REPORT

Tonkin+Taylor

Glenbrook Steel Mill Discharges

Freshwater Ecological Values and Effects Assessment

Prepared for
New Zealand Steel Ltd
Prepared by
Tonkin & Taylor Ltd
Date
March 2024
Job Number
1010577.2000 v3

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Document control

Title: Glenbrook Steel Mill Discharges					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
09/06/2021	1	Lodged version	M. Baber P. Lees	J. Quinn	J. Simpson
27/10/2022	2	Updated report for s92 response	P. Lees	J. Quinn M. Baber	J. Simpson
March 2024	3	Updated to include EAF	P. Lees S. Heggie-Gracie	J. Quinn M. Baber	J. Simpson

Distribution:

New Zealand Steel Ltd 1 electronic copy

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Glossary of Terms

Term	Meaning/ what happens here
Best Practicable Option (BPO)	Defined in section 2(1) of the Resource Management Act 1991 (RMA), as: *"in relation to a discharge of a practicable contaminant or an emission of noise, means the best method or option for preventing or minimising the adverse effects on the environment having regard, among others things, to —* *(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and* *(b) the financial implications, and the effects on the environment, of that option when compared with other options; and* *(c) the current state of technical knowledge and the likelihood that the option can be successfully applied."*
Brackish water	Water occurring in a natural environment that has more salinity than freshwater, but not as much as seawater.
Conductivity	Conductivity is a measure of the ability of water to pass an electrical current. It is an indirect measure of charged particles, such as dissolved salts and other inorganic chemicals. High conductivity is an indication of high salinity.
Contaminant	Defined in section 2(1) of the RMA, as: *"including any substance (including gases, odorous compounds, liquids, solids, and micro— organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat— (a) when discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or (b) when discharged onto or into land or into air, changes or is likely to change the physical, chemical or biological condition of the land or air onto or into which it is discharged."*
Council	Auckland Council.
Current Environment	The environment as it currently exists. Monitoring data and investigations undertaken during the preparation of this application describe the Current Environment, which reflects the effects of the operation of the Steel Mill over the past 53 years.
Dewatering Plant	Where the ironsand (or Primary Concentrate (PC)) slurry received from the ironsand mine is dewatered before stockpiling. This plant also includes a dedicated water treatment facility.
East Landfill	NZ Steel's existing active landfill located on the northern side of Brookside Road within the Site. This is subject to a separate suite of resource consents that are not within the scope of this replacement consents application. However, this application seeks authorisation for the ongoing discharge of landfill leachate from the Northside Outfall.

Term	Meaning/ what happens here
Electric Arc Furnace (EAF)	A furnace that heats material by directly exposing it to an electric arc and the current from the furnace terminals passes through the charged material. The EAF will enable reduced use of virgin steelmaking materials (including coal) and instead recycle Ferrous Scrap using electricity
Existing Permits	NZ Steel's existing discharge permits authorising the discharge of stormwater from the ITA Area, process water from the Steel Mill, and leachate from the East and West Landfills: • Permit 41027 – Industrial or Trade Activity (ITA) discharges • Permit 21575 – Northside Outfall discharge • Permit 21576 – Southside Outfall discharge • Permit 21577 – Dewatering Plant discharge These discharge permits all expire on 31 December 2021.
External Scrap	Ferrous Scrap that is sourced from sources other than the Steel Mill (i.e., from external sources). External Scrap will be processed off-site by Suppliers (including removal of non-ferrous material, shredding, cutting and grading) prior to arrival on Site.
Ferrous Scrap	Ferrous Scrap will be used in the EAF, it will consist of scrap from two sources: • NZ Steel's steel making and finishing processes (this scrap is referred to throughout this application as "uprisings"); and, • Parties other than NZ Steel (this scrap is referred to throughout this application as "External S crap").
Flashiness	In hydrology the term flashiness reflects the frequency and rapidity of short-term changes in streamflow and is an important component of a stream's hydrological regime. Land use and land management changes may lead to increased or decreased flashiness.
ITA Area	The ITA Area is the area of the Site from which the ITA stormwater is discharged. It includes all ITA activities and stockpiling landholdings, including provisional areas for potential future expansion. The area is bound to the north by Brookside Road and to the east by Mission Bush Road.
Lower North Stream	The Lower North Stream is located to the north of the Steel Mill and flows in a generally northerly direction between the East and West Landfills. Much of the original Lower North Stream was diverted to its current alignment along the West Landfill access road. The Lower North Stream is not officially named. It was previously (erroneously) known as the Northside Stream; however this was incorrect as the Northside Stream was an historical stream that flowed through the site to discharge at the current location of the Northside Outfall. The Northside Stream and valley were removed in the 1980s to facilitate the expansion of the Steel Mill.
Macroinvertebrate	Instream freshwater invertebrate fauna large enough to be visible to the eye without the use of a microscope.
Macroinvertebrate Community Index (MCI)	An index used in New Zealand to measure the water and habitat quality of freshwater streams. The presence or lack of macroinvertebrates such as insects, worms and snails in a river or stream can give a biological indicator on the health of that waterway.

Term	Meaning/ what happens here
Macrophyte	An aquatic plant large enough to be seen with the naked eye.
Metal Cutting Yard	Area in the north-western corner of the ITA Area previously used for metal cutting and recovery activities. Now referred to as the Kahawai Stream ITA Catchment
North Drain	The North Drain is a constructed drain that was constructed in the 1980s to convey Steel Mill discharges and is an artificial watercourse in accordance with the AUP definition. The North Drain flows entirely within the ITA Area and discharges into the Lower North Stream north of Brookside Road.
North Stream Catchment	The North Stream Catchment is the modified catchment area that includes the artificial North Drain ITA catchment and the Lower North Stream catchment. Appendix A Figure W-FWE1.
Process water	Process water is water that is used for a variety of manufacturing processes at the Steel Mill. For the purposes of this application, discharged process water includes both waste process water and landfill leachate.
Riparian margin	An area of land immediately adjacent to a permanent or intermittent river or stream.
Ruakohua Stream	The Ruakohua Stream (sometimes known as Ruakahua Stream) is located to the south of the main operational areas of NZ Steel's site. It is approximately 4 km in length and flows in a south westerly direction to discharge to NZ Steel's Ruakohua Dam. The lower reaches of the Ruakohua Stream were diverted around the NZ Steel development area during the 1970s/ 1980s. Shown in Appendix A Figure W-FWE1.
Receiving Environment	The environment that would exist without the activities and associated effects authorised by the expiring consents (i.e., removing the effects that arise as a result of current operations). In simplest terms, the Receiving Environment is the environment that would exist if the Mill was decommissioned and made safe. This application assesses the effects of the proposed activity on the Receiving Environment. The Receiving Environment is the Current Environment (i.e. the environment as it currently exists), modified to <u>exclude:</u> • the effects of the activity that are the subject of the application; • and modified to include: • any effects of the activity that are the subject of the application that unavoidably persist (e.g. build-up of metals in sediment, ongoing diversion of water in the North Drain, coastal structures); • non-fanciful permitted activities that can occur as of right without additional resource consents (for this application, no permitted land use changes or discharges have been assumed); and • activities that have been granted resource consents that are likely to be implemented (there are no known unimplemented resource consents in the wider area that would have a bearing on this application).
Residual Effect	Effects on biodiversity or ecological values that cannot practicably be avoided, remedied or mitigated.

Term	Meaning/ what happens here
Semi-quantitative Macroinvertebrate Community Index (SQMCI)	An index used in New Zealand to measure the water and habitat quality of freshwater streams. The SQMCI uses both the presence or lack of macroinvertebrates and their relative abundances to give a biological indicator on the health of that waterway.
Site	Includes all NZ Steel landholdings in relation to the Steel Mill at Glenbrook, which includes the Steel Mill (Glenbrook Steel Mill Precinct), industrial landfills and farming activities as well as the adjoining coastal esplanade strip owned by Auckland Council. Shown in Appendix A Figure W-FWE1.
Slag	A co-product of the steel making process that is similar in character to volcanic rock. Slag is a mixture of non-metallic and metallic materials that float on top of the molten iron or steel (removing impurities such as silicon, titanium and sulphur). Melter Slag is a co-product of the iron making process, that is similar in character to volcanic rock. KOBM Slag is a co-product of the steel making process, formed in the KOBM. It has cementitious properties and is used to partly replace limestone on Site. Vanadium Slag is a co-product of the steel making process, formed after oxygen is blown into a ladle of molten iron at the VRU. Steelmaking Slag means both KOBM Slag and Vanadium Slag.
Steel Mill/ Glenbrook Steel Mill	The integrated steel making facility in Glenbrook and ancillary activities on the Site.
Stormwater	Rainfall runoff from land, including constructed impervious areas such as roads, pavement, roofs and urban areas which may contain dissolved or entrained contaminants, and which is diverted and discharged to land and water.
Stream Ecological Valuation (SEV)	A method for assessing the ecological condition of streams based on the performance of their key ecological functions.
Substrate	The material that rests at the bottom of a stream.
Trigger Investigation Level	A numerical value above which investigation actions will be taken. Trigger Investigation Levels are included in the existing Stormwater Monitoring and Management Programme required by the Existing Permits and are proposed in consent conditions to be specified in the Water Quality Management Plan.
Turbidity	A measure of the clarity of water. Turbidity is the measurement of the amount of light scattered by suspended particulates present in the water when a light is shined through the water. The more total suspended particulates in the water, the murkier it can appear and the higher the turbidity.
Waiuku Estuary	The Steel Mill is located on the eastern bank of the Waiuku River which, despite its name, is a long and relatively narrow tidal arm (estuary) of the

Term	Meaning/ what happens here
	Manukau Harbour. For the avoidance of confusion, the term “Waiuku Estuary” is therefore used in this report to describe this area.

Abbreviations/Acronyms

Term	Meaning
AEE	Assessment of Effects on the Environment
ANZWQ	ANZ Water Quality Guidelines 2018
ANZWQ DGV	ANZ Water Quality Guidelines 2018 Default Guideline Value for sediment quality
ANZWQ High	ANZ Water Quality Guidelines 2018 High Guideline Value for sediment quality
AUP	Auckland Unitary Plan – Operative in part
BOC Ltd	British Oxygen Company Ltd
BPO	Best Practicable Option
CMA	Coastal Marine Area
Council	Auckland Council
DGV	Default Guideline Values
EAF	Electric Arc Furnace
EcIAG	Ecological Impact Assessment Guidelines 2018
EPT-a	All taxa within Ephemeroptera, Plecoptera and Trichoptera orders
EPT-b	Ephemeroptera, Plecoptera and Trichoptera orders, excluding the pollution tolerant *Hydroptilidae* species (order Trichoptera)
IBI	Index of Biological Integrity
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
GMT	Gee minnow traps
IBI	Index of Biological Integrity
ITA	Industrial and Trade Activities
MCI	Macroinvertebrate Community Index
NPSFM	National Policy Statement for Freshwater Management 2020
NPSIB	National Policy Statement for Indigenous Biodiversity 2023
NZFFD	The New Zealand Freshwater Fish Database
NZ Steel	New Zealand Steel Limited
OBL	Obligate
UL	Upland
SEV	Stream Ecological Valuations
SQMCI	Semi quantitative Macroinvertebrate Community Index
WDP	Wetland Delineation Protocol
WMP	Wetlands Management Plan

Executive summary

NZ Steel Ltd (NZ Steel) is seeking to replace existing resource consents[1] (Existing Permits) that authorise the discharges of Industrial or Trade Activity (ITA) stormwater and process water from its Glenbrook Steel Mill (the Site).

Three sub catchments of the Waiuku Estuary receive discharges from the Steel Mill. These are the North Stream Catchment (comprising the North Drain and Lower North Stream), the Ruakohua Stream and Kahawai Stream. All three sub catchments also contain wetlands which primarily comprise riparian wetlands that border defined stream channels and together form stream-wetland complexes.

This report provides an:

- Assessment of the ecological values of the streams and wetlands that receive the ITA stormwater and / or Dewatering Plant discharges that are the subject of the application.
- Assessment of the actual and potential freshwater ecological effects of these discharges.

In addition, this report includes assessment of the nature of effects that would occur with the installation of an Electric Arc Furnace (EAF) at the Site. NZ Steel has recently secured co-funding from the New Zealand Government to enable the substantial decarbonisation of its steel making process through the installation of the EAF and it is currently in the feasibility stage of plans to construct and operate the EAF within the existing Steel Plant facility .This assessment therefore considers the anticipated changes in effects on freshwater ecology of the Steel Mill, including the potential EAF, where relevant.

The activities requiring consent include the:

- Activities authorised by Existing Permits that have expired and are proposed to be replaced by these resource consent applications.
- Proposed effects of the ITA and Dewatering Plant discharge from the operation of a proposed EAF to the North Stream Catchment.

As the resource consent applications are seeking the replacement of Existing Permits, the assessment of effects on the environment must be undertaken as if the discharges authorised by the Existing Permits have been discontinued and the current proposal is an application for a new activity. Two key terms have been used throughout this assessment to describe the 'environment' against which effects have been assessed:

- 'Current Environment': refers to the actual stream and wetland environment presently physically at the Site. The Current Environment is representative of what the ecological effects of the proposed environment with discharges would be and will be assessed against the ecological value of the 'Receiving Environment'.
- 'Receiving Environment': refers to the environment against which effects must be assessed and excludes the continuation of activities for which consents are sought (but includes legacy effects of historical discharges that would exist in the absence of the Steel Mill). The ecological value of the stream and wetland 'Receiving Environment' has been determined based on field data, monitoring information and professional judgement as to the changes that could be expected were the discharges authorised by the Existing Permits were to cease. When assessing effects, the National Policy Statement for Freshwater Management requires consideration of the loss of 'potential' ecological values and accordingly, the Receiving

[1] Permits 41027, 21575, 21576, 21577 (each expiring on 31 December 2021)

Environment also includes consideration of 'potential' ecological values (NPSFM; amended 2023).

The assessment of ecological effects generally follows the approach set out in the Ecological Impact Assessment Guidelines (EcIAG) (EIANZ, 2018), where the overall ecological effect is based on the ecological value and the magnitude of the effect on those values. The EcIAG have been used to determine the ecological values of the Current Environment, based on field data, and then assumptions have been made to determine the ecological values of the Receiving Environment and the overall level of ecological effect.

Streams: ecological description and characterisation

The North Drain, the Kahawai Stream, and the Ruakohua Stream receive ITA stormwater discharges from the Steel Mill, and the North Drain also receives brackish process water from the Dewatering Plant.

The North Drain Receiving Environment has **'Low'** ecological value. This is due to the highly modified nature of the drain and low diversity of fish species present. Under the current situation, the process water discharge from the Dewatering Plant provides the only consistent flows to the North Drain, without which the North Drain Receiving Environment would only be an intermittently flowing watercourse rather than permanent.

The Lower North Stream, Kahawai Stream, and Ruakohua Stream Receiving Environments have **'Moderate'** ecological value. This is due to maturing and mature riparian plantings undertaken by NZ Steel which are improving aquatic ecological values by providing shading and organic matter input. Macroinvertebrate communities were representative of 'poor' to 'poor – fair' quality in each of these sites. Native fish diversity downstream of the discharges ranged from moderate (at the Lower North Stream and Ruakohua Stream) to very poor (at Kahawai Stream). Generally, the fish species identified at these sites comprised short and longfin eel (*Anguilla australis* and *Anguilla dieffenbachii*, respectively), and īnanga (*Galaxias maculatus*). Of these fish species longfin eel and īnanga have a national and regional conservation status of 'At Risk – Declining' (per Dunn *et al*., 2018; and Bloxham *et al*., 2013).

Streams: ecological effects

North Stream Catchment

It is considered that there will be no difference in the magnitude of effects of the Dewatering Plant discharges between the replacement of the Existing Permits and operation of the proposed EAF.

The Dewatering Plant and ITA stormwater discharges would have a **'Moderate'** magnitude of effect on the North Drain Receiving Environment and overall would have a **'Low'** level of ecological effect. In the Lower North Stream, the Dewatering Plant and ITA stormwater discharges would have a **'Low'** magnitude of effect on the Receiving Environment and overall would have a **'Low'** level of ecological effect. Accordingly, no further actions to address potential effects from the Dewatering Plant and the ITA stormwater discharges on the North Drain and Lower North Stream Receiving Environment are required.

Within the North Drain and the Lower North Stream contaminants derived from the Dewatering Plant and ITA stormwater discharges from the Steel Mill are at concentrations that exceed relevant levels to protect 80 % and / or 95 % of freshwater species (Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZWQGs, 2018).

Macroinvertebrate data from the North Drain and the Lower North Stream suggest that macroinvertebrate communities are affected by the existing discharges. The process water from the Dewatering Plant is also brackish. While saline sensitive macroinvertebrate species are affected by this discharge, the overall composition of the communities in the Lower North Stream is similar to reference sites. Additionally, the salinity (and associated water hardness) of the Dewatering Plant discharge and observed circum-neutral pH also regulates the toxicity of metal concentrations present in the Lower North Stream, further minimising potential effects from metal concentrations in the Dewatering Plant and ITA stormwater discharges.

Of note, is that the Dewatering Plant discharge is currently providing a permanent flow source to the North Drain and Lower North Stream. This flow contributes up to 80 % of flow at the stream mouth when the Dewatering Plant is operating[2]. This additional flow creates instream habitat and is a positive effect to the North Drain and Lower North Stream when compared to the intermittent flow regime of the North Drain and Lower North Stream Receiving Environment. Once the EAF is operational, the flow contribution will reduce by half (i.e., 40 % of flow at the stream mouth), this will see an initial spatial shift in available stream habitat. However, as the Dewatering Plant discharges will pass through the Dewatering Plant ponds, flows will be buffered into the North Drain (and ultimately the Lower North Stream) reducing the artificial flashiness. The buffered flows that will be observed under the operation of the EAF will retain key habitat values that, if there were no flow contribution would result in these habitat values being lost.

Sediment quality is expected to exceed ANZWQG (2018) sediment quality guidelines in the upper section of the Lower North Stream Receiving Environment. Sediment quality would be expected to meet ANZWQG sediment quality guidelines in the lower section of the Lower North Stream Receiving Environment. Overall, sediment quality is expected to improve over time as there would be a change in the concentration of metals in the Lower North Stream, coupled with rainfall events mobilising and re-distributing sediment.

NZ Steel is undertaking additional water quality monitoring to determine whether monitored metals and suspended sediment concentrations will meet ANZWQGs for the protection of 80 % of species in the North Drain and the ANZWQG for the protection of 95 % of species in the Lower North Stream. To ensure these guideline levels are met, NZ Steel proposes to implement additional measures (if required) to decrease metals concentrations and suspended sediment concentrations. With the implementation of this approach to further avoid and minimise effects of metals concentrations if required, it is considered that the overall level of ecological effects would remain low.

Kahawai Stream and Ruakohua Stream Catchments

The proposed ITA stormwater discharges would have a **'Low'** magnitude of effect on the Kahawai Stream and Ruakohua Stream Receiving Environment and overall ecological effects have been assessed to be **'Low'**. Accordingly, no actions are required to address potential effects on the Kahawai Stream and Ruakohua Stream.

Stormwater quality data indicate the proposed Steel Mill discharge contains contaminants at concentrations that exceed relevant ANZWQG values for the protection of 80 % and / or 95 % of freshwater species at both the Kahawai Stream and Ruakohua Stream. Macroinvertebrate data from the Kahawai Stream suggest there is a minor shift in the macroinvertebrate community index scores between the upstream and downstream sites. This shift is likely linked to the observed changes in habitat type and availability observed at the sample sites (i.e., from intermittent to permanent flow). Although there is a shift in macroinvertebrate index scores, the underlying composition of the macroinvertebrate community is similar between the upstream and downstream sites. While at Ruakohua Stream macroinvertebrate communities downstream of the monitored ITA stormwater discharge are better than upstream of the discharge. This suggests the water quality of the

[2] Calculated using the long-term median (50th percentile) flow.

Ruakohua Stream is primarily influenced by upstream catchment uses (beef and dairy farming and cropping).

NZ Steel has removed historical fill and undertaken additional treatment activities from the Kahawai Stream ITA area, with any remaining activities limited to low risk activities with negligible generation of contaminants. Therefore, any future water quality effects in the Kahawai Stream are expected to be avoided or minimised.

Wetlands: ecological description and characterisation

Several freshwater wetland[3] types are present across each of the three sub-catchments. The combined area of wetlands identified is approximately 2.36 ha. Most of the identified wetlands are dominated by exotic wetland species. However, several smaller and higher value native-dominated wetland types are also present.

The wetlands identified in the Lower North Stream sub catchment are of **'Moderate'** to **'High'** ecological value. These wetlands are generally buffered by native riparian plantings that were planted by NZ Steel from 1998 to 2014 and maintain ecological connectivity to coastal wetlands. The Lower North Stream wetlands also have the greatest diversity of wetland vegetation types and native species and are most likely to support spotless crake (*Zapornia tabuensis tabuensis*), which is classified as 'At Risk – Declining'. Moreover, the Lower North Stream wetlands are expected to support the nationally 'At Risk – Declining' banded rail (*Gallirallus philippensis assimilis*) where they are proximal to the Coastal Marine Area (CMA).

The wetlands identified in the Kahawai Stream sub-catchment are of **'Moderate'** to **'High'** ecological value. The highest value wetland is in the lower catchment and while it is dominated by exotic species, it includes several native plant species. This wetland is bordered by native riparian plantings that were planted by NZ Steel in 2010 and is immediately adjacent to coastal wetland habitat.

The wetlands identified in the Ruakohua Stream sub-catchment are of **'Moderate'** value. These wetlands are generally exotic dominated and comprised of narrow bands of wetland vegetation that border defined streams and are therefore deemed to be of lower ecological value.

Wetlands: ecological effects

The proposed discharge of Dewatering Plant process water and ITA stormwater into wetlands present within the North Stream Catchment is expected to have a **'Low'** magnitude of effect. In large part, this is because any effects associated with these discharges will be counter-balanced by the positive impact of the discharges preserving the current extent of the identified wetlands. Indeed, the proposed process water discharge generally accounts for 80 % of water inputs at the stream mouth. Without these discharges the wetlands would have a much more limited extent. If the EAF becomes operational, it is expected to reduce the amount of discharge from the Dewatering Plant by approximately 50% (i.e. reducing the Dewatering Plant's contribution to water inputs from 80% to 40%). However, the magnitude of effect of the EAF discharge is expected to remain low due to the counter-balancing effects of increased water (resulting in an increase in wetland extent), with some limited reductions of water quality.

The proposed ITA stormwater discharges to the individually assessed Kahawai Stream and Ruakohua Stream wetlands have also been assessed as having a **'Low'** magnitude of ecological effects and an overall **'Low'** level of ecological effect. If the EAF becomes operational, ITA discharges from the EAF will not affect these separate catchments. The magnitude of effect is therefore expected to remain low. The overall level of effects on wetland ecology values within the North Stream, Kahawai Stream

[3] All wetlands assessed in this report are natural freshwater inland wetlands.

and Ruakohua Stream catchment wetlands is considered to be **'Low'** once proposed water treatment measures to avoid, remedy or mitigate adverse effects are taken into account.

Management of residual effects

The overall level of effects on streams and wetlands within the North Stream, Kahawai, and Ruakohua catchments associated with ITA stormwater and Dewatering Plant discharges (North Stream Catchment only), as well as if the EAF becomes operational, has been assessed as **'Low'**.

Although the level of effects is assessed as **'Low'**, given the importance of wetlands and the guidance provided in existing national policy statements and relevant documents, NZ Steel has elected to propose additional enhancement measures to address the low level of residual effects on wetlands.

These measures will be managed via a Wetlands Management Plan (WMP) which NZ Steel has proposed as a condition of consent. Pursuant to the WMP, NZ Steel would undertake wetland native enrichment planting and wetland margin native revegetation enhancement planting around selected wetlands to improve their indigenous biodiversity values.

1 Introduction

1.1 Overview

New Zealand Steel Ltd (NZ Steel) owns and operates the Glenbrook Steel Mill near Waiuku, Auckland (the Site). NZ Steel holds resource consents (Existing Permits) that authorise the discharge of ITA stormwater and process water from the Steel Mill to surface freshwater and marine water. The Existing Permits held by NZ Steel expired on December 31 2021[4]. NZ Steel is seeking to replace the water discharge permits that authorise the ITA stormwater and Dewatering Plant discharges from the Site.

This report addresses the freshwater ecological effects of the ITA stormwater and Dewatering Plant discharges that enter the North Stream Catchment (comprising the North Drain and Lower North Stream) and the Ruakohua Stream from the Steel Mill; and any future ITA stormwater discharges to the Kahawai Stream. As well as well-defined streams, these catchments include natural inland wetland habitats. The locations of each of the catchments in relation to the Steel Mill and the various discharge outfalls are shown on Figures W-FWE1 and W-FWE2 in Appendix A.

In addition, NZ Steel has secured co-funding from the New Zealand Government to enable the installation of an Electric Arc Furnace (EAF) at the Site. NZ Steel is currently in the feasibility stage with plans to construct and operate an EAF within the existing Steel Mill facility. The installation of the EAF, which if progressed, is likely to be no later than early 2027, is part of the decarbonisation of the Steel Mill. The EAF will enable the reduction in the use of virgin steelmaking materials (iron sand and coal) and instead recycle ferrous scrap using electricity. Therefore, an EAF will enable the production of secondary steel from NZ Steel's own scrap uprisings and external scrap. This assessment therefore includes reference to the anticipated changes in effects on freshwater ecology as a result of a potential EAF, where relevant[5].

In this report NZ Steel has requested that Tonkin & Taylor Ltd (T+T) provides:

- An assessment of the ecological values of the streams and wetlands that receive, or have the potential to receive, ITA stormwater and / or Dewatering Plant discharges from the Site.
- An assessment of ecological effects on streams and wetlands associated with the activities proposed to be authorised.

1.2 Report context

The Steel Mill has operated since 1968 and there is a long record of monitoring of the environment which has been undertaken as a requirement of existing and previous resource consent conditions.

No baseline data are available for the North Stream Catchment, the Ruakohua Stream or the Kahawai Stream prior to NZ Steel discharges commencing in 1968. However, data are available for other similar streams in catchments near to the Steel Mill, which are useful proxy sites representative of what the affected streams would have been like without the presence of the Steel Mill discharges.

Without the transition to and the operation of the EAF, there will be no material changes in the proposed discharges from the Steel Mill compared to the current situation (save for improvements,

[4] Permits 41027, 21575, 21576, 21577 (each expiring on 31 December 2021)
[5] The original assessment was undertaken in 2021 and presented in the version of this report dated June 2021. Subsequent updates were made in response to section 92 requests and presented in the version of this report dated October 2022.

discussed in greater detail throughout this report). If the EAF is implemented, overall ecological effects are expected to reduce, as discussed further in Section 4.3.

1.3 Key terms – 'environment'

Several key terms have been used throughout this assessment to describe the 'environment' against which effects have been assessed. These include the following:

- 'Current Environment': refers to the actual stream and wetland environment presently physically at the Site. The Current Environment is representative of what the ecological effects of the proposed environment with discharges would be and will be assessed against the ecological value of the 'Receiving Environment'.
- 'Receiving Environment': refers to the environment against which effects must be assessed and excludes the continuation of activities for which consents are sought (but includes legacy effects of historical discharges that would exist in the absence of the Steel Mill). The ecological value of the stream and wetland 'Receiving Environment' has been determined based on field data, monitoring information and professional judgement as to the changes that could be expected were the discharges authorised by the Existing Permits to cease. Ultimately, the effects are assessed against the Receiving Environment. This approach is discussed further in Section 3.4.

The inclusions and exclusions of the Current Environment and the Receiving Environment are set out in Appendix B Table 1, together with assumptions made in relation to these applications.

1.4 EAF operating environment

Should an EAF become fully operational the manufacturing of steel will have less reliance on iron sands and coal. This change will potentially reduce the operating hours for the Dewatering Plant discharge by up to half with a subsequent reduction in the total volume discharged to the North Stream Catchment. Additionally, a reduction in contamination loads from coal stockpiling may occur as the runoff is directly linked to total stockpiling area.

Based on an initial assessment it is expected that effects on the Receiving Environment from the discharge of contaminants will be reduced from those detailed in this assessment should an EAF be installed. However, to remain conservative, any potential improvement in discharge quality has not been factored into this assessment. This assessment therefore presents a conservative 'worst case scenario' (for contaminants) based on the current operations that occur under the Existing Permits and their effect on the Receiving Environment. Although there is an expected reduction in contamination through the operation of an EAF, there will continue to be some continual effect from discharge volume to the North Stream Catchment. Consequently, the assessment presents both a 'worst case scenario' and an EAF expected scenario is presented.

Further information regarding the implications of the change to the EAF system are detailed in the ITA Report (T+T 2024a, Appendix G of the AEE) and Section 4.3.

1.5 Statutory context (ecology)

1.5.1 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management 2020 (NPSFM) came into force on 3 September 2020 (with subsequent amendments in December 2022, February 2023, and January 2024). The NPSFM is directly relevant as the Proposal involves discharges to freshwater environments and to land where it may enter freshwater environments.

The NPSFM addresses, as a matter of national significance, the management of freshwater through a framework that considers and recognises Te Mana o te Wai as an integral part of freshwater management. It imposes national bottom lines, seeks to improve degraded water bodies, and maintain or improve others, and seeks to avoid any further loss or degradation of wetlands and streams. The NPSFM provides local authorities with updated direction about how they should manage freshwater under the RMA through their policy statements, plans and resource consent decisions.

Sections 3.22 and 3.24 of the NPSFM direct that when assessing loss of extent or values, both the 'existing' and 'potential' stream and wetland values need to be considered.

For the purposes of this ecological assessment the 'Receiving Environment' is considered to:

- Exclude the continuation of activities for which consents are sought (i.e., the replacement of the Existing Permits).
- Include legacy effects of historical discharges that would exist in the absence of the Steel Mill.
- Include 'potential' stream and wetland ecological values based on the maturing of existing riparian planting.

1.5.2 National Policy Statement for Indigenous Biodiversity

The National Policy Statement for Indigenous Biodiversity (NPSIB) came into force on 4 August 2023. Its objective is to maintain indigenous biodiversity across Aotearoa New Zealand so that there is at least no overall loss in indigenous biodiversity after the commencement date. The NPSIB applies to indigenous biodiversity in the terrestrial environment throughout Aotearoa New Zealand but also includes provisions that relate to wetland habitats and fauna.

It includes national policy direction on the protection of Significant Natural Areas (SNAs), management of indigenous biodiversity outside SNAs, restoration of ecosystems, including natural inland wetlands and engaging with tangata whenua as partners (among other provisions).

The NPSIB affords protection to habitats of specified highly mobile fauna. Of these, spotless crake (*Zapornia tabuensis tabuensis*) and banded rail (*Gallirallus philippensis assimilis*) may be present in wetland habitats within the current and receiving environment at the Site.

It also includes the requirement to use the effects management hierarchy when undertaking effects assessments, and outlines principles for offsetting and compensation.

Where there is a conflict between the NPSIB and NPSFM, the latter prevails (as directed by Section 1.4(3) of the NPSIB).

1.6 Layout of this report

This report contains the following structure:

- Section 1: Introduction and context of report.
- Section 2: Description of the environments that receive Steel Mill discharges and location of the discharges.
- Section 3: Methods of assessment.
- Section 4: A characterisation of the quality and quantity of the Steel Mill discharges.
- Section 5: The stream and wetland ecological values.
- Section 6: An assessment of ecological effects of the discharges on the stream and wetland receiving environments.
- Section 7: Sets out the proposed measures to address residual ecological effects.

2 Site description

2.1 Overview

The Site (Figure 2.1) is located on the eastern bank of the Waiuku River, which despite its name, is a long and relatively narrow tidal arm (estuary) of the Manukau Harbour. For the avoidance of confusion, the term "Waiuku Estuary" is therefore used in this report to describe this part of the Waiuku River. The Site is approximately 5 km by road north of the Waiuku township. To the east of the Site, the Franklin lowlands stretch eastward to Papakura.

The land use surrounding the Site is varied and includes pastoral farming (particularly dairy farming), cropping, and lifestyle blocks. Within the Site an operational landfill (East Landfill) and a closed landfill (West Landfill) lie to the north of NZ Steel's industrial or trade activity (ITA) Area, and a historical landfill (North Landfill) lies immediately to the west.

The Site is drained by three main catchments: the North Stream Catchment (comprising the North Drain and the Lower North Stream), the Ruakohua Stream, and the Kahawai Stream. The North Drain, Lower North Stream and Kahawai Stream do not have legal names, so these names are used within this report.

All the streams include associated wetlands along much of their length, with most of the wetlands dominated by low-stature exotic wetland plants. However, several small native-dominated flax (*Phormium tenax*), raupō (*Typha orientalis*), rautahi (*Carex geminata*), and giant rush (e.g. *Juncus pallidus*) wetlands also exist.

The general Site location is shown on Figure 2.1 below. The locations of each of the catchments in relation to the Steel Mill and the various discharge outfalls are shown Appendix A1 and Appendix A2. The wetlands are shown on in Appendix A3.

Figure 2.1: Glenbrook Steel Mill Site location. Base map sourced from Land Information New Zealand.

2.1.1 North Stream Catchment

The North Stream Catchment comprises a singular channel flowing roughly south to north in the north-eastern part of the Site and includes associated wetland margins in its lower reaches (Appendix A1, A2, A3).

