WILLIAMSON
WATER & LAND ADVISORY

Delmore Subdivision - Orewa

Wetland and Culvert Assessment

VINEWAY LIMITED

WWLA1147 | Rev. 2

18 December 2025

Wetland and Culvert Assessment

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Williamson Water & Land Advisory

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1	3 December 2025	Vineway Limited	For planner's review
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Executive Summary

Williamson Water & Land Advisory (WWLA) were commissioned by Vineway Limited in June 2025 to undertake two hydrological assessments:

1. Hydric Soil and Wetland Hydrology Tool Assessments at 16 proposed wetland offset sites as part of the proposed residential development 'Delmore' in Upper Orewa, Auckland ("the Site"). The proposed wetland sites are currently not considered wetland according to their vegetation assemblage, as defined by the project ecologists (Viridis Consultants Ltd). However, each of the proposed sites is adjacent and/or adjoining existing wetlands and will provide a contiguous wetland if the site characteristics are appropriate and if allowed to coalesce into a natural state.
2. Potential effects of installation of proposed culverts on the wetlands.

The following summarises the key findings:

Hydric Soil and Wetland Hydrology Tool Assessments	
Project Objectives	The specific objective of the assessment was to: • Confirm the soil characteristics with a key focus on soil drainage, and the presence or absence of hydric soil and hydrology indicators of natural inland wetlands; and • Map areas where wetland transition would occur naturally without stock grazing, and/or develop interventions to create wetlands where the offset locations were considered suitable, based on the findings of the field assessment.
Methods	All investigations were undertaken in accordance with the Landcare Research (2018) and MfE (2021) guidelines for hydric soil and hydrology assessment for natural inland wetlands. The key focus of this methodology is the presence of hydric soils within the top 300 mm of soil, and/or the presence of a distinct soil horizon showing saturation or severe drainage limitation within the top 400 mm of soil. The work was undertaken during winter, following two days of dry weather. The ground conditions were drier than expected in two areas, with one area showing wetter ground conditions. Across the 16 proposed wetland offset sites, a total of 22 test pits were hand dug to provide an appropriate data coverage that represented the proposed wetland areas based on plan identification by ecologists. Test pits were dug to a depth of 400 mm and hand-augured further to 1,000 mm, with key lithological and morphological characteristics logged as the depth of investigation progressed. Each was measured, photographed and backfilled following investigation.
Summary of Results	In summary, soils comprised: • between 150-400 mm of mostly dryish topsoil, with some areas containing moist topsoil. • Underlying the topsoil was predominantly a clayey silt or silty clay of the East Coast Bays Formation and the Hukerenui Mudstone. • fill containing clayey SILT, with minor gravels was observed in one location (Site 13). • poor permeability in general. The soils examined within the Site were mostly unsaturated, with wetter (moist) topsoil observed in the northwestern portion of the site. Soils had been previously disturbed in one location, as mentioned above with fill present deeper than 1.0 m. All other locations comprised of clayey subsoils underlying topsoil, with generally poor permeability. Out of the 22 sites investigated 20 presented with low chroma soils. Whilst it is important to note that soil colour in the North Auckland area is not the most reliable indicator of hydric soils because of the pale colour of the parent rock material, and also the soil leaching from native podocarp forests that prevailed in this area prior to human inhabitation, the same low chroma soil sites in this case also presented hydrology indicators of wetlands – either rhizospheres, geomorphic position or algal mats. Overall, this suggests that these 20 sites are hydric, and the remaining 2 are not hydric. Most sites displaying hydric soils and hydrology tool indicators were located at landscape features such as a depression in gently undulating areas within an overland flow path (OLFP). These landscape features prevent water from draining freely, which explains the presence of hydric soils and hydrology indicators of wetland.

Key Conclusions	The assessment of potential wetland offset areas within the site using the hydric soil and hydrology delineation tools confirmed 20 sites (all sites except for site 6 and site 9) had both hydric soils and primary and/or secondary wetland hydrology tool indicators, The geomorphic position of the sites are in lowish lying areas adjacent to surface water courses and adjoining existing wetlands, and all sites have relatively low permeability soils. Some of the proposed wetland offset sites were identified as suitable for minor intervention to further impede drainage and provide high confidence that the sites would coalesce into wetland if allowed to return to a natural state. The long thin sites that are on the margin of existing wetlands or short sites between existing wetlands were considered not requiring any intervention other than cessation of stock or vehicle traffic.
Culvert Assessment	
	In our opinion, the proposed culverts have been appropriately designed to minimise and avoid potential effects on wetland hydrology. Two avenues of potential affects were reviewed; 1) concentration of flow (i.e., not maintaining flow across the width of wetland downstream), and 2) dewatering due to culvert embedment. Where wetlands are located immediately downstream, riprap aprons at the culvert outlet will aide in spreading flow laterally, and prevent a channelised discharge (i.e., maintain flow across the width of the wetland downstream), therefore no scour or erosion shall occur in the wetlands as a result of the proposed culverts, there will also not be any incision and draining of the wetlands. Potential effects on wetlands associated with the embedment of new culverts are considered to be a 'temporary impairment' only (i.e., minor in nature, and not permanent), resulting from the temporary and localised lowering of groundwater levels/seepage face. The lowering of groundwater will rapidly decrease over time as a natural bed is re-established. Adverse effects on wetlands are minimised by means of culvert design; culvert spans are sized at 1.3 times the width of the stream bed and will be embedded by 25% of the diameter. Whilst vegetation is not expected to persist within the culverts, this design will retain existing wetland hydrology and substrate through the structures. As a conservative assumption for wetland offset calculations, Viridis have treated all wetland features within the culvert footprints (including substrate and hydrology) as reclaimed.
Key Conclusions	Installation of proposed culverts will not result in adverse effects on the existing wetlands.
Overall Conclusions	**In conclusion, provided the drainage intervention recommendations in this report are implemented, we consider that all proposed wetland offset areas will support wetland hydrology, facilitate the establishment of wetland vegetation, and promote the development of hydric soils.**

Contents

1. Introduction

Williamson Water & Land Advisory (WWLA) were commissioned by Vineway Ltd to undertake Hydric Soil and Wetland Hydrology Tool Assessments in accordance with the guidance in Landcare Research (2018)[1] and MfE (2021)[2] in June 2025 at 16 sites located at 53b, 55 Russell Road and 88, 130 and 132 Upper Orewa Road as part of the Delmore development ("the Site").

The work was required to investigate the 16 sites identified by the project ecologists (Viridis Consultants Ltd) as not currently wetland according to the lack of hydrophytic plant assemblages, and hence potentially suitable as wetland offset areas. Each of the proposed sites is adjacent and/or adjoining existing wetlands and will provide a contiguous wetland if allowed to coalesce into a natural state. Hence, this assessment was focused on understanding how close the soils are to wetland soils and hence confirm whether the proposed wetland offset sites would likely coalesce to wetland if fenced from stock and allowed reach a natural state, or if some form of drainage intervention was implemented.

A previous assessment undertaken by Viridis Consultants Limited identified areas of existing wetlands based on possible hydrophytic vegetation, which are shown in **Figure 1** along with the proposed soil test locations.

WWLA were also commissioned by Vineway Ltd in June 2025 to provide an advice note on the proposed culvert design for the Delmore development in particular regards to the potential negative effects on the identified wetlands. The culvert review is detailed in **Section 7**.

A Geomorphic Risk Assessment undertaken by Morphum Consultants outlines whether culvert design appropriately mitigates risk from a geomorphic perspective. The findings of the Morphum Assessment have been incorporated into this Report.

The report structure is as summarised in **Table 1**.

Table 1. Report structure.

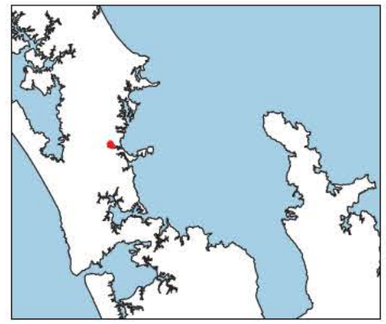
Section	Heading	Description
1	Introduction	Project overview and background.
2	Field Investigation Methodology	Description of the field investigation site and procedures undertaken, as well as an overview of the wetland assessment tools.
3	Environmental Setting	Description of climate, topography and drainage, soils and geology, and previous Investigations.
4	Hydric Soil Tool Assessment	Tool methodology, site specific considerations implementation and results.
5	Hydrology Tool Assessment	Tool methodology, site specific considerations and implementation and results.
6	Drainage Intervention	Description of intervention requirements.
7	Assessment of Culvert Effects on Wetlands	Review of proposed culverts immediately adjacent to wetlands.
8	Conclusions	Results of study.

[1] Landcare Research, 2018. Hydric soils – field identification guide. Consultancy report prepared for Tasman District Council under Envirolink Grant: C09X1702. June 2018.
[2] MfE, 2021. Wetland delineation hydrology tool for Aotearoa New Zealand. Published in July 2021 by the Ministry for the Environment. ISBN: 978-1-99-003362-9. Publication number: ME 1575.

Map Title:
Investigation locations

Project:
Wainui Subdivsion

Client:
Vineway Ltd



Legend

- Site boundary
- Internal boundaries
- 10 m n contours
- Existing Wetlands
- Proposed Wetlands
- Investigation locations

Data Provenance
LINZ 2024
Auckland Council GeoMaps

Drawn by: [redacted]
27/06/2025

Layout & Project File
A3 Landscape Template

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Figure 1.

2. Field Investigation Methodology

2.1 Overview

The investigation was conducted on 17-18 June 2025 by four WWLA environmental scientists.

The weather conditions at the time of the survey were sunny and dry, with temperatures recorded of 15º and 16ºC, respectively. Approximately 17.4 mm of rainfall had occurred 2 days prior on 15 June. The ground conditions were a mix of dry and some discrete areas of ponded water.

Ground cover typically consisted of a mixture of tall grasses, buttercup leaf, sporadic patches of reeds and gorse. Within the northwestern sites (No. 15A-15C and 16B), gorse was a predominant vegetation.

Soil investigation and hydrological inspection were undertaken at 22 assessment locations across 16 proposed wetland offset sites, as shown in **Figure 1** and summarised in **Table 9**. The hydric soil investigation plan was developed at scale of approximately 1:200 (one test per 200 m^2).

Table 2. Schedule of investigation holes at each location.

ID	Area (m^2)	No. Tests
1	268.45	1
2	138.91	1
3	497.15	2
4	133.83	1
5	225.49	1
6	42.48	1
7	36.01	1
8	23.58	1
9	138.47	1
10	619.49	3
11	26.5	1
12	213.27	1
13	135.43	1
14	65.26	1
15	936.2	3
16	363.29	2
TOTAL	3,864	22

2.2 Methodology

The field investigation methodology undertaken at each site involved:

- Hand excavation of a 400 x 400 mm hole to a depth of 400 mm, followed by hand auger of a 60 mm core to a depth of 1,000 mm;
- In 21 out of 22 locations water was poured into the test pits, with the depth of water measured immediately. The water was left to soak into the soils and was remeasured to identify the infiltration rate.

- Describing the soil in accordance with the NZ Geotechnical Society guidelines for soil and rock description, and the requirements for hydric soil identification provided in Section 5 of the Hydric Soils Identification Guide[1], which included:
  - Munsell Soil Colour Book 2009;
  - New Zealand Hydric Soils – Field Identification Guide Sheet; and
  - copies of the wetland soil data form.
- Recording the hydrological indicators of the site.
- In 21 of the 22 test locations, 20 L of water was poured into the test pits, with the depth of water measured immediately. The water level recession within the pits was measured to provide an estimate of the soil infiltration rate.

2.3 Overview of the Wetland Assessment Tools

The key objective of wetland hydric soil and hydrology tools is to aid in identifying and delineating wetlands[3], and are two of the three component suite of tools for conducting this type of wetland assessment, including:

1) Hydrophytic vegetation;
2) Hydric soils; and
3) Hydrology.

It is re-iterated that the site had previously been confirmed by the project Ecologists from Viridis Consultants Ltd as not meeting the hydrophytic vegetation threshold classification as wetlands. Hence, this assessment was focused on understanding whether the soil characteristics resembled wetland soils and hence confirm whether the proposed wetland offset sites would likely coalesce to wetland if allowed.

These tools are based on the US Army Corps of Engineers Wetlands Delineation manual for the USA originally developed in 1987 and refined through the 1990's. Since 1991, this document has been a mandatory requirement for permitting activities that potentially impact on wetlands (amongst other things) under Section 404 of the USA Clean Water Act (CWA). The use of this document is a legislative requirement of the National Policy Statement for Freshwater Management 2022 update.

The wetland hydrology tool outlines assessment procedures for primary and secondary hydrology indicators. To confirm the presence of wetland hydrology, positive identification of the following are required:

- One primary indicator, or
- Two secondary indicators.

There is an overlap in the guidelines between the hydric soil and hydrology tools, hence the guideline suggests the hydrology tool should be concurrently with the hydric soils tool. For this reason, this assignment completes both tasks in both the wetland hydric soil and hydrology tools.

3. Environmental Setting

3.1 Topography and Drainage

Topography and drainage patterns, within the Site, interpolated from high-resolution local LiDAR are indicated in **Figure 2**. Multiple streams traverse the site, accompanied by various overland flow paths running through the site and through the existing and proposed wetland areas. The proposed wetland areas lie within depressions in the topography and are adjacent to existing wetlands.

3.2 Soils

The New Zealand Soil Classification (NZSC) system classifies the soils as Perch-Gley (UP) and Albic Ultic (UE). It should be noted that there was limited information available for these soil classifications due to lack of investigations within this area.

3.3 Geology

The QMap geology for the area is presented in **Figure 3**, indicating the site is primarily underlain by the East Coast Bays Formation Alternating sandstone/siltstone to the north, west and the east of the site, the Hukerenui Mudstone which is part of the Northland Allochthon coming up through the southern central portion of the site.

Table 3. Geologic descriptions.

Map Code	Identifier	Key Group	Rock Group	Age	Description
eMi.sst7 eMi.sst10	East Coast Bays Formation	Waitemata Group	Alternating sandstone/siltstone	Mwe	Alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits.
lKPa.mst2_all	Hukerenui Mudstone	Northland Allochthon	Mudstone	Kkh	Weakly indurated, commonly sheared red, brown, grey and green mudstone.

3.4 Site Locations

The geomorphic setting and important land characteristics to understand the hydrological processes operating at each proposed wetland offset site are summarised in **Table 9**.

Table 4. Summary of geomorphic position.

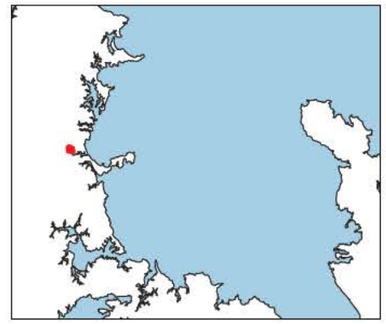
Site	Ground Elevation (mAMSL)	Distance from Stream or OLFP (m)	Average Hydrological Slope (%)	Summary of Ground Conditions (incl. Vegetation Cover)
1	22 to 24	3.5	25	The ground conditions were dry with areas of dry long grass.
2	15 to 12	11	38	The ground conditions were dry, with long grass and gorse to the right of the site location.
3	12 to 15	2	38	The ground conditions were dry and had areas of long grass.
4	11 to 14	0 to 13	12.6	The ground conditions were dry, the test pit location had long grass however within the general site four area the grass would not be considered long. The test pit location was uphill from a culvert.
5	13 to 14	0 to 4	28	The ground conditions were dry and typically covered in shorter grass and sporadic reeds. The test pit location was adjacent to the watercourse.
6	15	1 to 4	7	The ground conditions were dry and typically covered in shorter grasses with sporadic reeds. The test pit location was adjacent to the water course.

Site	Ground Elevation (mAMSL)	Distance from Stream or OLFP (m)	Average Hydrological Slope (%)	Summary of Ground Conditions (incl. Vegetation Cover)
7	17.5	1 to 4	16	The ground conditions were dry and typically covered in longer grass and sporadic reeds. The test pit location was on a farm crossing with the watercourse adjacent.
8	18	1 to 2	25	The ground conditions were dry and on a slope. The vegetation within this area typically comprised of longer grass and sporadic reeds.
9	17 to 20	2 to 4	22	As for site 8.
10	17 to 20	0 to 8	11.4	The ground conditions were within an area of shorter grass. There were no other evident areas of vegetation.
11	21	0 to 4	7	The ground conditions were within an area of shorter grass, with no other types of vegetation. The test pit location was undertaken on a farm crossing.
12	23 to 24	0 to 8	7	The ground conditions were moist, and pugging was evident. Vegetation present within this area included shorter grass and sporadic reeds.
13	30 to 31	1 to 14	<5	The ground conditions were within an area of shorter grass, with no other types of vegetation. The test pit location was undertaken on a farm crossing.
14	30	1 to 10	<5	The ground conditions were dry with long grasses and sporadic reeds. The site location was adjacent to a large, ponded area within the existing wetland.
15	30 to 36	2 to 20	22.8	The ground conditions were moist with long grasses, surrounded by dense gorse. However, the test pit location was not covered in gorse.
16	30	2 to 20	<5	The ground conditions were moist and surrounded by sporadic reeds and long grasses. The test pit location was slightly elevated from the ponded areas.

Map Title:
Topography and Drainage Plan

Project:
Wainui Subdivision

Client:
Vineway Ltd



Legend

- Site boundary
- Internal boundaries
- Overland Flow Paths
- 10 m contours
- Existing Wetlands
- Proposed Wetlands
- Test Pit Locations

Data Provenance
LINZ 2024
Auckland Council GeoMaps

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30/06/2025

Layout & Project File
A3 Landscape Template

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Figure 2.

N

eMi.sst10

eMi.sst7

lKPa.mst2_all

Q5+Q2.und

Upper Orewa Road

Russell Road

0 0.5 1 km

Map Title:
Site Geology

Project:
Wainui Subdivision

Client:
Vineway Limited

Legend

Refined Geology (code colours)

- Q5+Q2.und
- eMi.sst10
- eMi.sst7
- lKPa.mst2_all
- Existing Wetlands
- Proposed Wetlands
- Internal boundaries
- Site boundary
- Roads

Data Provenance
LINZ 2024
Auckland Council GeoMaps

Drawn by: [redacted]
30/06/2025

Layout & Project File
A3 Landscape Template

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Figure 3

4. Hydric Soil Tool Assessment

As discussed in **Section 1**, the hydric soil assessment undertaken in this report was undertaken using the Landcare Research (2018) field guide.

'Hydric soils' is a general term for soils that are poorly or very poorly drained and have a water table above, at, or near the surface long enough during the growing season to develop anaerobic conditions in the upper layers. Gley and Organic soils are the two main orders of hydric soils.

- Gley soils have pale subsoils often with reddish mottles. These colours are indicators of saturated low oxygen conditions.
- Organic soils are also formed in saturated conditions and have at least 300 mm of peaty material.

Generally hydric soils are peaty or humic or have pale light grey subsoil colours caused by saturation and a lack of oxygen. Blotches (mottles) of redder colour can occur in the topsoil or subsoil where air can get into the soil and oxidises iron minerals to form redder colours.

4.1 Indicators

The procedure for hydric soil testing involved examining various soil characteristics indicative of hydric soils including the following:

- ***Field observations and soil colour***: This provided valuable information about soil characteristics that can indicate wetland conditions, including the presence of gleyed colours (grey or bluish-grey), and presence of mottling (speckled, low chroma colours).
- ***Soil morphology***: Morphological features seen in the soil profile can provide details about potentially hydric conditions such as mottling, oxidised root channels, accumulation of organic matter, and presence of iron or manganese concretions can indicate perennial or prolonged wet conditions in the growing season.
- ***Soil structure and texture****:* Proportions of sand, silt, and clay influence water-holding capacity, drainage, and aeration potential. Hydric soils are often characterised by finer textures such as silty or clayey soils with poor drainage.
- ***Soil moisture***: Hydric soils typically exhibit saturated or ponded conditions for a significant portion of the year, resulting in anaerobic conditions that do not require oxygen for growth.
- ***Soil chemistry***: Chemical indicators such as iron and manganese reduction, accumulation of organic matter, and low redox potential, can suggest hydric soil conditions.

Soil colour[4] is one of the key defining feature for identification of hydric soils because the presence of water within the soil profile will affect the colour of soils, depending on the duration of anaerobic conditions. Soils that are subject to prolonged anaerobic conditions with the matrix iron reduced tend to have matrix with low chroma colours. The low chroma colour are typical of hydric soils, as shown in **Figure 4**. Note that dark topsoil colour values of 3 or less are not good indicators of hydric soils as many topsoils have colours in this range.

[4] Describing a colour requires three components: hue, value, and chroma. Hue refers to the colour (e.g. red, orange, yellow), value describes how light or dark the colour is, and chroma rates how bright or vibrant the colour is.

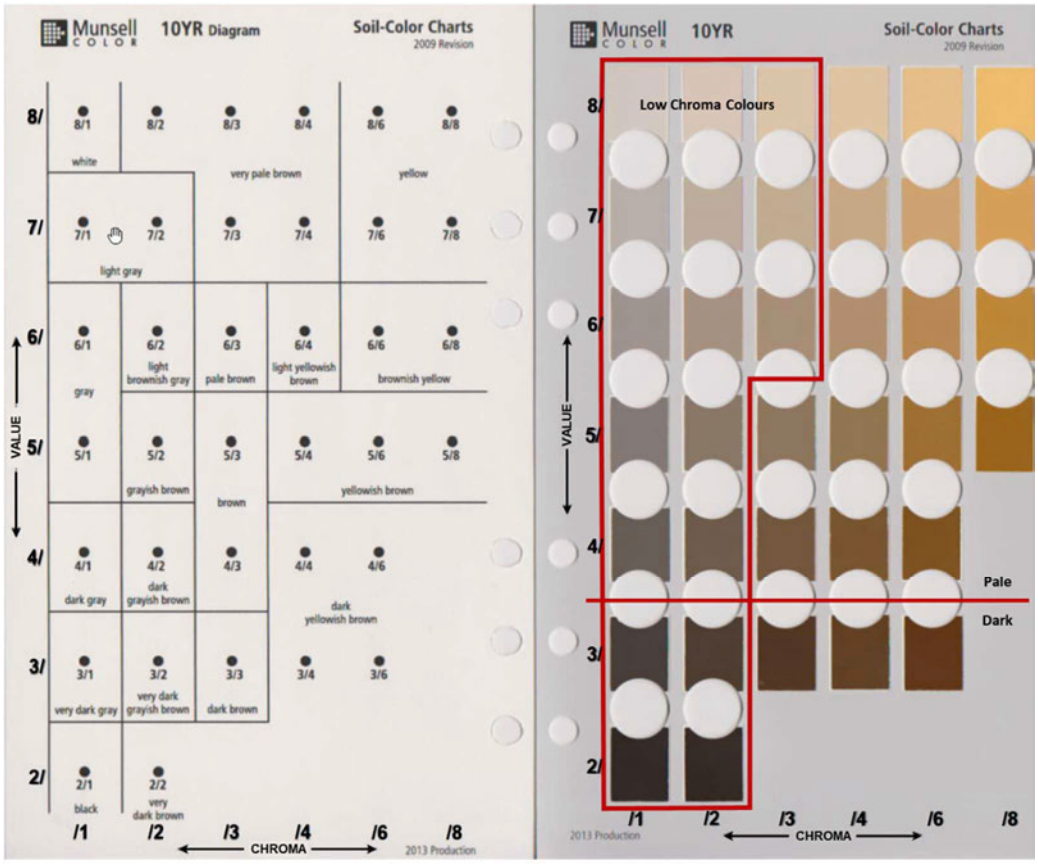


Figure 4. 10YR hue page from a soil colour chart.

A simple indicator for hydric soils is provided in Landcare Research (2018), which is reproduced in **Figure 5**.

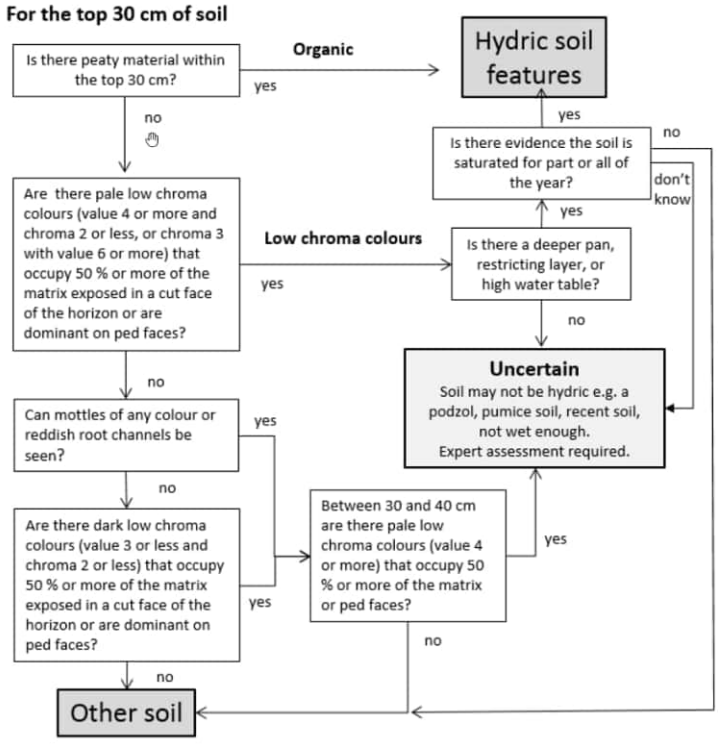


Figure 5. Simple key to identifying hydric soils.

4.2 Results

4.2.1 Soils Description

Details of the observations made at each site are summarised in **Table 5** and full descriptions along with photos are provided in full in **Appendix A.**

Table 5. Summary of hydric soil tests.

