Whenuapai Wastewater Servicing Package 1

Wetland Monitoring and Reinstatement Plan

Prepared for Watercare Services Ltd
Prepared by Beca Limited

27 October 2023

Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
1	Kimberley D'Souza Genevieve Smith	Draft for Client Review	06/10/2023
2	Kimberley D'Souza	Final Version	27/10/2023

Document Acceptance

Action	Name	Signed	Date
Prepared by	Kimberley D'Souza Genevieve Smith		26/10/2023
Reviewed by	Raymond Chang		26/10/2023
Approved by	Jenny Vince		26/10/2023
on behalf of	Beca Limited		

Introduction

1.1 Background

Beca Limited (Beca) has been commissioned on behalf of Watercare Services Ltd (Watercare) to prepare an Ecological Impact Assessment (EcIA) to support consenting requirements associated with Whenuapai Redhills: Package 1 Project[1]. The works are located between Brigham Creek Road (north), the South-Western Motorway (west), Northside Drive (south) and Mamari Road (east). These works will provide a new wastewater pipeline and pumpstation to accommodate for the growth of the North West region of Auckland.

The current proposed construction methodology outlines that work for the pump station will require trenching through Wetland C and the partial excavation of Wetland D, both of which are located adjacent to the gravity main and the pump station. The purpose of this Wetland Monitoring and Reinstatement Plan (WMP) is:

- To provide a site-specific monitoring methodology for Wetland C to confirm that the extent and value of the wetland will be maintained through the construction phase of the work.
- To provide a site specific-monitoring methodology for Wetland D to confirm that the remaining extent and value will be maintained through the construction phase of works.
- To provide a reinstatement plan for Wetland D so that pre-development extent and value is achieved following the completion of works.

1.2 Wetland C

Wetland C is located approximately 10 m north of the proposed pump station location. This wetland has been determined to be affected by the construction of the wastewater gravity pipe and pump station works. It is classified as a 'natural inland wetland' in accordance with the National Policy Statement for Freshwater Management (NPS – FM, 2022) and is therefore subject to regulation under the National Environmental Standards for Freshwater (NES- F, 2022) (Ministry for the Environment, 2022b, 2022a). The wetland was previously delineated by Tonkin and Taylor in 2021, and a subsequent site visit was undertaken by Beca ecologists to collect baseline vegetation and soil data from the wetland.

The wetland is located in a topographical depression in the landscape and has formed within an overland flow path depression which slopes towards Sinton Stream. The land appears to be currently unmaintained and is covered by an overgrowth of exotic grasses, and no native species have been identified. At the time of the site visit, soils were highly saturated with soil pits filling with water almost immediately, and in some areas surface water was present (Figure 1).

Within the wetland a small pond was also identified that was highly turbid and overgrown with *Persicaria* sp.

[1] Beca Limited. (2023). Whenuapai Wastewater Servicing Scheme Package 1: Ecological Impact Assessment. Prepared for Watercare Services Limited.

Figure 1. Vegetation identified within Wetland C comprised of primarily exotic grasses. Soils were highly saturated with pits filling up almost immediately within the wetland.

1.3 Wetland D

Wetland D is located within the footprint of the pump station in a sloped section in the landscape. The construction of the pump station is expected to result in the partial excavation (140 m^2) of Wetland D (both soils and vegetation) and may also impact the remaining extent of the wetland through altering hydrology.

Like Wetland C, Wetland D is highly modified with only exotic species present. At the time of the site visit, soils were wet with groundwater seepage observed to gradually occur (Figure 2).

Figure 2. Vegetation within Wetland D comprises of primarily FAC species, and two FACW species. Soils were wet at the time of the site visit, with water seepage observed gradually occurring (August 2023).

2 Proposed Management Methodology during Construction

During the construction phase of works, to maintain the measured extent of the Wetland C, and the remaining extent of Wetland D, it is proposed that a drip irrigation system is set up to recharge water (from dewatered groundwater) into the wetlands.

At concept design, it is proposed that the drip irrigation system be designed alongside principles of GD06 – Auckland Council's On-site Wastewater Management guideline[2]. The simplest irrigation system is likely to be a low pressure effluent irrigation system consisting of surface-mounted drip irrigation lines, or by pot-speaders/sprinklers.

