

BEFORE THE INDEPENDENT HEARINGS PANEL OF HUTT CITY COUNCIL

UNDER The Resource Management Act 1991

AND

IN THE MATTER of the Proposed District Plan

Hearing Stream 5 – Natural Hazards

STATEMENT OF EVIDENCE OF DAVID GIBSON

for
Te Kārearea Ltd and Rosco Ice Cream Ltd

Dated: 5th August 2026

EXPERIENCE

1. My full name is Alexander David Gibson, and I am a Technical Director with the firm of Spencer Holmes Limited. I hold a Bachelor of Surveying from the University of New South Wales and I am an Associate member of the New Zealand Planning Institute (NZPI) as well as a Professional Associate of Survey and Spatial New Zealand (S+SNZ). I have worked in the resource management planning field for thirty years.
2. My evidence is given on behalf of Te Kārearea Ltd and Rosco Ice Cream Ltd, who hold a lease over the property at 30 Benmore Crescent, Manor Park (the site). Te Kārearea Ltd and Rosco Ice Cream Ltd made various submissions on the Proposed District Plan (Submitter # 447).
3. I have been providing planning advice to the submitters in respect of the site at 30 Benmore Crescent for the last six years.

CODE OF CONDUCT

4. I am familiar with the Code of Conduct for Expert Witnesses set out in Section 7 of the Environment Court Practice Note, dated 2023. Whilst this is a Council hearing, I agree to comply with the relevant parts of the Code of Conduct. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my area of expertise as set out above. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

INTRODUCTION

5. I prepared the original submission for Te Kārearea Ltd (TKL) and Rosco Ice Cream Ltd (Rosco). Of relevance to Hearing Stream 5, the submission covered the following overlay maps of the Proposed District Plan.
 - (i) Fault Location Area, and
 - (ii) Flood Hazard Overlays.
6. For each submission point, my evidence will be in the following format.
 - (i) Summary of original submission point,
 - (ii) Summary of section 42A report Officers recommendation,
 - (iii) My response and further evidence on the submission point.

FAULT LOCATION AREA OVERLAY

Original Submission

7. TKL/Rosco made submissions that the proposed general rural zoning of 30 Benmore Crescent should instead be zoned as General Industrial with an allowance for site specific provisions that would address the position of the Fault Location Area within the site.
8. It is noted that Waste Management NZ Ltd made a further submission in support of the TKL/Rosco submission in respect of the faultline hazard overlay, to the effect that the overlay should reflect the most up to date, site specific information regarding the position of the fault location area.
9. Thus the submission did not dispute the existence of the faultline through the site, but sought that specific provisions should be included regarding the use of the land in respect of the location of the faultline and the proximity of future activities.

Section 42A Report

10. The section 42A report finds that the proposed provisions of the Natural Hazards Chapter are appropriate for all sites and that the mapping of the fault location area at 30 Benmore Crescent provides sufficient spatial definition of the hazard area [Para's 247 & 248].
11. Consequently, the submission by TKL/Rosco [447.6.1b] is recommended to be accepted in part to the extent that proposed hazard overlay already provides spatial definition of the faultline hazard area for 30 Benmore Crescent.

Response to Section 42A Report

12. The submitters have previously commissioned an investigation into the location of the faultline within the site. Tonkin and Taylor were engaged to undertake a site investigation and report on the location of the faultline. Refer to the report "*Te Rangiheata / Manor Park Development Wellington Fault Investigation Report*" dated 7 July 2021 prepared by Tonkin and Taylor. A copy of the Tonkin and Taylor report is

attached at Appendix A. This report was submitted for the earthworks resource consent for the site that has been approved by HCC under RM220258.

13. In respect of appropriate relief to address the submission by TKL/Rosco, I consider that there are three potential options that would provide a suitable outcome.
 - (i) Alter the mapping of the fault location area within the site; or
 - (i) Introduce a site specific restricted discretionary activity rule for 30 Benmore Crescent; or
 - (ii) Amend proposed rule NH-R6 to be a discretionary activity rather than a non-complying activity.
14. My recommendation is for the mapping of the fault location area within the site to be adjusted. The proposed mapping of the fault location area should be consistent with the Tonkin and Taylor mapping of the faultline zone plus a 20m setback area within 30 Benmore Crescent as per their report *“Te Rangiheata / Manor Park Development Wellington Fault Investigation Report”* dated 7 July 2021.
15. A comparison of the Proposed District Plan overlay mapping and the submitters proposed overly mapping (as per the Tonkin and Taylor report) is shown in Figure 1 over the page and also attached at Appendix B. The red hatched area in the figure below is the Fault Location Area from the Proposed District Plan. The pink lines represent the edge extents of the submitters proposed mapping of the Fault Location Area (including a 20m setback) derived from the Tonkin and Taylor report.
16. I also note that the proposed location of the Fault Location Area is the same as the current mapping of the Wellington Fault Rupture Hazard Overlay in the Operative District Plan.

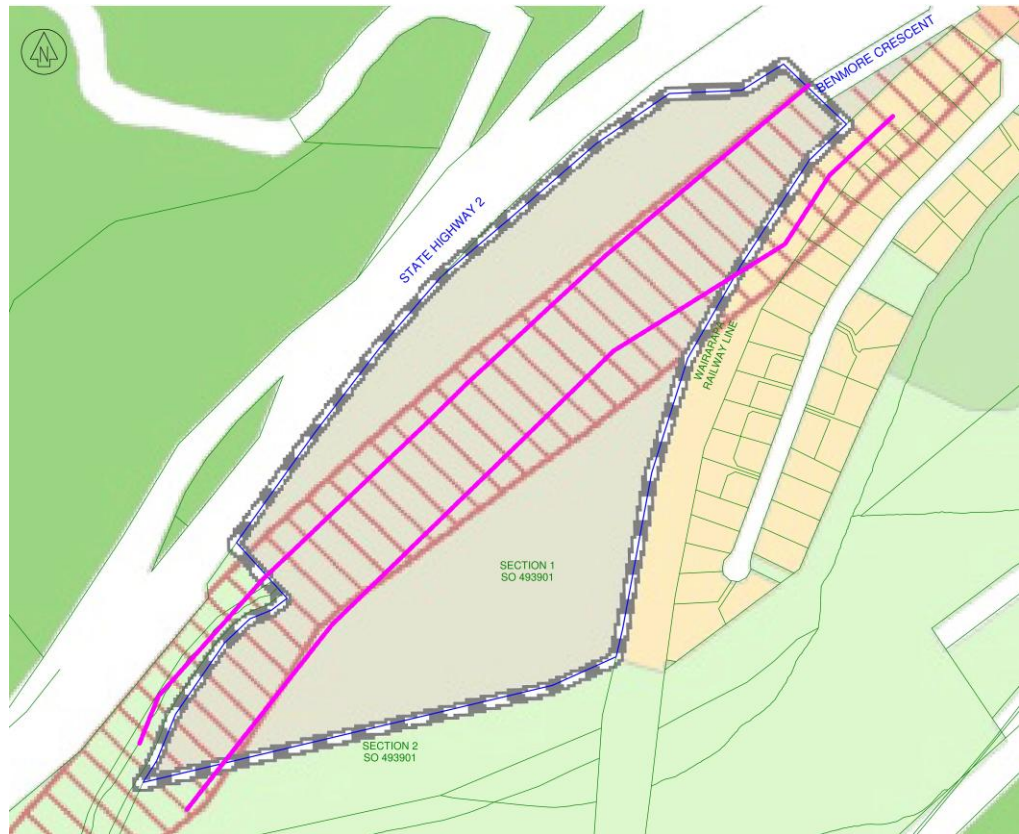


Figure 1: PDP Mapping of Fault Location Area versus Tonkin & Taylor Mapping

17. The next best alternative would be for a new site specific rule to be added to the Natural Hazards Chapter, which would provide as follows:

NH-R5A: Construction of new buildings / structures at 30 Benmore Crescent (Section 1 SO 493901), and the conversion of existing buildings, for activities potentially sensitive to natural hazards within the well-defined area of the Fault Location Area

1. Activity Status: Restricted discretionary

Matters of discretion are restricted to:

- 1. The location of buildings / structures relative to the fault line.*
- 2. Any mitigation measures to reduce the impacts to life and buildings from fault rupture.*
- 3. The relevant matters in NH-P7.*

Notification:

Public notification and limited notification are precluded for applications under this rule.

18. I consider that amending the mapping of the Fault Location Area for the site is appropriate, as the proposed mapping reflects a site specific and recent geotechnical investigation into the location of the fault line for the property at 30 Benmore Crescent.

FLOOD HAZARD OVERLAY AREAS

Original Submission

19. The TKL/Rosco submission opposes the mapping of the flood hazard overlay areas in respect of the property at 30 Benmore Crescent (refer to **Figure 2** over the page). This is because the Council's mapping (via Tiaki Wai) of the flooding extents shown in the Proposed District Plan maps is based on flood modelling that used ground levels from 2013 LiDAR data¹. The submitter has obtained resource consent RM220258 from HCC to undertake bulk earthworks across the site that would raise the ground level of the useable areas of the site such that the raised areas would be above the flood levels for the 1% AEP event (1 in 100 year event). The works authorised by RM220258 have been substantially completed, particularly on the eastern side of the property between Dry Creek and the Wairarapa Railway Line.
20. Therefore, the submission sought the removal of the flood hazard mapping from the majority of the site such that the areas shown to be subject to flooding would reflect the flood modelling undertaken by the submitters that was lodged in support of the earthworks resource consent approved under RM220258.

¹ Western Hills Stormwater Catchment Model Build Report – 2023, for Wellington Water by GHD

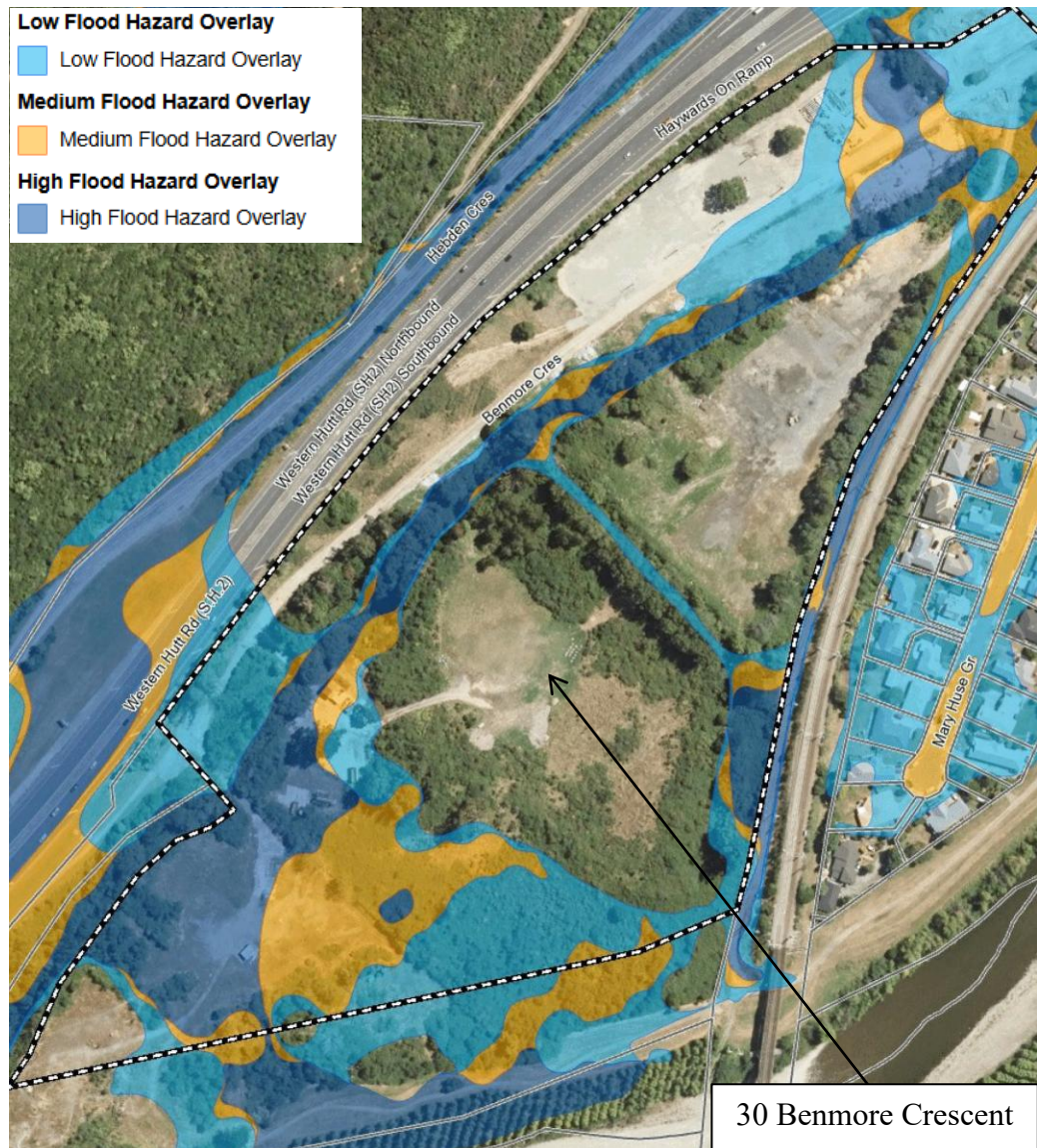


Figure 2: Proposed Flood Hazard Overlays from PDP (HCC Online Maps)

21. The flood model for the submitters was developed by River Edge Consulting Ltd and showed that the vast majority of the site would be flood free in a 1% AEP event upon completion of the earthworks, with only the watercourse channel of Dry Creek being subject to flooding. A copy of the River Edge Consulting Flood Model Memorandum (dated 1 November 2022) is attached at Appendix C.
22. It is noted that Waste Management NZ Ltd made a further submission in support of the TKL/Rosco submission in respect of the flood hazard overlays. The Waste Management NZ further submission sought that the overlay should reflect the flood modelling information presented to HCC for resource consent RM220258, which would remove the proposed flood hazard overlay from the property, with only the Dry Creek channel shown as being subject to flooding.

Section 42A Report

23. The Officers agree that the ground levels at the site have been altered subsequent to the date of the flood model terrain data used by Council [Para 22.84 – Appendix B1 Alistair Osborne Evidence]. Therefore, the Council’s flood modelling needs to be amended to reflect the current situation, which would result in the hazard overlay maps being amended for the property.
24. Additionally, Mr Osborne has reviewed the submitters flood modelling report done in 2022 for resource consent RM220258 and notes that the catchment area may not include all of the hillside area on the western side of the motorway that drains to Dry Creek. Consequently, Mr Osborne considers that the likely 1% AEP flowrate in Dry Creek (using a climate change factor of RCP8.5² to 2130) is 55m³/s. Whereas, Mr Wallace’s 2022 report calculated a flow of 30m³/s (using RCP8.5 to 2080-2010). It is also noted that the 2022 flood modelling by Mr Wallace included an allowance for a 0.25% AEP flood (1 in 440 years) in Te Awa Kairangi (the Hutt River), which is higher than the Council’s modelling has provided for the Hutt River.
25. However, there are other submissions that oppose or question the appropriateness of the climate change factors adopted by Council for flood modelling purposes, which in turn influences the extents of the flood hazard overlay areas. As the Officers are recommending that the climate change factors that have been used to prepare the Proposed District Plan should be reviewed and lowered, this means that the extents of flooding for specific properties will also be altered.
26. The Officers therefore recommend an interim situation, whereby the flood extents in the Proposed District Plan for 30 Benmore Crescent are reclassified as “low flood hazard overlays” until such time as Tiaki Wai can prepare revised flood modelling. The Tiaki Wai revised flood modelling would then take into account the current ground levels at 30 Benmore Crescent, any increased catchment area as well as incorporating any revised climate change factors as directed by the Hearings Panel.

² RCP8.5 = Representative Concentration Path 8.5 (i.e. high emissions scenario with temperature increase of 3.0°C to 5.1°C).

Response to Section 42A Report

27. My expectation is that if the Hearings Panel agree with the Officers suggestion to amend the climate change factors to be applied to the flood modelling, that the flood hazard mapping for the whole city will have to be repeated and the results will change. Thus, all submissions in respect of the flood hazard mapping will have to be reconsidered by the Officers and potentially, those submitters given the opportunity to make further submissions as necessary.
28. Nevertheless, in respect of 30 Benmore Crescent, the submitter has engaged Philip Wallace from River Edge Consulting limited to undertake updated flood modelling for the site.
29. The statement of evidence by Mr Wallace outlines the results of up to date flood modelling for the site. Mr Wallace's flood model terrain is based on the current site ground levels, as surveyed by Spencer Holmes Ltd in November 2025. The model also includes the existing culverts in Dry Creek, as these have not yet been removed / replaced with new upgraded culverts as approved by GWRC resource consent WGN230031[38594].
30. Regardless of the merits of what climate change factors should be applied to flood modelling to determine hazard extents and land use restrictions for District Plans, Mr Wallace has adopted a flow rate of 55m³/s in Dry Creek as suggested by Mr Osborne. This is considered to be a worst-case scenario in terms of the potential flooding effects for the site. I note that Mr Wallace considers the flow rate is more likely to be 47m³/s with RCP8.5.
31. The results of the up to date modelling using 55m³/s are shown at Figure 1 of Mr Wallace's statement of evidence. This is reproduced in Figure 3 below.
32. This modelling confirms that that the eastern side of the site (between Dry Creek and the Railway) is elevated above the 1% AEP flood levels with a suitable freeboard allowance. That is, the ground levels on the eastern side of the site are flood free. Therefore, the flood hazard mapping on the eastern area of the site should be removed. The flood hazard mapping on this eastern side can be removed regardless of whether any new flood modelling by Council includes any lowered climate change factors or changes in catchment areas.

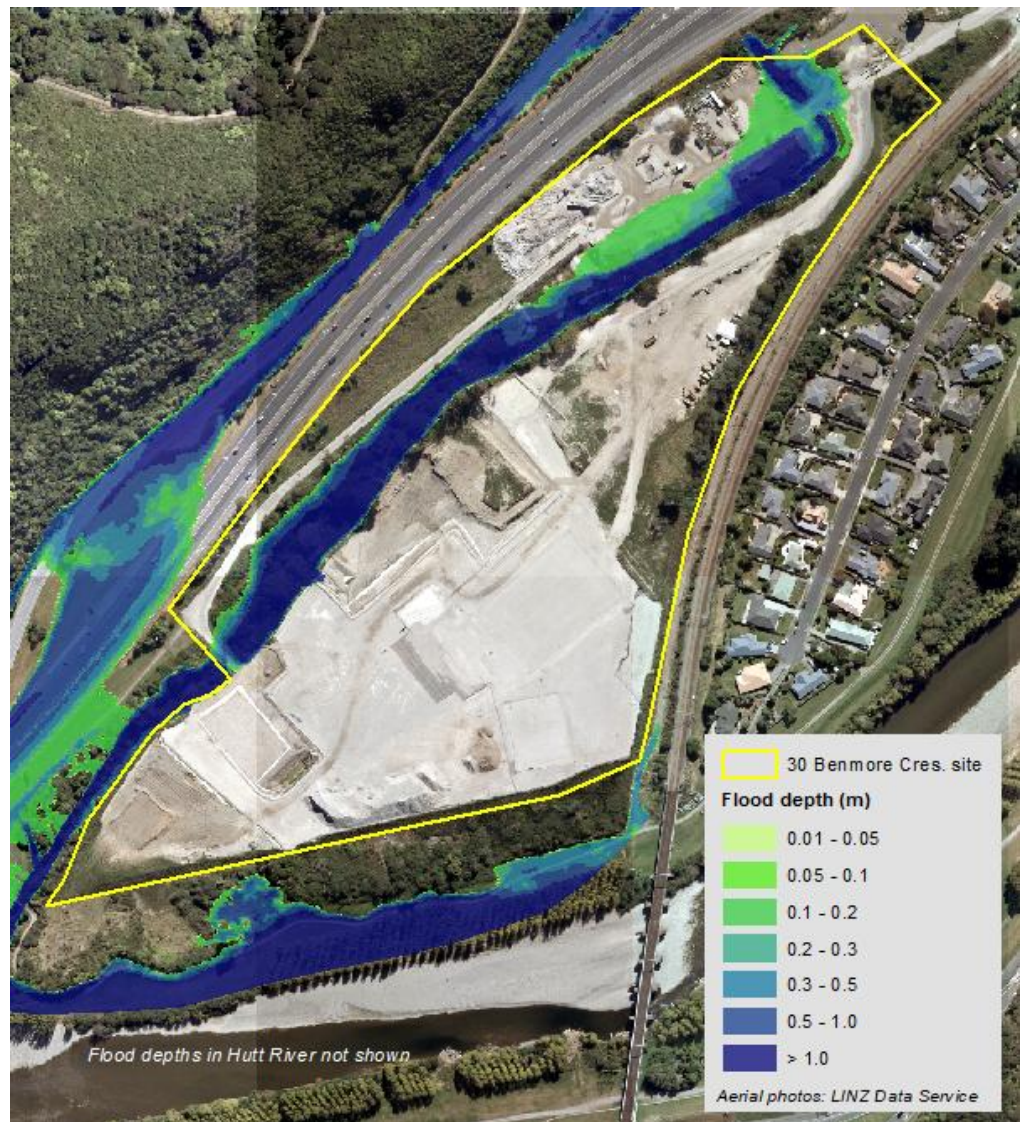


Figure 3: Predicted Flood Depths for 1% AEP for recent ground levels (Source = Figure 1 of Philip Wallace Statement of Evidence)

33. The up to date modelling does show some residual flooding on the western side of Dry Creek at the northern end of the site. Though I note that this may also be reduced with confirmed catchment boundaries and agreement on the use of a lower climate change factor.
34. I also note that these circumstances above would be sufficient for Wellington Water / Tiaki Wai to amend their further submission that opposed the TKL/Rosco submission, to being supportive – as there is a clear evidential basis for removing large areas of the site from the flood hazard maps.

35. Therefore, I consider that the Hearings Panel can have confidence that the site is largely flood free and therefore the flood hazard mapping can be removed from the majority of the site, except for within the Dry Creek channel.

David Gibson

Planning Consultant

5 August 2026

Appendix A:

Tonkin & Taylor Fault Investigation

Rosco Investments
111 Brougham Street
Mt Victoria,
Wellington 6011

Attention: Richard Burrell

Dear Richard

Te Rangihaeata / Manor Park Development Wellington Fault Investigation Report

1 Introduction

Tonkin & Taylor Ltd (T+T) have undertaken an investigation at the proposed Manor Park development site to constrain the likely location of the Wellington Fault. This work has been completed in accordance with our letter of engagement of 7 August 2020 and variation of 3 September 2020.

The Manor Park development site is located within the Hutt City Council (HCC) 'Wellington Fault Special Study Area' as presented in hazard maps of the HCC District Plan. A primary geotechnical issue concerning future development of the site is the proximity to the Wellington Fault, and the consequences of fault rupture. Specifically:

- a Fault rupture presents a risk of severe damage to future building development; and
- b Rule 14H2 of the HCC District Plan states: *'All structures and buildings on any site where the whole site or a portion of the site falls within the Wellington Fault Special Study Area', is a restricted discretionary activity i.e., requires resource consent.*
Clause 14H 1.1.1 states: *'Subdivision and development will be managed to ensure that no building is constructed within 20 metres of the fault line, and that no subdivision results in an allotment being created which is unusable for development purposes. An engineering report will be required prior to any development, to ensure that any buildings proposed are not within 20 metres of the fault line. The level of investigation required will depend on the particular circumstances and this could include a range of methods necessary to determine the position of the fault. The buildings will need to be constructed to New Zealand Building Code specifications. This will ensure that buildings are constructed in a safe manner and at a safe distance from the area susceptible to permanent ground deformation.'*

This report presents the results of the investigation and defines a zone depicting the likely location of the Wellington Fault through the site for the purposes of meeting local council regulatory requirements. Other District Plan rules may also be relevant to the proposal however we have only considered the requirements in relation to the Wellington Fault Special Study Area. Also, other geotechnical considerations e.g., liquefaction, lateral spreading, settlement, bearing capacity etc., have not been considered as part of this report, but are expected to be considered during next stages.

2 Previous fault investigations and mapping

The following section presents a review of previous investigations of the Wellington Fault in the vicinity of the site.

2.1 Begg & Mazengarb (1996)

In Begg & Mazengarb (1996)¹, the Wellington Fault through the Manor Park site was mapped as 'concealed' due to an overburden of alluvial deposits, and therefore the precise location was not well understood. This lineament through the site is based on interpretation of the geomorphology and aligns with surface exposure of the fault to the northeast and southwest of the site. This approximate location is shown in Figure A1, Appendix A.

2.2 Beetham et. al. (2008)

Beetham et. al. (2008)² carried out fault investigations in the vicinity of the Manor Park site to guide the planning and design of the major interchange between SH58 and SH2. The investigations completed included a fault trench immediately to the south of the site, and three micro-gravity survey profiles (one of which is located through the site, and two to the northeast). The investigation constrained the likely location of the Wellington fault to a narrow (35 to 60 m wide) zone through the site as shown in Figure A1, Appendix A. Two of the three survey profiles are also shown in Figure A1.

