Delmore Fast Track Application

Appendix 8: A19 (Stormwater and Geomorphology) to Response to Comments letter

From: James Beaumont (Riley); and Ezequiel Silva (Morphum); Barker & Associates

Date: 4 June 2026

Re: Response to Annexure 19 to Auckland Council Response – Stormwater and Geomorphology

1.1 Introduction

This memorandum responds to the Technical Specialist Memo prepared by Auckland Council (stormwater and geomorphology) in relation to the above fast-track application. This response addresses:

- Further information requests / technical queries; and
- Recommended amendments to consent conditions.

This memorandum incorporates responses from multiple disciplines including geotechnical (Riley), geomorphology (Morphum), and planning (Barker & Associates).

The following attachments are included to this memorandum:

- **Attachment A: Morphum Geomorphology Response Memo**
- **Attachment B: Email correspondence with Healthy Waters**
- **Attachment C: Geotechnical Memo**

1.2 Further Information Requests / Technical Comments

Information Request / Technical Comment from Council under section 53 FTAA	Applicant Response under Section 55 FTAA
A1. The Rapid Geomorphic Erosion Assessment (Morphum, 2025) identifies widespread active adjustment across the network, including 9 reaches scoring Considerable Instability and 22 scoring Moderate Instability. The RGEA is an appropriate screening tool. However, it is of my professional opinion that its findings warranted escalation to a more detailed quantitative assessment before definitive conclusions were drawn on setback adequacy, the absence of instream works, and the adequacy of T-bar spreaders as appropriate mitigation. • Were quantitative or scenario-based follow-up assessment undertaken in response to the RGEA findings, and where is it documented?	Refer to the memo prepared by Morphum in **Attachment A.**

• Both Morphum assessments state that this was not quantitative modelling. On what evidential basis are the definitive conclusions regarding setbacks, instream works, and T-bar adequacy derived from an observation-only screening assessment, where instability and risk is so clearly laid out?	
A2. The geomorphic assessment documents an actively adjusting gully system with "estimated" 1-2 m of further bed lowering anticipated across most reaches before bedrock is encountered, common knickpoints migrating upstream, widening by mass wasting, and toe undercutting that is likely to trigger slope instability. Despite this, the assessment concludes no instream works are required and 10 m setbacks are generally adequate. • Please demonstrate how the conclusion that '10 m setbacks are adequate' follows from the documented geomorphic conditions, specifically accounting for the anticipated vertical adjustment trajectory and associated slope destabilisation, not lateral migration alone.	• Refer to the memo prepared by Morphum in **Attachment A.** • Riley: As per advice from Morphum, we have analysed selected cross sections (refer Section 5.1.3, page 17 of our GIR, Riley ref:240065-Q, also our memo on Geomorphic Impacts on Slope Stability, Riley ref: 240065-T) to allow for stream down cutting of 2m and widening of 3m. The analysis results show that with appropriately designed stability enhancement measures, adequate FoS are available for the nominated setbacks.
A3. Lateral risk in confined gully systems is assessed primarily as planform migration. The RGEA data, site photos, and reach notes document sections of streams already in Stage IV widening, mass wasting slumps, undercut toes, and existing slope instability. In confined systems, lateral adjustment occurs predominantly through gully-wall instability, not meander migration. The assumption of low lateral risk is not defensible on the evidence presented. • Please provide a revised assessment of lateral adjustment potential that specifically addresses gully-wall instability and mass wasting mechanisms, and its implications for the proposed riparian setbacks and proposed outlet discharge proposals. This should account for long-term incisional processes and toe undercutting, with saturated banks.	• Refer to the memo prepared by Morphum in **Attachment A.** • Riley: The geotechnical stability analyses make allowance for the deepening and widening assessed by Morphum. As above, adequate FoS against instability are available following construction of the nominated stability enhancement measures. Refer Section 5.1.3, page 17 of our GIR, Riley ref:240065-Q, also our memo on Geomorphic Impacts on Slope Stability, Riley ref: 240065-T.
B1. Riparian setbacks of 10 m are proposed for most reaches. No analysis has been provided demonstrating how a 10 m horizontal setback accommodates future geomorphic adjustment over a 50-100 year planning horizon, including	• Refer to the memo prepared by Morphum in **Attachment A.** • Riley: As above, the stability analyses and assessment of required stability enhancement measures has considered 2m of downcutting and 3m widening as advised by Morphum. Refer

anticipated bed lowering of 1-2 m, progressive bank steepening, and associated slope destabilisation. Setbacks appear to be assumption-based rather than derived from geomorphic analysis. • For each actively adjusting and potentially actively adjusting reach, please provide a reach-specific justification for the proposed setback that accounts for the full anticipated adjustment trajectory, including vertical adjustment and its lateral consequences.	Section 5.1.3, page 17 of our GIR, Riley ref:240065-Q, also our memo on Geomorphic Impacts on Slope Stability, Riley ref: 240065-T.
B2. Where layout constraints prevent an increase in setback, the engineering response must be explicitly designed and costed for the full anticipated geomorphic adjustment, not current channel conditions. The application does not demonstrate that proposed retaining structures are designed to this standard. • Where proposed lots or structures cannot be set back to accommodate anticipated channel adjustment, please confirm that all stream-margin retaining and geotechnical structures are designed for the full anticipated bed lowering and bank steepening trajectory, including scour depth assumptions, and that this is documented in the geotechnical design.	• Refer to the memo prepared by Morphum in **Attachment A.** • Riley: As above, the stability analyses and assessment of required stability enhancement measures has considered 2m of downcutting and 3m widening, and setbacks as advised by Morphum. Refer Section 5.1.3, page 17 of our GIR, Riley ref:240065-Q, also our memo on Geomorphic Impacts on Slope Stability, Riley ref: 240065-T
C1. The geomorphic assessment acknowledges that development will alter the stream hydrograph, increasing flow peaks and efficiency of delivery. No analysis is provided of how post-development hydrology, including increased imperviousness, altered flow duration and frequency, and more efficient stormwater conveyance, will interact with the active geomorphic processes documented across the network. • Please provide an assessment of how post-development hydrological changes will affect the rate and extent of channel incision, knickpoint migration, and bank widening across the network.	Refer to the memo prepared by Morphum in **Attachment A**, including the hydraulic inputs at Appendix 1 of that document.
C2. The hydraulic model (McKenzie & Co, drawings 3725-0-4506 and 3725-0-4507) shows post-development 50% AEP velocities at monitored locations. These figures were not considered or referenced in the Morphum Geomorphic Assessment or Geomorphic Response Memo,	Refer to the memo prepared by Morphum in **Attachment A**, including the hydraulic inputs at Appendix 1 of that document.

despite forming part of the same application package. Key findings include: Location D: velocity increases from 0.79 to 1.10 m/s (+39%), crossing the critical erosion threshold for moderately consolidated clay at the 50% AEP. Location E: velocity increases from 0.10 to 0.69 m/s (+590%), a near-sevenfold increase at the 50% AEP, shifting a previously depositional reach into active erosion at near-annual recurrence. Locations A and F also show post-development velocity increases. Location I records 1.97 m/s in both pre- and post-development scenarios, persistently above the erosion threshold with no mitigation proposed. The SMP (section 9.9) states that the geomorphic assessment confirms the stormwater strategy will not adversely affect geomorphic risk. The hydraulic model data contradicts this conclusion. • Please explain how this internal inconsistency in the application documentation has been resolved.	
C3. At the 10% AEP, post-development velocities show reductions of approximately 10 to 26 percent at several locations. This is noted. However, even with these reductions, velocities at multiple locations remain above the critical erosion thresholds for the silt/clay channel materials documented across the network. The application does not demonstrate that the network is designed to accommodate the geomorphic forces generated by flows at and below the 10% AEP. • Please demonstrate that the stormwater network design accounts for the geomorphic forces generated by the full range of flows from the 10% AEP downwards, whether through increased channel resistance, adequate setbacks for adjustment, or both.	Refer to the memo prepared by Morphum in **Attachment A**, including the hydraulic inputs at Appendix 1 of that document.
C4. The hydraulic model provides peak velocity snapshots at the 50% AEP and 10% AEP. No long-term gauged flow record exists for this catchment, and no flow frequency or duration analysis has been provided. Channel morphological adjustment is governed by the frequency and cumulative duration of flows exceeding the erosion threshold,	Refer to the memo prepared by Morphum in **Attachment A**, including the hydraulic inputs at Appendix 1 of that document.

not by peak velocity or depths at selected AEP events alone. Without this analysis, the claim that the stormwater strategy maintains geomorphic equivalence cannot be evaluated. • In the absence of a gauged flow record, what approach has been used to assess how frequently and for how long erosive threshold conditions are exceeded at key reaches under post-development conditions? • If this analysis cannot be produced, please confirm that the precautionary principle has been applied in the design response, specifically through increased setbacks or enhanced channel resistance at reaches where post-development velocities exceed or approach erosion thresholds.	
D1. The pre-application meeting of 27 November 2025 included a request for flows and velocities through culverts to be included on plans and assessed geomorphically. This was to assist the Streamworks specialists' assessment. Velocity figures have been added to culvert drawings (series 3725-1-4800). Adding velocity numbers to drawings is not the same as a geomorphic assessment of those velocities. • Please provide a geomorphic risk assessment of the culvert velocity data, addressing whether those velocities are consistent with channel stability at those locations and whether the culvert design is appropriate given the geomorphic trajectory of the receiving reaches.	Refer to the memo prepared by Morphum in **Attachment A.**
D2. The installation of road culverts across multiple reaches will create a long-term operational requirement to remove large woody debris (LWD) from channels upstream of crossing structures to maintain conveyance capacity. LWD is the primary natural mechanism by which small steep streams in this setting dissipate flow energy, store sediment, and stabilise bed and bank materials. Its systematic removal accelerates bed incision, the dominant geomorphic process already documented across this network. This feedback is not addressed in any of the application documentation. • Please provide a large woody debris management plan addressing how LWD within	*B&A:* The majority of the proposed culverts are proposed to be vested to Auckland Transport as they will form part of the road reserve. Two culverts will remain within private ownership as these are located within JOALs, so will be managed by the Resident's Society. As part of the stormwater discharge conditions, an Operation and Maintenance Plan will be required for the culverts (refer to Condition 5 of the stormwater discharge permit). The subdivision conditions require that the Resident's Society manages all common infrastructure within the development (including

the riparian buffer will be managed to retain geomorphic function alongside culvert maintenance obligations.	culverts) (refer to Condition 32 and Condition 34 of the subdivision consent).
D3. The geomorphic assessment assumes no instream works will be undertaken. Despite this, the application documents active headcuts, culvert scour, mass wasting, rapid incision, outer-bend erosion, and toe undercutting across multiple reaches. The blanket exclusion of instream works as an option is inconsistent with the conditions described. • Please confirm whether targeted instream stabilisation works are proposed or available as a response to ongoing geomorphic adjustment, and if not, on what basis they have been excluded given the conditions documented.	Refer to the memo prepared by Morphum in **Attachment A.** *B&A:* The Applicant is currently engaging with Healthy Waters to progress draft conditions relating to geomorphology, and instream stabilisation works.
E1. The groundwater monitoring programme covers approximately two months (November to December 2024), capturing early summer conditions only. The GIR identifies saturated groundwater conditions as the primary driver of existing instability across the site. Wet season peak groundwater conditions, typically occurring late winter to spring in Auckland, have not been captured. • Please confirm if additional groundwater monitoring has been undertaken to capture wet season conditions, and how this informs the groundwater model underpinning the stability analyses.	*Riley:* Further groundwater monitoring has not been undertaken. The stability analyses consider various ground saturation scenarios. These have been reviewed and accepted by the Auckland Council Geotechnical Specialist as being suitably conservative with respect to ground saturation.
E2. Geotechnical measures address slope stability at specific cross-sections. They do not control ongoing channel evolution, prevent knickpoint retreat, manage progressive gully expansion, or account for downstream consequences of altered sediment supply and bed levels. The stability analyses confirm that factors of safety are met within the development area under the assumed adjustment parameters. They do not demonstrate that the geomorphic trajectory of the network has been arrested or that conditions will remain stable beyond the 50-year design window. • Please demonstrate how the proposed geotechnical measures address ongoing channel evolution across the network, not only	*Riley:* The geotechnical stability enhancement measures are not intended to control changes in the stream channels. Instead, have been assessed to provide adequate FoS to the land above them considering the long-term stream downcutting (2m) and widening (3m), and setbacks as advised by Morphum. Refer Section 5.1.3, page 17 of our GIR, Riley ref:240065-Q, also our memo on Geomorphic Impacts on Slope Stability, Riley ref: 240065-T. It should be appreciated that detailed design of the stability enhancement measures is to be undertaken in the future. This will consider downcutting and widening of the streams at additional locations along the alignments of the relevant stability enhancement measures and the

localised slope stability at the specific cross-sections analysed.	designs will be undertaken to ensure that adequate FoS are available.
E3. The ownership, maintenance, and liability framework for stream-margin retaining and geotechnical structures has not been resolved. These structures are proposed along actively incising channel margins where ongoing scour is anticipated. The stability designs are concept-level, with further amendments expected during detailed design and confirmed on-site during construction. Future landowners and Council should not inherit maintenance obligations or liability for structures whose consent-level design is explicitly described as preliminary. • Please provide a draft consent condition confirming that all retaining and geotechnical structures along stream margins remain in private ownership and will not be vested to Council. • Please confirm the proposed arrangement for ongoing inspection, maintenance, and renewal of all stream-margin structures over their design life, including who is responsible and how costs are met. • Please confirm what recourse exists if a structure fails due to stream toe erosion within the design life of the development.	*B&A:* The proposal includes engineered solutions adjacent to the streams, that would be located within private lots, as per the scheme plans included within **Appendix 4 to the Response to Comments Letter.** As with any engineered solution (such as a retaining wall), these are designed at concept level during resource consent stage and then developed and confirmed through detailed design. Like a retaining wall, it would be the responsibility of the lot owner to ensure it is maintained and retained. The following consent conditions are proposed and included within the conditions of consent at **Appendix 2 to the Response to Comments Letter**, which Council's geotechnical engineer has confirmed are acceptable: • Detailed construction methodology must be provided to Council and certified by Council's geotechnical engineer prior to works commencing. • The construction of the geotechnical measures are to be supervised by a chartered geo-professional. • A Geotechnical Completion Report (GCR) must be prepared following the completion of the geotechnical structures and submitted to Council. • The GCR must be provided to Council prior to s224(c) certification. • Development on residential lots is to be undertaken in accordance with the GCR, which identifies specific design zones and no-build zones. This is required to be complied with by the lot owner in perpetuity. In addition to the above which relates specifically to the geotechnical solutions, the Applicant is currently engaging with Healthy Waters to progress draft conditions relating to geomorphology.
F1. The geomorphic assessment identifies that multiple wetlands may rapidly convert to incised channels if upstream incision or knickpoint migration reaches them. No timeline or likelihood assessment is provided, no assessment of	Refer to the memo prepared by Morphum in **Attachment A.**

sediment release or downstream effects is made, and no mitigation or design response is recommended beyond monitoring. • Please provide an assessment of the likelihood and indicative timeframe for knickpoint migration to reach wetland systems at each at-risk location under post-development conditions. • Please specify the monitoring programme for wetland channelisation risk, including indicators, frequency, responsible party, intervention triggers, and the funded remediation pathway if channelisation is detected.	
G1. The geomorphic risks documented across this site, including ongoing channel incision, knickpoint migration, gully-wall instability, and associated slope adjustment, are expected to continue and affect properties adjacent to the stream network over their design life. Future landowners should be informed of these risks and of their maintenance obligations at the time of purchase. • Please confirm what language will be recorded on the property file and any Land Information Memorandum (LIM) for all lots within or adjacent to the riparian margin:	*B&A:* As per the above, the Applicant is currently engaging with Healthy Waters to progress draft conditions relating to geomorphology.