Site #	Soil Description Summary		Soil permeability (slow/moderate/ high)	Hydric Soil? (Yes/No/ Uncertain)
	Lithology	Hydric Soil Indicators		
1	0 - 300 mm. TOPSOIL, silt. Very dark grey. Dry and friable. Rootlets present (Topsoil)	Matrix Colour (7.5YR - Value/Chroma): • Topsoil - 3/1 Mottle Colour • Mottles – 5/6 (1%)	Moderate	Y (Marginally hydric based on colour and minor rhizospheres, noting parent geology is light in colour.)
	300 - 750 mm. Clayey SILT. Grey with brownish yellow mottles. Dry, moderate plasticity.	Matrix Colour (7.5YR - Value/Chroma): • Silt - 5/1 Mottle Colour (7.5YR - Value/Chroma): • Mottles - 6/8 (5%)		
	750 - 950 mm. Silty CLAY. Grey, with brownish yellow mottles. Dry and highly plastic.	Matrix Colour (7/5YR - Value/Chroma): • Clay - 6/1 Mottle Colour (7.5YR - Value/Chroma): • Mottles - 6/8 (5%)		
	950 – 1000 mm. Clayey SILT. Grey with brownish yellow mottles. Dry and moderately plastic.	Matrix Colour (7.5YR - Value/Chroma): • Clay - 6/1 Mottle Colour (7.5YR - Value/Chroma): • Mottles - 6/8 (50%)		
2	0 - 200 mm. TOPSOIL, silt. Dark grey, with some rootlets present. Dry and friable.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/1	High	Y (Marginally hydric based on colour, noting parent geology is light in colour.)
	200 - 400 mm. SILT. Yellowish brown, dry and low plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt - 5/4		
	400 - 700 mm. Clayey SILT. Brownish yellow, with yellowish brown mottles with light grey inclusions. Dry, moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Clay – 6/6 with 6/1 inclusions Mottle Colour (10YR - Value/Chroma): • Mottles – 5/8 (5%)		
	700 – 1000 mm Clayey SILT, very pale greyish brown, with brownish yellow mottles. Dry, moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Clay – 7/4 Mottle Colour (10YR - Value/Chroma): • Mottles – 6/8 (5%)		
3a	0 - 300 mm. TOPSOIL, silt. Dark grey. Dry and friable.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/1	Moderate	Y (Marginally hydric based on colour, plasticity and minor rhizospheres, noting parent
	300 - 700 mm. Silty CLAY. Brownish yellow, dry and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 6/6		
	700 - 1000 mm. Silty CLAY. Light yellowish brown, with light	Matrix Colour (10YR - Value/Chroma): • Clay – 6/4 with 7/1 inclusions		

Site #	Soil Description Summary		Soil permeability (slow/moderate/ high)	Hydric Soil? (Yes/No/ Uncertain)
	Lithology	Hydric Soil Indicators		
	grey inclusions and brownish yellow mottles. Dry and highly plastic.	Mottle Colour (10YR – Value/Chroma): • Mottles – 6/8 (5%)		geology is light in colour.)
3b	0 - 300 mm. TOPSOIL, silt. Dark grey. Dry and friable.	Matrix Colour (10YR - Value/Chroma): Topsoil - 4/1	Moderate	Y (Marginally hydric based on colour and minor rhizospheres, noting parent geology is light in colour.)
	300 - 700 mm. Silty CLAY. Brownish yellow, dry and highly plastic.	Matrix Colour (10YR - Value/Chroma): Clay – 6/6		
	700 - 1000 mm. Silty CLAY. Light yellowish brown, with light grey inclusions and brownish yellow mottles. Dry and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 6/4 with 7/1 inclusions Mottle Colour (10YR – Value/Chroma): Mottles – 6/8 (5%)		
4	0 - 300 mm. Topsoil, Clayey SILT. Very dark greyish brown. Some moisture and low plasticity.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 3/2	High	Y (Marginally hydric based on colour, noting parent geology is light in colour.)
	300 - 600 mm. Clayey SILT. Brownish yellow. Some moisture, low to medium plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt – 6/8		
	600 – 1000 mm. Silty CLAY, light grey, with light yellowish-brown streaks. Moderately moist, moderate to high plasticity.	Matrix Colour (10YR - Value/Chroma): • Clay - 7/1		
5	0 - 400 mm. TOPSOIL, silt. Very dark grey with clay inclusions, yellowish brown mottling within the clay. Rootlets are present.	Matrix Colour (10YR - Value/Chroma): • Topsoil – 3/1 (5%) Mottle Colour (10YR – Value/Chroma): • Clay – 5/8	Moderate	Y (Marginally hydric based on colour, noting parent geology is light in colour.)
	400 - 700 mm. Clayey SILT. Yellowish brown with dark grey mottles. Dry, moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt - 5/8 Mottle Colour (10YR – Value/Chroma): • Silt – 4/1		
	700 - 1000 mm. Silty CLAY. Very pale brown with light grey inclusions and brownish yellow mottles. Dry and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 7/4 Mottle Colour (10YR - Value/Chroma): • Mottles - 6/8 (1-5%)		
6	0 – 250 mm TOPSOIL, silt with minor clay. Yellowish brown with dark reddish orange mottles. Rootlets were present, dry.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 5/4 Mottle Colour (10YR - Value/Chroma): • Mottles - 7/8 (1-5%)	Moderate	N
	250 - 350 mm. Silty CLAY. Brownish yellow, moist and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 6/6		

Site #	Soil Description Summary		Soil permeability (slow/moderate/ high)	Hydric Soil? (Yes/No/ Uncertain)
	Lithology	Hydric Soil Indicators		
	350 - 1,000 mm. Clayey SILT. Dark greyish brown, with dark brown mottles. Moist, and moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt - 4/2 Mottle Colour (10YR - Value/Chroma): • Mottles – 3/3 (5%)		
7	0 - 100 mm. TOPSOIL, silt Dark greyish brown, with yellowish brown mottles. Rootlets present, slightly damp.	Matrix Colour (10YR - Value/Chroma) • Topsoil – 4/2 Mottle Colour (10YR – Value/Chroma): • Topsoil – 5/8 (10%)	Moderate	Y
	100 – 200 mm. Peat. Black, slightly damp and contains some charcoal pieces.	Matrix Colour (10YR - Value/Chroma) • Peat – 2/1		
	200 – 500 mm. Clayey SILT. Yellowish brown, with yellowish brown mottles. Dry, low plastic.	Matrix Colour (10YR - Value/Chroma) • Silt – 5/6 Mottle Colour (10YR – Value/Chroma): • Silt – 5/8 (10%)		
	500 – 1000 mm. Clayey SILT, light grey with yellowish brown streaks and mottles. Dry, moderate plasticity.	Matrix Colour (10YR - Value/Chroma) • Silt – 7/2 Mottle Colour (10YR – Value/Chroma): • Silt – 5/8 (10%)		
8	0 - 100 mm. TOPSOIL, silt with minor clay, very dark brown. Moderate moisture and low plasticity.	Matrix Colour (10YR - Value/Chroma): • Topsoil – 2/2	Moderate	Y (Marginally hydric based on colour, noting parent geology is light in colour.)
	100 - 600 mm. Silty CLAY. Light brown, some moisture and moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 5/8		
	600 - 1000 mm. Silty CLAY, yellow with light grey streaks. Some moisture, moderate to high plasticity.	Matrix Colour (10YR - Value/Chroma): • Clay – 7/6		
9	0 - 300 mm. TOPSOIL, Clayey SILT. Yellowish brown, some moisture and some plasticity.	Matrix Colour (10YR - Value/Chroma): • Topsoil – 5/8	Moderate	N
	300 - 600 mm. Silty CLAY. Yellow, with light grey streaks. Some moisture and moderate to high plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt – 7/6		
	600 - 1000 mm. Silty CLAY. Brownish yellow, dark orange inclusions. Moderately moist, low plasticity.	Matrix Colour (10YR - Value/Chroma): • Clay - 6/6		
10A	0 - 300 mm. TOPSOIL, Clayey silt. Dark brown. Some moisture, low plasticity.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 3/2	Moderate	Y (Marginally hydric based on

Site #	Soil Description Summary		Soil permeability (slow/moderate/ high)	Hydric Soil? (Yes/No/ Uncertain)
	Lithology	Hydric Soil Indicators		
	300 - 600 mm. Clayey SILT. Brownish yellow, some moisture, low to moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt – 6/8		colour, noting parent geology is light in colour.)
	600 – 1000 mm. Silty CLAY, light grey with light orange, brown streaks. Moderately moist, moderate to highly plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 7/1		
10B	0 - 300 mm. TOPSOIL, silt, very dark grey, with dark yellowish-brown mottles. Rootlets present.	Matrix Colour (10YR - Value/Chroma): • Topsoil – 3/1 Mottle Colour (10YR – Value/Chroma): • Topsoil – 3/6 (2%)	Moderate	Y (Marginally hydric based on colour, noting parent geology is light in colour.)
	300 - 500 mm. Clayey SILT. Yellowish brown, with brownish yellow mottles and grey inclusions. Dry, with low plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/4 Mottle Colour (10YR – Value/Chroma): • Silt – 6/8 (2%)		
	500 - 1000 mm Clayey SILT. Very pale brown, with yellowish brown mottles and streaks, dry and moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 7/3 Mottle Colour (10YR – Value/Chroma): • Silt – 5/8 (2%)		
10C	0 - 200 mm. TOPSOIL, silt. Very dark greyish brown, with brownish yellow mottles. Dry.	Matrix Colour (10YR - Value/Chroma): • Topsoil – 3/2 Mottle Colour (10YR – Value/Chroma): • Topsoil – 6/6 (5%)	Moderate	Y (Marginally hydric based on colour and rhizospheres, noting parent geology is light in colour.)
	200 – 1000 mm. Clayey SILT. Yellow with light grey streaks and yellow mottles. Dry, moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 7/8 Mottle Colour (10YR – Value/Chroma): • Silt – 7/8 (10%)		
11	0 - 200 mm. TOPSOIL, Silt with minor clay. Dark greyish brown with dark yellowish-brown mottles. Moist, some plasticity.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/2 Mottle Colour (10YR - Value/Chroma): • Mottles - 3/6 (10%)	Moderate	Y (Marginally hydric based on colour and rhizospheres, noting parent geology is light in colour.)
	200 - 300 mm. Clayey SILT. Greyish brown with yellow mottles. Dry with moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt - 5/2 Mottle Colour (10YR – Value/Chroma): • Mottles – 7/8 (5%)		
	300 - 1,000 mm. Clayey SILT. Light grey with yellow streaks and mottles. Dry, moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt – 7/1 Mottle Colour (10YR – Value/Chroma): • Mottles – 7/8 (5%)		
12	0 - 200 mm. TOPSOIL, Silt. Dark grey with dark yellowish-brown mottles. Dry and friable.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/1 Mottle Colour (10YR – Value/Chroma): • Mottles – 3/6 (5%)	Moderate	Y (Marginally hydric based on colour and

Site #	Soil Description Summary		Soil permeability (slow/moderate/ high)	Hydric Soil? (Yes/No/ Uncertain)
	Lithology	Hydric Soil Indicators		
	200 - 400 mm. Clayey SILT, with peat. Black with dark yellowish-brown mottles. Dry and moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 2/1 Mottle Colour (10YR – Value/Chroma): • Mottles – 3/6 (5%)		rhizospheres, noting parent geology is light in colour.)
	400 – 1000 mm Silty CLAY, black. Moist and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 2/1		
13	0 - 200 mm. TOPSOIL, silt. Dark grey with dark yellowish-brown mottles. Dry, rootlets present.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/1 Mottle Colour (10YR – Value/Chroma): • Topsoil – 3/4 (10%)	Slow	Y (Marginally hydric based on colour and rhizospheres, noting parent geology is light in colour.)
	200 - 1000 mm. Clayey SILT (Fill). Dark yellowish brown. Gravels were observed at 0.7 m.	Matrix Colour (10YR - Value/Chroma): • Silt – 4/6		
14	0 - 300 mm. TOPSOIL, silt. Dark greyish brown with dark yellowish-brown mottles. Dry and moderate plasticity.	Matrix Colour (7.5YR - Value/Chroma): • Topsoil - 4/2 Mottle Colour (7.5YR – Value/Chroma): • Mottles – 4/6 (10%)	Moderate	Y (Marginally hydric based on colour and rhizospheres, noting parent geology is light in colour.)
	300 - 1000 mm. Clayey SILT. Brownish yellow with light grey streaks, dry, moderate plasticity when moistened.	Matrix Colour (10YR - Value/Chroma): • Silt – 6/6 Streak Colour (10YR - Value/Chroma): • Streaks - 7/1		
15A	0 - 150 mm. TOPSOIL, Silt. Very dark greyish brown. Dry, friable.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 3/2	Moderate	Y (Marginally hydric based on colour and rhizospheres, noting parent geology is light in colour.)
	150 - 400 mm. SILT with minor clay. Dark greyish brown. No mottles but rhizospheres were present. Dry and friable.	Matrix Colour (10YR - Value/Chroma): • Silt - 4/2		
	400 - 500 mm. Clayey SILT. Yellowish brown with some mottles yellowish brown. Dry.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/4 Mottle Colour (10YR – Value/Chroma): • Mottles – 5/8 (5%)		
	500 – 800 mm. Clayey SILT, minor sand. Yellowish brown. Dry, moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/4		
	800 – 1000 mm. Silty CLAY, minor sand. Yellowish brown. Dry, highly plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/6		
15B	0 - 150 mm. TOPSOIL, Silt. Grey. Saturated. Slight sulfuric smell.	Matrix Colour (10YR - Value/Chroma): Topsoil - 5/1	Water table at surface, infiltration test not undertaken	Y
	150 - 600 mm. Silty CLAY. Light grey with brownish yellow mottles. Saturated and highly	Matrix Colour (10YR - Value/Chroma): • Silt - 7/1 Mottles Colour (7.5YR – Value/Chroma):		

Site #	Soil Description Summary		Soil permeability (slow/moderate/ high)	Hydric Soil? (Yes/No/ Uncertain)
	Lithology	Hydric Soil Indicators		
	plastic. EOH as everything was saturated and material was consistent.	Mottles – 6/8 (20%)		
15C	0 - 150 mm. TOPSOIL, Silt. Dark grey. Moist.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/1	Moderate	Y (Marginally hydric based on colour and rhizospheres, noting parent geology is light in colour.)
	150 - 450 mm. Clayey SILT, grey with brownish yellow clay inclusions. Moist and sticky with moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Clay - 5/1		
	450 - 1000 mm. Clayey SILT, light yellowish brown with yellow mottles and rhizospheres. Moist and moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Clay - 6/4 Mottles Colour (10YR – Value/Chroma): Mottles - 7/6 (10%)		
16A	0 - 300 mm. TOPSOIL, Silt, greyish brown with yellowish brown mottles. Moist.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 5/2 Mottles Colour (7.5YR – Value/Chroma): • Mottles – 5/8 (15-20%)	Moderate	Y
	300 - 900 mm. Clayey SILT. Light yellowish brown. Relatively dry and moderately plastic.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/2 Mottles Colour (7.5YR – Value/Chroma): • Mottles – 6/4 (2%)		
	900 – 1000 mm. Silty CLAY. Dark brown. Moist and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 3/3		
16B	0 - 200 mm. TOPSOIL, silt. Dark greyish brown with yellowish brown mottles. Moist.	Matrix Colour (10YR - Value/Chroma): • Topsoil - 4/2 Mottle Colour (10YR – Value/Chroma): • Mottles – 5/6 (5%)	Moderate	Y
	200 - 400 mm. Clayey SILT. Grey, with dark yellowish-brown mottles. Moist and moderately plastic. GW encountered at 350 mm. GW soil seepage at 270 mm.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/1 Mottle Colour (10YR – Value/Chroma): • Mottle – 3/4 (40%)		
	400 - 800 mm. Clayey SILT. Yellowish brown with dark yellowish-brown mottles. Moist with moderate plasticity.	Matrix Colour (10YR - Value/Chroma): • Silt – 5/4 Mottle Colour (10YR – Value/Chroma): • Mottle – 4/6 (10%)		
	800 - 1000 mm. Silty CLAY, light yellowish brown with light grey streaks and brownish yellow mottles. Moist and highly plastic.	Matrix Colour (10YR - Value/Chroma): • Clay – 6/4 Mottle Colour (10YR - Value/Chroma): • Mottles - 6/6 (5%)		

Of the 22 total tests pits, the hydric soil tool assessment found 20 pits that displayed hydric soil conditions within the top 400 mm.

One of the test pits (Site 13) contained fill material extending deeper than 1.0 m. As noted in **Table 5** there are 15 location which have been classified as marginal hydric soils due to soil colour, with 10 of those locations also containing oxidised rhizospheres on the roots.

4.2.2 Soil Infiltration Testing

Soil permeability reflects the rate at which surface water drains through the soil. It is influenced by factors such as potential rooting depth, the depth to any slowly permeable horizons, and internal soil drainage, which in turn depend on soil texture, structure, and density.

The permeability classes and their equivalent flow rates (mm/hr) from Clayden and Webb (1994) are as shown in **Table 6**, while **Table 9** shows the infiltration rates at each site.

Table 6. Soil permeability classes.

Class	Rate (mm/hr)
Slow	< 4
Moderate	4-72
High	>72

Table 7. Summary of soil infiltration test results.

Site ID	Test Duration (hr)	Water Level Change (m)	Water Drainage (mm/hr)	Soil Permeability Class	Observations
1	7	0.1	14	Moderate	
2	0.25	0.07	280	High	
3A	6	0.21	35	Moderate	
3B	6	0.21	35	Moderate	
4	0.25	0.03	120	High	Seepage at bottom of the hill.
5	4	0.17	43	Moderate	
6	4	0.20	50	Moderate	On soil bridge that has likely been built up. Thus, likely unnatural profile
7	4	0.20	50	Moderate	
8	3.75	0.233	62	Moderate	
9	3.75	0.05	13	Moderate	
10A	5	0.06	12	Moderate	
10B	5	0.06	12	Moderate	
10C	2.25	0.09	40	Moderate	
11	2	0.01	5	Moderate	
12	0.75	0.05	67	Moderate	
13	0.17	0	0	Low	
14	4	0.12	30	Moderate	
15A	0.25	0.04	160	Moderate	
15B	N/A	N/A	N/A	N/A	Water table at surface. No infiltration test possible.

Site ID	Test Duration (hr)	Water Level Change (m)	Water Drainage (mm/hr)	Soil Permeability Class	Observations
15C	0.5	0.04	80	Moderate	
16A	5.5	0	0	Moderate	Substantial core loss on auger. Seepage into dug hole.
16B	1.5	0.01	7	Moderate	

5. Hydrology Tool Assessment

Wetland hydrology can be defined as encompassing all hydrological characteristics of areas that are periodically inundated or have soils saturated to, or near, the surface during a portion of the growing season (based on US Army Corp of Engineers - Environmental Laboratory, 1987). To meet the standard for wetland hydrology, an area must be:

- Inundated for at least seven consecutive days during the growing season in most years (50 per cent probability of recurrence); or
- Saturated at or near the surface for at least 14 consecutive days during the growing season in most years (50 per cent probability of recurrence, for example, 5 years in 10).

Soils may be considered saturated if the water table is within:

- 150 mm of the surface for sands; and
- 300 mm of the surface for all other soils.

5.1 Indicators

Hydrology indicators are one-off observations that identify the presence or absence of a wetland in areas where hydrophytic vegetation and hydric soils are present or uncertain. Wetland delineation using the hydrology tool should be undertaken during periods of 'normal rainfall'. Because hydrology indicators can be highly transient, a follow-up visit may be required during normal and wetter periods of the growing season.

There are four indicator groups identified in the guidelines:

- Observation of flooding or groundwater;
- Evidence of flooding or ponding;
- Soil saturation; and
- Landscape, vegetation and soil observations (which may overlap with the vegetation and hydric soil tools).

Group 1 are primary indicators and Groups 2 to 4 have a mix of primary and secondary indicators. The presence of one primary indicator, or two secondary indicators, confirms the presence of a wetland. The full suite of 26 hydrology indicators are summarised in **Table 8**.

Table 8. Summary of wetlands hydrology indicators.

Indicator	Primary	2ndary	Observation Description ("observed in the area of interest during the growing season")
Group 1: Observation of flooding or groundwater			
1A: Surface water	✓		Surface water can be observed in the form of either flooding or ponding.
1B: Groundwater	✓		A high water table is observed within 30 centimeters of the soil surface as determined by soil pit, auger hole or shallow monitoring well.
1C: Soil saturation	✓		Soil saturation is observed in the top 30 centimeters of the soil profile. Indicated by 'water glistening on the surfaces and broken interior faces of the soil samples removed from a pit or auger hole'. Pg 19.
Group 2: Evidence of flooding or ponding			
2A: Water marks	✓		Water marks (discoloration or staining) are seen on trees, rocks, fences or other fixed objects. Lichen may also be absent below the flooding level.
2B: Sediment deposits	✓		Thin layers or coatings of fine mineral material (e.g., silt or clay) or organic matter (e.g., pollen) are seen on trees, rocks or other fixed objects.
2C: Drift deposits	✓		Debris (e.g., branches, leaves, plastic fragments) are seen deposited on the ground surface or entangled in vegetation or other fixed objects.

Indicator	Primary	2ndary	Observation Description ("observed in the area of interest during the growing season")
2D: Agal mat or crust	✓		An algal mat or crust is seen on or near the soil surface after the water has drained away.
2E: Iron deposits	✓		A thin orange or yellow crust or gel or oxidised iron is seen on or near the soil surface or as a sheen on standing water.
2F: Surface soil cracks	✓		Surface soil cracks are seen where mineral or organic sediment dry and shrink to form a network of cracks or polygons.
2G: Inundation visible on aerial imagery	✓		Inundation is seen on one or more recent aerial or satellite images.
2H: Sparsely vegetated concave surface	✓		A lack of vegetation (less than 5 per cent coverage) is seen on concave land surfaces resulting from prolonged ponding.
2I: Salt crust	✓		Hard or brittle deposits of salts are seen on the ground surface, usually in depressions, seeps or lake fringes, after evaporation of saline surface water.
2J: Aquatic invertebrates	✓		Numerous live or dead aquatic invertebrates, including diapausing eggs, remains of aquatic invertebrates, such as aquatic snails or crustaceans, are seen on the soil surface or plants or other emergent objects.
2K: Water-stained leaves	✓	✓	Water-stained grey or black leaves are visible due to long periods of saturation during the growing season
2L: Drainage patterns		✓	Areas that have recently experienced overland water flow may show soil erosion, low vegetation bent in the direction of water flow, or absence of leaf litter or small woody debris.
Group 3: Evidence of current or recent soil saturation			
3A: Hydrogen sulphide odour	✓		Hydrogen sulphide odour, similar to rotten eggs, is detected from the top 30 centimeters of the soil profile. Hydrogen sulphide is produced in soils only when saturation has been prolonged.
3B: Oxidised rhizospheres along living roots	✓		A soil horizon with greater than or equal to 2 per cent iron-oxide (orange coating) can be seen on the surfaces of living roots or soil pores immediately surrounding the roots within the top 30 centimeters of the soil profile.
3C: Reduced iron	✓		A soil layer containing reduced iron in the top 30 centimeters of the soil profile can be seen where the soil changes colour upon air exposure.
3D: Recent iron reduction in tilled soils	✓		A soil layer containing greater than or equal to 2 per cent redox concentrations (mottles) is visible in pore linings of masses in a soil that has been tilled less than two years ago within the tillage zone or the top 30 centimeters of the soil profile, whichever one is shallower.
3E: Dry-season water table		✓	A water-table depth between 30 centimeters and 60 centimeters of the soil profile can be seen during the normal dry season or a drier-than-normal period of the year.
3F: Saturation visible on aerial imagery		✓	Visual assessment of one or more aerial or satellite images can identify sites where soil saturation corresponds to depressions, drainage patterns, crop management, field verified hydric soils or other evidence of a seasonally high-water table during the growing season
Group 4: Evidence from other site conditions or data			
4A: Stunted or stressed plants	✓		It can be seen that most plants in cultivated or planted wetland areas are smaller, less vigorous or appear more stressed compared with neighbouring non-wetland areas
4B: Geomorphic position		✓	The possible wetland may be seen in a localised depression, swale, drainage system, concave position in a floodplain, at the toe of a slope, on extensive flatland, the low-elevation fringe of a pond or waterbody, or groundwater discharge zone.
4C: Shallow aquitard		✓	A semi-permeable–impermeable layer is confirmed within 60 centimeters of the soil surface, which decreases movement of groundwater and causes a perched water table within 30 centimeters of the soil surface. This semi-permeable–impermeable layer can be composed of clay or non-porous rock.
4D: Facultative-neutral test		✓	Plant test – normally done by ecologists.

Indicator	Primary	2ndary	Observation Description ("observed in the area of interest during the growing season")
4E: Frost-heave hummocks		✓	Frost-heave hummocks are produced as water-logged soils undergo freeze–thaw processes. Exclude livestock pugging hummocks.

5.2 Results

Full test data sheets and a table summarising the findings are provided in **Appendix B**.

With respect to the aforementioned assessment parameters, the presence of one primary indicator, or two secondary indicators confirms the presence of a wetland.

In summary, the key findings are as follows:

- ***Primary Indicators*** – 15 sites displayed primary indicators
- ***Secondary Indicators*** – 12 sites displayed one secondary indicator, but each of these site also displayed a primary indicator or hydric soil colour.

Of the total 22 test sites, 20 confirmed hydric soils, and 15 confirmed hydrology indicators of wetlands. Of these, sites (1, 3A-3B, 7, 8, 10C, 11-14, 15A-15C, 16A-16B) had both hydric soils and hydrology indicators of wetlands.

6. Drainage Intervention

To provide a high degree of confidence the sites will coalesce to wetlands, minor surface water drainage intervention is recommended to be constructed in the form of a series of shallow bunds. These bunds will retain stormwater and sub-soil interflow from upslope, allowing the environment to retain moisture, in much the same manner as the adjacent natural wetlands.

To construct the bunds, it is recommended that a small swale following the natural contour of the slope will be excavated, with a maximum depth of approximately 0.3 m and swale width of up to 2 m. The material removed to create the swale would then be used to raise the ground level for the bund, minimising work involved. **Figure 6** shows a conceptual schematic of each bund, with pooled water during or after a storm.

