: 1:25 Sheet 1 of 1

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Position: 1747647.7mE; 5947779.7mN Projection: NZTM
Elevation: 16.90m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			16.9			ML: Organic SILT: Dark brown. Low plasticity. Trace rootlets.			
			16.8			(Topsoil)			
						CH: Silty CLAY: Yellowish brown streaked greyish brown. High plasticity. Moderately sensitive. (Hukerenui Mudstone)			
	0.4	Peak = 106kPa Residual = 50kPa							
	0.8	Peak = 139kPa Residual = 59kPa				*... at 0.70m, Becoming light grey streaked light yellowish brown.*			
				1					
	1.2	Peak = 142kPa Residual = 77kPa				*... from 1.20m to 2.40m, Insensitive.*			
	1.6	Peak = 148kPa Residual = 89kPa					M		
	2.0	Peak = 159kPa Residual = 100kPa		2					
						... at 2.20m, Trace limonite staining.			
	2.4	Peak = 124kPa Residual = 83kPa						VSt	
30-10-2024	2.8	Peak = 133kPa Residual = 62kPa							
				3					
	3.2	Peak = 106kPa Residual = 62kPa	13.7			ML: SILT: Light whitish grey streaked pink. Low plasticity. Insensitive. (Hukerenui Mudstone)			
						... from 3.20m to 3.60m, Insensitive.			
	3.6	Peak = 112kPa Residual = 59kPa							
						... from 3.80m to 3.90m, Pink streaked light whitish grey.			
	4.0	Peak = 127kPa Residual = 56kPa		4			M to W		
			12.6			ML: SILT: Dark bluish grey. Low plasticity. Insensitive. (Hukerenui Mudstone)			
	4.4	Peak = 162kPa Residual = 89kPa							
	4.8	Peak = 150kPa Residual = 91kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1603 DCP No:
Remarks: Groundwater encountered at 3.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA06-24

Client: Fulton Hogan Land Development Ltd
Project: Milldale Wastewater Treatment Plant
Site Location: Milldale
Project No.: AKL2024-0185
Date: 01/11/2024
Borehole Location: Refer to Site Plan Logged by: JH Checked by: JP Scale: 1:25 Sheet 1 of 1

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Position: 1747733.1mE; 5947772.8mN Projection: NZTM
Elevation: 12.10m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			12.1			Hardfill: Coarse to cobble sized hardfill, Subangular to angular. Well compacted. (Fill)			
			11.6			CH: CLAY with minor silt: Brownish grey streaked yellowish brown. High plasticity. Insensitive. (Alluvium)		VSt	
	0.8	Peak = 108kPa Residual = 67kPa		1		... at 0.70m, Light grey streaked yellowish brown. Trace decomposing tree roots.			
	1.2	Peak = 48kPa Residual = 29kPa						St	
	1.6	Peak = 80kPa Residual = 48kPa				... at 1.70m, Becoming bluish grey.	M		
	2.0	Peak = 143kPa Residual = 64kPa		2		... from 2.00m to 2.80m, Moderately sensitive.			
	2.4	Peak = 130kPa Residual = 38kPa						VSt	
01-11-2024	2.8	Peak = 127kPa Residual = 32kPa	9.3			OH: Organic CLAY: Dark brown. High plasticity. Trace decomposing tree roots. (Alluvium)			
			9.2			SP: Silty SAND: Light grey. Poorly graded. Sand is medium grained. (Alluvium)			
			9.1	3		CH: Silty CLAY: Brown. High plasticity. Insensitive. Poor recovery. (Alluvium)			
	3.2	Peak = 35kPa Residual = 24kPa						S to F	
	3.6	Peak = 54kPa Residual = 29kPa							
	4.0	Peak = 64kPa Residual = 34kPa		4			S		
	4.4	Peak = 51kPa Residual = 32kPa							
	4.8	Peak = 45kPa Residual = 32kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.8m. Poor recovery from 3.0 to 5.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA04-23

Client: Fulton Hogan Land Development Ltd
Project: Milldale Stage 8
Site Location: Milldale
Project No.: AKL2022-0029
Date: 02/11/2023
Borehole Location: Refer to Site Plan Logged by: JH Checked by: NK Scale: 1:25 Sheet 1 of 1

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Position: 1747711.4mE; 5947639.4mN Projection: NZTM
Elevation: 11.55m Datum: NZVD2016 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			11.6			OH: Organic Clayey SILT: Dark brown. Low plasticity. Some rootlets.			
			11.5			(Topsoil)			
						CH: CLAY with minor silt: Light grey streaked grey. High plasticity. Some rootlets. (Alluvium)			
	0.4	Peak = 121kPa Residual = 53kPa				... at 0.40m, becoming CLAY. Light pinkish grey streaked orange brown and light greenish grey.			
	0.8	Peak = 121kPa Residual = 59kPa						VSt	
				1		... at 1.00m, becoming light grey streaked orange brown.			
	1.2	Peak = 145kPa Residual = 77kPa							
	1.6	Peak = >207 kPa				... at 1.60m, Trace of organics (decomposing tree roots).	M		
						... at 1.90m, Some organics (decomposing tree roots).			
	2.0	Peak = 201kPa Residual = 62kPa		2					
	2.4	Peak = 198kPa Residual = 92kPa						VSt to H	
						... at 2.50m, becoming with some silt. Light grey streaked light greenish grey.			
						... at 2.70m, becoming CLAY.			
	2.8	Peak = 136kPa Residual = 41kPa							
				3					
	3.2	Peak = >207 kPa							
						Borehole terminated at 3.2 m			
				4					
				5					

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA19-20

Client: Fulton Hogan Land Development Ltd
Project: Milldale Stage 7 Wastewater Investigation
Site Location: Northridge Estate
Project No.: AKL2020-0080
Date: 21/10/2020
Borehole Location: Refer to site plan Logged by: AA Checked by: CR Scale: 1:25 Sheet 1 of 1

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Position: 1747778.3mE; 5947757.4mN Projection: NZTM
Elevation: 10.50m Datum: AUCKHT1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			10.5			OL: TOPSOIL			
			10.3			CH: Silty CLAY: light brownish grey streaked orange. High plasticity. (Alluvium)			
	0.4	Peak = 93kPa Residual = 42kPa						VSt	
	0.8	Peak = 63kPa Residual = 27kPa				... at 0.80m, ...becoming light grey streaked orange	M		
				1				F	
	1.2	Peak = 48kPa Residual = 15kPa							
	1.6	Peak = 42kPa Residual = 9kPa							
						... from 1.90m to 2.10m, ...with some large rootlets			
	2.0	Peak = 21kPa Residual = 3kPa		2				S	
						... at 2.20m, ...becoming bluish grey			
	2.4	Peak = 30kPa Residual = 15kPa							
						... from 2.60m to 2.70m, ...with some organics			
	2.8	Peak = 27kPa Residual = 3kPa							
				3				F	
	3.2	Peak = 42kPa Residual = 9kPa				... at 3.20m, ...becoming light greyish blue	W		
	3.6	Peak = 48kPa Residual = 12kPa							
						... at 3.80m, ...becoming bluish grey			
	4.0	Peak = 45kPa Residual = 15kPa		4					
	4.4	Peak = 75kPa Residual = 33kPa						VSt	
	4.8	Peak = 81kPa Residual = 45kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2082 DCP No:
Remarks: Groundwater no encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA20-20

Client: Fulton Hogan Land Development Ltd
Project: Milldale Stage 7 Wastewater Investigation
Site Location: Northridge Estate
Project No.: AKL2020-0080
Date: 21/10/2020
Borehole Location: Refer to site plan Logged by: AA Checked by: CR Scale: 1:25 Sheet 1 of 1