2.2.1 Fault trench

A 15 m long fault trench on the western (true right) side of the Hutt River was excavated through alluvial gravels to Greywacke rock. The location of this trench was surveyed and is shown in Figure A1, Appendix A. We note that the river has subsequently eroded away the land where the trench was excavated.

A sub-horizontal rock bench was exposed at the base of the trench consisting of fault breccia i.e., disintegrated fault rock (also known as Cataclasite). The excavation also exposed a sub-vertical step (of at least 1 m) in the rock generally parallel with the Wellington Fault trace (strike 044°/dip 78° SE). Close to this step, the rock quality deteriorated from 'hard, grey fault breccia to moderately soft, dark brecciated argillite'. A thin (c. 1 cm) layer of soft gouge material consisting of angular rock fragments in a dark, clay-rich matrix was plastered against the face of the step. No deformation of the overlying alluvial gravels was observed.

The report concludes that this step is either the primary fault plane of the Wellington Fault, or at least its westernmost possible location.

¹ Begg, J.G., Mazengarb, C., 1996. Geology of the Wellington area, scale 1:50 000. Institute of Geological & Nuclear Sciences geological map 22. 1 sheet + 128 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences Limited.

² Beetham et. al. (2008). Investigation and location of the Wellington Fault at Manor Park, Report 2008/36. GNS Science.

2.2.2 Micro-gravity survey

A micro-gravity survey was carried out through the site located perpendicular to the inferred fault alignment.

A small variation in the gravity profile through the site was modelled as a vertical, 30 m high step in the greywacke basement rock, inferred to represent the location of the Wellington Fault.

2.3 Van Dissen (2020)

Observations of the Wellington Fault within the Hutt River bed and on the western (true right) riverbank were made in 2010 and 2014³, and have recently been presented to T+T by Van Dissen (2020). These observations were made immediately to the south of the Manor Park site as shown in Figure A1, Appendix A.

In 2010, a subvertical rock outcrop on the western (true right) riverbank exposed 30 to 50 cm thick fault gouge comprising dark brown clay and gravel and was inferred to be the Wellington Fault. Either side of the fault gouge was dark grey crushed and sheared greywacke which aligned with brecciated rock exposed in the riverbed about 50 m downstream. In 2014, the outcrop was examined again after further erosion had exposed more of the subvertical rock scarp.

3 Recent investigations

3.1 Methodology

Prior to commencing investigations, a series of fault investigation options were reviewed, and these are presented in our fault study and investigation options report⁴. These options were also discussed with GNS⁵.

It was considered unlikely that the location of the Wellington Fault could be obtained by traditional fault trenching due to the significant depth of overlying fill and alluvial deposits (c. 10 m) that have not seen displacement of the fault i.e., the last displacement of the fault pre-dates deposition of the alluvium. It was also noted that evidence (if any) of fault displacement in river gravels is not always well preserved.

Therefore, as agreed with you, we have progressed fault investigations in stages, after interrogation of past information and latest results. The following investigations have been completed:

- Three seismic refraction lines perpendicular to approximate fault trace to determine the rock head profile and the presence of low velocity zones within the rock;
- Four vertically drilled boreholes to verify the depth to rock obtained by seismic refraction surveys; and
- Two inclined machine drilled boreholes to verify low velocity signature obtained by the seismic refraction surveys i.e., drill through the inferred location of the Wellington Fault.

3.2 Seismic refraction survey

Three seismic refraction survey profiles (SL1, SL2 and SL3) were undertaken and assessed using the Plus-Minus method by A J Sutherland Consulting between 10 November and 16 December 2020. The start and end locations of SL1, SL2 and SL3 were surveyed by Spencer Holmes on 22 December 2020.

³ Russ Van Dissen (2020). Wellington Fault at Manor Park, presentation notes. GNS.

⁴ Tonkin + Taylor (14 December 2020). Manor Park Development – Wellington Fault Desktop Study and Investigation Options.

⁵ Meeting of 23/09/2020, Russ Van Dissen (GNS), Tim Haxell (T+T) and Nick Peters (T+T)

A plan showing the location of the profiles are presented in Figure A1, Appendix A, and the final A J Sutherland Consulting report is included in Appendix C.

Table 3.1: Seismic refraction survey summary

Seismic Line	Start Location (NZTM) ¹		End Location (NZTM) ¹		Total length (m)	Geophone spacing (m)
	Easting (m)	Northing (m)	Easting (m)	Northing (m)		
SL1	1765067	5441260	1765183	5441143	165	2.5
SL2	1765208	5441372	1765279	5441289	110	5 ²
SL3	1765316	5441460	1765387	5441375	110	5 ²

¹ Start and end locations were surveyed by Spencer Holmes (Total Station GPS).

² The geophone spacing was reduced to 1m over the low velocity zone to improve the data resolution.

3.3 Machine boreholes

Four vertical and two inclined boreholes was drilled over the period between 25 February 2021 and 23 March 2021. The works were carried out using a rotary coring drilling rig, supplied, and operated by Webster Drilling and Exploration.

All drilling works were completed under the supervision of an engineering geologist from T+T. The recovered drill core was photographed and logged to NZGS 'Field Description of Soil and Rock' guidelines. The borehole locations are presented in Figure A1, Appendix A. Borehole logs and core photographs are presented in Appendix B and summary details are presented in Table 3.2 below.

Table 3.2: Machine borehole summary

BH ID	Inclination from horizontal	Location (NZTM) ¹		Ground surface elevation RL (m) ²	Total depth drilled (m)
		Easting (m)	Northing (m)		
SL1-A	90°	1765108	5441219	26.1	12.5
SL1-B	90°	1765118	5441208	25.5	11.8
SL1-C	45° - NW	1765127	5441199	25.5	48.0
SL3-A	90°	1765339	5441433	32.8	14.6
SL3-B	90°	1765348	5441423	32.2	14.8
SL3-C	45° - NW	1765355	5441415	32.3	48.5

¹ Borehole locations were surveyed by Spencer Holmes (Total Station GPS).

² Ground level obtained by Wellington LiDAR 1m DEM (2013), from Land Information NZ.

3.4 Interpretation of results

3.4.1 Seismic refraction survey

A 5 m wide low velocity zone with a signal time loss of 4 and 6 milliseconds was observed in SL1 and SL2, respectively. We infer that the signal time loss is attributed to highly disintegrated material i.e., fault gouge of the Wellington Fault, which has a significantly reduced seismic velocity than the surrounding greywacke rock (which was measured between 2750 and 2900 m/s). Additionally, an attenuation of the maximum geophone signal amplitude at SL2 was observed within the low velocity zone.

A less-well defined, 3 m wide low velocity zone with a signal time loss of less than 1 milliseconds was observed in SL3. A small attenuation of the maximum geophone amplitude was also measured within the low velocity zone in this location. We infer that at this location, the fault width narrows and therefore the low velocity zone is less distinct than observed in SL1 or SL2. It is understood that the Wellington Fault zone varies in width along its length.

When extrapolating the low velocity zones between the seismic refraction surveys and the exposures observed by Van Dissen to the south of the site, the inferred alignment of the fault is relatively consistent through the site (azimuth ~048°).

No significant step in bedrock was identified that corroborates the 30 m step modelled by GNS (as described in Section 2.2.2 above). We infer that downcutting of the Hutt River has planed off any evidence of a step in bedrock at this location. It should be appreciated that due to the sensitivity of micro-gravity processing and modelling, other models of the bedrock profile i.e., without a 30 m high step, may still reconcile a small variation measured in the gravity survey.

3.4.2 Machine boreholes

Two cross sections presenting our interpretation of the ground model at SL1 and SL3 are shown in Figure A2 and A3, Appendix A. The depth to rock beneath the ground surface, obtained by seismic refraction survey, was verified by vertically drilled machine boreholes and is generally between 8 and 10 m below ground level. All boreholes encountered markedly crushed and broken greywacke rock i.e., cataclasite, formed by near-fault stresses.

No significant clay gouge thickness was encountered in the inclined (SL1-C and SL3-C) boreholes that were drilled through the inferred location of the Wellington Fault. It is expected that any softened material was washed away by the drilling process. At SL1-C and as shown in Figure A2, there is compounding evidence that confirms the existence of a low velocity zone and the likely location of the Wellington Fault. Specifically, within the low velocity zone we noted the following drilling observations which are recorded on Figures A2 and A3:

- Up to 1.4 m of core was loss (negligible core loss outside of the low velocity zone);
- Rock samples were more crushed and disintegrated;
- Drill core lengths were reduced by the driller due to an increase in pump pressure; and
- Driller noted 'soft' between 29.7 to 30 m (although no material was recovered).

The inclined (SL3-C) borehole provided less evidence to confirm the low velocity zone, however there was up to 0.7 m of core was loss within low velocity zone. There was negligible core loss outside of the low velocity zone.

4 Development considerations

Based on the previous and recent investigations discussed in Sections 2 and 3, we infer that the zone that constrains the likely location of the Wellington Fault through the site is highlighted yellow in Figure A1, Appendix A.

There are several uncertainties that have been allowed for when defining this zone, specifically:

- Deformation at the surface may not be a simple single plane rupture. During fault rupture, horizontal and vertical displacement through bedrock may distribute through overlying alluvial gravels and result in a wider zone of disturbance. It is unlikely that any additional investigation will reduce this uncertainty;
- Uncertainties in the measurement associated with seismic refraction survey and machine boreholes; and
- Limited investigation data the north of SL3. An additional seismic refraction survey could be completed to reduce this uncertainty however this would need to be completed outside the property boundary, adjacent to Manor Park Road.

The HCC District Plan requires that proposed buildings should not be located within 20 m of fault line. Therefore, any proposed buildings should not be within 20 m of the zone highlighted yellow in Figure A1, Appendix A.

The nature and continuity of the subsurface conditions away from the borehole locations and seismic refraction lines are inferred. It must be appreciated that strain along the Wellington Fault may exploit multiple other planes of weakness within the basement rock and overlying soils (that have not been investigated), and surface rupture may occur outside of the inferred zone presented in this report.

5 Applicability

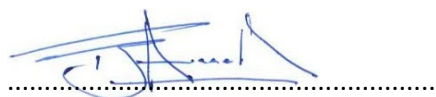
This report has been prepared for the exclusive use of our client, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Hutt City Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

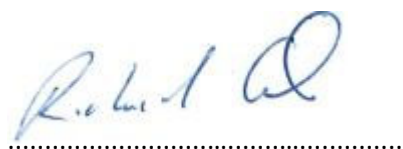
Environmental and Engineering Consultants

Report prepared by:



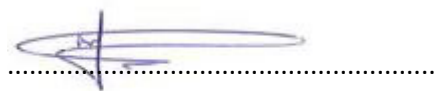
Tim Haxell
Engineering Geologist

Authorised for Tonkin & Taylor Ltd by:



Richard Cole
Project Director

Report Reviewed by:



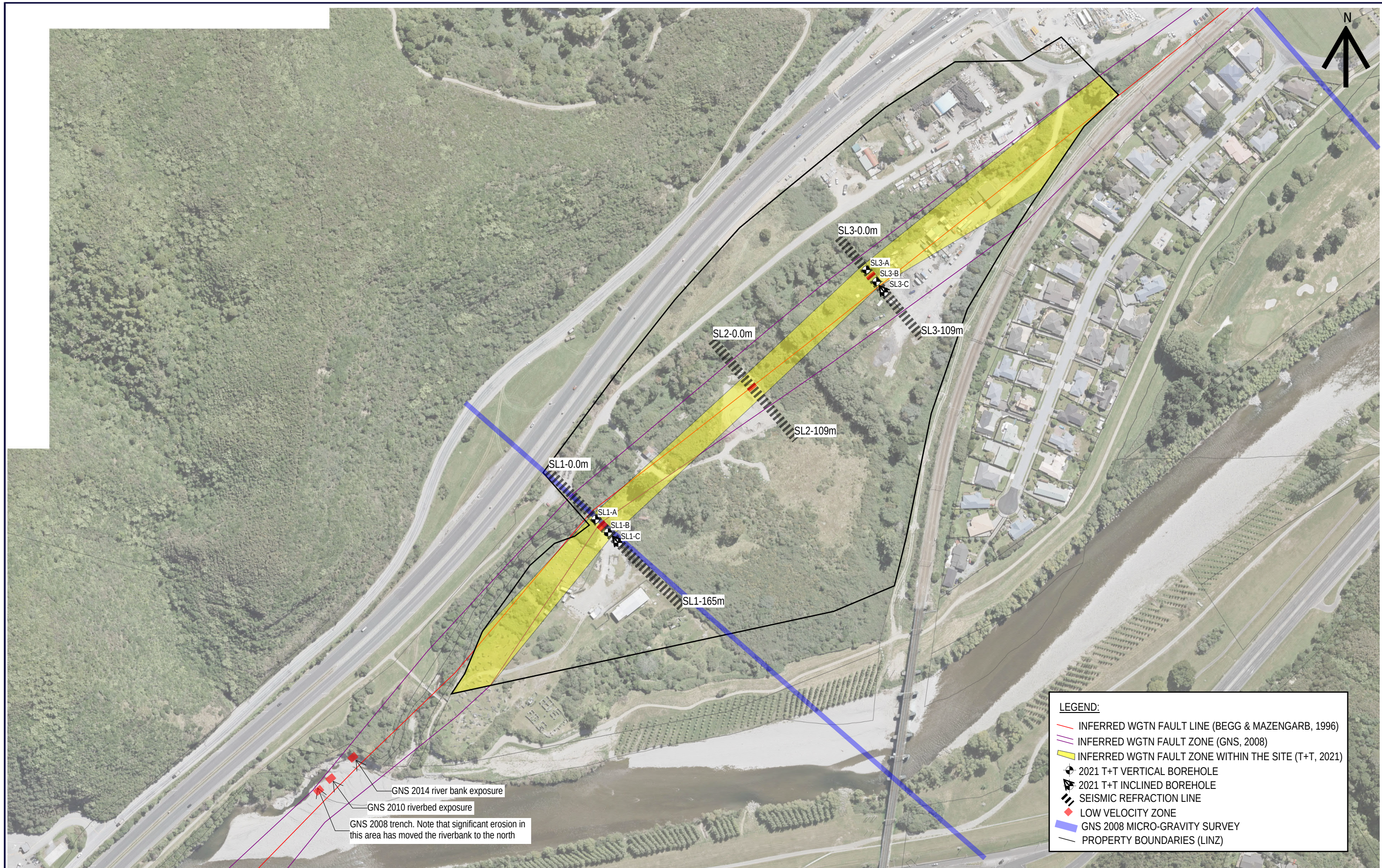
Nick Peters
Senior Engineering Geologist

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Appendix A: Figures

- **Figure A1 Wellington Fault investigation location plan**
- **Figure A2 Cross Section SL-1**
- **Figure A3 Cross Section SL-3**



- LEGEND:**
- INFERRED WGTN FAULT LINE (BEGG & MAZENGARB, 1996)
 - INFERRED WGTN FAULT ZONE (GNS, 2008)
 - INFERRED WGTN FAULT ZONE WITHIN THE SITE (T+T, 2021)
 - 2021 T+T VERTICAL BOREHOLE
 - 2021 T+T INCLINED BOREHOLE
 - - - SEISMIC REFRACTION LINE
 - ◆ LOW VELOCITY ZONE
 - GNS 2008 MICRO-GRAVITY SURVEY
 - PROPERTY BOUNDARIES (LINZ)



DRAWN	TH	1/05/21
CHECKED	NCP	1/06/21
APPROVED	RGC	1/06/21
FILE : \\ttgroup.local\corporate\Wellington\TT Projects\1015081\		
APPROX. SCALE (AT A3 SIZE)		
1:3000		
PROJECT No.	1015081	

TE RANGIHAEATA / MANOR PARK DEVELOPMENT
WELLINGTON FAULT INVESTIGATION PLAN

FIG. No. A1

REV. 0



Project: Manor Park
Development

Figure A2: Sketch Cross Section of Seismic Line 1

Computed: DAHE 08/04/2021 Office: WGTN

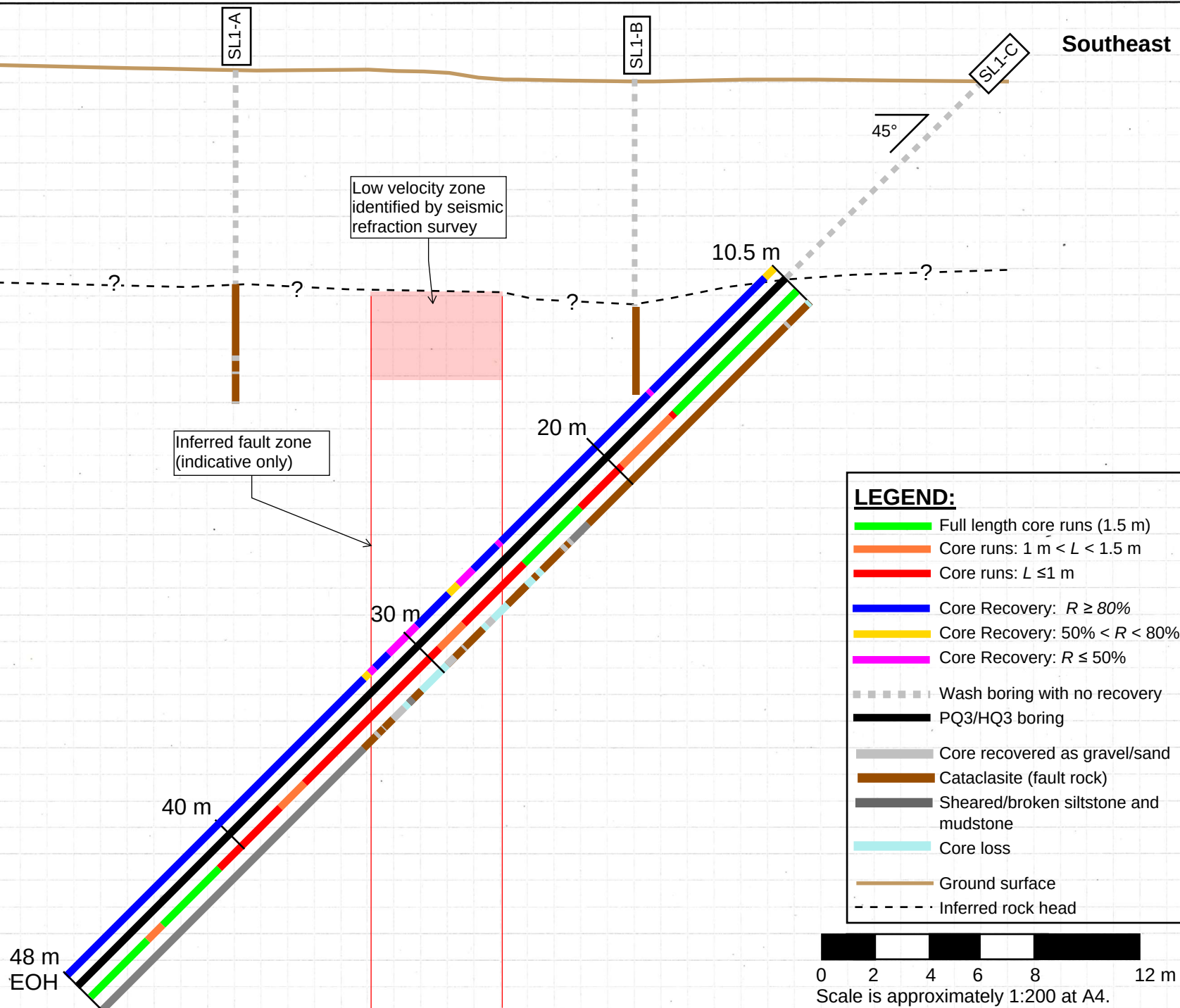
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Checked: 20 Sheet No.

Northwest

Southeast





Project: Manor Park
Development

Figure A2: Sketch Cross Section of Seismic Line 3

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Checked: NCP 08/04/2021 Job No: 1015081

Revised: 20 File:

Checked: 20 Sheet No.

Northwest

Southeast

SL3-A

SL3-B

SL3-C

45°

Low velocity zone
identified by seismic
refraction survey

Inferred fault zone
(indicative only)

LEGEND:

- Full length core runs (1.5 m)
- Core runs: $1\text{ m} < L < 1.5\text{ m}$
- Core runs: $L \leq 1\text{ m}$
- Core Recovery: $R \geq 80\%$
- Core Recovery: $50\% < R < 80\%$
- Core Recovery: $R \leq 50\%$
- Wash boring with no recovery
- PQ3/HQ3 boring
- Core recovered as gravel/sand
- Cataclasite (fault rock)
- Sheared/broken mudstone and siltstone
- Core loss
- Ground surface
- Inferred rock head

48.5 m
EOH

40 m

30 m

20 m

14.8 m

0 2 4 6 8 12 m
Scale is approximately 1:200 at A4.

Appendix B: Borehole logs

- BH SL1-A
- BH SL1-B
- BH SL1-C
- BH SL3-A
- BH SL3-B
- BH SL3-B

BOREHOLE LOG

BOREHOLE No.:
SL1-A

SHEET: 2 OF 2

DRILLED BY: Cody Longstaff
LOGGED BY: TH

CHECKED: NCP

START DATE: 25/02/2021
FINISH DATE: 26/02/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development
JOB No.: 1015081.0000
LOCATION: East side of culvert, adjacent to abandoned paintball stall and pedestrian access.

CO-ORDINATES: 5441219.11 mN
(NZTM2000) 1765107.63 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 26.10m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)							
Rakaia Terrane					PQ3	100		16												Box 2, 10.55-12.50m
	10.70m: Unweathered to slightly weathered, dark grey MUDSTONE and SILTSTONE. Weak to moderately strong, extremely closely spaced joints. Sheared rock. Discontinuities are filled with pale grey quartz. Recovered as gravel from 10.7 to 10.8.				PQ3	86		15												
	11.30 - 11.40m: Recovered as fine to coarse, angular gravel.				PQ3	100		14												
	12.00 - 12.10m: Recovered as fine to coarse, angular gravel.				PQ3	100														
	12.40 - 12.50m: Recovered as fine to coarse, angular gravel.				PQ3	100														
	12.5m: END OF BOREHOLE																			

COMMENTS: 1) Groundwater level not recorded. 2)Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
12.5m

Scale 1:50

CORE PHOTOS

BOREHOLE No.: **SL1-A**

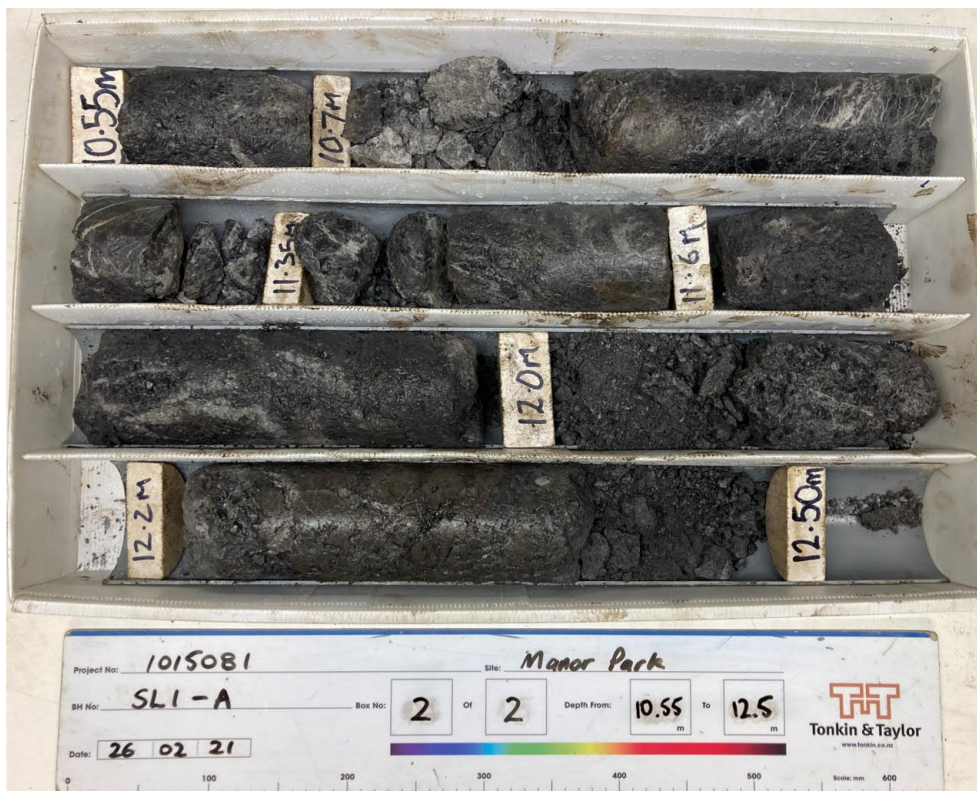
Hole Location: East side of culvert, adjacent to abandoned paintball stall and pedestrian access.

SHEET: 1 OF 1

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441219.11 mN (NZTM2000) 1765107.63 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 25/02/2021
R.L.:	26.10m	DRILL METHOD: RC	HOLE FINISHED: 26/02/2021
DATUM:	NZVD2016	LOGGED BY: TH	CHECKED: NCP



8.00-10.55m



10.55-12.50m

BOREHOLE LOG

BOREHOLE No.:
SL1-B

SHEET: 1 OF 2

DRILLED BY: Jacob Fuller

LOGGED BY: TH

CHECKED: NCP

START DATE: 24/02/2021

FINISH DATE: 26/02/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: On driveway to abandoned paintball stall on a the vacant lot.