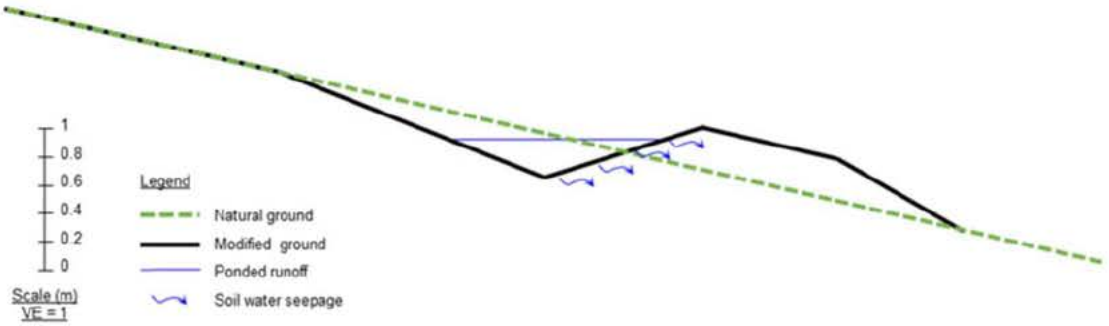


Figure 6. Cross section showing conceptual contour bund design.

A total of 14 bunds have been recommended within the non-hydric soil areas, at roughly 2 m change in elevation intervals. Each bund follows the natural contour of the slope with each end turned uphill to prevent water from flowing out of the bund – i.e. the only way runoff can migrate downslope is via sub-soil seepage or overtopping of the bunds during large storm events (refer to **Figure 7** to **Figure 9**). **Table 9** summarises the sites requiring drainage intervention.

Table 9. Summary of site requiring drainage intervention.

Sites	Required (Y/N)
1	Y
2	Y
3	Y
4	Y
5	N
6	N
7	N
8	N
9	Y
10	Y
11	N
12	N
13	Y
14	N
15	N
16	N

N

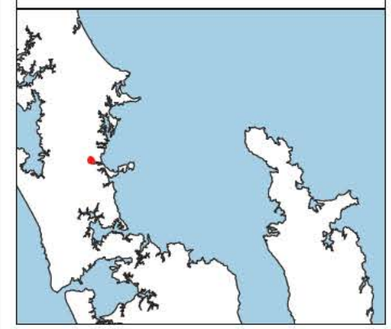
Site 1

0 30 60 m

Map Title:
Proposed Bund Design (Site 1)

Project:
Wainui Subdivision

Client:
Vineway Ltd



Legend

- Existing Wetlands
- Proposed Wetlands
- Bunds
- Overland Flow Path
- 1 m contours
- Test pit locations

Data Provenance
LINZ 2024
Auckland Council GeoMaps

Drawn by: [redacted]
30/06/2025

Layout & Project File
A3 Landscape Template

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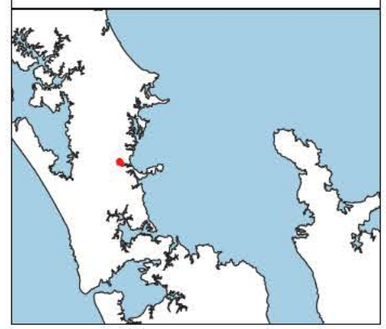
Figure 6

Map Title:
Proposed Bund Design (Site 2-4)

Project:
Wainui Subdivision

Client:
Vineway Ltd



Legend

- Site boundary
- Existing Wetlands
- Proposed Wetlands
- Bunds
- Overland Flow Paths
- 1 m contours
- Investigation locations

Data Provenance
LINZ 2024
Auckland Council GeoMaps

Drawn by: [redacted]
30/06/2025

Layout & Project File
A3 Landscape Template

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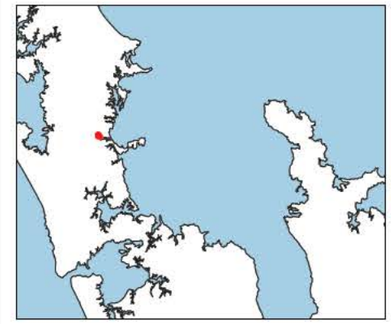
Figure 7

Map Title:
Proposed Bund Design (Sites 5-13)

Project:
Wainui Subdivision

Client:
Vineway Ltd



Legend

- Site boundary
- Internal boundaries
- Existing Wetlands
- Proposed Wetlands
- Bunds
- Overland Flow Paths
- 1 m contours
- Test pit locations

Data Provenance
LINZ 2024
Auckland Council GeoMaps

Drawn by [redacted]
30/06/2025

Layout & Project File
A3 Landscape Template

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Figure 8.

7. Assessment of Culvert Effects on Wetlands

7.1 Overview

Culverts are proposed to be constructed and installed across the site to manage stormwater, stream flows, and maintain hydrology across wetlands within the proposed residential development Delmore. This section provides an assessment of the suitability of culverts immediately adjacent to wetlands (Culverts 1, 3, 5, 7, 9, and 10).

The locations of the culverts proposed as part of the development are illustrated on Drawing 3725-0-4800 (Page 1) of **Appendix D**.

7.2 Culvert Review

With regard to potential impacts on existing wetlands, there was concern that construction and installation of six proposed culverts (1, 3, 5, 7, 9, and 10, as shown in **Figure 10**) will result in concentrated flow through the centre of the culvert, and that the side margins of the wetlands immediately downstream of these culverts will thus not receive flow. There was also potential concern regarding wetland dewatering during the removal of the existing culverts, and presumably until the bed within the embedded depth of the new culvert forms.

Common to all proposed culverts is that while hydrological aspects of wetland habitat, such as substrate and water flow, will be maintained inside the culvert due to the proposed embedment depth of 25% of the culvert height, wetland vegetation will not reestablish inside the culvert. Where these culverts overlay existing wetland, the project offsetting schedule (refer to **Section 6** of the Viridis Assessment) has accounted for the area inside the entire culvert as reclaimed. Hence, this aspect of wetland loss is not considered further in the hydrological assessment.

Each of the six culverts were reviewed and our hydrological assessment provided below.

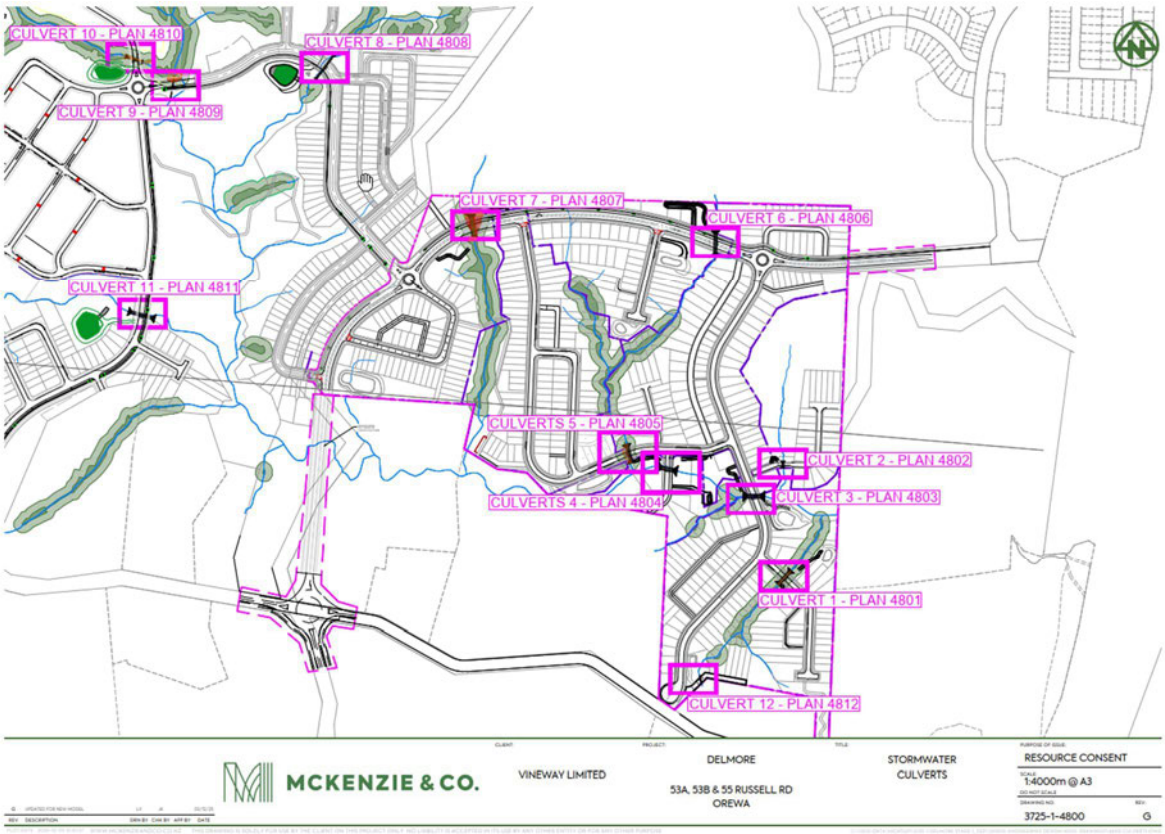


Figure 10. Culvert Plan (source: McKenzie & Co).

7.2.1 Culvert 1

Culvert 1 is located on a straight reach (Reach 8 – refer to Figure 5 of the Morphum Assessment), in a well-defined channel. The culvert has been designed to span 1.3 times the width of the stream bed and will be embedded by 25% of the height. The culvert will be installed at the average grade (slope) of the reach to be culverted.

It is expected that a natural bed will form within the embedded culvert that will reach an equilibrium state, tying in wetland material upstream and downstream of the culvert.

The channel is well defined, with a low point down the central axis that runs through the centre of the wetland. Flow discharged through the culvert will continue to flow through the central axis, as occurs at present. There will be no change in flow distribution across the wetland downstream.

As the channel is incised and flanked by higher elevation topography to both the north-west and south-eastern sides, the thalweg provides a control on groundwater levels (i.e., the water table is at, or near the surface, along the channel when groundwater levels are high (i.e., winter)). The installation of an embedded culvert will cause a temporary, localised lowering of the groundwater table, as illustrated by the schematic in **Figure 11**.

Using Culvert 1 as an example, the culvert will be embedded below the natural ground by ~0.5 m (25% of the 2.0 m high culvert). A 4.8 m long, D200 riprap apron will be installed at both the upstream and downstream ends of the culvert, tying back into the existing ground levels.

The embedded culvert will essentially create a localised drawdown either side of the culvert, lowering water levels by the embedment depth (0.5 m in this instance). This will have the effect of reducing the depth and frequency of saturation in the wetland soil profile immediately adjacent to the culvert. Maximum drawdown (equal to the depth of embedment) will occur immediately upstream and downstream of the culvert, and decrease with increasing distance away, depending on the topographical profile upstream and downstream. This effect will only be temporary until a new natural bed has established within the culvert, tying back into natural ground (as illustrated by the 'Reinstated Ground' in **Figure 11**).

The bed will begin to re-establish within the culvert with the first rainfall event post construction. The bed will progressively develop and continue to build up through deposition over time. The length of time it will take for the bed to re-establish is dependent on climatic conditions (i.e., intensity of storm events that generate erosion upstream, which is then deposited within the culvert), and hence it is not possible to quantify with precision. In our professional opinion, it is anticipated it will take in the order of 1-5 years for the bed to fully re-establish within the culvert.

Immediately following construction, there will be no wetland vegetation present within the culvert, or over the riprap aprons. Therefore, while there will be localised drawdown in these locations, there will be no wetland vegetation present in the location of maximum potential impact.

Any effects on wetlands (other than the area reclaimed as discussed above) are considered to be a 'temporary impairment' only (i.e., minor, and not permanent) and will not result in a complete loss of wetland extent or hydrological functioning. The 'temporary impairment' is a result of the temporary, and localised lowering of the groundwater level immediately adjacent to the culvert, with the effect rapidly decreasing in an exponential manner with distance from the culvert, i.e. the greatest temporary impairment effect will be experience adjacent to the culvert. The 'temporary impairment' will also decrease in magnitude through time, as the bed is re-established. As alluded to above, this is anticipated to occur within 1-5 years.

Surface water contributions and direct rainfall to the wetland (both upstream and downstream of the culvert) will remain unimpeded, hence temporary and localised drawdown of groundwater levels will not result in a total cutoff of water supply to the wetland.

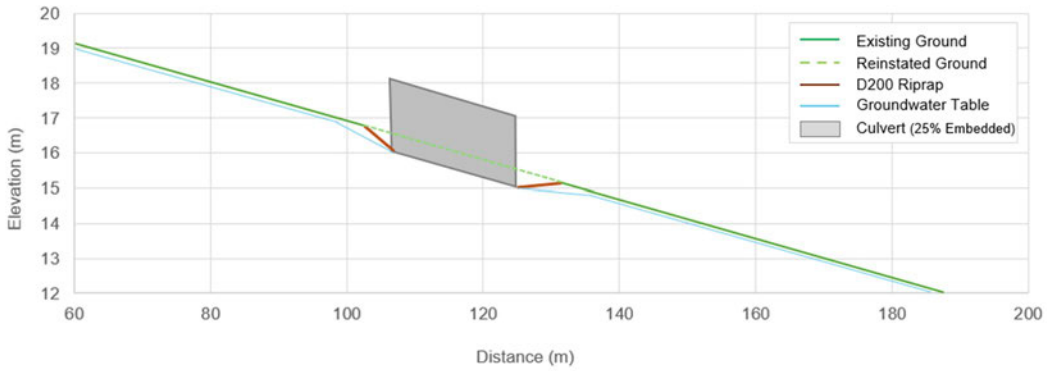


Figure 11. Conceptual schematic of temporary culvert dewatering.

7.2.2 Culvert 3

Culvert 3 is located approximately 12 metres downstream of a wetland. The wetland is within Reach 5 and Reach 11 of the Morphum Assessment, which according to their Figure 5 show considerable instability and moderate instability, respectively. There are no wetlands located directly downstream of the culvert itself.

A temporary drawdown in upstream groundwater levels will occur (as described for Culvert 1) and will likely extend into Wetland 3. We reiterate, this will result in a 'temporary impairment' only, until a new bed has established within the culvert. Surface water flows to the wetland from the catchment upstream will remain unimpeded.

In terms of geomorphic effects and erosion potential on the wetland 12 m upstream of Culvert 3, Morphum suggest wetland areas remain stable but may rapidly convert to channelised form if upstream incision propagates into them, hence they recommend that a stormwater management plan be put in place to monitor to for changes in the stream, particularly in relation to knickpoint migration towards wetlands, erosion around culverts, and erosion due to stormwater discharge.

7.2.3 Culvert 5

Culvert 5 is located within Reach 4 of the Morphum Assessment and is classified as having moderate instability (refer to Figure 5 of the Morphum Assessment). There is an existing culvert located at this location and the Moprhum Assessment identified that the upstream wetland is sustained by this existing culvert and is sensitive to changes that may create a preferential channel.

In terms of geomorphic effects and the potential for erosion potential on this wetland, the same recommendations as for Culvert 3 apply to Culvert 5.

7.2.4 Culvert 7

Culvert 7 is located within a wetland near the headwaters of a small catchment and within Reach 14 of the Morphum Assessment, which classifies this reach as having moderate instability (refer to Figure 5 of the Morphum Assessment). The wetland is located both upstream and downstream of (straddles) the proposed culvert location. There is no existing culvert at this location, so there will be no effects associated with removal of culverts.

The proposed culvert is a single 6.0 m wide by 2.0 m high box culvert, installed at a gradient similar to that of the natural reach. A riprap apron will be constructed along the downgradient end of the culvert. The riprap apron provides both erosion protection and distribution of flow. Flow through the culvert will be dispersed through the riprap, rather than discharging through a central point. This will ensure flow is maintained across

the width of the wetland immediately downstream. Overtime, as a natural bed forms within the embedded culvert, the flowpath will establish a new dynamic equilibrium and continue to convey flow downstream.

A temporary drawdown in groundwater levels will occur (as described for Culvert 1), and the radius of drawdown will extend into the wetland both upstream and downstream of the culvert. We reiterate, this will result in a 'temporary impairment' only until a new bed has established within the culvert and will not result in a loss of wetland, other than the reclaimed area as discussed above.

In terms of geomorphic effects and the potential for erosion potential on this wetland, the same recommendations as for Culvert 3 and Culvert 5 apply to Culvert 7.

7.2.5 Culvert 9

Culvert 9 is proposed to replace the existing 225 mm diameter concrete culvert located under the access track at this location and within Reach 27 of the Morphum Assessment, which classifies this reach as having moderate instability (refer to Figure 5 of the Morphum Assessment). There is a wetland present immediately upstream and the invert of the existing culvert controls the standing water level within this upstream wetland. There is no wetland present immediately downstream.

The existing culvert is proposed to be replaced by a new 4.0 m wide, 3.0 m high culvert, that on average will be embedded by 25% of the height. The upstream invert of the culvert will be set to the invert of the existing culvert to maintain the control on upstream water level. This will ensure there is no permanent dewatering of the upstream water levels and wetland.

In terms of geomorphic effects and the potential for erosion potential on this wetland, the following is noted.

Temporary dewatering of the wetland upstream could occur during the period from when the existing culvert is removed, until the new culvert is completed in place. This will be mitigated through the use of a temporary weir and diversion channel to maintain standing water levels during construction.

Surface water flows to the wetland from the catchment upstream will remain unimpeded.

Provided standing water levels are maintained in the wetland immediately upstream of Culvert 9 as currently proposed, there will be no effects on this wetland.

7.2.6 Culvert 10

Culvert 10 is located approximately 40 metres north-west of Culvert 9 and within Reach 25 of the Morphum Assessment, which classifies this reach as having moderate instability (refer to Figure 5 of the Morphum Assessment). . A wetland is located immediately upstream of Culvert 10, and another 8 m downstream. There is no culvert presently at this location.

A 6.0 m wide by 2.0 m high box culvert is proposed at a grade matching the existing topography. The culvert will be embedded by 25%. A riprap apron will be constructed along the downgradient end of the culvert. The riprap apron provides both erosion protection and distribution of flow. Flow through the culvert will be dispersed through the riprap, rather than discharging through a central point. This will ensure flow is maintained across the width of the wetland immediately downstream. Overtime, as a natural bed forms within the embedded culvert, the flow path will establish a new dynamic equilibrium and continue to convey flow downstream.

In terms of geomorphic effects and the potential for erosion potential on this wetland, the following is noted.

A temporary drawdown in groundwater levels will occur for the wetland upstream of Culvert 10, as described for Culvert 1. We reiterate, this will result in a 'temporary impairment' only until a new bed has established within the culvert and will not result in a loss of wetland.

The wetland immediately downstream of Culvert 10 will not be affected, as standing water levels in this wetland are maintained by the upstream invert level of Culvert 9.

7.3 Summary Statement on Potential Effects

In our opinion, the proposed culverts have been appropriately designed to minimise and avoid potential effects on wetland hydrology. Two avenues of potential affects were reviewed; 1) concentration of flow (i.e., not maintaining flow across the width of wetland downstream), and 2) dewatering due to culvert embedment.

Where wetlands are located immediately downstream, riprap aprons at the culvert outlet will aide in spreading flow laterally, and prevent a channelised discharge (i.e., maintain flow across the width of the wetland downstream)[5]. The purpose of the riprap apron is to prevent outfall erosion by distributing flow which:

- prevents the formation of channelisation or concentrated flow that can cause scour;
- provides a hydraulically rough surface to slow flow; and
- provides a hard surface that is resistant to erosion.

No scour or erosion will occur in the wetlands as a direct result of the proposed culverts. However, Morphum have identified that there are natural incision processes occurring within the existing wetland extents. Notwithstanding, the proposed batter embankment design has taken this into account and responds appropriately to protect the wetlands, such that once the embankments are in place no further erosion or incision effects on the identified wetlands are anticipated. A Stormwater Management Plan and monitoring is recommended by Morphum to ensure outcomes occur as anticipated.

Potential effects on wetlands associated with the embedment of new culverts are considered to be a 'temporary impairment' only (i.e., minor in nature, and not permanent), resulting from the temporary and localised lowering of groundwater levels/seepage face. The lowering of groundwater will rapidly decrease in an exponential manner with distance from the culvert, and through time as the natural bed is re-established. In our professional opinion, the bed will re-establish within 1-5 years (depending on climatic conditions and taking widening/incision into account), effectively returning the hydrological conditions to those of the present.

We consider that functioning wetland habitat will re-establish. Over time, sediment and bed material will be eroded from the catchment upstream and deposited inside the culvert – effectively re-establishing a natural bed within the culvert. The re-established bed inside culverts 1, 5, and 7 will be subject to the same hydrological processes that support the wetland immediately upstream and downstream of these culverts. Hence wetland habitat will effectively be reinstated, as wetland function (substrate and hydrology) is not solely dependent on the presence of wetland vegetation.

[5] Refer to **Appendix D**: Mckenzie & Co., 2025. Delmore Stage 1 & 2. Stormwater Culvert Plan Overall. Drawing No's, 3725-0-48XX

8. Conclusion

Hydric Soil and Hydrology Tool Assessment

Out of the 22 sites investigated, 20 presented with low chroma soils. Whilst it is important to note that soil colour in the North Auckland area is not the most reliable indicator of hydric soils because of the pale colour of the parent rock material, and also the soil leaching from native podocarp forests that prevailed in this area prior to human inhabitation, the same sites also presented hydrology indicators of wetlands – either rhizospheres, geomorphic position or algal mats. Overall, this suggests that these 20 sites are strongly hydric, and the remaining 2 are not hydric.

Most sites displaying hydric soils and hydrology tool indicators were located at landscape features such as the depression/valley in gently undulating areas within the OLFP. These landscape features prevent water from draining freely, which explains the presence of hydric soils/hydrology indicators.

The assessment of potential wetland offset areas within the site using the hydric soil and hydrology delineation tools confirmed 20 sites (all sites except for site 6 and site 9) had both hydric soils and primary and/or secondary wetland hydrology tool indicators.

The geomorphic position of the sites are in lowish lying areas adjacent to surface water courses and adjoining existing wetlands, and all sites have relatively slow to moderate permeability soils.

Some of the proposed wetland offset sites were identified as suitable for minor intervention to further impede drainage and provide high confidence that the sites would coalesce into wetland if allowed to return to a natural state. The long thin sites that are on the margin of existing wetlands or short sites between existing wetlands were considered not requiring any intervention other than cessation of stock or vehicle traffic.

Culvert Effects on Wetlands

The culverts that are proposed to be located adjacent to wetlands were reviewed. In our opinion, the culverts have been appropriately designed to avoid adverse effects on the wetlands.

Overall Conclusion

In conclusion, provided the drainage intervention recommendations in this report are implemented, we consider that all proposed wetland offset areas will support wetland hydrology, facilitate the establishment of wetland vegetation, and promote the development of hydric soils.

The physical works for drainage intervention recommended will be occurring within 10 m of natural inland wetland, but in our view the works are a permitted activity as they will protect and enhance the adjacent natural inland wetlands.

9. References

Landcare Research, 2018. Hydric soils – field identification guide. Consultancy report prepared for Tasman District Council under Envirolink Grant: C09X1702. June 2018.

MfE, 2021. Wetland delineation hydrology tool for Aotearoa New Zealand. Published in July 2021 by the Ministry for the Environment. ISBN: 978-1-99-003362-9. Publication number: ME 1575.

Edbrooke, S. W. (compiler), 2011. Geology of the Auckland area. Institute of Geological and Nuclear Sciences 1:250,000, geological map 3.