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Position: 1747788.5mE; 5947754.1mN Projection: NZTM
Elevation: 7.00m Datum: AUCKHT1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			7.0			OL: TOPOSIL			
			6.8			CH: Silty CLAY: orange brown streaked black. High plasticity. (Alluvium)	D to M		
	0.4	Peak = 120kPa Residual = 45kPa							
	0.8	Peak = 123kPa Residual = 57kPa		1			M	VSt	
						... at 1.10m, ...becoming grey streaked orange			
	1.2	Peak = 102kPa Residual = 48kPa				... at 1.30m, ...becoming CLAY. greyish brown		F	
						... at 1.50m, ...with trace organics			
	1.6	Peak = 36kPa Residual = 9kPa							
	2.0	Peak = 21kPa Residual = 6kPa		2				S	
	2.4	Peak = 24kPa Residual = 6kPa							
	2.8	Peak = 42kPa Residual = 9kPa					W		
				3					
	3.2	Peak = 42kPa Residual = 9kPa							
	3.6	Peak = 45kPa Residual = 15kPa						F	
						... at 3.80m, ...becoming bluish grey			
	4.0	Peak = 48kPa Residual = 15kPa		4					
▼	4.4	Peak = 42kPa Residual = 12kPa					S		
	4.8	Peak = 48kPa Residual = 18kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2082 DCP No:
Remarks: Groundwater encountered at 4.3m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

BOREHOLE LOG - MH01-20

Client: Fulton Hogan Land Development Ltd
Project: Wainui to Lysnar Tunnel
Site Location: Lysnar Road
Project No.: AKL2018-0171
Date: 05/03/2020
Borehole Location: Refer to site plan Logged by: AA Checked by: CR Scale: 1:50 Sheet 1 of 2

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Position: 1747732.7mE; 5947695.6mN Projection: NZTM2000
Angle from horizontal: 90°
Elevation: 10.00m Datum: AUCKHT1946
Survey Source: Hand Help GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	Drilling Method/ Support
		10.0		OL: TOPSOIL.					
		9.9		(Topsoil)					
				CH: Silty CLAY: light greyish brown streaked orange brown. High Plasticity. (Alluvium)					
0.5	Peak = UTP						100		OB / PQ3
				... at 0.60m, ...containing tree roots					
1.0	Peak = UTP		1	*... at 0.80m, ...becoming CLAY with minor silt: light greyish brown streaked orange brown*			100		OB / PQ3
1.5	SPT = (2,2,3) N* = 5						60		OB / PQ3
1.5	Peak = >217kPa						89		SPT
			2	*... at 1.95m, ...becoming light greyish yellow streaked orange*			100		OB / PQ3
				... at 2.75m, ...becoming CLAY with some silt: dark brownish purple streaked black					
3.0	Peak = 120kPa		3				100		SPT
3.0	Residual = 15kPa								
	SPT = (2,2,2) N* = 4								
				... at 3.55m, ...becoming CLAY with minor silt: light greenish grey mottled orange brown		VSt			
			4				100		OB / PQ3
4.5	SPT = (2,5,5) N* = 10								
4.5	Peak = UTP						100		SPT
			5		M				
							91		OB / PQ3
6.0	SPT = (2,4,4) N* = 8		6				100		SPT
6.0				*... at 6.25m, ...becoming CLAY with trace silt: light bluish grey mottled orange*					
				... at 6.45m, ...becoming light greyish brown streaked orange					
			7				73		OB / PQ3
				... at 7.30m, ...becoming dark bluish grey mottled orange					
			8	*... at 8.00m, ...becoming dark bluish grey*					
8.5	Peak = 75kPa					St	100		OB / PQ3
	Residual = 6kPa								
9.0	Peak = 81kPa		9				100		SPT
9.0	Residual = 6kPa								
	SPT = (2,2,3) N* = 5								
				... at 9.80m, ...becoming silty CLAY with trace sand: dark bluish grey. Sand is fine			100		OB / PQ3
			10						

Estimated Strength: EW, VW, W, MS, S, VS, ES
Defect Spacing (mm): <20, 20-60, 60-200, 200-600, 600-2000, >2000
Weathering: RS, CW, HW, MW, SW, UW
Structure & Other Observations: Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks

Termination Reason: Target depth reached
Shear Vane No: DCP No:
Remarks:

BOREHOLE LOG - MH01-20

Client: Fulton Hogan Land Development Ltd
Project: Wainui to Lysnar Tunnel
Site Location: Lysnar Road
Project No.: AKL2018-0171
Date: 05/03/2020
Borehole Location: Refer to site plan Logged by: AA Checked by: CR Scale: 1:50 Sheet 2 of 2

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Position: 1747732.7mE; 5947695.6mN Projection: NZTM2000
Elevation: 10.00m Datum: AUCKHT1946
Angle from horizontal: 90°
Survey Source: Hand Help GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Recovery	RQD	Drilling Method/ Support	Structure & Other Observations
10.5 10.5	Peak = 60kPa Residual = 15kPa SPT = (2,4,4) N* = 8		11	... at 10.10m, ...contains decomposing wood fragments ... at 10.50m, ...becoming dark grey	100		SPT	
					100		OB / PQ3	
		-1.8	12	SW: Medium SAND with trace silt: dark grey. Well graded, sub angular. (Alluvium)				
12.0 12.0	Peak = 30kPa Residual = 6kPa SPT = (2,3,4) N* = 7				100			
		-2.4		CH: CLAY with minor silt : dark bluish grey. High Plasticity (Alluvium)				
		-2.8		CI: SILTSTONE, dark brown, Weathered to Silty CLAY: dark brown. Low plasticity. (Transitional Northland Allochthon)	100		OB / PQ3	12.8-13.0m:1,CS,
13.1	Peak = UTP	-3.1	13	SILTSTONE, dark greyish brown. (Northland Allochthon)				13.1-13.5m:15,JN,45°,
		-3.5		SANDSTONE, light greenish grey. (Northland Allochthon)	89	28	TT / HQ3	13.3m:1,CS,
14.0	SPT = (22,34,16/100mm) N* = 50+		14					13.9m:1,B,45°,
		-4.2		SILTSTONE, dark greenish grey streaked white. (Northland Allochthon)	0	0	SPT	14.2-15.5m:8,B,30°,
			15		100	73	TT / HQ3	
15.5	SPT = (50/20mm) N* = 50+	-5.5		SILTSTONE, dark grey. (Northland Allochthon)	0	0	SPT	15.5-16.4m:4,B,15°,
			16		100	47	TT / HQ3	16.4-16.5m:1,CS,
		-6.5		SANDSTONE, dark grey. (Northland Allochthon)				16.8m:1,B,10°,
17.0	SPT = (50/20mm) N* = 50+		17	Borehole terminated at 17.00 m	0	0	SPT	
			18					
			19					
			20					

Moisture Condition: H
Consistency/ Relative Density: H
Weathering: RS, CW, HW, MW, SW, UW
Estimated Strength: EW, VW, W, MS, S, VS, ES
Defect Spacing (mm): <20, 20-60, 60-200, 200-600, 600-2000, >2000

Termination Reason: Target depth reached
Shear Vane No: DCP No:
Remarks:

BOREHOLE LOG - MH07-18

Client: Fulton Hogan Land Development Ltd
Project: Wainui to Lysnar Tunnel
Site Location: Lysnar Road
Project No.: AKL2018-0171
Date: 26/10/2018
Borehole Location: Refer to site plan Logged by: JW Checked by: MJC Scale: 1:50 Sheet 1 of 2