During the expansion of the Steel Mill in the 1980s the formerly named Northside Stream catchment was completely reclaimed (filled in). Which resulted in the upper catchment being diverted into the North Drain (a constructed watercourse) and the North Stream Catchment. The headwaters of the North Stream Catchment (including the North Drain) are entirely within the Site boundary immediately to the west of Mission Bush Road. There are no upstream headwaters or natural stream sections in the upper North Stream Catchment. The land use within the existing upper North Stream Catchment contains the Steel Mill and NZ Steel's two landfills (East Landfill and West Landfill), with a small amount of rural/agricultural in the lower reaches.

Due to the highly modified nature of the North Stream Catchment, the main channel is described in two distinct parts in this report:

- The North Drain, which comprises the channel between Mission Bush Road and 65 m downstream of Brookside Road; and
- The Lower North Stream, which comprises the section of natural modified watercourse that flows between the East and West Landfills (starting approximately 65 m downstream of Brookside Road) and the lower more natural reaches to the estuarine environment.

These two parts are described in more detail in the following sections.

2.1.1.1 North Drain

North Drain is a constructed watercourse that was formed to convey the Steel Mill's ITA stormwater discharges[6] when the former stream channel (Northside Stream, which flowed east to west) was reclaimed (Appendix A). The channel is entirely constructed with no natural upstream catchment, the flows within the North Drain consist of the Dewatering Plant and ITA stormwater discharges. With a fully operational EAF, the Dewatering Plant will continue to supplement flows (albeit at a lesser volume). As such, the North Drain is considered, and will continue to be considered with the operation of an EAF, an 'artificial watercourse' with permanent flows under the Auckland Unitary Plan (Operative in Part) (AUP)[7].

The North Drain adjacent to the BOC Ltd (BOC) air separation unit and switchyard is a straightened channel with a soft sediment bed. The section from the western side of the switchyard to Brookside Road is a straight concrete lined channel. The North Drain is culverted for a small section near the BOC air separation unit under an internal rail line switchyard and is culverted under Brookside Road. Riparian vegetation is absent along the majority of the North Drain, and the channel therefore has very little shading. The downstream extent of the North Drain is approximately 65 metres downstream of Brookside Road, where the current channel intersects a former tributary. Downstream of this point the North Drain becomes the Lower North Stream (described in further detail in Section 2.1.1.2).

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[6] Tonkin & Taylor Ltd & Bioresearches Ltd, June 1983. New Zealand Steel Limited Woolf Fisher Works application for water rights replacement, 1983. Report Prepared for New Zealand Steel Ltd. Reference 5744

[7] AUP Chapter J1 defines 'artificial watercourse' as "*constructed watercourses that contain no natural portions from their confluence with a river or stream to their headwaters*".

2.1.1.2 Lower North Stream

The Lower North Stream comprises the stream reaches located approximately 65 m downstream of Brookside Road and flows for approximately 2 km in a general northerly direction towards the Waiuku Estuary (Appendix A1, A2, A3).

This section of the North Stream Catchment is a permanently flowing, modified natural stream and includes wetland margins of variable width.

The Lower North Stream flows between the active East and closed West Landfills. The banks and channel in this section of the stream are lined with Melter aggregate (processed Melter Slag)[8]. The true-right riparian margin of the stream has been largely planted with native vegetation. The true-left bank riparian margin has not been planted as the Landfill Road runs along this side of the stream.

Two small culverts are present downstream of Brookside Road and allow access to the East Landfill. Approximately 1 km downstream of Brookside Road the North Stream trib confluences with the Lower North Stream, this tributaries catchment is in the East Landfill (Appendix A2). Located downstream of this confluence is a single box culvert (installed September 2022), which meets the permitted activity requirements of the Freshwater NES (including for fish passage). From this point the Lower North Stream continues for approximately 750 m, before discharging into the Waiuku Estuary (Appendix A).

Based on historical photographs the most downstream section of the Lower North Stream appears to follow the same flow path as it did in 1961 and is considered to be a natural stream. The riparian margins in this section of stream have been fenced since 1998 to exclude farm stock access and planted with native vegetation, which has now matured to provide shading to the stream. Farm pasture and cropping fields are adjacent to the riparian plantings.

2.1.2 Kahawai Stream

The Kahawai Stream[9] is located within the north west of the Site and flows in a general north westerly direction for approximately 1.2 km to the Waiuku Estuary (Appendix A and A3). The Kahawai Stream contains permanent and intermittent flowing sections and includes wetland margins of variable width along its entire length. A small ephemeral unnamed tributary (referred to as the Kahawai Tributary) flows into the Kahawai Stream (Appendix A). The Kahawai Tributary headwaters are within the Kahawai Stream ITA Catchment.

Most of the Kahawai Stream and Kahawai Tributary are fenced to exclude farm stock access and mature riparian vegetation is present along most of the stream (approximately 900 m). The native vegetation has matured and provides shading to the stream. Native riparian planting in the lower and upper reaches was undertaken by NZ Steel in accordance with Permit 34757 for the East Landfill and is covenanted to ensure its protection in perpetuity. Although not required by any resource consent, NZ Steel also undertook ecological planting along the mid-reaches of the streams, between the two covenanted areas.

Kahawai Stream (to the north and west) is surrounded mostly by agricultural land currently used for cattle grazing. The balance of Kahawai Stream catchment (to south) is currently undeveloped but within the Heavy Industry Zone. Within the existing Kahawai Stream ITA Catchment (an ~ 2 ha area) there is a small area which historically comprised the Metal Cutting Yard. As of June 2023, any

[8] A section of the Lower North Stream was diverted for construction of the West Landfill, authorised by Permit 896715. The Melter aggregate lining was undertaken in compliance with special condition 2 of that permit: “That the diversion channel shall have a suitable vegetative lining and be of stable cross-section, with an armoured low flow channel of rock cobbles or similar.”

[9] Note this stream is not officially named and has previously been referred to as the “MFS Stream”.

material that may have posed a potential source of contamination was removed from the Metal Cutting Yard[10]. The balance of the Heavy Industry Zone, also within the Kahawai Stream catchment is currently undeveloped.

2.1.3 Ruakohua Stream

The Ruakohua Stream is a permanent stream located to the south of the Site (Appendix A3). The Ruakohua Stream is approximately 4 km in length and flows in a south westerly direction towards NZ Steel's water supply dam (the Ruakohua Dam). The lower reaches of the Ruakohua Stream have historically been modified and straightened so that the stream flows over a weir and into the Ruakohua Dam. The stream includes narrow wetland margins along much of its length. Occasional overflows from the dam occur due to high rainfall. Overflows enter the Waiuku Estuary via an emergency spillway.

In 2015 NZ Steel installed spat ropes and fish ladders on the Ruakohua Dam structures to enhance fish passage through the culvert at the base of the dam and into the spillway stilling basin at the base of the spillway. Spat ropes were also installed on the spillway face. In 2017 spillway operations were altered to ensure that a continuous low flow was implemented down the spillway to maintain fish passage.

The land use within the upper portion of the Ruakohua Stream Catchment predominantly comprises rural activities, including beef and dairy farming and cropping. Where the Ruakohua Stream flows through the Site, there are Steel Mill activities, as well as ITA stormwater discharges from the Contractor's Yard and Yard 31 (Appendix A). To the south is the NZ Steel farm. The Ruakohua Stream lower catchment also receives discharges from NZ Steel's Waikato River water supply pipeline (separately consented) for use at the Site via the Ruakohua Stream lower tributary (known as the Ruakohua trib). NZ Steel has previously undertaken approximately 700 m of riparian planting along the section of the Ruakohua Stream that flows through the Site and on the Ruakohua trib. The native plantings are still maturing but will provide good shading in the future.

2.2 Discharges summary

NZ Steel is seeking resource consent to replace the Existing Permits that authorise the ITA stormwater and Dewatering Plant discharges from the Steel Mill. The current application also seeks consents to authorise the changes in discharges associated with the operation of an EAF (as described in Section 4.3). The following sections describe the proposed discharges that consent is sought for and the relative location of these in the context of the catchments.

2.2.1 North Stream Catchment

The North Stream Catchment receives several discharges from the Site (Appendix A), as well as adjacent Transpower and BOC sites (which are separately consented). All discharges, from the Site, enter the North Drain before flowing into the Lower North Stream. These include:

- Process water from the Dewatering Plant, which receives primary concentrate slurry, dewaters the primary concentrate, and treats the remaining slurry water before discharge. (Appendix A).
- Treated surface water from catchments within the Site (Coal Yard 1,2, 5 and 6 (via East Pond), a portion of an Aggregate yard (via Y56A Pond), Coal Yard 19 (via Coal Yard CY 19 pond)

[10] ITA discharges to the Kahawai Stream from the Kahawai Stream ITA Catchment (including the Metal Cutting Yard) do not currently occur. However, this area might be used for future ITA activities and has been retained to provide characterisation of the historic ITA discharges here for overall understanding of the Site.

(Appendix A). If the EAF is progressed, this will see either Coal Yard CY 5/6 or Coal Yard CY 19 converted from storage of coal to the storage of Ferrous Scrap for the EAF.

- Untreated water from the rail line subsoil drains.
- Untreated surface runoff (from farmed areas and the northern store area).

An additional potential future sub-catchment (identified as the Future ITA sub-catchment in the AEE) is proposed by this application. An area of approximately 25.9 ha which currently contains pasture, however, may be used in future for ITA activities. This sub-catchment currently flows to the North Drain via overland flow and no formal treatment exists. This sub-catchment is included in the ITA Area.

2.2.2 Kahawai Steam Catchment

The Kahawai Stream formerly received treated ITA stormwater from the Kahawai Stream ITA Catchment[11] in the north-western corner of the Site (Appendix A2). Historically this included runoff discharged via sheet flow along drains to the Metal Cutting Yard Pond. The Metal Cutting Yard Pond discharged to an unnamed ephemeral tributary of the Kahawai Stream (i.e., the Kahawai Trib), then into a small wetland (Exotic-dominated Wetland 5, Appendix A3) before flowing into the Kahawai Stream. Since the Existing Permit for the Kahawai Stream ITA stormwater discharge was issued in 2013[12], NZ Steel has undertaken a suite of improvement activities to meet the Existing Permit water quality Trigger Investigation Levels. The portion of the catchment containing the Melter slag stockpile has been redirected to the Northside Ponds and historical activities were discontinued. If NZ Steel require reinstatement of a larger working platform then a suitable, inert material will be selected.

In June 2023, NZ Steel removed the balance of the remaining material which was used to construct the working platform in the 1990s as this material may have been a source of contaminants. As such, there is no longer an ITA discharge to the Kahawai Stream[13].

2.2.3 Ruakohua Stream Catchment

The Ruakohua Stream within the Site receives stormwater from two ITA Areas; the Contractors' Compound and Yard 31 (Appendix A). These areas are currently used for administrative buildings and storage of equipment, sea-freight containers, vehicles, and steel products. ITA stormwater from the Contractors' Compound is treated via a filter bed and ITA stormwater from Yard 31 is treated via two sediment settlement ponds.

3 Methods

3.1 General approach

Our approach to assessing the potential ecological values and effects on the stream and wetland receiving environment has comprised the following:

- Review of ecological surveys and other available data relating to streams and associated wetlands from the North Stream Catchment, the Kahawai Stream and the Ruakohua Stream, as well as similar streams and wetlands nearby with similar catchments land uses.

[11] The Kahawai Stream ITA Catchment was previously referred to as the Metal Cutting Yard
[12] Permit 41027
[13] It is also likely that the Kahawai Stream receives passive discharges from the former activities within the Northside ITA Catchment. Any such discharges are authorised by DIS60419815.

- Determining what the Receiving Environment would be (taking into account restoration trajectories over time) were the existing Site discharges to cease upon expiry of the Existing Permits.
- Analysis of available field data relating to stream and wetland systems that have already been subject to NZ Steel discharges for a long period of time to inform the Current Environment.

Our approach to characterising the Current Environment has comprised the following:

- Collation and a desktop review of existing NZ Steel freshwater ecological and spot water quality monitoring data relevant to the Site.
- Collection of additional ecological data from the North Drain, Lower North Stream, Ruakohua Stream and Kahawai Stream between 4 and 6 August 2020[14].
- Determination of the extent and presence of wetlands following the Wetland Delineation Protocol (MfE, 2020).
- Determine how operating the EAF would alter the characteristics of the Current Environment.

3.2 Stream assessments

A desktop assessment was undertaken to compile and review relevant information and data on freshwater streams held by T+T on the Current Environment of the Site. Available data included the following sources of information:

- Ecological surveys conducted to inform the East Landfill Resource Consent Application in 2007 (T+T, 2007).
- Ruakohua Stream fish surveys conducted in 2011, 2013, 2014 and 2017 (T+T, 2017).
- Lower North Stream and North Drain ecological surveys conducted in 2012 (T+T, 2012a).
- Ruakohua Stream ecological surveys conducted in 2012 (T+T, 2012b).
- East Landfill fish relocations conducted between 2011 and 2016 (T+T, 2012c; T+T, 2012d; T+T, 2014; T+T, 2016).
- Lower North Stream macroinvertebrate monitoring conducted between 2005 and 2020, and 2022 (T+T, 2022).
- The results of a freshwater fish survey conducted in the Lower North Stream in 2017 and 2022.

The above data sources are from various surveys undertaken over multiple years. Although some of these surveys may have used non-comparable methodologies, the surveys do provide important information regarding the freshwater streams located on the Site. Similarly, as there has been no material change in the catchment discharges, it is considered that the data is relevant to determining ecological value of a site.

3.2.1 Stream surveys

Surveys were conducted between 4 and 6 August 2020 to classify and characterise the existing freshwater ecological values of the North Drain, the Lower North Stream, the Ruakohua Stream and the Kahawai Stream. Classifications of these streams are presented in Table 3.1 and are consistent with the definitions of watercourses provide in the AUP[15] . Climatic conditions during the ecological

[14] Site work was conducted within the recommended timeframe for conducting intermittent stream SEV's in the Auckland Region (July – October). While it is recommended that native fish surveys are conducted December to April, the survey data are considered appropriate given the results can be compared with existing data collected within the recommended timeframe.

[15] AUP Chapter J1

surveys were mainly fine with some light showers. Approximately 0.6 mm of rainfall was recorded at the Auckland Airport[16] weather station in the 48 hours preceding the site visit.

Further site specific ecological surveys were conducted within the Lower North Stream on 10 February 2021 and the 3 and 4 March 2022 (fish only); and within the Kahawai Stream on 2 December 2022 (macroinvertebrates only). Climatic conditions during the site visits were mainly fine with some light rain observed in the preceding 48 hours in the wider catchment. It is considered that the small amount of recorded rainfall would not have influenced the results of ecological surveys.

3.2.1.1 Stream site locations and survey types

A total of eleven sites were sampled in the North Stream Catchment, the Ruakohua Stream and the Kahawai Stream. Two sites were located on the North Drain, two on the Lower North Stream, five on the Ruakohua Stream and two on the Kahawai Stream (refer Appendix A1). The types of ecological surveys conducted at each site (Stream Ecological Valuations (SEV), freshwater fish surveys and macroinvertebrate community sampling) varied depending on the existing ecological data for each site.

Additionally, sediment samples were collected at six sites (Site A and Site 6 in the Lower North Stream, at the Upstream reach and Downstream reach sites in the Kahawai Stream and at Site 2 and 4 in the Ruakohua Stream) to characterise sediment quality.

The sampling locations and the types of ecological surveys conducted at each site are summarised in Table 3.1.

Table 3.1: Stream survey site locations and the surveys conducted at each site. Coordinates are presented in New Zealand Transverse Mercator 2000 Projection

Stream	Site	Easting / Northing	Stream classification / date surveyed	SEV	Fish	Macroinvertebrates	Sediment quality
North Drain	Site C	1753539 E 5881780 N	Artificial watercourse (August 2020)	Y	Y	Y	
	Site B	1753524 E 5881469 N			Y	Y	
Lower North Stream	Site A	1753908 E 5880812 N	Permanent Stream (August 2020, February 2021, March 2022)	Y	Y	Y	Y
	Site 6	1753498 E 5881029 N		Y[17]		Y*	Y
Ruakohua Stream	Site 1	1755455 E 5881029 N	Permanent Stream (August 2020)		Y	Y	
	Site 2	1754125 E 5880548 N		Y	Y	Y	Y

[16] Cliflol database. https://cliflo.niwa.co.nz/ Accessed 10 March 2021.
[17]This SEV was completed on 10 February 2021.

Stream	Site	Easting / Northing	Stream classification / date surveyed	SEV	Fish	Macroinvertebrates	Sediment quality
	Site 3	1754050 E 5880468 N				Y	
	Site 4	1753797 E 5880268 N		Y	Y	Y	Y
	Site 5	1753581 E 5880130 N				Y	
Kahawai Stream	Upstream reach	1752620 E 5881698 N	Intermittent Stream (August 2020, February 2021, December 2022)**	Y		Y	Y
	Downstream reach	1752407 E 5881977 N	Permanent Stream (August 2020, February 2021, December 2022)	Y	Y	Y	Y

*All sites had one macroinvertebrate sample replicate, except Site 6 which had three replicates collected

**Site was re-visited in February 2021 when it was observed that no water was present in the stream.

3.2.1.2 Stream Ecological Valuation

A Stream Ecological Valuation (SEV) survey was undertaken at seven of the ecological monitoring sites (Site A, Site C, Site 6, Site 2, Site 4, Kahawai Upstream and Kahawai Downstream). The SEVs conducted on permanent streams were carried out in accordance with the methods set out in the Auckland Council Technical Report 2011/009 (Neale *et al*., 2011). The intermittent Kahawai Upstream site was surveyed in accordance with the methods set out in Auckland Council Technical Report 2016/023 (Neale *et al*., 2016).

The SEV assessment determines the ecological function of a stream reach at least 100 metres long (including assessment of bed type, channel shape, sediment coverage, shade and the presence/absence of any aquatic vegetation). Site specific macroinvertebrate and freshwater fish data were also included in the SEV assessment. An overall SEV score was calculated for each site (out of a possible 1), with higher scores indicating better quality freshwater habitats.

The SEV score for each permanent stream site were calculated using the SEV Data Analysis Spreadsheet Version 2.3 (October 2017). The SEV score for the intermittent Kahawai Upstream site was calculated using the intermittent SEV Data Analysis Spreadsheet (June 2016). The function scores for each SEV survey are provided in Appendix E.

3.2.1.2.1 Potential value of the Receiving Environment

The potential ecological value of the North Drain, Lower North Stream, the Kahawai Stream, and the Ruakohua Stream Receiving Environment was derived based on assumptions that are set out in Section 3.4.1 and Appendix B Table 1. In particular, it assumes the exclusion of the discharge activities (and associated effects) authorised by the expiring consents (i.e., removing the effects that arise as a result of current operations) will result in a positive outcome to the receiving environment. However, the legacy effects of past activities that persist also remain relevant, as do any planned enhancement measures, to the environment against which effects are assessed.

The SEV assessment methodology was not used to determine the potential environmental state of the Receiving Environments within the stream systems of the Site water ways. That is because, generally (and in line with the SEV methodologies of Neale *et al*., 2011 and Neale *et al*., 2016) the SEV assessment is used to assess the ecological function of a stream based primarily on physical measures. Water quality is not the sole driver in determining ecological function and it is not specifically measured in the SEV. Additionally, the removal of specific contaminants from a water way is not likely to alter the SEV scores, as any change in water quality will not be factored into the ecological function scores within the SEV analysis. It was determined that utilising the SEV assessment was not appropriate to undertake quantitative comparative analysis to assess the potential environmental state of each stream system. Therefore, the assumptions of potential ecological value of the Receiving Environment that are outlined above and in Section 3.4.1 and Appendix B Table 1 are deemed appropriate.

3.2.1.3 Stream water quality

Spot *in situ* water quality measurements of temperature, pH, dissolved oxygen, and conductivity were collected at each SEV site at the time of survey using a calibrated Pro-ODO YSI hand-held meter and a calibrated PCSTestr 30 meter. Spot water quality measurements are used to provide an understanding of the water quality conditions at a single point in time and do not provide a longer term understanding of the water quality over the course of several hours, days or months.

3.2.1.4 Stream macroinvertebrate survey

A single macroinvertebrate sample was collected at each SEV site in August 2020 (with the exception of the Kahawai Stream sites where sampling was repeated in December 2022) and Site 6 where three samples were collected[18]. Macroinvertebrate samples were collected in accordance with Protocol C2[19] for macroinvertebrate sampling in wadeable streams (Stark *et al*., 2001).

Samples were preserved in ethanol and sent to Stark Environmental Limited (August 2020) or Environmental Impact Assessments Ltd (December 2022) for sorting and identification.

The results of the macroinvertebrate samples were used to calculate the Macroinvertebrate Community Index (MCI) and Semi Quantitative Macroinvertebrate Community Index (SQMCI) scores for each site. An interpretation of MCI and SQMCI scores is presented in Table 3.2. Macroinvertebrate samples were also analysed for the proportion of all Ephemeroptera, Plecoptera and Trichoptera (EPT-a) taxa and solely the pollution sensitive taxa which indicate good water and habitat quality taxa within these orders, i.e., EPT-b[20].

Table 3.2: Interpretation of macroinvertebrate community index values (Stark & Maxted, 2007)

Quality Class	MCI score	SQMCI score
Excellent	> 119	> 5.99
Good	100 - 119	5.00 – 5.99
Fair	80 – 99	4.00 – 4.99
Poor	< 80	< 4.00

[18] Regular monitoring of MCI data for Site 6 consists of three replicate samples. For this additional survey three samples were also collected so that collected data were directly comparable to existing data.
[19] Protocol C2 is designed for the collection of semi-quantitative macroinvertebrate data within soft-bottomed streams. This method involves the use of a 500 µm D-net to sample woody debris, macrophytes and overhanging bankside vegetation for macroinvertebrates.
[20] EPT-b excludes the pollution and low habitat quality tolerant *Hydroptilidae* species.

3.2.1.4.1 Assessing difference in MCI and SQMCI quality classes

At most of the sites assessed within this report, a single hand net sample has been collected from sites upstream and downstream of a discharge point. To determine if there is a statistically significant difference between site MCI and SQMCI scores, the detectable difference method detailed in Stark (1998) has been used. This method identifies that if an MCI or SQMCI score has a difference greater than 10.83 and 0.83, respectively, then this can be interpreted to be significantly different.

However, when interpreting the division between quality classes Stark and Maxted (2007) detail that there should be some flexibility incorporated into any assessment, and that the boundaries between classes should be "fuzzy". Further, Stark and Maxted (2007) stated that "fuzzy" boundaries are desirable because there is always a margin of error when estimating biotic indices. For the purpose of this assessment a single hand net sample has been collected at most of the sampled sites, Stark (1998) showed that this sampling method has a MCI precision of approximately ± 10 %. Therefore, for borderline biotic index values in this assessment a "fuzzy" boundary of ± 10 % has been included and that the ecologist should be able to choose the appropriate quality class to assign to the site based on their understanding and knowledge of the site.

The monitoring objective for this assessment was to detect if there is a deviation in the macroinvertebrate community between the upstream and downstream sites, and to understand the biological – and not statistical – significance of those deviations and / or the consequences. In light of the above, a statistically significant result between two samples may not be indicative of an important ecological effect, and conversely a non-statistically significant result may be ecologically important.

Therefore, where a statistically significant deviation in MCI and/or SQMCI score occurs, between upstream and downstream sites, an expanded assessment into the macroinvertebrate communities of both sites was undertaken. This assessment identified the taxa that disappeared between the two sites (i.e., lost taxa) and determined any patterns in the species assemblages. Additionally, available site data (i.e., aquatic habitat and water quality) was further investigated to understand whether the deviation in the macroinvertebrate community is ecologically meaningful based on the habitat and site information that was collected at the time of sample collection.

3.2.1.5 Freshwater fish survey

In addition to the historic fish survey data assessed during the desktop assessment, freshwater fish surveys were undertaken between 4 August and 6 August 2020[21] at all sites and in March 2022 within the Lower North Stream (Site 6 and Site A). Sampling was undertaken in general accordance with New Zealand freshwater fish sampling protocols (Joy *et al*., 2013). Given the nature of the site, and presence of aquatic plants, nets and traps were used.

In brief, a total of six baited fine-mesh fyke nets and 12 Gee minnow traps (GMT) were set at each site over an approximately 150 m reach of stream, with the exception of Site B where fyke nets were set but no GMT's were set due to the shallow water depth (refer to Table 3.1).

The nets and GMTs were set for one night and checked early the following morning. All caught fish were identified, measured and released back into the stream in which they were captured.

Freshwater fish were analysed using the Index of Biological Integrity – Auckland Region spreadsheet (IBI) to give the fish communities at each site a rating from 'very poor' to 'excellent'.

[21] While the timing of the August 2020 fish survey was not strictly aligned with protocols, data collected in 2020 have been compared with existing freshwater fish data collected at the same sites during summer months. This comparison found consistency with the species captured at the sampled sites between sampling occasions.

To provide further information on the fish community within the North Drain and Lower North Stream we have relied on historical fish survey data conducted either upstream of Site 6 (in the Lower North Stream) or within the immediate catchment. Although these surveys may have used non-comparable methodologies to those completed in August 2020 and March 2022, and may not have been completed to assess fish species presence/absence (i.e. as the purpose was fish relocation), the surveys do provide important information on the likely fish community (and subsequently ecological value) within the North Drain and Lower North Stream.

3.2.1.6 Stream sediment quality survey

A single sediment sample was collected on 10 February 2021 at each of the six sites identified in Table 3.1. At each site ten subsamples of superficial sediments (the top 20 mm) were collected across the stream channel and placed in a jar to make a composite sample. The samples were then couriered to RJ Hill Laboratories Ltd for analysis. Each sample was tested for the following parameters (all measured in mg/kg dry wt):

- Total recoverable aluminium
- Total recoverable arsenic
- Extractable arsenic (< 63 µm fraction)
- Total recoverable boron
- Extractable boron (< 63 µm fraction)
- Total recoverable cadmium
- Total recoverable chromium
- Extractable chromium (< 63 µm fraction)
- Total recoverable copper
- Extractable copper (< 63 µm fraction)
- Total recoverable iron
- Total recoverable lead
- Extractable lead (< 63 µm fraction)
- Total recoverable nickel
- Extractable nickel (< 63 µm fraction)
- Total recoverable vanadium
- Total recoverable zinc
- Extractable zinc (< 63 µm fraction)

3.3 Wetland assessments

On 16 April 2021, all potential wetlands in the Receiving Environment between the discharge points and the stream mouths of the North Stream Catchment, the Kahawai Stream and the Ruakohua Stream were assessed. A follow-up survey of wetlands in the North Stream Catchment was completed on 23 September 2022, with surveys undertaken to re-confirm whether these should be classified as natural inland wetlands applying the Wetland Delineation Protocol (WDP) (MfE, 2021).

Wetland assessments included the use of the WDP (MfE, 2020 and 2021) to determine the presence and extent of wetlands, wetland habitat type and associated values including:

- A description of the general wetland habitat type based on the dominant plant species;
- An assessment of native biodiversity values based on the native plant species dominance and richness (number of different native plant species); and
- An assessment of suitability for nationally ‘Threatened’ or ‘At Risk’ species, most notably wetland plants and birds.

An updated version of the WDP was released in 2022 (MfE, 2022). However, this did not change the outcome of the wetland delineation and assessment undertaken during 2020.

The WDP sets out the methods for classifying and delineating freshwater wetlands based on vegetation, soil and hydrological characteristics. This document refers to Clarkson et al. (2014) and Fraser et al. (2018) for vegetation and wetland (hydric) soil assessment methods, respectively. The wetland delineation hydrology tool (MfE, 2021) was released after field wetland assessments were undertaken. However, field assessments were undertaken in accordance with key hydrology indicators (e.g., observation of surface or ground water) that is entirely consistent with MfE's wetland delineation hydrology tool.

In accordance with the WDP the presence and relative abundance of all species was estimated, within all potential wetlands.

All areas were assessed as wetlands where plant species that are associated with wetland soils were common. The wetland plant categories in Clarkson *et al*. (2014) used within this assessment were:

- Obligate (OBL): species that occur almost always in wetlands (estimated probability > 99 % in wetlands).
- Facultative Wetland (FACW): species that occur usually in wetlands (67 – 99 %;).
- Facultative (FAC): species that are equally likely to occur in wetlands or non-wetlands (34 – 66 %).
- Facultative Upland (FACU): species that occur occasionally in wetlands (1 – 33 %).
- Upland (UPL): species that rarely occur in wetlands (< 1 %).

Where the vegetation present within the defined wetland area across all strata was dominated by species that are classified as OBL or FACW species, the wetland was confirmed to be a wetland.

If the wetland was not exclusively dominated by OBL or FACW species then a further Dominance Test was applied. To pass the dominance test, the most abundant plant species[22] that immediately exceed 50 % of the total cover for each stratum (plus any additional species comprising 20 % or more of the total cover for the stratum) must be OBL, FACW, or FAC. If the most dominant species were OBL or FACW then the dominance test was satisfied and the presence of a wetland was confirmed. Conversely if all or most of the dominant species were FAC then further testing was required to determine if the area was a wetland.

In such instances and as per the WDP, we used the Prevalence Index (PI) test. The Prevalence Index (PI) is a plot-based algorithm derived from the unique combination of OBL–UPL plants and their percentage cover. For the PI, OBL species are assigned a score of 1, FACW species a score of 2, FAC species a score of 3, FACU species a score of 4 and UPL species a score of 5. Correspondingly an area with a PI < 3.0 is deemed to be a wetland and an area > 3.0 is not.

Following confirmation of 'wetland' status, further assessment was undertaken to confirm the status of the wetlands as 'natural' as defined under the NPS FM 2020, as amended (February 2023). Specifically, if it was apparent that the wetland was constructed for a specific function in accordance with the NPSFM 2020 amendments (i.e., NPSFM amended 2023), then it was deemed to be a constructed wetland. Natural inland wetlands included all wetlands that did not meet the definition of a constructed wetland, irrespective of the degree of modification or inducement through anthropogenic land use activities.

3.4 Assessment of Ecological Effects

3.4.1 Current Environment and Receiving Environment – effects assessment approach

Section 104 and Schedule 4 of the RMA require that an assessment of an activity's effects on the environment be considered in the application for resource consent. The 'environment' upon which effects attributed to the replacement of the Existing Permits must be assessed against is the 'Receiving Environment'. This is the environment that is derived based on assumptions that are set out in Appendix B Table 1. In particular, it assumes the exclusion of the discharge activities (and associated effects) authorised by the expiring consents (i.e., removing the effects that arise as a result of current operations). However, the legacy effects of past activities that persist and any

[22] When ranked in descending order of abundance for each stratum

planned enhancement measures, also remain relevant to the environment against which effects are assessed.

To identify the effects of the Proposal on the environment we first assessed the Current Environment (i.e., the environment as it currently exists) and then excluded any effects of the activities that are the subject of the application to derive the Receiving Environment. We then assessed the effects of the Proposal activities on that Receiving Environment.

The differences between the Current and Receiving Environmental state are the actual and potential effects of the proposed Steel Mill activities that are the subject of this application and constitute the scenario for assessing the magnitude of effects on the Receiving Environment, as described in Section 3.4.2.2 below.

Where the operation of the EAF has specific effects (for example in the context of the North Stream Catchment) we have assessed both the effects of the current Steel Mill discharges as well as how those discharges will be altered by the EAF (in each case noting that the EAF will have the effect of reducing discharge/contaminants). Consequently, the assessment presented both a 'worst case scenario' and where required an EAF expected scenario is presented.

The scale of effect is generally different over the term of the consent, with some effects accumulating over the term of the consent to reach the maximum effect at the point of expiry. Rather than applying a sliding scale of effects, the assessment in the AEE (and in the attached specialist assessments, of which this report is one) takes a conservative approach, based on the maximum 35-year consent term that is sought in this application. That is, the assessment of the Receiving Environment is the environmental state in 35 years' time and therefore, the differences identified between the Current and Receiving Environment will be the accumulated effects **over the 35-year consent term**. The actual effects of the discharges would initially be much less than that, and only increase to that level over time.

An assessment of effects on freshwater streams and wetland ecology (Section 6) was carried out based on the information above and the details of the proposed activity.

3.4.2 Ecological Impact Assessment Guidelines

While taking into consideration the context of the Current and Receiving Environment outlined above, our assessment of ecological effects on streams and wetlands follows the framework outlined in the Environmental Institute of Australia and New Zealand Ecological Impact Assessment Guidelines (EcIAG) (Roper-Lindsay *et al.*, 2018).

Using a standard framework and matrix approach such as this provides a consistent and transparent assessment of ecological effects and is considered to be best industry practice. The EcIAG framework provides a robust structure but needs to incorporate sound ecological judgement to be meaningful.

The guidelines include a stepped assessment process to determine overall level of effect as follows:

- Identifying the ecological value of the existing environment (in the current application, the 'Receiving Environment').
- Assessing the magnitude of ecological effect from the proposed activities on the Receiving Environment.
- Determining the overall level of effect to determine if measures to address residual effects that cannot be avoided, remedied or mitigated are required.
- These steps are described below with reference tables included at Appendix C.

3.4.2.1 Assigning ecological value

Ecological values are assigned on a scale of 'Low' to 'Very High' based on species, communities, and habitats, using EcIAG criteria (Appendix C Table 6).

Matters that may be considered when assigning ecological value to freshwater streams and wetland systems include representativeness, rarity/distinctiveness, diversity and ecological context. The relative importance of these matters is often driven by availability of empirical information (measured attributes such as Macroinvertebrate community index (MCI) or water quality data). For streams an adapted assessment criteria has been used[23]. For individual plant and animal species, the national threat status was also used to determine potential ecological values of the site. Wetland and stream ecological values have been assigned using ecological characteristics described in Appendix C Table 5 and Appendix C Table 6).