Appendix A. Detailed Soil Logs

Site # and Soil Description	Soil Photo	
1 **0 - 300 mm.** TOPSOIL, silt. Very dark grey. Dry and friable. Rootlets present. Matrix colour - (7.5YR - Value/Chroma) - 3/1 Mottle Colour - Mottles – 5/6 (1%) Oxidised rhizospheres on roots **300 - 750 mm.** Clayey SILT. Grey with brownish yellow mottles. Dry, moderate plasticity. Matrix Colour (7.5YR - Value/Chroma) - 5/1 Mottle Colour (10YR - Value/Chroma) - 6/8 (5%) **750 - 950 mm.** Silty CLAY. Grey, with brownish yellow mottles. Dry and highly plastic. Matrix Colour (10YR - Value/Chroma) - 6/1 Mottle Colour (10YR -Value/Chroma) - 6/8 (5%) **950 – 1000 mm.** Clayey SILT. Grey with brownish yellow mottles. Dry and moderately plastic. Matrix Colour (10YR - Value/Chroma) - 6/1 Mottle Colour (10YR - Value/Chroma) - 6/8 (50%)	 **Photograph 1: Site 1 test pit.**	 **Photograph 2: Site 1 core.**
2 **0 - 200 mm.** TOPSOIL, silt. Dark grey, with some rootlets present. Dry and friable. Matrix Colour (10YR - Value/Chroma): Topsoil - 4/1 **200 - 400 mm.** SILT. Yellowish brown, dry and low plasticity. Matrix Colour (10YR - Value/Chroma) - 5/4 **400 - 700 mm.** Clayey SILT. Brownish yellow, with yellowish brown mottles with light grey inclusions. Dry, moderate plasticity. Matrix Colour (10YR - Value/Chroma) - 6/6 with 6/1 inclusions Mottle Colour (10YR - Value/Chroma) - 5/8 (5%) **700 – 1000 mm** Clayey SILT, very pale greyish brown, with brownish yellow mottles. Dry, moderate plasticity. Matrix Colour (10YR - Value/Chroma) - 7/4	 **Photograph 3: Site 2 test pit.**	 **Photograph 4: Site 2 core.**

Site # and Soil Description	Soil Photo	
Mottle Colour (10YR - Value/Chroma) - 6/8 (5%)		
3A **0 - 300 mm.** TOPSOIL, silt. Dark grey. Dry and friable. Matrix Colour (10YR - Value/Chroma) – 4/1 Oxidised rhizospheres on roots **300 - 700 mm.** Silty CLAY. Brownish yellow, dry and highly plastic. Matrix Colour (10YR - Value/Chroma) – 6/6 **700 - 1000 mm.** Silty CLAY. Light yellowish brown, with light grey inclusions and brownish yellow mottles. Dry and highly plastic. Matrix Colour (10YR - Value/Chroma) – 6/4 with 7/1 inclusions Mottle Colour (10YR – Value/Chroma): Mottles – 6/8	 **Photograph 5: Site 3A test pit.**	 **Photograph 6: Site 3A core.**
3B **0 - 300** mm. TOPSOIL, silt. Dark grey. Dry and friable. Matrix Colour (10YR - Value/Chroma) - 4/1 **300 - 700 mm.** Silty CLAY. Brownish yellow, dry and highly plastic. Matrix Colour (10YR - Value/Chroma) – 6/6 **700 - 1000 mm.** Silty CLAY. Light yellowish brown, with light grey inclusions and brownish yellow mottles. Dry and highly plastic. Matrix Colour (10YR - Value/Chroma):– 6/4 with 7/1 inclusions Mottle Colour (10YR – Value/Chroma): Mottles – 6/8 (5%) Oxidised rhizospheres on roots	 **Photograph 7: Site 3B test pit.**	 **Photograph 8: Site 3B core.**

Site # and Soil Description	Soil Photo	
4 **0 - 300 mm.** Topsoil, Clayey SILT. Very dark greyish brown. Some moisture and low plasticity. Matrix Colour (10YR - Value/Chroma):- 3/2 **300 - 600 mm.** Clayey SILT. Brownish yellow. Some moisture, low to medium plasticity. Matrix Colour (10YR - Value/Chroma) - 6/8 **600 – 1000 mm.** Silty CLAY, light grey, with light yellowish-brown streaks. Moderately moist, moderate to high plasticity. Matrix Colour (10YR - Value/Chroma) - 7/1	 **Photograph 9: Site 4 (looking towards culvert from test pit).**	
5 **0 - 400 mm.** TOPSOIL, silt. Very dark grey with clay inclusions, yellowish brown mottling within the clay. Rootlets are present. Matrix Colour (10YR - Value/Chroma) – 3/1 (5%) Mottle Colour (10YR – Value/Chroma) – 5/8 **400 - 700 mm.** Clayey SILT. Yellowish brown with dark grey mottles. Dry, moderately plastic. Matrix Colour (10YR - Value/Chroma) - 5/8 Mottle Colour (10YR – Value/Chroma) – 4/1 **700 - 1000 mm.** Silty CLAY. Very pale brown with light grey inclusions and brownish yellow mottles. Dry and highly plastic. Matrix Colour (10YR - Value/Chroma)– 7/4 Mottle Colour (10YR - Value/Chroma) - 6/8 (1-5%)	 **Photograph 10: Site 5 testpit.**	 **Photograph 11: Site 5 core.**

Site # and Soil Description	Soil Photo	
6 **0 -250 mm** Silty TOPSOIL with minor clay, yellowish brown, with rootlets, dry. Dark reddish yellow mottles Matrix Colour (10YR - Value/Chroma) - 5/4 Mottle Colour (10YR - Value/Chroma) - 7/8 (1-5%) **250 – 350 mm** Silty clay, brownish yellow, moist. High plasticity. Matrix Colour (10YR - Value/Chroma) - 6/6 **350 mm – 1 m** Clayey SILT. dark greyish brown, with dark brown mottles, moist, moderate plasticity. Matrix Colour (10YR - Value/Chroma) - 4/2 Mottle Colour (10YR - Value/Chroma) - 3/3 (5%)	 **Photograph 12: Site 6 test pit.**	 **Photograph 13: Site 6 topsoil.**
7 **0 – 100 mm** TOPSOIL, SILT, dark greyish brown, slightly damp, yellowish-brown mottles, rootlets. Matrix Colour (10YR - Value/Chroma) - 4/2 Mottle Colour (10YR – Value/Chroma) – 5/8 (10%) **100 – 200 mm** PEAT layer, some charcoal, black slightly damp. Matrix Colour (10YR - Value/Chroma) – 2/1 **200 – 500 mm** Clayey SILT, 5/6 yellowish brown. 5/8 yellowish brown mottles. 10% dry with low plasticity. Matrix Colour (10YR - Value/Chroma) – 5/6 Mottle Colour (10YR – Value/Chroma) – 5/8 (10%) **500 mm – 1 m** Clayey SILT, 7/2 light grey with 5/8 yellowish brown streaks and mottles. Dry with moderate plasticity. Matrix Colour (10YR - Value/Chroma) – 7/2 Mottle Colour (10YR – Value/Chroma) - 5/8 (10%) Oxidised rhizospheres on roots	 **Photograph 14: Site 7 test pit.**	 **Photograph 15: Site 7 core.**

Site # and Soil Description	Soil Photo	
8 **0 - 100 mm.** TOPSOIL, silt with minor clay, very dark brown. Moderate moisture and low plasticity. Matrix Colour (10YR - Value/Chroma):– 2/2 **100 - 600 mm.** Silty CLAY. Yellowish brown, some moisture and moderately plastic. Matrix Colour (10YR - Value/Chroma):– 5/8 **600 - 1000 mm.** Silty CLAY, yellow with light grey streaks. Some moisture, moderate to high plasticity. Matrix Colour (10YR - Value/Chroma): – 7/6	 **Photograph 16:Site 8 test pit.**	 **Photograph 17: Site 8 core.**
9 **0 - 300 mm.** TOPSOIL, Clayey SILT. Yellowish brown, some moisture and some plasticity. Matrix Colour (10YR - Value/Chroma):– 5/8 **300 - 600 mm.** Silty CLAY. Yellow with light grey streaks. Some moisture and moderate to high plasticity. Matrix Colour (10YR - Value/Chroma) – 7/6 **600 - 1000 mm.** Silty CLAY. Brownish yellow, dark orange inclusions. Moderately moist, low plasticity. Matrix Colour (10YR - Value/Chroma) - 6/6	 **Photograph 18: Site 9 test pit.**	 **Photograph 19: Site 9 core.**

Site # and Soil Description	Soil Photo	
10A **0 - 300 mm.** TOPSOIL, Clayey SILT. Dark brown. Some moisture, low plasticity. Matrix Colour (10YR - Value/Chroma):- 3/2 **300 - 600 mm.** Clayey SILT. Brownish yellow, some moisture, low to moderate plasticity. Matrix Colour (10YR - Value/Chroma) – 6/8 **600 – 1000 mm.** Silty CLAY, light grey with light orange, brown streaks. Moderately moist, moderate to highly plastic. Matrix Colour (10YR - Value/Chroma) – 7/1	 **Photograph 20: Ssite 10A Test pit.**	 **Photograph 21: Site 10A core.**
10B **0 - 300 mm.** TOPSOIL, silt, very dark grey, rootless, some dark yellowish-brown mottles. Matrix Colour (10YR - Value/Chroma) – 3/1 Mottle Colour (10YR – Value/Chroma) - 3/6 (2%) **300 – 500 mm**. Clayey SILT, yellowish brown with brownish yellow mottles and grey inclusions. Dry with low plasticity. Matrix Colour (10YR - Value/Chroma)– 5/4 Mottle Colour (10YR – Value/Chroma) - 6/8 (2%) **500 – 1000 mm.** Clayey SILT. 7/3 very pale brown and dry with yellowish brown mottles 5/8 and streaks, dry with moderate plasticity. Matrix Colour (10YR - Value/Chroma) - 7/3 Mottle Colour (10YR – Value/Chroma) – 5/8 (2%)	 **Photograph 22: Site 10B Test pit.**	 **Photograph 23: Site 10B core.**

Site # and Soil Description	Soil Photo	
10C **0 – 200 mm** TOPSOIL silt, very dark greyish brown, dry, brownish yellow mottles. Matrix Colour (10YR - Value/Chroma) – 3/2 Mottle Colour (10YR – Value/Chroma) – 6/6 (5%) **200 – 1000 mm.** Clayey SILT. Yellow with light grey streaks and yellow mottles. Dry, moderately plastic. Matrix Colour (10YR - Value/Chroma) – 7/8 Mottle Colour (10YR – Value/Chroma) – 7/8 (10%) Oxidised rhizospheres on roots	 **Photograph 24: Site 10C test pit.**	 **Photograph 25: Site 10C core.**
11 **0 - 200 mm.** TOPSOIL, Silt with minor clay. Dark greyish brown with dark yellowish-brown mottles. Moist, some plasticity. Matrix Colour (10YR - Value/Chroma) - 4/2 Mottle Colour (10YR - Value/Chroma) - 3/6 (10%) **200 - 300 mm.** Clayey SILT. Greyish brown. Dry with moderate plasticity. Matrix Colour (10YR - Value/Chroma) - 5/2 Mottle Colour (10YR – Value/Chroma) – 7/8 (5%) **300 - 1,000 mm.** Clayey SILT. Light grey with yellow streaks and mottles. Dry, moderate plasticity. Matrix Colour (10YR - Value/Chroma) – 7/1 Mottle Colour (10YR – Value/Chroma) – 7/8 (5%) Oxidised rhizospheres on roots	 **Photograph 26: Site 11 test pit.**	 **Photograph 27: Site 11 core.**

Site # and Soil Description	Soil Photo	
12 **0 - 200 mm.** TOPSOIL, Silt. Dark grey with dark yellowish-brown mottles. Dry and friable. Matrix Colour (10YR - Value/Chroma) - 4/1 Mottle Colour (10YR – Value/Chroma) – 3/6 (5%) **200 - 400 mm.** Clayey SILT, with peat. Dark grey. Dry and moderately plastic. Matrix Colour (10YR - Value/Chroma) – 2/1 Mottle Colour (10YR – Value/Chroma) – 3/6 (5%) **400 – 1000 mm** Silty CLAY, black with dark yellowish-brown. Moist and highly plastic. Matrix Colour (10YR - Value/Chroma) – 2/1 Oxidised rhizospheres observed on roots. Groundwater encountered at 900 mm	 **Photograph 28: Site 12 test pit.**	 **Photograph 29: Site 12 peat**
13 **0 - 200 mm.** TOPSOIL, silt. Dark grey with dark yellowish-brown mottles. Dry, rootlets present. Matrix Colour (10YR - Value/Chroma) - 4/1 Mottle Colour (10YR – Value/Chroma) – 3/4 (10%) **200 - 1000 mm.** Clayey SILT (Fill). Dark yellowish-brown. Gravels were observed at 0.7 m. Matrix Colour (10YR - Value/Chroma) – 4/6 Oxidised rhizospheres on roots	 **Photograph 30: Site 13 test pit**	 **Photograph 31: Site 13 topsoil**

Site # and Soil Description	Soil Photo	
14 **0 - 300 mm.** TOPSOIL, silt. Dark greyish brown with dark yellowish-brown mottles. Dry and moderate plasticity. Matrix Colour (7.5YR - Value/Chroma) - 4/2 Mottle Colour (7.5YR – Value/Chroma) – 4/6 (10%) **300 - 1000 mm.** Clayey SILT. Brownish yellow with light grey streaks, dry, moderate plasticity when moistened. Matrix Colour (10YR - Value/Chroma) – 6/6 Streak Colour (10YR - Value/Chroma) - 7/1 Oxidised rhizospheres on roots	 **Photograph 32: Site 14 test pit**	 **Photograph 33: Site 14 core**
15A **0 - 150 mm.** TOPSOIL, Silt. Very dark greyish brown. Dry, friable. Matrix Colour (10YR - Value/Chroma) - 3/2 **150 - 400 mm.** SILT with minor clay. Dark greyish brown. No mottles but rhizospheres were present. Dry and friable. Matrix Colour (10YR - Value/Chroma) - 4/2 **400 - 500 mm.** Clayey SILT. Yellowish brown with some mottles yellowish brown. Dry. Matrix Colour (10YR - Value/Chroma) – 5/4 Mottle Colour (10YR – Value/Chroma) – 5/8 (5%) **500 – 800 mm.** Clayey SILT, minor sand. Yellowish brown. Dry, moderately plastic. Matrix Colour (10YR - Value/Chroma) – 5/4 **800 – 1000 mm.** Silty CLAY, minor sand. Yellowish brown. Dry, highly plastic. Matrix Colour (10YR - Value/Chroma) – 5/6 Oxidised rhizospheres on roots	 **Photograph 34: Site 14 test pit**	 **Photograph 35: Site 14 core**

Site # and Soil Description	Soil Photo	
15B **0 - 150 mm.** TOPSOIL, Silt. Grey. Matrix Colour (10YR - Value/Chroma) - 5/1 **150 - 600 mm.** Silty CLAY. Light grey with brownish yellow mottles. Saturated and highly plastic. EOH as everything was saturated and material was consistent. Matrix Colour (10YR - Value/Chroma) - 7/1 Mottles Colour (7.5YR – Value/Chroma) – 6/8 (20%) Oxidised rhizospheres observed on roots, in addition to a hydrogen sulphide odour	 **Photograph 36: 15B - surface water filled the pit immediately.**	 **Photograph 37: 15B core**
15C **0 - 150 mm.** TOPSOIL, Silt. Dark grey. Moist. Matrix Colour (10YR - Value/Chroma) - 4/1 **150 - 450 mm.** Clayey SILT, grey with brownish yellow clay inclusions. Moist and sticky with moderate plasticity. **450 - 1000 mm.** Clayey SILT, light yellowish brown with yellow mottles and rhizospheres. Moist and moderately plastic. Matrix Colour (10YR - Value/Chroma) - 6/4 Mottles Colour (10YR – Value/Chroma) - 7/6 (10%) Oxidised rhizospheres observed on the roots.	 **Photograph 38: Site 15C core**	 **Photograph 39: Site 15C test pit**

Site # and Soil Description	Soil Photo	
16A **0 - 300 mm.** TOPSOIL, Silt, greyish brown with yellowish brown mottles. Moist. Matrix Colour (10YR - Value/Chroma) - 5/2 Mottles Colour (7.5YR – Value/Chroma) – 5/8 (15-20%) **300 - 900 mm.** Clayey SILT. Light yellowish brown with light brown mottles. Relatively dry and moderately plastic. Matrix Colour (10YR - Value/Chroma) – 5/2 Mottles Colour (7.5YR – Value/Chroma) – 6/4 (2%) **900 – 1000 mm.** Silty CLAY. Dark brown. Moist and highly plastic. Matrix Colour (10YR - Value/Chroma) – 3/3 Oxidised rhizospheres observed on the roots. Groundwater was encountered at 300 mm bgl.	 **Photograph 40: 16A test pit.**	 **Photograph 41: 16A core.**
16B **0 - 200 mm.** TOPSOIL, silt. Dark greyish brown with yellowish brown mottles. Moist. Matrix Colour (10YR - Value/Chroma) - 4/2 Mottle Colour (10YR – Value/Chroma) – 5/6 (5%) **200 - 400 mm.** Clayey SILT. Grey, with dark yellowish-brown mottles. Moist and moderately plastic. Matrix Colour (10YR - Value/Chroma) – 5/1 Mottle Colour (10YR – Value/Chroma) – 3/4 (40%) **400 - 800 mm.** Clayey SILT. Yellowish brown with dark yellowish-brown mottles. Moist with moderate plasticity. Matrix Colour (10YR - Value/Chroma) – 5/4 Mottle Colour (10YR – Value/Chroma) – 4/6 (10%) **800 - 1000 mm.** Silty CLAY, light yellowish brown with light grey streaks and brownish yellow mottles. Moist and highly plastic Matrix Colour (10YR - Value/Chroma) – 6/4	 **Photograph 42: Site 16B test pit**	 **Photograph 43: Site 16B core**

Site # and Soil Description	Soil Photo	
Mottle Colour (10YR - Value/Chroma) - 6/6 (5%) Oxidised rhizospheres on roots. GW encountered at 350 mm bgl. GW soil seepage at 270 mm bgl.		

Appendix B. Hydric Soil and Hydrology Tool Test Sheets

Site 1 All depths are in mm

SECTION C – SOIL AND HYDROLOGY

Profile description (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles % [1]	Mottles Size [2]	Mottle location [3]	Material [4]	Remarks
0-300	3/1 7.5yr	5/6 7.5yr	1	-	-	Topsoil SILT	Dry and friable
300-750	5/1 7.5yr	6/8 7.5yr	5	-	-	Clayey SILT	Dry, mod plastic
750-950	6/1 10yr	6/8 10yr	5	-	-	Silty CLAY	Dry, highly plastic
950-1000	6/1 10yr	6/8 10yr	50	-	-	Clayey SILT	Dry & mod plastic

[1] Use % area charts, [2] Use size classes, [3] Ped face, pore, within ped along roots, within matrix, [4] Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1 No OBL & FACW dominant species _____ (A)

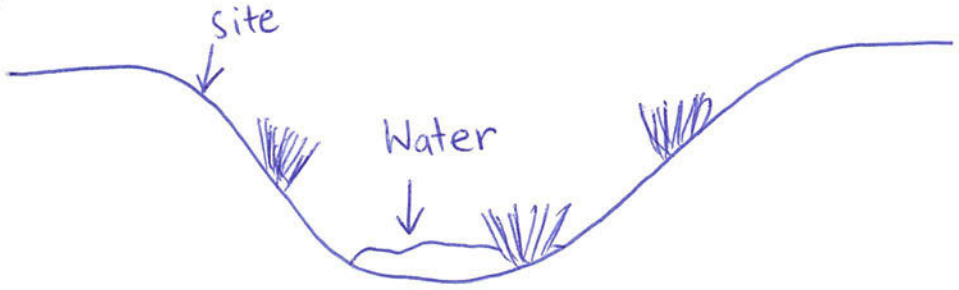
2 No FACU & UPL dominant species _____ (B)

3 Total _____ (A+B)

4 FAC-neutral (>50%) _____ (A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks

9:12 AM - Filled with 20L - 200mL from ground level

4:15 PM - 300mL from ground level Water @ top of auger hole

Site 2 All depths in mm

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-200	4/1 10yr	–	–	–	–	Topsoil silt	Dry → friable some rootlets
200-400	5/4 10yr	–	–	–	–	Silt	dry & low plasticity
400-700	6/6 with 10yr 6/1 inclusions	5/8 10yr	5%	–	–	clayey silt	Dry, mod plastic
700-1000	7/4 10yr	6/8 10yr	5%	–	–	Clayey silt	Dry, mod plastic

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

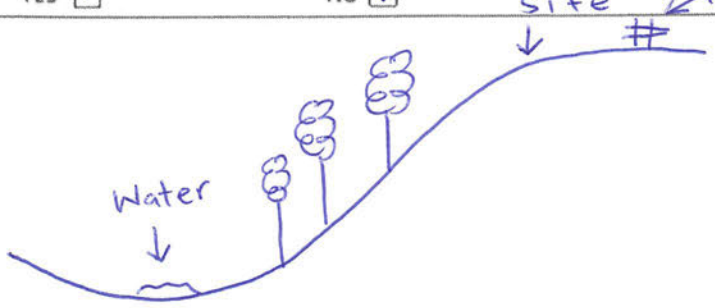
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____ (A)
2. No. FACU & UPL dominant species _____ (B)
3. Total _____ (A+B)
4. FAC-neutral (>50%) _____ (A/A+B)*100

Wetland hydrology present? YES ☐ NO ☑

Sketch of site/soil



Remarks

10L added

220mm from ground level @ 10:12 AM

400mm from ground level @ 10:19 AM → Down to top of auger

Added additional 10L @ 3:57pm

180mm Top of grass

250 mm Top of grass

Site 3A

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[2]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	4/1 10yr	-	-	-	-	Topsoil silt	Dry and friable
300-700	6/6 10yr	-	-	-	-	silty CLAY	Dry and highly plastic

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1 No OBL & FACW dominant species _____(A)

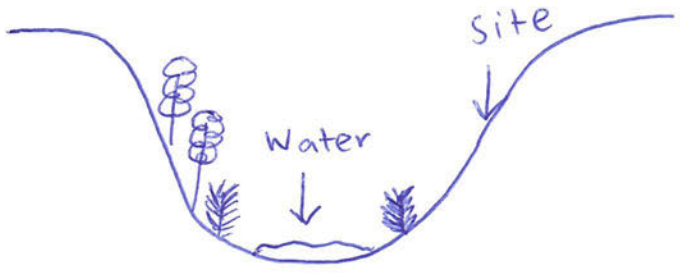
2 No FACU & UPL dominant species _____(B)

3 Total _____(A+B)

4 FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks

9:48 AM 200mm from ground level 20L added

10:02 AM 250mm from ground level

10:05 AM 300mm from ground level

3:56 PM 410mm from ground level

Site 3B

All depths are in mm

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	4/1 10yr	–	–	–	–	Topsoil silt	Dry and friable
300-700	6/6 10yr	–	–	–	–	Silty clay	Dry and highly plastic

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

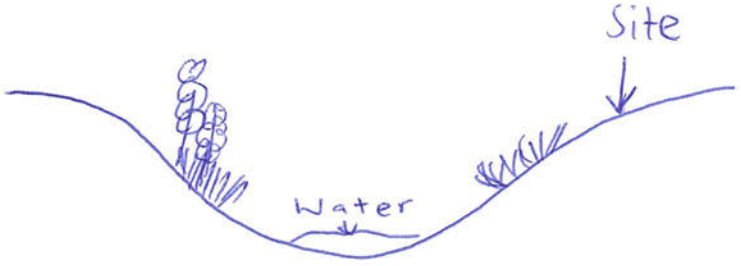
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____ (A)
2. No. FACU & UPL dominant species _____ (B)
3. Total _____ (A+B)
4. FAC-neutral (>50%) _____ (A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks

9:48 AM → 200mm from ground level

3:50 pm → 410 mm from ground level

2a added

Site 4

All depths are in mm

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	3/2 10yr	–	–	–	–	clayey silt	Topsoil, some moisture and low plastic
300-600	6/8 10yr	–	–	–	–	clayey silt	some moisture low to med plasticity.

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) ____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) ____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

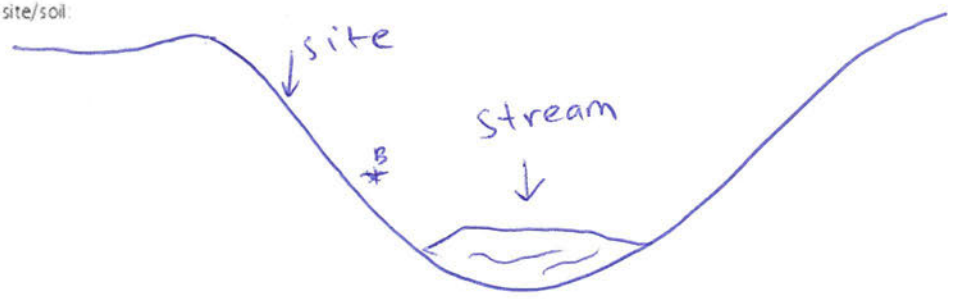
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☐ NO ☑

Sketch of site/soil



Remarks

GW seepage @ B* at bottom of hill
↳ orange biofilm present,
Drainage - 20 mins → 30mm below ground level
16:03 → 150mm from ground level.

Site 5

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-400	3/1 10YR	5/8 10YR	5			Topsoil, Silt	Clay inclusions, rootlets.

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- [ ] Organic soil material
- [ ] Litter
- [ ] Fibric
- [ ] Mesic
- [ ] Humic
- [ ] Peaty topsoil
- [ ] Peaty subsoil

Concretions:
- [ ] Iron concretions
- [ ] Manganese concretions
- [ ] Nodular

Consistence:
- [ ] Plastic
- [ ] Sticky
- [ ] Fluid

Colours: profile form either:
- [ ] Gley OR
- [x] Mottled

Horizon:
- [ ] Reductimorphic
- [ ] Redox mottled
- [ ] Redox segregations
- [ ] Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

- [ ] Pugged

Hydric soils present? YES [x] NO [ ] UNCERTAIN [ ] NZSC subgroup _____

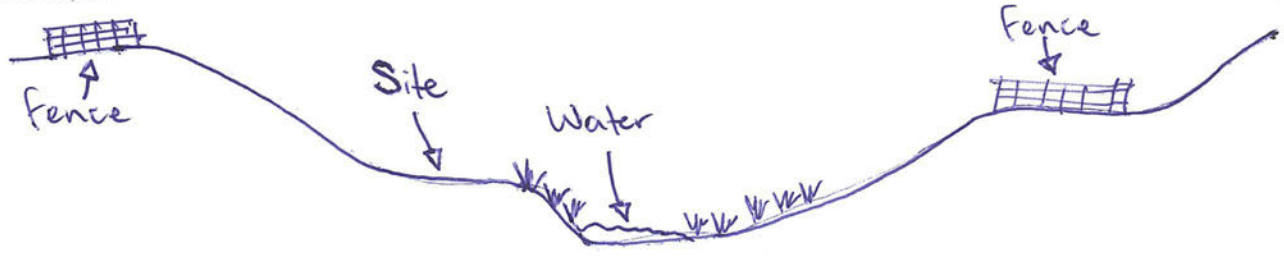
Primary hydrology indicators: minimum of 1 required; check all boxes that apply
- [ ] Surface water (1A)
- [ ] Groundwater <30 cm (1B)
- [ ] Soil saturation <30 cm (1C)
- [ ] Water marks (2A)
- [ ] Sediment deposits (2B)
- [ ] Drift deposits (2C)
- [ ] Algal mat/crust (2D)
- [ ] Iron deposits (2E)
- [ ] Surface soil cracks (2F)
- [ ] Inundation on aerial imagery (2G)
- [ ] Sparsely vegetated concave surface (2H)
- [ ] Salt crust (2I)
- [ ] Aquatic invertebrates (2J)
- [ ] Hydrogen sulphide odour (3A)
- [ ] Oxidised rhizosphere on roots (3B)
- [ ] Reduced iron (3C)
- [ ] Reduced iron in tilled soil (3D)
- [ ] High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply
- [ ] Water-stained leaves (2K)
- [ ] Drainage patterns (2L)
- [ ] Dry-season water table (3E)
- [ ] Saturation in aerial imagery (3F)
- [x] Geomorphic position (4B)
- [ ] Shallow aquitard (4C)
- [ ] FAC-neutral test (4D)
- [ ] Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation
1. No OBL & FACW dominant species _____(A)
2. No FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES [ ] NO [x]

Sketch of site/soil



Remarks 20L at 11:21, 200mm bgl
11:34, 250mm bgl
15:15, 370mm bgl

(Mottling is within clayey inclusions.)

