

Proposed Sutton Block, Drury Quarry

E2:9 Ecological Impact Assessment

for: Stevenson Aggregates Limited



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Cover Illustration: View across parts of the proposed Sutton Pit

EXECUTIVE SUMMARY

Background

Stevenson Aggregates Limited (SAL) is proposing a new quarry pit and associated facilities at Drury Quarry, Auckland. The proposed new pit is located immediately northeast of the existing pit, within a generally open area referred to as the Sutton Block. The Sutton Block is predominantly within a 'Special Purpose Zone: Quarry' (SPQZ) under the Auckland Unitary Plan – Operative in Part (AUP), with smaller perimeter areas zoned Mixed Rural Zone. It comprises some 87.7 ha of land which is predominantly grazing pasture, with streams, wetlands and fragments of indigenous and exotic vegetation.

Purpose and Scope

The purpose of the report is to evaluate the terrestrial and freshwater ecological features within the Sutton Block, and provide an assessment of the expected and potential effects of the proposed new pit, including construction and operation, on those values.

Methodology

This assessment generally follows Ecological Impact Assessment Guidelines (EciAG) for use in New Zealand, published by EIANZ (Roper-Lindsay et al. 2018). Data has been collected from both desktop investigations of relevant biodiversity databases, as well as site investigations of terrestrial and freshwater ecosystems. Flora surveys included vegetation mapping, searches for nationally and regionally threatened plants and recce plots. Fauna surveys included targeted search and survey for invertebrates, lizards (skinks and geckos), avifauna (terrestrial and wetland species) and long-tailed bats. Freshwater site investigations included stream ecological valuations, measures of water quality, macroinvertebrates, freshwater fish, and wetlands.

Results

Terrestrial ecosystems:

In total, 16.78 ha of indigenous vegetation and fauna habitat would be removed to accommodate the new pit and associated infrastructure. Of this, 14.25 ha (84.9%) is within a Significant Ecological Area (SEA) overlay. Three different ecosystem types would be affected: Taraire, tawa podocarp forest (7.33 ha), kānuka scrub/forest (8.8 ha) and Rock Forest (0.65 ha). The botanical values of the site are moderate to high. Areas of rock forest have high values and areas of Taraire, tawa podocarp Forest and kānuka forest have moderate values.

No Nationally Threatened plants were recorded within the Sutton Block. No threatened fauna were recorded, however At-Risk copper skink (*Oligosoma aeneum*), At-Risk New Zealand pipit (*Anthus novaeseelandiae*), and At-Risk longfin eel (*Anguilla dieffenbachii*) were recorded. Threatened long-tailed bats have been recorded in the surrounding landscape.

A Very High level of effect is expected for the loss of Rock Forest, moderate levels for Taraire, tawa podocarp Forest and low for kānuka Forest. For terrestrial fauna, low levels of effects are expected, following management in accordance with the effects management hierarchy, for invertebrates, lizards birds and bats. These low levels are largely driven by relatively low magnitudes, given the predominantly open, highly modified environment, and absence of bats from surveys.. Outside the SPQZ 9.18 ha of indigenous vegetation is to be cleared, of which 8.71 ha is within an SEA overlay. The indigenous vegetation outside the SPQZ is taraire, tawa podocarp forest and kānuka forest which will have moderate and low levels of effect, respectively. Within the SPQZ, loss of terrestrial ecological values cannot be avoided, however, recommendations are provided, in

accordance with the Effects Management Hierarchy (NPSIB), to manage, offset and compensate for adverse effects of the activity. Additional detail about this approach is provided in the REAR-TE (Biosearches and JS Ecology Ltd, 2025a).

Freshwater ecosystems

Aquatic habitats on the site comprised streams and wetlands. The final pit will result in 115m of stream diversion and 128 m of stream creation (within the footprint of the current upper dam pond). In total 3,341 m of stream length and 1.88 ha of wetland areas would be removed over the approximately 50-year life of the pit. As the loss of these habitats is variously assessed at a moderate or high level of effect, which cannot be avoided or minimised, offset and compensation is recommended to manage the adverse effects of the new quarry pit. Additional detail about this approach is provided in the REAR-FW (Biosearches, 2025).

Summary of effects

The level of effect for each ecological component varies among stages and ecological components. These effects are summarised in the table below.

Outcome

Based on the outcomes of this Ecological Impact Assessment, a suite of ecological management plans has been recommended to mitigate expected adverse effects, and significant residual effects are further addressed in residual effects analyses reports and associated net gain delivery plans (refer Table 1) for loss of streams, wetlands and terrestrial ecosystems.

DOCUMENT GUIDE

As part of the Sutton Block pit expansion, a full suite of ecology assessments, reports and plans have been developed (Table 1). A summary of each document, including its objectives and key findings are provided in this section. This table is provided at the start of each ecology document with the relevant document highlighted to improve navigation. This document is 2 of a series of 9 ecology documents (E2:9).

Table 1. Documents prepared as part of this project. This document is highlighted.

Document name (abbreviated name)	Aspects covered
E1:9 Ecology Documents Guide and Summary	Summary of the whole project and guidance for navigating documents.
Ecological Impact and Management	
E2:9 Ecological Impact Assessment (EclA)	Assessment of ecological values and impacts of the proposed Sutton Block on terrestrial and freshwater ecosystems, including regenerating and mature forest fragments, water courses and wetlands. Fauna values include common native invertebrates and birds, At Risk pipit, copper skinks, longfin eel and (potentially) threatened long-tailed bats. Recommendations are provided for avoiding, managing, offsetting and compensating for significant residual adverse effects.
E3:9 Ecological Management Plan (EMP)	Management of ecological impacts in accordance with the effects management hierarchy, prior to and during and following construction. Specific impacts and values addressed in this Plan include: a) Management of Vegetation Removal b) Avifauna Management Plan c) Long-Tailed Bats Management Plan d) Native Lizard Management Plan e) Edge Effects Management Plan f) Native Freshwater Fauna Management Plan g) Sutton Block Riparian Planting Plan
Residual Effects Analysis Reports (REAR)	
E4:9 REAR: Terrestrial Ecology (REAR-TE)	Residual effects on terrestrial ecosystems and fauna
E5:9 REAR: Stream and Wetland Loss (REAR-SW)	Residual effects on freshwater ecosystems
Net Gain Delivery Plans (NGDP)	
E6:9 NGDP: Planting Plan (NGDP:PP)	Terrestrial offset planting
E7:9 NGDP: Pest and Weed Control (NGDP:PWC)	Terrestrial offset pest and weed control
E8:9 NGDP: Wetland Planting (NGDP:WP)	Freshwater offset planting of wetlands.
E9:9 NGDP: Riparian Planting (NGDP:RP)	Freshwater offset planting of streams.

TABLE OF CONTENTS

Document Control and Revision Record	i
Executive Summary.....	ii
Document Guide.....	iv
LIST OF ACRONYMS AND ABBREVIATIONS.....	xiii
1 INTRODUCTION.....	1
1.1 Drury Quarry Expansion - Sutton Block	1
1.2 Purpose and Scope	8
1.3 Site Overview	9
1.4 Statutory Context	12
2 METHODS	16
2.1 Assessment Standard	16
2.2 Zone of Influence	17
2.3 Desktop and Scoping – Terrestrial and Freshwater Ecology	17
2.4 Site Investigations - Terrestrial Ecology.....	18
2.5 Site Investigations - Freshwater Ecology	37
3 ASSESSMENT OF ECOLOGICAL VALUES.....	42
3.1 Terrestrial Vegetation within the Sutton Block Pit.....	42
3.2 Terrestrial fauna	61
3.3 Freshwater Habitats	74
3.4 Freshwater Fauna	123
3.5 Summary of Ecological values of habitats and species within the site	126
4 ASSESSMENT OF ECOLOGICAL EFFECTS	128
4.1 Terrestrial Ecology	128
4.2 Freshwater Ecology	138
5 SUMMARY OF EFFECTS AND RECOMMENDATIONS FOR EFFECTS MANAGEMENT AND OFFSETTING.....	149
5.1 Terrestrial Ecology	149
5.2 Management of adverse effects on terrestrial ecology values	150
5.3 Freshwater Ecology Effects Assessment.....	155
5.4 Recommended Consent Conditions	163
REFERENCES.....	172
Applicability and Limitations	211

List of Tables

Table 1. Documents prepared as part of this project. This document is highlighted.iv	iv
Table 3. Characteristics of the SEAs found within the SAL property and the total area affected by the proposed Sutton Block pit..... 9	9
Table 4. Criteria matrix for describing level of effects (Roper-Lyndsay et al. 2018). 16	16
Table 5. List of RECCE plots undertaken and key information. Also see Figure 10 for RECCE plot locations. 19	19
Table 6. Number of quadrat searches per Investigation Area..... 24	24
Table 7. Survey effort for lizards over 2020 and 2021 (refer Figure 12 and Figure 13 for locations). 27	27
Table 8. SEV score interpretation. 37	37
Table 9. Fish IBI scores and classes for the Auckland Region (Joy and Henderson, 2004)..... 39	39
Table 10. Terrestrial ecological value of Taraire, tawa, podocarp Forest within the Quarry footprint. 50	50
Table 11. Terrestrial ecological value of Rock Forest within the Quarry footprint. 53	53
Table 12. Terrestrial ecological value of Kānuka Forest within the Quarry footprint. 56	56
Table 13. Relict native trees amongst pasture 58	58
Table 14. Terrestrial ecological value of small stands and individual native trees standing in pasture within the Quarry footprint..... 58	58
Table 15. Terrestrial ecological value of exotic forest within the Quarry footprint..... 59	59
Table 16. Terrestrial ecological value of exotic scrub within the Sutton Block pit footprint. 60	60
Table 17. Terrestrial ecological value of exotic grassland within the Quarry footprint. 60	60
Table 18. Threat classification of native lizards potentially found on site. Regional Threat category as per Melzer et al. (2022). 62	62
Table 19. Birds recorded as present or potentially present within the Site. 69	69
Table 20. 2020, 2021 and 2024 ABM survey results at Drury Quarry (refer Figure 4 for ABM locations). 72	72
Table 21. Summary of fauna values within the proposed Sutton Pit..... 73	73
Table 22. Drury Quarry Sutton Block SEV Stream Characteristics..... 81	81
Table 23. Ecological Value of Stream 1..... 83	83
Table 24. Ecological Value of Stream 2..... 85	85
Table 25. Ecological Value of Stream 2b 87	87
Table 26. Ecological Value of Stream 3..... 88	88
Table 27. Ecological Value of Stream 4..... 91	91
Table 28. Ecological Value of Stream 5..... 93	93
Table 29. Ecological Value of Stream 6..... 95	95
Table 30. Ecological Value of Stream 7..... 96	96
Table 31. Ecological Value of Stream 9..... 98	98
Table 32. Summary of stream ecological values and SEV scores. 98	98
Table 33. Ecological value of Wetland 1a..... 99	99
Table 34. Ecological value of Wetland 1b..... 101	101
Table 35. Ecological value of Wetland 1c..... 103	103
Table 36. Ecological value of Wetland 2a..... 105	105
Table 37. Ecological value of Wetland 2b..... 107	107
Table 38. Ecological value of Wetland 3..... 108	108
Table 39. Ecological value of Wetland 6a and Wetland 6b. 111	111
Table 40. Ecological value of Wetland 6c 113	113
Table 41. Ecological value of Wetland 6d..... 114	114

Table 42. Ecological value of Wetland 7a	116
Table 43. Ecological value of Wetland 7b.....	118
Table 44. Ecological value of Wetland 8.....	120
Table 45. Ecological value of Wetland 9.....	121
Table 46. Summary of wetland ecological values.	122
Table 47. Fish recorded within Sutton Block Streams and their Fish Index of Biotic Integrity.	124
Table 48. Summarised ecological values of the site for habitats and species	126
Table 49. Summary table of the magnitude of effect and level of effect upon each forest type.	136
Table 50. Sutton Block Pit Staging and Indicative Timeline of Works in Aquatic Habitats.....	139
Table 51. Parameters of intermittent and permanent stream habitat impacted within the Sutton Block.....	140
Table 52. Magnitude of effect and level of effect of the proposed works upon the streams identified within the Sutton Block.	143
Table 53. Parameters of wetlands impacted by the Sutton Block pit expansion area.....	144
Table 54. Magnitude of effect and level of effect of the proposed works upon the wetlands identified within the Sutton Block.	145
Table 55. Summary of freshwater effects and proposed effects management.....	147
Table 56. Summary of the total areas of vegetation within the Sutton Block, divided by within and outside both the SEA and SPQZ overlays. All areas in hectares (ha).....	149
Table 56. Summary of terrestrial vegetation and habitat loss, values and effects within the Quarry Pit extent. Values and effects assessments are as described in report, and as per EIANZ guidelines (Roper-Lindsay et al., 2018).	153
Table 58. Sutton Site Aquatic Habitat Potential Assuming Good Landuse Practices.....	156
Table 59. Summary of freshwater habitat loss, values and effects within the Sutton Pit extent. Values and effects assessments are as described in report, and as per EIANZ guidelines (Roper-Lindsay et al., 2018).	161
Table 60. Offset Planting Rates	166
Table 61. Factors to be considered in assigning value to species (Roper-Lindsay et al., 2018).....	178
Table 62. Attributes to be considered when assigning ecological value or importance to a site or area of terrestrial vegetation / habitat / community (as per Table 4 of Roper-Lindsay et al. 2018).....	178
Table 63. Matters that may be considered when assigning ecological value to a freshwater site or area (as per Table 7 of Roper-Lindsay et al. 2018).....	180
Table 64. Assigning ecological value (Roper-Lindsay et al. 2018).	180
Table 65. Criteria matrix for describing magnitude of effects (Roper-Lindsay et al. 2018).	181
Table 66. Criteria matrix for describing level of effects (Roper-Lindsay et al. 2018).	181
Table 67. Vegetation identified within Wetland 1a.	190
Table 68. Vegetation identified within Wetland 1b.	190
Table 69. Vegetation identified within Wetland 1c.....	190
Table 70. Vegetation identified within Wetland 2a.	191
Table 71. Vegetation identified within Wetland 2b.	191
Table 72. Vegetation identified within Wetland 3.	192
Table 73. Vegetation identified within Wetland 6a.	192
Table 74. Vegetation identified within Wetland 6b	192
Table 75. Vegetation identified within Wetland 6c.....	193
Table 76. Vegetation identified within Wetland 6d	193
Table 77. Vegetation identified within Wetland 7a.	193
Table 78. Vegetation identified within Wetland 7b	194

Table 79. Vegetation identified within Wetland 8.	194
Table 80. Vegetation observed within Wetland 9.....	194
Table 81. RECCE plot locations.	201
Table 82. RECCE plot summary of data for Sutton pit.....	204
Table 83. Summary of seedling and sapling data within Sutton Pit.	205
Table 84. Summary of seedling and sapling data for enhancement vegetation outside the Sutton pit.	206
Table 85. Indigenous bird species identified during the desktop review.....	207
Table 86. Bird species incidentally recorded throughout the project area.....	208
Table 87: Summary of the five-minute bird counts carried out within and around the proposed Sutton block.	209
Table 88: Summary information about the five-minute bird count locations and the proportion of native vs introduced species found at each station and each vegetation type.....	210

List of Photos

Photo 1. WF9-1 lies in the steep head of a gully (02.12.2021).	45
Photo 2. WF9-1 lacks the understorey and groundcover tiers (02.12.2021).	46
Photo 3. WF9-2 lies in a narrow, steep-sided stream gully (18.01.2022).	47
Photo 4. WF9-3 showing complete lack of understorey and groundcover tiers (16.10.2024)	48
Photo 5. View of WF9-3 from the south with dead tree fern trunks and kānuka in the foreground.	48
Photo 6. Northwest edge of SEA_T_5323 with weedy edge (12.07.2024).	49
Photo 7. Northwest puriri trees with ground cover of short nikau and grasses (12.07.24).	49
Photo 8. Rock forest fragment on east-facing slope (18.01.2022).	52
Photo 9. Rock forest interior (18.01.2022).	52
Photo 10. Kānuka Forest with WF9-3 top right within SEA_T_5323 (17.01.2022).	55
Photo 11. Left: Kānuka forest interior (17.01.2022). Right: Kahikatea trees amongst pasture at the lower (western) end of the kānuka forest (17.01.2022).	56
Photo 12. Native ant (Pachycondyla spp.) emerging from its nest in a rotten log in SEA_T_1177.	62
Photo 13. Left: Copper skink (2021 survey).	63
Photo 14. ABM 2 on Puriri tree facing towards rock forest fragment (2020) survey.	70
Photo 15. Riparian vegetation throughout Stream 1.	82
Photo 16. Incised channel of Stream 1.	82
Photo 17. Narrow flow path of Stream 1b	83
Photo 18. Pugged banks of Stream 1b	83
Photo 19. Headwaters of Stream 2	84
Photo 20. Stream 2 upper, permanent reach	84
Photo 21. Lower reach of Stream 2 with fyke net	85
Photo 22. Lower reach of Stream 2.	85
Photo 23. Stream 2b upper	86
Photo 24. Stream 2b, silted channel.	86
Photo 25. Upper reach of Stream 3.	88
Photo 26. Stream 3 impacted by stock access.	88
Photo 27. Stream 3 was dominated by soft substrates.	88
Photo 28. Lower reach of Stream 3.	88
Photo 29. Upper reach of Stream 4.	90
Photo 30. Upper reach of Stream 4.	90
Photo 31. Pond present on the downstream end of Stream 4.	90
Photo 32. Stream 4 mid section - wide and deep.	90
Photo 33. Stream 4 mid section – shallow flow over hard substrates.	90
Photo 34. Stream 4 – poor shading.	90
Photo 35. Stream 4 downstream reach – boulders, lack of riparian cover.	91
Photo 36. Stream 4 downstream reach.	91
Photo 37. Pool in upper reach of Stream 5.	93
Photo 38. Waterfall present downstream in Stream 5.	93
Photo 39. Shade was inconsistent throughout Stream 5.	93
Photo 40. Stream 6 was located within a gully.	94
Photo 41. A waterfall in upper reach of Stream 6.	94
Photo 42. Stream 6 contained poor riparian vegetation.	95
Photo 43. Area of hard substrates in Stream 6.	95
Photo 44. Stream 7 was entirely soft bottom with stock impacts.	96

Photo 45. Riparian vegetation consisted of gorse and rank pasture.	96
Photo 46. Lower section of Stream 7	96
Photo 47. The lower section of Stream 7 predominantly contained exotic vegetation.	96
Photo 48. Upper reach of Stream 9.....	98
Photo 49. Riparian vegetation of Stream 9	98
Photo 50 and Photo 51. Representative vegetation within Wetland 1a.....	99
Photo 52 and Photo 53. Representative vegetation within Wetland 1b	101
Photo 54 & Photo 55. Representative vegetation within Wetland 1c	103
Photos 56 and Photo 57. Representative vegetation within Wetland 2a.	105
Photos 58 and Photo 59. Representative vegetation within Wetland 2b.	107
Photo 60 and Photo 61. Representative vegetation within Wetland 6a (left) and Wetland 6b (left)	110
Photo 62 and Photo 63. Constructed wetlands present at the upper areas of Wetland 6a and Wetland 6b.....	110
Photos 64. and Photo 65. Representative vegetation within Wetland 6c.	112
Photo 66 and Photo 67. Representative vegetation within Wetland 6d.	114
Photos 68 and Photo 69. representative vegetation within Wetland 7a.....	116
Photo 70 and Photo 71. representative vegetation within Wetland 7a	118
Photos 72 and Photo 73. representative vegetation within Wetland 8.....	119
Photo 74 and Photo 75. representative vegetation within Wetland 9	121
Photo 76. Longfin eel observed within Stream 4.	126
Photo 77. Koura were present within the upper reaches of Stream 1 and Stream 2.	126

List of Figures

Figure 1. Drury Quarry and Sutton Block Expansion Area	1
Figure 2. Stages 1-5 of the Sutton Block pit expansion.	3
Figure 3. Indicative location of stage 1 Sutton Block Expansion Area.....	4
Figure 4. Indicative location of stage 2 Sutton Block Expansion Area.....	5
Figure 5. Indicative location of stage 3 Sutton Block Expansion Area.....	6
Figure 6. Indicative location of stage 4 Sutton Block Expansion Area.....	7
Figure 7. Indicative location of stage 5 Sutton Block Expansion Area.....	8
Figure 8. AUP overlays: Significant Ecological Areas (SEA), Special Purpose Quarry Zone (SPQZ)	11
Figure 9. Terrestrial and freshwater features at Drury Quarry, proposed Sutton Block Pit extent.	15
Figure 10. RECCE plot locations. Inset map shows the locations of sites used as RECCE plots for ecosystem reference locations. Also see Table 5	21
Figure 11. Invertebrate quadrat survey coverage for the Sutton Block and surrounding potential habitats.	25
Figure 12. Lizard survey coverage for the Sutton Block and surrounding potential habitats in 2020 and 2021.	28
Figure 13. Locations of nocturnal lizard searches undertaken in 2020 and 2021.....	29
Figure 14. Wetland bird survey locations using call playbacks for spotless crane and fernbird, and ABM recorders for bittern.	31
Figure 15. Terrestrial five-minute bird count locations in 2023 across the Quarry.	32
Figure 16. ABM placement in 2020, 2021, and 2024	34
Figure 17. Locations of eDNA samples taken.	36
Figure 18. Flowchart depicting the process used for assessing areas of potential wetland. Figure from Ministry for the Environment 2021a.	40
Figure 19. Terrestrial vegetation types within the Sutton Block pit boundary (Stages 1-5).	43
Figure 20. Copper skink locations during AR inspections in 2020 and 2021.	65
Figure 21. Bat detections from within the wider landscape recorded in the Department of Conservation bat database (updated February 2024).	71
Figure 22. Freshwater ecological features within the Sutton Pit.	76
Figure 23. Streams within the Sutton Pit and immediate vicinity.....	77
Figure 24. Wetlands within the Sutton Pit and immediate vicinity.....	78
Figure 25. Stream assessment and test reach/locations. Note, wetland features not shown for clarity..	79
Figure 26. Wetland assessment and test plot/locations. Note, stream features not shown for clarity	80
Figure 27. Freshwater fish and large macroinvertebrate sampling sites.	125
Figure 28. Bat survey information within a 10 kilometre radius surrounding Drury Quarry (DOC bat database accessed February 2024).	134
Figure 28. RECCE plot locations within the SPQZ.	202

List of Appendices

- Appendix A: Ecological Impact Assessment methodology
- Appendix B: Terrestrial Plant Species Lists for Native Forest Fragments
- Appendix C: Weather data during the ABM monitoring period
- Appendix D. Wetland Plant Species Lists
- Appendix E: Wetland Determination Spreadsheet
- Appendix F: Freshwater Macroinvertebrate Data
- Appendix G: RECCE Plots and Results
- Appendix H: Bird records from the desktop review and site investigations

LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation/Acronym	Explanation
5MBC	Five-minute bird counts
ABM	Automatic bat monitors
AEE	Assessment of Environmental Effects
ARDS	Amphibian and Reptile Distribution Scheme
AR	Artificial Retreat
AUP	Auckland Unitary Plan
AUP OP	Auckland Unitary Plan Operative in Part
EclA	Ecological Impact Assessment
ED	Ecological District
EG	Exotic Grassland
EMP	Ecological Management Plan
EXP	Planted Exotic Forest
EXS	Exotic Scrubland
FFDB	NIWA's New Zealand Freshwater Fish Database
VS2	Kānuka scrub/forest
Ha	Hectares
MCI	Macroinvertebrate Community Index
MFE	Ministry for the Environment's
MF4	Kahikatea forest
NES-F	National Environmental Standards for Freshwater
NGDP:PP	Net Gain Delivery Plan: Planting Plan
NGDP:PWC	Net Gain Delivery Plan: Pest and Weed Control
NGDP:WP	Net Gain Delivery Plan: Wetland Planting
NGDP:RP	Net Gain Delivery Plan: Riparian Planting
NPS-FM	National Policy Statement for Freshwater Management
NPS-IB	National Policy Statement – Indigenous Biodiversity
NVS	National Vegetation Survey
NZPCN	New Zealand Plant Conservation Network Database
REAR-TE	Residual Effects Analysis Report: Terrestrial Ecology
REAR-SW	Residual Effects Analysis Report: Stream and Wetland Loss
RF	Rock forest
SEA	Significant Ecological Area
SEV	Stream Ecological Valuation
Spp	Species
SPQZ	Special Purpose Quarry Zone
SQMCI	Semi-Quantitative Macroinvertebrate Community Index
VES	Visual Encounter Surveys
VS2	Kānuka scrub/forest
VS5	Broadleaved species scrub/forest
WF7	Pūriri Forest
WF9	Taraire, tawa, podocarp forest
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest
ZOI	Zone of Influence

1 INTRODUCTION

1.1 Drury Quarry Expansion - Sutton Block

Drury Quarry is located in Drury, Auckland Region, and has been in operation for over 80 years. Drury Quarry is a greywacke hard rock quarry supplying concrete, asphalt and roading aggregate to the Auckland market. The existing Drury Quarry pit is located within the wider landholdings owned by SAL which encompasses an area of approximately 562ha. This landholding includes quarry activities, a clean fill, farmland and large swathes of native vegetation.

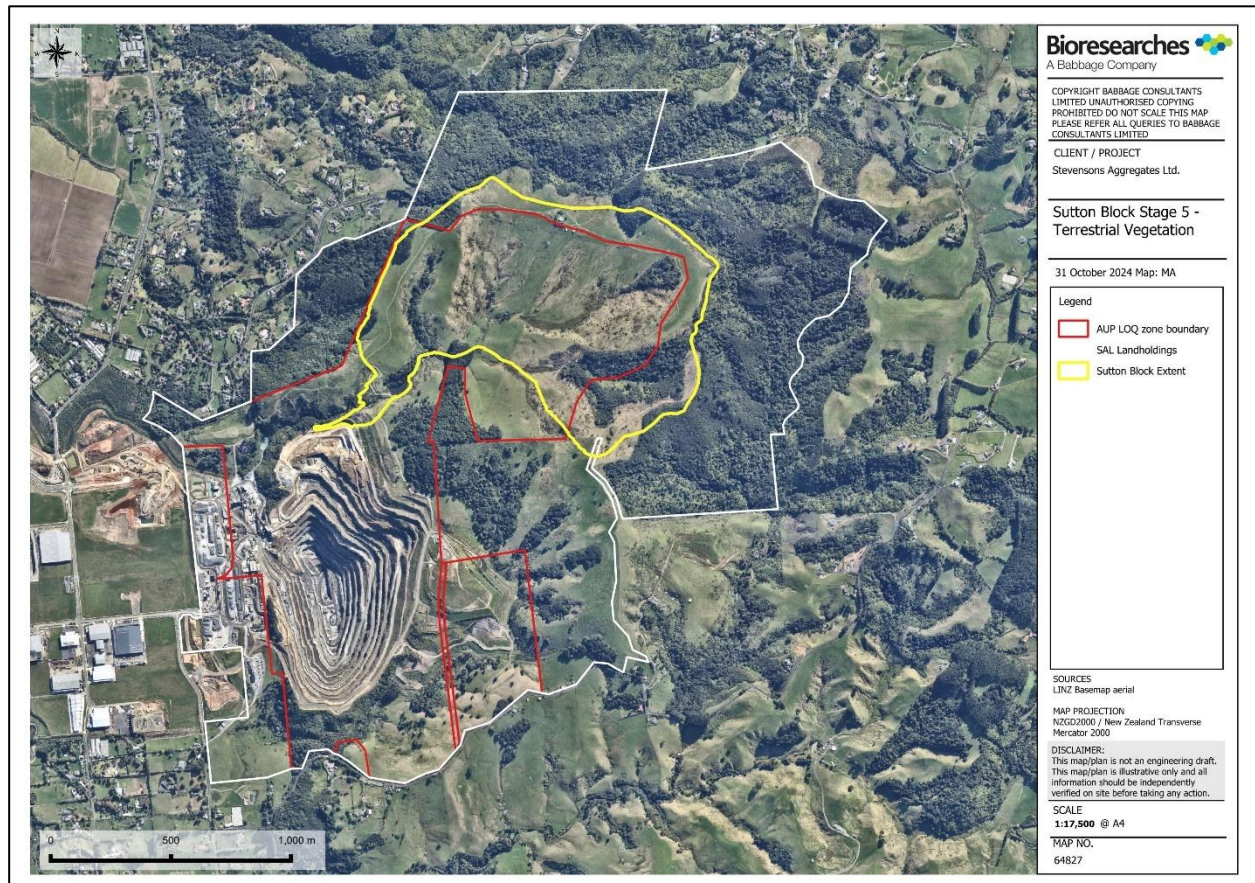


Figure 1. Drury Quarry and Sutton Block Expansion Area.

Based on current demand estimates, the existing pit will provide approximately 20 years of aggregate supply to Auckland. To continue to provide a local supply of aggregate resource SAL proposes to develop a new pit within the existing site, called the “Sutton Block”. The Sutton Block pit has been designed to provide approximately 240 Million Tonnes of additional aggregate to supply the market.

The Sutton Block is located to the northeast of the existing pit (see Figure 1). The development of the Sutton Block will involve the staged development of an area of approximately 108 ha to a maximum pit depth of approximately RL -60 m. The overall site layout, including staging plans, is shown on drawings SSQ_23_404, rev: 02 in Appendix C attached to the Assessment of Environmental Effects (AEE) report. The Sutton Block is designed to be a separate quarry pit although it will be serviced by the existing Drury Quarry ancillary site infrastructure and facilities. These include the Front of House (FOH) activities such as the weigh bridge, processing plant(s), storage bins and stockpile area, the lamella, staff facilities etc.

It is anticipated that as the existing Drury Quarry pit nears the end of its life and reduces aggregate extraction, the Sutton Block pit will increase its aggregate extraction. This will ensure a continuous aggregate supply to the market.

1.1.1 Proposed Sutton Block pit stages

To enable the development of the Sutton Block and support the extraction of aggregate, the proposal will also include the construction of road infrastructure to establish haul road access, overburden removal, stockpiles including bunding; and supporting infrastructure, and construction of a conveyor belt connecting the Sutton Block pit to the existing Drury Quarry FOH area. These areas have been assessed as they occur within the Sutton Block, which will be developed over five indicative stages as described below and as shown in Figure 2:

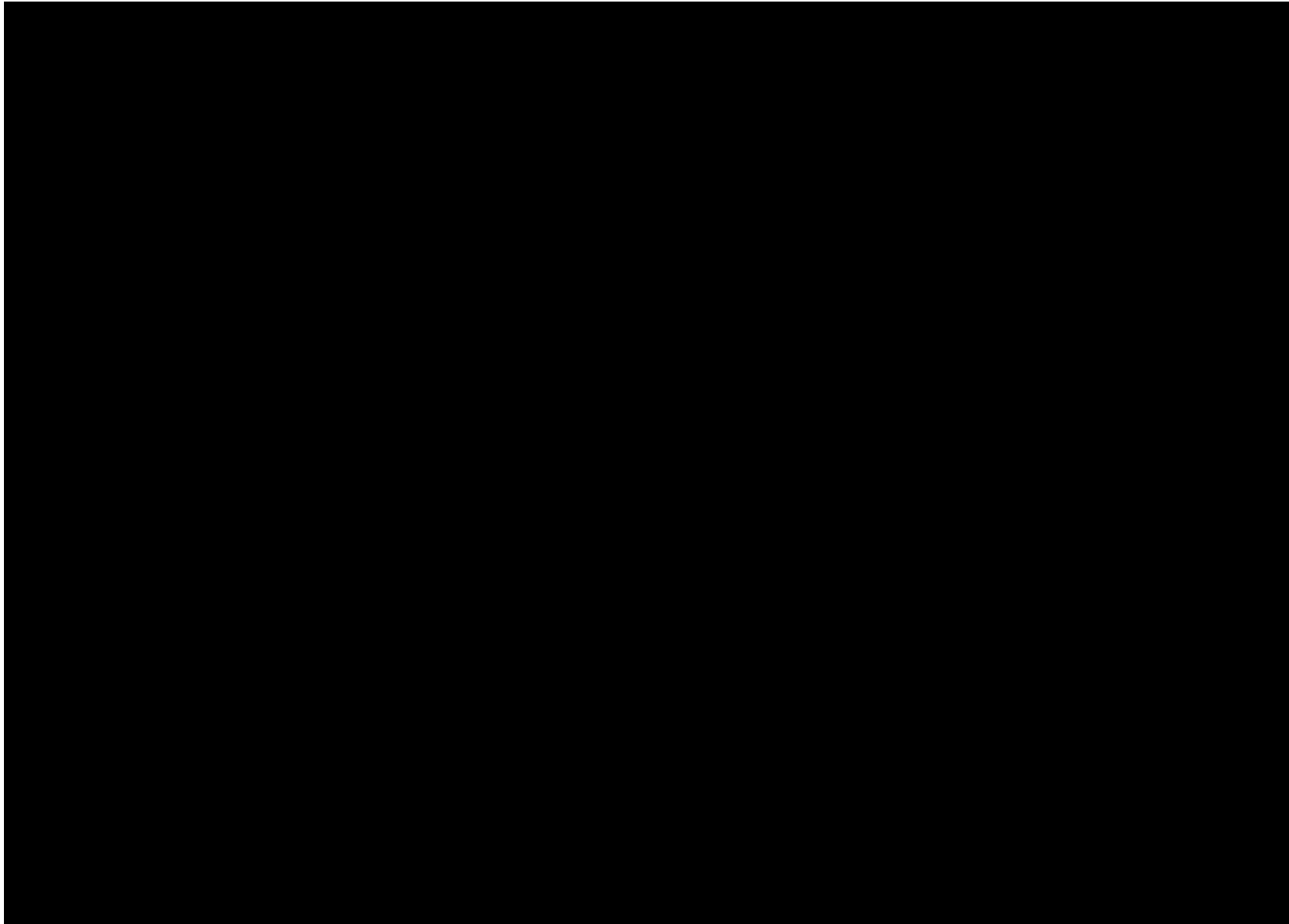


Figure 2. Stages 1-5 of the Sutton Block pit expansion.

Stage 1 – Infrastructure establishment (three-year plan)

The initial stage of work (Years 1 -3) involves the construction of the roading infrastructure required to access the site, draining of the existing farm dam to establish a sediment retention pond, associated stream diversion, initial offset planting, commencement of overburden removal, stockpiles (including bunding), and establishment of the conveyor system. Figure 3 below shows the indicative extent of Stage 1.



Figure 3. Indicative location of stage 1 Sutton Block Expansion Area.

Stage 2 -Operating Quarry (15- year plan)

The second stage of work is the 15- year plan which involves the commencement of quarrying within the interim pit boundary (refer to Figure 4 below). Whether the interim pit commences within the west or east of the pit boundary will be determined by market demand for blue or brown rock. Regardless, expansion of the pit will be incremental, deepening and widening as resource is extracted. Internal pit roads will be constructed as the pit expands. Offset planting and weed and pest control will continue.



Figure 4. Indicative location of stage 2 Sutton Block Expansion Area.

Stage 3 – Operating Quarry (30-year plan)

The third stage of works is further expansion of the interim pit boundary (refer to Figure 5 below). Like Stage 2, the direction of the expansion will depend on market demand. However, in indicative staging plan shows the expansion of the pit to the east. During this stage of the works, the expansion of the pit will be incremental, widening and deepening as resource is extracted. Internal pit roads will be constructed as the pit expands.

The works involved in Stage 3 will generally include the same activities as Stage 2.



Figure 5. Indicative location of stage 3 Sutton Block Expansion Area.

Stage 4– Operating Quarry (40-year plan)

The fourth stage of works is a further expansion of the interim pit boundary (refer to Figure 6 below). Like Stage 3, the direction of the expansion will depend on market demand. However, in indicative staging plan shows the expansion of the pit to the east. During this stage of the works, the expansion of the pit will be incremental, widening and deepening as resource is extracted. Internal pit roads will be constructed as the pit expands.

The works involved in Stage 4 will generally include the same activities as Stage 2 and 3.

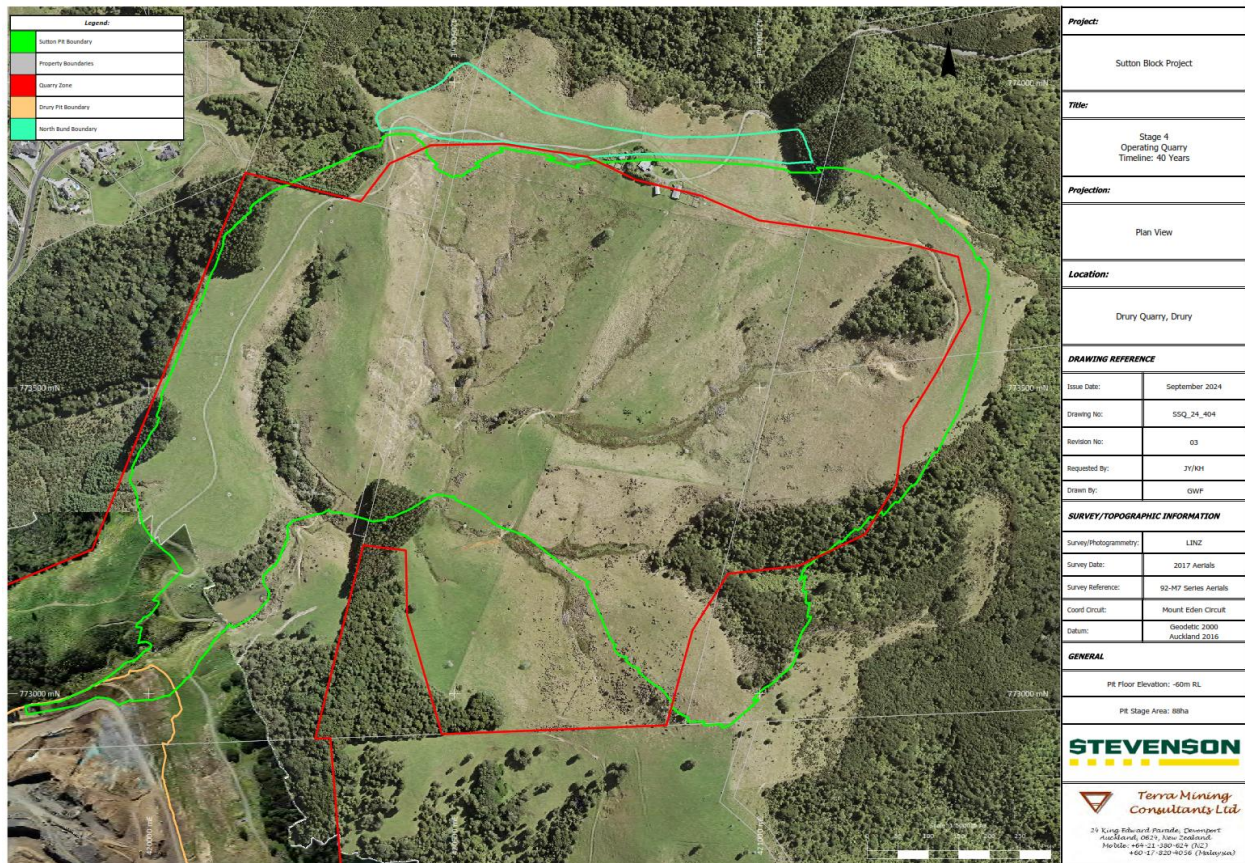


Figure 6. Indicative location of stage 4 Sutton Block Expansion Area.

Stage 5- Life of Quarry Plan (50-year plan)

The fifth stage reflects the full extent of the quarry pit over an approximate 50-year period (refer to Figure 7). As with Stage 4, expansion of the pit will be incremental, deepening and widening as resource is extracted. The indicative staging plans show the pit expanding to the north and east. During this stage, the temporary northern bund will be removed. Internal pit roads will be constructed as the pit expands.



Figure 7. Indicative location of stage 5 Sutton Block Expansion Area.

1.2 Purpose and Scope

The purpose of the report is to detail the methods, results and analysis of terrestrial and freshwater ecological values within the Sutton Block footprint and assess the expected and potential effects of the proposed construction and operation of the Sutton Block Pit on those values.

The values described in this report include terrestrial, wetland and freshwater ecology. The values were determined following desktop and database reviews, onsite assessments, and targeted surveys. The assessments and survey results reported herein were undertaken from 2020 to 2024, however previous ecological investigations of the surrounding Drury Quarry operational area (expansions of the existing pit and adjacent managed fill) have been undertaken by Bioresearches since 2000 (Bioresearches 2000, Bioresearches 2006, Bioresearches 2009, Bioresearches 2018) and are reviewed herein.

This report provides recommendations for measures to avoid, minimise and / or remedy identified adverse effects. Where residual effects are expected to be significant following the application of the effects-management hierarchy, recommendations are provided to offset or compensate for those effects.

This Ecological Impact Assessment (EcIA) report should be read alongside the AEE, which contains further details on the context of the project, and in conjunction with the terrestrial, wetland and freshwater management and offset plans.

1.3 Site Overview

The Site (i.e. the proposed Sutton Block quarry pit footprint; outline shown in Figure 1) lies within the southwestern part of the Hunua Ecological District (ED) and is largely within a Special Purpose Quarry Zone. There are four Significant Ecological Areas (SEA) within the immediately surrounding landscape of the SAL property (Table 2 and Figure 8), as identified in the Auckland Unitary Plan (AUP). These are identified as

- SEA_T_5346 (at the southern edge of the existing pit);
- SEA_T_5349 (near the north-eastern edge of the existing pit);
- SEA_T_5323 (surrounds the northern and eastern edges of the Sutton Block); and
- SEA_T_1177 (within the north-east corner of the Site).

Of these four SEAs, two are impacted by the proposed Sutton Block pit. SEA_T_1177 is 3.9 ha and lies entirely within the pit area (and within the SPQZ), requiring complete removal of this SEA. SEA_T_5323 is a larger SEA (619.77 ha), which extends into the site, with a predicted 13.87 ha (2.24%) to be removed. Approximately 3.68 ha of SEA_T_5323 to be removed is located within the SPQZ and the remaining 10.19 ha is located within the Mixed Rural Zone.

Table 2. Characteristics of the SEAs found within the SAL property and the total area affected by the proposed Sutton Block pit.

SNA number	Value*	Total Area (ha)	Area affected (ha)	Site
SEA_T_1177	2	3.9	3.9 (100%)	Within
SEA_T_5323	1,2,3,4	619.77	13.87 (2.24%)	Partially within
SEA_T_5346	1,2,3,4	18.53	0	Outside
SEA_T_5349	1,2,3	41.8	0	Outside

*Factors for assigning SEA value: 1 = Representativeness, 2 = Threat status and rarity, 3 = Diversity, 4 = Stepping-stones, migration pathways and buffers.

The site is a volcanic vent which forms a natural depression some 160m above sea level at its centre rising to 275m above sea level at the edges. Basalt boulders are scattered across many parts of the site and in the wider landscape along the Drury fault scarp.

Many other fragments of indigenous vegetation lie scattered across the hills to the north of the Site, particularly towards the Hunua Ranges which supports very high ecological values. The large SEA_T_5323 stretches east and north of Drury Quarry over the Drury Hills towards the Hunua Quarry and contains large areas of mature and regenerating native forest types.

There are nine watercourses or watercourse systems within the Site, with which fourteen, mainly exotic, pastoral wetlands are associated. None of these watercourses are formally named. Of the watercourses, three stream reaches are permanent streams and the remainder are intermittent. Two small upper tributary stock ponds are present, with one much larger artificial pond in the lower catchment, through which the main stream flows. The Sutton Block drains to the southwest, with the streams combining to form one stream which outflows from the Sutton Block site, down a significant waterfall to the large water storage pond for the current Drury Quarry operations. The water from the pond is then used for Quarry

operations or overflows into the straightened and modified stream system west of the quarry to eventually join the Hingaia Stream, which discharges into the Pahurehure Inlet of the Manukau Harbour.

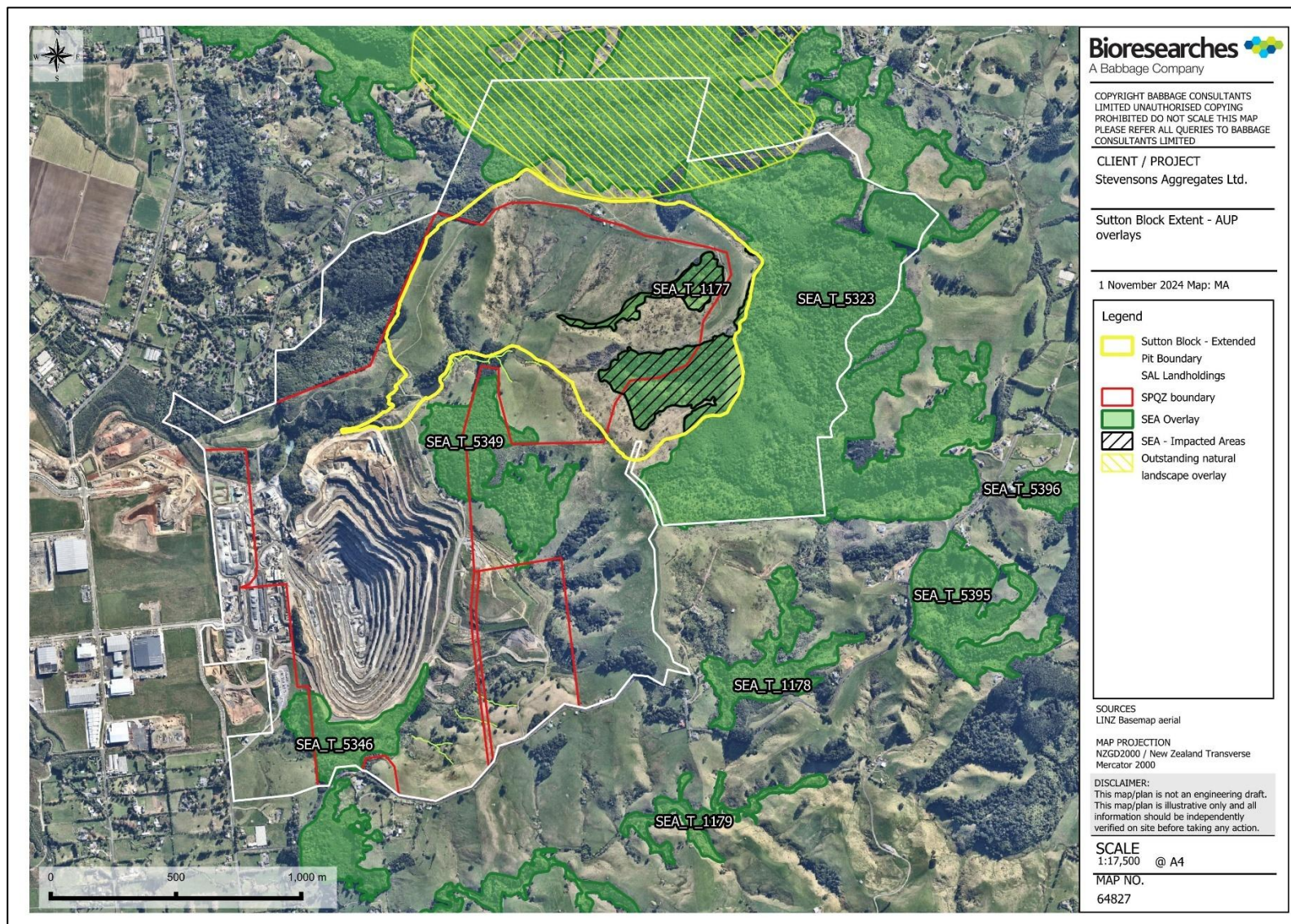


Figure 8. AUP overlays: Significant Ecological Areas (SEA), Special Purpose Quarry Zone (SPQZ)

1.4 Statutory Context

To help determine the level of assessment required for the Sutton Block Pit, we have considered the following statutory framework in guiding this assessment.

1.4.1 Auckland Unitary Plan

The proposed Sutton Block Pit largely sits within a Special Purpose Quarry Zone (SPQZ); however, parts of the expansion extend beyond this into Rural- Mixed Rural Zone. The SPQZ provides for significant mineral extraction activities in a way that ensures adverse effects are avoided, minimised and managed.

Chapters D9 and E15 of the Auckland Unitary Plan: Operative in Part (AUP) contain provisions specific to Drury Quarry with regard to SEAs within the SPQZ. Under Chapter D9.3 (8) the adverse effects from excavating minerals within the SPQZ on SEAs at Drury Quarry must be mitigated or offset. Under Chapter E15.8.2 (3) the adverse effects from excavating minerals within the SPQZ on SEAs at Drury Quarry must be mitigated or offset or provide for positive environmental benefits under the No Net Loss (NNL) principle. For any areas outside the SPQZ, provisions in the National Policy Statement on Indigenous Biodiversity (Clause 3.10) applies.

There are three SEA overlays within or adjacent to the Sutton Block Pit. These are SEA_T_1177, which sits entirely within the SPQZ and the proposed pit; SEA_T_5323, which covers indigenous vegetation predominantly around the eastern and northern parts of the surrounding environment, but which also comprises parts of the Sutton Block Pit, including where it occurs within the SPQZ and Rural zones; and SEA_T_5349, which sits to the south of the pit and is of very high ecological and cultural value. SEA_T_5349, known as Kaarearea Paa is not located within the Sutton Block Pit.

SEA_T_1177 has been scheduled as a SEA under Schedule 3: Factor 2b “Threat status and Rarity: Threatened species”, on the basis that longfin eel (*Anguilla dieffenbachia*) and koura (*Paranephrops planifrons*) have been recorded there in the past. Longfin eels are listed as ‘At Risk; declining’ (Dunn *et al.*, 2018), however koura are Not Threatened.

SEA_T_5323 is a large area of native vegetation (>650ha) that stretches east and north of Drury Quarry over the Drury Hills towards the Hunua Quarry. It has been scheduled as an SEA under factors 1, 2, 3, and 4 as containing representative vegetation types within the Hunua ED, nationally and regionally threatened species and ecosystem types, habitat diversity and buffering of a Protected Area.