1.3 Response to Recommended / Amended Conditions

Condition Request from Council	Applicant Response
Condition 119, the stormwater management of the private lots should under the stormwater discharge permit, it is recommended that an additional condition. It is recommended rather than Condition 119, a 'stormwater management works' condition, listed under the stormwater permit. A description of the table is provided. 1. 'Stormwater Management Works' *Note this is a description of the stormwater management works condition table recommended:* Specify each treatment device, outfalls, raingardens proposed that are to be included within this discharge consent, this should include the catchment area impervious proposed for each device, and the design requirements of these	A Stormwater Management Works table has been prepared and referenced in Condition 1 of the Stormwater Discharge permit. The specific tables are included within Attachment 5 of the consent. These tables have been sent to Council who has confirmed that the tables are acceptable.

devices (eg GD01). It is recommended this table could also display the assets to remain private and those which aim to be vested. Two tables could be created to aid in simplifying the consent, one with the proposed vested devices, and the others to remain private (stormwater tanks, t-bar dispersal devices)	
Amendments to conditions 109 and 110 are recommended to specify the operation and maintenance plan requirements per standard requirements. These conditions are recommended to be under the Stormwater Discharge Consent and not under the Land Use Consent. See the 'operation and maintenance plan' condition below.	The previous conditions requiring the Operation and Maintenance Plan to be prepared and submitted to Council has been removed from the subdivision consent and included within the Stormwater Discharge permit (refer condition 5 of the stormwater discharge permit). This condition has been expanded to include the information requested from Council. The conditions of the subdivision consent relating to consent notices have also been updated (refer below).
Additionally the enactment of 149 and 163 to require the operation and maintenance plan should be further amended and be provided for under the stormwater discharge consent. The following operation and maintenance conditions (2 – 9) are recommended under the Stormwater Discharge Permit including the incorporation of conditions requiring maintenance records to be held. 2. 'Operation and Maintenance Plan' An Operation and Maintenance Plan must be provided to and certified by the council five (5) working days prior to the commencement of discharge authorised by this consent. The plan must include a. Details of who will hold responsibility for long-term maintenance of the stormwater management system and the organisational structure which will support this process b. A programme for regular maintenance and inspection of the stormwater management system c. A programme for the collection and disposal of debris and sediment collected by the stormwater management devices or practices d. A programme for post-storm inspection and maintenance e. A programme for inspection and maintenance for the outfalls	

f. General inspection checklists for all aspects of the stormwater management system, including visual checks g. A programme for inspection and maintenance	
3. 'Operation and Maintenance Plan implementation' The stormwater management system must be managed in accordance with the final Operation and Maintenance Plan prepared in accordance with Condition 2.	This condition has been accepted and is included within the stormwater discharge permit (refer Condition 6).
4. 'Amendments to the Operation and Maintenance Plan' Any amendments or alterations to the Operation and Maintenance Plan must be submitted to the the council for confirmation, in writing prior to implementation.	This condition has been accepted and is included as part of the OMP condition within the stormwater discharge permit (refer Condition 5).
5. 'Maintenance Record' Details of all Maintenance Records (including inspections, servicing and maintenance) for the stormwater management system must be retained by the consent holder for a minimum of the preceding three years and must be provided to the council on request.	This condition has been accepted and is included within the stormwater discharge permit (refer Condition 7).
6. 'Contents of maintenance record' a. Details of any maintenance undertaken b. Details of any inspections, servicing and maintenance completed.	This condition has not been accepted as it is a repetition of the condition above.
7. 'Maintenance Responsibility' At the time of issue of the Certificates of Title for Lots (to be specified), a Covenant or other legal instrument to the satisfaction of the Council shall be registered on the titles of Lots (to be specified), requiring that on-site stormwater management works shall be undertaken to comply with the following: a) Rain tanks sized for roof runoff from each individual lot shall be designed and constructed to achieve hydrology mitigation in accordance with standard E8.6.3.1(1).	This condition has been accepted and is included within subdivision consent (refer Conditions 70, 89, 107).

b) At the time of application for Building Consent, detailed design for the proposed stormwater tank shall be submitted to and approved by the Council. c) The rain tanks shall be maintained to ensure the tanks continue to operate as a stormwater attenuation device. In particular, the owner shall not block or remove the part of the tank to be reserved for stormwater management. d) The stormwater management devices on each of the individual lots, are to be maintained by the owners of the lots in accordance with the Operation and Maintenance Plan as outlined in Condition 2 (final number to be inserted by lead planner) above [to be attached, prepared in accordance with Auckland Council Consent DIS######]. The Council's Solicitor will prepare the Covenant or other legal instrument at the consent holder's expense.	
204. This condition is recommend to be amended or an additional specifications of operation and maintenance plan are recommended. Refer to Healthy Waters memo for their comments and specific wording for their recommended changes to this condition.	The OMP condition has been updated in accordance with the wording provided by Council (refer Condition 5 of the stormwater discharge permit).

Attachment A: Morphum Geomorphology Response Memo

MORPHUM environmental

Memorandum

Date:	21/05/2026
To:	Vineway Ltd
From:	Ezequiel Silva
CC:	Charlotte MacDonald; James Kitchen; James Beaumont; Madeleine Wright; Andrew Allsopp-Smith
Project Number:	P05513
Released by:	Andrew Rossaak

Subject: Delmore Development Geomorphic Assessment. Response to Council RFI Memo (25.03.2026)

Introduction

Following Council's Stormwater and Geomorphology Section 67 Information Gaps[1] dated 25 March 2026, and the Freshwater Ecology Specialist Assessment[2] dated 24 March 2026, additional geomorphic input is required to address the information request. The information gaps Council identified relate to the basis of the geomorphic conclusions, the adequacy of the proposed setbacks, and how geomorphology interacts with post-development hydrology and geotechnical design.

This memo builds on the Geomorphic Assessment[3] (20 November 2025) and Geomorphic Response Memo[4] (19 December 2025) and provides clarification and further interpretation based on the information now available. The geomorphic assessment is based on the following inputs:

- Rapid Geomorphic Erosion Assessment (RGEA), site observations, photographs, and reach notes identifying widespread incision, widening, instability, and active channel adjustment processes across the network
- Hydraulic outputs provided by McKenzie[5], including velocity, depth, and water level rasters for pre- and post-development scenarios, referenced to provide spatial context for interpretation of potential changes in geomorphic behaviour
- Geotechnical inputs provided by Riley[6], including slope stability and groundwater considerations, referenced to provide context for bank response to channel adjustment.

[1] Auckland Council (2026). Technical Specialist Memo – Stormwater (Regulatory) and Geomorphology, 25 March 2026.

[2] Auckland Council (2026). Freshwater Ecology Memo, Antoinette Bootsma (Senior Freshwater Ecologist), 24 March 2026.

[3] Morphum Environmental Ltd. (2025). Delmore Development Geomorphic Assessment, 11 November 2025

[4] Morphum Environmental Ltd. (2025). Delmore Development - Geomorphic Response Memo, 19 December 2025.

[5] Appendix 1 compiles hydraulic modelling outputs, representative velocity assessments, culvert and outlet protection information, and supporting technical correspondence provided by McKenzie & Co.

[6] Riley Consultants Ltd. (2025). Geotechnical Report: Proposed Delmore Residential Development, Russell Road and Upper Ōrewa Road, Wainui. Report reference 240065-Q, prepared for Vineway Ltd.

Our responses have further been informed through a meeting of the project team with Auckland Councils fluvial geomorphology specialists (Danny Klimetz) on 20/04/2026. Our understanding from this meeting was that the scale and detail of the fluvial geomorphological assessment was accepted and that the risks areas identified would require additional consideration in detailed design.

Response to Council Information Gaps

A. Geomorphic Assessment Scope and Methodology

This section provides a consolidated response to Items A1 to A3 of the Council memo, focusing on the evidential basis for the geomorphic conclusions and the interpretation of channel adjustment processes.

Geomorphic Context and Adjustment Framework

The site comprises a confined gully system undergoing active adjustment. Field observations and RGEA results indicate ongoing vertical incision, associated bank steepening and toe undercutting, and localised widening through mass wasting. These processes are consistent across multiple reaches and represent the dominant mode of channel evolution at the site.

In this setting, channel adjustment is driven primarily by vertical incision and subsequent lateral widening within the existing valley-bottom corridor, rather than planform migration. Lateral risk therefore arises from slope destabilisation and bank retreat.

The expected adjustment trajectory is characterised by continued bed lowering, progressive bank steepening, and widening driven by gully-wall instability, which provides the basis for interpretation of setback adequacy and interaction with stormwater infrastructure.

Evidential Basis for Geomorphic Conclusions

The geomorphic conclusions are based on consistent evidence from:

- RGEA results identifying widespread moderate to considerable instability across the network
- Field observations of active incision, knickpoint migration, toe erosion, and mass wasting
- Geological and geotechnical context indicating erodible materials, elevated groundwater, and susceptibility to slope instability
- Reach-scale consistency of observed geomorphic processes across the site

These inputs provide a robust qualitative basis for defining the dominant adjustment mechanisms and expected channel response. The assessment adopts a process-based approach, where the likely trajectory of channel evolution is inferred from observed conditions and established geomorphic behaviour in confined gully systems.

Hydraulic outputs provided by McKenzie[7] have been used selectively to support interpretation at key locations, particularly where stormwater discharges interact with receiving slopes and channels.

[7] Appendix 1 compiles hydraulic modelling outputs, representative velocity assessments, culvert and outlet protection information, supporting technical correspondence, and relevant drawing references (including the 3725-0-45xx series) provided by McKenzie & Co.

Geotechnical inputs provided by Riley[8], including a supplementary geotechnical assessment[9] have also informed the interpretation of slope response to channel adjustment, particularly in relation to bank stability and groundwater influence.

Implications for Setbacks and Lateral Risk

Given the identified adjustment processes, setback adequacy is governed by the combined effect of vertical incision and its lateral consequences, including bank steepening, toe erosion, and slope destabilisation within the valley-bottom corridor.

Setbacks are therefore interpreted relative to this adjustment envelope, rather than as fixed offsets from the current channel position. In confined systems, channel location remains broadly fixed while the channel expands laterally through widening. Where constraints limit setback extent, geomorphic processes are expected to continue to act on the channel margins, and the performance of adjacent structures is dependent on geotechnical design responses to the anticipated adjustment trajectory.

Valley-Bottom Delineation (Supporting Spatial Interpretation)

A relative elevation analysis was undertaken to define an indicative valley-bottom corridor across the site by comparing ground surface to an interpolated streambed surface (Figure 1). This allows terrain elevation to be expressed relative to the local channel and provides a consistent basis to identify the active or near-active valley floor.

Lower relative elevations correspond to the active or near-active valley floor, while higher values represent surrounding hillslopes.

The resulting corridor aligns with observed areas of active adjustment and provides spatial context for interpretation of channel behaviour and setback considerations. It is not intended to define flood extents or design limits.

Interpretation and Key Observations

The valley-bottom delineation provides a consistent spatial framework to interpret channel behaviour and potential geomorphic adjustment across the site.

For the primary stream network (including Reaches 6, 5, 12, and 36), the indicative corridor is typically on the order of approximately 3 to 5 m on either side of the stream centreline. This is interpreted to represent the active adjustment corridor, within which incision, toe erosion, and widening are expected to occur.

For lower-order streams, the corridor is generally narrower, although wider extents are observed in wetland-associated reaches (including Reaches 1, 14, 3, and 35), where low gradients and saturated conditions result in a broader zone of geomorphic activity.

These observations provide context for assessing setback adequacy and identifying locations where increased hydraulic forcing may interact with geomorphically sensitive areas.

[8] Riley Consultants Ltd. (2025). Geotechnical Report: Proposed Delmore Residential Development, Russell Road and Upper Ōrewa Road, Wainui. Report reference 240065-Q, prepared for Vineway Ltd, 19 December 2025.

[9] Riley Consultants Ltd. (2025). Geomorphic Impacts on Slope Stability – Delmore Residential Development, Russell Road, Orewa (Appendix-20.1_Geotechnical-Supplementary-Memo_Redacted.pdf), 19 December 2025.

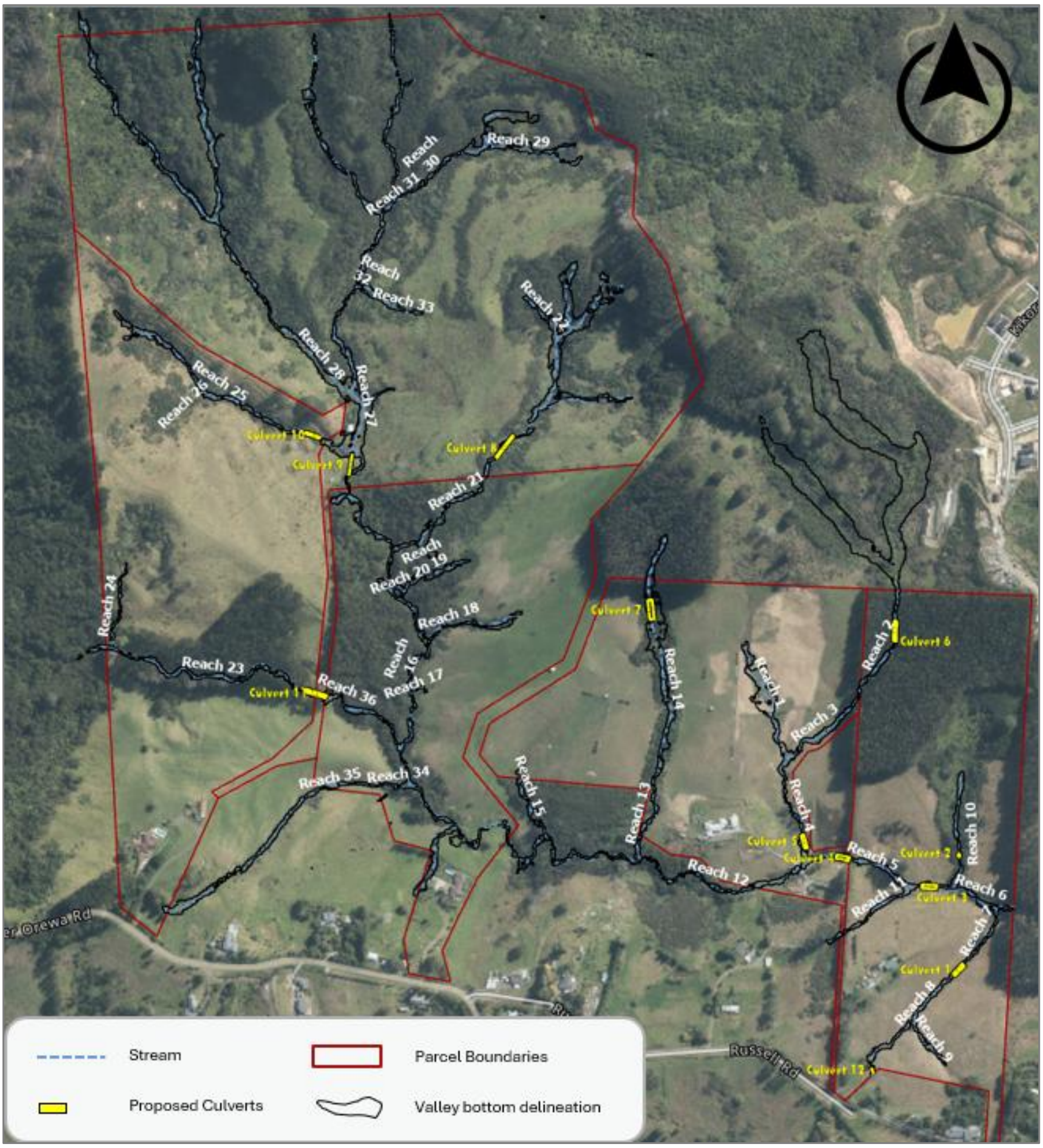


Figure 1 Valley-bottom Delineation

B. Setback Adequacy and Riparian Margins

This section addresses Items B1 and B2 of the Council memo, focusing on the relationship between anticipated geomorphic adjustment and the proposed riparian setbacks.

Setback Basis and Adequacy

Riparian setbacks have been assessed in the context of the expected geomorphic adjustment processes identified across the site. As outlined in Section A, channel evolution is driven by vertical incision and subsequent lateral widening through bank instability, including toe erosion and mass wasting. Setback adequacy is therefore defined relative to the adjustment envelope representing the spatial extent over which these processes are expected to occur over time.

The indicative valley-bottom corridor has been used to provide spatial context for this assessment. The adopted 10 m setback generally extends beyond the identified zone of active geomorphic adjustment, providing a margin to accommodate anticipated widening associated with incision and bank instability.

When considered together with the expected magnitude of incision (1–2 m) and associated lateral widening, the identified valley-bottom corridor provides a reasonable basis to infer that future channel adjustment is likely to remain within a lateral extent encompassed by the proposed setback across most reaches.

A 10 m setback is therefore generally considered appropriate from a geomorphic perspective. This reflects the confined nature of the system, the expected magnitude of widening relative to valley-bottom width, and the absence of significant planform migration.

This interpretation is supported by representative reaches across the site. In Reaches 6, 5, and 12, the mapped valley-bottom corridor and observed instability indicate that active adjustment is largely contained within a limited lateral extent relative to the proposed setback. In contrast, wetland-associated reaches (e.g. Reaches 1, 14, 3, and 35) exhibit wider valley-bottom extents and a broader zone of potential adjustment and have been considered separately.

Setback Constraints and Engineering Response

Figure 2 shows the relationship between the indicative valley-bottom corridor and proposed setback.

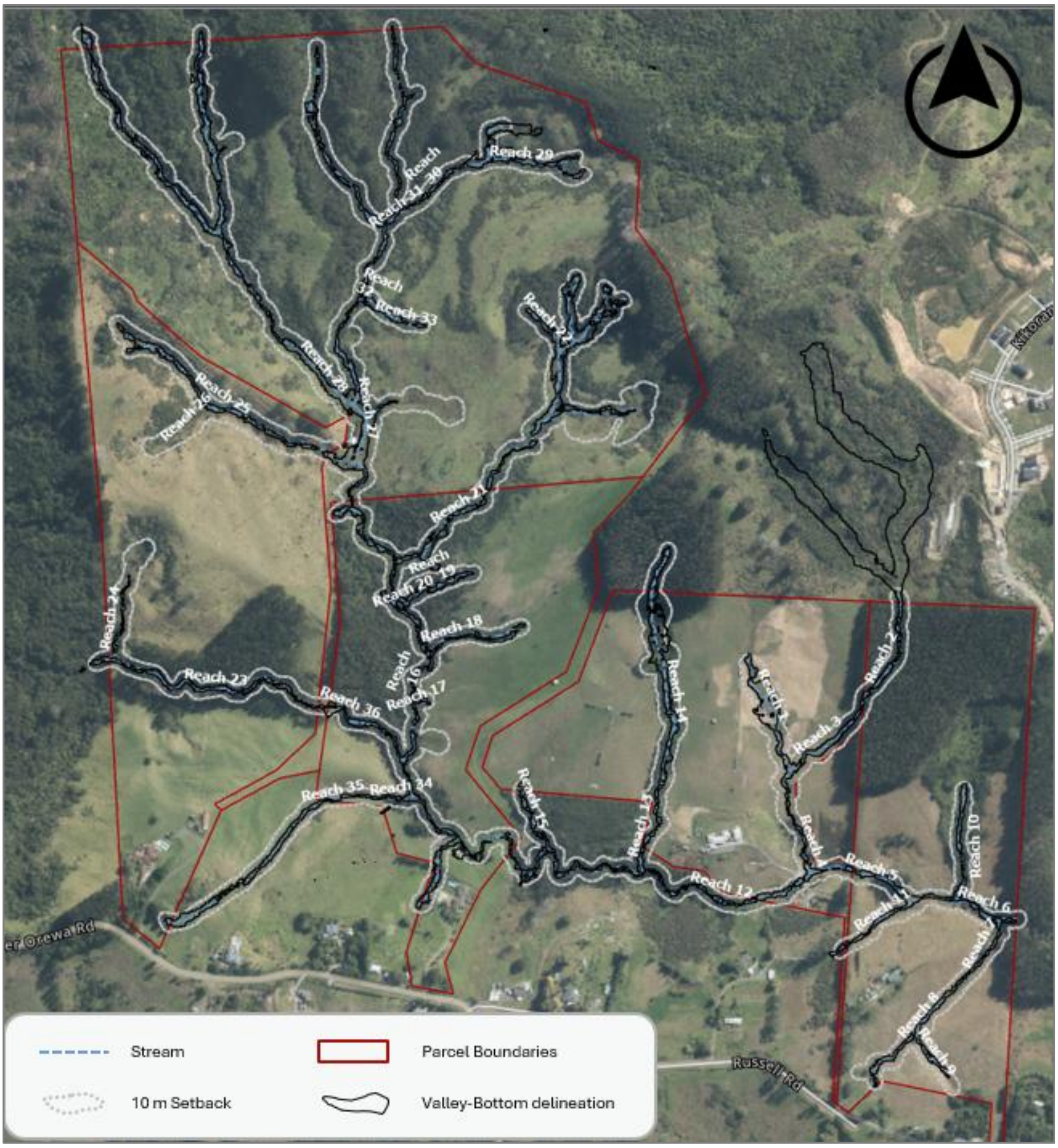


Figure 2 Valley-bottom corridor and the proposed setback

Where development layout constrains the ability to increase setbacks, geomorphic processes are expected to continue to act on channel margins. In these locations, the design approach is to accommodate, rather than avoid, channel adjustment.