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Position: 1747806.0mE; 5947800.0mN Projection: NZTM Angle from horizontal: 90°
Elevation: 10.50m Datum: AUCKHT1946 Survey Source: Hand Held GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	Drilling Method/ Support	Structure & Other Observations
		10.5		TOPSOIL						
		10.4		CH: Silty CLAY: light brownish grey. High plasticity. (Alluvium)	M	VSt	100		OB / PQ3	
0.5	Peak = 110kPa Residual = 46kPa	10.0		CH: CLAY: with minor silt and minor organics, brownish grey streaked black. High plasticity. Mottled orange. (Alluvium)						
			1				0		OB / PQ3	
2.0-2.5	1 U63		2		M to W	F to St			SPT	2.0m: washed out to 2.0m as couldn't retain sample Push Tube Sample
							100		OB / PQ3	
3.0 3.0	Peak = 25kPa Residual = 12kPa SPT = (0,0,0) N* = 0		3				0			3.0-3.4m: core lose, couldn't retain sample in barrel
		7.1		CH: CLAY: with some silt; greyish green. High plasticity. (Alluvium)						
		6.6		CH: Silty CLAY: greyish green. High plasticity. (Alluvium)			100		OB / PQ3	
4.5 4.5	Peak = 112kPa Residual = 26kPa SPT = (3,5,7) N* = 12		4							
			5			VSt	100		SPT	
							100		OB / PQ3	
6.0-6.5 6.0	2 U63 Peak = 84kPa Residual = 28kPa	4.5	6	CH: CLAY: with minor silt; greyish green. High plasticity, Trace organic inclusions, trace fine grained relict SILTSTONE clasts. (Alluvium)	M		100		SPT	Push Tube Sample
			7			VSt to H	67		TT / HQ3	6.5m: washed out to 7.0m, couldn't retain sample
		2.9		CH: Silty CLAY: greyish green. High plasticity, Completely weathered with some blocky structure. (Northland Allochthon)						
8.0	SPT = (6,7,13) N* = 20		8	Grey, MUDSTONE. Very shattered. Weathered to Silty Clay, grayish green, very stiff to hard. High plasticity. (Northland Allochthon)			100		SPT	
		2.0		*... at 8.70m, becoming grey*						8.5m: loosing approximately 80% water recovery
		1.5	9	Grey, MUDSTONE. Extremely shattered. Angular to sub angular, fine gravel to coarse gravel and cobbles. Clay along some fracture surfaces. (Northland Allochthon)			76			
9.5	SPT = (38,15/25mm) N* = 50+			Grey, MUDSTONE. Extremely shattered, medium to coarse gravel sized. Angular to sub angular, (NORTHLAND ALLOCHTHON). (Northland Allochthon)			100			
		0.5	10							

Termination Reason: Target depth reached
Shear Vane No: DCP No:

Remarks: Double piezometer installed from 0.0m to 8.0m and 0.0m to 12.5m.

BOREHOLE LOG - MH07-18

Client: Fulton Hogan Land Development Ltd
Project: Wainui to Lysnar Tunnel
Site Location: Lysnar Road
Project No.: AKL2018-0171
Date: 26/10/2018
Borehole Location: Refer to site plan Logged by: JW Checked by: MJC Scale: 1:50 Sheet 2 of 2

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Position: 1747806.0mE; 5947800.0mN Projection: NZTM
Elevation: 10.50m Datum: AUCKHT1946
Angle from horizontal: 90°
Survey Source: Hand Held GPS

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering	Recovery	RQD	Estimated Strength	Defect Spacing (mm)	Drilling Method/ Support	Structure & Other Observations
				0.3			Grey, MUDSTONE. Extremely fractured. Weather to Silty Clay, light grey, very stiff to hard. Low plasticity., (NORTHLAND ALLOCHTHON). (Northland Allochthon)			RS CW HW MW SW UW	100		EW VW W MS S VS ES	<20 20-60 60-200 200-600 600-2000 >2000		
				-0.5	11		Grey, MUDSTONE. Very shattered. Angular to sub Angular, fine sand to fine gravel sized clasts. Weathered to Silty Clay, grayish green, very stiff to hard. High plasticity. (Northland Allochthon)	D to M			100				TT / HQ3	10.7-11.0m: washed out due to sample being being too shattered to retain
					12		Borehole terminated at 12.50 m				100	73				

Termination Reason: Target depth reached
Shear Vane No: DCP No:

Remarks: Double piezometer installed from 0.0m to 8.0m and 0.0m to 12.5m.

BOREHOLE LOG - MH04-23

Client: Fulton Hogan Land Development Limited
Project: Waterloo Creek Bridge
Site Location: Milldale Stage 10/11
Project No.: AKL2023-0202
Date: 29/08/2023
Borehole Location: Refer to Site Plan

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Logged by: ZW/ ST | Checked by: MJC | Scale: 1:50 | Sheet 1 of 2

Position: 390019.3mE; 830479.0mN | Projection: EDENMT2000 | Angle from horizontal: 90°
Elevation: 7.87m | Datum: AUCKHT1946 | Survey Source: Handheld GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	Drilling Method/ Support	Structure & Other Observations
		7.9		OL: Clayey SILT: Dark brown. Low plasticity. Minor organic material present as decomposing tree roots. (Topsoil)			40		OB / PQ3	
0.5	Peak = 109kPa Residual = 71kPa	7.6		CH: Silty CLAY : Greyish brown, streaked orange. High plasticity. With minor rootlets. (Alluvium)		St to VSt	98		OB / PQ3	
1.0	Peak = UTP	6.9	1	*... at 0.54m, Becoming mottled orange with limonite staining.*			68		OB / PQ3	
1.5	SPT: N* = 20 (/ 8, 12) Peak = UTP			CH: Silty CLAY: Grey, mottled brown. High plasticity. With trace gravel. Gravel is fine, highly weathered, extremely weak SILTSTONE. (Mangakahia Complex)	M		80		SPT	
		6.0	2	*... from 1.56m to 1.87m, Becoming grey, mottled black.*			100		OB / PQ3	
		5.8		ML: Sandy SILT: Grey. Low plasticity. Poorly graded. Sand is fine grained. (Mangakahia Complex)			86		TT / HQ3	2.4-2.5m:1,JN,75°,PL,R,CL,CN,
3.0	SPT: Nc = 26 (/ 12, 14)	5.1	3	MH: SILT: Dark grey. Low plasticity. Completely weathered. Dark grey SILTSTONE. Extremely weak. (Mangakahia Complex)			0		SPT	
		4.4		*... from 2.58m to 2.80m, Becoming dark brown.*			100	100	TT / HQ3	3.6-3.7m:1,JN,40°,PL,R,CL,CN,
				MH: SILT : Light grey. With minor clay and gravel. Completely weathered. Extremely weak SILTSTONE. (Mangakahia Complex)						
4.5	SPT: Nc = 27 (/ 13, 14)		4	SILTSTONE: Highly weathered. Light grey. SILTSTONE: Extremely weak. Highly fractured, angular, tightly interlocking fabric. Gravel is fine to medium. (Mangakahia Complex)			0		SPT	
			5				100	94	TT / HQ3	
6.0	SPT: Nc = 35 (/ 18, 17)		6				0		SPT	
				... from 6.50m to 6.80m, Retrieved as clayey SILT, with some fine to medium angular gravel .			100	100	TT / HQ3	
			7							
7.5	SPT: Nc = 42 (/ 20, 22)						0		SPT	
			8				100	100	TT / HQ3	
				... at 8.50m, Some fine to coarse angular gravel inclusions, moderately weathered, extremely weak.						
9.0	SPT: Nc = 40 (/ 20, 20)		9				0		SPT	
			10				100	100	TT / HQ3	

Groundwater: 20-09-2023

Termination Reason: Target Depth Reached.
Shear Vane No: 3661 DCP No:
Remarks: Piezometer installed.