GD06 typically seeks to make sure that long-term dispersal of wastewater to a land parcel does not result in the risk of overland flows of wastewater and over-saturation of soils. In the case of this use case, it is expected that the on-going irrigation rate could be higher (to maintain closer to 'saturated' conditions more typical of wetlands), but reliance on the GD06 dispersal rate provides a starting point that minimises risk of overland flows from higher rates of discharge which could create other erosion and scour issues.

Based on the soil analysis undertaken to inform the EcIA at Wetland C and D, the soil category has been assessed in accordance with Table 35 of GD06 as Soil Category 5 – light clays. The recommended irrigation rate from low pressure effluent irrigation is 2.5 mm/day.

Hence, the initial wetland irrigation regime will start with an application rate of 2.5mm per day across the extent of the wetlands, and this rate will be adjusted accordingly, following the monitoring process set out Section 3.

3 Measuring Changes to Wetland C and D during Construction

3.1 Baseline Conditions of Wetland C and D

A baseline survey to inform the design of a construction monitoring regime was undertaken on 28th August 2023.

The wetland extent delineated at this time is the winter extent of the wetlands. As detailed in Section 3.2, a follow up wetland delineation survey will be undertaken to identify the summer wetland extent. This extent will form the basis from which changes will be measured against. The methodology utilised during the baseline monitoring will be followed for the duration of the monitoring period.

Refer to Appendix 1 for a full list of species identified in each wetland, percentage coverage, and baseline monitoring locations.

3.1.1 Vegetation and Prevalence Index

3.1.1.1 Wetland C

Vegetation across the plots mainly comprise of exotic species, with no native species identified. Species in higher dominance included creeping buttercup (*Ranunculus repens*), Yorkshire fog (*Holcus lanatus*), soft rush (*Juncus effusus*), creeping bent (*Agrostis stolonifera*).

The plots undertaken passed the dominance test and has a mean prevalence index score of 2.64.

3.1.1.2 Wetland D

[2] Z, Chen and G Silyn Roberts. (2021) *On-site wastewater management in the Auckland Region.* Auckland Council guideline document GD201/006.

Similar to Wetland C, Wetland D is also dominated by only exotic species, and passed the dominance test, and had a prevalence index score of 2.63.

3.1.2 Soil water characteristics

Soil samples were collected across three locations within Wetland C and one location at Wetland D (see Appendix 1) and underwent particle size distribution analysis. These soil water characteristics were collected and analysed to inform the EcIA and provide the context for the permanent wilting point (PWP) and the field capacity (FC) of the soil.

The results indicate that the range between PWP and FC occurs when soil moisture is between approximately 10 – 28%, which would equate to between 20 – 56 mm water in soil, assuming total soil depth of 300 mm. This information provides the baseline from which changes will be measured against.

Given this, soil moisture monitoring during the construction period cannot be below 10 %, and is recommended to be closer to, or greater than, 28%.

3.2 Vegetation Surveys

Vegetation plots will be set up across both Wetland C and D to monitor vegetation changes within the wetland during construction works. Vegetation surveys will be undertaken utilising the *Handbook for Monitoring Wetland Condition* (Clarkson et al., 2003) and using the Wetland Plot Sheet. It is recommended that vegetation surveys are undertaken during each monitoring visit.

For Wetland C, the baseline vegetation surveys undertaken provides an understanding of the current vegetation composition, character, and the winter extent of Wetland C. This forms the baseline from which changes will be compared to during the construction stage of works. It is recommended that vegetation plots are collected, and these positions are staked and flagged for the duration of the works.

For Wetland D, it is recommended that a follow up site visit is undertaken, and specific wetland delineation surveys are carried out within the undisturbed area of the wetland, prior to the construction works commencing. The locations of the plots will be flagged and staked, and the vegetation community and composition identified during this survey will form the baseline from which changes during construction are compared to. The vegetation boundary will also be re-delineated.

The recommended locations for the vegetation plots are displayed on Figure 3.

3.3 Soil Surveys

For Wetland C, soil samples will be collected, and locations should be within proximity to the samples collected during the baseline surveys. These locations should be staked and flagged for the duration of works.

For Wetland D, as is being done for the vegetation community and delineation of extent, soil samples will be collected within the undisturbed area prior to construction works and will inform the baseline soil assessment from which changes are compared to.

The locations of the soil samples are displayed on Figure 3.

As undertaken for the baseline assessments, soil samples will include:

- Particle size distribution analysis.
- Soil moisture with a handheld probe.