1.4.2 National Policy Statement for Indigenous Biodiversity (NPS-IB, 2023)

The NPS-IB provides direction to councils to protect, maintain and restore indigenous biodiversity in the terrestrial environment, requiring at least no further reduction nationally. It is relevant to the proposal because the Sutton Block is within the terrestrial environment, and it contains indigenous biodiversity as defined in Section 1.6 (Interpretation) of the NPS-IB.

The NPSIB recognises tangata whenua as kaitiaki of, and partners, in the management of indigenous biodiversity (NPSIB, Policy 2). In particular, Kaarearea Paa, is a culturally and ecologically significant feature for local iwi within SAL Landholdings. Tangata Whenua and cultural values are further addressed in Section 1.4.6.

The indigenous biodiversity within the site includes that which is subject to a notified Significant Natural Area (SNA, or SEA as per the AUP, NPS-IB), some of which is located within the SPQZ, as well as indigenous biodiversity that is not subject to SNA.

The NPS-IB requires that indigenous biodiversity that is not protected by an SNA:

- a. Is managed by applying the effects management hierarchy (avoid, minimise, remedy, offset, compensate), where those effects are significant.
- b. Is managed to give effect to its Objective and Policies, where those effects are not significant (Section 3.16 (2)).

The NPS-IB requires that adverse effects on indigenous biodiversity within an SNA be avoided, except where provided for aggregate extraction (3.11 (1) (a) (iii)) that provides significant national or regional public benefit that cannot be otherwise achieved using resources within New Zealand. The Sutton Block pit has been designed to provide approximately 240 million Tonnes of additional aggregate to supply the future needs of the Auckland Region. In addition, (3.11 (1) (b) (iii)) provides for if “there is a functional need or operational need for the new subdivision, use or development to be in that particular location”, which applies as the aggregate extraction can only occur where it is in situ.

Clauses 3.10(3) and (4) apply where there an exception to Clause 3.10 (2) is demonstrated under Clause 3.11 (1) (a) (iii). These require that the following are demonstrated:

- (a) how each step of the effects management hierarchy will be applied; and
- (b) if biodiversity offsetting or biodiversity compensation is applied, that principles 1 to 6 in Appendix 3 and 4 have been complied with and regard has been had to the remaining principles in Appendix 3 and 4, as appropriate.

1.4.3 National Policy Statement for Freshwater Management (NPS-FM, 2020)

The National Policy Statement for Freshwater Management 2020 (NPS-FM) provides direction under the RMA, to local authorities on managing activities that affect the health of freshwater, and provides protections to freshwater bodies, including natural inland wetlands, includes provisions for monitoring and reporting on freshwater quality and quantity, and for addressing the impacts of land use activities on freshwater resources.

1.4.4 National Environmental Standards for Freshwater (NES-F, 2020)

The National Environmental Standards for Freshwater 2020 (NES-F) set requirements for carrying out certain activities that pose risks to freshwater and freshwater ecosystems.

Reclamation of rivers is a Discretionary Activity, provided that a functional need for the reclamation in that location; and the effects management hierarchy is applied. Quarrying activities have a specific status under the NES-F regulations relating to natural inland wetlands, and any works proposed within, or within 100 m of a natural inland wetland are required to be assessed as to whether they trigger the requirements to obtain resource consent to ensure that potential impacts to the wetlands are managed.

1.4.5 Wildlife Act (1953)

The Wildlife Act (1953) provides legal protection to listed species classed as wildlife. It controls how people interact with Wildlife, including all native birds, bats, frogs and lizards and some invertebrates. Note is does not cover plants or freshwater fish.

1.4.6 Tangata Whenua as Partners

SAL have actively sought consultation with and maintained relationships with mana whenua. Five iwi have been engaged in consultation with Stevenson Aggregates over the past two years and Cultural Impact Assessments are expected from these iwi. Key outcomes from this partnership include the redesign of the Sutton Pit extent to exclude further areas around Kaarearea Paa from the quarry pit. The result of the redesign is that a wider set back of the proposed pit from Kaarearea Paa (around 200-250 m) will provide a larger buffer area between the Pā and the quarry activities, including preserving 610 m of natural stream length and 5,241 m² of natural inland wetland extent. For the quarry this has resulted in a reduction in pit depth and a consequent reduction in accessible rock resource.

Further feedback from Ngāti Te Ata and Ngāti Tamaoho iwi was a wish to see the additional buffer areas around the Pā replanted in native vegetation, and this has been incorporated into the Project design, particularly offset planting. Other matters arising out of iwi consultation include the salvage of forest resources such as timber for carving (whakairo), eco-sourcing seed from the Sutton Pit site to produce plants for restoration planting and opportunities to partner with iwi groups on weed and pest control.

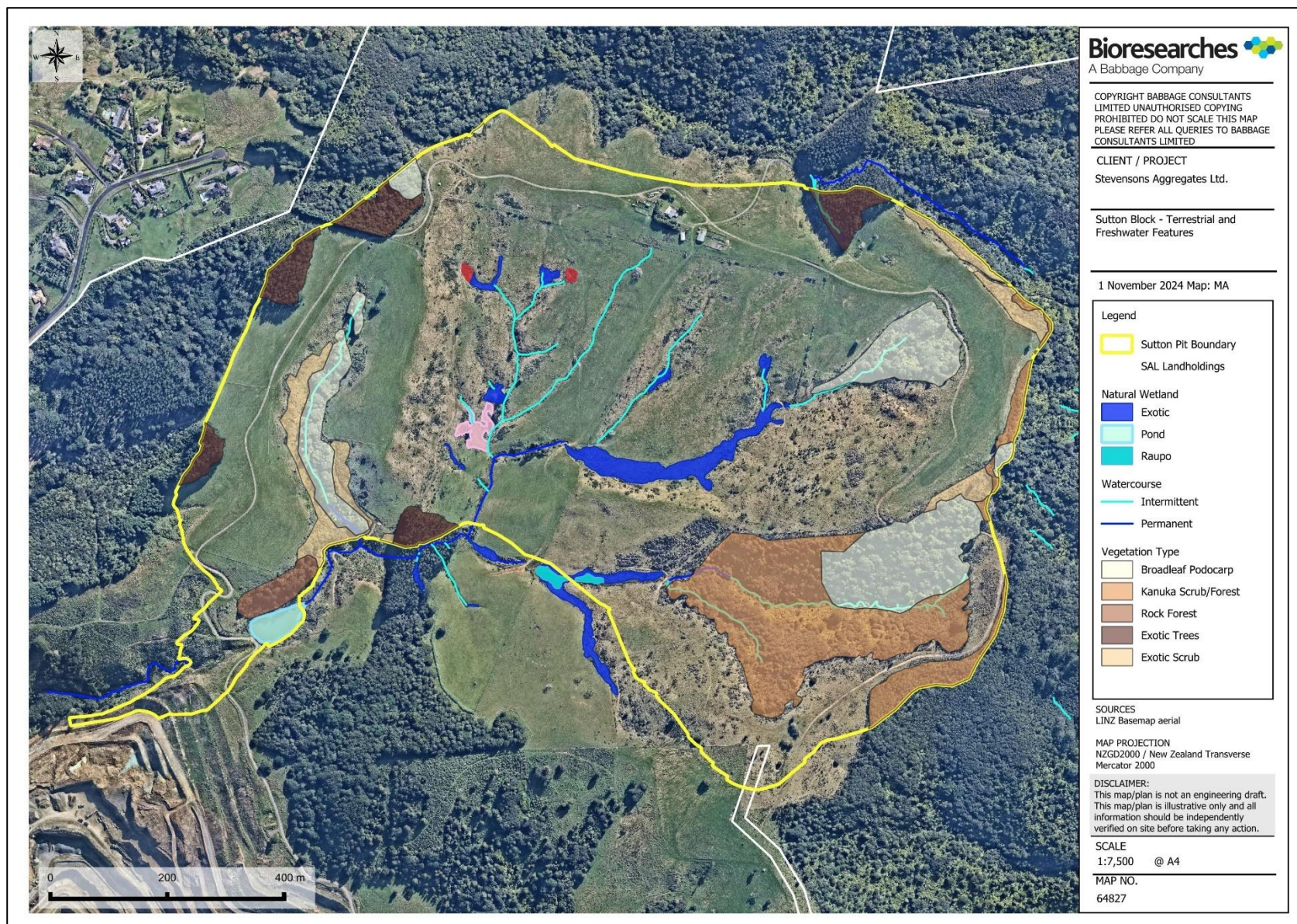


Figure 9. Terrestrial and freshwater features at Drury Quarry, proposed Sutton Block Pit extent.

2 METHODS

2.1 Assessment Standard

This assessment generally follows Ecological Impact Assessment Guidelines (EclAG) for use in New Zealand, published by EIANZ (Roper-Lindsay *et al.* 2018). The EclAGs provide a standardised matrix framework that allows ecological effects assessments to be clear, transparent and consistent. This framework is generally used in ecological impact assessments in New Zealand as good practice.

The EclAGs provide a three-step process for undertaking terrestrial and freshwater assessments as follows:

Step 1: Assess the **value** of the area, taking into consideration species and other attributes of importance for vegetation or habitats to assign an overall ecological value. Ecological values have been assigned (Very High, High, Moderate, Low, Negligible) for this assessment based on the following four criteria:

- a) Representativeness
- b) Rarity / Distinctiveness
- c) Diversity / Pattern
- d) Ecological Context

Step 2: Determine the **magnitude** of effect. This step also includes consideration of the timescale and permanence of the effect, whereby temporary (< 25 years) and long-term (substantial improvement after 25 years) effects are distinguished from permanent (beyond the span of a human generation) effects.

Step 3: Evaluate the overall severity or **level of effect** using a matrix of the ecological value and magnitude of effect (Table 3).

A more detailed analysis of this methodology is presented in Appendix B.

That analysis then leads to the development of an effects management programme that is appropriate in quality and scale to address the level of expected adverse ecological effect. After application of the effects management hierarchy and implementation of the effects management programme, the significant residual ecological effects must be offset or compensated (in accordance with the effects management hierarchy, NPSIB), such that it demonstrates a net biodiversity gain.

Plant species of interest included all those potentially present with a national conservation rating as per de Lange *et al.* (2018), as well as species of regional conservation significance (Simpkins *et al.* 2022). This assessment refers to ecosystem types identified for the Auckland Region (Singers *et al.* 2017) and Holdaway *et al.* (2012).

Fauna considered in this report includes terrestrial invertebrates as well as all those that are protected by the Wildlife Act 1953 including, lizards, birds and long-tailed bats; and native fish, which are not legally protected. Particular consideration is given where species with a conservation status of nationally 'At Risk' or higher have the potential to be present.

Table 3. Criteria matrix for describing level of effects (Roper-Lyndsay *et al.* 2018).

Ecological Value → Magnitude ↓	Very High	High	Moderate	Low	Negligible
Very High	<i>Very High</i>	<i>Very High</i>	<i>High</i>	<i>Moderate</i>	Low
High	<i>Very High</i>	<i>Very High</i>	<i>Moderate</i>	Low	Very Low
Moderate	<i>High</i>	<i>High</i>	<i>Moderate</i>	Low	Very Low
Low	<i>Moderate</i>	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

2.2 Zone of Influence

The zone of influence (**ZOI**) relates to an area occupied by habitats and species that are within or adjacent to the boundary of the Project area, and therefore may be affected by the proposal. It is defined in the EIANZ Guidelines as “the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities”.

The distance of the ZOI and type of effect can be different for different species and habitat types (e.g. sedentary vs. mobile species). For example, we applied a 10 km ZOI for highly mobile long-tailed bats (e.g. Figure 21). This is to ensure that important habitat within the wider landscape has been taken into consideration and can be used to inform the potential for flora and fauna to be present within each of the Project areas and also whether the Project ZOI extends out to these SEAs. Mobile species such as birds and long-tailed bats have large home ranges across more diverse habitats compared to lizards and threatened plant species which may be restricted to a small area or specific habitat type. This affects how a species could be impacted by the Project and this was taken into consideration during the desktop review and site investigations. To reflect the likelihood of a species occurring or its potential dispersal ability into each of the Project areas, varying search distances were used depending on the species context.

2.3 Desktop and Scoping – Terrestrial and Freshwater Ecology

A desktop review of up-to-date aerial imagery was undertaken to determine potential locations and extents of protected vegetation (riparian margins, SEAs), wetlands, overland flow paths, and to facilitate planning of targeted surveys. The Auckland Council’s Geomaps (AUP viewer) was reviewed to determine extents of Plan Zones, Overlays, Overland Flow Paths, and Biodiversity.

Desktop investigations also involved a review of relevant fauna databases, including:

- Department of Conservation's *Amphibian and Reptile Distribution Scheme* (ARDS) database (accessed September 2023);
- iNaturalist² (accessed September 2023, and within an approximate buffer of 5 km from the Sutton Block);
- New Zealand Bird Atlas eBird³ website, accessed September 2023, using Grid Square AE69 which is positioned over the site; and
- NIWA's New Zealand Freshwater Fish Database (FFDB); for fish records within the wider stream catchment

Literature which was reviewed included:

- Previous ecological assessments of the Sutton Block and the surrounding environment (including Bioresearches 2000, 2006, 2009, 2018; JS Ecology & Bioresearches 2021, Envoco, monthly reports);
- Auckland Council Geomaps⁴;
- Department of Conservation Threat Classification Series⁵;
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers *et al.*, 2017);
- Tāmaki Makaurau / Auckland Regional conservation status reports for vascular plants (Simpkins *et al.*, 2022), bats (Woolly *et al.*, 2023) and herpetofauna (Melzer *et al.*, 2022);
- Hunua Ecological District survey report for the Protected Natural Areas Programme (Tyrell *et al.*, 1999);
- Status assessment of New Zealand's naturally uncommon ecosystems (Holdaway *et al.*, 2012);
- Landcare Research S-map database online⁶; (Accessed October 2023); and
- New Zealand Plant Conservation Network Database (NZPCN).⁷

2.4 Site Investigations - Terrestrial Ecology

2.4.1 Vegetation and Flora

2.4.1.1 Survey and mapping

Survey of terrestrial vegetation was undertaken in October 2020. Further surveys were undertaken in July 2024 to characterise the vegetation within Stage 5 of the proposed pit extent. Areas of indigenous and exotic vegetation within the Sutton Block pit were traversed and their ecological features described using standard non-plot methods. The extent of each area was mapped using vantage points and binoculars where possible and a handheld GPS unit (Garmin Montana 650T). Vegetation mapping was further informed by reference to aerial imagery found on Auckland Council Geomaps and Google Earth. Individual mature native trees standing in paddocks with no understorey tiers were captured through measurement of the dbh (diameter at breast height, cm) of the trees and triangulation of heights to provide measurements of tree biomass.

² <https://www.inaturalist.org/>

³ <https://ebird.org/newzealand/home>

⁴ <https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html>

⁵ All Department of Conservation Threat Classification Documents are listed in the below webpage. When individual reports are referenced hereafter, they are referenced in-text and in Section 12 <https://www.doc.govt.nz/aboutus/science-publications/conservation-publications/nz-threat-classification-system/>

⁶ <http://www.landcareresearch.co.nz/resources/data/s-maponline>

⁷ <https://www.nzpcn.org.nz/>

Targeted searches for smaller species and threatened species were undertaken within areas of suitable habitat and the epiphyte community was examined using binoculars. All indigenous vascular plant species encountered were recorded.

2.4.1.1.1 Recce Plots

Detailed numerical data on the biodiversity values of indigenous vegetation within the proposed Sutton Block pit extent was obtained in December 2021 and January 2022 using a series of four standard 20m x 20m Recce plots. These were undertaken within representative native vegetation types across the site using standard methods described by Hurst & Allen (2007). The GPS location of each plot was recorded, and photographs taken at each corner. Further Recce plots were undertaken in October 2024 to characterise the additional vegetation within Stage 5 of the proposed pit (Figure 10 Recce plot 6).and additional seedling sapling data was collected from all previous plots. One reference plot was established in SEA_T_5349 amongst rock forest that has been deer-fenced for 13 years at Kaarearea Paa that has been deer-fenced for 13 years (Figure 10, RECCE plot 5). Two further reference plots were established in Kānuka forest within the Hunua Ranges and within Taraire forest at Kirk's Bush, Papakura. See Table 4 full list of RECCE plots and further information about each one.

The following key measurements were made:

- Average top height;
- Ground cover per cent composition;
- Percent cover by cover class within standard RECCE tier heights 1 - 6, including canopy, subcanopy, understorey, groundcover;
- Species present and their per cent cover by cover class in each tier;
- Basal area of all trees >10 cm dbh⁸; and
- Seedling and sapling regeneration of key canopy species.

These plots provided information on vegetation structure, tree density and biomass, species diversity and natural regeneration.

Table 4. *List of RECCE plots undertaken and key information. Also see Figure 10 for RECCE plot locations.*

Plot ID	Plot Type	Year	Ecosystem Type
1	Impact	2021	WF9
2	Impact	2021	VS2
3	Impact	2021	WF9
4	Impact	2021	RF
5	Ref	2024	RF
6	Reference	2021	WF9
7	Offset	2024	WF9
8	Offset	2024	RF
9	Offset	2024	VS2
10	Offset	2024	WF9
11	Reference	2024	WF9

⁸ Diameter at breast height (1.35m above ground level)

12	Reference	2024	VS2
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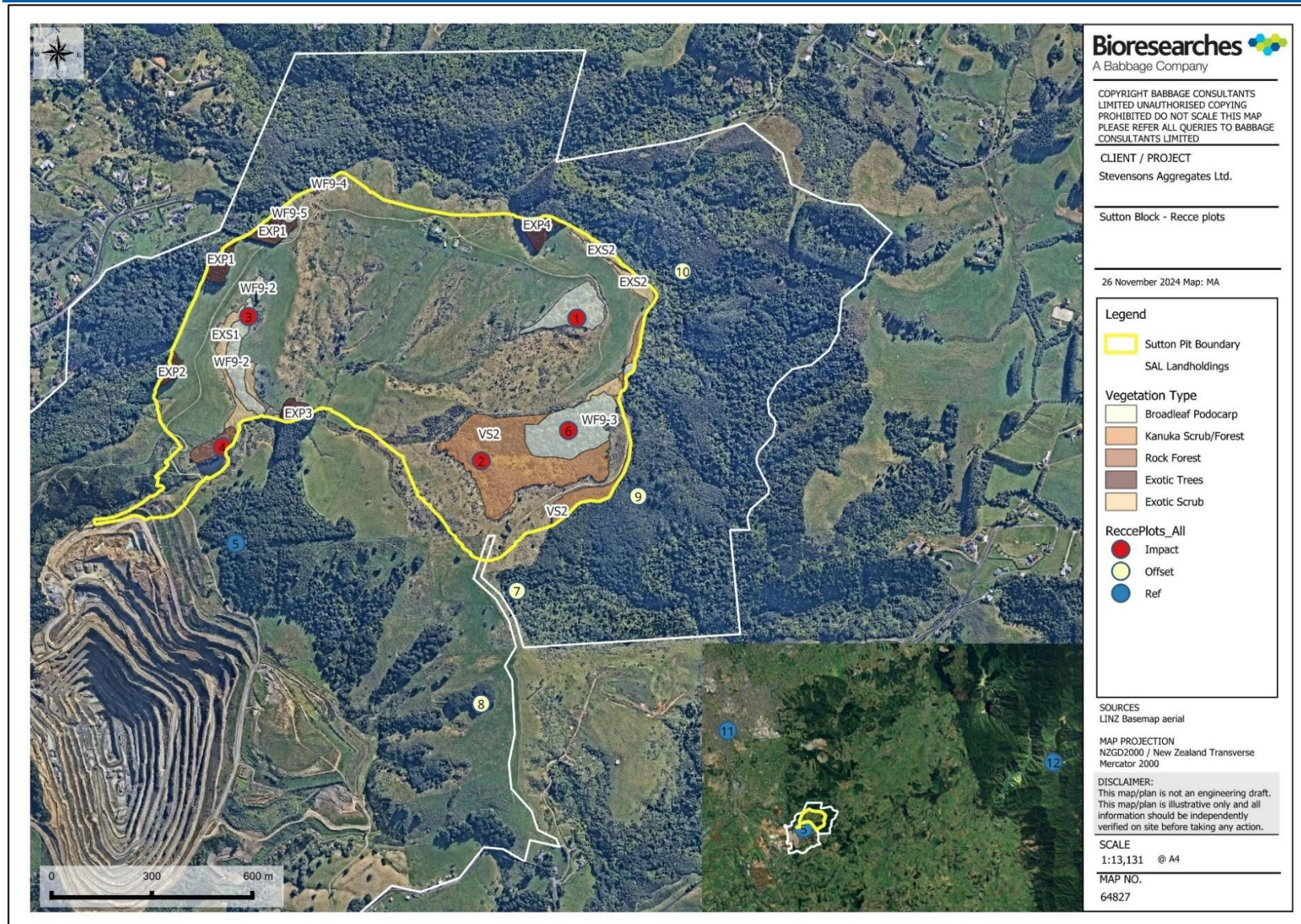


Figure 10. RECCE plot locations. Inset map shows the locations of sites used as RECCE plots for ecosystem reference locations. Also see Table 4

2.4.1.1.2 Representative Sampling and Plot selection

The sampling coverage and representativeness was designed to be consistent with the Recce approach. The individual areas of vegetation to be sampled within the Sutton Block Pit area were very small (0.67ha – 5.36ha), and included three different forest types (rock forest, podocarp broadleaved forest and Kānuka scrub/forest). With reference to Hurst & Allen (2007) it was determined that the most appropriate way to sample the vegetation was to place at least one plot within each of the different vegetation fragments, ensuring all forest types were sampled. The exception to this approach was BPL3 which was determined from prior qualitative assessment to be essentially the same type of forest as BLP1. Sampling this very small area (0.68ha) separately would not have added significantly to the overall data for the site. The size and shape of the fragments were such that it was not practical to systematically sample using a grid approach. Plots were as follows (Figure 10):

- Rock forest (RF01)
- Kānuka scrub/forest (VS2)
- Eastern Taraire, tawa podocarp forest (WF9-01)
- Western Taraire, tawa podocarp gully forest (WF9-02)

Each plot was placed in what was considered to be a representative area of the vegetation, excluding edges. The kānuka scrub/forest contains areas of tree fern and although these were not separately sampled the chosen plot did contain elements of this.

Since each 20 X 20m Recce plot samples 400m² of habitat (4% per hectare), the number of plots chosen was considered to adequately represent the vegetation characteristics of each forest type with a good degree of accuracy according to the Recce method. Sample coverage was as follows:

- Rock forest (0.65ha) 6% sampled
- Taraire, tawa podocarp forest (7.34ha) 1.1% sampled
- Kānuka scrub /forest (8.78ha) 0.4% sampled.

2.4.1.1.3 Threatened and At Risk plants and habitats.

Nationally and regionally threatened plants were surveyed through opportunistic and targeted searches within areas of suitable habitat (de Lange *et al.*, 2017; Simpkins *et al.*, 2022). Species of interest that may be potentially present were identified from national and regional lists of threatened or at-risk plant species and the plant habitats present at Drury Quarry.

Note: Due to the (2017) introduction of the fungal pathogen myrtle rust (*Austropuccinia psidii*) to New Zealand, all myrtaceous species have been assigned elevated threat classifications as a precautionary measure. The disease is now widespread in New Zealand, however its long-term effects on common native myrtaceous species of mānuka, kānuka and all species of the rata family (*Metrosideros* spp.) is not fully known as yet. Early results indicate that mānuka and kānuka are not as susceptible to myrtle rust infections as other New Zealand Myrtaceae species (Toome-Heller *et al.*, 2020); and these species may not be fatally affected by myrtle rust (Sutherland *et al.*, 2020).

Due to their widespread distribution and abundance within diverse landscapes and ecosystems, the threat status of these mānuka and kānuka is considered to be a precautionary measure for the purposes of this

assessment of effects, and therefore they are not considered within the assessment of threatened and At Risk plants. However, two myrtaceous species found in the Auckland Region (carmine rata and swamp maire) have a regional threat status that is due to factors other than myrtle rust, and these are considered to be threatened species.

Threatened terrestrial ecosystems, uncommon habitats or plant community types were documented and described (Singers *et al.*, 2017; Holdaway *et al.*, 2012). Naturally uncommon ecosystems in New Zealand are terrestrial ecosystems that were rare before humans colonised New Zealand. They are defined as those having a total extent of less than 0.5% (i.e. < 134 000 ha) of New Zealand's total area (268 680 km²). They often have highly specialised and diverse assemblages of flora and fauna, characterised by endemic and rare species.

Threatened indigenous vegetation types (Singers *et al.*, 2017, Holdaway *et al.*, 2012) that were potentially present were identified from Auckland Council Geomaps biodiversity layers including:

- Taraire, tawa, podocarp forest (WF9);
- Kahikatea forest (MF4);
- Pūriri Forest (WF7);
- Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13); and
- Rock forest on volcanic boulderfield.

2.4.2 Terrestrial Fauna

Fauna surveys included targeted search and survey for invertebrates, lizards (skinks and geckos), avifauna (terrestrial and wetland species) and long-tailed bats. These methods are detailed below.

2.4.2.1 Invertebrates

Most native invertebrates are not directly protected under the Wildlife Act 1953. Protected invertebrates are listed in Schedule 7 of the Act, and include various species, such as the kauri snail (*Paryphanta busbyi*), and Wētāpunga (*Deinacrida heteracantha*). While both of these species occur in the Auckland Region, they have restricted distributions that do not extend to south of Auckland city (Are not within the Sutton Block).

Other invertebrate species that are not listed as protected, but may be considered rare or distinctive, include the rhytid snail (*Amborhytida dunni*), a medium sized carnivorous land snail is classified as Nationally At-Risk (Mahlfeld *et al.*, 2012). The peripatus (Phylum: Onychophora) is also widely regarded as important from an evolutionary perspective, with characteristics of both worms and arthropods. Two described (Not Threatened, Trewick *et al.*, 2018) species are currently known to overlap through the Auckland Region (*Peripatoides aurorbis* and *P. sympatrica*). While neither of these are listed as 'At Risk or 'Threatened', they are poorly understood and their taxonomy and conservation status may reveal higher value, cryptic species (Department of Conservation, 2014).

Rhytid snails and peripatus require cool, moist areas of leaf litter in native forest and scrub. They can be found in deep leaf litter and in association with rotten logs and fallen nikau fronds.

Habitat searches

Habitat searches were undertaken within the Sutton Block and surrounding environment where suitable potential habitat was present (Figure 11). Habitat searches involved opportunistically lifting rocks, logs and other ground covers (e.g., nīkau fronds), as well as dedicated quadrat searches (below).

Quadrat searches

Systematic searches of the forest floor were undertaken within 1 m² quadrats where ground cover was available to be searched (Table 5, Figure 11). Quadrat searches targeted forest floor with ground cover that supported deep leaf litter and / or log fall, under which rare or distinctive invertebrates could be encountered.

Quadrat searches involved systematically removing all leaf litter and any other small ground cover (e.g. small rocks) from within the quadrat, so that invertebrates or other fauna could be identified.

Searchers wore a headlamp during all targeted and opportunistic habitat searches so that all search areas were fully illuminated.

A total of 28 quadrat searches were undertaken across three of the investigation areas (see for quadrat search locations in Figure 11). Some forested areas (e.g. BLP01, RF01, BLP02) were not searched with quadrats due to insufficient ground cover (often bare ground), but other habitat searches of logs, under rocks, were undertaken in absence of quadrats. Quadrat searches beyond the final proposed pit are retained in this assessment because they provide useful information about the values in areas that generally support more ground cover habitat.

Table 5. *Number of quadrat searches per Investigation Area.*

Area	Invertebrate quadrats
T_5346 South of Quarry Pit*	10
T_5349 Kaarearea Paa*	10
T_5323 Sutton Block	8

*Not within Sutton Block.

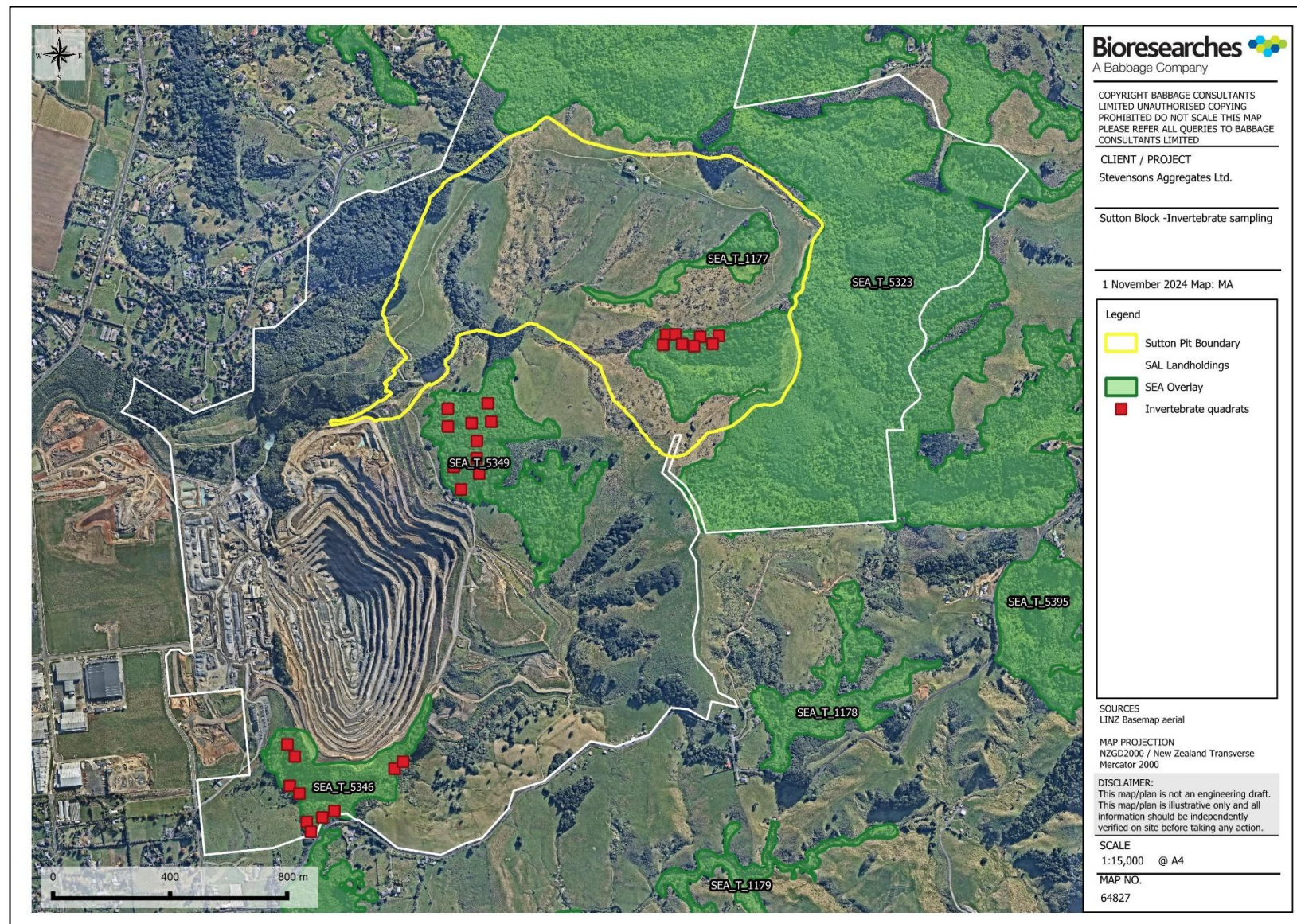


Figure 11. Invertebrate quadrat survey coverage for the Sutton Block and surrounding potential habitats.

2.4.2.2 Lizards

2.4.2.2.1 Habitat Survey

Desktop investigations to inform the habitat survey involved a review of the Department of Conservation's Amphibian and Reptile Distribution Scheme (ARDS) database (accessed September 2020), as well as an analysis of aerial and topographic imagery for the presence of tracks and vegetation cover to plan survey design and spatial coverage. The survey aspect of this assessment was completed by Chris Wedding acting under Wildlife Act Authority 37604-FAU. Surveys were undertaken in the summer of 2020 and 2021.

All vegetated areas or potential habitat features, such as boulder fields or rock outcrops that were identified as potentially supporting habitat for indigenous lizards were visited to undertake a qualitative habitat description. Where potential habitats supported logs or other debris that could be lifted, searches of these habitats were undertaken, and survey equipment (artificial lizard retreats (AR)) was installed.

Systematic searches were undertaken through potential habitats and this included inspection of rock crevices with headlamps. Potential habitat for arboreal geckos was also searched at night by way of nocturnal Visual Encounter Surveys (VES).

The survey coverage extended beyond the footprint of the Sutton Block in some areas as a result of refinements to the pit design and where opportunities to better understand lizard values in the surrounding landscape allowed. The survey methods are detailed below (see Figure 12, Figure 13 and Table 6 for lizard survey coverage and effort).

2.4.2.2.2 Artificial Retreat (AR) Surveys

Two separate AR surveys (2021, 2022, Table 6) were undertaken in accordance with the Department of Conservation best practice (Lettink, 2012). ARs are suitable for surveying skinks and geckos that use ground-based habitats, particularly vegetated edges with sunlight exposure, where ARs can retain heat and enable lizards that use them to maintain elevated body temperatures relative to their surrounding habitats during use (Batson *et al.*, 2015).

The locations where ARs were installed were considered to represent the most likely places for native lizard encounters. These areas supported dense leaf litter and dense edge vegetation. ARs were left in situ to acclimatise for a minimum four weeks to allow time for resident lizards to habituate to and use them. A minimum of four inspections were undertaken for all AR locations (Figure 12) between October and May during fine, settled weather.

2.4.2.2.3 Nocturnal Visual Encounter Surveys (VES)

Powerful headlamps, (LED Lenser™ H7), aided by Nikon Monarch™ 8 x 42 binoculars, were used to search for geckos on the ground, on tree branches and in foliage. Arboreal geckos are generally easier to detect at night by slowly scanning potential habitat with a focused light beam, while searching for the lizards' distinctive body shapes and reflective eye-shine (Whitaker, 1994). Searches began after dusk, during settled and dry weather and targeted the edges of vegetation (Figure 13).

Table 6. Survey effort for lizards over 2020 and 2021 (refer Figure 12 and Figure 13 for locations).

Survey year	AR stations	AR inspections	VES effort (person Search hours)
2020	32	128	44
2021	22	88	40
Total	54	216	84

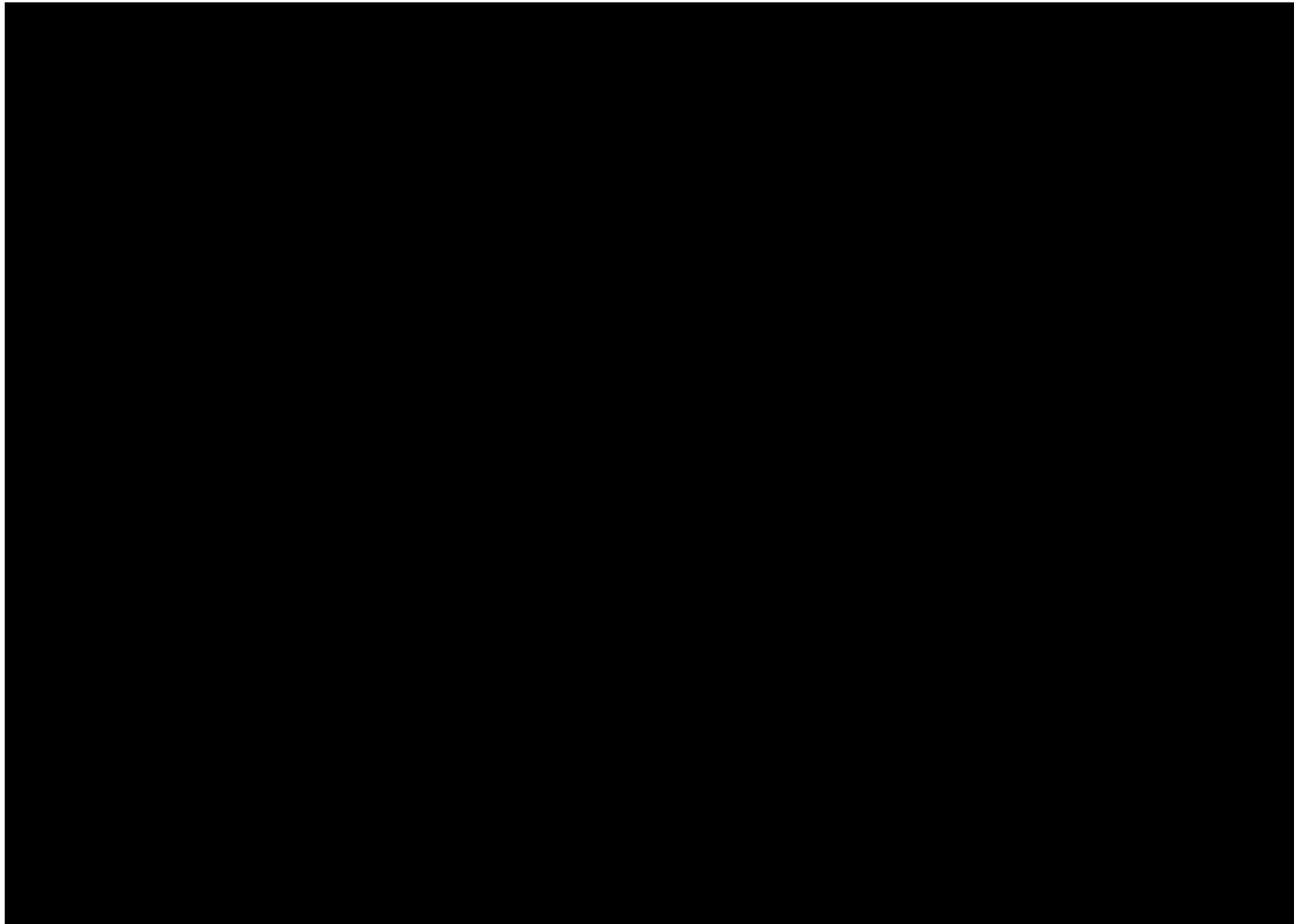


Figure 12. Lizard survey coverage for the Sutton Block and surrounding potential habitats in 2020 and 2021.

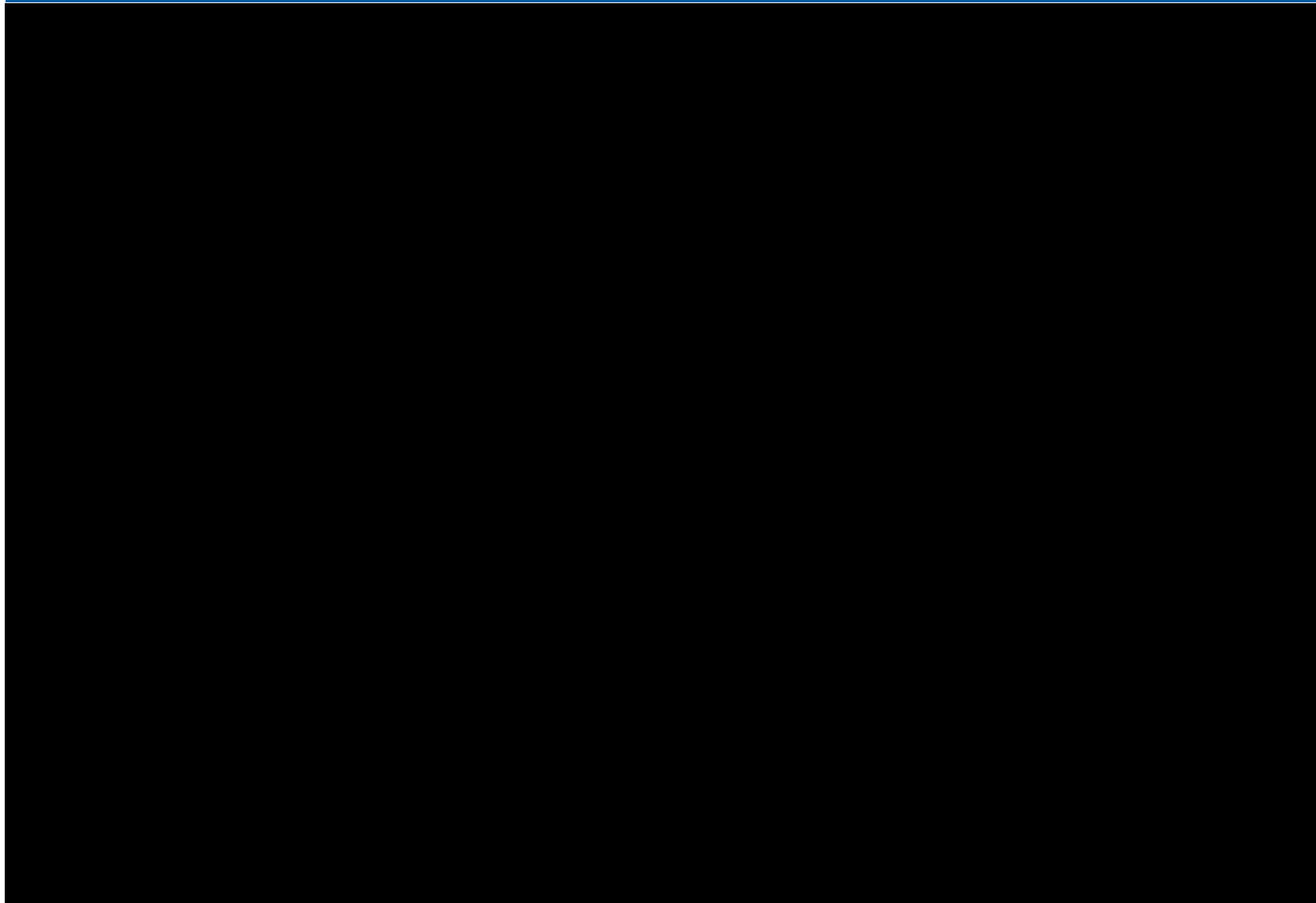


Figure 13. Locations of nocturnal lizard searches undertaken in 2020 and 2021.

2.4.2.3 Birds

2.4.2.3.1 Incidental Observations

During the multiple site investigations carried out, incidental native bird observations were recorded. This included both birds seen or heard within the ZOI.

2.4.2.3.2 Five-minute bird counts

In September 2023, 5-minute bird counts (5MBCs) were undertaken at 15 stations across the Sutton Block (Figure 15), in areas that represented kānuka, broadleaved and podocarp, and rock forest types, as well as exotic grassland (paddocks). All birds seen and/or heard in a c. 100 m radius were recorded in the counts.

2.4.2.3.3 Wetland and aquatic bird surveys

Surveys for wetland and aquatic bird species were undertaken by way of opportunistic observations of ponded areas and wetland areas. Binoculars were used to view wetland vegetation from higher vantage points, and the pond north of SEA_T_5349 was regularly inspected for aquatic birds, such as dabchick (*Poliocephalus rufopectus*) or shags (*Phalacrocorax* spp.).

Targeted surveys were undertaken at Wetland 1a and 2a in September and October 2021, when secretive wetland birds tend to be most vocal (O'Donnell & Williams, 2015). Call counts for bittern (*Botaurus poiciloptilus*) were undertaken over four evenings in September and October 2024 using two ABMs (Bittern points 27-28; Figure 14), from 30 minutes before dawn until 60 mins after dawn in the morning, and 30 mins before dusk until 60 mins after dusk in the evening, in accordance with O'Donnell & Williams (2015). One potential call was identified from these recordings, but the call was not clear enough to be certain. An additional 3 ABMs were deployed in November 2024 for 5 days (Bittern points 29-31; Figure 14), to provide further assurance about any possible Bittern presence.

Acoustic call playback was undertaken at Wetland 1a and 2a in September and October 2021. The playback involved playing recorded calls of spotless crane (*Zapornia tabuensis*) and fernbird (*Poodytes punctatus*) and waiting for a response. Additional callback surveys were undertaken in October 2024, which included additional locations outside of the main wetlands (e.g. farm ponds, scrub).

Playback surveys were undertaken by playing recordings after 5 minutes of silence upon arriving at the site, then playing the recording for 40 seconds, then 1-minute silence. This call sequence was repeated three times per species recording (spotless crane and fernbird). ABM recordings were processed using AviaNZ⁹, an automated call recognition software. Any potential calls were examined in more detail, with any potential calls scrutinized further in Raven¹⁰ to identify spectrographic properties.

⁹ <https://www.avianz.net>

¹⁰ <https://www.ravensoundsoftware.com/>



Figure 14. Wetland bird survey locations using call playbacks for spotless crane and fernbird, and ABM recorders for bittern.

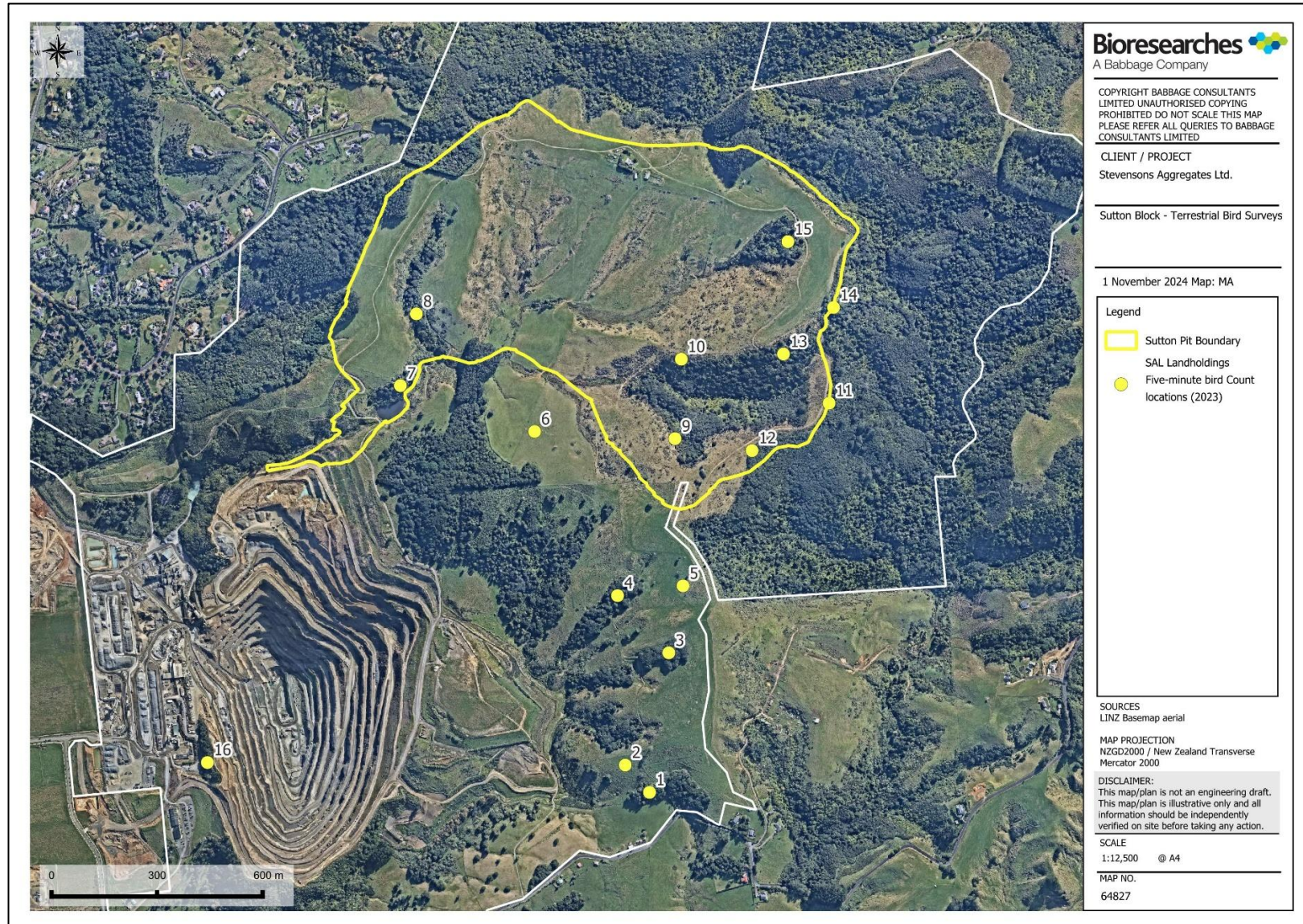


Figure 15. Terrestrial five-minute bird count locations in 2023 across the Quarry.

2.4.2.4 Bats

Surveys for native bats were undertaken over October 2020, in December 2021, March 2024, and October 2024 (refer Figure 16 for survey locations).

Long tailed bats (LTBs) are classified as 'Nationally Critical' and conservation dependent by the Department of Conservation (O'Donnell *et al.*, 2018). They are threatened by 'significant' habitat loss, increased impacts from vespid wasps, and ongoing declines where there is no predator control (O'Donnell *et al.*, 2018).

LTBs are a highly mobile species with very large home ranges (c. 100 km²). Their home ranges require large trees (including exotic and standing dead trees) with cavities (e.g. deep knot holes), epiphytes and loose bark for roosting. They will regularly change roosts, often every 2-3 nights, and have been recorded returning to roost trees annually.

LTBs typically use linear landscape features such as bush edges, gullies and water courses to transit between roosting and feeding sites (Borkin and Parsons, 2009; Griffiths, 1996). They tend to forage in open areas, including clearings (Borkin and Parsons, 2009; Griffiths, 1996), along forest edges (Alexander, 2001; O'Donnell and Sedgely, 1994), over wetlands, open water and along rivers and roadways (Borkin and Parsons, 2009; Griffiths, 1996).

2.4.2.4.1 Automatic bat monitors

Automatic bat monitors (ABMs) are used to record ultrasonic echolocation calls that are produced by bats during their navigation and foraging behaviours. An ABM records the ultrasonic echolocation calls emitted by bats and either converts them to frequencies that are audible to humans or records them as a spectrogram for visual assessment.

