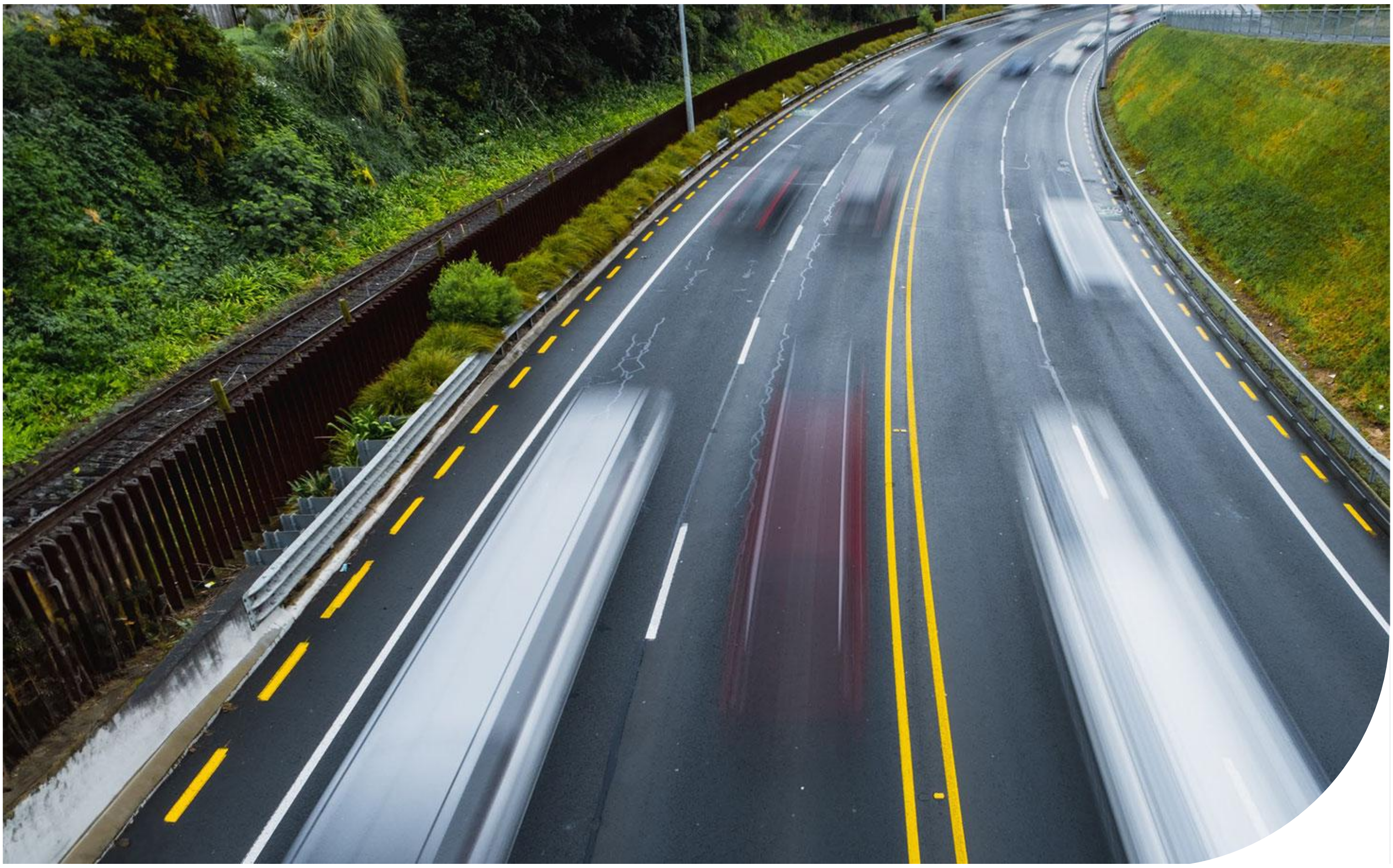

Assessment of Effects on Freshwater Ecology

Alternative to the Brynderwyn Hills – Brynderwyn Hills section

2 April 2026

Revision A

10722-PTA-2B0-PE-RPT-0010

NZ TRANSPORT AGENCY WAKA KOTAHI
Roads of National Significance
Te Kāwanatanga o Aotearoa
New Zealand Government

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Glossary of Acronyms and Abbreviations

The glossary of acronyms and abbreviations tables in Volumes A and B of the Substantive Application apply to this report and should be referred to in addition to the acronyms and abbreviations below.

Acronym / Abbreviation	Term
eDNA	Environmental DNA
EIANZ	Environment Institute of Australia and New Zealand
EPT	Ephemeroptera-Plecoptera-Trichoptera
FAC	Facultative plants
FACU	Facultative upland plants
FACW	Facultative wetland plants
FFDB	Freshwater Fish Data Base
IBR	Indigenous Biodiversity Ranking
IBI	Index of Biotic Integrity
LAWA	Land Air and Water Aotearoa
MCI	Macroinvertebrate community index
NIWA	National Institute of Water and Atmospheric Research
OBL	Obligate wetland plants
QMCI	Quantitative macroinvertebrate community index
RHAB	Rapid Habitat Assessment Protocol
RHA	Rapid Habitat Assessments
REC	River Environment Classification
SOE	State of the Environment
UPL	Obligate upland plants
WONI	Waters of National Importance

1. Introduction

1.1. Purpose and scope of this report

This report provides an assessment of the actual and potential freshwater ecology (streams and wetlands) effects associated with the construction and operation of the Brynderwyn Hills section of the Alternative to the Brynderwyn Hills project (the Project).

This assessment forms part of a suite of technical assessments prepared for New Zealand Transport Agency Waka Kotahi (NZTA) to inform the Substantive Application under the Fast-track Approvals Act 2024 (FTAA) for the Project. This report should be read in conjunction with Volume A of the Substantive Application.

The scope of this report is:

- a description of the methodology applied in preparing the assessment;
- a description of the ecological values of the existing environment;
- assessment of the actual and potential effects generated by the Project; and
- proposed measures to manage and mitigate adverse effects.

I note that the ecological values described in this report do not include cultural values (e.g. taonga species).

1.2. Qualifications and Experience

My full name is Vaughan Francis Keesing.

I am a Senior Ecologist and Director with the consulting firm of BlueGreen Ecology Limited. My qualifications include a B.Sc. (Hons, 1st) in Zoology and a Ph.D. in Ecology, both from Massey University, as well as a Certificate in Research Statistics.

I have been a consulting ecologist for the last 28 years. My skills lie in community ecology. I have specialist skills in the areas of plant ecology, entomology and freshwater ecology including wetlands. I have worked extensively in freshwater and terrestrial habitats throughout New Zealand.

I am a Member of the Ecological Society of New Zealand.

Prior to BlueGreen Ecology Limited, I was a partner in the consulting firm Boffa Miskell and had been a practising ecologist in Boffa Miskell for a little over 25 years.

Before that I held a Post Doctoral at Lincoln University (three years) where I taught applied ecology and undertook research.

My areas of expertise include both terrestrial and aquatic ecology. I have researched and prepared or co-authored around 30 published scientific research papers. I have supervised four PhD students. I have prepared ecological assessments with respect to resource consent applications, notices of requirement and for plan changes/ policy statements. I have also presented ecological evidence at over 50 Council hearings, five Boards of Inquiry hearings, at least 30 Environment Court hearings, one Court of Appeal and two criminal court cases.

Most projects I am involved with involve water crossings and management of water habitat and prevention of contaminant from discharges. Those directly related to roading have included:

- Extensive work on all facets of the waterways in Transmission Gully, from consenting to fish salvage, discharge effect monitoring, culvert design for fish passage, success monitoring, construction monitoring and all the components in between associated with road development for the last 15 years.
- At the same time and starting in 2009, I researched and presented the evidence for MacKay's to Peka Peka and then undertook all of the design and monitoring of stream and wetland reconstruction, fish salvage and effects monitoring for that roading project, finishing, more or less, in 2016.

- I also undertook the freshwater studies and effects considerations for the ALPURT extension of State Highway 1 between 1998 and 2006, collecting the fish and macroinvertebrate data and then monitoring through construction.
- I was the ecological reviewer for the Tauranga expressway (SH2 Ōmokoroa to Te Puna) reviewing all facets of that ecological assessment.
- I was also involved as one of the freshwater experts on the Puhoi State Highway 1 (SH1) extension, and the SH16-18 extension as well as the SH20 west extension (all in Auckland).
- I undertook the inventory and effects assessment for the Wēiti River crossing in 1999.

I have been involved with many other projects involving water values, water uses, water contamination and culverting, bridging, diverting and creating streams. Each has involved field data gathering (fish, invertebrates, plants, water quality, habitat quality), analysis of the data, a values assessment, and an effects assessment. My role has also involved making recommendations as to management of discharges, fish passage, fish salvage, mitigation options and conditions of consent relating primarily to the monitoring and management of aquatic ecosystems.

I have been involved in the Project since April 2025, including undertaking desktop research, designing field visit requirements, undertaking and supervising WSP freshwater ecologists undertaking field data collection, analysis using the results of the results and preparing this report. My role has included engagement with other members of the Project team relating to stormwater, hydrology, earthworks, sediment and erosion control, terrestrial ecology, avifauna, and planning. I have been involved in several Multi Criteria Analysis processes relating to freshwater ecology.

1.3. Code of Conduct

Although this application is not before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses as contained in Section 9 of the Environment Court Practice Note 2023. I agree to comply with that Code. My qualifications as an expert are set out above. I am satisfied that the matters which I address in this assessment are within my area of expertise, except where I state that I am relying on information provided by another person or expert. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

2. Assessment Methodology

This report considers the freshwater habitats (both streams and wetlands) present in the Proposed Designation. It draws on an array of information to characterise the existing level of modification and representativeness of freshwater habitats to form an opinion as to the health (condition) and value of each freshwater habitat in each catchment. The report then assesses the impact of the Indicative Alignment on streams and wetlands and undertakes sensitivity testing for potential changes to the alignment. It then identifies the appropriate effects management approach based on the values and condition of the impacted freshwater habitats and level of impact from the Project.

2.1. Statutory Framework

This assessment has been informed by the:

- Fast-track Approvals Act 2024 (FTAA);
- National Policy Statement for Freshwater Management 2020 (NPS-FM) (as amended December 2025);
- National Policy Statement for Infrastructure 2025 (NPS-I);
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-FW);
- Regional Policy Statement for Northland 2016 (RPSN); and
- Regional Plan for Northland 2026 (RPN).

Key aspects of the statutory framework are addressed at a high level below. A full assessment of the statutory framework relevant to the Project is provided in Part C2 of Volume B of the Substantive Application.

2.1.1. Fast-track Approvals Act 2024

I understand the FTAA:

- Requires a decision-maker to take into account matters that are relevant under the Resource Management Act 1991 (RMA), including the planning documents addressed below, although the purpose of the FTAA is to be given greater weight than those matters;
- Enables a decision-maker to decline an application if it considers the adverse impacts (with conditions) are sufficiently significant to be out of proportion to the project's regional or national benefits; and
- Specifies that a decision-maker must not set a condition that is more onerous than necessary to address the reason for which it is set.

2.1.2. National Policy Statement for Freshwater Management 2020

The NPS-FM has one objective and 15 policies. The objective is outlined at clause 2.1 of the NPS-FM:

> *… to ensure that natural and physical resources are managed in a way that prioritises:*
>
> *(a) first, the health and well-being of water bodies and freshwater ecosystems*
>
> *(b) second, the health needs of people (such as drinking water)*
>
> *(c) third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.*

The key policies of relevance to my assessment are:

> *Policy 6: There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted.*
>
> *Policy 7: The loss of river extent and values is avoided to the extent practicable.*

Policy 9: The habitats of indigenous freshwater species are protected.

Policy 10: The habitat of trout and salmon is protected, insofar as this is consistent with Policy 9.

2.1.3. National Policy Statement for Infrastructure 2025

The key policy of relevance to my assessment is Policy 9: Managing the effects of new infrastructure and major upgrades:

(1) Decision-makers must enable new infrastructure or major upgrades of existing infrastructure activities in all environments.

(2) Where infrastructure activities are proposed to locate in or are likely to have adverse effects on environments and values provided for in section 6 of the Act, the provisions of this policy must be read alongside other relevant national direction, regional policy statements and regional and district plans.

(3) Where (2) does not apply, the adverse effects of new infrastructure and major upgrades must be, where practicable, avoided, remedied or mitigated.

2.1.4. Resource Management (National Environmental Standards for Freshwater) Regulations 2020

The Project will involve:

- Earthworks, vegetation clearance and diversion of water within and/or near to natural inland wetlands,
- Reclamation within stream beds, and
- The construction of culverts within stream beds.

The NES-FW regulations of relevance to the Project are:

- Regulation 45 (relating to construction of specified infrastructure within or near natural inland wetlands);
- Regulation 57 (relating to the reclamation of a bed of a river); and
- Regulations 70-71 (relating to culverts).

The Project requires discretionary activity consent under the NES-FW.

2.1.5. Regional Policy Statement for Northland 2016 and Regional Plan for Northland 2026

Appendix 5[1] of the RPSN provides a set of criteria with which to test the significance of ecological features. A habitat(s) of indigenous fauna is significant if it meets one or more of the following criteria:

1. Representativeness
2. Rarity / distinctiveness
3. Diversity and pattern
4. Ecological context

The criteria specifically exclude man-made wetlands.[2]

I have also considered relevant objectives and policies from the Regional Plan for Northland.

2.2. Existing Environment Methodology

2.2.1. The relevance of values and condition of the existing environment

Throughout this assessment, I refer to two key measures when assessing the current state of streams and wetlands within the Proposed Designation:

[1] Regional Policy Statement for Northland, Appendix 5 - Areas of significant indigenous vegetation and significant habitats of indigenous fauna in terrestrial, freshwater and marine environments

[2] These are wetlands developed deliberately by artificial means or have been constructed on sites where: a) Wetlands have not occurred naturally previously; and b) The current vegetation cover cannot be delineated as indigenous wetland; or c) Man made wetlands have been previously constructed legally. Man made wetlands do not include induced wetlands; reverted wetlands or wetlands created for conservation purposes for example as a requirement of resource consent.

- **Condition (ecosystem health):** the state of a stream or wetland and its elements (i.e. the level of modification and 'healthiness' of the aquatic habitat) has implications on value. For example:
  - A wetland that is inhabited by creeping bent and butter cup and regularly grazed in a farm setting will qualify as a natural inland wetland but is a wetland in poor condition and may change rapidly.
  - A stream in poor ecosystem health because of water quality issues may nevertheless contain a long fin eel and its presence would trigger the rarity criterion relevant to value. However, the habitat is not conducive to persistence or sustainability of that value.
- **Value:** reflects rarity, representativeness, diversity, and context.

Features that are in poor condition may still have value(s). Similarly, habitats or species assigned high value (such as wetlands) because of rarity may be in poor condition and not have the values expected / allocated.

In this assessment, I have considered the values (and functions) of streams and wetlands and considered their condition (ecosystem health). The condition of a stream or wetland's physical habitat will inform its ability to function and sustain an appropriate diverse, complex, resilient assemblage and food web that persists over time. Here, because of the Project's setting (i.e. a long history of use and modification for most of the affected catchments, and the size, setting and condition of the streams and wetlands), I consider that rarity or species diversity of less weight in assessing the state of a stream or wetland. It is the health of the stream or wetland (i.e. its condition) that will more greatly influence the probability or presence and persistence of rare taxa. That said, condition is reflected in many of the metrics used to determine value.

2.2.2. Methodology for assigning ecological values

The Environment Institute of Australia and New Zealand (EIANZ) guidelines recommend ecological values be assigned on a scale of 'negligible', 'low', 'moderate', 'high', or 'very high' to each ecological feature or species (refer to Table 1 below).

For the Project, I have generally valued stream or wetland species according to their conservation status (i.e., those 'At Risk' or 'Threatened' were valued higher than those classified as 'Not Threatened'). Threat classifications have been sourced for fish ((Dunn *et al.*, 2018)), aquatic macroinvertebrates ((Grainger N, Harding J, Drinan T, Collier K, Smith B, Death R, Makan T, Rolfe J., 2018)) and plants (de Lange *et al.*, 2018).

I note that with respect to species and threat classification, the presence of an individual or even a small population of a Threatened or At risk species does not automatically cause a habitat to be of high value. There are a multitude of factors (including conservation status) which influence the value of a habitat, with the overall value comprising an "average" of those factors.

The five parameters typically considered when assigning ecological values to freshwater systems are:

- representativeness;
- rarity/distinctiveness;
- diversity and the ecological context;
- ecological integrity in terms of nativeness, pristineness, diversity; and
- resilience.

The EIANZ guidelines suggest the balance of states between those five parameters should be used to determine the value of the feature and/or the site.

In this assessment, as relevant to streams and/or wetlands, I use the following data to inform the five parameters:

- field observations;
- physical habitat metrics - condition (SEV, RHA, water quality);

- assembly metrics - representative fauna (macroinvertebrate assemblage (macroinvertebrate community index) (MCI)), fish assemblage (Index of biotic integrity) (IBI)), macrophyte assemblage, rarity (species at risk and threatened); and
- context (which includes condition and viability / trending condition).

I then consider the average across those parameters and follow the guidance in Table 1 below to assign the ecological value.

The NPS-FM also requires assessment of ecosystem health, indigenous biodiversity, hydrological functioning, amenity and Māori freshwater values (mahinga kai). My assessment is limited to ecosystem health (condition), indigenous biodiversity and hydrological functioning (in part). The data collected as indicated above addresses those aspects.

Amenity and Māori freshwater values are captured under other specialist assessments and cultural impact assessments. Hydrological functioning (in part) is assessed in the Assessment of Effects on Groundwater (Appendix D12 of Volume B of the Substantive Application) and Assessment of Operational Stormwater and Flooding Effects (Appendix D11 of Volume B of the Substantive Application).

Table 1: Criteria for assigning ecological value to species and freshwater communities (from Roper-Lindsay et al., 2018)

Value	Species Criteria	Habitat Values
Very High	Nationally 'Threatened' species occur or are expected to occur regularly within a project area on a permanent or seasonal basis.	Area rates High for physical habitat metrics and indigenous assemblage metrics. Likely to be nationally important and recognised as such.
High	Nationally 'At Risk-Declining' species occur or are expected to occur on a permanent or seasonal basis.	Area rates Moderate or High for a physical habitat condition metric and High for an indigenous assemblage metric, or High for a rarity metric. Likely to be regionally important and recognised as such.
Moderate	Species listed as a: ▪ 'At Risk' species occur or are expected to occur on a permanent or seasonal basis; or ▪ Locally uncommon or distinctive species.	Area rates Moderate for physical habitat metrics and High for an indigenous assemblage metric or rarity metric. Likely to be important at the level of the Ecological District.
Low	Nationally and locally common indigenous species.	Area rates Low or Very Low for majority of metrics and Moderate for one metric. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Exotic species, including pests, species having recreational value.	Area rates Low or Very Low for all metrics.

2.2.3. Methodology for desktop and field assessment

Information sources used in desktop assessment

The following information sources were pivotal to my initial desktop assessment of freshwater ecology:

- Northland Regional Council (NRC) Indigenous Biodiversity Ranking (IBR) and Condition Ranking model and GIS maps (Leathwick 2018)
- Land Environments of New Zealand: A Technical Guide (LENZ) (Leathwick J. et al 2024)
- Landcare Research - Land Cover Data Base version 6
- National Institute of Water and Atmospheric Research (NIWA) REC Stream layers
- Land Information New Zealand stream mapping
- NRC State of the Environment (State of the Environment (SOE)) reports

- Ecological Regions and Districts of New Zaland: *Third revised edition in four 1:500 000 maps.* (McEwen, M 1987)
- NIWA Freshwater Fish Data Base (FFDB)
- Land Air and Water Aotearoa (LAWA) online
- INaturalist data
- Wilderlab eDNA data
- A potential ecosystem map of the Northland region (Singers 2019).
- A GIS based IBR for the Northland Region - rivers (Leathwick 2018).
- NRC's GIS mapping of indigenous natural inland wetlands.
- Natural Areas surveys, Department of Conservation (DOC) records (Waters of National Importance (WONI) etc)
- Various published and grey (typically Council reports) literature research reports and information (described in the methods section below)

Streams - desktop assessment

Northland Regional Council biodiversity and condition ranking

The NRC Indigenous Biodiversity Ranking (IBR) (Leathwick 2018) allocates a biodiversity ranking to all reaches of river in the Northland Region. It allocates a score from 0-1 as to how important that system is to achieving a full representation (of that biodiversity type) across the area of different stream ecotypes. These rankings determine which are priority types to manage (i.e. the lower the rank the higher the priority for management given less representation within the region). In addition, the IBR has a condition ranking where the higher the score the better the value.

NRC determines the biodiversity and condition rankings within the region by using software to analyse high resolution data describing the distributions of indigenous-dominated terrestrial ecosystems, rivers, and lakes, including data from the:

- New Zealand Landcover Database (LCDB4.1) which predicts the potential distribution of terrestrial ecosystems in Northland (including those no longer supporting indigenous-dominated cover);
- DOC's Freshwater Ecosystems of New Zealand which records the spatial extent and descriptions of attributes for lakes, rivers and streams in Northland; and
- Other sources which describe the estimated condition of terrestrial sites, lakes, rivers and streams.

While the NRC's condition indices are largely based on desktop assessment, I have corroborated these through my field observations and consider that the condition ratings assigned to rivers through the IBR are relatively accurate.

I consider that the IBR is a good proxy for understanding instream habitat condition and value. In particular, because the IBR reflects what biodiversity types are present within a region, and what might be less represented and therefore necessary to protect to promote greater representation of different biodiversity types. The IBR is therefore a value assessment in and of itself. The IBR, coupled with the condition indices, help provide an indication of how much management is necessary to realise the value of a particular biodiversity type within the region (i.e. based on the health of a particular stream type). The IBR has supported my identification of stream value and condition within the Proposed Designation.

Water quality

There are a range of monitoring reports and studies on water quality within the Northland Region. Of particular relevance, one study (John Ballinger, 2012) researched water quality in the Waipū catchment (including the Ahuroa and Waihoihoi stream catchments), sampling and analysing the physical and chemical properties of waters across 10 locations. The results of this study are addressed in the Existing Environment section of this report.

I have reviewed water quality information available from LAWA. There was no useful regularly updating live data for the four catchments intersecting with the Proposed Designation (other than bathing quality guidance, and at the headwater area of the Ahuroa (by Piroa Falls)). There are also no other LAWA/Council monitoring sites for water quality in any of the relevant catchments.

Fish

NRC undertake regular fish monitoring across the region as part of its State of the Environment (SOE) monitoring (Suha Sanwar, 2024)). The SOE monitoring reports from 2021-2024 show the stability of assemblages and array of species present in the Northland region. However, there are no SOE monitoring sites within the Proposed Designation. I reviewed the SOE monitoring results from sites nearest to the Proposed Designation.

I also reviewed the 2015 Freshwater Native Fish in Northland Report (Kate McArthur and Alistair Beveridge, 2015) and the FFDB (NIWA).

This data is addressed in the Existing Environment section of this report.

Fish Index of Biotic Integrity

The Fish IBI (Joy and Death, 2004) is a set of biological metrics used to assess the richness of fish species by comparing the species present at a site to the species that would be expected in the absence of human impacts.

The Fish IBI was adapted to New Zealand in 2004 to account for the unique attributes of New Zealand freshwater fish, such as low species diversity and a high proportion of migratory species.

Fish IBI was incorporated as an attribute into the NPS-FM in 2020. The NPS-FM requires regional councils to sample fish abundance to calculate IBI scores and, at a minimum, develop action plans to achieve target states determined in consultation with communities.

The IBI will be calculated (using the IBI Calculator) based on the eDNA fish record data for the Northland region. The IBI scores are categorised into A-D based on score ranges, where A = high integrity (the records are similar to expected species richness prior to human disturbance), B = moderate, C = low integrity and D = severe loss of fish community integrity.

Macroinvertebrates

Wilderlabs Limited have developed an eDNA method to sequence DNA from samples collected in the natural environment (including from soil and water). Data from eDNA sampling can help understand the presence of particular species, providing a better than typical kick net lab sample return with respect to the number of species recognised. Given various factors that influence how long DNA is present, the results only represent what species have been present in a particular location reasonably recently. This information can be used to generate a normal matrix of information about macroinvertebrates (such as taxa richness[3], MCIs, and quantitative macroinvertebrate community indices (QMCIs)[4]).

The eDNA sampling data undertaken for the Project (discussed below) supports the literature we have identified relating to macroinvertebrate, including the NRC macroinvertebrate SOE monitoring. The NRC monitoring program (e.g. (Pohe, Stephen, 2010)) provides useful information in typifying the assemblages that should be expected in areas with similar land use catchments, topography, geology and rain fall.

The SOE monitoring indicates that over 50% of the monitored sites (i.e. those chosen to be representative of Northland's streams) have less than 20 taxa in a sample event, an Ephemeroptera-Plecoptera-Trichoptera (EPT) taxa % <30%, and an MCI value of less than 90 and QMCI <4. Water quality and / or habitat modification restricts the assemblages present. Sediments and a lack of appropriate riparian condition play a large role in that simplification of the assemblages, noting this is most often related to lowlands where forests are generally absent and land use more intensive.

The general pattern of macroinvertebrate metrics was found to be related to land use and substrate (Figure 1 below (Pohe, Stephen, 2010)).

[3] Number of species
[4] Species sensitivity indices formed based on the presence of particular species and their number

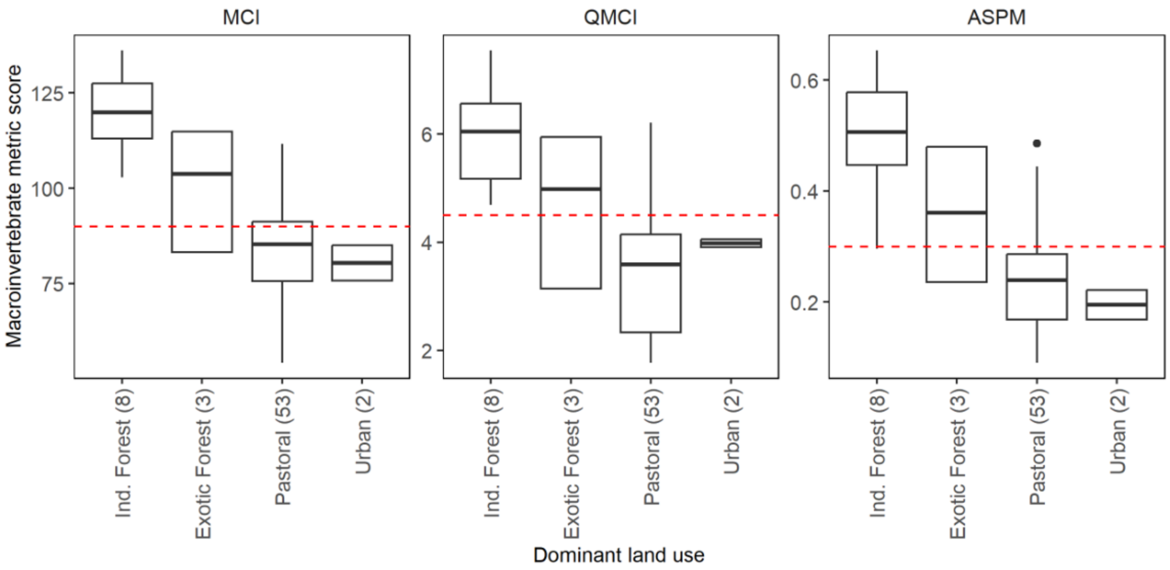


Figure 1: Typical distribution of macroinvertebrate metrics based on land use of the sub-catchment.

From that research, the eDNA data sampling undertaken for the Project and my own experience with macroinvertebrate field sampling, I consider the eDNA sample data provides sufficient information to obtain a good estimate of the composition of macroinvertebrate assemblages (and therefore quality metrics) of the streams potentially impacted by the Project.

2.2.4. Streams - field assessment

Site walkovers and freshwater surveys were conducted at each stream that intersects with the Indicative Alignment by myself and / or an aquatic ecologist from WSP. We collected SEV data and eDNA samples during October and November 2025. Field observations were made at all other streams within the Proposed Designation.

These walkovers and surveys allowed us to record the flow type, wetted width and depth, velocity profile, substrate composition, habitat form (pool, run, riffle, waterfalls etc), riparian condition, instream organic debris condition (wood, leaf matter etc), downstream connectivity and upstream condition and extent of each stream, eDNA and condition scores.

Using expert opinion, the flow type of each stream was classified based on the Auckland Unitary Plan Practice and Guidance Note for River / Stream Classification (July 2021) as either ephemeral, intermittent or perennial as follows:

- <u>Ephemeral</u> systems flow only during rainfall and for several days after rainfall, they do not contain surface water most of the time and are above ground water levels.
- <u>Intermittent</u> systems are flowing bodies of water that seasonally or periodically cease to flow in parts, being above the ground water but usually retain some areas of standing water (pools).
- <u>Perennial</u> systems are continually flowing bodies of water that contain a flow year round.

A stream is usually comprised of all three components, whose lengths vary seasonally and year to year.

The numerous ephemeral flow paths intersected by the Proposed Designation (especially in the Brynderwyn Hills area) were also confirmed by topographic and catchment size hydrological modelling. These are terrestrial systems that drain rain fall to the headwater (ephemeral) and do not have aquatic habitat and aquatic species (native frogs aside) therefore are not relevant for this assessment. Following their classification, I have not considered ephemeral systems further in undertaking this assessment.

Rapid Habitat Assessment

The rapid habitat assessment protocol (RHAB) (Clapcott et al; 2015) provides a ‘habitat quality score’ for streams based on its health and complexity, determined based on various factors including riparian condition, substrate condition, flow heterogeneity, presence of instream habitat features, etc. Like the SEV, the RHAB score reflects the condition and suitability of a reach as aquatic habitat and is a proxy for value (given value is often, but not always, correlated with condition). Ten factors are used in a semiquantitative way to rank each factor from 1 to 10 and sum the scores after that process to give a score out of 100 (with 0 being no aquatic habitat and 100 being excellent aquatic habitat). It is a condition score correlated to a quality of biota expected although other factors can cause a high RHA score without having a quality biota, such as isolation from sources of colonist (species available to invade the area), fish barriers to access the habitat etc.

The RHAB scores are used (in conjunction with the other metrics) in this assessment to reflect where the assessed streams fit from very poor to excellent physical habitat condition and forms part of the condition and values assessment.

Stream Ecological Valuation

The perennial and intermittent stream habitat was assessed using the SEV methodology. SEV has two forms: perennial and intermittent flow models (Storey et al 2011, Neale et al 2016) and is used to characterise the functional condition of streams.

SEV describes the measurable or estimated physical components of an aquatic system that relates to function rather than value. Although value and function are often correlated, the functional condition indicated by SEV does not directly equate to aquatic value.

The functional scores range from 0 to 1, with 1 representing a fully functional native unmodified stream and 0 no functions. Rural farm streams usually score 0.4-0.5, while most reference sites for regions (high quality, but not unmodified) score around 0.8.

While I have eDNA fish and macroinvertebrate data, I chose to use only the physical metrics components of the model in forming the SEV. As it is an averaged score, this approach does not overly modify the SEV outcome and better reflects the habitat condition.

The SEV scores are used (in conjunction with the other metrics) in the assessment to reflect where the assessed streams fit from very poor to excellent physical habitat condition and forms part of the condition and values assessment.

eDNA

Two sets of eDNA have been gathered for the Project: an early set reflecting areas within the lower catchment that could be publicly accessed, and a subsequent set undertaken when access to other areas was available.

One sample is sufficient to undertake eDNA analysis to determine the presence of a particular species. We were able to undertake 2 replicate (2L) samples at each SEV measurement site. Those samples are collected following the Wilderlab protocol and sent to Wilderlabs for analysis.

Fish passage determination

Recent NIWA-led fish passage guidance (Franklin *et al.*, July 2024) sets out objectives and design principles to facilitate fish passage, and where fish passage is recommended. Section 4.5 of the NIWA guidance considers culverts and what water depth, velocities and substrate-bed connectivity are required to provide passage for different fish species.

In this assessment, I have used an Auckland Council guidance flow chart to determine whether fish passage is required in any particular location (presented in Section 4.2.6). This flow chart considered (in relation to each new culvert):

- which fish species are present or likely upstream;
- whether any threatened species or threatened species habitat is present upstream; and
- how much habitat is upstream and what the condition of that habitat is.

These factors are worked through to determine whether fish passage is recommended for all species and / or if passage should be specifically designed for particular fish species only.

I note that the basic parameters reflected in Regulation 70 (2)(b-g)) of the NES-FW are usually sufficient to ensure a similar passage outcome is achieved where the culvert does not alter the velocity profile, bed continuity and absence of structures. Where that is not the case (and passage is required), then I recommend the culvert designers use the new NIWA fish passage guidance.

Where fish passage is currently marginal or relatively unimportant (for example, where there is only a small pool and 30m of intermittent reach up stream), this assessment may not identify the "need" for passage specific considerations and a standard approach to culvert design and installation which may not facilitate well passage will be ecologically acceptable.

Artificial water ways

North of the Brynderwyn Hills on the Aurora flood plains are a range of waterways intersected by the indicative alignment and within designation in the north. These systems are, however, farm drainage channels (artificial waterways). These farm drainage channels are in the lower plains towards the northern end of the proposed designation and the Ahuroa River main stem crossings. The farm drainage systems do not appear to be modified rivers (i.e. the RMA definition of a river excludes any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal). Retrolens aerial photograph (Figure 2) does not show stream patterns in the paddocks in earlier times and I consider the systems best fit the definition of a drainage systems (artificial waterways) likely dug into the land to assist the tile drains and topography to dry the river side pastures. Consequently, effects to these are not considered as adverse freshwater effects in this report.

Figure 2: 1973 Lower plains pasture of the Ahuroa at about chainage 10800 which do not indicate the presence of streams

2.2.5. Wetlands - relevant definitions

The Resource Management Act 1991 (RMA) defines a wetland as:

includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals[5] *that are adapted to wet conditions*

A natural inland wetland is defined in the NPS-FM as:

"… a wetland (as defined in the Act) that is not:

(a) in the coastal marine area; or

(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

(d) a geothermal wetland; or

(e) a wetland that:

(i) is within an area of pasture used for grazing; and

(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply."