When assigning ecological value, the 'potential' ecological values of each stream and wetland have also been considered in accordance with the National Policy Statement for Freshwater Management (NPSFM, 2020 and the subsequent amendment in December 2022, February 2023, and January 2024)[24]. The 'potential' value has been assumed to include planned enhancement measures and the maturing of existing riparian plantings.

3.4.2.2 Assessing magnitude of effect

The magnitude of effect is a measure of the extent or scale of the effect of an activity and the degree of change that it will cause. The magnitude of effect is assigned on a scale of 'Negligible' to 'Very High' and the following factors influence the magnitude of effect:

- Level of confidence in understanding the expected effect.
- Spatial scale of the effect.
- Duration and timescale of the effect.
- The permanence of the effect.
- Timing of the effect in respect of key ecological factors.

Further explanation of the factors influencing the magnitude of effect is provided Appendix C Table 6. In addition to the above and specifically in relation to this report, the steps taken to quantify the magnitude of effect are described in Section 3.4.1 above.

3.4.2.3 Assessment of the overall level of effects

An overall level of effect is identified for each activity or habitat/fauna type using a matrix approach (Appendix C Table 7) that combines the ecological values with the magnitude of effects resulting from each activity.

The matrix describes an overall level of effect on a scale of 'Very Low' to 'Very High'. Positive effects are also accounted for within the matrix to capture positive effects on ecological values proposed as part of a project.

The level of effect is then used to guide the extent and nature of the ecological management response required, which may include avoidance, remediation, mitigation, offsetting or compensation.

[23] Boffa Miskell Limited have developed these assessment criteria for freshwater streams. The assessment criteria have been applied to a wide range of projects in the Auckland Region.
[24] This assessment has specifically focussed on the potential ecological values in relation to ecosystem health and indigenous biodiversity. This assessment has not considered potential ecological values for other aspects of the NPSFM (such as hydrological functioning, Māori freshwater values or amenity).

The magnitude and overall level of effect on each ecological value (i.e. habitat or species) is assessed to determine if measures are required to address residual effects that cannot be avoided, remedied or minimised. Therefore, the need for and extent to which recommendations can reduce effects, if implemented, are clearly understood.

4 Discharge activities proposed to be authorised by the consent

NZ Steel is seeking replacement discharge permits for the Dewatering Plant discharge to the North Stream Catchment, as well as ITA stormwater discharges from parts of the Steel Mill to the North Stream Catchment and the Ruakohua Stream, and future ITA stormwater discharges to the Kahawai Stream. The application also seeks to authorise the changes in the discharges to the North Stream Catchment should an EAF be operated.

When considering the potential effects from Dewatering Plant and/or ITA stormwater discharges on the Receiving Environment it is useful to consider the long-term discharge quantity and quality of data sourced from NZ Steel. The data are appropriate for the purposes of our assessment of ecological effects in that they provide a clear indication of the expected post-discharge state.

A detailed review of the discharge data can be found in the Industrial and Trade Activity Report (ITA Report; T+T, 2024a; included as Appendix G to the AEE). A summary of that information is presented in the sections below.

4.1 Dewatering Plant discharge

4.1.1 Discharge quality

Dewatering Plant discharge turbidity measurements have been collected from October 2016 – September 2021 and are presented in Appendix D Table 1. Dewatering Plant water quality data for metals, total suspended solids and conductivity have been collected from September 2019 to September 2021 for the North Stream Catchment and are presented in Appendix D Table 2. Where available, data are compared against the Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZWQGs, 2018), 80 % and 95 % species protection level and Existing Permit limits. All metals are measured as total fraction (dissolved and particulate).

The turbidity results from the 2016 - 2021 monitoring show a high degree of compliance with the Existing Permit limits for the Dewatering Plant (Appendix D Table 1). The higher frequency with which the clarifier outlet results exceeded this Existing Permit limit indicates that re-routing the flow to settling ponds is an effective measure to reduce the turbidity of the discharge.

Aluminium, total suspended sediment concentrations and conductivity measurements (average and median values) exceeded ANZWQG for the protection of 80 % of freshwater species (Appendix D Table 2). The Dewatering Plant discharge is brackish, as it is sourced within the tidal zone at the mouth of the Waikato River so higher conductivities are not unexpected[25]. Average copper concentrations exceeded the ANZWQG for the protection of 80 % of freshwater species. However, the median value was within the guideline. Median lead concentrations slightly exceeded the 80 % species protection level, while the average lead concentration met this protection level. Iron concentrations (average and median values) met the ANZWQG for the protection of 80 % of freshwater species.

All cadmium levels were less than the analytical laboratory detection limit, however as the detection limit is greater than the ANZWQG protection for 95 and 80 % of freshwater species a comparison to this guideline could not be undertaken.

[25] Conductivity is the measure of water's capability to pass an electrical flow. This ability is directly related to the concentration of ions in the water.

Average and median concentrations for all other monitored parameters met ANZWQGs for the protection of 95 % of species.

4.1.2 Discharge quantity

Dewatering Plant discharge quantities to the North Drain between January 2016 and July 2020 have been supplied by NZ Steel. The average daily Dewatering Plant discharge between 2016 and 2020 was 3,915 m^3 per day on the 5 or 6 days each week that it is operating. This is well within the average daily flow volume of 7,400 m^3 per day over each calendar month authorised by the Existing Permit. The maximum daily Dewatering Plant discharge value between 2016 and 2020 was 8,474 m^3 per day. It is understood that the Dewatering Plant discharge is the primary source of flow to the North Drain and the Lower North Stream. A high-level assessment using flows from the Council's Freshwater Management Tool[26] and recorded Dewatering Plant flows indicates that when it is operating[27] the Dewatering Plant contributes on average 80 % of the total flow within the Lower North Stream at the stream mouth.

Inherently, the high contribution of base flows to the North Stream Catchment from the Dewatering Plant results in the hydrological regime having a high level of flashiness. Changes in stream flows in the North Stream catchment reflect the frequency and rapidity of short-term changes in the stream flow, determined by the operation of the Dewatering Plant.

Over the course of the operation of the Dewatering Plant, it has been observed that base flows may cease for a period of up to approximately 8 hours[28] when maintenance of the Mine Site and / or Dewatering Plant occurs or when operational issues occur at either location. During this period the North Drain and the Lower North Stream do not receive base flows from the Dewatering Plant discharge. However, during operation of the Dewatering Plant discharge water from the Dewatering Plant becomes ponded (and backflows upstream) due to the low gradient nature of the North Drain. When the discharge ceases the ponded water continues to provide flow contributions to the Lower North Stream. The ponded water essentially provides an indirect source of flow to the Lower North Stream. This maintains and provides a level of capacity to buffer toxicity effects (through the brackish nature of the discharge (Section 6.2.1)) and continues to provide overflow from the stream to the floodplain wetlands identified in the North Stream catchment (Section 6.3.1.1).

4.2 ITA stormwater

Monitored parameters in the North Drain, the Lower North Stream, the Ruakohua Stream and the Kahawai Stream ITA stormwater discharges and relevant ANZWQG are summarised in Appendix D Table 3 to Appendix D Table 6. Where applicable, the ANZWQ default guideline values (DGV) for the protection of 80 % and 95 % of species have been applied.

All metal concentrations have been measured as the total fraction present (a combination of dissolved and particulate fractions). It is important to note that the ANZWQG are set for long-term, ambient concentrations, whereas the stormwater monitoring results are typically grab samples taken in response to rainfall events, when contaminant concentrations are expected to be higher. Each stream catchment has been assessed in relation to the type and length of data available, and the potential pathways that discharges occur in each catchment.

[26] The Freshwater Management Tool is an Auckland Council hydrological model that estimates flows and water quality for watercourses in the Auckland Region. In the case of the Lower North Stream, the flows account for only the unmodified, 'natural' stream catchment, and therefore provide a basis for the stream flows without the site stormwater or Dewatering Plant discharge.

[27] Calculated using the long-term median (50th percentile) flow.

[28] It is understood that periodically the shutdown period will exceed 8 hours. However, this is rare and generally occurs during the summer when the Steel Mill is closed.

4.2.1 North Drain and Lower North Stream

Water quality monitoring data for seven discharge and receiving environment locations within the North Stream Catchment have been used to characterise the ITA discharge between 2015 to 2020. Water quality samples were collected following significant rainfall events when stormwater discharges were flowing. The exception to this was total suspended solids data which were collected on approximately 12 occasions between February to March 2021. These sites are shown on Appendix A and are described below:

- Site 1C is located in the North Drain, immediately upstream of the Brookside Road culvert. This site represents the quality of the Lower North Stream following Dewatering Plant and ITA stormwater discharges after reasonable mixing.
- Sites 1A and 1B are located in the North Drain downstream of the Brookside Road culvert and landfill sediment pond outlets.
- Site 4A is located in the eastern tributary of the Lower North Stream (the North Stream tributary). This site receives no ITA stormwater discharges.
- Sites 4B (upstream of the confluence with the North Stream tributary) and 4C (downstream of the confluence) are located in the Lower North Stream.
- Site 6 is located in the Lower North Stream, in the natural channel upstream of the estuary and downstream of all of the above sites (1C, 1A, 1B, 4A, 4B and 4C).

A summary of the data is presented in Appendix D Table 3. More detailed results can be found in the ITA Report (T+T, 2023a, included as Appendix G to the AEE).

Median water quality values for most monitored parameters at Site 1C typically met the ANZWQG for 95 % species protection. Average water quality data typically met the ANZWQG for 80 % species protection for most monitored parameters. Parameters that did not meet ANZWQG for either 80 % or 95 % protection included aluminium (average value), cadmium (average value), conductivity (median and average values), total suspended solids (median and average values) and pH (median and average values). Downstream of Site 1C at Site 1B, average copper and lead concentrations exceeded ANZWQGs for 80 % species protection.

Water quality at the Lower North Stream showed a similar pattern, with average aluminium and cadmium concentrations and average conductivity measurements exceeding ANZWQG for 80 % species protection at most sites. Average copper concentrations at Site 4C exceeded ANZWQG for 80 % species protection. Comparatively, median concentrations of aluminium (80 % level of protection), copper and cadmium (both 95 % level of protection) met ANZWQGs. Median conductivity measurements also exceeded ANZWQG.

Total suspended solids concentrations met guideline values at Site 4B, Site 4C and Site 6. Average and median pH values did not meet ANZWQG values in the North Drain (i.e. at Sites 1C, 1A, and 1B), however, guideline values were met in the Lower North Stream (i.e. Sites 4B, 4C, and 6).

All other parameters did not have associated guideline values or met ANZWQG, with most meeting the 95 % level of protection. Overall, the parameters that had the greatest exceedances of ANZWQG in the North Stream Catchment were aluminium and conductivity.

The ITA Report (T+T, 2024a, Appendix G of the AEE) provides further assessment of the long-term effects of ITA discharges on the Lower North Stream by assessing the results of a period of continuous sampling that was undertaken in 2021- 2022. This showed that while there are short term exceedances of the relevant ANZWQG during heavy rain, the longer-term averages meet the relevant ANZWQG within the Lower North Stream.

4.2.2 Kahawai Stream

Water quality monitoring data are available for three sites within the Kahawai Stream and Kahawai Tributary has been used to characterise the ITA stormwater discharges between 2015 – 2020. There is no longer an ITA discharge occurring in the Kahawai Stream, however, it should be noted that the Kahawai Stream ITA catchment might be used for future ITA activities. Therefore, the assessment of ITA discharges on the Kahawai Stream is retained to aide in the characterisation of the historic ITA discharges and to provide an overall understanding of the Site.

These water quality monitoring sites are shown on Appendix A1 and A2 and are described below:

- Kahawai Upstream is located 50 metres upstream of the culvert confluence with the Kahawai Tributary, and is unaffected by the stormwater flows from the ITA stormwater discharge.
- Kahawai Culvert is located on the Kahawai Tributary, which receives stormwater flows from the ITA Area.
- Kahawai Downstream is located in the stream channel approximately 500 metres downstream of the confluence with the Kahawai Tributary.

A summary of the data is presented in Appendix D Table 4. More detailed results can be found in the ITA Report (T+T, 2024a, included as Appendix G to the AEE). This includes an assessment between current (2019-2021) monitoring data and historical (2015-2020) monitoring data, the later has been used within this assessment to characterise the ITA stormwater discharge (Section 4.2.2.1).

4.2.2.1 ITA stormwater characterisation

The monitoring results from the Kahawai Upstream site found median and average concentrations of boron, iron and lead exceeded relevant ANZWQG values for the protection of 80 % of species[29]. Average concentrations of aluminium, copper and zinc also exceeded relevant ANZWQG values for the protection of 80 % of species[29]. Further, average and median pH values did not fit in the ANZWQG 20th and 80th percentile range. The monitoring results at the Kahawai Downstream site found these parameters also exceeded guideline values, along with median / average concentrations of total suspended solids.

Monitoring results from the Kahawai Culvert site found median and average concentrations of aluminium, boron, copper, lead and total suspended solids exceeded relevant ANZWQG values for the protection of 80 % of species. Further, average and median pH values did not fit in the ANZWQG 20th and 80th percentile range. The minimum (3.4 at the Kahawai Upstream site) and maximum values (11.9 at the Kahawai Culvert) showed a wide range in pH values at the sites.

Overall, the available Kahawai Stream water quality data identified several parameters that have concentrations that potentially result in adverse effects on freshwater fauna. The parameters that had the greatest exceedances of ANZWQGs in the Kahawai Stream, downstream of the ITA stormwater discharge were pH, aluminium and boron.

4.2.3 Ruakohua Stream

Monitoring data for three sites within the Ruakohua Stream have been used to characterise the ITA stormwater discharges between 2015 – 2020. This data consists of water quality data (Ruakohua Upstream) and ITA Stormwater discharge quality data (Contractors Compound and Yard 31). These sites are shown in Appendix A1 and A2 and are described below:

[29] It is important to note that > 85 % of samples analysed for lead and copper at the Kahawai Upstream site were recorded less than the ADL that was used at the time of sampling, and therefore, caution should be taken when assessing these results against the ANZWQG values for the protection of 80 % of species.

- Ruakohua Upstream - located upstream of the Contractors Compound and Yard 31 discharge points. Water quality data are available from June to August 2020.
- Contractors Compound – Stormwater discharge quality monitoring data is available at this site for 5 years.
- Yard 31 - Stormwater discharge quality monitoring data are available at this site for 5 years.

A summary of the data is presented in Appendix C Table 5. It is important to note that the data presented for the Contractors Compound and Yard 31 do not account for any mixing in Ruakohua Stream.

4.2.3.1 ITA stormwater characterisation

Monitoring results found average or median concentrations of aluminium, iron, total suspended solids and pH exceeded relevant ANZWQG values for the protection of 80 % of species at the Ruakohua Upstream site. Monitoring results at the Contractors Compound discharge point found average or median concentrations of aluminium, copper and lead exceeded relevant ANZWQG values for the protection of 80 % of species. Monitoring results at the Yard 31 discharge point found average and / or median concentrations for aluminium, iron, copper, lead, zinc total suspended solids and pH concentrations exceeded relevant ANZWQG values for the protection of 80% of species. Overall, the parameter that had the greatest exceedances of ANZWQG in the Ruakohua Stream was aluminium.

4.3 EAF anticipated changes to discharge quantity and quality

Should an EAF become fully operational the manufacturing of steel will have less reliance on iron sands and coal. This change is expected to reduce the amount of Dewatering Plant process water entering the North Stream Catchment and reduce the contamination loads from coal stockpiling as the runoff is directly linked to total stockpiling area. Further information regarding the implications of the change to an EAF system are detailed in the ITA Report (T+T 2024a, Appendix G of the AEE), however; to provide context to this assessment a summary is provided below of the anticipated discharge quantity and quality characteristics if an EAF becomes operational.

4.3.1 EAF discharge quantity

With an operational EAF, the operating hours for the Dewatering Plant discharge are expected to reduce by up to half with a subsequent reduction in total volume discharged. This would result in a reduction in the overall pumping hours, although the pumping volume per hour would not reduce. Based on the current operation, this would mean the variability in flow within the North Drain (and subsequently the Lower North Stream) would change, with an increased period where no pumping would occur. To reduce any effect from any increase in variability to stream flows and the subsequent increased period of no flows, it is proposed that the Dewatering Plant discharges will discharge into the existing Dewatering Plant ponds to buffer the discharge.

The proposed change of discharge path will buffer flows into the North Drain (and ultimately the Lower North Stream) reducing the artificial flashiness in flow which can currently occur, while still allowing natural flushing flow events (i.e., from rain events in the catchment) to impact the flows in the Lower North Stream. Overall, with an EAF operating, the Dewatering Plant discharge will contribute ~ 40 % of stream flow within the Lower North Stream at the stream mouth (compared to ~ 80 % without the EAF operating).

4.3.2 EAF discharge quality

Any contaminant effects on the Receiving Environment from the operation of an EAF will be reduced from those detailed in the assessment of the replacement Existing Permits. This will primarily be through a reduction in the quantity of coal being stockpiled and the areas currently used for coal storage potentially being converted to scrap storage yards (the buffer storage yard is identified as being either CY 5/6 or CY 19).

The only new contaminant generating activity associated with an EAF will be stormwater runoff from any new Scrap Yard. If one of the existing coal yards (CY 5/6 or CY 19) is converted to a Scrap Yard, additional stormwater treatment will be provided including the conversion of existing ponds into a sediment pond/ wetland treatment series. Therefore, the changes associated with the stockpiling of materials within the North Drain ITA Catchment are likely to result in a reduction in the overall contaminant loads (especially from suspended solids and metals). Should CY 5/6 be chosen as the Buffer Scrap Yard area, this will include potential improvements in the performance of the East Pond due to a reduction in the area discharging to the pond.

The implementation of a comprehensive Best Practicable Option (BPO) treatment will ensure the discharge of different contaminants from the ferrous scrap yards is minimised with discharges expected to meet the relevant ecological based guidelines (see T+T, 2024a). With the proposed controls and treatment, the discharges related to the operation of the EAF are not expected to increase the contaminant levels to the North Drain or impact on existing water quality compared to those presently observed in the Current Environment.

4.3.3 Anticipated effects to the North Stream Catchment from an EAF

As outlined in Section 1.4 and above, on review of the initial information it is expected that effects from contaminants on the Receiving Environment from the operation of an EAF will be ***reduced*** from those detailed wider in this assessment. However, to remain conservative, any potential improvement in discharge quality associated with operation of an EAF has not been factored into these assessments, and therefore a 'worst case scenario' for contaminants based on the current operations has been presented. Given the above, discussion in this report related to potential effects of discharges following implementation of an EAF focuses on potential effects of changes in discharge quantity, rather than discharge quality. Consequently, the assessment presents both a 'worst case scenario' and where required an EAF expected scenario.

5 Assessment of ecological values

The following section presents the Current Environment ecological values of the North Stream Catchment, Kahawai Stream, Ruakohua Stream and wetlands that are either within the Site, or potentially affected by the proposed ITA stormwater or Dewatering Plant. The ecological values of each stream catchment are described in separate sections, followed by an assessment of wetland ecological values across all catchments in Section 5.6. In the summary for each stream, the ecological value for the Current Environment and the Receiving Environment is provided.

5.1 Overview of stream assessments

The assessment of stream ecological value is informed by the water quality and ecological data presented in Table 5.1. Site locations are shown in Appendix A. For the purposes of this report, these results are indicative of the future environment in which the potential effects of the proposed discharges are operating (if consent is authorised), rather than values of the Receiving Environment. Additionally, spot water quality and macroinvertebrate data[30] was compared to two reference sites located on the Waitangi and Mauku Streams (Table 5.1). Ecological descriptions of the reference sites are provided in Section 5.1.1 below.

[30] Land Air Water Aotearoa website, accessed 5 March 2021.

Table 5.1: Summary of datasets available for each stream (and reference sites)

Data type	North Drain (Sites B and C)	Lower North Stream (Sites A and Site 6)	Ruakohua Stream	Kahawai Stream	Waitangi Stream (reference site)	Mauku Stream (reference site)
Stream Ecological Valuation	2012, 2018, 2020	2012, 2020, 2021	2011, 2020	2007, 2020	-	-
Spot water quality (water temperature, dissolved oxygen, pH, conductivity)	2012, 2020	2013-2015, 2018, 2020	2013-2015, 2020	2020	2017	-
Macroinvertebrates	2012, 2020	2005, 2009 –2020	2011, 2020	2005, 2007, 2020, 2022	2010-2019	2003 – 2013
Freshwater fish	2012, 2020, 2022	2011-2017, 2022	2011–2017, 2020	2020	-	-

Site locations shown on Figure W-FWE1 in Appendix A.

5.1.1 Ecological description of reference catchments

This section provides a high-level summary of available ecological data from the Auckland Council River Ecology Monitoring Programme (REMP) and predicted catchment information available on the NIWA administered NZ River Maps[31] for the two reference catchments (Waitangi and Mauku).

5.1.1.1 Waitangi Stream catchment

The Waitangi Stream catchment is located approximately 2.5 km to the south of the Site and encompasses an approximate 1,890 ha catchment comprised predominantly of high producing exotic grasslands, annual short rotation cropland, and indigenous forest and exotic forest. The Waitangi Stream flows in an easterly direction and ultimately discharges into the Waiuku River estuary. The Waitangi Stream is a similar sized stream (to those within the NZ Steel site) with a rural catchment and is a useful reference site for macroinvertebrate and water quality data (noting the aforementioned limitations with spot water quality data). Spot water quality data were compared with data collected by Auckland Council in 2017 from the Waitangi Stream (Buckthought, 2019) and macroinvertebrate data were compared with data collected by Auckland Council between 2010 and 2019.

The Waitangi Stream monitoring site is located in the lower reaches of the catchment, approximately 500 m from its confluence with the Waiuku River estuary. Monitoring at the Waitangi Stream site began in 2009 and continues to be included in the Auckland Council's REMP. The monitoring site is characterised by substrates primarily consisting of muds/silts, and occasional coarse gravels and cobbles. Riparian vegetation is a mix of large exotic trees and native plantings with an understory that consist of weedy herbaceous plants providing filtering of overland flow paths. Recent analysis by Auckland Council (Chaffe, 2021) shows that the 5-year median SEV score at the Waitangi Stream monitoring site is 0.62 (min = 0.57 and max = 0.64), this relates to a SEV class of 'good'.

5.1.1.2 Mauku Stream catchment

The Mauku Stream catchment is located approximately 6.5 km to the east – south east of the Steel Mill and is comprised of high producing exotic grasslands and annual short rotation cropland. The

[31] NZ River Maps, accessed 09 November 2021

Mauku Stream catchment is approximately 3,847 ha, and ultimately discharges into the Taihiki River estuary. The Mauku Stream is a similar sized stream (to those within the NZ Steel site) with a rural catchment and is a useful reference site for water quality and macroinvertebrate data. The available water quality and macroinvertebrate data was collected by Auckland Council between 2003 to 2013 from the Mauku Stream (Neale *et al.*, 2017).

The Mauku Stream monitoring site was sampled from 2005 to 2013 in the REMP and the monitoring site was located approximately 2.3 km from its confluence with the Taihiki River estuary. The monitoring site is characterised by substrates primarily consisting of muds/silts, and occasional coarse gravels and cobbles. Riparian vegetation is a mix of large exotic trees and occasional native plantings with an understory of that consist of weedy herbaceous plants providing filtering of overland flow paths. No summary analysis of SEV scores or trends has been completed for this site.

5.2 North Stream Catchment – North Drain

5.2.1 Stream ecological valuation

Key habitat characteristics and the SEV scores for the North Drain sites are described in the section below. The SEV site locations are shown on Appendix A Figure W-FWE1 and the SEV results are presented in Appendix E Table 1.

5.2.1.1 Site C

Site C (Photograph 5.1) is located on the North Drain upstream of the proposed ITA stormwater and / or Dewatering Plant discharges. Site C had an average wetted width of 2.1 m and average depth of 0.2 m. Macrophyte growth covered the entire stream channel at Site C at all sampled cross sections. Silt/sand was the only substrate type present. Habitat abundance and diversity was ‘poor’ with very little favourable habitat present.

The overall SEV score for Site C (including biodiversity values) was 0.19 (Appendix E Table 1). This score was lower than the SEV score (0.31) calculated from the survey conducted in 2012 (Appendix F Table 1). An increase in macrophyte coverage at Site C since 2012 is the likely cause of the decrease in SEV score.

Photograph 5.1: Typical channel at Site C, North Drain.

5.2.1.2 Site B

An SEV was conducted at Site B in 2018 (Photograph 5.2). Site B is located on the North Drain downstream of the Dewatering Plant discharge and most of the ITA stormwater discharge points. Site B had an average wetted width of 2.2 m and average depth of 0.05 m. No macrophyte growth was present within the stream channel which is expected given the stream bed is completely lined with concrete. A thin layer of periphyton growth was present on the concrete. Habitat abundance and diversity was ‘poor’ with very little favourable habitat present. The overall SEV score for Site B (including biodiversity values) was 0.23 (Appendix F Table 1).

Photograph 5.2: Typical channel at Site B, North Drain (no flow from Dewatering Plant at time of photograph).

5.2.2 Spot water quality

Spot water quality data from North Drain sites are presented in Appendix G Tables 1 and 2. The data are indicative of water quality conditions at the time of survey only, being in August 2020 and September 2012.

Spot water quality data from North Drain (collected in the afternoon of 4 August 2020) is characterised as follows:

- Water temperatures in the North Drain were similar upstream and downstream of the Dewatering Plant discharges.
- Dissolved oxygen concentrations were typically high, well within Band A (> 8.0 mg/l) of the NPSFM. This suggests that no stress to aquatic organism is expected (NPSFM, 2020). The exception to this was Site C in 2020 where dissolved oxygen levels (6.77 mg/l) fell within Band C, suggesting moderate stress on a number of aquatic organisms could be expected (NPSFM, 2020).
- North Drain pH values were all near neutral, except for at Site B in 2020, which had a much lower pH value of 4.8. All pH values fell outside of the ANZWQG range for pH (7.26 – 7.8) (ANZWQGs, 2018).
- Conductivity measurements in the North Drain were lower upstream of the Dewatering Plant discharges than downstream. The Dewatering Plant discharge is brackish, as it is sourced within the tidal zone at the mouth of the Waikato River.

Overall, spot water quality was generally similar in the North Drain upstream (Site C) and downstream (Site B) of the Dewatering Plant discharges, with the exception of conductivity measurements which were higher downstream of the Dewatering Plant discharge. Spot water quality in the North Drain typically met or were near to established NPSFM and ANZWQG values.

5.2.3 Macroinvertebrate communities

Macroinvertebrate data for the North Drain are presented in Appendix H Table 1 and Appendix H Table 2. The data are summarised as follows:

- The number of taxa present in North Drain samples are typically low. EPT taxa (both EPT-a and EPT-b) are either absent in samples collected, or the percent present in the samples is low.
- MCI scores are all indicative of 'poor' habitat and water quality. This indicates that macroinvertebrate communities are dominated by pollution-tolerant taxa both upstream and downstream of the discharges in the North Drain. MCI scores all fell within Band D (< 90) of the NPSFM [32]. In addition, the macroinvertebrate communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment (NPSFM, 2020). Further, almost all MCI scores were below the Auckland Unitary Plan (AUP) MCI guideline[33] for rural areas land use (94).
- SQMCI scores are all indicative of 'poor' habitat and water quality. The exception to this is the SQMCI score for Site C in 2020 (4.0) which is indicative of 'fair' habitat and water quality, this is on the border between 'poor' and 'fair' quality.

Based on the above, it is considered that the macroinvertebrate communities in the North Drain Receiving Environment would be of a similar quality to the current communities if the discharges ceased, but that saline sensitive taxa would likely return (if appropriate habitat were present). Given that upstream macroinvertebrate communities at Site C (located upstream of the Steel Mill Site discharges) are also indicative of 'poor' (MCI) and 'fair' (SQMCI) quality, with a low proportion of EPT taxa, other upstream catchment factors are likely influencing macroinvertebrate communities in the North Drain along with poor habitat quality and the Steel Mill Site discharges.

5.2.4 Freshwater fish communities

The diversity of species present in the North Drain is low, with only shortfin eels/Hau (*Anguilla australis*; 'Not Threatened' species classification per Dun et al 2018 and Bloxham et al 2023), unidentified eels and unidentified pest fish species present (Appendix I Table 1 and Appendix I Table 2). The IBI score for Site B (14) corresponded to a rating of 'very poor' and fell within Band D (< 18) of the NPSFM. This suggests a severe loss of fish community integrity (NPSFM, 2020). An IBI score for Site C could not be calculated as, although eels and pest fish were observed in the drain, they were not able to be captured to allow proper identification. The IBI is expected to be similar to or lower than the downstream Site B due to the available habitat and those species observed.

Based on the above, it is considered that Receiving Environment fish communities would be similar in terms of species present. However, as available instream habitat would decrease compared to the Current Environment due to the loss of the primary source of flows in the North Drain species abundances may reduce.

5.2.5 Assignment of Ecological value to the North Drain

The Current Environment and Receiving Environment ecological values for the North Drain are summarised below. Each value has been assigned following the approach set out in Section 3.4.2.

5.2.5.1 Current Environment ecological value

The North Drain Current Environment is considered to be of **'Low'** ecological value. This is due to the MCI and SQMCI scores being indicative of 'poor' habitat quality, a 'very poor' native fish diversity being present, and the highly modified nature of the channel (Appendix B Table 1).

[32] While macroinvertebrate surveys were conducted outside of the recommended sampling timeframe (December to March) and were processed using Protocol P1 (coded abundance) instead of Protocol P2 (fixed count with at least 200 individuals) or P3 (full count), the survey data are considered indicative of the MCI attribute band that macroinvertebrate communities would fall within.

[33] Chapter E1 – Water quality and integrated management, Policy E1.3 – Freshwater quality and ecosystem health interim guidelines.

5.2.5.2 Receiving Environment ecological value

The ecological value of the North Drain Receiving Environment is considered to be **'Low'** (Appendix C Table 3). This is on the basis that the channel bed and banks are highly modified (concrete lined downstream of the discharge points). This modification would make it difficult to implement any easily achievable potential enhancements (such as riparian planting). The North Drain Receiving Environment would also have less instream habitat available. This is because without the Dewatering Plant discharge, which provides the flow to the North Drain, the North Drain would not have a permanent flow and would only flow intermittently. However, without the Dewatering Plant discharge the North Drain Receiving Environment would have better water quality (notably lower aluminium concentrations and conductivity measurements) when natural flows are present within the watercourse.

5.3 North Stream Catchment – Lower North Stream

5.3.1 Stream ecological valuation

Key habitat characteristics and the SEV scores for the Lower North Stream sites are described in the section below. While approximately 65 m of this SEV reach was located in the North Drain it is considered to be representative of the existing values of the Lower North Stream.

The SEV site locations are shown on Appendix A Figure W-FWE1 and the SEV results are presented in Appendix E Table 1. Lower North Stream SEV scores from 2020 ranged from 'low' (Site A) to 'moderate' (Site 6)[34].

5.3.1.1 Site A

Site A is located on the Lower North Stream, downstream of the Steel Mill and Brookside Road, in the modified natural stream section (Photograph 5.3). Site A had an average wetted width of 0.8 m and average depth of 0.3 m. The average macrophyte cover of the stream channel at Site A was 26 %. The dominant substrate present was silt/sand, with sporadic areas of small-medium and large gravels. Habitat abundance and diversity was 'poor' with very little favourable habitat present.

The overall SEV score for Site A (including biodiversity values) was 0.27 (Appendix E Table 1). This low score is primarily due to the lack of riparian shading and the modified nature of the catchment. This score was similar to the SEV score (0.28) calculated from the survey conducted in 2012 (Appendix F Table 1). Since the 2012 SEV was conducted a mature stand of pine trees adjacent to Site A had been harvested. This reduction in channel shading likely accounts for the small decrease in SEV score. Restorative riparian plantings not associated with Existing Permit condition requirements were undertaken by NZ Steel in 2012 along the true-right bank that should improve riparian shading as they mature.

[34] The SEV descriptors are from the assessment criteria for freshwater streams developed by Boffa Miskell Limited presented in Appendix C Table 3.

Photograph 5.3: Typical stream channel at Site A, Lower North Stream.

5.3.1.2 Site 6

Site 6 is located on the Lower North Stream downstream of the Steel Mill (Photograph 5.4). Site 6 had an average wetted width of 1.9 m and average depth of 0.4 m. The average macrophyte cover of the stream channel at Site 6 is 64 %, with reed sweet grass (*Glyceria maxima*) the dominant species present on the flood plain and in the stream. The dominant substrate present was silt/sand. Habitat abundance and diversity was 'suboptimal' with a mixture of woody debris, root mats, rooted aquatic vegetation and undercut banks.

The overall SEV score for Site 6 (including biodiversity values) was 0.67 (Appendix E Table 1). This 'moderate'[34] score was primarily due to the established native riparian vegetation that was planted approximately 22 years ago along this section of the Lower North Stream.

Photograph 5.4: Typical stream channel at Site 6, Lower North Stream.

5.3.2 Spot water quality

Spot water quality data from the Lower North Stream are presented in Appendix G Table 1 and Appendix G Table 2. The data are indicative of water quality conditions at the time of survey only. Summary reference water quality data from the Waitangi Stream (reference site) are presented in Appendix K Table 1.