An ABM is comprised of two ultrasound sensors and microphones, a sound-activated recording device, a timer to turn the system on and off each day, and in some models a rain-noise detector that turns the system off in the event of heavy, persistent rainfall. ABMs record and store data passively and have the capacity to record both long-tailed (40 kHz) and lesser short-tailed (28 kHz) bat calls.

A total of 26 ABMs (Department of Conservation, 'Otterbox' and AR4 versions in 2020, 2021 and 2024, range approx. 50 m) were installed at fixed locations (Figure 16) within and around the Sutton Block over four surveys, where potential flyways, foraging, or roosting habitat were considered most likely. The ABMs were set to begin recording in line with current advice at the time (1 hour before sunset to 1 hour after sunrise, excepting the 2020 survey which was 30 minutes either side) and were left in situ for two to four weeks.

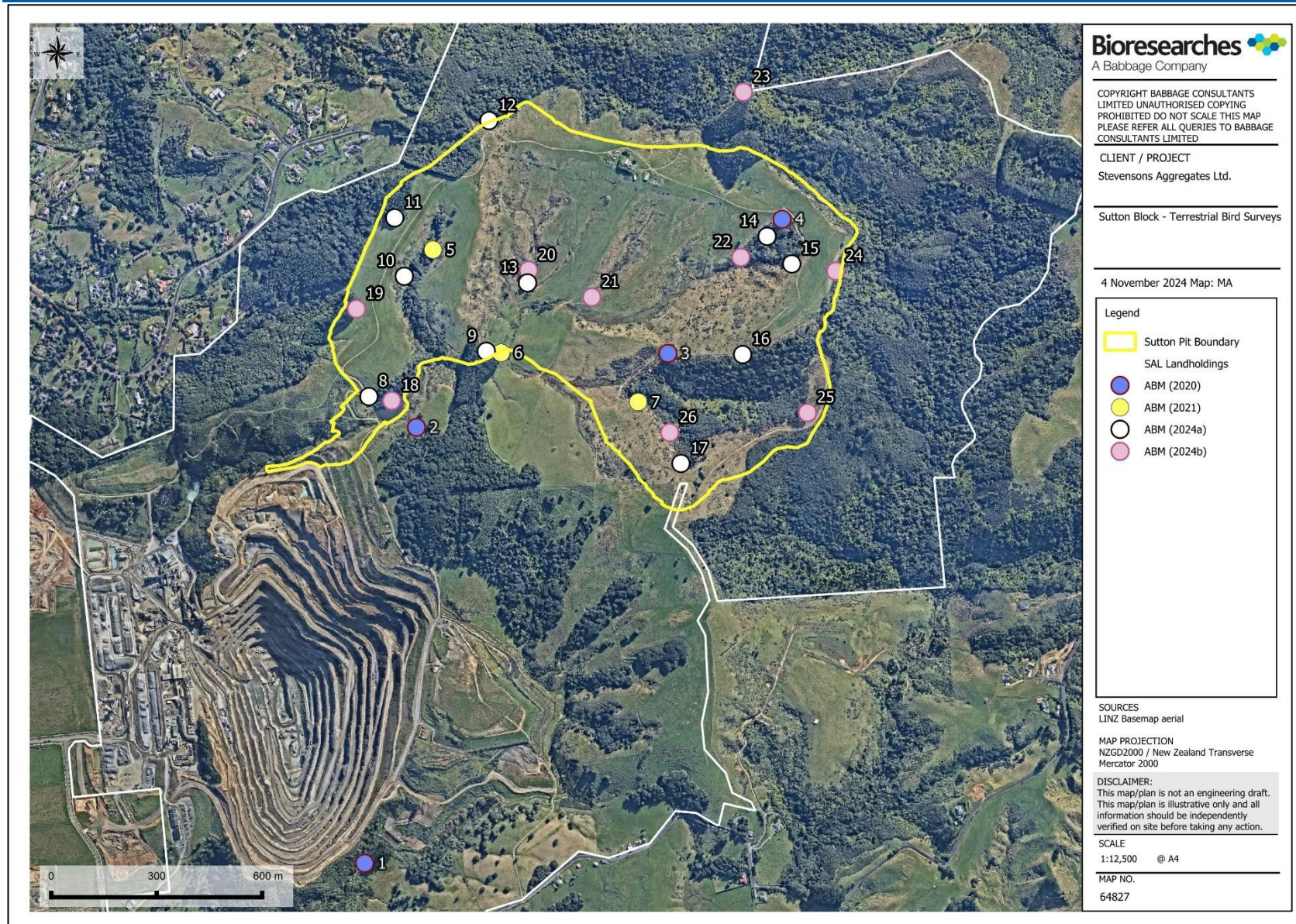


Figure 16. ABM placement in 2020, 2021, and 2024

2.4.2.4.2 Bat data analysis

Acoustic data were downloaded from the ABMs and analysed using software developed by the Department of Conservation (Batsearch v3.12- v3.23). Bat echolocation passes were distinguished from other noises (e.g., wind, rain, invertebrates) and each 'pass' was time (hour/minute/second) and date stamped (year/month/day) providing timing information for activity.

Long-tailed bat activity is influenced by a range of environmental conditions, but current understanding has shifted over the course of the survey period. 'Valid' survey nights were required to meet minimum requirements for rainfall, temperature, moon phase (early surveys) and wind speed (new criterion) as defined by best practice guidelines issued by DOC (Department of Conservation 2021; 2024).

The total number of 'valid' survey nights was determined using climate data for Pukekohe Station, the closest weather station to the site with data for the relevant time periods (CliFlo, New Zealand's National Climate Database, NIWA) and sunset times and moon phase data for Auckland from the Time and Date website.¹¹ For 2024 surveys, temperature and rainfall data were acquired from the Auckland Council Environmental Data Portal as a closer weather station was identified (Turner Road, Drury), and wind speed data were obtained for the 2024b survey from a weather station in Ararimu (IDRURY7, Weather Underground).

2.4.2.5 Hochstetter's Frogs

Hochstetter's frog (*Leiopelma hochstetteri*) is a small, endemic frog that occurs in scattered, fragmented populations throughout the northern half of the North Island and on Great Barrier Island (Green & Tessier, 1990). It is listed as 'At-Risk – Declining' by the Department of Conservation (Burns *et al.*, 2018) and Auckland Council (Melzer *et al.* 2022).

Auckland Council manages four genetically distinct groups (Evolutionarily significant Units / ESUs) that occur within the Auckland Region (ESU's represent historically isolated, genetically distinct groupings that warrant treating them independently for conservation management purposes (Melzer *et al.* 2022)). One of these ESUs occurs within the Hunua E.D., the closest known frog populations to Drury Quarry, and are among the most well studied of the species.

Hochstetter's frog is most commonly associated with shaded streambeds or seepages under mature native forest. However, it is capable of tolerating modified habitats, such as exotic forest (Douglas, 1999; Bell *et al.*, 2004; Stephenson & Stephenson, 1957). Hochstetter's frogs are sensitive and vulnerable to environmental disturbances, such as floods and sedimentation (Najera-Hillman *et al.*, 2009) and because they tend to occur in small and localised populations (Newman, 1996).

2.4.2.5.1 Methods

Desktop investigations involved a review of the Department of Conservation's *Amphibian and Reptile Distribution Scheme* (ARDS) database (accessed March 2023), as well as an analysis of aerial and topographic imagery for the presence of first and second order streams, where potential habitat is most likely.

¹¹ <https://www.timeanddate.com/moon/phases/new-zealand/auckland?year=2022>; www.timeanddate.com/sun/new-zealand/Auckland

To detect the potential presence of Hochstetter's frogs, frog two searches by experienced herpetologists, in March and November 2024, were undertaken along Stream 5 (Figure 23)- the only watercourse within the Sutton Block Pit that supported suitable potential frog habitat (bedrock substrate- and particularly a small waterfall). Both searches were undertaken during the daytime and involved looking underneath liftable rocks, cobbles, and overhanging vegetation, along with looking into crevices and cracks in and around bedrock waterfalls and cascades. Searches were conducted with the use of headtorches to maximise the visibility of potentially present frogs in their refuge positions. The total time spent searching was 2 person hours per survey (4 person search hours in total).

In addition to surveys, three environmental DNA (eDNA) samples were collected. eDNA is genetic material that is shed by organisms as they move in, through, and around their environment (Wilderlab, 2024). Wilderlab sampling kits were used to filter 1 litre of water and samples sent to Wilderlab to analyse for the presence/absence of species. Three samples were taken on the 27th of March, 2024, at the lower reaches of Stream 5 within Sutton Block (see Figure 17). These sites were selected as they are 5, 10 and 20 metres downstream from the small waterfall and is the lower reaches of the catchment for the entire Sutton Block proposed pit.

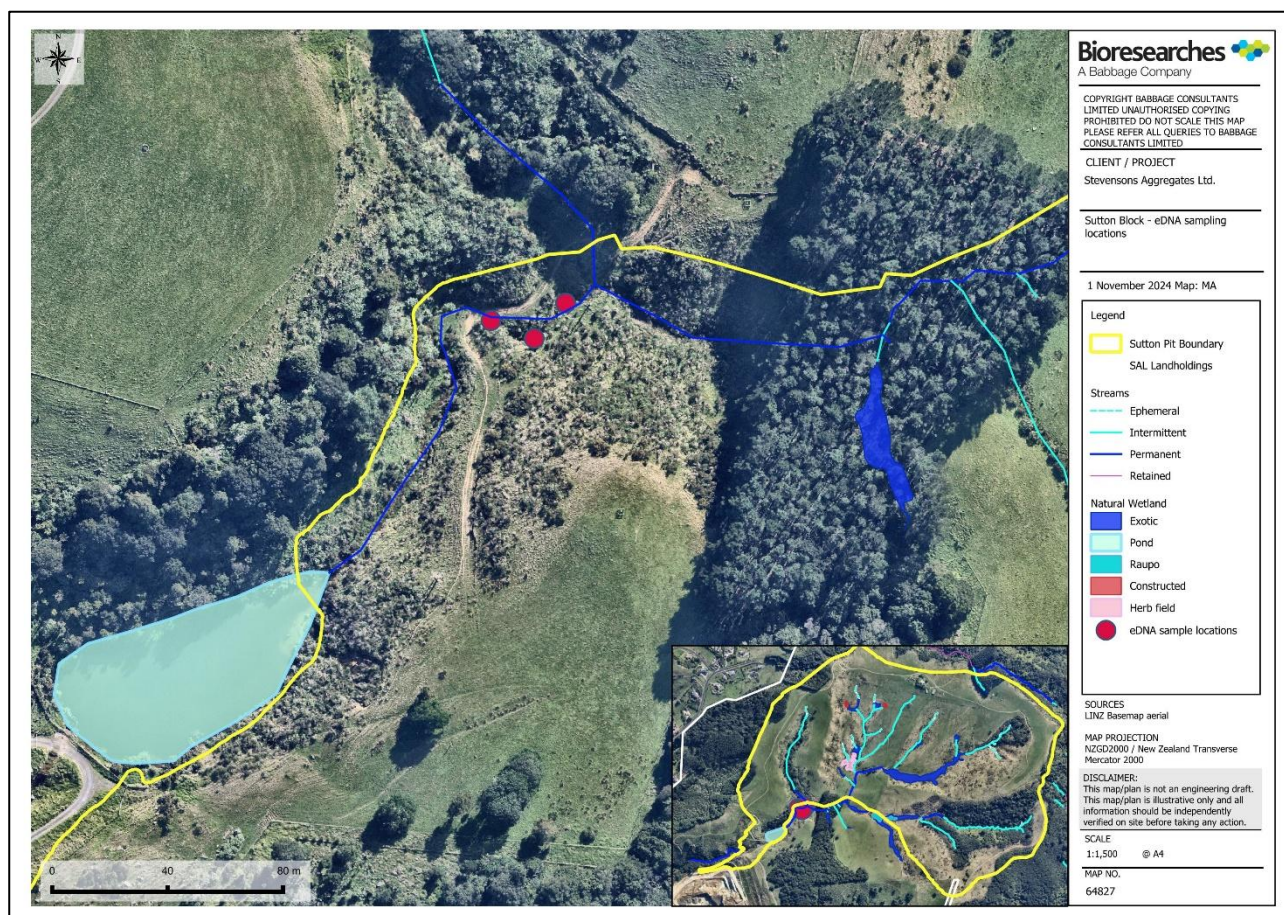


Figure 17. Locations of eDNA samples taken.

2.5 Site Investigations - Freshwater Ecology

2.5.1 Streams

Watercourses were classified under the AUP to determine, in accordance with the AUP definitions in the plan, the ephemeral, intermittent or permanent status of these watercourses. During the site assessment, the presence and extent of water was noted, reference photos were taken and freshwater habitats were marked using a handheld GPS unit. The quality of the aquatic habitat was assessed, noting ecological aspects such as channel modification, hydrological heterogeneity, riparian vegetation extent, substrate type and any fish or macroinvertebrate habitat observed. Riparian and catchment information was also reviewed.

2.5.2 Stream Ecological Valuation

Detailed assessments of nine representative reaches of the streams were undertaken using the Stream Ecological Valuation (SEV) methodology (Auckland Council Technical Report 2011/009) over the 2020 and 2024 survey periods, with additional SEV data used from assessments carried out downstream of the proposed Sutton Block pit in 2018. The SEV methodology (Storey *et al.*, 2011; Neal *et al.*, 2016) enables the overall function of the stream to be assessed and compared to the quality of other streams in the Auckland Region. The SEV procedure involves the collection of habitat data (e.g. stream depth, substrate type, riparian cover), and sampling of fish communities and macroinvertebrates (e.g. insect larvae, snails), the latter being recognised indicators of habitat quality. Fourteen variables are assessed through the collection of data and are assigned to four ecological functions (Neale *et al.*, 2016):

- Hydraulic – assesses natural flow regime, floodplain effectiveness and connectivity for natural species migration and groundwater of the stream reach;
- Biogeochemical – assesses in-stream water chemistry, the processing of pollutants and the in-stream particle retention and organic matter inputs to the stream reach;
- Habitat provision – assesses suitability of the stream reach for aquatic fauna and spawning habitat of indigenous fish; and
- Biodiversity – assesses the condition of aquatic fauna, including fish and macroinvertebrates and the intactness of the riparian yard.

The SEV method gives a score between 0 (low quality) and 1 (high quality) for each of the attributes which are weighted in terms of their contribution to overall stream value. These attributes are then combined to give an overall SEV score, on a scale of 0 – 1 ([Table 7](#)).

Table 7. SEV score interpretation.

Score	Category
0 – 0.20	Very Poor
0.21 – 0.40	Poor
0.41 – 0.60	Moderate
0.61 – 0.80	Good
0.81 – 1.0	Excellent

The SEV assessments were undertaken over a representative 100 m reach of each of the selected watercourses in the proposed Sutton Block pit area, over ten cross sections. At each cross section, the relative cross-section measurement was undertaken, bankfull width of the stream measured and reference

photographs taken. The SEV reach was marked at the upstream and downstream boundaries with a handheld GPS.

2.5.3 Water Quality

Spot measurements of basic water quality parameters were collected using a calibrated Yellow-Springs Instrument (YSI) alongside SEV surveys. Basic water quality parameters taken included temperature, dissolved oxygen concentration and saturation, and conductivity.

2.5.4 Macroinvertebrates

Macroinvertebrate communities, including the structure, abundance and diversity, are indicators of long-term health of streams and water quality. Different taxa display varying tolerance to pollutants with presence/absence providing indicators to stream health and condition.

Macroinvertebrates were sampled from each SEV reach instream habitat to obtain semi-quantitative data in accordance with the Ministry for the Environment's current 'Protocols for Sampling Macroinvertebrates in Wadeable Streams' (Stark *et al.*, 2001). Sampling was undertaken along each SEV reach, using protocol 'C1: hard-bottomed, semi-quantitative' as the streams were hard bottomed. The macroinvertebrate sample was preserved in 70% ethyl alcohol (ethanol), returned to the laboratory and sorted (using protocol 'P3: full count with sub-sampling option', Stark *et al.*, 2001). Macroinvertebrates were then identified to the lowest practicable level and counted to enable biotic indices to be calculated.

Five biotic indices were calculated, namely:

- The number of taxa;
- The number and percentage of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) recorded in a sample (%EPT);
- The Macroinvertebrate Community Index (MCI) and; and
- The Semi-Quantitative Macroinvertebrate Community Index (SQMCI).

EPT are three orders of insects that are generally sensitive to organic or nutrient enrichment, but the calculation of %EPT specifically excludes *Oxyethira* and *Paroxyethira* as these taxa are not sensitive and can proliferate in degraded habitats. The MCI and SQMCI are based on the average sensitivity score of individual taxa recorded, although the SQMCI is calculated using coded abundances instead of actual scores.

For MCI and SQMCI, respectively, scores of:

- ≥ 120 and ≥ 6.0 are indicative of excellent habitat quality;
- 100 – 119 and 5.0 – 5.9 are indicative of good habitat quality;
- 80 – 99 and 4.0 – 4.9 are indicative of fair habitat quality; and
- < 80 and < 4.0 are indicative of poor habitat quality (Stark & Maxted, 2007b).

2.5.5 Freshwater Fish

Fish communities can be good indicators of stream ecosystem health. The New Zealand Freshwater Fish Database (NZFFDB) provides data on the location and species of freshwater fish throughout New Zealand. A

review of the NZFFDB was undertaken to determine the likelihood of freshwater fish species that may be present within the Sutton Block area prior to freshwater fish surveys.

Fish communities were sampled in October 2020, November 2021. At each survey location, two fyke nets and four Gee's minnow traps were attempted to be set, where sufficient water was present. Nets and traps were baited and left overnight at each site. Nets and traps set in general accordance with the New Zealand Freshwater Fish Sampling Protocols (Joy *et al.*, 2013)¹², but in reduced density than recommended in the protocols because of the very small size of most of the streams. Immediately downstream in the main stream watercourse draining the Sutton Block is a very long, very steep waterfall. The waterfall, plus two large, constructed ponds with culverts or weirs that provide almost complete fish barriers, has restricted the diadromous native fish in the catchment to eels and banded kokopu. Nets were collected the following morning, and the species of each fish was determined, the size of each individual was measured, and the number of fish captured. General condition of each fish (i.e. parasites, lesions, wounds,) were noted and recorded before fish were returned to habitat.

Prior to the release of fish back to their habitat, electric fishing was carried out using an EFM300 backpack electric fishing machine. The electric fishing machine temporarily stuns the fish, allowing them to be captured. All fish captured were identified and counted, their size measured and general condition noted before being released back into their habitat.

In addition, three eDNA samples were collected from Stream 4 (Figure 17) in March 2024 (refer to Section 2.4.2). The eDNA samples recorded shortfin and longfin eels, as found in the other fish surveys, and did not record any additional native fish species.

The results of the fish surveys were used to calculate the Index of Biotic Integrity (IBI, Table 8.) was calculated for the streams based on fish species present, altitude and distance inland. The IBI compares the community of fish present, with what might be expected to occur considering altitude and distance inland from the coast. Natural or artificial barrier to fish passage are not accounted for in the IBI (Joy & Henderson, 2004).

Table 8. Fish IBI scores and classes for the Auckland Region (Joy and Henderson, 2004)

Total IBI score	Integrity class	Attributes
50 – 60	Excellent	Comparable to the best situation without human disturbance; all regionally expected species for the stream position are present. Site is above the 97 th percentile of Auckland sites.
42 – 49	Very good	Site is above the 90 th percentile of all Auckland sites, species richness is slightly less than best for the region.
36 -42	Good	Site is above the 70 th percentile of Auckland sites but species richness and habitat or migratory access reduced, some signs of stress.
28 – 35	Fair	Score is just above average, but species richness is significantly reduced. Habitat and or access impaired.
18 – 27	Poor	Site is less than average for Auckland region IBI scores, less than the 50 th percentile thus species richness and or habitat are severely impacted.
6 – 17	Very poor	Site is impacted or migratory access almost non-existent.

¹² The number of fykes set was limited by the depth and width constraints of the stream, but each fyke was accompanied by two GMTs, with additional GMTs set where sufficient water and depth was present.

0	No fish	Site is grossly impacted or migratory access non-existent.
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2.5.6 Wetlands

Potential wetland areas were assessed following the Ministry for the Environment's (MfE) wetland delineation protocols (Ministry for the Environment, 2020¹³). This process included identifying areas which met the definition of a 'natural inland wetland' under the National Policy Statement for Freshwater Management (NPS-FM); based upon the results of up to four 'tests' including the rapid test, vegetation tests, soil tests and hydrology tests, as depicted in Figure 18 and elaborated upon below. Assessments were carried out within the Auckland region's 'growing season' (Ministry for the Environment, 2021b).

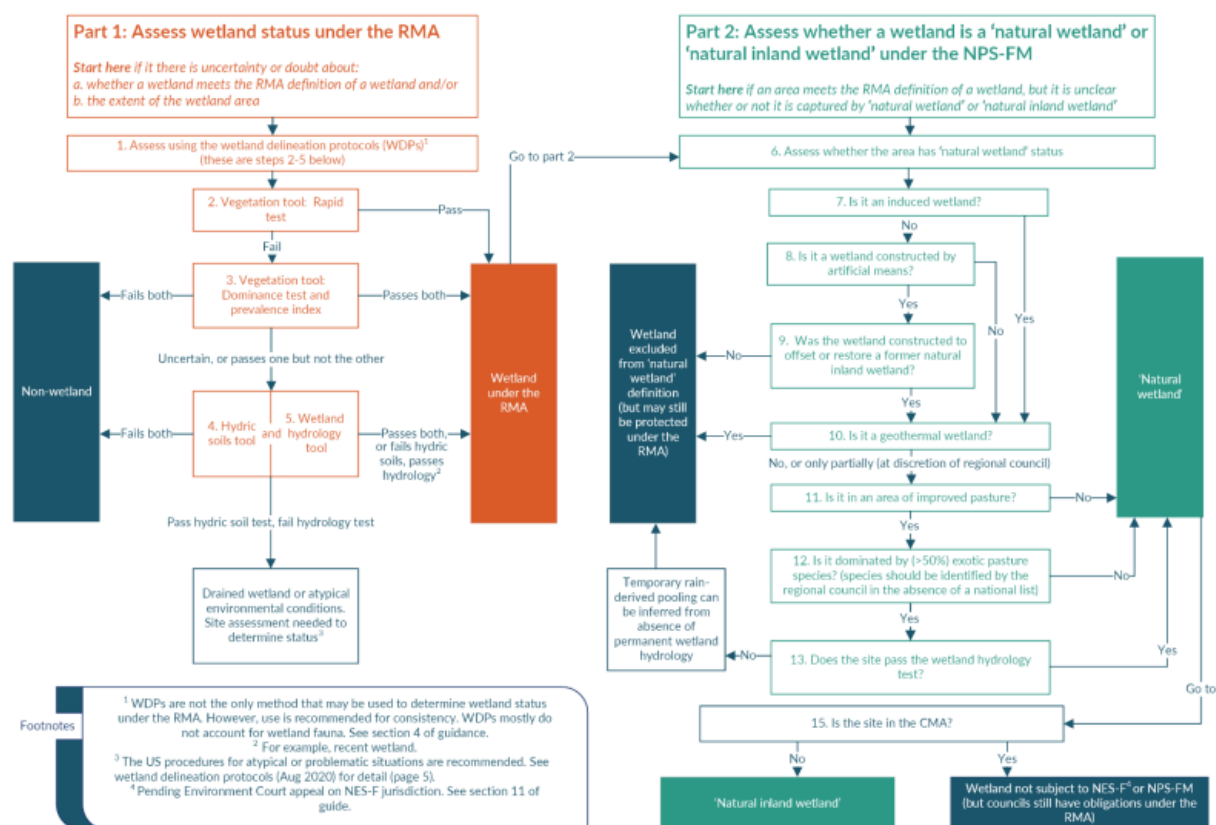


Figure 18. Flowchart depicting the process used for assessing areas of potential wetland. Figure from Ministry for the Environment 2021a.

If the rapid test was not appropriate for determining if an area was a wetland, vegetation was assessed in accordance with Clarkson (2014); based on the dominance and prevalence of:

- Obligate wetland vegetation (OBL) – almost always a hydrophyte, rarely in upland
- Facultative wetland (FACW) – usually a hydrophyte but occasionally found in uplands
- Facultative (FAC) – commonly occurs as either a hydrophyte or non-hydrophyte
- Facultative upland (FACU) – occasionally a hydrophyte by usually occurs in uplands
- Upland (UPL) – rarely a hydrophyte, almost always in uplands

¹³ Up-dated January 2024.

Where the dominance and/or prevalence tests showed unclear results, hydric soils and hydrology tests were undertaken in accordance with the associated protocol (Ministry for the Environment, 2021; Fraser *et al.*, 2021).

If the area met the definition of a natural inland wetland, it was classified as to its habitat type as per Singers *et al.* (2017). Its ecological value was then assessed, based upon this classification and the condition of the wetland, considering factors such as damage caused by stock access and weed invasion, and modifications to natural hydrology.

3 ASSESSMENT OF ECOLOGICAL VALUES

3.1 Terrestrial Vegetation within the Sutton Block Pit

Four small areas of indigenous terrestrial vegetation occur within the Sutton Block pit; which belong to two main types: Taraire, tawa podocarp Forest ('WF9') and Kānuka scrub/forest ('VS2'). Rock forest ('RF'), occurring on volcanic boulder field is a specialized variant of WF9 with a suite of species being particular to the habitat, and consequently has been assessed separately.

All areas of indigenous vegetation within the Sutton Block pit are accessed by livestock and are thoroughly grazed. Farming practices such as weed control and growing of forage crops occur in the agricultural matrix adjacent to the native forest remnants. These practices have impacted the extent and ecological health of the remnants over the preceding decade, leading to incremental loss of extent for some areas.

The WF9 types are most similar to Taraire, tawa, podocarp forest (WF9) described by Singers et al. (2017), however forest tiers other than the canopy trees are virtually absent and the areas meet the definition of Treeland (TL1) given by Singers et al. (2017) under the current grazing regime. Although several threatened plant species are found within the Kaarearea Paa area, none were detected within the Sutton Block Pit extent other than common myrtaceous species that have been classified as threatened due to their perceived vulnerability to myrtle rust.

Exotic terrestrial habitats within the Sutton Block pit include small patches of planted exotic forest (EXP) on the western side of the SPQZ, mainly on the edges. In addition, there are areas of exotic scrubland (EXS) and exotic grassland (EG) within the Sutton Block pit.

Vegetation types are mapped in Figure 19 and botanical descriptions are given below. A terrestrial vegetation species list for the site is given in Appendix B.

All areas of native vegetation within the proposed Sutton Pit extent are impacted by ongoing agricultural practices. The lower forest tiers are absent, effectively leaving only the mature canopy trees, a restricted range of unpalatable species, and epiphytes which are above the browse height of livestock. The ongoing effects of trampling of tree root systems, rubbing and chewing of tree bark and cambium layers by livestock and general edge effects are contributing to the declining viability of the relict mature trees. While all of these areas retain the ability to recover if protected from biodiversity threats, under current land use practices they will continue to degrade and contract in extent. Natural regeneration is being prevented due to browsing of native seedlings by livestock. If current land use practices remain, these unfenced forest fragments will not survive in the long term since natural ecosystem processes, including regeneration, are not occurring.

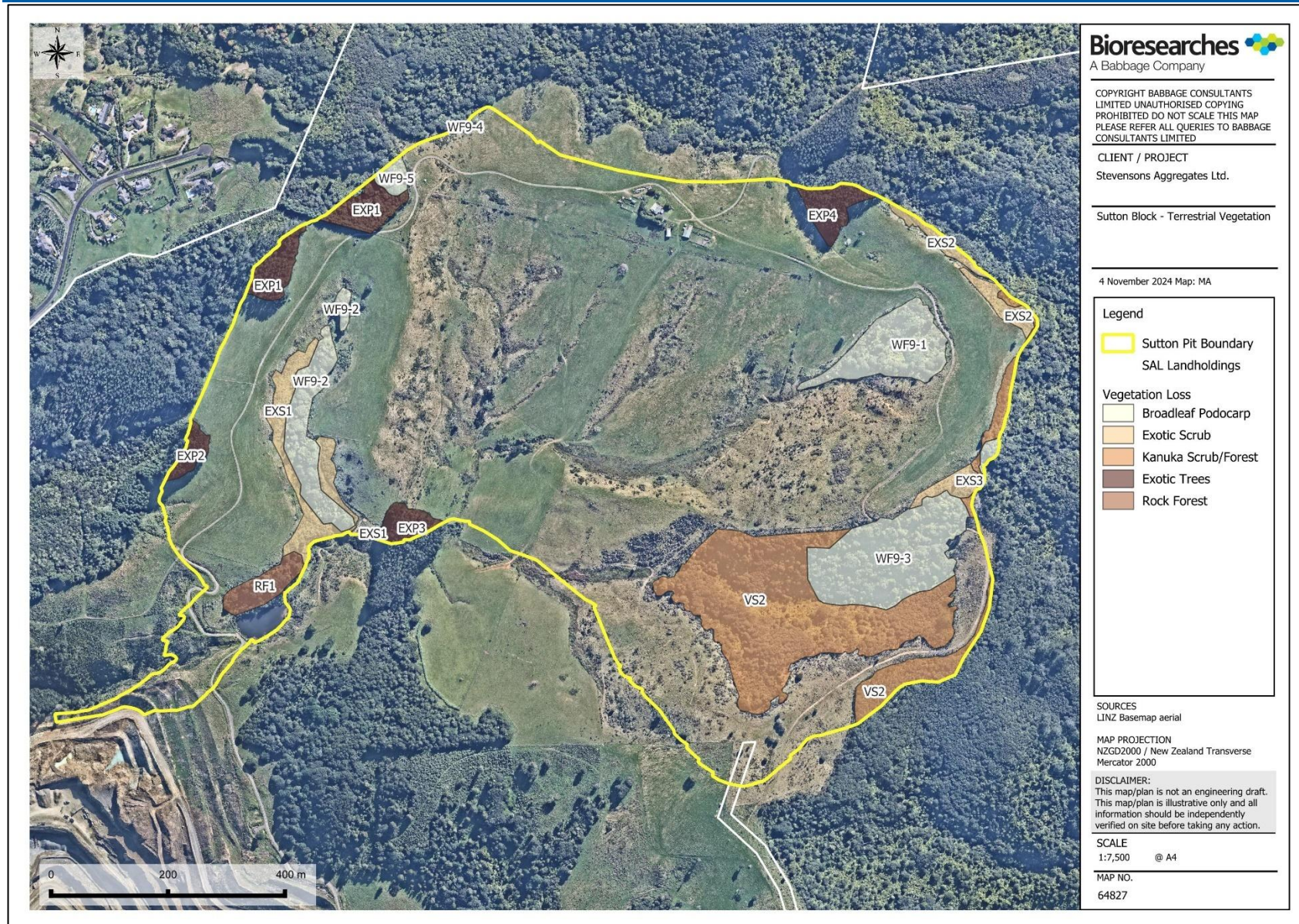


Figure 19. Terrestrial vegetation types within the Sutton Block pit boundary (Stages 1-5).

3.1.1 Taraire, tawa, podocarp Forest (WF9)

Three separate areas of Taraire, tawa, podocarp forest (WF9) are present within the proposed Sutton block pit. Areas of WF9 have old growth signatures of taraire, tawa, podocarp forest (WF9), however due to long-term degradation resulting from impacts of stock access and adjacent, intensive agricultural land use, their value is only equivalent to a Taraire, tawa podocarp ecosystem type. Each area of WF9 is described separately in Sections 3.1.1.1, 3.1.1.2, and 3.1.1.3 below.

All Taraire, tawa podocarp ecosystem types (WF9, WF11, WF12, WF13) apart from WF13 have a regional threat status of “Endangered” under the IUCN¹⁴ ecosystem threat classification, meaning they are regionally threatened (Singers *et al.*, 2017). WF13 has a status of “Vulnerable” The key criteria they would meet under the IUCN threatened ecosystems classification are:

- Reduction in geographic distribution; and
- Disruption of biotic processes and interactions.

Within the Hunua Ecological District where the SAL Holdings is located, taraire forest covers more than 1200 ha (Tyrell *et al.*, 1999) and collectively Taraire, tawa podocarp forests and kauri cover >20,000 ha (Lindsay *et al.*, 2009). All these mature forest types have decreased greatly in extent in the Auckland Region. The major loss of extent for these forest types is mainly historic and coincided with the arrival of European settlers who cleared the lowland forests for agriculture. Locally however, there are still large tracts of these ecosystem types that remain within the Hunua ED and much of this is protected under Department of Conservation control. Rules in the AUP provide protection for native vegetation on private land upon development and therefore the extent of native ecosystems is considered to be reasonably stable.

3.1.1.1 WF9-1 (1.87 ha)

WF9-1 is a small (1.87 ha), isolated patch of Taraire, tawa podocarp forest that lies at the head of a gully on the north eastern edge of the SPQZ at approximately 230m a.s.l (Photo 1). It is overlaid by Auckland Council as SEA_T_1177 and is separated from the vegetation in WF9-3 (which forms part of SEA_T_5323) by a grassed ridge to the east and south. It is noted that the freshwater assessment did not record longfin eel from the stream, although koura were found. Taraire, tawa podocarp forest (WF9 - WF12) is however regionally endangered (Singers *et al* 2017).

The heavily grazed forest remnant has a broken canopy of native trees, composed mainly of taraire (*Beilschmiedia tarairi*), tawa (*Beilschmiedia tawa*), rewarewa (*Knightia excelsa*), rimu (*Dacrydium cupressinum*), tōtara (*Podocarpus totara*), pūriri (*Vitex lucens*) and kahikatea (*Dacrycarpus dacrydioides*). Pukatea (*Laurelia novaezelandiae*) is common in the gully bottom along the small stream where some 25 -30 of these trees stand. Less common are miro (*Pectinopitys ferruginea*) and white maire (*Nestegis lanceolata*) with only one or two specimens of each occurring within this remnant.

Native understorey and groundcover tiers are virtually absent although some tall tree ferns (*Alsophila tricolor*) and nīkau (*Rhopalostylis sapida*) above browse height do occur; and a range of epiphytes and lianes

¹⁴ International Union for the Conservation of Nature

are present (Photo 2). Very small numbers of tiny seedlings of a range of native species were noted in the ground layer which is composed of bare ground, leaf litter and exotic grasses.

Some dieback of the taraire and marginal pukatea trees is evident, and numerous dead tree fern trunks stand in pasture on the southern side of the fragment. Historic aerial imagery shows that c. 0.9 ha of tree ferns has been lost from the southern side of this fragment since 2010.



Photo 1. WF9-1 lies in the steep head of a gully (02.12.2021).



Photo 2. WF9-1 lacks the understorey and groundcover tiers (02.12.2021).

3.1.1.2 WF9-2 (1.63 ha)

This area of heavily grazed treeland runs up a long narrow stream gully north-west of Kaarearea Paa on the western side of the SPQZ (Photo 3). The tree canopy is similar to the other WF9 remnants with taraire, pukatea, rewarewa, rimu, kahikatea and pūriri, some of them of large size. Scattered large māhoe (*Melicytus ramiflorus*) and tall mapou (*Myrsine australis*) up to 6 m in height are all that remain of the sub canopy. The ground is generally bare or covered in leaf litter with patches of exotic grass.

Very small and scattered native seedlings are found in places that are less accessible to livestock. A range of lianes and epiphytes are present including supplejack, tank lily (*Astelia hastata*), perching lily (*A. solandri*), white rātā (*Metrosideros diffusa*), small white rātā (*M. perforātā*) and epiphytic ferns such as hanging spleenwort (*Asplenium flaccidum*), hounds tongue fern (*Zealandia pustulata*) and nini (*Icarus filiformis*). This is another small fragment of regionally endangered podocarp broadleaved forest.



Photo 3. WF9-2 lies in a narrow, steep-sided stream gully (18.01.2022).

3.1.1.3 WF9-3 (3.56ha)

WF9-3 lies within SEA_T_5323 where it juts into the SPQZ on the eastern side. It has a broken canopy of large taraire trees, kahikatea (Photo 5), and scattered specimens of other species such as tawa, rewarewa and pukatea. It is heavily grazed and pugged; with supplejack (*Ripogonum scandens*), kiekie (*Freycinetia banksii*) and whekī (*Dicksonia squarrosa*) in the gully bottom, indicating it is a damp environment (Photo 4). This area is regionally endangered Taraire, tawa podocarp forest ecosystem type (Singers et al. 2017).

3.1.1.4 WF9-4 (0.02 ha)

The northern edge of the Sutton Block Stage 5 and bund passes through a small corner of SEA (SEA_T_5323), with fenced podocarp broadleaved forest (Photo 6). This vegetation is at the margin of the larger SEA vegetation and is lower quality vegetation with some weedier areas, and mostly immature trees. Other large mature trees to the northwest could be indirectly affected if the works encroached their root systems. Edge effects may also negatively affect the remaining forest.

3.1.1.5 WF9-5 (0.25 ha)

WF9-5 lies on the northwest margin of the proposed Sutton Pit. It is not SEA vegetation and is adjacent to a section of exotic forest (EXP1). This small area is predominantly Puriri trees (*Vitex lucens*) with a mixture of native and exotic vegetation on the margin and understorey (Photo 7).



Photo 4. WF9-3 showing complete lack of understorey and groundcover tiers (16.10.2024)



Photo 5. View of WF9-3 from the south with dead tree fern trunks and kānuka in the foreground.



Photo 6. Northwest edge of SEA_T_5323 with weedy edge (12.07.2024).



Photo 7. Northwest puriri trees with ground cover of short nikau and grasses (12.07.24).

3.1.1.6 Ecological value

Taraire, tawa podocarp forest is represented within the Sutton Pit footprint by five areas, three of which are subject to SEA overlays (comprising SEA_5323 and SEA_1177) and consist of 7.33 ha in total. All of the WF9 forest is heavily degraded as a result on ongoing stock access. It has **Moderate** ecological value overall (Table 9).

Table 9. Terrestrial ecological value of Taraire, tawa, podocarp Forest within the Quarry footprint.

Matter	Score and justification
Representativeness	Moderate The vegetation of small WF9 remnants within the Sutton Block Pit extent has been severely damaged by past and current land use practices. Its structure and composition are modified. Native understorey and groundcover tiers are virtually absent and numerous trees exhibit dieback. A significant amount of vegetation has been lost from around the edges of most fragments, particularly tree ferns and other buffering native vegetation. While the canopy is representative of WF9 types and numerous plants from the lower tiers still maintain a presence at low abundance, mainly as tiny seedlings, the forest is effectively treeland. The intensively grazed understory of the WF9s on site leaves little habitat cover (coarse woody debris, leaf litter) for native skinks, however copper skinks were still recorded in two separate WF9 areas on site. While there are mature native trees that are representative of WF9 forest types, no arboreal geckos have been recorded at Drury Quarry from recent or previous survey work. Mature trees within WF9 have the capacity to support bats roosts, and a single bat pass recorded in 2020, within the surrounding landscape, (from 516 survey nights over 2020-2024) indicates that there is some potential for roost activity within the Sutton Block. WF9 forest fragments within the Sutton Block Pit extent are rated as moderate representativeness based only on their canopy tier.
Rarity/distinctiveness	High The WF9 forest fragments do not contain any naturally uncommon or rare species. While all Taraire, tawa podocarp forest is are considered to be threatened in the Auckland Region, these fragments are not an example of an intact forest community. Fauna species represented within this vegetation type are almost all 'Not Threatened' species with the exception of 'High Value' copper skinks ('At Risk'). While there is some potential for additional 'At Risk' or threatened species that have not been recorded from recent or previous surveys (invertebrates, lizards, bats), the likelihood of their presence or intermittent use of these environments is low. The WF9 fragments rate as high for rarity and distinctiveness on the basis of the damaged WF9 forest and presence of copper skink. This system also supports a high level of endemism.
Diversity and Pattern	Low

	Although the damaged forest fragments retain a moderate level of native plant species richness many species are in very low abundance and are failing to regenerate. Species will continue to be lost from the area due to current land use and ecological patterns are severely compromised. Similarly for fauna, diversity of avifauna is typical suite of common and exotic species, and the diversity of other fauna groups (bats, lizards, invertebrates) is low. Overall, the WF9 fragments rate as low for diversity and pattern.
Ecological context	Low The main WF9 remnants generally have large edge to interior ratios with no areas of true forest interior. Apart from WF9-3, all areas lack buffering due to stock access and are in a poor condition ecologically. They remain vulnerable to ongoing damage and degradation from the surrounding land use practices. They generally contribute incrementally to landscape connectivity however they do not comprise important stepping stone habitat or migratory pathways within the wider landscape. WF9-2 does, however, provide some additional connectivity between Kaarearea Paa and SEA_T_5323 to the north. Small areas on the edges of the Stage 5 pit do not contribute greatly to ecological connectivity, however, the 3 large puriri trees in WF9-5 provide valuable habitat and food resources for fauna. Overall, they rate as low for this attribute.
Ecological Value	Moderate

3.1.2 Rock Forest (RF)

A small remnant of rock forest (0.65 ha) lies close to Kaarearea Paa to the northwest (Photo 8). It occupies a small southeast facing scarp of large boulders, amongst which the vegetation grows. The area is unfenced and subject to livestock grazing. The broken canopy is composed of taraire, tawa, rewarewa, māhoe, pukatea and kahikatea.

Smaller trees include lancewood (*Pseudopanax crassifolius*), mahoe (*Melicytus ramiflorus*), pigeonwood (*Hedycarya arborea*) and nīkau. The groundcover and understorey are completely absent apart from sparse, unpalatable native ground ferns and exotic pest plants or weeds (Photo 9).

On the edges of the remnant the native vegetation thins out and pest plants, particularly woolly nightshade (*Solanum mauritianum*) and gorse (*Ulex europaeus*) form a weedy understorey. A range of epiphytes and lianes are still present on the trees, including kōhia vine (*Passiflora tetrandra*), scarlet rātā (*Metrosideros fulgens*), white rātā, small white rātā and supplejack. Epiphytic ferns including hanging spleenwort, hounds tongue fern, leather fern and jointed fern (*Arthropteris tenella*) are present, the latter growing over the boulders in some places. No threatened or rare species were recorded.



Photo 8. Rock forest fragment on east-facing slope (18.01.2022).



Photo 9. Rock forest interior (18.01.2022).

Rock forest/scrub is defined by Williams *et al.* (2007) as vegetation growing on volcanic boulderfields of recent basic (basalt) boulders (> 256 mm diameter). Volcanic boulder field is a naturally uncommon and endangered ecosystem (Holdaway *et al.* 2012). It has a boulder substrate that favours rupestral species and can be subject to extreme drainage.

The occurrence of volcanic boulder field vegetation within the Auckland region appears to be poorly documented. An estimated 5000 ha originally occurred on the Auckland Isthmus volcanic field of which 29 ha or 0.5% is thought to remain here (Lindsay *et al.*, 2009); however, there is little information about this ecosystem type for other parts of the region. The Drury Fault basalt of which the Drury Quarry is part, covers c. 100ha within the Hunua E.D (Tyrell *et al.*, 1999). Little is known about the extent or quality of other areas of native vegetation on this basalt or about native vegetation on boulder fields associated with volcanic cones within the Hunua E.D.

The most intact and significant example of rock forest at the site is on Kaarearea Paa, where pūriri forest (WF7), Taraire, tawa, podocarp forest (WF9) and anthropogenic totara forest grow on the ridge and steep sides of the cone. This fragment (c. 10 ha) contains several threatened and uncommon plants of the Auckland Region including carmine rātā (*Metrosideros carminea*), mikoikoi (*Libertia grandiflora*) and kōwhai (*Sophora microphylla*) (Simpkins *et al.*, 2022).

Kaarearea Paa is recognised as a significant example of rock forest on volcanic boulderfield within the Auckland Region. It is fenced and protected as a cultural site and lies outside the Sutton Pit extent.

The small fragment of rock forest within the Sutton Pit extent contains no species that are specific to that ecosystem type other than jointed fern (*Arthropteris tenella*) which is not a regionally or nationally threatened species. The vegetation is otherwise similar to taraire forest (WF9), however Singers *et al* (2017) classify forest on volcanic boulder fields in the Auckland Region as a variant of Puriri Forest (WF7.2).

3.1.2.1 Ecological value

A total of 0.65 ha of Rock Forest occurs within the Site, where it consists of a single fragment, degraded by stock grazing. It is of high ecological value overall (Table 10).

Table 10. Terrestrial ecological value of Rock Forest within the Quarry footprint.

Matter	Score and justification
Representativeness	High The small and isolated rock forest fragment lacks the natural diversity and structure expected for the ecosystem type due to livestock impacts and surrounding land use practices. Fauna values are generally considered to be low in this fragment, where birds are represented by common native and exotic species and no lizards or bats were recorded.

	The rock features do provide retreat opportunities for native lizards; however, ground cover is sparse and typically bare due to intense grazing. The mature canopy cover within this forest provides suitable habitat for native birds and bats (mature trees with DBH > 15 cm). However, while no bat passes were recorded close to the rock forest (ABM location 2; Figure 16), their detection in the surrounding landscape (1 pass, 2020) indicates some potential for roost use. However, based on the scarcity of intact examples of the ecosystem type within the Auckland Region, the fragment rates as high for representativeness
Rarity/distinctiveness	High Native scrub/forest on volcanic boulder field is a naturally uncommon ecosystem nationally and is considered endangered. No rare or threatened species were recorded despite this forest provided some habitat in mature trees and rock retreats. There is still some potential for higher value fauna to use this feature (invertebrates, lizards, bats) though none have been recorded. Overall, the very small and damaged rock forest fragment rates as high for rarity and distinctiveness based on the naturally uncommon status of the ecosystem type.
Diversity and Pattern	Moderate The volcanic boulderfield substrate with a discontinuous forest canopy provides unusual potential plant habitats, for example large boulders and rock faces suitable for rupestral species. However, such species are largely absent. The area rates as moderate for this attribute.
Ecological context	Low The rock forest fragment is not directly connected to nearby areas of native forest. It contributes incrementally to landscape connectivity however it does not provide important stepping-stone habitat or migratory pathways within the wider landscape. It rates as low for this attribute.
Ecological Value	High

3.1.3 Kānuka Forest (VS2)

Kānuka forest occupies part of the gully system (8.8 ha) on the eastern side of the Sutton Block pit within SEA_T_5323 (Photo 10). It is divided into two areas, with the larger section (7.33 ha) to the west is adjoining WF9-3, and the smaller section (1.47 ha) to the east is separated by a farm track. As with the other forest remnants, the larger section is thoroughly grazed and largely devoid of any native ground cover or understorey. Parts of this remnant are a near monoculture of kānuka (*Kunzea robusta*) with an average top height of 6-10 m. Tōtara is common on the southern side of the larger section with a few medium sized trees scattered around the edges. There are some patches of tree fern (*Cyathea dealbata* & *C. medullaris*) amongst the kānuka, and this also has very low species diversity. At the lower end of the gully on wetter soils a stand of kahikatea with a multi-trunked pukatea are found (Photo 11). Again, this is treeland with no lower forest tiers.

Lancewood (*Pseudopanax crassifolium*), rewarewa, māhoe and pigeonwood are occasional, particularly on the northern side of the gully. Land management practices have adversely affected this fragment and there are dead kānuka trees and tree fern trunks on the edges. Tiny native seedlings of a range of species can be

found clinging to banks and stream edges while a range of epiphytic and liane species maintain a sparse presence. Tōtara can be found as browsed seedlings, saplings, and small trees on the southern side of the remnant.

The smaller section (1.47 ha) to the east of the farm track is fenced off from livestock. There are signs of deer browse within this remnant and deer have been sighted nearby. However, the composition of this area does not differ significantly from the larger section except that the grazed larger section has more grass groundcover. Seedlings in both areas are small (<30 cm) and sparse while saplings are virtually absent except for tree ferns.

The part of SEA_T_5323 within the Sutton Pit footprint does not contain regionally or nationally threatened species or ecosystem types. However, its removal will result in some loss of buffering to the rest of the SEA that lies outside the Sutton Pit to the east. Vegetation removal will leave a new edge on the western boundary of the SEA.



Photo 10. Kānuka Forest with WF9-3 top right within SEA_T_5323 (17.01.2022).



Photo 11. Left: Kānuka forest interior (17.01.2022). Right: Kahikatea trees amongst pasture at the lower (western) end of the kānuka forest (17.01.2022).

3.1.3.1 Ecological value

Two areas of kānuka forest (8.8 ha) occur within the quarry footprint, a larger section that is a regenerating protrusion of SEA_T_5323 to the west, and a smaller section that is the existing western boundary of the larger section of SEA_T_5323. As with other indigenous ecosystem types within the footprint, kānuka forest is degraded by stock access and is generally of **Moderate** overall value (Table 11).

Table 11. Terrestrial ecological value of Kānuka Forest within the Quarry footprint.