It is recommended that these surveys are undertaken during each monitoring visit, in conjunction with the vegetation surveys.

3.4 Photo Points

In addition to vegetation and soil surveys, photo points will be set up to as an additional measure of recording vegetation change for the duration of the proposed works. These photo points will be established at the same locations as the vegetation plots.

3.5 Measuring Changes to Wetland C

As the soil saturation is dependent on the hydrological input received by Wetland C, the best method identified to detect change is through the change in the vegetation community, composition, and condition. These changes can be used to identify any potential impacts the discharge is having on the wetland structure, and if need be, alter discharge amounts.

The threshold for a marked decline in the vegetation community and ecological value of the wetland will be determined by a 20% change in the prevalence index score across the monitoring locations. Should the prevalence score show an increase over time, further investigation into the potential causes will be undertaken. This will include altering the rate of water discharged into the wetland.

3.6 Measuring Changes to Wetland D

Monitoring changes at Wetland D will be undertaken in a similar manner to Wetland C. Monitoring during the dewatering and discharge works will be undertaken at the undisturbed extent of Wetland D. This will primarily comprise of monitoring the value and extent of the wetland and will include:

- Undertaking vegetation plots across the undisturbed extent – in the same locations as identified during the follow up surveys.
- Mapping the vegetation boundary extent and noting any changes (expansion or contraction) of the boundary.

3.7 Response to changes (if measured)

The threshold for a marked decline in the vegetation community and ecological value of the wetland will be determined by a 20% change in the prevalence index score across the monitoring locations.

Should the prevalence score show an increase overtime (indicating a transition to less wetland species coverage), further investigation into the potential causes will be undertaken. This will include altering the rate of water discharged into the wetland.