CO-ORDINATES: 5441208.38 mN
(NZTM2000) 1765118.18 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 25.50m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
											Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	UW MS MW SW CN	US MS MW SW CN																	
Rakaia Terrane	0.00m: Wash boring with no sample recovered.																		
	8.50m: 8.5 to 8.6 m: Core loss. 8.60m: Unweathered to slightly weathered, dark grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of dark grey clay.				HQ3	HQ3													

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
11.8m

BOREHOLE LOG

BOREHOLE No.:
SL1-B

SHEET: 2 OF 2

DRILLED BY: Jacob Fuller

LOGGED BY: TH

CHECKED: NCP

START DATE: 24/02/2021

FINISH DATE: 26/02/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: On driveway to abandoned paintball stall on a the vacant lot.

CO-ORDINATES: 5441208.38 mN
(NZTM2000) 1765118.18 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 25.50m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Rakaia Terrane			UW MS CS US UW MS CS US																

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
11.8m

Scale 1:50

Rev.: B

CORE PHOTOS

BOREHOLE No.: **SL1-B**

Hole Location: On driveway to abandoned paintball stall on a the vacant lot.

SHEET: 1 OF 1

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441208.38 mN (NZTM2000) 1765118.18 mE	DRILL TYPE: Tractor-Mounted Rig	HOLE STARTED: 24/02/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 26/02/2021
DATUM:	NZVD2016	LOGGED BY: TH	CHECKED: NCP



8.50-11.40m



11.40-11.80m

BOREHOLE LOG

BOREHOLE No.:

SL1-C

SHEET: 2 OF 5

DRILLED BY: Cody Longstaff

LOGGED BY: DAHE

CHECKED: NCP

START DATE: 01/03/2021

FINISH DATE: 10/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

CO-ORDINATES: 5441199.09 mN
(NZTM2000) 1765127.21 mE

DIRECTION: 315°

ANGLE FROM HORIZ.: -45°

R.L. GROUND: 25.50m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M36 M37 M38 M39 M40 M41 M42 M43 M44 M45 M46 M47 M48 M49 M50 M51 M52 M53 M54 M55 M56 M57 M58 M59 M60 M61 M62 M63 M64 M65 M66 M67 M68 M69 M70 M71 M72 M73 M74 M75 M76 M77 M78 M79 M80 M81 M82 M83 M84 M85 M86 M87 M88 M89 M90 M91 M92 M93 M94 M95 M96 M97 M98 M99 M100	US S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25 S26 S27 S28 S29 S30 S31 S32 S33 S34 S35 S36 S37 S38 S39 S40 S41 S42 S43 S44 S45 S46 S47 S48 S49 S50 S51 S52 S53 S54 S55 S56 S57 S58 S59 S60 S61 S62 S63 S64 S65 S66 S67 S68 S69 S70 S71 S72 S73 S74 S75 S76 S77 S78 S79 S80 S81 S82 S83 S84 S85 S86 S87 S88 S89 S90 S91 S92 S93 S94 S95 S96 S97 S98 S99 S100	PQ3	70			18					0					
	10.50m: Core loss.																	
	10.65m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a pale grey clay matrix.			PQ3	70			11										
	11.60 - 11.75m: Recovered as fine to coarse, angular gravel.			PQ3	100			17										
	12.00 - 12.80m: Bands of dark grey argillite within the siltstone dip at approximately 45°. The bands are estimated to be subvertical when in situ.			PQ3	100			13										
	12.80 - 13.10m: Crushed siltstone is dark grey with argillite inclusions.			PQ3	100			16										
	14.55 - 14.65m: Argillite bands dip at approximately 45° in the core. Bands are estimated to be subvertical when in-situ.			PQ3	100			15										
	14.75 - 14.80m: Large argillite band within siltstone.			PQ3	100			15										
	15.75 - 15.95m: Thick, subvertical argillite band. Argillite is moderately weathered, dark grey, weak.			PQ3	100			14										
	16.80 - 17.00m: Argillite bands dip at approximately 45° in the core. Bands are estimated to be subvertical when in-situ.			PQ3	50			17										
	17.60m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a pale grey to dark grey clay matrix. Colour varies along the length of the core.			PQ3	100			13										
				PQ3	100			12										

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
48m

BOREHOLE LOG

BOREHOLE No.:

SL1-C

SHEET: 3 OF 5

DRILLED BY: Cody Longstaff

LOGGED BY: DAHE

CHECKED: NCP

START DATE: 01/03/2021

FINISH DATE: 10/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

CO-ORDINATES: 5441199.09 mN
(NZTM2000) 1765127.21 mE

DIRECTION: 315°

ANGLE FROM HORIZ.: -45°

R.L. GROUND: 25.50m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW MS MW SW CS US MS MW SW CS US MS MW SW CS	US MS MW SW CS US MS MW SW CS US MS MW SW CS	PQ3	100			11										
				PQ3	118			10				0						
	22.20m: Unweathered to slightly weathered, dark grey MUDSTONE and SILTSTONE. Weak to moderately strong, extremely closely spaced joints. Sheared rock. Discontinuities are filled with pale grey quartz.			PQ3	100			22				0						
	23.10 - 23.25m: Recovered as fine to coarse, angular gravel.							23				0						
	23.25m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a pale grey to dark grey clay matrix. Colour varies along the length of the core.							9				0						
	23.40 - 23.60m: Recovered as fine to coarse, angular gravel.			PQ3	83			24				0						
	24.75m: Core loss.							8				0						
	25.00m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a grey clay matrix.			PQ3	0			25				0						
	25.20m: Core loss.			PQ3	87			26				0						
	25.50m: Unweathered to slightly weathered, dark grey CATACLASITE. Weak, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a dark grey clay matrix.			PQ3	100			26				0						
	25.60 - 25.70m: Sheared mudstone and siltstone. Moderately strong, extremely closely spaced joints. Abrupt transition at 45°. Transition is estimated to be subvertical when in-situ.			PQ3	0			27				0						
	25.70 - 26.30m: Cataclasite becomes dark grey and moderately strong			PQ3	0			27				0						
	26.30 - 26.50m: Cataclasite is black, slightly weathered and weak. Transition to black material is abrupt and at a 45°. Transition is estimated to be subvertical when in-situ.			PQ3	0			27				0						
	26.50m: Core loss.							6				0						
	27.30m: Unweathered to slightly weathered, dark grey CATACLASITE. Weak, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in dark grey clay matrix. Recovered as angular, fine to coarse gravel.			PQ3	56			28				0						
	27.58m: Core loss.			PQ3	100			28				0						
	27.80m: Unweathered to slightly weathered, dark grey CATACLASITE. Weak to moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a dark grey clay matrix.			PQ3	100			29				0						
	28.76 - 28.85m: Recovered as fine to coarse, angular gravel.							5				0						
	28.85 - 29.30m: Becomes more broken. Fine, white infill in joints.							5				0						
	29.30 - 29.70m: Recovered as fine to coarse, angular gravel and sand.							5				0						
	29.70m: Core loss.			PQ3	0			29				0						

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
48m

Scale 1:50

Rev.: B



Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:

SL1-C

SHEET: 4 OF 5

DRILLED BY: Cody Longstaff

LOGGED BY: DAHE

CHECKED: NCP

START DATE: 01/03/2021

FINISH DATE: 10/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

CO-ORDINATES: 5441199.09 mN
(NZTM2000) 1765127.21 mE

DIRECTION: 315°

ANGLE FROM HORIZ.: -45°

R.L. GROUND: 25.50m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Rakaia Terrane	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M36 M37 M38 M39 M40 M41 M42 M43 M44 M45 M46 M47 M48 M49 M50 M51 M52 M53 M54 M55 M56 M57 M58 M59 M60 M61 M62 M63 M64 M65 M66 M67 M68 M69 M70 M71 M72 M73 M74 M75 M76 M77 M78 M79 M80 M81 M82 M83 M84 M85 M86 M87 M88 M89 M90 M91 M92 M93 M94 M95 M96 M97 M98 M99 M100	US S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25 S26 S27 S28 S29 S30 S31 S32 S33 S34 S35 S36 S37 S38 S39 S40 S41 S42 S43 S44 S45 S46 S47 S48 S49 S50 S51 S52 S53 S54 S55 S56 S57 S58 S59 S60 S61 S62 S63 S64 S65 S66 S67 S68 S69 S70 S71 S72 S73 S74 S75 S76 S77 S78 S79 S80 S81 S82 S83 S84 S85 S86 S87 S88 S89 S90 S91 S92 S93 S94 S95 S96 S97 S98 S99 S100	PQ3	0		4											
	31.10m: Slightly weathered, dark grey CATACLASITE. Weak to moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a dark grey clay matrix. 31.50m: Unweathered to slightly weathered, grey MUDSTONE and SILTSTONE. Weak, extremely closely spaced joints. Sheared rock. 31.75m: Core loss. 32.00m: Slightly weathered, dark grey CATACLASITE. Weak to moderately strong, crushed. Fine to coarse, angular sandstone, siltstone and mudstone gravel in a dark grey clay matrix. 32.00 - 32.60m: Recovered as fine to coarse, angular gravel with some fine to coarse, angular sand. 33.05 - 33.10m: Recovered as fine to coarse, angular gravel. 33.35 - 33.50m: Recovered as fine to coarse, angular gravel with some fine to coarse, angular sand.			PQ3	75		31					0						
	34.15m: Unweathered to slightly weathered, dark grey to black SILTSTONE and MUDSTONE. Moderately strong, crushed and sheared, extremely closely spaced joints. Discontinuities are filled with pale grey quartz.			PQ3	100		32					0						
				PQ3	100		33					0						
				PQ3	100		34					0						
				PQ3	100		35					0						
				PQ3	100		36					0						
				PQ3	100		37					0						
				PQ3	100		38					0						
				PQ3	100		39					0						
				PQ3	100		40					0						
				PQ3	100		41					0						
				PQ3	100		42					0						
				PQ3	100		43					0						
				PQ3	100		44					0						
				PQ3	100		45					0						
				PQ3	100		46					0						
				PQ3	100		47					0						
				PQ3	100		48					0						
				PQ3	100		49					0						
				PQ3	100		50					0						
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				PQ3	100		96					0						
				PQ3	100		97					0						
				PQ3	100		98					0						
				PQ3	100		99					0						
				PQ3	100		100					0						

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
48m

Scale 1:50

Rev.: B

BOREHOLE LOG

BOREHOLE No.:
SL1-C

SHEET: 5 OF 5

DRILLED BY: Cody Longstaff
LOGGED BY: DAHE
CHECKED: NCP
START DATE: 01/03/2021
FINISH DATE: 10/03/2021
CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development
JOB No.: 1015081.0000
LOCATION: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

CO-ORDINATES: 5441199.09 mN
(NZTM2000) 1765127.21 mE

DIRECTION: 315°
ANGLE FROM HORIZ.: -45°

R.L. GROUND: 25.50m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Rakaia Terrane	45.00m: SILTSTONE and MUDSTONE become slightly weathered and weak.		<																

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
48m

Scale 1:50

Rev.: B

CORE PHOTOS

BOREHOLE No.: **SL1-C**

Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 1 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000) 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



10.50-12.80m



12.80-14.85m

CORE PHOTOS

BOREHOLE No.: **SL1-C**

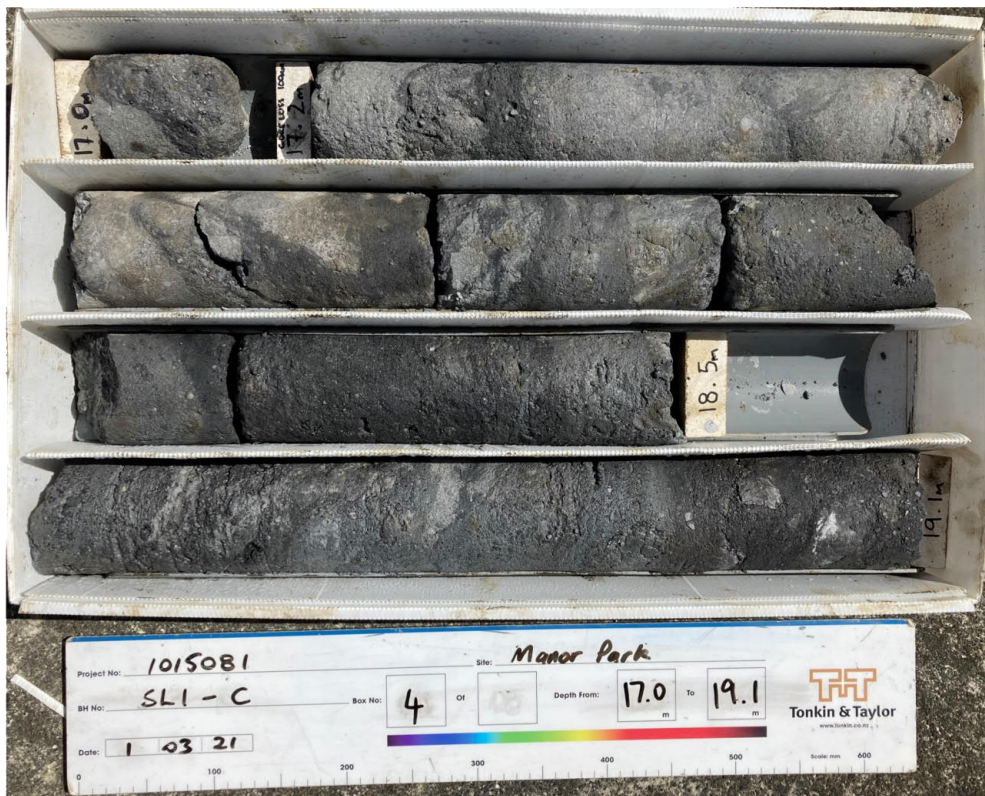
Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 2 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000) 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE CHECKED: NCP



14.85-17.00m



17.00-19.10m

CORE PHOTOS

BOREHOLE No.: **SL1-C**

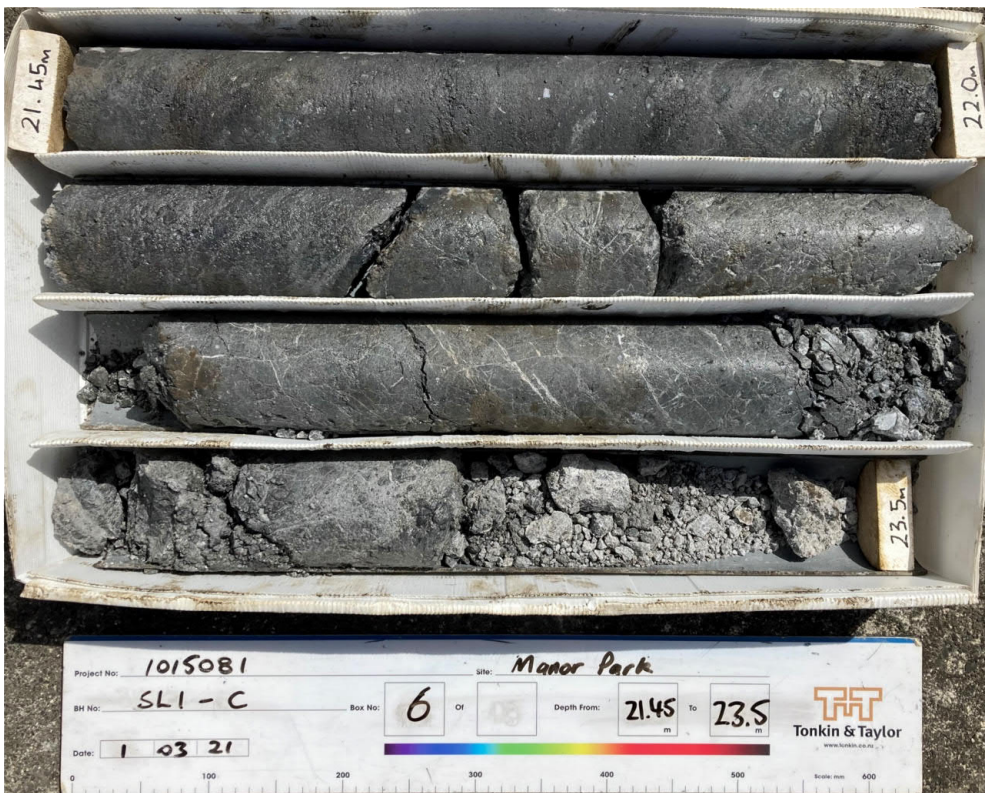
Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 3 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000)	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



19.10-21.45m



21.45-23.50m

CORE PHOTOS

BOREHOLE No.: **SL1-C**

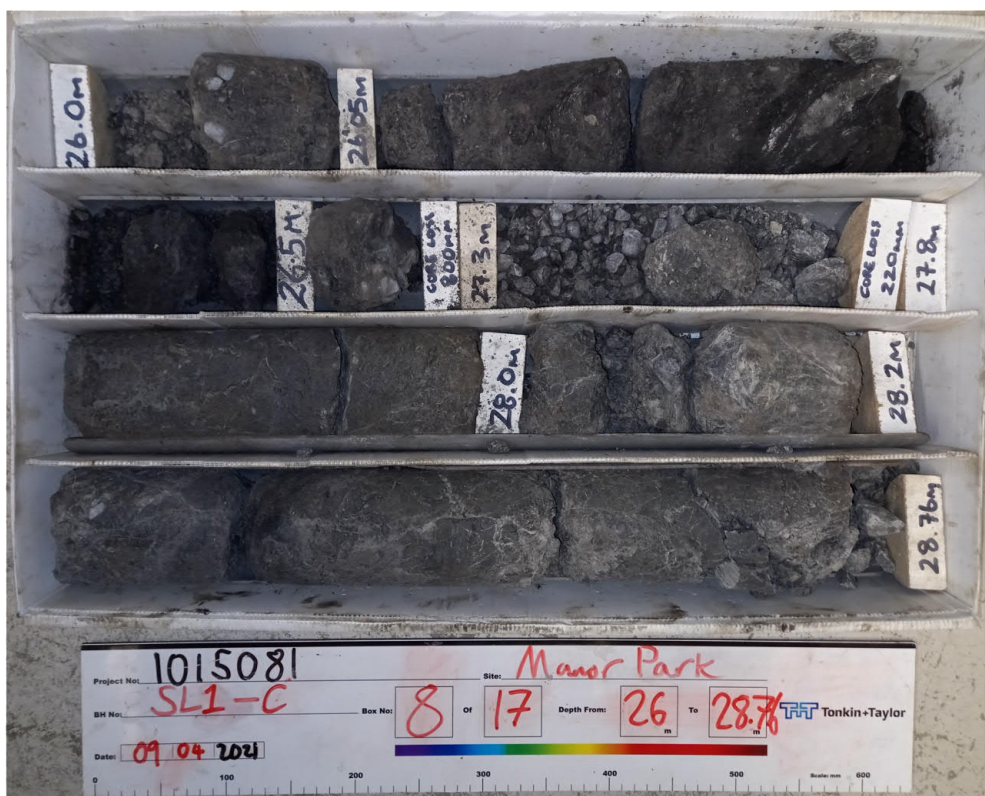
Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 4 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000) 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



23.50-26.00m



26.00-28.76m

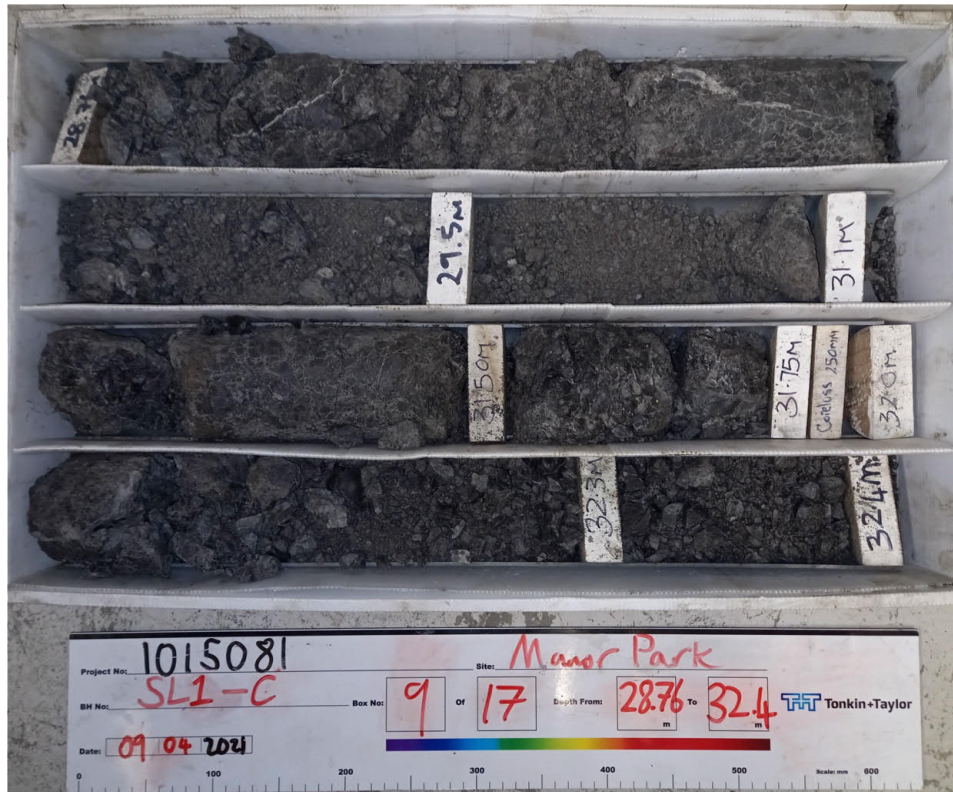
CORE PHOTOS

BOREHOLE No.: **SL1-C**

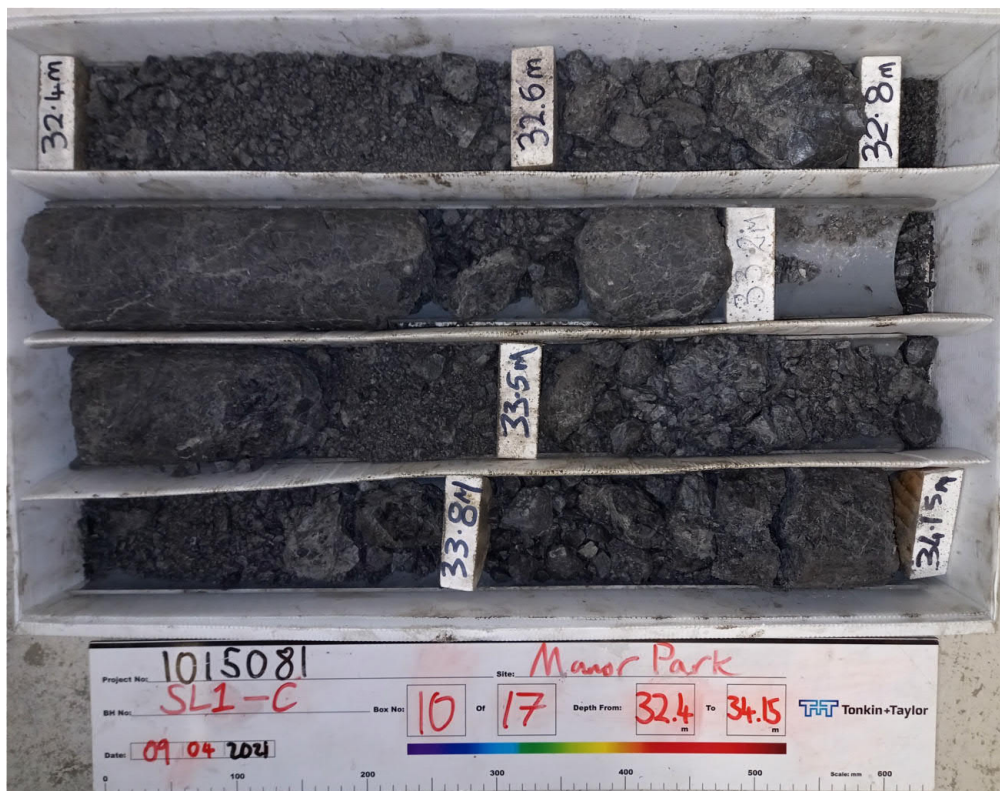
Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 5 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES: (NZTM2000)	5441199.09 mN 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE
			CHECKED: NCP