The geomorphic assessment defines the expected adjustment envelope, including anticipated bed lowering, bank steepening, and widening. Slope stability analyses undertaken by Riley[10], including a supplementary geotechnical assessment[11] have been updated to incorporate long-term channel downcutting and widening considerations. We understand that their analyses indicate that acceptable factors of safety can be achieved, with localised refinement where required. Further details on the slope stability analyses and safety factors adopted to address the geomorphic adjustment processes identified in this assessment, including anticipated bed lowering and channel widening, are provided in Appendix I of the Riley geotechnical assessment[10].

Residual Risk and Design Implications

Geomorphic processes are expected to continue over the life of the development. Setbacks reduce exposure to these processes but do not eliminate risk, which remains where adjustment is most active or development is located closer to channel margins. In these areas, performance depends on the interaction between geomorphic processes and engineered responses.

Residual risk is highest where existing instability coincides with increased hydraulic forcing or constrained setbacks, particularly in reaches identified as geomorphically sensitive (Red classification[12]). A precautionary approach has therefore been adopted, whereby these areas are assumed to continue adjusting unless demonstrated otherwise.

In these reaches, geotechnical design has been refined by Riley[10] to account for the anticipated adjustment trajectory, including channel downcutting and associated slope response. This includes targeted adjustments at representative locations, such as Reach 12 (already unstable with increased setbacks), Reach 23 (upstream of Culvert 11 with asymmetric erosion potential), Reach 36 (downstream scour risk), and Reach 2 (active incision and widening), with similar refinements applied at other sensitive reaches.

These responses include modification of slope geometry, increased embedment depths, and extension of reinforcement to accommodate slope instability and toe erosion, with additional measures, where required, to address groundwater influences. Overall, the design has been refined in response to reach-specific geomorphic conditions rather than applying a uniform solution across the site.

C. Post-Development Hydrology and Geomorphic Response

C1 – Post-Development Hydrological Change

Development of the site is expected to modify the hydrological regime through increased imperviousness and more efficient stormwater conveyance. This results in higher peak flows and more rapid delivery of runoff to the stream network, increasing the magnitude and responsiveness of flow events.

---

[10] Riley Consultants Ltd. (2025). Geotechnical Report: Proposed Delmore Residential Development, Russell Road and Upper Ōrewa Road, Wainui. Report reference 240065-Q, prepared for Vineway Ltd, 19 December 2025.

[11] Riley Consultants Ltd. (2025). Geomorphic Impacts on Slope Stability – Delmore Residential Development, Russell Road, Orewa (Appendix-20.1_Geotechnical-Supplementary-Memo_Redacted.pdf), 19 December 2025.

[12] Morphum Environmental Ltd. (2025). Delmore Development Geomorphic Assessment, 11 November 2025. Appendix 1

From a geomorphic perspective, these changes act as a forcing mechanism on an already actively adjusting system, increasing the potential for incision, bank instability, and channel widening where erosion thresholds are exceeded.

Hydraulic outputs provided by McKenzie (refer Appendix 1) have been used to compare pre- and post-development conditions and identify areas where changes in velocity and flow concentration may influence channel behaviour.

C2–C3 Velocity Changes and Erosion Risk

Spatial comparison of pre- and post-development velocity outputs indicates that velocity increases occur at a number of locations across the network, with some reaches transitioning from low-energy conditions to conditions capable of mobilising bed and bank materials. These increases are primarily associated with discharge points and upstream of culvert structures, where flow is concentrated or redirected (e.g. upstream of Culvert 11 in Reach 23 and Culvert 4 in Reach 12), as well as at localised flow convergence zones within the stream network.

Velocity outputs have been interpreted in relation to indicative erosion thresholds for the soil types present on site (e.g. GD08 Table 2-10). Based on geotechnical input, site materials are broadly representative of silt loam and alluvial silt, and thresholds have been interpreted accordingly. In several locations, post-development velocities approach or exceed these thresholds, indicating potential for increased erosion relative to pre-development conditions.

Figure 3 shows the velocity change (m/s) for the 1% AEP event with climate change (3.8°C), derived from hydraulic modelling provided by McKenzie, calculated as post-development minus pre-development conditions.

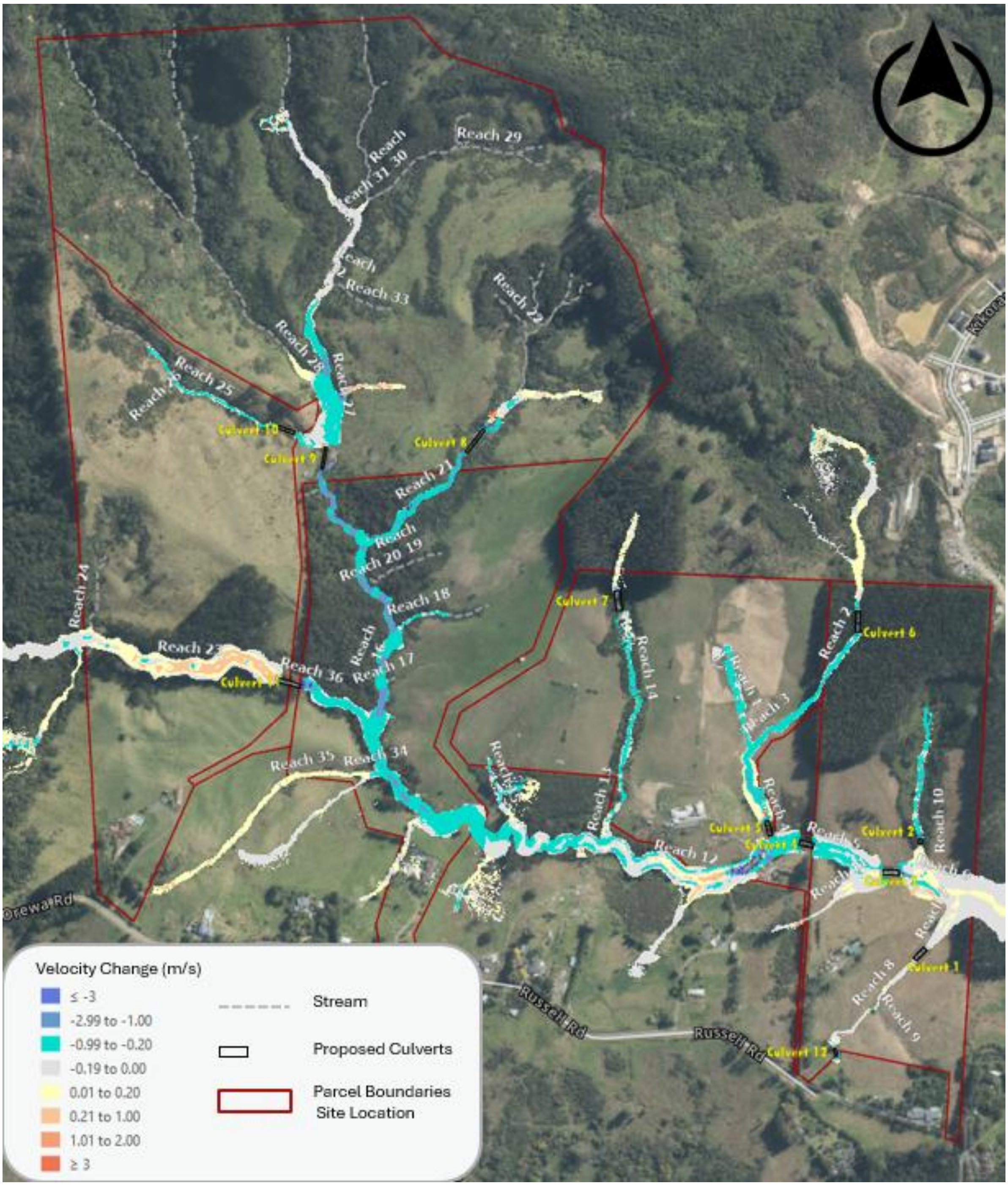


Figure 3 Velocity change (m/s) for the 1% AEP event with climate change (3.8°C), calculated as post-development minus pre-development conditions.

Drivers of Localised Velocity Increases

These increases are not uniform and are typically associated with:

- Concentrated discharges, including T-bar outlets and culvert outfalls
- Changes in flow routing and conveyance efficiency
- Existing zones of instability where channels are already actively adjusting

Geomorphic Response and Design Interaction

At these locations, geomorphic response is expected to include increased incision, toe erosion, and widening, consistent with the adjustment framework outlined in Section A. This spatial pattern aligns with reaches identified as geomorphically sensitive in the site-wide assessment (Section B), where increased hydraulic forcing coincides with existing instability. Without intervention, the hotspot reaches will continue to incise and create instability. Therefore, stream bed protection is recommended in hotspot reaches.

Representative hotspot locations

Representative hotspot locations identified within the 50% AEP hydraulic modelling outputs provided by McKenzie include Locations D, E, A, F, and I. These locations generally correspond to reaches where concentrated flow routing, culvert interaction, or localised increases in conveyance efficiency result in increased hydraulic forcing relative to pre-development conditions, including within reaches already identified as geomorphically sensitive within the broader site-wide assessment.

Potential geomorphic response mechanisms may include localised incision, toe erosion, widening, and channel adjustment where erosive thresholds are exceeded. These reaches may also represent suitable locations for targeted instream stabilisation or energy dissipation measures during subsequent design stages, where required. Example approaches are outlined in Appendix 2, including riffles, riprap toe protection, timber cross-vane weirs, timber step pools, and other localised energy dissipation measures.

C4 Temporal Characteristics of Erosive Flows (Item C4 and Ecology Memo 6.2)

Hydraulic outputs provided by McKenzie (refer Appendix 1) include indicative durations for which velocities exceed erosion thresholds (e.g. 0.6 m/s based on site-specific soil conditions). These results indicate that threshold exceedance generally occurs over limited periods during storm events rather than as sustained conditions.

Table 1. Summary of duration of velocities >0.6 m/s (post-development vs pre-development, based on McKenzie modelling [see Appendix 1])

Event (ARI)	Maximum Duration (minutes)	Overall Change
2-year	~420	-7%
10-year	~1050	0%
100-year	~1030	+8%

Maximum durations represent localised conditions associated with flow concentration and convergence within the network. In contrast, exceedance of erosion thresholds across most reaches is typically limited in duration and varies significantly across the network, with shorter durations occurring across most reaches and longer durations confined to localised conditions.

While localised increases in exceedance duration are observed at specific cross sections, these are not consistent across the network and are offset by reductions in other locations. This indicates that the development is not expected to result in a uniform or sustained increase in erosive conditions across the system, but rather a redistribution of hydraulic effects, with localised increases occurring in areas already identified as geomorphically sensitive.

Localised Discharge Conditions

At localised discharge points (e.g. T-bar outlets), hydraulic calculations represent conservative assumptions, with full lot runoff assumed to be captured and conveyed to a single discharge location. In practice, some proportion of runoff may occur as sheet flow, reducing flow concentration relative to modelled conditions. As a result, modelled velocities at these locations are considered conservative for the purpose of geomorphic interpretation.

Indicative flow estimates at T-bar outlets are based on rational method calculations provided by McKenzie (refer Appendix 1) and are used for contextual interpretation. Outlet protection measures, including riprap at T-bar outlets, have been incorporated to mitigate localised velocity increases and reduce erosion potential at discharge points, in accordance with established design guidance.

Precautionary Approach

While indicative duration data is available, a full frequency-duration assessment across all reaches has not been undertaken. Accordingly, a precautionary approach has been adopted, whereby locations approaching or exceeding erosion thresholds are assumed to remain susceptible to ongoing geomorphic adjustment

D. Stormwater Management and Geomorphic Interaction

D1 – Culverts and T-Bar Discharges

Culverts and T-bar discharge locations represent localised points where stormwater infrastructure interacts directly with the receiving channel. Geomorphic response at these locations is primarily controlled by outlet velocity, flow concentration, receiving slope, and the existing condition of the channel.

Hydraulic outputs and supporting information provided by McKenzie[13] have been used as contextual inputs to inform geomorphic interpretation. This includes consideration of how outlet conditions may interact with the expected adjustment trajectory of the receiving reaches, as described in Section A.

From a geomorphic perspective, outlet velocities at culvert and T-bar discharge locations are generally consistent with the behaviour of an actively adjusting system. Localised increases in velocity are expected to promote incision and bank instability at discharge points, particularly where flow is concentrated.

These effects are consistent with the adjustment processes described in Section A and do not introduce new geomorphic behaviours beyond those already identified. The geomorphic acceptability of culvert discharge conditions is therefore dependent on the capacity of the receiving channel and associated geotechnical measures to accommodate these localised effects, as reflected in the reach-scale assessments in Sections B and C.

D2 – Large Woody Debris Management

Large woody debris has an important geomorphic function in small steep stream systems by increasing channel roughness, dissipating flow energy, trapping sediment, and supporting bed and bank stability.

Detailed LWD management requirements should be addressed through the stormwater operation and maintenance framework.

D3 – Instream Works

Previous assessments adopted a position that instream works would not be required.

The geomorphic assessment confirms that active processes, including incision, toe erosion, and widening, are expected to continue.

A targeted and conditional approach to instream works may be considered. This recognises that intervention may be required at specific locations where:

[13] Refer to Appendix 1 for hydraulic modelling outputs and supporting calculations provided by McKenzie & Co.

• Post-development velocities exceed or approach erosion thresholds

• Discharges are concentrated or poorly dispersed

• Existing instability is likely to be exacerbated by changes in hydraulic conditions

Potential measures include increasing channel roughness, flow spreading, and localised stabilisation to reduce flow concentration and erosion potential. This may include vegetative reinforcement, use of woody material (e.g. logs) for toe protection and energy dissipation, and other surface stabilisation measures, subject to detailed hydraulic and geotechnical design.

This assessment does not include detailed instream design but identifies locations and conditions where targeted intervention may be appropriate or required. The need for instream measures should be confirmed during detailed design, informed by hydraulic outputs and site-specific geomorphic conditions. Example approaches are outlined in Appendix 2, including riffles, riprap toe protection, timber cross-vane weirs, timber step pools, and other localised energy dissipation measures.

F. Wetland Channelisation Risk

F1 – Wetland Channelisation

Wetlands within the site are sensitive to changes in hydrology and channel behaviour. Based on the geomorphic assessment, this risk is associated with locations where:

• Upstream reaches are actively incising

• Hydraulic conditions indicate potential for increased velocities or flow concentration

• Defined flow paths may develop within currently low-gradient or weakly defined wetland areas

Hydraulic outputs have been reviewed to identify wetlands potentially affected by concentrated flows and increased velocities. Velocity change mapping (Figure 3) indicates that wetland-associated reaches (including Reaches 1, 3, 8, 19, and 25–28) generally experience either a reduction or only minor increases in velocity under post-development conditions. Where increases are observed, these are small in magnitude and are not considered sufficient to drive a transition from diffuse wetland flow to defined channelised conditions.

Available hydraulic information, including velocity change mapping and duration-based indicators (refer Section C4), has been considered in the assessment of channelisation risk. While localised increases in hydraulic forcing may occur, these are not widespread across wetland reaches and are not expected to materially alter the existing diffuse flow regime.

A proportionate monitoring approach is therefore recommended. This must include:

• Monitoring of wetland areas identified as potentially at risk

• Identification of early indicators of channelisation, such as localised incision, headcut formation, or development of preferential flow paths and thresholds that would trigger an intervention

• Provision for targeted intervention if channelisation is observed or initiated

This assessment identifies the geomorphic risk mechanism and supports a monitoring-based approach to identify and manage wetland channelisation risk.

Conclusions

The site comprises an actively adjusting gully system, where channel evolution is driven by ongoing incision and lateral widening within a confined valley-bottom corridor.

Post-development hydrological changes are expected to locally increase hydraulic forcing, particularly at discharge points and upstream of culvert structures. These changes are not uniform across the network and are primarily associated with flow concentration and conveyance effects.

From a geomorphic perspective, the proposed setbacks are generally appropriate across most reaches, as they extend beyond the active adjustment corridor and account for anticipated channel widening. Where constraints limit setback extent, performance is dependent on geotechnical design responses informed by the expected adjustment trajectory.