Site 6

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[2]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-250	5/4 10YR YELLOWISH BROWN	7.5YR 7/6 DARK yellow REDDISH ~~GRAVEL~~				SILT WITH MINOR CLAY	TOPSOIL / ROOTLETS, DRY
250-350	6/6 10YR BROWNISH YELLOW					SILTY CLAY	MOIST, HIGH PLASTICITY
350-1000	4/2 10YR DARK GREYISH BROWN	3/3 10YR	5			CLAYEY SILT	MOIST, MODERATE PLASTICITY.

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley Gully Slope

Water table: Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) ____

Pan: Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers: Depth (cm) ____

Slow perm: argillic

☐ Pugged

Hydric soils present? YES ☐ NO ☑ UNCERTAIN ☐ NZSC subgroup ____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1 No. OBL & FACW dominant species ____ (A)

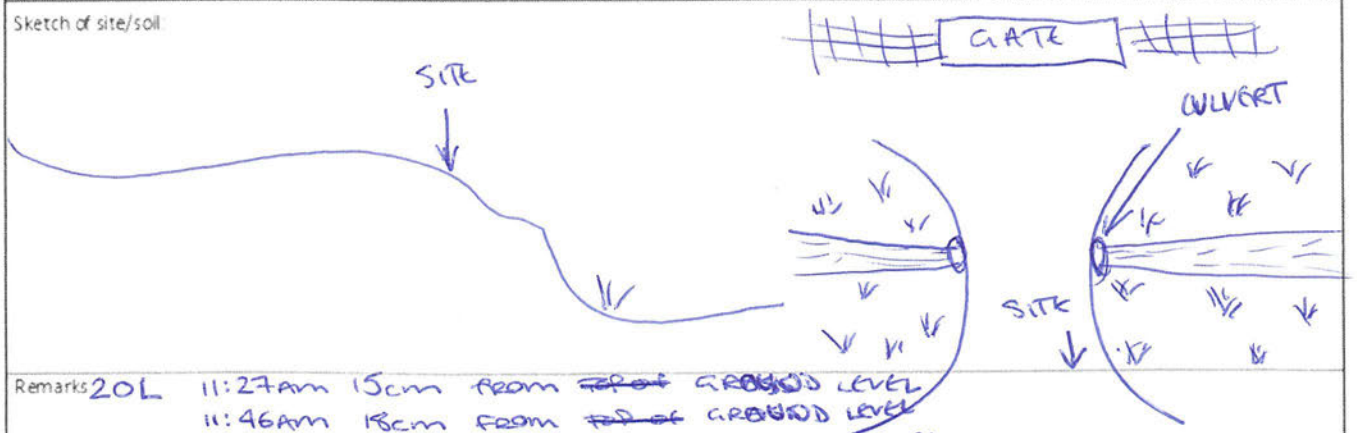
2 No. FACU & UPL dominant species ____ (B)

3 Total ____ (A+B)

4 FAC-neutral (>50%) ____ (A/A+B)*100

Wetland hydrology present? YES ☐ NO ☑

Sketch of site/soil



Remarks 20L 11:27am 15cm from ~~TOP OF~~ GROUND LEVEL
11:46am 18cm from ~~TOP OF~~ GROUND LEVEL
15:27pm 35cm from ~~TOP OF~~ GROUND LEVEL
SITE IS LOCATED ON SOIL/CULVERT BRIDGE THAT HAS LIKELY BEEN BUILT UP, THUS UNLIKELY TO BE A NATURAL PROFILE.

Site 7

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0–100	4/2 10YR DARK GREYISH BROWN	5/8 10YR YELLOWISH BROWN	10			SILT	TOPSOIL, SLIGHTLY DAMP, ROOTLETS
100–200	2/1 10YR BLACK					PEAT	SOME CHARCOAL/WOOD, DRY/SLIGHTLY DAMP.
300–500	5/6 10YR YELLOWISH BROWN	5/8 10YR YELLOWISH BROWN	10			CLAYEY SILT	DRY, LOW PLASTICITY

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators: Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☑ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☑ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):
Location Depression Flat Valley Gully Slope
Water table Depth (cm) ____
High GW Perched Seepage Tidal Lithic
Pans Depth (cm) _____
Pan Humus Fe-pan Densi- Duri- Fragi Ortstein
Layers Depth (cm) _____
Slow perm argillic
☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

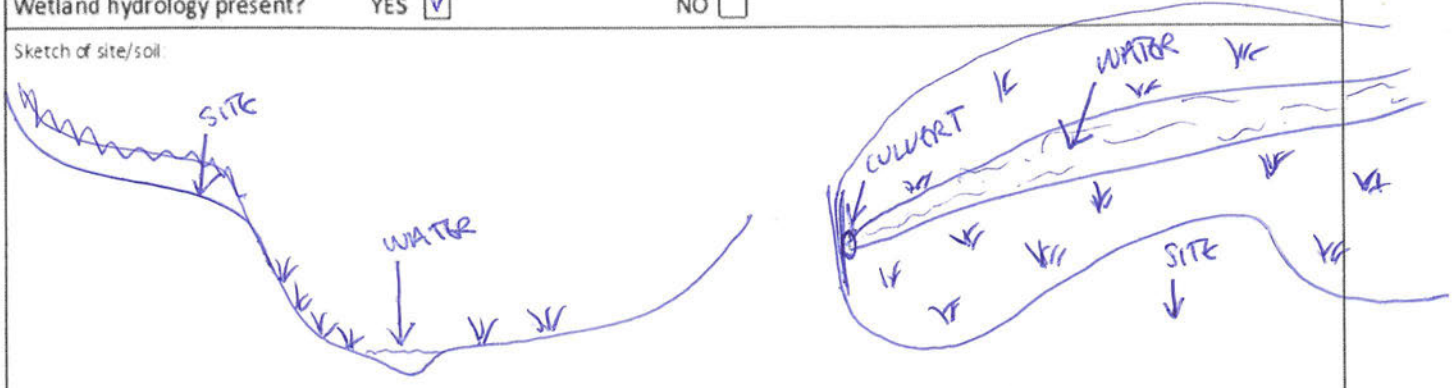
Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation
1. No. OBL & FACW dominant species _____ (A)
2. No. FACU & UPL dominant species _____ (B)
3. Total _____ (A+B)
4. FAC-neutral (>50%) _____ (A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks 20L 11:49am 18cm from ~~TOP OF~~ GROUND LEVEL
12:03pm 22cm FROM GROUND LEVEL
15:28pm 38cm FROM GROUND LEVEL. → DOWN TO ~~BOTTOM~~ OF AUGER HOLE

Site 8

SECTION C – SOIL AND HYDROLOGY

Profile description (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-100	2/2 10YR VERY DARK BROWN					SILT WITH MINOR CLAY	TOPSOIL, MODERATE MOISTURE, LOW PLASTICITY
100-600	5/8 10YR ~~YELLOW BROWN~~ yellowish brown					SILTY CLAY	MOIST, MODERATELY PLASTIC

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators: Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):
Location Depression Flat Valley Gully Slope
Water table Depth (cm) ____
High GW Perched Seepage Tidal Lithic
Pans Depth (cm) _____
Pan Humus Fe-pan Densi- Duri- Fragi Ortstein
Layers Depth (cm) _____
Slow perm argillic
☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☑ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

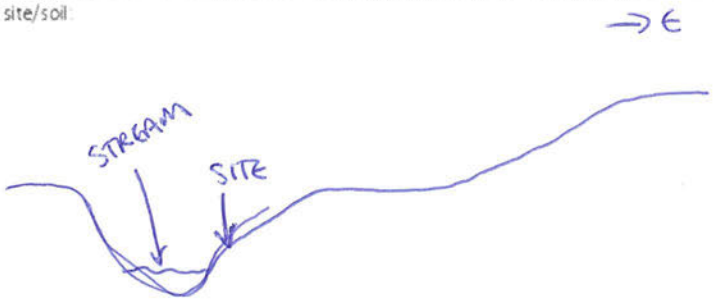
Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation
1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks 11 L 1:47pm 7cm BELOW GROUND LEVEL
3:30pm 303cm BELOW GROUND LEVEL

Site 9 All depths in mm

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	5/8 10yr	–	–	–	–	Topsoil clayey silt	topsoil, moist, low plasticity
300-400	7/6 10yr	–	–	–	–	silty clay	moist, mod plasticity

[1]Use% area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley Gully Slope

Water table: Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers: Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☐ NO ☑ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

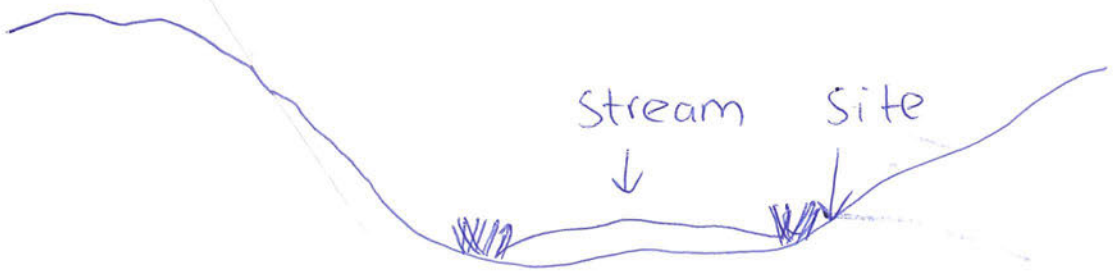
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D); refer to Section B: Vegetation

1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☐ NO ☑

Sketch of site/soil:



Remarks:

10L 1:53pm 100mm Below ground level
2:12pm 110mm Below ground level
3:33pm 150mm Below ground level

Site 10A

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	3/2 10YR DARK BROWN					CLAYEY SILT	TOPSOIL SOME MOISTURE, LOW PLASTICITY
300-600	6/8 10YR BROWNISH YELLOW					CLAYEY SILT	SOME MOISTURE, LOW-MODERATE PLASTICITY

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley Gully Slope

Water table: Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) _____

Pan: Humus Fe-pan Densi- Duri- Fragi- Ortstein

Layers: Depth (cm) _____

Slow perm: argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

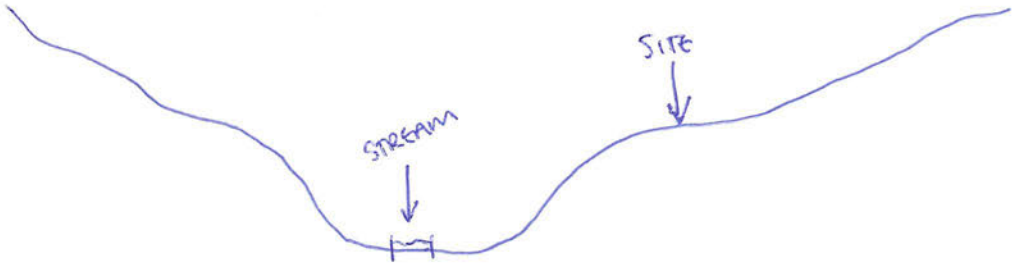
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☐ NO ☑

Sketch of site/soil:



Remarks GW SEEPAGE NEAR STREAM + BIOFILM ORANGE STREAM

8L 12:10pm 18cm BELOW GROUND LEVEL

15:20pm 24cm BELOW GROUND LEVEL

Site 10B

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[2]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	3/1 10YR	3/6 10YR	2			SILT	TOPSOIL, ROOTLETS
300-500	5/4 10YR	6/8 10YR & 6/1 10YR INCLUSIONS	2			CLAYEY SILT	DRY, LOW PLASTICITY

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Grey OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley Gully Slope

Water table: Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) _____

Pan: Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers: Depth (cm) _____

Slow perm: argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

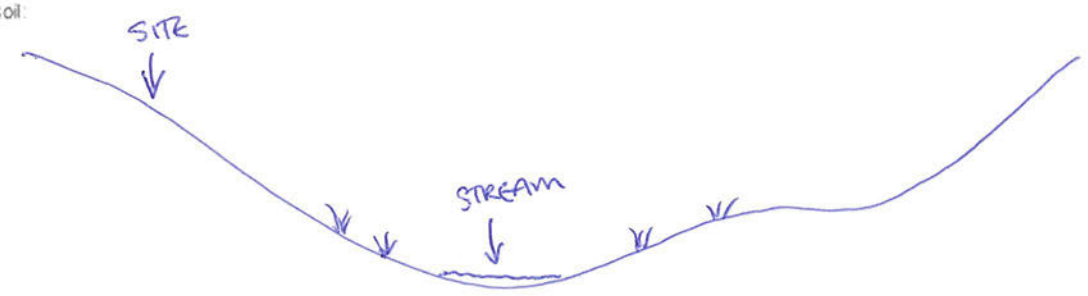
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____ (A)
2. No. FACU & UPL dominant species _____ (B)
3. Total _____ (A+B)
4. FAC-neutral (>50%) _____ (A/A+B)*100

Wetland hydrology present? YES ☐ NO ☑

Sketch of site/soil:



Remarks: 16.5L 12:09pm 20cm BELOW GROUND LEVEL

15:21 PM 26cm BELOW GROUND LEVEL

Site 10C

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-200	3/2 10YR	6/6 10YR	5		BOTTOM OF TOPSOIL	SILT	TOPSOIL, DRY
200-400	7/8 10YR	7/8 10YR	10		THROUGHOUT LAYER	CLAYEY SILT	DRY, MODERATE PLASTICITY

[1]Use% area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☑ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1 No. OBL & FACW dominant species _____(A)

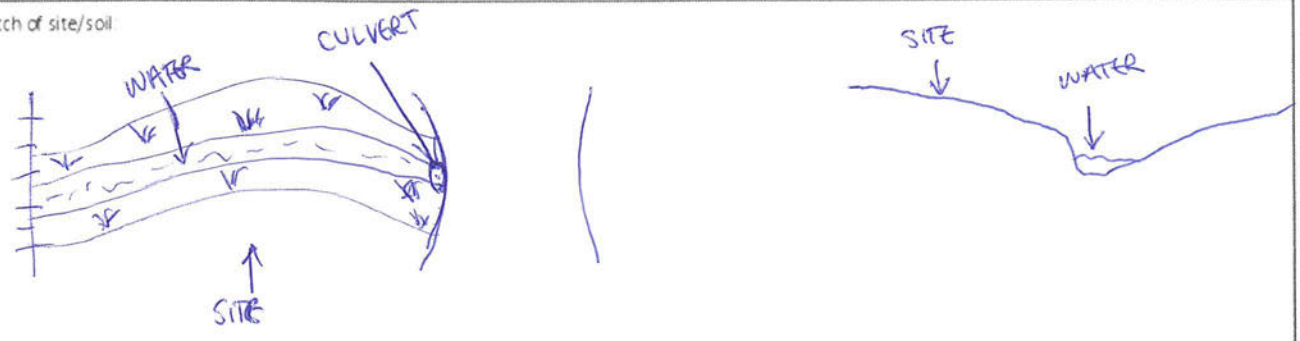
2 No. FACU & UPL dominant species _____(B)

3 Total _____(A+B)

4 FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks

17L 13:03pm 15cm BELOW GROUND LEVEL

13:38pm 20cm BELOW GROUND LEVEL

15:17pm 24cm BELOW GROUND LEVEL

SMALL AREA OF MOSS ON TOPSOIL.

Site 11

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth ~~(cm)~~ (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-200	4/2 10YR	3/6 10YR	10			Topsoil, Silt m-clay	Moist, Some-plastic
200-300	5/2 10YR	7/8 10YR	5			Clayey Silt	Dry, Mod-plastic
300-1000	7/1 10YR	7/8 10YR	5			Clayey Silt	Dry, Mod-plastic

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

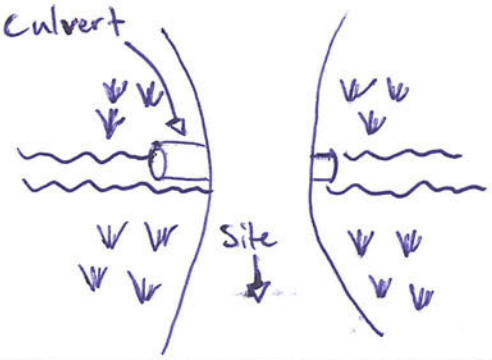
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____ (A)
2. No. FACU & UPL dominant species _____ (B)
3. Total _____ (A+B)
4. FAC-neutral (>50%) _____ (A/A+B) * 100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil:



Remarks: 15L at 13:20, 200 mm bgl
13:40, 200 mm bgl
15:16 210 mm bgl

Site 12

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (mm)	Matrix colour (moist) (10YR)	Mottles colour (moist)	Mottles % [1]	Mottles Size [2]	Mottle location [3]	Material [4]	Remarks
0-200	4/1	3/6	5			Topsoil	Dry, Friable
200-400	2/1	3/6	5			Clayey silt with peat	Dry, Mod-plastic
400-1000	2/1	–	–			Silty Clay	Moist, high-plastic

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☑ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D): refer to Section B Vegetation

1 No OBL & FACW dominant species _____(A)

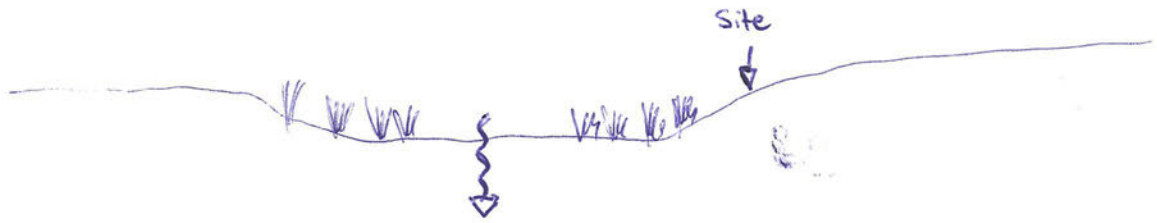
2 No FACU & UPL dominant species _____(B)

3 Total _____(A+B)

4 FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks

GW at 0.9 mbgl

15L at 14:35, 200mm from ground level

14:49, "

15:15, 250mm "

Site 13

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth ~~from~~ (mm)	Matrix colour (moist) (10YR)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-0-200	4/1	3/4	10			Topsoil, silt	Dry, rootlets
200-1000	4/6	-	-			clayey Silt (fill)	Gravels at 0.7, dry

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators: Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):
Location Depression Flat Valley Gully Slope
Water table Depth (cm) ____
High GW Perched Seepage Tidal Lithic
Pans Depth (cm) _____
Pan Humus Fe-pan Densi- Duri- Fragi Ortstein
Layers Depth (cm) _____
Slow perm argillic
☑ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

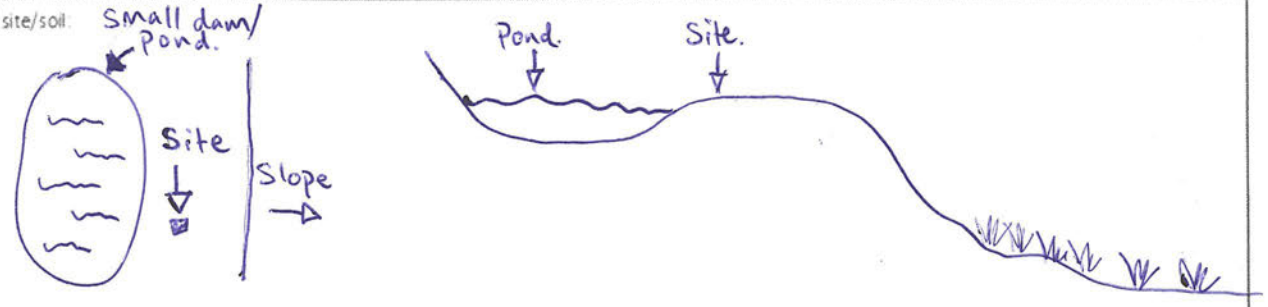
Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation
1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil:



Remarks

Site 14

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth[1] (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[2]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	4/2 7.5YR	4/6 7.5YR				Topsoil, silt	Dry, mod-plastic
300-1000	6/6 10YR	7/1 10YR					Dry, mod-plastic

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators: Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):
Location Depression Flat Valley Gully Slope
Water table Depth (cm) ____
High GW Perched Seepage Tidal Lithic
Pans Depth (cm) _____
Pan Humus Fe-pan Densi- Duri- Fragi Ortstein
Layers Depth (cm) _____
Slow perm argillic
☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

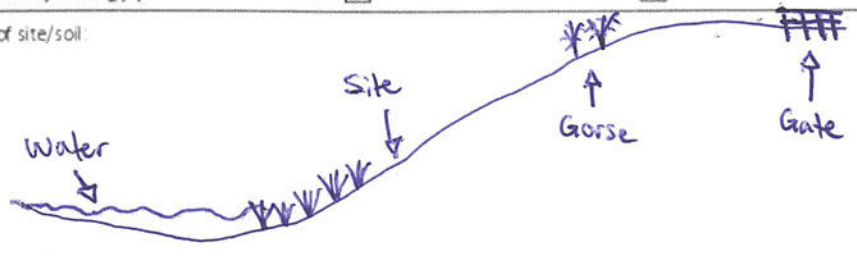
Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation
1 No OBL & FACW dominant species _____(A)
2 No FACU & UPL dominant species _____(B)
3 Total _____(A+B)
4 FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil:



Remarks: Nearby wetland, biofilm on surface of ponding water, indicates GW input
10L at 09:38, 130mm bgL
10:08, 140mm bgL
13:40, 250mm bgL.

Site 15A

SECTION C – SOIL AND HYDROLOGY

Profile description. (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (~~mm~~) (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-150	3/2 10YR	-	-			Topsoil, Silt.	Dry, friable
150-400	4/2 10YR	-	-			Silt, minor clay	Dry, friable

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

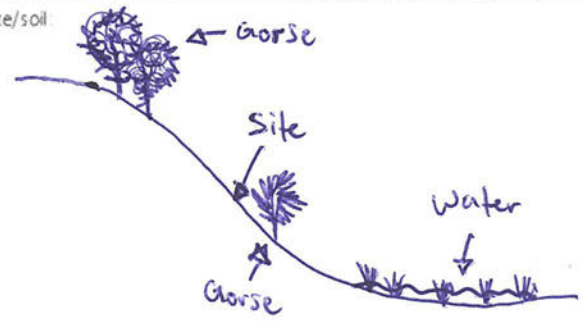
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks

7L at 13:00, 300 mm bgl
13:10, 400 mm bgl
8L at 13:13, 280 mm bgl
13:24, 320 mm bgl

Site15B

SECTION C – SOIL AND HYDROLOGY

Profile description (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %	Mottles Size	Mottle location	Material	Remarks
0-150	5/1 10YR	–				Topsoil, silt	Saturated
150-600	7/1 10YR	6/8 7.5YR	20			Silty clay	Saturated, high plastic

[1]Use % area charts, [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☑ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi Duri Fragi Orbstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☑ Surface water (1A)
- ☑ Groundwater <30 cm (1B)
- ☑ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☑ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D) refer to Section B Vegetation

1 No OBL & FACW dominant species _____(A)

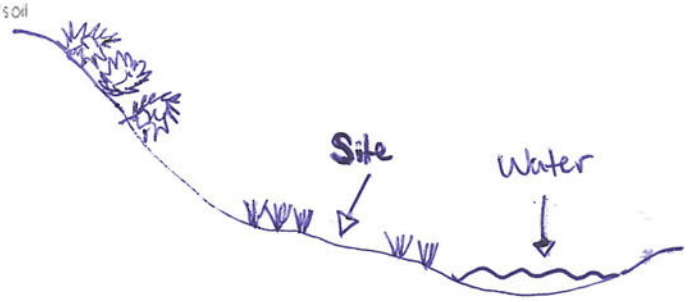
2 No FACU & UPL dominant species _____(B)

3 Total _____(A+B)

4 FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks Water table at surface.
Infiltration test not possible.

Site 15C

SECTION C – SOIL AND HYDROLOGY

Profile description (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth ~~(cm)~~ (mm)	Matrix colour (moist)	Mottles colour (moist)	Mottles % [1]	Mottles Size [2]	Mottle location [3]	Material [4]	Remarks
0-150	4/1 10YR	–	–		~~Topsoil, Silt~~	Topsoil, Silt	Moist, rootlets
150-450	5/1 10YR					Clayey Silt	Moist, sticky, mod-plastic

[1]Use % area charts; [2]Use size classes, [3]Ped face, pore, within ped along roots, within matrix, [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☑ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location Depression Flat Valley Gully Slope

Water table Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

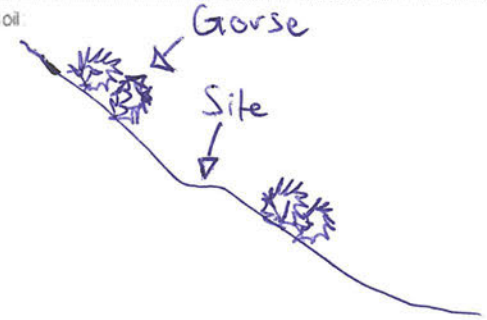
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation

1. No OBL & FACW dominant species _____(A)
2. No FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil



Remarks 5L at 15:25, 50mm bgl
15:37, 70mm bgl
15:51, 90mm bgl

Site 16A

SECTION C – SOIL AND HYDROLOGY

Profile description (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (~~cm~~)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-300	5/2 10YR	5/8 7.5YR	15-20			Topsoil, silt	Moist
300-900	5/2 10YR	6/4 7.5YR	2			Clayey Silt	Relatively dry, med-plastic

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators: Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☑ Mottled

Horizon:
- ☐ Reductimorphic
- ☑ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):
Location Depression Flat Valley Gully Slope
Water table Depth (cm) ____
High GW Perched Seepage Tidal Lithic
Pans Depth (cm) _____
Pan Humus Fe-pan Densi- Duri- Fragi Ortstein
Layers Depth (cm) _____
Slow perm argillic
☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☑ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

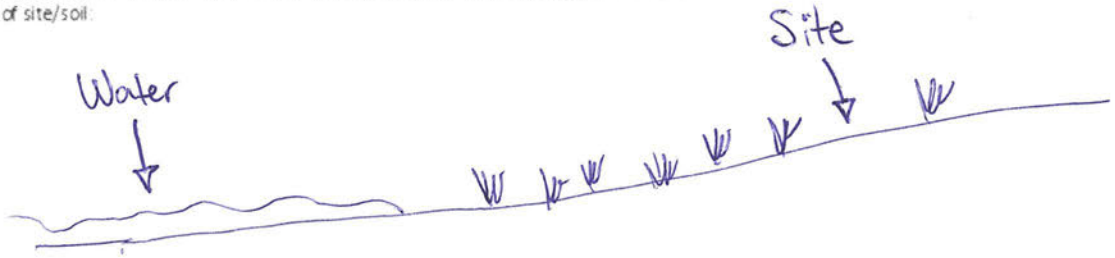
Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D), refer to Section B Vegetation
1. No OBL & FACW dominant species _____(A)
2. No FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil:



Remarks: Substantial core loss on auger
Seepage into hole, see photos.