Matter	Score and justification
Representativeness	Moderate The grazed kānuka forest lacks a functional understorey and ground cover tiers. While its ecological integrity is compromised by browse pressure, it is a typically kānuka-dominated regenerating scrub/forest. A stand of kahikatea trees at the lower end have been valued separately as treeland (Photo 10). The fauna diversity is not high, and many expected species are not present. In the absence of lizards and little evidence of an avian community resident, representativeness of VS2 on site is moderate.
Rarity/distinctiveness	Moderate

	No naturally uncommon or rare flora species were recorded. Copper skinks, while not rare or distinctive, are present and are a 'High Value' species because it is declining nationally. It is also often associated with edge and regenerating ecosystems. As with other forest types assessed, the diversity of avifauna is typical suite of common and exotic species, and the diversity of other fauna groups (bats, lizards, invertebrates) is low. Overall, kānuka forest rates moderate on the basis of supporting a high value lizard species.
Diversity and Pattern	Low Floral diversity and pattern are low due to lack of the expected range and abundance of species in all vegetation tiers. There is a lack of diversity of fruiting and flowering species that would provide year-round food source that would attract a wide diversity of native avifauna, and the diversity of fauna groups generally (bats, birds, lizards, invertebrates) is low (although noting that, while a single bat pass was recorded from the surrounding landscape (2020), bats have not been recorded from the Sutton Block). Overall values for diversity and pattern are low.
Ecological context	Low The kānuka portion of SEA_T_5323, where it occurs within the footprint, is largely a protrusion of SEA_T_5323, which is surrounded on three sides by pasture. It is therefore not providing any meaningful buffering to the rest of the SEA and is not providing any particularly important ecological linkages or migration pathways. Its ecological integrity is compromised by high edge to area ratio and understorey grazing. Some large areas of dead ponga trunks on the southern edges are testimony to recent damage and loss in area of the kānuka scrub/forest. A smaller section kānuka scrub/forest will be removed from the existing margin of the larger section of the SEA, which will create a new edge (~400m long). This portion is currently fenced and not damaged by stock; however it is browsed by feral deer and has similar values to the larger, grazed section of SEA_T_5323. It rates as low for ecological context.
Ecological Value	Moderate

3.1.4 Relict native trees amongst pasture.

A number of native trees are found across the site. The most numerous of these are the stand of kahikatea at the lower western end of the kānuka forest. The trees are judged to be 50 – 60 years old based on their dbh measurements (Tanes Trees Trust 2011) and they occupy an area of <0.1 ha. Some 84 kahikatea trees and one multi-trunked pukatea were measured within this stand.

A small stand of nine pukatea trees grow in a gully to the west of WF9-1 and there are other scattered specimens of this species, tōtara and kahikatea across the site. Many of these are in poor health, displaying signs of stress due to exposure.

Aerial imagery of the Sutton Block Pit footprint shows loss of >5 ha of native vegetation from the Sutton Block pit area over the last 10 years. The scattered trees across the centre of the pit area are relicts of this former vegetation. The three puriri trees within WF9-5 are captured in Table 12 as these are essentially a stand of three key trees. The three taraire trees to the west of these puriri trees have also been included because it is unclear whether they will be lost or not. If they are not removed, they are likely to suffer from loss of major roots and would be susceptible to serious edge effects.

Table 12. Relict native trees amongst pasture

Tree species	Number of individuals	Average dbh (cm)	Total basal area (m ²)	Average height (m)
Kahikatea	99	29	9.78	17-18
Pukatea	12	31.6	1.99	14
Tōtara	14	37	2.058	12
Rewarewa	1	25	0.049	12
Rimu	1	35.2	0.097	15
Puriri	5	1784	5.46	16
Taraire	3	65.1	1	16
Total	130		20.43	

Table 13. Terrestrial ecological value of small stands and individual native trees standing in pasture within the Quarry footprint.

Matter	Score and justification
Representativeness	Low. Only the native canopy trees are present and the trees are not representative of intact forest types. Tree within the main kahikatea stand at the lower end of the VS2 in SEA_T_5323 are of moderate age and size, as are most other individual trees except for the puriri trees which are of large size.
Rarity/distinctiveness	Moderate: The main stand of kahikatea trees is a degraded remnant of a Critically Endangered ecosystem for the Auckland Region (WF8: Kahikatea pukatea forest. While no bat passes were recorded through the Sutton Block, their detection in the surrounding landscape (1 pass, 2020) indicates some potential for use of these trees for roosting.
Diversity and Pattern	Low: Species richness is very low, although a canopy heavily dominated by a few species (kahikatea, pukatea) is typical of the original WF8 forest type for the kahikatea stand. A total of six canopy species are represented, with scarcely any other native plants except for relict epiphytes.
Ecological context	Low:

	Individual trees and small stands of trees have no buffering and are exposed to prevailing conditions in the agricultural matrix. Many are damaged by livestock and exhibit dieback and other symptoms of stress. Mature individual trees potentially provide food resources for native fauna however and may still act as a seed source.
Ecological Value	Low

3.1.5 Exotic Forest (EXP)

Three small areas of plantation pine forest (EXP 1 – 4) ranging from 0.3 to 1.33 ha in size are found within the Sutton Block pit footprint. The trees are semi-mature and generally have no native understorey or groundcover. Where some understorey is present it is generally composed of pest plants, particularly gorse and woolly nightshade, although some early successional native species are present. Māhoe and mapou are the most common of these native species and where there is any ground cover, it is exotic grass.

In the northwest corner of the pit extent shown as the northern part of EXP1 is a small area (c. 0.7 ha) of Mexican cypress (*Cupressus lusitanica*) shelterbelt and planted Tasmanian blackwood that intersects with the pit extent. There is no understorey to the Mexican cypress and the Tasmanian black wood trees stand amongst pest plants and the occasional specimen of mānuka (*Leptospermum scoparium*) or māhoe. There is no groundcover apart from weedy exotic species. This habitat is considered to be of low ecological value overall (Table 14).

Table 14. Terrestrial ecological value of exotic forest within the Quarry footprint.

Matter	Score and justification
Representativeness	Low Areas of exotic forest are representative of EF2: Exotic Forest with <50% native understorey and/or ground biomass (Singers <i>et al.</i> , 2017). This is not an indigenous ecosystem type and these areas rate as low for this attribute.
Rarity/distinctiveness	Moderate Rare and distinct flora or fauna species were not recorded in the exotic forest type. Long-tailed bats have potential to roost in exotic trees such as pine, macrocarpa, however no such activity is indicated from current survey information. Copper skinks, while neither rare or distinctive, have high value species and are expected to be present in areas of this vegetation, particularly where weedy scrub is regenerating around other indigenous forest types that they occur in. This vegetation type rates moderate based on values for copper skinks.
Diversity and Pattern	Low These areas of vegetation types are dominated by exotic species and therefore have low indigenous diversity.
Ecological context	Low

	None of the small areas of plantation forest to be lost within the Sutton Pit extent are providing important linkages or steppingstone habitat within the local or wider landscape context. None are providing significant or important buffering to indigenous areas of vegetation. They have low value for ecological context.
Ecological Value	Low

3.1.6 Exotic Scrub (EXS)

Exotic scrub (EXS1) is mostly gorse (*Ulex europaeus*), some of which has previously been sprayed with herbicide and is dying, with occasional woolly nightshade (*Solanum mauritianum*). Exotic scrub on the eastern pit margin (EXS2 and EXS3) is similar, with primarily gorse and woolly nightshade present. It is considered to be of negligible ecological value overall (Table 15).

Table 15. Terrestrial ecological value of exotic scrub within the Sutton Block pit footprint.

Matter	Score and justification
Representativeness	Low Areas of exotic scrub are representative of Exotic Scrubland (Singers <i>et al.</i> , 2017). This is not an indigenous ecosystem type and these areas rate as low for this attribute.
Rarity/distinctiveness	Low Beneath this scrubland there is little to no groundcover and therefore this habitat is not suitable for native lizards. In addition, it provides no foraging habitat for other native fauna and at most may be occasionally visited by ground-dwelling birds such as pūkeko.
Diversity and Pattern	Negligible These areas of vegetation types are dominated by exotic species and therefore have low indigenous diversity.
Ecological context	Low None of the small areas of exotic scrub to be lost within the Sutton Pit extent are providing important linkages or stepping stone habitat within the local or wider landscape context. None are providing significant or important buffering to indigenous areas of vegetation. They have low value for ecological context.
Ecological Value	Negligible

3.1.7 Exotic Grassland

Exotic grassland habitats within the Sutton Block pit are vegetated with a suite of common pasture species. These habitats are intensively grazed, and sometimes sprayed out and replaced with crops. Due to the similar ecological values of both the exotic grassland and the cropped areas, these have been assessed as one ecological unit.

Table 16. Terrestrial ecological value of exotic grassland within the Quarry footprint.

Matter	Score and justification
Representativeness	Low

	This is not an indigenous ecosystem type.
Rarity/distinctiveness	Moderate Due to the intensively grazed nature of the grassland and the monoculture of the crops, they provide very little to no habitat for native fauna. They do not provide enough cover to support native lizards; although they do provide some habitat for native birds, such as pūkeko, spur winged plover (both Not Threatened) and pipit (At Risk - Declining), although for the latter they only provide foraging habitat (note this species was observed on occasion). No bat passes were recorded within the SAL holdings, and the detection of a single pass from the surrounding landscape (2020) indicates that open grassland areas are not important commuting or foraging habitats to bats.
Diversity and Pattern	Low These areas of vegetation types are dominated by exotic species and therefore have low indigenous diversity.
Ecological context	Low None of the grassland to be lost within the Sutton Pit extent are providing important linkages or stepping-stone habitat within the local or wider landscape context. None are providing significant or important buffering to indigenous areas of vegetation. They have low value for ecological context.
Ecological Value	Low

3.2 Terrestrial fauna

3.2.1 Invertebrates

3.2.1.1 Field survey results

Habitat searches did not reveal any peripatus or *Amborhytida dunni* snails. However, the closely related snail, *Rhytida greenwoodi* was found south of the existing pit at SEA T_5346 and at SEA T_5349 (Kaarearea Paa). This species is not threatened.

Quadrat searches identified common invertebrate groups that would be expected to be present, including millipedes (Class: diplopoda); landhoppers (Amphipoda) small (>10 mm diameter) land snails; slaters (Isopoda) and cockroaches (Blattodea).

Opportunistic searches revealed other invertebrate species, particularly species not always associated with leaf litter, including various weevils (Curculionidae), ground wētā (Anostomatidae) and leaf-veined slugs (Athoracophoridae). A native ant nest (*Pachycondyla* spp.) was recorded from habitat searches in the northern fragment (SEA_T_1177) within a rotten log (Photo 12). This species is notable because it is one of New Zealand's largest ant species (up to 6 mm) but is not of conservation concern (i.e. it is not 'At Risk' or 'Threatened').



Photo 12. Native ant (*Pachycondyla* spp.) emerging from its nest in a rotten log in SEA_T_1177.

3.2.1.2 Ecological value

Overall, the invertebrate fauna throughout the investigation area consisted of an expected diversity of common native species of **low** value.

3.2.2 Hochstetter's Frogs

The desktop study found that the nearest records of Hochstetter's frogs to the Sutton Block are approximately 9 km northeast, on the western edge of the Hunua Ranges.

Targeted searches did not identify any native frogs and the eDNA samples at Stream 5, did not identify Hochstetter's or other frog species. Given these factors, Hochstetter's frogs are not considered to be present within the footprint of the proposed Sutton Block pit.

3.2.3 Lizards

3.2.3.1 Desktop review

At least six native lizard species (van Winkel *et al.*, 2018) (Table 17) are considered to have some potential to occur within the Sutton Block pit, based on their presence in similar habitats within the Auckland Region. All of these species are classified as 'Regionally At Risk' (Melzer *et al.*, 2022). The assigned regional threat assessments only differ from national threat assessments in that Pacific gecko (*Dactylocnemis pacificus*) is classified as 'Not Threatened' on a national basis (Hitchmough *et al.*, 2021). Therefore, the regional assessments for lizards potentially provide a more conservative valuation - where this species is present.

Table 17. Threat classification of native lizards potentially found on site. Regional Threat category as per Melzer *et al.* (2022).

Common name	Scientific name	National threat classification (Hitchmough <i>et al.</i> , 2021)	Regional threat classification (Melzer <i>et al.</i> , 2022)
Copper skink	<i>Oligosoma aeneum</i>	At Risk – Declining	Regionally declining
Ornate skink	<i>Oligosoma ornatum</i>	At Risk – Declining	Regionally declining

Striped skink	<i>Oligosoma striatum</i>	At Risk – Declining	Regionally declining
Forest gecko	<i>Mokopirirakau granulatus</i>	At Risk – Declining	Regionally declining
Pacific gecko	<i>Dactylocnemis pacificus</i>	Not threatened	Regionally declining
Elegant (green) gecko	<i>Naultinus elegans</i>	At Risk – Declining	Regionally declining

A review of lizard records in (ARDS bioweb, accessed May 2020) indicates that copper skink has previously been recorded in habitats at Drury Quarry (Bioresearches, 2017) and green gecko (*Naultinus elegans*) have been recorded from kānuka vegetation at Hunua Quarry, within 5 km of Drury. Forest gecko (*Mokopirirakau granulatus*) has also been recorded nearby at Ararimu (iNaturalist).

Other areas within SAL Holdings where copper skinks have been recorded, include areas of stone fields in rough grass (non-pasture) near the northern extent of the existing pit.

3.2.3.2 Artificial retreat survey

The 2020 lizard survey recorded four copper skinks from SEA_T_5323, and one copper skink was recorded during the 2021 survey (Photo 13, Figure 20). The records indicate this species is present in both the WF9 (Taraire, tawa, podocarp Forest) and regenerating kānuka (VS2) vegetation types.



Photo 13. Left: Copper skink (2021 survey).



Right: AR placement in WF9 forest.

No other native species were recorded during the AR inspections, nocturnal searches, or destructive searches in either survey.

3.2.3.3 Ecological value

Copper skinks are the only native lizard species, which was confirmed to be present within the site, of the six species originally identified as potentially present (Table 17). While other native species may also be present, the lack of detection of from recent and previous survey efforts indicates that any other species, if present at all, are at very low densities. Copper skinks, as well as the other lizard species identified as potentially present are classified as Regionally Declining. Their value is therefore ‘**High**’ under EIANZ criteria for valuing species (Table 60).

All of the potential habitats within the Site are heavily degraded, partly as a result of extensive grazing (but also pest predators and browsers) which has severely reduced ground cover throughout and subsequently the availability of habitat and habitat quality for copper skink. Over a longer period, lack of natural regeneration can modify vegetation structure, and potentially also arboreal habitat availability.

The presence of one lizard species represents low herpetofauna diversity. While it is acknowledged that there is some potential for additional species to be present, the poor habitat quality indicates limited capacity to support a more diverse and representative assemblage of native lizards (geckos and skinks). Overall, the lizard values within the site are considered to be **moderate**, on the basis of the presence of one species at relatively low abundance, within low-quality habitat.

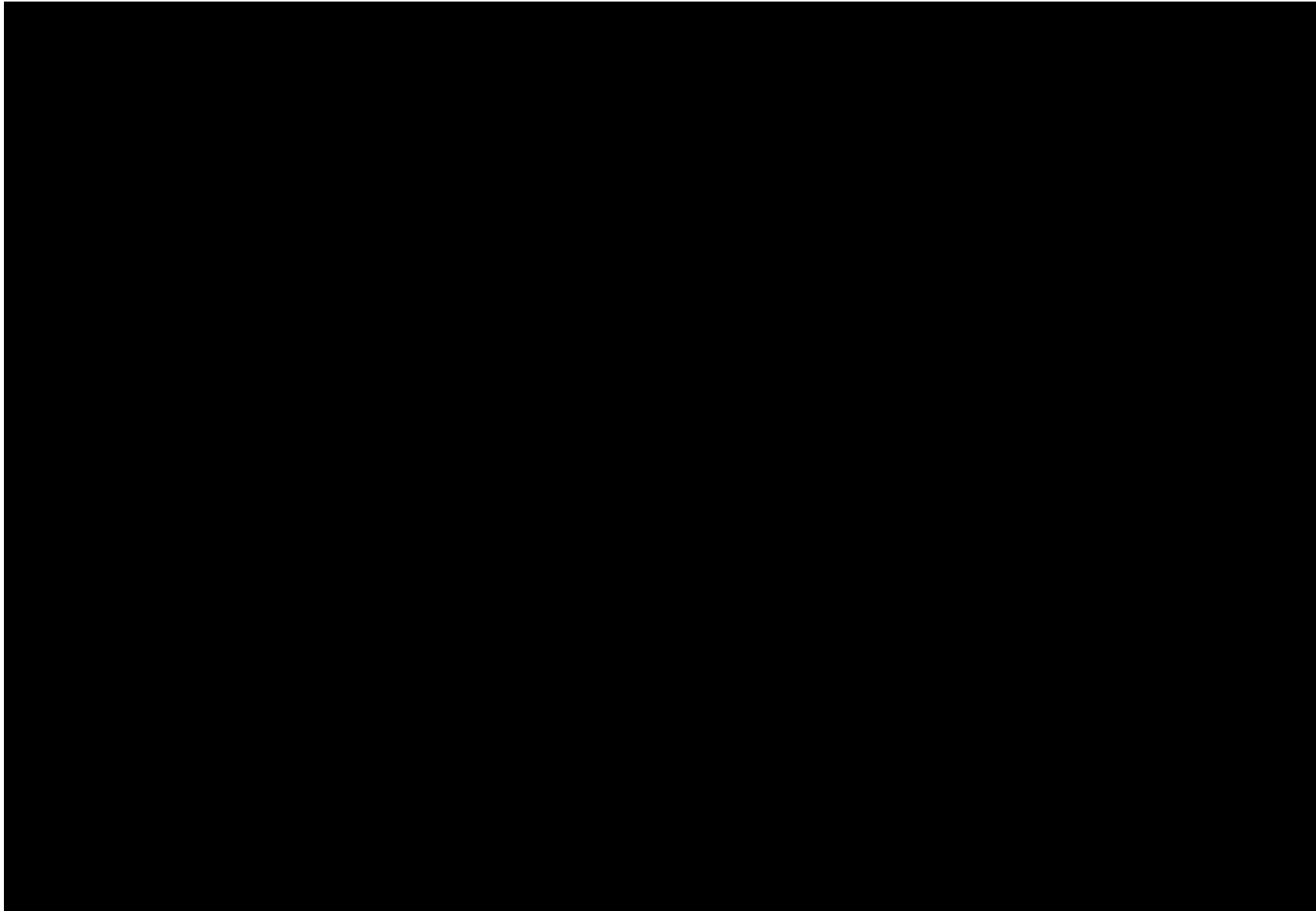


Figure 20. Copper skink locations during AR inspections in 2020 and 2021.

3.2.4 Birds

3.2.4.1 Desktop review and field survey results

Table 18 presents a collated list of bird species recorded during the desktop review, incidentally on site, and during five-minute bird counts. None of the wetland birds specifically targeted by the wetland bird surveys (bittern, dabchick, spotless crane, fernbird, or shags) were recorded. Full results for each of these data collection methodologies are presented in Table 18.

The results of the site investigations conclude that the site is home to a wide suite of common, Not Threatened native birds, as well as a range of exotic bird species. Many of these species are confirmed to be, or likely to be breeding and living permanently or for much of their life cycle within the site. However, many of these species are not overly specific in their habitat needs and therefore would also be equally likely to utilise adjacent farmland and forest habitats.

Only one Threatened or At Risk (TAR) bird species was confirmed to be present within the site; the pipit (*Anthus novaeseelandiae novaeseelandiae*; At Risk – Declining). This species was observed once, foraging in the pastoral areas within the site. Pipits are considered likely to have benefitted from forest clearance for pasture, however, have subsequently declined with land-use intensification (Beauchamp, 2013). Under previous forest cover, this species would not have occurred within the Sutton Block, as it would not have supported their open habitat requirements. Pipits therefore have benefitted, to some degree, from historic forest clearance. It is known that pipits are present at lower frequencies in areas of heavily grazed pasture (such as is present within the site) than in areas of rough pasture (Beauchamp, 2013), and consequently, much of the site would be considered to be of relatively low value for pipit, although they are known to utilise wetlands. Pipits require tussocks or long grass for breeding, and therefore, because of the heavily grazed nature of the site, are considered unlikely to breed within the site.

Of the Threatened or At-Risk bird species recorded near the site during the desktop study, many are not expected to be present because the site is lacking in their specific habitat requirements. This is discussed further for each subspecies in the sections below.

3.2.4.1.1 Forest birds (kākā and kōkako)

Both kākā (*Nestor meridionalis*) and kōkako (*Callaeas wilsoni*) have a strong association with the Hunua Ranges, located 10 km to the east of the site. Kōkako in particular, is poorly flighted, and only persists in forests where there is sustained control of mammalian predators (Innes, 2013). Consequently, it is highly unlikely to occur within the site.

Kākā are rare to uncommon in mainland forests, however they are known to periodically leave the offshore islands they inhabit (e.g., Great and Little Barrier Islands, but also some mainland sanctuaries, including Hunua Ranges) and disperse across mainland Auckland for foraging, primarily in winter months (Moorhouse, 2013). Consequently, it is possible that they may visit the site periodically for foraging purposes, however this is likely to occur infrequently, if at all. Consequently, the site is considered to be of very low value for kākā, and their presence within the site is unlikely on any regular basis.

3.2.4.1.2 Pārea / grey duck

Pārea (*Anas supersilicosa*) are threatened due to extensive hybridisation with the introduced mallard duck (*Anas platyrhynchos*), and consequently, 'pure' pārea are now very uncommon, and largely limited to remote lakes and headwater rivers (Williams, 2013b). It is generally accepted that pārea records from urbanised areas are likely to be incorrect and instead are likely to be hybrids. Due to the location of the site, as well as the recorded presence of mallard ducks within the site, it is considered highly unlikely that true pārea would be present, although hybrids may be. These are assigned an 'introduced and naturalised' threat classification (Robertson *et al.*, 2021).

3.2.4.1.3 Wetland birds (dabchick, bittern, mātātā/fernbird, spotless crane)

As described above, these wetland birds were surveyed for, and none were detected. However, for completeness the potential for presence of these species is further discussed here. With the exception of bittern, these birds were recorded during the desktop study, all to the west of the site in the extensive coastal wetlands nearer to Drury.

The initial bittern survey recorded one call that was identified by Avianz as a bittern call. This recording had a peak amplitude at 170 Hz, which was near the correct call frequency for a Bittern (120-150 Hz) (Znidarsic *et al.*, 2024) but was very faint and some uncertainty about the accuracy remained. The additional ABM surveys did not detect any other bittern calls. If the recording was in fact a Bittern, it is likely that it visited the site briefly, as they are a highly mobile species. There was no evidence that this species is resident or breeding at the site.

Dabchick (*Poliocephalus rufopectus*) are known to require areas of open freshwater with adjacent dense vegetation or reedbeds for breeding (Szabo, 2013). These habitats are not present on site, as the wetlands do not have open water areas, and the large pond present on site does not have adjacent reed beds and is extensively grazed on its periphery. Therefore, it is considered their presence on site is highly unlikely.

Spotless crane (*Zapornia tabuensis*) and fernbird (*Poodytes punctatus*) are known to inhabit dense freshwater wetlands, including raupō reedlands (Fitzgerald, 2013; Miskelly, 2013), which is a habitat type present on site. However, this wetland is relatively small and lacks connectivity to any other wetlands with suitable vegetation.

All of these species are particularly sensitive to mammalian predators. Bittern are a highly mobile species but are most often found in extensive areas of wetland. They are highly sensitive to disturbance (Williams, 2013a) and consequently may be deterred from the site due to the adjacent quarrying activities.

Given the dedicated survey effort for all of these wetland bird species, as well as the time spent within and adjacent to the wetlands delineating them and completing vegetation surveys, it is considered highly unlikely that these species are present and have not been detected. Whilst bittern are highly mobile and could possibly periodically visit the site, given the limited and low quality wetland habitat present within the Sutton Block; and a lack of more suitable habitat close by, it is considered highly unlikely they would visit the site.

3.2.4.1.4 Shags (Black shag, little black shag, pied shag, and little shag)

Shags are most likely to visit the site for periodic feeding at the large pond. It is considered highly unlikely any of the shags recorded in the desktop study would have utilised the site for breeding without detection during the multiple site visits undertaken, and despite repeated site visits undertaken across a wide range of seasons and a dedicated survey effort, these birds have not been detected on site. Consequently, they are considered unlikely to be present.

3.2.4.1.5 Karearea / New Zealand falcon (*Falco novaeseelandiae*).

Karearea are not known to be permanent residents within the Auckland Region (they are also considered absent north of Auckland), however, they are occasionally sighted in the region. Of note, Karearea have been identified as of particular cultural significance and are likely to have formerly been a regular or resident species. Karearea occupy habitats, similar to those that occur within Drury Quarry in other parts of New Zealand, including rough open farmland, exotic and native forest. As a highly mobile species, particularly juvenile dispersers over winter months, karearea could potentially hold territories within the Sutton Block and surrounding area, however breeding is considered unlikely.

3.2.4.2 Ecological value

The site is known to support one 'At Risk – Declining' bird species, the pipit, but is not expected to support any other Threatened or At Risk species. In addition, it supports a range of common, Not Threatened bird species. As described above, the site is expected to only provide foraging habitat for pipit due to its heavily grazed nature. Consequently, the site overall is considered to be of **moderate** value for birds.

Table 18. Birds recorded as present or potentially present within the Site.

Common name	Scientific name	National threat classification (Robertson <i>et al.</i> , 2021)	Desktop study	Incidental observations	Five-minute bird counts
Australasian harrier, kāhu	<i>Circus approximans</i>	Not Threatened	✓	✓	
Banded rail, moho pererū	<i>Gallirallus philippensis assimilis</i>	At Risk - Declining	✓		
Black shag, kawau tuawhenua	<i>Phalacrocorax carbo novaehollandiae</i>	Threatened - Nationally Vulnerable	✓		
Grey duck, pāpera	<i>Anas superciliosa</i>	Threatened - Nationally Vulnerable	✓		
Grey teal, tētē moroiti	<i>Anas gracilis</i>	Not Threatened	✓		
Grey warbler, riroriro	<i>Gerygone igata</i>	Not Threatened	✓	✓	✓
Karearea	<i>Falco novaeseelandiae</i>	Threatened - Nationally Increasing			
Kererū, New Zealand pigeon,	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	✓	✓	✓
Morepork, ruru	<i>Ninox novaeseelandiae novaeseelandiae</i>	Not Threatened	✓	✓	
Little black shag, kawau tūi	<i>Phalacrocorax sulcirostris</i>	At Risk - Naturally Uncommon	✓		
Little shag, kawau paka	<i>Microcarbo melanoleucos brevirostris</i>	At Risk - Relict	✓		
New Zealand dabchick, weweia	<i>Poliocephalus rufopectus</i>	Threatened - Nationally Increasing	✓		
New Zealand kingfisher, kōtare	<i>Todiramphus sanctus vagans</i>	Not Threatened	✓	✓	✓
New Zealand pipit, pīhoihoi	<i>Anthus novaeseelandiae novaeseelandiae</i>	At Risk - Declining	✓	✓	
North Island fantail, pīwakawaka	<i>Rhipidura fuliginosa placabilis</i>	Not Threatened	✓	✓	✓
North Island kākā	<i>Nestor meridionalis septentrionalis</i>	At Risk - Recovering	✓		
North Island kōkako	<i>Callaeas wilsoni</i>	Threatened - Nationally Increasing	✓		
Paradise shelduck	<i>Tadorna variegata</i>	Not threatened		✓	✓
Pied shag, kāruhiruhi	<i>Phalacrocorax varius varius</i>	At Risk - Recovering	✓		
Pūkeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened	✓	✓	✓
Shining cuckoo, pīpīwharaua	<i>Chrysococcyx lucidus</i>	Not threatened		✓	
Silvereye, tauhou	<i>Zosterops lateralis</i>	Not Threatened	✓	✓	✓
Spotless crane, pūweto	<i>Zapornia tabuensis tabuensis</i>	At Risk - Declining	✓		
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened	✓	✓	✓
Tūi	<i>Prosthemadera novaeseelandiae novaeseelandiae</i>	Not Threatened	✓	✓	✓
Welcome swallow, warou	<i>Hirundo neoxena neoxena</i>	Not Threatened	✓	✓	✓
White-faced heron	<i>Egretta novaehollandiae novaehollandiae</i>	Not Threatened	✓		

3.2.5 Bats

3.2.5.1 Desktop review

The Department of Conservation's National bat database identifies multiple long-tailed bat records at the Hunua Ranges, which supports one of the best-known populations of bats in the Auckland Region. Nearer to Drury Quarry, bats have been recorded at Ponga Road, 1-2 km (2014) from the Site (Figure 21).

3.2.5.2 Bat Survey

Four bat surveys were undertaken, covering spring, summer and autumn over 2020 (September & October), 2021/22 (December- February), and twice in 2024 (March/April and October / November). Weather conditions during the four survey periods were assessed against relevant DOC criteria (2021; 2024) for 'valid survey nights'. This found that of a total of 161 survey nights, 125 had suitable weather conditions. The weather analysis data is presented in Appendix D.

In the 2020 survey, one possible pass was detected from AR4 at SEA_T_5346, at the southern edge of the existing pit (beyond the Sutton Block). This area is located at the southern end of the existing Drury Quarry Pit and not within the ZOI. It and was not associated with foraging activity (feeding buzz) or indicative of a nearby day-roost, because it was recorded shortly after midnight. No other passes were detected within or adjacent to the Site over 2020, 2021 or 2024 (Table 19).

It is noted that, while the survey period in 2020 included four recorders operating on nine nights outside the main bat survey period (1 October– 30 April, Department of Conservation 2021), nights which did not meet valid survey night parameters were excluded from analysis.



Photo 14. ABM 2 on Puriri tree facing towards rock forest fragment (2020) survey.

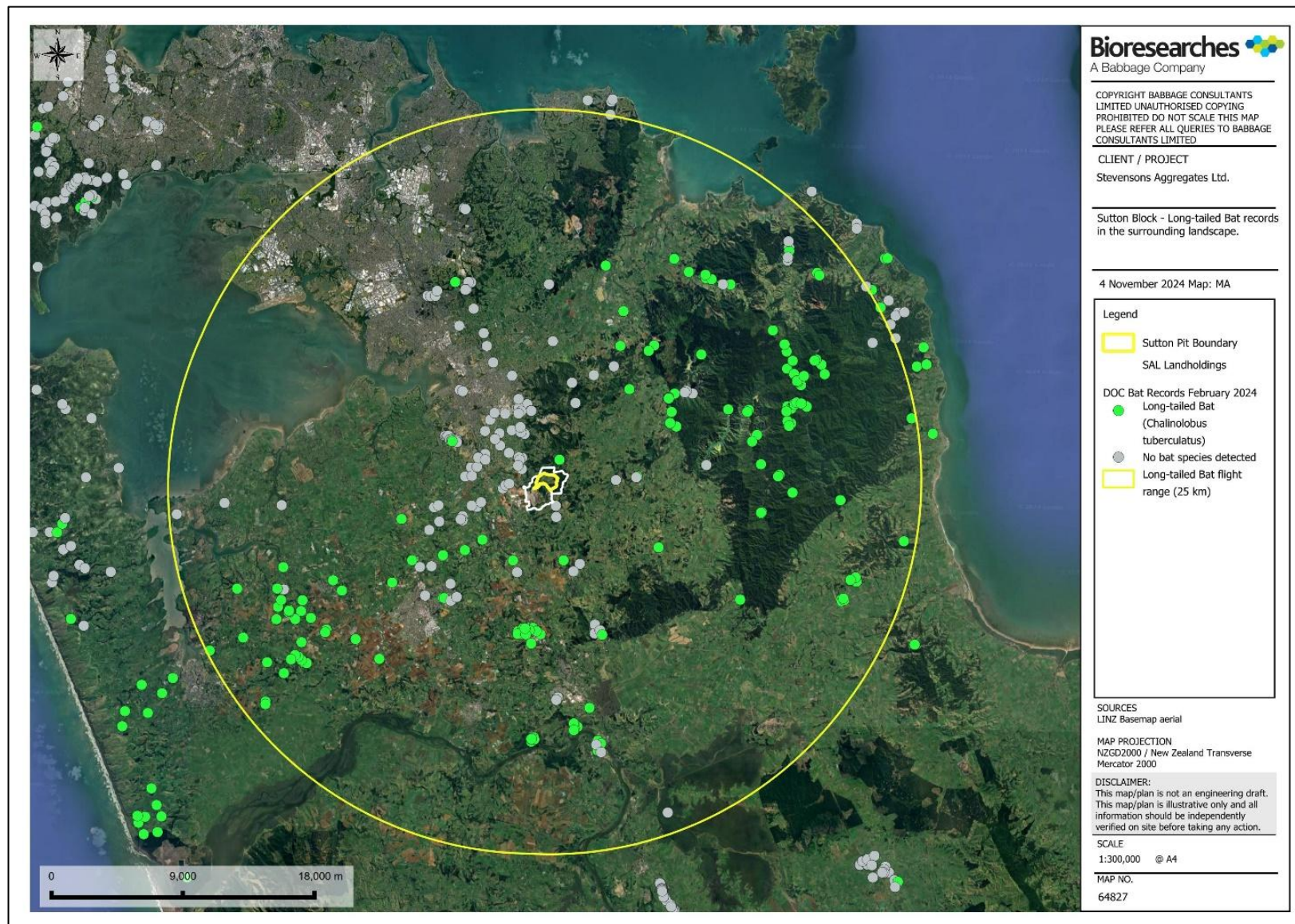


Figure 21. Bat detections from within the wider landscape recorded in the Department of Conservation bat database (updated February 2024).

Table 19. 2020, 2021 and 2024 ABM survey results at Drury Quarry (refer Figure 4 for ABM locations).

Survey year	Bat recorder	Start date	End date	Useable nights	Passes
2020	1	22/09/2020	27/10/2020	19	1*
	2	22/09/2020	27/10/2020	19	0
	3	22/09/2020	27/10/2020	19	0
	4	22/09/2020	27/10/2020	19	0
2021	5	11/12/2021	14/02/2022	66	0
	6	11/12/2021	14/02/2022	66	0
	7	11/12/2021	14/02/2022	66	0
2024a	8	27/03/2024	16/04/2024	16	0
	9	27/03/2024	13/04/2024	14	0
	10	27/03/2024	16/04/2024	16	0
	11	27/03/2024	16/04/2024	16	0
	12	27/03/2024	12/04/2024	14	0
	13	27/03/2024	16/04/2024	16	0
	14	6/03/2024	11/03/2024	6	0
	15	5/03/2024	22/03/2024	17	0
	16	5/03/2024	21/03/2024	16	0
	17	5/03/2024	7/04/2024	12	0
2024b	18	18/10/2024	4/11/2024	11	0
	19	18/10/2024	4/11/2024	11	0
	20	18/10/2024	4/11/2024	11	0
	21	18/10/2024	4/11/2024	11	0
	22	18/10/2024	4/11/2024	11	0
	23	18/10/2024	4/11/2024	11	0
	24	18/10/2024	4/11/2024	11	0
	25	18/10/2024	4/11/2024	11	0
	26	18/10/2024	4/11/2024	11	0
Total				516	1

*possible pass

3.2.5.3 Ecological value

Long-tailed bats are Nationally ‘critical’ and are a high priority for conservation. Their value is therefore ‘**Very High**’ under EIANZ criteria for valuing species (Table 60). However, because they can have very large home ranges (>50 km²) and move tens of kilometres each night (O’Donnell, 2001), it is not uncommon for bats (often solitary individuals) to be detected flying over open areas at great distance from their roost and foraging habitats.

Because they are a highly mobile species (they are widely cited as being able to travel up to 50 km per night), it is possible that the recording (outside the proposed Sutton Block Pit area) originated from a lone bat passing over or through the site from roost habitat beyond the SAL Landholdings. The time of the possible pass would support this, as it was recorded shortly after midnight. This indicates that the activity recorded

at SEA_T_5349 was not associated with leaving or entering a day-roost, an important indicator of high value habitat.

However, long-tailed bats are also known to use different parts of their habitat within their home ranges at different times of the year, as they move between roost trees and foraging sites. For this reason, non-detection of bats at other parts of the investigation area during the survey period does not necessarily infer that these areas are not important bat habitat at other times of the year. However, the lack of detection with the bat recorders, in conjunction with few bat database records for bats in the surrounding landscape, do indicate that the Sutton Block is unlikely to be regularly accessed by bats for roosting, foraging and commuting. Therefore, while it is acknowledged that a bats or bats may still potentially be present within the site intermittently, or at some point in the future, they have not been detected from repeat surveys over spring, summer and autumn.

Large trees with potential roost habitat were observed within all four forest types within the investigation area. Some of these trees are also suitable for communal roosting, which would be highly significant if used at any time during the year, because roosts are chosen specifically for their thermal properties, and such trees will be a limited resource to bats. Further, there is some potential for roost values to change over time, with respect to the indicative staging. In particular, trees in indicative stage 4 (including kākūka dominant vegetation and SEA_T_1177 may have greater capacity to support roosts as this vegetation matures, however active, adjacent quarry activities, (light, noise, vibrations and as per existing quarry operations) may be a deterrent.

Overall, very high value bats have not been recorded within Sutton Block and are not considered to be present on any regular basis. While individuals have potential to visit the site intermittently (such as dispersing juveniles), the value of the potential habitats to bats is considered **moderate** on the basis that there is no indication that they are used (i.e. negligible-low value), but they occur within the ZOI and range of low-level activity recorded in the wider landscape of Sutton Block (e.g possible pass south of existing pit, Pong Road to the north).

3.2.6 Summary of fauna values

A site-wide summary of fauna values is provided in Table 20, as species and taxa assessed are generally associated with multiple habitat types that have been identified or are potentially present within the proposed Sutton Block Pit. Overall, fauna values within the proposed Sutton Block Pit are considered conservatively Moderate, based on the presence of two high value species. Of these, copper skink, while a declining species, remains common and widespread in the Auckland region, including urban gardens. Similarly, pipit are widespread in rough, open habitats such as pasture and rough farmland and would not otherwise be expected to be present with forest or scrub vegetation cover.

Table 20. Summary of fauna values within the proposed Sutton Pit.

Fauna	Score and justification
Invertebrates	Low The invertebrate searches did not identify any threatened or 'At Risk' species and ground cover was highly modified in all habitat types (some fragments did not support sufficient ground cover for quadrat searches).

Lizards	Moderate Available habitats for skinks and geckos are highly degraded, and survey results indicate low apparent diversity, being one 'high value' species. While it is acknowledged that there is some potential for additional species to be present, the poor habitat quality indicates limited capacity to support a more diverse and representative assemblage of native lizards (geckos and skinks). A moderate assessment of value recognises presence of a high values species, at multiple locations across the proposed pit area, but at relatively low abundance. Coper skinks are common and widespread in the Auckland Region.
Birds	Moderate One 'At Risk – Declining', High value bird species was recorded (pipit) using open pastoral areas, and the species is widespread in such environments. The Sutton Block is not considered to support breeding habitat due to intensive grazing, and no other TAR species are expected to be present. The site supports a range of common, Not Threatened bird species that are generally tolerant of degraded and highly modified environments. The Sutton Block is considered conservatively moderate, based on the presence of one 'High value' species.
Bats	Moderate No indication that potential roost habitats are used, but they occur within the range of bats that have been recorded from low-level activity in the wider landscape of Sutton Block.
Hochstetter's Frogs	NIL Hochstetter's Frogs are not considered to be present.
Overall Fauna Value	Moderate

3.3 Freshwater Habitats

All aquatic habitats with the Sutton Block pit were assessed. Field surveys of aquatic habitats were carried out between July 2018 and September 2024. The aquatic habitats in the expansion area and immediately adjacent, were comprised of nine un-named streams (or stream systems), a mix of permanent and intermittent streams, all upper tributaries to the Hingaia Stream, and fourteen areas of wetland, all of which meet the definition of a Natural Inland Wetland in the NPS-FM. No additional AUP wetlands were determined. The wetlands are numbered in general accordance with the catchment or stream system within which they are located. All freshwater habitats are depicted in Figure 22, with the streams and wetlands separately mapped as Figure 23 to Figure 26 provide the location of the SEV reaches and wetland plots.

Most aquatic catchments / subcatchments had both streams and wetlands, the exceptions being Streams 4 and 5, which only had streams; and Wetland 8, which was only wetland.

The Sutton Block Pit was redesigned in 2023 to avoid all known wāhi tapu and taonga sites within the wider surrounding area, and was moved 20 m further to the north from Kaarearea Paa, resulting in significant reduction of stream and wetland reclamation. This redesign avoids the reclamation of Stream 4 and southern boundary streams and wetlands. Further redesign in 2024 has resulted in the stream flow being supplemented from the pit from the upper reach of Stream 4 at the confluence of the lower Stream 2 system,

minimising the potential adverse effects of reduction in flow from the reduction in the contributing catchment.

The streams characteristics are described Section 3.3.1 below, with the characteristics of each of the representative SEV reaches summarised in Table 21.

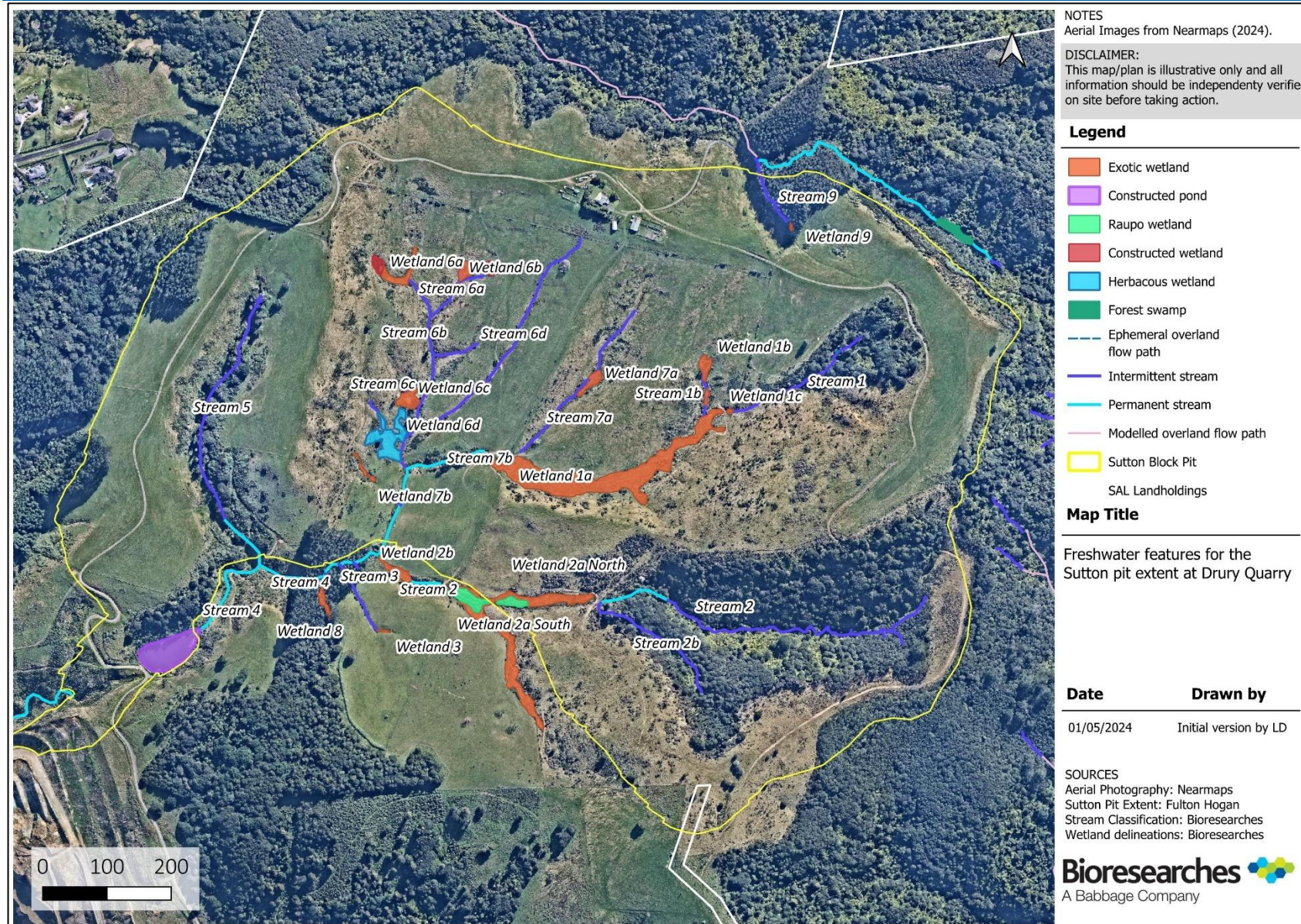


Figure 22. Freshwater ecological features within the Sutton Pit.

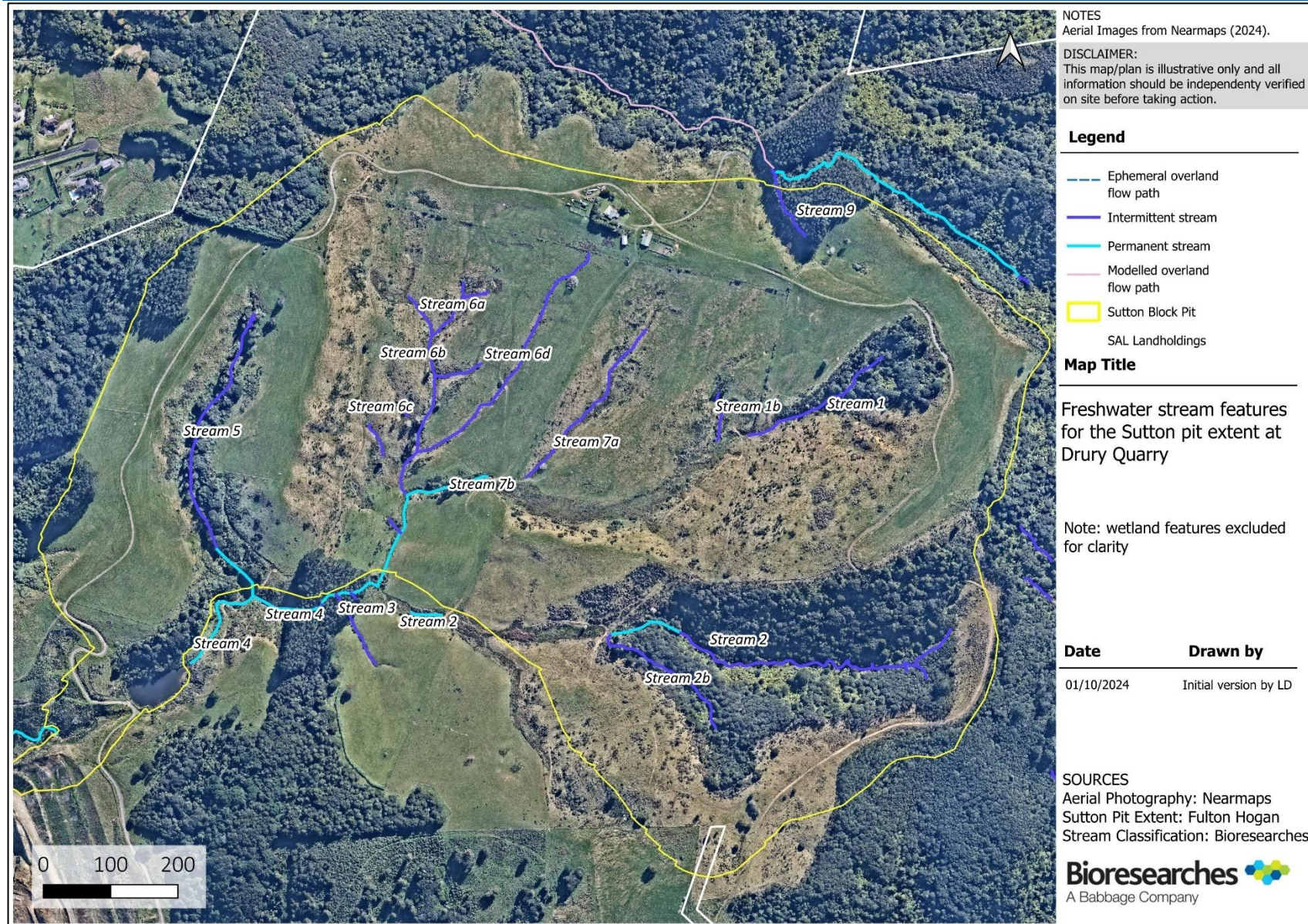


Figure 23. Streams within the Sutton Pit and immediate vicinity.

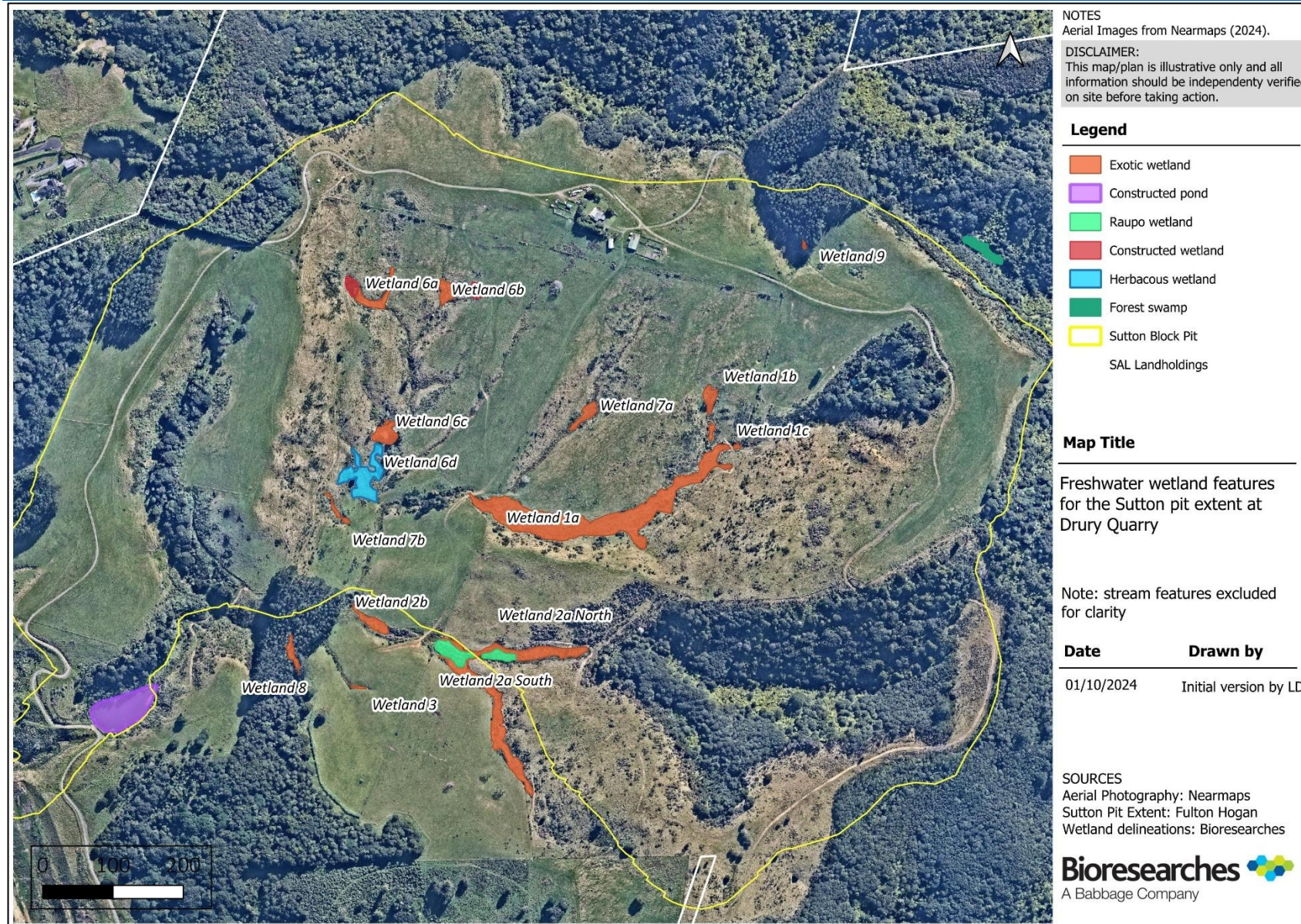


Figure 24. Wetlands within the Sutton Pit and immediate vicinity.