A precautionary approach has been adopted in areas of increased sensitivity, informed by the geomorphic assessment and identification of reaches where ongoing adjustment is expected. Morphum have identified the geomorphic processes, adjustment mechanisms, and locations of elevated risk, which have informed the development layout and geotechnical design by others. From a geomorphic perspective, this integrated response is considered appropriate to manage residual risk, recognising that ongoing adjustment cannot be eliminated but can be managed through integrated design.

Targeted instream stabilisation or energy dissipation measures may also be considered during subsequent detailed design stages where localised geomorphic sensitivity or elevated hydraulic forcing is identified. Morphum does not provide comment on access to, or maintenance requirements of, any geotechnical structures, which remain the responsibility of the relevant design disciplines. From a geomorphic perspective, no structures should be located within the active watercourse or within areas that may be subject to channel erosion or lateral adjustment, where this could result in direct interaction between flows and geotechnical stabilisation structures.

Limitations

This assessment is qualitative and based on interpretation of available information. Morphum has not undertaken hydraulic or geotechnical modelling and has not reviewed or verified the outputs provided by others. Hydraulic inputs have been generated by others and are used for contextual interpretation only. The conclusions presented are therefore indicative and subject to confirmation through detailed design and analysis by others.

Disclaimer Statement

This report has been prepared for Vineway Ltd, according to their instructions, for the particular purpose and objectives described in the report. Morphum Environmental Ltd accepts no responsibility for the content of this report if it is used by any other party or for any other purpose or objective. Any use of or reliance on the information contained in this report for decisions made by third parties are the responsibility of these third parties. Morphum Environmental Ltd accepts no responsibility for damage incurred by third parties resulting from the use of or reliance on this report, or if the report is used by any party for other than the purpose and objectives described herein.

Ezequiel Silva
Environmental Engineer and Geomorphologist
Morphum Environmental Ltd
Ezequiel.silva@morphum.com

Appendix 1. Hydraulic Inputs and Supporting Information (McKenzie & Co)

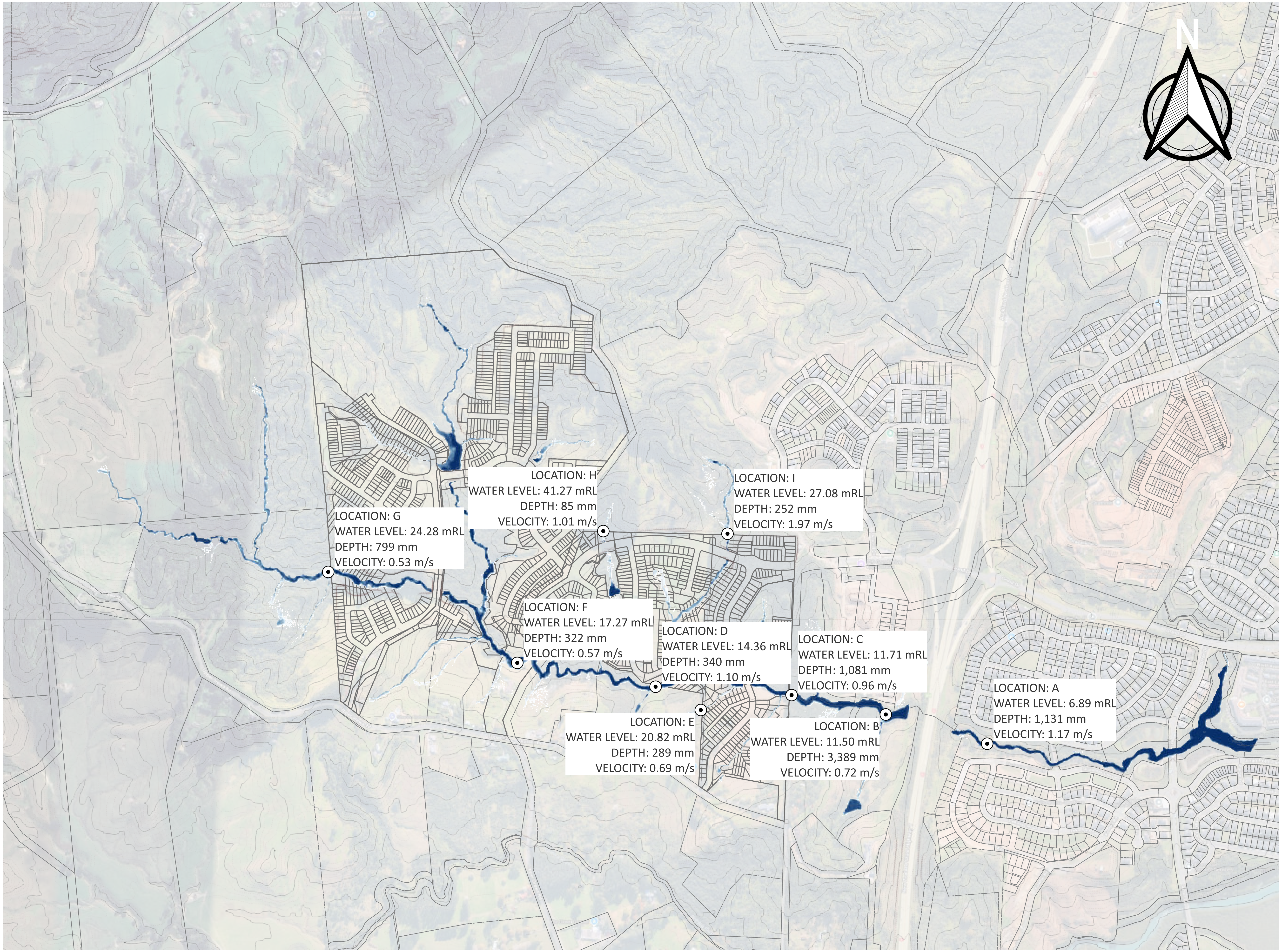
Supporting hydraulic information provided by McKenzie & Co has been used as contextual input for this assessment.

This includes:

- Pre- and post-development hydraulic outputs, including velocity, depth, and water level results
- Indicative duration of velocities exceeding erosion thresholds at representative locations
- Rational method flow estimates and associated velocity calculations for localised discharge points (e.g. T-bar outlets)

Supporting correspondence from McKenzie & Co has also been used to clarify discharge assumptions, outlet treatment, and localised erosion management approaches.

This information has been used to support spatial interpretation of potential changes in geomorphic behaviour and identification of locations where hydraulic forcing may influence channel response. Morphum has not undertaken hydraulic modelling and has not independently verified the hydraulic calculations or outputs provided.



NOTES:

1. SCENARIO ID IS D_MPD21CC050AEPTWABASE_PDT

2. 50% AEP SCENARIO, WITH 2.1 DEGREE CLIMATE CHANGE, LAND USE IS MAXIMUM PROBABLE DEVELOPMENT WITHIN THE DELMORE SITE, EXISTING OUTSIDE THE DEVELOPMENT SITE.

3. CONTOUR INTERVAL IS 2.5m

MAP PROJECTION/ VERTICAL DATUM:
NZGD2000 / MT EDEN 2000
(EPSG: 2105)
NEW ZEALAND VERTICAL DATUM 2016

REV	DESCRIPTION	DRN	BYCHK	BY APP	BY DATE
C	RE-SUBMISSION	HS	-	-	22/12/25
B	MODELLING UPDATE	HS	-	-	21/07/25
A	FIRST ISSUE	HS	-	-	16/01/2025

MCKENZIE & CO.

CLIENT:
VINEWAY LIMITED

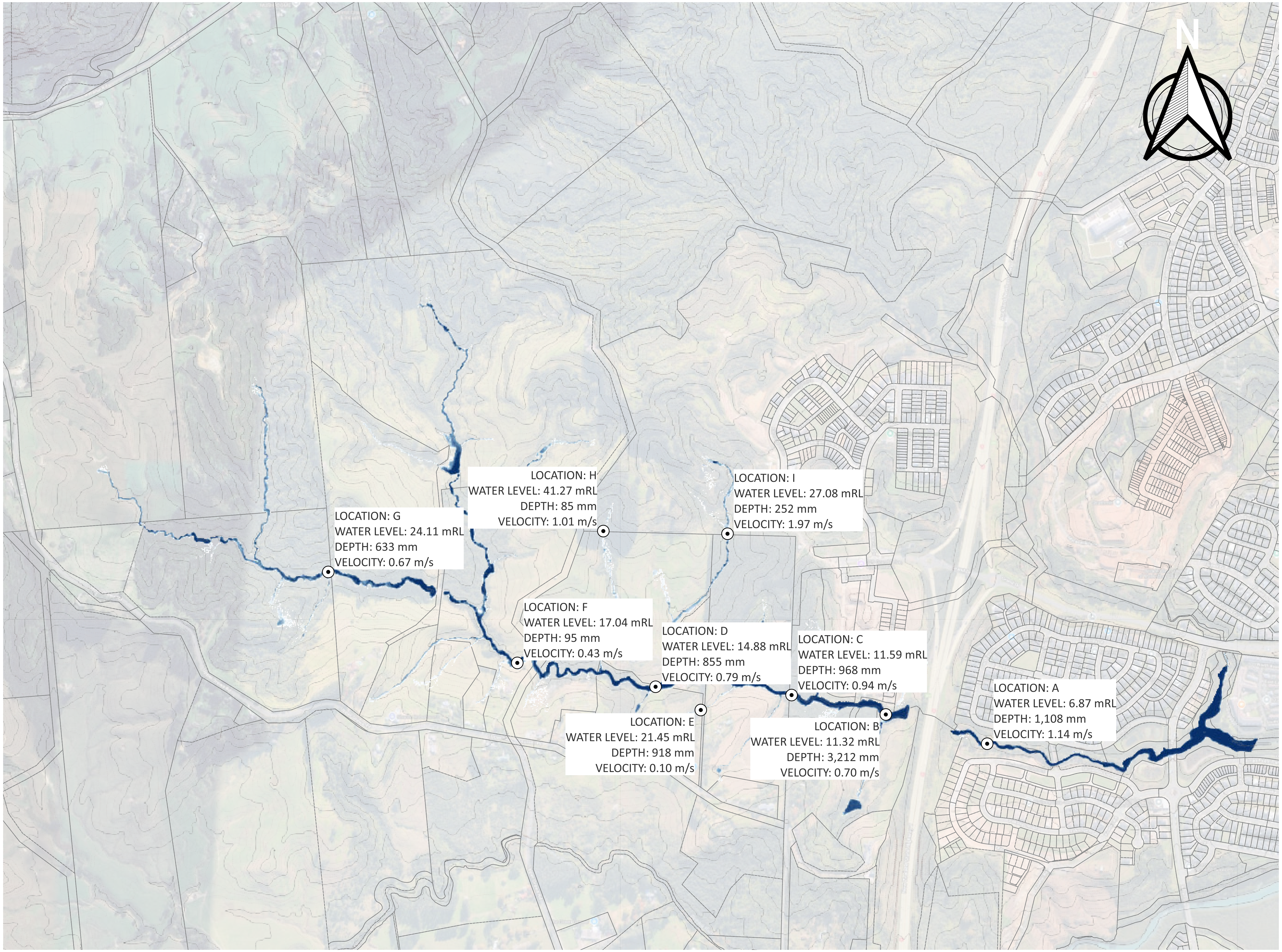
PROJECT:
DELMORE
53A, 53B & 55 RUSSELL ROAD
OREWA

TITLE:
STORMWATER
FLOOD ASSESSMENT
50% AEP POST-DEVELOPMENT
FLOOD PLAIN PLAN (2.1D CC)

PURPOSE OF ISSUE:
FOR DISCUSSION ONLY

SCALE:
1:10,000

DRAWING NO.: 3725-0-4506
REV: C



NOTES:

1. SCENARIO ID IS EXD21CC050AEPTWABASE_EXT
2. 50% AEP SCENARIO, WITH 2.1 DEGREE CLIMATE CHANGE, LAND USE IS CURRENT (PRE-EXISTING).
3. CONTOUR INTERVAL IS 2.5m

MAP PROJECTION/ VERTICAL DATUM:
NZGD2000 / MT EDEN 2000
(EPSG: 2105)
NEW ZEALAND VERTICAL DATUM 2016

REV	DESCRIPTION	DRN	BYCHK	BY APP	BY DATE
C	RE-SUBMISSION	HS	-	-	22/12/25
B	MODELLING UPDATE	HS	-	-	21/07/25
A	FIRST ISSUE	HS	-	-	16/01/2025

MCKENZIE & CO.

CLIENT:
VINEWAY LIMITED

PROJECT:
DELMORE
53A, 53B & 55 RUSSELL ROAD
OREWA

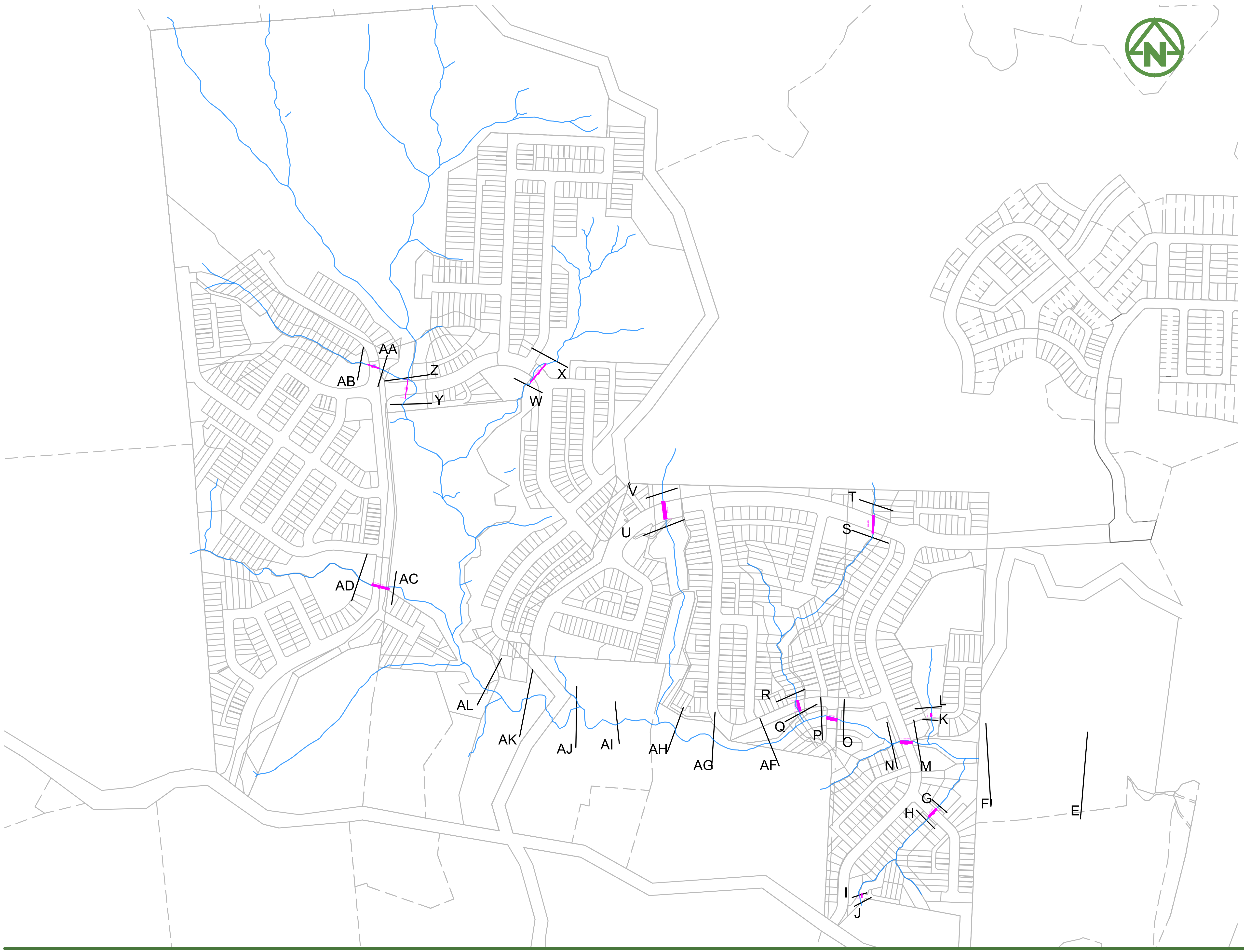
TITLE:
STORMWATER
FLOOD ASSESSMENT
50% AEP PRE-DEVELOPMENT
FLOOD PLAIN PLAN (2.1D CC)

PURPOSE OF ISSUE:
FOR CONSENT

SCALE:
1:10,000

DRAWING NO:
3725-0-4507

REV:
C



LEGEND:

STREAM	
SECTION LOCATION	
CULVERT LOCATION	

MCKENZIE & CO.