BOREHOLE LOG - MH04-23

Client: Fulton Hogan Land Development Limited
Project: Waterloo Creek Bridge
Site Location: Milldale Stage 10/11
Project No.: AKL2023-0202
Date: 29/08/2023
Borehole Location: Refer to Site Plan
Logged by: ZW/ ST
Checked by: MJC
Scale: 1:50
Sheet 2 of 2

Position: 390019.3mE; 830479.0mN
Projection: EDENMT2000
Angle from horizontal: 90°

Elevation: 7.87m
Datum: AUCKHT1946
Survey Source: Handheld GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Recovery	RQD	Drilling Method/ Support	Structure & Other Observations
10.5	SPT: Nc = 41 (/ 19, 22)		11		0		SPT	
					100	100	TT / HQ3	11.5m:1,JN,25°,PL,CN,
12.0	SPT: Nc = 46 (/ 16, 30)		12		0		SPT	
					100	100	TT / HQ3	12.8m:1,JN,80°,PL,CN,
		-5.3	13	SILTSTONE: Highly weathered. Grey, mottled dark grey brown and occasional orange brown. Massive MUDSTONE. Extremely weak. Intermixed SILTSTONE (Mangakahia Complex) (Hukerenui Mudstone)				13.4m:1,JN,15°,PL,CN,
13.5	SPT: Nc = 50+ (/ 36, 14 for 50mm)				0		SPT	
			14		100	103	TT / HQ3	
15.0	SPT: Nc = 50+ (/ 30, 20 for 75mm)		15		0		SPT	
		-7.8		SILTSTONE: Highly weathered. Grey. SILTSTONE. Extremely weak. Highly fractured, angular, tightly interlocking fabric. Gravel is fine to medium. (Mangakahia Complex)				
			16	*... from 15.69m to 15.78m, Retrieved as silty GRAVEL, with trace clay. Gravel is fine to medium, angular.*	100	52	TT / HQ3	
16.5	SPT: Nc = 50+ (/ 26, 24 for 15mm)			*... from 16.05m to 16.15m, Retrieved as silty GRAVEL. Gravel fine to medium, angular.*	0		SPT	
			17	Borehole terminated at 16.50 m				
			18					
			19					
			20					

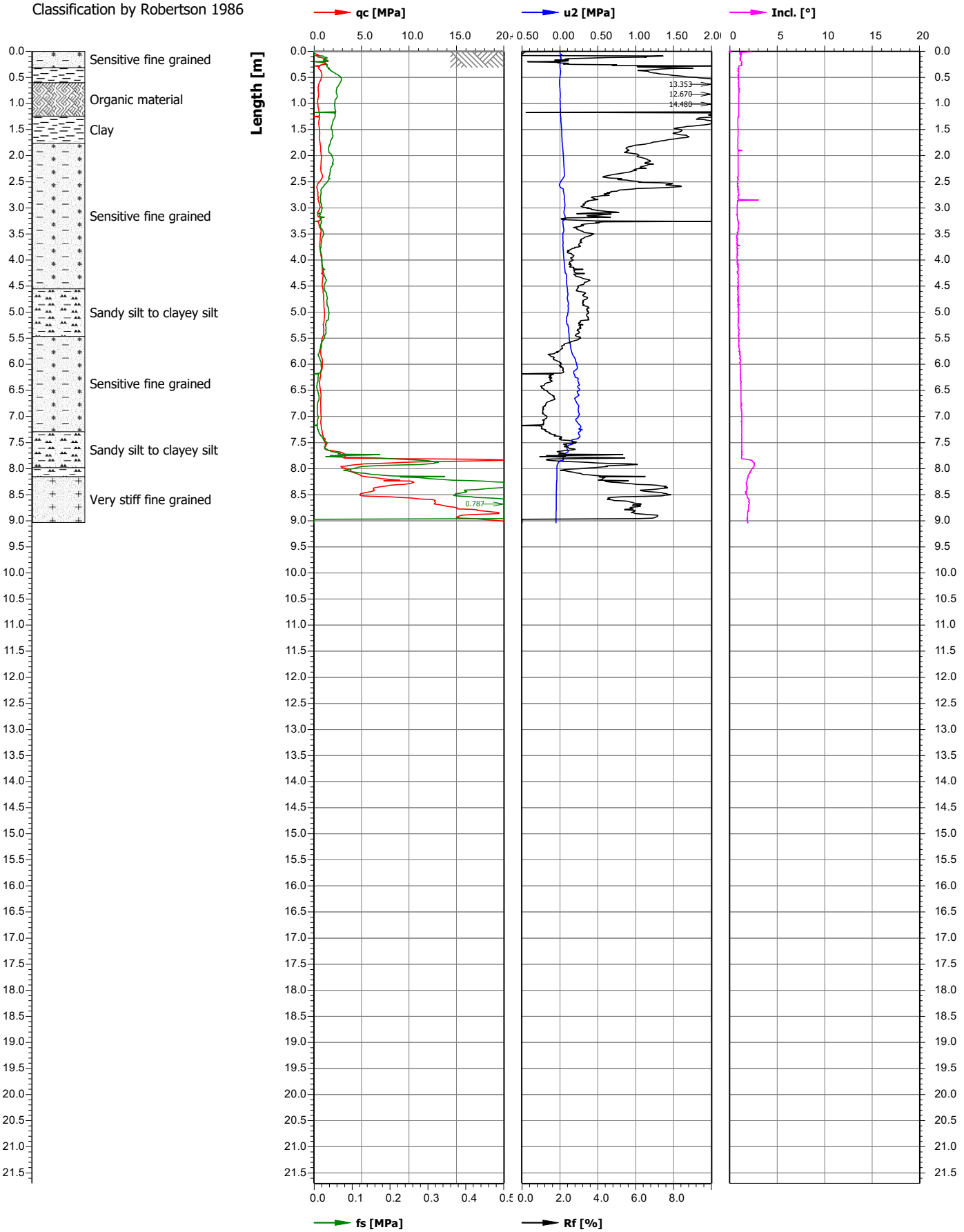
Termination Reason: Target Depth Reached.
Shear Vane No: 3661
DCP No:

Remarks: Piezometer installed.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

PRO-DRILL SPECIALIST DRILLING ENGINEERS	Project name: CMW-Milldale Stage 8	Date investigation: 15/08/2023	
	Test name: CPT02	Cone name: S10CFIIP.2013	
Test location name	Client: CMW	Net surface area quotient of ...: 0.800/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project location name: Argent Lane	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1: Refusal Anchors Pulled at 9.04m - W/L Collapsed			

Classification by Robertson 1986



APPENDIX E

Annexure 9 - Geotechnical

Milldale Fast-Track

29/07/2025 – Auckland Council Response

Annexure 9:

Geotechnical

Technical Specialist Memo – Geotechnical

To:	Dylan Pope – Processing Planner Carly Hinde – Premium Project Lead
From:	Luke Xu – Senior Geotechnical Specialist Engineering Assets and Technical Advisory
Date:	16/07/2025

1.0 APPLICATION DESCRIPTION

Application and property details

Fast-Track project name:	Milldale
Fast-Track application number:	BUN60446761 & FTAA-2503-1038
Site address:	Wainui Road, Upper Orewa

2.0 Executive Summary / Principal Issues

A consent is sought for the Milldale Development that involves Stages 10-13 and Stage 4C works, together with a supporting temporary Wastewater Treatment Plant. We have undertaken a regulatory geotechnical review based on the information provided and outlined in Section 3.0. While the information provided appears to be generally reasonable for the proposed development, we have identified inconsistencies and missing information in certain areas which raise concern whether the risk posed by geohazards has been fully captured. Based on discussion with the applicant's geotechnical engineer CMW, we understand that our queries would be addressed via an addendum, which has not been provided at the time of writing this memo.