The Regional Plan for Northland 2026 (RPN) defines a "significant wetland" as:

A natural wetland that meets the significance criteria in the Regional Policy Statement, Appendix 5 –"Areas of significant indigenous vegetation and significant habitats of indigenous fauna in terrestrial, freshwater and marine environments. This includes natural wetlands comprising indigenous vegetation exceeding any of the following area thresholds:

- *saltmarsh greater than 0.5 hectare in area, or*
- *lake margins and riverbeds with shallow water less than two metres deep and greater than 0.5 hectare in area, or*
- *swamp greater than 0.4 hectare in area, or*
- *bog greater than 0.2 hectare in area, or*
- *wet heathland (including gumland and ironstone heathland) greater than 0.2 hectare in area, or*
- *marsh, fen, ephemeral wetland or seepage greater than 0.05 hectares in area.*

The RPN defines a "natural wetland" as:

Any wetland including an induced wetland and a reverted wetland, regardless of whether it is dominated by indigenous vegetation, but does not include:

- *a constructed wetland, or*
- *wet pasture, damp gully heads, or*
- *areas where water temporarily ponds after rain, or*
- *pasture containing patches of rushes, or*
- *artificial water storage facilities; detention dams; reservoirs for firefighting, irrigation, domestic or community water supply; engineered soil conservation structures including sediment traps; and roadside drainage channels.*

In essence there is no difference between the definitions of "natural inland wetland" in the NPS-FM and "natural wetland" in the ORPN only the exceptions are worded differently with subtle differences in identifying pasture exceptions.

[5] I note that in a recent research study for MfE concluded that any feature that meets the plant delineation protocol as wetland will almost certainly contain wet adapted animals too, making survey for wetland animals unnecessary.

The RPN defines a “constructed wetland” as:

A wetland developed deliberately by artificial means or constructed on a site where:

- *a wetland has not occurred naturally previously, or*
- *a wetland has been previously constructed legally.*

This does not include induced wetland, reverted wetland or wetland created solely for ecological restoration purposes.

Artificial water storage facilities; detention dams; reservoirs for firefighting, irrigation, domestic or community water supply; engineered soil conservation structures including sediment traps; and roadside drainage channels are also not constructed wetlands or natural wetlands

2.2.6. Wetlands - desktop identification

I have reviewed the following publicly available information to understand the extent of wetlands (as defined by the NPS-FM and ORPN) within the Proposed Designation:

- Waipū and Otamatea Protected Natural Area Programme / Significant Natural Area survey reports.
- NRC GIS wetland maps.

I note that NRC has not undertaken a condition and biodiversity type ranking or mapping exercise for wetlands, although they have mapped some larger indigenous PNAP identified wetlands. I have also not found any publications detailing wetlands in or in the vicinity of the Proposed Designation, or species or factors affecting them.

Irrespective, most wetlands within the Proposed Designation have not, as yet, been recognised by NRC.

2.2.7. Wetlands - field identification

Site walkovers and survey (where access permission allowed) were conducted at each potential wetland feature that intersects the alignment or was within the boundary of the Proposed Designation (and those south of SH12 by a WSP aquatic ecologist) to determine whether they meet the relevant wetland definitions in the months of October and November 2025.

The primary method of identification/delineation of natural inland wetlands (that meet the above NPS-FM definition) in the field, is outlined in Ministry for the Environment (MfE) guidance, shown in Figure 3 below.

The MfE protocol is the current best practice method for identifying and delineating wetlands, noting it does not have a focus or exclusion to indigenous dominated wetlands. Relevant published guidance on this protocol includes Clarkson, 2013; Clarkson *et al.*, 2021; Clarkson B., Denyer, K, and Bartlam, S., 2022; Cosgrove, Dodd and James, 2022.

The MfE protocol was used when assessing wetland features during field assessments.

The NPS-FM definition of natural inland wetland does not differentiate between wetlands dominated by indigenous or exotic vegetation. Therefore, no detailed botanic assessment is required to determine if a feature is or is not a natural inland wetland under that definition. Many natural inland wetlands can be identified by applying the MfE rapid assessment test (the first step in the protocol shown in Figure 3 below), where the vegetation cover is obviously dominated by facultative wet and obligative wet plant species. If it is not obvious, then the remaining steps of the protocol are engaged, including vegetation plots and the formation of dominance and prevalence indices.

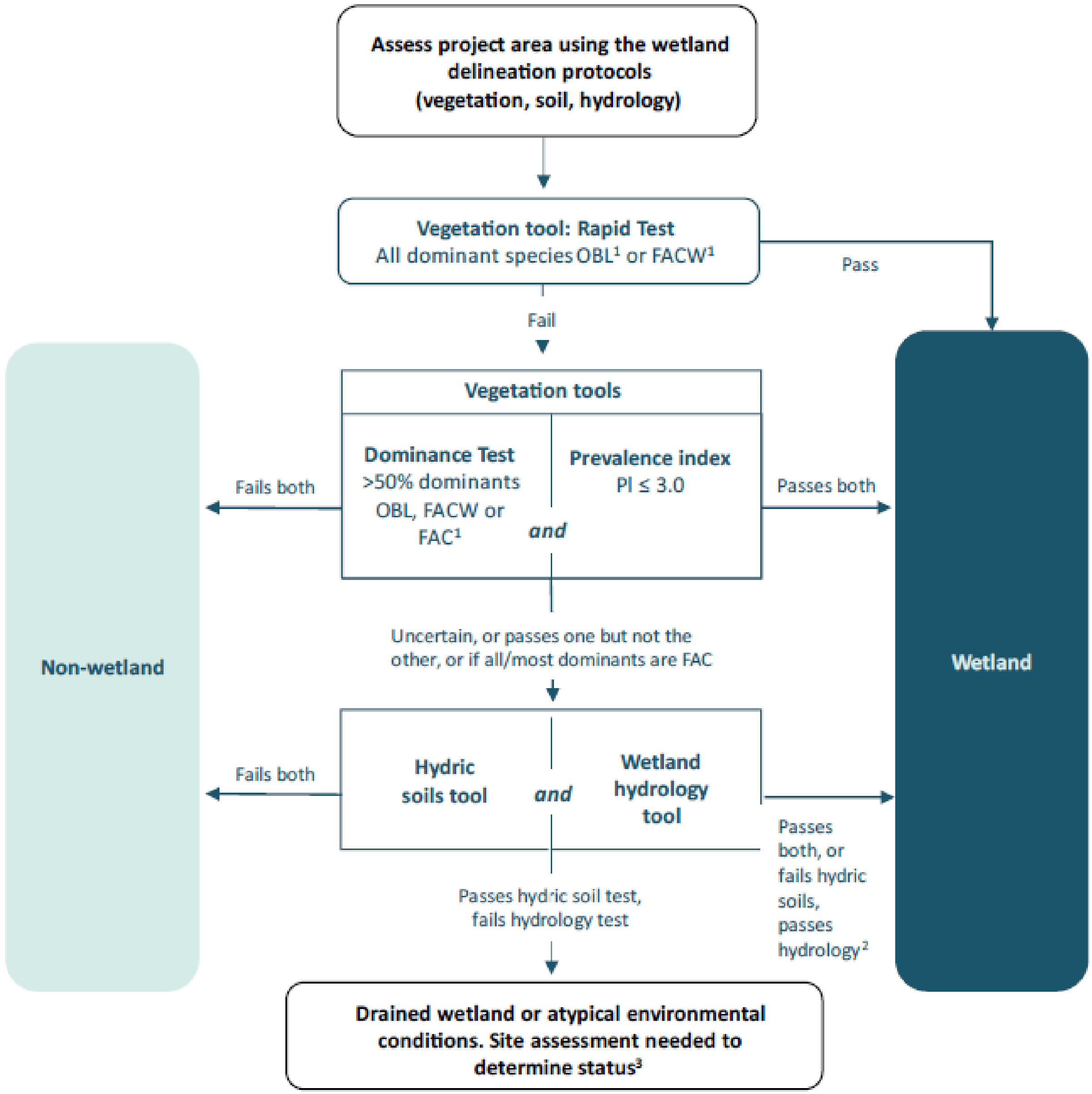


Figure 3: MfE natural inland wetland determination protocol

Where vegetation plots are required, the following analysis is required.

Dominance Test

A wetland species dominance test considers the dominant species in a plot and their wetland affinity rating. This test can aid in determining if an area is a natural inland wetland.

This test ascertains the “dominant” species following a 50/20 rule, whereby all species are ranked according to their percentage cover, and the highest covering species are sequentially selected until cumulative coverage immediately exceeds 50%. Any other species which comprise at least 20% coverage are also selected. If more than 50% of the dominant species are obligate, facultative wetland plants (FACW) or facultative plants (FAC), the threshold for being considered a natural inland wetland is met for that plot.

Prevalence Test

To determine if an area could be considered a wetland where it has met the dominance test, each vegetation species identified is allocated to a prescribed category based on their degree of affinity for water, as described by Clarkson (2013). These categories are:

- Obligate wetland plants (OBL): Obligate wetland plants occur almost always in wetlands (estimated probability >99%)
- FACW: Facultative wetland plants usually occur in wetlands (estimated probability 67–99%)
- FAC: Facultative plants are equally likely to occur in wetlands or non-wetlands (estimated probability 34–66%)
- Facultative upland plants (FACU): Facultative upland plants are usually in non-wetlands (estimated probability 1–33%)
- UPL: Obligate upland plants are almost always in uplands (estimated probability <1%)

Using these data, a Prevalence Index Score was calculated for each plot. Mathematically, this score must fall between 1 and 5, with 1 indicating entirely wetland species (OBL), and 5 indicating entirely upland species (UPL). A score below 3 is indicative of a wetland/hydrophilic community, though Clarkson (2013) cautions that a score between 2.5 and 3.5 is not reliable for determining a hydrophilic community on vegetation measures alone.

Hydric soils and hydrology

Where the test for natural inland wetland is complex or problematic because the plant indices do not deliver a clear verdict, soils and hydrology become part of the test. Two tools are available – Frazer et al 2018 – for soils and Lambie et al 2021. Neither are referenced in the NPS-FM suite of methods to be used in assisting the determination of the presence of natural inland wetland. However, these tools were not required in this study as the rapid testing and some vegetation plot testing were sufficient to determine areas that could be natural inland wetland.

2.2.8. Wetlands – values and condition (ecosystem health) assessment

While the NPS-FM delineation protocol was used to establish if a natural inland wetland is present, the values assessment was based on:

- the observed species present (which relates to the NPS FM indigenous biodiversity criterion)
- the observed condition (a subjective measure like the RHAB of streams) (which relates to the NPS FM ecosystem health criterion), and
- the landscape setting of the feature (which relates to the NPS FM hydrological function criterion).

That is, the inputs to the values assessment are based on the NPS FM criteria, rather than the EIANZ (2018) process. However, those inputs informed my view on the representativeness, diversity & pattern, rarity, and ecological context of each natural inland wetland (in accordance with Section 2.2.2) and my assessment of significance (in accordance with the Regional Plan criteria).

2.3. Assessment of Effects Methodology

2.3.1. The appropriate scale for assessment of effects

In general, I do not consider it is appropriate to assess effects at a site or reach scale. In my opinion, a site or reach scale has no ecological meaning, and is based on an arbitrary boundary. If one only uses the site or reach scale at each place of effect, then the outcome will always be a high magnitude of effect.

A river system is a connected linear habitat defined by its catchment (an area that provides the water for the system). Each catchment has its own freshwater ecology of a river and connected wetlands. All aquatic life in a catchment is connected by the network of waterways (tributaries, streams, rivers and wetlands). Values in, and effects to, a portion of a river are reflected in the health and condition of the catchment.

For those reasons, I consider a catchment is the scale that is most appropriate for assessing the extent (or magnitude) of freshwater effects of the Project. This approach is based on EIANZ (2018), section 6.3.1- "*it is recommended that an assessment at the scale of the feature (e.g. contiguous dunes, wetland system, forest community) should be done*". A catchment is much smaller than an ecological district, which is the scale most often used in assessing effects on terrestrial ecology.

The exception to that general approach is where there is a feature of particular special condition, value or size that makes the catchment scale too unresponsive. For example, there could be an exceptional indigenous wetland in an otherwise farmed landscape, or an excellent condition stream section in a rare indigenous forested reserve – both of which are completely dissimilar to any other feature in the catchment. However generally, where the features potentially impacted are reflective of the “run of the mill” types of systems within the wider catchment then I consider the catchment scale is the appropriate scale.

2.3.2. Scale for assessment of effects on streams

For this Project, I have used a resource base at the catchment level, determining the amount of perennial and intermittent streams within each of the four catchments.

Sometimes, the stream order within the catchment can be used as the resource base. However, this approach is only possible where the River Environment Classification (REC) data layer is sufficiently accurate. In the Project’s four catchments (Ahuroa, Waihoihoi, Wairau and Pukekaroro), the REC stream order data is less than 50% accurate.

My GIS assistant modelled the linear lengths of the streams in each of the catchments using a rain fall geomorphic model and then calculated river class supported by field assessment to partition ephemeral from intermittent and perennial streams. The lengths for each of perennial and intermittent stream provide the bases for determining the proportional effects of the Project on the different stream types within the catchments.

2.3.3. Scale for assessment of effects on wetlands

The area of natural inland wetland within each catchment has been determined using GIS analysis following field work.

For each catchment, the total recorded or known area of natural inland wetland is used as the baseline. Council surveys have not yet been completed across the region or within individual catchments. Existing datasets, such as the LCDB6 and other spatial layers tend to capture only larger, predominantly indigenous wetlands, and in most cases overlook smaller and mainly exotic wetlands that will qualify under as Natural Inland Wetlands the NPS-FM. As a result, I consider the baseline I have used in my assessment understates the extent of natural inland wetland within each catchment.

2.3.4. Magnitude of Effects

I have assessed the magnitude of an effect based on:

- a proportional consideration of the amount of resource impacted / removed from the system at a relevant (catchment) spatial scale; and / or
- the temporal extent of an impact (i.e. is it a temporary and recovered condition, or a permanent condition or for how long the temporal process lasts (e.g. will it stop fish migration for a season or more, will the wetland be dry for a month then rehydrate and recover its wetland species).

The magnitude of an effect does not consider the value of the feature and is not influenced by rarity or any other such aspect. This is because the overall effect is determined using a matrix that considers ecological values and magnitude of effect.

2.3.5. Methodology for determining magnitude of effects on streams

I consider the linear extent of the affected streams (those in the zone of influence (EIANZ 2018)) against the linear length of streams within the affected catchment, to determine the proportional effect of the Project on perennial and intermittent streams in each catchment.

I use the catchment scale because a river is a continuous connected ecosystem where physical and chemical and biological characteristics gradually change from the headwaters to the river mouth. A catchment has shared species, many of which move throughout the river daily or in their lifetimes. A catchment also has connected inorganic and organic resources in the same way as a continuous forest patch is one habitat even while there are a number of microhabitats within. It is therefore the amount of that continuous river lost or affected that determines the magnitude of effect to that ecosystem.

The magnitude of the effect is considered in the context of the EIANZ (2018) matrix (Table 2) where the stream length is the range of the element in question.

Table 2: *Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018)*

MAGNITUDE	DESCRIPTION
Very High	Total loss of, or very major alteration, to key elements / features of the baseline conditions such that the post development character, composition and / or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element / feature.
High	Major loss or major alteration to key elements / features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element / feature.
Moderate	Loss or alteration to one or more key elements / features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element / feature.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element / feature.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable, approximating to the “no change” situation; AND/OR Having a negligible effect on the known population or range of the element / feature.

I describe the magnitude of effect as ‘Negligible’, ‘Low’, ‘Moderate’, High’, or ‘Very High’ based on the proportion of the element (stream length) affected, as set out below. The proportions are based on the EIANZ guidance in Table 2 and I consider the proportions add a level of transparency around the determination of magnitude of effect.

- <1% of the total catchment’s waterway affected = negligible,
- 1-10% = low,
- 10+-25% = moderate,
- 25+-50% = high,
- >50% = very high

Some potential effects on streams (e.g. lighting, discharges, fish migration disturbance, biosecurity effects) are not given to proportional assessment. I have instead applied my professional experience and judgement to establish the likely magnitude in these types of potential effect.

2.3.6. Methodology for determining magnitude of effects on wetlands

I consider the area of the affected wetlands against the area of natural inland wetlands within the affected catchment that could be defined, to determine the proportional effect of the Project on wetlands in each catchment.

The magnitude of the effect is then described as ‘Negligible’, ‘Low’, ‘Moderate’, High’, or ‘Very High’ based on the following proportions:

- <1% of the total catchment’s natural inland wetland affected = negligible,
- 1-10% = low,
- 10+-25% = moderate,
- 25+-50% = high,
- >50% = very high

As noted above, the baseline I have used understates the extent of natural inland wetlands within the existing environment. The result is therefore a very conservative assessment of the magnitude of effect of the Project (because the proportion is higher when the baseline is lower e.g. 2 / 7 is a larger number than 2 / 9).

2.3.7. Overall Level of Effects

The Environment Institute of Australia and New Zealand (EIANZ) guidelines outline a framework for undertaking ecological impact assessments (Roper-Lindsay *et al.*, 2018). This framework recommends assigning ecological values and the magnitude of effect of a proposal in order to determine the overall effects in a consistent and transparent way (as shown in Table 3). However, sound professional judgement is required when applying the framework and undertaking the assessment.

Table 3: EIANZ level of effect matrix

Table 10. Criteria for describing level of effects (Adapted from Regini (2000) and Boffa Miskell (2011))

Ecological Value ▸ Magnitude ▾	Very high	High	Moderate	Low	Negligible
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very Low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

2.4. Changes to the alignment within the Proposed Designation

The Indicative Alignment within the Proposed Designation represents a possible alignment which has been developed for assessment purposes and to illustrate what the Project's final design might look like, and the effects generated by its construction and operation. The alignment that gets built including the design and placement of bridges, culverts, stormwater systems, soil disposal areas and landscaping, will be refined and confirmed during the detailed design stage.

As a result, this assessment considers the effects of the Indicative Alignment and then goes on to provide sensitivity testing for changes to the alignment within the Proposed Designation. The recommended mitigation is intended to ensure effects on the environment are adequately avoided, remedied or mitigated, regardless of the final design and construction methodology for the Project.

3. Existing Environment

The Proposed Designation crosses four water catchments (shown on Figure 4 below). From south to north, these catchments are:

- Pukekaroro catchment (that discharges south to the Kaiwaka River at Kaiwaka);
- Wairau catchment (that discharges from east to west to the Otamatea River);
- Ahuroa catchment (which includes the Piroa Stream and numerous tributaries from the Brynderwyn forested hills and discharges north to the Waipu River); and
- Waihoihoi catchment (including the Waihoihoi River and several tributaries which discharge north also to the Waipu River).

Each catchment contains streams and wetlands that may be affected by the Project, as outlined below.

3.1. Wetlands

From my desktop and field assessments, I have identified three broad types of wetlands that persist in the wider landscape in and surrounding the Proposed Designation:

1. Large indigenous dominated natural inland wetlands: these wetlands are those that have been identified using survey data, and are recognised in the Natural Areas surveys, DOC records (WONI etc) and Council records (those available on GIS and other public access mediums). There are no large indigenous dominated natural inland wetlands that have been identified within the Proposed Designation.
2. Smaller (and in part theoretical i.e. predicted to be present, but not ground truthed) natural inland wetlands recognised in Singers, 2019 modelled potential ecosystems. One feature, Wetland Q08/066 was identified in this set of data, signifying that the landforms and hydraulic conditions and soils are not those of wetland types, but of kauri and other forest types.
3. Pastural landscape wetlands identified using aerial photography to target field investigation that I considered at the time of viewing likely to trigger the NPS-FM delineation protocol (MfE, 2022).

A total of 25 natural inland wetlands in the Proposed Designation and two natural inland wetlands outside, but near the Proposed Designation have been identified through field studies and mapped. Maps of these identified natural inland wetlands (by catchment) are included in **Appendix A**, and a description and photo of the wetland features are shown in **Appendix B**.

All 25 wetlands within the Proposed Designation identified in Appendices A and B meet the definition of ‘natural inland wetland’ under the NPS-FM and the definitions of wetland, natural wetland, and natural inland wetland under the RPN.

Overall, 22 of these natural inland wetlands are predominantly pastural (exotic) wet features, with a small suite of common exotic wetland species not recognised as pasture, and a few native wetland species. There were no threatened or at risk wetland taxa found. There are a range of wet species the Clarkson 2021 pasture lists (relevant under both the NPS-FM and the RPN) do not recognise as pasture. As a result, no feature could be excluded as wet pasture (or damp gully head). Some features could be excluded as wet pasture with patches of rushes; I did not exclude the larger areas of such features.

While indigenous wetlands are underrepresented in the Waipū and Otamatea Ecological Districts and wider Northland region, predominantly pastural (exotic) wet features are common and are not underrepresented and do not reflect indigenous dominated assemblages. Accordingly, they do not trigger the representativeness or rarity aspects, nor the diversity and pattern or ecological context criteria of the RPSN significance criteria.

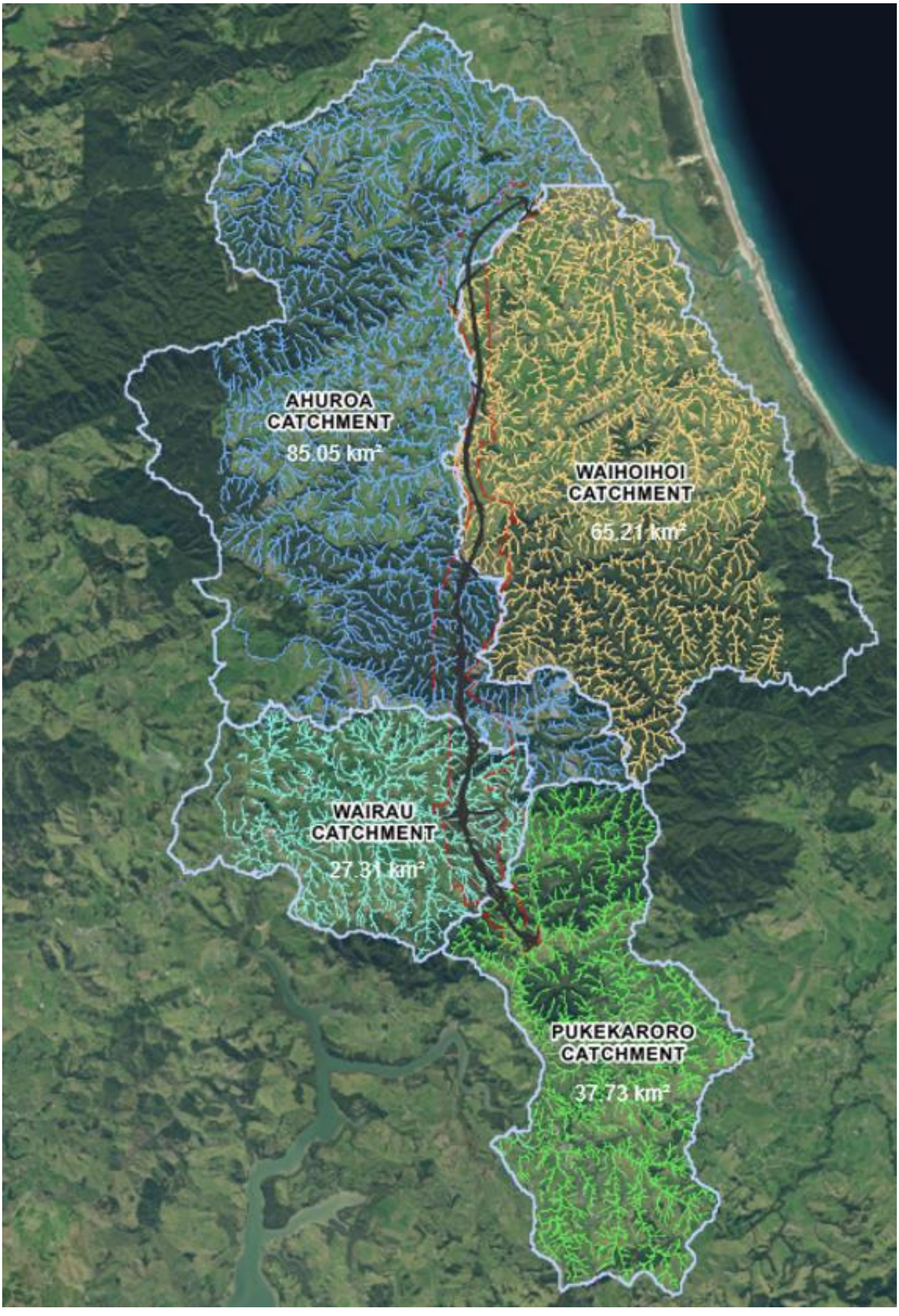


Figure 4: Water catchments of the Proposed Designation and surrounding landscape

3.1.1. Condition and values of exotic pasture wetlands

In my opinion, while the predominantly exotic pastural natural inland wetlands reflect in a small way limited hydrology patterns, they do not have patterns and diversity reflecting indigenous community responses to environmental gradients. While it is remotely possible some of these exotic wet pasture wetlands play some basic hydrological functions[6], I do not consider these wetlands have functional roles associated with natural representative wetlands as they are small, have species similar to pasture and are modified (and subject to continued modification due to surrounding land use). I expand on the reasons for this conclusion below.

While it is obvious that the exotic dominated wetlands have very limited indigenous biodiversity and poor ecosystem health, their hydrological functions cannot be seen or derived easily.

The term 'wetland hydrology' describes the water flow in and out of the wetland. Wetland hydrology determines:

- the amount of nutrients entering and leaving a wetland
- the chemistry of water in a wetland
- the chemistry of soil in a wetland
- the plants that grow in a wetland
- the animals that live in a wetland
- the productivity of a wetland.

To me these are the crucial components of hydrological functioning that separate natural inland wetlands and wet pastures.

A wetland's productivity mainly relates to the amount of carbon that plants fix during photosynthesis. Some wetlands, especially swamps in valleys and depressions at the bottoms of catchments, have very high biological productivity because they offer few constraints to photosynthesis (they contain plenty of water and nutrients compared with ecosystems on dry land).

I considered whether the exotic dominated wetlands (especially wetlands 1-18) differ markedly from the productivity of the surrounding pasture (i.e., is their soil and water chemistry markedly different and do they retain much more water than the surrounding pasture (detention of rain inputs at the catchment scale) and does that water detained feed base flow to streams.

I have no on-site measurements of soil chemistry differences and biomass productivity differences (i.e. between wetland and surrounding pasture). But from my observations, the species, density, height in the exotic dominated wetlands mimic the surrounding pasture. All areas are grazed and treated to fertilisers and farmed in the same way. Accordingly, I see no reason to expect markedly different soil chemistry or nutrient status or productivity (carbon storage) in the exotic dominated wetlands. The main difference between the exotic dominant wetlands and surrounding pasture is that the lower lying exotic dominant wetland areas stay moister longer in summer and wetter in winter to a small degree.

What published New Zealand science there is with regard to nutrient filtration / management in natural wetland is largely inconclusive, but several studies show that denitrification (of Nitrate) occurs in sweet grass pasture swales, but that process produces more nitrogen oxide and dinitrogen (Zaman et al 2008, 2009). Research also shows (Luo et al 2000[7]) that dairy pasture soils also cause denitrification and that the rate is linked to season, pasture use, moisture level. It is not clear from research that farm wetlands are different from pasture in terms of nutrient filtration and dentification.

Rutherford et al 2009[8] show evidence that riparian wetlands support stream base flow. They show that attenuation of water and nutrients can occur in small **riparian** wetlands (small meaning 5% of catchment area) where there is no or infrequent stock access and the wetlands are densely vegetated (tall exotic grasses, flax, manuka, Carex, juncus). Such wetlands can supply water, because they detain it during rain,

[6] For example, water purification (filtration), flood mitigation, nitrogen cycling, wildlife habitat and carbon sequence functions.
[7] Soil biology and biochemistry vol 32, issue 4, April 2000
[8] NZJMFR 2009, vol 43:1079-1094

to the order of 10-15% of mean annual water in base flow conditions. So, where there are large riparian wetlands, these typically support summer base flows in adjacent streams.

For this Project there are no riparian wetlands that meet the criteria described above. Wetland 2 is a wetland over a stream and therefore doesn't provide filtration. All other exotic dominant wetlands sit in pasture and are not riparian. Furthermore, they are very small (at a catchment scale) and while one (Wetland 13, with a size of 1.3ha) has a gradient that drains water to the Waihoihoi, most do not. Wetland 13 may supply some small addition to the Waihoihoi main stem in summer but given the size of the Waihoihoi here (large) and the minimal extent of nutrient filtration, I cannot see it having a much greater impact than the discharge off the wider pastures.

I conclude that those natural inland wetlands I class as exotic pasture wetlands are insufficiently different in functions from the surrounding pasture as to allocate a hydrological functioning value to them. Wetlands 8, 16 and 24 are more likely to have wetland hydrology.

Overall, because the exotic pasture wetlands are induced, have a dominant exotic species composition, are of low diversity, lack any significant or Threatened / At risk floral species or hydrological functions, they have a low or negligible value.

3.1.2. Condition and values of wetlands 8, 16 (part) and 24

There are only three natural inland wetlands in the Proposed Designation that have some level of ecological value and are significant based on the RPSN criteria:

- Wetlands 8 and 24 are simple and highly modified, however they do retain raupō wetland communities (with some other indigenous species as well as wetland exotic species). They are therefore representative of a natural assemblage in the gully depressions they inhabitant. Tall abundant raupō also provides potential habitat for wetland birds and has a greater functional value.
- Wetland 16 has parts (centrally) that have species assemblages that better represent a natural state of wetland. However, the lower and upper sections of Wetland 16 there are highly modified and exotic grass dominated.

Wetlands 8 and 24 and part of Wetland 16 are of high value due to the currently low presence of indigenous natural inland wetlands in the Waipū / Otamatea Ecological Districts, making any wetland of some indigenous assemblage of greater importance. I note that all of the wetland features present today were once under forest. Therefore, these gullies and headwater basin areas would have been kahikatea components of a wider podocarp-kauri forest landscape, and not the rush and pasture they are today.

3.1.3. Summary of condition and values of natural inland wetlands

I have prepared a table summarising the condition (based on species present, physical appearance, water condition, stock access) and values for each of the identified natural inland wetlands (Table 4).

Table 4: Summary of the condition and values of natural inland wetlands within the Proposed Designation

Wetland # (map label)	Wetland Type	Indigenous biodiversity	Ecosystem health	Hydrological function	Value
Ahuroa Catchment					
1	Creeping butter cup drainage	Negligible	Poor	Negligible	Negligible
19	Creeping butter cup		Poor	Negligible	Negligible
Waihoihoi Catchment					
2	Exotic dominated: purslane, water pepper & rushes	Low	Poor	Low	Low
3	Juncus, creeping bent, buttercup	Negligible	Poor	Negligible	Negligible
4	Juncus, buttercup, creeping bent	Negligible	Poor	Negligible	Negligible
5	Juncus, creeping butter cup	Negligible	Poor	Negligible	Negligible
6	Juncus, creeping butter cup	Negligible	Poor	Negligible	Negligible
7	Juncus, Isolepis, Creeping butter cup	Negligible	Poor	Negligible	Low
8	Raupō, Isolepis, water purslane, Juncus	High	Moderate	High	High

Wetland # (map label)	Wetland Type	Indigenous biodiversity	Ecosystem health	Hydrological function	Value
9	Juncus, Isolepis, Creeping butter cup	Negligible	Poor	Negligible	Negligible
10	Juncus, Isolepis, Creeping butter cup	Negligible	Poor	Negligible	Negligible
11	Juncus, creeping buttercup, creeping bent, Gylceria.	Negligible	Poor	Negligible	Negligible
12	Kahikatea with creeping bent, Gylceria, water pepper, creeping buttercup,	Negligible	Poor	Negligible	Low
13	Juncus, creeping butter cup, creeping bent.	Negligible	Poor	Negligible	Low
14	Wet pasture with Juncus and creeping bent	Negligible	Poor	Negligible	Negligible
15	Wet pasture with Juncus and creeping bent	Negligible	Poor	Negligible	Negligible
16	Lower, juncus, Gylceria, creeping bent, upper wet pasture, mid - raupō, kiekie, sedges	Low	Mostly poor, centrally some moderate condition	Negligible	Mostly low, but a central 1/3rd is of High value.
17	Headwater small Isolepis and creeping butter cup	Negligible	Poor	Negligible	Negligible
18	Headwater small Isolepis and creeping butter cup	Negligible	Poor	Negligible	Negligible
Wairau Catchment					
20	Creeping bent, buttercup,	Negligible	Poor	Negligible	Negligible
21	Juncus, giant umbrella sedge, Isolepis sedgeland (	Low	Mostly poor, some indigenous species present in scattered areas.	Negligible	Low
22	Creeping buttercup, cabbage tree	Negligible	Poor	Negligible	Low
23	Juncus, creeping bent and buttercup	Negligible	Poor	Negligible	Negligible
24	Raupō gully with edge willow	High	Fair	High	High
Q08/066	Open water, poplar, juncus, creeping bent and butter cup	Negligible	Poor	Moderate	Moderate (fauna)

3.2. Streams

The extent of perennial and intermittent streams within the Proposed Designation in each catchment are shown in Table 5 below.

Table 5: Streams within the catchments intersected by the Proposed Designation for the Project

Catchment	Perennial (km)	Intermittent (km)	Total (km)
Ahuroa	**109.93**	**235.35**	**638.05**
Pukekaroro	**51.19**	**106.88**	**318.32**
Waihoihoi	**85.51**	**178.99**	**508.78**
Wairau	**45.72**	**66.06**	**222.22**
Total	**292.35**	**587.29**	**1687.36**

All streams intersected by the Proposed Designation are shown on the maps in **Appendix C**, with a description of these streams and their respective freshwater habitats (by catchment) is outlined in **Appendix D.**

Detailed surveys were undertaken at the following streams (which are impacted by the Indicative Alignment; intermittent or perennial and indicative of the better stream values in the Proposed Designation) numbered 1-12 in **Appendix C**:

- In the Ahuroa catchment, the Piroa stream and two tributaries, east and western, and two pine tributaries, (middle and northern). There are a range of short intermittent sections of tributaries that may be in spoil sites or dewatering zones that have not been surveyed but based on my field observations I consider they have lower values than the streams surveyed in detail.
- In the Waihoihoi catchment, the northern and southern Waipu station tributaries and the Waihoihoi River. Again, there is at least one smaller tributary and a range of intermittent reaches that were not surveyed but based on my field observations I consider they are of lesser value than those streams surveyed in detail.
- In the Wairau catchment, four larger tributaries and a number of smaller intermittent systems on the Mayflower and Puriri Downs properties. Again, survey in detail was limited to the Mayflower North and Mayflower main stem streams. I consider the other intermittent and perennial streams on the Mayflower property to be even poorer value aquatic habitats based on my field observations. Furthermore, across the Puriri Downs property, a number of farm modified small tributaries have not been surveyed but based on my field observations I consider they are typical of or poorer value than Wairau north.
- In the Pukekaroro catchment, one tributary was surveyed.

Field observations were made at all other streams within the Proposed Designation to identify any streams with potential to have better condition or higher values. These waterways, however, sit in the same landscape with the same modifications and drivers of the streams where detailed surveys were undertaken. I am confident that they share the same values, fauna and condition as those surveyed and that there are no missed good value aquatic habitats or habitats that are not represented by the focused stream study areas.