28.76-32.40m



32.40-34.15m

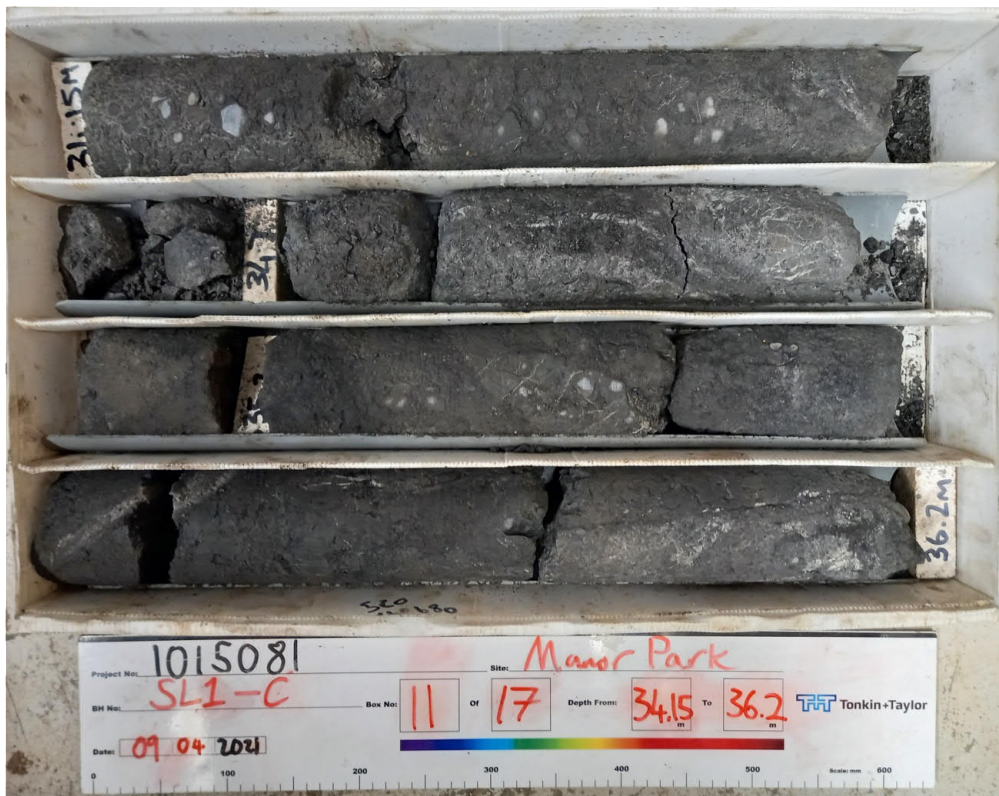
CORE PHOTOS

BOREHOLE No.: **SL1-C**

Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 6 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000) 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE CHECKED: NCP



34.15-36.20m



36.20-38.54m

CORE PHOTOS

BOREHOLE No.: **SL1-C**

Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 7 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000) 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



38.54-40.71m



40.71-42.82m

CORE PHOTOS

BOREHOLE No.: **SL1-C**

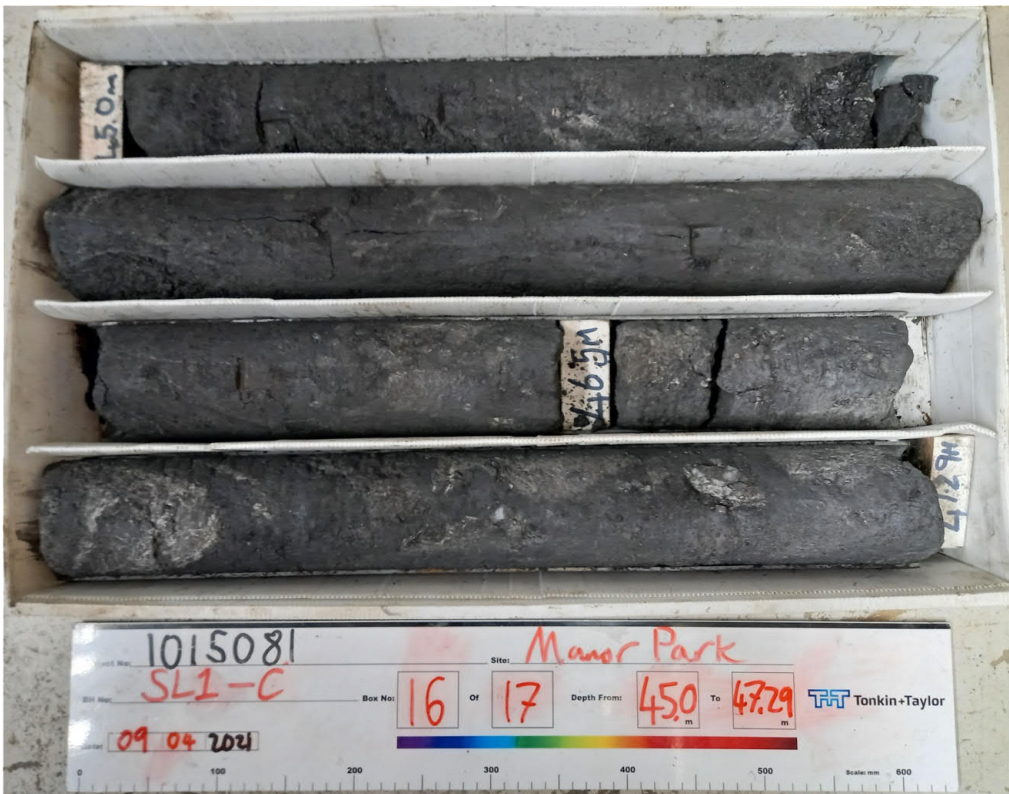
Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 8 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441199.09 mN (NZTM2000) 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE CHECKED: NCP



42.82-45.00m



45.00-47.29m

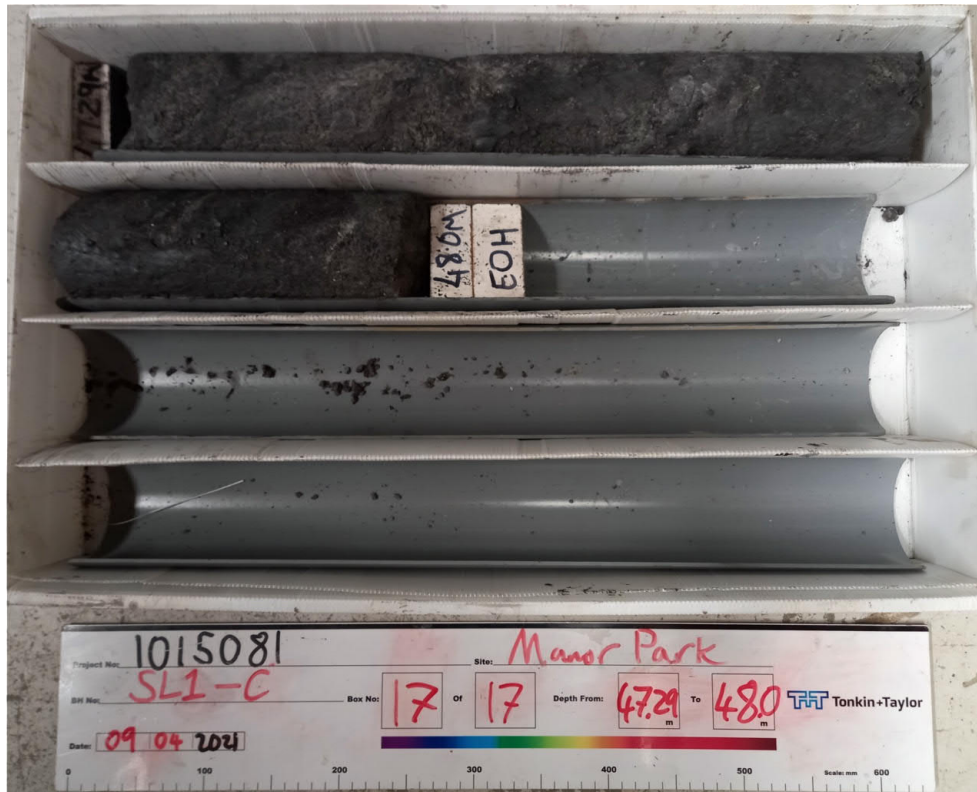
CORE PHOTOS

BOREHOLE No.: **SL1-C**

Hole Location: In line with SL1-A and SL1-B, on the driveway to the abandoned paintball stall on the vacant lot.

SHEET: 9 OF 9

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES: (NZTM2000)	5441199.09 mN 1765127.21 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 01/03/2021
R.L.:	25.50m	DRILL METHOD: RC	HOLE FINISHED: 10/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE CHECKED: NCP



47.29-48.00m

BOREHOLE LOG

BOREHOLE No.:
SL3-A

SHEET: 1 OF 2

DRILLED BY: Jacob Fuller

LOGGED BY: DAHE

CHECKED: NCP

START DATE: 02/03/2021

FINISH DATE: 04/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: At far western corner of the northernmost vacant industrial lot.

CO-ORDINATES: 5441432.76 mN
(NZTM2000) 1765339.49 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 32.80m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering UW US MS MW CW CS	Rock Strength US MS MW CW CS	Sampling Method US MS MW CW CS	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%) 25 50 75	Water Level 03/05/2021; Afternoon reading.	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log 2000 1000 500 200 50 20	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	0.00m: Wash boring with no sample recovered.																	

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
14.6m

Scale 1:50

Rev.: B

BOREHOLE LOG

BOREHOLE No.:
SL3-A

SHEET: 2 OF 2

DRILLED BY: Jacob Fuller

LOGGED BY: DAHE

CHECKED: NCP

START DATE: 02/03/2021

FINISH DATE: 04/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: At far western corner of the northernmost vacant industrial lot.

CO-ORDINATES: 5441432.76 mN
(NZTM2000) 1765339.49 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 32.80m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
Rakaia Terrane			UW MA MC CN	US MS MW EW					22			2000 1500 1000 500 200 100 50 20								
									11											
		11.60m: Unweathered to slightly weathered, dark grey CATACLASITE. Weak. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of dark grey clay. 12.00 - 12.15m: Pale grey vein. Weak. Subvertical. 5 to 10 mm across.			HQ3	100			12				0							
		12.40m: Unweathered to slightly weathered, black CATACLASITE. Very weak to weak. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of dark grey clay. Breaks down to silt and fine to coarse sand and gravel 12.70m: Unweathered to slightly weathered, grey CATACLASITE. Weak. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale to dark grey clay. Colour of material varies along the core sample. 13.25 - 13.45m: Unweathered to slightly weathered, pale grey CATACLASITE cobble. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay.			HQ3	100			13				0							
	14.6m: END OF BOREHOLE								18											
									15											
									17											
									16											
									17											
									15											
									18											
									14											
									19											
									13											

Box 1, 11.60-14.30m

COMMENTS: Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.

Hole Depth
14.6m

Scale 1:50

Rev.: B

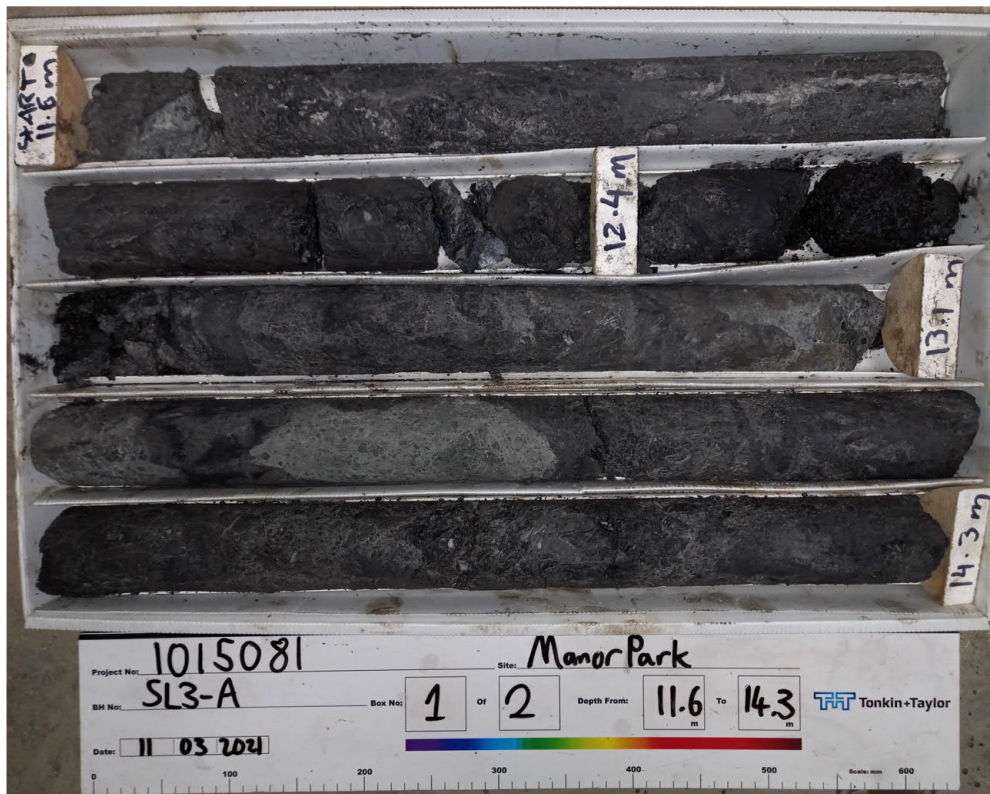
CORE PHOTOS

BOREHOLE No.: **SL3-A**

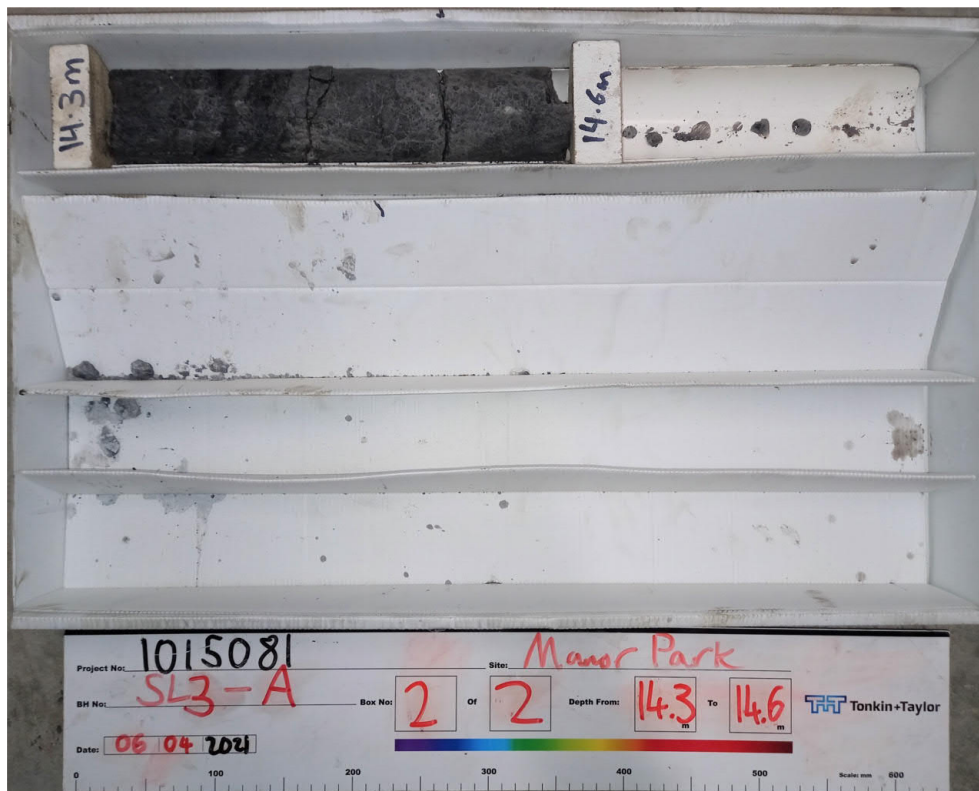
Hole Location: At far western corner of the northernmost vacant industrial lot.

SHEET: 1 OF 1

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441432.76 mN (NZTM2000) 1765339.49 mE	DRILL TYPE: Tractor-Mounted Rig	HOLE STARTED: 02/03/2021
R.L.:	32.80m	DRILL METHOD: RC	HOLE FINISHED: 04/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



11.60-14.30m



14.30-14.60m

BOREHOLE LOG

BOREHOLE No.:
SL3-B

SHEET: 1 OF 2

DRILLED BY: Jacob Fuller

LOGGED BY: TH

CHECKED: NCP

START DATE: 01/03/2021

FINISH DATE: 02/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: At far western corner of the northernmost vacant industrial lot.

CO-ORDINATES: 5441422.77 mN
(NZTM2000) 1765347.82 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 32.20m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering USF MSF MAF CF US MS MA CF USF MSF MAF CF	Rock Strength US MS MA CF USF MSF MAF CF	Sampling Method US MS MA CF USF MSF MAF CF	Core Recovery (%) US MS MA CF USF MSF MAF CF	Testing US MS MA CF USF MSF MAF CF	RL (m) US MS MA CF USF MSF MAF CF	Depth (m) US MS MA CF USF MSF MAF CF	Graphic Log US MS MA CF USF MSF MAF CF	ROCK DEFECTS				Fluid Loss (%) US MS MA CF USF MSF MAF CF	Water Level US MS MA CF USF MSF MAF CF	Casing US MS MA CF USF MSF MAF CF	Installation US MS MA CF USF MSF MAF CF	Core Box No US MS MA CF USF MSF MAF CF
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log US MS MA CF USF MSF MAF CF	Fracture Spacing (mm) US MS MA CF USF MSF MAF CF	RQD (%) US MS MA CF USF MSF MAF CF	Description & Additional Observations					
	0.00m: Wash boring with no sample recovered.																	

COMMENTS: 1) Groundwater level not recorded.2) Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.3) Borehole is vertical so angles of shear zones represent the angle from horizontal.

Hole Depth
14.8m

Scale 1:50

Rev.: B

BOREHOLE LOG

BOREHOLE No.:
SL3-B

SHEET: 2 OF 2

DRILLED BY: Jacob Fuller

LOGGED BY: TH

CHECKED: NCP

START DATE: 01/03/2021

FINISH DATE: 02/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: At far western corner of the northernmost vacant industrial lot.

CO-ORDINATES: 5441422.77 mN
(NZTM2000) 1765347.82 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 32.20m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering UW MS MW SW CN	Rock Strength US MS MW SW CN	Sampling Method		Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box No
				HQ3	Core Recovery (%)						Description & Additional Observations	Fracture Spacing (mm) 2000 1000 500 200 100 20	RQD (%)							
	11.50m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay. 12.70 - 12.73m: Shear zone at 80°. 3 mm across. Hard, dark grey. 13.00m: Core loss. 13.30m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay. 14.20 - 14.23m: Shear zone at 80°. 3 mm across. Hard, dark grey.	UW MS MW SW CN	US MS MW SW CN	HQ3	66			22												
				HQ3	80			21												
				HQ3	112			20												
				HQ3	100			19												
								18												
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COMMENTS: 1) Groundwater level not recorded.2) Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded.3) Borehole is vertical so angles of shear zones represent the angle from horizontal.

Hole Depth
14.8m

Scale 1:50

Rev.: B

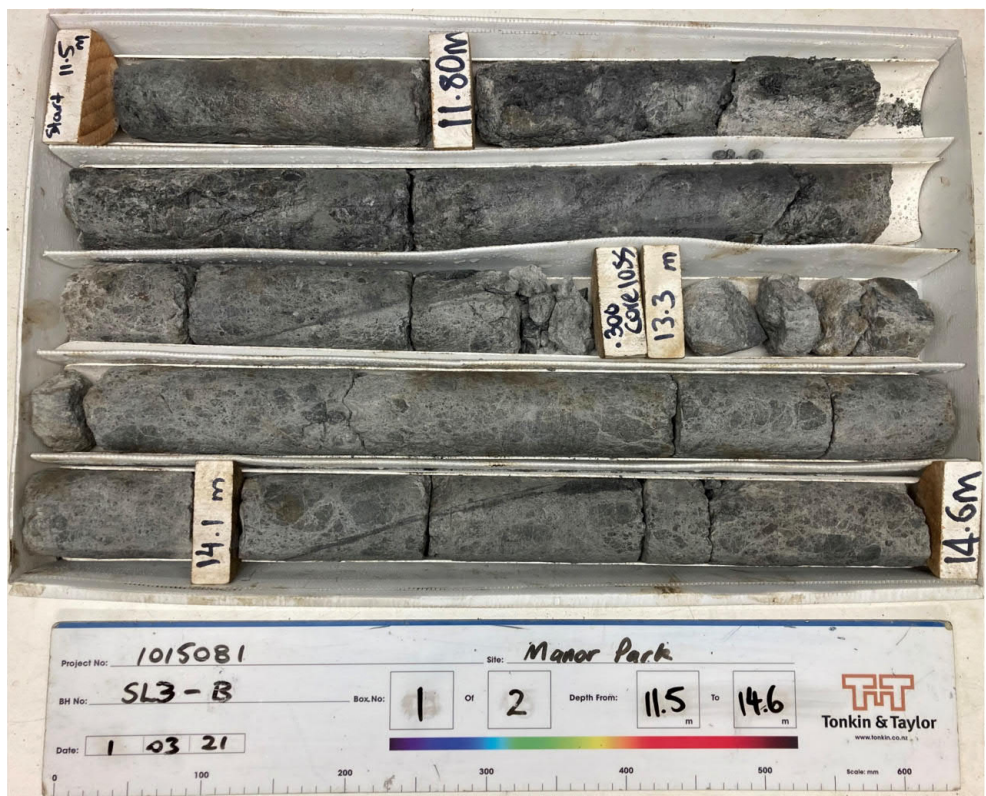
CORE PHOTOS

BOREHOLE No.: **SL3-B**

Hole Location: At far western corner of the northernmost vacant industrial lot.

SHEET: 1 OF 1

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441422.77 mN (NZTM2000) 1765347.82 mE	DRILL TYPE: Tractor-Mounted Rig	HOLE STARTED: 01/03/2021
R.L.:	32.20m	DRILL METHOD: RC	HOLE FINISHED: 02/03/2021
DATUM:	NZVD2016	LOGGED BY: TH	CHECKED: NCP



11.50-14.60m



14.60-14.80m

BOREHOLE LOG

BOREHOLE No.:
SL3-C

SHEET: 3 OF 5

DRILLED BY: Cody Longstaff
LOGGED BY: DAHE
CHECKED: NCP
START DATE: 12/03/2021
FINISH DATE: 23/03/2021
CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development
JOB No.: 1015081.0000
LOCATION: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

CO-ORDINATES: 5441414.59 mN
(NZTM2000) 1765355.11 mE

R.L. GROUND: 32.30m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station/Surveyed

DIRECTION: 310°
ANGLE FROM HORIZ.: -45°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering		Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation		UW	MS								Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Rakala Terrane	20.20 - 20.50m: Colour changes to dark grey. Matrix composed of dark grey clay.					PQ3	100		18					0						
	20.50 - 21.10m: Material becomes weak. Partially recovered as fine to coarse sand and fine to coarse gravel; dark grey.					PQ3	100		21					0						
	22.05 - 22.25m: Dark grey. Cataclasite with dark grey matrix. Weak. Abrupt transition.					PQ3	100		22					0						
						PQ3	100		23					0						
						PQ3	100		24					0						
	25.00 - 25.20m: Partially recovered as fine to coarse, angular gravel and sand.					PQ3	100		25					0						
	25.30 - 25.45m: Rock is recovered as fine to coarse, angular gravel and sand.					PQ3	80		26					0						
	25.45 - 25.90m: Colour darkens to dark grey.					PQ3	100		27					0						
	25.60 - 25.62m: Pale grey band of cataclasite at 45°. Band is estimated to be subvertical when in-situ.					PQ3	77		28					0						
	25.90 - 25.95m: Recovered as fine to coarse, angular gravel.					PQ3	100		29					0						
Rakala Terrane	25.95m: Unweathered to slightly weathered, pale grey MUDSTONE and SILTSTONE. Moderately strong, extremely closely spaced joints. Sheared rock. Discontinuities are filled with pale grey quartz.					PQ3	100		26					0						
	26.55 - 26.65m: Recovered as fine to coarse, angular gravel.					PQ3	100		27					0						
	26.80 - 26.85m: Recovered as fine to coarse, angular gravel.					PQ3	100		28					0						
	27.00m: Unweathered to slightly weathered, grey CATACLASITE. Weak. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay. Partially recovered as fine to coarse, angular gravel from 27.0 to 27.15 m.					PQ3	77		29					0						
	27.15 - 27.25m: Recovered as fine to coarse, angular gravel.					PQ3	100		30					0						
	27.45 - 27.50m: Recovered as fine to coarse, angular gravel.					PQ3	100		31					0						
	27.50m: Core loss.					PQ3	100		32					0						
	28.20m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay.					PQ3	100		33					0						
	28.90 - 29.10m: Dark grey band of cataclasite at approximately 60°. Dip angle in the core implies an in-situ dip angle of approximately 15° from vertical.					PQ3	100		34					0						
	29.15 - 29.25m: Sheared rock. Very closely spaced joints.					PQ3	100		35					0						

COMMENTS: 1) Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded. 2) Measurements of groundwater level on 5th and 8th March were both taken on the mornings of those days.