Spot water quality data from the Lower North Stream (collected in the afternoon of 4 August 2020) is characterised as follows:

- Water temperatures all fell within the recorded range in of the Waitangi Stream reference site.
- Dissolved oxygen concentrations typically showed a high concentration, well within Band A (> 8.0 mg/l) of the NPSFM. This suggests that no stress to aquatic organism is expected (NPSFM, 2020). Dissolved oxygen concentrations were typically higher in the Lower North Stream than the recorded range in the Waitangi Stream.
- Lower North Stream pH values were all near neutral and typically met or were near to the ANZWQG values for pH (7.26 – 7.8) (ANZWQGs, 2018). The pH values were all similar to median pH value in the Waitangi Stream.
- Conductivity measurements in the Lower North Stream (downstream of the Dewatering Plant and ITA stormwater discharges) were all higher than the maximum recorded value in the Waitangi Stream. This is expected as the Dewatering Plant discharge is brackish, as it is sourced within the tidal zone at the mouth of the Waikato River.

Spot water quality in the Lower North Stream typically met or were near to established NPSFM and ANZWQG values. Conductivity measurements increase downstream of the Dewatering Plant and ITA stormwater discharges.

5.3.3 Macroinvertebrate communities

Macroinvertebrate data for the Lower North Stream are presented in Appendix H Table 1 to Appendix H Table 3; with reference site data available in Appendix H Table 8. The data are summarised as follows:

- The number of taxa present in the Lower North Stream samples are typically low. The percent of sensitive EPT-b taxa present in the samples are also low.
- MCI scores are nearly all indicative of 'poor' quality, except for Site A in 2020 where the MCI score was indicative of 'fair' quality. The MCI score in 2012 and 2020 for Site 6 was significantly lower than Site A, based on the Stark (1998) detectable difference method of assessment (a difference > 10.83 in MCI score for one replicate[35]). This suggests there is a difference between the macroinvertebrate communities present at Site A and Site 6.
- MCI scores from the lower catchment (Site 6) are all indicative of 'poor' quality, with the exception of 2009, 2014, and 2022 data where scores were indicative of 'fair' habitat quality class.
- Almost all MCI scores fell within Band D (< 90) of the NPSFM[36]. This suggests the communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment (NPSFM, 2020). Further, almost all MCI scores were below the AUP MCI guideline for rural areas land use (94)[33].
- Semi Quantitative Macroinvertebrate Community Index (SQMCI) scores are all indicative of 'poor' habitat and water quality. The SQMCI score in 2012 and 2020 for Site 6 was significantly lower than Site A, based on the Stark (1998) detectable difference method of assessment (a difference > 0.83 in SQMCI score for one replicate). This suggests there is a difference between the macroinvertebrate communities present at Site A and Site 6.

[35] Three replicates were taken at site 6, but only one at Site A. Therefore, the comparison between replicates has been made on the basis of the average of the three replicates at Site 6, compared to the single replicate at Site A.
[36] While macroinvertebrate surveys were conducted outside of the recommended sampling timeframe (December to March) and were processed using Protocol P1 (coded abundance) instead of Protocol P2 (fixed count with at least 200 individuals) or P3 (full count), the survey data are considered indicative of the MCI attribute band that macroinvertebrate communities would fall within.

- MCI scores were similar to median MCI scores from the Waitangi Stream (poor quality) and Mauku Stream (fair quality). Both of these streams are located in catchments near the Site but are not impacted by Steel Mill activities.
- Several saline tolerant species were present at Sites A and 6 such as *Paratya* shrimp and the snail *Potamopyrgus*. Saline sensitive species (such dobsonflies and beetles and some trueflies) were generally absent. Comparatively, saline sensitive species were present in the nearby Kahawai Stream.

Macroinvertebrate data suggest the Site discharges influence the macroinvertebrate communities in the Lower North Stream. In particular, several saline tolerant species were present at Sites A and 6 while saline sensitive species were absent. However, the overall communities present are similar (both in taxa and quality) to those present in the Ruakohua Stream (upstream of the Steel Mill) and other nearby reference catchments (the Waitangi and Mauku).

Based on the above, it is considered that the Receiving Environment macroinvertebrate communities in the Lower North Stream would be of a similar quality to the current communities if the discharges ceased, but that saline sensitive taxa would return (where habitat was available). Given that upstream macroinvertebrate communities at Site C (located in the North Drain upstream of the Site discharges) are also indicative of 'poor' (MCI) and 'fair' (SQMCI) quality with low proportion of EPT taxa, the macroinvertebrate communities in the Lower North Stream are also being influenced by upstream catchment factors other than those associated with the Steel Mill discharges.

5.3.4 Freshwater fish communities

Native fish species caught in the Lower North Stream are presented in Appendix I Table 3 to Appendix I Table 5). The IBI scores for the Lower North Stream catchment corresponded to a rating of 'fair' through to 'excellent'. This suggests a moderate to high integrity of the fish community where migratory access and habitat have minimal degradation but at times show signs of stress (NPSFM, 2020). Species present included longfin eel/tuna (*Anguilla dieffenbachii*) (Site A and Site 6), shortfin eels/hau (Site A and Site 6) and īnanga (*Galaxias maculatus*) (Site 6). Banded kōkopu (*Galaxias fasciatus*) have been captured in the wider catchment (Appendix I Table 5). Longfin eels and īnanga have a national and regional conservation status of 'At Risk – Declining', while the other species have a status of 'Not Threatened' (Dunn *et al*., 2018, Bloxham *et al*., 2013).

The fish surveys that identified banded kōkopu and īnanga were undertaken in December 2016 and March 2017, and March 2022 (īnanga only). The 2016 and 2017 surveys were not undertaken for the purpose of this assessment (for example banded kōkopu were identified during a fish relocation attempt), and as such there is a level of uncertainty around the use of these surveys for anything other than catchment presence data. However, the data are used here to provide additional information when assigning ecological value at this site, as we consider that these species would inhabit and utilise the Lower North Stream as a pathway to access the habitat that they were identified in.

Additional to field survey data, the New Zealand Freshwater Fish Database (NZFFD) also lists common smelt/pōrohe (*Retropinna retropinna*; nationally 'Not Threatened' per Dunn *et al*. 2018; regionally 'Threatened – Regionally Vulnerable' Bloxham *et al*. 2023) as being historically present in the wider catchment[37].

The single box culvert (which was installed in September 2022) meets the permitted activity requirements in the Freshwater NES and provides fish passage at this location.

[37] The pōrohe catch record is dated from 1998 and was located where the east landfill is now located. No pōrohe have been captured in any subsequent sampling efforts. Including during fish relocation efforts associated with the stream works associated with the east landfill expansion.

Based on the above, it is considered that the Receiving Environment fish communities would be similar in terms of species diversity present in the Current Environment. However, the available instream habitat of the Receiving Environment would be reduced in extent when compared to the Current Environment due to the loss of a primary source of flows in the Lower North Stream. A reduced abundance of fish would therefore be expected. Furthermore, as a primary source of flow would be reduced in the Receiving Environment, compared to the Current Environment, stream connectivity (and fish passage) to the upper Lower North Stream could be restricted to a wider range of fish species at certain flows. Currently, both eel species are capable of passage to upstream habitats during most of the year, as the Dewatering Plant contributes a large proportion of flow[38]. With a loss in flows to the Receiving Environment, stream connectivity may reduce, which will limit the extent of time that fish can move to upstream habitats to times when storm flow events occur[39].

5.3.5 Sediment quality

Sediment quality data from Lower North Stream are presented in Appendix J Table 1. Sample site locations are shown in Appendix A1.

The results show that most parameters met the ANZWQ DVG's at Site A. The exception to this was zinc concentrations (total recoverable and extractable) which exceeded the ANZWQ high guideline value for sediment quality. Total recoverable arsenic, total recoverable chromium and nickel (total recoverable and extractable) concentrations exceed ANZWQ DVG's but met the ANZWQ High guideline value for sediment quality. While there is no guideline value for aluminium, the result obtained was high, although was comparative to concentrations observed at other sample sites at the Site. This is expected given the depositional nature of the sample site and the concentrations of aluminium in the Dewatering Plant discharge.

Comparatively, all parameters met the ANZWQ DVG's at Site 6. Macrophyte growth present in the upper Lower North Stream catchment likely causes suspended sediments to settle out of suspension between Site A and Site 6.

Based on the above, it is considered that in the absence of the proposed NZ Steel discharges, the sediment quality would improve over time as large rainfall events would mobilise sediments and re-distribute them downstream. Consequently, over time sediment quality would be expected to meet ANZWQGs in the Lower North Stream Receiving Environment catchment.

5.3.6 Assignment of ecological value to the Lower North Stream

The Current Environment and Receiving Environment ecological values for the Lower North Stream are summarised below. Each value has been assigned following the approach set out in Section 3.4.1.

5.3.6.1 Current Environment ecological value

The Lower North Stream Current Environment is considered to be of **'Moderate'** ecological value (Appendix C Table 3). This is because riparian planting has been undertaken along the natural stream (Site 6) section of the stream which has increased SEV scores. The Lower North Stream (Site 6) also provides habitat to longfin eel and īnanga which are listed as 'At Risk' species (Dunn *et al*, 2018; and Bloxham *et al*. 2023), and historically common smelt (regionally 'threatened' per Bloxham *et al*. 2023). The modified natural stream section of the Lower North Stream (Site A) is of lower quality

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38 Approximately 80 % at the annual average flow (calculated using the long-term median (50th percentile) flow) and 99 % at low flow events. The impact on flows has the potential to decrease by up to 50 % with the operation of the EAF.
39 Storm flow events approximately equate to the average daily contribution of the Dewatering Plant (estimated 95th percentile natural storm flow at the mouth of the Lower North Stream is 86 L/s and daily average Dewatering Plant discharge to the North Drain is 83 L/s).

compared to Site 6; however, this section of stream does provide habitat to longfin eel (and likely shortfin eel).

With the implementation of the WQMP, the increased level of monitoring and on-going implementation of the continuous improvement programme, the water quality associated with the replacement Existing Permits is expected to improve over the term of the consent. It should be noted that any contaminants assessed do not account for the likely reduction in flow volumes and contaminant loads should an EAF be installed and operated. Therefore, these present a worst-case scenario and conservative assessment based on current operations.

Under the Current Environment, when the Dewatering Plant is operating the discharge contributes on average 80 % of the flow within the Lower North Stream at the stream mouth. This contributes to a marked increase in instream habitat that would not be available in the Lower North Stream if the discharge was to cease. Although, it is important to note that due to the flow contribution being linked to the operating hours of the Dewatering Plant, there is an inherent high-level of flashiness with this flow.

Within an EAF impacted environment the Dewatering Plant discharge is estimated to account for approximately 40 % of flow within the Lower North Stream at the stream mouth. This will result in a reduction in flows over what is present in the Current Environment. However, this will still maintain the Lower North Stream as a permanent watercourse and provide an increase in available instream habitat (relative to the Receiving Environment which would exclude Dewatering Plant flows entirely). Over time, it is expected that the Lower North Stream would find a new natural equilibrium associated with any reduced flows, particularly as these would have reduced flow variability due to being buffered through the Dewater Plant ponds. In addition, habitat types are likely to become redistributed throughout the Lower North Stream.

5.3.6.2 Receiving Environment ecological value

The ecological value of the Lower North Stream Receiving Environment is considered to be of **'Moderate'** ecological value (Appendix C Table 3). The Lower North Stream Receiving Environment would revert to an intermittent stream without the Steel Mill discharges. Intermittent stream types still have important intrinsic value, support biological communities and influencing the chemical, physical and biological integrity of downstream waters. In the absence of the Steel Mill discharge, saline sensitive macroinvertebrate taxa would be expected to return, however; MCI and SQMCI score would be of a similar quality to the Current Environment communities. This is primarily due to the intermittent stream habitat present in the Receiving Environment. Native fish communities would also be expected to remain similar to those currently present, but available instream habitat would be impacted (reduced) by the shift to an intermittent stream type due to the reduction in flows that would occur if the discharges that are the subject of the replacement consent application ceased.

5.4 Kahawai Stream

5.4.1 Stream ecological valuation

Key habitat characteristics and the SEV scores for the Kahawai Stream sites are described in the section below. The SEV results are presented in Appendix E Table 1.

5.4.1.1 Kahawai Upstream

The Kahawai Upstream site is located directly upstream of the confluence with the unnamed tributary that receives the ITA stormwater discharge (Photograph 5.5; Appendix A2) and is intermittent. The Kahawai Upstream site had an average wetted width of 0.6 m and average depth of 0.06 m. Channel shading ranged from very low to high. The average macrophyte cover of the stream channel was 77 %. The dominant substrate present was silt/sands with some small wood present. Habitat abundance and diversity was 'marginal' with woody debris and undercut banks present.

The overall SEV score (intermittent) for the Kahawai Upstream site (including biodiversity values) was 0.50 (Appendix E Table 1). This moderate score is primarily due to the ecological benefits provided by the riparian planting that has been previously undertaken by NZ Steel. This score was higher than the SEV score (0.39) calculated from the previous survey conducted in 2007 suggesting the ecological values of the site have increased (Appendix F Table 1). It should be noted that the 2007 survey used an earlier version of the SEV (Rowe *et al*., 2006) which has been demonstrated to be comparable.

Photograph 5.5: Typical stream channel at the Kahawai Upstream site.

5.4.1.2 Kahawai Downstream

The Kahawai Downstream site is located approximately 300 m downstream of the ITA stormwater discharge outfall (Photograph 5.6; Appendix A2). The Kahawai Downstream site had an average wetted width of 1 m and average depth of 0.2 m. Channel shading ranged from low to high. The average macrophyte cover of the stream channel at the Kahawai Downstream site was 25 %. The dominant substrates present were silt/sands, with small, medium and large wood all present. Habitat abundance and diversity was 'suboptimal' with 3-4 habitat types (riffles, woody debris, and undercut banks) present.

The overall SEV score for the Kahawai Downstream site (including biodiversity values) was 0.65 (Appendix E Table 1). This moderate score is primarily due to the ecological benefits provided by the riparian planting that has been previously undertaken by NZ Steel and the greater diversity and abundance of instream habitat features. This score was higher than the SEV score (0.46) calculated from the previous survey conducted in 2007 suggesting the ecological values of the site have increased (Appendix F Table 1). It should be noted that the 2007 survey used an earlier version of the SEV (Rowe *et al*., 2006) which has been demonstrated to be comparable.

Photograph 5.6: Typical stream channel at Kahawai Downstream site.

5.4.2 Spot water quality

Spot water quality data from Kahawai Stream are presented in Appendix G Table 6. The data (collected in the afternoon of 6 August 2020) are indicative of water quality conditions at the time of survey only. Summary reference water quality data from the Waitangi Stream (reference site) are presented in Appendix K Table 1.

Spot water quality data from Kahawai Stream is characterised as follows:

- Water temperatures all fell within the recorded range in the Waitangi Stream.
- Dissolved oxygen concentrations were lower upstream of the discharge than downstream. The dissolved oxygen concentration at the Upstream Reach site fell within Band D (< 5.0 mg/l, indicating significant and persistent stress on aquatic organisms), while the Downstream Reach site fell within Band C (≥ 5.0 and < 7.0 mg/l, indicating moderate stress on a number of aquatic organisms) (Table 7, Appendix 2A[40], NPSFM, 2020). The variation in Kahawai Stream dissolved oxygen concentrations was generally similar to the recorded range in the Waitangi Stream.
- pH values were all near neutral. The pH value at the Downstream Reach site met the ANZWQG values for pH (7.26 – 7.8) (ANZWQGs, 2018). The Upstream Reach site pH value was slightly lower than the guideline value. The pH measurements were all similar to the Waitangi Stream median pH value.
- Conductivity measurements in the Kahawai Stream were higher downstream of the ITA stormwater discharge than upstream of the discharge. Conductivity measurements were higher at both sites than the maximum recorded value in the Waitangi Stream. This suggests that concentrations of dissolved ions in the Kahawai Stream are elevated, possibly due to existing upstream catchment influences (the Kahawai Upstream site) and the ITA stormwater discharge (the Kahawai Downstream site).

Spot water quality typically highlighted that dissolved oxygen concentrations could result in stress to aquatic organisms.

[40] 7 day mean used as spot samples collected outside of summer period 1 November to 30 April.

5.4.3 Macroinvertebrate survey

The 2020 and 2022 macroinvertebrate data for the Kahawai Stream are presented in Appendix H Table 6 and Appendix H Table 7. Macroinvertebrate data are summarised as follows:

- The number of taxa present in samples was typically high, with ≥ 20 taxa identified at both sites on both sampling occasions.
- The percent of sensitive EPT taxa (i.e., EPT-b) present in the samples were low and were typically < 5 % of the sampled community. Only one EPT species was identified at the upstream site in 2020 (the free-living caddisfly *Polyplectropus sp*). In 2022, four sensitive EPT taxa were identified, two at the upstream site (*Polyplectropus sp* and the cased caddisfly *Hudsonema sp*) and three at the downstream site (the free-living caddisflies *Hydrobiosis sp, Psilochorema sp*, and *Polyplectropus sp*).
- In 2020, the MCI score for the Kahawai Downstream site were indicative of 'poor' (MCI = 72) quality, while the Kahawai Upstream site was indicative of 'fair' (MCI = 85) quality. In 2022, the MCI score for the Kahawai Downstream site were indicative of 'poor' (MCI = 78), while the Kahawai Upstream site was indicative of 'fair' (MCI = 87) quality.
- Based on the Stark (1998) detectable difference method of assessment a difference > 10.83 in MCI score (for one replicate) is indicative of a statistical difference in MCI scores. Therefore, the MCI score for the Kahawai Downstream site was significantly lower than the Kahawai Upstream site MCI score in 2020, however; in 2022 no statistical significance was observed.
- MCI scores collected in 2005 and 2007 were indicative of 'fair' habitat and water quality. It should be noted that the exact location of where the 2005 and 2007 samples were collected in the Kahawai Stream is unknown.
- All MCI scores fell within Band D (< 90) of the NPSFM (Table 14 of the NPSFM, 2020)[41]. This suggests the communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment (NPSFM, 2020). Further, all MCI scores were below the AUP MCI guideline for rural areas land use (94)[33].
- SQMCI scores for both sites are indicative of 'poor' habitat and water quality. Based on the Stark (1998) detectable difference method of assessment a difference > 0.83 in SMQCI score (for one replicate) is indicative of a statistical difference in SQMCI scores. In 2020, the SQMCI score for the Kahawai Downstream site was significantly lower than the Kahawai Upstream site SQMCI score, however; in 2022 no significant difference in SQMCI score was observed.
- MCI scores were similar to median MCI scores from the Waitangi Stream (poor quality) and Mauku Stream (fair quality) (Appendix H Table 8).
- Both streams are located in catchments near the Site but are not impacted by Steel Mill activities.

Based on the above, it is considered that Receiving Environment macroinvertebrate communities would be similar in terms of species compared to the Current Environment. This is because while macroinvertebrate communities would be expected to improve over time; water quality, stream and riparian habitat type/availability in the catchment would mean macroinvertebrate communities would be expected to be of a similar quality to the Kahawai Upstream Current Environment site (see Section 6.2.2.1).

[41] While macroinvertebrate surveys were conducted outside of the recommended sampling timeframe (December to March) and were processed using Protocol P1 (coded abundance) instead of Protocol P2 (fixed count with at least 200 individuals) or P3 (full count), the survey data are considered indicative of the MCI attribute band that macroinvertebrate communities would fall within.

5.4.4 Freshwater fish communities

The results of the 2020 survey (presented in Appendix I Table 9) were the only data held for the Kahawai Stream. A single shortfin eel was the only species identified in the stream. Shortfin eels have a conservation status of 'Not Threatened' (Dunn *et al*., 2018 and Bloxham *et al.* 2023). No NZFFD records exist for the Kahawai Stream. The IBI score for the Kahawai Downstream site (14) had a corresponding rating of 'very poor' and fell within Band D (< 18) of the NPSFM. This suggests a severe loss of fish community integrity (Table 13, NPSFM, 2020). An IBI score for the Kahawai Upstream site could not be calculated as no fish were caught. This suggests that the Kahawai Stream is of lower value for native fish communities, or alternatively access into the catchment is not available. Based on the above, it is considered that Receiving Environment fish communities would be similar compared to the Current Environment.

5.4.5 Sediment quality

Sediment quality data from Kahawai Stream are presented in Appendix J Table 2. Site locations are shown in Appendix A Figure W-FWE1.

The results show that all parameters met the ANZWQ DGV's at the Kahawai Upstream Reach site. The exception to this were zinc concentrations (total recoverable and extractable) which met the ANZWQG high value but not the DGV. All parameters met the ANZWQ DGV's at the Kahawai Downstream site. The exception to this were zinc concentrations (total recoverable and extractable) which exceeded ANZWQG high value. While there is no guideline value for aluminium or iron, the results obtained were high at both the Kahawai Upstream and Downstream sites.

Based on the above, it is considered that Kahawai Stream Receiving Environment sediment quality would be similar to the Current Environment, but that zinc concentrations would decrease over time.

5.4.6 Assignment of ecological value to the Kahawai Stream

The Current Environment and Receiving Environment ecological values for the Kahawai Stream are summarised below. Each value has been assigned following the approach set out in Section 3.4.

5.4.6.1 Current Environment ecological value

The Kahawai Stream Current Environment is considered to be of **'Moderate'** ecological value (Appendix C Table 3). This is because SEV values are indicative of 'moderate' value and that macroinvertebrate communities are indicative of 'poor' / 'fair' quality.

Sediment and water quality data suggest there are existing water and sediment quality issues in the Kahawai Stream catchment. However, with the remediation and removal of all the Metal Cutting Yard material that may be a potential source of contamination in June 2023, it is expected that water quality will improve over time.

5.4.6.2 Receiving Environment ecological value

The ecological value of the Kahawai Stream Receiving Environment is considered to be of **'Moderate'** ecological value (Appendix C Table 3). This is because while macroinvertebrate communities and sediment quality in the Currently Environment would be expected to improve over time, wider stream and riparian habitat type/availability and associated water quality issues in the upstream catchment would mean macroinvertebrate communities and sediment quality would be expected to be of a similar quality to the Kahawai Upstream Current Environment site. Native fish communities would also be expected to remain similar given the Kahawai Downstream site has previously been enhanced with riparian plantings and the Kahawai Upstream site is an intermittent stream which limits instream habitat.

5.5 Ruakohua Stream

5.5.1 Stream ecological valuation

Key habitat characteristics and the SEV scores for the Ruakohua Stream sites are described in the section below. The SEV results are presented in Appendix E Table 1.

5.5.1.1 Site 2

Site 2 is located on the Ruakohua Stream upstream of the Site (Photograph 5.8; Appendix A2) and outside any influences from NZ Steel discharges. Site 2 had an average wetted width of 1.7 m and average depth of 0.3 m. The average macrophyte cover of the stream channel at Site 2 was 66 %. The dominant substrate present was silt and sands, with small amounts of small gravels. Habitat abundance and diversity was 'marginal' with woody debris and undercut bank habitat types present.

The overall SEV score for Site 2 (including biodiversity values) was 0.46 (Appendix E Table 1). This moderate score is primarily due to the ecological benefits provided by the riparian planting that has been previously undertaken by NZ Steel. This SEV score was similar to the SEV score (0.47) calculated from the previous survey conducted in 2011 that followed an earlier version of the SEV (Rowe *et al*., 2008) (Appendix F Table 1) which has been demonstrated to be comparative.

Photograph 5.7: Typical stream channel at Site 2, Ruakohua Stream.

5.5.1.2 Site 4

Site 4 is located on the Ruakohua Stream downstream of the ITA stormwater discharge point (Contractor's yard) but upstream of the Yard 31 discharge (Photograph 5.8; Appendix A2). Site 4 had an average wetted width of 1.8 m and average depth of 0.3 m. The average macrophyte cover of the stream channel at Site 4 was 41 %. The dominant substrate present were silt/sands and bedrock. Habitat abundance and diversity was 'suboptimal' with riffles, woody debris and undercut bank habitat types present.

The overall SEV score for Site 4 (including biodiversity values) was 0.54 (Appendix E Table 1). This moderate score is primarily due to the ecological benefits provided by the riparian planting that has been previously undertaken by NZ Steel. This score was similar to the SEV score (0.52) calculated from the previous survey conducted in 2011 that followed an earlier version of the SEV (Rowe *et al*., 2008) (Appendix F Table 1) which has been demonstrated to be comparative.

Photograph 5.8: Typical stream channel at Site 4, Ruakohua Stream.

5.5.2 Spot water quality

Spot water quality data from Ruakohua Stream are presented in Appendix G Table 3 to Appendix G Table 5. The data are indicative of water quality conditions at the time of survey only. Stormwater was not observed to be discharging at the time of sampling. Summary reference water quality data from the Waitangi Stream (reference site) are presented in Appendix K Table 1.

Spot water quality data from Ruakohua Stream (collected in the morning of 4 August 2020) are characterised as follows:

- Water temperatures all fell within the recorded range in the Waitangi Stream.
- Dissolved oxygen concentrations were lower upstream of the discharge points than downstream. Dissolved oxygen concentrations typically showed a high level of saturation and fell within Band A (> 8.0 mg/l) of the NPSFM. This suggests that no stress to aquatic organism is expected (NPSFM, 2020). Dissolved oxygen concentrations fell within the recorded range in the Waitangi Stream.
- pH values are all near neutral but were typically slightly lower than the ANZWQG range of values for pH (7.26 – 7.7) (ANZWQGs, 2018). Ruakohua Stream pH values are all similar to the Waitangi Stream median pH value.
- Conductivity measurements in the Ruakohua Stream were similar upstream and downstream of the ITA stormwater discharge point. Conductivity measurements were generally similar to the maximum recorded value in the Waitangi Stream. This suggests that concentrations of dissolved ions in the Ruakohua Stream are elevated. The conductivity readings are likely linked to the upstream catchment land uses (beef and dairy farming and cropping) as these high results were recorded at all sites.

Spot water quality typically highlighted that measurements were similar to those from the Waitangi Stream. Where some parameters (i.e. dissolved oxygen concentrations and pH measurements) did not meet NPSFM and ANZWQG values (Appendix K).

5.5.3 Macroinvertebrate communities

Macroinvertebrate data for the Ruakohua Stream are presented in Appendix H Table 4 to Appendix H Table 5. The data are summarised as follows:

- The number of taxa present in Ruakohua Stream samples were typically low. The percent of sensitive EPT taxa present in the samples were also low both upstream and downstream of the ITA stormwater discharge outfall.

- MCI scores in 2020 are indicative of 'poor' quality. MCI scores were lower upstream of the ITA stormwater discharge outfall (Site 2 and 3) than downstream (Sites 4 and 5). Based on the Stark (1998) detectable difference method of assessment (a difference > 10.83 in MCI score for one replicate), the MCI score at Site 4 downstream of the stormwater discharge outfall was significantly higher than the upstream sites (Sites 2 and 3). The MCI score at Site 5 was also higher than the upstream sites but the difference was not significant.
- MCI scores all fell within Band D (< 90) of Table 14 in the NPSFM[42]. This suggests the communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment (NPSFM, 2020). Further, all MCI scores were below the AUP MCI guideline for rural areas land use (i.e., MCI = > 94)[33].
- SQMCI scores were indicative of 'poor' quality. Based on the Stark (1998) detectable difference method of assessment (a difference > 0.83 in SQMCI score for one replicate), the SQMCI score at Site 4 (downstream of the stormwater discharge outfall) was significantly higher than the upstream sites (Sites 2 and 3). The SQMCI score at Site 5 was lower than the upstream sites, but there is no significant difference between the sites.
- MCI scores were generally similar to median MCI scores from the Waitangi Stream (poor quality) and lower than the Mauku Stream (fair quality) (Appendix H Table 8).
- Both of these streams are located in catchments near the Site but are not impacted by Steel Mill activities.

MCI and SQMCI results were indicative of 'poor' quality at all sites. These results were similar to data collected in 2011. This suggests that macroinvertebrate communities are dominated by pollution-tolerant taxa both upstream and downstream of the ITA stormwater discharge, and that macroinvertebrate communities are primarily affected by upstream catchment uses (which is predominantly rural and include mixed use farmland and market gardens) rather than the proposed ITA stormwater discharge. Based on the above, it is considered that Receiving Environment macroinvertebrate communities would be similar in terms of species compared to the Current Environment.

5.5.4 Freshwater fish communities

Native fish species caught in the Ruakohua Stream are presented in Appendix I Table 6 – Appendix I Table 8. The data show that the Ruakohua Stream contains a moderate diversity of native freshwater fish species. Native species present include longfin eels, shortfin eels, common bullies (*Gobiomorphus cotidianus*), and the pest fish species gambusia (*Gambusia affinis*). The NZFFD also lists grass carp (*Ctenopharyngodon idella*) as present in the reservoir of the Ruakohua Dam. Longfin eels have a conservation status of 'At Risk – Declining', while common bullies have a status of 'Not Threatened' (Dunn *et al*., 2018; and Bloxham *et al*. 2023). Gambusia and grass carp are introduced species (with the former being a pest species). The IBI score at Site 4 (28) had a corresponding rating of 'fair' and fell within Band B of Table 13 in the NPSFM. This suggests a moderate integrity of the fish community (NPSFM, 2020). The IBI score at Site 2 (16) had corresponding ratings of 'very poor'. And fell within Band D (< 18) of Table 13 of the NPSFM. This suggests a severe loss of fish community integrity (NPSFM, 2020). The lower rating at Site 2 was due to longfin eel and gambusia being the only species caught at this site (Appendix I Table 6).

[42] While macroinvertebrate surveys were conducted outside of the recommended sampling timeframe (December to March), and were processed using Protocol P1 (coded abundance) instead of Protocol P2 (fixed count with at least 200 individuals) or P3 (full count), the survey data are considered indicative of the MCI attribute band that macroinvertebrate communities would fall within.

Based on the above, it is considered that Receiving Environment fish communities would be similar in terms of species compared to the Current Environment due to the presence of the Ruakohua Dam in the downstream catchment.

5.5.5 Sediment quality

Sediment quality data from Ruakohua Stream are presented in Appendix J Table 3. Site locations are shown in Appendix A1.

The results show that all parameters met the ANZWQ DGV’s at Site 2. Comparatively, all parameters met the ANZWQ DVG’s at Site 4. The exception to this were total recoverable nickel and total recoverable zinc concentrations which exceeded the ANZWQ DGV’s but met the ANZWQ high guideline value for sediment quality. However, the extractable nickel and zinc (< 63 µm fraction) concentrations met the ANZWQ DVG’s. This sediment fraction is considered to be the most readily re-suspended or potentially ingested by organisms (ANZWQGs, 2018). While there are no guideline values for aluminium and iron, the results obtained were high at both Site 2 and Site 4. Comparatively, aluminium and iron concentrations were highest in water quality samples collected upstream of the ITA stormwater discharge points.

Based on the above, it is considered that Receiving Environment sediment quality would be similar to the Current Environment.

5.5.6 Assignment of ecological value to the Ruakohua Stream

The Current Environment and Receiving Environment ecological values for the Ruakohua Stream are summarised below. Each value has been assigned following the approach set out in Section 3.4.

5.5.6.1 Current Environment ecological value

The Ruakohua Stream Current Environment is considered to be of **‘Moderate’** ecological value (Appendix C Table 3). This is on the basis that while there are existing water quality issues in the upstream catchment and despite macroinvertebrate communities being indicative of ‘poor’ habitat quality, the Ruakohua Stream provides habitat to longfin eel, an ‘At Risk’ species and restorative riparian plantings have also been undertaken on NZ Steel land.

5.5.6.2 Receiving Environment ecological value

The ecological value of the Ruakohua Stream Receiving Environment is considered to be of **‘Moderate’** ecological value (Appendix C Table 3). This is on the basis that while ITA stormwater discharges are excluded from the Receiving Environment, upstream catchment influences that include beef and dairy farming and cropping activities would continue to impact water quality and macroinvertebrate communities (which are indicative of ‘poor’ habitat quality). Native fish communities would also be expected to remain similar to those of the Current Environment.

5.6 Wetland characteristics and values

A description of wetland characteristics is provided in Section 5.6.1. The assessment of ecological values is provided in Section 5.6.2 and is informed by descriptions in Section 5.6.1 and assessed in accordance with the ECIAG. Natural inland wetland characteristics

5.6.1 Overview

Several natural inland wetland habitat types were identified within the catchments subject to discharges, totalling approximately 2.36 ha. The majority of these were riparian wetlands that bordered defined stream channels and together formed stream-wetland complexes[43] (Appendix A3). Most of these wetlands were exotic and dominated by reed grass, water celery, mercer grass and willow weed. However, five smaller and higher value native-dominated wetland types were also present, and these were dominated by flax, raupō, rautahi, or native rushland/reedland (Table 5.2).

A summary of the ecological characteristics of the 19 wetland areas that were individually assessed is provided in Table 5.3. Wetlands included a total of 47 plant species, made up of at least 36 exotic species and 11 native species (Appendix L).

Where wetlands were bordered by riparian margins or dominated by native vegetation, they were also likely to support spotless crake (*Zapornia tabuensis tabuensis*)[44], due to the higher habitat complexity of these wetlands and the corresponding provision of foraging and nesting habitat. Spotless crake are classified as 'At Risk – Declining' (Robertson *et al*., 2021).

Moreover, wetlands within the Site were also expected to support the nationally 'At Risk – Declining' banded rail (*Gallirallus philippensis assimilis*)[44](Robertson *et al*. 2021)) where they were adjacent to the Coastal Marine Area (CMA). These wetlands are expected to provide suitable foraging and nesting habitat for this species.