A more detailed breakdown is included below

<u>Stage 10-13:</u>

We consider additional characterisation of geohazards including settlement monitoring of filling works and slope stability analyses is necessary to inform E12, E36 and E38 assessment.

We have queried if the cross sections utilised for slope stability analyses are representative as the most critical cases, particularly around if deeper softened alluvium material could be present. Furthermore, we have also raised concern that some geotechnical design parameters were identified in the report but not utilised in the current slope stability analyses.

There are a number of inconsistencies and missing components in the information provided, such as investigation records (TPO4-24), lack of assessment of impact for the proposed stockpile location, lack of commentary on boundary stability, lack of consideration on stream meandering and its impact on the proposed development, reinforced slopes which are shown in P24-128-00-0013-SU however are omitted from the remedial slope stability analyses etc.

Stage 4C:

We identified a lack of site investigations to support reporting, assessment and recommendations.

The geotechnical assessment for this area of work was assessed on the basis of existing information on and surrounding this site, as well as previous construction activities that were conducted on this site (e.g., preloading). However, we were not made available to these supporting documents and therefore are unable to verify the relevance or applicability of the referenced information on the intended works for Stage 4C. Geological cross section(s) is also missing from the submission, which its presence would largely aid in understanding the underlying geological conditions of the site and thus informing the potential geohazards.

With the available information supported, we note that earthworks and retaining are intended to be staged but details to clarify how stability will be maintained between the substages of Stage 4C2 - 5 (particularly where earthworks and retaining are proposed at the stage boundaries) remain lacking. This is necessary to inform E12 and E38 assessment.

WWTP:

We consider there to be some gaps in the information provided, particularly with historical geotechnical reporting not supplied and how the deep ground profile was developed. Additionally, the evidence provided does not wholly address potential for global instability as the site is underlain by Allochthonous materials and the proposal seeks to create slopes up to 1V:3H. This is necessary to inform E12 assessment.

3.0 Documents Reviewed

Stage 10-13:

- Geotechnical Investigation Report by CMW Geosciences (Reference: AKL2024-0257AB Rev3, dated 24 March 2025)
- Consent Drawings by Woods (Title: Milldale Fast Track Stages 10-13 Rev1, dated February 2025)

Stage 4C:

- Geotechnical Assessment Report by CMW Geosciences (Reference: AKL2024-0257AD Rev1, dated 20 February 2025)
- Consent Drawings by Woods (Title: Milldale Fast Track Stages 4C Rev1, dated February 2025)

WWTP:

- Geotechnical Investigation Report by CMW Geosciences (Reference: AKL2024-0185AC Rev1, dated 26 February 2025)
- Consent Drawings by Woods (Title: Milldale Fast Track Private Wastewater Treatment Plant Rev1, dated February 2025)

Conditions:

- Milldale Stages 10-13, 4C and WWTP Proposed Conditions of Consent, Rev1, dated 28 March 2025

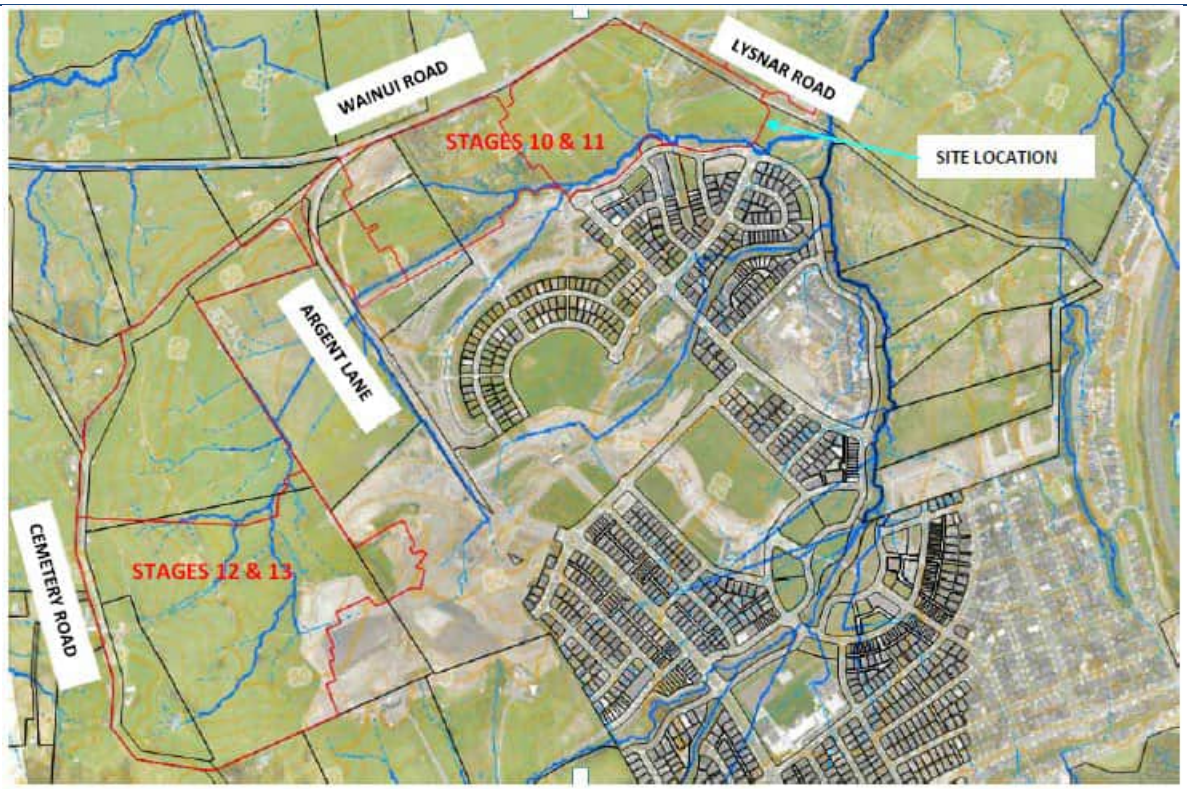
4.0 Additional Reasons for Consent Not included in AEE

- Stage 10 – 13 AEE excludes E36 for land which may be subject to land instability. We anticipate that despite historic reporting for the wider area, the geotechnical reporting may not be specific to the intended works and may be a reason for consent as a restricted discretionary activity.