CLIENT:
VINEWAY LTD

PROJECT:
53A, 53B & 55 RUSSELL ROAD
OREWA, DELMORE

TITLE:
PRE & POST DEVELOPMENT
VELOCITY COMPARISION
(2YR, 10YR, & 100YR)
LOCATION PLAN

PURPOSE OF ISSUE:
RESOURCE CONSENT

SCALE:
1:6000m @ A3
DO NOT SCALE

DRAWING NO: 3725-0-3550

REV: A

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
A	FIRST ISSUE	PK	LM	LM	30/04/26

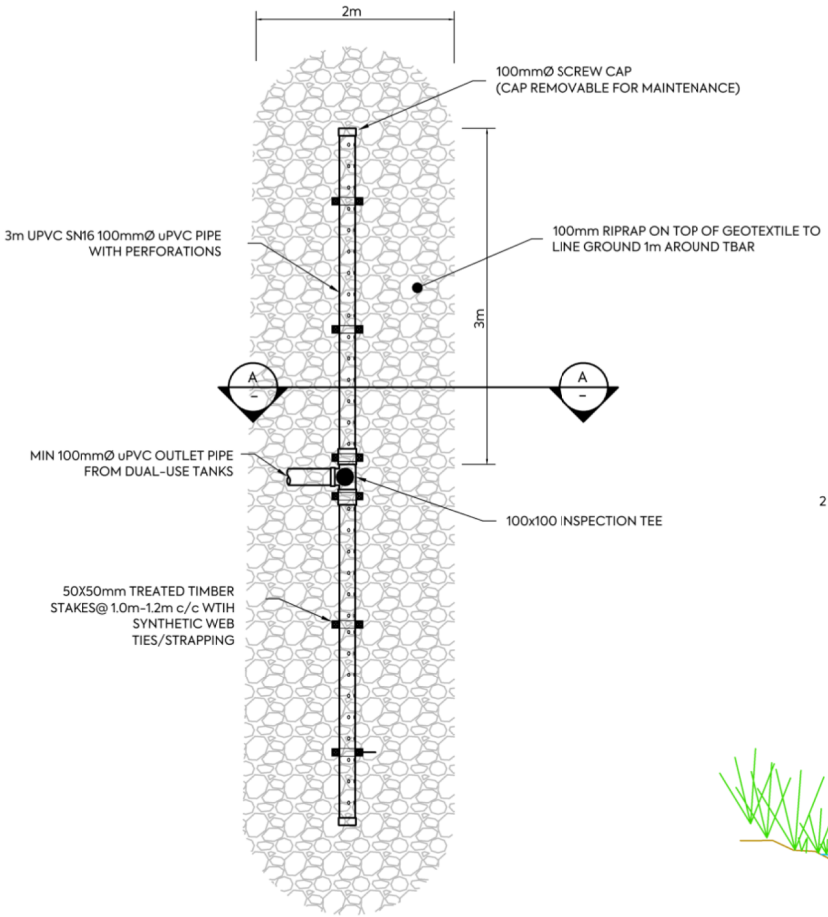
C:\12DS\DATA\MCKFS01\3725-2 DELMORE STAGE 2_5201\06000. ENGINEERING DESIGN\6500. DRAWINGS\DELMORE MORPHUM LOCATION.DWG

HY-8	Culvert Parameters			1% AEP					OUTLET - TR 2013-018			
									Equation 20	Equation 21		Equation 23
	Span (mm)	Rise (mm)	Embedment (mm)	HEC-RAS 1% AEP flow (m^3/s)	Headwater above embedment (m)	HEC-RAS Inlet velocity (m/s)	Outlet depth (m)	HEC-RAS Outlet velocity (m/s)	Froude No	Riprap size D50	Riprap size (m)	Apron Length (m)
Culvert 1	4000	2000	350	3.01	0.58	1.155	0.25	1.616	1.03	0.06	0.20	2.1
Culvert 2	1950	1950	650	2.83	0.8	0.435	0.31	1.389	0.80	0.06	0.15	2.0
Culvert 3	5000	4000	350	39.83	4.41	1.082	2.27	1.457	0.31	0.18	0.25	-1.6
Culvert 4	5000	4000	350	44.86	4.8	1.132	2.57	1.525	0.30	0.20	0.25	-2.1
Culvert 5	4000	1000	350	6.52	3.25	1.401	0.65	0.41	0.16	0.03	0.15	-3.6
Culvert 6	4000	2000	350	6.76	1.22	0.605	0.77	0.825	0.30	0.06	0.15	-0.7
Culvert 7	6000	2000	350	1.31	0.28	0.814	0.12	0.904	0.83	0.02	0.15	0.8
Culvert 8	2000	1000	600	3.06	5.13	0.64	0.4	0.641	0.32	0.03	0.15	-0.2
Culvert 9	900	900	150	2.82	5.85	0.256	0.75	0.708	0.26	0.05	0.15	-1.5
Culvert 10	2100	2100	700	0.63	1.11	0.728	0.48	0.428	0.20	0.02	0.15	-2.0
Culvert 11	4000	1700	350	25.72	7.9	0.901	1.35	1.185	0.33	0.11	0.15	-0.4
Culvert 12	1500	1500	400		0.48		0.2	0.249	0.18	0.01	0.15	-1.0

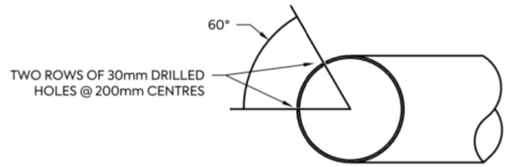
Where apron length is < the width of the pipe, the pipe width will be set as the apron length.

Duration of velocity > 0.6 m/s by cross section (minutes) — computed from raw timeseries

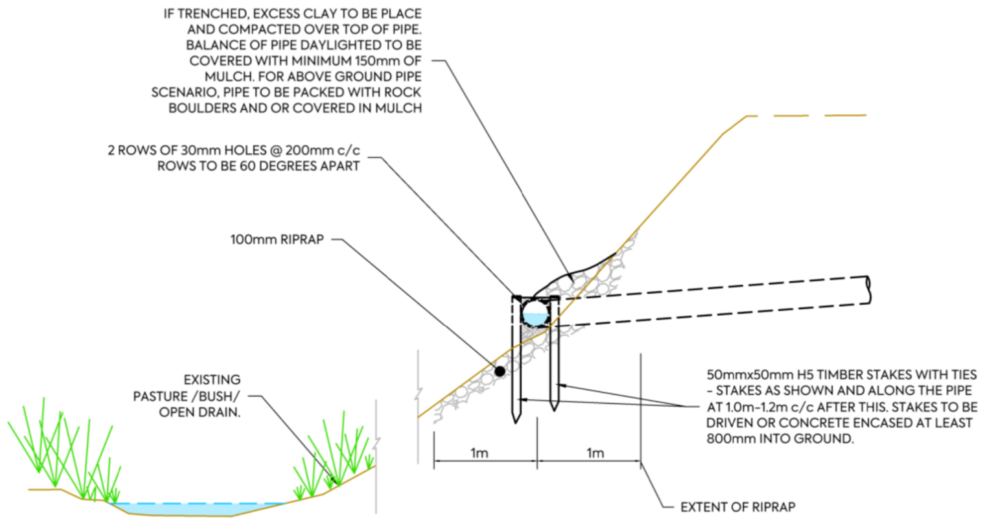
		2 Year ARI				10 Year ARI				100 Year ARI			
		Pre-Dev	Post-Dev	Δ	%	Pre-Dev	Post-Dev	Δ	%	Pre-Dev	Post-Dev	Δ	%
Downstream (Outside Subject Site)	E	27.7	27.5	-0.3	-1%	20.4	22.9	2.5	12%	35.4	39.0	3.6	10%
Downstream (Outside Subject Site)	F	78.9	75.2	-3.7	-5%	37.5	42.2	4.6	12%	88.4	94.0	5.6	6%
Downstream of Culvert 1	G	92.4	106.2	13.7	15%	246.3	294.8	48.5	20%	345.0	418.3	73.3	21%
Upstream of Culvert 11	H	92.4	106.2	13.7	15%	246.3	294.8	48.5	20%	345.0	418.3	73.3	21%
Downstream of Culvert 12	I	89.9	41.4	-48.5	-54%	242.4	97.6	-144.8	-60%	526.0	243.3	-282.7	-54%
Unspecified Location	K	421.4	516.7	95.2	23%	885.0	1052.7	167.7	19%	842.3	894.7	52.4	6%
Unspecified Location	L	236.3	94.8	-141.5	-60%	492.0	242.5	-249.5	-51%	1010.0	528.7	-481.3	-48%
Downstream of Culvert 3	M	112.4	202.0	89.6	80%	107.0	344.1	237.1	222%	158.0	600.9	442.9	280%
Upstream of Culvert 3	N	462.2	800.0	337.8	73%	719.9	820.9	101.0	14%	612.8	673.9	61.1	10%
Downstream of Culvert 4	O	215.0	232.8	17.8	8%	390.3	420.3	30.0	8%	598.4	656.8	58.3	10%
Upstream of Culvert 4	P	379.4	470.0	90.6	24%	815.0	827.9	12.9	2%	650.2	704.5	54.3	8%
Downstream of Culvert 5	Q	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%
Upstream of Culvert 5	R	0.0	0.0	0.0	0%	0.0	4.7	4.7	0%	18.5	0.0	-18.5	0%
Downstream of Culvert 6	S	38.6	6.5	-32.2	-83%	91.9	40.5	-51.4	-56%	207.8	91.0	-116.8	-56%
Upstream of Culvert 6	T	0.0	0.0	0.0	0%	8.0	8.7	0.6	0%	38.5	38.5	0.0	0%
Downstream of Culvert 7	U	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%	22.4	23.1	0.7	0%
Upstream of Culvert 7	V	0.0	0.0	0.0	0%	20.4	20.4	0.0	0%	47.6	47.6	0.0	0%
Downstream of Culvert 8	W	20.9	17.3	-3.7	-17%	53.8	58.8	5.0	9%	107.5	137.5	30.0	28%
Upstream of Culvert 8	X	28.5	35.9	7.4	26%	81.9	51.0	-30.9	-38%	181.0	67.6	-113.4	-63%
Downstream of Culvert 9	Y	20.7	0.0	-20.7	-100%	68.1	0.0	-68.1	-100%	128.9	0.0	-128.9	-100%
Upstream of Culvert 9	Z	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%
Downstream of Culvert 10	AA	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%
Upstream of Culvert 10	AB	85.7	18.9	-66.8	-78%	238.0	39.7	-198.2	-83%	493.6	44.1	-449.5	-91%
Downstream of Culvert 11	AC	0.0	0.0	0.0	0%	62.5	30.0	-32.5	0%	120.0	70.8	-49.2	0%
Upstream of Culvert 11	AD	729.8	215.0	-514.8	-71%	783.2	486.7	-296.5	-38%	784.7	920.0	135.3	17%
Reach 12	AF	0.0	34.8	34.8	0%	0.0	63.1	63.1	0%	26.9	57.9	31.0	0%
Reach 12	AG	95.5	157.9	62.5	65%	176.7	390.0	213.3	121%	225.3	516.7	291.3	129%
Reach 12	AH	47.5	49.7	2.2	5%	111.7	110.7	-1.0	-1%	91.8	92.6	0.8	1%
Reach 12	AI	85.4	117.3	31.9	37%	223.0	303.3	80.3	36%	225.1	462.5	237.4	105%
Reach 12	AJ	66.3	75.0	8.7	13%	165.3	210.0	44.8	27%	160.0	341.7	181.7	114%
Reach 12	AK	417.1	0.0	-417.1	-100%	881.0	57.5	-823.5	-93%	924.2	80.6	-843.7	-91%
Reach 12	AL	768.8	433.3	-335.4	-44%	911.7	890.0	-21.7	-2%	1020.9	1032.5	11.6	1%
		Overall change			-7%				0%				8%



PLAN



PIPE OUTLET HOLE ARRANGEMENT
DETAIL



SECTION A-A

ABOVE GROUND LEVEL SPREADER OUTLET

(FIGURE C22 - COUNTRYSIDE LIVING TOOLBOX)

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
C	FOR CONSENT	SJO			02/07/25
B	FOR TENDER	MO	PO		15/05/25
A	FIRST ISSUE	JDK			31/01/25

MCKENZIE & CO.

CLIENT: VINEWAY LTD

PROJECT: DELMORE
53A, 53B & 55 RUSSELL ROAD
ŌREWA

TITLE: STORMWATER
T-BAR LEVEL SPREADER
TYPICAL DETAILS

PURPOSE OF ISSUE: FOR CONSENT

SCALE: 1:25m @ A3
DO NOT SCALE

DRAWING NO: 3725-1-4360 REV: C

C:\12DS\DATA\MCKFS01\3725-1 DELMORE STAGE 1_5231\06000. ENGINEERING DESIGN\6500. DRAWINGS\4350.DWG

Ezequiel Silva

From:	Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Sent:	Thursday, 30 April 2026 3:40 pm
To:	Ezequiel Silva
Cc:	James Kitchen; Lachlan Van der Meij; Andrew Rossaak
Subject:	Re: T-Bar flow
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hi Ezequiel

The calculation assumes the whole lot area discharges into the t-bar, which we believe is the worst case scenario for concentrated flow.

In reality, only the roof runoff gets into the t-bar while the remainder of the catchment runoff as a sheet flow. I can't think of an easy way to work this out apart from creating a 2d model with the lots in isolation. We just need to pick a lot that will represent the typical discharge.

As for the energy dissipation measures, there will be ripraps at t-bar outlet to mitigate the velocity

Let us know how you want to proceed.

Haka Subagio CMEngNZ, CPEng, IntPE(NZ), APEC Engineer
Senior Civil Engineer

021 345 593

Level 6, 41 Shortland Street, Auckland 1010
PO Box 259309, Botany 2163
09 320 5707

MCKENZIE & CO.

mckenzieandco.co.nz

From: Ezequiel Silva <Ezequiel.Silva@morphum.com>
Sent: Thursday, April 30, 2026 9:39 AM
To: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Cc: James Kitchen <james@mckenzieandco.co.nz>; Lachlan Van der Meij <Lachlan@mckenzieandco.co.nz>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: T-Bar flow

Hi Haka,

Thanks for providing the calculation. I have a few points to confirm so we can move forward with the geomorphic assessment:

- Design Event: The calculation uses the 10-year ARI (RCP 8.5) and covers 0.03 ha (both impervious and pervious). Can you confirm if the T-bar and internal pipes are designed to manage this specific flow, or will some of it travel via overland flow? I want to make sure we are assessing a realistic discharge for this device.
- Worst-case scenario: To ensure our assessment is complete, please confirm which specific lot or T-bar this calculation represents.
- Velocity: Even with the 6m width and 0.035 Manning's, the velocity is 0.538 m/s. This is above the limit for some soil types. Are there any specific site measures, such as planting or local stabilisation, to manage this at the discharge points?
- Cumulative effects: From my review, it appears there are no locations where multiple T-bars discharge into the same area. Can you please confirm if this is correct?

Please let me know your thoughts on the above.

Ngā mihi | Kind Regards

Ezequiel Silva

ENVIRONMENTAL ENGINEER | MATAARO TAIAO

p. +64 9 377 9779 m. +64 27 487 4840 www.morphum.com

MORPHUM environmental

From: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Sent: Wednesday, 29 April 2026 10:20 am
To: Ezequiel Silva <Ezequiel.Silva@morphum.com>
Cc: James Kitchen <james@mckenzieandco.co.nz>; Lachlan Van der Meij <Lachlan@mckenzieandco.co.nz>
Subject: T-Bar flow

Hi Ezequiel,

This is our calculation for the T-bar discharge, is this information sufficient on your end.

If you could please confirm this is sufficient for your analysis.

Haka Subagio CMEngNZ, CPEng, IntPE(NZ), APEC Engineer
Senior Civil Engineer

021 345 593

Level 6, 41 Shortland Street, Auckland 1010
PO Box 259309, Botany 2163
09 320 5707

MCKENZIE & CO.

mckenzieandco.co.nz

Ezequiel Silva

From: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Sent: Thursday, 30 April 2026 3:23 pm
To: Ezequiel Silva
Cc: James Kitchen; Lachlan Van der Meij; Andrew Rossaak
Subject: RE: T-Bar flow
Attachments: Velocity Output Delmore.xlsx

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Ezequiel

Attached is the duration where the velocity exceeds 0.6m/s per the council table based on the soil type confirmed by Riley.

I am away today, but will send you the location plan tomorrow; this would capture the velocity within the proximity of the culverts.

Be in touch tomorrow.

Feel free to comment on the level of info provided.

Haka Subagio CMEngNZ, CPEng, IntPE(NZ), APEC Engineer
Senior Civil Engineer

021 345 593

Level 6, 41 Shortland Street, Auckland 1010
PO Box 259309, Botany 2163
09 320 5707

MCKENZIE & CO.

mckenzieandco.co.nz

From: Ezequiel Silva <Ezequiel.Silva@morphum.com>
Sent: Thursday, April 30, 2026 2:47 PM
To: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Cc: James Kitchen <james@mckenzieandco.co.nz>; Lachlan Van der Meij <Lachlan@mckenzieandco.co.nz>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: T-Bar flow

Hi Haka,

Following up on my previous email, it would be helpful to clarify a few points and better understand how velocities behave over time at a few key locations.

If available, could you please provide velocity hydrographs or time series for a small number of representative sections, for example:

- a culvert outlet
- a section upstream of a wetland area
- a representative high-risk reach identified in the assessment
- a representative worst-case scenario

This will help us understand how long elevated velocities persist, rather than relying on peak values only.

Let me know what you're able to pull from the model, and we'll work around that.

Ngā mihi | Kind Regards

Ezequiel Silva

ENVIRONMENTAL ENGINEER | MATAARO TAIAO

p. +64 9 377 9779 **m.** +64 27 487 4840 **www.morphum.com**

MORPHUM environmental

From: Ezequiel Silva
Sent: Thursday, 30 April 2026 9:39 am
To: 'Haka Subagio' <Haka.Subagio@mckenzieandco.co.nz>
Cc: James Kitchen <james@mckenzieandco.co.nz>; Lachlan Van der Meij <Lachlan@mckenzieandco.co.nz>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: T-Bar flow

Hi Haka,

Thanks for providing the calculation. I have a few points to confirm so we can move forward with the geomorphic assessment:

- Design Event: The calculation uses the 10-year ARI (RCP 8.5) and covers 0.03 ha (both impervious and pervious). Can you confirm if the T-bar and internal pipes are designed to manage this specific flow, or will some of it travel via overland flow? I want to make sure we are assessing a realistic discharge for this device.
- Worst-case scenario: To ensure our assessment is complete, please confirm which specific lot or T-bar this calculation represents.
- Velocity: Even with the 6m width and 0.035 Manning's, the velocity is 0.538 m/s. This is above the limit for some soil types. Are there any specific site measures, such as planting or local stabilisation, to manage this at the discharge points?
- Cumulative effects: From my review, it appears there are no locations where multiple T-bars discharge into the same area. Can you please confirm if this is correct?

Please let me know your thoughts on the above.