Hole Depth
48.5m

Scale 1:50

Rev.: C

BOREHOLE LOG

BOREHOLE No.:
SL3-C

SHEET: 4 OF 5

DRILLED BY: Cody Longstaff
LOGGED BY: DAHE
CHECKED: NCP
START DATE: 12/03/2021
FINISH DATE: 23/03/2021
CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development
JOB No.: 1015081.0000
LOCATION: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

CO-ORDINATES: 5441414.59 mN
(NZTM2000) 1765355.11 mE

DIRECTION: 310°
ANGLE FROM HORIZ.: -45°

R.L. GROUND: 32.30m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station/Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Rakala Terrane	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M36 M37 M38 M39 M40 M41 M42 M43 M44 M45 M46 M47 M48 M49 M50 M51 M52 M53 M54 M55 M56 M57 M58 M59 M60 M61 M62 M63 M64 M65 M66 M67 M68 M69 M70 M71 M72 M73 M74 M75 M76 M77 M78 M79 M80 M81 M82 M83 M84 M85 M86 M87 M88 M89 M90 M91 M92 M93 M94 M95 M96 M97 M98 M99 M100	US S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25 S26 S27 S28 S29 S30 S31 S32 S33 S34 S35 S36 S37 S38 S39 S40 S41 S42 S43 S44 S45 S46 S47 S48 S49 S50 S51 S52 S53 S54 S55 S56 S57 S58 S59 S60 S61 S62 S63 S64 S65 S66 S67 S68 S69 S70 S71 S72 S73 S74 S75 S76 S77 S78 S79 S80 S81 S82 S83 S84 S85 S86 S87 S88 S89 S90 S91 S92 S93 S94 S95 S96 S97 S98 S99 S100	PQ3	100		11											
				PQ3	100		31					0						
				PQ3	100		10					0						
				PQ3	100		32					0						
				PQ3	100		9					0						
	33.25 - 33.45m: Large, dark grey, argillitic band. Weak. 60° relative to core. Dip angle in core suggests an in-situ angle of approximately 15° from vertical.			PQ3	100		33					0						
				PQ3	100		34					0						
	34.95m: Unweathered to slightly weathered, dark grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of dark grey clay.			PQ3	100		35					0						
	35.45m: Unweathered to slightly weathered, pale grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay.			PQ3	93		36					0						
	36.00 - 36.60m: Colour becomes dark grey. Clay infill is dark grey.						37					0						
				PQ3	100		38					0						
	38.51m: Core loss.			PQ3	44		5					0						
	38.90m: Unweathered to slightly weathered, pale grey CATACLASITE. Weak to moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay.			PQ3	75		39					0						
	39.05m: 39.05 to 39.3 m: Core loss.			PQ3	100							0						
	39.30m: Unweathered to slightly weathered, pale grey CATACLASITE. Description same as described at 38.9 m.			PQ3	100							0						

COMMENTS: 1) Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded. 2) Measurements of groundwater level on 5th and 8th March were both taken on the mornings of those days.

Hole Depth
48.5m

Scale 1:50

Rev.: C

BOREHOLE LOG

BOREHOLE No.:

SL3-C

SHEET: 5 OF 5

DRILLED BY: Cody Longstaff

LOGGED BY: DAHE

CHECKED: NCP

START DATE: 12/03/2021

FINISH DATE: 23/03/2021

CONTRACTOR: Webster Drilling

PROJECT: Manor Park Development

JOB No.: 1015081.0000

LOCATION: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

CO-ORDINATES: 5441414.59 mN
(NZTM2000) 1765355.11 mE

DIRECTION: 310°

ANGLE FROM HORIZ.: -45°

R.L. GROUND: 32.30m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station/Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log relative to inclination	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Rakaiia Terrane	39.95 - 41.10m: Recovered as fine to coarse, angular gravel and sand.			PQ3	100		4					0						
	40.10 - 40.20m: Recovered as fine to coarse, angular gravel and sand.			PQ3	100		41					0						
	41.10 - 41.38m: Cataclasite is smeared with CLAY; pale grey. Very soft, saturated.			PQ3	100		42					0						
				PQ3	100		43					0						
				PQ3	100		44					0						
	44.30 - 44.40m: Recovered as fine to coarse, angular gravel.			PQ3	100		45					0						
				PQ3	100		46					0						
	46.10m: Core loss.			PQ3	0		47					0						
	46.65m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay.			PQ3	100		48					0						
	47.00 - 47.15m: Recovered as fine to coarse, angular gravel and sand.			PQ3	0		49					0						
	47.15m: Core loss.																	
	47.80m: Unweathered to slightly weathered, grey CATACLASITE. Moderately strong. Comprises fine to coarse, angular sandstone, siltstone and mudstone gravel within a matrix of pale grey clay.			PQ3	100													
	48.05m: Unweathered to slightly weathered, pale grey MUDSTONE and SILTSTONE. Moderately strong, extremely closely spaced joints. Sheared rock. Discontinuities are filled with pale grey quartz.																	
	48.45 - 48.50m: Recovered as fine to coarse, angular gravel.																	
	48.5m: END OF BOREHOLE																	

COMMENTS: 1) Due to the significant crushing and shearing throughout the length of the core, no specific defect data has been recorded. 2) Measurements of groundwater level on 5th and 8th March were both taken on the mornings of those days.

Hole Depth
48.5m

Scale 1:50

Rev.: C

CORE PHOTOS

BOREHOLE No.: **SL3-C**

Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 1 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441414.59 mN (NZTM2000) 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



14.80-17.00m



17.00-19.29m

CORE PHOTOS

BOREHOLE No.: **SL3-C**

Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 2 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441414.59 mN (NZTM2000) 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



19.29-21.70m



21.70-23.67m

CORE PHOTOS

BOREHOLE No.: **SL3-C**

Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 3 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES: (NZTM2000)	5441414.59 mN 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



23.67-25.88m



25.88-28.60m

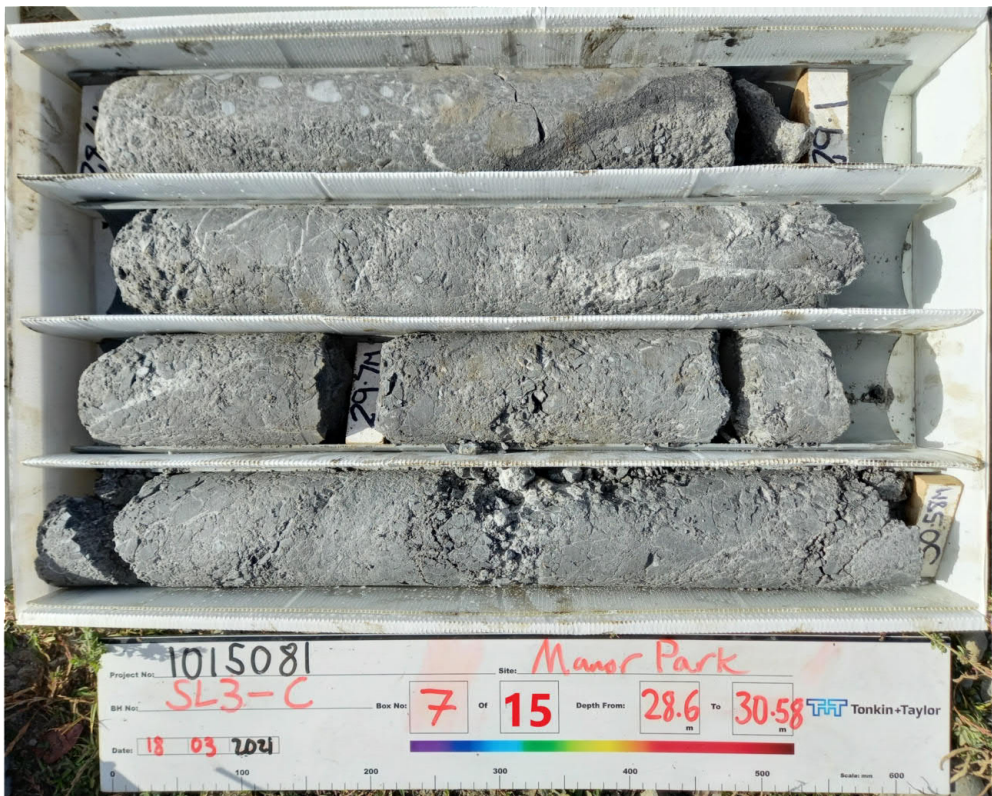
CORE PHOTOS

BOREHOLE No.: **SL3-C**

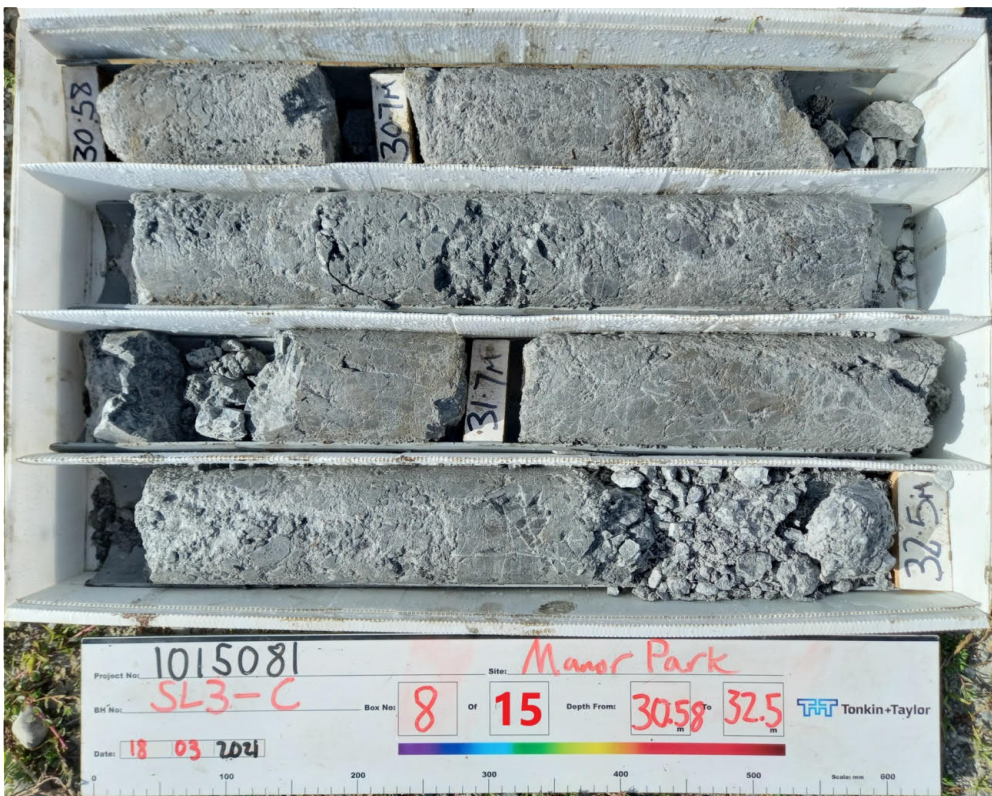
Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 4 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441414.59 mN (NZTM2000) 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



28.60-30.58m



30.58-32.50m

CORE PHOTOS

BOREHOLE No.: **SL3-C**

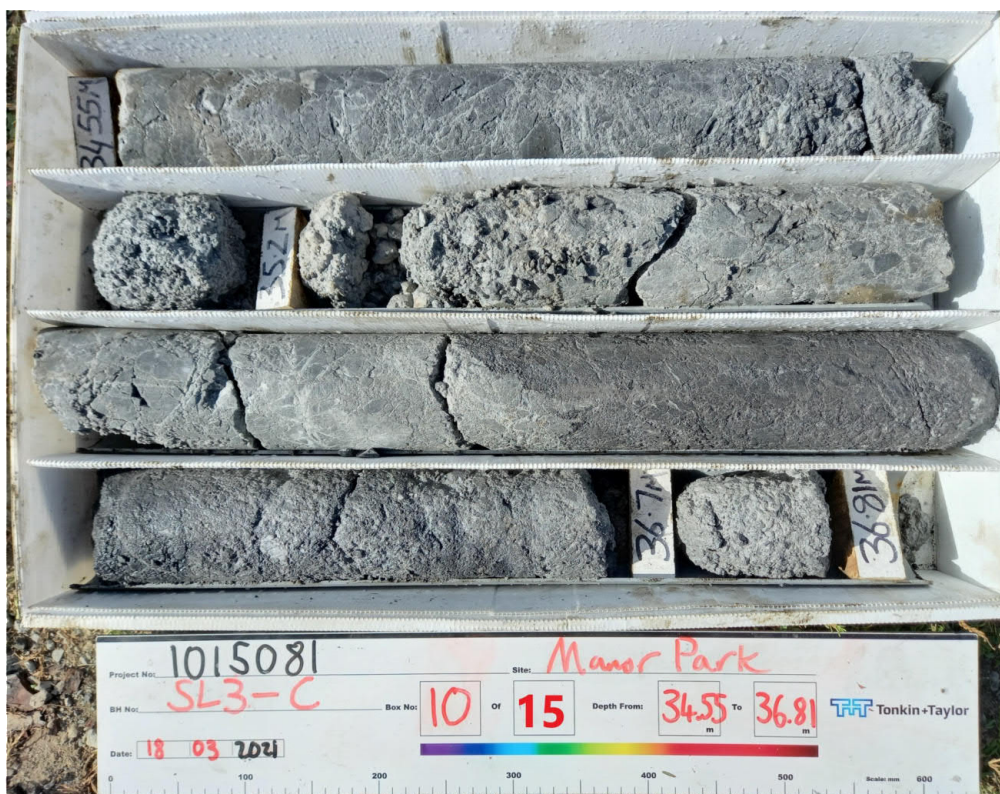
Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 5 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES: (NZTM2000)	5441414.59 mN 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



32.50-34.55m



34.55-36.81m

CORE PHOTOS

BOREHOLE No.: **SL3-C**

Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 6 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441414.59 mN (NZTM2000) 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016	LOGGED BY: DAHE	CHECKED: NCP



36.81-39.45m



39.45-41.38m

CORE PHOTOS

BOREHOLE No.: **SL3-C**

Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 7 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES:	5441414.59 mN (NZTM2000) 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE
			CHECKED: NCP



41.38-43.35m



43.35-45.72m

CORE PHOTOS

BOREHOLE No.: **SL3-C**

Hole Location: At far western corner of the northernmost vacant industrial lot. In line with SL3-A and SL3-B

SHEET: 8 OF 8

PROJECT: Manor Park Development		LOCATION:	JOB No.: 1015081.0000
CO-ORDINATES: (NZTM2000)	5441414.59 mN 1765355.11 mE	DRILL TYPE: Atlas Drill Rig	HOLE STARTED: 12/03/2021
R.L.:	32.30m	DRILL METHOD: RC	HOLE FINISHED: 23/03/2021
DATUM:	NZVD2016		DRILLED BY: Webster Drilling
			LOGGED BY: DAHE CHECKED: NCP



45.72-48.50m

Appendix C: Supporting documentation

- **A J Sutherland Consulting. Manor Park seismic refraction survey, January 2021**

Manor Park Seismic Refraction Survey

January 2021

A J Sutherland Consulting Ltd

Prepared for Tonkin and Taylor

Prepared by Alan Sutherland

Contents

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1 Introduction

This report describes the test procedures and results of a seismic refraction survey, comprising three lines, at Manor Park. The site is accessed from Benmore Crescent.

The site work for these lines was completed between 10 November and 16 December 2020.

2 Seismic Refraction Surveying Procedures

The seismic refraction survey was carried out using small explosive charges (shots) placed in augered holes. The compression wave arrival times, for each shot, were measured on a spread of up to 24 geophones at a time, connected to cables laid along the ground. The lines were marked out by tape measure and pegged or marked on the ground. The end points of the lines were surveyed later. The survey data is shown in Appendix C.

Shots were placed at regular intervals along the line and offset from the end of each spread. A total of up to 6 shots were fired for each spread of 24 geophones.

Data were recorded on a 24 channel Geometrics Geode digital seismograph which was attached to the shot firing equipment. Shot firing was controlled by the geophysicist operating the seismograph after receiving an “all clear” from the geophysicist placing the charges. The explosive used in this survey was Senatel MagnumTM emulsion explosive, initiated with instantaneous electric detonators.

3 Data Processing and Interpretation

The first stage of the data processing, involving measurement of the p-wave arrival times for each shot was carried out using LabView™ routines. Subsequent processing was carried out interactively using spreadsheet calculations, rather than by relying on semi-automatic processing software.

Seismic velocities and depths to shallow layers were determined using the Plus-Minus method, which is essentially the same as the GRM method for shallow refractors. The program GRAPHER™ was used plot the depth and velocity data and to measure the seismic velocities from the gradients of linear fits applied to appropriate segments of the data.

The calculations used to produce the profiles are based on some assumptions. For example, both velocity and depth calculations assume that seismic waves travel along the survey line in two dimensions (longitudinal and vertical). If there are major lateral variations in the refractor depth, then this assumption may be inaccurate and the calculated “depth” may in fact be a slope distance to a point on the refractor surface to the side of the seismic line.

The interpretation also assumes that layers will increase in velocity with depth. Any layer with a velocity lower than the layer above will not be detected and will lead to an error in the depth calculation.

Velocities calculated are the velocity at the top of a particular layer and these velocities may increase slightly within the layer.

Intercepts and delay times from either direction were also used to determine depths to rock to supplement the depths calculated by the Plus-Minus method. This was generally used where there was insufficient overlap to use the Plus-Minus method for all geophone positions.

Low velocity zones were identified on the minus times plot, where shots from opposite ends of the line are subtracted from each other. This is normally used to determine the velocity of the rock, but will also indicate low velocity zones within the rock.

In addition, the signal amplitude of the signal was looked at to determine whether there was an increase in the attenuation, coinciding with the low velocity zone. This was useful for lines SL2 and SL3, but on SL1 the location of the low velocity zone coincided with the edge of a concrete slab at the surface which influenced the signal amplitude.

4 Survey Results

Cross sections of each seismic line are attached in Appendix A and time distance plots are shown in Appendix B. The cross sections show:

- the estimated ground surface profile along each line,
- seismic compression wave (p-wave) velocity and thickness of the various surface layers and
- the compression wave velocity of the rock layer.

All velocities referred to are compression wave velocities measured in metres per second (m/s).

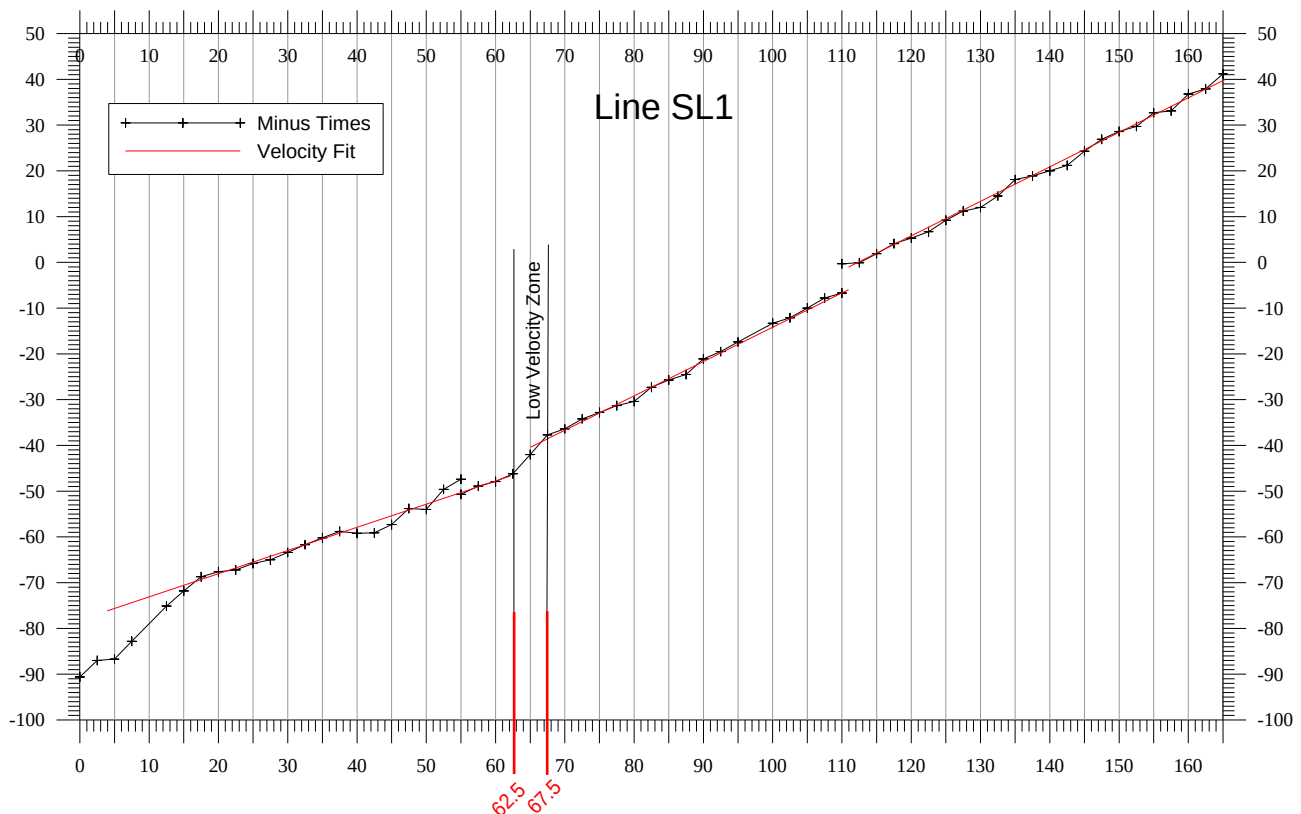
The following is a brief description of any features found on each of the seismic lines. The purpose of the survey was to locate low velocity zones and/or steps associated with the Wellington Fault.

4.1 Seismic Line 1

This line ran along an access track, starting on the grass slope up to SH2, at the end of Benmore Crescent. The total length of the line is 165 metres. The geophone spacing was 2.5m.

A surface layer of 300m/s is present along all of the line and an intermediate layer of 900m/s is also present. The rock layer has a velocity of 2750m/s along the eastern end of the line and 3900m/s at the western end of the line.

The plot below shows the times for the end shots at peg zero subtracted from the times for the offset shot at the far end of the line. The slope of the line is related to the velocity of the rock where the refraction is from the rock. A low velocity zone with a loss of 4 milliseconds was found between pegs 62.5 and 67.5m.



4.2 Seismic Line 2

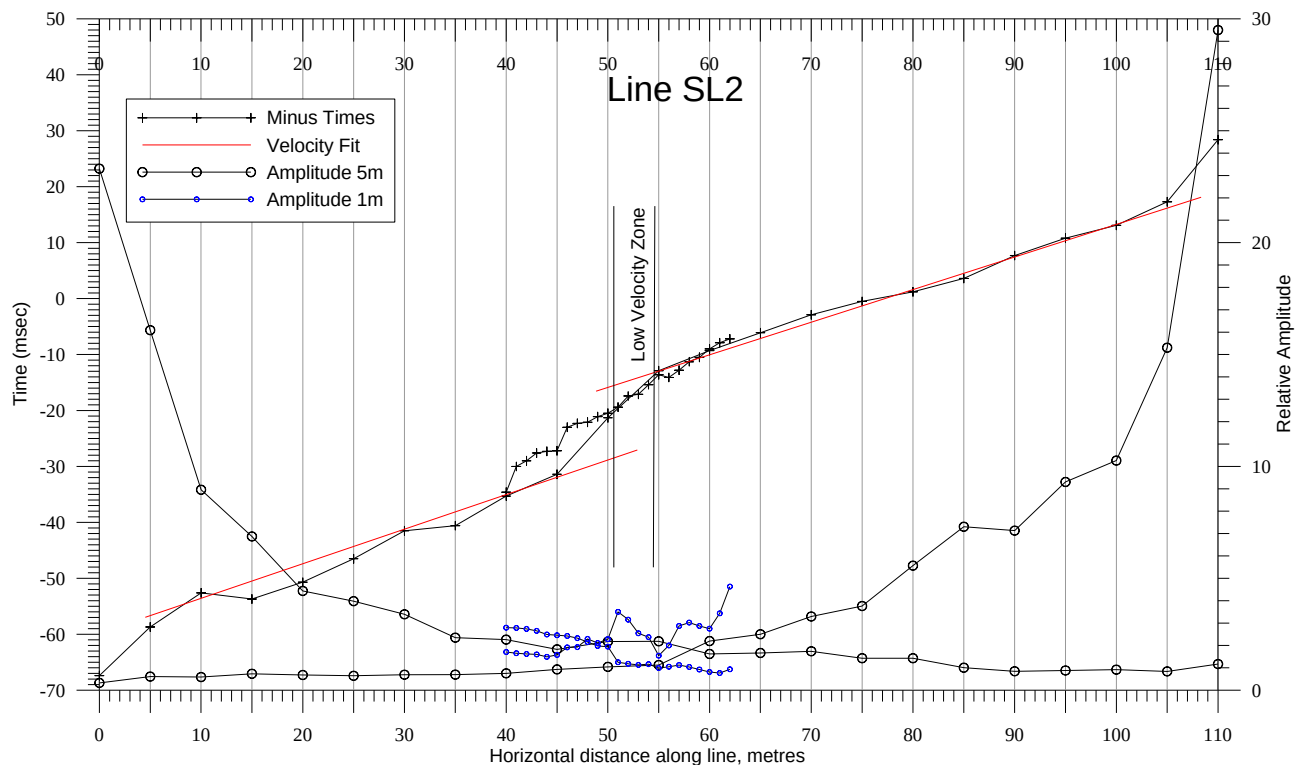
This line to the east of Benmore Crescent, beside the stream, North of SL1, then crossed the stream and ran up the slope to a flat area of fill. The total length of the line is 110 metres. The geophone spacing was 5m.

After firing 6 shots, the arrival times for the two offset shots were picked and a velocity plot of the line was made to locate the likely position of the low velocity zone. The geophones were then placed at 1m spacing over the likely zone and two more shots, at the offset positions were fired.

A surface layer of 250 to 300m/s is present along all of the line and an intermediate layer of 700 to 800m/s is also present. The rock layer has a velocity of 2900m/s along the length of the line.