Most of the Indicative Alignment intersects with small headwater tributaries and upper reaches of those tributaries and are typically around 1m in width. The Proposed Designation includes (and in some cases the Indicative Alignment intersects with) some lower catchment larger streams that have a wetted width over 2 m (such as the Waihoihoi main stem, the Mayflower Wairau tributary and the Piroa stream main stem).

3.2.1. Water quality

A study (John Ballinger, 2012) showed that the Ahuroa catchment and Waihoihoi catchment are heavily impacted, and at the time of the study failed to meet the majority of relevant water quality guidelines (including those now contained in NPS-FM). Total Nitrogen, phosphorus and *E.coli* levels were constantly above recommended levels. Dissolved oxygen was also often below recommended guidelines (noting diurnal fluctuations). These results were similar to other highly modified catchments in Northland (including Awanui, Mangere and Mangonui), illustrating that land use and reliance on chemicals and fertilisers have resulted in universally poor water quality in these catchments.

Overall, this study found that water quality at all sample sites in the Ahuroa and Waihoihoi catchments was generally poor. However, upstream sites (in hill country above the general farmland, which is similar to the Brynderwyn hills native forest areas) were slightly better than downstream sites. Ballinger concluded that there was little difference between rivers that were sampled due to the similar land use ratios, with small amounts of indigenous/plantation forestry in catchments dominated by intensive pastoral farming. Although there were consents that authorised the discharge of sewage to land, he considered that the majority of pollutants related to pastoral farming (a conclusion which was supported by microbial source tracking).

The NRC water quality trend report (Northland Regional Council, 2007) is a good barometer of the general state of most rivers in the region. Overall, the results show that many of Northland's rivers have poor water quality on occasion and some consistently have poor water quality, noting that this study did not include any of the catchments within this Project's Proposed Designation. Water quality is related to surrounding land use. Sites in catchments dominated by native forest have the best water quality, including the Waipoua, followed by those with catchments dominated by exotic forestry. The worst water quality is at sites surrounded by intensive pastoral farming and urban environments.

Overall, it is clear from the desktop information that water quality is **poor** generally in all four catchments that interact with the Proposed Designation. There are a few areas of likely better condition related to the forests on the Brynderwyn Hills (when pine harvest is not being conducted) and one tributary of the Pukekaroro. These tributaries are still modified by SH1 run off and flow disruption and therefore have existing water quality issues. All other tributaries within the Proposed Designation suffer from farm related run off issues, or sediment issues from periodic pine forest harvesting.

3.2.2. Fish species

Desktop information

The nearest SOE monitoring site is in Ruakaka at Flygers Road to the north of the Proposed Designation and at the Hakaru tributary to the south of the Proposed Designation. Tanekaha east (Mangawhai) has recently been added. The SOE monitoring reports show that the catch in all streams comprises 66% bully, 12% eel, 9% torrent fish, 7% galaxiid and 6% smelt. That data shows that red fin bully and common bully are the most abundant in samples, with inanga more common close to the sea in large low gradient sites and eel in low abundances throughout. NRC's monitoring sites had a maximum species richness of 7, but more typically 5-6 taxa.

The 2015 Freshwater Native Fish in Northland Report (Kate McArthur and Alistair Beveridge, 2015) considered all existing fish data at that time, largely in the upper-mid Waihoihoi, upper-mid Wairau and upper mid-Ahuroa systems. That paper does not indicate there are any fish taxa of conservation importance within the Project's four catchments. The only taxa that is 'At Risk declining' are long fin eel and inanga. However, as discussed below, the conclusions in this report are contrary to eDNA records for the Project, which indicate the presence of torrent fish and giant kōkopu within the Ahuroa catchment (Waipu Gorge).

The FFDB (NIWA) shows a small range of sampled sites, some in the lower Ahuroa catchment, some in the upper Waihoihoi catchment and some in the mid Wairau catchment. The following table (Table 6) outlines species (excluding marine wanderers) that have been recorded within the FFDB (marked 'x') as present within three areas of the catchments: coastal, lower plains and upper hill country (distance from the sea <5km, 5-10km, >10km).

Table 6: Fish species recorded in the FFDB as present in each of the three main catchments (excluding Pukekaroro as the FFDB has no records in that catchment).

		Ahuroa	Waihoihoi	Wairau
Coastal lowland (<5km)				
Anguilla australis	Short fin eel		x	x
Anguilla dieffenbachii	Long fin eel		x	x
Galaxias fasciatus	Banded kōkopu			x
Galaxias maculatus	Inanga		x	x
Gobiomorphus gobioides	Giant bully		x	x
Gobiomorphus basalis	Crans bully			x
Gobiomorphus cotidianus	Common bully		x	x
Gobiomorphus huttoni	Red fin bully		x	x
Common smelt	smelt		x	x
Cheimarrichthys fosteri			x	
Gambusia affinis	Mosquito fish			x
Low land plains reaches (5-10km)				
Anguilla australis		x		x
Anguilla dieffenbachii			x	x
Galaxias fasciatus		x	x	x
Galaxias maculatus		x	x	

		Ahuroa	Waihoihoi	Wairau
Gobiomorphus basalis				x
Gobiomorphus cotidianus			x	
Gobiomorphus huttoni		x	x	
Common smelt				
Cheimarrichthys fosteri			x	
	Uplands >10km			
guilla australis		x*	x	
Anguilla dieffenbachii		x*	x	
Galaxias fasciatus		x*	x	
Galaxias maculatus		x	x	
Galaxias argenteus		x		
Gobiomorphus basalis		x	x	
Gobiomorphus cotidianus		x	x	
Gobiomorphus huttoni		x	x	
Cheimarrichthys fosteri		x		x

** steep high hill sites (elevation > 100 m)*

The frequency of reporting in the FFDB suggests that the most commonly occurring species within these three catchments are long and short fin eel, inanga, banded kōkopu, redfin and common bully (with lesser amounts of Crans bully). Other species occurrences are much less frequent. Smelt and giant bully (and marine wanders) are only identified in lower coastal areas, and those habitats are not within the Proposed Designation. It is curious to note that records from standard fish surveys recorded in the FFDB do not show the presence of giant kōkopu or torrent fish (despite these being identified through the Project's eDNA sampling)

Based on the data outlined above, we anticipate that:

- In steep and elevated stream tributaries within the Proposed Designation that are high in their respective catchments, only long and short fin eel, banded kōkopu and less often red fin bully are likely to be present.
- Natural barriers (such as the Piroa Falls) will naturally restrict many species from being present in streams within the Proposed Designation, due to the Project being a substantive distance inland from the coast, and the presence of hard climbing barriers.
- The Waihoihoi tributaries within the Proposed Designation currently have some fish passage challenges, and therefore I expect only long fin and short fin eel, and banded kōkoputo be present.
- The Wairau systems are closer to the coast and less naturally difficult for fish passage. However, these streams have many more human induced challenges (i.e. culverts and water quality issues). In these locations, we consider that long fin and short fin eel and banded kōkopu are certain to be present, and common bully, Crans bully and red fin bully may also occur.

3.2.3. eDNA

Early eDNA sampling was undertaken by WSP ecologists for the Project in waterways from public access points. These sampling locations are shown on the maps in **Appendix E.** The early results (Table 7) show that short fin eel were located in all surveyed waterways, and long fin eel, banded kōkopu and red fin bully are common in the lower reaches. Crans bully, giant kōkopu and common smelt were also present in these waterways, but infrequently (one record each).

Table 7: Early collected, less site specific, fish results from the collected eDNA. P = present

	Redfin bully	Common bully	Shortfin eel	Banded kōkopu	Longfin eel	Inanga	Giant bully	Common smelt	Torrent fish	Giant kōkopu	Crans bully
Lower Ahuroa	P	P	P	P	P	0	P	0	0	0	P
Waipu gorge	P	P	P	P	P	0	0	0	P	0	0
Lower Waihoihoi	P	P	P	P	P	P	0	P	P	0	0
Mid Waihoihoi	P	P	P	P	P	P	0	P	P	0	0
Upper Waihoihoi	P	P	P	P	P	P	0	0	0	0	0
Upper Waihoihoi trib (SH1)	0	0	P	P	0	0	0	0	0	P	0
Piroa trib	0	0	P	0	0	0	0	0	0	0	0
Wairau (SH12)	P	P	P	0	P	0	0	0	P	0	0
New threat classification (2025)	AR NU	NT	NT	AR NU	AR-D	AR-D	AR - NU	AR-D	AR NU	AR-D	AR NU

(AR = At Risk, NU = naturally uncommon, D = declining, NT = not threatened)

Site specific eDNA sampling was undertaken higher in the catchments (Figure 5) and a pine tributary in the Brynderwyn hills west area. The results are presented in Table 8. This sampling confirmed conclusions in the desktop information indicating that banded kōkopu, long fin eel and short fin eel are the fish species with the highest probability of being encountered in the middle to upper reaches of most tributaries.

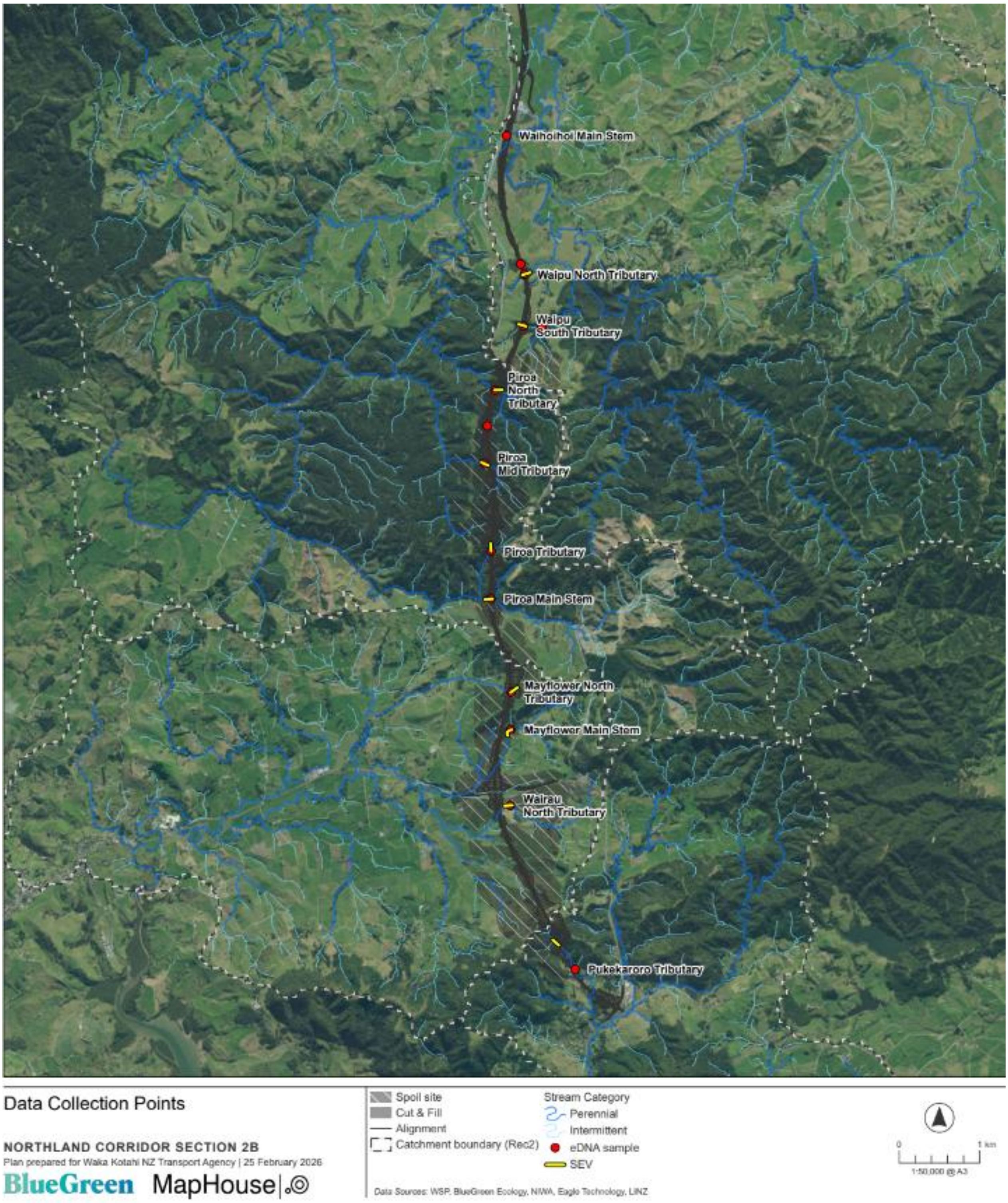


Figure 5: Sample and survey locations associated with the October-November 2025 surveys

Table 8: Site specific eDNA sampling results for fish fauna (1 = present).

	Shortfin eel	Longfin eel (AR-D)	Banded kokopu (AR NU)	Redfin bully (AR NU)	Bullies	Inanga (AR-D)	Giant bully (AR NU)	Common smelt (AR NU)
Robertsons	1	1	1	0	1	0	0	0
Waihoihoi main stem	1	1	0	1	0	1	1	1
Waipu nth tributary	1	0	1	0	0	0	0	0
Waipu nth	1	0	1	0	1	0	0	0
Waipu sth	1	1	1	0	0	0	0	0
Murray Property	1	1	1	1	0	0	0	0
Pine nth	1	1	1	0	0	0	0	0
Pine tributary	1	0	0	0	0	0	0	0
Pine mid	1	1	1	0	0	0	0	0
Piroa tributary	1	1	0	0	0	0	0	0
Piroa main	1	1	0	0	0	0	0	0
Mayflower nth	1	0	0	0	0	0	0	0
Mayflower main stem	1	1	0	1	0	0	0	0
Pukekaroro tributary	1	1	1	0	0	0	0	0

3.2.4. Macroinvertebrates

Macroinvertebrate eDNA sampling allowed examination of the macroinvertebrate assemblages at each sampling location shown in Figure 5. These data reveal the aquatic taxa present in a more detailed way than standard sample collection laboratory analysis as it often enables identification of the taxa to a species level. Table 9 summarises the taxa richness (i.e. total count of different types of organisms) and proportion of the assemblage (i.e. the amount of that species relative to the different species in the total sample) that are Ephemeroptera-Plecoptera-Trichoptera (EPT) taxa and the calculated MCI of the relevant stream. The MCI data is further presented in Figure 6, which shows the water/habitat quality divisions illustrating which sites exhibit tolerant assemblages, reflecting poorer quality aquatic habitats.

In essence, the data is as expected. In the lower, flatter sites, sediment and nutrient pollution result in low MCI and lower EPT proportions. In forested, faster flowing, less sedimented and nutrient enriched sites, there are better assemblages with greater EPT representation and better MCI.

Table 9: Macroinvertebrate summary assemblage statistics

Metric	# of taxa	# EPT taxa	% EPT taxa	MCI
Waipu nth tributary	16	6	37.5	86
Waipu north	32	12	37.5	74
Robertsons tributary	13	2	15.4	51
Waihoihoi main	16	3	18.8	57
Waipu south	29	11	37.9	85
Murray Property	31	14	45.2	101
Pine nth	16	11	68.7	127
Pine tributary	18	9	50	108
Pine mid	26	14	53.8	96

Metric	# of taxa	# EPT taxa	% EPT taxa	MCI
Piroa tributary	22	11	50	111
Piroa main	40	17	42.5	84
Mayflower nth	23	2	8.7	62
Mayflower main stem	39	14	35.9	86
Pukekaroro	38	16	42.19	89

In summary:

- Three sample sites had fauna representing a good (MCI >100) invertebrate habitat. These sites were the Brynderwyn hills forested tributaries (i.e. pine tributary and Piroa tributary) and the Murry property tributary (Waihoihoi catchment).
- One sample site was excellent (>120) (i.e. Pine north).
- Most sites are poor (<80) to fair (80-100) quality habitat for macroinvertebrates. The poorest habitat was the Robertsons tributary and the Waihoihoi main stem. The Waihoihoi main stem result may be due to undertaking an eDNA sample in such a large volume of water, but also likely reflects the very heavy sediment and longer term nutrient pollution build up on the bed.

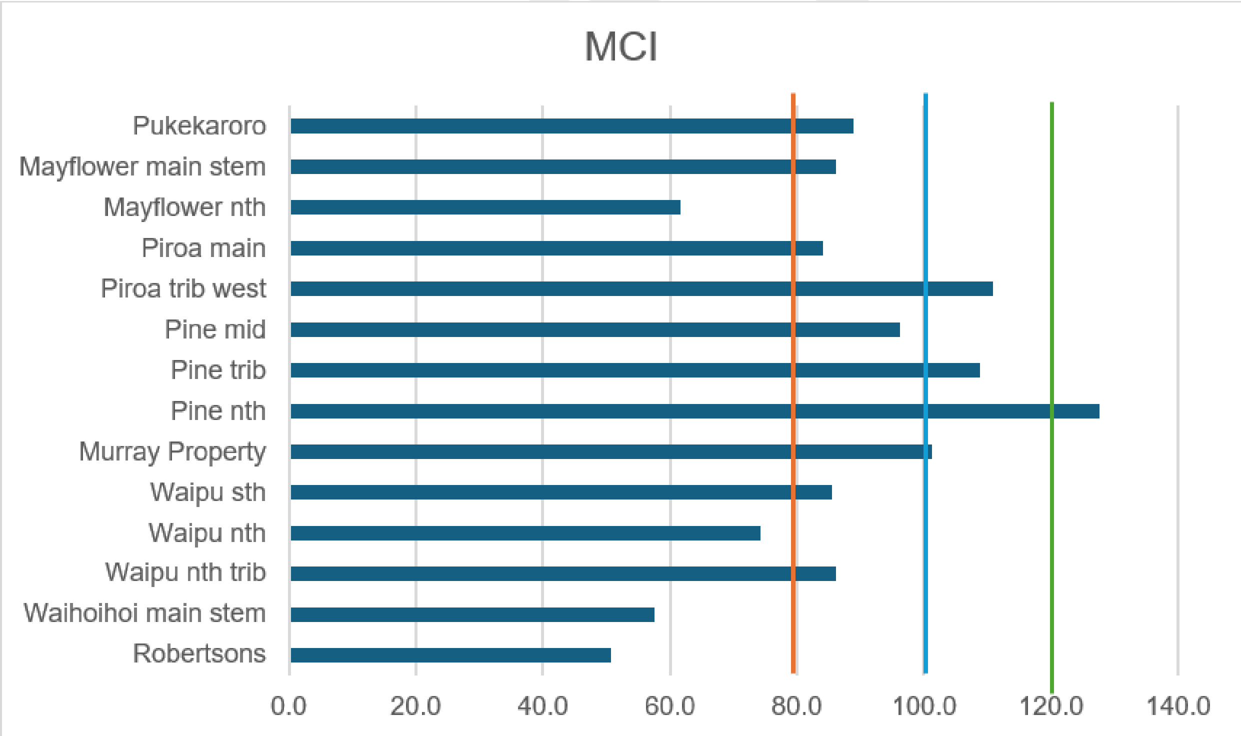


Figure 6: MCI calculated for each survey site. <80 = poor, 80-100 = fair, 100-120 good and >120 excellent.

eDNA sampling also indicated the presence of freshwater mussel (kakahi, *Echyridella menziesii*) in the Waihoihoi River, specifically in the Waihoihoi tributary that runs up into the Murphy property (near Wetland 16).

No koaro have been recorded in any eDNA sampling. Koaro are commonly understood to act as the transport for kakahi larvae. However, it is possible that banded kōkopu perform the same function.

3.2.5. Summary of stream conditions and value

The streams within the Proposed Designation comprise systems with varying degrees of modification.

The Waihoihoi catchment contains hill country headwater reaches in forest cover (although much is in pine plantation and may be harvested in the future), retaining a good headwater source of natural native resources. Similar (but reduced) amounts of quality headwater habitat are also present in the Wairau and

Pukekaroro catchments. The Ahuroa catchment has hill catchment extents in native forest along its western catchment and the forests of the Brynderwyn Hills although much of that is pine plantation.

I acknowledge that the stream habitats in the Brynderwyn pine forest (sites: pine north and pine mid) will suffer at harvest of those pine forests (which I understand is a permitted activity) as usually forest harvest results in substantive sediment discharge and woody debris (slash) introduction to those small headwater tributaries. Where the earthworks for the Project occur after such a harvest, the effects predicted here will be substantively different (less) because the values in streams may be substantively different.

All streams in this assessment have varying degrees of issues that impact their condition and value including water quality, bed sedimentation, invasion of exotic macrophyte and other species. In addition, these streams generally lack sufficient riparian cover, reducing instream habitat complexity, or where there is some native and appropriate riparian cover (supplying woody debris and leaf litter) this is only in short and few sections. Most of the streams that the Proposed Designation intersects are also partially intermittent because the intersections occur high in the catchments near the upper end of aquatic habitat.

The most "natural" stream reaches are those of the Piroa east and west tributaries and the headwaters of the Pukekaroro tributary (see **Appendix C** stream maps). The Mayflower and Piroa main stems are partially supported with some (true right bank) native cover, but both suffer extensive land use issues.

Overall, ecological values of streams within the Proposed Designation are low-moderate due to the poor condition, high levels of historic modification and general lack of representative assemblages and rare species and habitats. While few notable species have been found within the Proposed Designation, New Zealand fish species have recently been revised in terms of their threat classification and Dunn et al 2025 have rerevised many species that were not considered threatened to now be At Risk, naturally uncommon which under the EIANZ system creates a moderate value for the presence of populations of those species in a habitat. The data collected shows that all but one stream (the pine tributary) had long fin eel and most also had banded kokopu which is to be expected and, given only these species, a low diversity. Only the Waihoihoi main stem had multiple species of conservation concern and can truly be said to be habitat of threatened fish taxa. It is possible lamprey and inanga may also be present within the Proposed Designation - most likely associated with the Waihoihoi main stem, but that has not been concluded through any sample data. If so, then there are management options to minimise or avoid effects when the Waihoihoi main stem is realigned.

The new classification means that all NZ native fish other than short fin eel and common bully have a threat classification of some sort. I do not consider it is appropriate to identify any poor quality habitat with a record of the presence of any native fish as a high value stream, or even in the case of naturally uncommon taxa, a moderate value stream. The condition of the habitat and abundance of those fish species as well as the values associated with other species (macroinvertebrates etc) presence are averaged to arrive at a site value. With that in mind and that the NPS FM uses fish IBI scores as a measure, then in the following (Table 10) assessment I too use the IBI score rather than threat status, unless there is / was a threatened status fish species (nationally critical, endangered, vulnerable).

Table 11: lists the factors that have contributed to my assessment of freshwater ecology condition of streams impacted by the Indicative Alignment and representative of streams within the Proposed Designation. The condition scores are then converted to the "Negligible to Very High" rankings related to the EIANZ values determination in Table 11 to derive an average value (a feature can be of poor condition and high value and vice versa).

- Numerical ranking is reflected as very low to very high generally in clusters of 20 (i.e. <20 (or 0.2) very low, 20-40 low, 40-60 moderate, 60-80 high, >80 very high), poor reflects low, fair = moderate, good = high and excellent = very high.

- Taxa richness reflects comparison with a richness expected for a native unmodified stream state.

sums these values for each parameter and determines an average score for representativeness, rarity and distinctiveness, diversity and pattern, and ecological context (as per Table 7, Chapter 5 of the EIANZ guidance document). These feature values then determine the final overall ecological value which has been carried forward into the assessment of effects below.

While these values apply to the reaches where the data has been gathered, the observations of the other streams within the Proposed Designation suggest that the streams up and downstream of those intersected by the Indicative Alignment have the same or similar values and there are no obvious better or poorer reaches that require separate assessment.

I note that in regard to Piroa tributary east there are two potentially affected tributaries of similar size, length, flows, cover, setting etc. The eastern one was not initially likely to be affected by the Indicative Alignment and so I did not collect data in it, other than observational data. However, the eastern tributary is sufficiently similar in all habitat aspects that I assign it the same value and condition as the Piroa tributary west.

Table 10: Assessment of stream condition based on relevant metrics

	Pukekaroro tributary	Wairau north	Mayflower main	Mayflower north	Piroa main	Piroa tributary west	Pine mid	Pine north	Waipu south	Waipu north	Robertsons	Waihoihoi main
Stream ref #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
SEV hydraulic & biogeochemical function	0.86	0.48	0.55	0.3	0.86	0.85	0.86)	0.82	0.8	0.52	0.44	No data
SEV habitat provision	0.54	0.33	0.31	0.18	0.57	0.43	0.41	0.63	0.65	0.22	0.11	No data
NCR BioDiv condition score	0.468	0.19	0.215	0.18	0.32	0.45	0.285	0.36	0.328	0.243	0.235	0.264
RHA	45	19	40	17	52	62	60	54	59	59	18	28
NCR Biodiv ranking (rank mean)	0.91	0.333	0.38	0.46	0.88	0.77	0.25	0.86	0.76	0.86	0.31	0.73
WQ (NRC data and studies)	Good	Poor	Poor	Poor	Poor	Moderate	Moderate	Moderate	Moderate	Poor	Poor	Poor
Macroinvertebrate taxa richness	38	21	29	23	40	22	26	16	29	32	13	16
eDNA fish IBI (# taxa)	Moderate	Very low	Moderate	Low	Low	Low	Moderate	Low	Moderate	Low	Moderate	High
eDNA MCI	89	54	86	62	84	111	96	128	86	74	51	58
Dominant class	P	P	P	We	P	P	P	P	We	P	We	P
Fish passage function	Negligible	Low	Moderate	Negligible	Moderate	Negligible	Negligible	Moderate	Negligible	Negligible	Negligible	Very high
Position reach in catchment	Headwater	Upper	Upper	Headwater	Upper	Headwater	Headwater	Upper	Headwater	Headwater	Headwater	Lower
Ecosystem health (condition)	Moderate-high	Very poor	Poor	Very poor	Moderate	Moderate	Moderate	Moderate	Moderate	Poor-moderate	Very poor	Poor

Table 11: Assessment of ecological values based on relevant metrics (LF=long fin eel).

	Pukekaroro tributary	Wairau north	Mayflower main	Mayflower north	Piroa main	Piroa tributary west	Pine mid	Pine north	Waipu south	Waipu north	Robertsons	Waihoihoi main
Stream ref #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Representativeness	Moderate	low	moderate	Very low	Moderate	High	High	Moderate	Moderate	Low	Low	Moderate
SEV hydraulic & biogeochemical function	very high	moderate	moderate	Low	very high	very high	very high	very high	High	moderate	moderate	(moderate)
SEV habitat provision	moderate	low	low	very low	moderate	moderate	moderate	High	High	Low	low	(moderate)
NCR BioDiv condition score	moderate	Very low	low	Very low	low	moderate	low	low	low	low	low	low
RHA	Moderate	Very low	Moderate	Very low	Moderate	high	high	Moderate	Moderate	Moderate	Very low	low
eDNA fish IBI	Moderate	Low	Moderate	Low	Low	Low	Moderate	Low	Moderate	Low	Moderate	High
Rarity & distinctiveness	Moderate	Negligible	Moderate	Negligible	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Low	High
Rare habitat / distinctive	Moderate	Negligible	Moderate	Negligible	Moderate	High	Low	Low	Moderate	Moderate	Negligible	Moderate
Rare species	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High
Diversity & pattern	High	low	Moderate	low	Moderate	High	Moderate	Moderate	Moderate	Moderate	Very low	low
Fish species richness	Moderate	Very low	Moderate	Very low	Moderate	high	high	Moderate	Moderate	Moderate	Very low	low
Macroinvertebrate taxa richness	High	Assumed very low	Moderate	low	High	low	Moderate	low	Moderate	moderate	Very low	low
eDNA MCI	moderate	low	moderate	low	moderate	High	moderate	very high	moderate	low	low	low
Ecological Context	low	low	moderate	Very low	moderate	low	low	Moderate	low	low	low	High
Fish passage function	Negligible	Low	Moderate	Negligible	Moderate	Negligible	Negligible	Moderate	Negligible	Negligible	Negligible	Very high
Position reach in catchment	low	Moderate	Moderate	low	Moderate	low	low	Moderate	low	low	low	High
WQ (NRC condition rank	high	low	low	low	low	Moderate	Moderate	Moderate	Moderate	low	low	low
Ecosystem health (condition)	Moderate-high	Very poor	Poor	Very poor	Moderate	Moderate	Moderate	Moderate	Moderate	Poor-moderate	Very poor	Poor
Value conclusion	Moderate	low	Moderate	Negligible	Moderate	High	Moderate	Moderate	Moderate	Low	Low	High

3.3. Sufficient information

The ecological data necessary to manage effects on freshwater ecology is relatively low. Understanding effects on streams does not require extensive studies of water quality, spatially detailed macroinvertebrate data sets, extensive fish surveys or complex details of physical habitat. Instead, it is important that there is sufficient data to determine:

- if avoidance of any particular stream or wetland is paramount; and
- the quantum and condition of streams that are being affected to apply an appropriate quantity of mitigation measures in the correct locations.

This is also the case for natural inland wetlands. In my opinion, it is not critical to know the type and abundance of every species in every wetland. Instead, I consider that provided there is sufficient data to:

- classify whether a feature is a wetland, a natural wetland, a significant natural wetland and / or a natural inland wetland (NPS-FM and RPN definitions); and
- measure the quantum and condition / representativeness of the area affected;

This data will be sufficient to inform the assessment of effects and appropriate effects management approach. The nature of a particular natural inland wetland will also determine if special taxa are likely to be present, and whether these drive the need for more detailed surveys to be undertaken for those species to enable appropriate effects management (e.g. species such as mud fish or bittern).

Cryptic and low abundance taxa that are often also rare or have a high conservation status are likely to be missed in the absence of very detailed study. However, given the modified landscape in which all of these features exist, the chance of such species being present in these habitats under the existing land uses, is highly unlikely.

In light of the above, this assessment seeks to ensure there is sufficient information to:

- characterise the values and condition of streams and wetlands that may be affected by the Project;
- measure the nature and spatial extent of likely effects on those streams and wetlands based on the Indicative Alignment, as well as sensitivity testing for potential changes to alignment;
- determine if those effects will have an impact at the catchment level (i.e. the relevant freshwater spatial scale of this assessment);
- be sufficiently informed of fish passage requirements to determine where the Project must maintain fish passage; and
- establish the appropriate effects management response.

In my opinion, the data presented in Section 3 of this report supports the identification of the likely fish and macroinvertebrate present generally and is more useful than undertaking spot surveys at a particular location. For example, I do not consider it is necessary to undertake separate specific fish surveys at every site as these surveys only represent a moment in time and do not accurately reflect all of the fauna that is actually present in a particular location. Instead, I have used wider fish presence records, eDNA data, and field observed habitat connectivity and predict what species are likely present. This approach is more conservative than undertaking a national standard single pass electronic fish monitoring survey (as per Joy et al 2011), at each site, which often discover no or limited fish species in a particular location at that moment in time. Similarly, sampling of macroinvertebrate assemblages at a site merely provides a species list and some metrics in relation to these species. These samples only contribute a small part to the understandings of macroinvertebrate value of a feature or site, which I consider can be predicted with reasonably accuracy through eDNA without standard kick net / Surba surveys.

Accordingly, I consider Section 3 of this report appropriately characterises the existing environment to inform the assessment of effects and effects management recommendations in Sections 4 and 5 of this report.

4. Assessment of Effects on Freshwater Ecology

4.1. Overview

The Project may have the following potential construction and operational effects (direct and indirect) on freshwater (stream and wetland) ecosystems:

- Construction Effects:
  - Stream habitat quality reduction and loss related to:
    - Stream reclamation without replacement (loss)
    - Stream replacement (culverting and associated erosion control) resulting in reduced habitat quality
  - Stream realignment and diversion into a new constructed waterway:
  - New (realigned) streams in natural ground; and
  - New streams associated with spoil site reclamation of an original stream.
  - Stream reduction or loss due to groundwater changes from the Project earthworks (e.g. cut faces)
  - Wetland reclamation (infill for earthworks, structures and spoil)
  - Wetland reduction or loss due to groundwater changes from the Project earthworks
  - Contaminant discharges: sediment, concrete, and machinery fuels
  - Temporary stream disturbance and fish migration disturbance
  - Fish mortality
  - Aquatic biosecurity
- Operational Effects:
  - Stormwater runoff and hydrological change
  - Lighting
  - Fish passage and potential wider habitat fragmentation

4.1.1. Project construction and design assumptions

My assessment is informed by the following assumptions:

- I have assumed a construction area generally within the footprint of the Indicative Alignment, with additional haul roads and spoil sites and access requirements.
- I have assumed that realigned streams in natural ground will have a similar length and the same or better morphology as the impacted stream (and so have the same hydrology).
- The size of culverts and their exact location may change as a result of detailed design. However, I have assumed that culverts will generally be sized and installed to meet the NES-FW (Regulation 70) culvert requirements related to gradient, width as that relates to the natural channel and invert level.
- I have assumed that approximately 10m downstream and 5m upstream of erosion control (e.g. rock riprap) will be installed instream at each stormwater discharge locations and culvert inlet and outlet.

4.1.2. Effects addressed by standard management measures

I consider the following freshwater ecology effects will be appropriately avoided or minimised through standard management practices so that the effect will be ‘less than minor’:

- Contaminant discharges: NZTA will implement:
  - Standard protections against discharges from refuelling.
- Temporary stream disturbances (particularly construction access over streams requiring temporary culvert installation and removal):
  - Any culverting in the Waihoihoi main stem to be avoided where practicable.
  - Where a haul road needs to cross a stream, a temporary bridge or culvert will be installed. The temporary bridge or culvert will be extracted following the completion of the relevant construction

works and the site left as it was found (which might include replacing substrate and replacing riparian vegetation).

- Any temporary culvert that is instream for longer than two weeks in a fish migration period will facilitate fish passage.

- Fish mortality:
  - All instream works (temporary or otherwise) that could harm fish (diversions, dewatering or any other physical disturbances) will require (1) fish salvage and transfer and (2) fish exclusion prior to those works commencing.
- Aquatic biosecurity:
  - All machinery coming on to site or moving to different catchments within the site must undergo standard cleaning and checking processes for freshwater pests.
- Stormwater management and retention of flow hydrology:
  - The stormwater system (post construction) will collect, convey, and treat road run-off such that receiving habitats (wetlands and streams) will receive treated water. At the discharge point, the water quality will be no worse than current and the flow rates will be the same or similar to pre-construction.
- Lighting:
  - Any lighting will be minimal and orientated downwards (subject to complying with road safety requirements).

4.2. Effects on Streams

4.2.1. Hypothetical worst-case impacts on stream habitat (prior to realignment and culverting)

The stream habitat that will be impacted by the Indicative Alignment is shown in Table 12 below. This table divides the different streams into their respective catchments and their classification (perennial or intermittent) and shows the amount of stream that will be affected in kilometres.