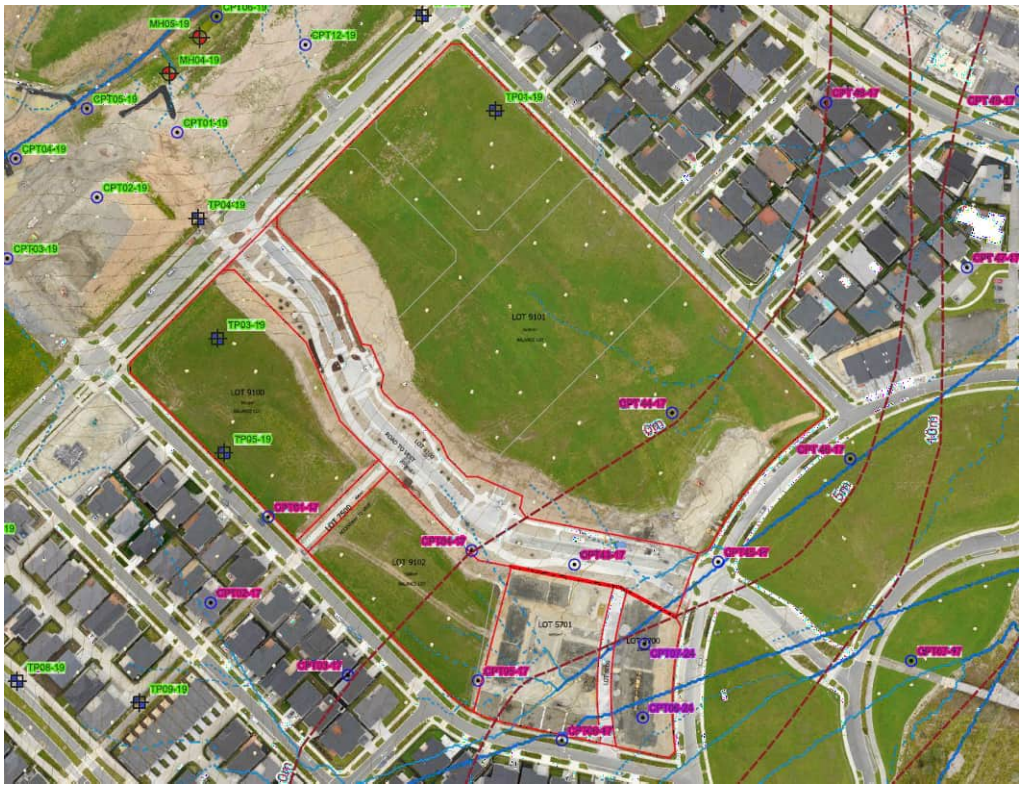
5.0 Specialist Assessment

Overall Site Plan

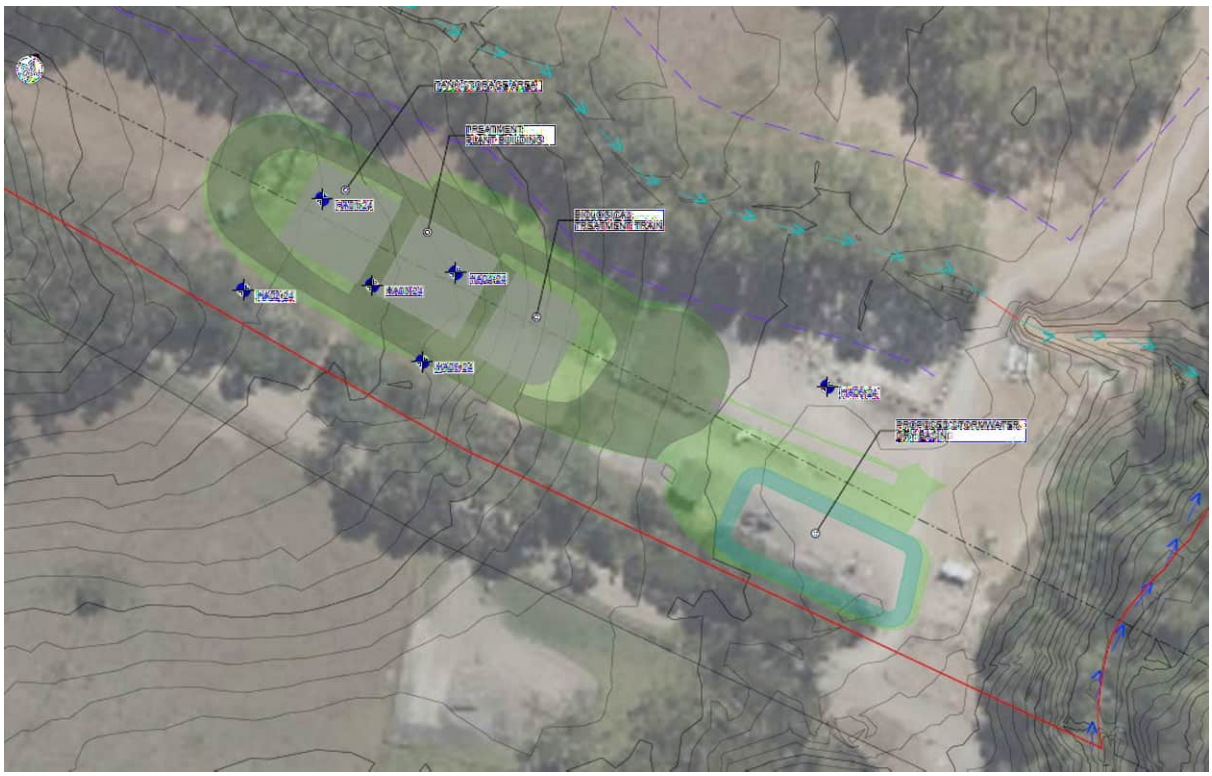
Stage 10-13:


WAINUI ROAD
LYSNAR ROAD
STAGES 10 & 11
SITE LOCATION
ARGENT LANE
CEMETERY ROAD
STAGES 12 & 13

Stage 4C:



WWTP:



The documents reviewed have been included in Section 3.0 above.

1. **<u>Stage 10-13:</u>**

<u>Geohazards:</u>

Geohazards such as land instability, liquefaction, compressible soil has been discussed in the reporting provided. Mitigation measures in the form of retaining walls, shear keys, engineered fill buttresses, underfill drain etc. have been proposed to mitigate the identified geohazards.

A development restriction zone plan to protect the proposed reinforced earth batters should be provided in a Geotechnical Completion Report.

Slope stability

The analyses results and approach undertaken are generally reasonable, where the proposal achieves the minimum factor of safety requirements at the location of the areas of development under the Auckland Council Code of Practice for land development and subdivision. However, we have noticed some concerns.

- Softened alluvium material was identified in the site investigation. There is no cross section or slope stability analysis along the existing overland flow path where the softened alluvium material is expected to be the deepest.

- The design parameters utilised in the slope stability analyses have omitted the 'softened base contact' material that was previously identified in the geotechnical reporting.
- There is a proposed stockpile area located above a gully feature and overland flow path, which may pose a risk of instability. This was not addressed in detail in the geotechnical report.

Based on discussions with CMW Geosciences, the design parameters will be updated to align with the reporting, additional sensitivity assessment will be carried out to verify the effects of deeper softened alluvium material, and a memo will be provided to address the location and effects for the stockpile. Further, slope stability analyses which had missing information (e.g., outputs for Cross Section A are not presented in the 'remediation outputs' figure when remediation has been identified as being required), adopted retaining structure parameters was not labeled in the outputs. These inconsistencies and omissions in the slope stability analyses are understood to be provided as an addendum to the current geotechnical report. This addendum was not received at the time of this memo.

Effects on boundary excavation

We note cut works have been proposed along the site boundary with no comments made in the geotechnical report regarding how stability will be maintained. CMW informs they will be providing further clarification on this matter. We expect a preliminary construction methodology to be necessary to address this concern.

Significant filling

Significant filling may incur subsidence through ground settlement. We understand that this has been addressed via proposed preloading on site as well as implementation of a settlement monitoring plan. We find this approach generally agreeable, however, it is noted that the t90 timeframe (time to reach 90% of consolidation settlement) was not explicitly stated in the geotechnical report and only partially addressed with reference to t90 observed for filling works done in nearby areas.

We have reviewed the provided Earthworks Specification as part of the geotechnical report. The content of the document is generally reasonable. We sought clarity from CMW on whether the earthworks relating to the structural components of the project will be covered by this Earthworks Specification (e.g. backfill of retaining walls, fill works of reinforced slopes etc.), which we understood that it would be.

It was noted that the compaction acceptance criteria proposed in the specification deviate from the recommendations of NZS 4431:2022 (which was referenced in the Specification). Our understanding is that CMW will be providing additional clarification to verify that the deviation in industry standards will be able to produce compacted hardfill that is fit for purpose for the site.

Liquefaction potential has been discussed in the geotechnical report. CMW concludes that *'the site is expected to perform relatively well with negligible liquefaction induced settlement'*.