The plot below shows the times for the offset shots from peg zero subtracted from the times for the offset shot at the far end of the line. The slope of the line is related to the velocity of the rock where the refraction is from the rock. A low velocity zone with a loss of 6 milliseconds was found between pegs 45 and 55m. Additionally, the maximum amplitude of the signal at each geophone, for each offset shot is shown. The signal should be attenuated as it passes through the low velocity zone. The values of amplitude will be affected by background noise superimposed on the signal so may have some scatter in the values. The 1m spaced shot from the zero end of the shows a sudden step between 50 and 51m, with a relatively even attenuation either side.

Taking into account the velocity step and the amplitude changes the most likely position of the low velocity zone is between pegs 50 to 55m.



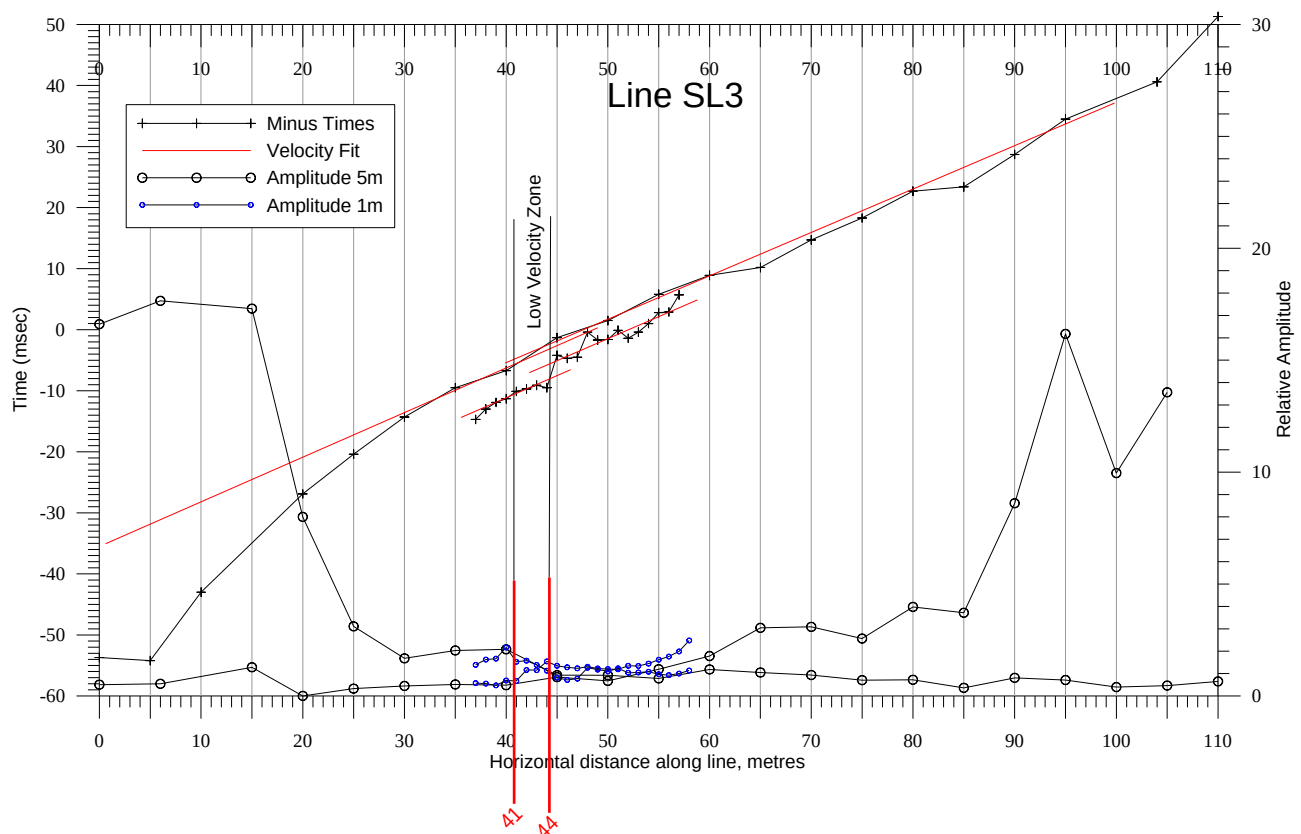
4.3 Seismic Line 3

This line to the east of Benmore Crescent, beside the stream, further North of SL2, then crossed the stream and ran up the slope to a flat area of fill. The total length of the line is 110 metres. The initial geophone spacing was 5m.

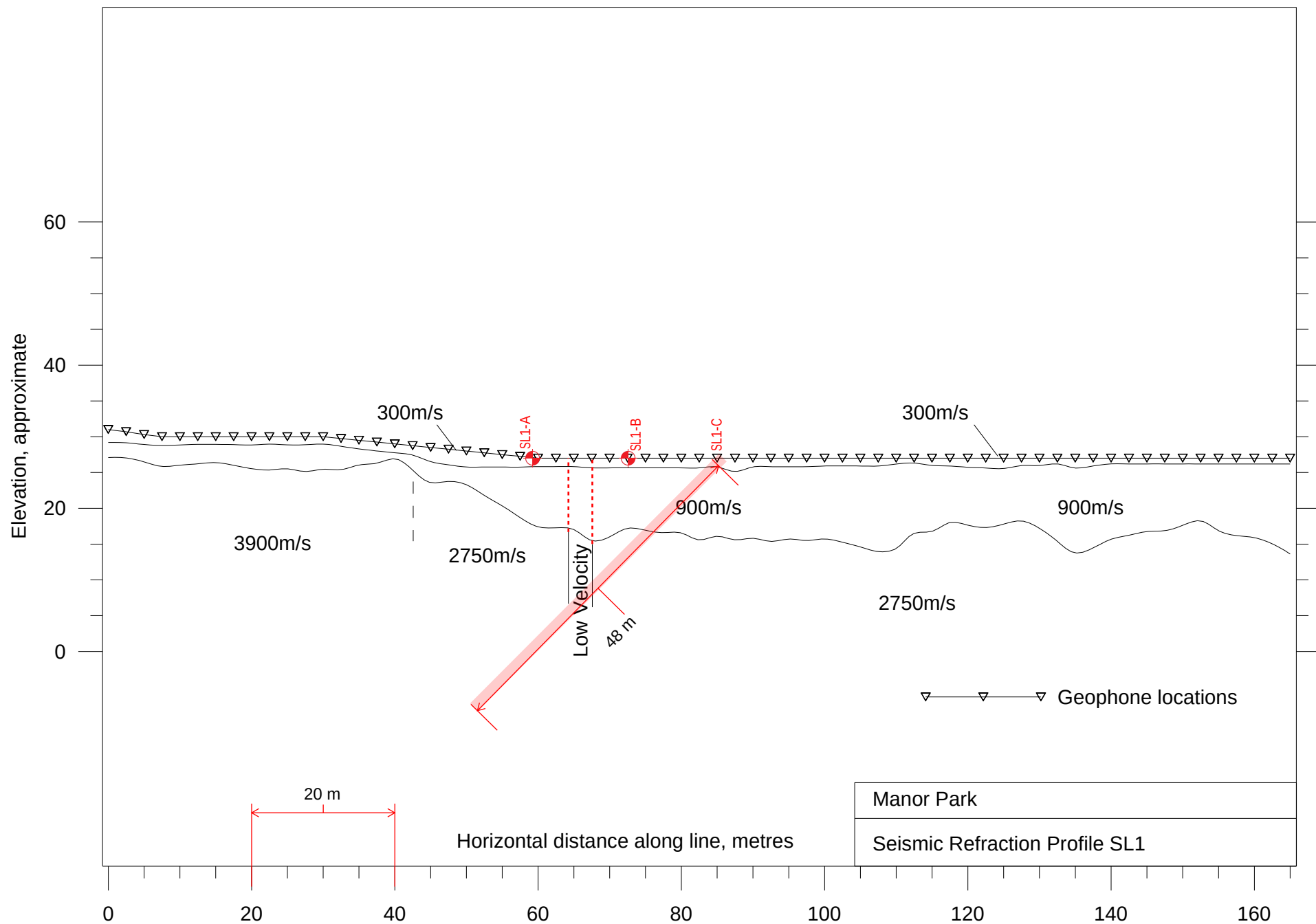
After firing 6 shots, the arrival times for the two offset shots were picked and a velocity plot of the line was made to locate the likely position of the low velocity zone. The geophones were then placed at 1m spacing over the likely zone and two more shots, at the offset positions were fired.

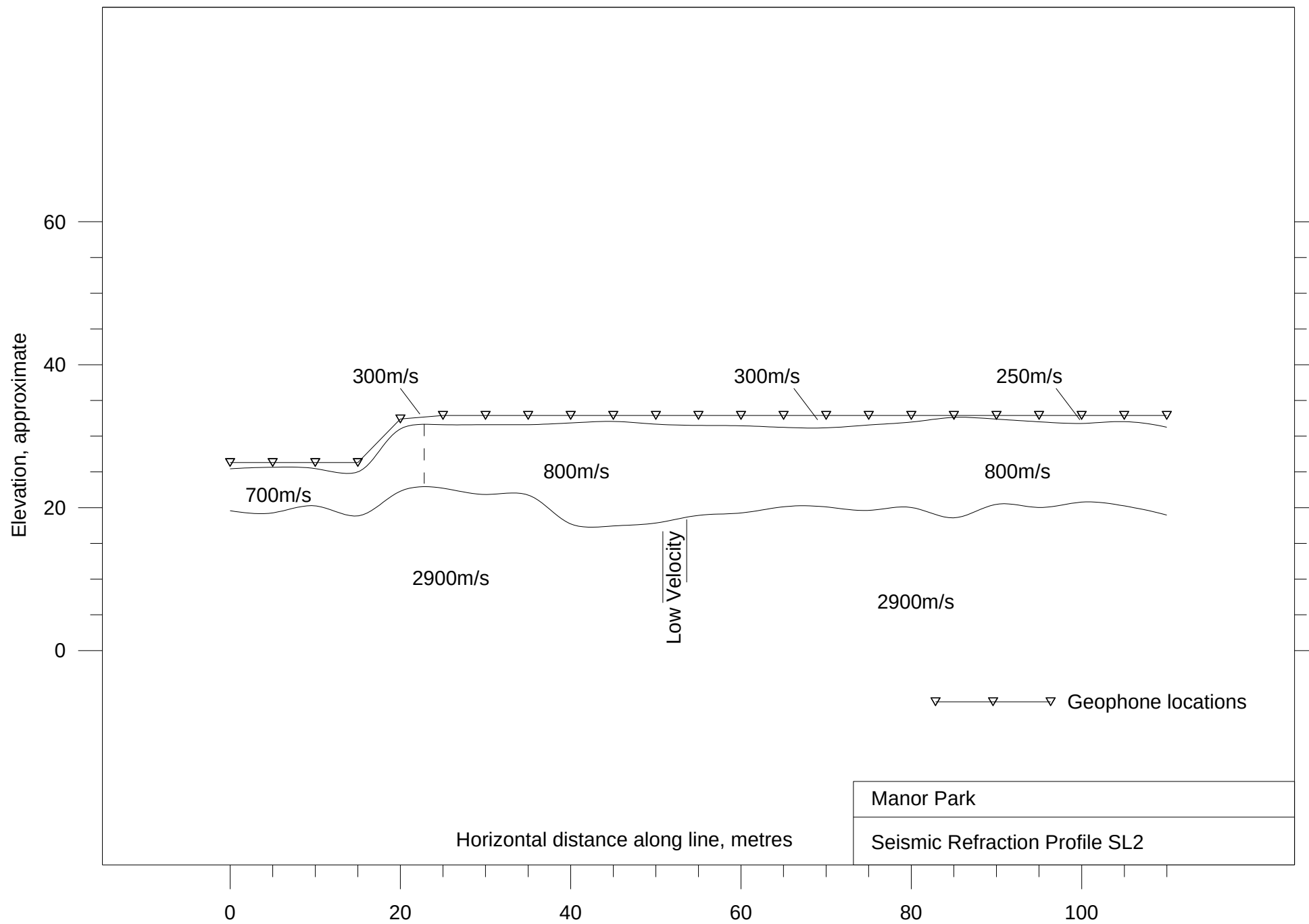
A surface layer of 300m/s is present along all of the line and an intermediate layer of 600 to 800m/s is also present. The rock layer has a velocity of 2900m/s along the length of the line.

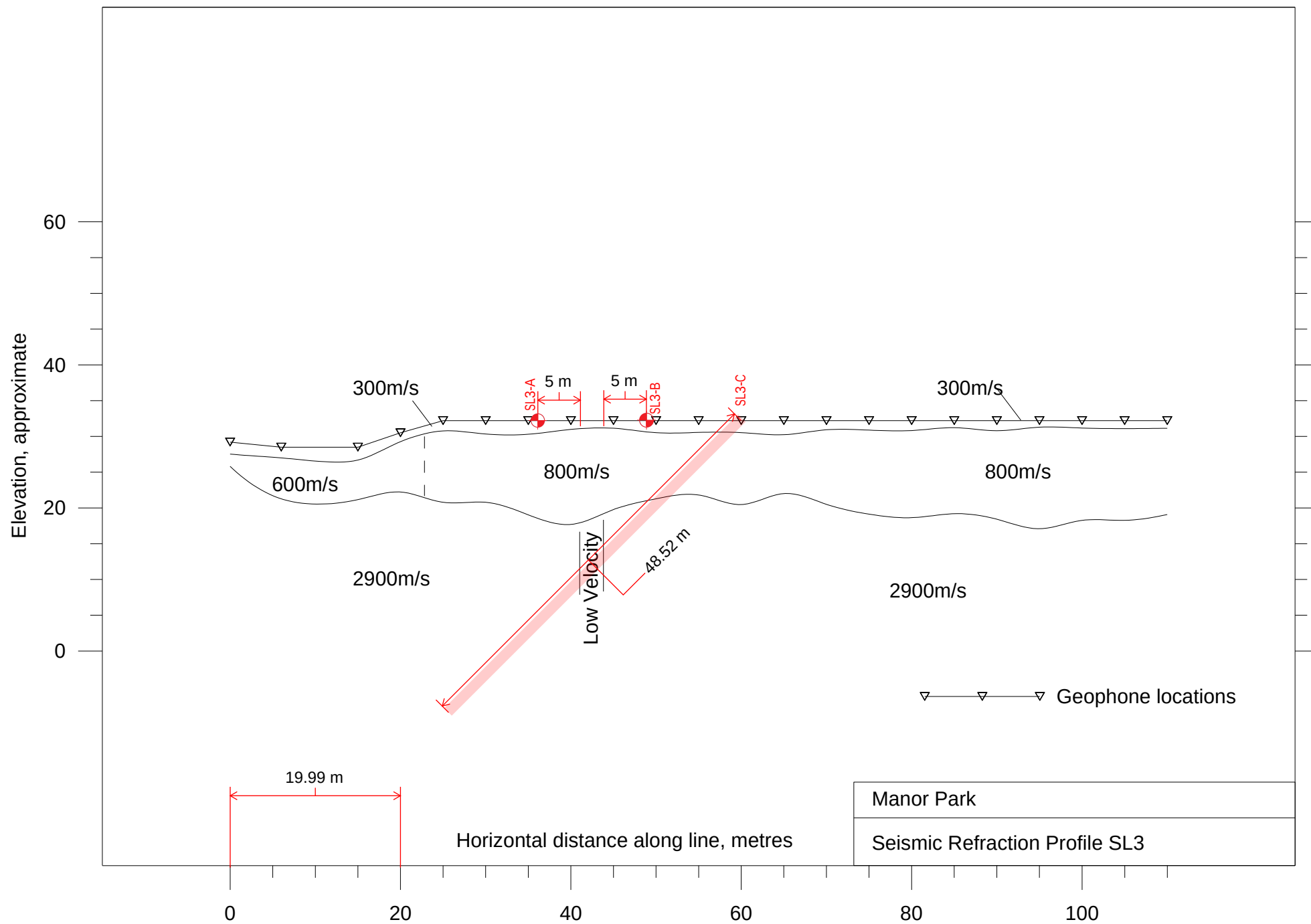
The plot below shows the times for the offset shots from peg zero subtracted from the times for the offset shot at the far end of the line. The slope of the line is related to the velocity of the rock where the refraction is from the rock. A low velocity zone with a loss less than 1 milliseconds was found between pegs 40 and 45m. Additionally the maximum amplitude of the signal at each geophone, for each offset shot is shown, as with line 2. Both of the 1m spaced shots and the 5m spaced offset from the zero end of the shows a step between 40 and 45m, which reinforces the small step seen on the velocity plot.



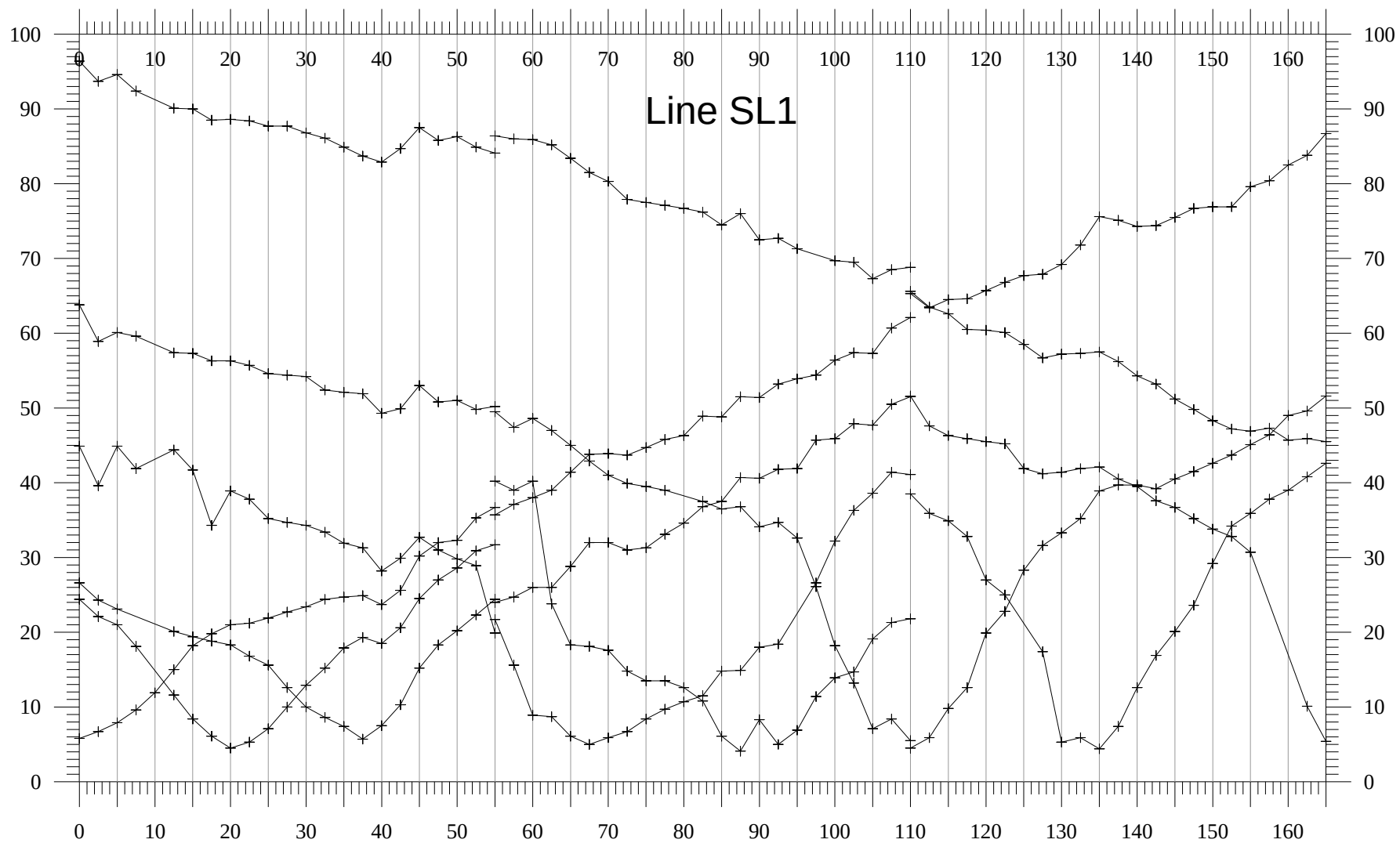
Appendix A: Seismic Refraction Cross Section