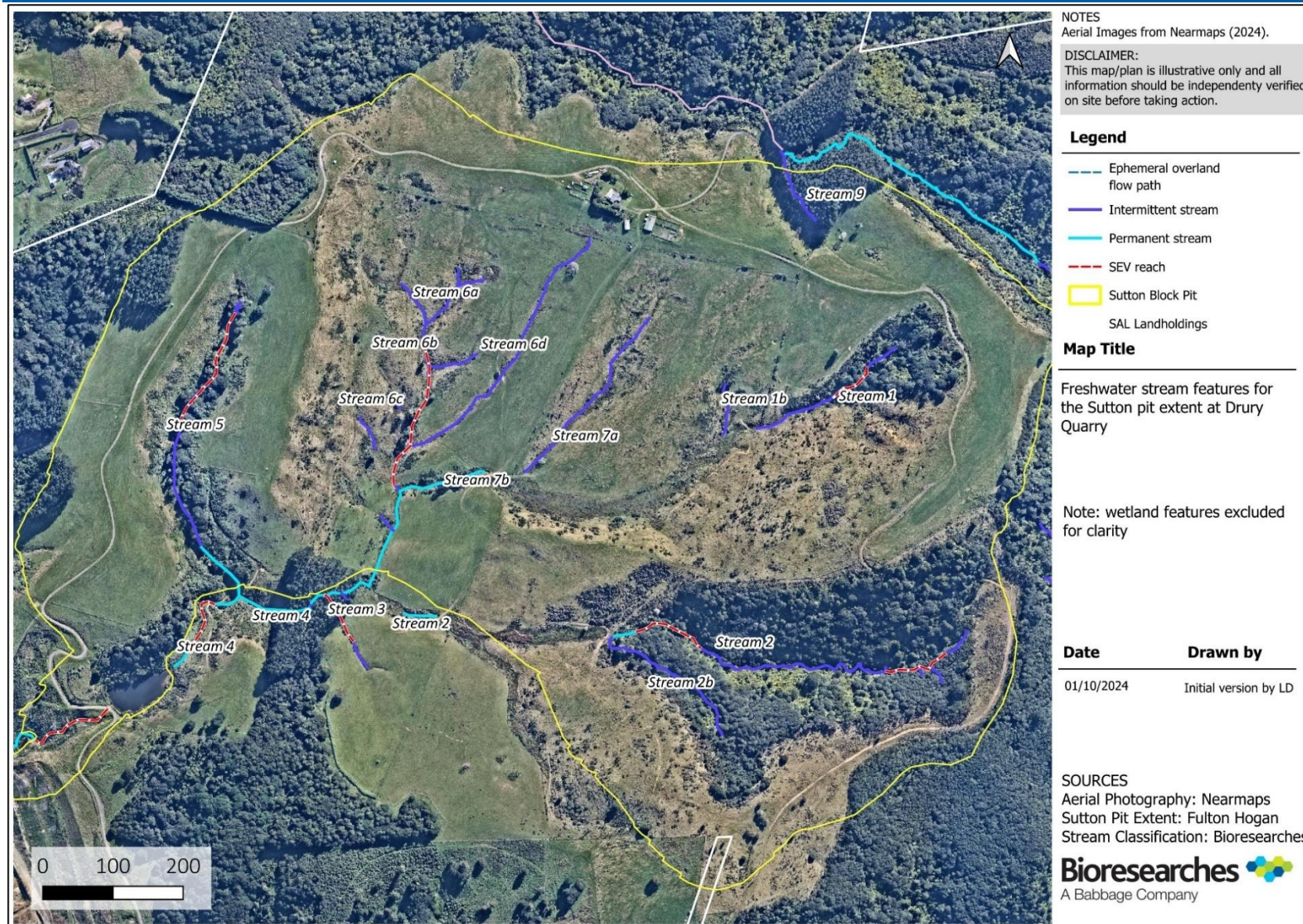


Figure 25. Stream assessment and test reach/locations. Note, wetland features not shown for clarity

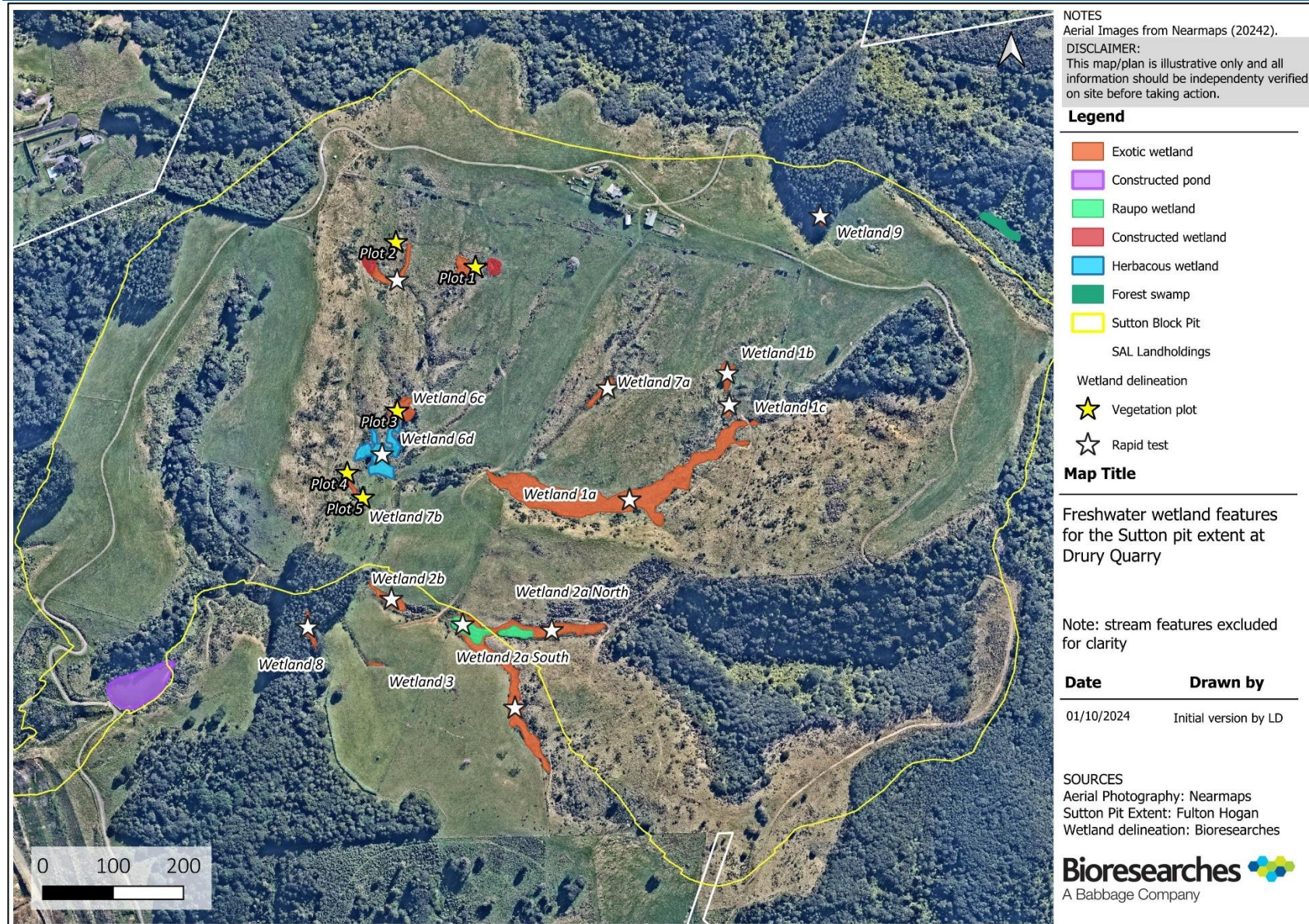


Figure 26. Wetland assessment and test plot/locations. Note, stream features not shown for clarity

Table 21. Drury Quarry Sutton Block SEV Stream Characteristics

Habitat Parameter	Stream 1	Stream 2 Headwaters	Stream 2 Upper	Stream 3	Stream 4 Upper & mid	Stream 4 lower	Stream 5	Stream 6	Stream 7	Stream 9
Habitat Features										
Average width (m)	0.68	0.43	0.71	0.39	1.65	2.51	0.56	0.61	0.53	0.36
Average depth (m)	0.14	0.04	0.19	0.03	0.22	0.21	0.06	0.08	0.15	0.04
Dominant substrates	Gravel, silt, woody debris	Silt	Gravel, cobble, silt	Clay and silt	Bedrock, cobbles and gravel	Boulders, cobble, silt	Silt over bedrock	Silt with bedrock	Silt	Silt
Macrophyte abundance	Nil	Nil	Nil	Nil	Occasional	Rare starwort or watercress	Nil	Rare starwort or watercress	Occasional starwort	Nil
Riparian vegetation	Grass and damaged native trees	Native scrub	Native scrub in upper reach; pasture; exotic pines lower reach	Pasture	Gorse and pasture, with occasional native shrubs	Pasture with occasional gorse and pampas	Pasture and regenerating native bush	Pasture with occasional native trees	Pasture and gorse	Native scrub
Water Quality										
Date	12/10/2020	14/08/2024	12/10/2020	12/10/2020	10/11/2021	27/07/2018	10/11/2021	17/11/2021	17/11/2022	14/08/2024
Time	10:00	11:00	13:20	-	9:55	-	14:20	-	-	11:00
Temperature (oC)	13.2	-	13.1	-	15.1	-	18.1	-	-	-
Oxygen saturation (%)	87	-	97	-	86.7	-	81.2	-	-	-
Dissolved oxygen (g/m3)	9.1	-	10.1	-	8.7	-	7.86	-	-	-
Conductivity (mS/cm)	98.1	-	102	-	109.6	-	95.4	-	-	-
Macroinvertebrates										
Sampling protocol	HB	-	HB	-	HB	-	SB	HB	-	-
No. of taxa	11	-	27	-	18	-	14	15	-	-
Dominant taxon	Mayfly <i>Zephlebia</i>	-	Mayfly <i>Zephlebia</i>	-	Amphipod	-	Amphipod	Freshwater snail	-	-
EPT	5	-	17	-	2	-	2	5	-	-
%EPT*	96	-	64	-	2	-	10	3	-	-
MCI	116 'Good'	-	114 'Good'	-	73 'Poor'	-	107 'Good'	112 'Good'	-	-
SQMCI	6.92 'Excellent'	-	5.98 'Good'	-	4.57 'Fair'	-	5.64 'Good'	4.16 'Good'	-	-
Koura	Common	-	Common upstream	-	Occasional	-	-	-	-	-
Fish										
Species recorded	Nil	Nil	Shortfin & longfin eel*	Nil	Longfin eel	-	Nil	Nil	-	Nil
Number of fish	0	0	2	0	1	-	0	0	-	0
Fish IBI Score & Rating	0 'no natives'	0 'no natives'	34 'Fair'	0 'no natives'	30 'Fair'	-	0 'no natives'	0 'no natives'	-	0 'no natives'
Stream Ecological Value										
SEV Score	0.55	0.54	0.67	0.46	0.46	0.42	0.53	0.4	0.34	0.51

3.3.1 Stream Habitats and Values

3.3.1.1 Stream 1 (SEV1)

Stream 1 was the most north-eastern stream within the Sutton Pit Expansion area and was considered to be of moderate ecological value (Table 22). There was a continuous depth and presence of water, and a large catchment size (3.4 ha), and Stream 1 was classified as a permanent stream.

Stream 1 flowed in a general east to west direction for 241 m before discharging directly into Wetland 1a. The stream channel ranged between 0.14 m to 1.20 m (average 0.68) in width, with an average water depth of 0.14 m with incised banks and undercut banks present. Water flow was good with a moderate degree of hydrological heterogeneity present, including riffles, runs, drops and deep pools approximately 0.49 m deep. The substrate was dominated by silt with wood and small gravel providing some low-quality macroinvertebrate habitat.

The riparian area was damaged by stock and was comprised of grass and bare ground under a canopy of native trees, dominated by ponga, nīkau and pukatea with rātā epiphytes growing on ponga trunks. Although there was little understory or ground cover the trees provided moderate to high shading on the watercourse, which was reflected in the comparatively low water temperature. (Photo 15 and Photo 16).



Photo 15. Riparian vegetation throughout Stream 1. **Photo 16. Incised channel of Stream 1.**

The SEV score for Stream 1 was 0.55, indicative of 'Moderate' stream health. The SEV scored well in the biogeochemical functions, however the score reflected the impacted riparian yard, low connectivity to the floodplain and high levels of silt in the watercourse.

Stream 1b was present just downstream of Stream 1 and was considered to be of very low ecological value. The reach met three of the intermittent stream criteria, and due to the shallow depth throughout and small size, it was classified as an intermittent stream. Stream 1b was 74 m long, flowing in a north to south and drained into the upper portion of Wetland 1a. The headwaters of Stream 1b originated within a small palustrine wetland, further described in Wetland 1b, and flowed through an exotic wetland described in Wetland 1c. The stream channel was narrow (average 0.19 m) and shallow (average 0.03 m) (Photo 17), with pugging impacts observed through the channel banks (Photo 18).



Photo 17. Narrow flow path of Stream 1b



Photo 18. Pugged banks of Stream 1b

Table 22. Ecological Value of Stream 1

Matter	Score and Justification
Representativeness	Low Intermittent to permanent stream with degraded channel banks and riparian yard due to stock access. Flow was good with organic matter providing some variation in substrate.
Rarity/distinctiveness	Moderate No freshwater fish observed through, and most valuable for koura. Low diversity of macroinvertebrate taxa however MCI scores reflect 'Good' to 'Excellent' quality habitat with mayfly dominating sample and high %EPT taxa. Predominantly soft bottomed and dominated by silt substrates, reducing the quality and abundance of aquatic habitat
Diversity and pattern	Moderate Reasonable diversity of in-stream habitats including riffles, runs, drops and deep pools. Stream banks degraded through stock access with some incision in the upper catchment. Riparian yard containing indigenous vegetation with good shade, however sub-canopy and groundcover poor.
Ecological context	Low First order stream hydrologically supporting a large natural inland wetland and forms headwaters to the Hingaia Stream. Stream with bare ground and rank pasture grass present throughout, however indigenous canopy provides high shade to the stream. Some good instream habitats with SEV scores indicating 'Moderate' stream health
Ecological Value	Moderate

3.3.1.2 Stream 2

Stream 2 is situated on the south-east extent of the Sutton Block Pit, and flows in a general west to east direction. The stream measures a total of 688 m in length, and is classified as intermittent at its upper reaches, transitioning to a permanent stream before draining into Wetland 2a (excluding the wetland extents). The stream flows for a further 45 m before terminating at a culverted farm crossing and forming a confluence with Stream 4. Two SEV assessments were conducted: one on an intermittent section at the headwaters (Photo 19; headwaters) and another on the permanent section approximately 120 metres from Wetland 2a (Photo 20).



Photo 19. Headwaters of Stream 2



Photo 20. Stream 2 upper, permanent reach

In the headwaters, Stream 2 features a defined channel with shallow flowing water that dries up during the summer months. Observations of scour, erosion, and substrate sorting support the classification of this section as intermittent. The lower reach is permanent, and contains a continuous depth and presence of standing water with large catchment size (4 ha), supporting two wetlands (further discussed below as Wetland 2a and Wetland 2b).

The headwaters of Stream 2 ranged between 0.01 and 0.13 m in depth (average = 0.04 m), and between 0.15 and 0.94 m in width (average = 0.43 m). The lower reach was typically deeper and wider, ranging between 0.06 m to 0.54 m (average 0.19 m) in depth and 0.14 m and 1.65 m in width (average 0.71 m). The headwaters exhibited low hydrological heterogeneity, and the channel was characterized by slow, shallow runs and chutes. In the lower reaches, variety of hydrological features are present, including pool-run sequences, riffles, chutes, and large pools, offering high hydrological diversity.

The headwaters of Stream 2 are situated within a significant ecological area (SEA_T_5323) and the riparian vegetation is dominated by indigenous species such as whekī, nikau, kānuka, mahoe, kahikatea, tarata, lancewood, red matipo, and ponga. The lower reach features a mix of indigenous and native species, including, but not limited to, gorse, pine, and hydric vegetation associated with Wetland 2a and Wetland 2b. Ground cover vegetation is largely absent, with a thick layer of organic debris blanketing the ground. The riparian vegetation typically offered moderate to high levels of shading across both the assessed reaches. It is expected that the riparian vegetation offers a high degree of riparian functions, particularly in the headwaters, including shading, filtration, bank stability, and organic material input. Further downstream, the riparian yard is replaced with pasture grasses and exotic shrubs, inhibiting the riparian functions. (Photo 21 and Photo 22).



Photo 21. Lower reach of Stream 2 with fyke net



Photo 22. Lower reach of Stream 2.

Gravels, cobbles and bedrock, were common across the channel, however, interstitial spaces were smothered by deposited fine sediment reducing the habitat available for macroinvertebrates. This sedimentation has been influenced by stock impacts upstream, with evidence of pugging observed in the upstream reaches. This sedimentation increases further downstream from the assessed SEV's, attributable to stock impacts and a lack of riparian vegetation. Despite the high levels of sedimentation, hard substrates, organic material (wood and leaf litter), undercut banks, and root mats offered moderate value habitat for aquatic biota.

The SEV score for the headwaters of Stream 2 was 0.54, indicative of 'Moderate' stream health. The SEV score for the upper reach of Stream 2 was 0.67, the highest score for the Sutton Block and indicating 'Good' stream health. Despite evidence of stock impacts, the relatively high SEV scores reflected the intact and largely indigenous riparian zone in the headwaters, the unmodified stream channels, and the high abundance of aquatic habitat in the lower reaches. The SEV score downstream of the lower reach of Stream 2, between Wetland 2a and Wetland 2b, likely aligns more closely to Stream 6 (0.40) reflecting 'Poor' stream health, due to the farm impacted stream.

Table 23. Ecological Value of Stream 2

Matter	Score and Justification
Representativeness	Moderate Intermittent stream transitions to a large permanent stream, which offers year-long aquatic habitat with stable substrates. Some sedimentation and turbidity present. The stream channel was un-modified, and the riparian zone was typically dominated by indigenous vegetation in the headwaters, although it is replaced by pasture and exotic shrubs downstream.
Rarity/distinctiveness	Moderate Supports longfin eel and common indigenous fauna. Stream dominated by hard substrates, uncommon in the Auckland Region. Moderate diversity of macroinvertebrate taxa however MCI scores reflect 'Good' quality habitat with mayfly dominating sample, moderate abundance of EPT taxa and %EPT.
Diversity and pattern	Moderate Diverse stream bank profile and stream depth and high hydrological heterogeneity and aquatic habitat; however, this decreases downstream where the stream flows through pasture/farmland where stock impacts present. Habitat variability was typically high, however, interstitial spaces favoured by macroinvertebrates were typically reduced by sedimentation.
Ecological context	Moderate

	First order stream hydrologically supports large natural inland wetlands and contains a diverse mix of exotic and indigenous riparian vegetation. The headwaters of the stream offer high levels of riparian function (i.e. shading, filtration, bank stability) which likely enhances the water quality for the receiving wetlands. However, the stream ecological value diminishes in the downstream reaches, where riparian vegetation is confined to pasture grasses and exotic shrubs offering limited riparian functions, and the stock impacts in this area have led to increased sedimentation. SEV reflects channel modification and degradation with 'Good' to 'Poor' stream health as the watercourse flows downstream
Ecological Value	Moderate

3.3.1.3 Stream 2b

Stream 2b was present on the south-east extent of the Sutton Pit and was considered to be of low ecological value ([Table 24](#)). Stream 2b forms a confluence with Stream 2 prior to entering Wetland 2a. Stream 2b contained defined banks, very shallow water resulting in flow, pools and evidence of erosion and scour. (Photo 23 and Photo 24). The stream has a small catchment, and was classified as an intermittent stream., which flows in a general east to west direction for 241 m in length, before forming a confluence with Stream 2.



Photo 23. Stream 2b upper



Photo 24. Stream 2b, silted channel

Stream 2b ranged between 0.16 m and 0.59 m in width (average 0.28 m) and the depth ranged between 0.06 m to 0.15 m within an incised channel. There was a low degree of hydrological heterogeneity, with the stream largely consisting of shallow pool run sequences. The substrate was dominated by hard substrates including gravel and bedrock; however, the streambed was coated with a layer of deposited fine sediments, infilling interstitial space, reducing the quality of macroinvertebrate habitat.

The riparian vegetation through the entirety of Stream 2b consisted of sparse native trees with the sub-canopy and ground cover consisting of pasture grasses. The stream is located within section of SEA (SEA_T_5323). Vegetation observed included, predominantly consisted of kahikatea, ponga and kānuka. Shading was relatively low throughout, due to the riparian vegetation not containing full canopy cover. It is expected the riparian yard in the upper reaches would provide a low degree of riparian functions such as filtration, bank stability, and organic matter due to the sparse tree canopy and pasture understory and ground cover.

Table 24. Ecological Value of Stream 2b

Matter	Score and Justification
Representativeness	Low Intermittent reach which has been impacted through stock access with sedimentation present from the surrounding land use. Water flow slow and shallow on average reducing habitat abundance.
Rarity/distinctiveness	Moderate No fish or large macroinvertebrates recorded through the stream reaches. Stream is naturally hard bottomed with a bed rock base, uncommon in the Auckland Region, but covered with silts.
Diversity and pattern	Low Low habitat variability and pattern present with limited aquatic habitats due to low, shallow flows. Riparian vegetation provided good shading functions to the stream with a diverse range of indigenous vegetation.
Ecological context	Low First order stream with modified habitat subject to stock impacts resulting in pugging on stream banks. Riparian mixed exotic and native with sub-canopy and ground cover impacted.
Ecological Value	Low

3.3.1.4 Stream 3

Stream 3 was present on the southern area of the Sutton Pit extent and was considered to be of very low ecological value (Table 25). The reach met three of the intermittent stream criteria, and due to the shallow depth throughout and small catchment size (2.9 ha), it was classified as an intermittent stream. With the pit design changes, Stream 3 is avoided.

Stream 3 was 135 m long, flowing in a south to north direction and drained into the upper reach of Stream 4. The headwaters of Stream 3 originated within a small palustrine wetland, further described in Wetland 3. The stream channel ranged between 0.28 m to 1 m (average 0.39 m) and depth ranged between 0.005 m and 0.09 m (average 0.03 m), with pugging impacts observed through the channel banks. Water flow was slow with the stream reach consisting of a single run and the substrate dominated by soft substrates with an unnatural loading of fine sediments and some woody debris providing low quality macroinvertebrate habitat. (Photo 25 to Photo 28).



Photo 25. Upper reach of Stream 3.



Photo 26. Stream 3 impacted by stock access.



Photo 27. Stream 3 was dominated by soft substrates.



Photo 28. Lower reach of Stream 3.

Shading on the channel was overall very low, with the upper reach present within pastoral farmland, and the lower 40 m flowing through pine. The riparian vegetation predominantly consisted of pasture grass with pines present on the downstream reach. Additional vegetation observed throughout the entire reach of Stream 3 included gorse, and some kiokio.

Table 25. Ecological Value of Stream 3

Matter	Score and Justification
Representativeness	Low Intermittent stream which predominantly flows through pastoral land and modified through pugging from stock access. Low flow diversity and generally unstable substrate and low in-stream habitats.
Rarity/distinctiveness	Very Low No freshwater fish or large macroinvertebrates observed, and stream unlikely to support fish life, even on an intermittent basis. In-stream habitat low.
Diversity and pattern	Very Low Low diversity of in-stream habitat and variation with reach largely restricted to single run with soft substrates. Riparian yard dominated by pastoral landscape with transition to pine providing no diversity in structure or species.
Ecological context	Very Low

	First order stream is predominantly soft bottomed with fine sediments present throughout and pugging impacts degrading the stream bank. Riparian vegetation of poor quality and largely consists of rank pasture grasses providing no shade before transitioning to exotic pine forest.
Ecological Value	Very Low

3.3.1.5 Stream 4 (SEV 3 and SEV 7)

Stream 4 flowed in an east to west direction and formed the main stem to which all the watercourses in the Sutton Block drain. Stream 4 was a third order permanent stream and considered to be of moderate ecological value within and downstream of the expansion area (Table 26).

Stream 4 from the confluence with Streams 2 and 7 (Figure 22) to the constructed pond (upper dam) was 371 m in length, flowing in a general east to west direction. The large constructed pond of the upper dam was approximately 128 m in length and discharges via a culvert under the access road, before continuing as a stream to flow west down a steep, boulder reach for an additional 115 m, before exiting the Sutton Block expansion area. The stream continues west through the steep bouldery gully system, over a very high waterfall into the lower dam, a large constructed pond which forms part of the existing quarry operations. Over the approximately 400m from the edge of the Sutton Block expansion area to the downstream pond the stream drops almost 100 m in height, including the approximate 20m waterfall.

The upper 371 metres of Stream 4 (between Stream 2 and Stream 5's confluences) had an average width of 1.52 m (0.9 m to 2.58 m); the middle reach, (between Stream 5 and the pond), had an average width of 1.78 m (1.1 m – 2.54 m); and the downstream reach, downstream of the access road culvert below the pond, had an average width of 2.51 m (1.52 m – 4.5 m).

The upper and middle reaches of the stream were contained within incised banks and water depth ranged between 0.02 m and 0.59 m (average 0.22 m). Water flow was good throughout the reach with pools runs and riffles present, and the stream was dominated by hard substrates, including gravel, cobbles and bedrock with some wood present, providing good macroinvertebrate habitat. Silt substrates were present and there was an unnatural loading of fine sediments throughout the reach, reducing the quality of macroinvertebrate habitat. (Photo 29 to Photo 36).



Photo 29. Upper reach of Stream 4.



Photo 30. Upper reach of Stream 4.



Photo 31. Pond present on the downstream end of Stream 4.



Photo 32. Stream 4 mid section - wide and deep.



Photo 33. Stream 4 mid section – shallow flow over hard substrates.



Photo 34. Stream 4 – poor shading.

The lower reach, below the access road culvert, was permanent. An SEV was carried out in August 2018 as part of the proposed biodiversity offset for loss of stream habitat for the previous Northern Expansion of the current pit. The stream was a hard-bottomed natural channel with a significant proportion of boulders and bedrock, and high hydrological variation with runs, deep pools, riffles and drops. The riparian vegetation was predominantly pasture grass, with occasional woolly nightshade, gorse and pampas. The channel had steep banks and stock had complete access. The stream had an average width of 2.51m (after heavy rain) and an average depth of 0.21 m. (Photo 35 and Photo 36)



Photo 35. Stream 4 downstream reach – boulders, lack of riparian cover. **Photo 36. Stream 4 downstream reach.**

Stream 4 had an overall low degree of shading provided by the riparian vegetation and topography. Vegetation observed throughout the riparian yard included gorse and pasture grass with some native vegetation present. The ground cover of pasture grass was largely uniform with sparse patches of bare banks, providing a moderate degree of filtration. The macrophytes starwort (*Callitriche stagnalis*), water cress (*Nasturtium officinale*) and water celery (*Apium nodiflorum*), and stonewort (*Nitella leonhardii*) were growing within the stream where shade was low.

The SEV score for the Stream 4 was 0.46 in the middle reach and 0.42 in the lower reach, indicating 'Moderate' stream health for both stream reaches. The SEV scored well for hydrological and some biochemical functions but less for fish spawning habitat and riparian yard integrity. The SEV score reflected the low-quality riparian vegetation due to stock damage.

Table 26. Ecological Value of Stream 4.

Matter	Score and Justification
Representativeness	Moderate Permanent stream providing a permanent presence of aquatic habitat. Stream flow is good however incised banks limit floodplain connectivity. Good flow and aquatic habitat and diversity however high sediment loading present.
Rarity/distinctiveness	Moderate Hard-bottomed stream, uncommon in the Auckland Region supporting mature longfin eel. Low diversity of macroinvertebrate taxa with MCI scores reflect 'Poor' to 'Fair' quality habitat with amphipod dominating sample and low abundance of EPT taxa.
Diversity and pattern	Moderate

	Good diversity of aquatic habitat (pools, riffles, runs) throughout stream with a range of stream widths and depths. Some modification through farming practices. Riparian vegetation dominated by exotic species with stream subject to high loading of fine sediment.
Ecological context	Moderate Third order stream forming upper catchment of the Hingaia Stream. Stream losses ecological value due to the lack of a closed canopy providing shade, sedimentation and low-quality riparian yard dominated by exotic vegetation. SEV scores are okay and indicate 'Moderate' stream health.
Ecological Value	Moderate

3.3.1.6 Stream 5

Stream was present on the north-western area of the Sutton pit extent and was considered to be of moderate ecological value (Table 27). The upper reach of Stream 5 met four of the intermittent stream criteria and transitioned to a permanent stream 386 m downstream.

Stream 5 was a cumulative 452 m in length, with the upper 397 m classified as intermittent before transitioning to permanent for the downstream 55 m and forming a confluence with Stream 4. The stream ranged between 0.21 m to 1.3 m in width (average 0.56m) and water depth between 0.005 m and 0.25 m (average 0.06 m) with the channel banks highly pugged and incised. Water flow was slow throughout the reach and runs, chutes, pools and a large waterfall present, and the substrate was dominated by fine sediments smothering the bedrock base. Occasional hard substrates and small wood was present within Stream 5, providing some low-quality macroinvertebrate habitat.

Shade was variable throughout the stream, ranging from moderate to high and provided by the topography of the area and riparian vegetation. Vegetation within the riparian yard included rank grasses, foxglove, gorse, and woolly nightshade, with a diverse range of indigenous vegetation including, but not limited to, kahikatea, tawa, tōtara, nīkau, taraire and miro. The riparian yard and ground cover provided a high degree of filtration. (Photo 37 to Photo 39).



Photo 37. Pool in upper reach of Stream 5.



Photo 39. Shade was inconsistent throughout Stream 5.



Photo 38. Waterfall present downstream in Stream 5.

The SEV score for Stream 5 was 0.53, indicating 'Moderate' stream health. The SEV scored highest in the biochemical functions and lowest in habitat provisions, particularly galaxiid and bully spawning habitat due to the incised banks and layer of fine sediments on the stream bed.

Table 27. Ecological Value of Stream 5.

Matter	Score and Justification
Representativeness	Low Intermittent reach which transitions to permanent. Channel impacted through stock access with sedimentation present from the surrounding land use. Water flow slow and shallow on average reducing habitat abundance.
Rarity/distinctiveness	Moderate No fish or large macroinvertebrates recorded through the stream reaches. Invertebrate communities dominated by amphipod with MCI scores of 'Good' Habitat quality. Stream is naturally hard bottomed with a bed rock base, uncommon in the Auckland Region, but covered with silts.
Diversity and pattern	Moderate High habitat variability and pattern present with range of aquatic habitats but low, shallow flows. Riparian vegetation provided good shading functions to the stream with a diverse range of indigenous vegetation, however exotic pest vegetation present.
Ecological context	Low

	First order stream with modified habitat subject to stock impacts resulting in pugging on stream banks. Riparian mixed exotic and native with sub-canopy and ground cover impacted. SEV scores reflect 'Moderate' stream health.
Ecological Value	Moderate

3.3.1.7 Stream 6

Stream 6 was present within the northern extent of the Sutton Pit Expansion and was considered to be of low ecological value (Table 28). Stream 6 meet six of the intermittent stream criteria, and due to the shallow depth of water throughout and small catchment size, Stream 6 was classified as an intermittent stream. Stream 6 flowed in a southern direction forming a confluence and draining into Watercourse 7. Multiple tributaries flow into Stream 6, with the headwater catchment creating a total of 1,043 m of stream length as follows:

- Stream 6a "headwater tributaries" = 207 m;
- Stream 6b "lower" = 257 m;
- Stream 6c "west branches" = 92; and
- Stream 6d "east branch" = 487 m.

The tributaries were narrow and similar in stream profiles, between 0.1 m to 0.61 m in width (overall average width of 0.26 m). These tributaries contained flowing water with incised banks and pugging impacts throughout, with much of the tributary channels unobservable due to thick slash overlaying the stream.

The channel of Stream 6 ranged between 0.32 m and 0.96 m (average 0.61 m) with the water depth between 0 m and 0.2 m (average 0.08 m). The channel banks were highly incised with some undercut banks present and the stream dominated by soft substrates with some hard substrates. Water flow was slow with runs, riffles and shallow pools present providing a moderate degree of habitat to macroinvertebrates and rock face waterfalls present on the upper reach, which likely acts as a natural barrier to fish passage. (Photo 40 and Photo 41).



Photo 40. Stream 6 was located within a gully.



Photo 41. A waterfall in upper reach of Stream 6.

Shade was relatively low throughout the stream reach, and predominantly provided by the topography of the site, slash from felled trees and sparse mature trees. The riparian vegetation largely consisted of rank pasture grasses and fox glove, with mature trees including pine, kānuka, pukatea, and gorse. (Photo 42 and Photo 43).



Photo 42. Stream 6 contained poor riparian vegetation.



Photo 43. Area of hard substrates in Stream 6.

An SEV was completed over 100 m of stream length, and was undertaken within the intermittent reach of Stream 6. The SEV score was 0.40, indicating 'Poor' stream health. The SEV scored well in hydraulic functioning and lowest in habitat provisions, particularly fish spawning habitat and water quality.

Table 28. Ecological Value of Stream 6

Matter	Score and Justification
Representativeness	Low Intermittent reach. Channel contains incised banks and is modified through land use practices with reduced habitat heterogeneity and riparian vegetation is largely absent.
Rarity/distinctiveness	Moderate No fish species or large macroinvertebrates caught. MCI indicated 'Good' habitat, however sample dominated by freshwater snail and low %EPT. Largely hard bottomed, uncommon in the Auckland Region, but dominated by excess fine sediment. Riparian yard dominated by exotic species.
Diversity and pattern	Low Moderate diversity of aquatic habitat but slow flowing with sedimentation from surround pastoral land use present. Riparian vegetation of low quality due to dominance of rank pasture grasses and sparse mature trees to provide shade.
Ecological context	Low Second order stream with multiple intermittent tributaries draining in. Surrounding land use agricultural with banks and riparian yard degraded through stock and land use practices. SEV scores low and indicative of 'Poor' stream health.
Ecological Value	Low

3.3.1.8 Stream 7

Stream 7 was on the northern area of the Sutton Pit Expansion and was considered to be of very low ecological value (Table 29). Stream 7 met five of the criteria for intermittent streams, and as the water depth was shallow and catchment size small (2.5 ha), Stream 7 was classified as an intermittent stream, which transitions to permanent downstream of Wetland 1a.

The intermittent section of Stream 7 flowed in a north-east to south-west direction for 292 m, with a palustrine wetland present within the reach (Wetland 7) and the stream channel continued through Wetland 1a, turning permanent and flowing for an additional 270 m before forming a confluence with Stream 4. The

channel of Stream 7 ranged between 0.18 m to 3.1 m (average 0.53 m upper, average 1.38 m lower) and water depth ranged between 0.01 m and 0.19 m (average 0.15 m) with the stream banks highly impacted by stock pugging. The stream bed was entirely soft bottomed with the base consisting of compacted clay, and as such, there was poor hydrological heterogeneity with the reach consisting of a single run.

Riparian vegetation throughout Stream 7 included gorse and pasture grass, with some hydric vegetation associated with Wetland 7. due to the poor-quality riparian vegetation, shading and associated riparian functions were low. Where shade was lowest, starwort and water pepper were established. Due to the bare banks, pugging impacts and poor-quality riparian yard, the filtration function of the riparian yard is very low. The SEV score was 0.34, indicating poor stream health. (Photo 44 to Photo 47).



Photo 44. Stream 7 was entirely soft bottom with stock impacts.



Photo 45. Riparian vegetation consisted of gorse and rank pasture.



Photo 46. Lower section of Stream 7



Photo 47. The lower section of Stream 7 predominantly contained exotic vegetation.

Table 29 Ecological Value of Stream 7

Matter	Score and Justification
Representativeness	Very Low

	Intermittent stream which transitions to permanent. Stream channel heavily degraded through stock access and pugging. Predominantly soft bottomed, with hard substrates common downstream, however subject to heavy loading if silt.
Rarity/distinctiveness	Very Low No fish species caught or observed throughout reach. In-stream habitat poor and riparian yard dominated by exotic species throughout the reach.
Diversity and pattern	Very Low Stock access and degradation present throughout with shallow water and low diversity in aquatic habitat and hydrology.
Ecological context	Low Third order. Downstream contains permanent habitat and hard substrates is entirely soft bottomed. Highly modified stream reach due to stock impacts (e.g., pugging and collapsed banks) with a low diversity of aquatic habitat and riparian vegetation. SEV scores indicate 'Poor' quality habitat.
Ecological Value	Very Low

3.3.1.9 Stream 9

Stream 9 is situated on the north-east extent of the Stage 5 Sutton Block Pit extent, and was considered to be of very **low** ecological value (Table 30). The reach met three of the intermittent stream criteria, and due to the shallow depth throughout and small catchment size (2.9 ha), it was classified as an intermittent stream. The headwaters of Stream 9 originate within a small palustrine wetland, further described in Wetland 9. From here, the stream flows in a general south to north direction for approximately 85 m before intercepting the proposed pit boundary. Stream 9 is within a separate catchment to Stream 1-7.

Stream 9 ranged between 0.22 and 0.45 m in width (average 0.36 m), and the stream was typically shallow (Photo 48), with large sections running subterranean and an average depth of 0.04m (range: 0 – 0.17 m). Hydrologic heterogeneity was minimal, and confined to shallow trickles and isolated pools, with pooling observed below a large fallen tree. Habitat heterogeneity was minimal, and confined to a slow run, with limited flow velocity and sections of stagnant water. Club mosses were observed within the channel, suggesting sustained periods of low flow.

Riparian vegetation on the true left bank was typically exotic, with canopy forming vegetation limited to a strip of planted pine trees. The understory vegetation on the true left bank was exotic, and confined to woolly nightshade, gorse, cocksfoot and kikuyu, with pasture grasses on the outer margins. The true right bank, however, hosted increased diversity, and a more extensive and dense area of riparian planting. Whilst canopy forming vegetation was also dominated by pine, the understory vegetation on the true right bank included a range of both indigenous and exotic vegetation, such as māhoe, gorse, lancewood, ponga and whekī. This vegetation, alongside the topography, offered high to very high levels of shading across the stream (Photo 49).

The substrate of the stream was smothered by sediment, with organic matter interspersed including leaf litter and wood, offering some low-quality macroinvertebrate habitat. Hard substrates were confined to rare cobbles, with the substrate composition limiting the interstitial spaces available for the colonisation of macroinvertebrates. Whilst no constructed barriers were present across Stream 9, the subterranean sections and fallen tree elicit a barrier to fish passage. This limitation, alongside a lack of flow permanence or suitable habitat means it is unlikely that fish inhabit this stream.



Photo 48. Upper reach of Stream 9.



Photo 49. Riparian vegetation of Stream 9

The SEV score for Stream 9 was 0.51, indicative of 'Moderate' stream health. The SEV scored well in some of the biogeochemical and hydrological functions, with low scores observed for habitat provisioning, particularly for galaxiids.

Table 30. Ecological Value of Stream 9

Matter	Score and Justification
Representativeness	Low Canopy forming vegetation is largely confined to pine trees, with a mix of exotic and indigenous sub-canopy vegetation. Water flow typically absent, and subterranean sections reduce habitat abundance.
Rarity/distinctiveness	Very Low Lack of flow permanence and suitable features inhibit the habitat quality for fish, and subterranean sections are a barrier to fish passage. Only low-quality macroinvertebrate habitat (e.g. wood, leaf litter) available, with interstitial spaces smothered by fine sediment. No freshwater fish or large macroinvertebrates observed, and stream unlikely to support fish life, even on an intermittent basis
Diversity and pattern	Low Low diversity of in-stream habitat and variation with reach largely restricted to single run with soft substrates. Substrate limited to soft sediment, and woody debris. Riparian yard dominated by pines with some tree ferns but limited diversity in structure or species.
Ecological context	Low First order stream smothered by soft sediment. Riparian vegetation, particularly on the true right bank, provided good shading functions to the stream, however, the extent and value of this vegetation was limited on the TRB, and stock impacts were apparent.
Ecological Value	Low

3.3.1.10 Summary of stream ecological values

The ecological value of each of the streams is based both on the SEV score and the four broad matters of representativeness, rarity/distinctiveness, diversity and pattern and ecological context, presented in Table 22 to Table 30 and summarised in Table 31.

Table 31. Summary of stream ecological values and SEV scores.

Stream	Ecological Value	SEV Score
Stream 1	Moderate	0.55
Stream 1b	Very Low	0.34
Stream 2	Moderate	0.40 – 0.67

Stream 2b	Low	0.46
Stream 3	Very Low	0.34
Stream 4	Moderate	0.42 – 0.60
Stream 5	Moderate	0.53
Stream 6	Very Low – Low	0.34 – 0.40
Stream 7	Very Low – Low	0.34 – 0.40
Stream 9	Low	0.51

3.3.2 Wetland Habitats and Values

3.3.2.1 Wetland 1a

Wetland 1a is an 10,730 m² palustrine swamp which the headwaters of Stream 1 flow into at the wetland's upstream end. Stream 7 also flows into this wetland at its downstream end, and a single stream (Stream 1) outflows to the wetland. The wetland has formed in a valley bottom with a wide, flat base which has naturally slowed drainage. It is likely fed via a combination of surface water and groundwater flows, along with inputs from Stream 1; and to a lesser degree, Stream 7. This wetland was identified as a natural inland wetland via the rapid test. It is likely to be saturated year-round, and therefore is considered to be a permanent wetland. Vegetation identified within the wetland was dominated by exotic species such as spearwort (*Ranunculus flammula*), soft rush (*Juncus effusus* var. *effusus* and *J. effusus* var. *compactus*), Yorkshire fog (*Holcus lanatus*) and creeping bent (*Agrostis stolonifera*), with occasional native species present such as kiokio (*Parablechnum novae-zelandiae*) and wīwī (*Juncus edgariae*). This vegetation is depicted in Photo 50 and 51. A full species list is provided in Appendix D (Table 66).

During the desktop study and site visit, the wetland was assessed based upon the four matters discussed in Section 2.1 and this was used alongside the criteria in Table 63 (Appendix A) to assign an ecological value. This information is presented in Table 32.



Photo 50 and Photo 51. Representative vegetation within Wetland 1a.

Table 32. Ecological value of Wetland 1a.

Matter	Score and justification
Representativeness	Moderate

	The wetland is just over 1 ha in size. Lindsay <i>et al.</i> (2009) estimated that of the original 6336 ha of wetland originally present within the Hunua Ecological District, only 87 ha (1%) remained in 2009. Although this is likely a low estimate, as the current definition of a wetland under the NES F is very broad and would likely identify many additional areas of wetland not included in Lindsay <i>et al.</i> (2009)'s calculations, conservatively it could be assumed that this wetland accounts for 1% of the wetland area within the Hunua Ecological District. This wetland is highly likely to be permanently saturated, as it is fed by a permanent stream, and was observed to be saturated at the time of survey. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture and for a portion of the wetland upstream, canopy cover with bare ground beneath the trees. This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is relatively low (approximately 11:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Moderate The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. May provide temporary habitat for At Risk longfin eel as they migrate upstream. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier (although there are occasional dead tree ferns and cabbage trees standing throughout the wetland), which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed.

	The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no living trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. The upper portion was under some tree cover, however stock had access to this area and the ground beneath the trees was predominantly bare soil. Therefore, aside from shading this area did not provide any buffering or protection for the wetland. The wetland is linked to an area of forest upstream, and via the watercourses on site is linked to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Moderate

3.3.2.2 Wetland 1b

Wetland 1b is a 492 m² palustrine seepage wetland located at the headwaters of Stream 1b. It is fed via groundwater and surface flows and is likely to be intermittently saturated, and therefore is considered to be an intermittent wetland. Wetland 1b was identified as a natural inland wetland via the rapid test, and is likely an induced wetland which has formed as the channel and margins of an intermittent stream have been repeatedly pugged and flattened into a wider, flatter channel by stock, impeding drainage.

Herbaceous tier vegetation identified within the wetland was dominated by wetted pasture with soft rush, wīwī, creeping buttercup, and *Isolepis sepulcraulis* (see Photo 52 and 53). Within the centre of the wetland, a patch of titoki, rimū, and nikau remained. A full species list is provided in Appendix D (Table 67), and the ecological value and justification for this is presented in Table 33.



Photo 52 and Photo 53. Representative vegetation within Wetland 1b

Table 33. Ecological value of Wetland 1b.

Matter	Score and justification
Representativeness	Low The wetland is 492 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.05% of the wetland area within the Hunua Ecological District when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest, however discrete indigenous trees remain within the wetland.

	The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture. This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has an irregular basin shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 5:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At-Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At-Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat and highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has two vegetative tiers', providing some low -level diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – woody tier vegetation provides limited presence of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and predominantly herbaceous, discreet native tree tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.3 Wetland 1c

Wetland 1c is a 136 m² palustrine wetland located on the floodplain of Stream 1b. It is fed via groundwater and surface flows and is likely to be intermittently saturated and therefore is considered to be an intermittent wetland. Wetland 1c was identified as a natural inland wetland via the rapid test, and is likely an induced wetland which has formed as the channel and margins of an intermittent stream have been repeatedly pugged and flattened into a wider, flatter channel by stock, impeding drainage (Photo 54 and Photo 55).

Herbaceous tier vegetation identified within the wetland was dominated by wetted pasture with soft rush, wīwī, creeping buttercup, *Isolepis sepulcraulis*, water plantain (*Alisma lanceolatum*) and creeping bent. A full species list is provided in Appendix D (Table 68), and the ecological value and justification for this is presented in Table 34.



Photo 54 & Photo 55. Representative vegetation within Wetland 1c

Table 34. Ecological value of Wetland 1c.

Matter	Score and justification
Representativeness	Low The wetland is 136 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.01% of the wetland area within the Hunua Ecological District when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest, however discrete indigenous trees remain within the wetland. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. There is no effective riparian buffer (surrounding vegetation includes short, grazed pasture. This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 2:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status.

	No Threatened or At-Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At-Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat and highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one vegetative tier providing low diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and predominantly herbaceous, discreet native tree tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.4 Wetland 2a

Wetland 2a is a 6,536 m² palustrine swamp. It has two arms, one which extends in an eastern direction, and into which Stream 2 flows (Wetland 2a North), with the wetland forming 580 m downstream of the headwaters of Stream 2. The second arm extends in a south-eastern direction (Wetland 2a South). The wetland has formed in a valley bottom with a wider, flatter base which has naturally slowed drainage, and is likely fed via a combination of surface water and groundwater flows; with additional inputs from Stream 2 for the eastern arm. This wetland was identified as a natural inland wetland via the rapid test. It is likely to be saturated year-round, and therefore is considered to be a permanent wetland.

The wetland had two distinct vegetation types. The type which covered the majority of the wetland was Exotic Wetland vegetation with a similar composition to Wetland 1a and forms 5,030 m² of Wetland 2a's extent. The exotic portion of Wetland 2a was dominated by creeping bent, Yorkshire fog, soft rush and spearwort.

The second vegetation type was a Raupō Reedland (WL19), which was dominated by raupō (*Typha orientalis*), was growing within the exotic wetland component and forming 1,506 m² of Wetland 2a. The two vegetation types are depicted in Photos 56 and 57. A full species list is provided in Appendix D (Table 67), and the ecological value and justification for this is presented in Table 35.



Photos 56 and Photo 57. Representative vegetation within Wetland 2a.

Table 35. Ecological value of Wetland 2a.

Matter	Score and justification
Representativeness	Moderate The wetland is 6536 m² in size. Lindsay et al. (2009) estimated that of the original 6336 ha of wetland originally present within the Hunua Ecological District, only 87 ha (1%) remained in 2009. Although this is likely a low estimate, as the current definition of a wetland under the NES F is very broad and would likely identify many additional areas of wetland not included in Lindsay et al. (2009)'s calculations, conservatively it could be assumed that this wetland accounts for 0.75% of the wetland area within the Hunua Ecological District. This wetland is highly likely to be permanently saturated throughout much of its extent, as it is fed by a permanent stream, and was observed to be saturated at the time of survey. The upper extent of the south-eastern arm (Wetland 2a South) may be intermittently wet, as this was observed to be drier and is not fed by a stream. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture and for a portion of the wetland upstream, canopy cover with bare ground beneath the trees. This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 7:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Moderate The wetland has two distinct vegetation types (classified in accordance with Singers <i>et al.</i> (2017)): Raupō reedland (WL19), which is located at the base of the eastern arm of the wetland and within the wetland below the confluence of the two arms. This habitat has a regional IUCN threat status of 'Endangered' (Singers <i>et al.</i>, 2017), and covers 1506 m² (23 %) of the wetland.