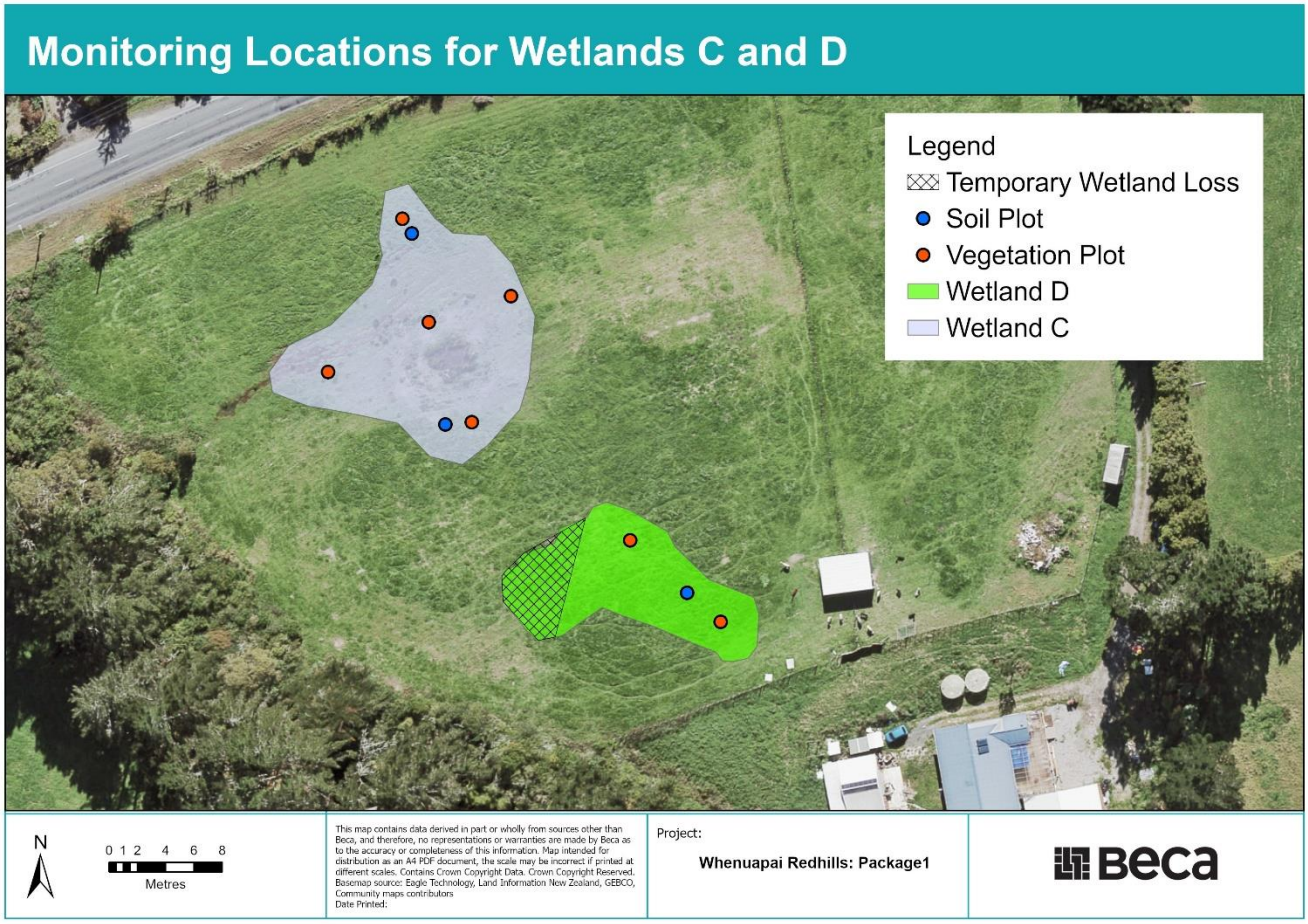

Figure 3. Proposed vegetation and soil monitoring locations with Wetland C and D during the construction phase of works.

4 Reinstatement Requirements for Wetland D

The proposed works for the construction of the pump station will result in the excavation of approximately over half of the current (winter) extent of Wetland D. Given this, it is expected that this may impact the remaining extent of Wetland D through the alteration of the soil profile and hydrology. As a result, there is uncertainty as to whether wetland soils, hydrology, and vegetation will naturally re-establish following an (unguided) reinstatement of the soil.

For this reason, the proposed reinstatement guideline has been recommended with the aim of achieving the current extent and value of Wetland D post-development.

4.1 Pre-development Investigations

Prior to the commencement of the pump station and associated construction works, the following follow-up site surveys are recommended:

- Further soil investigations:
  a) Confirmation of the soil horizon sequence
  b) Site investigation to replicate the permeability of the soil layers and surface contours
  c) Obtain baseline data on location of the water table and chemical parameters (nutrients and OM)
  d) Particle size distribution analysis

e) Soil moisture with a handheld probe

- Further vegetation and boundary assessment:

  a) Re-delineate the wetland boundary prior to construction to understand summer extent of wetland (this will be the wetland extent to be achieved post development).

4.2 Water Recharge during Construction

In order to mitigate the potential loss of the remaining extent of Wetland D, it is proposed that dewatered water (from the pump station works) will be discharged into Wetland D and the details of this are in Section 2.

4.3 Reinstatement Requirements for Wetland D

The below guidelines will be followed to make sure that appropriate reinstatement of Wetland D is undertaken; post construction works:

- Back fill material should be a permeable material to allow for water infiltration. The exact material type will be confirmed by a geo-technical specialist prior to any restatement works commence.
- To reinstate hydrological conditions, capping the backfill material above the storage tanks with a less permeable material (e.g., low permeability clay) will allow water to pool rather than seep through the backfill.
- Re-planting of Wetland D with native wetland plants suitable for the local climate.
- Post-reinstatement monitoring of Wetland D as set out in Section 5.2 and Figure 4.
- Other measures as considered necessary by the Ecologist and/or Hydrologist on completion of the works, such as re-grading of landscaping to maintain contours to allow for surface water runoff/run-on water; and/or other measures to manage and maintain hydrogeological functionality of the wetland