Ngā mihi | Kind Regards

Ezequiel Silva

ENVIRONMENTAL ENGINEER | MATAARO TAIAO

p. +64 9 377 9779 m. +64 27 487 4840 www.morphum.com

MORPHUM environmental

From: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Sent: Wednesday, 29 April 2026 10:20 am
To: Ezequiel Silva <Ezequiel.Silva@morphum.com>
Cc: James Kitchen <james@mckenzieandco.co.nz>; Lachlan Van der Meij <Lachlan@mckenzieandco.co.nz>
Subject: T-Bar flow

Hi Ezequiel,

This is our calculation for the T-bar discharge, is this information sufficient on your end.

If you could please confirm this is sufficient for your analysis.

Haka Subagio CMEngNZ, CPEng, IntPE(NZ), APEC Engineer
Senior Civil Engineer

021 345 593

Level 6, 41 Shortland Street, Auckland 1010
PO Box 259309, Botany 2163
09 320 5707

MCKENZIE & CO.

mckenzieandco.co.nz

Ezequiel Silva

From: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Sent: Friday, 1 May 2026 4:02 pm
To: Ezequiel Silva
Cc: James Kitchen; Lachlan Van der Meij; Andrew Rossaak

Subject: RE: T-Bar flow
Attachments: T-Bar standard drawing.pdf; RE: [External] Material selection; 3725-0-3550.pdf; Velocity Output Delmore.xlsx; HY8 Calcs and Culvert Checklist.xlsx; 20251203 Delmore Culvert Drawings.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Ezequiel

Following up from my email yesterday, please find attached the standard T-bar detail, which shows riprap along the outlet points.

Also attached is a location plan for the section of velocity measurement and duration of the velocity exceeding 0.6m/s

- Design Event: The calculation uses the 10-year ARI (RCP 8.5) and covers 0.03 ha (both impervious and pervious). Can you confirm if the T-bar and internal pipes are designed to manage this specific flow, or will some of it travel via overland flow? I want to make sure we are assessing a realistic discharge for this device.

  This is collecting impervious areas on the site, such as roof, driveway and paths. Realistically not all flows would make it into the pipe so this is conservative. This is generally driven by the building code E1. Where flows exceed capacity, it would spill over and essentially follow flows the same as overland flow paths. It is impossible to capture the full site into a pipe, even though we generally model for this event.
- Worst-case scenario: To ensure our assessment is complete, please confirm which specific lot or T-bar this calculation represents. – This is a typical configuration which represents all the lot within Delmore
- Velocity: Even with the 6m width and 0.035 Manning's, the velocity is 0.538 m/s. This is above the limit for some soil types. Are there any specific site measures, such as planting or local stabilisation, to manage this at the discharge points? We had advice from Riley in regard to the appropriate selection on the Table 2-10, being 0.6. The slopes are topsoiled and planted out. And the T-bars have riprap as shown on standard drawing lodged with application.
- Cumulative effects: From my review, it appears there are no locations where multiple T-bars discharge into the same area. Can you please confirm if this is correct? Yes – no T-bars are discharging on top of each other.

Haka Subagio CMEngNZ, CPEng, IntPE(NZ), APEC Engineer
Senior Civil Engineer

021 345 593

Level 6, 41 Shortland Street, Auckland 1010
PO Box 259309, Botany 2163

From: James Beaumont <jbeaumont@riley.co.nz>
Sent: Monday, 20 April 2026 12:00 pm
To: James Kitchen
Cc: Haka Subagio
Subject: RE: [External] Material selection

The silt loam and alluvial silt is probably the most representative.

From: James Kitchen <james@mckenzieandco.co.nz>
Sent: Monday, 20 April 2026 11:57 am
To: James Beaumont <jbeaumont@riley.co.nz>
Cc: Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Subject: [External] Material selection

Hi James,

Can you confirm if this is the best material selection from the below table for the 1 in 1 fill slopes ?

Thanks

https://www.aucklanddesignmanual.co.nz/content/dam/adm/adm-website/developing-infrastructure/infrastructure-technical-guides/gd08-design-of-inlets,-outlets-and-coastal-outfalls-/GD08_Inlet%20and%20Outlet%20Design_Coastal_July%202025.pdf

Table 2-10: Maximum velocities for erosion control

Material	Maximum velocities for erosion control in unlined channels (m s-1)	Source
Fine sand, colloidal	0.45	B
Sandy loam, noncolloidal	0.50	A
Silt loam and alluvial silt, noncolloidal	0.60	A

Auckland Council Guideline Document: GD08, Version 1, draft, July :

Design of inlets, outlets and coastal outfalls in the Auckland region

Material	Maximum velocities for erosion control in unlined channels (m s-1)	Source
Ordinary firm loam	0.76	B
Volcanic ash	0.76	B
Stiff clay and alluvial silt, colloidal	1.10	A
Shales and hardpans	1.80	A
Fine gravel	0.76	A
Graded loam to cobbles, noncolloidal	1.10	A

James Kitchen CMEngNZ, CPEng, IntPE(NZ)
Director

021 951 230

Level 6, 41 Shortland Street, Auckland 1010
PO Box 259309, Botany 2163
09 320 5707

MCKENZIE & CO.

mckenzieandco.co.nz

Appendix 2. Conceptual instream stabilisation toolbox

The following options are presented as a toolbox of measures that may be used to control high energy flows within the stream system. These examples represent conceptual instream stabilisation and energy dissipation measures that may be considered during detailed design stage development where localised geomorphic sensitivity or concentrated hydraulic forcing is identified. The measures presented are indicative only and are not intended to represent detailed hydraulic, geotechnical, or civil design.

Tool one: Riffles as grade control devices

Riffles are an instream intervention that mimic naturally occurring riffles. This option is a natural approach to stream grading and will assist in controlling energy in erosive flow events, protecting both the stream bed and banks. Riffles are an opportunity for creating habitat enhancing pools, allowing small fish and insects to inhabit the areas surrounding the rocks.

By creating a v-notch in the crest of the riffle, flows are directed towards the centreline of the stream, meaning that less flow is concentrated on channel banks, reducing bank scour, and maintaining pool channel depth downstream.

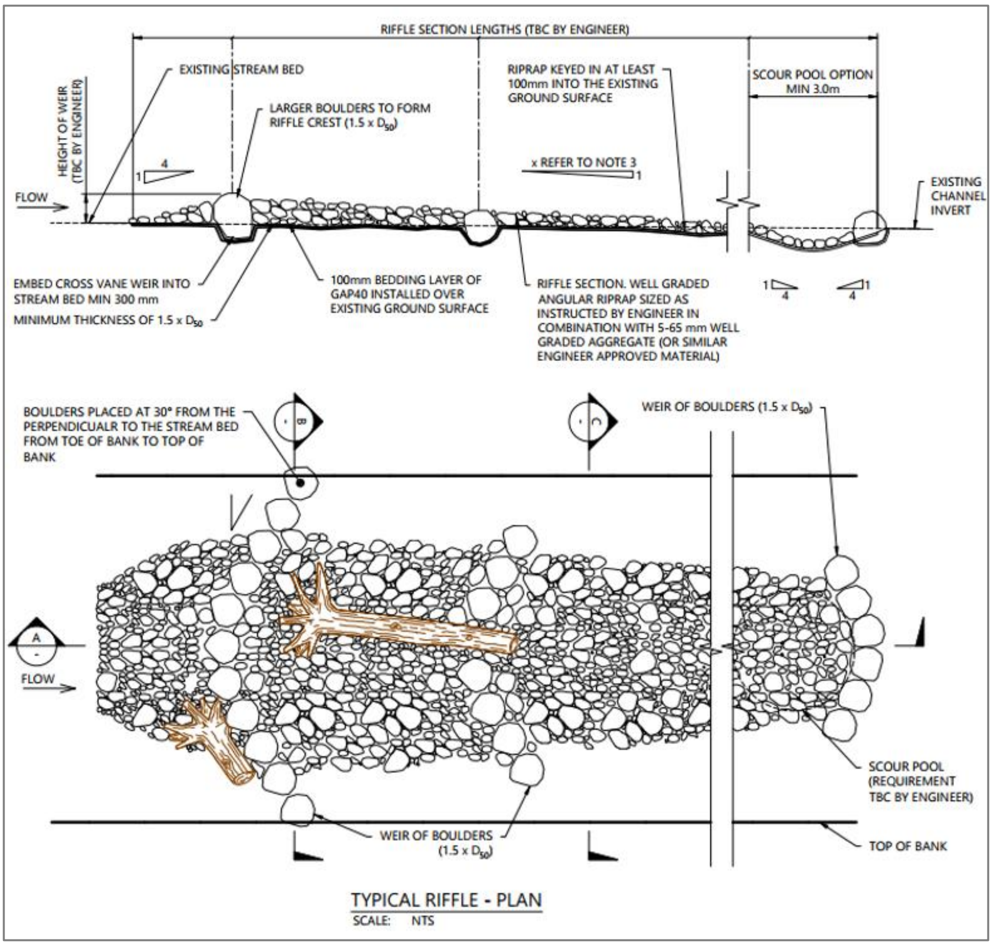


Figure A1: Typical Newbury Rock Riffle design detail

Advantages

- Prevents bed downcutting and localised scour
- Concentrates high velocities within armoured sections
- Directs flows away from channel banks, reducing toe erosion
- Provides habitat enhancement opportunities with a smaller footprint than wholesale rock lining

Opportunity locations

• Upstream of channel bends
• Downstream of steep or high velocity reaches
• Narrow stream sections with suitable site access
• Locations where grade control or flow redirection is required

Limitations

• Additional localised protection measures may still be required at critical scour locations
• Performance reduces during larger flood events where structures become submerged
• Large rock placement may be constrained by site access and constructability

Design considerations

• Riffles act as grade control points to reduce velocities and stabilise channel bed levels
• V-notch crest geometry directs flows toward the channel centreline and reduces bank scour
• Downstream slopes can be designed to maintain fish passage
• Measures may be integrated with localised widening, roughness enhancement, and energy dissipation approaches

Hydraulic considerations

• Riffles introduce localised high resistance zones that assist with energy dissipation and bed stabilisation
• Final sizing and detailed design should be confirmed during subsequent hydraulic and civil design stages

Tool two: Riprap toe protection and bank stabilisation planting

Tool two involves localised riprap toe protection within areas where scour has undermined soft alluvium and vulnerable stream banks. Stabilisation may be supplemented through deep-rooting riparian vegetation resilient to hydraulic loading and wet ground conditions. Riprap acts as a protective barrier between hydraulic forces and exposed soils and may be combined with riffles, spurs, root wads, lunkers, or other energy dissipation measures where additional flow control is required.

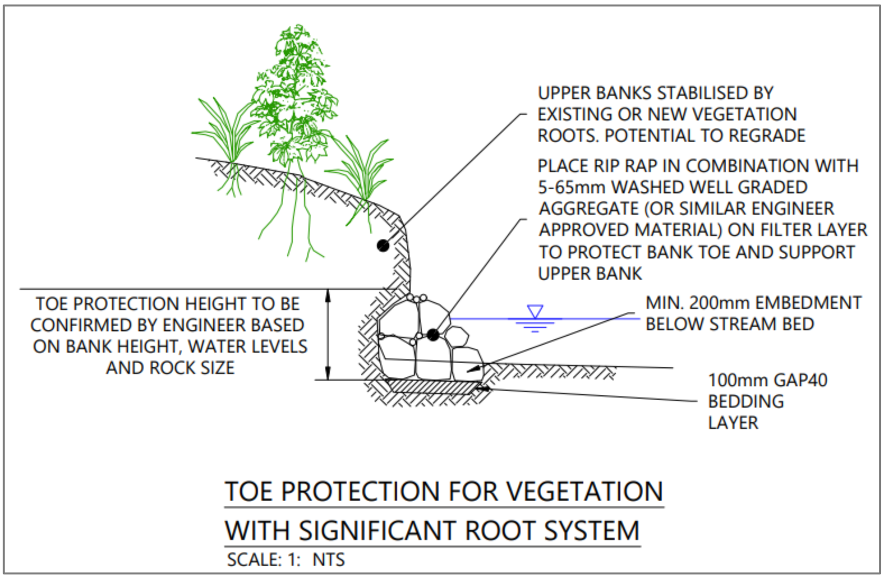


Figure A2. Example of a toe protecting rock armouring

Advantages

• Reduces toe scour and localised bank instability
• Provides habitat and riparian enhancement opportunities
• Can be integrated with vegetative stabilisation and energy dissipation measures

Opportunity locations

• Localised areas affected by toe scour or bank undermining
• Soil-based stream beds and banks vulnerable to erosion
• Reaches requiring localised bank stabilisation

Limitations

• Excavation and embedment requirements may limit applicability at some locations
• Toe protection alone may not protect upper banks during larger flow events
• Less suitable where rapid bed degradation or incision is occurring
• Constructability and rock placement may be constrained by site access and bank conditions

Design considerations

• May be integrated with riffles, spurs, root wads, lunkers, or vegetative reinforcement measures
• Temporary erosion protection may be required during vegetation establishment
• Final sizing, embedment depth, and detailed design should be confirmed during subsequent hydraulic, geotechnical, and civil design stages

Tool three: Timber cross-vane weirs

Cross-vane weirs are instream structures designed to concentrate flows toward the centre of the channel, reducing bank shear stress and localised erosion along channel margins. The structures also function as grade control features, increasing upstream water depth, reducing flow velocities, maintaining sediment transport capacity, and dissipating flow energy. Concentrating stream power toward the channel centreline can also promote pool formation and increase habitat diversity within the stream system.

Cross-vane weirs may be constructed using timber, rock, or hybrid timber-rock configurations.

Advantages

• Reduces bank shear stress and localised bank erosion
• Provides grade control and energy dissipation
• Encourages pool formation and habitat diversity
• Smaller footprint than wholesale channel armouring

Opportunity locations

• Upstream of channel bends
• Steep or high velocity reaches
• Narrow stream sections with suitable site access
• Locations requiring localised grade control or flow redirection

Limitations

• Less suitable within bedrock-controlled or rapidly incising reaches
• Additional localised scour protection measures may still be required

• Performance reduces during larger flood events where structures become submerged
• Constructability may be constrained by access, rock placement, and embedment requirements

Design considerations

• Embedded structures should be designed to resist anticipated flood loading
• Timber and rock elements may require substantial embedment into soil or bed material
• Final sizing and detailed design should be confirmed during subsequent hydraulic, geotechnical, and civil design stages

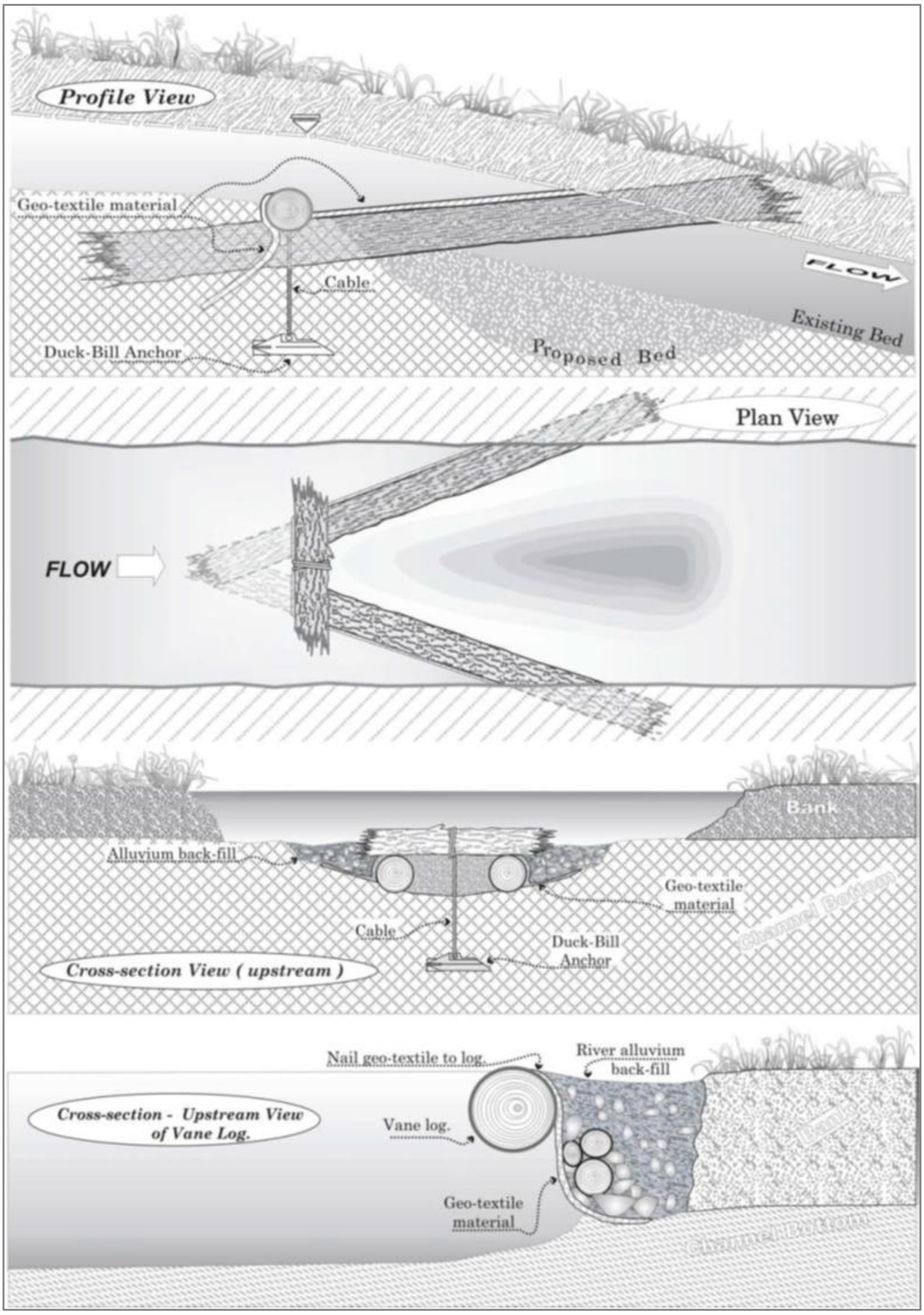


Figure A3: Typical design sketch of a log cross-vane weir, from Wildland Hydrology Inc - Cross-Vane, W-Weir, and J-Hook Vane Structures (Rosgen, 2006)

Tool four: Timber step pools

Step pools are instream grade control structures designed to dissipate flow energy and manage elevation changes within steep or incised channel sections. The structures create a series of controlled drops and localised scour pools, reducing overall flow velocities while maintaining sediment transport capacity and providing habitat diversity within the stream system.