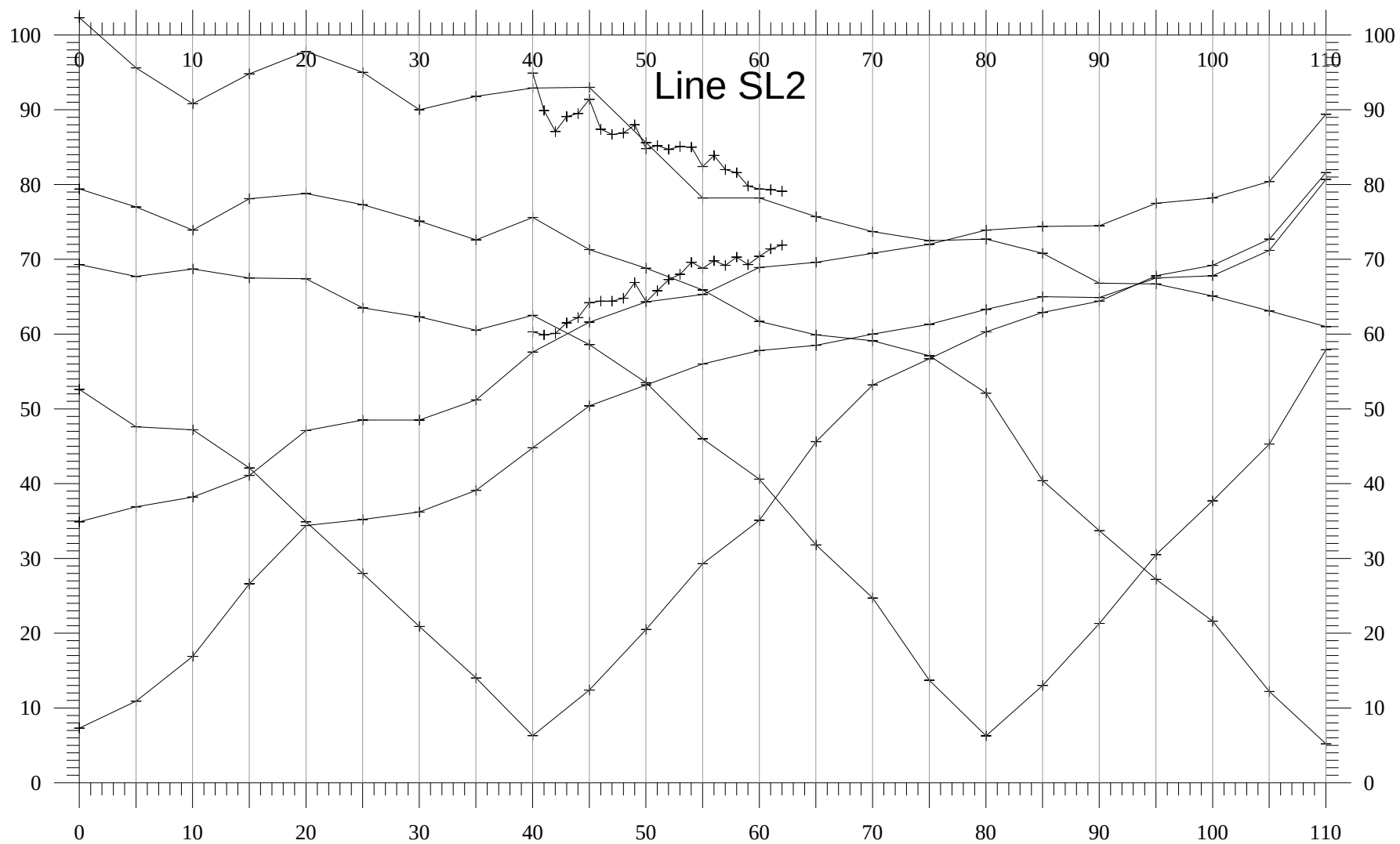


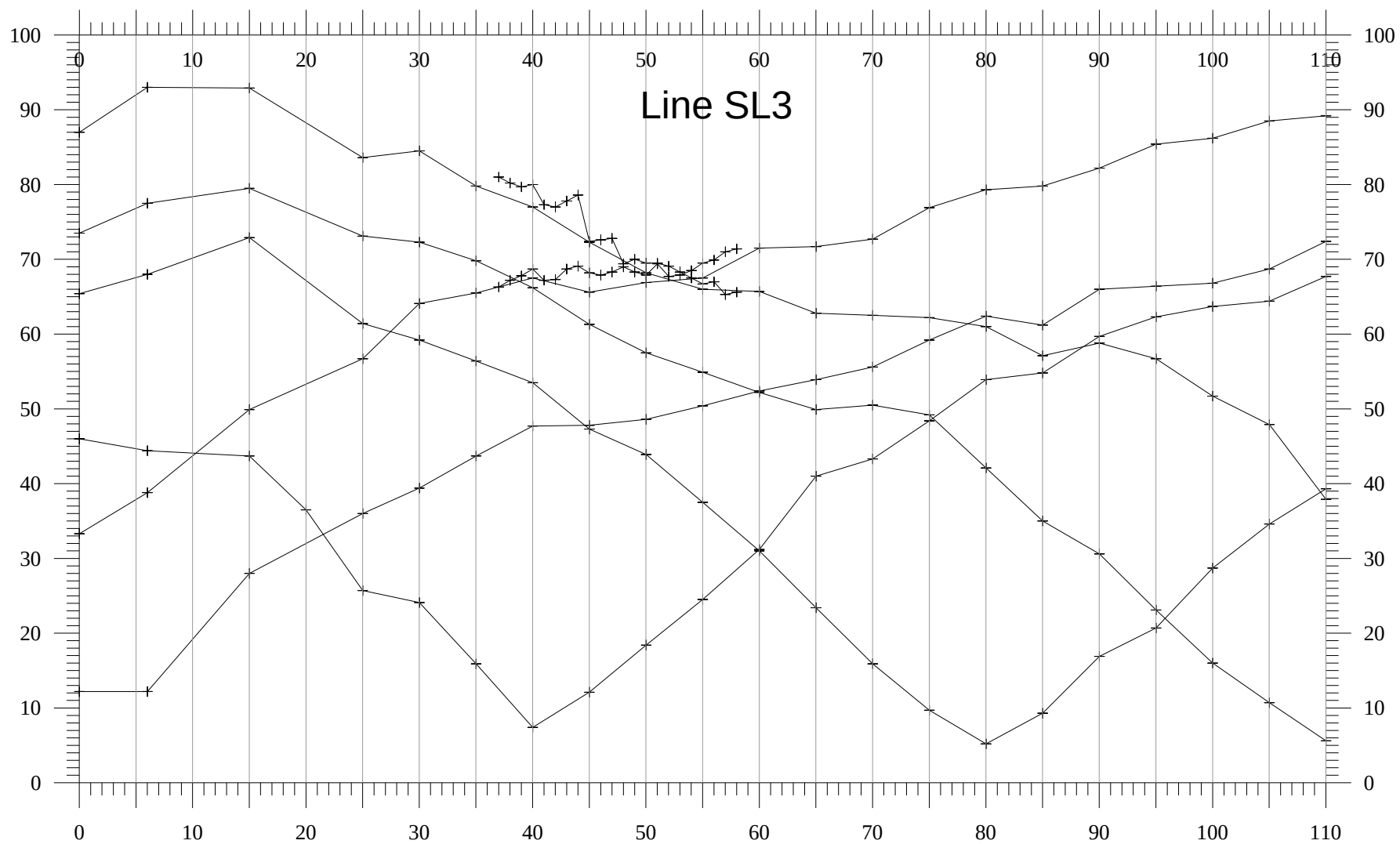




Appendix B: Time Distance Plots







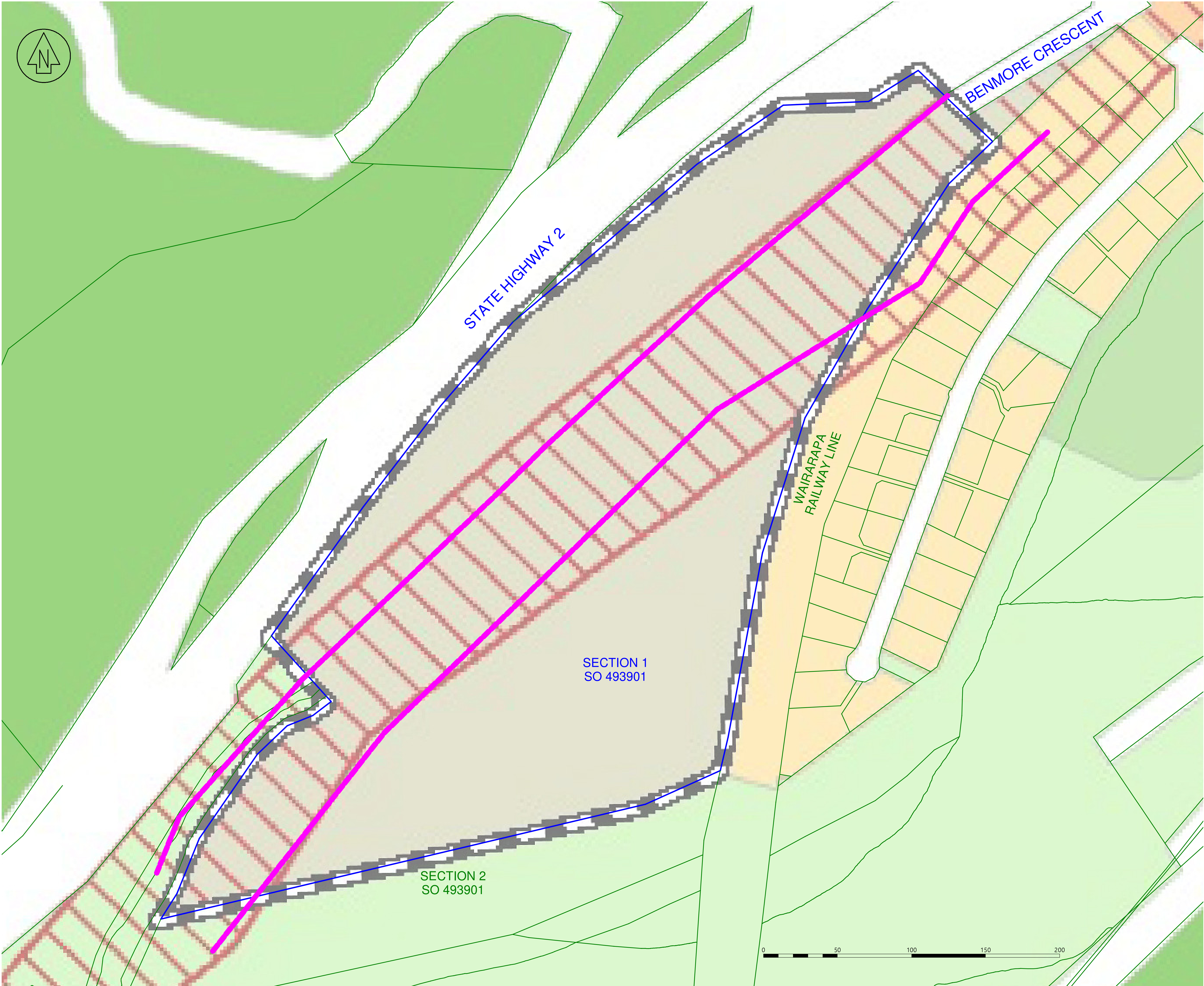
Appendix C: Survey Data

Survey data,

Peg number	Eastings	Northings	Elevation
SL1 - 0	1765067	5441260	30.602
SL1 - 165	1765183	5441143	25.743
SL2 - 0	1765208	5441372	26.296
SL2 - 110	1765279	5441289	32.909
SL3 - 0	1765316	5441460	29.189
SL3 - 110	1765387	5441375	32.187

Appendix B:

Faultline Mapping Drawing – S20-0380-FL01/A



NO	REVISION	BY	DATE
A	FIRST ISSUE		

LEGEND

 PROPOSED DISTRICT PLAN

 TONKIN & TAYLOR

SpencerHolmes
engineers - surveyors - planners

Level 10 - 57 Willis Street
PO Box 588 Wellington New Zealand
(04) 472-2261 www.spencerholmes.co.nz

CLIENT
TE KAREAREA LTD

PROJECT
**TE KAREAREA
30 BENMORE CRESCENT
MANOR PARK**

DRAWING TITLE
**FAULTLINE MAPPING
COMPARISON**

Copyright of this drawing is vested in Spencer Holmes Ltd.
The Contractor shall verify all dimensions on site.

CAUTION - The information shown on this plan has been prepared under specific instruction from the client and is intended solely for the clients use. The information is valid as at the date of survey. Spencer Holmes Limited will accept no liability for any consequence arising out of the use of this plan, or the information thereon whether in hard copy or electronic format by any other party for any purpose whatsoever.

□ S20-0380 FAULT-1A - S20-0380-FL01
□ DRAWN ADG
□ CHECKED ADG

□ DATE 3/08/2026

SCALE
1 : 1200

DRAWING NUMBER
S20-0380-FL01

AT
A1

REV
A

Appendix C:

River Edge Consulting Memo (Nov 2022)

Memorandum



To: Mark Cooney, Spencer Holmes Ltd

Cc: Alex Gifford, Tonkin + Taylor

From: Philip Wallace, River Edge Consulting

Date: 1 November 2022

Re: Benmore Crescent – Alternative culvert option

1. Introduction

In June 2022 I prepared a flood assessment report for the site and proposed Te Rangihaeata development at 30 Benmore Crescent. I subsequently carried out an assessment of a proposal for an alternative culvert arrangement and reported the findings in a memo dated 27 July.

I have now carried out a flood assessment of further refinements to the proposed layout of the developed site. The current assessment has also incorporated additional stream bed survey data collected by Spencer Holmes in September 2022, immediately downstream of the last culvert crossing within the site.

2. Modified proposal for site

2.1 Fill Platform and earthworks

The previous assessments of the proposal were based on a fill platform prepared by Tonkin + Taylor. Spencer Holmes has prepared a revised fill platform, the latest being dated 26 October 2022. That revised platform is shown in Figure 1.

The design leaves the existing stream channel untouched. A flood channel of at least 20 m width is also provided.

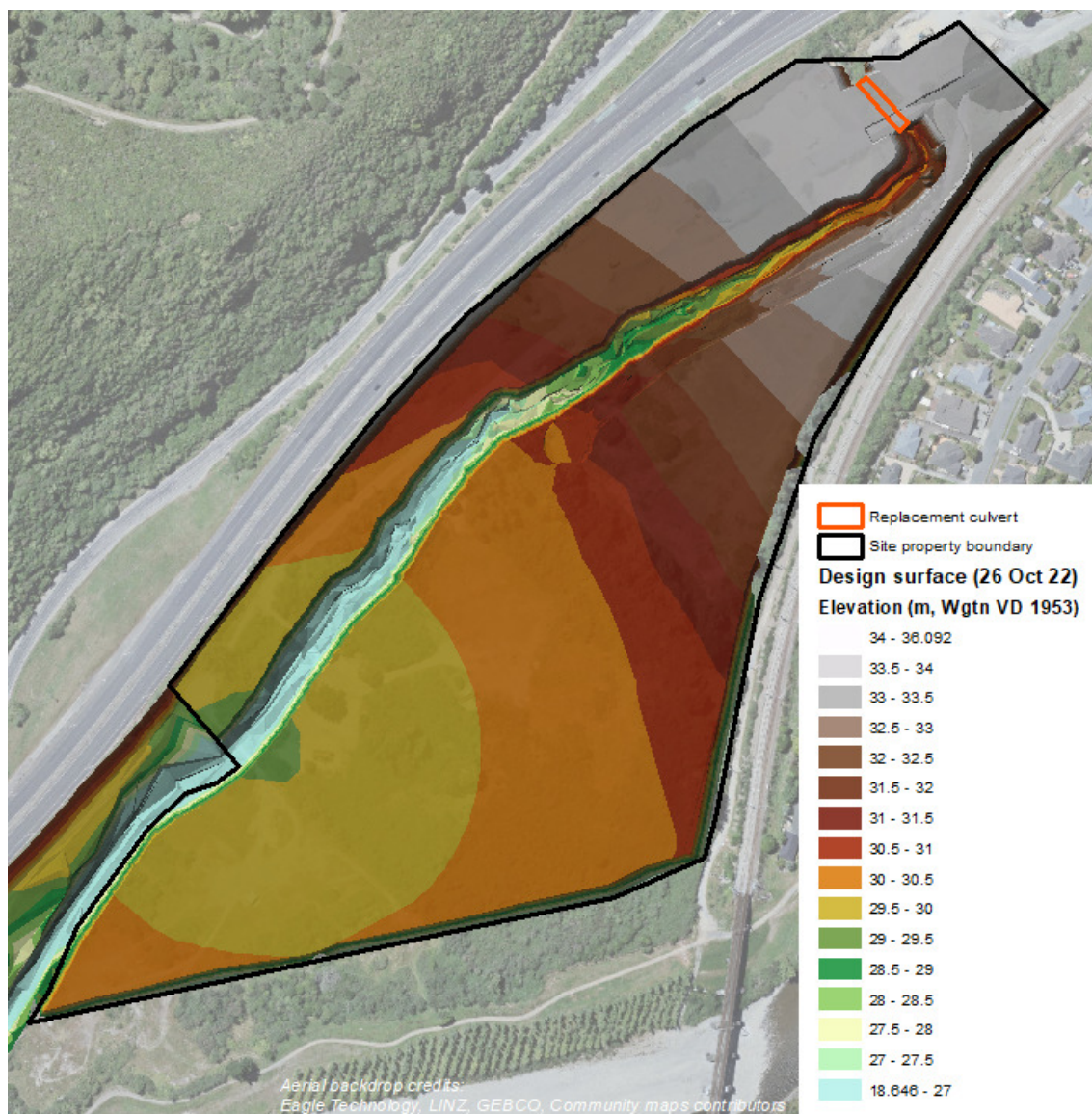


Figure 1 Design platform surface, 26 October 2022

2.2 Culverts

As with the option assessed in July, the proposal under consideration involves removal of all of the Dry Creek culverts within the site and replacement of only culvert 1. Figure 2 shows the location of the culverts.

Culvert 1 is proposed to be 35 m long (Figure 3). While the July assessment assumed culvert 1 would consist of twin 2.5 m wide x 2 m high box concrete culverts, the current assessment now assumes twin 3 m wide x 2 m high box concrete culverts. These would be embedded by around 500 mm, to provide a natural gravel bed and meet fish passage guidelines. Thus the effective height of the twin culverts would be 1.5 m.

An alternative of twin 3.5 m wide x 2 m high culverts has also been tested.

The new culvert is proposed to be laid a gradient (2.3%) reflecting the general gradient of the stream bed in the vicinity, although it is expected that stream gradient will adjust itself in light of

the much larger culvert opening proposed (compared to the existing culvert opening). Having an initial embedment of 500 mm will provide some leeway for the bed to adjust itself. Figure 4 shows the existing stream bed gradient and the culvert invert levels. The dotted red line shows the level at which the culvert invert would be laid while the solid red line, 500 mm higher, shows the bed level assumed through the culvert.

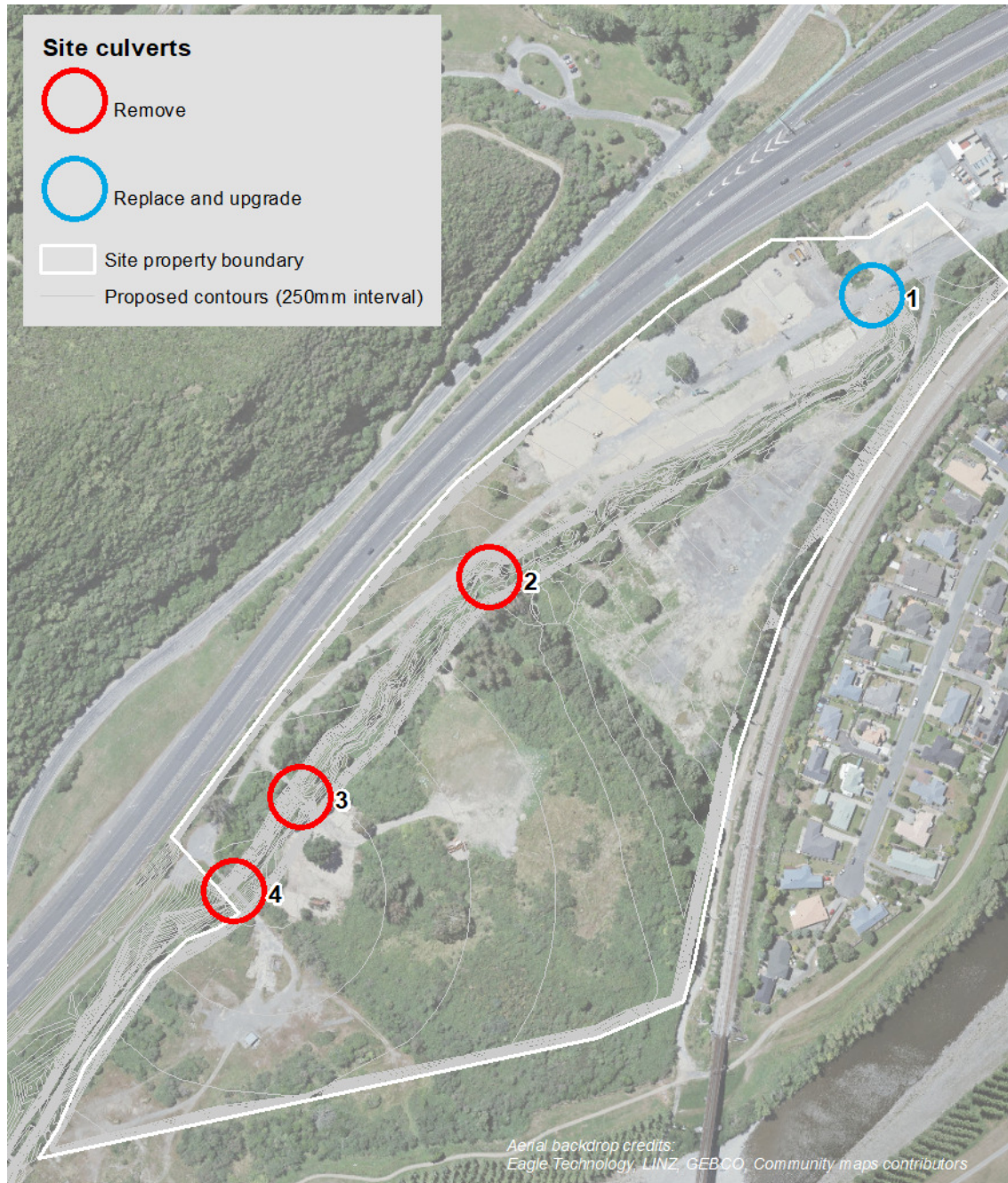


Figure 2 Culvert option, October 2022: removal and replacement

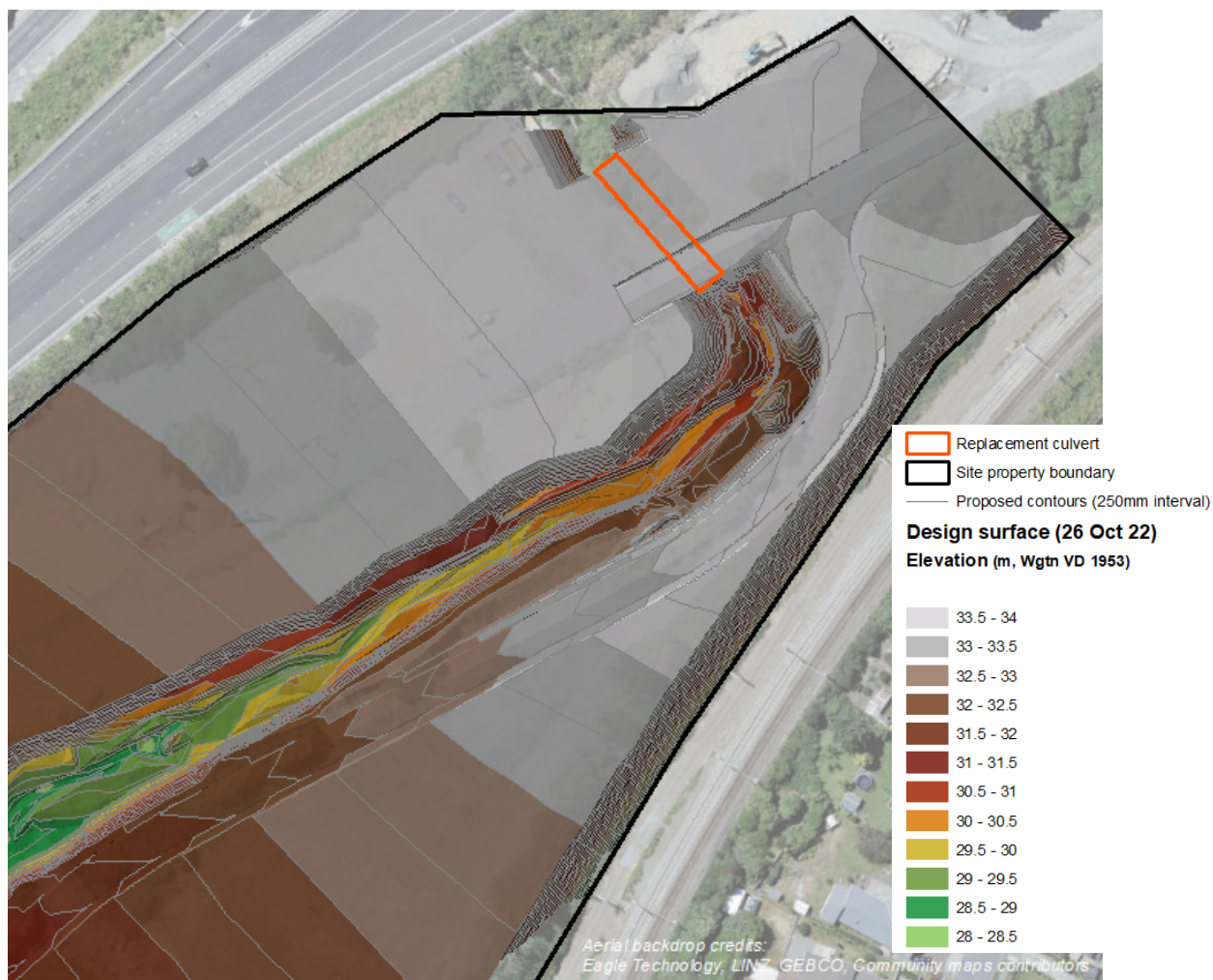


Figure 3 Alternative culvert option, October 2022: culvert 1 replacement

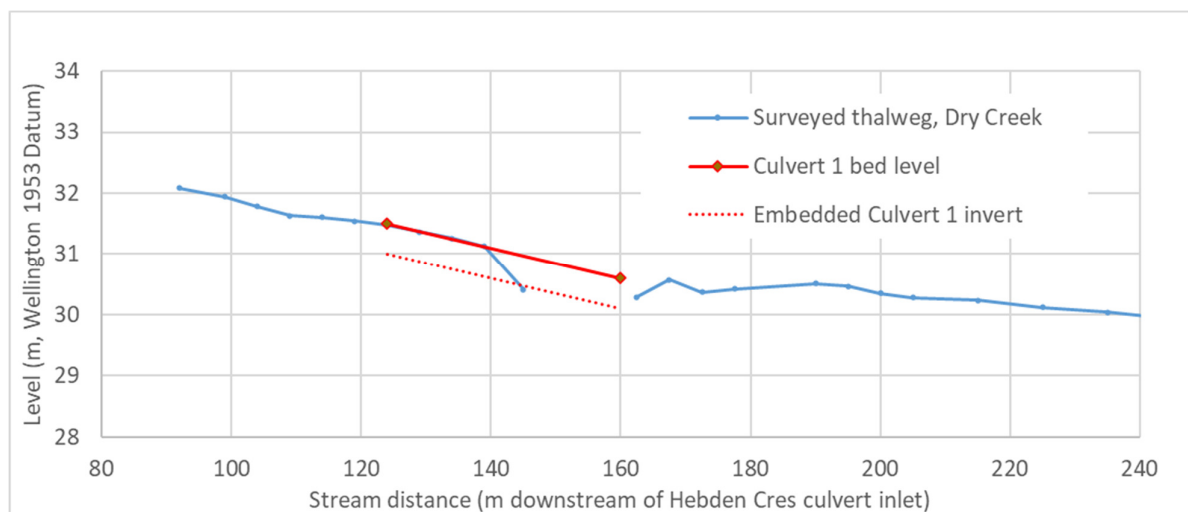


Figure 4 Alternative culvert option, October 2022: culvert 1 bed and invert levels

3. Model results

3.1 Existing situation

Flood depths for the existing situation are shown in Figure 5. Results have been reported previously, in the June 2022 report and the incorporation of the additional survey data made very little difference for the existing situation.