Inconsistencies:

We also have noticed the following inconsistencies within the geotechnical report, as well as between the report and the lodged plans, including:

- Missing labels in the geological cross section e.g., groundwater table, proposed remedial works, lot boundaries/accessways etc. We consider these necessary to show underlying geological conditions and therefore ascertain expected geohazards which may be endured. Of note, CMW has explained that groundwater table in the underlying material is perched and showing one uniform profile is not representative of the actual condition of the site.
- Missing investigation records for test pit (TP04-24). In follow up conversations we understand that this test was not conducted.
- Draft settlement monitoring plan presented utilises an outdated earthworks plan underlay.
- Civil plans showing the retaining walls do not show the full extent of wall that is considered necessary for remediation purpose by CMW.
- A single site investigation referenced but missing its log sheet in the report.

We understand that these discrepancies will be revised and presented in an updated addendum/drawing set.

Other Matters:

We have highlighted that considerations should be made to the potential migration of streams over the 100-year period for assessment under E36.9(2). Noting that streams can meander and therefore encroach on building platforms/access ways therefore posing a risk to future development and potential development yield. We understand that this is to be addressed by others.

We also noticed that laboratory tests results for this stage of the project are still pending. We have highlighted that this should be provided when available or with updated geotechnical reporting as this can inform on the appropriateness of geotechnical parameters applied in the geohazard analyses.

2. Stage 4C

Geohazards:

No intrusive geotechnical investigation was provided for this stage of works. The geotechnical assessment relied upon reporting from previous stages including investigations and completion reports. While this approach can be acceptable given the context of the site and CMW's long history of involvement, we have not been made available to these supporting documents as part of this consent and are therefore unable to verify the assumptions made in the geotechnical report for this stage of work. We have communicated this to CMW and have been informed that supporting documents referenced in the geotechnical report will be provided.

Slope stability

This was not considered to be a significant concern due to the gently sloping landform. We consider this to be acceptable, but have requested this conclusion to be confirmed in representative geological cross section(s).

Filling

Filling works are proposed on site including near site boundaries, parts of which also include retaining structures at the boundary. We have requested clarification on how stability of the work will be maintained between substages, including a preliminary construction methodology for the proposed retaining structures.

Preloading is reported to have been historically undertaken at the southeast section of the site. The settlement analysis undertaken indicates up to 50mm of post construction settlement may be expected for future development load of 10kPa. On the basis that the planned development does not exceed this load, no further mitigation has been proposed. We suggest that this be communicated to the applicant and included as an advice note or other similar approaches to ensure it is captured. If the proposal deviates from the expected future development load, additional assessment is required to ensure a safe and safe building platform and accessway is achieved.

Liquefaction

Liquefaction potential is based on assessment from reports from previous stages. CMW concludes the site *'is not susceptible to liquefaction'*.

3. WWTP

Geohazards:

Geohazards such as land instability, cut/fill batter stability, compressible soil has been discussed in the reporting provided. No specific mitigation measures was proposed other than excavation and replacement of uncontrolled fill on site. CMW concludes all potential geohazard was considered to have an acceptable risk. We find the information provided to be generally reasonable in supporting the proposed development, but have identified some missing information which we believe relevant to the regulatory review:

- The geotechnical report has references to previous deep investigation undertaken for this site and the adjacent site. However, this information was not provided for our review nor were the previous investigation locations identified on the provided site plan. This raises concerns about the accuracy of the geological long section given that only shallow investigation was completed for this stage of works.
- Indicative groundwater levels and dry basin profile are not presented in the geological long section. This raises uncertainty about how the proposed facility will be affected by the underlying ground condition.

Slope stability

Slope stability was not considered to be a concern due to the gently sloping landform. We noticed that maximum cut and fill batter gradients of 1V:5H and 1V:3H respectively will be created. Given the large surcharge loading and underlying Allochthonous soils, we consider it appropriate to undertake slope stability analyses to demonstrate their stability. Based on conversation with CMW, we understand that additional analyses will be provided.

Filling

Settlement analysis has been undertaken and indicated that predicted post-construction settlements range from 5 to 25 mm and differential settlements from 10 to 25 mm based on a maximum structural bearing pressure of 100 kPa have been estimated. Settlement monitoring has been proposed, and it was recommended that certification of building platform will only take place once settlement targets have been reached. We are agreeable to this approach and recommend the following advice notes:

- structural or civil engineer to confirm the estimated differential settlement of 25mm is acceptable for the proposed wastewater treatment plant.
- settlement analysis to be reassessed if there is a change in the assumed loading.

The provided Earthworks Specification is generally reasonable with exception to the recommended compaction acceptance criteria which deviates from the recommendations of NZS 4431:2022 (which was also referenced by the Specification). Our understanding is that CMW will be providing additional clarification that the variation in requirement will still be able to produce compacted hardfill that is fit for purpose for the site.

6.0 Section 67 Information Gap

I have identified the following Section 67 information gaps:

Information gap	Nature of deficiency	Decision-making impact	Risk / uncertainty created
1. *Additional characterization of geohazards required for Stage 10-13 works.*	***Slope stability analyses*** *to be updated for relevant sensitivity assessment and missing design parameters. Including clarification on how the stockpile location will be affecting the site stability.* *Additional clarification is to be sought for how* ***stability will be maintained*** *throughout the different substages of the work.* ***Inconsistencies*** *in the reports and drawings to be revised for clarity.* ***Missing laboratory testing*** *to verify applied parameters to geohazards.*	*Geohazard risks not fully captured in current assessment.*	***High*** *Potential for inadequate assessment of affecting geohazards.*
2. *Lack of site-specific investigation*	***Relating previous investigation information that was referenced, and geological long section*** *is to*	*Cannot accurately assess the appropriateness on*	***High***

information to support the geotechnical reporting, assessment and recommendations of Stage 4C works.	*be provided to justify how the assessment outcome was reached.*	*how the provided assessment were undertaken due to lack of information.*	*Potential for inadequate assessment of affecting geohazards.*
3. Partially missing information to justify the geohazard assessment outcome of the WWTP.	***Relating previous investigation information that was referenced*** *to be provided to justify the accuracy of the provided geological long section.* ***Slope stability analyses*** *to demonstrate stability of proposed permanent batters.*	*Geohazard risks not fully captured in current assessment.*	***Moderate*** *Potential for unforeseen risks in underlying geohazards and impacting serviceability for wider developments.*

7.0 Recommendation

Based on the information available, there are information gaps and inconsistencies in the geotechnical aspect of the consent which restricts the validity of geohazard characterisation and assessment. I recommend further information is provided to support the consent and such information should be supplied and reviewed prior to consent issue.

8.0 Proposed Conditions

Stage 10-13:

We notice that **Conditions 43 and 44** appear to be in duplication on what they intend to achieve. We recommend removing Condition 43 in favour of Condition 44 to make clear on the expected completion documentation requirements.