Table 12 below *does not show stream loss* as most of the impacted waterways will be culverted or realigned and therefore will not be 'lost'. The purpose of Table 12 is to allow consideration of the proportion of the catchments that are affected by the Project.

In total, approximately 5.7 km of perennial stream and 5 km of intermittent stream are affected by the Indicative Alignment, including spoil sites. (some 11 km of stream aquatic habitat in total).

Most of the impacted streams are smaller headwater streams as is indicated by REC mapping (NIWA). REC class 1 (first order stream) is the most affected (46% of the impacted streams), and REC class 2 (second order stream) is the second most affected (26% of impacted streams).

Table 12: Stream length (km) impacted by the Indicative Alignment, relative to the total catchment stream length, prior to realignment and culverting.

Overall length of stream affected by the Indicative Alignment (km)				
Stream	Perennial	Intermittent	Total	Proportion of stream length in catchment affected (%)
Ahuroa- Waipū catchment	107.32	232.17	339.48	0.94%
Pine North Tributary	0.5	0.33	0.84	0.25%
Pine Mid Tributary	0.4	0.82	1.22	0.36%
Piroa Tributary East	0.29	0.07	0.36	0.10%
Piroa Tributary West	0.31		0.31	0.09%
Piroa Main Stem	0.26	0.21	0.47	0.14%

Overall length of stream affected by the Indicative Alignment (km)				
Stream	**Perennial**	**Intermittent**	**Total**	**Proportion of stream length in catchment affected (%)**
Catchment total			*3.2*	
Waihoihoi- Waipū catchment	84.46	179.98	264.4	1.0%
Robertson's Tributary	0.09	0.45	0.54	0.2%
Waihoihoi Main Stem	0.78		0.78	0.3%
Waipu North Tributary	0.21	0.08	0.29	0.11%
Waipu South Tributary		1.09	1.09	0.41%
Catchment total			*2.7*	
Wairau catchment	45.59	65.48	111.07	3.6%
Mayflower Main Stem	0.56	0.03	0.59	0.53%
Mayflower North Tributary	0.52	0.08	0.528	0.48%
Wairau North Tributary	0.26	0.77	1.03	0.93%
Wairau South Tributary	0.81	1.06	1.87	1.7%
Catchment total			*4.0*	
Pukekaroro catchment	51.19	107.23	158.42	0.65%
Pukekaroro Tributary	0.86	0.16	1.03	0.65%
Total stream length affected	**5.78**	**5.05**	**10.93**	

Note: Piroa Tributary East and Wairau South were not surveyed, but as explained in Section 3.2.4 above I consider these streams have the same values and condition as Piroa Tributary West and Wairau North respectively. The Ahuroa Main Stem was not surveyed given it will not be affected by the Project.

Table 13 below presents a hypothetical potential maximum effect of the Project in the absence of any culvert design requirements or realignment.

Table 13 presents the values assigned to each stream (as detailed in Table 10), the corresponding magnitude of effect (based on the proportion of stream length affected set out in Table 12 and the proportions outlined in the methodology on magnitude) and, finally, the overall level of impact (prior to any effects management) determined in accordance with the EIANZ matrix.

Table 13: Level of stream effect based on value and magnitude of the effect.

Affected streams	Value	Magnitude of potential stream loss	Level of effect
Pine north	Moderate	Negligible	Very Low
Pine mid	Moderate	Negligible	Very Low
Piroa west tributary	High	Negligible**	Very Low
Piroa main	Moderate	Negligible	Very Low
Waihoihoi main***	High	Negligible	Very Low
Robertsons	Low	Negligible	Very Low
Waipu north	Low	Negligible	Very Low
Waipu south	Moderate	Negligible	Very Low
Mayflower north	Negligible	Negligible	Very Low
Mayflower main	Moderate	Negligible	Very Low
Wairau north	Low	Negligible	Very Low
Wairau South	Low	Low	Very Low
Pukekaroro tributary	Moderate	Negligible	Very Low

*** There is an argument to be made for the Piroa west tributary that because the state (native vegetated relatively unmodified stream) is more poorly represented in the Ahuroa catchment - due to historic land uses, the use of the* *catchment as the spatial scale for magnitude for these streams is not sufficiently representative. However, native forested headwater streams in the catchment amount to some 30 km (approximately). At that scale the magnitude of effect would be 1.4% or low and a high value system receiving a low level of effect is a low magnitude of effect. That level of effect is perhaps still in the less minor range rather than minor.*

***** This assessment is based on the short section under the works affected being realigned with high quality habitat.*

4.2.2. Hypothetical worst case cumulative effects on stream habitat in each catchment

To understand the hypothetical worst case cumulative effects, in Table 14, I:

- Characterise the catchments as generally being of moderate value overall. This moderate value classification applies even while upper catchment areas are typically forested, whether in exotic or native species; and
- Sum the length of individual streams effects to present the total stream loss as a percentage of the catchment; and
- Present the overall level of impact.

Given the relatively short stream lengths affected as compared to the amount of stream in each catchment and the condition of those typically smaller headwater reaches, I do not consider that there is an accumulation of effects across any one of the four catchments impacted. That is, the effects remain Very Low to Low when considered cumulatively across each catchment.

Table 14: Cumulative effect of stream loss in each catchment

Affected Catchments	Value	Magnitude of change	Level of the accumulated effect
Ahuroa	Moderate	Negligible	Very Low
Waihoihoi	Moderate	Low	Low
Wairau	Moderate	Low	Low
Pukekaroro	Moderate	Negligible	Very Low

4.2.3. Impact of Project on stream extent

The Project will only result in stream reclamation and therefore loss of stream extent where a section of impacted stream is not replaced by the same length of realigned stream or culvert. The installation of a culvert or creation of a realigned stream does not result in loss of stream extent (assuming the length of the culvert or realigned stream matches the length of impacted stream), as the stream continues to flow - albeit in a modified manner or slightly different location.

Table 15 below sets out (for the Indicative Alignment):

- the length of stream impacted by the Project;
- the length of culverts that will be created; and
- the length of realigned streams that will be created (either in natural ground or assuming successful spoil site realignment).

Where the length of realigned stream and culvert equals the length of stream impacted, there will be a neutral outcome with respect to extent (i.e. area) of stream habitat.

As shown in Table 15, across the Indicative Alignment and the four catchments impacted, the total extent of stream loss is calculated to be 554 m. I consider 554 m of stream loss to be a negligible change accepting that culvert in pipe habitat is poorer in general than open channel habitat, whether taken as a whole or broken down into each of the four catchments intersected by the Indicative Alignment. There is a caveat to that extent which is addressed in the last row of Table 15 related to the success of the realignments of streams affected by spoil sites. The last row indicates a ‘worst case’ outcome on the basis all stream realignments in spoil were unsuccessful. I address my recommended approach to spoil site realignments later in this report.

Table 15: Impact of Project on stream length after realignment and culverting

Stream affected	Length of stream affected (m)	Realignment in spoil (m)	Culvert length (m)	Realignment in natural ground (m)	Length of stream loss (m)
Pine Mid Tributary					
Under earthworks	330		330		0
Under spoil or borrow	880	880			0
Pine North Tributary					0
Under earthworks	700		370		-330
Under spoil or borrow	130	130			0
Piroa East Tributary					0
Under earthworks	290		220		-70
Piroa Main Stem					0
Under earthworks	470		220		-40
Piroa western Tributary					0
Under earthworks	310		265		-45
Robertson's Tributary					0
Under earthworks	88		80		-8
Length required to be diverted	450			500	50
Waihoihoi Main Stem					0
Under earthworks	160				-160
Realignment	620			930	190
Waipu North Tributary					0
Under earthworks	290		175		-115
Waipu South Tributary					0
Under earthworks	300		185		
Under spoil or borrow	780	760			-20
Mayflower Main Stem					0
Under earthworks	460		270	650	0
Under spoil or borrow	120	120			0
Mayflower North Tributary					0
Under earthworks, or because of diversion	520		380		-140
Wairau North Tributary					0
Under earthworks	160		152	30	82
Under spoil or borrow	870	870			0
Wairau South					
Under earthworks	200		200		0
Under spoil	1670	1670			0
Pukekaroro Tributary					0
Under earthworks	1003		530	400	30
Total resultant change in **stream length across the Indicative Alignment**					-554
Total **change in stream length if the spoil site realignments are not successful**					-4984

4.2.4. Impact of realignment on stream values

The Indicative Alignment includes stream realignment as set out in Table 15 above and shown in the Stormwater Drawings in Volume A, Appendix D.

The realigned streams can be designed to ensure they have the same value as the impacted streams they are replacing ('like for like'). Importantly, stream realignment must be implemented in the immediate vicinity of the impacted stream (as it must connect A and B) and will therefore traverse a similar landscape and environmental context.

While there will be a small lag time while benthic fauna, periphyton and macrophytes reestablish, my experience with a number of such realignments is that that the lag time (recovery) is around 6 months to a year. In my opinion that temporary effect is less than minor. As set out above, this assessment also assumes fish salvage has occurred prior to diversion of water from the impacted stream to the realigned stream.

To minimise effects on freshwater values, I recommend that where practicable, a stream realignment should meet the following design requirements (compared to the impacted stream):

- The same channel morphology, depths, and wetted width potentials (i.e. the same bed and bank dimensions);
- Similar surface flows and depths;
- The same or similar velocity profile;
- A similar riparian condition; and
- A similar substrate.

Provided those design requirements are met, I consider a stream realignment will have at least reduced effect and often no effect on stream values.

If those design requirements cannot be met in a particular perennial stream, then I consider there will be a residual effect. However, this residual effect will be less than minor because even without remedial action the level of effect of loss of these waterways based on their values and the magnitude of the streams affected is very low (less than minor) in each catchment.

4.2.5. Impact of culverting on stream values

The Indicative Alignment includes the culverts set out in Table 15 above and shown in the Stormwater Drawings in Volume A, Appendix D.

The installation of a culvert decreases the habitat value by reducing the habitat quality and changing the benthos to a strictly detritivore community and so the carrying capacity of the reach can be reduced. The magnitude of that effect can be minimised through the design of the culvert. To minimise the effect of culverts on freshwater values, I recommend that where practicable, the culverts are designed to provide:

- Benthic habitat (through in-pipe substrate retention);
- The same or similar velocity as the impacted stream under typical flow conditions; and
- Accessible inlet and outlet structures for climbing fish species.

Culverting a stream also requires erosion control (such as armouring) at the ends which increases the length of effect. That armouring and the size and installation of a culvert are the fundamental aspects that influence in pipe velocities as compared to the natural stream and therefore impact fish passage and in pipe habitat (including then substrate).

Nevertheless, culverts do provide some habitat and therefore retain some stream values. Recent studies show that culverts develop and retain aquatic life (James 2020, Neale and Moffett, 2016; Hintz *et al.*, 2022).

Table 16 compares the SEV scores of the impacted streams (assuming my recommendations regarding design can be satisfied) with the expected SEV scores of the culverts (based on other project modelling expectations) to demonstrate the retention of value resulting from culverting. It identifies the proportion of the original SEV that would remain following installation of the culvert (i.e. the magnitude of change).

Table 16: SEV score change with culverting and expected retention of aquatic habitat values.

Length of stream affected (km)	SEV pre works	SEV following installation of culvert with natural bed	Proportion of SEV retained
Pine Mid Tributary*	0.71	0.3	42%
Pine North Tributary	0.75	0.3	40%
Piroa Main Stem	0.76	0.3	39%
Piroa western Tributary*	0.61	0.3	49%
Robertson's Tributary	0.33	0.3	91%
Waipu North Tributary*	0.42	0.3	71%
Waipu South Tributary*	0.75	0.3	40%
Mayflower Main Stem	0.47	0.3	64%
Mayflower North Tributary	0.26	0.3	100%
Wairau North Tributary	0.43	0.3	70%
Pukekaroro Tributary	0.75	0.3	40%

** Streams where recommendation concerning in-pipe substrate may be unable to be achieved due to gradient.*

For streams with a higher SEV, the installation of a culvert (in accordance with my recommendations regarding design) will reduce the SEV by up to around 60%. For streams with a lower SEV, the installation of a culvert will cause little or no reduction in the SEV.

If my recommendations regarding design cannot be satisfied, in particular the retention of in-pipe substrate and same or similar velocities, then the aquatic habitat value in the culvert will be much less. In that scenario, I consider the culvert length should be considered a stream loss.

As Table 12 shows, even if all culverts cannot satisfy my design recommendations, the level of effect of the stream loss from culverting would remain less than minor ((very low (Table 13)) in the streams in each of the catchments, but the minimisation of habitat loss through better culvert design is good practice where it can be achieved.

4.2.6. Fish passage interruption

Permanent culverts may impact the ability of migrating native fish species to move upstream (and adults downstream) depending on the type of culvert installed, the topography and hydrology of the stream, and upstream fish presence. Downward migrating species face less challenges where streams are replaced by culverts (if any at all).

Most of the streams at or near the Indicative Alignment fall downstream in steps through small waterfalls and cascades between generally flat sections with pools, runs and riffles (until on the Ahuroa-Waihoihoi lowlands). Fish must negotiate these frequent but small steps with rest places in-between. The higher in the catchment, the more natural challenge to fish passage is present and fish species diminish to reflect only the best climbing species. There are, on occasions, extreme passage challenges naturally such as very large (high) waterfalls (like Piroa falls) or very steep headwater sections with a long series of falls but interspersed with pools above which have no fish populations.

The installation of a culvert creates one long, uninterrupted and uniform route that fish must pass. In hill country, these culverts are often steep creating higher velocity and limited rest areas. There are no rest places between climb efforts in a culvert (without good baffles or a natural substrate allowed to mould with water flow), and a uniform (usually fast) water flow, even where the culvert seeks to mimic the natural gradient of a stream.

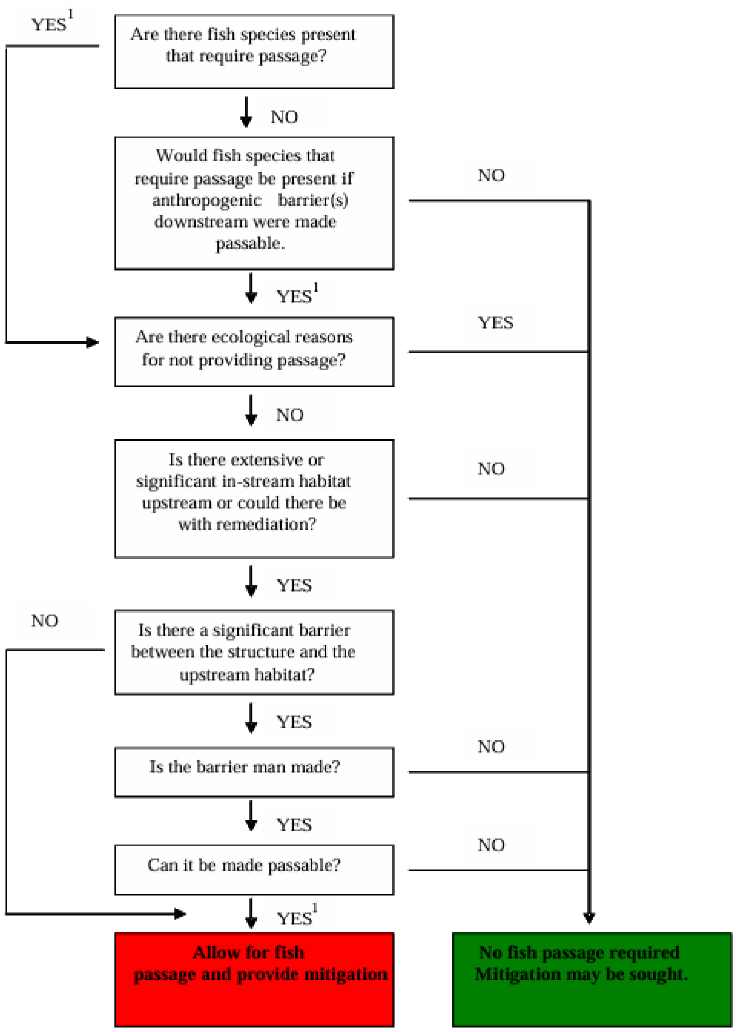
Such habitat can make it difficult for fish to pass, depending on the water velocity and volume, whether the culvert has in pipe assistance structures (baffles, substrate) and the nature of the entrance and exit to the culvert (i.e. headwall design and level of invert). Design features that avoid exacerbating these factors (such as those in Regulation 70 in the NES-FW) help mitigate these issues.

Most of the Indicative Alignment intersects with streams in headwater habitats near the upper end of the stream's catchments.[9]

These habitats are located on sections that are the steepest, furthest from the sea, and have the shortest (smallest) area of habitat up stream (**Appendix B**). They also have the smallest sub-catchment areas and the least amount of water. As a result, the amount of fish habitat potentially lost through absence of passage is small, as only small numbers of fish and a limited amount of viable fish habitat would be affected. For example, at Waipu South (**Appendix B**), there is only about 10 m of pool habitat above the upper extent of the Indicative Alignment, which currently supports a limited banded kōkopu population (only 3 individuals observed). In the Waipu north (**Appendix B**) there is about 150 m up stream of which perhaps half is suitable fish habitat (limited by the depths of water). There is no habitat above the Pine mid tributary, and about 10m of perennial habitat above the Piroa west tributary. Fish passage is recommended in the Pine north tributary as there is a reasonable extent of suitable habitat above that culvert.

Auckland Council's Fish Passage in the Auckland Region (Council, 2009) provides a flow diagram to guide whether fish passage should be provided, as shown in Figure 7 below.

Flow diagram to assist in assessing whether fish passage is required.



[1]Note: In the case of multi-barrier situations, a catch and truck system located at the lowest barrier can be used to transfer fish upstream of the uppermost barrier.

Figure 7: Auckland Council guidance flow diagram to determine if fish passage should be provided

[9] For example, Waipu North and South, Pine Mid, Piroa West tributary, Mayflower North, Mayflower main stem, and Pukekaroro tributary.

The eDNA data collected at each perennial stream that intersects with the Indicative Alignment indicates the presence of short fin eel, and often also long fin eel and banded kōkopu, at and upstream of these intersections. These three taxa are also the most frequently surveyed in the Auckland Region (Council, 2009) and the Northland Region (Monitoring reports 2020-2023). All three are known to be good climbers (McDowall, 1993), capable of navigating steep and fast-flowing water environments, which explains their widespread presence.

Applying the flow diagram set out above:

1. *Are there fish species present that require passage?* Yes, at all streams that intersect with the Indicative Alignment.
2. *Is there an ecological reason for restricting passage (e.g. to protect a vulnerable native species up stream)?* No such reason has been identified at any of the sites.
3. *Is there extensive or significant instream habitat upstream, or could there be with remediation?* For most streams that intersect with the Indicative Alignment (excluding the Waihoihoi, Piroa main stem, and possibly the Mayflower tributary main stem and the Wairau north tributary), the answer is no, there is not. There is little, if any, stable or high-quality fish habitat upstream.

According to Auckland Council's guidance document, if the third question is answered "no", fish passage is generally not required. I consider that outcome is appropriate at most streams that will be culverted for the Project, as most affected headwater sections are intermittent and offer limited, poor quality fish habitat upstream or have existing barriers (including the current severe barrier presented by the current SH1 batter).

4.2.7. Fish passage effects in the Waihoihoi main stem, the Piroa main stem, the Mayflower tributary main stem, and the Wairau north tributary

Based on the flow diagram set out above, I consider fish passage should be provided for the Waihoihoi main stem, the Piroa main stem, the Mayflower tributary main stem, and the Wairau north tributary. These streams are all located in relatively flat, lower reaches of the catchment and will not require special devices (where the crossing is via a culvert) - only adherence to the requirements of Regulation 70 of the NES-FW to maintain appropriate velocities, depths, wetted widths (in culvert) and grade alignment with a natural substrate stream bed.

I also recommend that the Pine North tributary should enable fish passage equivalent to the current (a steeper landform than the above culvert locations) as there is a reasonable amount of fish habitat of a suitable quality upstream even though the eDNA data does not suggest a rich fish fauna.

For these streams, if fish passage was not provided, it will result in the loss of habitat for a high value (long fin eel population) or moderate value (at risk uncommon species). The magnitude of effect would be negligible in all, but the Waihoihoi main stem where it would be high. The overall impact to all except the Waihoihoi main stem would be a very low (less than minor) effect. The effect of cessation of fish passage in the Waihoihoi main stem, however, would be high and is sufficiently important as to be a driver for avoidance of that effect (i.e. a high level of effect in EIANZ terms and so a significant adverse effect in RMA terms).

Fish passage effects in other locations

Even in the locations where the Auckland Council guidance document indicates fish passage is not required, the stormwater designers should not actively design against fish passage. I consider the following design requirements (based on the NES-FW) should still be applied:

- culverts do not reduce the natural stream width (which would increase water velocity);
- the culvert invert (culvert bed) is set below the natural bed level; and
- the headwalls and armouring do not impede the wetted width or water depth at the culvert entrance and exit.

While specific fish passage enhancements are not required in those locations, the installation of flexi baffles or similar devices is a low-cost, simple mitigation to address velocity and provide resting areas within culverts. They would also help retain the substrates recommended to be in the culvert beds.

Four culverts, as designed currently, have gradients over 10%, at which slope substrates may not be retained in the bed, and downstream erosion defences may be more aggressive. Those factors create challenge to upward migrating fish because of surface texture, steepness and water velocity. These steeper culverts are the road culvert in Waipu north and Waipu South, the Pine mid tributary and the Piroa west tributary. For reasons described earlier I am not concerned for fish passage in these streams. Firstly, neither the Waipu north or south tributaries have much fish habitat up stream and the species present (banded kokopu and eel) are the most likely to still pass such gradients. With respect to the Pine mid tributary most of the upstream habitat is removed by spoil for the Project and is ephemeral and intermittent in the main. Likewise, the Piroa west tributary only has a small area of viable fish habitat above the culvert area and that space is reduced by the Project's drawdown effects and spoil deposition.

Indeed, all of the streams not identified as requiring fish passage have relatively small habitat areas up stream (especially after the project actions) and / or small and often single species representation. The loss of these small and often intermittent habitat reaches from one or two fish taxa (long fin eel and banded kokopu) will only cause a very low (less than minor) level of effect (based on a High (if a population) value for long fin eel or moderate value (At Risk uncommon species) and a negligible magnitude (reflecting the small amount of habitat up stream available in the catchment)) of effect.

4.2.8. Fish passage in culverts intersecting ephemeral flow paths

I note that many other culverts in the Indicative Alignment only intersect ephemeral flow paths with no upstream aquatic habitat. These culverts do not require fish passage or any further aquatic effects management (aside from ensuring appropriate hydrological connectivity to the correct sub catchments).

4.2.9. Sedimentation effects

The freshwater habitats in the Proposed Designation already experience seasonally high levels of sedimentation (with the resulting impacts seen in the SEV data and RHA scoring presented in Section 3). In this context, sediment discharges from construction works will commonly have a low impact. Nevertheless, NZTA will implement good practice erosion and sediment control measures.

Mr Ridley (Table 17) assesses the likely sediment discharge arising from earthworks (with erosion and sediment control measures) for the Project in the Construction Water Assessment (Appendix D10 of Volume B). He predicts the following changes in in stream sediment levels:

Table 17: Sediment yields by catchment and difference in each catchment related of works from the Construction Water Assessment (Appendix D10 of Volume B)

Catchment	Catchment Area (ha)	Catchment Wide Sediment Yield (tonnes) Without Project	Catchment Wide Sediment Yield (tonnes) with Project	Project Sediment Yield Contribution (%)
Waihoihoi	6521	19,563	20,505.50	4.60
Ahuroa	8505	25,515	27,897.20	8.54
Wairau	2731	8,193	9,794.10	16.35
Pukekaroro	3773	11,319	11,509.90	1.66

I consider the low levels of additional sediment yield predicted in the Pukekaroro and Waihoihoi are not of concern ecologically, especially given the existing environments.

The sediment yield received by the Pine tributaries in the Ahuroa catchment will also be raised and those tributaries have good (high MCI) macroinvertebrate communities prior to any pine harvest. However, during the 7 years of stream monitoring for the NZTA's Transmission Gully, I found that the Te Puka and Horokiri streams (which received relatively high levels of earthwork sediments over five of those years) retained their significant macroinvertebrate (and fish) communities through time. While there were occasional temporary abundance changes, the communities all persisted and recovered. I expect the same outcome for the Pine tributaries under the predicted sediment discharge.

The Wairau catchment has a more significant predicted increase in sediment discharge. The Wairau North stream data shows the impacted tributaries to be generally poor quality with macroinvertebrate communities reflective of soft sediment poor water quality already (MCI 89, fish IBI very low, SEV habitat provision 0.3, NC condition indices 0.19). However, I consider a 16% rise in sediment yield could still bury the assemblages in these tributaries. At least over the life of the earthworks in that catchment, the sediment discharge could damage the instream fauna and habitat downstream could be degraded.

While I do not consider that the effect in the Wairau tributaries would be substantive or lasting, I do, because the additional sediment yield is unusually high, recommend that a monitoring programme be established. The monitoring programme should measure discharge from the site controls to any freshwater system downstream such that a known amount of sediment in terms of suspended sediment is recorded. I recommend a trigger level be set (such as 500 NTU discharge in any perennial or intermittent tributary) which triggers instream ecological assessment through deposited sediment measures (SAM2 and 6 (Clapcott et al 2011)) to ascertain the levels of sedimentation and so potential effect on the benthic communities. That measure would need to be assessed against the current (base) measure. Those measuring sites would need to be established prior to the works and a base line measure taken (using SAM 2 and 6 and a benthic macroinvertebrate set of samples) and be in areas of the streams not currently deep in sediment – i.e. riffles.

The additions will need to be confirmed through on-site earthworks monitoring.

4.2.10. Sensitivity testing

At a catchment scale the effects of the Project on streams are sufficiently minor as to have a very low level of effect. Nevertheless, in my opinion, the impact of the Project on stream extent and values and fish passage can be minimised as set out above. Regardless of the final alignment, my assessment will remain the same provided that fish passage is provided for any stream crossings within the Waihoihoi or Ahuroa streams.

I note that the streams in the Brynderwyn pine forest (Pine North and Pine Mid) will reduce in value at harvest of those pine forests (which I understand is a permitted activity). Forest harvest will result in substantive sediment discharge and woody debris (slash) introduction to those small headwater tributaries. Therefore, if the earthworks for the Project occur after the harvest of those pine forests, the effects of the Project will be less than assessed in this report because the values in streams may be substantively different.

4.3. Effects on Natural Inland Wetlands

4.3.1. Effect of Indicative Alignment on each natural inland wetland

Table 18 shows the area of natural inland wetland within each catchment affected by the Indicative Alignment, which has been determined using GIS analysis following field work.

For each catchment, the total recorded or known area of natural inland wetland is used as the baseline (see

Table 18). As explained earlier, due to a lack of data, this baseline is very likely to underestimate the true extent of natural inland wetlands within each catchment. As a result, the proportion of natural inland wetlands affected by the Project that I have presented in my assessment is very conservative and is highly likely to be lower if all natural inland wetlands were included in the baseline.

As there are no natural inland wetlands in the Pukekaroro catchment, it is not addressed in

Table 18.

Table 18: Natural inland wetland areas (m^2) impacted by works assocated with the Indicative Alignment derived from the surveyed wetland data set

Wetland impacted by Indicative Alignment	Wetland impacted in Ahuroa catchment	Wetland impacted in Waihoihoi catchment	Wetland impacted in Wairau catchment	Effect as a Proportion (%) of known wetlands in catchment
2		2500		3.0%
3		600		0.71%
4		2700		3.2%
11		2000		2.4%
12 s		3600		4.3%
13		2700		3.2%
14 s		5000		5.9%
20	400		100	0.28%
21			100	0.28%
23			298	0.83%
24			10500	29.4%
Total sum affected (m^2)	400	19100	10998	
Sum of known natural inland wetlands in catchment	**51717**	**84326**	**35715**	
Proportion of natural inland wetlands in catchment affected	0.8%	22.6%	30.7%	

Based on the ecosystem health and value of each wetland and the proportion of the base resource affected in each catchment, I assess the impacts of the Indicative Alignment on each affected natural inland wetland as follows (Table 19):

Table 19: Level of effect of wetland change based on value and magnitude of change

Wetland #	Condition	Value	Magnitude of effect	Level of effect
Waihoihoi				
2	Poor (exotic)	Low	Low	Very Low
3	Poor (exotic)	Negligible	Negligible	Very Low
4	Poor (exotic)	Negligible	Low	Very Low
11	Poor (exotic)	Negligible	Low	Very Low
12	Poor (exotic)	Low	Low	Very Low
13	Poor (exotic)	Low	Low	Very Low
14	Poor (exotic)	Negligible	Low	Very Low
Wairau				

Wetland #	Condition	Value	Magnitude of effect	Level of effect
20	Poor (exotic)	Low	Negligible	Very Low
21	Poor (mixed)	Low	Low	Very Low
23	Poor (exotic)	Negligible	Negligible	Very Low
24	Fair	High	High	High

Wetland 24 (the Wairau south gully raupō and willow wetland) is the only feature of notable size and representativeness, with mostly indigenous vegetation cover (mainly raupō), impacted by the Indicative Alignment. Design adjustments have reduced the area of Wetland 24 impacted by the Indicative Alignment to around 1 ha so that 2/3 of the wetland is not impacted by the Indicative Alignment. Nevertheless, I consider the level of effect remains high (more than minor) and warrants effects management as discussed in Section 5.

In addition, I have considered the potential for a (hypothetical) change to the nutrient flow pattern downstream into the remainder of Wetland 24 following the Project if there are farm discharges from the reclaimed land (depending on what the post spoil reclamation land is used for). That is, the remainder of Wetland 24 (raupō wetland) will receive the upper catchments hydrology, post Project works, as a point source discharge through the road culvert without the benefit of raupō filtration that is currently present in the 1ha of wetland 24 that will be lost. However, I consider that effect is unlikely to eventuate. The current upper end of Wetland 24 currently receives that same farm input with some but minimal filtration, so most of the runoff currently enters the wetland as an upper gully point source. Yet the upper end of Wetland 24 is present and as healthy as the rest of the wetland.

The other natural inland wetlands affected by the Project are of negligible or low ecological value (including because they are not indigenous assemblages) and the level of effect is very low. These areas are essentially wet pasture areas, without any distinctive wetland functions or indigenous habitat values.

4.3.2. Cumulative effects to the amount of wetland habitat

I have also considered the cumulative effects of impacts on natural inland wetlands across the three catchments including their hydrological functional role (based on accumulative size). I have characterised the wetlands within each of the catchments as generally being of low to negligible ecological value overall based on the condition and value of the individual wetlands noted above. As set out in Table 20 below, I consider the cumulative effects to be very low to low.

Table 20: Cumulative effect of wetland loss in each catchment

Affected Catchment	Value of wetlands in catchment	Magnitude of change to wetlands in catchment	Hydrological functional loss	Level of the cumulative effect
Waihoihoi	Negligible	Moderate	Negligible	Very Low
Wairau	Low	High	Low	Low

If the cumulative effects of impacts on natural inland wetlands were considered at the Ecological District level (instead of catchment level), I consider the loss of the negligible to low value (and primarily exotic induced) wetlands would result in very low to low cumulative effects.

4.3.3. Sensitivity testing

If all of Wetland 24 was impacted by the final alignment (rather than just 1/3) the impact would still be moderate, but the required extent of effects management would change as detailed in Section 5 below.

Wetlands 8 and 16 share similar characteristics and values to Wetland 24. Those wetlands are within the Proposed Designation but are not impacted by the Indicative Alignment. However, if changes to the alignment were to result in substantive portions (i.e. greater than 10%) of either of Wetlands 8 and 16 being impacted by the Project, then the level of effect on those wetlands would be High and would require similar effects management as detailed in Section 5 below.

4.4. Potential groundwater drawdown effects on streams and wetlands

There is a potential risk that large scale earthwork cuts (at four areas: Pukekaroro ridge, the Brynderwyn Hills, the Mayflower ridge and the Southern Waipu hills) could change the water tables (ground water) at and about those areas and potentially decrease groundwater seepage to natural inland wetlands and streams.

Mrs Soltau has modelled the potential groundwater drawdown associated with the three large cut areas in the Assessment of Effects on Groundwater (Appendix D12 of Volume B of the Substantive Application). She concludes that extensive groundwater drawdown may occur where cuts are made below the groundwater table and groundwater drainage is required in the construction phase. The groundwater drawdown could be temporary.

Most of the streams and wetlands in the Proposed Designation and surrounding area receive water from both rainfall runoff and groundwater seepage. In the summer period (when rain is less common) wetlands and streams become drier where groundwater does not support the near surface or surface flows. Where it does, the groundwater base flow drives the retention of a range of species or the feature itself through the dry period.

Most of the water abstracted by the Project's permanent drainage system will be diverted to stormwater treatment systems and after that, discharged into nearby surface water downstream of the Indicative Alignment. This approach means that the lower-lying streams and wetlands near the Project will continue to receive the water that would have previously flowed in via groundwater seepage.

However, wetlands and streams that are more proximate to the large cuts may be impacted by a reduction of groundwater inflows caused by the depression of ground water by the deep cuts. Such water depression, where it was atypical through seasons, could result in perennial stream reaches becoming intermittent and intermittent stream reaches taking on the characteristics of ephemeral flow paths. Wetland areas could be diminished in extent.

The modelling undertaken by WSP illustrates the amount of groundwater drawdown predicted, with moderate drawdown being 15-30% of the base flow, high drawdown being 30-80% of the base flow and very high drawdown being >80% of the base flow. The modelled drawdown at intermittent and perennial streams and natural inland wetlands is:

- *North of the Brynderwyn Hills (Wairau north and south tributaries and Wetlands 3-18):* The predicted drawdown at these tributaries and wetlands is generally minor or outside the prediction zone. There are high to very high drawdown predictions in the headwater areas, but in those locations the streams present are already ephemeral or else already under road works. I note wetlands 8 and 16 are outside of the modelled effect distances and note that they are also somewhat independent of these catchments inflows.

South of the Brynderwyn Hills (Piroa tributary, Pine South and Pine Mid, no wetlands in this area)(chainage 1900-2000): Very high predicted drawdown at Piroa tributary and Pine South. Moderate predicted drawdown at Pine Mid. The impact of the predicted drawdown at the Piroa west tributary (very high (Figure 4 of the Assessment of Effects on Groundwater (Appendix D12 of Volume B of the Substantive Application)) is muted by the stream being culverted at about the point of the cut and major draw down. The reach in the culvert will be reliant on surface water from upstream rather than ground water as it will be separated from the ground water. Further upstream, the modelling predicts a very high drawdown of 25m of perennial stream and 400m of intermittent stream in two branches further upstream. As there are minimal fish this high in the catchment, there would be little impact from the perennial reach becoming more intermittent and no or little impact from the intermittent sections becoming more ephemeral, other than some potential loss in abundance of some particular macroinvertebrate taxa.