Table 5.2: Wetland habitat types and characteristics

Wetland Vegetation type	**Areal extent/ location**	**Description and values**
Exotic-dominated wetlands	*2.215 ha*	Exotic wetlands generally dominated by reed grass, water celery, mercer grass and willow weed and some wetlands do include native wetland species. These wetlands provide ecological function in the landscape and some of these wetlands may provide habitat for the nationally 'At Risk' spotless crake where they are bordered by riparian vegetation.
Native rautahi wetland	*0.013 ha*	Dominated almost exclusively by native rautahi (*Carex geminate*) and predominately surrounded by native riparian vegetation. This wetland type may support spotless crake, which is classified as 'At Risk' (relict).
Raupō reedland	*0.0551 ha*	*Raupō reedland* is classified as regionally 'endangered' (i.e., WL 19 in Singers et al. 2017). The raupō wetland is close to the CMA (W-FWE3 in Appendix A3) may support spotless crake and banded rail, which is classified as 'At Risk' (declining). The raupō wetland shown in W-FWE3 in Appendix A3 may also support spotless crake.
Oioi, restiad rushland/ reedland	*0.0503 ha*	Oioi, restiad rushland/ reedland is classified as regionally 'endangered' (i.e., WL 10 in Singers et al. 2017). This wetland was almost exclusively dominated by clubrush and is likely to provide foraging and nesting habitat for spotless crake and banded rail.

[43] Stream-wetland complexes include defined stream channels that are bordered riparian wetland habitat.
[44] Specified highly mobile fauna listed in the NPSIB.

5.6.1.1 Wetland characteristics in the North Stream catchment

Wetlands within the Lower North Stream Catchment (identified in Figures W-FW3 and W-FW4 in Appendix A3) were buffered by maturing native riparian planting undertaken by NZ Steel over 20 years ago. In addition, these wetlands included the highest diversity of wetland vegetation types and species; were most likely to support threatened birds including spotless crake and banded rail; and maintained ecological connectivity to coastal wetlands. A summary of the characteristics of the North Stream wetlands is provided in Table 5.3.

The extent of wetlands within the North Stream Catchment was positively influenced by discharges from the Steel Mill. Specifically, a high-level assessment using flows from the Council's Freshwater Management Tool[45] and recorded Dewatering Plant flows indicates that when it is operating the Dewatering Plant contributes to approximately 80 % of the total flow within the Lower North Stream at the stream mouth[46].

In the absence of NZ Steel's discharges that are enabled by the present consent application, the wetlands in this catchment would not receive the same inflow and would be considerably smaller in extent. Water quality in the smaller wetland areas would likely be higher in the absence of the Dewatering Plant or ITA stormwater discharges but total wetland area would be substantially reduced, though the scale is unclear. Regardless of the higher water quality, it is expected that the smaller wetlands would still be dominated by the same invasive exotic species (e.g. reed grass), and they would still be influenced by ongoing sedimentation and nutrient runoff associated with horticultural and farming land use in the wider catchment.

5.6.1.2 Wetland characteristics in the Kahawai Stream catchment

Wetland characteristics within the Kahawai Stream catchment (identified in Figure W-FW5 in Appendix A3) vary, with wetland values being higher in the lower part of the catchment. This wetland included several native wetland plant species, was bordered by 10-year-old native riparian plantings undertaken by NZ Steel and was immediately adjacent to coastal wetland habitat.

With the cessation of ITA activities in the catchment, it is expected that wetlands will still be dominated by invasive species (e.g., mercer grass), and influenced by ongoing sedimentation and nutrient runoff associated with farming land use activities to varying degrees. Similarly, the extent of wetlands in this catchment would be similar though water quality would likely be higher in the absence of ITA stormwater discharges.

A summary of the characteristics of the Kahawai Stream wetlands are provided in Table 5.3.

5.6.1.3 Wetland characteristics in the Ruakohua Stream catchment

Wetland complexes within the Ruakohua Stream catchment (identified in Figure W-FW6in Appendix A3) were generally exotic dominated narrow bands of wetland vegetation that bordered defined streams and were therefore deemed to be of lower ecological value.

In the absence of the proposed ITA stormwater discharges from the Site, the extent of wetlands in this catchment would be similar though water quality would likely be higher in the absence of ITA stormwater discharges. However, it is expected that wetlands would still be dominated by invasive species (e.g., exotic water celery), and influenced by ongoing sedimentation and nutrient runoff associated with upstream farming landuse activities to varying degrees.

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[45] The Freshwater Management Tool is an Auckland Council hydrological model that estimates flows and water quality for watercourses in the Auckland Region. In the case of the Lower North Stream, the flows account for only the unmodified, 'natural' stream catchment, and therefore provide a basis for the stream flows without the site stormwater or Dewatering Plant discharge.

[46] Calculated using the long-term median (50th percentile) flow.

A summary of the characteristics of the Ruakohua Stream wetlands is provided in Table 5.3.

5.6.1.4 Summary of wetland characteristics

Table 5.3 below summarises the characteristics of the wetlands in each of the stream catchments. Figures W-FW3 to W-FW6 (in Appendix A3) depict the location of each of these wetlands.

Table 5.3: Wetland characteristics summary

Wetland name	Size (m^2)	Dominant species	Native species richness	Threatened birds	
				Spotless crake	Banded rail
North Stream Catchment wetlands					
Lower North Stream: Exotic Wetland 1	5,678	Exotic reed grass	4	Likely	Likely
Lower North Stream: Giant Rush	503	Giant rush	1*	Likely	Likely
Lower North Stream: Native Raupō Wetland	251	Raupō	1*	Likely	Likely
Lower North Stream: Native Flax Wetland	160	Flax	1*	Likely	No
Lower North Stream: Exotic Wetland 2	777	Exotic reed grass and exotic creeping buttercup	0	No	No
Lower North Stream: Exotic Wetland 3	4,021	Exotic reed grass	2	No	No
Lower North Stream: Exotic Wetland 4	431	Exotic reed grass	0	No	No
Kahawai Stream Catchment wetlands					
Kahawai Stream: Exotic Wetland 1	891	Exotic mercer grass	5	Yes	Yes
Kahawai Stream: Exotic Wetland 2	594	Exotic mercer grass	4	Yes	No
Kahawai Stream: Rautahi (*Carex geminata)* Wetland	133	Native *Carex geminata*	1	Yes	No
Kahawai Stream Exotic Wetland 3	3,547	Exotic mercer grass, native *Carex geminata*, exotic kikuyu	1	No	No
Kahawai Stream: Exotic Wetland 4	2,855	Exotic mercer grass	2	No	No
Kahawai Stream: Exotic Wetland 5	543	Exotic mercer grass	4	No	No
Kahawai Stream: Native Raupō Wetland	300	Native raupō	1*	Yes	No

Wetland name	Size (m²)	Dominant species	Native species richness	Threatened birds	
				Spotless crake	Banded rail
Kahawai Unnamed Tributary (Lower)	66	Exotic kikuyu	2	No	No
Kahawai Unnamed Tributary (Upper)	30	Giant rush and exotic kikuyu	1	No	No
Ruakohua Stream Catchment wetlands					
Ruakohua Stream: Exotic Wetland 1	666	Exotic creeping buttercup and exotic water celery	4	No	No
Ruakohua Stream: Exotic Wetland 2	856	Exotic water celery and exotic mercer grass	3	No	No
Ruakohua Stream: Exotic Wetland 3	1,288	Exotic water celery and exotic mercer grass	2	No	No

5.6.2 Assignment of ecological value for wetlands

The Current Environment and Receiving Environment ecological values assessments for the wetlands are summarised below. Each ecological value assessment has been undertaken using the EcIAG as set out in Section 3.3.

5.6.2.1 Current Environment ecological value

Overall based on EcIAG (EIANZ, 2018) wetland values are assessed as **'Moderate** to **'High'**. In general the identified wetlands were assessed as:

- Low to moderate for representativeness;
- Moderate to high for rarity and distinctiveness;
- Low to moderate for diversity and pattern; and
- Moderate to high for ecological context (i.e., buffering, connectivity and function).

Table 5.4 sets out the specific ecological value assessment for each assessed wetland, this is based on information provided in Sections 5.6.1.1 to 5.6.1.3.

Table 5.4: Summary of current ecological values of wetlands

Wetland name	Ecological value description	EcIAG value
Lower North stream: Exotic Wetland 1	Low for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk fauna, moderate for diversity and pattern because 4 native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. One high, two moderate and one low equates to high overall value.	High
Lower North Stream Giant Rush Wetland	Moderate for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk fauna, moderate for diversity and pattern because native species are dominant and moderate for ecological context due to	High

Wetland name	Ecological value description	EcIAG value
	buffering, ecological connectivity, and ecological function values. One high, and three moderate scores equates to a high overall value.	
Lower North Stream Native Raupō Wetland	High for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk fauna and regional threat status of raupō wetlands, moderate for diversity and pattern because native species are dominant and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Two high, and two moderate scores equates to a High overall value.	High
Lower North Stream: Exotic Wetland 2	Low for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk fauna, Low for diversity and pattern because non-native species are dominant and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. One high, one moderate and two low sub-criteria scores equates to a moderate overall value.	Moderate
Lower North Stream Native Flax Wetland	Moderate for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk fauna, moderate for diversity and pattern because native species are dominant and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. One high, and three moderate scores equates to a high overall value.	High
Lower North Stream: Exotic Wetland 3	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, Moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub-criteria scores equates to a moderate overall value.	Moderate
Lower North Stream: Exotic Wetland 4	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, Low for diversity and pattern because no native plant species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Two moderate and two Low sub-criteria scores equates to a moderate overall value.	Moderate
Kahawai Stream: Exotic Wetland 1	Moderate for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk species, moderate for diversity and pattern because five native species are present and moderate for ecological context due to buffering, ecological connectivity and ecological function values. One high and three moderates equate to a high overall value.	High
Kahawai Stream: Exotic Wetland 2	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because four native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate

Wetland name	**Ecological value description**	**EcIAG value**
Kahawai Stream: Rautahi (*Carex geminata*) Wetland	Moderate for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk fauna, moderate for diversity and pattern because native species are dominant and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. One high, and three moderate scores equates to a high overall value.	High
Kahawai Stream: Exotic Wetland 3	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate
Kahawai Stream: Exotic Wetland 4	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate
Kahawai Stream: Exotic Wetland 5	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate
Kahawai Stream: Native Raupō Wetland	Moderate for representativeness, high for rarity and distinctiveness due to likely presence of At-Risk species and regional threat status of raupō wetlands, moderate for diversity and pattern because native species are dominant and moderate for ecological context due to buffering, ecological connectivity and ecological function values. One high, and three moderate scores equates to a high overall value.	High
Kahawai Unnamed Tributary (Upper)	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate
Kahawai Unnamed Tributary (Lower)	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate
Ruakohua Stream: Exotic Wetland 1	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are	Moderate

Wetland name	Ecological value description	EcIAG value
	present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	
Ruakohua Stream: Exotic Wetland 2	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate
Ruakohua Stream: Exotic Wetland 3	Low for representativeness, moderate for rarity and distinctiveness due to the overall threat status of wetlands, moderate for diversity and pattern because native species are present and moderate for ecological context due to buffering, ecological connectivity, and ecological function values. Three moderate and one Low sub criteria score equates to a moderate overall value.	Moderate

5.6.2.2 Receiving Environment ecological value

In general terms, the Receiving Environment ecological values would be similar to the Current Environment for the Kahawai and Ruakohua Stream catchment wetlands. Conversely, the Receiving Environment wetland values are likely to be lower in the North Stream Catchment than the Current Environment values because the overall wetland extent in the absence of the proposed Dewatering Plant discharge would be notably smaller. It is difficult to determine the degree to which ecological value within each individually assessed wetland within the North Stream Catchment would decrease. However, it is likely that most of these wetlands would drop in value and some wetlands may even cease to be wetlands, reverting to either channelised streams or a terrestrial habitat. Most notably, the Receiving Environment values associated with diversity and pattern and ecological context would be lower than Current Environment values because both these value criteria are strongly correlated with wetland size (Baber et al. 2021a).

6 Assessment of ecological effects on the Receiving Environment

6.1 Overview

This section provides an assessment of potential ecological effects from the proposed continuation of Steel Mill discharges on the stream and wetland Receiving Environments present in the North Stream Catchment (the North Drain, the Lower North Stream) the Ruakohua Stream and the Kahawai Stream. As previously discussed in Section 4.3, a worst-case scenario (for contaminants) has been assessed that assumes the unchanged continuation of current Steel Mill discharges. If the EAF becomes operational, overall contaminant effects on North Stream Catchment will be reduced, and therefore the following assessment is conservative in that regard.

Potential ecological effects that have been identified include the following:

- Potential changes in water quality.
- Potential changes to the flow regime in the North Stream / Wetland Catchment.
- Potential changes to contaminants in deposited sediments.

- Potential effects from the discharges of process / ITA stormwater on macroinvertebrate communities.
- Potential effects from the discharges of process / ITA stormwater on freshwater fish communities.
- Potential effects on wetlands and wetland species associated with discharges.

The assessment of potential ecological effects follows the framework outlined in the Environmental Institute of Australia and New Zealand guidelines (EcIAG) (Roper-Lindsay *et al*., 2018). The EcIAG assessment involves assigning a level to the ecological value (see Section 4.3) and the magnitude of the effect, which is then used to determine the overall level of effect using the matrix presented in Appendix C Table 4. The EcIAG approach is set out in full in Appendix C.

6.2 Assessment of effects on streams

6.2.1 North Stream Catchment

6.2.1.1 Ecological effects on North Drain

6.2.1.1.1 Magnitude of effects of the Dewatering Plant discharge on North Drain

Monitoring data (for September 2019 – September 2021) show that the Dewatering Plant discharge contains aluminium, copper, lead and total suspended solids concentrations and conductivity levels that could have adverse effects on water quality and instream ecological communities in the North Drain Receiving Environment. Sediment quality data also show extractable nickel and zinc concentrations at Site A slightly exceeded the ANZWQ high guideline value for sediment quality, which could also have effects on instream ecological communities.

The removal of the Dewatering Plant discharge, which provides flows to the North Drain, would change the North Drain Receiving Environment flow regime from permanent to intermittent. The parameters that could have adverse effects on water quality and instream ecological communities in the North Drain Receiving Environment are discussed in further detail below.

<u>Aluminium</u>

The average concentrations of aluminium in the North Drain exceed guidelines for protection of 80 % of species. While aluminium has little known biological function, it is toxic to aquatic fish, invertebrates and plants. Fish are considered the most sensitive to aluminium due to it being a gill toxicant, causing ion regulation and respiratory issues. The toxicity of aluminium is highest at low (< 5.5) and high (> 9) pH. Spot pH measurements from the North Drain showed the pH ranged between 4.8 to 6.8. Both the pH and high concentrations suggest that aluminium toxicity could be a potential issue at times (ANZWQGs, 2018).

Based on the above, it is considered that aluminium concentrations could have a measurable effect on water quality and instream ecological communities in the North Drain Receiving Environment, although effects would be greatest at times of low and high pH.

<u>Copper</u>

The maximum concentration of copper in the North Drain exceeds guidelines for protection of 80 % of species. Copper is a trace element that is essential for most aquatic organisms, although toxic concentrations of copper are only slightly above concentrations required for the optimum growth of algae. This means that there could be changes observed instream that also have a detrimental effect on fauna, prior to the toxic concentration being reached. The toxicity of copper can be influenced by the levels of dissolved organic matter, pH, water hardness, and salinity. Copper is strongly adsorbed by suspended material and complexes with dissolved organic matter. Generally, the uptake and toxicity of copper decreases with decreasing pH, however an increase in toxicity with decreasing pH over the pH range of 6.0 - 8.5 (ANZWQGs, 2018). In freshwater organisms, toxicity generally decreases with increasing water hardness and alkalinity and generally increases as salinity decreases (ANZWQGs, 2018).

Based on the above, it is considered that the maximum copper concentrations could have a measurable effect on water quality and instream communities in the North Drain Receiving Environment, but that the level of the effect would be regulated by the brackish nature of the discharge.

Lead

Median and maximum lead concentrations (both 0.01 mg/L) only slightly exceeded the 80 % species protection level of 0.0094 mg/L. The average concentration of lead (0.0073 mg/L) was well below this guideline value. The toxicity of lead to freshwater organisms generally decreases with increasing water hardness and alkalinity. The general understanding is that the uptake and toxicity of lead is enhanced at low pH (< 6), compared to that at circumneutral pH (6 to 8) (ANZWQGs, 2018).

Based on the above, it is considered that lead concentrations are unlikely to have a measurable effect on water quality and instream ecological communities in the North Drain Receiving Environment, due to the level of effect being regulated by the circumneutral pH and brackish nature of the water.

Conductivity

Elevated conductivity in the North Drain is primarily due to brackish (saline) water present in the Dewatering Plant discharge. Salinity in freshwater environments can be harmful to organisms when concentrations are beyond the natural fluctuations for the organism within the specific environments, as it exceeds their ability to balance salt concentrations. It is likely that the discharge to the Receiving Environment would exclude saline sensitive macroinvertebrate species from the North Drain (Canedo-Arguelles *et al*., 2019).

Based on the above, it is considered that conductivity levels would have a measurable effect on water quality and saline sensitive macroinvertebrate communities in the North Drain Receiving Environment. The brackish Dewatering Plant discharge is not expected to affect the freshwater fish species present in the North Drain (short fin eels). This species is known to be able to inhabit tidal streams that experience increases in brackish (estuarine) conditions from time to time.

Total Suspended Solids

The average concentration of total suspended solids in the North Drain exceeds the level for 80 % for protection of species. Elevated total suspended solids can impact native fish directly through physical effects, or indirectly through effects on water clarity, or the habitat that fish rely on for feeding or cover (Cavanagh *et al*., 2014). Settlement of suspended sediments on the bed of a water body can also affect the macroinvertebrate community's diversity and abundance, as well as reduce photosynthetic activity in aquatic plants (Davis-Colley *et al.*, 2015). However, the habitat in the North Drain is concrete lined, providing limited habitat to macroinvertebrate and fish communities.

Based on the above, it is considered that total suspended solids concentrations could have a measurable effect on water quality in the North Drain Receiving Environment. However, the level of effect on macroinvertebrate and fish communities would be minimal given the low diversity of fauna due to the limited habitat available in the drain.

Discharge quantity

The discharge from the Dewatering Plant provides the majority of flows in the North Drain. The removal of the entire discharge from the Receiving Environment would result in a change from a permanent to an intermittent flow regime within the North Stream Catchment. In turn, reducing instream habitat availability for macroinvertebrate and fish communities which are present in the North Stream Catchment Current Environment.

Therefore, the effect of the proposed discharge from the Dewatering Plant is the creation of permanent long term stream habitat, which will provide additional habitat for macroinvertebrate and fish species compared to what would be present without the discharge. This is considered to be beneficial despite the quality of the discharge, in some instances, having some effects on fauna.

<u>Overall magnitude of effects</u>

Overall, it is considered the Dewatering Plant discharge would have a **'Moderate'** magnitude of effect on the North Drain Receiving Environment from the discharge point to Site 1C (approximately 400 m downstream of the discharge). This is on the basis that the discharge would increase aluminium, copper and total suspended solids concentrations as well as the conductivity measurements in the North Drain at Site 1C.

Any effect of aluminium concentrations would be greatest at times of low flow and high pH. The brackish nature of the discharge would reduce the likelihood that copper concentrations would have an effect on the ecology of the drain (ANZWQGs, 2018). The limited habitat within the North Drain would also reduce the likelihood that total suspended solids concentrations and sediment quality would affect macroinvertebrate or fish communities, as existing data show very few species (a total of five macroinvertebrate taxa and only shortfin eel in 2020) were inhabiting the concrete lined section of the North Drain.

As the Dewatering Plant discharge is the primary source of flow in the North Drain, the flow regime in the Receiving Environment (i.e. completely excluding any Steel Mill discharges) would be intermittent, compared to having permanent flow if the Dewatering Plant discharge continued. The increase in flow from the Dewatering Plant discharge to the North Drain will provide a positive effect to the flow characteristics of the drain, which is beneficial for freshwater species that inhabit the wider catchment downstream (i.e. shortfin and longfin eel, and īnanga).

6.2.1.1.2 Overall level of effects of the Dewatering Plant discharge on North Drain

When considering the **'Low'** ecological value and the **'Moderate'** magnitude of effect, the overall level of ecological effect of the Dewatering Plant discharge on the North Drain Receiving Environment is **'Low'** (Appendix C Table 4). Correspondingly, no further actions to avoid, remedy or minimise potential effects on the North Drain are required.

6.2.1.1.3 Magnitude of effects of the ITA stormwater discharge on North Drain

Monitoring data show that ITA stormwater discharge contains aluminium, copper, cadmium, and lead concentrations that could have adverse effects on water quality and instream communities in the North Drain Receiving Environment. The potential effects of aluminium and copper (average concentrations exceed the level for protection of 80 % of species) are discussed in Section 6.2.1.1.1. Cadmium and lead are discussed in further detail below.

<u>Cadmium</u>

The average concentration of cadmium in the North Drain ITA stormwater discharge exceeds the level for protection of 80 % of species. Cadmium is a metal element with a high toxicity. Bioconcentration of cadmium may occur in a number of aquatic organisms. Cadmium toxicity is impacted by a number of factors including levels of dissolved organic matter and suspended matter, water hardness, salinity and pH. Cadmium toxicity is reduced by the presence of dissolved organic matter, clays, minerals and biotic surfaces due to the sorption of the cadmium to the material. Increased water hardness and salinity also decreases the toxicity of cadmium in freshwater organisms. While no site-specific water hardness data are available, brackish water is considered hard given the various dissolved minerals contained within it[47]. Studies have shown the toxicity of cadmium to freshwater species generally decreases with decreasing pH (ANZWQGs, 2018).

Based on the above, it is considered that cadmium concentrations would have a low likelihood of resulting in effects on instream communities in the North Drain.

Lead

The average concentration of lead in the North Drain ITA stormwater discharge exceeds the level for protection of 80 % of species. Lead is a heavy metal element which impacts the environment primarily through anthropogenic sources including street runoff and industrial discharges. Lead is strongly adsorbed by dissolved organic matter and clays which reduces toxicity. Lead toxicity also decreases with increases in salinity due to the formation of chloride complexes (ANZWQGs,2018).

Based on the above, it is considered that lead concentrations would have an effect on water quality and instream communities in the North Drain Receiving Environment. However, the level of the effect would be regulated by the brackish nature of the North Drain, which would reduce the likelihood of effects on instream communities in the North Drain.

Overall magnitude of effects

Overall, it is considered that the ITA stormwater discharges would have a **'Moderate'** magnitude of effect on the water quality in the North Drain Receiving Environment. This is on the basis that the ITA stormwater discharges would result in average aluminium, copper, cadmium, and lead concentrations exceeding relevant guideline values in the North Drain at Site 1C (approximately 400 m downstream of the discharge).

Previous work into the toxicity of aluminium concluded impacts are likely to be at a low level and are also likely to not be significant in relation to other factors which govern the health of aquatic communities (ARC, TP226).

Flows in the North Drain are also brackish, which would reduce the toxicity of copper, cadmium and lead concentrations and the likelihood that macroinvertebrate taxa or native fish would be affected (ANZWQGs, 2018).

6.2.1.1.4 Overall level of effects of ITA stormwater discharges on the North Drain

When considering the **'Low'** ecological value and the **'Moderate'** magnitude of effect, the overall level of ecological effect on the North Drain Receiving Environment from ITA stormwater discharges is **'Low'** (refer to Appendix C Table 4). Correspondingly, no further actions to avoid, remedy or minimise potential effects on the North Drain are required.

Notwithstanding this finding, NZ Steel is undertaking additional monitoring to determine whether monitored metals and suspended sediment concentrations will meet the relevant ANZWQGs for the protection of 80 % of species measured at Site 1C (immediately upstream of Brookside Road). NZ Steel is also considering additional measures (if required) to further decrease metal concentrations and suspended sediment concentrations depending on the outcome of the additional monitoring to ensure these guideline levels are met.

6.2.1.2 Ecological effects on the Lower North Stream

Data collected at sites in the Lower North Stream (Sites 4B, 4C and 6 in Appendix A1 and A2) are considered representative of the potential effects of the Dewatering Plant and ITA stormwater discharges.

[47] Generally, conductivity > 840 µS/cm is characterised as being 'very hard'.

Water quality data for sites in the Lower North Stream (Sites 4B, 4C and 6) indicate the discharges contain parameters (aluminium, cadmium, copper and conductivity) that exceed relevant ANZWQG values for the protection of freshwater species. This suggests the Dewatering Plant and ITA stormwater discharges could have adverse effects on water quality and instream communities in the Lower North Stream Receiving Environment.

The potential effects of the exceedance of water quality parameters (i.e., aluminium, cadmium, copper and electrical conductivity) are summarised below and are discussed in greater detail in Section 5.3. Due to the mixing of the ITA and Dewatering Plant discharges within the North Drain, it is difficult to distinguish the effects of the exceeded parameters from each source discharge on the Lower North Stream. Therefore, it is appropriate to only separate out the parameters that are known to originate from a specific discharge source. In this instance, the magnitude and level of effects of the discharge quantity and electrical conductivity of the Dewatering Plant discharge are assessed first (in Sections 6.2.1.2.1and 6.2.1.2.2), followed by the effects of the ITA exceedance parameters observed in the Lower North Stream from the ITA and Dewatering Plant discharges (in Sections 6.2.1.2.3 and 6.2.1.2.4).

6.2.1.2.1 Magnitude of effects of the Dewatering Plant discharges on the Lower North Stream

Discharge quantity

Historical changes in the hydrological regime, from the introduction of the Dewatering Plant discharge, equates to approximately 80 % (and up to 40 % with the operation of the EAF) of the flow at the stream mouth which has shifted the Lower North Stream from an intermittent to permanent flowing stream.

The increase in flow from the Dewatering Plant is beneficial to the downstream receiving freshwater environment as it:

a Positively affects habitat availability for freshwater species (particularly macroinvertebrates and fish (including shortfin and longfin eel; and īnanga).

b Provides a level of capacity to buffer toxicity effects (through the brackish nature of the discharge) within the Lower North Stream.

Currently, the hydrological regime has a high-level of flashiness, primarily because the major contributions to flow are linked to the operational hours of the Dewatering Plant. During periods when the Dewatering Plant is shut down for maintenance (generally up to approximately an 8-hour period) and/ or when discharges from the Dewatering Plant are not occurring, discharges to the Lower North Stream will cease. However, due to the low gradient nature of the North Drain, discharges from the Dewatering Plant become ponded and create a large backwater that extends upstream of the discharge point to the beginning of the North Drain. This does provide a level of flow buffering, as any backed up flow will continue to provide a proportion of the flow to the Lower North Stream.

If the EAF is operational, the Dewatering Plant discharge will increase flows at the stream mouth by an estimated 40 %. This will maintain the Lower North Stream as a permanent stream but will be a reduction in flows compared to the Current Environment. In addition, the Dewatering Plant will discharge into the existing Dewatering Plant ponds to buffer the discharge. The proposed change of discharge path will buffer flows into the North Drain (and ultimately the Lower North Stream) reducing the artificial flashiness in flow which can currently occur[48]. The change in flows will likely cause a shift in the available instream habitat associated with the Current Environment Dewatering Plant discharges. However, the flow that is likely to occur if the EAF is installed will still provide the

[48] Section 4.3.1 provides further information on the purpose of the Dewatering Plant ponds

same benefits identified above (i.e., positive effects on instream habitat and buffering of toxicity effects).

Electrical Conductivity

Elevated conductivity in the Lower North Stream is primarily due to brackish water present in the Dewatering Plant discharge (due to high salinity at the source water). Similarly, to the effect of increased salinity observed in the North Drain (Section 6.2.1.1.1), the observed levels within the Lower North Stream are likely causing some changes to the macroinvertebrate community which favour salinity-tolerant taxa. Any changes to the discharge volume due to the operation of the EAF will not likely result in a change in the salinity/ brackish nature of the discharge as this is associated with the source water.

Any loss or shift of specific macroinvertebrate taxa from the Lower North Stream could impact fish species diversity if the loss included prey species for fish that are known to be present. However, the fish identified in the Lower North Stream (i.e., both īnanga and shortfin eel) can inhabit tidal streams. Therefore, these species are considered capable of withstanding the salinity conditions observed in the Lower North Stream and it is likely that the prey species will include those that can withstand increased salinities.

Furthermore, the increases in flow to the receiving environment from the Dewatering Plant discharge, provide a positive effect on instream habitat and as such increases the area available for colonisation by macroinvertebrates and increases the potential for drifting macroinvertebrates in the water column. In terms of prey selection, shortfin eel are generalist/opportunistic feeders and īnanga feed within the water column on drifting macroinvertebrates, therefore the addition of the Dewatering Plant discharge may provide additional feeding area and prey availability.

Based on the above, it is unlikely that the Dewatering Plant discharge would negatively impact the availability of prey for the fish species identified within the Lower North Stream (if anything there is likely to be an improvement as a result of the increased volume discharged), and there does not appear to be a detectable adverse effect on high-order species, such as fish.

Overall magnitude of effects

Overall, the Dewatering Plant discharges, in both the without-EAF and with-EAF scenarios, would have a **'Low'** magnitude of effect on the Lower North Stream Receiving Environment.

While there are some exceedances of water quality parameters at Site 6, and some changes to the macroinvertebrate assemblage towards salinity-tolerant taxa, these do not appear to translate through to detectable effects on sediment quality (see Section 6.2.1.2.3) or high-order species such as fish. A loss or shift of specific macroinvertebrate taxa from the Lower North Stream could impact fish species diversity if the loss included prey species for fish that are currently present. However, the fish identified in the Lower North Stream (i.e. both īnanga and shortfin eel) are known to inhabit tidal streams (which can experience high salinity conditions).

It is likely that any potential effect of the changes in water chemistry is regulated by other factors, including the presence of dissolved organic matter, clays, minerals and biotic surfaces, pH, water hardness and the saline water present in the discharge (ANZWQGs, 2018). Due to the Dewatering Plant contributing on average 80 % (in the Current Environment) and a predicted 40 % (if EAF becomes operational) of total flow at the Lower North Stream mouth[49], compared to if the Dewatering Plant discharge was discontinued, the flow regime would be intermittent rather than permanent. This increase in flow provides additional instream habitat to aquatic communities within the Lower North Stream.

[49] Calculated using the long-term median (50th percentile) flow.

6.2.1.2.2 Overall level of effect of the Dewatering Plant on the Lower North Stream.

Overall, the Dewatering Plant discharge is the primary source of flow in the Lower North Stream. The discontinuance of this flow would change the classification of the Lower North Stream from permanent to intermittent. This would result in a reduction in habitat available for macroinvertebrate communities and fish species present in the Current Environment. The change in predicted discharge volume if the EAF becomes operational will likely see an initial spatial shift in the habitat available for macroinvertebrates and fish. However, the introduction of the buffered flows that will be observed under the operation of the EAF will retain key habitat values that, if there were no flow contribution (for example if Dewatering Plant discharges ceased) would result in these habitat values being lost.

Further, while the brackish Dewatering Plant discharge affects the types of macroinvertebrate taxa present in the Lower North Stream, MCI and SQMCI scores are similar to reference sites and the Kahawai Stream which do not receive the Dewatering Plant discharge.

Additionally, the changes to macroinvertebrate taxa, to include those that are more tolerant of brackish conditions, is unlikely to affect the fish communities present in the Lower North Stream. The fish species present are either generalist/opportunistic feeders and/or known to inhabit tidal streams so their prey species includes those that are tolerant of increased salinity conditions. The salinity (and associated water hardness) of the Dewatering Plant discharge will also regulate the toxicity of metals concentrations present in the Lower North Stream (ANZWQGs, 2018). This toxicity regulation will further minimise potential ecological effects from metals concentrations in the Dewatering Plant and ITA stormwater discharges.

NZ Steel has investigated several alternative options to address the potential salinity effects of the Dewatering Plant discharge. These options have included the following:

- Diversion of the discharge to other locations on the Steel Mill Site.
- Diversion of the discharge to the mouth of the Lower North Stream.
- Addressing saline intrusion into the water intake.
- Construction of a desalination plant.

A detailed analysis of these options is presented in the ITA Report (T+T, 2023, Appendix G to the AEE), which includes an assessment of the best practicable option for the discharge. That report concludes that all of those options listed above are impractical and/or that the costs substantially outweigh any benefits secured. Therefore, this assessment of effects has been completed on the current receiving environment condition.

It is considered that the overall level of ecological effect on the Lower North Stream Receiving Environment is **'Low'** (refer to Appendix C Table 6), as a result of the Dewatering Plant discharge, when considering the **'Moderate'** ecological value and the **'Low'** magnitude of effect. Correspondingly, it is considered that no further actions are required to address potential effects from the Dewatering Plant discharges on the Lower North Stream Receiving Environment.

Notwithstanding this, as set out in Section 7 below, NZ Steel has elected to propose an enhancement package to provide for positive effects on wetlands. The enhancement package includes the potential enhancement of riparian planting along the lower section of the Lower North Stream, which will provide some incidental benefits to instream ecology.

6.2.1.2.3 Magnitude of effect of the ITA Stormwater and Dewatering Plant discharges on the Lower North Stream

Monitoring data showed that the ITA stormwater discharge and Dewatering Plant discharges contained aluminium, copper and cadmium concentrations, and average and median conductivity measurements that could have adverse effects on water quality and instream communities in the Lower North Stream Receiving Environment. The potential effects of aluminium, copper and cadmium (where average concentrations exceed the level for protection of 80 % of species) are discussed in further detail below. The potential effects of conductivity are discussed in Section 6.2.1.2.1.