Step pools may be constructed using timber logs, rock boulders, or hybrid timber-rock configurations. Given the existing presence of woody debris within the stream system, timber-based approaches may integrate well with the natural character and ecology of the receiving environment.

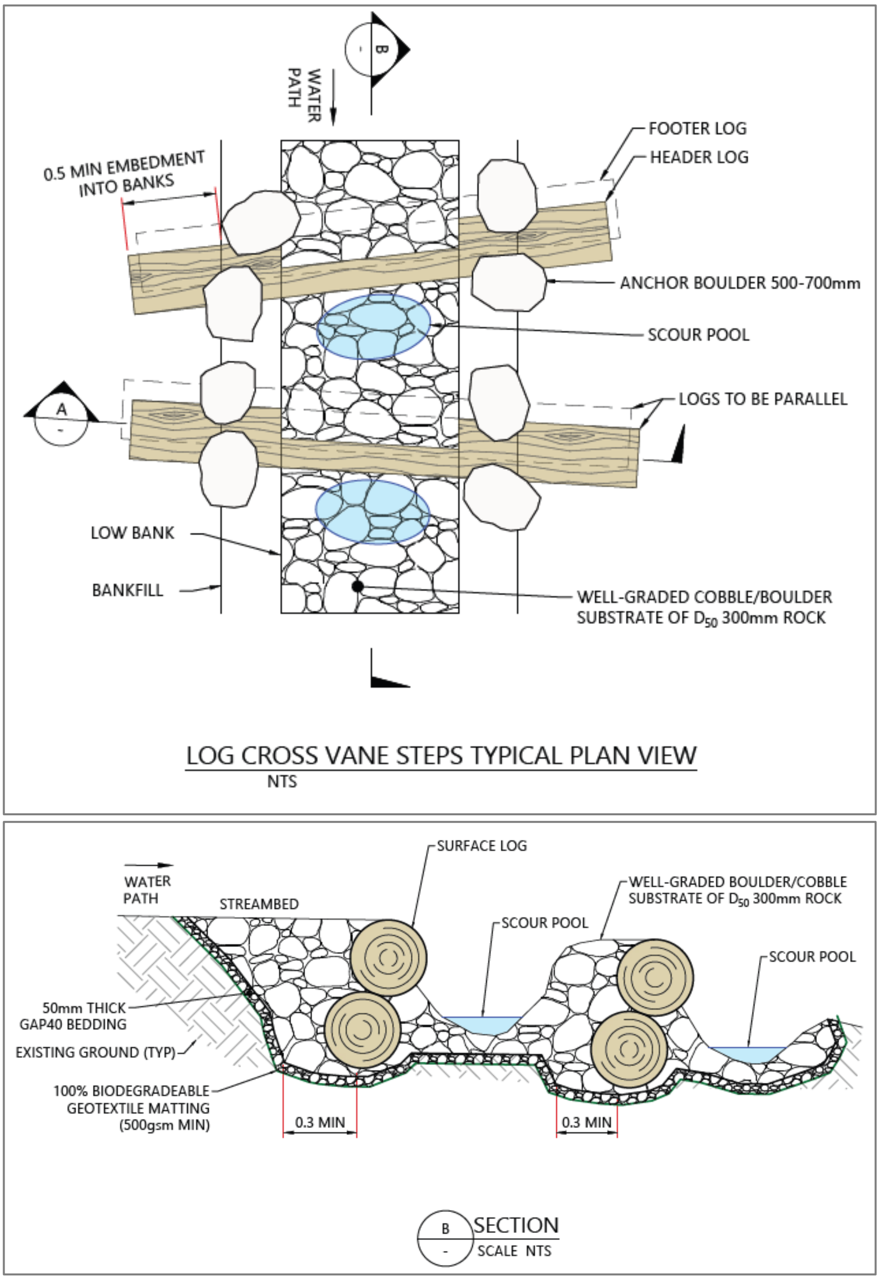


Figure A4: Timber step pool typical detail example

Advantages

- Dissipates flow energy and reduces localised erosion
- Provides grade control within steep or incised reaches

• Encourages pool formation and habitat diversity
• Concentrates high velocities within armoured sections

Opportunity locations

• Steep or high velocity reaches
• Deeply incised channel sections
• Narrow stream reaches with suitable site access
• Locations requiring localised grade control and energy dissipation

Limitations

• Less suitable within bedrock-controlled or rapidly incising reaches
• Additional localised scour protection measures may still be required
• Constructability may be constrained by site access and embedment requirements
• Timber and rock placement may require substantial earthworks and construction access

Design considerations

• Structures may incorporate timber logs, rock boulders, or hybrid configurations
• Embedded elements should be designed to resist anticipated flood loading
• Final sizing and detailed design should be confirmed during subsequent hydraulic, geotechnical, and civil design stages

Figure A5: Timber step pool example in Upper Portland Road stream

Attachment B: Email Correspondence with Healthy Waters

From:	Danny Klimetz
To:	Andrew Rossaak
Cc:	Charlotte MacDonald; Andrew Allsopp-Smith; Ezequiel Silva
Subject:	Re: Delmore fluvial geomorphology
Date:	Friday, 22 May 2026 12:22:29 pm
Attachments:	Outlook-Shape Des.png

Apologies all, I've been swamped and just got to reading my emails. I won't be able to join today in a call...

Thanks Andrew, your summary is correct. A few additions to help highlight the key points:

- The hazards and sensitivities of the natural channels were appropriately identified in the Morphum report.
- At design stage, more detailed assessment will be required to ensure all risks and effects are appropriately avoided or mitigated. This would likely include:
  - A bed and channel management plan, with better quantification of actual incision rates and spatial extents across the affected reaches.
  - That plan should address bed mobility and sidewall instability, but also downstream throttling and flood conveyance concerns.
- My comments have focused on site stability. There may be additional concerns raised by the ecology specialists that would also need to be addressed.
- While BSTEM is a useful tool for estimating channel widening rates over time, I agree it is not necessary at this stage. The risk assessment has already identified the potential hazards, effects, and risks. What is needed now is a clear accounting of those risks and a plan to incorporate appropriate design and mitigation solutions at the detailed design stage.
  - It is worth noting that riparian margin planting and SMAF-type solutions alone are unlikely to be sufficient to fully address all effects or mitigate the identified natural hazards. The channel management plan will need to consider a broader range of interventions.

Just to note I'm providing comment(s) as a SME for my field of Fluvial Geomorphology and not as a representative of Healthy Waters!

Cheers!

Danny Klimetz | Mātanga Aporei | Principal Waterways Planning
Wai Tātai - Waterways Planning | Healthy Waters and Flood Resilience
Mobile | 027 266 8459
Auckland Council | Te Wharau o Tāmaki – Auckland House | Level 17
Visit our website: aucklandcouncil.govt.nz

From: Andrew Rossaak <andrew.rossaak@morphum.com>
Sent: Thursday, May 21, 2026 3:43 PM
To: Danny Klimetz <danny.klimetz@aucklandcouncil.govt.nz>

Cc: Charlotte MacDonald <charlottem@barker.co.nz>; Andrew Allsopp-Smith <andrew.as@mylandpartners.com>; Ezequiel Silva <Ezequiel.Silva@morphum.com>
Subject: Delmore fluvial geomorphology

Hi Danny,

Thanks for taking my call.

As discussed, we have had a project team meeting looking at finalising responses to the Council questions following our previous meeting with you.

The project team are keen to have a meeting with you to confirm the responses. We acknowledge we may not be able to resolve all items, raised but a keen to ensure the submission material will have greater acceptance by council. If you could let us know if you are able and available to meet this week (ideally Fri AM).

From our discussion, I took away the following:

- That the level of detail on the Morphum Fluvial Geomorphology assessment was generally acceptable for the site and that it appropriately highlighted the risk areas.

- The proposed activities in the risk areas should have recognition of and indicate that the identified geomorphological risks will be addressed in the detailed design. In such locations, a BSTEM or probably another more suitable assessments would be useful to inform the detailed design in the risk areas (and therefore not required now).

- That the indications in the Fluvial Geomorphology Report regarding likely incision, riparian widths and risk reaches should be considered in the site works plan. The stream bed is actively incising and the development will likely accelerate this in some areas necessitating stream bed management actions.   These can be expanded upon at detailed design stage.

- Knick point monitoring, with a threshold of migration that will trigger an action, is appropriate. Some of these knick points may be mitigated to an extent by the proposed culverts.

Please let me know if I have miss interpreted anything or if you have any additions.

Again, many thanks for your time on the phone.

Ngā Mihi,

Andrew Rossaak M.Sc
ENVIRONMENTAL SCIENCE LEAD / KAIARATAKI PŪTAIAO AO TŪROA
p. +64 9 377 9779   m. +64 21 638 192   www.morphum.com

MORPHUM ENVIRONMENTAL

Attachment C: Geotechnical Memo

Vineway Ltd
andrew.as@mylandpartners.com

Attention: Andrew Allsopp-Smith

19 December 2025

Riley Ref: 240065-T
Reissue of: 240065-R

Dear Andrew

Geomorphic Impacts on Slope Stability
Delmore Residential Development
Russell Road, Orewa

1.0 Introduction

Further to the request from Charlotte MacDonald acting on your behalf, we have prepared this letter summarising the required amendments to the stability enhancement measures to accommodate the recommended stream setbacks and long-term channel downcutting/alignment considerations. This letter is intended for use by Auckland Council to support Morphum Environmental's (Morphum) response to the feedback from Healthy Waters on the previous Resource Consent application. This letter is not intended to support a new Resource Consent application.

A geomorphic assessment has been completed by Morphum (Ref. Delmore Development Geomorphic Assessment – Final Memo, dated 20 November 2025) following feedback from Healthy Waters requiring an evaluation as to whether the proposed riparian setbacks are appropriate given existing stream conditions and expected future stream adjustments.

The assessment identified areas of the streams (reaches) where geomorphic processes are most relevant and further changes to the design, including geotechnical design, are required to be considered.

2.0 Design Considerations

Within their geomorphic assessment, Morphum identified reaches where further geotechnical assessment was required. The reaches were classified into red, orange and green to differentiate where the offset was acceptable or needed additional consideration. There is a 10m stream restriction set back to all reaches, except Reach 2 which requires a setback of 15m. Where the toe of the design is set back less than 10m, the gradient of the design profile has been steepened to accommodate the required set-back distance. The edges of the proposed building platforms remain unchanged.

The following requirements and design considerations were provided in an email from Morphum on 29 October 2025 (attached).

1. *Green Areas: We are comfortable with the setback distances along these reaches. However, there are some engineering structures alongside the stream, such as palisade walls, MSE walls or road bridges. Where the table indicates a check is required, we would like confirmation that the structures have been designed to take account of the potential for downcutting and widening. The current profiles of streams vary, so for simplicity, assume a stream depth of 2m with a width of 3m and vertical side banks.*
2. *Red and Orange Areas: There is concern that stream adjustment will impact on the Lots and/or structures along these reaches and the current set back distance may be inadequate. In some cases, this appears to be less than 10 m. The location of structures and Lot boundaries should be revised, and we recommend these be at least 10m (and 15 m for Reach 2). Structure design and slope stability should assume a stream depth of 2m with a width of 3m and vertical side banks. While 10 m is proposed as a minimum, there may be instances where other constraints mean this is difficult and we are happy to discuss these on a case-by-case basis.*

3.0 Slope Stability Analyses

We have carried out further slope stability analysis along the Reaches highlighted by Morphum using the cross-sections previously analysed as part of our Geotechnical Investigation Report (GIR, Ref. 240065-F, dated 14 February 2025). For locations where no suitable existing cross-sections were available, we have generated and analysed additional cross-sections (Cross-sections AE to AH).

For the Reaches identified by Morphum that needed further consideration, the stability analyses were updated to consider the long term downcutting and channel widening recommended by Morphum. They also considered amendments to the stability enhancement measures to provide the required riparian setbacks.

The slope stability analysis adopted the same parameters and methodology as presented in Section 5.1 of the GIR and subsequent updates to address scenarios specifically requested by Auckland Council. The finished surface profile used in the analysis was the same as that used in our GIR.

The outcome of the analysis is that some minor changes will be needed to the previously advised concept stability enhancement measures, but that in all cases, adequate Factor of Safety (FoS) were able to be achieved with the inclusion of the geomorphic considerations. A summary of the changes is presented in Table 1 attached. Stability analysis outputs are not attached. It should be noted that the changes included in the table are the minimum changes that were required to achieve the target FoS, and further amendments are likely during the detailed design process, and during any changes to the proposed design.

4.0 Conclusions

The stability analyses have been updated for the Reaches highlighted by Morphum. These give consideration to the potential impact of stream channel adjustments (downcutting/alignment) as recommended by Morphum. The analysis results have shown that some minor adjustments to the stability enhancement measures are required, but in all analysed cases, adequate FoS were able to be achieved.

For future Resource Consent applications, the slope stability analyses will need to be updated for the new design profile and an updated corresponding GIR will be required. Any future slope stability analyses will need to consider the geomorphic design requirements identified by Morphum along the high-risk reaches.

5.0 Limitation

This Letter report has been prepared solely for the benefit of Vineway Ltd as our client with respect to the brief and Auckland Council. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Recommendations and opinions in this letter are based on data from limited test positions. The nature and continuity of subsoil conditions away from the test positions are inferred, and it must be appreciated that actual conditions could vary considerably from the assumed model.

Yours faithfully
<u>**Riley Consultants Ltd**</u>

Prepared by:	Reviewed by:	Approved for issue by:
Alice Boyd	James Beaumont	Brett Black
Engineering Geologist	**Principal Geotechnical Engineer, CPEng**	**Project Director, CPEng**

Enc: Table 1
Table 2
Email from Morphum, dated 29 October 2025

cc: Gus Finlayson, Barker & Associates Ltd (gusf@barker.co.nz)
Charlotte MacDonald, Barker & Associates Ltd (charlottem@barker.co.nz)
Madeleine Wright, Mills Lane Chambers (madeleine.wright@millslane.co.nz)

Table 1: Summary of Updated Slide Analysis Results for Geomorphic Considerations

Critical Level[1]	Reach[1]	Cross Section[2]	Previous Design[2]	Previous Set-Back Distance	Updated Design After Geomorphic Consideration[3]
Red	2	B	REB slope with geogrid and shear pile. NOTE: Cross Section B is at the southern extent of Reach 2. Additional section (AG) has been cut and analysed further north along the reach where distances decrease.	Approx. 15m	No change to remedial design required to meet minimum FoS.
		AG (NEW)	Assumed to be REB slope with geogrid and shear pile (as per proposed remedial concept design in this area).	Approx. 11m	Proposed design meets minimum FoS. REB slope is steepened from 45° to 55° to create 15m set-back distance. Shear pile to 9m depth at 1.5m spacing with shear capacity of 640kN. Geogrids 9.5m lengths at 0.6m vertical intervals, except within 1.2m of surface under a building platform which is limited to 2m long. NOTE: Additional detail and detailed design consideration will be required at the bend and tie in detail with the REB wall between Sections AG and J (i.e. where the building platforms join the proposed road/road crossing).
Red	36	AH (NEW)	Assumed REB slope, geogrid, shear key and counterfort drains (as per proposed remedial concept design in this area).	Approx. 4m	Proposed design meets minimum FoS. REB slope is steepened from 45° to 57° to create 10m setback distance. Shear key is 4m deep and 11m wide. Counterfort drains extending approx. 13m upslope. Geogrid is 10m long, except within 1.2m of surface under a building platform which is limited to 2m long.