18L at 10:50, 150mm bgl
11:19, 150mm bgl
16:15, 150mm bgl.

Site 16B

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-200	4/3 10YR	5/6 10YR	5			Topsoil, Silt	Moist, Sticky
200-400	5/1 10YR	3/4 10YR	40			Clayey Silt	Moist, mod-plastic

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley OR
- ☐ Mottled

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley Gully Slope

Water table: Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers: Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☑ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☑ Oxidised rhizosphere on roots (3B)
- ☑ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

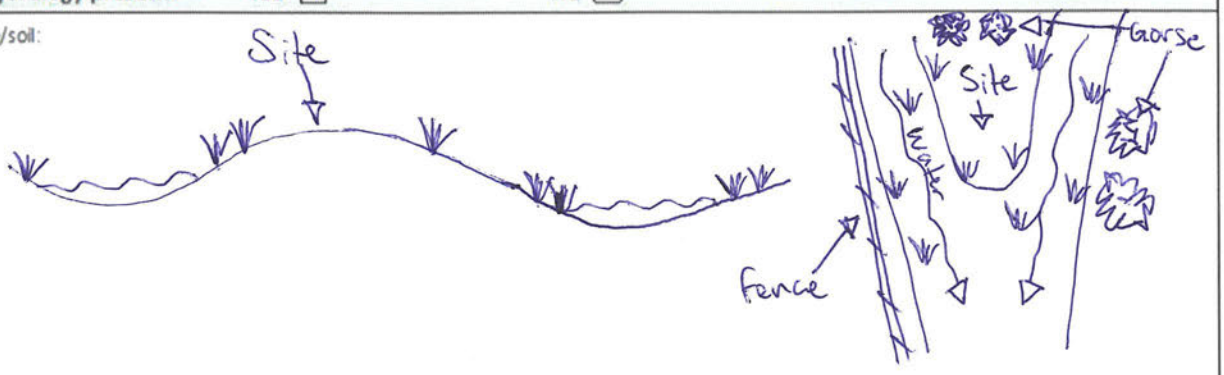
- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D); refer to Section B: Vegetation

1. No. OBL & FACW dominant species _____ (A)
2. No. FACU & UPL dominant species _____ (B)
3. Total _____ (A+B)
4. FAC-neutral (>50%) _____ (A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/soil:

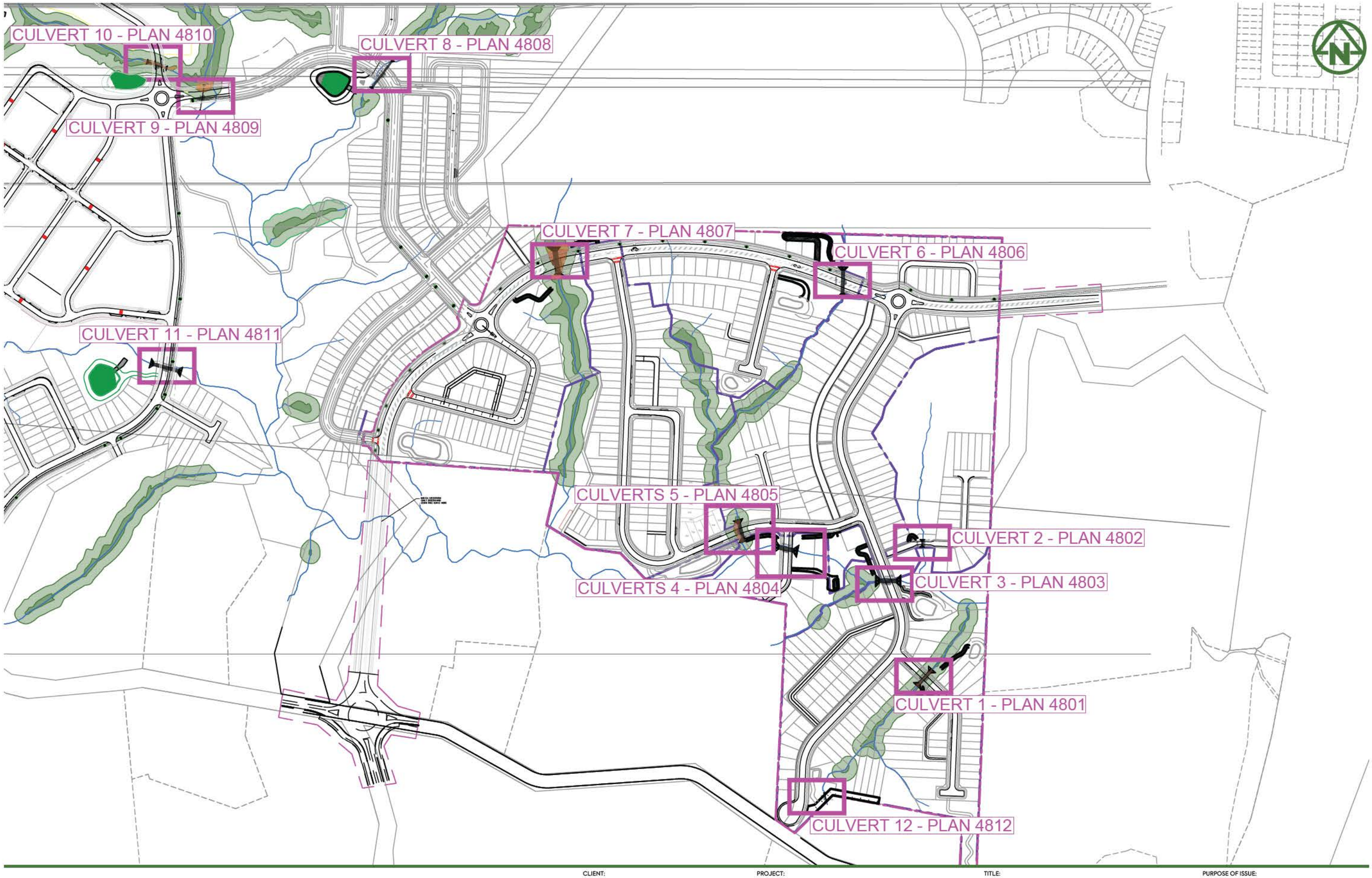


Remarks: GW at 350 mm, Seepage at 270mm after 5 mins
13L at 12:03, 200mm bgl
12:34, 200mm bgl
13:27, 210mm bgl

Appendix C. Hydrology Tool Indicator Table

Indicator		Group 1: Observation of flooding or groundwater			Group 2: Evidence of flooding or ponding												Group 3: Evidence of current or recent soil saturation					Group 4: Evidence from other site conditions or data				
		1A: Surface water	1B: Ground-water	1C: Soil saturation	2A: Water marks	2B: Sediment deposits	2C: Drift deposits	2D: Agal mat or crust	2E: Iron deposits	2F: Surface soil cracks	2G: Inundation visible on aerial imagery	2H: Sparsely vegetated concave surface	2I: Salt crust	2J: Aquatic invert-ebrates	2K: Water-stained leaves	2L: Drainage patterns	3A: Hydrogen sulphide odour	3B: Oxidised rhizo-spheres along living roots	3C: Red-uced iron	3D: Recent iron reduction in tilled soils	3E: Dry-season water table	3F: Saturation visible on aerial imagery	4A: Stunted or stressed plants	4B: Geo-morphic position	4C: Shallow aquitard	4D: Facul-tative-neutral test	4E: Frost-heave humm-ocks
	Prim.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓				
Site	Sec.														✓	✓					✓	✓		✓	✓	✓	✓
1		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
2		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
3A		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
3B		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
4		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
5		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
6		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
7		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
8		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
9		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
10A		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
10B		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
10C		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
11		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
12		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
13		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
14		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
15A		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
15B		✓	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×
15C		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	✓	×	×	×
16A		×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
16B		×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	✓	×	×	×	×	✓	×	×	×

Appendix D. Culvert Drawings



MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE

53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT

SCALE: 1:4000m @ A3

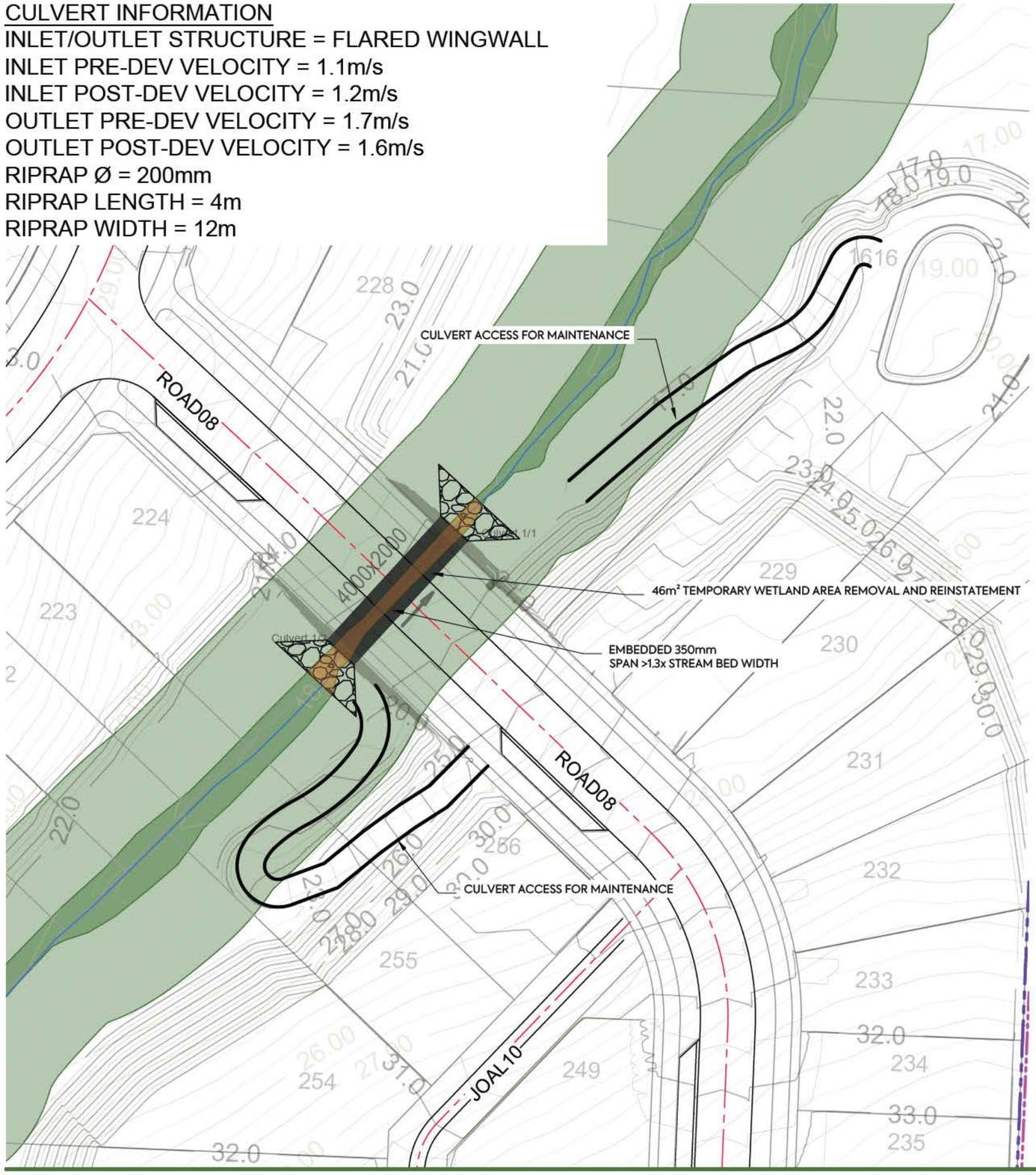
DO NOT SCALE

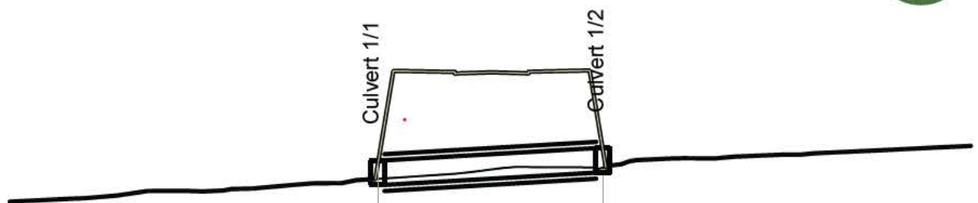
DRAWING NO: 3725-1-4800

REV: G

CULVERT INFORMATION

INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 1.1m/s
INLET POST-DEV VELOCITY = 1.2m/s
OUTLET PRE-DEV VELOCITY = 1.7m/s
OUTLET POST-DEV VELOCITY = 1.6m/s
RIPRAP Ø = 200mm
RIPRAP LENGTH = 4m
RIPRAP WIDTH = 12m

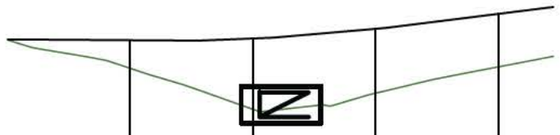




DATUM = 5.0

DESIGN SURFACE	17.65		18.92
DEPTH TO INVERT	1.65	1.65	1.92
INVERT LEVEL	16.00	16.00	17.00
EXISTING SURFACE	16.49		17.40
PIPE DETAILS		5.45% 4000x2000mmø BOX	
LENGTH		18.35m	

Culvert 01 - LONGSECTION



DATUM = 14.00

DESIGN SURFACE	23.06	23.20	23.98	25.20
CUT/FILL DEPTHS	2.29	5.78	5.25	4.32
EXISTING SURFACE	20.76	17.42	18.74	20.88
CHAINAGES	10.0	20.0	30.0	40.0

Culvert 01 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

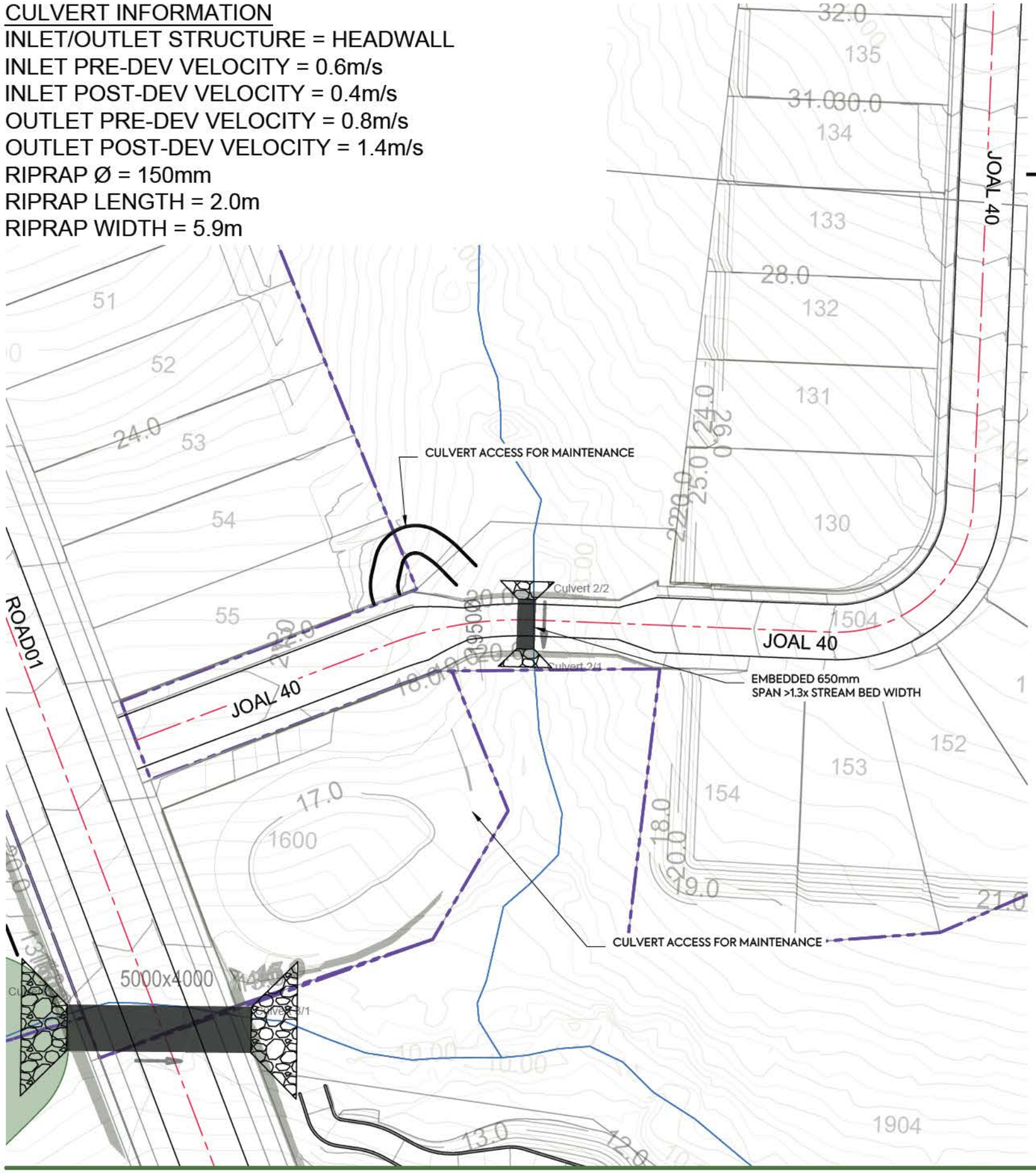
PROJECT: DELMORE
STAGE 1
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4801
REV: G

C:\12DS\DATA\MCKFS01\3725-1 DELMORE STAGE 1_5231\06000. ENGINEERING DESIGN\6500. DRAWINGS\4800 CULVERTS.DWG

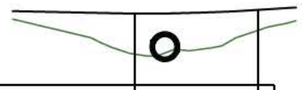
CULVERT INFORMATION
INLET/OUTLET STRUCTURE = HEADWALL
INLET PRE-DEV VELOCITY = 0.6m/s
INLET POST-DEV VELOCITY = 0.4m/s
OUTLET PRE-DEV VELOCITY = 0.8m/s
OUTLET POST-DEV VELOCITY = 1.4m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 2.0m
RIPRAP WIDTH = 5.9m



DATUM = 2.0

DESIGN SURFACE	18.16	18.46
DEPTH TO INVERT	2.46 / 2.46	2.26
INVERT LEVEL	15.70 / 15.70	16.20
EXISTING SURFACE	16.23	16.82
PIPE DETAILS		7.63% 1950mmø RCRRJ Class 4
LENGTH		6.56m

Culvert 02 - LONGSECTION



DATUM = 14.00

DESIGN SURFACE	19.86	20.15
CUT/FILL DEPTHS	3.33	1.68
EXISTING SURFACE	16.53	18.47
CHAINAGES	10.0	20.0

Culvert 02 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

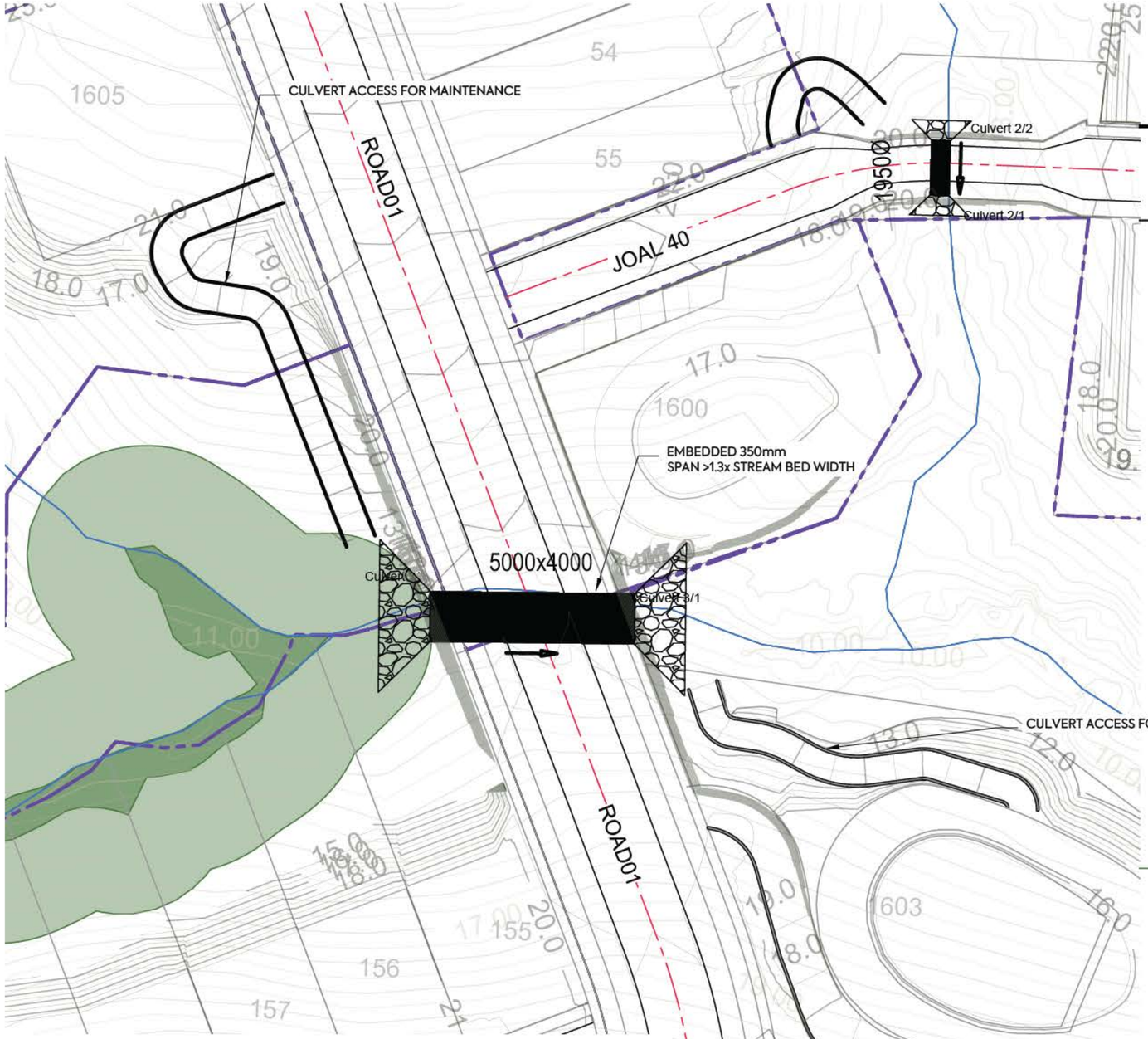
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

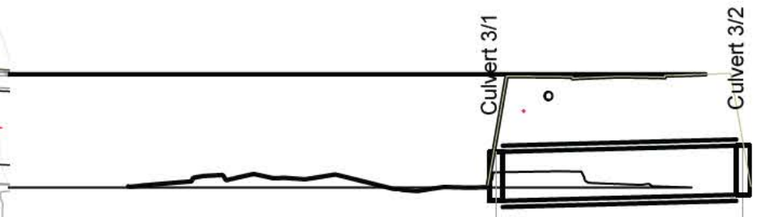
CLIENT: VINEWAY LIMITED

PROJECT: DELMORE
STAGE 1
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4802
REV: G





DATUM = -1.0

DESIGN SURFACE	14.65		14.27
DEPTH TO INVERT	5.15	5.15	4.27
INVERT LEVEL	9.50	9.50	10.00
EXISTING SURFACE	11.83		10.65
PIPE DETAILS		2.48% 5000x4000mmø BOX	
LENGTH		20.13m	

Culvert 03 - LONGSECTION

DATUM = 7.00

DESIGN SURFACE	18.73	18.49	18.46	18.53
CUT/FILL DEPTHS	4.47	7.23	6.29	4.27
EXISTING SURFACE	14.26	11.26	12.17	14.26
CHAINAGES	10.0	20.0	30.0	40.0

Culvert 03 - ELEVATION VIEW

SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

CULVERT INFORMATION

INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 1.1m/s
INLET POST-DEV VELOCITY = 1.1m/s
OUTLET PRE-DEV VELOCITY = 1.6m/s
OUTLET POST-DEV VELOCITY = 1.5m/s
RIPRAP Ø = 250mm
RIPRAP LENGTH = 5m
RIPRAP WIDTH = 15m

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE STAGE 1 53A, 53B & 55 RUSSELL RD OREWA