	Exotic wetland (EW), which the south-eastern arm is entirely comprised of, as well as the upper reaches of the eastern arm and the peripheries of the raupō wetland areas. The EW component of this wetland covers 5030 m² (77 %) of the wetland. No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. May provide temporary habitat for At Risk longfin eel as they migrate upstream. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation tiers are uniform throughout the wetland and consisted entirely of exotic and native herbaceous tiered vegetation. No trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Moderate

3.3.2.5 Wetland 2b

Wetland 2b is a 604 m² palustrine swamp. It forms part of watercourse two and is located 70 m downstream of Wetland 2a. Like Wetland 2a, the wetland has formed in a valley bottom with a wider, flatter base which has naturally slowed drainage, and is likely fed via a combination of surface water and groundwater flows; with additional inputs from Stream 2. This wetland was identified as a natural inland wetland via the rapid test. It is likely to be saturated year-round, and therefore is considered to be a permanent wetland.

Vegetation identified within the wetland was dominated by *Juncus* spp., Yorkshire fog, creeping bent and spearwort. This vegetation is depicted in Photos 58 and 59. A full species list is provided in Appendix D (Table 70) and the ecological value and justification for this is presented in Table 36.



Photos 58 and Photo 59. Representative vegetation within Wetland 2b.

Table 36. Ecological value of Wetland 2b

Matter	Score and justification
Representativeness	Low The wetland is 604 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.07% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is highly likely to be permanently saturated, as it is fed by a permanent stream, and was observed to be saturated at the time of survey. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture gorse, canopy cover with bare ground beneath the trees). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 4:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely.

	May provide temporary habitat for longfin eel as they migrate upstream. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.6 Wetland 3

Wetland 3 is a palustrine seepage wetland. It is fed via groundwater and surface flows and forms the headwaters of Watercourse 3. It is likely only intermittently saturated, and therefore is considered to be an intermittent wetland. This wetland was identified as a natural inland wetland via the rapid test. It is likely an induced wetland which has formed as the channel and margins of an intermittent stream have been repeatedly pugged and flattened into a wider, flatter channel by stock, which has then impeded drainage.

Vegetation identified within the wetland was dominated by *Juncus* spp., creeping buttercup (*Ranunculus repens*), *Isolepis sepulcraulis*, and sweet vernal (*Anthosachne odoratum*). Within the centre of the wetland where the stream channel remained, it was vegetated with occasional macrophytes such as water purslane (*Ludwigia palustris*) and water celery (*Helosciadium nodiflorum*, previously *Apium nodiflorum*). A full species list is provided in Appendix D (Table 71), and the ecological value and justification for this is presented in Table 37.

Table 37. Ecological value of Wetland 3.

Matter	Score and justification
Representativeness	Low The wetland is 51 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.005% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest.

	The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture and gorse, underneath which is bare ground). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 1:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At-Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At-Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.7 Wetland 6a and Wetland 6b

Wetland 6a and Wetland 6b are highly similar in terms of hydrology, vegetation composition and placement in the landscape. The wetlands are palustrine seepage wetlands located at the headwaters of Stream 6, and have formed in a natural, albeit small basins. They are likely fed via groundwater and surface water flows. Due to the small catchment sizes, plant assemblages observed and the fact that the wetlands outflow forms intermittent streams, it is likely that the wetlands are intermittent throughout most, if not all of their extents. Wetland 6b is relatively uniform in shape and topography, falling within a defined basin. Wetland 6a has two arms which extent in north-east and north-west directions with a small hill separating the arms. Both of these

arms were very similar in terms of vegetation composition, size and degree of wetness (Photo 60 to Photo 63).

These wetlands were identified as natural inland wetlands via vegetation plots, as presented in Appendix E: Plot 1 (Wetland 6a) and Plot 2 (Wetland 6b). Vegetation identified within the wetlands was dominated by creeping bent and Yorkshire fog, with *Juncus* spp. and buttercup also present. A full species list is provided in Appendix D (Table 72), and the ecological values and justification for the assessments is presented in Table 38.

Upstream of both natural inland wetlands, stock ponds were present with the earth contoured and modified to facilitate the historic construction of the stock ponds. Wetted pasture and *Juncus* sp. were established through the contoured areas (Photo 62 & Photo 63). The stock ponds and associated vegetation was classified as constructed wetlands under the NPS-FM definitions.



Photo 60 and Photo 61. Representative vegetation within Wetland 6a (left) and Wetland 6b (left)



Photo 62 and Photo 63. Constructed wetlands present at the upper areas of Wetland 6a and Wetland 6b

Table 38. Ecological value of Wetland 6a and Wetland 6b.

Matter	Score and justification
Representativeness	Low Wetland 6a is 669 m² in size and Wetland 6b is 693 m². Conservatively, it could be assumed that the wetlands both account for up to 0.07% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). The wetlands are considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetlands are dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetlands are unfenced and is subject to frequent stock access which has led to obvious damage, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetlands have no effective riparian buffer (surrounding vegetation includes short, grazed pasture). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low 5:1 (Wetland 6a) and approximately 3:1 (Wetland 6b), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetlands are classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At Risk flora or fauna species were identified. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetlands have one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetlands are limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetlands have only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed.

	The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.8 Wetland 6c

Wetland 6c is a palustrine wetland located on the floodplain of Stream 6. Wetland 6c is 768 m² in size and established within a gently sloping depression which has naturally slowed drainage, and is likely fed via a combination of surface water and groundwater flows; with additional inputs from Stream 2. This wetland was identified as a natural inland wetland via vegetation plots (Plot C; Appendix E). It is likely to be saturated during wet periods, and therefore is considered to be a permanent wetland.

Vegetation identified within the wetland was dominated by soft rush, jointed rush, Yorkshire fog, and sweet vernal. Towards the out edges of Wetland 6c, individual kahikatea trees were present, which contained no connectivity with the wider terrestrial environment. This vegetation is depicted in Photos 64. and Photo 67. A full species list is provided in Appendix D (Table 70) and the ecological value and justification for this is presented in Table 39.



Photos 64. and Photo 65. Representative vegetation within Wetland 6c.

Table 39. Ecological value of Wetland 6c

Matter	Score and justification
Representativeness	Low The wetland is 768 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.08% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is highly likely to be intermittently saturated, as it is fed by an intermittent stream. The wetland was observed to be saturated at the time of survey (2023); however abnormal rain conditions were present 2023. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture gorse, canopy cover with bare ground beneath the trees). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has an irregular, but circular shape and the area-to-perimeter ratio of the wetland is low (approximately 5:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Unlikely to provided habitat for longfin eel due to low aquatic habitats. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Occasional kahikatea, tree tier vegetation present, however these do not overly contribute to the wetland's ecosystem function. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna. The kahikatea provide little in the way of nectar or fruit bearing plants for native birds or lizards. The lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. Open section of channel is present on the upper area of the wetland; however, this disperses throughout the wetland body, likely as a result of stock pugging.

	The vegetation type was uniform throughout the wetland and predominantly consisted of one herbaceous tier. The kahikatea tree tier is present but in poor condition. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.9 Wetland 6d

Wetland 6d is a 2,263 m² palustrine wetland located on the floodplain of Stream 6 with an intermittent stream flowing into the upper wetland before the channel disperse through the wetland boundary. The topography through the wetland was variable with depressions and raises defining the wetland boundary and resulting in an irregular shape and slow drainage. Deep standing water and saturated ground was present throughout the wetland and is likely fed via a combination of surface water and groundwater flows; with additional inputs from Stream 2. This wetland was identified as a natural inland wetland via the rapid test. It is likely to be saturated year-round, and therefore is considered to be a permanent wetland.

Vegetation identified within the wetland interior was dominated by sharp spike sedge (*Eleocharis acuta*), Yorkshire fog, creeping bent water forget-me-not, and water cress. The outer margins of the wetland consisted of rushes, with jointed rush, soft rush, wīwī and fan flowered rush. The vegetation did not meet the classification of an Exotic Wetland, nor any identified indigenous wetland types under Singers *et al.*, 2017 due to the dominance of sharp-spike sedge and wetted pasture grasses. This vegetation is depicted in Photo 66 and Photo 67. A full species list is provided in Appendix D (Table 75) and the ecological value and justification for this is presented in Table 40.



Photo 66 and Photo 67. Representative vegetation within Wetland 6d.

Table 40. Ecological value of Wetland 6d

Matter	Score and justification
Representativeness	Low The wetland is 2,263 m ² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.2% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009).

	This wetland is highly likely to be permanently saturated, as it is fed by a permanent stream, and was observed to be saturated at the time of survey. The wetland is dominated by exotic plant species with low native plant diversity and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture gorse, canopy cover with bare ground beneath the trees). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a highly irregular shape, and consequently the area-to-perimeter ratio of the wetland is moderate (approximately 19:1), indicating there is some 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is an herbaceous wetland. The wetland does not meet the classification of an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) due to the dominance (>50%) of native vegetation, however the wetland does not meet the criteria of an indigenous wetland under Singers <i>et al.</i> (2017). No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. May provide temporary habitat for longfin eel as they migrate upstream. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.10 Wetland 7a

Wetland 7a is a palustrine seepage wetland located midway along the length of Stream 7 and is located adjacent to the main stream channel. It is fed via a portion of the flows from Stream 7, as well as groundwater and surface flows. It is likely only intermittently saturated, and therefore is considered to be an intermittent wetland. This wetland was identified as a natural inland wetland via the rapid test. It is likely an induced wetland which has formed as the channel and margins of Stream 7 intermittent stream have been repeatedly pugged and flattened into a wider, flatter channel by stock, which has then impeded drainage.

Vegetation identified within the wetland was dominated by creeping bent and jointed rush (*Juncus articulatus*). This vegetation is depicted in Photos 68 and Photo 69. A full species list is provided in Appendix D (Table 73), and the ecological value and justification for this is presented in Table 41.



Photos 68 and Photo 69. representative vegetation within Wetland 7a.

Table 41. Ecological value of Wetland 7a

Matter	Score and justification
Representativeness	Low The wetland is 487 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.06% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows.

	The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture and gorse, underneath which is bare ground). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 4:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier, which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.11 Wetland 7b

Wetland 7b is a 194 m² palustrine wetland located within a shallow depression, uneven depression. It is fed via groundwater and surface flows and is likely to be intermittently saturated, and therefore is considered to be an intermittent wetland. Wetland 7b was identified as a natural inland wetland via the vegetative plots (Plot 4 and Plot 5; Appendix E), and is likely an induced wetland which has formed as the channel and margins of an intermittent stream have been repeatedly pugged and flattened into a wider, flatter channel by stock, impeding drainage. The irregular shape of the wetland has resulted in water primarily pooling towards the west, with the majority of OBL vegetation located on the upper extent of the wetland.

Herbaceous tier vegetation identified within the wetland was dominated by wetted pasture with *Juncus* spp., creeping buttercup, *Isolepis sepulcraulis*, sweet vernal, and budding club-rush (*Isolepis prolifera*). This

vegetation is depicted in Photo 70 and Photo 71. A full species list is provided in Appendix D (Table 71), and the ecological value and justification for this is presented in Table 42.



Photo 70 and Photo 71. representative vegetation within Wetland 7a

Table 42. Ecological value of Wetland 7b.

Matter	Score and justification
Representativeness	Low The wetland is 194 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.02% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest, however discrete indigenous trees remain within the wetland. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The wetland also has no effective riparian buffer (surrounding vegetation includes short, grazed pasture and gorse). This means that the wetland is highly susceptible to edge effects and has increased exposure to temperature fluctuations, wind, light and weeds. The wetland has a tenuous shape, and consequently the area-to-perimeter ratio of the wetland is low (approximately 2:1), indicating there is little 'interior' of the wetland which is not subject to these effects.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At-Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At-Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat and highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.

Diversity and Pattern	Low The wetland has one vegetative tier providing low diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.12 Wetland 8

Wetland 8 is a palustrine seepage wetland which has formed in an overland flow path which discharges directly into Watercourse 4. A small area of ephemeral watercourse was present upstream of the wetland. This wetland was identified as a natural inland wetland via the rapid test. The wetland is located within a stand of planted pine trees, however these were not growing within the wetland and as such were not considered to be part of the wetland vegetation, although they did offer the wetland shading and some protection from wind.

Vegetation identified within the wetland was dominated by exotic grasses and pasture species, including Yorkshire fog. Also present were ground ferns such as kiokio (*Parablechnum novaezealandiae*), Japanese lady fern (*Deparia petersenii*) and *Diplazium australe*. This vegetation is depicted in Photos 72 and Photo 73. A full species list is provided in Appendix D (Table 78), and the ecological value and justification for this is presented in Table 43.



Photos 72 and Photo 73. representative vegetation within Wetland 8.

Table 43. Ecological value of Wetland 8.

Matter	Score and justification
Representativeness	Low The wetland is 373 m² in size. Conservatively, it could be assumed that this wetland accounts for up to 0.04% of the wetland area within the Hunua ED when compared to the estimates of Lindsay <i>et al.</i> (2009). This wetland is considered to be primarily an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland vegetated with a mix of native and exotic species and therefore is somewhat modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest. The pine canopy is likely acting to somewhat replicate the permanent forest cover which would have been originally present, by providing shade and shelter to the wetland. The wetland is unfenced and is subject to frequent stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased the area of bare ground within the wetland, increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The pine plantings within the riparian zone provide some buffer to the wetland, however, beneath the pine canopy, other vegetation tiers are limited, with a very sparse subcanopy, and groundcover was largely non-existent.
Rarity/distinctiveness	Low The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) as it is dominated by exotic species. This habitat type has no recognised threat status. No Threatened or At Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At Risk wetland birds, as the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Highly unlikely to provide habitat for long-fin eel due to the lack of upstream habitat. Highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Low The wetland has one dominant vegetative tier (the pine canopy has been excluded as it does not form part of the wetland vegetation), which limits its diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had no riparian buffer for much of its extent. In some areas, gorse bushes were present however these would offer little riparian function or benefit to the wetland. The wetland is linked via the watercourses on site to the other wetlands described in this report, however it is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.13 Wetland 9

Wetland 9 is a 40 m² palustrine wetland located within a shallow depression, at the headwaters of Stream 9. It is fed via groundwater and surface flows and is likely to be intermittently saturated, and therefore is considered to be an intermittent wetland. Wetland 9 was identified as a natural inland wetland via the rapid test and is likely an induced wetland which has formed as the channel and margins of an intermittent stream have been repeatedly pugged and flattened into a wider, flatter channel by stock, impeding drainage.

Vegetation identified within the wetland was dominated by exotic grasses and pasture species, including Yorkshire fog. Also present were soft rush, swamp sedge (*Carex virgata*) and starwort (*Callitriche stagnalis*). This vegetation is depicted in Photo 74 and Photo 75. A full species list is provided in Appendix D (Table 79), and the ecological value and justification for this is presented in Table 44.



Photo 74 and Photo 75. representative vegetation within Wetland 9

Table 44. Ecological value of Wetland 9.

Matter	Score and justification
Representativeness	Low The wetland is 40 m² in size. This wetland is considered to be an intermittent wetland, due to the small size of its contributing catchment and the composition of plant species observed. The wetland is dominated by exotic plant species and therefore is highly modified from its original vegetation, which would likely have been a form of wetland forest such as Kahikatea, pukatea (WF8) forest, however none are present and the surround vegetation is plantation forestry of Monterey pine. Wheki and ponga are present adjacent to the headwater intermittent stream that the wetland drains to. The wetland is partially fenced and is subject to occasional stock access which has led to obvious damage to the wetland, including pugging, grazing of wetland vegetation, which in turn have increased sedimentation and reduced water quality as well as the wetland's ability to act as a 'filter' for nutrients and sediment and a 'regulator' of water flows. The pine plantings within the riparian zone provide some buffer to the wetland, however, beneath the pine canopy, other vegetation tiers are limited, with a very sparse subcanopy, and groundcover was largely non-existent.
Rarity/distinctiveness	Very Low

	The wetland is classified as an 'Exotic Wetland' in accordance with Singers <i>et al.</i> (2017) and is almost entirely vegetated with non-native plant species. This habitat type has no recognised threat status. No Threatened or At-Risk flora or fauna species were identified within the wetland. It is not expected to provide suitable habitat for Threatened or At-Risk wetland birds, as the area of wetland is very small and the vegetation lacks density and complexity. In addition, these are often poorly flighted species and the lack of connectivity to other habitats means their presence is highly unlikely. Does not provide habitat for long-fin eel due to the lack of habitat and highly unlikely to provide habitat for native herpetofauna due to the high levels of disturbance to the habitat and the lack of food-provisioning plant species.
Diversity and Pattern	Very Low The wetland has one vegetative tier providing low diversity both in terms of vegetation and in the provision of microhabitats for flora and fauna. Because of its very small size and the highly modified, predominantly exotic vegetation community, the wetland is limited in how it can provide food resources to native fauna – there are little in the way of nectar or fruit bearing plants for native birds or lizards, and the lack of hydrological variation (discussed further below) greatly limits the habitat availability for native fish.
Ecological context	Low The wetland has only one dominant hydrological unit, which is where flows are non-channelised and slowly move through the vegetation. No pools or open sections of channel were observed. The vegetation type was uniform throughout the wetland and consisted entirely of one herbaceous tier, with no trees or other structural tiers present. The wetland had a riparian buffer (pines) to the north and no buffer to the south (grazed pasture. In some areas, occasional tree ferns (wheki, ponga) were present. The wetland is linked to a head-water intermittent stream draining to the north of the site and is not linked to any areas of higher quality wetland habitat.
Ecological Value	Low

3.3.2.14 Summary of wetland ecological values

The ecological value of the each of the wetlands is based on the four broad matters of representativeness, rarity/distinctiveness, diversity and pattern and ecological context, presented in Table 32 to Table 44 and summarised in Table 45.

Table 45. Summary of wetland ecological values.

Wetland	Ecological Value
Wetland 1a	Moderate
Wetland 1b	Low
Wetland 1c	Low
Wetland 2a north exotic & WL19 raupō	Moderate
Wetland 2a south	Low
Wetland 2b	Low
Wetland 3	Low
Wetland 6	Low
Wetland 6b	Low
Wetland 6c	Low

Wetland 6d	Low
Wetland 7a	Low
Wetland 7b	Low
Wetland 8	Low
Wetland 9	Low

3.4 Freshwater Fauna

3.4.1 Freshwater Macroinvertebrates

Macroinvertebrates were sampled with Stream 4, 5 and 6. Full results of this sampling are presented in Appendix F.

Macroinvertebrate diversity, as represented by the number of taxa present, was highly variable with the highest number of taxa recorded at Stream 4 (18 taxa) and the lowest at Stream 5 (14 taxa). The freshwater snail, *Potamopyrgus* was observed within each site, albeit at very low abundances within Stream 4 and Stream 5.

Stream 4 was dominated by amphipod (*Paracalliope fluviatilis*), where they comprised 79% of the total sample. Blackfly larvae (*Austrosimulium australense*) and damselfly (*Xanthocnemis zealandica*) were the next abundant species accounting for 3.3% and 2.8%. Stream 4 contained 2 EPT taxa, comprising less than 1% of the sample, however these taxa are not considered to be sensitive (individual MCI ≥ 8). Stream 4 had an MCI score of 74 rated as 'Poor', a SQMCI score of 4.57 rated 'Poor' and an EPT% of 2.4, reflecting the low diversity and abundance of pollutant tolerant macroinvertebrate species.

Stream 5 was dominated by the amphipods which comprised 76% of the sample. The second most dominant taxa within Stream 5 consisted of caddisfly (*Hydrobiosis parumbripennis*) making up 10% of the sample and damselfly (2.7% of the sample). Two EPT taxa were within the sample, with an EPT% of 10.3, however the EPT taxa observed were not considered to be sensitive (individual MCI ≥ 8). The MCI score was 107 rated 'good' and a SQMCI of 5.64 rated 'good'.

Stream 6 was dominated by the freshwater snail which made up 87% of the macroinvertebrate sample. Acari mites and damselfly were the next dominant taxa within the Stream 6 and made up 4.3% and 2.7% of the sample. Five EPT taxa were observed within the Stream 6 sample, of which EPT taxa are considered to be sensitive (individual MCI ≥ 8), with an EPT% of 3.3. The MCI scored 97 rated 'fair' and an SQMCI score of 4.16 rated 'fair'.

3.4.2 Native Fish and Large Macroinvertebrates

Indigenous fish were surveyed over four sites within the Sutton Block. Survey sites were located within Stream 1, Stream 4 and within an upstream and downstream reach of Stream 2 (Figure 27). Fish communities surveyed were indigenous to New Zealand, however at low abundances and diversities. Within Stream 1, multiple kōura (*Paranephrops planifrons*) were captured and no indigenous fish were observed. Within the Stream 2, kōura, longfin eel (*Anguilla dieffenbachii*), and shortfin eel (*Anguilla australis*) were captured. The longfin eel measured at 800 mm. Similarly, one mature longfin eel was captured within Stream 4, measuring over 1 m in length. Previous ecological surveys carried out within the Sutton Block streams showed kōura and longfin eel to be present (Photo 76 and Photo 77). No other indigenous fish species were observed.

Fish communities within the Sutton Block will be naturally restricted due to the presence of an approximately 20 m high waterfall downstream of Stream 4, and the lack of fish passage under the road, until very recently to the online pond in Stream 4. The very long and steep waterfall acts as an almost impassable barrier to fish passage, with only juvenile eels and potentially juvenile banded kōkopu able to ascend the waterfall. This barrier is further exemplified by the high biodiversity of fish life below the waterfall, with additional species including common bully (*Gobiomorphus cotidianus*), banded kōkopu, and īnanga (*Galaxias maculatus*) recorded within 2 km downstream of the Sutton Block.

The New Zealand Freshwater Fish Database show similar assemblages of native aquatic fauna have been recorded within the Sutton Block, with shortfin eel, and kākahi (*Echydella menziesi*) previously observed within Stream 4, Stream 6, Stream 7, kōura, kākahi and banded kōkopu (*Galaxias fasciatus*) within Stream 6, and kōura and kākahi within Stream 5. Due to the elevation/altitude of the streams and presence of a waterfall downstream of Stream 4, it is expected that a low diversity of climbing capable species would access and reside within the freshwater catchments (including streams and wetlands) within the Sutton Block. The Fish IBI scores were 'Fair' within Stream 2 (IBI_34) and Stream 4 (IBI_30), indicating a low diversity of species in comparison to other Auckland Streams, given the altitude and distance from the sea (Joy & Henderson, 2004). Longfin eels are listed as 'At Risk; declining' on the threatened species list (Dunn *et al.*, 2018) with the qualifiers of conservation dependant and data poor. Their presence elevates the value of Stream 2 and Stream 4 as habitat for 'At Risk' aquatic biota.

Table 46. Fish recorded within Sutton Block Streams and their Fish Index of Biotic Integrity.

Sample stream	Species	IBI	Rating
Stream 1	Kōura	0	No fish
Stream 2	Longfin eel, Shortfin eel, Kōura	34	Fair
Stream 3	No fish observed	0	No fish
Stream 4	Longfin eel; shortfin eel (eDNA only)	34	Fair
Stream 5	No fish observed	0	No fish
Stream 6	No fish observed	0	No fish

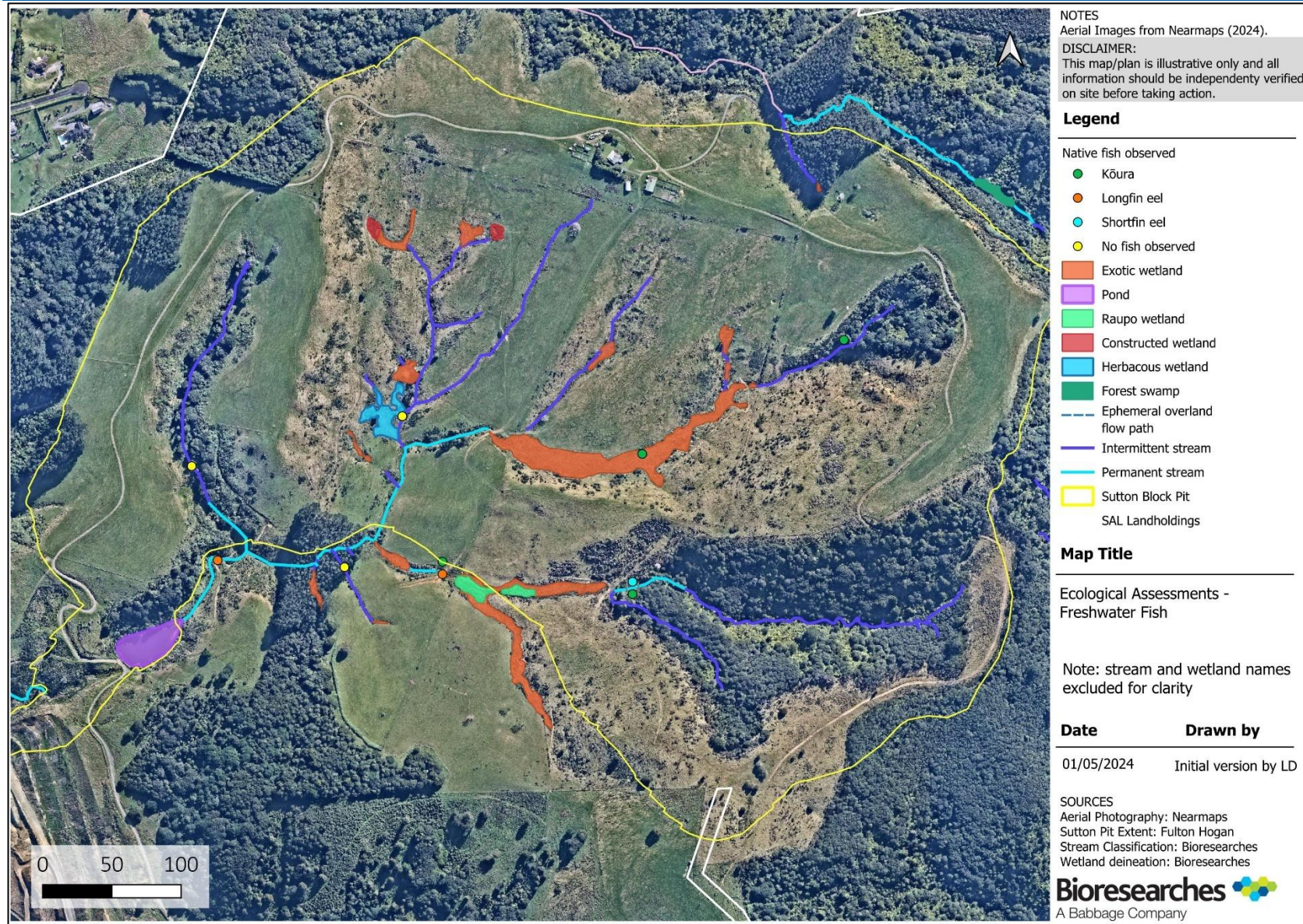


Figure 27. Freshwater fish and large macroinvertebrate sampling sites.



Photo 76. Longfin eel observed within Stream 4.



Photo 77. Koura were present within the upper reaches of Stream 1 and Stream 2.

3.5 Summary of Ecological values of habitats and species within the site

Table 47 provides a summary of the ecological values of each of the habitats and species discussed above.

Table 47. Summarised ecological values of the site for habitats and species

Group	Ecological feature	Ecological value
Terrestrial Habitats	Taraire, tawa, podocarp Forest (WF9)	Moderate
	Rock Forest (RF)	High
	Kānuka Forest (VS2)	Moderate
	Exotic Forest	Low
	Exotic Scrub	Negligible
	Exotic Grassland	Low
Terrestrial fauna	Invertebrates	Low
	Lizards	Moderate
	Birds	Moderate
	Bats	Very High
Freshwater Habitats	Stream 1	Moderate & Very Low
	Stream 2	Moderate & Low
	Stream 3	Very Low
	Stream 4	Moderate
	Stream 5	Moderate
	Stream 6	Low & Very Low
	Stream 7	Low & Very Low
	Stream 9	Low
	Wetland 1a	Moderate
	Wetland 1(b – c)	Low
	Wetland 2a (north exotic)	Moderate
	Wetland 2a (north raupō)	Moderate
	Wetland 2b	Low
	Wetland 3	Low
	Wetland 6 (a – d)	Low
	Wetland 7 (a – b)	Low
	Wetland 8	Low
	Wetland 9	Low
Freshwater fauna	Invertebrates	Low

	Fish	Moderate
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4 ASSESSMENT OF ECOLOGICAL EFFECTS

4.1 Terrestrial Ecology

Within the Sutton Pit extent, a total of 16.78 ha of indigenous vegetation, consisting of 7.33 ha of Taraire, tawa podocarp forest, 8.8 ha of kānuka scrub/forest, and 0.65 ha of naturally uncommon rock forest will be removed. A further 5.25 ha of exotic vegetation will also be lost.

Habitats of the following high value fauna and their identified habitats would be removed:

- Copper skink (At Risk- declining)
- Pipit (At Risk- declining)

In addition, some fauna, not recorded from survey and assessments, have potential to use parts of the Sutton Block in the future, particularly those highly mobile and cryptic species. In particular:

- Long-tailed bats (Threatened- nationally critical)- potential roost habitat in WF9, rock forest and standing native trees; potential commuting and foraging habitat over wetlands and forest edges.
- Karearea (*Falco novaeseelandiae*)- potential visitor, this species is rare north of Rotorua (absent in Northland), though it is noted that this species holds significance to iwi and therefore may have had a regular presence in the Drury area. Breeding locations for this species could include epiphytic vegetation, pine forest and at ground level, particularly near a ledge.
- Australasian bittern (Threatened- nationally critical)- potential for intermittent foraging or roosting around identified wetland and adjacent areas.
- Other 'At Risk' lizard species. Not identified from targeted surveys in this assessment, other indigenous lizard species may be identified following precautionary management measures undertaken in accordance with standard approaches to lizard management plans (systematic searching, capture and relocation). Methods for capture, relocation, restoration and enhancement generally apply to a range of indigenous skinks and geckos that occur within the Auckland Region.

For this assessment, the appropriate scale at which to determine the magnitude and level of effects is the local landscape, where there are large areas of protected (SEA) indigenous vegetation that extend north of the Sutton Block and east towards the Hunua Ranges. In the case of the naturally uncommon rock forest, the appropriate scale is Auckland Region. Rock forest is assessed at a wider scale because it is a much rarer ecosystem type.

4.1.1 Rock Forest (RF)

4.1.1.1 Direct effects

The 0.65 ha of damaged rock forest remnant (RF01) will be totally removed, resulting in the loss of mature, native canopy trees. These trees currently contribute to the provision of food resources for native fauna in the wider landscape and their loss will reduce the local availability of these resources. Large areas of mature native vegetation containing the same species are present within the nearby SEA_T_5323 (>500 ha) and therefore the overall impact of the loss of the canopy trees will be minor.

Little information is documented about this ecosystem type for other parts of the region. The Sutton Block Pit lies along the Drury Fault, on which Kaarearea Paa represents a major volcanic cone at the northern end of the Drury Fault basalt intrusion. The Drury Fault basalt covers c. 100 ha within the Hunua ED; however little is documented about other areas of native vegetation on this basalt. Conservatively it is calculated that

some 12 ha of rock forest exists within the wider SAL Landholdings outside the Sutton Block Pit extent and the SPQZ. Other fragments also exist across the Drury Hills area on private land. Rock forest on the Auckland Isthmus is estimated at 29 ha and the total known amount including the Drury Quarry site is 41 ha. This is likely to be a significant underestimate as areas of rock forest in the extensive South Auckland Volcanic field have not been documented. The Rock Forest (RF01) within the site therefore is estimated to comprise approximately 1.6% of the remaining RF habitat within the local area.

There is cumulative ongoing damage and loss to this ecosystem type on private land outside the Drury Quarry site and SAL Landholdings, through stock impacts and anthropogenic activities such as subdivision and development.

The permanent loss of 0.65 ha of damaged Rock Forest, comprising 1.6% of its known extent in the Auckland Region represents a **high** magnitude of effect given its endangered status and ongoing loss.

4.1.1.2 Indirect effects

The loss of mature forest fragments from within the Sutton Block Pit extent will reduce ecological connectivity in the local landscape in a minor way. Any loss of mature individuals from a local population decreases the genetic diversity of that population as a whole. There will be minimal effects on the genetic diversity of local native tree populations, however since all species involved are widespread and common throughout the Hunua Ecological District and the loss of this small fragment is not expected to result in any adverse effects on adjacent systems. Indirect effects (on adjacent systems) are expected to be **negligible** in the context of the complete loss of the existing fragment.

4.1.2 Taraire, tawa, podocarp Forest (WF9)

4.1.2.1 Direct effects

Loss of a total 7.33 ha of Taraire, tawa podocarp forest within the Sutton Block Pit extent (see Figure 9) will result in a c. 7.5% reduction in this forest type within the wider SAL Landholdings site where 98.3ha is protected within SEA or via covenants. The reduction in extent of the forest ecosystem type within the Sutton Pit represents a small proportion of this larger area. All taraire, tawa, podocarp ecosystem types are threatened however, and any permanent loss is material.

The loss of flowering and fruiting canopy trees that currently contribute to the provision of food resources for native fauna in the wider landscape will reduce the local availability of these resources. Large areas of mature native vegetation containing the same species occur within the nearby SEA_T_5323 (>500 ha), however the loss of the mature canopy trees is still significant. These effects are cumulative, as the timescales required to replace the mature trees are long. Overall, the magnitude of effects due to loss of WF9 is **moderate**.

4.1.2.2 Indirect effects

The loss of mature forest fragments from within the Sutton Block Pit extent will reduce ecological connectivity in the local landscape in a minor way, however there will be no increase in habitat fragmentation. Any loss of mature individuals from a local population decreases the genetic diversity of that population as a whole. There will be minimal effects on the genetic diversity of local native tree populations, however since all species involved are widespread and common throughout the Hunua ED.

The loss of 3.56 ha from the western edge of SEA_T_5323 will result in the creation new forest edge through WF9-3 and Kānuka scrub/forest. However, much of WF9-3 is already edge, so the new edge created will be relatively small, with some parts potentially already cleared and now impacted by adjacent exotic scrub (EXS3). Edge effects are well-documented and result in drier, windier and warmer conditions in forest edges that can result in negative effects on forest flora and fauna. However, the area is surrounded on three sides by pasture and most of it is already subject to edge effects to some degree. Heavy grazing has resulted in a loss of forest understorey tiers which exacerbates edge effects. The magnitude of indirect effects of loss of WF9-3 on adjacent SEA are **low**.

4.1.3 Kānuka Forest (VS2)

4.1.3.1 Direct effects

The loss 8.8 ha of kānuka forest will result in a very minor reduction in the existing extent of this ecosystem type from the Hunua ED where some 8900 ha of regenerating shrublands occur. Of these, kānuka forest /scrub is by far the most common (Lindsay et al. 2009; Tyrell *et al* 1999). This is a **Low** magnitude of loss.

4.1.3.2 Indirect effects

The loss of 8.8 ha of kānuka forest on the western edge of SEA_T_5323 will not significantly reduce ecological connectivity or result in habitat fragmentation. It will result in the creation of a new forest edge as set out in section 4.1.2 above. The indirect effect of loss of kānuka scrub/forest on the adjacent SEA is **Low**.

4.1.4 Relict native trees amongst pasture

4.1.4.1 Direct effects

Mature native trees have values as sources of seed for regeneration in nearby forest areas and as a potential source of food and nest sites for mobile native fauna such as birds. The loss of these ecological features will have a minor effect on the populations of these common trees within the Hunua Ecological District, and on a local scale they are common species amongst surrounding forest areas. The magnitude of effect is **Low**.

4.1.4.2 Indirect effects

The indirect effects of the loss of these individual trees and small stands will have no effect on buffering of remaining forest areas. They could act as minor stepping stone habitat across the agricultural matrix of open pasture for birds, although, except for the 5 identified puriri trees, their utility by birds is likely to be low. The magnitude of indirect effects is considered to be **Low**.

4.1.5 Exotic Forest

4.1.5.1 Direct effects

Direct effects of removal of the exotic forest patches are restricted to the loss of any indigenous understorey. Where there is an understorey to the exotic plantation trees it is predominantly pest plants with no ecological value. Scattered throughout the patches there are small areas or individual specimens of common native pioneer forest species, mostly māhoe and māpou. These plants are of low ecological value and do not form a cohesive forest tier or ecosystem type. Their loss comprises a **negligible** magnitude of effect.

4.1.5.2 Indirect effects

Removal of areas of exotic forest along the western edge of the Sutton Block Pit extent will not result in loss of buffering for native ecosystems. Removal of pine forest to the north of Kaarearea Paa can be undertaken in a manner that leaves a buffer of existing pine trees in place on the edge of the northern extension of the native forest. The indirect effects caused by their removal comprises a **negligible** magnitude of effect.

4.1.6 Exotic Scrub

4.1.6.1 Direct effects

Direct effects of removal of the exotic scrub patches are restricted to the loss of any indigenous vegetation interspersed amongst exotic weed species. Scattered throughout the patches there are small areas or individual specimens of common native pioneer forest species. These plants are of low ecological value and do not form a cohesive forest tier or ecosystem type. Their loss comprises a **negligible** magnitude of effect.

4.1.6.2 Indirect effects

Removal of areas of exotic scrub along the eastern edge of the Sutton Block Pit extent may result in loss of some buffering for native ecosystems. The indirect effects caused by their removal comprises a **negligible** magnitude of effect.

4.1.7 Effects on fauna

Removal of vegetation (both native and exotic) and habitat is expected to result in habitat loss, displacement and mortality to fauna, including invertebrates, lizards, flightless birds (such as unfledged chicks) and potentially (but unlikely) also roosting bats. Vegetation removal activities may result in direct mortality, injury and/or displacement of native fauna, of which lizards, birds, and bats (potentially present in roost trees) are protected (Wildlife Act 1953). Displaced fauna have a lower likelihood of survival where the carrying capacity of adjacent habitats is stressed through increased competition for fewer resources. Displaced animals have a higher probability of risk of predation by both exotic and native predators. For 'At Risk' and 'Threatened' species, this effect can be significantly greater, and greater still during important seasonal periods such as breeding.

4.1.7.1 Lizards

Overall, the footprint occupies an area that is predominantly heavily grazed, including open pasture and other vegetation cover (exotic, rock forest, Taraire, tawa, podocarp, kānuka forests) which are degraded as a result of ongoing stock access. The lizard fauna values, identified by surveys and site observations, reflect this degradation, being generally low diversity (one species identified) and a species that is tolerant of highly modified environments, (including At risk pipit, discussed below). Copper skink, while assessed as a 'high value' declining species, remains common and widespread in the Auckland region, including urban gardens. Copper skinks also readily colonise newly growing vegetation, particularly rough grass along forest edges, including areas that are not maintained for several months.

High value copper skinks, and potentially other native lizard species present at less than detectable levels, are present at low abundance within vegetation that would be removed to construct the Sutton Block pit. These native lizards are likely to be killed or injured during vegetation removal because they would be unable

to move out of habitats as they are cleared (c.f. volant birds can fly away). Therefore, mortality and injury should be avoided through capture and relocation prior to and during vegetation removal, as detailed in a lizard management plan.

While present within ground cover vegetation both within the Sutton Block and in surrounding habitats, this species (and potentially other lizard species) are present at relatively low abundance. The magnitude of loss of these degraded environments to native lizards, including copper skinks, is considered to be **Low** on the basis that:

1. The population is represented by presence of one species at low abundance and within low-quality habitat where they occur within the Sutton Block.
2. There are very large areas of significant vegetation in the immediate landscape very large adjacent areas of SEA, beyond the Sutton Block, such as (and refer S 1.3, Table 2) SEA_T_5349 (41.8 ha, Kaarearea Paa, which is avoided), SEA_T_5346 (18.53 ha, avoided); SEA_T_5323 (619.77 ha, 13.87 ha affected).

4.1.7.2 Avifauna

Removal of foraging (e.g. high value pipit in rough grassland, fruiting & flowering trees), roosting and nesting habitat would result in displacement of avifauna into the surrounding environment. However, avifauna are typically highly mobile and those species using roosting, foraging and nesting resources within Sutton Block will also be using such resources within the very large adjacent areas of SEA, beyond the Sutton Block, such as (and refer S 1.3, Table 2) SEA_T_5349 (41.8 ha, Kaarearea Paa, which is avoided), SEA_T_5346 (18.53 ha, avoided); SEA_T_5323 (619.77 ha, 13.87 ha affected).

Removal of trees during the avifauna breeding season has the potential to result in direct mortality to eggs, unfledged chicks and potentially also adults on nests (e.g. cavity nesting or roosting species such as ruru and kingfisher).

The breeding season for At-Risk pipit is from August to February, with egg-laying from August to January. New Zealand Falcon are unlikely to be on site, but their breeding season is more extended, from August to May, with egg laying from August to January as well. Therefore, vegetation clearance season should aim to avoid these months where possible, however, could be accommodated (with other seasonal requirements for fauna management) through or pre-felling nest surveys that inform presence of active nests that could be avoided.

At Risk pipits are widespread in rough, open habitats such as pasture and rough farmland throughout the Auckland Region and would not otherwise be expected to be present with forest or scrub vegetation cover.

Overall, the magnitude of loss of these highly modified environments to avifauna, including those forest fragments is **low** and mortality would be avoided through timing of vegetation removal (including identified rough grasses) and / or pre-felling avifauna nest surveys. Pre-felling avifauna surveys would ensure that low level effects are further minimised at Sutton Block.

4.1.7.3 Long-tailed bats

Long-tailed bats have not been recorded from multiple surveys within the Sutton Block. While it is acknowledged that these bats are highly mobile, have been recorded within the surrounding landscape, and that the Sutton Block supports trees that have potential roost features, they are not considered to use these potential habitats on any regular basis. However, because there remains to be some potential for bats to use available roost habitat within Sutton Block in the future, there is a risk of mortality to bats at the time of tree removal. For example, during removal of roost trees, bats (if present, though unlikely at Sutton Block Pit) can be injured and killed if they are occupying a tree at the time of removal. This risk is greater during winter, when bats are less active but may be occupying roosts, or in summer, when roosting behaviour can include groups of females (potentially pregnant) and their young. Communal and maternal roosts (typically larger trees with deep cavities) can represent a large component of a population, having both significant immediate and long-term population-level effects across a landscape larger than the Sutton Block.

When roost trees are removed, bat home ranges may become smaller, potentially reflecting smaller colony sizes and lower roost availability. These factors would represent a high magnitude effect, given that roost trees are a limited landscape resource, resulting in increased colony isolation and vulnerability to localised extinction (Borkin & Parsons 2014; Borkin *et al.* 2011).

The magnitude of the loss of moderate value (potential) roost habitat to long-tailed bats is **moderate**, given that surveys indicate that these environments are not used by bats (negligible or low magnitude), but that actual use would elevate this magnitude within the landscape. It is acknowledged that there is some uncertainty with this assessment, on the basis that bats are highly mobile and may use the Sutton Block at a future time over the life of the quarry, given that the Sutton Block has a 50-year indicative life and occurs with the ZOI, where bats in the wider landscape have been recorded (Figure 28, but at relatively low levels of activity). Given the very high value of bats, a precautionary approach should be undertaken, whereby all potential roost trees (trees that support roost features as defined by the Bat Recovery Group) within the Sutton Block should be subject to the Department of Conservation's Bat Roost Protocol (from DOC BRP, version 4, October 2024 or any subsequent revision), and detailed in a Bat Management Plan. Where any active bat roost is identified during further bat precautionary management, the Bat Management Plan should provide for artificial bat roost habitat in accordance with the DOC advisory note on artificial bat roost provision. It is considered that provision of this precautionary management would further reduce potential effects on any bats that may use Sutton Block to a low overall level of effect.

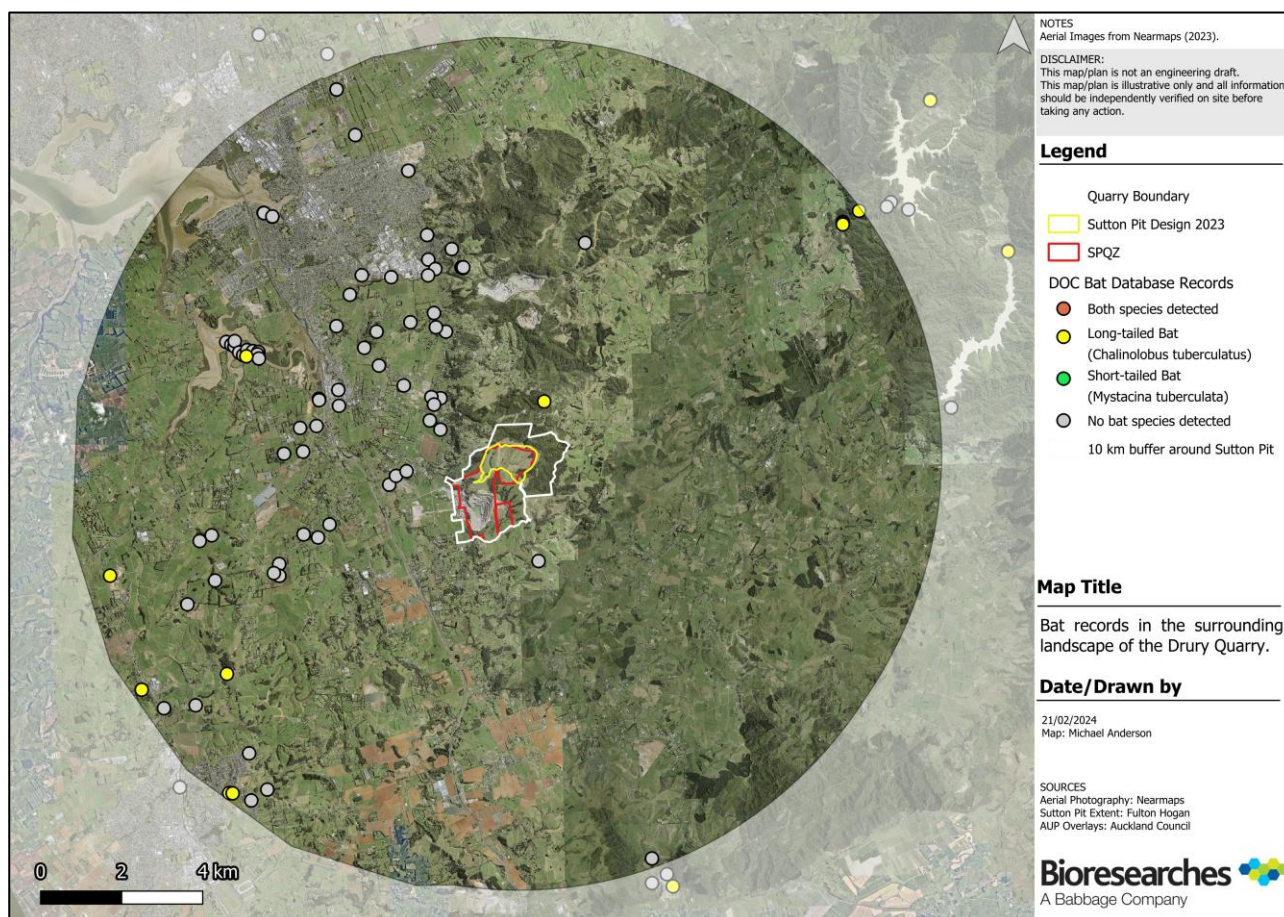


Figure 28. Bat survey information within a 10 kilometre radius surrounding Drury Quarry (DOC bat database accessed February 2024).

4.1.7.4 Indirect effects on fauna

4.1.7.4.1 Edge effects

The loss of habitats will also result in the creation new forest edge along the new pit where it abuts retained habitats. These areas occur around low value exotic forest edges along the western edge of the proposed pit, and moderate value kākara and broadleaved forest along the eastern and northern extent of the proposed pit. These habitats are heavily degraded and exhibit 'edge effect' effect conditions, being very open, dry, and having limited vegetation cover due to heavy browse pressure. They are characteristically dominated by flora and fauna that are tolerant of open environments and higher light levels. Consequently, the expected edge effects are likely to be minor on these adjacent environments, as they are already degraded. However, they could be enhanced through dense buffer planting, and pest animal control. Overall, edge effects are considered **moderate**.

4.1.7.4.2 Noise and vibration

Quarry activities will generate noise by intermittent blasting and more regular truck movements within and around the quarry, although it is noted that an electric conveyor belt is proposed as the main form of transporting rock from Sutton Block to the Front of House processing facilities, reducing the amount of truck activity. Noise impacts are likely to have a degradation effect on the habitats of birds and bats and is likely to cause some displacement of avifauna from adjacent habitats where they are present adjacent to quarry

noises. The blast vibration and noise study (Orica, 2023) and the Assessment of Noise Effects (Marshall Day Acoustics, 2024) provides more details about potential noise and vibration impacts for the proposed Sutton Block pit. The Orica report considered that the blasting technique currently used (short holes and limited explosive volumes) means that vibrations emitted is minimal, which will also be the technique used for Sutton Block. Blast noise with current activities that was recorded at Kaarearea Paa (163m from pit) varied from 0dBL to 118.1dBL. Marshall Day Acoustics considered that noise levels will be elevated near MacWhinney Drive (Western side of pit), but noise levels to the North (Near Sonja Drive and Ponga Road) will be dominated by natural noise sources (e.g. birds, wind). The overall noise effects were considered reasonable and within AUP limits.

Noise has been shown to affect biodiversity as it can impede communication, decrease reproductive success, change foraging behaviours, decrease the ability to detect predators, initiate flushing responses and increase avoidance behaviours (Harbrow et al, 2011). The effects of vibration have been shown to disrupt animal behaviours, communication and physiology, especially in species that rely on acoustic or auditory signals (Cross et al, 2021).