Aluminium

The average concentration of aluminium in the Lower North Stream exceeds the guidelines for protection of 80 % of species at Site 4B and Site 6. The potential effects of aluminium to freshwater fauna are described in Section 6.2.1.1.1. However, the spot pH measurements recorded in the Lower North Stream sites ranged from 7.1 to 8.3 (with average pH values ranging between 7.5 – 7.7), which may provide a greater level of protection from increased aluminium compared to the North Drain described in Section 6.2.1.1.1.

Based on the above, it is considered that aluminium concentrations could have a measurable effect on water quality and instream ecological communities in the Lower North Stream Receiving Environment, although toxicity effects could be lower than in the North Drain due to the observed pH values within the Lower North Stream.

Copper

The average concentration of copper in the Lower North Stream exceeds the level for protection of 80 % of species at Site 4C, and maximum concentration of copper exceeds this level of protection at all sites. The potential effects of copper to freshwater fauna are described in Section 6.2.1.1.1, and it is considered likely that these potential effects will be similar in the Lower North Stream. Similarly, to the effects of copper in the North Drain, the level of the effect would be regulated by the brackish nature of the discharge.

Cadmium

The average and maximum concentrations of cadmium in the Lower North Stream exceeds the level for protection of 80 % of species. The potential effects of cadmium to freshwater fauna is described in Section 6.2.1.1.3, and it is considered likely that these potential effects will be lower in the Lower North Stream compared to the North Drain. This is due to pH values (average circumneutral pH at all sample sites in the Lower North Stream) and the brackish nature of the discharge increasing the hardness of the water decreasing the toxicity effects of cadmium in the Lower North Stream.

Based on the above, it is considered that cadmium concentrations would have a low likelihood of resulting in effects on instream communities in the Lower North Stream.

Sediment quality

Sediment quality data show extractable nickel concentrations at Site A slightly exceeded the ANZWQ DGV but met the ANZWQG high value. This suggests that nickel concentrations are unlikely to result in significant adverse effects. Extractable zinc concentrations exceeded the ANZWQG high value suggesting effects on instream ecological communities are likely at Site A. While there is no guideline value for aluminium, the result obtained at Site A was high when compared to the other North Stream sites.

All sediment quality parameters met guidelines at Site 6 in the lower catchment. The exceedances at Site A, but not at Site 6 suggest that toxicity-related effects might be expected at Site A but not at Site 6 (ANZWQGs, 2018). This also suggests that sediment in the Dewatering Plant / ITA stormwater discharges settles out on the bed of the Lower North Stream. Sediment quality in the Lower North Stream Receiving Environment would be expected to exceed ANZWQGs directly downstream of Brookside Road. However, sediment quality would also be expected to have improved over time as large rainfall events mobilise sediments and re-distribute them downstream and away from the Lower North Stream[50].

<u>Overall magnitude of effects</u>

Overall, the discharges would have a **'Low'** magnitude of effect on the water quality in the Lower North Stream Receiving Environment. This is on the basis that the ITA stormwater discharges could result in average aluminium, copper, and cadmium concentrations continuing to exceed relevant guideline values in the Lower North Stream sites.

Previous work into the toxicity of aluminium concluded impacts are likely to be at a low level and are not likely to be significant in relation to other factors which govern the health of aquatic communities (ARC, TP226).

Flows in the Lower North Stream are also brackish and have a lower overall average pH value than the North Drain. Both of which reduce the toxicity of copper, aluminium and cadmium concentrations and the likelihood that macroinvertebrate taxa or native fish would be affected (ANZWQGs, 2018). In addition, the potential toxicity of in stream sediments decreased longitudinally downstream within the Lower North Stream. Sediment quality parameters at Site 6 are not anticipated to have toxicity related effects, however at Site A (downstream of the North Drain) toxicity effects might be expected.

6.2.1.2.4 Overall level of effect of the ITA Stormwater discharge on the Lower North Stream (with additional measures to address effects)

Where possible, effects have been avoided, minimised or remedied through notable water management improvements implemented since the Existing Permits were issued in 2003 (T+T, 2021).

In regard to the ITA stormwater discharges occurring in the Current Environment, NZ Steel is undertaking additional monitoring to greater understand the long-term contaminant concentrations within the Lower North Stream and to understand the variability in concentrations due to both short term changes due to rainfall and long-term averages. This comprehensive monitoring will determine whether metals and suspended sediment concentrations (derived from the ITA stormwater discharge) will meet the relevant ANZWQGs for the protection of 80 % of species measured at Site 1C (immediately upstream of Brookside Road) and 95 % of species at Site 4 (Appendix A2). To ensure the ANZWQG levels are met, NZ Steel proposes to implement additional measures (if required) to decrease metals concentrations and suspended sediment concentrations (including additional treatment and further use of chemical treatment).

Consequently, it is considered that the magnitude of effect of the ITA stormwater discharges on the Lower North Stream Receiving Environment would be **'Low'**. This is due to the implementation of the continuous improvement approach to avoid and minimise effects of metals and suspended sediment concentrations (which are to be continued if the EAF becomes operational), including the proposed measures to ensure ANZWQG levels are met.

Therefore, the overall level of ecological effect from the ITA stormwater discharge would also be **'Low'** (refer to Appendix C Table 4). Correspondingly, no further actions to avoid, remedy or mitigate potential effects are required to reduce effects on the Lower North Stream from the ITA stormwater discharge.

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[50] An assessment of whether the concentrations of contaminants present in sediments are likely to result in adverse effects on marine biota is available in the Marine Ecology report prepared for this application, attached to the AEE at Appendix I.

6.2.2 Ecological effects on Kahawai Stream and tributary

6.2.2.1 Magnitude of effects on Kahawai Stream

Kahawai Stream ITA stormwater discharge quality data collected by NZ Steel indicate the discharge contained parameters that exceeded relevant ANZWQG values for the protection of freshwater species. The exceedances suggest the discharges could have resulted in adverse effects on freshwater ecological values in the Kahawai Stream.

Sediment quality data from the Kahawai Upstream and Downstream sites exceeded the ANZWQG DVG's for zinc. The Kahawai Downstream site also exceeded the ANZWQG high value. These exceedances suggest that toxicity-related effects would be expected at the Kahawai Downstream site (ANZWQGs, 2018). Stormwater quality data suggest that the source of the zinc is upstream of the ITA stormwater discharge.

MCI and SQMCI scores for the Kahawai Downstream site were significantly lower (statistically) than the Kahawai Upstream site in 2020 but not in 2022. These results were from a single upstream and downstream sample during each sampling occasion, and any inference of statistical significance should consider that a single replicate sample may be inadequate in determining a statistical difference. However, as described in Section 3.2.1.4.1 a statistically significant deviation between upstream and downstream macroinvertebrate populations may not be indicative of an important ecological/biological effect. When incorporating "fuzzy" boundaries (i.e., ± 10 % error) the true MCI score could be anywhere from 76 to 96 for the upstream site and from 65 to 86 for the downstream site over both sampling occasions. This would likely still place the downstream site in the "poor" class, and the upstream site in the "fair" class, but it could be classified as "poor" if at the lower end of the range. It should be noted that the SQMCI results for the Kahawai Downstream and Upstream sites were both indicative of 'poor' quality.

To further understand what might influence the small decline in MCI values between the two Kahawai Stream sites, the species data for both the 2020 and 2022 sampling occasions were reviewed to identify the taxa that disappeared between the two sites (i.e., lost taxa) and to determine any patterns in the species assemblages.

This review showed that in 2020:

- 11 taxa were absent between the upstream and the downstream sites. Of these, nine were "rare" (1 - 4 counted), with the remaining being "common" (5 – 19 counted) and "abundant" (20 – 99 counted). The majority of lost taxa had low to moderate MCI values (i.e. MCI value < 6), only two taxa had high MCI value (i.e. MCI value > 8, the caddisfly *Polyplectropus sp* and the Diptera *Paradixa sp*) none of which were considered common or abundant in the upstream sample.
- Diptera (i.e., flies) was the order with the greatest number of lost taxa. Generally, the lost Diptera taxa inhabit pond-like, slow flowing streams with high proportion of macrophyte growth and sediment cover. This habitat was observed to a greater extent in the upstream site than at the downstream site, as represented by the results from the SEV sampling (Section 5.4.1). Of the lost Diptera taxa, only two had high (MCI value > 8) or moderate (MCI value > 6) MCI value (*Paradixa sp and Phsychodea s*p, respectively).

While in 2022:

- Nine taxa were absent between the upstream and the downstream sites. Of these, eight were "rare" (1 - 4 counted), with the remaining species being "abundant" (20 – 99 counted).
- In contrast to 2020, moderate to high MCI values (i.e. MCI value > 6) were more common with five species lost (*Hudsonema sp, Hydrophilidae sp,*including the Diptera *Paradixa sp, Paralimnophila sp*, and *Tanypodinae* sp); the caddisfly *Hudsonema sp,* and the beetle

Hydrophilidae sp). While four lost taxa had low MCI values (i.e. MCI value ≤ 5), these species included the Crustacea *Paraleptamphopus sp,* and *Isopoda sp,* and the Diptera *Zelandotipula sp,* and *Muscidae sp*. Of the species lost only *Paraleptamphopus* sp was considered abundant.

- Diptera had the greatest number of lost taxa. Like 2020, the lost Diptera taxa generally inhabit pond-like, slow flowing streams with high proportion of macrophyte growth and sediment cover. This habitat was observed to a greater extent in the upstream site than at the downstream site, as represented by the results from the SEV sampling (Section 5.4.1). Of these the lost Diptera taxa, three had moderate or high MCI values (*Pradixia*value (*Paradixa sp and, Paralimnophila sp*, and *Tanypodinae sp*, respectively).

It is likely that the availability and quality of upstream habitat is influencing the type and structure of the macroinvertebrate community within the Kahawai Stream. The upstream habitat type is generally the preferred habitat type for the species observed to be lost at the downstream site. Furthermore, as samples were collected from two locations with two different habitat types, it is expected that there will be some changes in the macroinvertebrate community due to natural variability in populations. Therefore, solely relying on a statistical test to determine a change in population is somewhat inappropriate (especially with a small sample size consisting of a single sample upstream and downstream).

To summarise, although there was a statistically significant difference in MCI values in 2020, this did not eventuate in 2022, and it is likely that the 2020 change is a statistical effect rather than a meaningful biological/ecological effect. This is primarily due to the change in MCI appearing to be largely driven by an absence of "rare" taxa that prefer the type of habitat present upstream. As a result, it is appropriate to describe the MCI quality class of both the Kahawai Stream sites as "poor - fair".

Activities in the Kahawai Stream ITA Area included metal recycling and storage, and bulk gas cutting of uncoated iron and steel scrap metal. The key sources of contaminants are considered to be associated with the historical fill material rather than any potential on-going gas cutting activities. Remediation of the area has occurred, through the removal of fill material which will reduce the size of the yard and consolidate the metal cutting activities on the eastern side of the yard area. A vegetated filter strip was established to provide treatment for the residual metal cutting yard area and activities. Additionally, on-going monitoring will confirm that the remediation works and filter strip are effective in managing the on-going runoff to ensure any effects are minimised. Therefore, water quality effects in the Kahawai Stream from ITA stormwater discharges will be avoided or minimised to levels that are acceptable.

Based on the information outlined above, it is expected that the ITA stormwater discharge would have a **'Low'** magnitude of effect on the Kahawai Stream Receiving Environment.

6.2.2.2 Overall level of effect on Kahawai Stream

When considering the **'Moderate'** ecological value, and the **'Low'** magnitude of effect, the overall level of ecological effect on the Kahawai Stream Receiving Environment will be **'Low'** (refer to Appendix C Table 4). Correspondingly, no further actions to avoid, remedy or mitigate potential effects are required.

6.2.3 Ecological effects on Ruakohua Stream

6.2.3.1 Magnitude of effects on Ruakohua Stream

Ruakohua Stream ITA stormwater discharge quality data collected by NZ Steel indicate the discharge contains parameters that exceed relevant ANZWQG values for the protection of freshwater species. The exceedances suggest the discharges could result in adverse effects on freshwater ecological values in the Ruakohua Stream at times when ITA stormwater is flowing into the stream. It should be noted the discharge data does not provide for mixing in the Ruakohua Stream. Sediment quality data collected at Site 4 (downstream of the Contractors Compound stormwater discharge outfall, which is upstream of Yard 31 discharges) met the ANZWQ DVG's, suggesting there was a low risk of effects.

While the ITA stormwater discharge has the potential to result in adverse effects on the freshwater ecology of the Ruakohua Stream, MCI and SQMCI scores for sites downstream of the Contractors Compound stormwater discharge outfall (Sites 4 and 5) were significantly higher than the upstream sites (Sites 2 and 3 adjacent to the Site). This indicates that the Site discharge has not historically contributed to effects on macroinvertebrate fauna. However, as described in Section 3.2.1.4.1 and Section 6.2.2.1, care must be taken when interpreting differences in MCI and SQMCI scores, and quality classes between sites. Longfin eel were caught upstream and downstream of the discharges, indicating that the proposed ITA stormwater discharges into the Ruakohua Stream are not contributing to an effect on the distribution of longfin eel within the catchment.

Based on the information outlined above, it is expected that the ITA stormwater discharge would have a **'Low'** magnitude of effect on the Ruakohua Stream Receiving Environment.

6.2.3.2 Overall level of effect on Ruakohua Stream

When considering the **'Moderate'** ecological value and **'Low'** magnitude of effect, the overall level of ecological effect on the Ruakohua Stream Receiving Environment is **'Low'** (refer to Appendix C Table 4). Correspondingly, no further actions to avoid, remedy or mitigate potential effects are required.

6.2.4 Summary of ecological effects on streams

A summary of the ecological effects relating to the effects of the Dewatering Plant and ITA stormwater discharges on the North Drain, Lower North Stream, Kahawai Stream and Ruakohua Stream Receiving Environments is set out below in Table 6.1. It is considered that this assessment presents a 'worst case scenario' based on the current operations that occur under the Existing Permits and their contaminant-related effects on the Receiving Environment. It is expected that contamination effects on the Receiving Environment will be reduced from those detailed in this assessment should an EAF become operational. Therefore, it is anticipated that there will be no difference in the magnitude of adverse effects of the discharges between the Current Environment and if the EAF is operating.

The ecological values of the freshwater stream sites range from **'Low'** to **'Moderate'**. There are expected to be some adverse effects on these ecosystems, resulting from the Dewatering Plant and ITA stormwater discharges, however, with the inclusion of planned effects management measures, the ITA stormwater discharges are expected to have a '**Low**' magnitude and **'Low'** overall level of effect. In addition to these planned measures, the ongoing maturing of riparian planting undertaken previously by NZ Steel along some of the streams will continue to improve ecological values of the freshwater systems.

The overall level of effect from the Dewatering Plant discharge on the Lower North Stream is also expected to be **'Low'**.

Additional measures are proposed to be put in place by NZ Steel to either avoid or mitigate adverse effects. Measures include changes in the Kahawai catchment (i.e., the removal of activities or implementing improvements to ITA stormwater discharge quality (completed June 2023)) and further improving the quality of ITA stormwater discharges to the North Drain if monitoring shows this is required. In addition, notwithstanding that the '**Low'** level of effect of the Proposal on wetlands does not require any further mitigation measures, an additional wetland enhancement package is proposed by NZ Steel (Section 7 below).

The wetland enhancement package includes enhancement of riparian planting along the lower section of the Lower North Stream, which will provide some incidental benefits to instream ecology.

Benefits of the enhancement package to instream ecology include improved channel shading, overland flows management, improved bank stability, shading out the macrophyte growth dominant within the stream channel, and increasing woody debris and leaf litter into the stream which will enhance the instream habitat for fauna. Additional enhancement measures proposed include wetland infill planting, animal pest control and ongoing pest plant control.

With the proposed site controls, mitigation and enhancement measures, it is considered that the actual and potential adverse effects on freshwater ecosystems from the proposed discharges can be adequately managed (both under the replacement of the Existing Permits and if the EAF becomes operational).

Table 6.1: Summary of stream ecological effects using EcIAG terminology (Roper-Lindsay *et al.*, 2018)

Watercourse / Wetland	Discharge type	Ecological value category (Receiving Environment value)	Magnitude of effects category	Overall level of effects category before measures are taken into account	Additional measures required to further address effects?	Overall level of effects category after additional measures taken into account	Further measures required?	Further measures applied
North Drain	Dewatering Plant	Low	Moderate	Low	No	-	-	-
	ITA Stormwater	Low	Moderate	Low	No	-	-	-
Lower North Stream	Dewatering Plant	Moderate	Low	Low	No	Low	No	
	ITA Stormwater					Low	No	
Kahawai Stream	ITA Stormwater	Moderate	Low	Low	No	-	-	-
Ruakohua Stream	ITA Stormwater	Moderate	Low	Low	No	-	-	-

6.3 Assessment of effects on wetlands

Section 6.3.1 below sets out the general types of discharge-related effects on wetlands within the North Stream, Kahawai and Ruakohua Catchments and Section 7 describes in general terms the possible measures to avoid, remedy or minimise these types of effects. Specific magnitude of effects assessments for wetlands within each of the three catchments are then presented in Section 6.3.2 and an overall Level of Effects summary is provided in Section 6.3.3.

6.3.1 Summary of discharge effects

All wetlands in the North Stream Catchment will be subject to the Dewatering Plant and ITA stormwater discharges whereas wetlands in the Kahawai and Ruakohua Catchments will be subject to ITA stormwater discharges only.

6.3.1.1 Dewatering Plant discharges

The potential changes to water quality and quantity within the North Stream Catchment are described at Section 6.2.1.2 above. Specifically in relation to wetlands, the Dewatering Plant discharge is known to include aluminium, copper and total suspended solids concentrations and conductivity levels that could have direct effects on wetland plants and invertebrates and potential indirect effects on wetland birds (through bioaccumulation).

Elevated conductivity is primarily due to brackish (saline) water present in the discharge. The concentrations described are likely to prevent the establishment of salinity-sensitive wetland plants and macroinvertebrates in the North Stream Catchment wetlands.

A high-level assessment using flows from the Council's Freshwater Management Tool[26] and recorded Dewatering Plant flows indicates that the Dewatering Plant contributes on average 80 % of the total flow within the Lower North Stream at the stream mouth. Specifically, in the Current Environment, the Dewatering Plant discharge comprises approximately 60 % of the long-term average flows at the stream mouth, 80 % of the flows for the 50th percentile event, and 99 % for low-flow events.

Exclusion of the discharge would change the stream flow regime in the Receiving Environment from permanent to intermittent. The identified wetlands are essentially floodplain wetlands and are fed by overflow from the streams and groundwater incursion; there is no indication that there is any influence from seepage from the surrounding land area. A reduction in the volume of water within the stream (i.e., by increasing intermittency of stream flows) would impact the extent of the identified wetlands by drawing down the amount of water available to be utilised to maintain wetland extent. This in turn would reduce the area of wetland habitat within the North Stream Catchment, although the degree of reduction in the extent of individual wetlands is difficult to predict. All else being equal, removal of the discharge would likely reduce indigenous biodiversity values because smaller wetlands and ephemeral wetlands (resulting from reduced extent and inflows) generally support a lower diversity of native species. For instance, the hydroperiod (period of inundation) may become too short for the aquatic life-cycles of some wetland macroinvertebrate species. Similarly, the exclusion of the discharge may render some or all of the remaining wetlands unsuitable for wetland bird species through a reduction in the extent and/or quality of wetland foraging or nesting habitat.

6.3.1.2 ITA stormwater discharges

As described in Section 4.2.1 monitoring data collected by NZ steel show that ITA stormwater discharges contain aluminium, copper, cadmium, and lead concentrations, and in a number of instances exceed relevant ANZWQGs for freshwater species. Correspondingly, ITA stormwater discharges have the potential to adversely affect wetland biodiversity within the Receiving

Environment wetlands in the Lower North Stream, Kahawai Stream and Ruakohua Stream catchments.

6.3.1.3 EAF discharge quantity

The operation of an EAF will result in changes to discharge volumes from the Dewatering Plant. The operation of the EAF is expected to reduce the approximate volume of discharge to the North Stream Catchment from the Dewatering Plant by half (compared to the Current Environment). This includes a proportional reduction of saline water being discharged and a proportional reduction in contaminants associated with the use of coal and iron sands used in the steel making process. The discharge effects are expected to be similar to those described in the Dewatering Plant Discharges (Section 6.3.1.1).

Measures to avoid, remedy or mitigate discharge effects

Measures to address ecological effects associated with the ITA stormwater discharges to the Lower North Stream and Kahawai Stream have been considered, improvements will be made if required as set out above. In addition, notable water management improvements have been made to further avoid, remedy or mitigate effects implemented since the Existing Permits were issued in 2003 (refer to the ITA Report, T+T, 2021).

In summary, these water treatment measures centre on efforts to reduce metal concentrations to better meet ANZWQGs for a larger proportion of instream freshwater fauna.

As also described above, NZ Steel has investigated several alternative options to address the brackish nature of the Dewatering Plant discharge. However, those options have been ruled out due to practicality or cost considerations.

6.3.2 Magnitude of effects assessment

6.3.2.1 North Stream Catchment wetlands

For the North Stream Catchment wetlands, the magnitude of effects associated with Dewatering Plant discharge is considered to be **'Negligible'**. Adverse effects on wetland water quality are expected due to low level salinity changes and a general reduction in water quality, however, these effects would likely be counterbalanced by the increase in wetland extent resulting from the volume of discharge. Indeed, were the proposed discharges excluded the resulting reduction in wetland extent and wetland biodiversity values for each of the 7 wetlands, while uncertain, is expected to be considerable. That is because the proposed discharges represent about 80 % of the overall flows at the stream mouth[51].

When the EAF becomes operational, the magnitude of effects associated with Dewatering Plant discharge quantity is considered to remain **'Negligible'**. In comparison to the scenario above, there is a decrease in wetland extent (but still an overall increase in extent compared to the Receiving Environment in the absence of plant discharges). These changes ultimately counterbalance relative to the pre-EAF scenario (i.e., the Current Environment) and thus there is no change in the overall magnitude of effect associated with the EAF discharge.

6.3.2.2 Kahawai Stream Catchment wetlands

Monitoring indicates that the former Kahawai Stream ITA stormwater discharge contains parameters that exceed relevant ANZWQG values for the protection of freshwater species. These exceedances suggest that discharges could result in adverse effects on freshwater ecological values in the Kahawai Stream. However, as described in Section 6.2.2, NZ Steel's proposed changes to the

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[51] Calculated using the long-term median (50th percentile) flow.

Kahawai ITA Area and water treatment devices will result in improved stormwater quality in this location, which will avoid or mitigate the water quality effects of the Proposal on the Kahawai Stream. Correspondingly, the effects of ITA stormwater discharges on the Kahawai Stream catchment wetlands are expected to be **'Low'**.

6.3.2.3 Ruakohua Stream Catchment wetlands

Monitoring indicates that ITA stormwater discharge into the Ruakohua Stream, contains parameters that exceed relevant ANZWQG values for the protection of freshwater species. However, the quality of macroinvertebrate communities downstream of the ITA stormwater discharge point are significantly better than those upstream of the Site, suggesting that the water quality of the Ruakohua Stream is primarily influenced by upstream catchment uses (beef and dairy farming and cropping), rather than the proposed discharges. On that basis, the effects of ITA stormwater discharges on the Ruakohua Stream catchment wetlands are expected to result in a **'Low'** magnitude of effect.

6.3.3 Level of effects assessment after measures to avoid, remedy or mitigate effects

Despite the ecological values of individual wetlands within the catchments being assessed as **'Moderate'** or **'High'**, the overall level of effects on wetlands has been assessed as **'Low'**, because:

- The magnitude of effects on wetlands associated with ITA stormwater discharges into the North Stream, Kahawai Stream and Ruakohua Stream catchments has in each case been assessed as **'Low'** as they are expected to result in only a minor shift away from baseline Receiving Environment conditions. This is based on:
  - The existing state of indigenous wetland values, which are already degraded through surrounding landuse activities and a corresponding dominance of exotic species;
  - The ANZWQ stream monitoring results as described in Section 6.2 and more briefly in Section 6.3.2 above and the corresponding conclusion that these results indicate that the effects on freshwater ecology values will be low; and
  - The expectation that effects on freshwater ecological values will be further minimised through removal of historical fill material and additional stormwater treatment in the Kahawai ITA Catchment, and potential improvement of the ITA stormwater quality discharged to the North Drain.
- The magnitude of effects on wetlands associated with the Dewatering Plant discharge into the North Stream Catchment has been assessed as **'Negligible'** due to the expectation that potential effects associated with water quality would likely be counterbalanced by the expected increase in extent and biodiversity value resulting from the volume of discharge. The same negligible effect and the same counter-balance is expected without EAF and with EAF.

7 Residual effects management

Overall, the level of residual effects on streams and wetlands associated with Dewatering Plant discharges and ITA stormwater discharges into the North Stream were assessed as **'Low'**. The ITA stormwater discharges into the Kahawai Stream and Ruakohua Stream Catchments, were also assessed as **'Low'**.

Although the level of effects is assessed as **'Low'**, NZ Steel has elected to propose enhancement measures to provide positive ecological outcomes for wetlands and associated indigenous biodiversity.

This will include native wetland plantings and native wetland margin plantings and a 10 year infill planting and weed and animal pest control programme. This will be undertaken in the North Stream

Catchment (primarily the Lower North Stream) where ecological gains are expected to be highest. The following outcomes are expected from the proposed enhancement measures:

- Improved water quality through shading and a reduced runoff from surrounding horticultural and farming land use practices through wetland margin plantings.
- Increased diversity and abundance of indigenous wetland and terrestrial plants and associated wetland and terrestrial biodiversity through native wetland and wetland margin plantings.

It is proposed that these measures are actioned through the implementation of a Wetlands Management Plan (WMP), which is proposed as a condition of consent.

The proposed WMP condition includes the objective of the WMP (being to describe the management and monitoring practices and procedures to be implemented to provide for freshwater wetland enhancement) and includes but is not limited to the following:

- Confirmation of the area/s for enhancement activities including a map showing the location/s.
- Description of enhancement to be implemented, including details of scope, methodology and timing.
- Details of maintenance to be undertaken on an ongoing basis to support enhancement activities undertaken, including animal and plant pest control as required.
- Details on how the Consent Holder will assess the effectiveness of the enhancement once implemented. This will include a monitoring programme that includes objectives, performance targets and performance standards to verify that expected benefits are achieved and to inform adaptive management responses if required.
- Reporting requirements for implementation of the WMP, including enhancement activities, maintenance, and monitoring.
- Identification of employee roles and responsibilities in relation to the WMP.

It is considered that the implementation of and compliance with the WMP will ensure that additional enhancement measures will be successful in achieving overall positive outcomes for freshwater wetlands.

8 Summary

The freshwater ecological values of the site typically range from **'Low'** to **'Moderate'**, with some wetlands characterised as having **'High'** value. There are expected to be some adverse effects on these ecosystems, resulting from the discharge of ITA stormwater and the Dewatering Plant discharge as a result of the replacement of the Existing Permits.

For the most part, the proposed activities (being activities associated with the replacement of the Existing Permits) are expected to have a **'Low'** magnitude and **'Low'** overall level of effect. Under an operational EAF scenario, the magnitude and overall level of effect from the ITA stormwater and the Dewatering Plant discharge on the North Stream Catchment is unlikely to change.

The overall effects on wetlands are expected to be **'Low'**, but ecological enhancement measures are proposed to provide additional overall positive outcomes for wetlands. The proposed enhancement will also have incidental benefits for instream ecology. With the proposed site controls, mitigation and enhancement measures, it is considered that the actual and potential adverse effects on freshwater ecosystems resulting from the proposed Site discharges will be adequately managed.

In addition to the above measures, riparian planting undertaken previously by NZ Steel along some of the streams will continue to improve ecological values of the freshwater systems.

9 Applicability

This report has been prepared for the exclusive use of our client NZ Steel Ltd, with respect to the particular brief given to us and in accordance with the scope of work set out in our letter of engagement dated 17 June 2019 and associated variations. It may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

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

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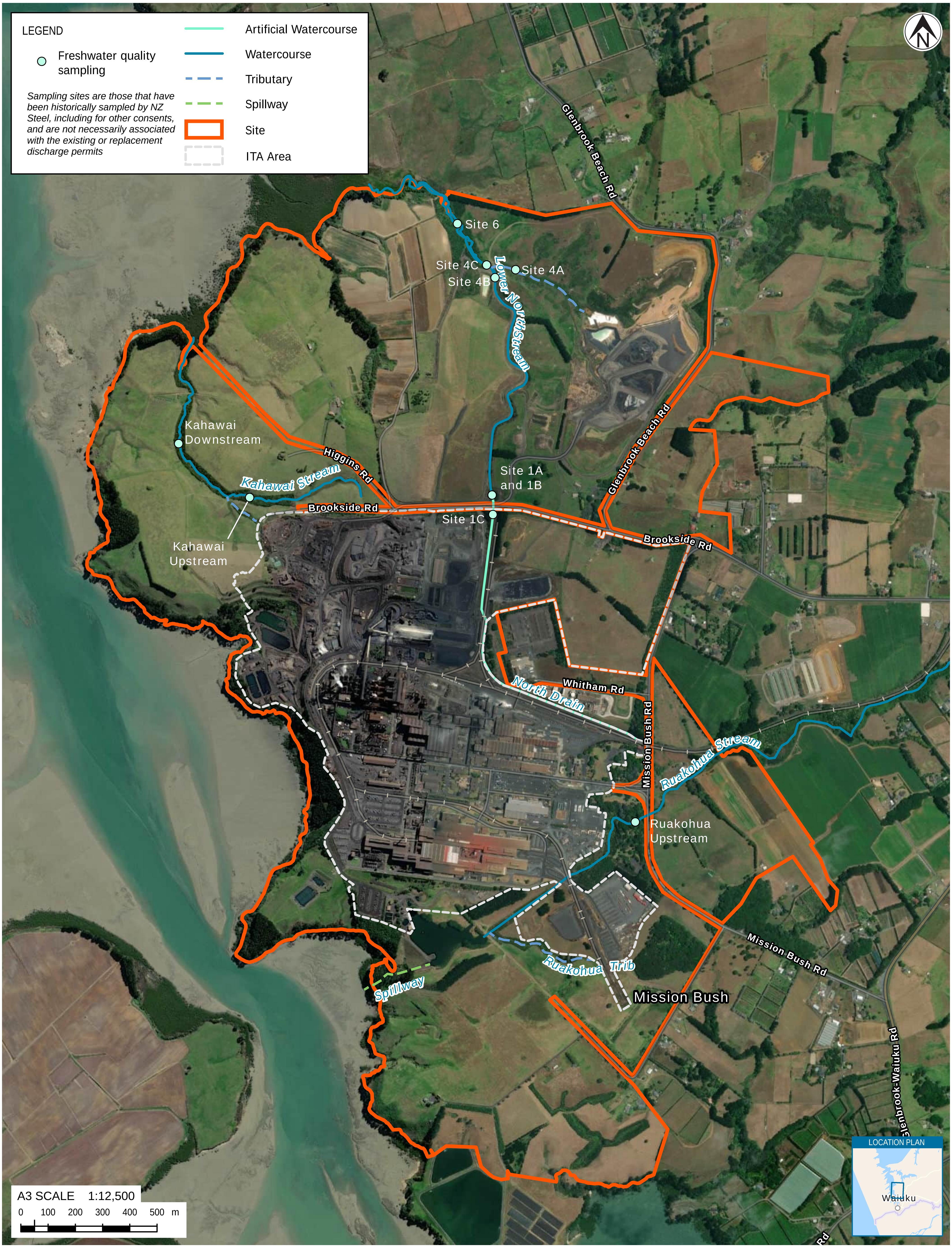
Appendix A Site Figures

A1 Freshwater ecological monitoring locations



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REV	DESCRIPTION	GIS	CHK	DATE
0	First version	JORB	ANTH	27/06/21
1	Second version	JORB	CHSA	29/09/22

PROJECT No.	1010577	
DESIGNED	JORB	SEP.22
DRAWN	JORB	SEP.22
CHECKED	CHSA	SEP.22
APPROVED		DATE

CLIENT NZ STEEL
PROJECT RECONSENTING GLENBROOK STEEL MILL
TITLE FRESHWATER DISCHARGE QUALITY MONITORING LOCATIONS (EXISTING AND HISTORICAL)
SCALE (A3) 1:12,500 FIG No. FIGURE W-FWE2 REV 1

A2 Freshwater discharge quality monitoring locations

T:\Auckland\Projects\1010577\WorkingMaterial\GIS\Map_Documents\P1010577_Water_Updated.aprx Layout: W-FWE1 - Freshwater - Ecological Monitoring Locations 2024-Mar-05 3:48 pm Drawn by: JORB