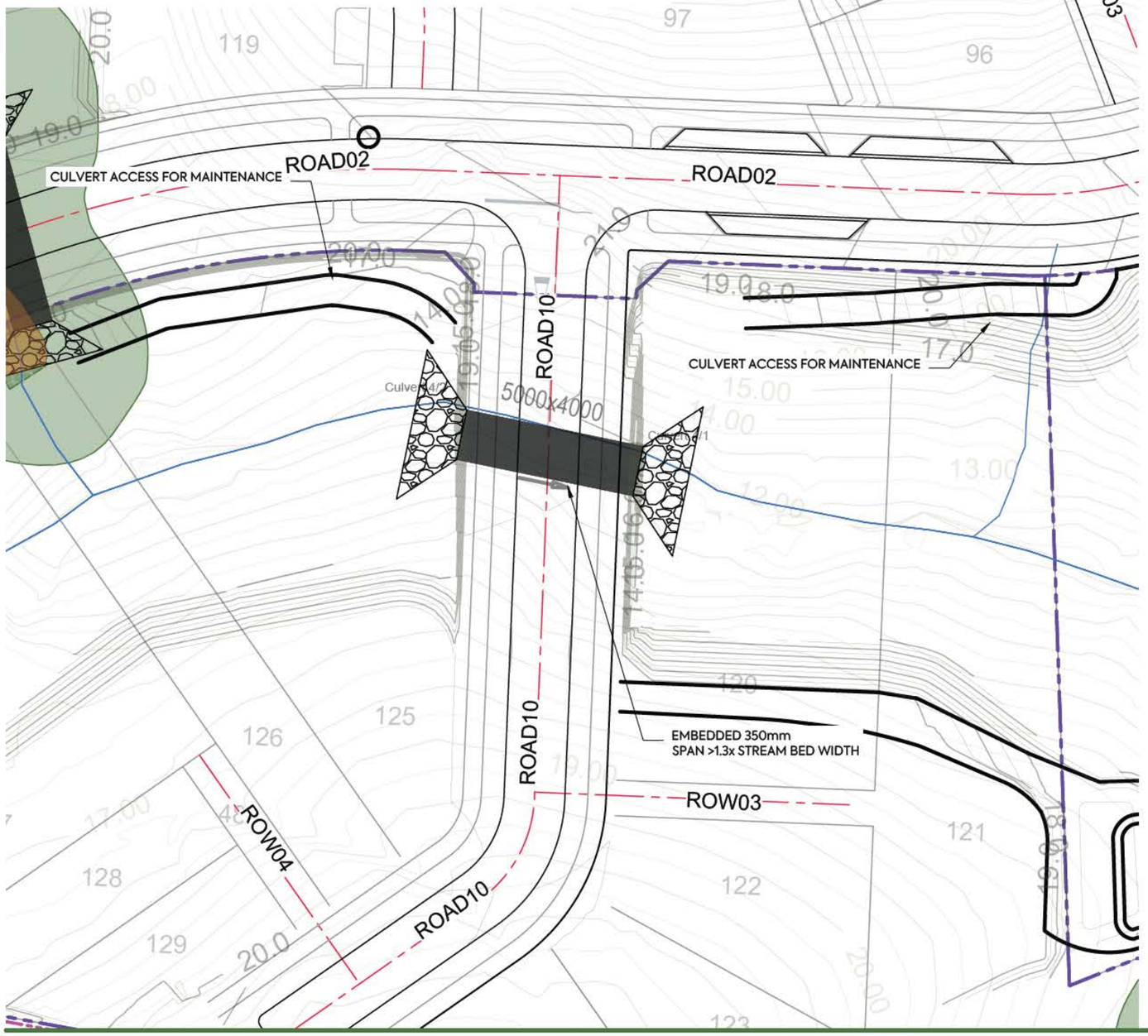
TITLE: STORMWATER CULVERTS

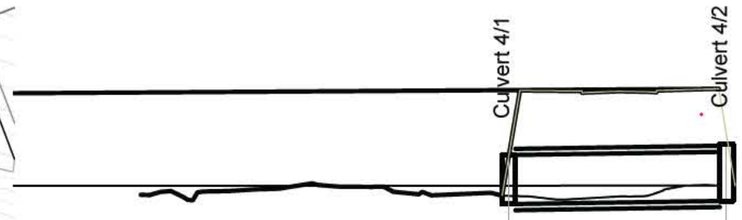
PURPOSE OF ISSUE: RESOURCE CONSENT

SCALE: 1:1000m @ A3 DO NOT SCALE

DRAWING NO: 3725-1-4803 REV: G

CULVERT INFORMATION
INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 1.6m/s
INLET POST-DEV VELOCITY = 1.5m/s
OUTLET PRE-DEV VELOCITY = 2.0m/s
OUTLET POST-DEV VELOCITY = 1.1m/s
RIPRAP Ø = 250mm
RIPRAP LENGTH = 5m
RIPRAP WIDTH = 15m

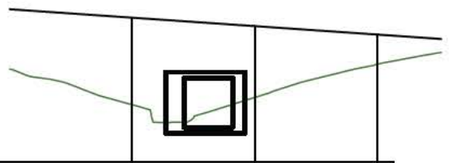




DATUM = 0.0

DESIGN SURFACE	14.50		16.24
DEPTH TO INVERT	3.90	3.90	5.39
INVERT LEVEL	10.60	10.60	10.85
EXISTING SURFACE	11.26		12.09
PIPE DETAILS		1.41% 5000x4000mmø BOX	
LENGTH		17.75m	

Culvert 04 - LONGSECTION



DATUM = 8.00

DESIGN SURFACE	19.79	19.10	18.41
CUT/FILL DEPTHS	7.10	5.81	2.42
EXISTING SURFACE	12.69	13.29	15.99
CHAINAGES	10.0	20.0	30.0

Culvert 04 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE STAGE 1 53A, 53B & 55 RUSSELL RD OREWA

TITLE: STORMWATER CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT

SCALE: 1:1000m @ A3 DO NOT SCALE

DRAWING NO: 3725-1-4804 REV: G

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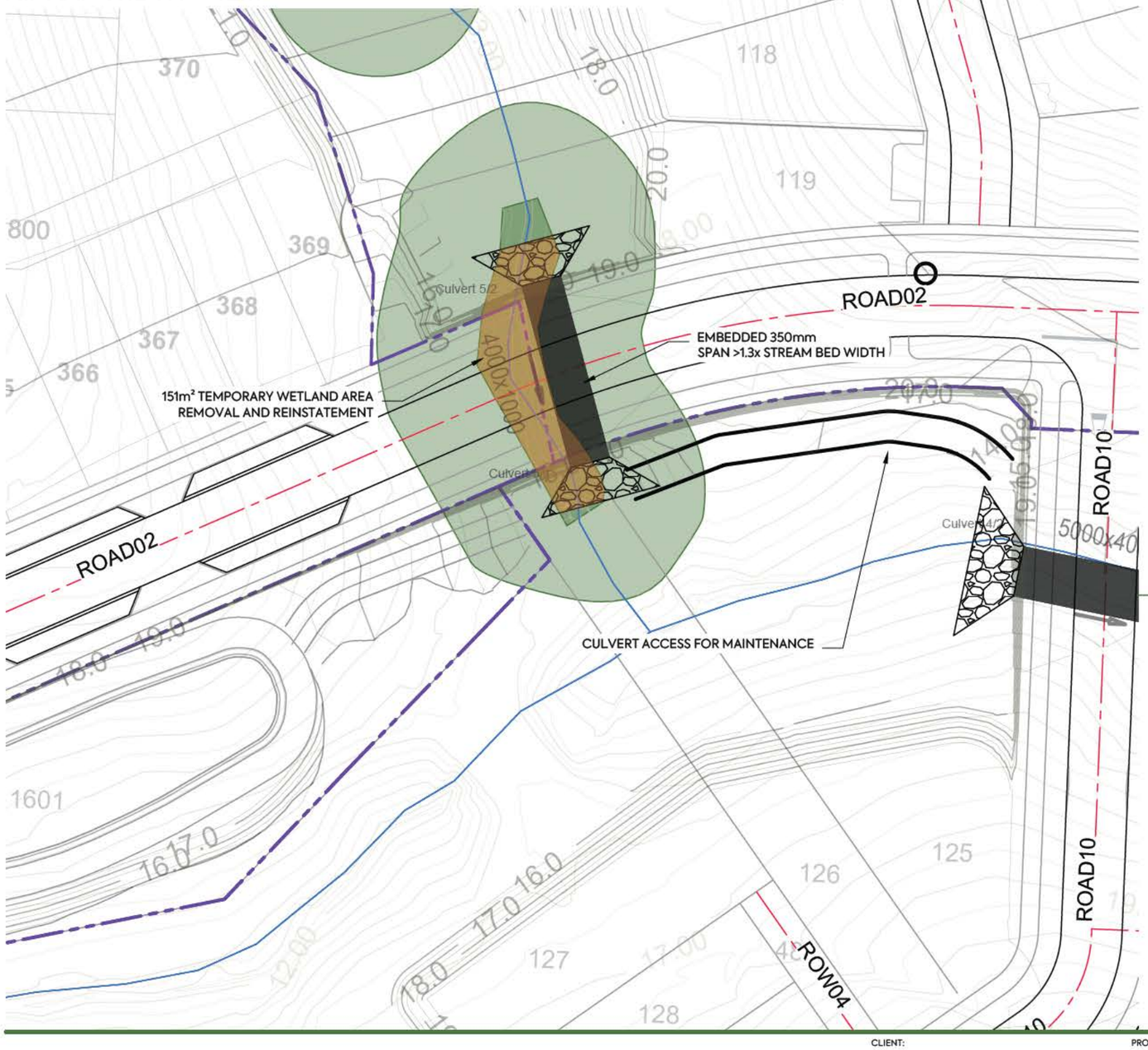
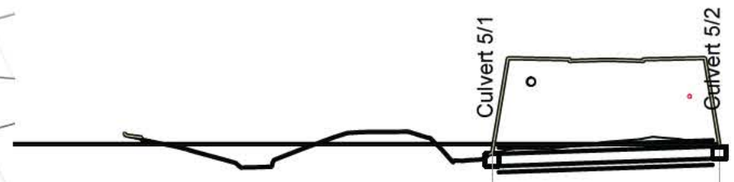
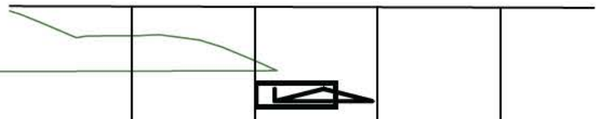
CULVERT INFORMATION
INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 2.3m/s
INLET POST-DEV VELOCITY = 0.4m/s
OUTLET PRE-DEV VELOCITY = 0.9m/s
OUTLET POST-DEV VELOCITY = 1.4m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 4m
RIPRAP WIDTH = 12m





DATUM = 1.0			
DESIGN SURFACE	12.77		13.50
DEPTH TO INVERT	1.07	1.07	1.20
INVERT LEVEL	11.70	11.70	12.30
EXISTING SURFACE	12.71		13.50
PIPE DETAILS		3.24% 4000x1000mmø BOX	
LENGTH		18.53m	

Culvert 05 - LONGSECTION



DATUM = 10.00				
DESIGN SURFACE	19.94	19.91	19.87	19.84
CUT/FILL DEPTHS	2.39	4.39	6.23	3.98
EXISTING SURFACE	17.54	15.52	13.65	15.86
CHAINAGES	10.0	20.0	30.0	40.0

Culvert 05 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

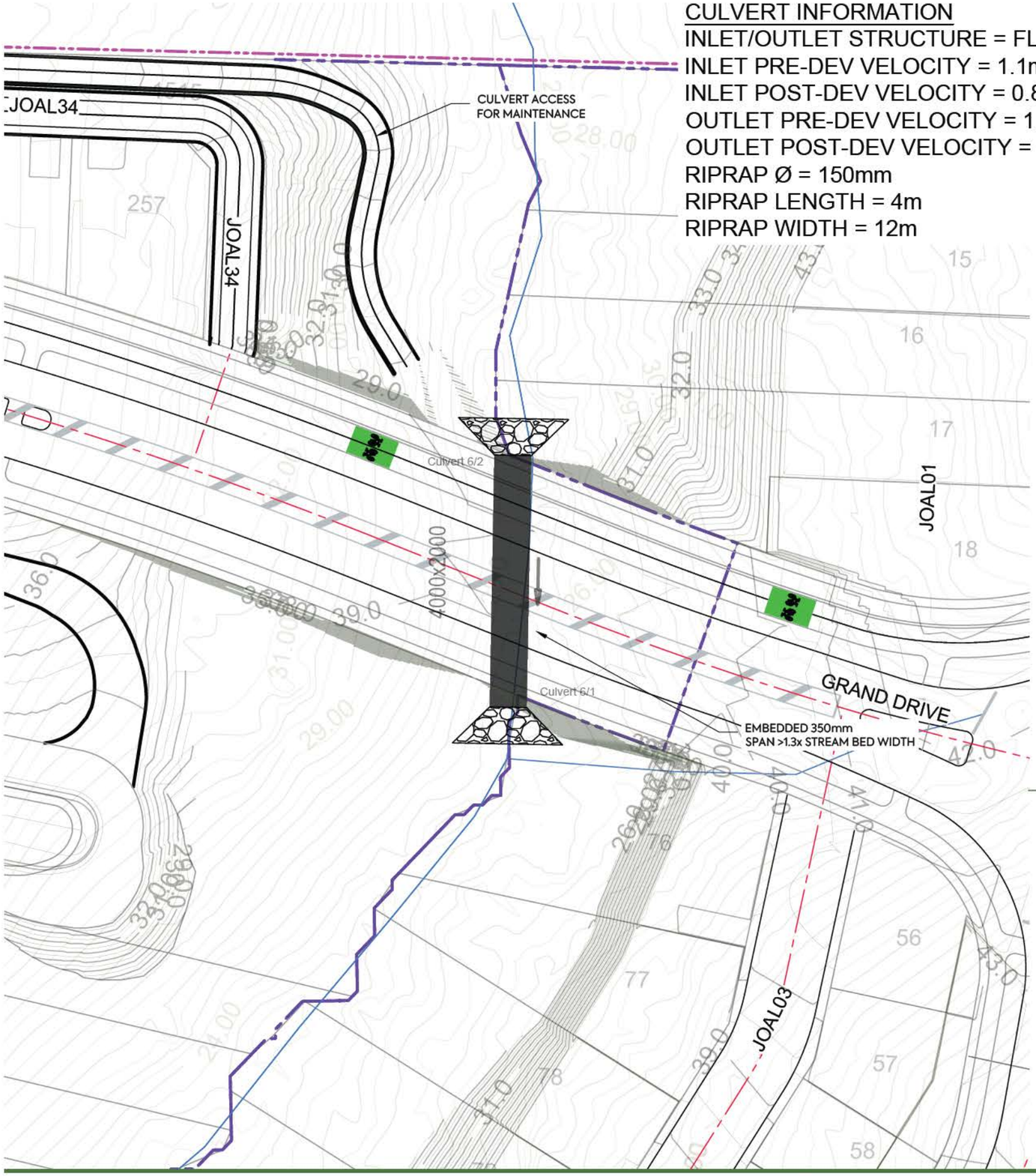
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

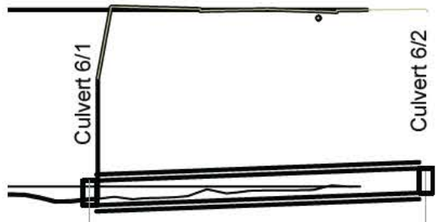
PROJECT: DELMORE
STAGE 1
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4805
REV: G

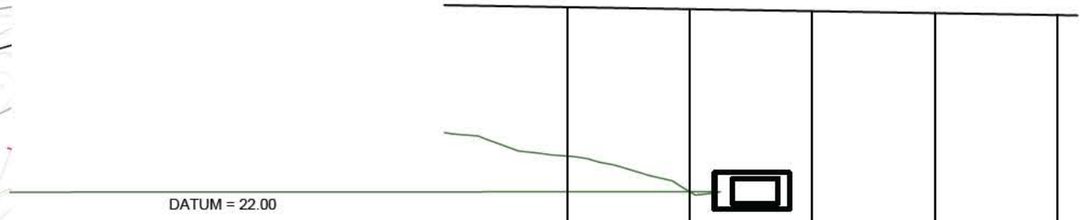


CULVERT INFORMATION
INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 1.1m/s
INLET POST-DEV VELOCITY = 0.8m/s
OUTLET PRE-DEV VELOCITY = 1.5m/s
OUTLET POST-DEV VELOCITY = 0.6m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 4m
RIPRAP WIDTH = 12m



DATUM = 16.0			
DESIGN SURFACE	23.68		39.18
DEPTH TO INVERT	0.48	0.48	14.98
INVERT LEVEL	23.20	23.20	24.20
EXISTING SURFACE	23.68		24.48
PIPE DETAILS		3.65% 4000x2000mmø BOX	
LENGTH		27.42m	

Culvert 06 - LONGSECTION



DESIGN SURFACE	40.03	39.86	39.70	39.54	39.38
CUT/FILL DEPTHS	12.14	14.87	13.89	10.95	7.97
EXISTING SURFACE	27.89	24.99	25.81	28.59	31.41
CHAINAGES	10.0	20.0	30.0	40.0	50.0

Culvert 06 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE
STAGE 1
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4806
REV: G

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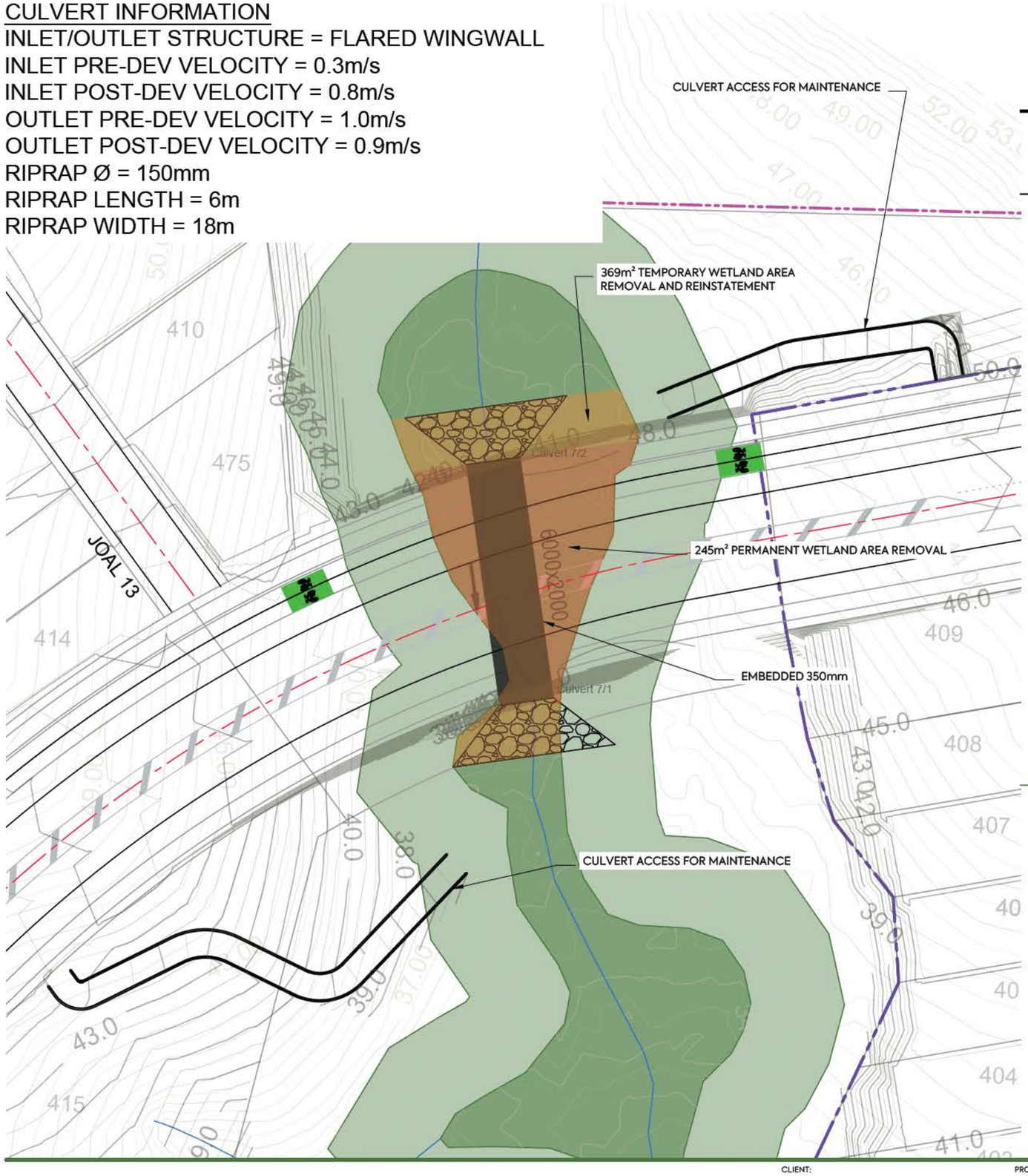
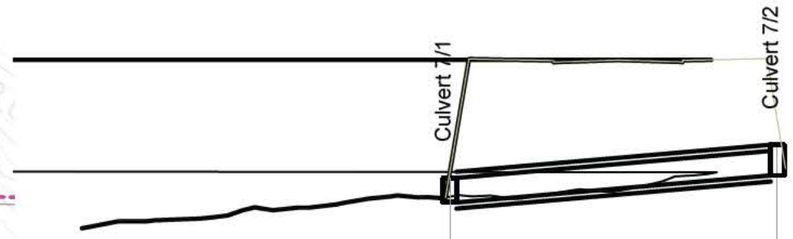
CULVERT INFORMATION
INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 0.3m/s
INLET POST-DEV VELOCITY = 0.8m/s
OUTLET PRE-DEV VELOCITY = 1.0m/s
OUTLET POST-DEV VELOCITY = 0.9m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 6m
RIPRAP WIDTH = 18m





DATUM = 27.0			
DESIGN SURFACE	38.78		43.00
DEPTH TO INVERT	2.48	2.48	4.50
INVERT LEVEL	36.30	36.30	38.50
EXISTING SURFACE	36.77		39.13
PIPE DETAILS		8.24% 6000x2000mmø BOX	
LENGTH		26.7m	

Culvert 07 - LONGSECTION

DESIGN SURFACE	47.83	47.85	47.87	47.89	47.91
CUT/FILL DEPTHS	7.57	9.08	8.93	9.29	6.46
EXISTING SURFACE	40.25	38.77	38.94	38.60	41.46
CHAINAGES	10.0	20.0	30.0	40.0	50.0

Culvert 07 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED

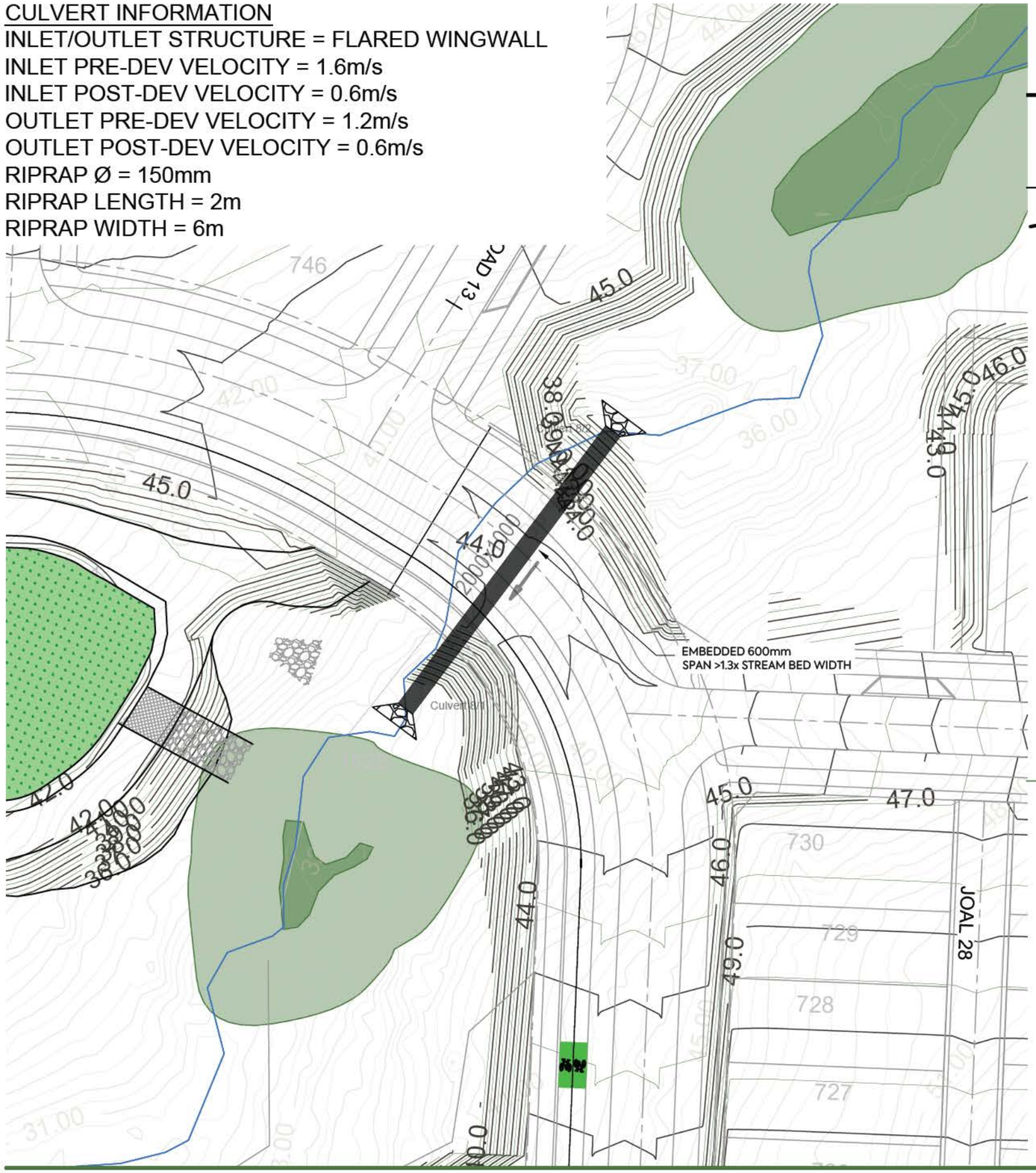
PROJECT: DELMORE
STAGE 1
53A, 53B & 55 RUSSELL RD
OREWA

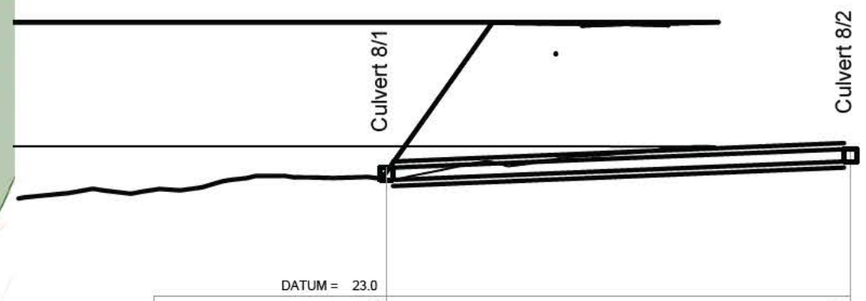
TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4807
REV: G