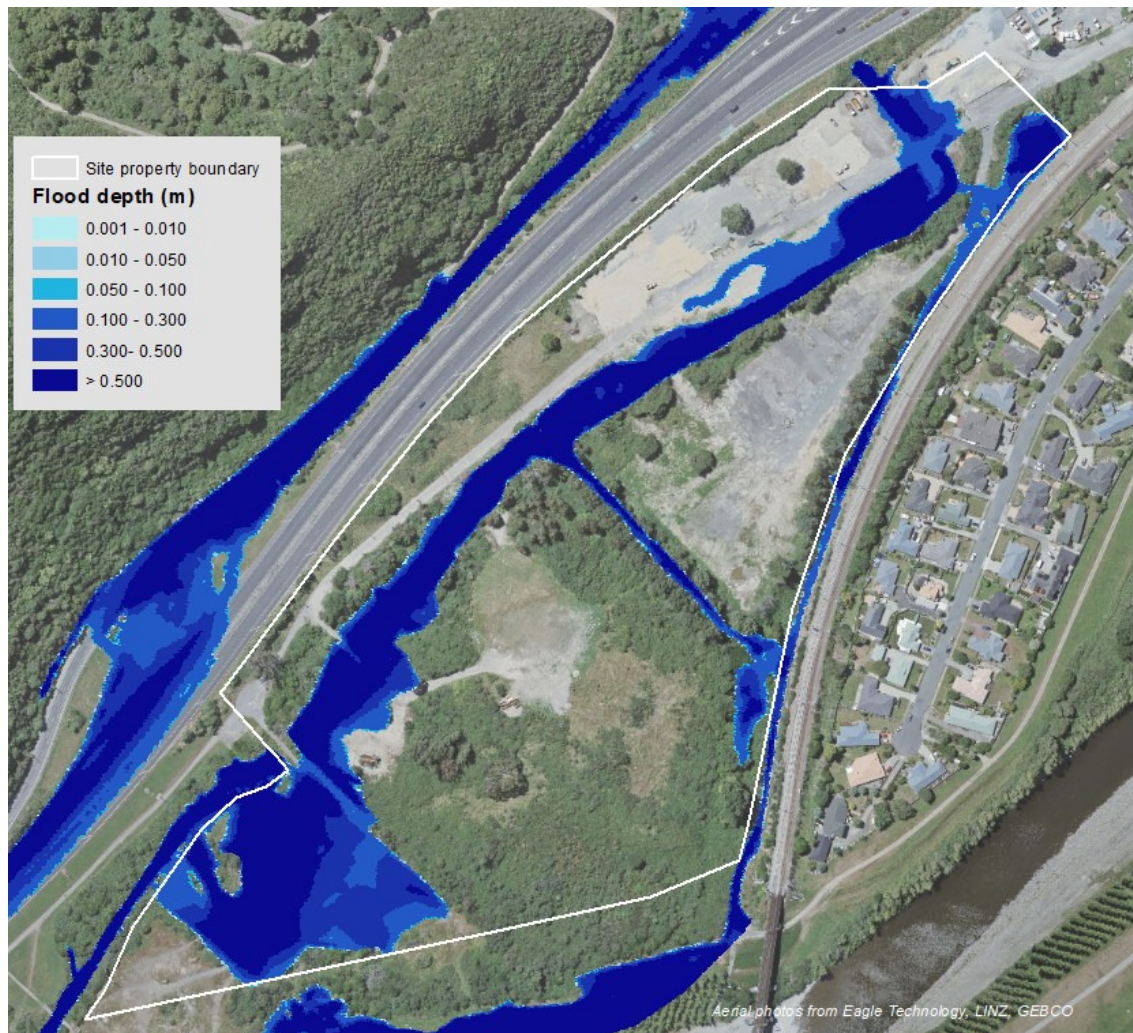


Figure 5 Predicted flood depths, existing situation

3.2 Proposed development situation - twin 3m wide replacement culverts under Benmore Ave

Flood depths for the proposed situation are shown in Figure 6. Floodwaters are contained within the wider stream corridor within the site.

Model results predict that the peak flow through culvert 1 would be 14.4 m³/s, with a velocity of 1.65 m/s.

Figure 7 shows the impact of the proposed development platform on flood levels. Increases of less than 300 mm are predicted in the incised stream channel downstream of where the existing culvert 4 is, which would pose no additional risk to people or assets. There is also a trivial

amount of additional flooding in the stream channel between the upstream end of the site and SH2 (Figure 8).

Otherwise, all increases in depth are contained within the site. Floodwaters are cut off along the KiwiRail access track alongside the railway, hence a small decrease in depth along the track is shown in Figure 7.

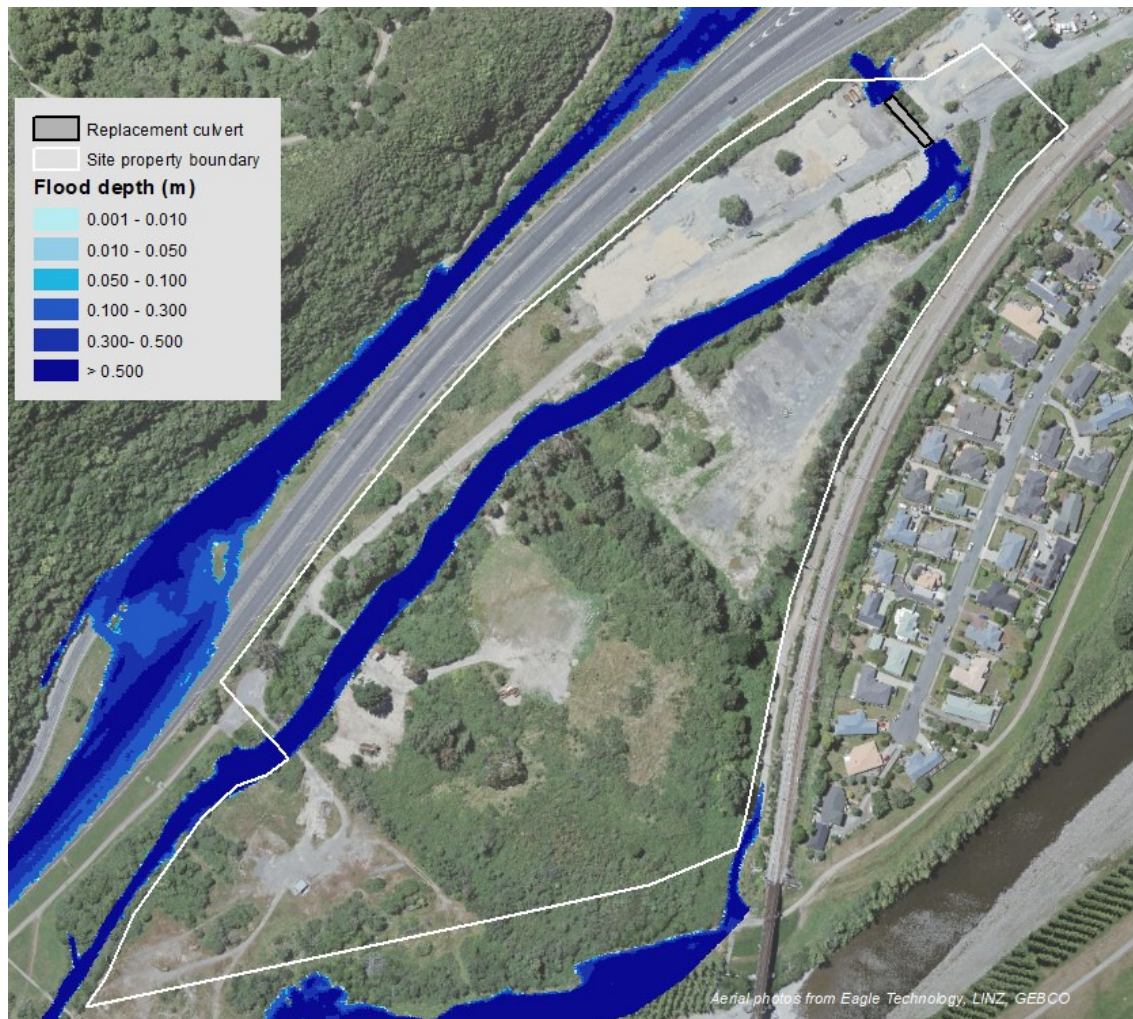


Figure 6 Predicted flood depths, developed situation

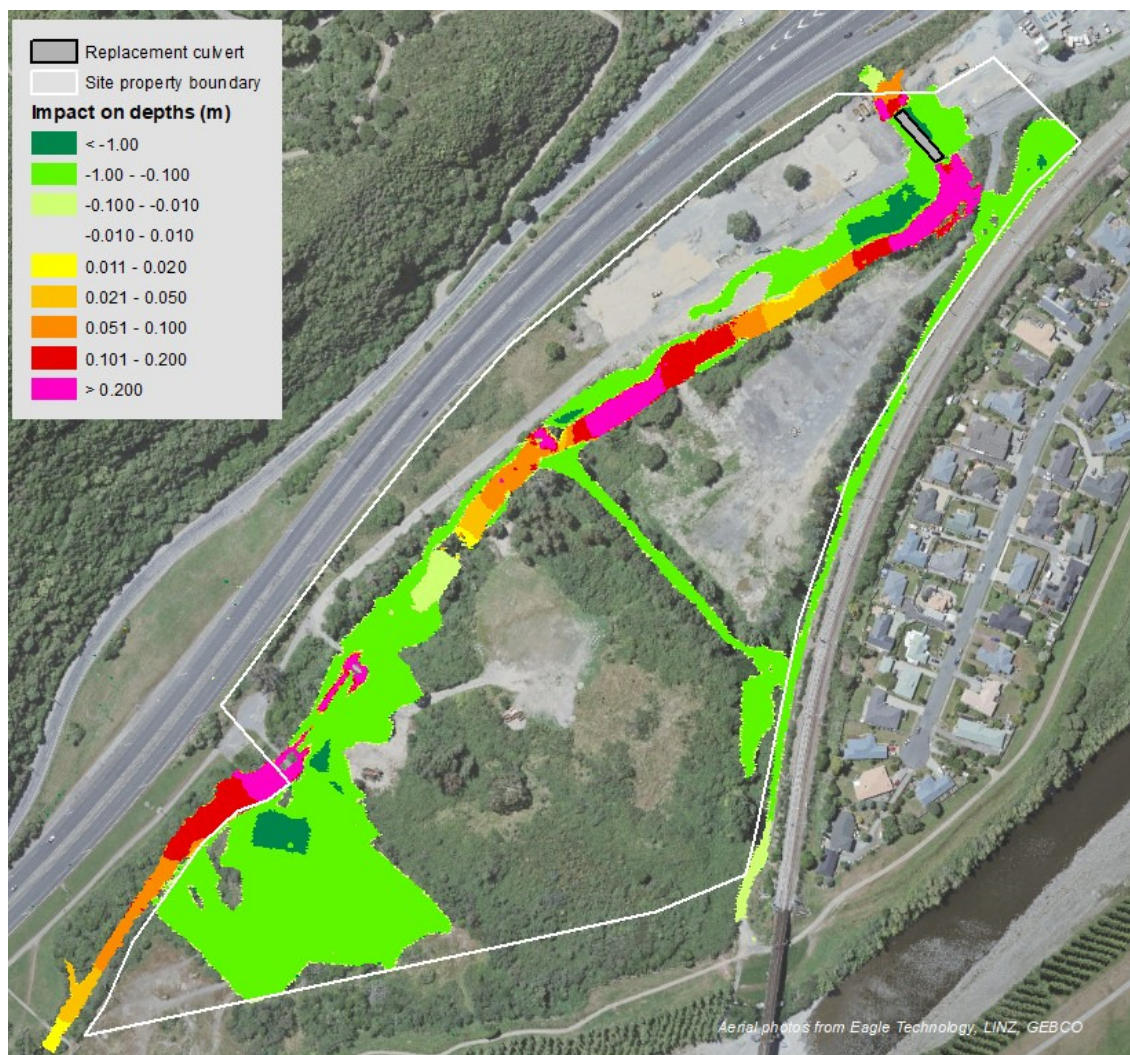


Figure 7 Impact of proposed development on peak flood depths

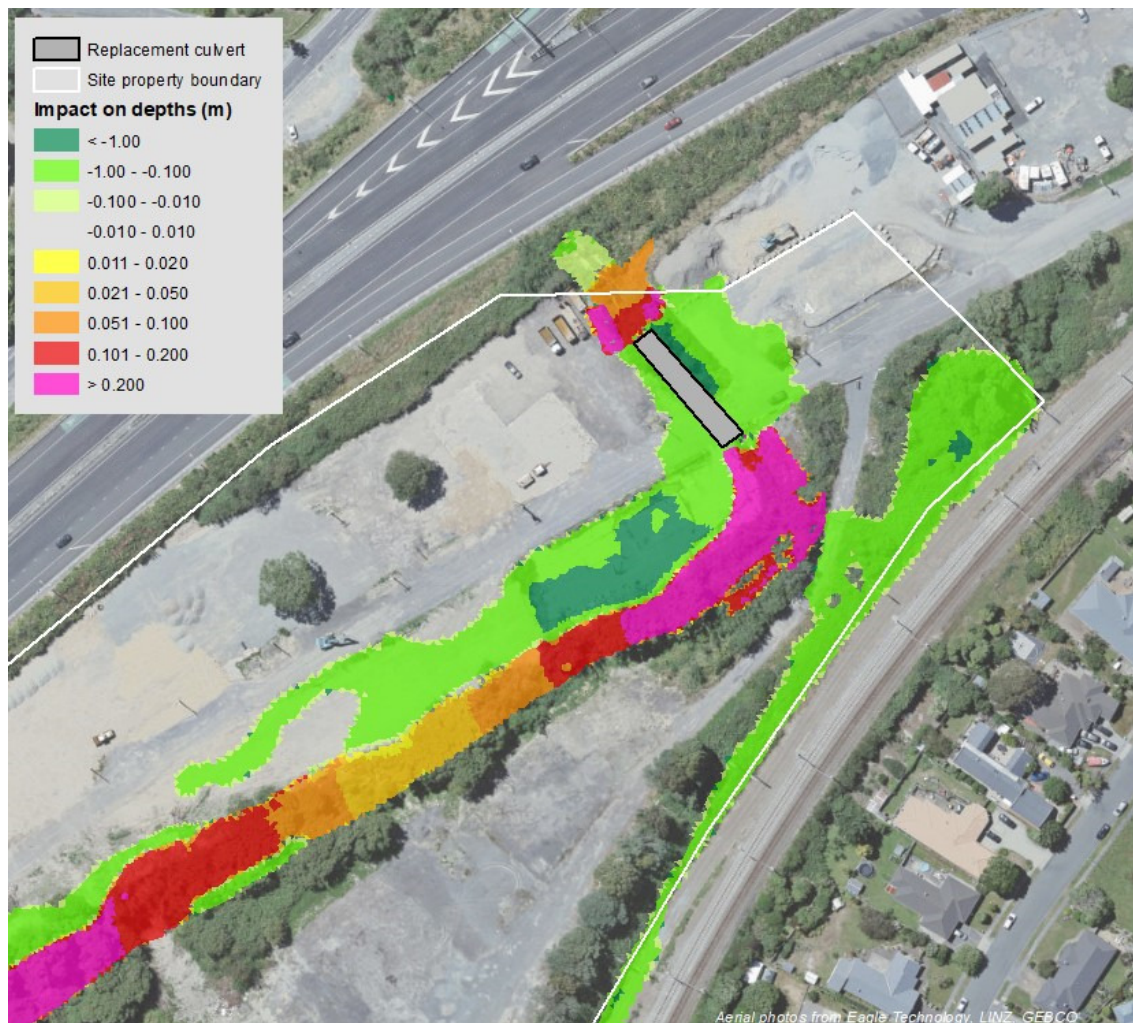


Figure 8 Impact of proposed development on peak flood depths, close-up at northern end of site

3.3 Proposed development situation - twin 3.5 m wide replacement culverts under Benmore Ave

A variation with twin 3.5 m culverts under Benmore Ave was also modelled. This showed a slight reduction of around 50 mm in flood levels upstream of the culvert, with no change to downstream flood levels. The predicted peak velocity through the culvert is 1.55 m/s.

As the reduction in water levels, compared to the twin 3 m wide culverts option is small, the flood depth map for the twin 3.5 m culverts option is not presented.

3.4 Freeboard

Results for the design scenario (twin 3 m culverts) have then had freeboard added. NZS 4404 specifies a minimum freeboard of 0.3 m for commercial or industrial buildings, but higher levels are suggested here, to provide greater protection for any high value assets. GWRC uses 0.9 m freeboard for Hutt River design levels, so that has been added to the Hutt River levels in this current study. A lesser amount, 0.5 m, has been applied to the Dry Creek flood levels, in recognition that this is a much smaller stream.

The model has been rerun with the freeboard applied. The resulting depths are as shown in Figure 9; it can be seen that the floodwaters do not reach the site platform and remain within the wider stream channel.

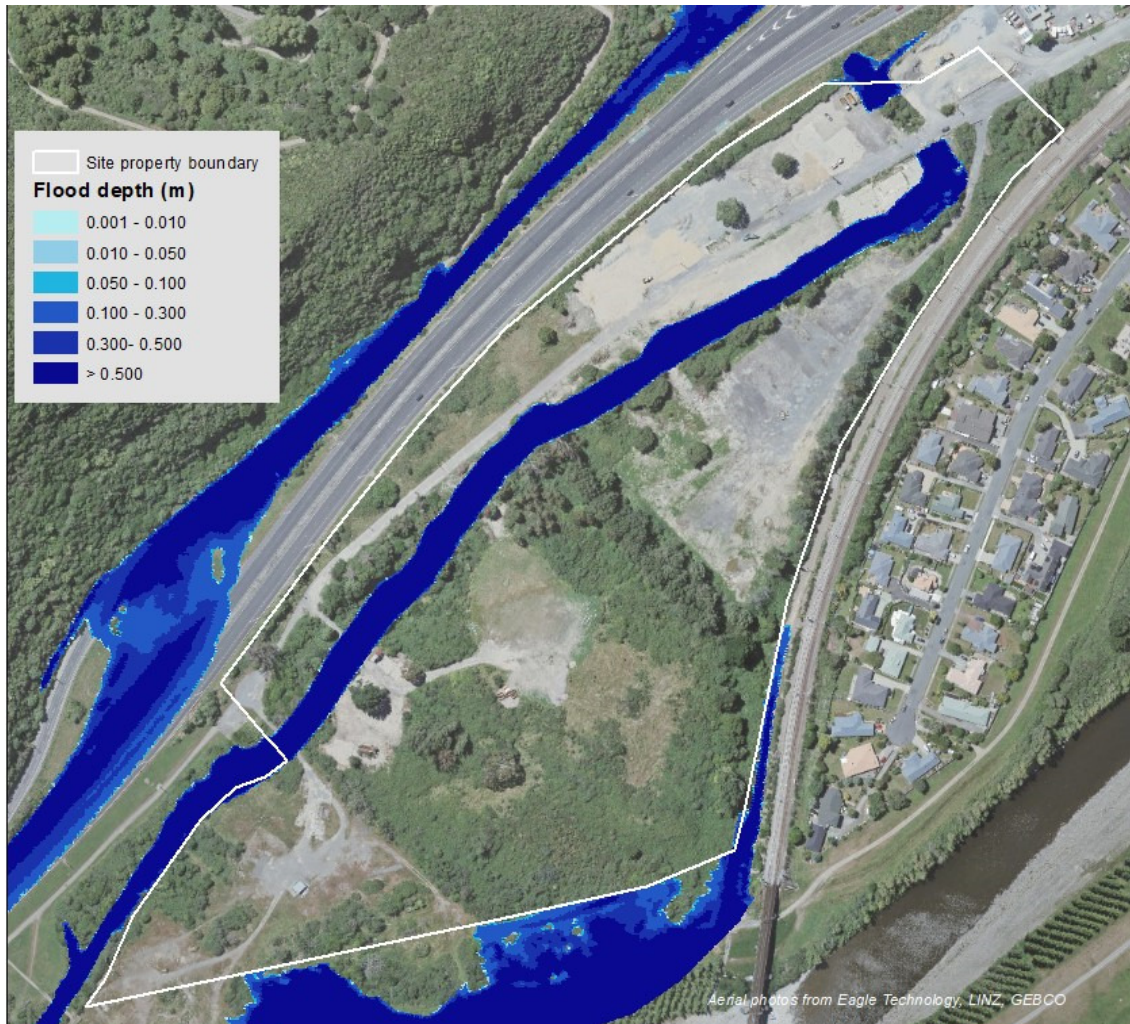


Figure 9 Predicted flood depths, developed situation with freeboard allowance

Figure 10 and Table 1 present a longitudinal profile of flood levels and the platform levels down the stream corridor; these are updates of Figure 7-6 and Table 7-1 in the original report.

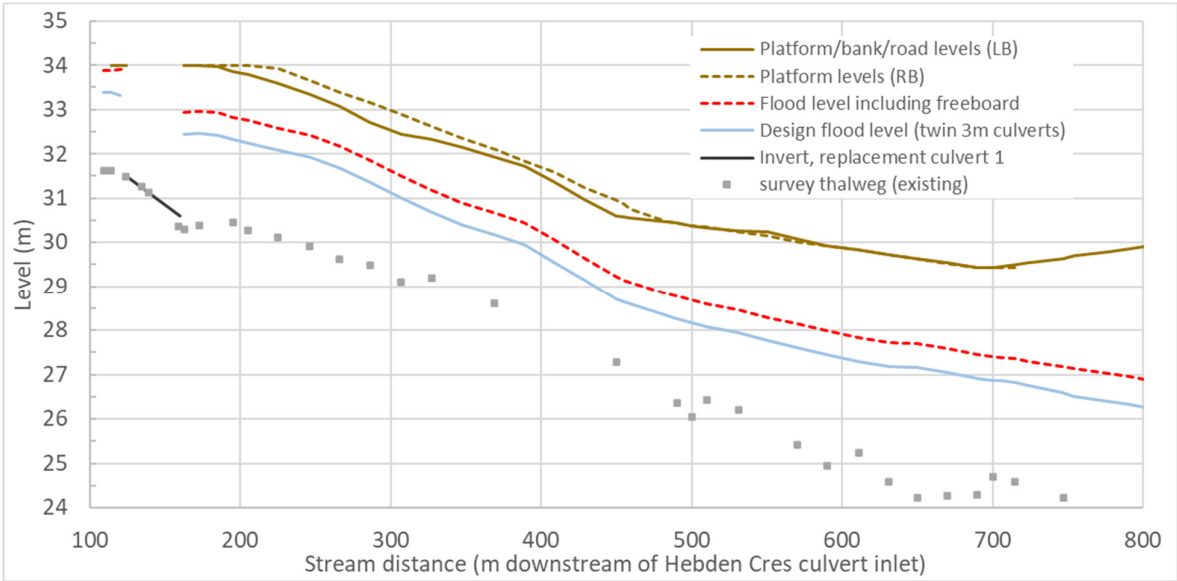


Figure 10 Longitudinal profiles along stream of bed levels, culvert invert levels, flood levels, conceptual fill platform levels (proposed case)

Table 1 Bed levels, culvert invert levels, flood levels, conceptual fill platform levels (proposed case) along stream

Stream chainage	Thalweg (surveyed)	Replacement culvert invert	Platform level		Flood level		
			Left bank	Right bank	Model prediction		incl. freeboard
					Twin 3m	Twin 3.5m	
109	31.63						
114	31.61		34.00	34.00	33.38	33.32	33.88
124	31.48	31.5	34.00	34.00	33.39	33.33	33.89
131							33.93
134	31.26						
139	31.13	culvert 1					
144							
149							
159	30.36	30.6					
163	30.29		34.00	34.00	32.44	32.44	32.94
166			34.00	34.00	32.46	32.46	32.96
173	30.39		34.00	34.00	32.43	32.43	32.93
185			33.96	34.00	32.32	32.32	32.82
195	30.46		33.86	34.00	32.25	32.25	32.75
205	30.28		33.78	34.00	32.07	32.07	32.57
225	30.12		33.59	33.92	31.93	31.93	32.43
246	29.91		33.34	33.65	31.68	31.68	32.18
266	29.62		33.07	33.39	31.37	31.37	31.87
286	29.49		32.71	33.16	31.00	31.00	31.50
307	29.11		32.44	32.89	30.69	30.69	31.19
327	29.19		32.34	32.62	30.39	30.39	30.89
347			32.14	32.36	30.16	30.16	30.66
369	28.61		31.93	32.11	29.95	29.95	30.45
389			31.72	31.84	29.55	29.55	30.05
409			31.37	31.58	29.13	29.13	29.63
429			30.96	31.23	28.72	28.72	29.22
450	27.28		30.60	30.95	28.64	28.64	29.14
455			30.57	30.87	28.33	28.33	28.83
459			30.55	30.76	28.27	28.27	28.77
484			30.46	30.47	28.18	28.18	28.68
485			30.46	30.47	28.09	28.09	28.60
490	26.35		30.43	30.44	27.94	27.94	28.46
500	26.04		30.38	30.38	27.76	27.76	28.28
510	26.42		30.33	30.34	27.60	27.60	28.14
531	26.20		30.26	30.24	27.46	27.46	27.99
551			30.24	30.14	27.29	27.29	27.84
570	25.41		30.07	30.02	27.19	27.19	27.73
590	24.95		29.92	29.93	27.15	27.15	27.69
611	25.23		29.83	29.83	27.05	27.05	27.59
631	24.59		29.73	29.72	26.91	26.91	27.45
650	24.23		29.63	29.63	26.89	26.89	27.43
670	24.28		29.54	29.52	26.87	26.87	27.41
690	24.30		29.44	29.44	26.86	26.86	27.39

Table 1(cont). Bed levels, culvert invert levels, flood levels, conceptual fill platform levels (proposed case) along stream

Stream chainage	Thalweg (surveyed)	Replacement culvert invert	Platform level		Flood level		
			Left bank	Right bank	Model prediction		incl. freeboard
					Twin 3m	Twin 3.5m	
695			29.42	29.43	26.82	26.82	27.35
697			29.42	29.43	26.75	26.75	27.29
700	24.69		29.42	29.42	26.60	26.60	27.19
715	24.58		29.49	29.42	26.50	26.50	27.13
719			29.51		26.38	26.38	27.03
724			29.55		26.33	26.33	26.96
747	24.23		29.64		26.21	26.21	26.84
754			29.69				
777	22.43		29.79				
791			29.85				
795	23.27		29.94				
808	22.89		29.94				