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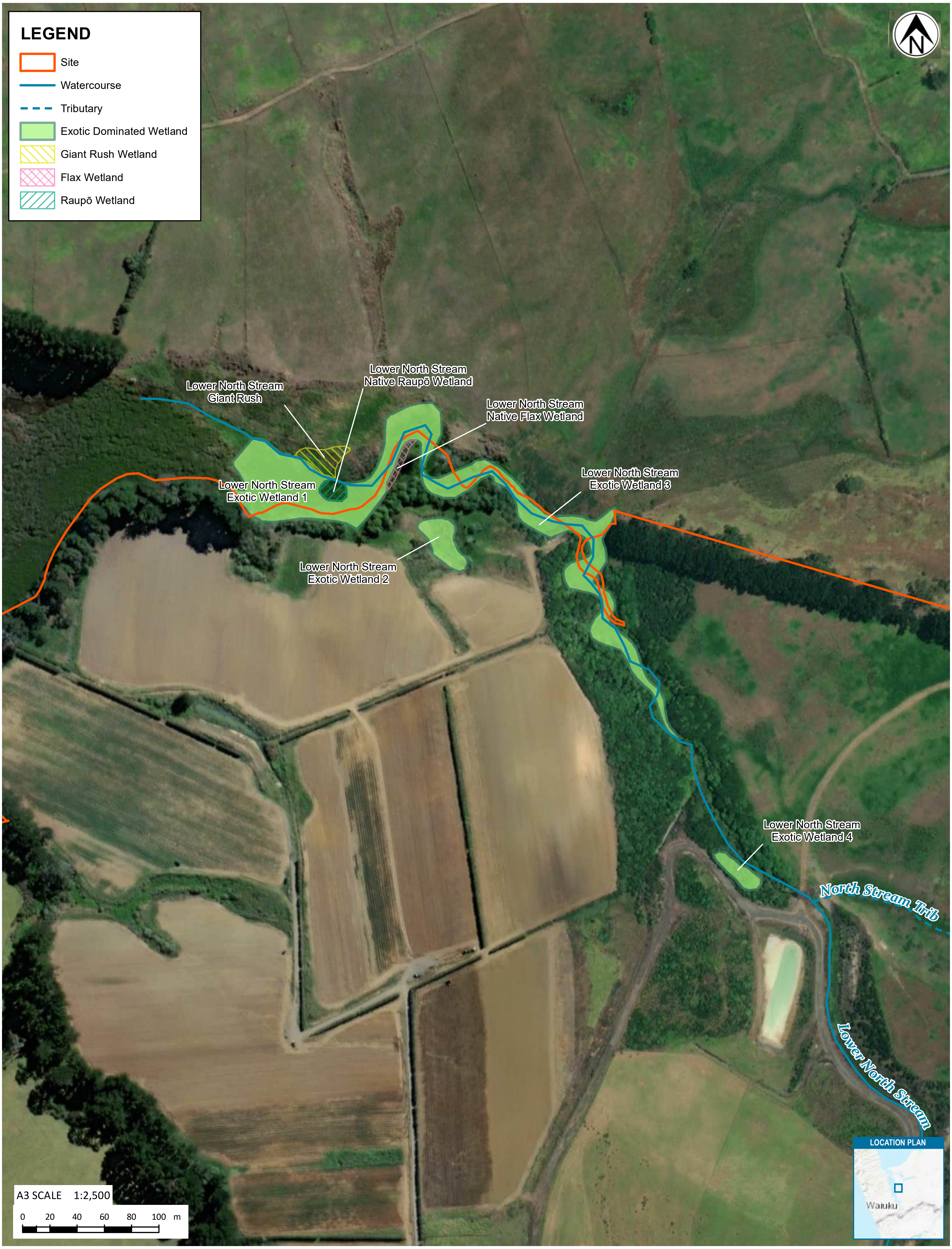
1	Second version	JORB	CHSA	29/09/22		
2	Third version	JORB	CHSA	08/03/24		

PROJECT No.	1010577	
DESIGNED	JORB	MAR.24
DRAWN	JORB	MAR.24
CHECKED	CHSA	MAR.24

CLIENT **NZ STEEL**
PROJECT **RECONSENTING GLENBROOK STEEL MILL**
TITLE FRESHWATER ECOLOGY SAMPLING LOCATIONS

SCALE (A3) 1:15,000 FIG No. FIGURE W-FWE1 REV 0

A3 Wetland complexes



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World Imagery: Maxar

REV	DESCRIPTION	GIS	CHK	DATE
0	First Version	ANTH	JORB	28/06/21

PROJECT No.	1010577	
DESIGNED	ANTH	JUN. 21
DRAWN	ANTH	JUN. 21
CHECKED	JORB	JUN. 21
APPROVED		DATE

CLIENT NZ STEEL
PROJECT RECONSENTING GLENBROOK STEEL MILL
TITLE WETLAND COMPLEXES 1
SCALE (A3) 1:2,500 FIG No. FIGURE W-FWE3 REV 0

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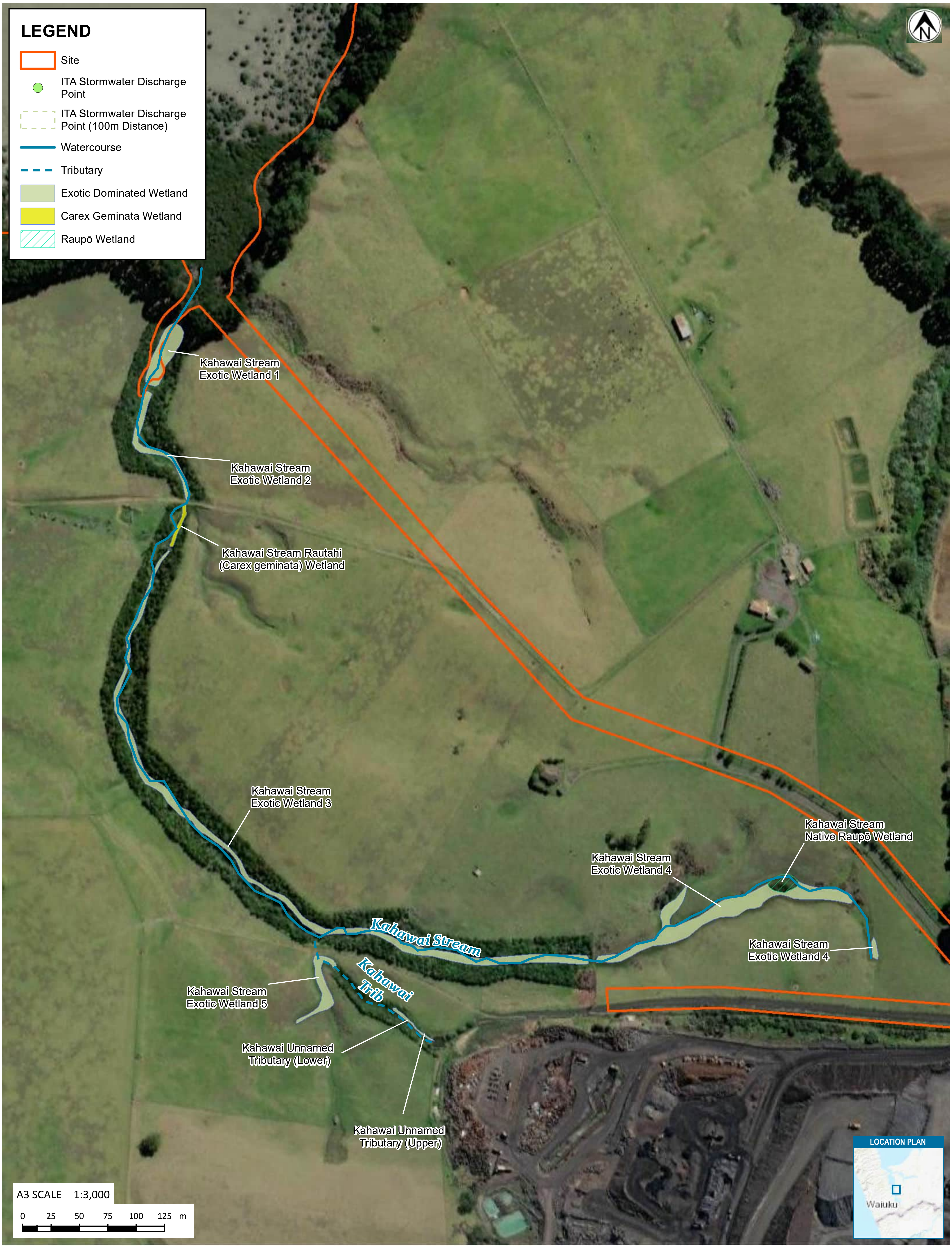
0	First Version	ANTH	JORB	28/06/21		

PROJECT No.	1010577	
DESIGNED	ANTH	JUN. 21
DRAWN	ANTH	JUN. 21
CHECKED	JORB	JUN. 21

CLIENT NZ STEEL
PROJECT RECONSENTING GLENBROOK STEEL MILL
TITLE WETLAND COMPLEXES 2

SCALE (A3) 1:3,000 FIG No. FIGURE W-FWE4 REV 0



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REV	DESCRIPTION	GIS	CHK	DATE
0	First Version	ANTH	JORB	28/06/21

PROJECT No.	1010577	
DESIGNED	ANTH	JUN. 21
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CHECKED	JORB	JUN. 21
APPROVED		DATE

CLIENT NZ STEEL
PROJECT RECONSENTING GLENBROOK STEEL MILL
TITLE WETLAND COMPLEXES 3

SCALE (A3) 1:3,000 FIG No. FIGURE W-FWE5 REV 0

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REV	DESCRIPTION	GIS	CHK	DATE
0	First Version	ANTH	JORB	28/06/21

PROJECT No.	1010577	
DESIGNED	ANTH	JUN. 21
DRAWN	ANTH	JUN. 21
CHECKED	JORB	JUN. 21
APPROVED		DATE

CLIENT NZ STEEL
PROJECT RECONSENTING GLENBROOK STEEL MILL
TITLE WETLAND COMPLEXES 4

SCALE (A3) 1:2,500 FIG No. FIGURE W-FWE6 REV 0

Appendix B Statutory context for "environment"

Appendix B Table 1: Assumptions made when considering the Receiving Environment

	Activities and effects included and excluded from the receiving environment	**Comments and assumptions**
Base	The Current Environment	Monitoring data and investigations undertaken during the preparation of this application provide a baseline. This "environment" reflects the effects of the operation of the Steel Mill over the past 53 years.
Excluded	The effects of the activity that are the subject of the application	In order to exclude the effects of the expiring consents from the "environment", it has been assumed that the relevant discharges were excluded. The exclusion of these discharges would essentially mean that the Steel Mill operation would cease, including other discharges from the site (e.g., air discharges). This is a hypothetical scenario as, even if the Steel Mill operation were excluded, and the site was made safe, there would be ongoing discharges of stormwater runoff from impervious surfaces that may require consent, or with active management, may meet permitted activity standards. However, to take a conservative approach, it has been assumed that there are no ongoing discharges from the site. This assumption produces the most conservative (high) magnitude of effect of the ongoing operation of the Steel Mill.
Included	Any effects of the activity that are the subject of the application that unavoidably persist	In a scenario where the Steel Mill discharges were excluded, there would be effects of the activity that would persist. Relevant activities and effects that would persist that have been assumed for the purposes of this assessment are: • Build up of metals in sediment; and • Ongoing diversion of water in the North Drain.
Included	Non-fanciful permitted activities that can occur on site as of right without additional resource consents	While some minimal industrial development could occur on the Heavy Industry Zone land to the south of the Steel Mill as of right, most industrial development would trigger resource consent requirements and therefore assumptions have not included development of the Heavy Industry Zone land. No permitted land use changes or discharges have been assumed in the wider area.
Included	Activities that have been granted resource consents that are likely to be implemented	There are no known unimplemented resource consents in the wider area that would have a bearing on this application.

Appendix C Ecological Impact Assessment Guidelines

Appendix C Table 1: Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community

Magnitude	Attributes to consider
Representativeness	Criteria for representative vegetation and aquatic habitats: • Typical structure and composition; • Indigenous species dominate; • Expected species and tiers are present; • Thresholds may need to be lowered where all examples of a type are strongly modified; • Criteria for representative species and species assemblages; • Species assemblages that are typical of the habitat; and • Indigenous species that appear in most of the guilds expected for the habitat.
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity; • Amount of habitat or vegetation remaining; • Distinctive ecological features; • National priority for protection; • Criteria for rare/distinctive species or species assemblages: • Habitat supporting nationally 'Threatened' or 'At Risk' species, or locally uncommon species; • Regional or national distribution limits of species communities; • Unusual species or assemblages; and • Endemism.
Diversity and pattern	• Level of natural diversity, abundance and distribution; • Biodiversity reflecting underlying diversity; • Biogeographical considerations – pattern, complexity; and • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation.
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities; • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from 'intrinsic value' as defined in the RMA); • Size, shape and buffering; • Condition and sensitivity to change; • Contribution of the site to ecological networks, linkages and pathways and the protection and exchange of genetic material; and • Species role in ecosystem functioning – high level, key species identification, habitat as proxy.

Appendix C Table 2: Scoring for sites or areas combining values for four matters in Appendix B Table 3.

Value	Description
Very High	Area rates Very High for 3 or all of the four assessment matters listed in Appendix C, Table 3. Likely to be nationally important and recognised as such.
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder.

Appendix C Table 3: Ecological values assigned to freshwater ecology (adapted from Roper-Lindsay *et al*., 2018)[52]

Value	Explanation	Characteristics
Very High	A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation e.g., stream within a native forest catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 120 or greater. EPT richness and proportion of overall benthic invertebrate community typically high. SEV scores high, typically > 0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat natural and unmodified.

[52] Boffa Miskell Limited have developed these assessment criteria and applied them to a wide range of projects.

Value	Explanation	Characteristics
High	A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g., exotic forest or mixed forest/agriculture catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 80 - 100 or greater. EPT richness and proportion of overall benthic invertebrate community typically moderate to high. SEV scores moderate to high, typically 0.6 - 0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. No pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat largely unmodified.
Moderate	A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g., high-intensity agriculture catchment.	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 40 - 80. EPT richness and proportion of overall benthic invertebrate community typically low. SEV scores moderate, typically 0.4 - 0.6. Fish communities typically moderate diversity of only 3 - 4 species. Pest or invasive fish species (excluding trout and salmon) may be present. Stream channel and morphology typically modified (e.g., channelised) Stream banks may be modified or managed and may be highly engineered and/or evidence of significant erosion. Riparian vegetation may have a well-established closed canopy. Habitat modified.

Value	Explanation	Characteristics
Low	A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g., modified urban stream	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 60 or lower. EPT richness and proportion of overall benthic invertebrate community typically low or zero. SEV scores low to moderate, typically less than 0.4. Fish communities typically low diversity of only 1 - 2 species. Pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology typically modified (e.g. channelised). Stream banks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion. Riparian vegetation typically without a well-established closed canopy. Habitat highly modified.

Appendix C Table 4: Summary of the criteria for describing the magnitude of effect.

Magnitude	Description
Very High	Total loss of, or very 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 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 the 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 existing 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 or patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the ‘no change’ situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Appendix C Table 5: Timescale for duration of effects (Roper-Lindsay *et al.*, 2018).

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years)
Long-term	Where there is likely to be substantial improvement after a 25 year period (e.g. the replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'
Temporary[1]	Long term (15-25 years or longer – see above) Medium term (5-15 years) Short term (up to 5 years) Construction phase (days or months)

[1] Note that in the context of some planning documents, 'temporary' can have a defined timeframe

Appendix C Table 6: Criteria for describing overall levels of ecological effects.

Factors influencing the magnitude of effect	Application to the discharge permits sought
Level of confidence in understanding the expected effect	Our assessment is based on water quality and ecological data collected at various times over a 10-year period so we understand the post-discharge impacts.
	The contaminant-related effects have been assessed on a 'worst case scenario' basis. The assessed effects do not take into account the expected improvements in the Dewatering Plant and ITA stormwater discharges over the next 35 years for the North Stream, Kahawai and Ruakohua Stream catchments due to the implementation of the Water Quality Management Plan (WQMP) and continuous improvement programmes. Nor does the assessment include the indicated improvements to water quality contamination levels from the operation of the EAF.
Spatial scale of the effect	Water quality and ecological data have been collected at established sampling sites, allowing any spatial effects of the discharges to be assessed.
Duration and timescale of the effect (Appendix C Table 5)	ITA stormwater discharges are intermittent in nature and limited to periods of rainfall.
	The Dewatering Plant discharge to the North Drain provides substantial flows to the North Stream Catchment, however; high-level variability in the hydrological regime is apparent due to discharges being linked to the operation of the Dewatering Plant. Any supplementary flows will continue as long as the Dewatering Plant is operating. The total volume discharged is dependent on the operating hours for the Dewatering Plant. A change in overall pumping hours will change the overall volume pumped, although the pumping volume per hour would not reduce.
	Sediment quality data are available which allows assessment of any potential long-term effects of the discharges.
The permanence of the effect	Dewatering Plant and ITA stormwater discharge effects would immediately stop if the discharges were ceased and would begin immediately if the discharges re-started.
	Sediment quality data are available which allows assessment of any potential long-term effects of the discharges.

Factors influencing the magnitude of effect	Application to the discharge permits sought
Timing of the effect in respect of key ecological factors	ITA stormwater discharges are intermittent in nature and limited to periods of rainfall.
	The Dewatering Plant discharge to the North Drain provides baseflows to the North Drain and Lower North Stream.

Appendix C Table 7: Criteria for describing overall levels of ecological effects.

Magnitude of effect	Ecological Value			
	Very high	**High**	**Moderate**	**Low**
Very high	Very high	Very high	High	Moderate
High	Very high	Very high	Moderate	Low
Moderate	High	High	Moderate	Low
Low	Moderate	Low	Low	Very low
Negligible	Low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain

Appendix D Discharge quality results

Appendix D Table 1: Dewatering Plant consent monitoring results, January 2016 to August 2020[1]

Assessment type	Parameter	% zero readings	Existing Permit limit	% above Existing Permit limit
Monthly average	Daily flow volume, m^3	0%	7400	0%
	Flow-weighted turbidity, NTU	2.9%	20	0%
Daily flow-weighted average	Turbidity, NTU	36%	30	**0.4%**
	Turbidity (Clarifier Outlet), NTU	0.2%	30	**3.0%**

Notes: 1. Clarifier outlet and monthly flow-weighted average turbidity data are from Oct 2016 to Aug 2019

Appendix D Table 2: Dewatering Plant water quality monitoring, Sep 2019 to Sep 2021[5]

Parameter (units)	ANZ Guideline 80%, freshwater[1]	ANZ Guideline 95%, freshwater	Min	Max	Average	Median
Aluminium, mg/L	0.15	0.055	0.045	2.1	0.40	0.305
Boron, mg/L[2]	2.5	0.94	0.164	2.1	0.562	0.500
Cadmium, mg/L[3]	0.0008	0.0002	< 0.005	< 0.005	< 0.005	< 0.005
Chromium (III), mg/L[2]	0.039	0.0031	0.0003	0.008	0.002	0.0015
Copper, mg/L	0.0025	0.0014	0.0003	0.01	0.0024	0.0015
Iron, mg/L[2]	1.4	0.7	0.042	5.9	1.0	0.775
Lead, mg/L[3]	0.0094	0.0034	0.0001	0.01	0.0073	0.01
Nickel, mg/L	0.017	0.011	0.0003	0.0036	0.0022	0.0025
Zinc, mg/L[2]	0.031	0.008	0.0006	0.122	0.0105	0.004
Total suspended solids, mg/L[4]	8.8	-	2.5	64.8	13.7	10
Conductivity, µS/cm[4]	115	N/A	242	7820	1345	710

Notes:

1: Cells highlighted indicate the level of ANZ guidelines species protection achieved: blue indicates 95 % species protection; green indicates 80 % species protection, and orange indicates < 80 % species protection.

2: Guideline values are the new proposed freshwater quality guidelines released by the ANZ guidelines for consultation and submissions on 29 June 2020 (T+T, 2020).

3: All cadmium and the majority of lead results were below detection, but the ANZ guideline values are higher than the detection limits.

4: ANZWQG 80^{th} percentile value (River Environment Classification: Warm Wet Low-elevation).

5: A total of 20 sample results for metals and 25 for conductivity.

Appendix D Table 3: North Stream Catchment monitoring data, 2015 - 2020

Parameter	ANZ Guideline freshwater[1]			North Drain			Trib.	Lower North Stream		
	80%	95%		Site 1C	Site 1A	Site 1B	Site 4A	Site 4B	Site 4C	Site 6
Total Aluminium (mg/L)	0.15	0.055	Min	0.020	0.023	0.024	0.005	0.013	0.007	0.031
			Med.	0.100	0.113	0.121	0.058	0.083	0.081	0.107
			Avg.	0.167	0.164	0.167	0.117	0.153	0.126	0.165
			Max	1.310	0.860	0.980	0.920	2.109	0.960	0.639
Total Arsenic (mg/L)[2]	0.36	0.024	Min	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
			Med.	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
			Avg.	0.0014	0.0014	0.0015	0.0012	0.0016	0.0015	0.0012
			Max	0.0025	0.0022	0.0024	0.0018	0.0053	0.0053	0.0018
Total Boron (mg/L)[3]	2.5	0.94	Min	0.21	0.23	0.21	0.11	0.23	0.23	0.35
			Med.	0.54	0.53	0.57	0.99	0.62	0.66	0.72
			Avg.	0.66	0.65	0.68	0.99	0.77	0.77	0.91
			Max	2.60	2.30	2.50	7.20	3.24	2.20	2.70
Total cadmium (mg/L)	0.0008	0.0002	Min	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
			Med.	0.00005	0.00005	0.00011	0.00500	0.00005	0.00008	0.00005
			Avg.	0.00386	0.00367	0.00403	0.00429	0.00387	0.00421	0.00254
			Max	0.01000	0.01000	0.01000	0.01000	0.01000	0.01000	0.01000
Total chromium (mg/L)[3]	0.039	0.0031	Min	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
			Med.	0.0024	0.0026	0.0030	0.0030	0.0019	0.0021	0.0012
			Avg.	0.0049	0.0050	0.0048	0.0042	0.0047	0.0049	0.0033
			Max	0.0100	0.0100	0.0100	0.0100	0.0116	0.0100	0.0100
Total cobalt (mg/L)	N/a	N/a	Min	0.01	0.01	0.005	0.005	0.01	0.01	0.01
			Med.	0.01	0.01	0.01	0.01	0.01	0.01	0.01
			Avg.	0.010	0.010	0.008	0.008	0.010	0.010	0.010
			Max	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total copper (mg/L)	0.0025	0.0014	Min	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
			Med.	0.0010	0.0010	0.0011	0.0005	0.0009	0.0009	0.0009
			Avg.	0.0025	0.0025	0.0026	0.0024	0.0025	0.0026	0.0022
			Max	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
	1.4	0.7	Min	0.104	0.084	0.118	0.039	0.070	0.108	0.223

Parameter	ANZ Guideline freshwater[1]			North Drain			Trib.	Lower North Stream		
	80%	95%		Site 1C	Site 1A	Site 1B	Site 4A	Site 4B	Site 4C	Site 6
Total iron (mg/L)[3]			Med.	0.280	0.375	0.333	0.291	0.211	0.227	0.325
			Avg.	0.3285	0.4035	0.3798	0.8910	0.9221	0.2952	0.6435
			Max	0.910	0.709	0.726	4.482	8.845	0.908	1.382
Total lead (mg/L)	0.0094	0.0034	Min	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
			Med.	0.0004	0.0006	0.0012	0.0200	0.0002	0.0004	0.0002
			Avg.	0.0078	0.0075	0.0097	0.0103	0.0078	0.0085	0.0052
			Max	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200
Total nickel (mg/L)	0.017	0.011	Min	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
			Med.	0.0011	0.0012	0.0018	0.0050	0.0011	0.0011	0.0007
			Avg.	0.0043	0.0042	0.0045	0.0045	0.0043	0.0046	0.0030
			Max	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Total zinc (mg/L)	0.031	0.008	Min	0.0011	0.0011	0.0011	0.0011	0.0013	0.0017	0.0011
			Med.	0.0045	0.0051	0.0040	0.0015	0.0055	0.0054	0.0046
			Avg.	0.0088	0.0103	0.0070	0.0044	0.0116	0.0076	0.0065
			Max	0.1180	0.1230	0.0860	0.0740	0.3027	0.0390	0.0181
Electrical Conductivity (µS/cm)	115	N/a	Min	237	238	238	132	243	245	254
			Med.	355	344	451	211	439	381	311
			Avg.	941	903	1,047	247	1,165	1,087	1,347
			Max	4,120	4,050	4,050	569	5,830	5,810	5,450
Total Suspended solids (mg/L)	8.8[4]	N/a	Min	5.0	-	-	5.0	5.0	5.0	5.0
			Med.	17.4	-	-	6.7	5.0	5.0	5.0
			Avg.	88.6	-	-	183.9	7.0	6.0	6.3
			Max	393.2	-	-	717.0	17.2	14.8	16.4
Temperature (°C)	N/a	N/a	Min	15.0	14.9	15.3	10.8	11.6	11.6	15.9
			Med.	19.9	19.7	20.1	16.9	19.4	19.6	18.4
			Avg.	20.5	20.6	20.8	17.4	19.6	19.6	18.7
			Max	26.6	26.4	26.8	23.1	25.8	25.6	22.2
pH (pH Units)	7.26 – 7.7[5]	N/a	Min	7.5	7.4	7.6	6.6	7.1	7.1	7.2
			Med.	7.9	7.8	7.9	7.2	7.7	7.7	7.5
			Avg.	7.9	7.8	7.9	7.2	7.7	7.6	7.5
			Max	8.8	8.6	8.6	8.0	8.3	8.1	7.8

Notes:

1: Cells highlighted indicate the level of ANZ guidelines species protection achieved: blue indicates 95 % species protection; green indicates 80 % species protection, and orange indicates < 80% species protection.

2: Arsenic guidelines values are for AsIII speciation.

3: Guideline values are the new proposed water quality guidelines released by the ANZ guidelines for consultation and submissions on 29 June 2020 (T+T, 2020).

4: ANZWQG 80th percentile value (River Environment Classification: Warm Wet Low-elevation).

5: ANZWQG 20th percentile and 80th percentile values (River Environment Classification: Warm Wet Low-elevation).

Appendix D Table 4: Kahawai Stream monitoring data, 2015 - 2020

Parameter	ANZ guideline freshwater[1]			Kahawai Stream		
	80%	95%		Kahawai Culvert	Kahawai Upstream	Kahawai Downstream
Total aluminium (mg/L)	0.15	0.055	Min	0.050	0.050	0.103
			Median	2.407	0.050	0.901
			Average	4.478	0.275	2.015
			Max	79.000	7.145	21.000
Total boron (mg/L)[2]	2.5	0.94	Min	0.500	1.860	1.689
			Median	13.810	4.884	8.612
			Average	16.496	4.909	11.605
			Max	33.348	9.903	28.037
Total chromium (III) (mg/L)[2]	0.039	0.0031	Min	0.002	0.000	0.002
			Median	0.005	0.005	0.005
			Average	0.007	0.005	0.006
			Max	0.039	0.005	0.045
Total copper (mg/L)	0.0025	0.0014	Min	0.002	0.000	0.002
			Median	0.004	0.002	0.003
			Average	0.004	0.003	0.003
			Max	0.033	0.009	0.009
Total iron (mg/L)[2]	1.4	0.7	Min	0.039	0.368	0.428
			Median	0.550	1.869	1.013
			Average	1.297	3.780	1.949
			Max	9.856	30.808	30.551
Total lead (mg/L)	0.0094	0.0034	Min	0.001	0.000	0.000
			Median	0.010	0.010	0.010
			Average	0.010	0.010	0.010
			Max	0.036	0.024	0.010
Total nickel (mg/L)	0.017	0.011	Min	0.001	0.000	0.001
			Median	0.005	0.005	0.005
			Average	0.005	0.005	0.005
			Max	0.020	0.013	0.005
Total zinc (mg/L)	0.031	0.008	Min	0.001	0.005	0.001
			Median	0.012	0.005	0.005
			Average	0.025	0.098	0.022
			Max	0.189	2.168	0.379
Total suspended solids (mg/L)	8.8[3]	N/a	Min	2.5	2.5	2.5
			Median	23.4	5.6	9.2
			Average	68.7	11.3	19.7
			Max	1349.0	48.8	275.5

Parameter	ANZ guideline freshwater[1]			Kahawai Stream		
	80%	95%		Kahawai Culvert	Kahawai Upstream	Kahawai Downstream
pH	7.26 -7.7[4]	N/a	Min	8.5	3.4	7.1
			Median	11.1	7.1	9.8
			Average	10.9	7.0	9.6
			Max	11.9	7.6	11.3

Note:

1: Cells highlighted indicate the level of ANZ guideline species protection achieved: blue indicates 95 % species protection; green indicates 80 % species protection, and red indicates < 80 % species protection.

2: Guideline values are the new proposed water quality guidelines released by the ANZ guidelines for consultation and submissions on 29 June 2020 (T+T, 2020).

3: ANZWQG 80th percentile value (River Environment Classification: Warm Wet Low-elevation).

4: ANZWQG 20th percentile and 80th percentile values (River Environment Classification: Warm Wet Low-elevation).

Appendix D Table 5: Kahawai Stream Wilcoxon Signed Rank Test (matched pairs) results for aluminium and zinc.

Aluminium

Number	W Statistic	Standard Deviation	Z-score	P-value
57	26	125.86	6.36	0.00

Zinc

Number	W Statistic	Standard Deviation	Z-score	P-value
57	677	125.86	1.18	0.24

Appendix D Table 6: Ruakohua Stream monitoring data, 2015 - 2020

Parameter	ANZ guideline freshwater[1]			Ruakohua Stream		
	80%	95%		Upstream[5]	Contractors Compound	Yard 31
Total aluminium (mg/L)	0.15	0.055	Min	0.113	0.044	0.330
			Median	1.510	0.103	0.860
			Average	2.941	0.169	1.78
			Max	7.200	0.545	6.5
Total boron (mg/L)[2]	2.5	0.94	Min	0.03	0.26	0.5
			Median	0.04	0.5	0.5
			Average	0.06	0.513	0.666
			Max	0.13	1.41	1.08
Total chromium (III) (mg/L)[2]	0.039	0.0031	Min	0.0009	0.00096	0.0015
			Median	0.0017	0.005	0.005
			Average	0.0028	0.005	0.008
			Max	0.0058	0.005	0.035
Total copper (mg/L)	0.0025	0.0014	Min	0.0006	0.00075	0.00075
			Median	0.0016	0.0017	0.0026
			Average	0.0025	0.0029	0.0036
			Max	0.0054	0.005	0.0104
Total iron (mg/L)[2]	1.4	0.7	Min	0.360	0.01	0.41
			Median	1.350	0.15	1.31
			Average	2.370	0.34	3.26
			Max	5.400	1.17	13.6
Total lead (mg/L)	0.0094	0.0034	Min	0.0001	0.000055	0.0023
			Median	0.0008	0.01	0.01
			Average	0.0019	0.0082	0.0091
			Max	0.0048	0.01	0.01
Total nickel (mg/L)	0.017	0.011	Min	0.0006	0.0002	0.001
			Median	0.0007	0.005	0.005
			Average	0.0009	0.0041	0.0043
			Max	0.0014	0.005	0.005
Total zinc (mg/L)	0.031	0.008	Min	0.0032	0.0039	0.005
			Median	0.0065	0.005	0.0179
			Average	0.0087	0.0136	0.0346
			Max	0.0165	0.0395	0.143
Total suspended solids (mg/L)	8.8[3]	N/a	Min	5.2	2.5	7.2
			Median	81.4	2.5	17.6
			Average	81.4	3.7	35.3
			Max	157.6	11.6	129.2

Parameter	ANZ guideline freshwater[1]			Ruakohua Stream		
	80%	95%		Upstream[5]	Contractors Compound	Yard 31
pH	7.26 – 7.7[4]	N/a	Min	6.6	7.5	7.4
			Median	6.9	7.8	7.8
			Average	6.9	7.8	7.9
			Max	7.1	8.1	9.2

Note:

1: Cells highlighted indicate the level of ANZ guideline species protection achieved: blue indicates 95% species protection; green indicates 80% species protection, and red indicates <80% species protection.

2: Guideline values are the new proposed water quality guidelines released by the ANZ guidelines for consultation and submissions on 29 June 2020 (T+T, 2020).

3: ANZWQG 80th percentile value (River Environment Classification: Warm Wet Low-elevation).

4: ANZWQG 20th percentile and 80th percentile values (River Environment Classification: Warm Wet - Low-elevation).

5: Limited data available, samples collected monthly between June and August 2020.

Appendix E Stream Ecological Valuation summary results

Appendix E Table 1: Stream ecological valuation (SEV) summary results from 2020 and 2021

Function Type	Function	North Drain / Lower North Stream			Ruakohua Stream		Kahawai Stream	
		Site A	**Site C**	**Site 6**	**Site 2**	**Site 4**	**Upstream**	**Downstream**
Hydraulic	Natural flow regime maintained	0.04	0.08	0.73	0.25	0.25	0.95	0.96
	Connectivity to floodplain intact / Floodplain effectiveness	0.00	0.10	1.00	0.78	0.50	0.63	0.66
	Connectivity for species migrations	1.00	1.00	1.00	1.00	1.00	0.30	1.00
	Connectivity to groundwater intact	0.20	0.44	0.93	0.75	0.95	0.91	0.93
Biogeochemical	Water temperature controlled	0.30	0.00	0.66	0.30	0.50	0.52	0.56
	Dissolved oxygen maintained	0.40	0.17	0.40	0.40	0.60	0.50	0.60
	Organic matter input maintained	0.20	0.00	0.80	0.29	0.59	0.35	0.43
	Instream particles retained	0.20	0.00	0.50	0.40	0.66	0.28	0.78
	Decontamination of pollutants	0.37	0.44	0.82	0.82	0.58	0.84	0.81
Habitat provision	Fish spawning habitat intact	0.05	0.05	0.43	0.18	0.40	0.43	0.88
	Habitat for aquatic fauna intact	0.25	0.21	0.63	0.51	0.64	0.52	0.66
Biodiversity	Fish fauna intact	0.47	0.00	0.47	0.27	0.47	0.00	0.23
	Invertebrate fauna intact	0.25	0.12	0.25	0.20	0.22	0.47	0.31
	Riparian vegetation intact	0.00	0.00	0.72	0.25	0.20	0.27	0.30
Overall SEV Score[1]		**0.27**	**0.19**	**0.67**	**0.46**	**0.54**	**0.50**	**0.65**

1: Overall SEV Score rounded to 2 d.p.