  - The Pine South tributary is largely ephemeral with a small area of intermittent stream. The macroinvertebrate communities present are already adapted to variable water present year to year. Accordingly, I do not consider it is likely that a measurable change in macroinvertebrate assemblage will occur.

- At Pine Mid the modelling predicts moderate drawdown over around 300m of the perennial stream and around 300m of largely intermittent headwater. The drawdown may mean the perennial section moves more towards intermittency and the intermittent upper reaches become closer to ephemeral channel. Given the extent of the predicted draw down and the existing state of the stream (moderate value based on macroinvertebrate assemblages) I do not consider this effect (if it occurs) to be substantive, rather it will be a low level – minor effect. Nevertheless, here some monitoring of the extent and level of draw down in the perennial and intermittent reaches should be undertaken to see if the modelling was accurate. If so, then remedy or offset could be considered if an effect is observed.
- *Mayflower Ridge (Mayflower North tributary, Wetland 20 and Wetland Q08/066):* Very high to negligible draw down at the Mayflower North tributary. Very high predicted drawdown at the western gully arms of Wetland Q08/066

The Mayflower North tributary affected by the very high drawn down is largely ephemeral and wetland 20 (also affected) is a very small low value exotic “farm” wetland. Those effects (a drying possibly to remove the wetland status, but more likely to shift the wetland from FACW to FAC wetland) would be a less than minor adverse effect (based on value and magnitude). The main stem north Mayflower is not so affected but is also culverted at the point of very high predicted drawdown. Upstream and downstream of that culvert, the drawdown is predicted to be negligible. It is possible the drawdown will result in less water flowing into the culvert and therefore downstream, but upstream of the culvert the predicted drawdown is negligible.
Wetland Q08/066 is a large open water body wetland (PNAP Q08/066 (Brynderwyn Farm Pond)). It is a constructed open water body with three western upper draining gully arms variously in rush (*broom and Edgar’s rush*) and pasture and creeping buttercup. Since the PNA survey, these gullies appear to have been fenced (perhaps planted). If the draw down is as predicted and more than short term, it is likely that the wet pasture rushland and sedges will revert to pasture dominated (FAC and FACU) species but there will still be substantive wetland and that effect would be minor at the wetland-only scale, but also in the catchment context. However, this site is recommended as a wetland offset site. I recommend that this potential effect be managed on site by reorienting the vegetation towards manuka-fern or placing small weirs in the arms to retain rainwater.

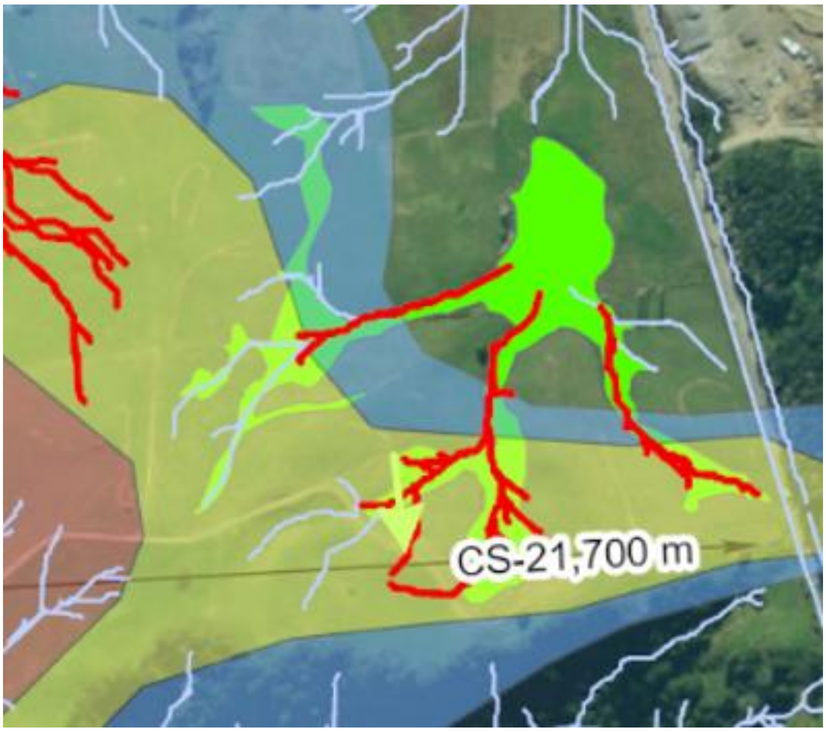


Figure 8 Ground water drawn down assessment around Mayflower ridge (chainage 21800) produced by WSP (Assessment of Effects on Groundwater (Appendix D12 of Volume B)).

- *Pukekaroro ridge (Pukekaroro tributary and Wetland 24) (chainage 24300-2500)*: The predicted drawdown at the upper end of the Pukekaroro tributary is negligible. The draw down on the northern side is very high but in the epithermal reaches draining to the wetland and the model suggests that lower down the hill sides the ground water depletion is much reduced to the point where it appears the important feature wetland, 24 is not affected. I note however, that it is the northern upper edge of wetland 24 which might suffer some depletion, but this area is already to be impacted by the Indicative Alignment. Effects of the cut area are unlikely to reduce the retained lower catchment wetland 22.

The potential adverse effects considered above are based on the level of drawdown predicted by the modelling eventuating and that drawdown being more than temporary. In monitoring both Transmission Gully and McKay's to Peka Peka over the last 15 years, I have not seen this effect on streams or wetlands arising from the large cuts required for those projects. I therefore remain sceptical that the drawdown will occur or will occur to the extent predicted with the effects assessed above.

If the final alignment changes, the drawdown may occur in slightly different locations. However, for the most part, those streams have already been assessed as impacted by spoil sites elsewhere in this assessment.

In conclusion, there is a potential that groundwater drawdown arising from large cuts will result in aquatic habitat reduction or loss. But because of the nature of the existing streams and wetlands in those drawn down zones, the effect is most likely to be subtle macroinvertebrate assemblage changes. I consider that effect will be less than minor and likely very difficult to measure.

5. Effects Management Recommendations

5.1. Overview

This section of the report recommends methods to avoid, minimise, remedy, offset and / or compensate for the Project's potential effects on streams and natural inland wetlands. In this report, the term 'mitigation' is used as a general term to encompass avoidance, minimisation, remediation, offset or compensation.

The statutory framework relevant to the Project is outlined at Section 2 above. I acknowledge the NPS-FM policy direction is to achieve no loss of extent or values of both streams (where practicable) and natural inland wetlands. For specified infrastructure, the NPS-FM policy direction is for that outcome to be achieved through application of the effects management hierarchy. However, I also acknowledge the FTAA and NPS-I mean that strict application of the NPS-FM policy direction is not required in this context.

My recommendations have been informed by that statutory framework. I have applied my own professional judgment when making recommendations, which is informed by whether I consider the natural inland wetlands and streams that may be impacted by the Project have values that warrant mitigation. I explain below the basis for my recommendations for managing the effects of the Project on natural inland wetlands and streams.

5.2. Avoidance of freshwater effects

During development of the Project, I advised the Project Team on whether the values of the wetlands and streams within the Proposed Designation are sufficiently high as to justify the avoidance of effects. I consider there are no aquatic or wetland values within the Proposed Designation that would justify an avoidance response other than the need to maintain fish passage in the Waihoihoi main stem. I also participated in a workshop that discussed options for stream crossing systems (e.g. bridges, and different culvert designs) to avoid or minimise effects. This report identifies that the Waihoihoi main stem has high values, including because it has an important functional role with respect to fish populations in the catchment. However, I consider that function can be retained through other management measures if the Waihoihoi main stem is impacted by the final alignment.

I also advised the Project Team on the impacts of spoil sites on freshwater values. As a result of design refinement, the extent of spoil sites in gullies and streams (which are the "easy" spoil sites from an engineering perspective) has reduced. As a result, the extent of potentially difficult stream realignments (see 5.3.4 below) has also reduced.

Despite the above, it is not possible for the Project to avoid all impacts on all streams or wetlands given the width extent of the Proposed Designation, the natural direction of the streams and locations of wetland and the likely road alignment.

A range of actions to mitigate effects on streams and wetlands has been considered in the context of other project requirements (including the width of the road batters and lengths of culverts and the location and nature of spoil sites). Reducing the extent of spoil sites or changing how spoil sites are constructed, would further minimise effects but in my view that is not required to manage adverse impacts on the values of the streams and wetlands present in the Proposed Designation.

5.3. Streams

5.3.1. Reclamation

As set out in Section 4, the total extent of stream loss from the Indicative Alignment is calculated to be 554m (Table 15). However, this calculation assumes the spoil site realignments are successful. I note that as a result of the refinement of the stream intersection with the road at the Mayflower property (Mayflower main stem) a long culvert is no longer needed and the downstream perennial stream has been retained through a short southern culvert. This change has lessened the amount of loss for the Mayflower main stem.

If the streams under the proposed spoil sites cannot be successfully realigned, then there will be a loss of extent of 4,984m of stream (made up of loss in the Ahuroa of 925 m and Pukekaroro 73 m and gains in the Wairau of 342m and 102m in the Waihoihoi). While that is a loss of extent in terms of the NPS-FM in those two catchments, I consider (as the pre mitigation assessment showed above) that even this amount of stream loss in either catchment represents a negligible magnitude of stream loss (<1%) relative to the amount of aquatic habitat in the catchments. As such, I consider this loss results in a less than minor (very low) level of effect.

5.3.2. Design requirements for culverts

As set out above, the impacts of culverting in each catchment will be less than minor (very low in most cases and low in Pukekaroro). I do not consider any effects management is necessary to manage effects to a low level.

Nevertheless, as a matter of good practice, I have recommended design requirements to minimise the effect of habitat reduction and better ensure fish passage. These design requirements are that, where practicable, the culverts are designed to provide:

- Benthic habitat (through in-pipe substrate retention);
- The same or similar velocity as the impacted stream under typical flow conditions; and
- Accessible inlet and outlet structures for climbing fish species.

The above design considerations for realigned culverts need to be given the same weight as flood volume and erosion and scour considerations. Conditions of consent will need to ensure the design considerations are applied to the final alignment (where practicable).

5.3.3. Design requirements for stream realignments in natural ground

As set out above, I consider stream realignments constructed to mimic the streams they replace (if not better) is not required to manage effects to a low (or lesser) level. Even without stream realignment, I consider there will be no more than minor residual effects and accordingly no effects that require any management.

Nevertheless, I recommend (where practicable), as good practice, the minimisation of effects through stream realignments which provide a “like for like” replacement of the original stream by meeting the following design requirements:

- The same channel morphology, depths, and wetted width potentials (i.e. the same bed and bank dimensions);
- Similar surface flows and depths;
- The same or similar velocity profile;
- A similar riparian condition; and
- A similar substrate.

The above design considerations for realigned streams need to be given the same weight as flood volume and erosion and scour considerations. Conditions of consent will need to ensure the design considerations are applied to the final alignment.

5.3.4. Design requirements for stream realignments at spoil sites

Good practice stream realignments at spoil sites requires the same design requirements as stream realignments in natural ground, however there are different hydrology considerations.

It is currently unclear how the spoil sites will be developed and designed and if a realigned stream in or at the edge of a spoil site will gain sufficient water and hold sufficient water to reform a suitable aquatic habitat. I recommend the stream realignments be located at the edge of any spoil site such that the bed and one side at least are on natural ground. This location means where water is diverted into that channel only one side has greater potential for water loss into the fill and that can be more easily managed than if the entire channel is built into fill. The project hydrologist is also uncertain if the ground water currently supporting the streams will also be available to the realigned stream given it will not be in the gully bed. As a result, the realigned streams at spoil sites may be mostly reliant on upstream surface flow.

These hydrological factors may mean stream realignments cannot be successfully established at spoil sites such that intermittent streams may become ephemeral and perennial may become intermittent.

It may be that in detailed design the spoil site location and extent will vary and this stream effect may be somewhat or even greatly reduced.

I recommend that:

1. A 'trial' stream realignment be undertaken at one spoil site and monitored to gauge the level of success (i.e. monitor physical parameters and hydrology to demonstrate aquatic habitat has been created). If the trial is successful, stream realignments should be implemented and tested spoil site by spoil site. Where that is successful and so when implemented to success in all spoil sites with streams then the Project's impact on stream extent will be near zero.
2. If the trial is not successful, and the Panel are of a mind to weight the NPS FM direction in respect to avoiding loss of extent of waterway then, and despite the effect being less than minor, then stream offsetting or compensation would be the next step to implement.

If stream realignment is unsuccessful and that effect is not accepted as less than minor (or that the NPS FM avoidance of loss of extent has greater weight) then I recommend that for every failed realignment (or for all perennial and intermittent streams within spoil sites post an unsuccessful trial), an offset/compensation be developed based on SEV and ECR. I do not consider however, that the ECR requires a default multiplier or that the future potential value of the SEV of the impacted stream should factor into the calculation as these are heavily modified farmed streams without obvious improvements in their near future). I have an indicative SEV for the Wairau north and Pine south streams (which are affected by spoil), but I consider an updated SEV for each affected stream will be required immediately before impact, which might be several years out from now. The offset/compensation should be focused on enhancement of existing waterways because there is little to no opportunity to create new waterway within the Proposed Designation. I expect the ECR will be between 2 and 4 to 1.

Alternatively, NZTA might consider moving straight to the compensation option which I suggest would be freshwater stream focused to assist community groups and or iwi and or Council to achieve significant local stream betterment.

5.4. Natural Inland Wetlands

I consider natural inland wetlands with higher ecological values and condition should be treated differently to those with lower ecological values and condition. The effects management approach taken should be proportionate to the ecological value and condition of the affected feature and the impact of the Project.

5.4.1. Recommendations for negligible or low value (exotic, pastural) natural inland wetlands

As outlined above, the majority of natural inland wetlands within the Proposed Designation are exotic, pastural wetlands, induced by grazing and land management. These natural inland wetlands have low or no indigenous biodiversity, rely on artificial or manipulated hydrology, and are in poor condition due to ongoing stock damage and disturbance.

Given the lower values of these natural inland wetlands, I consider that they have little or no ecological value warranting protection of their extent (and therefore do not need to be avoided).

5.4.2. For those features, where adverse effects are assessed as low or very low (see Summary of condition and values of natural inland wetlands

I have prepared a table summarising the condition (based on species present, physical appearance, water condition, stock access) and values for each of the identified natural inland wetlands (Table 4).

Table 4: Summary of the condition and values above), and where they are classified as exotic pasture wetlands, I recommend no mitigation as they do not have values nor functions that merit protection or to

be offset regardless of the extent of loss. The loss of a low value, exotic pastural wetland that has little to no water storage or filtration functions or indigenous faunal habitat does not constitute the loss of a valuable or functional wetland feature and does not reduce the representation of indigenous representative wetlands in the ED. Such losses could also occur under current land uses.

Further, under the NPS-FM effects management hierarchy, the offset principles require a like for like response. In theory, that would require recreation of an equivalent extent of low value, exotic pastural wetlands. However, as noted above, replacing lost wetlands with new areas dominated by exotic species (such as creeping bent and butter cup or soft rush) is not consistent with the intention of the policies and objectives in the NPS-FM.

5.4.3. Recommendations for Wetlands 8, 16 and 24

Wetland 24 is a relatively large, moderate value natural inland wetland. It is the only wetland affected by the Indicative Alignment that has ecological values that I consider warrant protection and effects management. I recommend Wetland 24 is avoided if practicable.

In addition, Wetlands 8 and 16 (two other relatively large wetlands with some indigenous representative values (centrally for wetland 16)) would also warrant effects management if affected by the final alignment and to the same degree as wetland 24. However, these features are currently avoided by the Indicative Alignment. I recommend that any changes to the Indicative Alignment avoid these features if practicable.

Due to a range of constraints, I understand it is not practicable for the Project to completely avoid impacts on Wetland 24. While the original spoil covering most of Wetland 24 has been pulled back as part of ongoing design refinement avoiding much of the wetland, the Indicative Alignment still passes over around 1 ha of the upstream end of the wetland. As a result, there will still be some effects that I consider will require management.

I think it unlikely that there are opportunities for remediation of effects on Wetland 24. Considerable care will be needed to maintain the hydrology to the wetland and to minimise the fill from the road embitters and wider spoil deposition, haul roads, lay downs etc.

Figure 9 below shows the Indicative Alignment, and I note that in the upstream area the flow paths to the wetland receive spoil fill. The water they supply to the wetland under rain must continue to be delivered to what will be the fragmented upper portion that will remain.

That said the upper remnant will be small and it is questionable if the area surrounded by works will be meaningfully retained. If it is not, the area (1,500 m^2) should be added to the offset totals for this wetland (see below).

Water is then passed through a culvert (red line in Figure 9) to the retained wider wetland downstream. In a similar fashion the tributaries south and west receive spoil fill and must also continue to pass all the current water to the lower end of the wetland to sustain the wetland's hydrology. These tributaries, while mapped as intermittent and perennial, are no more than larger farm drains and I do not consider them to have sufficient natural form and values to be considered streams requiring consideration independently.

Figure 9: Wetland 24 and the intersection of the indicative alignment and spoil sites.

Minimising the extent of infill and ensuring no earthworks discharge to the remaining wetland while also retaining the hydrological input is likely all that could be undertaken to minimise effects (as well as standard biosecurity protocols to not introduce weeds or pests to the site).

I recommend the residual adverse effects on Wetland 24 (and Wetlands 8 and 16, if these are impacted by the final alignment) should be addressed through ecological offsetting. Specifically, by establishing a new wetland area focused on returning a largely raupō swamp (to replace that which is lost). That wetland should be at least 2 hectares in size (or two 1 ha wetlands, see below for the ratio) and in addition to accommodate a range of wetland assemblages including replacement habitat to create a 2.44ha wetland to satisfy the avian offset requirement (at Section 5.2 of the Assessment of Effects on Avifauna Ecology in Appendix D8 of Volume B).

The most appropriate location for Wetland 24 offsetting is within the Wairau catchment. I have identified a location that might be appropriate from a freshwater ecology perspective (see bottom yellow box on Figure 10 below). This site appears to have suitable hydrology but would likely require areas of excavation and full revegetation. The location is at the corner of SH1 and SH12 and is around 4 hectares in a lower bowl (into which an open water area of 0.15 ha would need to be created and which I understand is acceptable with respect to the avian offsetting requirements and proximity to the new road).

An alternative location is wetland Q08/066 (top yellow box, shown in Figure 10 below). Although this wetland is technically within the Ahuroa catchment, it is south of the Brynderwyn Hills and has the same avian fauna as wetland 24.

That said, I consider wetland Q08/066 is a better (less risky) wetland opportunity than an alternative site at the SH12-1 intersection (Figure 10). Wetland Q08/066 presents opportunities to improve the current pastural edges, plenty of space for several hectares of raupō (once 1 ha is established the raupō will spread to much more when given the opportunity).

I note that the final site or sites and design must consider the proximity to the final alignment, so as not to endanger the bird life that may use the new wetland/s habitat (discussed in the Avifauna Assessment Report (Appendix D8 of Volume B).

If an appropriate site cannot be located within the Wairau catchment, then I consider an appropriate site within the Ecological District should be chosen. Principal 7 of Appendix 6 of the updated NPS-FM says that while “*an aquatic offset action is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district*” which suggests that wetland creation outside of the Wairau catchment, but within the Ecological District, should also be considered as an offset.

I recommend the offset wetland(s) is/are designed to meet the following requirements (regardless of the actual number of wetlands created):

- A mix of wetland hydrology with a majority of shallow water suitable for raupō;
- At least 1ha of raupō in large and solid stands;
- At least 1 ha of edges of Carex sedgelands and rushland;
- At least 20m wide inland of dry land riparian buffer;
- Fenced against stock access;
- Established in a wetland weed and pest free area and maintained to be wetland weed and pest limited until well established; and
- Established following a wetland creation management plan prepared by a suitably qualified person and certified by the relevant consent authority.

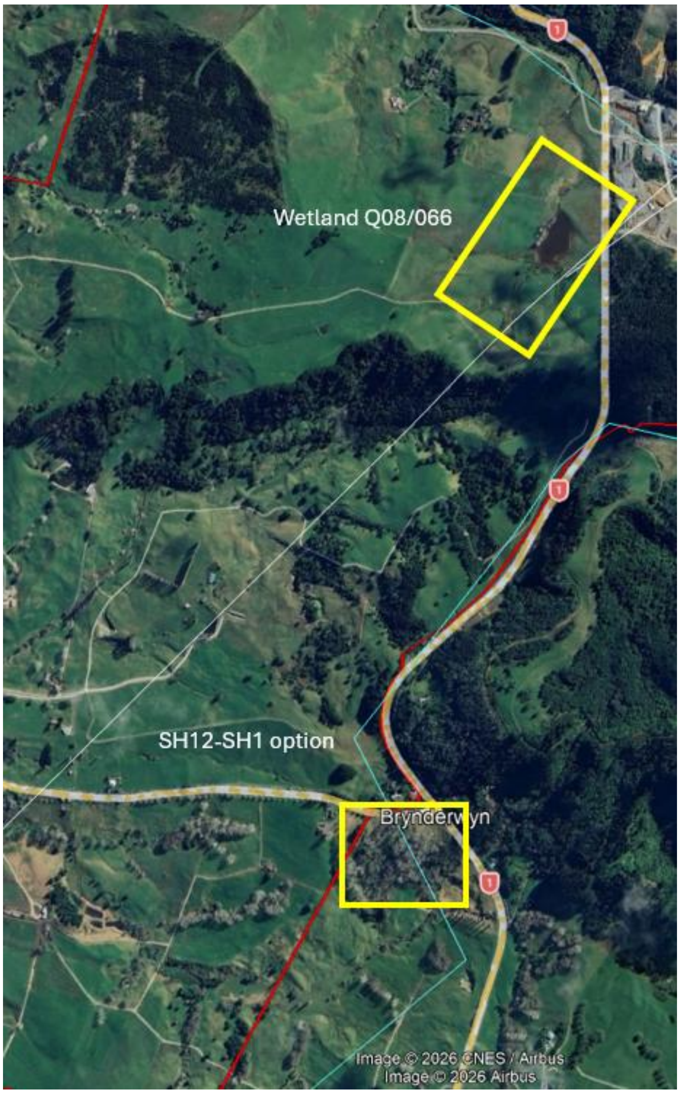


Figure 10 Possible offset wetland areas (yellow indicated area).

In terms of the area of the offset wetland, offset ratios should be applied so that the offset is proportionate to the impact of the final alignment.

Ratios used in recent years, based on biodiversity offset models (DoC, 2014; Maseyk *et al.*, 2018)), that I am aware of have ranged from 1:1 to 1:4 for raupō-dominated (native) wetlands, depending on the project and timing of offset establishment.

- 4:1- 1:1 ratio for raupō-dominated wetlands, depending on the time of creation relative to the time of loss (4:1 if after loss, 1:1 if 3 years prior to loss (Cambridge to Piarere, Singers et al., 2024)).
- 1:3.5 ratio rush-sedge wetlands (Plimmerton Farms, RMA Ecology, 2023).
- 1:2 ratio (Drury Quarry – Sutton Block Extension, Bioresearchers, 2025).

I see no sense in repeating a biodiversity offset model for an impact on 1 ha of raupō wetland. Instead, based on my experience, I consider a 1:2 ratio to be appropriate where that undertaking is post effect (up to 5 years post), or 1:1 where the offset is undertaken 3 years prior to the effect, or 1:1.5 where the offset is completed within 1 year of the effect). While that may appear initially at the lower end of examples identified above, I consider that ratio to be appropriate because I recommend that the offset causes a sequence of wetland (from dry land riparian through sedgeland into raupō reedland) rather than just offsetting raupō (a relatively low diversity simple community), so long as the raupō reedland component is at least 1 ha. In this way, I consider 2ha of better wetland (but retaining the 1 ha of raupō) can be achieved and is a better approach than simply 3.5 ha of raupō. This approach is consistent with the 'trading up' principle.

If Wetlands 24, 8 and/or 16 cannot be avoided, I recommend wetland creation is undertaken in accordance with the design requirements set out above and the following ratios:

- If the offset wetland is created within 5 years of the impact: a 1:2 ratio;
- If the offset wetland is created within 1 year of the impact: a 1:1.5 ratio; or
- If the offset wetland is created more than 3 years before the impact: a 1:1 ratio.

Any offset wetland needs to be monitored and maintained until the vegetation assemblages are established and the vegetation attains 80% cover of the required areas to be vegetated (noting some must be open water) and no wetland threat plant species are present. At that time, I consider the wetlands will be sufficiently established such that no ongoing monitoring or maintenance measures are required.

Overall, with application of the effects management measures outlined above, I consider that the Project's impacts on wetlands will be neutral at worst, but more likely positive, if an offset wetland is constructed (given it will be required to be more diverse and fenced, which the existing wetlands are not).

I do not consider any offset wetland would need to be legally protected in perpetuity. The affected wetland(s) are not legally protected now. Once the offset wetland that meets condition criteria set out above, the effect of the Project would be neutral or positive. The offset wetland would be open to the same potential for change as it the current wetland.

5.5. Potential groundwater drawdown effects

I consider the ground water in the three west wetland arms of Wetland Q08/696 should be monitored to test whether there is any impact as well as the scale of any effect (on surface water). The monitoring should be undertaken for 3 years post-earthwork cuts and should consist of wetland adjacent shallow piezometers, one in each arm. If monitoring demonstrates an effect, the amount of wetland loss from groundwater drawdown should be offset at a ratio of 1:1 given Wetland Q08/696 is largely exotic. and the offset should be achieved on site by way of planting a FAC indigenous assemblage (e.g. a manuka fen) more tolerant of the likely new hydrological condition.

6. Conclusion

The Project is located in a rural landscape where most streams and wetlands are low value and in poor condition. No stream or wetland within the Proposed Designation has values that warrants a total avoidance response.

The Project intersects largely small headwater streams (many intermittent) and will affect by way of culverts, spoil deposition and stream realignment some 10km of stream in four catchments based on the Indicative Alignment. It also intersects one higher value natural inland wetland and a number of exotic induced pastural wetlands, depending on the final route alignment. The largest potential for adverse effect is in the realignment of the Waihoihoi main stem.

In any one catchment the effect on the amount of stream habitat reduced in value or lost is sufficiently small that the magnitude of the effect prior to any mitigation is low or typically very low. That coupled with the generally low values (and typically poor condition) result in an effect that is less than minor even before mitigations are considered.

Given this overall low or very low level of effect, I do not consider that additional effects management measures (including, for example, good practice measures related to culvert installation or alignment design) are strictly required in order to mitigate effects.

Nevertheless, I recommend good practice measures to install culverts such that they can function as habitat, do not change the velocity profiles and do not change fish passage where practicable.

Likewise, it is good practice for realignments to be designed to create an aquatic habitat condition comparable or better than that lost and so achieve no loss of extent and values.

Fish passage is generally not required (above maintenance of flows) except in a few of the more major streams (Waihoihoi main stem, Pine north, Piroa main stem, Mayflower main stem, Wairau north main stem). It is unlikely fish distribution or population size in any of the headwaters will be affected regardless of the way culverts are installed. That said where fish passage has been identified as required the gradients and size of the streams are such that design should have no issue in providing fish passage.

There is only one natural inland wetland with indigenous representativeness and value warranting offsetting of effects (or up to three if the alignment changes during detailed design). There is space and conditions within the Proposed Designation to undertake that work and parameters, and an offset ratio are provided.

In the round, I consider the freshwater stream effects are of such a scale that little mitigation is required to appropriately manage effects. Nevertheless, I have recommended good practice effects minimisation measures related to the infrastructure that affects them.

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APPENDICES

Appendix A
Wetland Maps

File Ref: C:\Users\hayle\maphouse\GIS\MH2507_BG_NorthernCorridor\GIS\MH2507.aprx MH2507_WetlandAssessment_A3Pmb 5:01 pm

Projection: NZGD 2000 New Zealand Transverse Mercator

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Wetland Assessment

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Preferred route
Cut & Fill
Catchment boundary (REC2 NIWA)
Alignment
Potential wetland

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Wetland Assessment

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Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

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- Cut & Fill
- Catchment boundary (REC2 NIWA)
- Alignment
- Potential wetland

0 — 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

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Alignment
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Potential wetland

0 50 m
1:2,500 @ A3

Wetland Assessment

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Wetland Assessment

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Alignment
Potential wetland

0 50 m
1:2,500 @ A3

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1:2,500 @ A3

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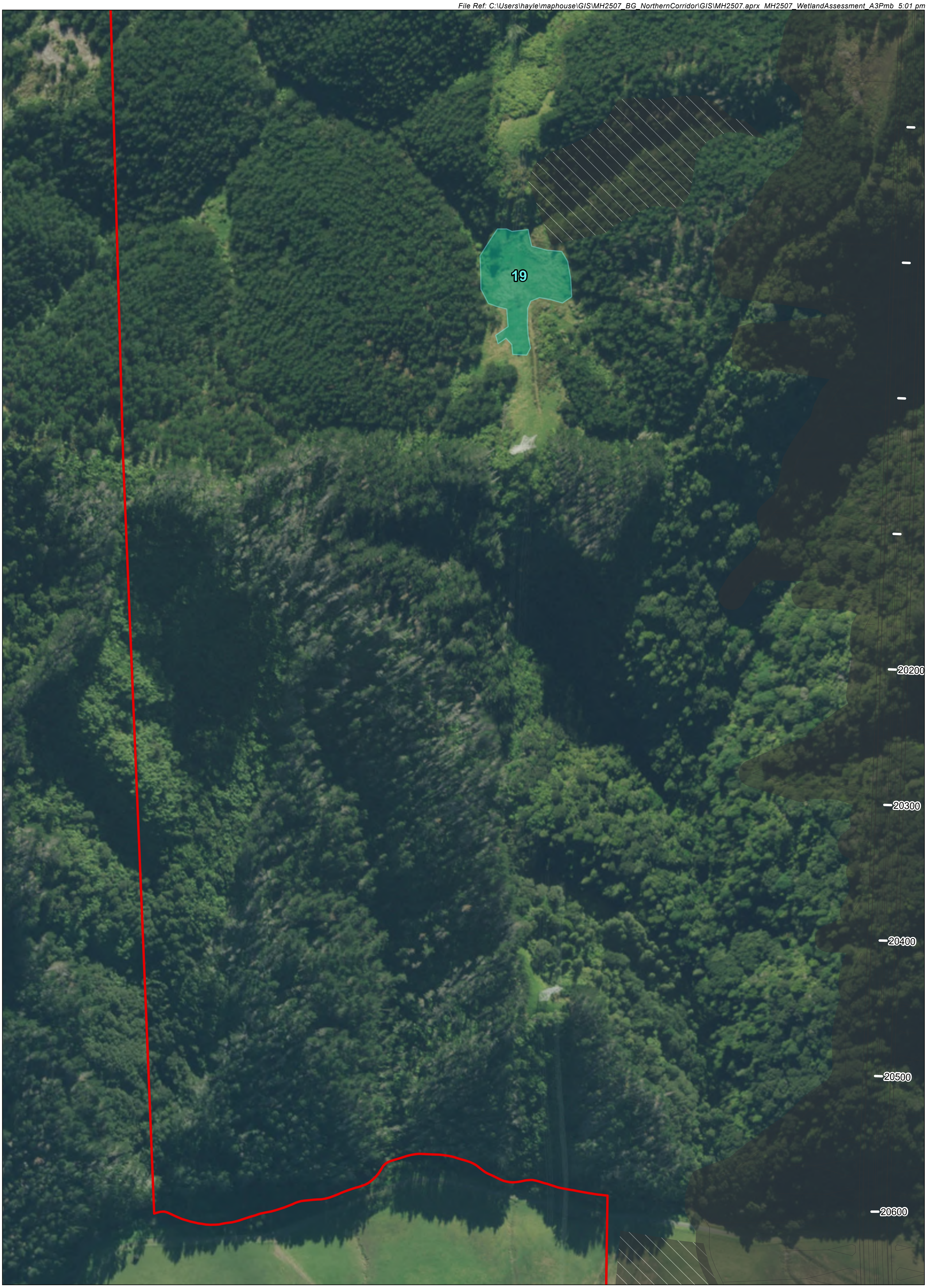


Wetland Assessment

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

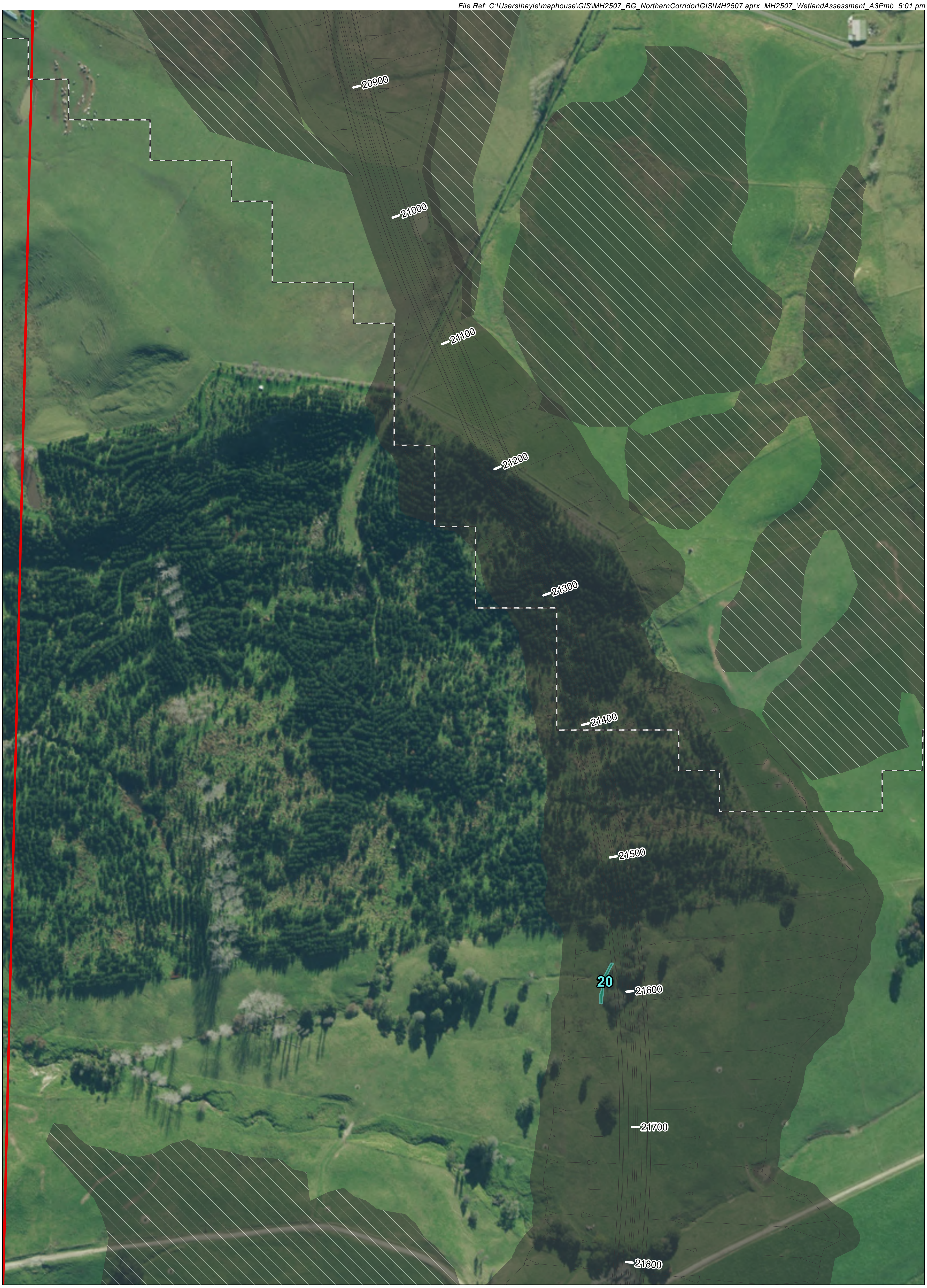
Preferred route
Alignment
Cut & Fill
Spoil site
Catchment boundary (REC2 NIWA)
Potential wetland