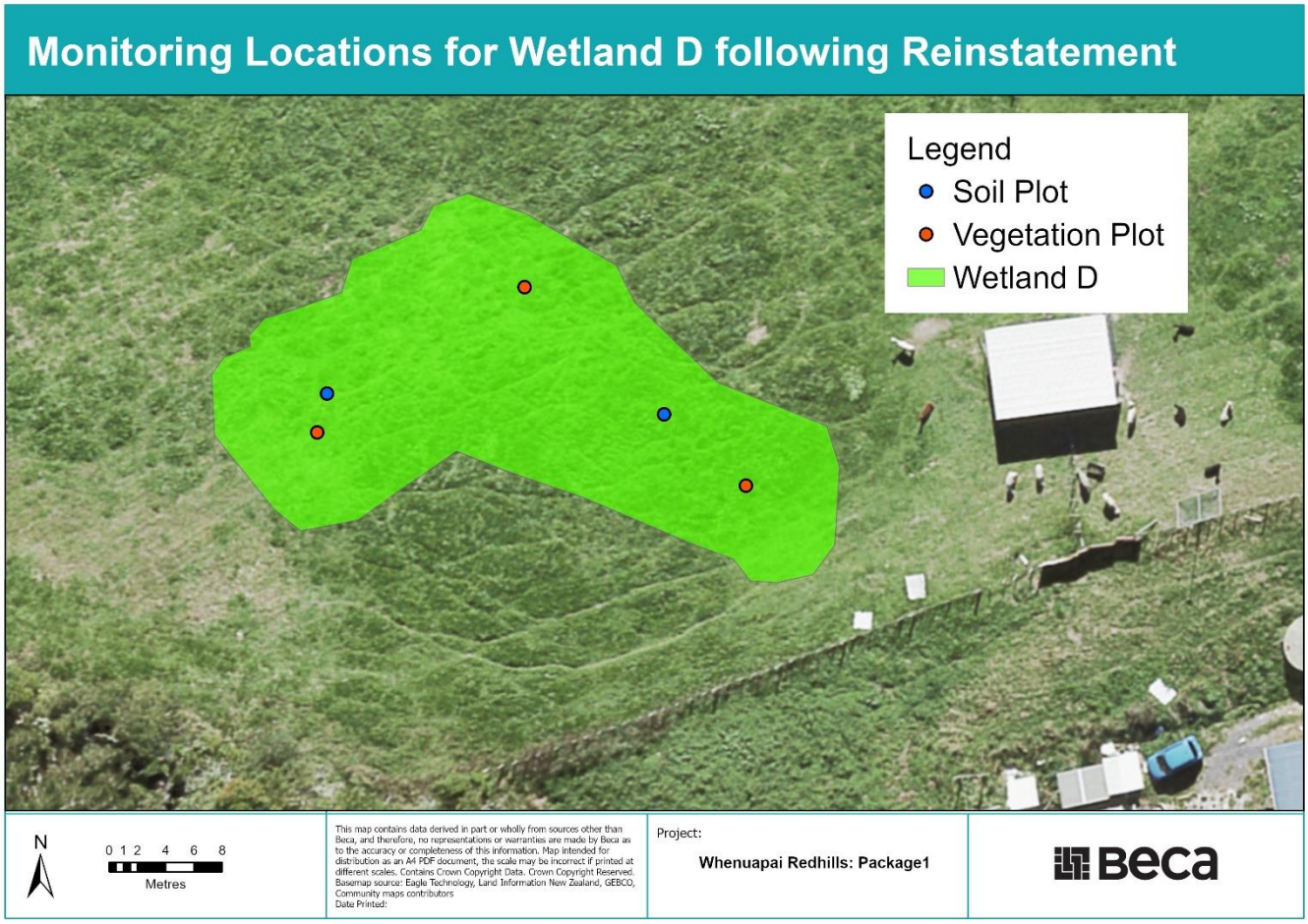

Figure 4. Recommended monitoring locations within Wetland D following the reinstatement works.

5 Monitoring and Reporting of Wetland C and D

5.1 Monitoring Timing and Frequency

Following the monitoring of both Wetland C and D is recommended for the duration of the dewatering and discharge works (approximately 2.5 years).

- The first monitoring visit is undertaken within the first month of drip irrigation commencing to undertake soil moisture monitoring to detect immediate changes.
- In the first year, monitoring should be undertaken approximately every three months.
- Then in the following two years, and depending on changes noted, can be reduced to twice a year.

5.2 Reinstatement Monitoring of Wetland D

Following the completion of the pump station works and reinstatement of the contours, soil, and hydrology of Wetland D (as informed in Section 4.3), it is recommended that Wetland D be monitored for a period of 2 years to confirm reinstatement has achieved the pre-development extent and ecological value (low) of Wetland D (Figure 4). This will include:

- Repeat soil monitoring (parameters as identified in Section 3.3).
- Monitor vegetation community and percentage coverage.

Monitoring frequency and timing is proposed to be
seasonal change, to determine if changes are seasonally influenced or due to reinstatement activities.