C:\12DS\DATA\MCKFS01\3725-1 DELMORE STAGE 1_5231\06000. ENGINEERING DESIGN\6500. DRAWINGS\4800 CULVERTS.DWG

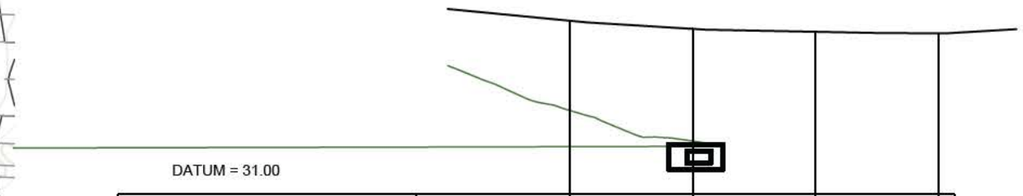
CULVERT INFORMATION
INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 1.6m/s
INLET POST-DEV VELOCITY = 0.6m/s
OUTLET PRE-DEV VELOCITY = 1.2m/s
OUTLET POST-DEV VELOCITY = 0.6m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 2m
RIPRAP WIDTH = 6m





DATUM = 23.0				
DESIGN SURFACE	33.15			35.62
DEPTH TO INVERT	0.65	0.65		1.62
INVERT LEVEL	32.50	32.50		34.00
EXISTING SURFACE	32.54			34.33
PIPE DETAILS		3.96% 2000x1000mmø BOX		
LENGTH		37.86m		

Culvert 08 - LONGSECTION



DATUM = 31.00

DESIGN SURFACE	45.14	44.49	44.25	44.12
CUT/FILL DEPTHS	7.32	9.15	8.89	4.35
EXISTING SURFACE	37.83	35.34	35.36	39.77
CHAINAGES	10.0	20.0	30.0	40.0

Culvert 08 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

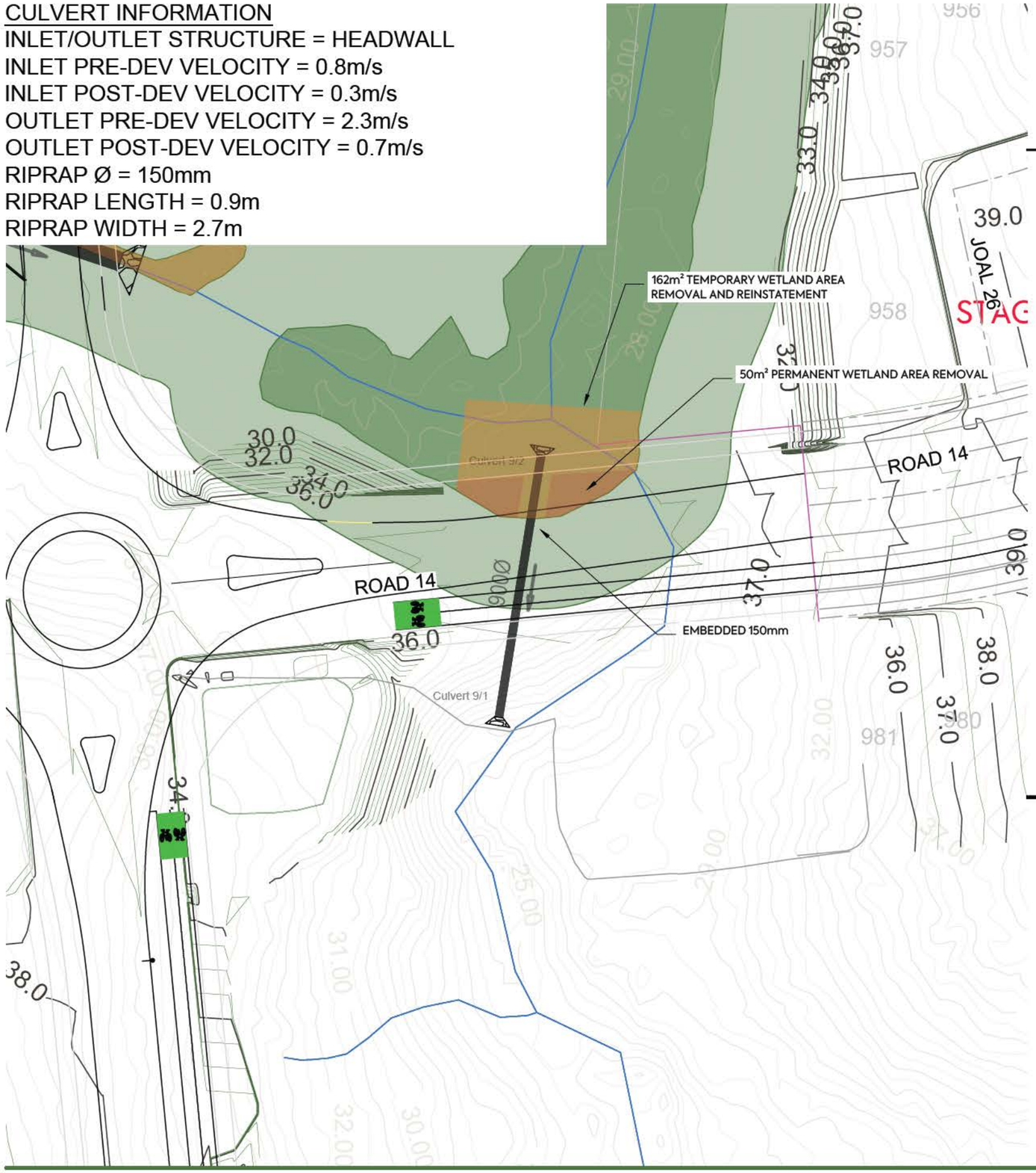
CLIENT: VINEWAY LIMITED

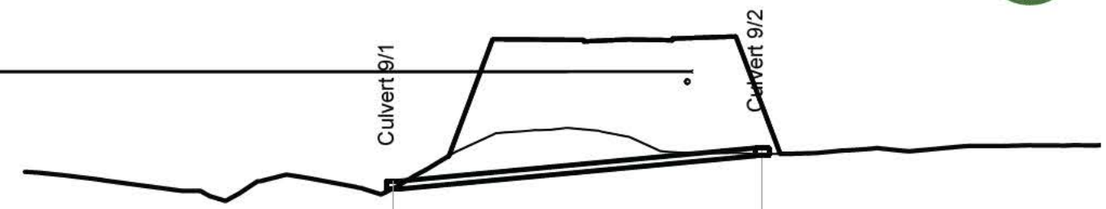
PROJECT: DELMORE
STAGE 2
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4808
REV: G

CULVERT INFORMATION
INLET/OUTLET STRUCTURE = HEADWALL
INLET PRE-DEV VELOCITY = 0.8m/s
INLET POST-DEV VELOCITY = 0.3m/s
OUTLET PRE-DEV VELOCITY = 2.3m/s
OUTLET POST-DEV VELOCITY = 0.7m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 0.9m
RIPRAP WIDTH = 2.7m





DESIGN SURFACE	25.32		32.03
DEPTH TO INVERT	0.02	0.02	4.03
INVERT LEVEL	25.30	25.30	28.00
EXISTING SURFACE	25.32		28.14
PIPE DETAILS		8.97% 900mmø RCRRJ Class 4	
LENGTH		27.38m	

Culvert 09 - LONGSECTION

DESIGN SURFACE	36.23	36.35	36.48	36.60	36.72	
CUT/FILL DEPTHS	6.10	8.31	8.29	8.04	6.70	
EXISTING SURFACE	30.13	28.05	28.18	28.56	30.02	
CHAINAGES	10.0	20.0	30.0	40.0	50.0	

Culvert 09 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

CLIENT: VINEWAY LIMITED
PROJECT: DELMORE STAGE 2 53A, 53B & 55 RUSSELL RD OREWA
TITLE: STORMWATER CULVERTS
PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3 DO NOT SCALE
DRAWING NO: 3725-1-4809
REV: G

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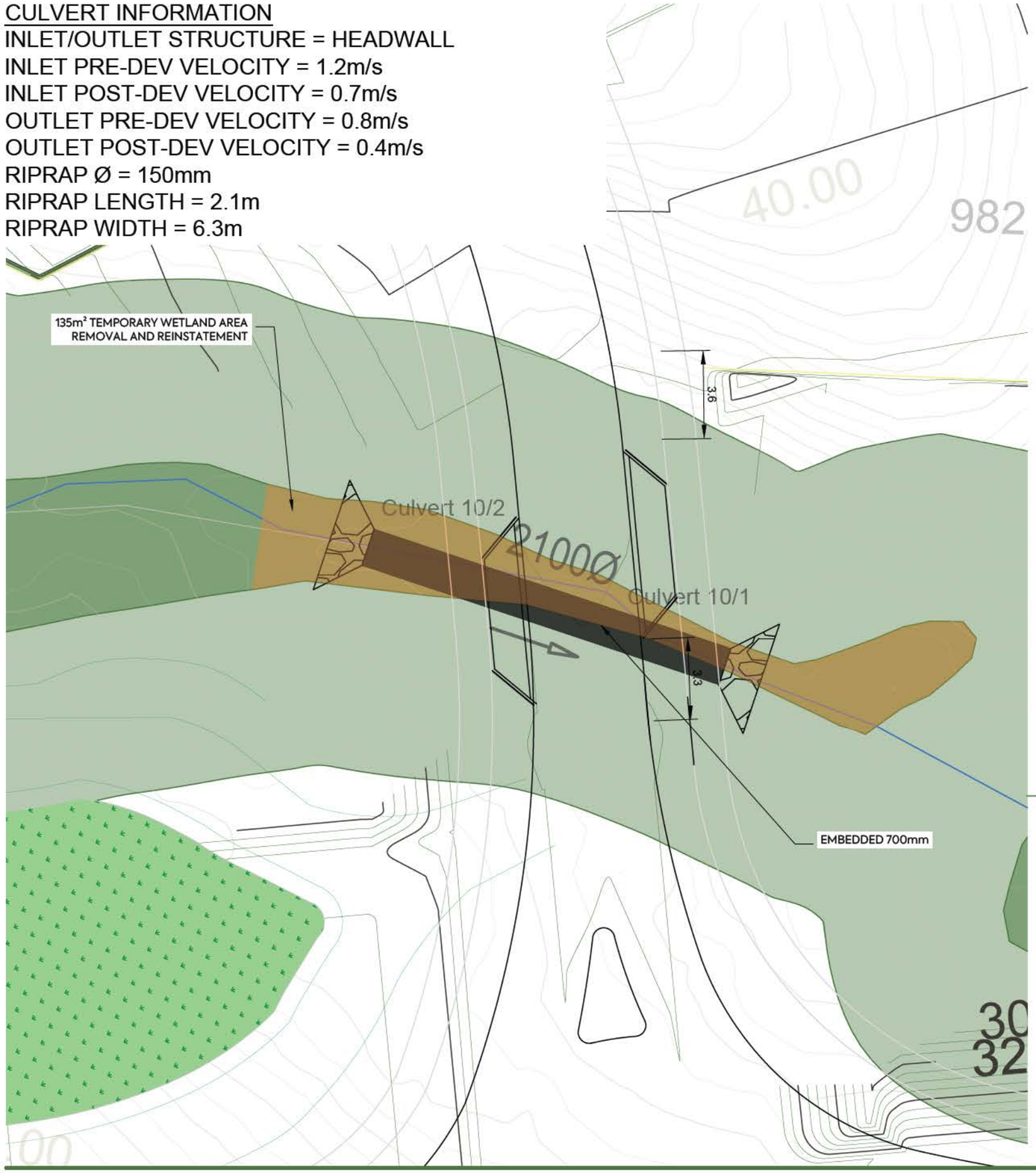
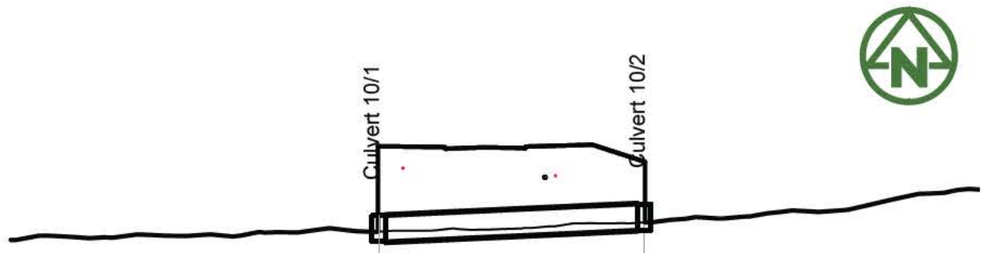
CULVERT INFORMATION
INLET/OUTLET STRUCTURE = HEADWALL
INLET PRE-DEV VELOCITY = 1.2m/s
INLET POST-DEV VELOCITY = 0.7m/s
OUTLET PRE-DEV VELOCITY = 0.8m/s
OUTLET POST-DEV VELOCITY = 0.4m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 2.1m
RIPRAP WIDTH = 6.3m





DATUM = 18.0			
DESIGN SURFACE	37.10		35.85
DEPTH TO INVERT	7.77	7.77	5.58
INVERT LEVEL	29.33	29.33	30.27
EXISTING SURFACE	30.13		30.89
PIPE DETAILS		4.32% 2100mmø RCRRJ Class 4	
LENGTH		21.66m	

Culvert 10 - LONGSECTION

DESIGN SURFACE	37.17	37.08	37.22	37.55
CUT/FILL DEPTHS	6.42	6.88	5.27	2.79
EXISTING SURFACE	30.75	30.20	31.95	34.76
CHAINAGES	10.0	20.0	30.0	40.0

Culvert 10 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

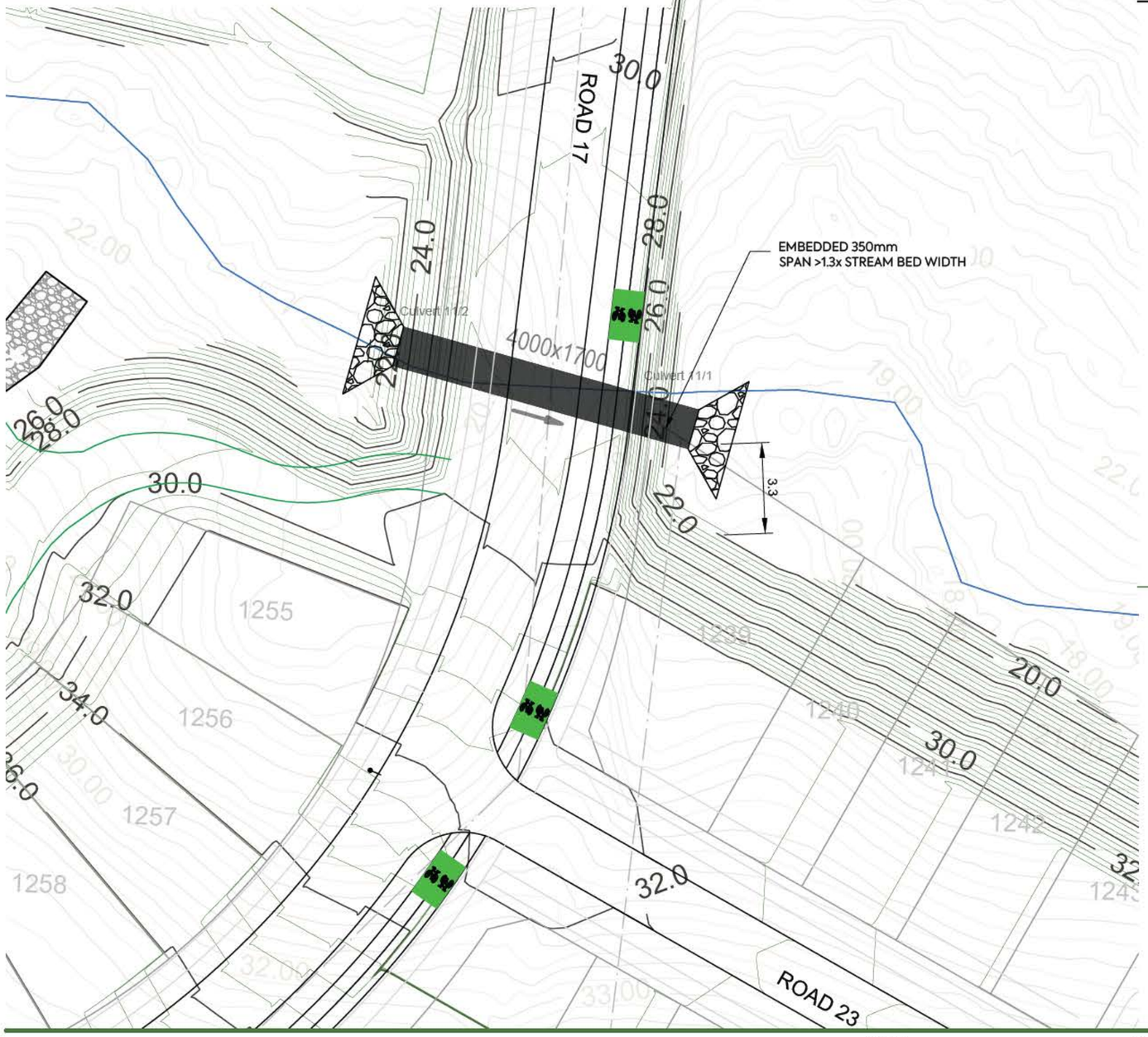
CLIENT: VINEWAY LIMITED

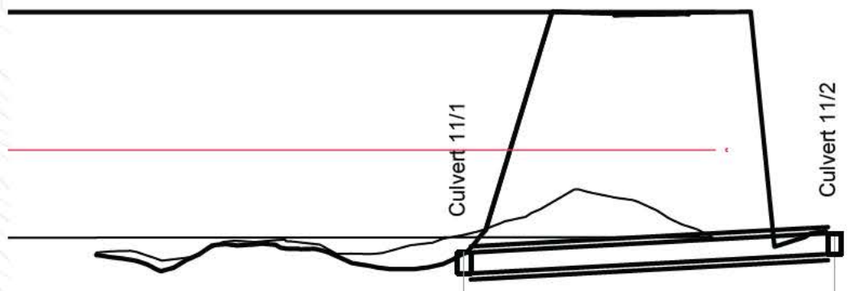
PROJECT: DELMORE
STAGE 2
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4810
REV: G

CULVERT INFORMATION
INLET/OUTLET STRUCTURE = FLARED WINGWALL
INLET PRE-DEV VELOCITY = 0.4m/s
INLET POST-DEV VELOCITY = 0.9m/s
OUTLET PRE-DEV VELOCITY = 1.2m/s
OUTLET POST-DEV VELOCITY = 1.2m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 4m
RIPRAP WIDTH = 12m





DATUM = 12.0			
DESIGN SURFACE	18.95		20.32
DEPTH TO INVERT	1.62	1.62	1.42
INVERT LEVEL	17.33	17.33	18.90
EXISTING SURFACE	20.48		20.20
PIPE DETAILS		5.2% 4000x1700mmø BOX	
LENGTH		30.22m	

Culvert 11 - LONGSECTION

DATUM = 16.00

DESIGN SURFACE	29.68	29.51	29.53	29.80	30.41
CUT/FILL DEPTHS	5.80	7.92	10.00	8.59	7.99
EXISTING SURFACE	23.88	21.60	19.54	21.21	22.42
CHAINAGES	10.0	20.0	30.0	40.0	50.0

Culvert 11 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

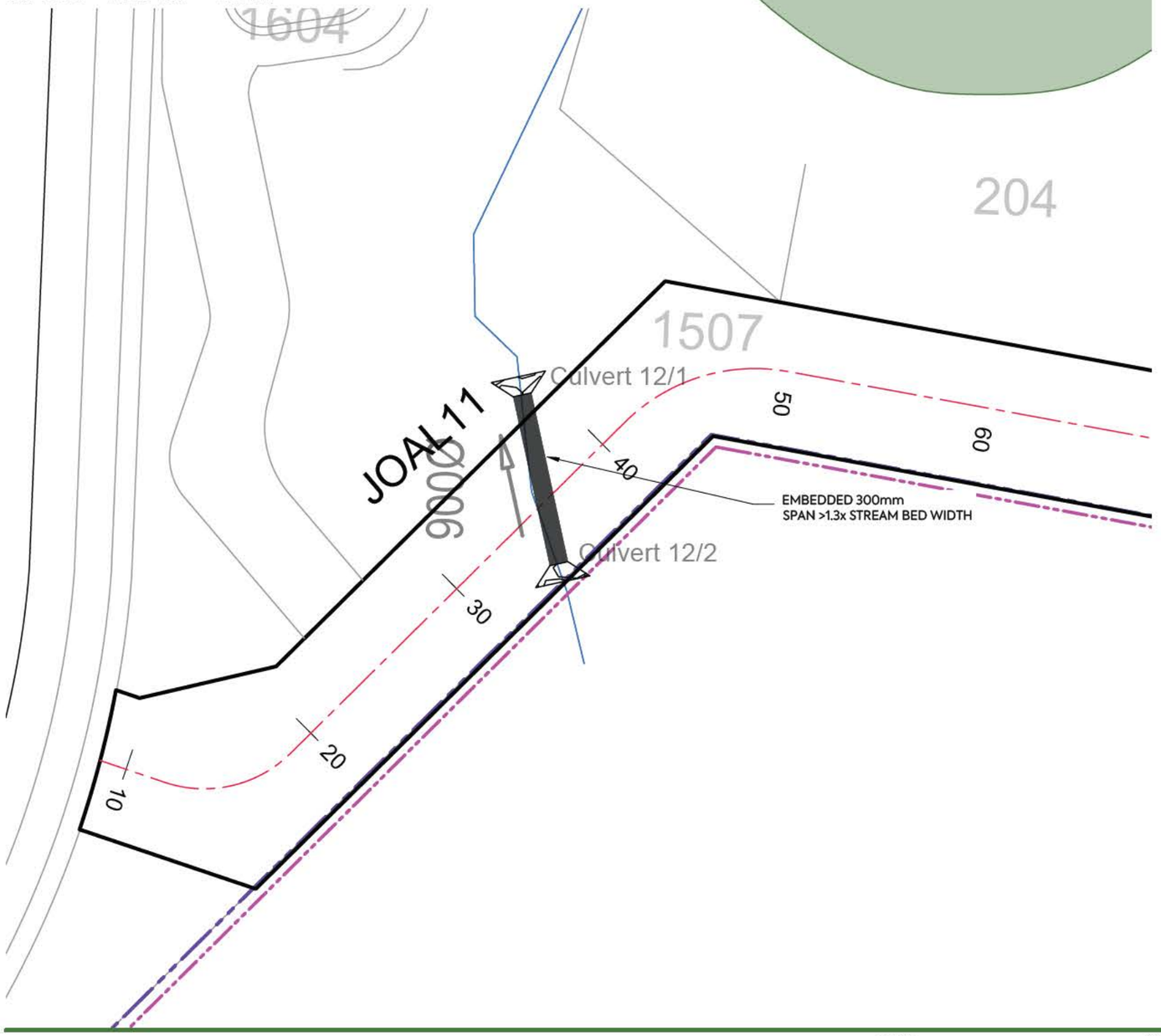
CLIENT: VINEWAY LIMITED

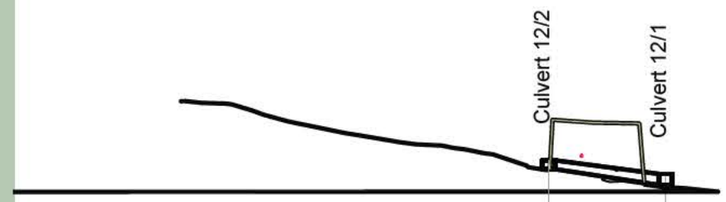
PROJECT: DELMORE
STAGE 2
53A, 53B & 55 RUSSELL RD
OREWA

TITLE: STORMWATER
CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT
SCALE: 1:1000m @ A3
DO NOT SCALE
DRAWING NO: 3725-1-4811
REV: G

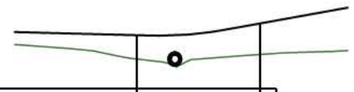
CULVERT INFORMATION
INLET/OUTLET STRUCTURE = HEADWALL
INLET PRE-DEV VELOCITY = UNDEFINED
INLET POST-DEV VELOCITY = UNDEFINED
OUTLET PRE-DEV VELOCITY = 0.1m/s
OUTLET POST-DEV VELOCITY = 0.2m/s
RIPRAP Ø = 150mm
RIPRAP LENGTH = 0.9m
RIPRAP WIDTH = 2.7m





DATUM = 16.0			
DESIGN SURFACE	30.23		28.72
DEPTH TO INVERT		0.05	-0.18 -0.18
INVERT LEVEL		30.18	28.90 28.90
EXISTING SURFACE	30.23		28.72
PIPE DETAILS		13.47% 900mmø RCRRJ	
LENGTH		10.5m	

Culvert 12 - LONGSECTION



DATUM = 27.00		
DESIGN SURFACE	31.38	32.34
CUT/FILL DEPTHS	1.94	2.53
EXISTING SURFACE	29.44	29.81
CHAINAGES	10.0	20.0

Culvert 12 - ELEVATION VIEW
SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
G	UPDATED FOR NEW MODEL	LV	JK		03/12/25

MCKENZIE & CO.

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE STAGE 1 53A, 53B & 55 RUSSELL RD OREWA

TITLE: STORMWATER CULVERTS

PURPOSE OF ISSUE: RESOURCE CONSENT

SCALE: 1:1000m @ A3
DO NOT SCALE

DRAWING NO: 3725-1-4812

REV: G