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Wetland Assessment

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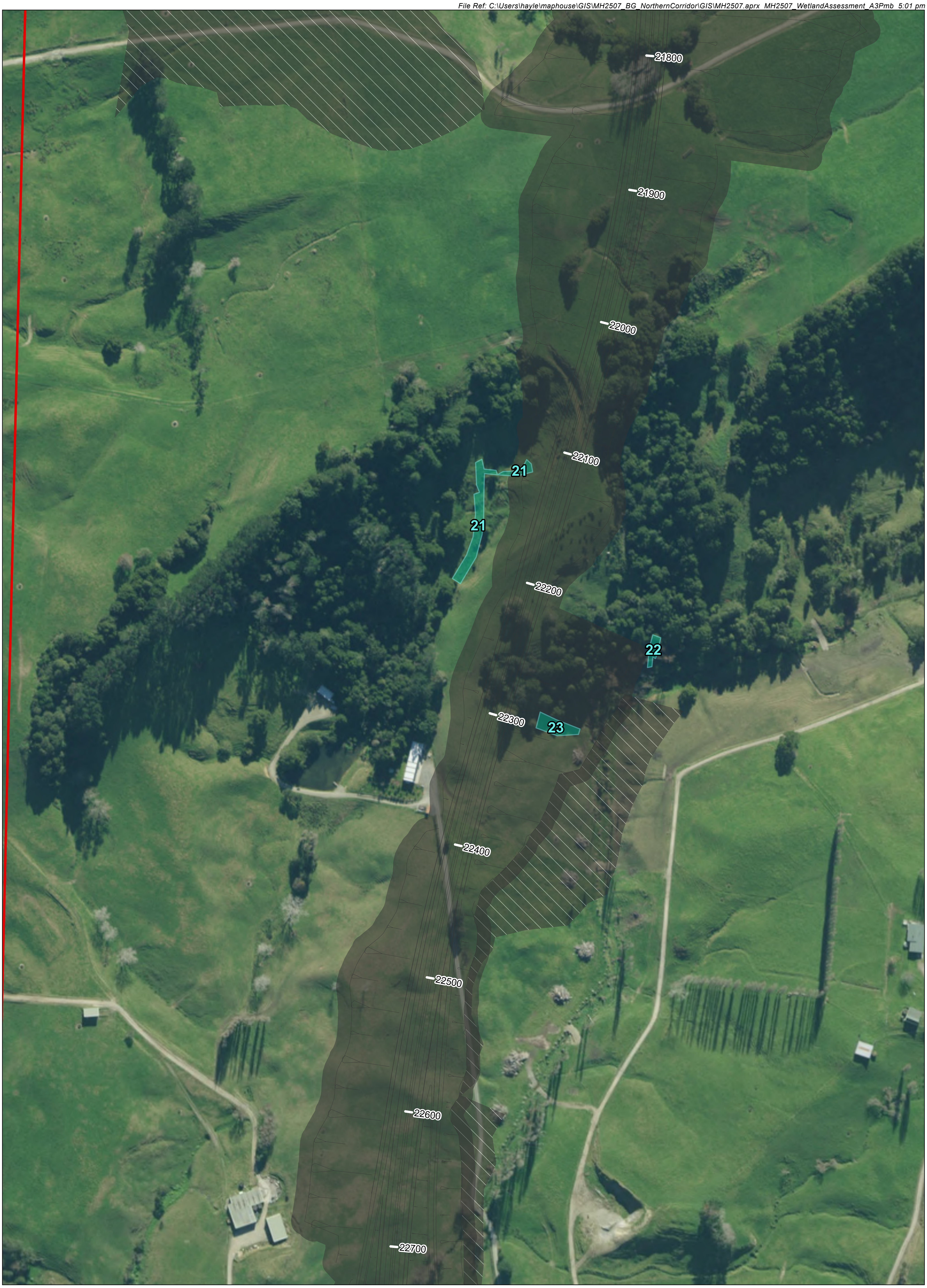

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Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

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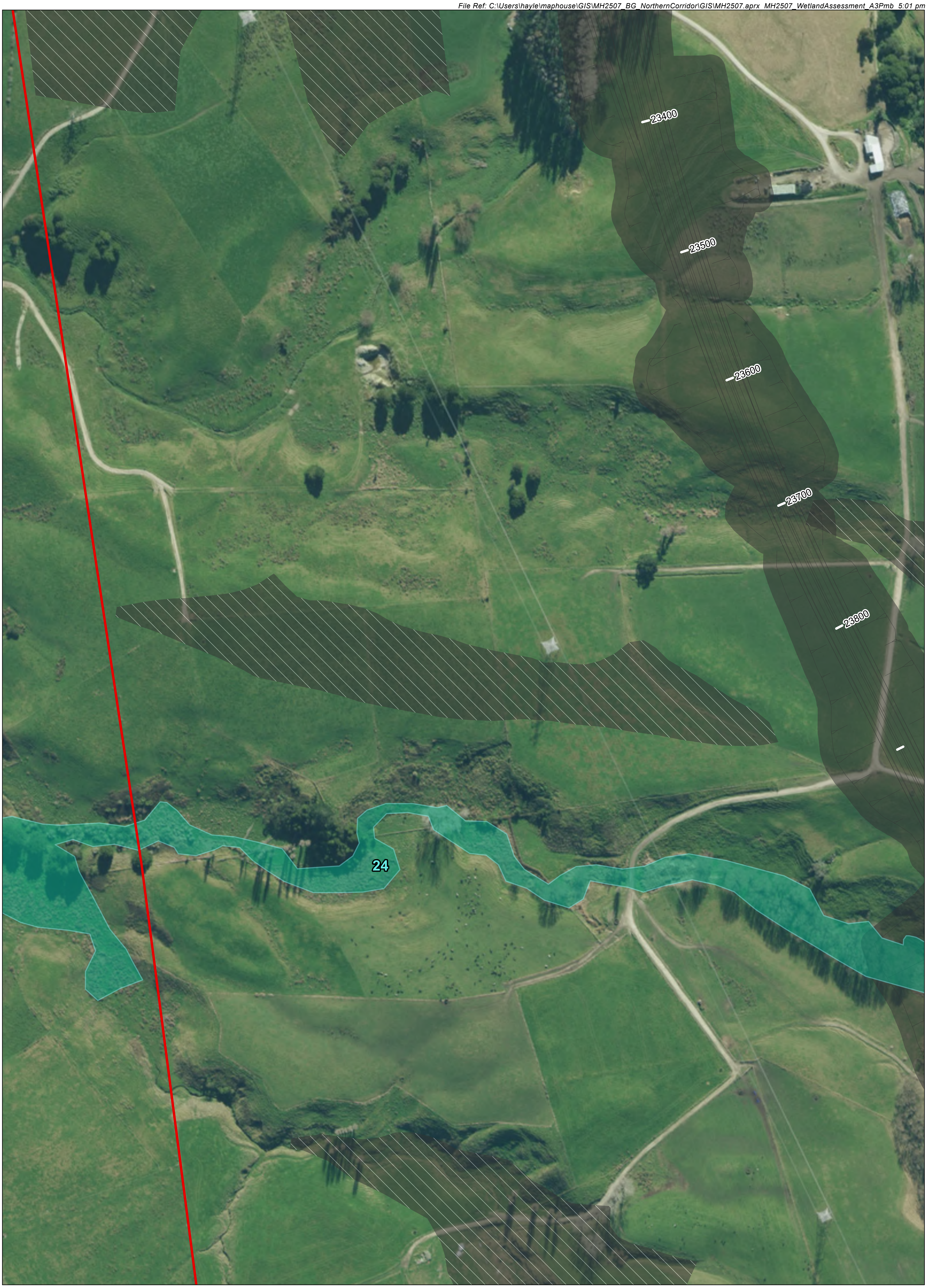
Projection: NZGD 2000 New Zealand Transverse Mercator



Wetland Assessment

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B

Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

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1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

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Appendix B
Description of Wetlands

Appendix A Map # reference - Location	Description	Photos
Ahuroa Catchment		
Wetland 1 - at the end of a system of pasture drainage channels prior to entrance of that water into the main stem of the Ahuroa River	Largely an exotic wetland formed around the discharge channel and covered primarily in exotic water celery / cow cress (*Heloscaiadium nodiflorum*) (>80%) and creeping buttercup (15%). There are also a couple of Tī Kōuka present.	
Wetland 19 - Brynderwyn Hills transmission line clearing	An open area with a topology that allows surface water to pool. In this location, tree establishment is restricted to manage potential impacts on the transmission lines. The vegetation cover is largely creeping butter cup (>50%), a few wheki, tall fescue (30%), Juncus effusus (5%) and other exotic wetland common species.	

Appendix A Map # reference - Location	Description	Photos
Waihoihoi catchment		
Wetland 2 - [Alongside SH1, Waipu]	Although this was previously a stream, it has become so overgrown in wetland plant species with such a stagnant flow that I now consider it appropriate to classify as a natural inland wetland. This natural inland wetland is a wet sediment-based compilation containing blunt pond weed (1%), alligator weed (2%), water purslane (50%), *Isolepis prolifera* (10%), water starwort (10%), common duckweed (5%) and water pepper (30%) with edges of creeping butter cup (30%), soft rush, Edgar's rush, dock and pasture species (60%). It is fed by drainage from the west of the existing State Highway. This is not an indigenous representative wetland but is different from wet pasture – more aquatic. It is unlikely to constitute the habitat of any special wetland species (acknowledging it is currently frequented by pūkeko). Tuna (eel) are likely to frequent the natural inland wetland when sufficient water allows them access from the Waihoihoi main stem. Upstream, the natural inland wetland reduces to the more defined banks of the stream it once was and passes under SH1 in culvert.	
Pasture Wetlands 3, 4, 5, 6, 7, 9 and 10	Further upstream on the Waipū property (at chainage 15400-15800) there is a low point in the land. In this location, there is a cluster of 7 wet features in pasture near an access track. These features are within pasture and accessible to the stock, and would normally be identified as wet pasture. However, during my site visit, I observed that in these features there was standing water sometimes up to 200mm in depth, and a cover predominantly of non-pasture wetland species ((Cosgrove, Dodd and James, 2022)) including water pepper (5%), creeping bent (5%), creeping butter cup (50%), docks (2%), Yorkshire fog, lotus (10%), *Isolepis prolifera* (5%), starwort, arum lily, water purslane, broom rush, Edgar's rush, and soft rush (rushes in total 30% but variable). Accordingly, these features qualify as natural inland wetlands (despite being exotic and induced).	 **Wetland 7**

Appendix A Map # reference - Location	Description	Photos
		 Wetland 6  Wetlands 4 (foreground) and 9 (background).

Appendix A Map # reference - Location	Description	Photos
Wetland 8 - Lowlands adjacent to the Waihoihoi River	There is a larger feature associated with the Waihoihoi main stem (adjacent to a power pylon). This feature is a depression and contains a central area of raupō (80%+), and dense edges of *Isolepis prolifera* and water purslane (as well as lotus soft rush, creeping bent, creeping buttercup, Edgars rush, gorse in the drier areas, with wet arms of rushes and water purslane). It is well connected to the Waihoihoi River.	
Wetlands 11, 13, lower 16 – lower pastural slopes draining to the Waihoihoi	There are four gullies that drain small remnant bush gullies and streams (two arms meeting in Wetland 13), each containing a similar array of wetland exotic and common native plant species with wet settings and so techincally natural inland wetland. They are generally vegetated with: water purslane (35%), water pepper (5%), *Isolepis prolifera* (5%), Edgar's rush (10%), soft rush, *Gylceria maxima* (20%), starwort, common ducks foot, false water celery (5%), water cress (2%), lotus (10%), creeping bent, creeping buttercup (10%), occasional *Machaerina*, and arum lily, mixed at the edges with the pastures and open to stock Although these are a wetter community than the pasture Wetlands 3-7 and 9, they contain similar assemblages. I consider that although these features were once streams under forest, they are now natural inland wetlands due to years of seidmentation and a resultant lack of an open channel and clear flow paths and are mostly full of wetland vegetation (despite being stock pugged). Towards the Waihoihoi the channels appear to be formed and maintained.	 **Looking up Wetland 11 from the farm road (wettest part, more open water).**

Appendix A Map # reference - Location	Description	Photos
		 **Lower channelised wetland 13 leading into the Waihoihoi (behind the author).**  **Lower end of wetland 16, largely similar to wetlands 11 and 13 here – exotic - very mounded.**

Appendix A Map # reference - Location	Description	Photos
Upper gullies Wetlands 12 and 14 - Hill gullies of the slopes below SH 1 on the decent from the Brynderwyn hills	Wetland 12 is a side system leading into the common Wetland 13 gully. Wetland area contains a feature that was once a section of tree sheltered stream. However, with the removal of the trees and sedimentation it now qualifies as a natural inland wetland comprising mainly of soft rush (60%) *Gylceria* (10%), Isolepis (5%) and lotus (10%), Yorkshire fog (10%) and docks (5%). Further into the bush fragment, there are kahikatea evident along the edge of the wet ground. There is also a seepage over an expanded area part way into the bush which is stock pugged and covered in creeping butter cup (80%), several sedges in low abundance and a lower canopy of a few wheki. Wetland 16 is treated as pasture by stock. In terms of composition, this feature has appreciable pasture grasses, but is >50% soft rush, Edgar's rush, creeping bent (not recognised as a pasture grass) (20%), creeping butter cup (20%) and starwort. The feature also has wetland hydrology and saturated soils. Depending on vegetation plot location, areas within this feature will classify as pasture or as natural inland wetland. Overall, we observed that on average most plots will indicate natural inland wetland over pasture, so have treated this feature as a natural inland wetland for the purposes of this assessment.	 **Wetland 12**  **Wetland 14 upper gully pasture and soft rush**

Appendix A Map # reference - Location	Description	Photos
General Gully heads (15, 17, 18)	The remaining natural inland wetlands I observed on the Waipū property are small headwater mud sponges (i.e. 5m by 10m in size under canopy) in the heads of forest fragments. These natural inland wetlands comprise creeping butter cup (30%) and soft rush (30%) and *Isolepis* sp. (30%) in the main surrounded by kikuyu or forest ground tier.	 **Example of a small wet area in a gully head**
Upper Wetland 16 - Lower Gully on the upstream most tributary of the Waihoihoi river within the designation	Some of this wetland system is located within the Proposed Designation (on the Murphy property). In the forest, moving upstream, there is a small section of more intact forest gully wetland. This natural inlamd wetland contains a central gully wet floor, comprising a compilation of both stream and wetland. The lower portion of the forest contain beds of raupō, Carex, lemna, and an area of gully floor kiekie. Upstream, the flood plain remains mostly exotic wetland species and pasture grasses, as the flood plain progresses to a reasonably well defined stream (Figure 19). Upstream however, a high level of modification is evident, and the feature could better be described as a stream under a loose native tree canopy with wet butter cup and grass edging.	 **Wetland 16 under forest with abundant kiekie.**

Appendix A Map # reference - Location	Description	Photos
		 Upstream, wetland 16 is largely creeping butter cup, sweet grass and wet pasture.
Wairau Catchment		
Wetland Q08/066 – Opposite Atlas Quarry	PNAP site Q08/066 (Brynderwyn Farm Pond) in the Otamatea Protected Natural Area report ((Lux and Beadel, 2006)). This is a constructed open water body with three upper catchment draining gully arms variously in rush (*broom and Edgar's rush*) and pasture and creeping buttercup. This feature has a few willow on the eastern edge and drains to the Piroa main stem through more gully wetland. Since the PNA survey, these gullies appear to have been fenced. Given this feature is a deliberately dug water body that has caused gully features to retain water and rushes, I consider that the wetland gully arms and the water body are likely exempt from qualification as a natural inland wetland under the exclusions under the NPS-FM.	

Appendix A Map # reference - Location	Description	Photos
Wetland 19	An open area with a topology that allows surface water to pool. In this location, tree establishment is restricted to manage potential impacts on the transmission lines. The vegetation cover is largely creeping butter cup (>50%), a few wheki, tall fescue (30%), Juncus effusus (5%) and other exotic wetland common species.	

Appendix A Map # reference - Location	Description	Photos
Wetland 20 - Mayflower property, side gully	In the north and at the eastern edge of the Indicative Alignment is a small wetland feature caused by the damming of an ephemeral flow path. This feature is largely creeping butter cup (10%), soft rush (10%), creeping bent (50%), lotus (10%), Edgar's rush, *Isolepis* (15%) and water forget me not (5%). These plants are confined into a channel that was likely the excavation for the dam and as the water reserve with an edge of old puriri, totara and a kahikatea.	
Wetland 21 – Mayflower property, steep side gully	The western most feature is a forest edge gully bottom. This feature contains a 5m wide section of pasture species on the true left side. In its lower reaches, under forest canopy, this gully feature is a stream. However, upstream out of the canopy, the future is a soft rush (30%), creeping butter cup (20%), *Gylceria maxima* (20%) swale with some giant umbrella sedge, *Isolepis Eleocharis acuta*, water forget me not, dock and false water celery. This feature also contains occasional wheki. At the head of the gully, the depression forms two arms and a general central basin which contains a mix of wet pasture and natural inland wetland of exotic common pastural wetland species. While small areas of this feature are quite native in composition the average overall feature is exotic rushes and creeping butter cup and wet pastures (creeping bent).	

Appendix A Map # reference - Location	Description	Photos
Wetland 22 & 23 – Mayflower, adjacent to the main stem tributary under loose canopy and pasture edge.	Both these features are small gully bottom flood plain areas prior to drainage into the main stem of the main tributary on the Mayflower property. These features are pugged pasture wetlands with a predominance of creeping butter cup (>50%), creeping bent, soft rush, water forget me not, *Isolepis cernua*, dock, Yorkshire fog. Given the species coverage they both qualify as natural inland wetlands. The eastern feature (23) is under a light canopy of kahikatea and nikau.	 **Wetland 22, wet pasture (creeping bent and butter cup).**  **Wetland 23, dominantly (>80%) creeping better cup.**

Appendix A Map # reference - Location	Description	Photos
Wetland 24 – Southern gully prior to the ridge over to the Pukekaroro catchment	This natural inland wetland is the southernmost tributary gully (located at chainage 24100). It comprises a 30m wide, willow edged raupō (orange colour in photo) dominated swamp feature (swamp as defined by (Johnson and Gerbeaux, 2004)) and is fed by the headwater seeps of two small tributaries approximately 500m above the wetland. The main south tributary in this gully has a stock pond and dam up stream, the northern originating from seepage need the farm track. A third southern entering tributary occurs near the lower end of the main raupō feature and above the new willow. In 2010, this raupō feature was more intact and did not have the willow edge cover it does now. Over the last 15 years, the edge of the natural inland wetland has been planted or invaded by willow. Although this invasion has caused the wetland edge to change, buffering and hiding the raupō wetlands will also have benefits. If unmanaged, the willow will (as can been seen within the raupō as young willow saplings emerge) overtake and change the wetland from raupō to a willow wet feature with a drier bed and likely exotic and willow herb and paper under growth. Currently, this natural inland wetland is the largest most representative freshwater natural inland wetland discovered within the Proposed Designation (and probably within the Wairau catchment). However, this natural inland wetland is sufficiently small and poor in condition as to not have been recognised in the Wildlands 2011 ranking of top wetlands in the Northland Region or the Otamatea PNA survey and report.	 

Appendix C
Map of Streams identified

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Catchment boundary (REC2)

Stream Category
Perennial
Intermittent
Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

File Ref: C:\Users\hayle\maphouse\GIS\MH2507_BG_NorthernCorridor\GIS\MH2507.aprx MH2507_StreamCategories_A3Pmb 4:55 pm

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

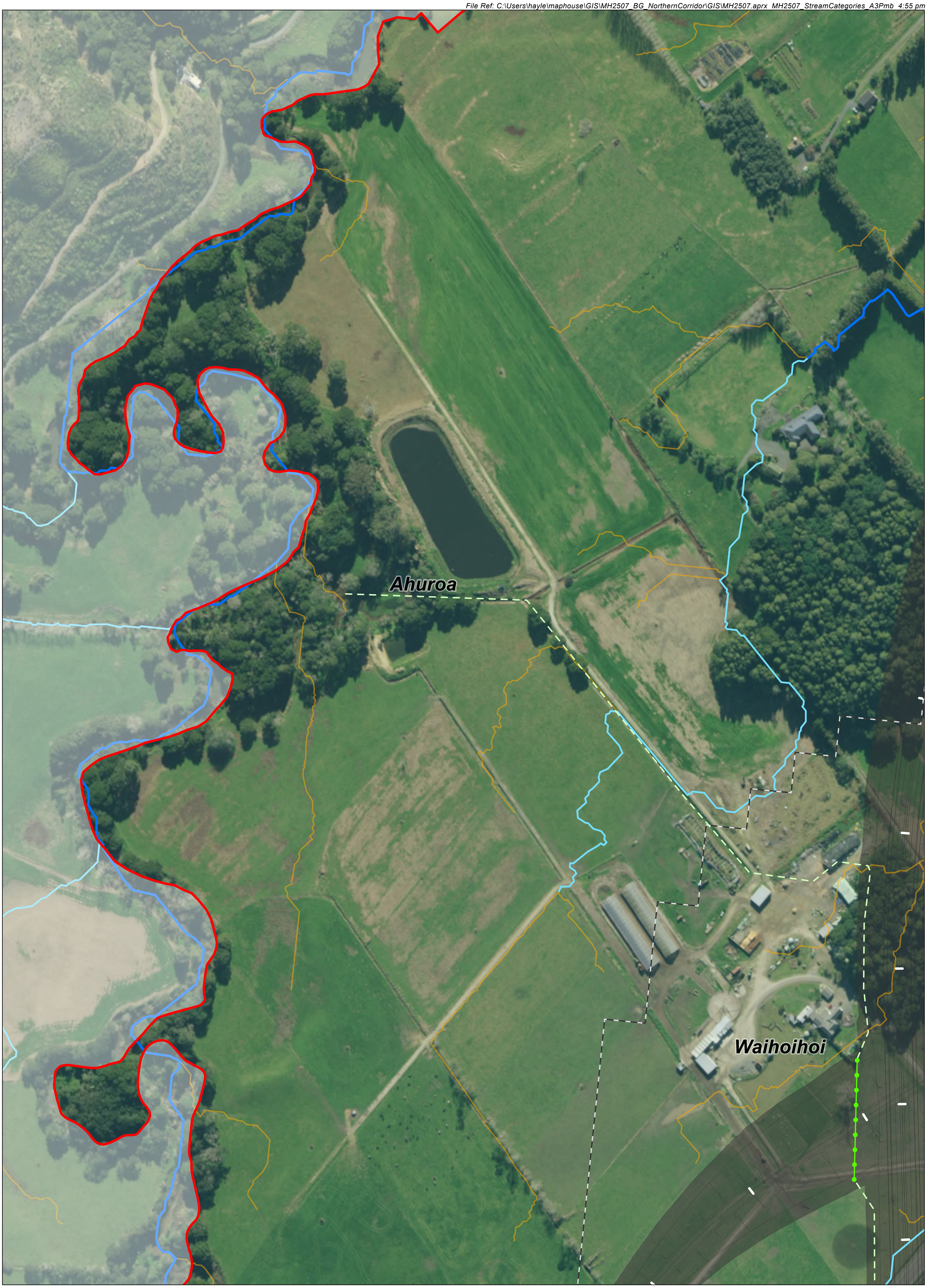
- Section 2B designation
- Alignment
- Cut & Fill
- Catchment boundary (REC2)
- Potential wetland
- Stream Category
  - Perennial
  - Intermittent
  - Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B

Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Catchment boundary (REC2)

Stream Category
Perennial
Intermittent
Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
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BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Catchment boundary (REC2)

Stream Category
Perennial
Intermittent
Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

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Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
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BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Catchment boundary (REC2)

Stream Category
Perennial
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Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

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FRESHWATER CONTEXT
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BlueGreen MapHouse

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DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

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BlueGreen MapHouse

- Section 2B designation
- Alignment
- Cut & Fill
- Catchment boundary (REC2)

Stream Category
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- Intermittent
- Ephemeral

0 50 m
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Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

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Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

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- Alignment
- Cut & Fill
- Catchment boundary (REC2)
- Potential wetland

Stream Category
- Perennial
- Intermittent
- Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

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BlueGreen MapHouse

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Stream Category
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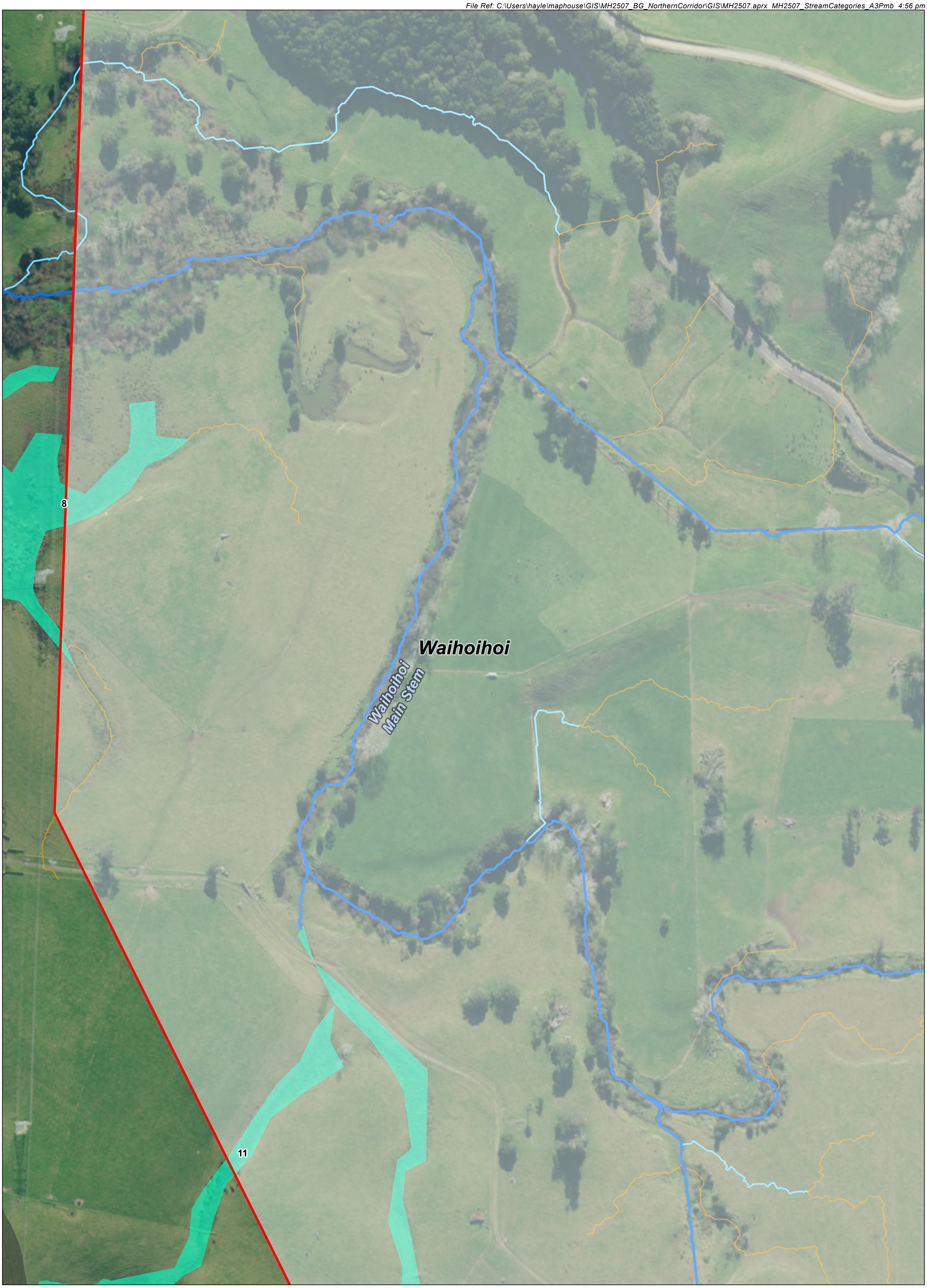
- Intermittent
- Ephemeral

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Catchment boundary (REC2)
Potential wetland
Stream Category
Perennial
Intermittent
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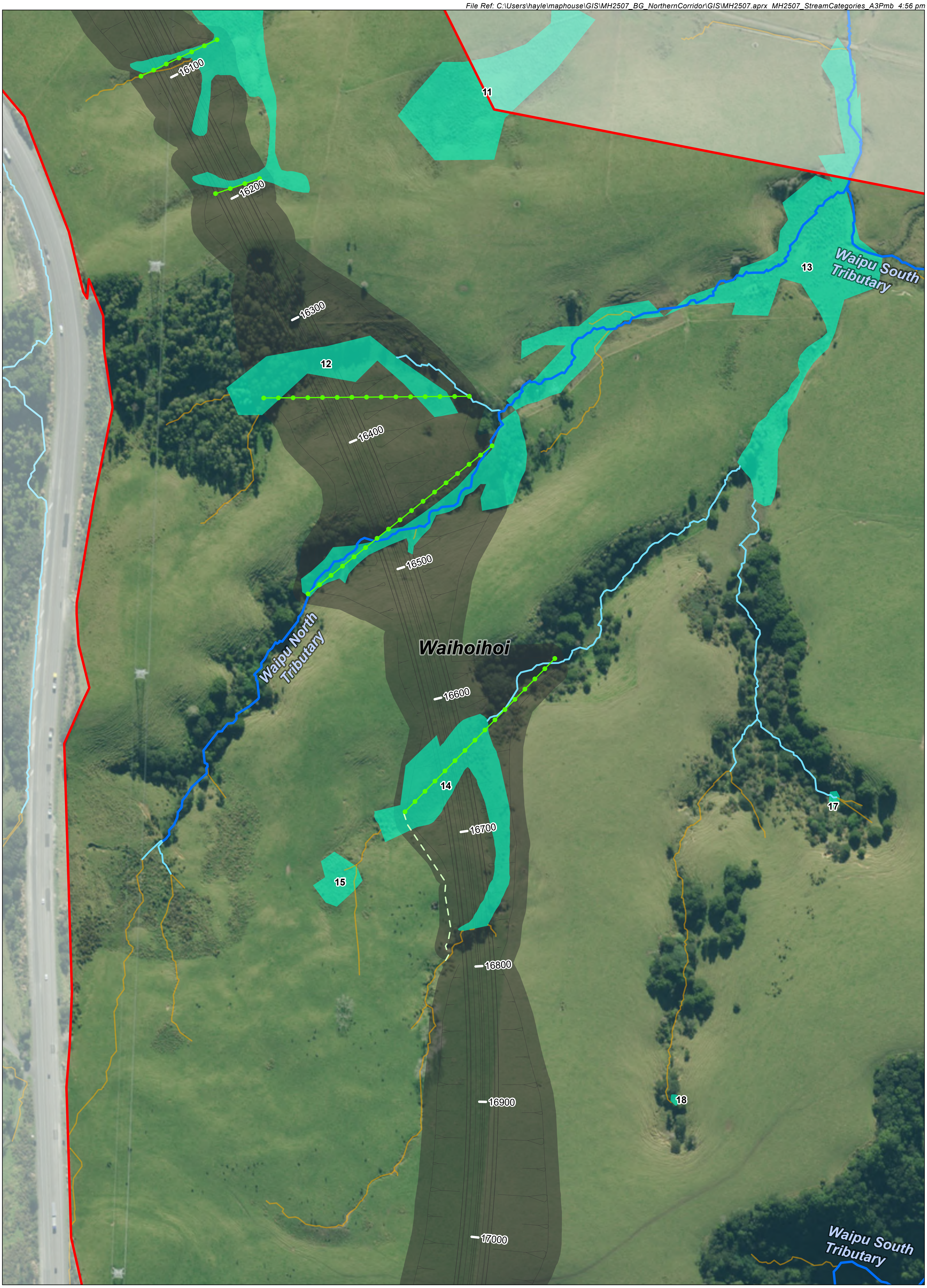
Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