5.3 Reporting

A short annual report of findings from the wetland monitoring will be prepared and will include:

- A map identifying the monitoring locations
- The vegetation cover, composition, and condition for each plot at each wetland
- Soil water and soil moisture characteristics
- All photos displaying visual characteristics of the wetland
- Any observations made of the wetland during the surveys
- Any detectable changes in the vegetation community and soil characteristic of the wetland

Two years after the reinstatement of Wetland D a final report will be produced which will confirm that the value and extent of the Wetland D has been met, and if not, the offset mitigation which will be instigated (Section 5.5).

5.4 Adaptive Management

Over the course of the surveying should detectable differences be identified within the vegetation community and soil characteristics this will trigger the requirement for an investigation to be undertaken. These further investigations will include repeat sampling data to be collected (prior to the next monitoring time), to confirm findings. From there, adaptions will include altering the rate of recharge (increase or decrease) in the first instance.

5.5 Offset Wetland Restoration at 32 Mamari Road

Following 2 years of post-reinstatement monitoring at Wetland D, should the extent and value (low) not be achieved, this will instigate offset planting and restoration to be undertaken at 32 Mamari Road. This is the location of the Contractor Area South and Break Pressure Chamber (BPC) . A natural inland wetland was identified at the site as part of investigations for the Whenuapai Wastewater Servicing Scheme Package 2 works in October 2022. The restoration, enhancement, and increase in extent and value, through native revegetation planting of this wetland is considered to adequately offset for the loss of extent and value of Wetland D.

6 References

Auckland Council. (2023). *Auckland Council Environmental Data Portal*. https://environmentauckland.org.nz/Data/Location/Summary/Location/649818/Interval/Latest

Clarkson, B., Reeves, P., Champion, P., Partridge, T., & Clarkson, B. (2003). *Handbook for Monitoring Wetland Condition(Revised October 2004)*. 73. https://doi.org/10.7931/J2Z60KZ3

Ministry for the Environment. (2022a). *National Environmental Standards for Freshwater*. https://www.legislation.govt.nz/regulation/public/2020/0174/latest/whole.html#LMS364316

Ministry for the Environment. (2022b). National Policy Statement for Freshwater Management 2022 (NPS-FM). In *Publication reference ME 1155 34p*.

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Appendix 1 – Wetland Baseline Assessments

Baseline Assessments for Wetland C and D

Baseline Monitoring

A baseline survey to inform the design of a construction monitoring regime was undertaken on 28th August 2023. Weather at the time of the site visit was sunny and clear, and there has been little to no rain in the week prior, and approximately 65mm of rain 3 weeks prior (Auckland Council, 2023).

The wetland extent delineated at this time is considered to be the winter extent of the wetland, from which changes will be measured against. The methodology utilised during the baseline monitoring will be followed for the duration of the monitoring period.

Vegetation Survey Plots

To monitor the vegetation communities and any changes over the next approximately 2 years that dewatering and discharge will occur for, permanent vegetation plots will be established within the wetland. The baseline vegetation surveys were undertaken within guidance from the *Handbook for Monitoring Wetland Condition* (Clarkson et al., 2003) and using the Wetland Plot Sheet.

Wetland C

A total of three 2 x 2 m wetland vegetation plots were undertaken along a transect in representative vegetation areas. In each plot the various vegetation types were noted along with the approximate % cover and heights (m).

Wetland C is currently dominated by exotic species only, with one FACW species identified within each plot, and a majority of vegetation was FAC (Table 1A).

Table 1A. Vegetation plots undertaken at Wetland C.

Plot Number	Common name	Species name	Percentage	Dominant	Status	Pasture sp?	Bio status
Plot 1	Creeping buttercup	*Ranunculus repens*	*60*	*Yes*	FAC	No	Exotic
	Yorkshire fog	*Holcus lanatus*	*55*	*Yes*	FAC	Yes	Exotic
	Soft rush	*Juncus effusus*	*40*	*Yes*	FACW	No	Exotic
	Narrow-leaved plantain	*Plantago lanceolata*	*1*	*No*	FACU	Yes	Exotic
	Curled dock	*Rumex crispus*	*2*	*No*	FAC	No	Exotic
	Lotus	*Lotus pedunculatus*	*2*	*No*	FAC	Yes	Exotic
Plot 2	Soft rush	*Juncus effusus*	*80*	*Yes*	FACW	No	Exotic
	Yorkshire fog	*Holcus lanatus*	*80*	*Yes*	FAC	Yes	Exotic
	Creeping buttercup	*Ranunculus repens*	*7*	*No*	FAC	No	Exotic
Plot 3	Soft rush	*Juncus effusus*	*35*	*Yes*	FACW	No	Exotic
	Creeping buttercup	*Ranunculus repens*	*40*	*Yes*	FAC	No	Exotic