Bats

Bats are nocturnal, and would generally be active outside quarry operation hours, therefore potential effects would be expected to arise should bats be roosting nearby during the day when the quarry is operational. It is noted that on site investigations have not shown any indication of roosts being present on site, with bat records more likely to be associated with foraging behaviours or bats flying between habitats (see section 3.2.5). Should there be a bat roost present in the surrounding habitat, it is uncertain whether blasting or other noise would cause bats to abandon a roost during the day and there is no research to suggest this would occur. However, bats are a highly mobile species and will move from their day roost every 1-2 days, potentially travelling several km to new roosts over very large home ranges. Therefore, it is reasonable to consider that any such disturbance as a result of blasting nearby an active roost could be considered temporary, with consideration to roosting bats potentially using adjacent roosts intermittently.

Avifauna

In general, we consider that noise effects on avifauna in habitats adjacent to the proposed Sutton Block pit would be intermittent (blasting) and localised to active areas of the quarry. These effects have not been well studied in relation to New Zealand fauna. However, the proposed noise conditions (see the Assessment of Noise Effects) provide limitations to noise levels from both the operation of the quarry activity and truck movements and blast noise. While we have not assessed the potential for avifauna to habituate to vehicle traffic during day operations, it should be noted that the natural contours within the proposed footprint will help to attenuate noise effects, with potentially impacted habitats located below a ridge, that will not be impacted until Stage 5.

Lizards

Impacts on lizards from noise and vibration are uncertain, however geckos and skinks occur in habitat edges of other active quarry sites, including Brookby, Hunua and Drury. Lizards are likely to habituate to regular noise and often occur in edge habitat alongside high vehicle traffic, including parks, reserves and alongside SH1 in the Auckland Region.

Overall, noise impacts are considered **low**.

4.1.7.4.3 Lighting

Quarry activities will be concentrated during diurnal hours with activities scaled-down compared to daytime, so that they meet noise requirements. Night-time works will be scaled down to comply with 45 dB noise limit at the closest dwelling. To achieve this, night-time activities will be limited to the base of the pit only with no mobile plant working on high benches. Artificial light at night (ALAN) has the potential to affect fauna on site and within distant ecosystems, disrupting behaviours, interactions between individuals and altering community assemblages (Longcore & Rich, 2004). ALAN has been shown to have a significant negative effect on migratory seabirds, disorientating them, consequently causing hundreds of collisions and mortalities annually within New Zealand (Heswall et al, 2022). Those seabirds most at risk are fledglings within the group *Procellariidae* (i.e., shearwaters, prions, petrels) and have been shown to be grounded in response to artificial light 15 km away (Rodríguez et al, 2014). Drury quarry is inland and not near the coastlines (~35 km from the West Coast, ~20 km from Hauraki gulf to the north and ~25 km to the Firth of Thames to the east). Impacts on seabirds are considered unlikely.

Impacts of ALAN on bats are well known, with bats generally avoiding artificial light while foraging (Stone *et al.*, 2015). It is not anticipated that any light spill from quarrying activities will impact on surrounding vegetation or forest edges that may be used for foraging.

Overall, lighting impacts are considered **negligible**.

4.1.7.4.4 Dust

The effects of dust generated from construction or operation of the Sutton Block Pit, could also be expected to affect the surrounding vegetation. Dust may smother fauna habitats (including foraging areas and retreat sites) small seedlings, ferns and epiphytes, impeding their growth and increasing mortality. Effects from dust on the surrounding landscape can be reduced by: avoiding windy dry weather days for ground stripping, site design with regards to prevailing winds, screening, and by wet suppression of unpaved roads, up to 1 L per square metre per hour as per the Ministry for the Environment 'Good Practice Guide for Assessing and Managing Dust' section 5.2 (Ministry for the Environment, 2016). Potential dust effects are considered to be **low**.

4.1.8 Summary Level of Effects

In summary, the ecological value for rock forest is very high and for Taraire, tawa, podocarp forest and kākūka scrub/forest ecological values are moderate.

Table 48. Summary table of the magnitude of effect and level of effect upon each forest type.

Forest type	Ecological value	Magnitude of effect	Level of effect
Rock Forest	High	Area: 0.65 ha Magnitude: High Rationale: It is an uncommon ecosystem type with a status of "endangered". There is ongoing loss within the Auckland Region.	Very High

Taraire, tawa, podocarp Forest	Moderate	Area: 7.33 ha Magnitude: Moderate Rationale: Taraire, tawa podocarp forest types have a regional threat status of “endangered” and the scale of direct loss is moderate in the context of the remaining area of this vegetation type in the local landscape. Indirect effects will also be minor.	Moderate
Kānuka Forest	Moderate	Area: 8.8 ha Magnitude: Low Rationale: This a common ecosystem type which is severely damaged by agricultural impacts. The scale of loss is small compared to the extent of remaining kānuka scrub/forest within the E.D.	Low
Relict trees amongst pasture	Low	Area: <0.1 ha Magnitude: Negligible Rationale: Small stands and individual native trees are making only a minor contribution to landscape connectivity and food resources for common native birds.	Very Low
Exotic Forest	Negligible	Area: 2.79 ha Magnitude: Negligible Rationale: Exotic vegetation with no buffering function to indigenous vegetation and minimal habitat for indigenous plants. Vegetation type regenerates rapidly and is abundant in the surrounding environment	Very Low
Exotic Scrub	Negligible	Area: 2.47 ha Magnitude: Negligible Rationale: Exotic vegetation with no buffering function to indigenous vegetation and minimal habitat for indigenous plants. Vegetation type regenerates rapidly and is abundant in the surrounding environment	Very Low
Exotic Grassland	Low	Area: 83.5 ha Magnitude: Negligible Rationale: Exotic pasture with no buffering function to indigenous vegetation and minimal habitat for indigenous plants. Vegetation type regenerates rapidly and is abundant in the surrounding environment	Very Low
Invertebrates	Low	Magnitude: Low Rationale: Suite of common native and exotic invertebrate species occurring in highly modified pasture, wetland and grazed forests	Very Low

Lizards	High	Magnitude: Moderate Rationale: Ground cover generally sparse (heavily grazed), some areas of rough regenerating edge grasses, though these areas largely unstable over time. Copper skink records are widespread in surrounding landscape (no other spp. recorded) but generally low abundance. Large areas of ungrazed and potential habitats in surrounding landscape, though not surveyed beyond SAL landholdings.	Potentially High (conservative)
Birds	Moderate	Magnitude: Low Rationale: Habitats within the Sutton Block are predominantly pastures, with forest fragments lacking in structure (unfenced with grazed understories) and flora diversity. Extensive areas of protected, significant vegetation (SEA_T_5323, c. 650 ha) extend around the proposed Sutton pit and north to Hunua Quarry.	Low
Bats	Very High	Magnitude: Moderate Rationale: Low activity (1 pass recorded from 516 survey nights over 2020-2024) in surrounding landscape suggests that the Sutton Block is of low value to bats, however large trees with potential roost habitat are present within all forest areas, including exotic pines. Many of these trees are also suitable for communal roosting, which would be significant because roosts are chosen specifically for their thermal properties, and such trees will be a limited resource to bats.	Potentially High (conservative)

4.2 Freshwater Ecology

4.2.1 Construction of the Sutton Block Pit

The flow of water, staging of stream diversions, stream and wetland reclamations is detailed in the Erosion and Sediment Control Plans (Drury Quarry – Sutton Block Erosion and Sediment Control Plan - Enabling Works and stages¹⁶) and summarised below (and in the Figures in Section 1.1).

Stage 1 is the infrastructure development stage and includes the initial pit. The flow into the current dam pond will be diverted through a new temporary stream channel along the left bank to join the culvert under the current accessway, allowing the pond to dry for approximately two months before earthworks commence. A sediment retention pond (SRP) will be built within the dam footprint, and discharge to the culvert under the current access road. All site water will be directed to the pond. A combination of SRPs,

¹⁶ Drawing No. ESCP-DQSB-01 to 10, ESCP-DQSB-P-01 to 05. ESCP-DQSB-NB-01, HR-01, OB-01. ESCP-Sutton Blk -H20. Dated 14.12.23 to 17.10.24.

decanting earth bunds, silt fences, dirty water diversion and clean water diversions controls will be utilized to manage erosion and sediment control.

Below the dam, a new stream diversion channel will be constructed on the benches on the northern bank of the existing stream channel below the dam. The new permanent stream channel, below the current dam, will be constructed with project ecologist design, including sinuosity, boulders and other stream enhancements. The sediment retention pond will be removed and a new stream channel constructed within part of the footprint of the current pond above the dam.

Once the lower permanent stream channel has been completed and signed off by the project ecologist, a temporary culvert will be installed to divert the stream flows from the temporary stream diversion channel (around the eastern side of the old dam) to the new permanent stream channel.

Once the new permanent stream channel is made live, works will commence to complete the access road, reclaiming the original stream channel below the dam.

When the new stream channel, within the footprint of the dam pond, has been completed, the temporary stream diversion around the side of the old pond will be disestablished and flows re-directed to the top of the new stream channel.

The initial pit is created at the end of Stage 1, with the temporary overburden placed in the gully to the north-west of the pit. The pit footprint over Stage 2 (approximately 15 years) will result in the continued removal of Stream 5, the stream in the north-western corner of the site (initial pit), and the headwater wetlands and upper reaches of Stream 6 (overburden stockpile area). The clean water will continue to flow to the site streams with clean water from the pit pumped to the head of Stream 4, at the confluence with Stream 2 and 7.

The indicative operative 30-year pit (Stage 3) will extend to include all of Streams 5, 6 and 7, including their wetlands; and Stream 1 and the remainder of Wetland 1a will drain to the new quarry pit, where site water will be pumped from the pit to the upper reaches of Stream 4.

The indicative operative 40-year pit (Stage 4) will include the remainder of Stream 9 and associated wetland, Stream 1 and associated wetlands, and part of the upper branches of Stream 2 and eastern branch of Wetland 2a (Wetland 2a North). During this stage the upper reaches of Stream 2 will drain to the quarry pit and then be pumped to the head of Stream 4.

The final pit footprint (Stage 5 – Life of Quarry) will include the remainder of Stream 2 (intermittent stream).

The staging and the timeline of the loss / modification to the aquatic habitats is summarised as Table 49.

Table 49. Sutton Block Pit Staging and Indicative Timeline of Works in Aquatic Habitats.

Stage	Aquatic Habitat Loss / Effect	Year Stage / Indicative Timing of works
Stage 0	Current situation	
Stage 1	Stages to north of the pond	0 to 3 years

	Diversions of Stream 4 in lower site	
	Initial pit created, including loss of lower half of Stream 5; loss of connection to the upper half of Stream 5; loss of most of Stream 6 catchment (to overburden stockpiles); lower reach of Stream 4 diversion complete.	
Stage 2	Increasing size of pit to west, with the exception of the upper reach of Stream 5, no additional aquatic habitat loss.	3 to 15 years
Stage 3	Stream 7 and Stream 7 catchment wetlands, downstream half of Wetland 1a lost.	15 to 30 years
Stage 4	Wetland 1a and Stream 1 lost; Upper section of Stream 2 and eastern branch of Wetland 2a lost.	30 to 40 years
Stage 5 (Life of Quarry)	Headwaters of Stream 2, Stream 9 and Wetland 9 lost.	50 year plan

4.2.2 Streams

Within the Sutton Block site, 2,902 linear metres of intermittent stream and 439 linear metres of permanent stream will be removed; and in the lower catchment 115 linear metres of permanent stream will be diverted within the initial stage of development. The Sutton pit, will result in the total loss of 3,341 m of stream extent, 115m of stream diversion and 128 m of stream creation (within the footprint of the current upper dam pond). The length and bed area of streams within the Sutton pit expansion and the indicative staging of each activity are provided in Table 50.

Table 50. Parameters of intermittent and permanent stream habitat impacted within the Sutton Block

Stream	Total length (m)	Average width (m)	Bed area (m ²)	Activity	Indicative Activity Staging
Stream 1	241	0.68	164	Reclamation	Stage 4
Stream 1b	74	0.5	37	Reclamation	Stage 4
Stream 2 (headwaters)	367	0.43	128	Reclamation	Stage 5
Stream 2 (intermittent upper)	162	0.39	63	Reclamation	Stage 4
Stream 2 (permanent mid)	114	0.4	46	Reclamation	Stage 4
Stream 2 (permanent lower)	45	0.8	36	Loss of catchment	Stage 4
Stream 2b	241	0.28	67	Reclamation	Stage 4
Stream 4 (upper)	208	1.2	250	Loss of catchment	Stages 2 - 4
Stream 4 (middle)	163	1.62	264	Loss of catchment	Stages 2 - 4
Stream 4 (lower)	115	2.51	289	Diversion	Stage 1
Stream 5 (intermittent)	397	0.56	222	Reclamation	Stage 1 -2
Stream 5 (permanent)	55	0.56	31	Reclamation	Stage 1
Stream 6 headwater tributaries	207	0.3	62	Reclamation	Stage 1
Stream 6 lower	257	0.6	154	Reclamation	Stage 1
Stream 6 east branch	487	0.25	122	Reclamation	Stage 1

Stream 6 west branches	92	0.15	14	Reclamation	Stage 1
Stream 7 upper (intermittent)	292	0.53	155	Reclamation	Stage 3
Stream 7 lower (permanent)	270	1.38	373	Reclamation	Stage 3
Stream 9	85	0.36	31	Reclamation	Stages 1 & 4
Pond	128	-	-	Stream creation	Stage 1
Total stream lengths	(m)				
Diversion	115			Diversion	Stage 1
Loss of catchment	416			Works in the vicinity	Stages 2 to 4
Total stream loss Total length lost to reclamation	3,341	-		Reclamation	Stages 1 to 4
Total stream loss Bed area lost to reclamation			1,698	Reclamation	Stages 1 to 4

The loss of the streams and flow paths will result in actual and potential ecological effects of:

- Loss or degradation of freshwater habitats;
- Diversion and alteration of freshwater habitats;
- Death and injury to freshwater fauna;
- Sedimentation; and
- Loss of freshwater volume and connectivity.

Although a wide range of metrics and measures are used in the assessment of freshwaters there is no unifying set of attributes used to assign value or significance. Measures that are considered when assigning ecological value to a freshwater site fall broadly into the four matters of representativeness; rarity/ distinctiveness; diversity and pattern; and ecological context as discussed in Section 2.1, but, aside from the transport and connection of water with other habitats, the primary ecological values lost with the loss of the streams is freshwater habitat for macroinvertebrates and native fish. Many insects are dependent upon streams for the larval stage of their lifecycle, which forms large part of the macroinvertebrate fauna in streams. The leafy and woody inputs to streams from their riparian yards and connection with upstream habitats provide substrate, shelter and food for the macroinvertebrates (leaf shedders and scrapers), food and habitat for native fish. Some intermittent streams can provide for the same stream values of macroinvertebrates, macrophytes, leaf litter, fish and fish habitat, but it is by definition only intermittently, and some, as significant lengths on the Sutton Block, for only very short periods of the year. In Auckland the small intermittent streams, such as intermittent branches of Stream 6 and 7 at this site, often completely dry out for most of the year and consequently provide very poor-quality habitat for aquatic flora and fauna when compared to a permanent stream, which provides stable, consistent habitat year around. Permanent streams on the other hand usually provide all of these ecological values plus more, often including deeper refuges (pools, undercut banks), larger woody habitat, habitat for a greater variety of native fish and macroinvertebrates, and most importantly habitat (water) all year.

The design has avoided much of the loss of the more valuable permanent stream habitat on the site, e.g. Stream 4 and the stream east of Stream 9 (Figure 23), and where possible has designed to avoid permanent loss of stream habitat through stream diversion, rather than reclamation, with no loss of stream bed area. In

addition, where loss of catchment is likely, riparian planting and augmentation of water to the stream systems is proposed to minimise the adverse effects on the primary values (habitat for macroinvertebrates and native fish) on the streams.

The magnitude of effect from the different activity types on streams is summarised in Table 51. This is assigned against the highest ecological value of each stream relevant to the activity to calculate the overall level of effect (as detailed in Table 65 in Appendix A).

The EIANZ Guidelines require effects management to be undertaken where the level of effect is moderate or greater. As the level of effect is 'moderate' or 'high' for the loss or alteration of each stream (which combined comprise 3,341m of stream loss) effects management is required. Minimisation of effects can be applied to some of the effects, but as the project will involve the total loss of some of the streams at the site, offsetting, to ensure No Net Loss and preferably a Net Gain in biodiversity, is required to manage the effects to those streams.

Table 51. Magnitude of effect and level of effect of the proposed works upon the streams identified within the Sutton Block.

Effect/activity	Stream	Ecological Value	Effect description	Magnitude of effects and justification	Level of Effect
Stream reclamation	Stream 1 Stream 2 Stream 5 Stream 6 Stream 7 Stream 9	Moderate to Very Low	Total loss of 2,902 m of intermittent stream and 439 m of permanent stream resulting in the loss of 1,698 m ² of stream bed extent.	Very High The construction of the project will result in the complete loss of 3,341 linear metres of intermittent and permanent stream within its footprint. The likelihood of this effect occurring is definite and will have a direct (rather than indirect) impact on the stream habitat. The loss of the stream habitat will be permanent and irreversible.	High to Low
Stream diversion	Stream 4 lower – below pond	Moderate	Diversion of 115 linear metres of stream.	Moderate The construction will result in a temporary loss of aquatic habitat when the diversion is brought on line, while the stream re-establishes itself on the new flow path. There will be no loss of stream extent. Indirect potential effects may result in short term increases in fine sediments to the downstream receiving environment.	Moderate
Fish injury or mortality	Stream 1, 2 Stream 4: lower Stream 6, 7	Moderate	Direct impacts to 3,341 m of stream habitat	High Potential loss, mortality or harm to indigenous freshwater fauna, including 'At Risk' species.	Moderate
Sedimentation	All streams	Moderate	Increase in sediment load during initial construction period (Stage 1 only). Decrease in long-term sediment discharge.	High Potential for smothering of stream substrates. All streams potentially effected via sedimentation due to the staging of the works. Transportation of excess fine sediment to the downstream receiving catchment. Sedimentation effects (without minimisation) would be localised to the quarry works footprint, and be treated from the downstream pond under the current operations.	Moderate
Freshwater volume and connectivity	Stream 2: lower Stream 4: upper	Moderate	Reduction in contributing catchment. Reduced flow volume and changes to aquatic habitats.	High Volume of water hydrological supporting Stream 4 will be reduced through the reclamation of headwaters. Decreased contributing catchment will result in a reduction in the hydrological functioning of the watercourse, and is likely to result in a loss of aquatic habitat extent and quality.	Moderate
Potential loss of stream base flows	Maketu Stream and Northern Tributary (outside of the site)	High	Loss of baseflow.	Moderate The hydrological assessments noted the potential for a reduction in base flows in the main streams outside of the site, specifically the Maketu Stream and the Northern Tributary. Loss of base flow could result in faster and less variable flows, habitat shrinkage, potential effects on biodiversity through reduction in habitat abundance and/or quality.	High

4.2.3 Wetland Habitats

Within the Sutton Block extent, 18,758 m² of wetland will be lost to the final pit after 50 years. The area of wetland loss within the Sutton Block pit expansion and the indicative staging of each activity are provided in Table 52.

The primary ecological values of wetlands are as “the kidneys” of the aquatic ecosystem, providing filtration and improvements in water quality in water from the catchment; and, similarly to streams, the provision of habitat for plants and animals adapted to wet conditions. The majority of wetlands on the Sutton Block are small, highly degraded pastoral wetlands, dominated by exotic vegetation, with low ecological values with respect to indigenous biodiversity. Several wetlands (Wetlands 1a and 2a) are much larger in extent and provide more habitat, albeit highly degraded, and consequently provide higher wetland ecological values (refer Section 3.3.2 and Table 45).

Table 52. Parameters of wetlands impacted by the Sutton Block pit expansion area.

Wetland	Wetland Classification	Size m ²	Activity	Indicative Activity Staging	
Wetland 1a	Exotic	10,730	Reclamation	Stage 3 & 4	30+ years
Wetland 1b	Exotic	492	Reclamation	Stage 4	> 30 years
Wetland 1c	Exotic	136	Reclamation	Stage 4	> 30 years
Wetland 2a north exotic	Exotic	1,780	Reclamation	Stage 4	> 30 years
Wetland 2a north raupō	WL19	506	Reclamation	Stage 4	> 30 years
Wetland 2a south	Exotic	4,250	Loss of catchment	Stage 4	> 30 years
Wetland 2b	Exotic	604	Loss of catchment	Stage 4	> 30 years
Wetland 3	Exotic	51	No direct effects	-	-
Wetland 6	Exotic	669	Reclamation	Stage 2	3 - 15 years
Wetland 6b	Exotic	693	Reclamation	Stage 2	3 - 15 years
Wetland 6c	Exotic	768	Reclamation	Stage 2	3 - 15 years
Wetland 6d	Exotic	2,263	Reclamation	Stage 2	3 - 15 years
Wetland 7a	Exotic	487	Reclamation	Stage 3	> 15 years
Wetland 7b	Exotic	194	Reclamation	Stage 2	3 - 15 years
Wetland 8	Exotic	373	No direct effects	-	-
Wetland 9	Exotic	40	Reclamation	Stage 4	> 40 years
Stage 1 wetland loss ~0 - 3 years		0			

Stage 2 wetland loss ~3 - 15 years		4,587			
Stage 3 wetland loss ~15 - 30 years		5,852			
Stage 4 wetland loss ~30 - 40 years		8,319			
Stage 5 wetland loss ~40 – 50 years		0			
Total Wetland Loss		18,758			

Table 53 presents the magnitude of effect of the proposed works upon the wetlands identified within the Sutton Block. This is then assessed against the ecological value assigned to each wetland (as detailed in Table 65 in Appendix A) to calculate an overall level of effect.

Table 53. Magnitude of effect and level of effect of the proposed works upon the wetlands identified within the Sutton Block.

Wetland and indicative staging	Ecological value	Effect description	Magnitude of effect and justification	Level of effect
Wetland 1a (Stage 3 and Stage 4)	Moderate	- Total loss of 10, 730 m² of wetland habitat - Mortality or harm to aquatic life	Very High The construction of the Sutton Block Pit will result in the complete loss of all wetland habitat within its footprint. The likelihood of this effect occurring is definite and will have a direct (rather than indirect) impact on the wetland habitat. The loss of the wetland habitat will be permanent and irreversible. Potential loss, mortality or harm to indigenous freshwater fauna, including 'At Risk' species	High
Wetlands 1b-c (Stage 4)	Low	- Total loss of 628 m² of wetland habitat - Mortality or harm to aquatic life		Moderate
Wetland 9 (Stage 4)	Low	Total loss of 40 m² of wetland habitat		Moderate
Wetland 6a-d (Stage 2)	Low	- Total loss of 4,393 m² of wetland habitat - Mortality or harm to aquatic life		Moderate
Wetland 7a (Stage 3), Wetland 7b (Stage 2)	Low	- Total loss of 681 m² of wetland habitat - Mortality or harm to aquatic life		Moderate
Wetland 2a north (Stage 4)	Moderate	- Reclamation of 2,286 m² of wetland habitat. - Sedimentation - Mortality or harm to aquatic life	Very High	High

			The construction of the Sutton Block Pit will result in the partial loss of all wetland habitat within its footprint. The likelihood of this effect occurring is definite and will have a direct (rather than indirect) impact on the wetland habitat. The loss of the wetland habitat will be permanent and irreversible.	
Wetland 2a south (Stage 4)	Moderate	- Reduction in 20 ha contributing catchment - Sedimentation - Mortality or harm to aquatic life	Moderate Loss of upstream contributing catchment to wetland habitats, reducing the hydrological function. The likelihood of this effect occurring is definite and will have a direct impact on the wetland habitat.	Moderate
Wetland 2b (Stage 4)	Low	- Reduction in 20 ha of contributing catchment - Sedimentation	Moderate The construction of the Sutton Block Pit will result in the loss of upstream contributing catchment to wetland habitats, reducing the hydrological function. The likelihood of this effect occurring is definite and will have a direct impact on the wetland habitat.	Low
Wetland 3	Low	Earthworks within 100 m	Negligible No direct effects, wetlands hydrologically buffered from works by Stream 4.	Very low
Wetland 8	Low			Very low

4.2.4 Effects Management Hierarchy

The EIANZ Guidelines require effects management to be undertaken where the level of effect is moderate or greater. As the level of effect is 'moderate' or 'high' for the loss of all of the wetlands, which combined comprise 18,758 m² of wetland habitat within the Sutton Block, effects management is required. Minimisation of effects can be applied to some of the effects on the wetlands, but as the project will involve the total loss of wetland values for Wetlands 1a-c, 2a in part, 6a-d, 7a-b and Wetland 9, offsetting (or compensation) is required to manage the effects to these wetlands.

4.2.5 Summary of Effects on Aquatic Habitat and Proposed Effects Management

In summary, the values for streams and wetlands are low to moderate and the level of effect is moderate to high. Table 54 presents the activity/effect on freshwater ecosystems and the effects management strategy proposed. The effects management strategy for freshwater ecosystems is discussed in further detail in Section 5.3 below.

Table 54. Summary of freshwater effects and proposed effects management.

Surface water system	Ecological Value	Classification	Activity	Effects Management Offset ¹⁷ /Minimise
Stream 1	Moderate	Intermittent	Reclamation	Offset
Stream 1b	Low	Intermittent	Reclamation	Offset
Stream 2 (upper & mid)	Moderate	Intermittent and permanent	Reclamation	Offset
Stream 2 (lower)	Low	Permanent	Loss of catchment	Minimise
Stream 2b	Moderate	Intermittent	Reclamation	Offset
Stream 4 upper & middle	Moderate	Permanent	Loss of catchment	Minimise
Stream 4 lower	Moderate	Permanent	Diversion	Minimise
Stream 5	Moderate	Intermittent and permanent	Reclamation	Offset
Stream 6 and tributaries	Low & Very Low	Intermittent	Reclamation	Offset
Stream 7 upper	Very Low	Intermittent	Reclamation	Offset
Stream 7 lower	Very Low	Permanent	Reclamation	Offset
Stream 9	Low	Intermittent	Reclamation	Offset
Wetland 1a	Moderate	Exotic	Reclamation	Offset
Wetland 1b	Low	Exotic	Reclamation	Offset
Wetland 1c	Low	Exotic	Reclamation	Offset
Wetland 2a north exotic	Moderate	Exotic	Partial reclamation	Offset
Wetland 2a north raupō	Moderate	WL19	Partial reclamation	Offset
Wetland 2a south	Low	Exotic	Loss of catchment	Minimise

¹⁷ Under the NPS-FM and the effects hierarchy, offset is the next step for reclamation of aquatic habitats. Offset may step to Compensation once further assessments are carried out if the criteria for offset cannot be met. This will be detailed in the Residual Effects Analysis Report-Streams and Wetlands.

Wetland 2b	Low	Exotic	Loss of catchment	Minimise
Wetland 6	Low	Exotic	Reclamation	Offset
Wetland 6b	Low	Exotic	Reclamation	Offset
Wetland 6c	Low	Exotic	Reclamation	Offset
Wetland 6d	Low	Exotic	Reclamation	Offset
Wetland 7a	Low	Exotic	Reclamation	Offset
Wetland 7b	Low	Exotic	Reclamation	Offset
Wetland 9	Low	Exotic	Reclamation	Offset
Total Stream loss at Life of Quarry		3,341m	1704m ²	Minimise and Offset
Total Wetland loss at life of Quarry		-	18,758	Offset
Pond restoration to stream		128	tbc	Net positive gain

5 SUMMARY OF EFFECTS AND RECOMMENDATIONS FOR EFFECTS MANAGEMENT AND OFFSETTING

5.1 Terrestrial Ecology

A total of 16.78 ha of indigenous vegetation of moderate to high value would be removed to access and construct the quarry. This vegetation comprises 8.8 ha of moderate value regenerating kākūka forest; 7.33 ha of moderate value Broadleaf-podocarp Forest, and a 0.65 ha fragment of high value rock forest. Of the total 22.04 ha of vegetation, 14.25 ha is from within an SEA overlay (SEA_T_5323, SEA_T_1177).

A further 5.25 ha of negligible value exotic vegetation and habitats, comprising regenerating gorse, herbaceous weeds and pine plantation would also be removed.

SPQZ

The assessment of ecological values did not specifically consider differences in vegetation within and outside of the SPQZ, although it is noted that there was no clear distinction between the two areas for vegetation that traversed this boundary. In total, 16.79 ha of indigenous vegetation will be cleared, of which 9.18 ha is outside the SPQZ (Table 55). Of the total indigenous vegetation outside the SPQZ to be cleared, 8.71 ha is within an SEA overlay. The indigenous vegetation outside the SPQZ is WF9 (3.1 ha) and VS2 (6.08 ha), which will have a moderate and low levels of effect, respectively. .

Table 55. Summary of the total areas of vegetation within the Sutton Block, divided by within and outside both the SEA and SPQZ overlays. All areas in hectares (ha).

		Outside SEAs			Within SEAs			SPQZ Totals		Total
		Inside SPQZ	Outside SPQZ	Total	Inside SPQZ	Outside SPQZ	Total	Inside SPQZ	Outside SPQZ	Total
Vegetation type	WF9	1.96	0.26	2.22	2.28	2.84	5.12	4.24	3.10	7.34
	VS2	0.00	0.21	0.21	2.72	5.88	8.59	2.72	6.08	8.80
	RF	0.65	0.00	0.65	0.00	0.00	0.00	0.65	0.00	0.65
	EXS	1.41	1.06	2.47	0.00	0.00	0.00	1.41	1.06	2.47
	EXP	1.41	1.37	2.79	0.00	0.00	0.00	1.41	1.37	2.79
Subtotals	Indigenous	2.61	0.47	3.08	4.99	8.71	13.71	7.61	9.18	16.79
	Exotic	2.82	2.43	5.25	0.00	0.00	0.00	2.82	2.43	5.25
Total		5.44	2.90	8.33	4.99	8.71	13.71	10.43	11.61	22.04

Direct effects

The loss of this vegetation would result in significant direct effects as a result of complete loss of these indigenous values (vegetation and fauna habitat). These effects should be minimised as far as practicable by way of fauna management (capture relocation of lizards, bird nest surveys, bat roost tree felling protocols) that should be detailed in specific fauna management plans. Significant residual adverse effects are anticipated and should be addressed through biodiversity offsetting in accordance with best practice. This would include revegetation and habitat enhancement as quantified via offset modelling and adhere to best practice principles of offsetting (Appendix 3 of the NPSIB).

Indirect effects

Indirect effects associated with edge creation ('edge effects') could be expected up to 50 m from the edge of the Sutton Block Pit (e.g. Young et al. 1994, light, humidity, weed invasion). Edge effects would be expected to result from the creation of a new forest edge at SEA_T_5323, where the removal of grazed-under kānuka forest would expose similar degraded kānuka forest to increased wind, solar radiation, resulting in drier windier conditions on microhabitats for plants and fauna. The creation of new edges typically also results in increased susceptibility to weed invasion, such as observed along roads and vehicle tracks throughout New Zealand. Edge effects are known to reduce indigenous biodiversity to favour species more tolerant of open environments.

These effects are likely to be minor on seral systems (such as the affected components of SEA_T_5323, which is currently degraded by pest and livestock grazing), however such effects could be improved through buffer planting newly created edges of retained vegetation.

5.2 Management of adverse effects on terrestrial ecology values

The National Policy Statement for Indigenous Biodiversity (New Zealand Government, 2023) requires that identified adverse effects within SNAs are avoided, except where provided for under Clause 3.11, which identifies significant national or regional benefit that cannot otherwise be achieved using resources within New Zealand (NPSIB, 3.11(1(aiii))). An explanation of the Sutton Block proposal with respect to this exception is provided with the application, however where adverse effects are managed pursuant to subclause 3, the following is required to be demonstrated:

1. How each step of the effect's management hierarchy will be applied
2. if biodiversity offsetting or biodiversity compensation is applied, how the proposal has complied with principles 1 to 6 in Appendix 3 and 4 and has had regard to the remaining principles in Appendix 3 and 4, as appropriate.

5.2.1 Effects Management Hierarchy (NPSIB, 2023)

The effects management hierarchy is an approach to managing the adverse effects of an activity on indigenous biodiversity that requires that:

- a. adverse effects are avoided where practicable; then
- b. where adverse effects cannot be avoided, they are minimised where practicable; then
- c. where adverse effects cannot be minimised, they are remedied where practicable; then
- d. where more than minor residual adverse effects cannot be avoided, minimised, or remedied, biodiversity offsetting is provided where possible; then
- e. where biodiversity offsetting of more than minor residual adverse effects is not possible, biodiversity compensation is provided; then
- f. if biodiversity compensation is not appropriate, the activity itself is avoided.

5.2.2 Drury Quarry Sutton Pit Approach to the Effects Management Hierarchy

5.2.2.1 Adverse effects that are avoided, where practicable

The proposed Sutton Block Pit has been specifically designed to avoid Kaarearea Paa, a significant ecological feature (Rock Forest) and it is of very high cultural value. Cultural engagement resulted in design

amendments that provided for a greater setback from this feature than earlier designs. As a result of iwi consultation, the Sutton Block Pit extent has been moved further away from Kaarearea Paa, providing a larger buffer (approximately 13.2 ha) for the site on the north-eastern and western sides and avoiding 610 m of stream loss and 5,241 m² of wetland loss. This updated design has resulted in a reduction in pit depth. Further, species-specific adverse effects (mortality) will be avoided through specific methodologies including timing of vegetation removal outside the main bird breeding season where possible, and undertaking pre-clearance surveys for nesting native birds and long-tailed bats (including tree roost protocols) to ensure works do not cause injury or mortality to protected wildlife.

5.2.2.2 Adverse effects that are minimised, where practicable

Species-specific adverse effects (mortality) must be minimised through specific methodology, as addressed in management plans such as capture-relocation, propagation, translocation, habitat enhancement and pre-vegetation removal surveys to avoid nesting birds and roosting bats. Therefore, the following species / taxa-specific management plans will be required to provide management methods to avoid and minimise these adverse effects on fauna and flora species. Further details about these plans are also provided in the Ecological Management Plan and the recommended consent conditions in section 5.4:

- A. **Native lizard management plan:** to provide details on how injury and mortality to any high-value lizards within the footprint will be minimised to ensure that there is no overall reduction in the size of populations of At-Risk lizard species (copper skink and other potentially present species) and occupancy across their natural ranges. The Native lizard management plan will provide methods for capture, including trapping and / or search effort, timing of implementation, an assessment of the release locations, any habitat enhancement required and monitoring methods.
- B. **Bat management plan:** to provide details on how injury and mortality to long-tailed bats will be avoided during vegetation removal. The Bat management Plan will provide details that adhere to the Department of Conservation's protocols for minimising the risk of felling occupied bat roosts (Department of Conservation, 2024) and, where roost habitat is identified within the footprint, those roost habitats will be compensated in accordance with the Department of Conservation's Artificial Bat Roost Advisory not (DOC -6734955).
- C. **Avifauna management plan:** to provide details on how injury and mortality to forest, wetland and grassland birds will be avoided during vegetation removal.
- D. **Edge effects management plan:** to provide detail on how adverse edge effects on retained and protected indigenous vegetation around the Sutton Pit edge will be minimised through dense buffer and infill planting. The Edge Effects Management Plan will provide details on planting schedules, timing of planting, monitoring and maintenance.
- E. **Vegetation management plan** to provide detail on staging of vegetation removal, vegetation removal methods and salvage methods for reuse of forest resources.

5.2.2.3 Adverse effects that are remediated, where practicable

No adverse effects are proposed to be remediated, as all vegetation and habitat values that are proposed to be removed, would be within the proposed pit.

5.2.2.4 Residual adverse effects that are offset

The project will offset both significant residual adverse effects, and other low level effects, on the following biodiversity types because they meet the principles for biodiversity offsetting as set out in Appendix 3 of the NPSIB.

- Very high-level effect resulting from the loss of High value Rock Forest
- Low-level effect resulting from the loss of moderate value regenerating kānuka forest.
- Moderate- level effect resulting from the permanent loss of Moderate value taraire, tawa, podocarp forest.
- Very low-level effect resulting from the permanent loss of Low value Relict trees.

Offsetting is not strictly required for the loss of relict trees within pasture, as the overall effect is less than moderate. However, mature native trees have ecological value as sources of seed for regeneration in nearby forest habitats and as potential sources of food and nest/roost sites for mobile native fauna such as birds. Although their overall value to the Sutton site is assessed as **Low** and the level of effect due to their loss as **Very low**, replacement planting to offset their loss is considered appropriate. This will ensure the resources they provide are replaced and exceeded in the long term and their genetic provenance is maintained.

5.2.2.5 Residual adverse effects that are compensated

Compensation actions are not proposed for this Project.

Table 56. Summary of terrestrial vegetation and habitat loss, values and effects within the Quarry Pit extent. Values and effects assessments are as described in report, and as per EIANZ guidelines (Roper-Lindsay et al., 2018).

Ecological Component	Ecological Value	Magnitude of effect	Level of effect (without minimisation)	Recommended Minimisation of effects	Recommended offset of residual adverse effects	Level of Effect (with minimisation, offset or compensation)
Rock Forest (RF)	High	High	Very high	1. Timing of vegetation removal to avoid the main bird breeding season (or preclearance nesting surveys). 2. Implementation of a lizard management plan. 3. Adoption of bat tree-felling protocol.	1. Offset planting on appropriate rock substrate with like-for-like rock forest vegetation, in accordance with a BOAM that demonstrates a net gain outcome for appropriate disaggregated values. 2. Enhancement of an appropriate quantum of existing rock forest as determined by a BBOAM that demonstrates a net gain outcome for appropriate disaggregated values.	Net Gain (Biodiversity Offset)
Taraire, tawa, podocarp Forest (WF9)	Moderate	Moderate	Moderate	1. Timing of vegetation removal to avoid the main bird breeding season (or preclearance nesting surveys). 2. Implementation of a lizard management plan. 3. Adoption of bat tree-felling protocol. 4. Edge management, including buffer planting of newly created SEA edge (SEA_T_5323).	1. Offset planting of like-for like WF9 forest vegetation, in accordance with a BOAM that demonstrates net positive biodiversity gains for appropriate disaggregated values. 2. Enhancement of an appropriate quantum of existing WF9 forest as determined by a BOAM that demonstrates positive biodiversity gains for appropriate disaggregated values.	Net Gain (Biodiversity Offset)
Kānuka Forest (VS2)	Moderate	Low	Low	1. Timing of vegetation removal to avoid the main bird breeding season (or preclearance nesting surveys). 2. Implementation of a lizard management plan. 3. Adoption of bat tree-felling protocol. 4. Edge management, including buffer planting of newly created SEA edge (SEA_T_5323).	1. Offset planting of like-for like VS2 forest vegetation, in accordance with a biodiversity offset model that demonstrates at least a no-net-loss for flora and fauna habitat values. 2. Enhancement of an appropriate quantum of existing VS2 forest as determined by a Biodiversity offset Model that demonstrates at least a no-net-loss for flora and fauna habitat values.	Net Gain (Biodiversity Offset)
Native trees amongst pasture	Low	Low	Very low	1. Timing of vegetation removal to avoid the main bird breeding season (or preclearance nesting surveys). 2. Implementation of a lizard management plan. 3. Adoption of bat tree-felling protocol.	Replacement planting of trees in suitable habitats. Modelled to replace basal area within 25 years	Net Gain (Biodiversity Offset)

Exotic Forest	Negligible	Low	Very Low		No offset or compensation required	No significant residual effects
Exotic Scrub	Negligible	Low	Very Low		No offset or compensation required	No significant residual effects
Exotic grassland	Low	Low	Very Low	1. Timing of vegetation removal to avoid the main bird breeding season (or preclearance nesting surveys).	No offset or compensation required	No significant residual effects
Invertebrates	Low	Low	Very Low		None, but expected benefits from ecosystem offsets, which include modelled outcomes for log fall and leaf-litter, which are important ground cover habitats	No significant residual effects
Lizards	Moderate	Low	Low	Implementation of a lizard management plan to capture and relocate skinks and geckos from within the Project footprint, undertake habitat enhancement and revegetation to compensate for habitat loss.	None, but expected benefits from ecosystem offsets, which include modelled outcomes for log fall and leaf-litter, which are important ground cover habitats	No significant residual effects
Birds	Moderate	Low	Low	Implementation of an avifauna management plan including timing of vegetation removal to avoid the main bird breeding season (or preclearance nesting surveys).	None, but expected benefits from ecosystem offsets, which include modelled outcomes for fauna food resources (fruiting and flowering species, log fall and leaf-litter, and modelled bird breeding success from forest enhancement.	No significant residual effects
Bats	Moderate	Moderate	Moderate	Implementation of a bat management plan including adoption of bat tree-felling protocol to avoid mortality to any bats potentially roosting in trees (site wide, including indigenous and exotic) at time of removal.	Provision of multiple artificial roosts in accordance with DOC advice note -DOC-6734955 for any single bat roost discovered. Artificial design would be detailed in a bat management plan and in consultation with DOC, and provide for multiple roost designs and placement, to support robust research into the effectiveness of artificial roosts at replacing natural roosts.	No significant residual effects

5.3 Freshwater Ecology Effects Assessment

5.3.1 Stream and wetland loss

The proposed quarry construction and ancillary works will result in the infilling of 3,341 linear metres of intermittent and permanent streams, ranging from Moderate to Low ecological value.

The staging of the quarry works will result in 1,565 m of stream length and 4,587 m² of wetland habitat reclaimed within the first 15 years (indicative), under Stages 1 and 2, most of which will occur under the temporary overburden area. The majority of aquatic habitat loss will occur under Stages 3 and 4, mostly at 20 years or more, with an additional 1,118 linear metres of stream and 14,131 m² of wetland extent reclaimed. The total stream length lost in the final Stage 5 pit at approximately 50 years will be 3,341 m, and the total wetland loss will be 18,758 m².

Lindsay *et al.* (2009) estimated that of the original 6,336 ha of wetland originally present within the Hunua Ecological District, only 87 ha (1%) remained in 2009, although this is likely a very low estimate, as the current definition of a wetland under the NPS-FM is very broad and would identify many additional areas of wetland not included in Lindsay *et al.* (2009)'s calculations. The wetlands present within the Sutton Pit equate to a conservative total of 2.35% of the total wetland area within the Hunua Ecological. However, of this very conservative 2.35% total wetland cover, 0.4 % of wetland consists of induced wetland habitat as a result of the surrounding land use practices and stock access.

The magnitude of stream and wetland loss is assessed as 'Very high' due to the complete loss of these surface water systems, which is definite and will have a direct impact. The effects will be permanent and irreversible. Stream and wetland reclamation cannot be minimised or remedied, and as the overall level of effect is 'Moderate' to High' (depending upon the ecological values of the habitats) the effects on streams and wetlands will need to be offset or compensated. This will be detailed in the separate REAR-Stream and Wetland report, which will also require the NGDP: Riparian Planting Plan (NGDP:RP) and NGDP: Wetland Planting Plan (NGDP:WP), as recommended in the conditions of consent (Section 5.4).

The upper reaches of Streams 1 and 2 within the SEA, occasionally supported small (6 – 20 m²) riparian or seepage wetlands against the stream channels. A contingency (2%) will be added to the total area of wetland offset or compensation (at the proposed wetland offset sites) to ensure there is no loss of values or extent for these areas.

The NPS-FM refers to avoidance of loss of river extent and values to the extent practicable. In regard to loss of extent, the Sutton Block expansion area was redesigned in 2023 to avoid Kaarearea Paa, avoid significant additional reclamation, including further reclamation of Stream 4; avoid the loss of the southern boundary streams and wetlands; and then further redesigned in 2024 to avoid the approximately 550 m of stream and wetland system east of Stream 9. The 2023 redesign avoided the loss of 610 m of natural stream length (and 5,241 m² of wetland extent). The current upper dam pond, below the proposed Sutton Block Pit, will be restored as a stream channel, reconnecting to Stream 4, resulting in the restoration of 128m of stream length. In addition, where possible stream extent has been maintained or lengthened by stream diversions, in the lower catchment, below the upper dam (115 m) (Refer to Stream Diversion section below).

5.3.2 Stream and Wetland Potential

The potential for the aquatic habitats within the Sutton pit area assumes good land use practice within the current land use. In a rural environment, with a mix stock farm, good land use practice would be fencing off the streams and wetland areas from stock; perhaps some riparian planting of the streams and wetlands, but no restoration planting within the wetlands, and it is highly likely the wetlands would remain exotic (Table 57).

Within the SPQZ located outside of the rural urban boundary, such as the majority of this site, there is no AUP 'riparian yard' or riparian setback, and even if the site was located within the rural urban boundary, the 10m yard would only apply to streams greater than 3 m i.e. only the downstream reach of Stream 4, below the dam. (AUP H26.8.6.2.5).

Therefore, the potential for the site has assumed fencing from stock, and the effective rural riparian planting zone in Auckland of 3 - 5 m (Dairy NZ, 2016), which would provide an uplift in ecological value through the increased shade, bank stability and filtration, and plant biodiversity of the site.

Restoration activities would not result in a significant increase in aquatic habitat throughout the majority of the streams due to the intermittent nature, with none of the streams with the exception of Stream 4 and fragments of Stream 2 and Stream 7 providing permanent, year-round habitats.

Streams located within the SEA (Stream 1 and Stream 2 & 2b) are currently surrounded by trees and shrubs, and benefits would mostly likely result from fencing.

Table 57. Sutton Site Aquatic Habitat Potential Assuming Good Landuse Practices.

Aquatic habitat	Current Ecological Value	Potential Ecological Value and Justification
Stream 1	Moderate	Moderate – Fencing from stock. No significant change assumed due to forested riparian yard.
Stream 2	Moderate	Moderate - High – Fencing from Stock. No significant change assumed due to largely forested riparian yard.
Stream 4	Moderate	Moderate – Fencing from Stock. No significant change assumed due to partially forested catchment, but some riparian planting.
Stream 5	Moderate	Moderate – Fencing from Stock. No significant change assumed due to forested riparian yard
Stream 6	Low	Moderate – Fencing from stock. Some uplift in values but no significant change assumed.
Stream 7	Very Low	Low – Fencing from stock, still very limited aquatic habitat due to small size and duration of in the watercourse.
Stream 9	Low	Low – currently fenced and planted with exotic pines
Wetland 1a-1c	Moderate	Moderate – Fencing from stock. Some uplift in values through reduction of pugging and stock effects but no significant change assumed.

Wetland 2a-2b	Moderate	Moderate – Fencing from stock. Some uplift in values through reduction of pugging and stock effects but no significant change assumed.
Wetland 6a-6d	Low	Moderate – Fencing from stock. Some uplift in values through reduction of pugging and stock effects but no significant change assumed.
Wetland 7a-7d	Low	Moderate – Fencing from stock. Some uplift in values through reduction of pugging and stock effects but no significant change assumed.
Wetland 9	Low	Low – currently mostly fenced from stock. Very limited aquatic habitat due to small size. No significant change assumed.

With the exception of the upper permanent section of Stream 2, none of the aquatic habitats have the potential, under good practice land use, to provide more than Moderate ecological values. Even if they were assessed as having higher potential, the outcome is still the same, with adverse effects on all the aquatic habitats offset or compensated, if effects could not be avoided or minimised.

5.3.3 Stream diversion

The proposed quarry construction and ancillary works will result in the diversion of 115 linear metres of stream below the current dam, and the temporary channelisation and diversion, followed by the restoration of 128 m of stream in the footprint of the current pond above the dam within the first three years of operation (refer Appendix A).

The lower diverted stream channel is proposed to be constructed on the new benches, adjacent to and parallel with the current flow path. The diversion channel will be designed collaboratively with the project engineers and the project ecologists to provide a naturalised channel with meanders, variations in hydrology and large boulders, similar to the current stream reach, with no loss in current SEV values or stream length.

The permanent diversion of the downstream reach of Stream 4 and the re-naturalisation of the dam pond into a stream will likely result in the temporary loss of aquatic habitat during the construction phase, but within a short period of time (less than three years) provide a complex and well-functioning stream habitat within the footprint of the upper dam pond, and immediately downstream of the current dam, a shaded, rocky stream channel connecting the upper and lower catchment.

A Stream Diversion Enhancement Plan (SDEP) is recommended as a condition of consent (Section 5.4).

5.3.4 Freshwater fauna

The magnitude and level of the potential effect on native fauna is considered to be **Moderate** due to the nature of the activity, extent of habitat loss/alteration, the density and threat status of impacted species, and the ability of fauna to escape the disturbance. There is a high potential for injury or mortality of native freshwater fauna during in-filling and diversions of streams and wetlands in the absence of controls.

Potential adverse effects can be minimised through timing of the stream and wetland works, and native fish recovery and relocation immediately prior to streamworks. The native fish recovery and relocation plan

should include, at a minimum, methods to capture fish, measures to prevent fish re-entering the reach, fishing efforts, relocation sites, storage and transportation to prevent stress and death/predation.

Additionally, kākahi recovery protocols will be implemented. Recovery protocols will be undertaken within suitable kākahi habitats which includes soft sediments located under undercut banks, under submerged logs, and on the edges of large pools. The soft bed and bank sediments shall be hand searched during the dewatering phase and a benthic viewer may be used in deeper waters if necessary.

Fish and kākahi management will be implemented within one week prior to streamworks/reclamation. Where streamworks will result in the disconnection of upstream habitats to the wider catchment (i.e. the partial reclamation of Stream 5 under Stage 1 and Wetland 1a under Stage 3), fish and fauna management will be extended throughout the entire reach to ensure no populations become isolated and “trapped”.