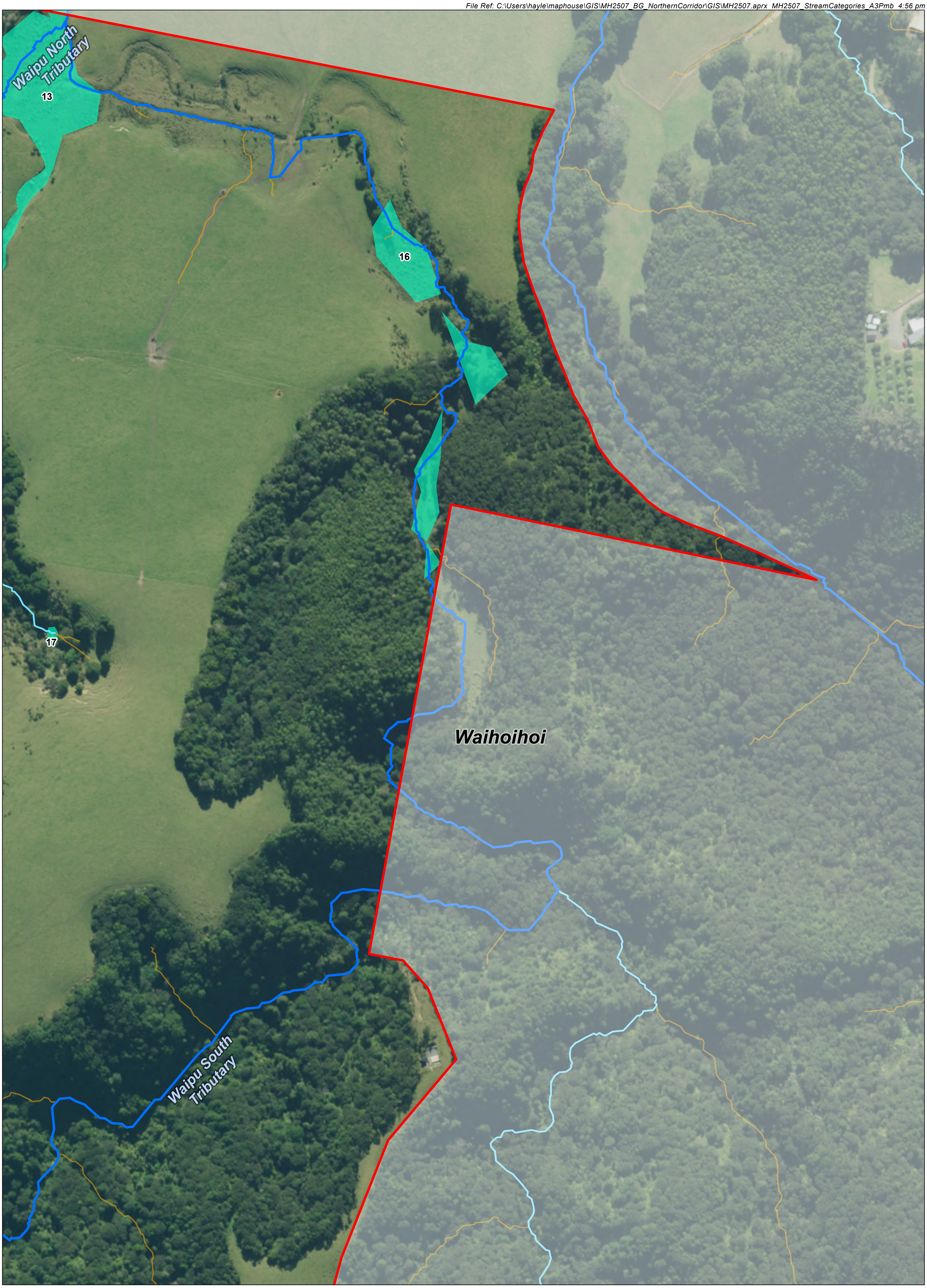
- Section 2B designation
- Alignment
- Cut & Fill
- Catchment boundary (REC2)
- Potential wetland

Stream Category
- Perennial
- Intermittent
- Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 — 50 m
1:2,500 @ A3

DRAFT



Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

- Section 2B designation
- Catchment boundary (REC2)
- Potential wetland

Stream Category
- Perennial
- Intermittent
- Ephemeral

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

- Section 2B designation
- Alignment
- Cut & Fill
- Spoil site
- Catchment boundary (REC2)

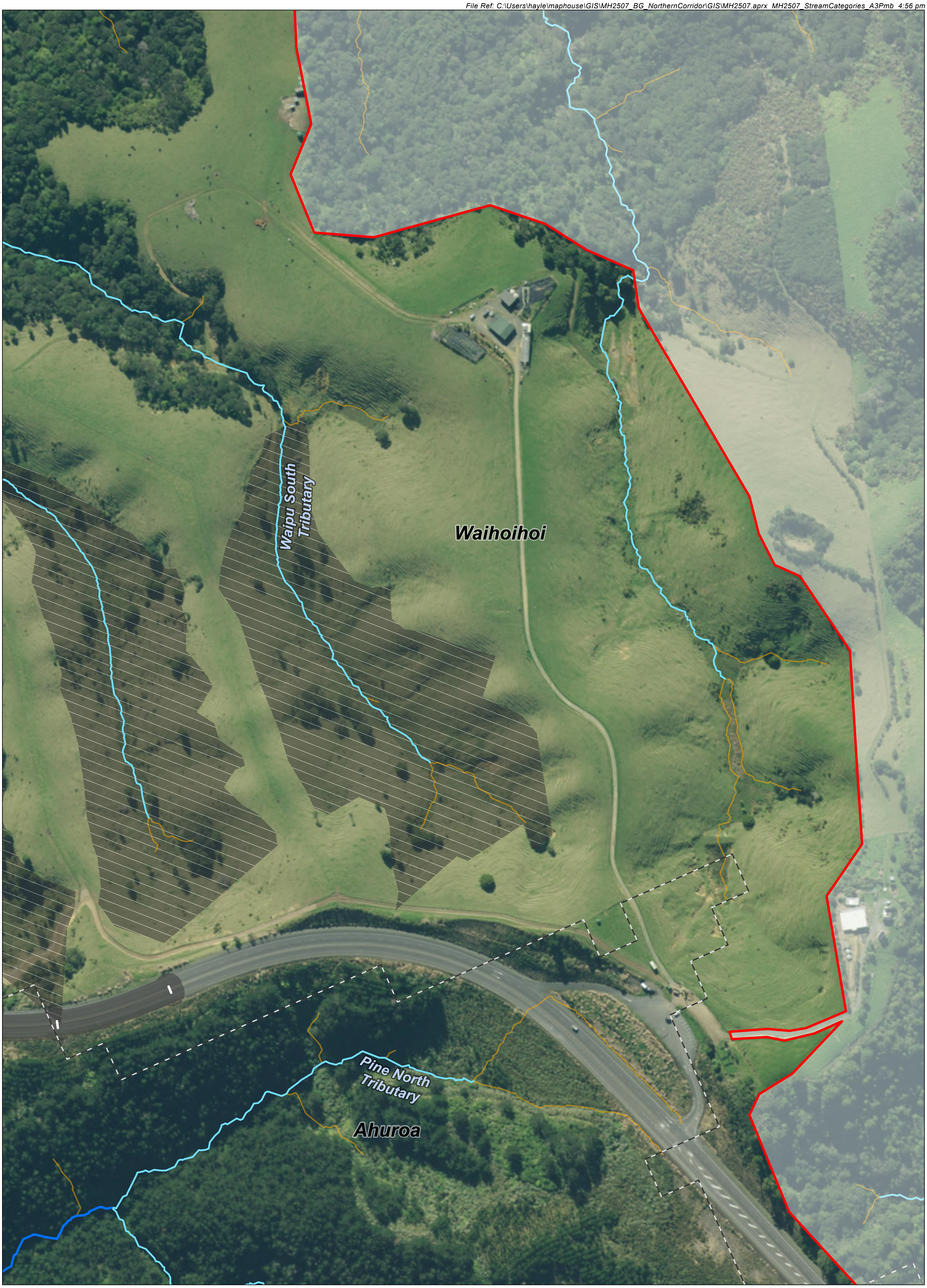
Stream Category
- Perennial
- Intermittent
- Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

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- Cut & Fill
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Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

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1:2,500 @ A3

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FRESHWATER CONTEXT
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Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
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Intermittent
Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

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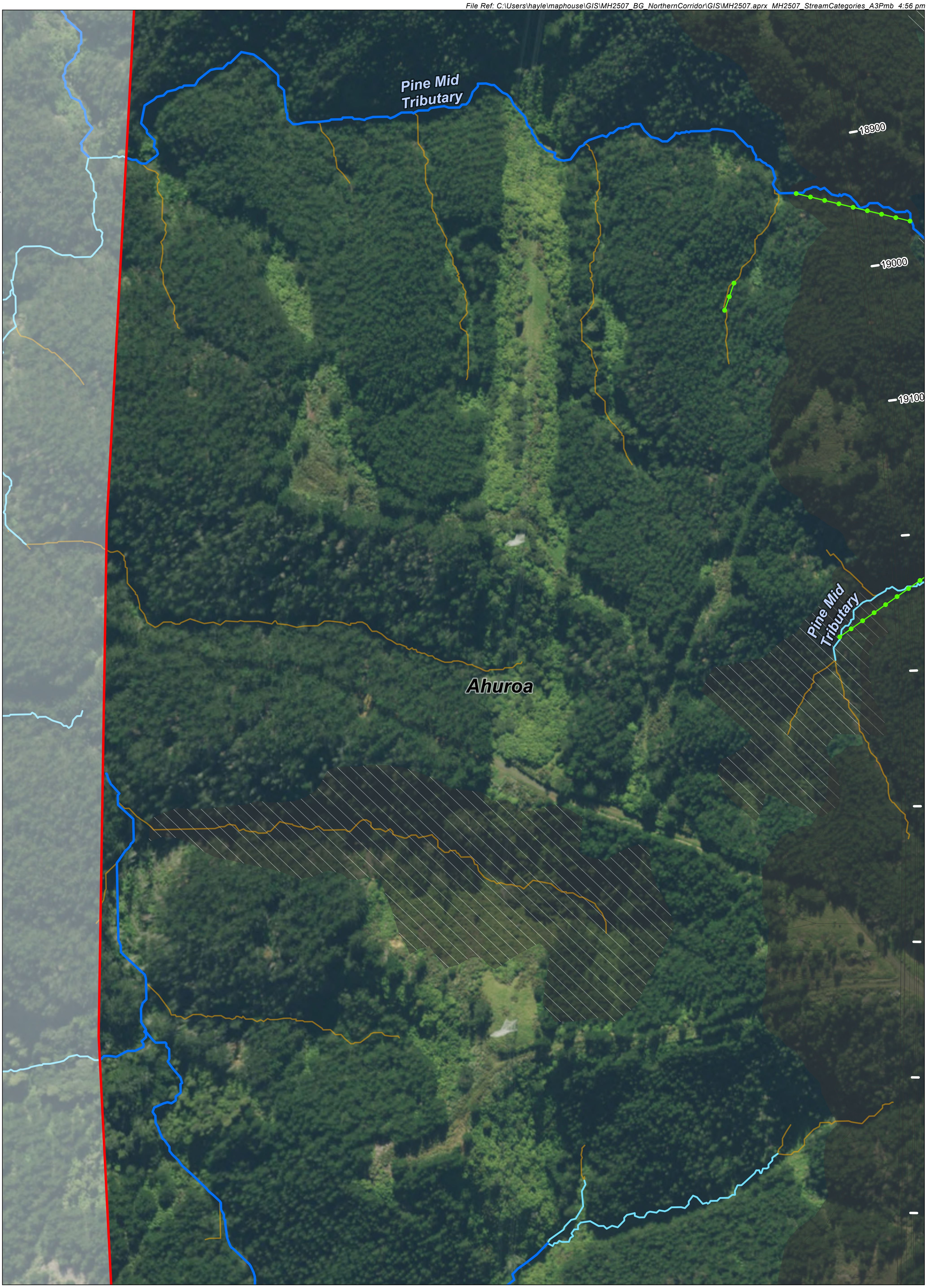

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
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BlueGreen MapHouse

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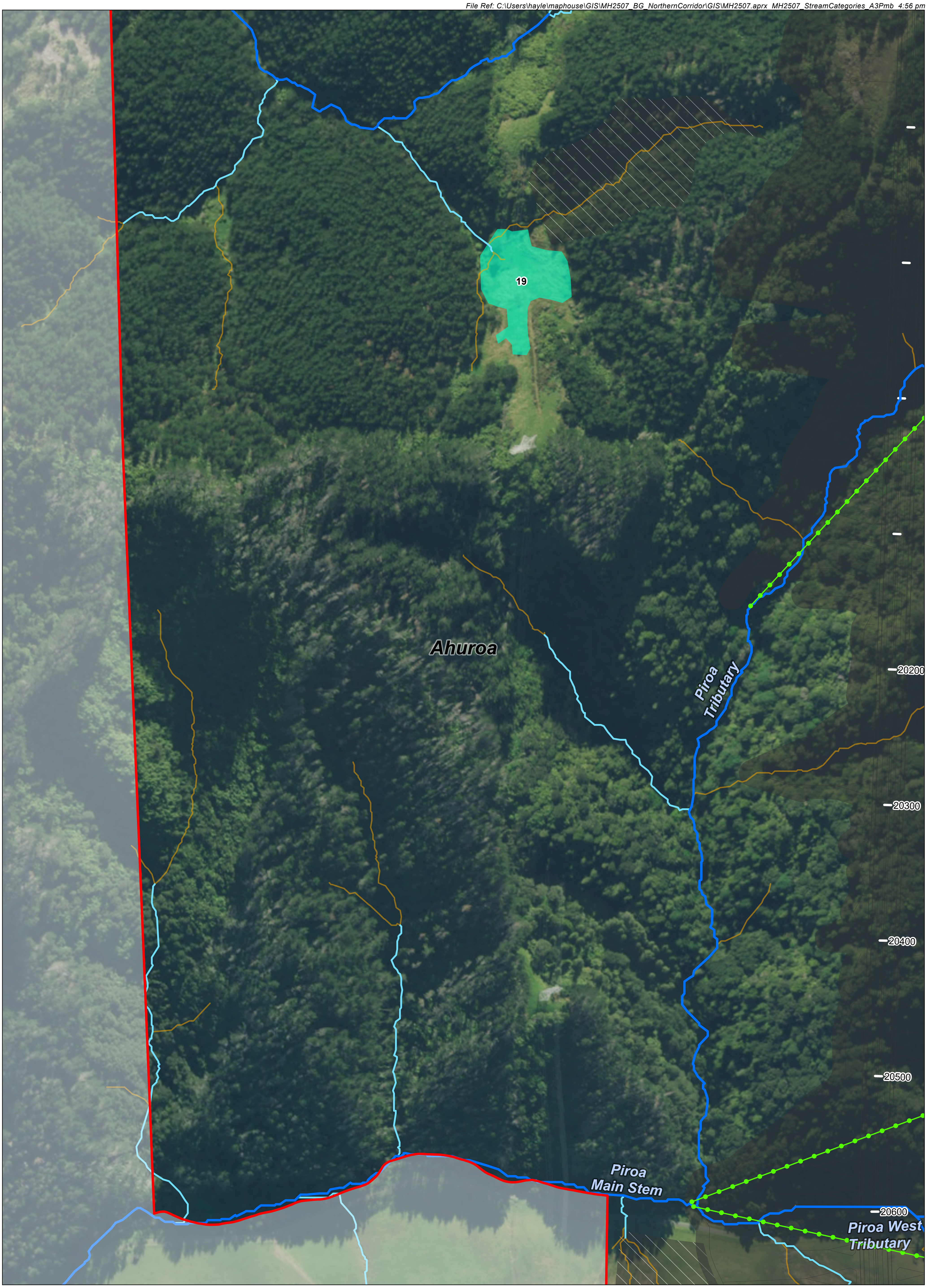

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

- Section 2B designation
- Alignment
- Cut & Fill
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- Potential wetland

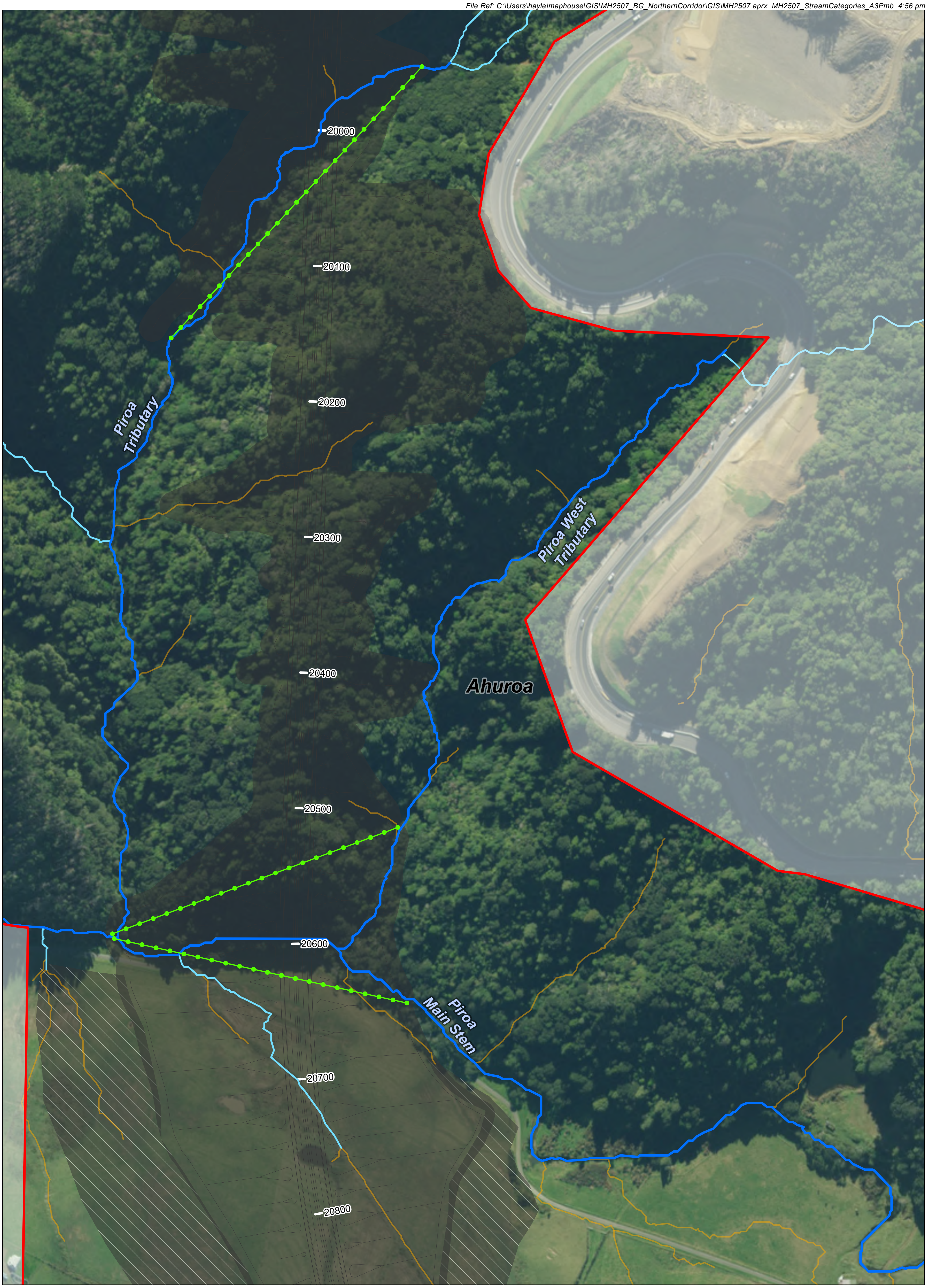
Stream Category
- Perennial
- Intermittent
- Ephemeral

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
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BlueGreen MapHouse

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Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

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0 50 m
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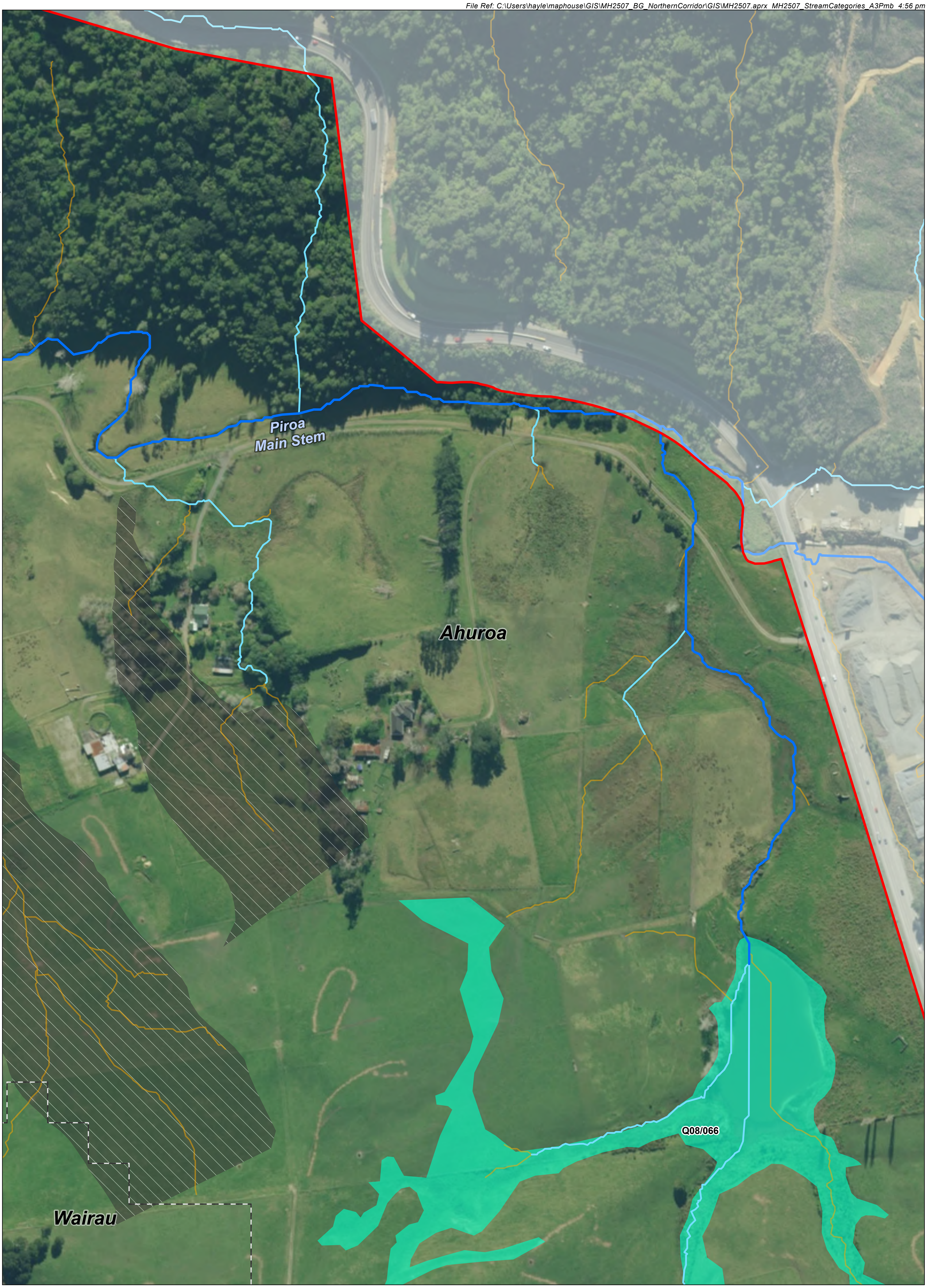
Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

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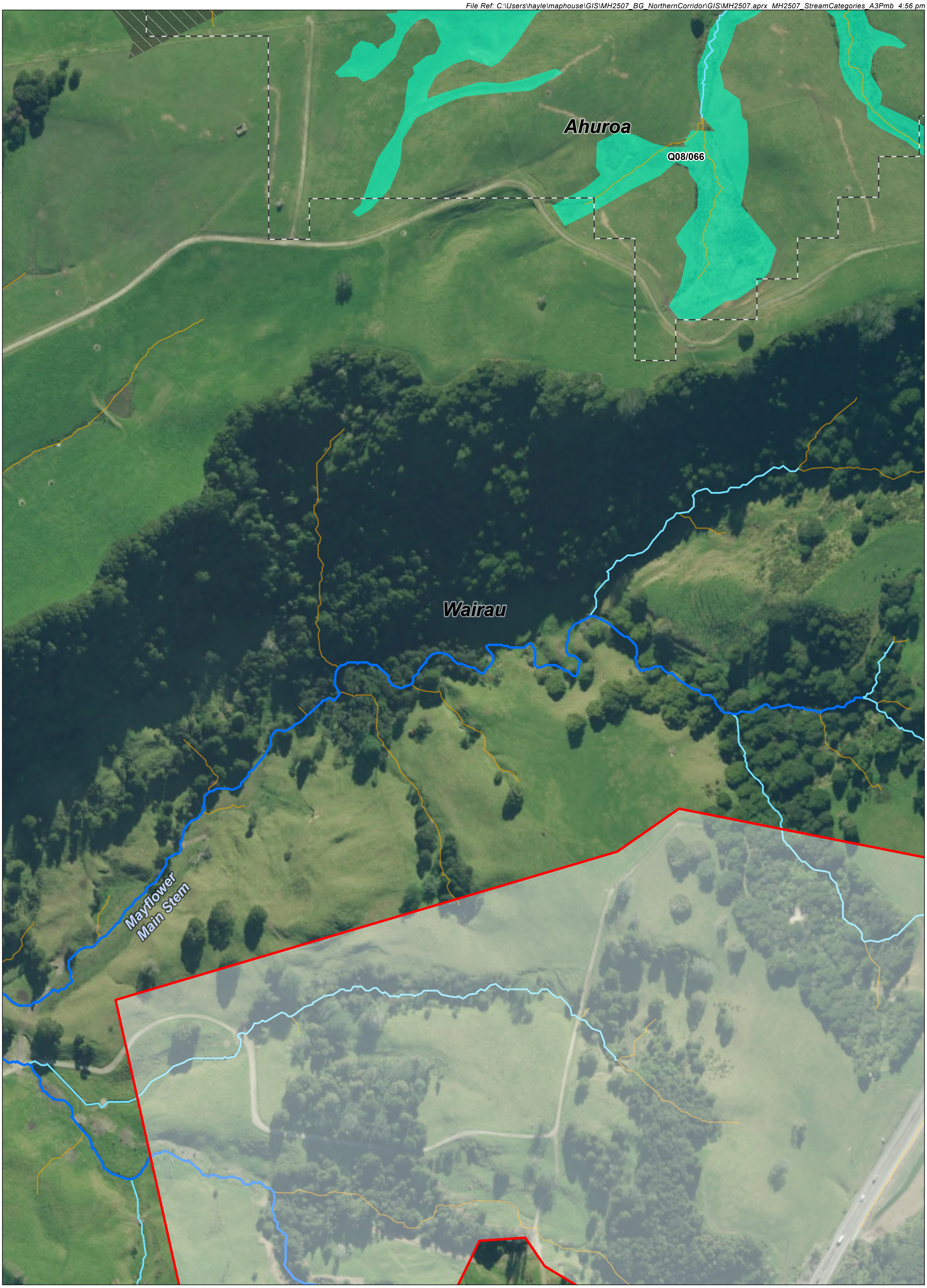
0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
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BlueGreen MapHouse

Section 2B designation
Spoil site
Catchment boundary (REC2)
Potential wetland

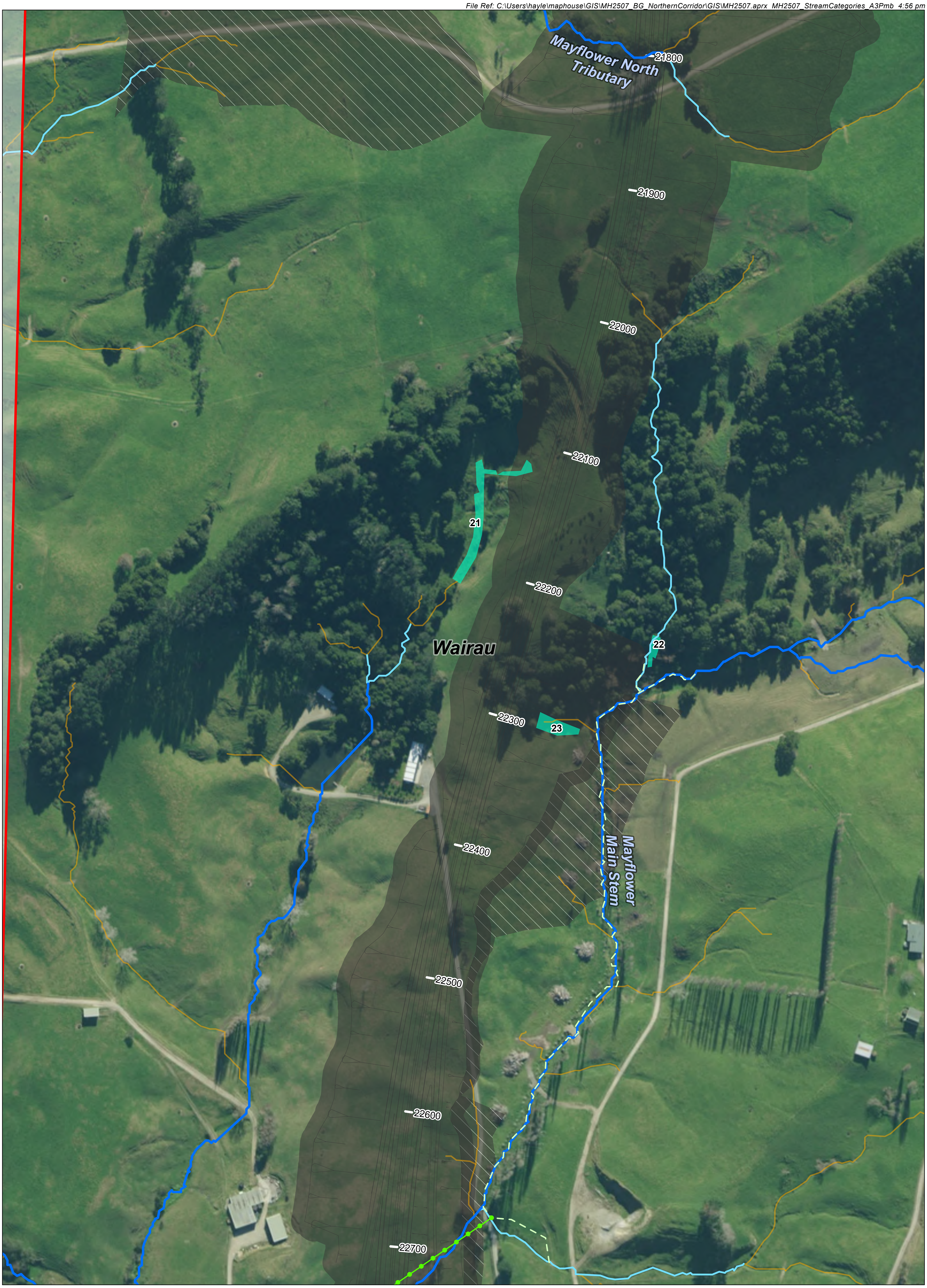
Stream Category
Perennial
Intermittent
Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Spoil site
Catchment boundary (REC2)
Potential wetland

Stream Category
Perennial
Intermittent
Ephemeral

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

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Stream Category
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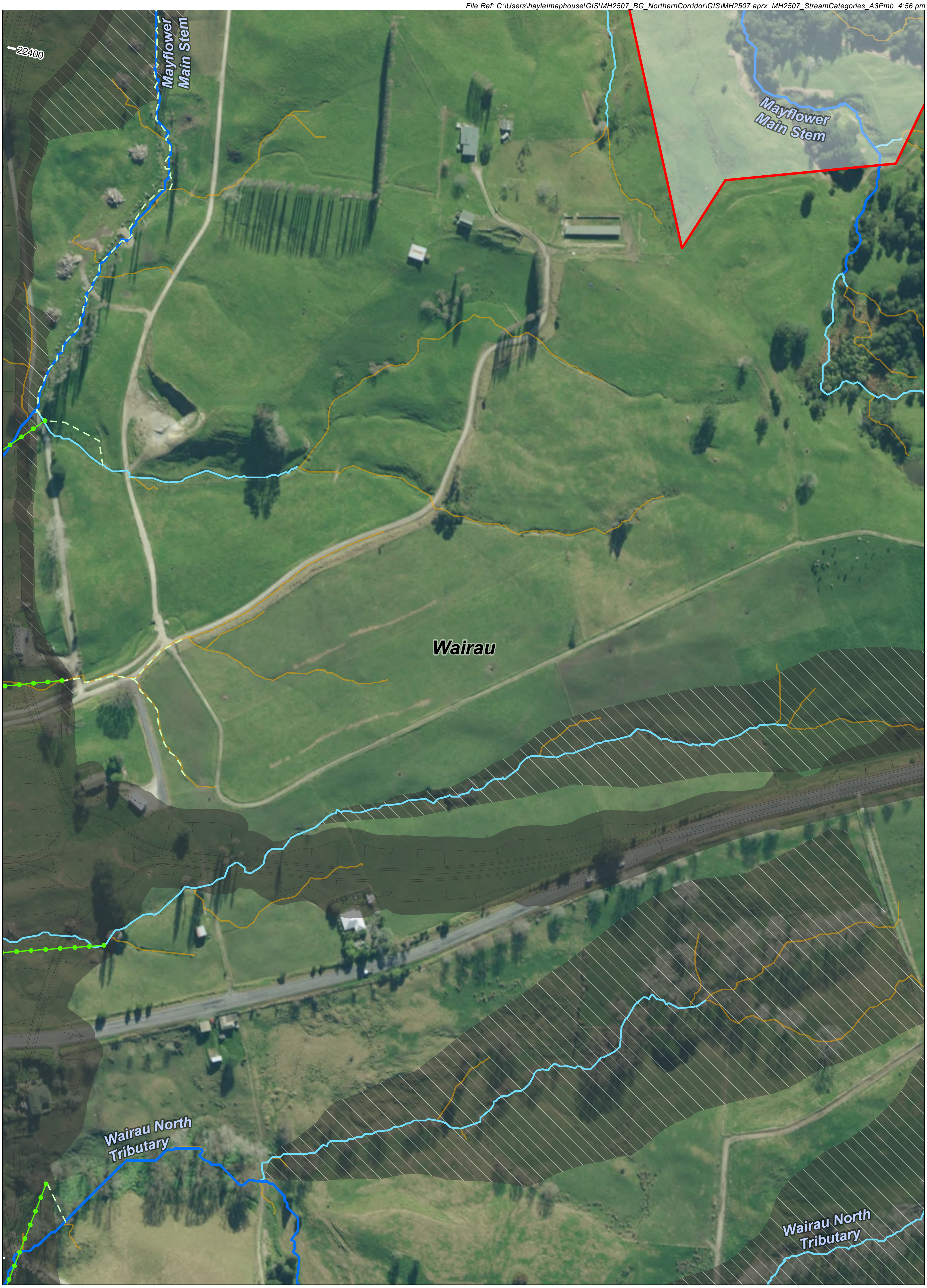
- Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
Spoil site
Catchment boundary (REC2)
Stream Category
Perennial
Intermittent
Ephemeral

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

Stream Category

FRESHWATER CONTEXT
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Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

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DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator

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Potential wetland
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DRAFT