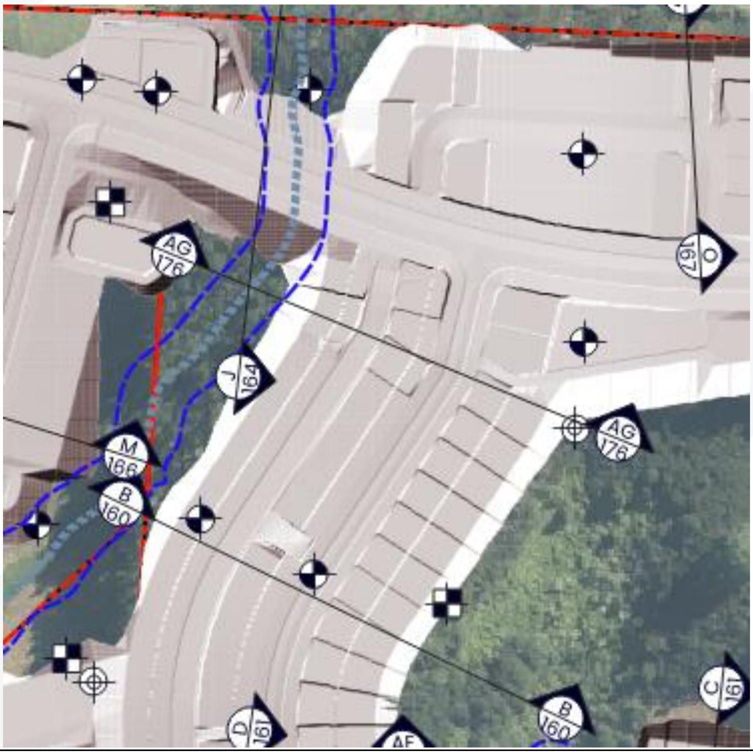
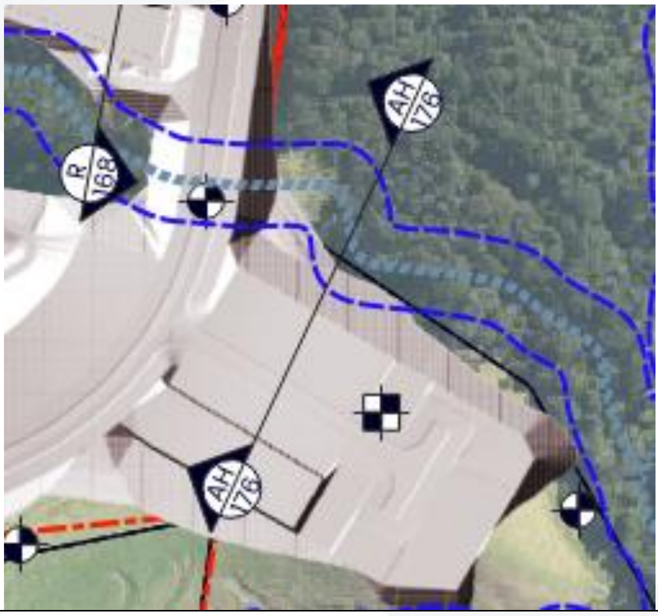
Critical Level[1]	Reach[1]	Cross Section[2]	Previous Design[2]	Previous Set-Back Distance	Updated Design After Geomorphic Consideration[3]
Red	23	R	REB slope with geogrid, shear pile and shear key.	Approx. 7m	REB slope is steepened from 40° to 54° to create 10m set-back distance. Shear pile deepened by 0.5m (3.5m to 4m length) to meet the same assumed rock boundary at this location. Shear key deepened from 1.3m to 2.3m but reduced width from 6.4m to 5.1m. Geogrid increased in length from 5m to 6m.
		AA	REB slope with geogrid and shear key.	Approx. 7.5m	REB slope is steepened from 45° to 51° to create 10m set-back distance. Shear key deepened from 5.4m to 5.7m. Geogrid increased in length from 10-13m to 13.5-14m.
		AB	REB slope with geogrid and shear key.	Approx. 8m	REB slope is steepened from 37° to 39° to create 10m set-back distance. Shear key deepened from 4.2m to 5.3m and widened from 10m to 11m. Geogrid increased in length from 10.5m to between 10.5m and 15.5m.
Red	24	Z	Palisade wall.	>10m	Palisade wall shear capacity increase from 200kN to 250kN. No change required to pile spacing or pile length.
		AA	Refer Reach 23 above.		
Orange	10	L	Retaining wall separating lots.	Approx. 14m	No change to remedial design required to meet minimum FoS.
Orange	29	V (R-L)	REB slope with geogrid, shear pile and counterfort drains.	Approx. 3m	REB slope is steepened from 45° to 63° to create 10m set-back distance. Geogrid length does not need to increase due to change in failure model from increase in gradient of REB slope.

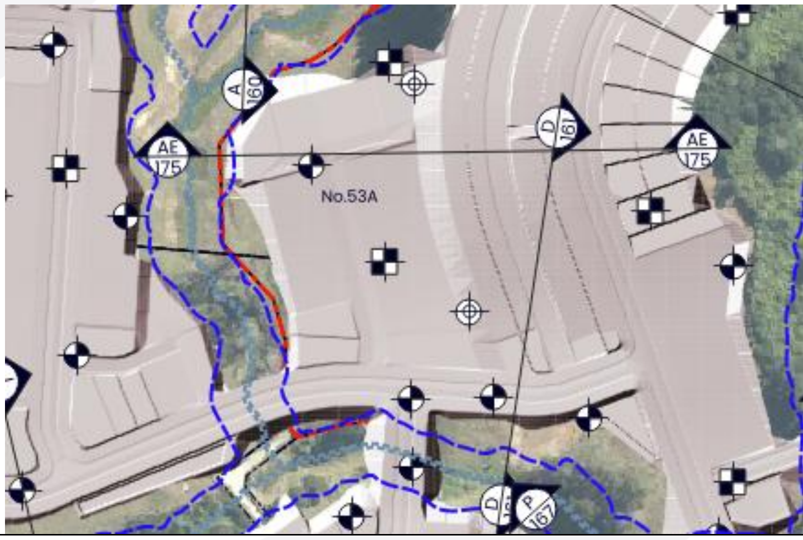
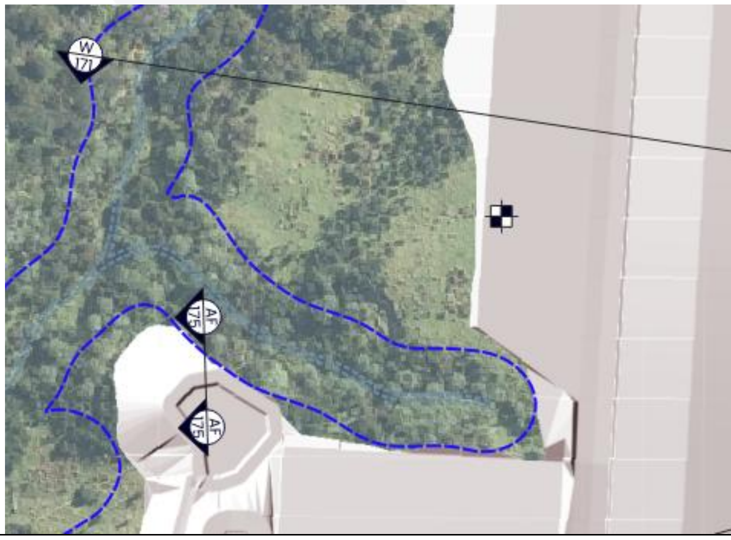
Critical Level[1]	Reach[1]	Cross Section[2]	Previous Design[2]	Previous Set-Back Distance	Updated Design After Geomorphic Consideration[3]
					Shear pile increased from 300kN to 400kN.
Green	7	E (reach 8)	REB slope with geogrid and shear pile.	Approx. 13m	No change to remedial design required to meet minimum FoS.
		F (reach 8)	None.	Approx. 25m	No change to remedial design required to meet minimum FoS.
Green	4	AE (NEW)	Assumed REB slope, geogrid and shear pile.	Approx. 11m	Proposed design meets minimum FoS. REB slope is at 45°. Shear pile to 6m depth at 1.5m spacing with shear capacity of 280kN. Geogrids 4m long, except within 1.2m of the surface under a building platform which is limited to 2m long.
Green	13 - 14	H	REB slope with geogrid and shear pile.	Approx. 8m	REB slope is steepened from 30° to 33° to create 10m set-back distance. Increase in cut to enable placement of engineered fill extending 11m into the slope (previous 9.2m). Geogrid increased in length from alternating 2m and 8.5m to 10m.
		AI (NEW)	Assumed REB slope, geogrid and shear pile.	East – Approx. 22m West – Approx. 12m	Eastern slope: REB slope is 45°. Geogrids 6m long, except within 1.2m of the surface under a building platform which is limited to 2m long. Western slope: REB slope is 55°. Geogrids 7m long, except within 1.2m of the surface under a building platform which is limited to 2m long. Shear pile to 6m depth at 1.5m spacing with shear capacity of 240kN.

Critical Level[1]	Reach[1]	Cross Section[2]	Previous Design[2]	Previous Set-Back Distance	Updated Design After Geomorphic Consideration[3]
Green	32	AF (NEW)	None assigned.	<10m	Cut section: The alignment of the stormwater retention pond would need to be moved in the design to provide the 10m set-back distance. Palisade wall to 4m depth at 1.5m spacing with shear capacity of 280kN (approximately 310UC97 or steel reinforced 600mm-750mm steel reinforced concrete piles) Fill section: REB slope can be steepened from 27° to 33° to create 10m set-back distance. Geogrids to be a minimum of 2m length. Further detailing is required to ensure topsoil stays in place on the steepened batter.

[1] As defined in Delmore Development Geomorphic Assessment - Field Investigation Memo, dated 20 November 2025.
[2] Refer to 250065-F, dated 14 February 2025.
[3] Stability run to include 3m wide x 2m deep stream.

Table 2: Figures Showing Relative Locations of New Cross Sections

Critical Level[1]	Reach[1]	Cross Section	Cross Section Location[2]
Red	2	AG (NEW)	
Red	36	AH (NEW)	

Critical Level[1]	Reach[1]	Cross Section	Cross Section Location[2]
Green	4	AE (NEW)	
Green	13-14	AI (NEW)	
Green	32	AF (NEW)	

[1] As defined in Delmore Development Geomorphic Assessment - Field Investigation Memo, dated 20 November 2025.

Alice Boyd

From: Ezequiel Silva <Ezequiel.Silva@morphum.com>
Sent: Wednesday, 29 October 2025 4:29 pm
To: James Beaumont
Cc: 'James Kitchen'; Jacqui McCord; Djordje Petkovic; Andrew Rossaak; Madeleine Wright; Andrew Allsopp-Smith; Charlotte MacDonald
Subject: Re: Delmore - Geomorphic Risk Assessment

Hi James,

Thanks for your time earlier. Below is a summary of our discussion, including input from Jacqui M and Andrew R from Morphum:

1. Green Areas: We are comfortable with the setback distances along these reaches. However, there are some engineering structures alongside the stream, such as palisade walls, MSE walls or road bridges. Where the table indicates a check is required, we would like confirmation that the structures have been designed to take account of the potential for downcutting and widening. The current profiles of streams vary, so for simplicity, assume a stream depth of 2m with a width of 3m and vertical side banks.
2. Red and Orange Areas: There is concern that stream adjustment will impact on the Lots and/or structures along these reaches and the current set back distance may be inadequate. In some cases, this appears to be less than 10 m. The location of structures and Lot boundaries should be revised and we recommend these be at least 10 m (and 15 m for Reach 2). Structure design and slope stability should assume a stream depth of 2m with a width of 3m and vertical side banks. While 10 m is proposed as a minimum, there may be instances where other constraints mean this is difficult and we are happy to discuss these on a case-by-case basis.
3. There are some areas, i.e., the wetlands, which are at risk of being channelised if the hydrology changes. For these, we are seeking clarification that stormwater controls are being put in place to minimise the change to the current flow hydrograph, i.e., through retention and detention. In general, we don't have concerns about T-Bars from a geomorphic perspective, as these will spread the flow over the slopes rather than create a concentrate discharge point to the stream. We recommend that the slopes around T-bars be vegetated to improve evapotranspiration, enhance bank stability, and slow the flow of the discharge downslope which will reduce the risk of surface scouring.

If you're unsure of what is required for any of the reaches, let us know and we can clarify them for you.

Ngā mihi | Kind Regards

Ezequiel Silva

ENVIRONMENTAL ENGINEER
m. +64 29 124 54570 www.morphum.com

MORPHUM ENVIRONMENTAL

From: Madeleine Wright <Madeleine.Wright@millslane.co.nz>
Sent: Wednesday, 29 October 2025 3:15 pm
To: James Beaumont <jbeaumont@riley.co.nz>; Andrew Allsopp-Smith <andrew.as@mylandpartners.com>; Ezequiel Silva <Ezequiel.Silva@morphum.com>; Charlotte MacDonald <CharlotteM@barker.co.nz>
Cc: 'James Kitchen' <james@mckenzieandco.co.nz>; Jacqui McCord <Jacqui.McCord@morphum.com>; Djordje Petkovic <djordje@mylandpartners.com>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: [External] Re: Delmore - Geomorphic Risk Assessment

Hi all

Thanks for the meeting just now. That was very helpful. Actions below:

1. JM: to come back on JB email and correct understanding about scope of work required (see below first bullet).
2. JM: to address the t-bar in final report explaining why best option from geomorphic perspective.
3. JB: to provide responses on Morphum table regarding how green and orange by end of week, and to advise on estimated timing for reds then too.

Kind regards

Madeleine

Madeleine Wright | Barrister
MILLS LANE CHAMBERS
M +64 27 468 7778
Level 27, 125 Queen Street, Auckland, 1010
PO Box 537, Shortland Street, Auckland 1140

Madeleine Wright | Barrister
MILLS LANE CHAMBERS
M +64 27 468 7778
Level 27, 125 Queen Street, Auckland, 1010
PO Box 537, Shortland Street, Auckland 1140

From: James Beaumont <jbeaumont@riley.co.nz>
Sent: Wednesday, 29 October 2025 9:56 AM
To: Andrew Allsopp-Smith <andrew.as@mylandpartners.com>; Ezequiel Silva <Ezequiel.Silva@morphum.com>; Charlotte MacDonald <CharlotteM@barker.co.nz>
Cc: 'James Kitchen' <james@mckenzieandco.co.nz>; Madeleine Wright <Madeleine.Wright@millslane.co.nz>; Jacqui McCord <Jacqui.McCord@morphum.com>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: [External] Re: Delmore - Geomorphic Risk Assessment

Hi Ezequiel,

Thanks for your time to discuss the implications of your geomorphic assessment for the geotechnical stability enhancement measures.

To summarise our conversation I understand the following:

- That 1-2m of downcutting and 1-2m of channel migration/widening needs to be considered at all locations regardless of whether the reaches are classified as green, yellow or red, and that both need to be considered at each location.
- For the red zone, stability enhancement measures need to be located at least 15m from the stream (where noted, eg Reach 2).
- As discussed the depth to bedrock is variable across the site and at 4-5m depth at a number of locations near the streams. As discussed I understand that a downcutting allowance of only 1-2m needs to be made even where bedrock is at these depths.

- That the 1-2m downcutting and channel migration/widening is estimated to typically occur over a 50yr period.

Can you please confirm that I have captured that correctly. Also I think it would be helpful for those who have to use this and also for the Commissioners/Council if these elements could be explicitly stated so that they can easily understand what the recommended technical response to your assessment is. Perhaps that could be included as a separate section in the text after the summary.

I realise that we have only discussed the matters that have implications for the geotechnical aspects of the development. James K might also have some questions/comments regarding stormwater/hydrology matters.

Please feel free to call if you have any questions.

Regards

James Beaumont
RILEY
M: 022 657 5584

From: Andrew Allsopp-Smith <andrew.as@mylandpartners.com>
Sent: Tuesday, 28 October 2025 9:02 am
To: Ezequiel Silva <Ezequiel.Silva@morphum.com>; Charlotte MacDonald <CharlotteM@barker.co.nz>
Cc: 'James Kitchen' <james@mckenzieandco.co.nz>; James Beaumont <jbeaumont@riley.co.nz>; Madeleine Wright <madeleine.wright@millslane.co.nz>; Jacqui McCord <Jacqui.McCord@morphum.com>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: [External] Re: Delmore - Geomorphic Risk Assessment

Hi James K and James B

Have you reviewed this and made any assessment on the areas?

Regards,

myland PARTNERS

Andrew Allsopp-Smith

m: +64 21 780055
e: Andrew.as@mylandpartners.com
w: mylandpartners.com

From: Ezequiel Silva <Ezequiel.Silva@morphum.com>
Date: Wednesday, 22 October 2025 at 10:51 AM
To: Charlotte MacDonald <CharlotteM@barker.co.nz>
Cc: James Kitchen <james@mckenzieandco.co.nz>, James Beaumont <jbeaumont@riley.co.nz>, Madeleine

Wright <madeleine.wright@millslane.co.nz>, AAaaaa <andrew.as@mylandpartners.com>, Jacqui McCord <Jacqui.McCord@morphum.com>, Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: Delmore - Geomorphic Risk Assessment

Hi Charlotte,

Please find attached the memo with the preliminary findings from our field investigation.
Please let me know if you have any questions.

Ngā mihi | Kind Regards

Ezequiel Silva

ENVIRONMENTAL ENGINEER
m. +64 29 124 54570 www.morphum.com

MORPHUM ENVIRONMENTAL

From: Ezequiel Silva
Sent: Tuesday, 21 October 2025 8:36 am
To: Charlotte MacDonald <CharlotteM@barker.co.nz>
Cc: 'James Kitchen' <james@mckenzieandco.co.nz>; James Beaumont <jbeaumont@riley.co.nz>; Madeleine Wright <madeleine.wright@millslane.co.nz>; Andrew Allsopp-Smith <andrew.as@mylandpartners.com>; Jacqui McCord <Jacqui.McCord@morphum.com>; Andrew Rossaak <andrew.rossaak@morphum.com>
Subject: RE: Delmore - Geomorphic Risk Assessment

Hi Charlotte,

Our draft memo, including the tables and maps, is now under QA review. I'll send it through shortly.

Ngā mihi | Kind Regards

Ezequiel Silva

ENVIRONMENTAL ENGINEER
m. +64 29 124 54570 www.morphum.com

MORPHUM ENVIRONMENTAL

From: Charlotte MacDonald <CharlotteM@barker.co.nz>
Sent: Monday, 20 October 2025 4:45 pm
To: Ezequiel Silva <Ezequiel.Silva@morphum.com>; Jacqui McCord <Jacqui.McCord@morphum.com>; Andrew Rossaak <andrew.rossaak@morphum.com>
Cc: 'James Kitchen' <james@mckenzieandco.co.nz>; James Beaumont <jbeaumont@riley.co.nz>; Madeleine Wright <madeleine.wright@millslane.co.nz>; Andrew Allsopp-Smith <andrew.as@mylandpartners.com>
Subject: Delmore - Geomorphic Risk Assessment

Hi all,

Thanks for the catch-up last week to discuss your findings on the geomorphic risk assessment.

I have cc'd in James Kitchen (McKenzie & Co – civil engineer) and James Beaumont (Riley – geotechnical engineer). Can you please touch base to work through the engineering solutions for the high-risk areas as discussed during the meeting.

Nga mihi | Kind regards,

CHARLOTTE
MACDONALD
Associate
027 296 5383
CharlotteM@barker.co.nz

100 First Avenue,
Tauranga 3110

barker.co.nz

Urban & Environmental

Kerikeri | Whangarei | Warkworth |
Auckland | Hamilton | Cambridge |
Tauranga | Havelock North | Wellington
|
Christchurch | Wanaka & Queenstown