Plot Number	Common name	Species name	Percentage	Dominant	Status	Pasture sp?	Bio status
	Narrow-leaved plantain	*Plantago lanceolata*	*7*	*No*	FACU	Yes	Exotic
	Yorkshire fog	*Holcus lanatus*	*25*	*No*	FAC	Yes	Exotic
	Lotus	*Lotus pedunculatus*	*2*	*No*	FAC	Yes	Exotic
	Creeping bent	*Agrostis stolonifera*	*20*	*No*	FACW	No	Exotic

Wetland D

One wetland plot was undertaken at Wetland D in an area of representative vegetation types. . In each plot the various vegetation types were noted along with the approximate % cover and heights (m).

Similar to Wetland C, Wetland D is also dominated by only exotic species, with two FACW species identified (Table 1B).

Table 1B. Vegetation types and percentage coverage in Wetland D.

Species Name	Common Name	Vegetation Type	% Cover	Dominant
Juncus effusus	Soft rush	FACW	35	Yes
Ranunculus repens	Creeping buttercup	FAC	40	Yes
Plantago lanceolata	Narrow-leaved plantain	FACU	7	No
Holcus lanatus	Yorkshire fog	FAC	25	No
Lotus pedunculatus	Lotus	FAC	2	No
Agrostis stolonifera	Creeping bent	FACW	20	No

Soil-Water Characterisation

The purpose of this survey was to collect soil samples along a transect that are representative of the soil composition at the affected site. The physical properties of the samples were used to estimate field capacity (FC) and permanent wilting point (PWP) of the soil. These values can be used to assist in identifying the rate and volume of water that should be applied to maintain plant-available water at the site. At FC, the soil is wet and contains all the water that can be held against gravity. Beyond FC, the soil has reached saturation excess, and runoff is generated. Beneath the PWP, water is considered unavailable to plants. Therefore, in order to maintain sufficient water volume for plants at the site, the plant available water (PAW) between FC and PWP needed to be identified.

Soil samples were collected at three locations along the edge of the Wetland C and one location at Wetland D (Figure 1A). Samples were unable to be taken within the wetland due to the presence of surface water and a high water table. In most cases, where soil pits were dug within the wetland, they immediately filled with water, making samples difficult to collect. At the chosen sampling locations, soil was noted to be highly saturated, and the soil pits did fill with water, but more gradually. Soil samples were collected from the top 20 cm of the soil profile, placed in Psoil250 containers, and sent to Hill Laboratories (‘Hills’) in Hamilton for analysis.

The samples underwent particle size distribution analysis at Waikato University (subcontracted by Hills), which provided a proportion of sand, silt and clay in soils at the site. These proportions could then be used to estimate generalised soil-water characteristics from texture, including field capacity (FC), permanent wilting point (PWP), saturated conductivity, porosity, and bulk density. The Saxton Equation was used to complete

these calculations (Saxton, 1986). The analytical results and Saxton Equation outputs are presented in Table 1C.

On average, the range between PWP and FC occurs when soil moisture is between approximately 10 – 28%. This would equate to between 20 – 56 mm water in soil, assuming total soil depth of 300 mm. Dependent on the vegetation species present at the site, irrigating to FC may introduce water stress. Therefore, it may be beneficial to maintain a small soil moisture deficit in soil.

Table 1C. Soil water characteristics.