Appendix F Previous Stream Ecological Valuation Scores

Appendix F Table 1: Previous SEV scores

Watercourse		Lower North Stream / North Drain				Ruakohua Stream		Kahawai Stream	
Site		**Site A 2012**	**Site B 2012**	**Site B 2018**	**Site C 2012**	**Site 2 2011**	**Site 4 2011**	**Upstream 2007**	**Downstream 2007**
Function Type	**Function**								
Hydraulic	Natural flow regime maintained	0.10	0.06	0.07	0.10	0.60	0.49	0.85	0.85
	Connectivity to floodplain intact / Floodplain effectiveness	0.07	0.00	0.00	0.30	0.55	0.25	0.05	0.25
	Connectivity for species migrations	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Connectivity to groundwater intact	0.60	0.33	0.07	0.60	0.71	0.70	0.70	0.70
Biogeochemical	Water temperature controlled	0.04	0.02	0.00	0.12	0.51	0.73	0.33	0.53
	Dissolved oxygen maintained	0.68	0.68	0.68	0.34	0.50	0.37	0.08	0.06
	Organic matter input maintained	0.05	0.03	0.00	0.13	0.11	0.44	0.00	0.11
	Instream particles retained	0.20	0.20	0.20	0.20	0.06	0.50	0.57	0.57
	Decontamination of pollutants	0.27	0.24	0.48	0.60	1.00	1.00	1.00	1.00
	Flood-plain particle retention*	-	-	-	-	0.62	0.42	0.07	0.26
Habitat provision	Fish spawning habitat intact	0.05	0.05	0.05	0.05	0.05	0.50	0.14	0.425
	Habitat for aquatic fauna intact	0.20	0.12	0.11	0.33	0.38	0.50	0.38	0.52
Biodiversity	Fish fauna intact	0.23	0.23	0.23	0.23	0.53	0.53	0.40	0.40
	Invertebrate fauna intact	0.38	0.15	0.27	0.20	0.19	0.09	0.05	0.05
	Aquatic biodiversity intact*	-	-	-	-	0.36	0.42	0.28	0.28
	Riparian vegetation intact	0.00	0.00	0.00	0.15	0.38	0.57	0.37	0.35
Overall SEV Score		**0.28**	**0.22**	**0.23**	**0.31**	**0.47**	**0.52**	**0.39**	**0.46**

*These functions are no longer included in the current SEV method (Storey *et al*., 2011).

Appendix G Spot water quality data

Appendix G Table 1: Spot water quality measurements collected from North Drain and Lower North Stream on 4 August 2020.

	Site	Time	Temp (°C)	DO (%)	DO (mg/l)	pH	Conductivity (µS/cm)
Lower North Stream	Site A	13:00	17.6	103.9	9.93	7.63	475
North Drain	Site B	15:00	14.6	97.4	9.89	4.8	568
	Site C	15:50	14.4	-	6.77	6.81	300

Appendix G Table 2: Spot water quality measurements collected from North Drain and Lower North Stream on 5 September 2012

	Site	Time	Temp (°C)	DO (%)	DO (mg/l)	pH	Conductivity (µS/cm)
Lower North Stream	Site A	14:30	17.4	106.6	10.21	7.2	316
North Drain	Site B	10:40	16	105	10.3	6.8	383
	Site C	12:30	14.9	110.5	11.12	7.1	210

Appendix G Table 3: Spot water quality measurements collected from the Ruakohua Stream on 4 August 2020.

Stream	Site	Time	Temp (°C)	DO (%)	DO (mg/l)	pH	Conductivity (µS/cm)
Ruakohua Stream	Site 2	10:00	11.7	76.9	8.38	7.06	245
	Site 4	10:43	11.2	84.3	9.27	6.98	243

Appendix G Table 4: Water quality results for the Ruakohua Stream (17 October 2013 and 29 January 2014)

Parameter	Site 2		Site 4	
	17/10/2013	29/01/2014	17/10/2013	29/01/2014
Time	14:00	11:30	11:00	10:00
Temperature (°C)	17.6	17.1	15.7	16.1
Dissolved oxygen (%)	78.4	43.1	89.5	56
Dissolved oxygen (mg/L)	7.51	4.16	8.89	5.51
pH	7.3	6.66	6.9	6.52
Conductivity (µs/cm)	199	294.4	199	279.8

Appendix G Table 5: Water quality results for the Ruakohua Stream (4 November 2014 and 15 January 2015)

Parameter	**Site 2**		**Site 4**	
	4/11/14	15/1/15	4/11/14	15/1/15
Time	12:15 pm	10:20 am	10:00 am	10:35 am
Temperature (°C)	16.9	16.4	15.8	16.8
Dissolved oxygen (%)	81.0	55.5	93.4	58.5
Dissolved oxygen (mg/L)	7.86	5.27	9.25	5.60
pH	7.1	6.5	7.1	6.8
Conductivity (µs/cm)	220	272	219	262

Appendix G Table 6: Spot water quality measurements collected from the Kahawai Stream 6 August 2020.

Stream	**Site**	**Time**	**Temp (°C)**	**DO (%)**	**DO (mg/l)**	**pH**	**Conductivity (µS/cm)**
Kahawai Stream	Upstream	14:55	12.1	46.9	4.94	6.76	301
	Downstream	14:30	12.5	68.6	7.32	7.43	445

Appendix H Macroinvertebrate data

Appendix H Table 1: Macroinvertebrate community survey results collected from North Drain and North Stream between 4 – 6 August 2020.

Stream	Site	No. of Taxa	% EPT Taxa		MCI score	MCI Quality Class	SQMCI score	SQMCI Quality Class
			% EPT-a	% EPT-b				
North Drain / North Stream	Site A	11	0	0	82	Fair	3.5	Poor
	Site B	5	20	0	37	Poor	2.1	Poor
	Site C	11	0	0	64	Poor	4.0	Fair
	Site 6	9	11	0	65	Poor	2.0	Poor

Appendix H Table 2: Macroinvertebrate results collected from North Drain / North Stream on 5 September 2012.

North Drain / North Stream	No. of taxa	MCI	No. of EPT taxa
Site A	11	79.8	2
Site B	5	68.8	0
Site C	7	73.7	0

Appendix H Table 3: Macroinvertebrate results collected from North Stream at Site 6 between 2005 and 2019

Taxa		MCI-SB score	Aug-05	Oct-09	Aug-10	Aug-11 Rep 1	Aug-11 Rep 2	Aug-11 Rep 3	Aug-12 Rep 1	Aug-12 Rep 2	Aug-12 Rep 3	Sep-13 Rep 1	Sep-13 Rep 2	Sep-13 Rep 3	Sep-14 Rep 1	Sep-14 Rep 2	Sep-14 Rep 3	Aug 15-Rep 1	Aug-15-Rep 2	Aug-15-Rep 3
Caddisflies	*Hydrobiosis*	6.7		r																
	Oxyethria	1.2	✓		r	c			r			c	r	r	r	r				
	Paroxyethira hendersoni	3.7																		
	Polyplectropus																			
Odonata	*Xanthocnemis*	1.2	✓			r			r		r			r				r		
	Anisops	2.2																		
Hemiptera	*Microvelia*	4.6	✓			r						r	r	r	r	r		r	c	r
Beetles	*Elmidae*	7.2													r	r	r	r		
	Hydrophilidae	8.0												r	r	c	a			
	Enochrus	3.0																r	r	
	Liodessus	4.9	✓																r	
	Staphylinidae	4.5																	r	
Trueflies	*Austrosimulium*	3.9	✓	a	c								r		r	r	r			
	Corynoneura	1.7	✓																	
	Ephydridae	1.4																		
	Hexatomini	6.7	✓		r							r	r	r	r		r			r
	Muscidae	1.6																		r
	Orthocladiinae	3.2	✓	r	c	c			c	r		r	r		r	r	r	r	r	r
	Polypedilum	8.0							r			r								
	Psychodidae	6.1																		
	Sciomyzidae	3.0							r		r		r	r						
	Tanytarsini	4.5										r	r							

Taxa		**MCI-SB score**	**Aug-05**	**Oct-09**	**Aug-10**	**Aug-11 Rep 1**	**Aug-11 Rep 2**	**Aug-11 Rep 3**	**Aug-12 Rep 1**	**Aug-12 Rep 2**	**Aug-12 Rep 3**	**Sep-13 Rep 1**	**Sep-13 Rep 2**	**Sep-13 Rep 3**	**Sep-14 Rep 1**	**Sep-14 Rep 2**	**Sep-14 Rep 3**	**Aug 15-Rep 1**	**Aug-15-Rep 2**	**Aug-15-Rep 3**
	Chironomus	3.4																		
	Tanypodinae																			
	Zelandotipula																			
Collembola		5.3								r	r	c	c	c	c		r	a	c	r
Acarina		5.2	✓			r							r		a	c	a	r	c	c
Crustacea	*Amphipoda*	5.5		r	c					r						r		r	r	r
	Paratya	3.6	✓	r	r		r		c	r	r		r		r	r	r	r		
	Paracalliope	5.5																		
	Palaemon affinis	5.0																		
	Ostracoda	1.9																		
	Talitridae	5.5																		
Isopoda		4.5																r		
Oligochaeta		3.8	✓	r	r	c	c	r	r	r	r	c	r	r	c	c	c	r	r	r
Nemertea		1.8																		
Platyhelminthes (Flatworms)		0.9	✓																r	
Hirudinea (Leeches)		1.2			r				r											
Mollusca	*Lymnaea*	1.2	✓																	
	Physa	0.1												r	r			r		
	Potamopyrgus	2.1	✓	va	va	c	c	a	va	va	va	va	c	a	vva	va	va	vva	vva	va
	Sphaeriidae	2.9	✓																	
No. of taxa			**15**	**7**	**9**	**7**	**3**	**2**	**9**	**6**	**6**	**9**	**12**	**10**	**13**	**11**	**10**	**13**	**11**	**9**
MCI-sb			**66.5**	**82.3**	**69.3**	**60.9**	**63.3**	**59**	**60.7**	**78.3**	**63.3**	**87.6**	**77.7**	**72.0**	**84.5**	**87.8**	**98.0**	**75.2**	**78.4**	**84.4**
No. of EPT taxa			**1**	**1**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**

Taxa	MCI-SB score	Aug-05	Oct-09	Aug-10	Aug-11 Rep 1	Aug-11 Rep 2	Aug-11 Rep 3	Aug-12 Rep 1	Aug-12 Rep 2	Aug-12 Rep 3	Sep-13 Rep 1	Sep-13 Rep 2	Sep-13 Rep 3	Sep-14 Rep 1	Sep-14 Rep 2	Sep-14 Rep 3	Aug 15-Rep 1	Aug-15-Rep 2	Aug-15-Rep 3
✓ = present; r = rare = 1-4; c = common = 5-19; a = abundant = 20-99; va = very abundant = 100-499; vva = very, very abundant = 500+																			

Taxa		MCI-SB score	Oct-16 Rep 1	Oct-16 Rep 2	Oct-16 Rep 3	Aug-17 Rep 1	Aug-17 Rep 2	Aug-17 Rep 3	Sep-18 Rep 1	Sep-18 Rep 2	Sep-18 Rep 3	Oct-19 Rep 1	Oct-19 Rep 2	Oct-19 Rep 3
Caddisflies	*Hydrobiosis*	6.7												
	Oxyethria	1.2	r	r		r	r	r	r	r		r	c	c
	Paroxyethira hendersoni	3.7	r											
	Polyplectropus												r	
Odonata	*Xanthocnemis*	1.2						r						
	Anisops	2.2		r	r									
Hemiptera	*Microvelia*	4.6								r				
Beetles	*Elmidae*	7.2												
	Hydrophilidae	8.0		r										
	Enochrus	3.0												
	Liodessus	4.9												
	Staphylinidae	4.5												
Trueflies	*Austrosimulium*	3.9	c	c					r	c		c	c	c
	Corynoneura	1.7												
	Ephydridae	1.4				r		r						
	Hexatomini	6.7					r	r					r	
	Muscidae	1.6			r									
	Orthocladiinae	3.2		c	r	c	c	r	r	c	r	r	r	
	Polypedilum	8.0					r							

Taxa		MCI-SB score	Oct-16 Rep 1	Oct-16 Rep 2	Oct-16 Rep 3	Aug-17 Rep 1	Aug-17 Rep 2	Aug-17 Rep 3	Sep-18 Rep 1	Sep-18 Rep 2	Sep-18 Rep 3	Oct-19 Rep 1	Oct-19 Rep 2	Oct-19 Rep 3
	Psychodidae	6.1				r								
	Sciomyzidae	3.0										r	r	
	Tanytarsini	4.5												
	Chironomus	3.4								c				
	Tanypodinae												r	
	Zelandotipula												r	
Collembola		5.3					r	r		r		r	r	
Acarina		5.2				r	r	c	r	r	r	r	c	
Crustacea	*Amphipoda*	5.5	r	r										
	Paratya	3.6				r		r			r	c	r	c
	Paracalliope	5.5				c	c	r	c	c		c	va	r
	Palaemon affinis	5.0	r											
	Ostracoda	1.9								r		r		
	Talitridae	5.5								r				
Isopoda		4.5	r											
Oligochaeta		3.8	c	c	c	r	c	r	r	r				r
Nemertea		1.8							r	r	r		r	
Platyhelminthes (Flatworms)		0.9							r	r	r		c	r
Hirudinea (Leeches)		1.2												
Mollusca	*Lymnaea*	1.2												
	Physa	0.1												
	Potamopyrgus	2.1	va	vva	va	vva	vva	vva	vva	va	vva	vva	vva	vva
	Sphaeriidae	2.9												

Taxa	MCI-SB score	Oct-16 Rep 1	Oct-16 Rep 2	Oct-16 Rep 3	Aug-17 Rep 1	Aug-17 Rep 2	Aug-17 Rep 3	Sep-18 Rep 1	Sep-18 Rep 2	Sep-18 Rep 3	Oct-19 Rep 1	Oct-19 Rep 2	Oct-19 Rep 3
No. of taxa		**8**	**7**	**5**	**9**	**9**	**11**	**8**	**14**	**6**	**10**	**15**	**7**
MCI-sb		**74.3**	**74.6**	**51.6**	**64.4**	**73.3**	**80.0**	**67.0**	**69.0**	**56.0**	**70**	**81**	**60**
No. of EPT taxa		**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**2**	**1**
✓ = present; r = rare = 1-4; c = common = 5-19; a = abundant = 20-99; va = very abundant = 100-499; vva = very, very abundant = 500+													

Appendix H Table 4: Macroinvertebrate community survey results collected from Ruakohua Stream between 4 – 6 August 2020.

Stream	Site	No, of Taxa	% EPT taxa		MCI score	MCI Quality Class	SQMCI score	SQMCI Quality Class
			% EPT-a	% EPT-b				
Ruakohua Stream	Site 2	16	6	0	58	Poor	2.0	Poor
	Site 3	20	5	0	63	Poor	2.2	Poor
	Site 4	10	0	0	77	Poor	2.5	Poor
	Site 5	15	7	0	73	Poor	1.9	Poor

Appendix H Table 5: Macroinvertebrate results collected from Ruakohua Stream, 27 July 2011.

Ruakohua Stream	No. of taxa	MCI	No. of EPT taxa
Site 2	10	68.2	2
Site 3	5	83.2	2
Site 4	9	83.8	1
Site 5	6	84.3	1

Appendix H Table 6: Macroinvertebrate community survey results from Kahawai Stream on 6 August 2020 and December 2022.

Stream	Site	No. of Taxa	% EPT taxa		MCI score	MCI Quality Class	SQMCI score	SQMCI Quality Class
			% EPT-a	% EPT-b				
Kahawai Stream - 2020	Upstream	28	7	4	85	Fair	3.4	Poor
	Downstream	20	5	0	72	Poor	2.5	Poor
Kahawai Stream - 2022	Upstream	22	9	19	87	Fair	3.9	Poor
	Downstream	21	9	19	78	Poor	3.6	Poor

Appendix H Table 7: Macroinvertebrate results collected from Kahawai Stream, 2005 and 2007.

Sample Site	Date	No. of taxa	% EPT taxa		MCI score	MCI Quality Class	SQMCI score	SQMCI Quality Class
			% EPT-a	% EPT-b				
Kahawai Stream	27/09/2005	19	11	-	84.2	Fair	-	-
Kahawai Stream	13/11/2007	6	0	0	86.7	Fair	5.2	Fair

Appendix H Table 8: Macroinvertebrate results collected from Reference sites

Reference site	Year	Substrate / Primary land cover	Median number of taxa	Median MCI score	Median % EPT taxa	Source
Waitangi Stream	2014 - 2019	Soft bottomed / Rural high	13	56.4	0 %	LAWA
Mauku Stream	2005 - 2013	Soft bottomed / Rural high	20	84.5	20 %	TR 2017-11

Appendix I Freshwater fish data

Appendix I Table 1: Freshwater fish survey results from North Stream Catchment 5-6 August 2020

Stream	Site	Species and number of fish caught (size range in mm)	
		Longfin eel	**Shortfin eel**
North Stream Catchment	Site A	1 (300)	6 (230 - 280)
	Site B	-	1 (280)
	Site C	-	-

Appendix I Table 2: North Stream Catchment electric fishing results 5 September 2012, number of fish captured with size range (mm) in brackets

Site	Shortfin eel (*A. australis*)	Unidentified eel	Unidentified pest fish
Site A	5 (70 - 200)	7	-
Site B	1 (80)	-	-
Site C	-	6	2 (100)

Appendix I Table 3: Lower North Stream (approximately 200 m upstream of Site 6) fish survey 2 March 2017

Species	Upstream of culvert		Downstream of culvert (upstream of weir)		Downstream of culvert (downstream of weir)	
	Count	Size (mm)	Count	Size (mm)	Count	Size (mm)
Longfin eel	-	-	-	-	2	500 - 600
Shortfin eel	5	150 - 400	1	80	-	-
Īnanga	-	-	15	50 - 60	36	50 - 55

Appendix I Table 4: Lower North Stream (approximately 200 m upstream of Site 6) fish survey March 2022

Species	Site 6		Site A	
	Count	Size (mm)	Count	Size (mm)
Elver	2	-		
Longfin eel	9	230 - 860	1	400
Shortfin eel	10	230 - 620	18	200 - 410
Īnanga	39	35 - 80		

Appendix I Table 5: East Landfill fish relocation results 2011 – 2016.

Year	Shortfin eel (*A. australis*)	Banded kokopu (*Galaxias fasciatus*)
November 2011	1 (100)	
December 2014	8 (200 - 350)	-

January 2016	4 (200 – 350)	-
December 2016	8 (250 -400)	44 (60 – 120)

Appendix I Table 6: Freshwater fish survey results from Ruakohua Stream 4-5 August 2020

Stream	Site	Species and number of fish caught (size range in mm)			
		Longfin eel	**Shortfin eel**	**Common bully**	**Gambusia**
Ruakohua Stream	Site 1	-	18 (180-510)	-	33
	Site 2	3 (550-630)	-	-	45
	Site 4	2 (110-900)	-	37 (35-80)	-

Appendix I Table 7: Ruakohua stream electric fishing results August 2011 – March 2017, number of fish captured with size range (mm) in brackets

Year	Shortfin eel (*A. australis*)			Longfin eel (*A. dieffenbachii*)			Common bully (*G. cotidianus*)		
	Site 1	**Site 2**	**Site 4**	**Site 1**	**Site 2**	**Site 4**	**Site 1**	**Site 2**	**Site 4**
Aug-11	5 (150 - 400)	3 (250 - 300)	1 (350)	32 (60 - 850)	6 (150 - 400)	4 (300 - 700)	-	1 (80)	1 (45)
Oct-13	29 (80 - 700)	16 (150 - 500)	3 (150 - 400)	2 (730 - 1400)	2 (450 - 500)	1 (800)	-	-	-
Jan-14	31 (150 - 700)	4 (180 - 650)	3 (100 - 300)	1 (350)	1 (400)	1 (1000)	-	1 (35)	-
Nov-14	8 (200 - 500)	2 (450 - 600)	1 (300)	1 (350)	-	1 (800)	-	-	6 (35-65)
Jan-15	12 (300 - 800)	-	2 (100-500)	-	-	-	-	-	3 (40 - 70)
Mar - 17	5 (100 - 400)	2 (200 - 400)	1 (90)	-	-	-	-	-	6 (20 - 40)

Note: Unidentified eels and freshwater shrimp data not included.

Appendix I Table 8: Ruakohua stream netting results October 2013 – March 2017, number of fish captured with size range (mm) in brackets

Year	Shortfin eel (*A. australis*)			Longfin eel (*A. dieffenbachii*)			Common bully (*G. cotidianus*)		
	Site 1	**Site 2**	**Site 4**	**Site 1**	**Site 2**	**Site 4**	**Site 1**	**Site 2**	**Site 4**
Oct-13	3 (500 - 610)	1 (350)	-	2 (730 - 1400)	4 (350 - 1300)	2 (550 - 1150)	-	-	8 (65 - 95)
Jan-14	9 (300 - 700)	3 (500 - 600)	-	-	2 (800 - 850)	2 (600 - 1200)	-	2 (30-100)	41 (30 - 85)
Nov-14	3	2	-	3	4	2	-	1 (100)	12

	(550 - 600)	(350 - 750)		(550 - 600)	(500 - 820)	(200 - 1200)			(50 - 100)
Jan-15	3 (150 - 500)	8 (400 - 900)	1 (400)	1 (1100)	2 (600 - 1050)	3 (500 - 1200)	-	-	44 (3 – 70)
Mar - 17	2 (300 - 450)	2 (120 - 550)	1 (450)	-	-	1 (650)	-	-	156 (15 - 80)

Note: Unidentified eels and freshwater shrimp data not included.

Appendix I Table 9: Freshwater fish survey results for the Kahawai Stream

Stream	Site	Species and number of fish caught (size range in mm)				
		Longfin eel	Shortfin eel	Common bully	Gambusia	Shrimp
Kahawai Stream	Downstream reach	-	1 (410)	-	-	6

Appendix J Sediment quality data

Appendix J Table 1: Sediment quality results for the Lower North Stream

Parameter	Unit	ANZ guideline		Lower North Stream	
		Default guideline value	Guideline value - high	Site A	Site 6
Total Recoverable Aluminium	mg/kg dry wt	-	-	25,000	7,900
Total Recoverable Cadmium	mg/kg dry wt	1.5	10	0.29	0.058
Total Recoverable Vanadium	mg/kg dry wt	-	-	1,260	189
Total Recoverable Arsenic	mg/kg dry wt	20	70	22	4.4
Extractable Arsenic (<63 µm Fraction)	mg/kg dry wt	20	70	5.2	4
Total Recoverable Boron	mg/kg dry wt	-	-	42	< 20
Extractable Boron (<63 µm Fraction)	mg/kg dry wt	-	-	96	13
Total Recoverable Chromium	mg/kg dry wt	80	370	99	11.4
Extractable Chromium (<63 µm Fraction)	mg/kg dry wt	80	370	69	15.9
Total Recoverable Copper	mg/kg dry wt	65	270	26	3.5
Extractable Copper (<63 µm Fraction)	mg/kg dry wt	65	270	18	8.9
Total Recoverable Iron	mg/kg dry wt	-	-	133,000	16,300
Total Recoverable Lead	mg/kg dry wt	50	220	23	5.8
Extractable Lead (<63 µm Fraction)	mg/kg dry wt	50	220	20	16.6
Total Recoverable Nickel	mg/kg dry wt	21	52	39	3.6
Extractable Nickel (<63 µm Fraction)	mg/kg dry wt	21	52	26	5.1
Total Recoverable Zinc	mg/kg dry wt	200	410	500	64
Extractable Zinc (<63 µm Fraction)	mg/kg dry wt	200	410	440	146

Appendix J Table 2: Sediment quality results for the Kahawai Stream

Parameter	Unit	ANZ guideline		Kahawai Stream	
		Default guideline value	Guideline value - high	Upstream	Downstream
Total Recoverable Aluminium	mg/kg dry wt	-	-	13,500	32,000
Total Recoverable Cadmium	mg/kg dry wt	1.5	10	0.46	0.76
Total Recoverable Vanadium	mg/kg dry wt	-	-	1,380	2,500
Total Recoverable Arsenic	mg/kg dry wt	20	70	13.3	12
Extractable Arsenic (< 63 µm Fraction)	mg/kg dry wt	20	70	8.3	3.1
Total Recoverable Boron	mg/kg dry wt	-	-	69	116
Extractable Boron (< 63 µm Fraction)	mg/kg dry wt	-	-	184	153
Total Recoverable Chromium	mg/kg dry wt	80	370	26	66
Extractable Chromium (< 63 µm Fraction)	mg/kg dry wt	80	370	16.9	37
Total Recoverable Copper	mg/kg dry wt	65	270	16.7	18.4
Extractable Copper (< 63 µm Fraction)	mg/kg dry wt	65	270	13.7	15.2
Total Recoverable Iron	mg/kg dry wt	-	-	124,000	93,000
Total Recoverable Lead	mg/kg dry wt	50	220	11.1	21
Extractable Lead (< 63 µm Fraction)	mg/kg dry wt	50	220	11.5	17.9
Total Recoverable Nickel	mg/kg dry wt	21	52	11.3	19
Extractable Nickel (< 63 µm Fraction)	mg/kg dry wt	21	52	7.8	10.9
Total Recoverable Zinc	mg/kg dry wt	200	410	390	1,260
Extractable Zinc (< 63 µm Fraction)	mg/kg dry wt	200	410	320	1,350

Appendix J Table 3: Sediment quality results for the Ruakohua Stream

Parameter	Unit	ANZ guideline		Ruakohua Stream	
		Default guideline value	Guideline value - high	Site 2	Site 4
Total Recoverable Aluminium	mg/kg dry wt	-	-	51,000	40,000
Total Recoverable Cadmium	mg/kg dry wt	1.5	10	0.38	0.42
Total Recoverable Vanadium	mg/kg dry wt	-	-	160	350
Total Recoverable Arsenic	mg/kg dry wt	20	70	9.6	6.8
Extractable Arsenic (< 63 µm Fraction)	mg/kg dry wt	20	70	< 1.0	< 1.0
Total Recoverable Boron	mg/kg dry wt	-	-	< 20	< 20
Extractable Boron (< 63 µm Fraction)	mg/kg dry wt	-	-	< 10	15
Total Recoverable Chromium	mg/kg dry wt	80	370	50	74
Extractable Chromium (< 63 µm Fraction)	mg/kg dry wt	80	370	18	21
Total Recoverable Copper	mg/kg dry wt	65	270	20	22
Extractable Copper (< 63 µm Fraction)	mg/kg dry wt	65	270	13.6	13.6
Total Recoverable Iron	mg/kg dry wt	-	-	76,000	58,000
Total Recoverable Lead	mg/kg dry wt	50	220	25	18.5
Extractable Lead (< 63 µm Fraction)	mg/kg dry wt	50	220	21	17.3
Total Recoverable Nickel	mg/kg dry wt	21	52	13.9	27
Extractable Nickel (< 63 µm Fraction)	mg/kg dry wt	21	52	4.8	9.3
Total Recoverable Zinc	mg/kg dry wt	200	410	112	210
Extractable Zinc (< 63 µm Fraction)	mg/kg dry wt	200	410	89	157

Appendix K Waitangi Stream reference water quality data

Appendix K Table 1: Summary of water quality measurements from Waitangi Stream collected monthly by Auckland Council (Buckthought, 2017).

Parameter	Median value	Range of values
Temperature (°C)	15.26	11.25 – 19.36
Dissolved Oxygen (%)	90.05	63.10 – 98.8
Dissolved Oxygen (mg/l)	9.24	5.85 – 10.88
pH (pH units)	7.14	5.99 – 7.47
Conductivity (µs/cm)	196	175 – 229

Appendix L Wetland plant composition and relative abundance

Appendix L Table 1: North stream wetland plant composition and abundance. Dominant species are highlighted in green.

	Clarkson *et al* 2014 hydric vegetation category	**Lower North Stream wetlands (Appendix A: Figures W-FW3)**			
		Lower North stream. Exotic wetland 1	**Lower North Stream exotic wetland 2**	**Lower North Stream. Exotic wetland 3**	**Lower North Stream Exotic wetland 4**
Wetland status		Yes	Yes	Yes	Yes
Rapid test or Prevalence Test		Rapid	Rapid	Rapid	Rapid
Common name (latin abbrev)					
Creeping buttercup (RANrep)	FAC	2	21	<1	10
Bindweed (CALsep)	FAC	3	5		
Mercer grass (PASdis)	FACW			<1	
Giant rush (JUNpal)	FACW	10			
Kikuyu grass (PENcla)	FACU		15		
Isolepis prolifera (ISOpro)	OBL			<1	
Flax (PHOten)	FAC	5		2	
Yorkshire fog (HOLlan)	FAC		3		
Willow weed (PERmac)	FACW		5	7	3
Pampas (CORsel)	FAC		10		
Gorse (ULEero)	FACU		2		
Woolly nightshade SOLmau)	N/A		5		
Reed grass (GLYmax)	OBL	76	33	90	82
Dallis grass (PASdil)	FACU				
Raupo (TYPoli)	OBL	3			
Cabbage tree (CORaus)	FACW	< 1			
Inkweed (PHYoct)	FACU				5
Pondweed sp (Potamogeton spp.)	OBL			< 1	

Appendix L Table 2: Kahawai stream wetland plant composition and abundance. Dominant species are highlighted in green

	Clarkson *et al* 2014 hydric vegetation category	Kahawai stream wetlands (Appendix A: Figure W-FW5)					
		Kahawai stream exotic wetland 1	**Kahawai stream exotic wetland 2**	**Kahawai stream Rautahi wetland**	**Kahawai stream exotic wetland 3**	**Kahawai stream exotic wetland 4**	**Kahawai stream exotic wetland 5**
Wetland status		Yes	Yes	Yes	Yes	Yes	Yes
Rapid test or Prevalence Test		Rapid	Rapid	Rapid	Rapid	Rapid	Rapid
Common name (latin abbrev)							
Creeping buttercup (RANrep)	FAC	2					
Bindweed (CALsep)	FAC		1		4		
Mercer grass (PASdis)	FACW	80	69		30	80	50
Kikuyu grass (PENcla)	FACU	< 1	15		20		17
Isolepis prolifera (ISOpro)	OBL					< 1	
Flax (PHOten)	FAC	< 1	1				
Carex geminata (CARgem)	FACW	5	2	97	30	< 1	
Carex virgata (CARvir)	OBL	10	5		10		
Yorkshire fog (HOLlan)	FAC	< 1				2	2
Willow weed (PERmac)	FACW		1		1		
Gorse (ULEero)	FACU	< 1	1				
Woolly nightshade SOLmau)	N/A		< 1	1			
Black nightshade (SOLnig)	FACU			1	1		
Creeping bent (AGRsto)	FACU					< 1	
Giant umbrella sedge (CYPust)	FACW	1					
Oioi (APOsim))	FACW	< 1	< 1				
Bristly oxtongue (HELech)	N/A	< 1		1	1		
Reed grass (GLYmax)	OBL	1					
Soft rush (JUNeff)	FACW	< 1				5	
Watercress (NASmic)	OBL	< 1	2		1		
Ragwort (JACvul)	FACU				1		
Buffalo grass (STEsec)	N/A		< 1				
Blackberry (RUBfru)	FACU		2				
Dallis grass (PASdil)	FACU		< 1				
Raupo (TYPoli)	OBL					5	
Birds-foot trefoil (LOTcor)	FACU					< 1	
Jointed rush (JUNart)	FACW					1	
Swamp plantain (PLAaus)	FAC						1
Sharp rush (JUNacu)	FACW					3	30
Umbrella sedge (CYPera)	FACW					1	
Bog bullrush (SCHpun)	FACW*					3	

Appendix L Table 3: Ruakohua stream wetland plant composition and abundance. Dominant species are highlighted in green

		Ruakohua wetlands (Appendix A: Figure W-FW6)				
	Clarkson *et al* 2014 hydric vegetation category	**Ruakohua exotic wetland 1**	**Ruakohua exotic wetland 2**	**North Landfill exotic wetland**	**ITA 'swale' (lower)**	**ITA 'swale' (upper)**
Wetland status		Yes	Yes	Yes	No	Yes
Rapid test or Prevalence Test		Prevalance	Rapid	Rapid	No	Rapid
Common name (latin abbrev)						
Creeping buttercup (RANrep)	FAC	41	15	2		5
Bindweed (CALsep)	FAC		5			
Mercer grass (PASdis)	FACW		37	85		10
Giant rush (JUNpal)	FACW		< 1			43
Kikuyu grass (PENcla)	FACU		2	5	95	40
Flax (PHOten)	FAC				4	
Water celery (APInod)	OBL	30	40			
Carex geminata (CARgem)	FACW	10				
Carex virgata (CARvir)	OBL	3	< 1			
Yorkshire fog (HOLlan)	FAC	10				
Willow weed (PERmac)	FACW	3				
Duckweed (AZOfil)	OBL	2				
Water fern (HISinc)	FAC	< 1	< 1			
Pampas (CORsel)	FAC	< 1				
Gorse (ULEero)	FACU	< 1				
Woolly nightshade SOLmau)	N/A	< 1				
Black nightshade (SOLnig)	FACU	< 1				
Creeping bent (AGRsto)	FACU			< 1		
Giant umbrella sedge (CYPust)	FACW				< 1	
Soft rush (JUNeff)	FACW			6		