We also suggest the following amendments to be considered for the conditions below:

Land-use Condition		**Commentary**
12	**Settlement Monitoring Plan** A Settlement Monitoring Plan (SMP) for consolidation settlement due to placement of fill must be submitted to the Council prior to commencement of earthworks onsite. The SMP must be prepared by a suitably qualified geotechnical engineering professional. Any proposed amendment to	Change from 'shall' to 'must' to align with current practice. We also highlight that the acronym for the settlement monitoring plan (SMP) is similar to the site management & remedial action plan (SMP/RAP) and may cause confusion.

	the SMP must also be submitted to the Council. The SMP must include, as a minimum, the following information: a) A monitoring location plan showing the layout and type of all settlement monitoring stations within the fill areas; b) Timing and frequency of survey of the settlement monitoring stations; and c) Define the settlement criteria to be met on completion of earthworks.	
26	**Geotechnical Works - Supervision and Certification** All earthworks including the construction of retaining walls, building foundations and the placement and compaction of fill material must be supervised by a suitably qualified geo-professional. In supervising the works, the suitably qualified geo-professional must ensure that they are constructed and otherwise completed in general accordance with the "Geotechnical Investigation Report, ref: AKL2024-0257AB, Rev. 2, prepared by CMW Geosciences, dated 25 February 2025" including the engineering plans and geotechnical recommendations, relevant engineering codes of practice and detailed plans forming part of the application. The supervising engineer's contact details must be provided in writing to the Council at least two weeks prior to earthworks commencing on site.	Referenced document outdated. Most up to date version is Rev3, dated 24 March 2025
44	**Geotechnical Completion Report** At the completion of each stage of earthworks, a Geotechnical Completion Report (GCR) prepared by suitably qualified engineering professional must be provided to the Council to confirm the suitability of the site for the intended development. The GCR must include (but not to be limited to): a) Earthworks operations (e.g. excavations, filling works, replacement of unsuitable materials etc); b) Retaining wall and reinforced earth slope construction; c) Settlement monitoring; d) Testing; and e) Inspections. f) Statement of professional opinion g) Certified as-built plans	We suggest the inclusion of a statement of professional opinion and certified as-built plans as part of the GCR requirements.

	The GCR must also provide justification on soil expansivity, foundation design parameters, and settlement criteria defined in the SMP (as per condition 10) have been met. The GCR must be provided to the satisfaction of the Council. Advice Notes • Further investigation/testing may be required to determine soil expansivity. • A building consent may be required for the construction of retaining walls and reinforced earth slope. • Please send documents required as a condition of consent for the Council to: *monitoring@aucklandCouncil.govt.nz*	
69	**Design and Construction of Earthworks and Retaining Walls** The design and construction of the earthworks and retaining walls must be undertaken in general accordance with the specifications contained in the following documents: a) A report titled "Geotechnical Investigation Report, ref: AKL2024-0257AB, Rev. 2, prepared by CMW Geosciences, dated 25 February 2025" referenced in condition 1. b) Engineering plans "Milldale Fast track Stages 10 - 13", prepared by Woods, dated Feb 2025" referenced in condition 1. c) A report titled "Earthworks Methodology Report – Milldale Earthworks 10 – 13, Version 1, prepared by Woods, dated 19 March 2025" referenced in condition 1.	Referenced document outdated. Most up to date version is Rev3, dated 24 March 2025
86	**Geotechnical** The Consent Holder must construct retaining walls, construct reinforced earth slopes and place and compact material in general accordance with the recommendations of the "Geotechnical Assessment Report, ref AKL2024-0257AD, Rev. 1 prepared by CMW Geosciences, dated 20 February 2025" and subsequent	Referenced document seems to be in error as this is the geotechnical report for Stage 4C works

	Council approved versions to ensure the site is stable and suitable for development.	

Stage 4C – Phase 1:

Condition 22 may require an update to reflect updated geotechnical reporting noting that lack of site investigations undertaken. In addition, we suggest the following amendments to be considered for the conditions below:

Land-use Condition		**Commentary**
14	**Settlement Monitoring Plan** A Settlement Monitoring Plan (SMP) for consolidation settlement due to placement of fill must be submitted to the Council prior to commencement of earthworks onsite. The SMP must be prepared by a suitably qualified geotechnical engineering professional. Any proposed amendment to the SMP must also be submitted to the Council. The SMP must include, as a minimum, the following information: a) A monitoring location plan showing the layout and type of all settlement monitoring stations within the fill areas; b) Timing and frequency of survey of the settlement monitoring stations; and c) Define the settlement criteria to be met on completion of earthworks.	Change from 'shall' to 'must' to align with current practice. We also highlight that the acronym for the settlement monitoring plan (SMP) is similar to the site management & remedial action plan (SMP/RAP) and may cause confusion.
29	**Geotechnical Completion Report** A Geotechnical Completion Report (GCR) which includes a statement of professional opinion for the suitability of the site for the intended development, signed by a chartered geo-professional must be provided to the Council. The GCR must include (but not to be limited to): a) Earthworks operations (e.g. excavations, filling works, replacement of unsuitable materials etc); b) Retaining walls; c) Settlement monitoring; d) Testing; and e) Inspections. f) Certified as-built plans The GCR must also provide justification on soil expansivity, building and/or earthworks limitations, and foundation design	We suggest the inclusion of certified as-built plans as part of the GCR requirements.

	parameters. The GCR must be provided to the satisfaction of the Council. Advice Notes • Further investigation/testing may be required to determine soil expansivity. • A building consent may be required for the construction of retaining walls. • Please send documents required as a condition of consent for 'The Council' to: monitoring@aucklandCouncil.govt.nz	

Stage 4C – Phase 2:

We suggest the following amendments to be considered for the conditions below:

Land-use Condition		**Commentary**
20	**Geotechnical Completion Report** A Geotechnical Completion Report (GCR) prepared by suitably qualified engineering professional must be provided to the Council to confirm the suitability of the site for the intended development. The GCR must include (but not to be limited to): a) Earthworks operations (e.g. excavations, filling works, replacement of unsuitable materials etc); b) Retaining wall; c) Settlement monitoring; d) Testing; and e) Inspections. f) Statement of professional opinion g) Certified as-built plans The GCR must also provide justification on soil expansivity, building and/or earthworks limitations, and foundation design parameters. The GCR must be provided to the satisfaction of the Council. Advice Notes • Further investigation/testing may be required to determine soil expansivity. • Historic pre-loading and settlement analyses is based on a future development load of 10kPa. If there is an increase in anticipated loading, further assessment may be required.	We suggest the inclusion of a statement of professional opinion and certified as-built plans as part of the GCR requirements.

	• A building consent may be required for the construction of retaining walls. • Please send documents required as a condition of consent for 'The Council' to: monitoring@aucklandCouncil.govt.nz	

WWTP:

Given the relatively small scale of work, we consider it may not be necessary to condition a full geotechnical completion report as outlined in Condition 27. We recommend revising it to be more akin to Condition 43 for the Stage 10-13 works.

CMW Geosciences

Great People | Practical Solutions

Auckland

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Rosedale 0632
New Zealand

Ph: +64 9 4144 632

www.cmwgeosciences.com

Geotechnical Background Information

Auckland Council has asked for copies of geotechnical reports completed for previous Milldale Stages in their formal feedback to the Panel. These files are information that relate to previous stages of the Milldale development and not directly to the Substantive Application.

This background reporting consists of large files and as it is not directly relevant to Milldale Stages 10 – 13, Stage 4C and the Wastewater Treatment Plant it has not been uploaded into the EPA portal.

The background information requested will be issued via a OneDrive download link which will be shared with the following email recipients:

- Carly Hinde: carly.hinde@aucklandcouncil.govt.nz
- Luke Xu: luke.xu@aucklandcouncil.govt.nz

If any additional recipients require access, please advise and we will update the sharing permissions accordingly.

The background information that has been compiled includes the following documents:

Stage 4C

- Geotechnical Investigation Report – Milldale Stages 2 & 3
- Geotechnical Investigation Report – Milldale Earthworks 3A
- Geotechnical Investigation Report – Milldale Subdivision Stage 4
- Earthfills Completion Report – Milldale Earthworks 2 & 2A (Wainui East)
- Earthfills Completion Report – Milldale Earthworks 3A
- Geotechnical Letter Stage 4C-1 Earthworks Consent
- Geotechnical Completion Report – Milldale Stage 4C-1

Wastewater Treatment Plant

- Geotechnical Investigation Report - Milldale Stage 8