Parameter	Soil 1 Wetland C	Soil 2 Wetland C	Soil 3 Wetland C	Soil 4 Wetland D	Average
OM %	14.2	10.6	8.6	6.6	10
Ash	86	89	91	93	89.8
Clay % (2 um)	7.8	12.2	14.6	20.4	13.8
@geSilt % (2 - 50 um)	61.6	64.8	61.6	58.3	61.6
Sand % (50 - 2000 um)	30.5	23.0	23.8	21.3	24.7
Porosity (g/m3)	0.42	0.45	0.46	0.48	0.45
PWP (%)	9	10	11	12	10.5
Field Capacity (%)	27	28	28	29	28
Available Water (%)	18	18	17	17	17.5
Saturated hydraulic conductivity (mm/hr)	3.49	2.40	1.87	1.07	2.21
Bulk Density (g/cm3)	1.53	1.45	1.42	1.37	1.44

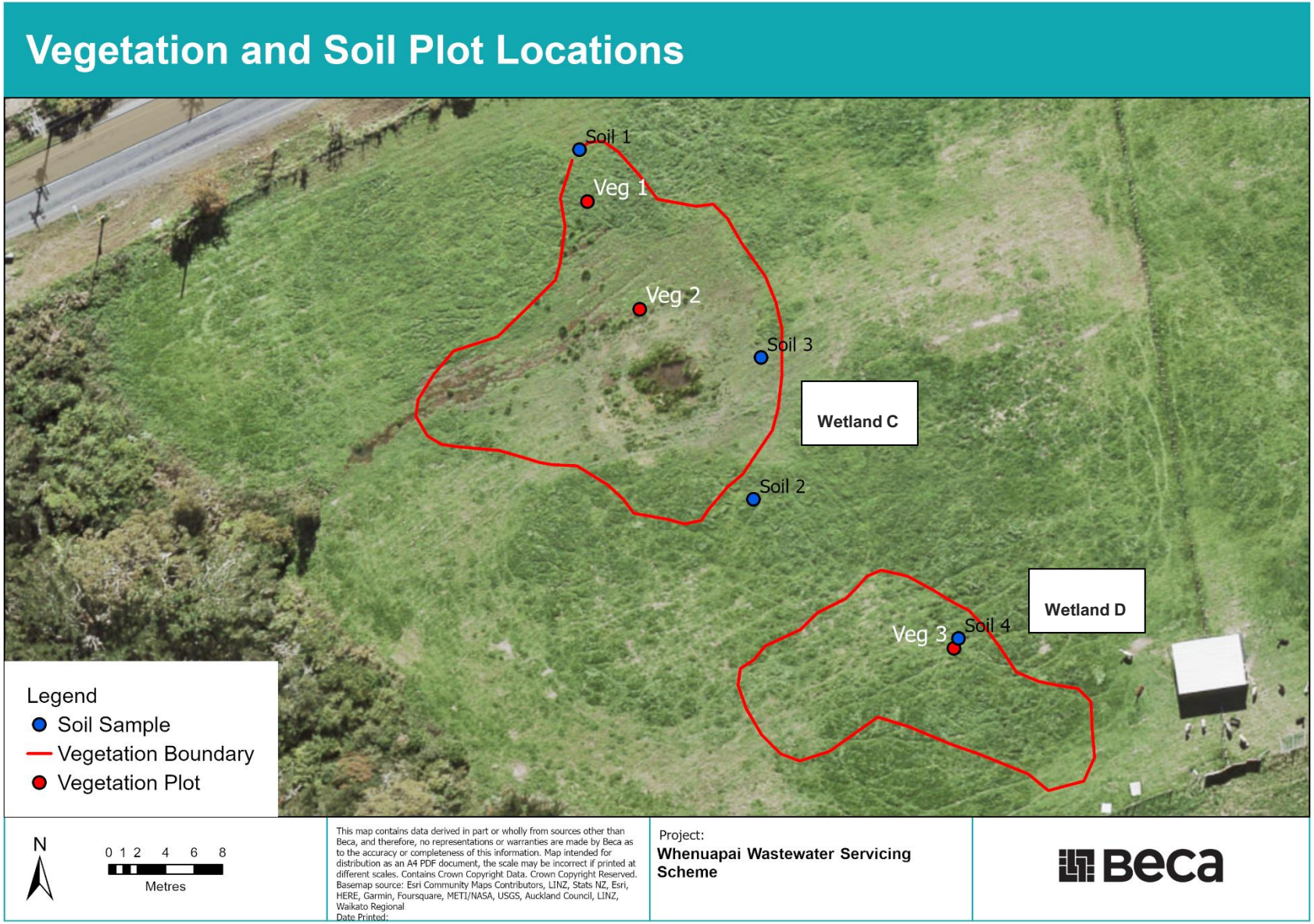

Figure 1A. Locations of the vegetation and soil sampling plots taken at Wetland C and D. Red boundaries indicates the vegetation extents at the time of the site visit (August 2023).