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

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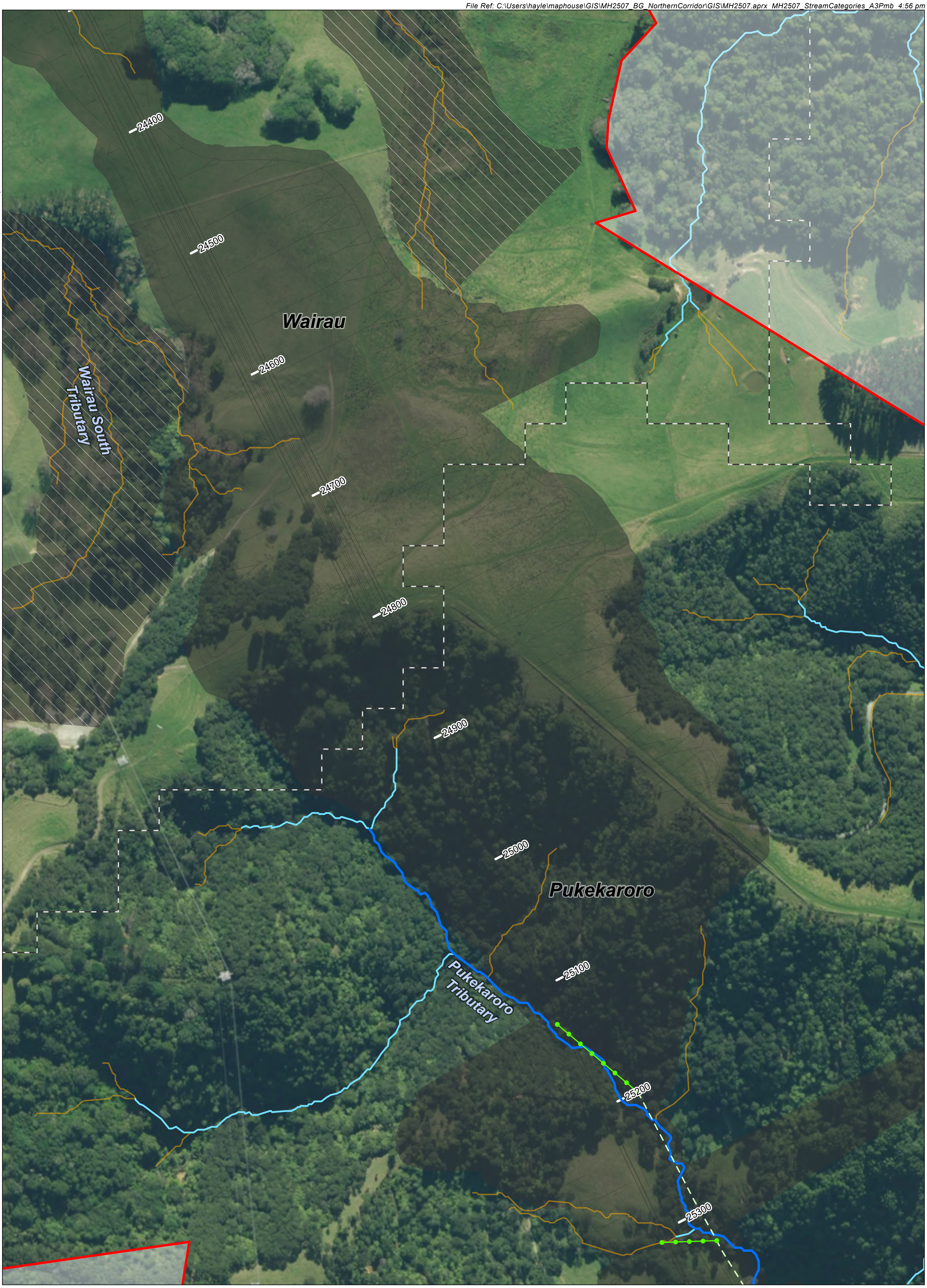
0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
NORTHLAND CORRIDOR SECTION 2B
Plan prepared for Waka Kotahi NZ Transport Agency | 26 March 2026

BlueGreen MapHouse

Section 2B designation
Alignment
Cut & Fill
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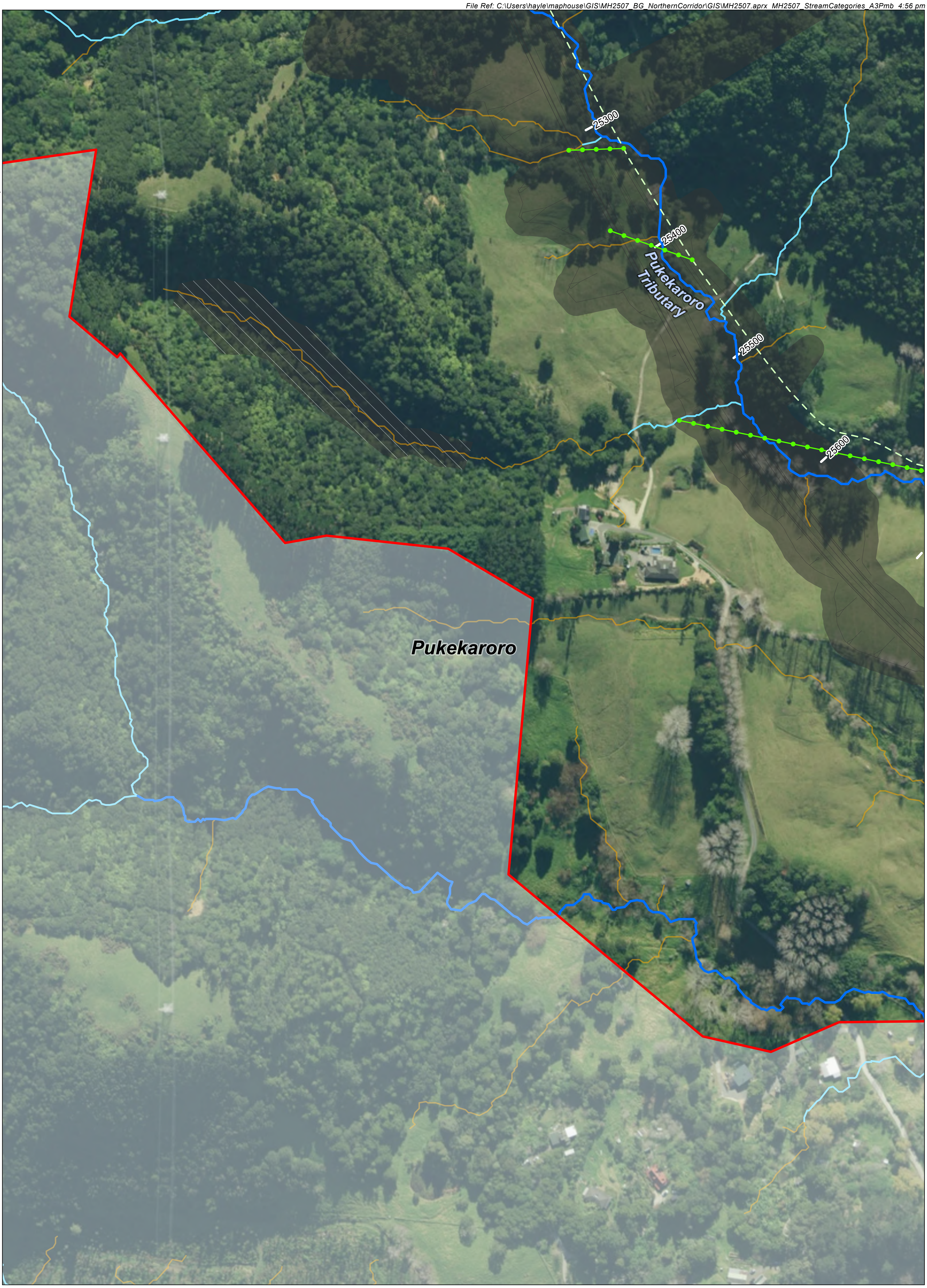
Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

0 50 m
1:2,500 @ A3

DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



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NORTHLAND CORRIDOR SECTION 2B
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0 50 m
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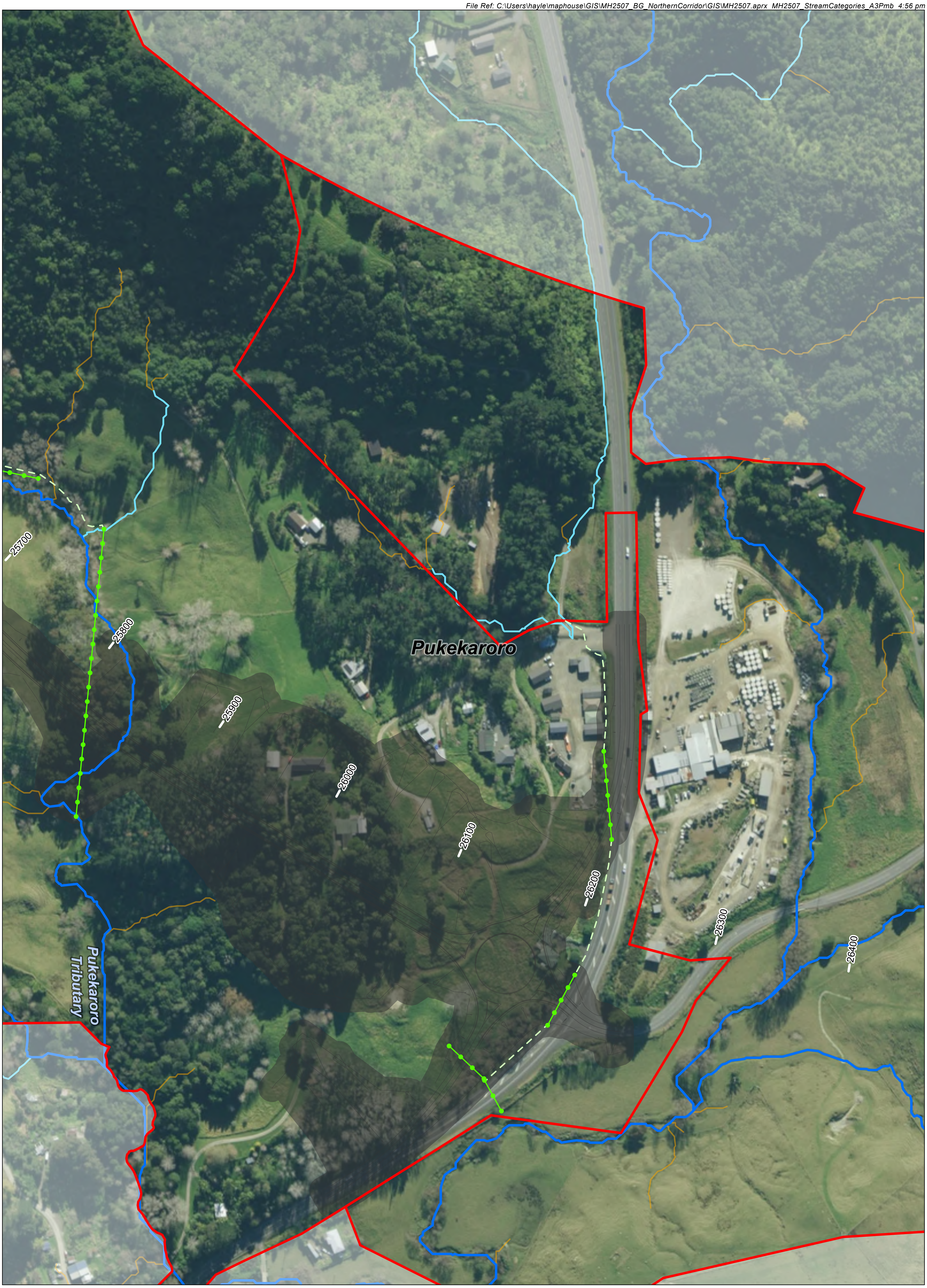
DRAFT

Projection: NZGD 2000 New Zealand Transverse Mercator



Stream Category

FRESHWATER CONTEXT
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Stream Category
Perennial
Intermittent
Ephemeral

0 50 m
1:2,500 @ A3

Data Sources: Waka Kotahi NZTA, NIWA, Eagle Technology, LINZ

DRAFT

Appendix D
Description of Streams

Name (map label)	Description	Photos
Pukekaroro Catchment		
Pukekaroro tributary	The Proposed Designation intersects with one tributary of the Pukekaroro catchment. This tributary is located to the west of SH1 and is one of three similar forest clad headwater tributaries in the immediate area that drain south to the main stem of the Pukekaroro Stream. The headwaters of this tributary are in regenerating native shrublands (kanuka shrublands with tree fern in the main). The initially steep cascaded headwaters cut into hard substrates, softening downstream. These headwaters are typically narrow and shallow and are probably somewhat intermittent year to year. This steeper forested section of the tributary runs for about 400m until it opens into farmland. The stream then traverses areas of mixed riparian condition, including exotic, pine and pasture plant species. The tributary is then (downstream) generally under some form of tree cover for the next 1200m until it passes under the SH and joins the main stem. The channel of this tributary is typically 1m wide with well-defined banks. There is a mix of bed substrates within this tributary, but over half are sedimented, burying much of the sands and fine gravels, leaving the larger cobble exposed and some gravels in the shallow areas. The bed rock bank areas are covered in moss, liverwort and areas of paratanewha, adding cover and some habitat for kōura and frogs. The geology in this tributary is soft, comprising allochthonous under dacite (a soft volcanic material prone to fine sediments with high suspension qualities giving lasting milky waters). Pools within the tributary are infrequent and small while velocities are typically high (0.4m/s). Woody debris is common but small and there are some (but not accumulated) native course organic inputs (i.e. leaf material). This tributary is 95-140m above sea level and approximately 4.5km inland of the major coastal river meaning migratory fish access is difficult. Based on these factors, I consider that it is highly likely this tributary (if not the majority of this headwater) will only have a thin sheet flow during summer, and therefore no stable fish habitat. I consider it is unlikely to be an important habitat for native fish.	 **Headwater stream in the Pukekaroro tributary.**
Wairau River catchment		
Pukekaroro southern tributaries	Predominantly small and mostly ephemeral headwater tributaries that drain generally west into wetland 26. Some are partially held up by farm crossings and dams downstream. The converge after wetland 26 to then pass north to the main Wairau stem. Typically, they are in pasture and are seasonally dry.	

Northern Wairau tributary (Puriri Downs)	This tributary starts a little east of the existing SH1 in the pine vegetated south slope of Puroa Hill. It travels down the valley westward through at least two access road culverts, meeting the main stem of the Wairua main stem near SH16. The reach of this tributary likely to be impacted by the indicative alignment is highly modified, likely a manipulated channel covered in arum lily. About 2000 linear meters upstream, the tributary traverses farmland with mixed exotic treelines or pasture along the margins. The tributary continues downstream for around 1000m, until it rejoins the main stem of the Wairua River. The channel is around 1.5m in width which was the wetted width when surveyed. The tributary is a deeper run at on average 300mm with several deeper areas of 500-600mm. Velocities are moderate to slow (0.2m/s), but the bed comprises almost entirely soft (aerobic) sediments. The riparian condition of this tributary is full of pest plant species, including dense tradescantia along the bank and into the water and arum lily. Both are problematic weeds, blocking light and instream flow. There are also the occasional willow and a few cabbage trees along the riparian margins of this stream. This tributary is 50m above sea level and some 7km inland of the nearest major coastal river. Given the depth and sediment cover of the tributary, it is likely that only eel will be common in this channel (along with kōura).	
Mayflower property	The Mayflower property contains a large tributary of the Wairau River and a number of ephemeral and intermittent farm drainage systems. Further north of the forested escarpment on this property, there is also a small tributary which has a stock pond in the headwater and a long ephemeral section leading into a perennial restoration site and further ephemeral channels (as shown in the maps in **Appendix B**). The intermittent farm drain system is a very poor condition, comprising grass edges, eroded banks, low flows and a full macrophyte cover. While all the channels are not ephemeral, the amount of surface water is insufficient for fish and the macroinvertebrate community given it has a sediment base with a full cover of pasture grasses and macrophyte (false water celery). There are number of small culverts facilitating farm tracks which also result in fish barriers. The mainstem of the Mayflower property is a tributary of the Wairau catchment (stream 3) and runs from near the existing SH1 south along the fault scarp for the length of the native forest escarpment. After this the tributary continues through open grass / farm to the SH12 / Brynderwyn Road intersection. At this point, the tributary flows as an open channel under SH12 to join the main stem of the Wairau River. The Proposed Designation runs through the southern end of the main forested escarpment and around 1100m of stream remains above the Indicative Alignment in this location. At this location, the stream is perennial in a channel, varying in width between 2m to 6m bank to bank. The stream has a typical wetted width of 1.0m and gravel beaches on the sides (although sometimes the wetted width is as wide as the banks where these are narrow (1.5m)). The depth of the stream varies but is typically in a moderate velocity run (average 0.4 m/s) around 100 mm depth. Runs are the dominant habitat but there are occasional pools (Ca 300mm) and some small waterfalls (often with accumulated wood).	 **Unmeasured intermitent and ephemeral drainage channel on the Mayflower property.**

	The bed substrate is a mix of medium cobble over sands and gravels with a sediment composition of around 20%. The true right (north) side banks of the stream have the last of the scattered trees (nikau, willow) of the more fully forested section up stream, and then for most of the indicative alignment affected reach, open grass and cut down exotic trees. The true left side bank of the stream is entirely pasture grasses and weeds. Bank erosion is evident and common across the stream length. There are several plastic culverts currently located in the stream including at least one that is perched and therefore a fish passage barrier, as well as several small waterfalls.	 **Looking up stream of the Mayflower main stem**  **Looking downstream on the Mayflower main stem over a perched culvert.**

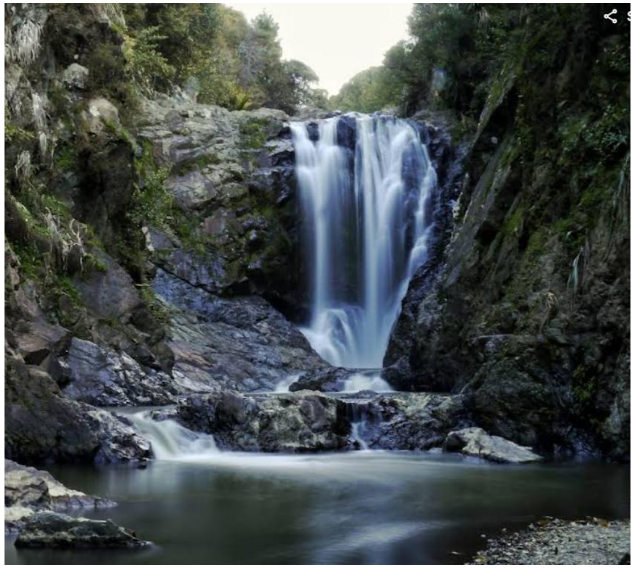
Northern Mayflower Wairau tributary	North of the forested escarpment on the Mayflower property is the second tributary system. This tributary system starts just above the Indicative Alignment as a dammed stock pond. Below this dammed stock pond is an ephemeral channel better described as a narrow linear wetland except that it does not meet the definition of a natural inland wetland in the NPS-FM. This ephemeral channel enters a small tree canopy area and a culvert under a track down stream. The stream is met by a small tributary on the downside of the culvert, which is also supported by a dammed farm pond and ephemeral channel above the confluence. At about this confluence, the stream is in a formed and deeper channel with riparian shade of native trees. The flow of the stream is intermittent, before becoming perennial downstream. This perennial system enters a fenced off section that appears to have received riparian revegetation effort. Prior to that point, the system is a run with an average depth of 80mm and a velocity of 0.24m/s. There are no deep pools. The substrate retains small gravel and cobble areas but is 70% sediment. Lower down bed rock areas are evident and are an unusual feature of this tributary. Most of the tributary within the Indicative Alignment is ephemeral channel, but the western edge affects the confluence and the intermittent reach, and a short distance of the perennial reach (away from the restored area).	 **Ephemeral upper section of the Mayflower north tributary**  **Lower reach in restoration planting of the Mayflower north tributary**

Mayflower third tributary	The third tributary in the Mayflower property further north, is not directly affected by the Indicative Alignment. This tributary begins as a dammed wetland area with old native trees (puriri and kahikatea) leading to an ephemeral channel that becomes intermittent that eventually joins with the earlier described northern tributary of the Mayflower property. In my opinion I consider that it is highly unlikely there is a stable fish population in this upper headwater portion of the tributary. However, there may be a resident long fin eel or two in the perennial section below the track culvert.	
Waihoihoi Catchment		
Waihoihoi main stem	The Waihoihoi River is one of the main rivers that intersects with the Proposed Designation. The river has a median flow of 0.28 m3/s, but an average flow rate of 0.540 m3/s that drops to 0.09m^3/s (7 day MALF). This river arises in the coastal Waipū hapu (lagoon) and passes south through a low lying flood plain back into the Brynderwyn Hills east of SH1. Much of the upper catchment of this river is in forests. However, the lower reaches of this river are in farmland and are recorded as having poor water quality related to discharges from that land use. The river varies in wetted width along its lower course from 5m to 8m. Areas of the river are covered in willow or have raised banks with old macrocarpa. However, much of the riparian cover is periodic and largely comprises weeds, pasture grasses and low scrub. There are occasional side braids that form small islands. Willow is prominent both in channel where depth allows it and along many edges. The substrate is predominantly sands and sediments with large *Egeria* (exotic) submerged macrophyte rafts holding those sediments. Large woody debris is not infrequent and important habitat. As with the Ahuroa River, this lower reach of the Waihoihoi is the gateway for all migratory fish species that pass between the uplands, and the salt influenced lower river and sea. The river also includes inanga spawning (downstream) and marine wanders. The river is good habitat for short fin eel and will produce large amounts of tuna food in the form of chironomids that enjoy the heavy sedimented bed and organic enriched waters.	 **Waihoihoi man stem at about the Indicative Alignment position**

		 **A side branch of the Waihoihoi main stem forming an island**
Robertson's stream	This tributary is a small highly modified stream of the lower Waihoihoi River on the west (between the existing SH and Waihoihoi River). This stream arises as groundwater surfacing in and around a remnant stand of totara fenced with under growth (but also old farm rubbish). The stream then passes as a series of artificially dug drains in paddocks northward to coalesce into a single stream channel. That channel drains northward forming in to slightly better aquatic habitat until the SH 1 is reached and then after 400m running parrel to the SH turns east and then north again to reach the Waihoihoi. The stream is almost entirely modified with almost nothing remaining of its natural state. There is only one small area of exotic tree buffer (only on the true right side) under which is a dense cover of Tradescantia to and over the banks edge. The stream has exclusion fencing set at 1m from the bank and that vegetation is rank pasture (exotic three cornered garlic). Duck weed and starwort are prominent as surface water cover and submerged macrophyte in the more northern deeper channel. The channel itself is 1m wide and has a wetted width of 1m (bank to bank). The depth is typically 250mm and entirely run habitat with some deeper 400mm areas. Velocity is very uniform and slow at 0.14m/s. The substrate throughout this section is 100% deep muds and sediment.	 **North end of Robertsons**

		 **Central channel collecting paddock sub-channels in the Robertsons**
Waipu north tributary	The northern Waihoihoi tributary (chainage 16500) starts as a wet paddock area just south of SH 1. The surface flows are near the upper end of the forested area, and the stream bed is steep with a series of small pools and water falls in the first 40m. After this point, the tributary levels to a relatively flat run for the next 50m before becoming a stream within a defuse wetland flood plain feature under forest for the next 200m. The tributary then opens out into a paddock wetland area (wetland 12). In the area likely to be impacted by the indicative alignment the stream varies in width between 0.5m and 1.2m with a few 2m wetted width areas, and the banks extend up to 6m wide. The runs and riffles are shallow (100mm) and generally slow (0.1m/s), but there are a few faster riffle sections up to 0.4 m/s. The substrates are a mix of sediment (60%) and medium cobble with small amounts of gravel becoming near 100% sediments in the flatter wetland gully area downstream. The riparian cover is loose native trees but largely only good cover on the true left (north) side. There is little good fish habitat until the short 40m section above the first water fall and instream woody debris and litter is minimal.	

Waipu south tributary	The Southern tributary (chainage 17200) has a reasonable native forest riparian cover over a steep sided deep gully. The upper most part of the stream is ephemeral, and it is not until near the tributary intersects with the Indicative Alignment that the flow become intermittent. At this point, there was a pool in which we observed two banded kōkopu. In this location, the stream is commonly around 1 m wetted width and sits in a bank-to-bank system of around 2m. It is a shallow collection of long runs and short step sections of riffle and pool. The run sections are Ca 100mm deep and there are slow and fast water sections (0.1-0.6 m/s). The substrate is a mix of large and medium cobble on bed rock but there is a quarter of the bed covered in sediment, and turbid water occurs frequently we suspect. There were only small amounts of woody debris and leaf litter in the stream. While the amenity of the stream appears good, the aquatic habitat present is not as good as the amenity suggests with considerable sediment and minimal water. Lower down the stream and its aquatic habitat conditions improve. These remnant forested farmland stream habitats are complex as they contain a range of conditions, have some good qualities and offer some quality habitat. However, they also have a range of modifications that reduce the persistence of some species and the ability of others to colonise.	
Ahuroa- Waipū Catchment This catchment drains into the Waipū coastal hapu from the surrounding hill country into the Brynderwyn to the south and the Mareretu Forest to the north. The Ahuroa River is one of three main rivers that enter this coastal lagoon area. It has an average flow of 1.25 m3/s and a median flow of 0.56 m3/s. The low annual flow (7 day MALF) of the catchment is recorded as 0.16m3/s. The Ahuroa River is a moderate sized river, wide in the lower river plains but becomes much narrower with greater velocities in the hill country south (The Waipu Gorge). LAWA data (measured in the Waipū Gorge) suggests that the river is unsuitable for swimming in terms of its water quality. The issue is primarily *E. coli* levels which 40% of measures are unsuitable (contact recreation).		

Piroa main stem	The Piroa stream is the southern most of the main tributaries draining to the main stem of the Ahuroa River. On the southern side is pasture and on the northern side is forest, mostly native with some pine. The Indicative Alignment is around 1km downstream of the Atlas quarry and the headwaters pass under SH1, through the quarry and back up into the forested hill lands east of the quarry for around 900m. There is an array of culverts and channelling of the stream through the quarry. Downstream the Piroa Stream changes direction to the north to pass through the Waipū Gorge and in doing so it passes over the Piroa waterfalls, a significant natural fish barrier. The main stem is typically between 4m and 6m wide bank to bank and has a wetted width commonly around 3-4m. It is most commonly run habitat of relatively uniform depth at an average of 320mm with an average velocity of 0.3m/s (although there are 0.8m/s fast sections and 0.1m/s slow glide runs). The bed substrate has areas with high amounts of surface sediment cover but is best described as bed rock and boulder with an array of cobble sizes and small amounts of gravel. The riparian condition is reasonable on the true right with native forest near but not always hard up against the bank. The riparian condition on the true left is mostly open with scattered shrub and tree fern.	 **Piroa Falls (outside of the Proposed Designation)**  **Piroa main stem at about the Indicative Alignment.**

		 **Piroa main stem at old Transmission line service track**
Western Piroa Tributary	This tributary has a minor (first order) branch to the north part way up stream (300m), originating in a pine plantation forest. The headwaters also are in the pine plantation forest, but around 800m of the lower stream is in maturing native forest. While the headwaters have a very steep section resulting in pool and waterfall habitat the majority of the lower stream is relatively flat and is run and riffle habitat. There is a higher than expected amount of sediment in the bed given the native forest setting, reflective of the erodible banks, high velocity waters during rain fall and historic plantation logging. The reach at the Indicative Alignment is relatively uniform in bank width and in wetted width and depth. Commonly the width of the tributary in this location is 2m, but the eroded banks have blow outs that can expand up to 3m. There is no flood plain, the stream is deeply set and the slopes either side are fully vegetated but relatively steep. The substrate is over 60% sediment, with a scattering of various cobble sizes and areas of bed rock. There is little woody debris, but occasional wood dams which collect leaf litter. The typical depth of the runs is 110mm and the riffles 50mm. The velocities in the main area of this tributary (below the upper water fall section are slow at Ca. 0.1m/s (when not raining). Given the depth of water, limited cover and simple shallow habitat opportunity (noting the distance inland and the barriers to fish passage despite the native forest cover), we anticipate only a few banded kōkopu will be located in few pools (at the water fall areas up stream) (see eDNA results in section 3 of the assessment above).	

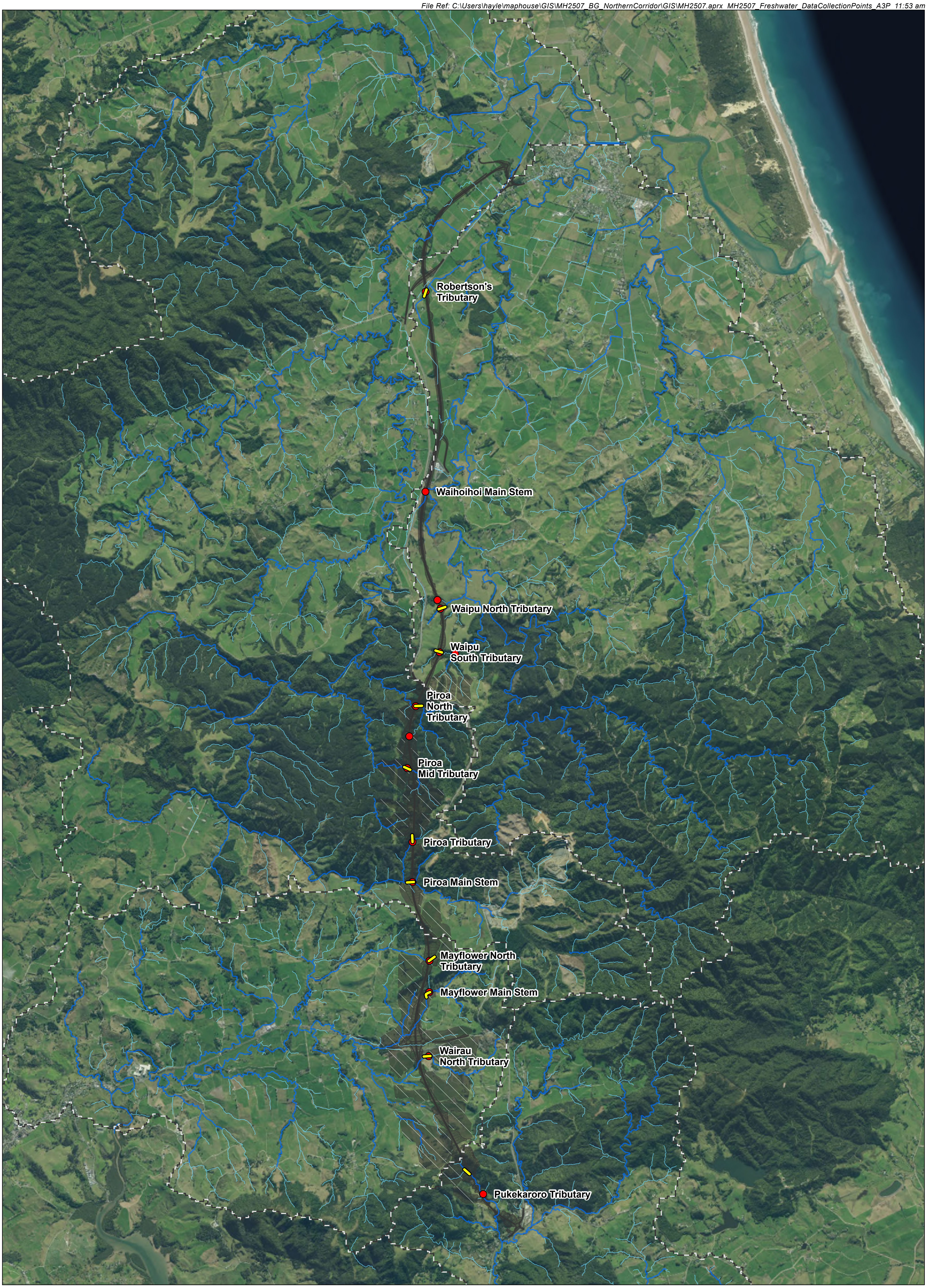
Eastern Piroa tributary	The eastern tributary is shorter with a smaller catchment area. There is less than 250 m of stream above the existing SH1, and no fish access past SH1 because of the nature of the SH 1 retaining wall and piping. This stream is approximately 600m in length, ranging from very steep and in small water falls north to relatively flat small runs and pools in the lower portion (south). At survey, the confluence with the Piroa main stem was strong (Ca. 12L/s) through a larger cobble build up. No SEV was carried out in this tributary as it will be sufficiently similar to that of the western tributary and there may not be effects to the tributary. On that basis, we consider that the MCI in this stream is likely to be around 120 with a QMCI towards 7. However, fish abundance is likely to be restricted to banded kōkopu, and only a few in any stable pool.	
Mid pine tributary	The second largest tributary in the pine plantation area is the middle tributary, at chainage 18950. This tributary comprises 800m of stream and several ephemeral side tributaries above it. This stream is perennial and under a pine forest, resulting in pine needle litter in the bed and substantive amounts of pine slash that acts as dams. There is a fair amount of sub canopy riparian cover of native lower tier vegetation. The stream system is relatively complex with a degree of varying steepness causing cascades, pools and riffle and run sections. Most notably, there are sizeable pools. However, there is a considerable amount of sediment covering the bed, likely reflective of surrounding land uses over time. The channel width is typically 1.2m wetted width of water and 2m bank to bank although this narrows and expands. The average measured depth is 140mm, with pools ranging from 200-300mm in depth. Velocities average at 0.15 m/l, but there are sections of faster water at 0.4m/s. Bed rock was the most common substrate (Ca. 50%), demonstrating the high water velocities of the hills. While sediment is clearly evident in the photographs, its measure was < 20% bed cover, and there are scattered cobbles and clusters of cobble substrate in faster water areas. There have been several fish surveys up the northern and southern tributaries of this stream, indicating there are banded kōkopu and kōura below this area (eDNA survey data and through Wilderlabs open site data). The habitat in this stream is suitable for banded kōkopu, red fin bully and long fin eel.	

Northern pine tributary	The northern pine plantation tributary (chainage 17990) is similar to the middle pine tributary in all aspects. However, it is a larger tributary with a larger upper catchment than the middle stream with more tributaries that feed into it. The upper reach a little below SH1, and the longest headwater that intersects with the Indicative Alignment is around 1600m of largely intermittent aquatic habitat under pine forest. The wetted width through this section of stream averages 1.85m inside a bank around 3m wide. In this location, there is a run and pool system with occasional fast run almost riffle sections. This is the deepest tributary in the pine forest area, measuring an average of 200mm in depth, mostly as run sections but with pools up to 400mm and fast almost riffle sections up to 100mm in depth. Velocities are also faster than elsewhere in the pine forest, averaging 0.33m/s and up to as fast as 0.77m/s. The substrate is composed of a mix of cobble, some bedrock and a fair amount of large cobble (23%). However, the substrate with the largest cover is sediment (31%). The riparian condition is relatively open upper canopy pine with a mixed broadleaf shrub and tree fern cover. This cover provides substantive shade (70% +) to the aquatic habitat. Woody debris is also common but mostly comprising pine.	

Appendix E
Freshwater Data Collection Points

File Ref: C:\Users\hayle\maphouse\GIS\MH2507_BG_NorthernCorridor\GIS\MH2507.aprx MH2507_Freshwater_DataCollectionPoints_A3P 11:53 am

Projection: NZGD 2000 New Zealand Transverse Mercator



Data Collection Points

NORTHLAND CORRIDOR SECTION 2B

Plan prepared for Waka Kotahi NZ Transport Agency | 25 February 2026

BlueGreen MapHouse

Spoil site
Cut & Fill
Alignment
Catchment boundary (Rec2)

Stream Category
Perennial
Intermittent
eDNA sample
SEV

0 1 km
1:50,000 @ A3

Data Sources: WSP, BlueGreen Ecology, NIWA, Eagle Technology, LINZ

DRAFT