Implementation of native fish and aquatic macrofauna recovery protocols, will reduce the magnitude of effect on freshwater fauna to ‘**Low**’, therefore a Native Freshwater Fauna Management Plan (NFFMP) is recommended as a condition of consent (Section 5.4)

5.3.5 Sedimentation

Works within the site can generate sediment, which would negatively impact freshwater habitats adjacent to the site which will not be fully reclaimed, such as Stream 4, and the immediate downstream receiving environment. The effects of excessive sedimentation are recognised as a significant effect on river and land-use, and can impact aquatic fauna through increased turbidity, heat absorption and light refraction. The potential magnitude of sedimentation effects without minimisation is considered to be ‘**High**’ due to potential adverse effects to the immediate downstream receiving environment between the Sutton Block Pit and the lower dam. The lower dam is a quarry operations water storage dam, from which water was previously taken for use for operating the site, then collected and treated (through a lamella system) and discharged back into the pond. It now acts as a backup emergency supply for the quarry and storage pond, with water continuously discharging into the lower reaches of Stream 4 (NT1).

To minimise the potential for excess fine sediment entering the catchment, an Erosion and Sediment Control Plan (ESCP) has been prepared and will be implemented by an appropriately qualified professional using the industry best practice. The plan details methods on managing sediment in discharges of water as well as dust. No works should occur without the ESCP recommendations being in place. With regard to protection of aquatic health, maintenance and management of the controls adjacent to the streams and wetlands streams should be stringent, with erosion and sediment controls checked prior to and immediately following heavy rain events to minimise the potential for failure and sedimentation of the downstream receiving environment.

The potential adverse effects of sedimentation will be limited both in time and magnitude. Erosion, and the consequent mobilisation of sediment will primarily occur during the initial stages of the development of the pit, i.e. in the first three years, and over a 2 – 4 ha area, which is comparable to a small earthworks site. Once the initial overburden has been cleared for the first stage of the pit and the temporary stockpile relocated, the worked areas will be comprised of rock. When the new pit is operational, after approximately three years, all water will be directed into the pit, and what comes out of the pit will be managed by automated

systems, including automated turbidity monitoring, minimising the potential for sedimentation downstream of the pit.

Following the implementation of the minimise measures, the magnitude of effect will be ‘**Low**’.

5.3.6 Connectivity

The replacement of the current double barrel culvert at the dam face with a new longer culvert joining the newly created stream in the current dam pond footprint, with permanent stream diversion downstream of the current dam, presents the potential for a barrier to fish passage. To minimise this potential loss of upstream connectivity to freshwater fauna, the culverts should be designed and installed in accordance with the New Zealand Fish Passage Guidelines. This should ensure indigenous fauna are able to safely access the upstream catchment during migrations. The culvert designs will be required to provide for fish passage for climbing capable species (i.e. eels and banded kōkopu) only, as the waterfall downstream of the Sutton Block works extent acts as a natural barrier to fish passage, naturally preventing swimming species such as īnanga from accessing the upper catchment.

5.3.7 Freshwater volume

The effects of the reduction of freshwater volume and connectivity can be separated into:

- reduction in contributing catchment within the site; and
- potential loss of stream base flows in the Maketu Stream and surrounding streams.

The reduction of the catchment size contributing to the remaining streams and wetlands immediately adjacent to the Sutton Block, (Wetland 2a south, Wetland 2b, lower Stream 2 and Stream 4) will result in a reduction of freshwater volume. Reduction of freshwater volume has the potential to increase the stress on aquatic fauna with pressures on temperature control and aquatic habitat abundance; changing the regime from permanent to intermittent, or intermittent to ephemeral.

As the majority of the contributing catchment to Wetland 2a South is outside of the final pit and this wetland flows to remnant Wetland 2b and Stream 2, the habitats are likely to retain their permanent nature, albeit there are likely some changes in wetland vegetation with the loss of the Wetland 2a – North. The water levels in the wetland immediately below the current junction of Wetland 2a South and North will require monitoring and if a reduction in levels is determined in the later Stages of the pit development then augmentation will likely be needed.

The reduction in catchment to Stream 4, with the loss of Streams 6 and 7, and further down the catchment the loss of Stream 5, will result in a loss of water volume in the main stem stream. As the contributing catchment to upper Stream 4 will be 18.5 ha after Stage 5, and the stream is located near the base of Kaarearea Pa, it is highly probable the stream will maintain permanent water. To ensure the baseflows to Stream 4 remain, clean water from the pit will be pumped up to just above the confluence of the Stream 7 and Stream 2 catchments, at the top of Stream 4 (refer to Pattle Delamore (2024) assessment), ensuring no flow loss to Stream 4. Downstream of the Sutton Block and within Drury Quarry, the main tributary is augmented with ground water and surface water from the Drury quarry sumps and stormwater from the

Front of House, and therefore no stream volume loss within the stream outside of the quarry is likely (Pattle Delamore, 2024).

The potential adverse effects of the loss of freshwater volume within the stream reaches immediately adjacent to the Sutton pit are proposed to be minimised with the riparian planting with native vegetation of the remaining reach of Stream 2; all of Stream 4 adjacent to the boundary; the bulk of Wetland 2a; all of Wetland 2b; Stream 3 and its small headwater wetland; and Wetland 8. The riparian planting will be 20m either side of the main tributary (Streams 2 and 4) and 10m either side of the minor tributaries and wetlands leading to the main tributary (Stream 3 and Wetland 8). The riparian planting will be contiguous with the proposed terrestrial offset planting, and provide temperature control to the stream, woody and leafy inputs, providing habitat for instream fauna, minimising the effects of the reduction of the catchment to the main stem stream and wetland. This will be included in the NGDP:RP as recommended as a condition of consent (Section 5.4).

To minimise potential adverse ecological effects on the streams in the wider catchments, a groundwater and surface water effects assessment was carried out by Pattle Delamore (2024). The report recommended augmentation to the Maketu Streams to offset groundwater flow captured by the Sutton pit quarry sump. The augmentation discharge points would be located upstream of the stream reaches that could potentially be affected by the dewatering, and the augmentation rates would be revised based on the long-term stream flow and groundwater level monitoring programmes. In addition, a 'Water Temperature and Dissolved Oxygen Mitigation Plan' will be implemented to ensure increases in water temperatures downstream and reductions in dissolved oxygen concentration are minimal.

Other streams located further away from the proposed Sutton Block (i.e. Mangawheau and Hingaia Tributary Streams) will be monitored for stream flow and augmented if required; whereas the Symonds, Hays and Peach Hill Streams are already being augmented under an existing consent, and it was determined that no change to this was required (Pattle Delamore, 2023).

5.3.8 Summary of Freshwater Effects Management

Table 58 provides a summary of the freshwater habitat values, level of effect of the proposed Sutton Pit without minimising or remediating on those values, the recommended measures to minimise or offset adverse effects, and level of effect with minimisation or offset. Freshwater effects that require offset (or compensation) will be addressed separately and will be detailed in the Residual Effects Analysis Report-Streams and Wetlands (document E5:9 REAR-SW) for this site.

Table 58. Summary of freshwater habitat loss, values and effects within the Sutton Pit extent. Values and effects assessments are as described in report, and as per EIANZ guidelines (Roper-Lindsay et al., 2018).

Effect/activity	Magnitude	Level of Effect (without minimising or remediating)	Recommended minimisation	Recommended offset of residual adverse effects	Level of effect (with minimisation or offset)
Stream reclamation	Very high	High	Effects cannot be minimised or remediated and the effects will be required to be offset. Offsetting of all features regardless of staging will occur during the offset of ecological features reclaimed during the first stages of the works. This staging of reclamation will provide 15 or more years for the offsetting measures for the majority of the site to establish prior to the reclamation.	Enhancement and restoration planting of stream extent and 20 m riparian yard within the Stevenson's Drury Site and Stevenson's Tuakau Site – the proposed offset sites. Enhancement, restoration and creation of up to 2 -3 ha of currently degraded wetland habitat at both sites. Protection in perpetuity of the offset streams and wetlands.	Demonstrable No-net loss (but preferably a net gain).
Wetland reclamation	Very high	High			Demonstrable No-net loss (but preferably a net gain).
Stream diversion	High	Moderate	Diverted stream to be constructed to reflect 'natural' stream channel with provision of aquatic habitat, riparian vegetation.	With proposed meander there should be not loss of stream length if, on final design, there is any stream length loss occurring as a result of the diversion, or the final design will not match or exceed the current SEV value of the stream to be diverted, additional offset will be carried out at the Tuakau Site.	Low
Fish injury or mortality	High	Moderate	Implementation of a native fish recovery plan immediately prior to streamworks.	-	Low
Sedimentation	High	High	Implementation of Erosion and Sediment Control Plan. All water including 'dirty water' that flows into the pit will be pumped to the main site and will be treated prior to discharge to the downstream receiving environment.	-	Low
Freshwater volume and connectivity on site	Moderate	Moderate	Contributing catchment remains sufficient to support permanent stream and wetland habitat. Clean pit water will be pumped to upper Stream 4. Potential adverse effects on freshwater habitats are minimised with 10 m (minor tributaries) and 20 m (main tributaries) riparian planting throughout the remaining reaches and wetlands. Riparian planting to be contiguous with the proposed terrestrial offset planting, to provide temperature control and improve the provision of habitat (woody debris, leaf litter).	-	Low

			Culvert to be designed for fish passage for the target species locomotion (i.e. climbing capable) – do not need to provide passage for swimming locomotion fish due to significant natural barrier downstream		
Potential Loss of stream base flow for Maketu Stream and northern tributary streams	Low	Moderate	Continuous flow data monitoring from gauging stations in the potentially affected areas with trigger values set for the requirement for augmenting flows to commence at Maketu and northern tributary streams. The augmentation discharge points will be upstream of the stream reaches that may potentially be affected by the dewatering. Preparation and implementation of a 'Water Temperature and Dissolved Oxygen Mitigation Plan' to ensure the supplemented flows do not result in, after reasonable mixing, less than 3°C increase in water temperatures downstream and equal to or greater than 6 milligrams per litre in dissolved oxygen concentration.		Low

5.4 Recommended Consent Conditions

A total of 16.78 ha of indigenous vegetation and fauna habitats would be removed to accommodate the new Sutton Block Pit and associated infrastructure. The loss of these vegetation and fauna values would require actions to avoid and minimise expected adverse effects, as detailed in specific management plans. Following these, significant residual adverse effects expected as a result of loss of ecosystems and associated flora and fauna habitats, would require countermeasures to offset or compensate for those losses. These actions should be modelled to demonstrate overall net gain outcomes where possible (within the limitations of biodiversity offsetting and compensation).

The following recommendations are provided to ensure appropriate ecological management and offset actions are applied to minimise, offset and compensate for adverse ecological effects:

1. Legal protection and monitoring

All restoration actions will be legally protected in perpetuity by way of covenant and monitored for a minimum 30 years to ensure offset targets are achieved.

2. Ecological Management Plan (EMP)

The objectives of the EMP are:

- a) to identify how the project will address and manage adverse effects on the ecological values of the land within the Drury Quarry – Sutton Block footprint and its surrounds.
- b) sets out procedures for how Drury Quarry will minimise and manage adverse effects on ecological values.

a. Management of vegetation removal

Prior to any vegetation removal, an accurate survey of the clearance area and clear visual demarcation of the edges. During vegetation clearance:

- i) The EEMP should be complied with;
- ii) Salvage and utilisation of forest resources should be undertaken to assist with planting projects, as set out in the BOPP.

b. Avifauna Management Plan (AMP)

Prior to any vegetation removal, an Avifauna Management Plan shall be prepared, certified by Auckland Council and implemented by the Consent Holder. The objective of the AMP is to avoid and minimise the potential effects of the Sutton Block Pit on native birds.

The AMP must be prepared by a SQEP and include as a minimum:

- i) The area to be impacted by the works.
- ii) Credentials and contact details of the ecologist/ornithologist who will implement the AMP.
- iii) Timing of the implementation of the AMP.
- iv) A description of methodology for nest surveys and management around active nests. This should include species specific details for potentially present Threatened and At-Risk species, including but not limited to,
 - description of potential nest locations,
 - duration of the breeding season, including duration of incubation, nestling and period of post-fledging parental dependence.
 - Exclusion zone requirements around active nests for vegetation clearance.

c. Bat Management Plan (BMP)

The objective of the BMP is to avoid or minimise the potential adverse effects of the Sutton Block Pit on bats.

It must:

- a) Be prepared by SQEP(s).
- b) Include as a minimum:
 - i) Take into account the outcomes of consultation with local Iwi.
 - ii) Include procedures for potential bat roost tree felling protocols.
 - iii) Where necessary, set out an approach to habitat replacement and pest control, consistent with the Department of Conservation's artificial bat roost advisory note.
 - iv) Be updated to achieve consistency with any authorisation given by the Director-General of Conservation under s53 of the Wildlife Act 1953 where any such authorisation is required.

d. Native Lizard Management Plan (NLMP)

Prior to any vegetation removal, a Native Lizard Management Plan shall be prepared, certified by Auckland Council and implemented by the Consent Holder. The objective of the LMP is to avoid and minimise the potential effects of the Sutton Block Pit on native lizards.

It must:

- a) Be prepared by SQEP(s).
- b) Include as a minimum:
 - i) The area to be impacted by the works (including a plan) and the proposed release site for the lizards.
 - ii) Credentials and contact details of the ecologist/herpetologist who will implement the LMP.
 - iii) Timing of the implementation of the LMP.
 - iv) A description of methodology for survey, trapping and relocation of lizards rescued including but not limited to: salvage protocols, relocation protocols (including method used to identify suitable relocation site(s)), nocturnal and diurnal capture protocols, supervised habitat clearance/transfer protocols, and opportunistic relocation protocols.
 - v) Whether a lizard exclusion fence (e.g. a super silt fence) needs to be erected around the boundary of the vegetation removal area during or immediately following removal works occurring to prevent re-colonisation by native lizards.
 - vi) A description of the relocation site; including discussion of:
 - provision for additional refugia, if required (e.g. depositing salvaged logs, wood or debris, installing tree covers) for captured lizards;
 - any protection mechanisms (if required) to ensure the relocation site is maintained (e.g. covenants or consent notices);
 - any weed and pest management to ensure the relocation site is maintained as an appropriate habitat.
 - vii) A description of the lizard monitoring methodology, including but not limited to: baseline surveys as necessary, to identify potential release sites for salvaged lizard populations and lizard monitoring sites, ongoing annual surveys to evaluate translocation success, pre and post – translocation surveys, and monitoring of effectiveness of pest control and/or any potential adverse effects on lizards associated with pest control.

e. Edge Effects Management Plan (EEMP)

The edge effects management plan (EEMP) shall be prepared, certified by Auckland Council and implemented by the Consent Holder. The objective of the EEMP is to avoid impacts from edge effects following vegetation clearance.

The EEMP must be:

- a) Be prepared by SQEP(s).
- b) Include as a minimum:
 - ii) Take into account the outcomes of consultation with the Ngai Tai ki Tamaki Trust.
 - iii) Provide information about planting buffer widths, planting and maintenance requirements.
 - iv) Provide details about fencing requirements where suitable planting buffers widths are not available, including fencing maintenance. Fences should be designed to provide sufficient mitigation for light, dust and wind impacts on vegetation edges.

f. Native Freshwater Fauna Management Plan (NFFMP)

Prior to any streamworks, a Native Freshwater Fauna Management Plan (NFFMP) shall be prepared, certified by Auckland Council and implemented by the Consent Holder. The objective of the NFFMP is to avoid, remedy or minimise the potential adverse effects of the Sutton Block Pit on native fish, kōura and kākahi.

The NFFMP must be:

- 2) Be prepared by SQEP(s).
- 3) Include as a minimum:
 - i) Take into account the outcomes of consultation with the Ngai Tai ki Tamaki Trust.
 - ii) Methodologies to capture fish within the impact streams.
 - iii) Methods to recover kākahi and kōura
 - iv) Fishing effort.
 - v) Details of the relocation site.
 - vi) Storage and transport measures including the best practice for prevention of predation and death during capture.
 - vii) Euthanasia methods for diseased or pest species.

g. Sutton Block Riparian Planting Plan (SRPP)

The objective of the SRPP is to ensure riparian planting of the northern tributary / main stem stream adjacent to the final pit, and its tributaries.

The SRPP must:

- a) Be prepared by SQEP(s).
- b) Include as a minimum:
 - i) Take into account the outcomes of consultation with relevant local Iwi.
 - ii) Plans identifying the areas of proposed riparian planting;
 - iii) Describe plant species mixes; plant spacing, density and layout; plant size (at time of planting); and planting methods (including ground preparation, mulching and trials);
 - iv) Describe where the plants will be eco-sourced from (including species genetic source and propagation methodology).
 - v) Describe fencing (location, type and maintenance requirements), stock exclusion, or any other physical works necessary to protect planted areas from livestock;

- vi) Describe the legal arrangements (land purchase, leasing or covenanting) to be entered into to ensure the planted areas are retained in perpetuity;
- vii) Include a plant pest management programme that as a minimum targets species that threaten new or replacement plantings;
- viii) Include an animal pest management programme.
- ix) Describe the ongoing maintenance and management of planted areas, including a requirement that over a 5-year period (or until 80% canopy cover is achieved) plants that fail to establish are replaced.

3. Net Gain Delivery Plan: Planting Plan (NGDP:PP).

The objectives of the NGDP:PP are:

- a) to ensure that sufficient quantity and quality of planting is achieved to counteract the loss of terrestrial vegetation and habitats to be removed as a result of the Sutton Block Pit;
- b) to ensure that the offset and compensation planting is managed in an appropriate manner to facilitate the on-going survival and development of the recreated and enhanced habitats; and
- c) to ensure the offset and compensation plantings are maintained and monitored, and suitably protected so as to ensure they achieve an overall net gain in accordance with the modelled targets.

The NGDP:PP is to be based on the modelled requirements of the REAR-TE at the Sutton Block (Bioresearches and JS Ecology, 2025a) and is to provide in part for the offset of the loss of vegetation in the Sutton Block Pit area at the following approximate rates in Table 59.

Table 59. Offset Planting Rates

Biodiversity type	Area Lost/ha	Compensation Planting/ha
Rock Forest	0.65	8.32
Taraire, tawa podocarp Forest (WF9-2, WF9-5)	1.89	12
Taraire, tawa podocarp Forest (WF9-1, WF9-3, WF9-4)	5.44	20
Kānuka Forest (VS2)	8.8	22
Total	16.78	62.32

The NGDP:PP must be certified in accordance with Condition 38. It must:

- a) Be prepared by SQEP(s);
- b) Include as a minimum:
 - i) Take into account the outcomes of consultation with local Iwi.
 - ii) Require that the planting of pioneer species commences within the second planting season following the commencement of vegetation removal within the Project.
 - iii) Require that all pioneer planting be completed within 10 years from commencement
 - iv) Identify when the enrichment planting is to be undertaken for each area of pioneer planting (based on the monitoring of the growth of the pioneer planting and which is expected to be within three to five years of the pioneer planting).
 - v) Identify areas (including legal boundaries) where planting is to occur including staging.
 - vi) Describe plant species mixes, plant spacing, density and layout, plant size (at time of planting) and planting methods (including ground preparation, mulching and trials).

- vii) Describe where the plants will be eco-sourced from (including species genetic source and propagation methodology).
- viii) Describe fencing (location and type), stock exclusion, or any other physical works necessary to protect planted areas from livestock.
- ix) Describe the legal arrangements (land purchase, leasing or covenanting) to be entered into to ensure the planted areas are retained in perpetuity.
- x) Include a plant pest management programme that as a minimum targets species that threaten new or replacement plantings, forest regeneration, forest succession, and the regeneration of any retirement areas.
- xii) Describe the ongoing maintenance and management of planted areas, including a requirement that over a 5-year period (or until 80% canopy cover is achieved) plants that fail to establish are replaced.

Advice Note: This condition does not cover the Riparian Planting requirements.

4. Net Gain Delivery Plan: Pest and Weed Control (NGDP:PWC).

The objectives of the NGDP:PWC are:

- a) to ensure that sufficient quantity and quality of pest control is achieved to counteract the loss of terrestrial vegetation and habitats to be removed as a result of the Project;
- b) to ensure that the offset and compensation pest control is managed in an appropriate manner to facilitate the on-going survival and development of the enhanced habitats; and
- c) to ensure the offset and compensation pest control are maintained and monitored and suitably protected so as to ensure they achieve an overall net gain in accordance with the modelled targets.

The NGDP:PWC is to be based on the modelled requirements of the REAR-TE at the proposed Sutton Pit (Biosearches and JS Ecology, 2025) and is to provide in part for the offset of the loss of vegetation in the Project area at the following approximate rates in Table 59.

The NGDP:PWC must be certified in accordance with Condition 38. It must:

- a) Be prepared by SQEP(s);
- b) Include as a minimum:
 - i) Take into account the outcomes of consultation with local Iwi.
 - ii) Include an animal pest management programme that describes the ongoing maintenance and management of pest predator (possums, rats, mustelids) and ungulate (pigs, goats and deer) species, including control methods, catch targets and ongoing population monitoring.
 - iii) Include a pest plant management programme that describes the ongoing maintenance and management of pest plant (weed) species, including control methods and ongoing monitoring.
 - iv) Describe fencing (location and type), stock exclusion, or any other physical works necessary to protect enhanced areas from livestock.
 - v) Describe the legal arrangements (land purchase, leasing or covenanting) to be entered into to ensure the enhanced areas are retained in perpetuity.
 - v) An annual report is required to be submitted to the Drury Quarry Environmental Manager in November each year setting out all weed and pest control actions undertaken and their results for that year.

5. Net Gain Delivery Plan: Riparian Planting (NGDP:RP)

The objectives of the NGDP:RP are:

- a. To provide for the calculated offset of the loss of watercourses in the Project area based on the Environmental Compensation Ratios included in the REAR:FW (Biosearches, 2025).
- b. To ensure riparian planting of the Peach Hill Road Streams, Davies Road Stream, Tutaenui Stream and West Stream on the Tuakau offset site are undertaken in an appropriate manner to facilitate the on-going survival of those plants and to achieve the long-term enhancement of the water-course values as set out in the Stream and Wetland Offset Report (Biosearches, 2025).

The NGDP:RP must be certified. It must:

a) Be prepared by SQEP(s).

b) Include as a minimum:

- i) Take into account the outcomes of consultation with relevant local Iwi.
- ii) Specific restoration design details, including
 - a. location and flow paths;
 - b. Supporting design drawings including profiles;
 - c. Details of ecological enhancements,
 - d. Monitoring and maintenance requirements.
- iii) Planting Plans
 - a) Plans identifying the areas of proposed riparian planting and any in-stream enhancement works (for example, any culverts or flood gates to be removed or relocated).
 - b) Describe plant species mixes; plant spacing, density and layout; plant size (at time of planting); and planting methods (including ground preparation, mulching and trials).
 - c) Describe where the plants will be eco-sourced from (including species genetic source and propagation methodology).
 - d) Describe fencing (location, type and maintenance requirements), stock exclusion, or any other physical works necessary to protect planted areas from livestock.
 - e) Describe the legal arrangements (land purchase, leasing or covenanting) to be entered into to ensure the planted areas are retained in perpetuity.
 - f) Include a plant pest management programme that as a minimum targets species that threaten new or replacement plantings.
 - g) Include an animal pest management programme.
 - h) Describe the ongoing maintenance and management of planted areas, including a requirement that over a 5-year period (or until 80% canopy cover is achieved) plants that fail to establish are replaced.

6. Net Gain Delivery Plan: Wetland Planting (NGDP:WP)

The objectives of the NGDP:WP are:

To provide for the compensation of the loss of wetlands in the Project area based on the Biodiversity Compensation Model included in the REAR:FW (Biosearches, 2025).

To ensure that the wetland restoration and planting at the Tuakau offset site is designed and undertaken in an appropriate manner to facilitate the on-going survival of the wetland and those plants and to achieve the long-term enhancement of the wetland values as set out in the REAR:FW (Biosearches, 2025).

The NGDP:WP must be certified. It must:

a) Be prepared by SQEP(s).

b) Include as a minimum:

- iv) Take into account the outcomes of consultation with relevant local Iwi.
- v) Specific wetland restoration design details, including
 - e. location and flow paths;
 - f. supporting design drawings including profiles;
 - g. details of any construction methods;
 - h. Details of ecological enhancements, including meander; low flow channel; pools;
 - i. Monitoring and maintenance requirements.
- vi) Planting Plans
 - i) Describe plant species mixes; plant spacing, density and layout; plant size (at time of planting); and planting methods (including ground preparation, mulching and trials).
 - j) Describe where the plants will be eco-sourced from (including species genetic source and propagation methodology).
 - k) Describe fencing (location, type and maintenance requirements), stock exclusion, or any other physical works necessary to protect planted areas from livestock.
 - l) Describe the legal arrangements (land purchase, leasing or covenanting) to be entered into to ensure the planted areas are retained in perpetuity.
 - m) Include a plant pest management programme that as a minimum targets species that threaten new or replacement plantings.
 - n) Include an animal pest management programme.
 - o) Describe the ongoing maintenance and management of planted areas, including a requirement that over a 5-year period (or until 80% canopy cover is achieved) plants that fail to establish are replaced.

7. Annual Report on Planting and Riparian Planting for Years 1 - 5 (From Planting)

On or before 1 November each year a Suitably Qualified and Experienced Person (SQEP) shall undertake an audit and prepare a report on the planting and riparian planting undertaken.

This report shall include the following:

- a) Plan of planting undertaken to date and period of planting.
- b) Plan of riparian planting undertaken to date and period of planting.
- c) Plan of ecological enhancement area.
- d) Description of planting (species, numbers, grade and spacing), riparian planting (species, numbers, grade and spacing) and pest and weed management undertaken during the previous 12 months.
- f) Identification of any replacement planting or additional planting required.
- g) Identification of any additional weed or pest management required.
- h) Recommendations on any changes required to the NGDP:PP, NGDP:RP, NGDP:WP,.

This report is to be provided to Council within three months of the audit being undertaken.

The auditing of a planting and riparian planting area shall continue for a period of five years from the period an area of pioneer or riparian planting is completed.

8. Five Year Baseline Report for Offset Planting

Within 12 months of the completion of the five years annual monitoring of the planting in each identified planting area, the Consent Holder will submit a planting establishment report prepared by a SQEP verifying that planting has been completed in accordance with the approved detailed restoration planting plan for the area and all relevant resource consent conditions.

A series of permanently marked Recce plots and photo points are to be established within each planting type (Rock Forest, taraire, tawa podocarp and kānuka) to collect data on the following biodiversity attributes for comparison with modelled targets as follows:

- Indigenous Canopy cover (%)
- Indigenous subcanopy cover (%)
- Indigenous understory cover (%)
- Indigenous ground cover (%)
- Total native vascular plant species richness
- Native ground cover species richness
- Basal area >10 cm diameter (m² /ha)
- Mean canopy height
- Log fall (m3 / ha)
- Leaf litter depth (mm)
- Native winter fruit diversity (count)
- Native winter flower diversity (count)

The report shall provide an assessment against the modelled 5-year monitoring targets for the relevant vegetation type contained in the Biodiversity Offset and Compensation Plan for Terrestrial Ecological Values at Drury Quarry Sutton Block (Biosearches & JS Ecology, 2025a).

9. Long Term Reports on Planting Areas for Years 7 to 30 (From Planting)

A full review of each planting area shall be carried out by a SQEP at Years 7, 10, 15, 20 & 30 following completion of the implementation of the pioneer planting.

The objective of each review is to determine whether the biodiversity compensation and/or offset strategies used to address the ecological effects of the project are achieving the modelled 10, 20 and 30 year monitoring targets contained in the REAR:TE at Drury Quarry Stage 3 (Biosearches & JS Ecology, 2025a) and associated management plans for each area.

Permanently marked Recce plots and photo points (as established at Year 5 under previous condition) are to be used within each biodiversity planting type (Rock Forest, taraire, tawa podocarp and kānuka) to collect data on the following biodiversity attributes for comparison with modelled targets as follows:

- Indigenous Canopy cover (%)
- Indigenous subcanopy cover (%)
- Indigenous understory cover (%)
- Indigenous ground cover (%)
- Total native vascular plant species richness
- Native ground cover species richness
- Basal area >10 cm diameter (m² /ha)
- Mean canopy height
- Log fall (m3 / ha)
- Leaf litter depth (mm)
- Native winter fruit diversity (count)
- Native winter flower diversity (count)

The report must compare measured data with modelled monitoring targets and consider whether the progress of the planting to date is likely to result in the achievement of the modelled endpoint target for each biodiversity type.

The Consent Holder is to submit an Offset and Compensation Planting Progress Report within 12 months of each planting area having reached the 5, 10, 20 and 30 year anniversaries since planting which may recommend any identified contingency actions.

10. Ecological Enhancement Monitoring and Reporting for Years 1 – 25

The objective of this monitoring is to assess the effectiveness of the ecological enhancement to offset and compensate habitat loss at Drury Quarry.

Monitoring is to be undertaken at Years 2, 5, 10, 15, 20 and 25 from the full implementation of the ecological enhancement at each site.

Monitoring shall include but is not limited to:

- a) Residual trap catch rates
- b) Bait uptake rates
- c) Tracking tunnel and chew card results
- d) Additional methods as technical innovations in pest monitoring become available
- e) 5-minute bird counts
- f) Pest plant mapping
- g) Photo points
- h) Permanent Recce plots to monitor forest condition parameters including:
 - Ground cover (%)
 - Sapling diversity
 - Foliar Browse index
 - Seedling and sapling counts

The Consent Holder is to submit an Ecological Enhancement Progress Report within 12 months of the required monitoring dates. This is to include an assessment of the measured data against the modelled monitoring targets and may recommend any identified contingency actions.

Advice Note: In the event that new monitoring technology becomes available which can be used for (a) to (f) above, then this can be utilised without the requirement to modify this consent condition.

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Appendix A: Ecological Impact Assessment methodology

The ecological assessments undertaken for the proposed expansion of Drury Quarry generally follow Ecological Impact Assessment guidelines for use in New Zealand (EclAG) published by EIANZ¹⁸ (Roper-Lindsay *et al.* 2018). The EclAGs provide a standardised matrix framework that allows ecological effects assessments to be clear, transparent and consistent. The EclAG framework is generally used in impact assessments in New Zealand as good practice.

The EclAGs provide a four-step process for undertaking terrestrial and freshwater assessments as follows:

Step 1: Assess the **value** of the area (terrestrial and/or freshwater), taking into consideration species (Table 60) and other attributes of importance for fauna, vegetation or habitats (Table 60, Table 61 and Table 62) to assign an overall ecological value (Table 63).

Step 2: Determine the **magnitude** of effect (Table 64). This step also includes consideration of the timescale and permanence of the effect, whereby temporary (< 25 years) and long-term (substantial improvement after 25 years) effects are distinguished from permanent (beyond the span of a human generation) effects.

Step 3: Evaluate the overall severity or **level of effect** using a matrix (Table 65) of the ecological value and magnitude of effect.

Step 4: In the EclAG process, Step 4 involves determining the 'RMA effect' based on the overall level of ecological impact. This assessment is carried out by planners in collaboration with ecologists and is documented in the AEE report, rather than the ecology report. This ensures that the descriptions of ecological effects are aligned with other types of effects that may result from the proposed activity, which are evaluated in other parts of the application documents.

Fauna considered in this report include all those that are protected by the Wildlife Act (1953), including lizards, birds and long-tailed bats. Particular consideration was given where species with a conservation status of nationally 'At Risk' or higher have the potential to be present.

Table 60. Factors to be considered in assigning value to species (Roper-Lindsay *et al.*, 2018).

Determining factors	Value
Nationally threatened species, found in the ZOI either permanently or seasonally	Very High
Species listed as 'At Risk' – declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of 'At Risk' found in the ZOI (Zone of Interest) either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

Table 61. Attributes to be considered when assigning ecological value or importance to a site or area of terrestrial vegetation / habitat / community (as per Table 4 of Roper-Lindsay *et al.* 2018).

¹⁸ Environmental Institute of Australia and New Zealand

Matters	Attributes to be considered
Representativeness	1. Criteria for representative vegetation: 2. Typical structure and composition 3. Indigenous species dominate 4. Expected species and tiers are present 5. Criteria for representative vegetation: 6. Species assemblages that are typical of the habitat 7. Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/Distinctiveness	8. Criteria for rare/distinctive vegetation and habitats: 9. Naturally uncommon or induced scarcity 10. Amount of habitat or vegetation remaining 11. Distinctive ecological features 12. National Priority for Protection 13. Criteria for rare/distinctive species of species assemblages: 14. Habitat supporting nationally threatened or At-Risk species, or locally uncommon species 15. Regional or national distribution limits of species or communities 16. Unusual species or assemblages 17. Endemism
Diversity and pattern	18. Level of natural diversity, abundance and distribution 19. Biodiversity reflecting underlying diversity 20. Biogeographical considerations- pattern, complexity 21. Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	22. Site history and local environment conditions which have influenced the development of habitats and communities 23. The essential characteristics that determine an ecosystems integrity, form, functioning and resilience (from 'intrinsic value' as defined in RMA) 24. Size, shape and buffering 25. Condition and sensitivity to change 26. Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material 27. Species role in ecosystem functioning - high level, key species identification, habitat as proxy

Table 62. Matters that may be considered when assigning ecological value to a freshwater site or area (as per Table 7 of Roper-Lindsay et al. 2018).

Matters	Attributes to be considered
Representative ness	1. Extent to which site/catchment is typical or characteristic 2. Stream order 3. Permanent, intermittent or ephemeral waterway 4. Catchment size 5. Standing water characteristics
Rarity/ Distinctiveness	6. Supporting nationally or locally Threatened, At Risk or uncommon species 7. National distribution limits 8. Endemism 9. Distinctive ecological features 10. Type of lake/pond/wetland/spring
Diversity and pattern	11. Level of natural diversity 12. Diversity metrics 13. Complexity of community 14. Biogeographical considerations - pattern, complexity, size, shape
Ecological context	15. Stream order 16. Instream habitat 17. Riparian habitat 18. Local environmental conditions and influences, site history and development 19. Intactness, health and resilience of populations and communities 20. Contribution to ecological networks, linkages, pathways 21. Role in ecosystem functioning – high level, proxies

Table 63. Assigning ecological value (Roper-Lindsay et al. 2018).

Magnitude	Description
Very High	Area rates High for 3 or all of the four assessment matters listed in Table 61 or Table 62. 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 matters, 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.

Table 64. Criteria matrix for describing magnitude of effects (Roper-Lindsay et al. 2018).

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

Table 65. Criteria matrix for describing level of effects (Roper-Lindsay et al. 2018).

Ecological value → magnitude ↓	Very high	High	Moderate	Low	Negligible
Very High	<i>Very High</i>	<i>Very High</i>	<i>High</i>	<i>Moderate</i>	Low
High	<i>Very High</i>	<i>Very High</i>	<i>Moderate</i>	Low	Very Low
Moderate	<i>High</i>	<i>High</i>	<i>Moderate</i>	Low	Very Low
Low	<i>Moderate</i>	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Appendix B: Terrestrial Plant Species Lists for Native Forest Fragments

Botanical name	Common name	Occurrence
Gymnosperms		
<i>Dacrydium cupressinum</i>	rimu	WF9-1 WF9-3
<i>Dacrycarpus dacrydioides</i>	kahikatea	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Podocarpus totara</i>	totara	WF9-1 VS2
<i>Phyllocladus trichomanoides</i>	tanekaha	WF9-3
<i>Prumnopitys ferrugineus</i>	miro	WF9-1 WF9-2 WF9-3
Dicot trees and shrubs		
<i>Beilschmiedia tarairi</i>	taraire	WF9-1 WF9-2 WF9-3 RF
<i>Beilschmiedia tawa</i>	tawa	WF9-1 WF9-2 WF9-3 RF
<i>Carpodetus serratus</i>	putaputaweta/ marble leaf	WF9-1 VS2
<i>Coprosma arboreus</i>	Tree coprosma	WF9-1 VS2
<i>Coprosma areolata</i>	Thin leaved coprosma	VS2 WF9-2
<i>Coprosma rhamnoides</i>	Twiggy coprosma	VS2
<i>Coprosma robusta</i>	Karamu	VS2
<i>Coprosma spathulata</i>		WF9-1
<i>Corynocarpus laevigatus</i>	Karaka	
<i>Dysoxylum spectabile</i>	kohekohe	WF9-1
<i>Griselinia lucida</i>	puka	WF9-1
<i>Geniostoma ligustrifolium</i> var. <i>ligustrifolium</i>	Hangehange	WF9-1 WF9-3 VS2
<i>Hedycarya arborea</i>	Pigeonwood	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Knightia excelsa</i>	Rewarewa	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Kunzea robusta</i>	Kānuka	WF9-1 VS2
<i>Laurelia novaezealandiae</i>	pukatea	WF9-1 WF9-2 WF9-3 RF
<i>Leptospermum scoparium</i>	Mānuka	WF9-1
<i>Leucopogon fasciculatus</i>	Mingimingi	5323 5346
<i>Melicetyus ramiflorus</i>	Māhoe	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Metrosideros diffusa</i>	White rātā	WF9-1 WF9-3 RF
<i>Metrosideros fulgens</i>	rātā	WF9-1 WF9-2 RF
<i>Metrosideros perforatā</i>	Small white rātā	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Myrsine australis</i>	Mapou/ matipo	WF9-1 WF9-3 VS2
<i>Nestegis lanceolata</i>	White maire	WF9-1
<i>Olearia rani</i>	Heketara	WF9-1
<i>Parsonsia heterophylla</i>	NZ jasmine	WF9-1 RF
<i>Passiflora tetrandra</i>	Kohia vine/ NZ passion vine	WF9-1 RF
<i>Piper excelsum</i>	kawakawa	WF9-1 BPL3
<i>Pseudopanax crassifolius</i>	Lancewood	WF9-1 WF9-3 VS2 RF
<i>Schefflera digitata</i>	Pate	WF9-2
<i>Vitex lucens</i>	Puriri	WF9-1 WF9-3
Dicot herbs		
<i>Callitriche muellerii</i>	Mueller's starwort	WF9-1 VS2
<i>Centella uniflora</i>	Centella	VS2
<i>Haloragis erecta</i>	Shrubby haloragis	5349
<i>Hydrocotyle dissecta</i>		WF9-1 VS2
<i>Ranunculus reflexus</i>	Hairy buttercup	WF9-1 VS2

Monocots		
<i>Astelia solandri</i>	Perching lily	WF9-1 WF9-2 WF9-3 RF
<i>Astelia hastata</i>	Tank lily	WF9-1 WF9-2 WF9-3
<i>Cordyline australis</i>	Tī kōuka/ cabbage tree	WF9-1
<i>Corybas trilobus</i>		WF9-1 WF9-2
<i>Earina mucronata</i>	Bamboo orchid	WF9-1 WF9-2 RF
<i>Freycinetia banksii</i>	kiekie	WF9-1 WF9-2 RF
<i>Rhopalostylis sapida</i>	nikau palm	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Ripogonum scandens</i>	supplejack	WF9-1 WF9-2 RF
Ferns & fern allies		
<i>Arthropteris tenella</i>	Jointed fern	RF
<i>Asplenium bulbiferum</i>	Hen & chickens fern	WF9-1
<i>Asplenium flaccidum</i>	Hanging spleenwort	WF9-1 WF9-3 RF
<i>Asplenium oblongifolium</i>	Shining spleenwort	WF9-1 WF9-3
<i>Asplenium polyodon</i>	Sickle spleenwort	WF9-2
<i>Austroblechnum lanceolatum</i>	Lance fern	WF9-1 VS2
<i>Cranfillia fluviatilis</i>	kiwakiwa	WF9-3
<i>Cyathea dealbata</i>	Silver fern	WF9-1 WF9-2 WF9-3 VS2 RF
<i>Cyathea medullaris</i>	Black ponga	WF9-1 VS2
<i>Dendroconche scandens</i>	Fragrant fern/mokimoki	WF9-1 WF9-3
<i>Deparia petersenii</i>		WF9-3
<i>Dicksonia squarrosa</i>	Whekī ponga	WF9-1 VS2
<i>Diplazium australe</i>		WF9-3 VS2
<i>Doodia australis</i>	Rasp fern	VS2
<i>Hypolepis distans</i>		WF9-1
<i>Icarus filiformis</i>	Thread fern/ nini	WF9-1 WF9-3 VS2 RF
<i>Leptopteris hymenophylloides</i>	Crape fern/heruheru	WF9-2
<i>Loxogramme dictyopteris</i>	Lance fern	WF9-1 WF9-2 WF9-3
<i>Lygodium articulatum</i>	Mangemange	VS2
<i>Parablechnum novae-zelandiae</i>	Kiokio	WF9-1 VS2
<i>Parapolystichum glabellum</i>	Smooth shield fern	WF9-1 BPL3
<i>Pneumatopteris pennigera</i>	Gully fern	WF9-1 WF9-3 VS2
<i>Pteridium esculentum</i>	Shaking brake	VS2
<i>Pteris macilenta</i>	Sweet fern	VS2
<i>Pteris tremula</i>	Shaking brake	PBL3
<i>Pyrrosia eleagnifolia</i>		WF9-1 WF9-2 WF9-3 RF
<i>Rumohra adiantiformis</i>	Leathery shield fern	5323
<i>Tmesipteris lanceolata</i>	Fork fern	VS2
<i>Trichomanes venosum</i>	Veined bristle fern	VS2
<i>Zealandia pustulatum</i>	Hound's tongue fern	WF9-1 WF9-2 WF9-3 RF
Sedges, rushes and grasses		
<i>Carex uncinata</i>	Hook sedge	WF9-3
<i>Carex dissita</i>	Forest sedge	WF9-3
<i>Eleocharis acuta</i>	Sharp spike sedge	WF9-1
<i>Isachne globosa</i>	Swamp millet	WF9-1
<i>Juncus australis</i>	Wīwī/leafless rush	WF9-1
<i>Juncus edgariae</i>	Wīwī/Edgar's rush	WF9-1
<i>Juncus prismatocarpus</i>		WF9-1

<i>Microlaena avenacea</i>	Bush rice grass	5323
<i>Oplismenus hirtellus</i> subsp. <i>imbecilis</i>	Basket grass	WF9-1 WF9-3 VS2 RF

Appendix C: Weather data during the ABM monitoring period

Note that protocols for defining valid survey nights is different between the 2020/2021 and 2024 survey periods. This is due to the criteria for valid survey nights being updated by the Department of Conservation in October 2021 (DOC, 2021). Within the updated protocols for minimising the risk of felling bat roosts, the section on ABM survey work outlays the revised criteria (Section 4b), which no longer includes nights with full moon and new criteria for amounts of rainfall.

2020-2021 Data

Date	Sunset time	Minimum overnight temperature (°C)	Rainfall in 2 hours after dusk (mm)	Full moon?	Suitable night?
22/09/2020	6:17 p.m.	6.2	0		No
23/09/2020	6:18 p.m.	9	0		No
24/09/2020	6:19 p.m.	13.6	0		Yes
25/09/2020	6:19 p.m.	9.6	0		No
26/09/2020	6:20 p.m.	8.8	0		No
27/09/2020	7:21 p.m.	12.4	0.5		Yes
28/09/2020	7:22 p.m.	11	0.8		Yes
29/09/2020	7:23 p.m.	9.5	0		No
30/09/2020	7:24 p.m.	6.3	0		No
1/10/2020	7:24 p.m.	4	0		No
2/10/2020	7:25 p.m.	3.9	0	Yes	No
3/10/2020	7:26 p.m.	6.6	0		No
4/10/2020	7:27 p.m.	6.5	0		No
5/10/2020	7:28 p.m.	10.5	0		Yes
6/10/2020	7:29 p.m.	12	0		Yes
7/10/2020	7:30 p.m.	11.6	0		Yes
8/10/2020	7:30 p.m.	10.6	0.7		Yes
9/10/2020	7:31 p.m.	9	0		No
10/10/2020	7:32 p.m.	10.2	0		Yes
11/10/2020	7:33 p.m.	11.3	0		Yes
12/10/2020	7:34 p.m.	13.8	0		Yes
13/10/2020	7:35 p.m.	10.2	0		Yes
14/10/2020	7:36 p.m.	7.3	0.1		No
15/10/2020	7:37 p.m.	6.9	0.3		No
16/10/2020	7:38 p.m.	4.6	0		No
17/10/2020	7:39 p.m.	2.7	0		No
18/10/2020	7:40 p.m.	4.9	0		No
19/10/2020	7:41 p.m.	13.2	0		Yes
20/10/2020	7:41 p.m.	14.6	0.3		Yes
21/10/2020	7:42 p.m.	12.7	0		Yes
22/10/2020	7:43 p.m.	11	0		Yes
23/10/2020	7:44 p.m.	10.3	0		Yes
24/10/2020	7:45 p.m.	12.8	0		Yes

25/10/2020	7:46 p.m.	13.7	0		Yes
26/10/2020	7:47 p.m.	12.9	0		Yes
27/10/2020	7:48 p.m.	13.1	0		Yes
11/12/2021	8:33 p.m.	16.4	1.6		Yes
12/12/2021	8:34 p.m.	18.7	0.2		Yes
13/12/2021	8:34 p.m.	17.9	1.1		Yes
14/12/2021	8:35 p.m.	17.2	2.3		Yes
15/12/2021	8:36 p.m.	16.2	0		Yes
16/12/2021	8:36 p.m.	15.6	2.2		Yes
17/12/2021	8:37 p.m.	15.6	0		Yes
18/12/2021	8:38 p.m.	14.9	0		No
19/12/2021	8:38 p.m.	12	0	Yes	No
20/12/2021	8:39 p.m.	10.3	0		No
21/12/2021	8:39 p.m.	14.5	0		Yes
22/12/2021	8:40 p.m.	15.4	0		Yes
23/12/2021	8:40 p.m.	15.2	0		Yes
24/12/2021	8:41 p.m.	16.1	0		Yes
25/12/2021	8:41 p.m.	14.1	0		Yes
26/12/2021	8:41 p.m.	17.7	0		Yes
27/12/2021	8:42 p.m.	17.2	0		Yes
28/12/2021	8:42 p.m.	19.3	0		Yes
29/12/2021	8:42 p.m.	16	0		Yes
30/12/2021	8:42 p.m.	14	0		Yes
31/12/2021	8:43 p.m.	15.2	0		Yes
1/01/2022	8:43 p.m.	14.8	0		Yes
2/01/2022	8:43 p.m.	15.1	0		Yes
3/01/2022	8:43 p.m.	14.7	0		Yes
4/01/2022	8:43 p.m.	15.3	0		Yes
5/01/2022	8:43 p.m.	14.9	0		Yes
6/01/2022	8:43 p.m.	17.6	0		Yes
7/01/2022	8:43 p.m.	17.7	0		Yes
8/01/2022	8:43 p.m.	16.3	0		Yes
9/01/2022	8:43 p.m.	15.2	0		Yes
10/01/2022	8:43 p.m.	16.4	0		Yes
11/01/2022	8:43 p.m.	15.4	0		Yes
12/01/2022	8:43 p.m.	16.9	0		Yes
13/01/2022	8:42 p.m.	14.2	0		Yes
14/01/2022	8:42 p.m.	13.1	0		Yes
15/01/2022	8:42 p.m.	13.2	0		Yes
16/01/2022	8:41 p.m.	13.3	0		Yes
17/01/2022	8:41 p.m.	13.5	0		No
18/01/2022	8:41 p.m.	16.5	0	Yes	No
19/01/2022	8:40 p.m.	14.1	0		No
20/01/2022	8:40 p.m.	15.2	0		Yes
21/01/2022	8:39 p.m.	10.8	0		Yes

22/01/2022	8:39 p.m.	12.3	0		Yes
23/01/2022	8:38 p.m.	14.2	0		Yes
24/01/2022	8:38 p.m.	16.9	0		Yes
25/01/2022	8:37 p.m.	16.1	0		Yes
26/01/2022	8:36 p.m.	17.6	0		Yes
27/01/2022	8:36 p.m.	16.3	0		Yes
28/01/2022	8:35 p.m.	14.8	0		Yes
29/01/2022	8:34 p.m.	12.4	0		Yes
30/01/2022	8:33 p.m.	13.2	0		Yes
31/01/2022	8:33 p.m.	14.1	0		Yes
1/02/2022	8:32 p.m.	17.7	0		Yes
2/02/2022	8:31 p.m.	19.3	0		Yes
3/02/2022	8:30 p.m.	19.2	0		Yes
4/02/2022	8:29 p.m.	17.6	0		Yes
5/02/2022	8:28 p.m.	20.7	0		Yes
6/02/2022	8:27 p.m.	17.4	1.2		Yes
7/02/2022	8:26 p.m.	16.6	0.3		Yes
8/02/2022	8:25 p.m.	20.2	0		Yes
9/02/2022	8:24 p.m.	21.5	0		Yes
10/02/2022	8:23 p.m.	21.4	0		Yes
11/02/2022	8:22 p.m.	20.7	1.7		Yes
12/02/2022	8:21 p.m.	23	0		Yes
13/02/2022	8:20 p.m.	13.8	0		Yes
14/02/2022	8:19 p.m.	13.9	0		Yes
Totals	Suitable				80
	Unsuitable				22
Grand total					102

* = Sunset times and moon phases are for Auckland and are retrieved from the Time and Date website¹⁹

** = Rainfall is retrieved in hourly cumulative totals, therefore three hours of rainfall data was used to calculate rainfall which fell within 2.5 hours of sunset. For example, for an 1830 sunset, the total rainfall was calculated by totalling all rainfall which fell from 1800 until 2059.

2024 Summer Data

Date	Min temp within 4 hrs of sunset (°C)	Sunset	Rainfall 2hrs after dusk (mm)	Rainfall 4hrs after dusk (mm)	Valid night?
5/03/2024	20.6	19:54	0	0	Yes
6/03/2024	11.3	19:52	0	0	Yes
7/03/2024	12.6	19:51	0	0	Yes
8/03/2024	13.3	19:49	0	0	Yes
9/03/2024	11.5	19:48	0	0	Yes
10/03/2024	14.3	19:46	0	0	Yes
11/03/2024	13.8	19:45	0	0	Yes
12/03/2024	14.9	19:44	0	0	Yes
13/03/2024	14.2	19:42	0	0	Yes

¹⁹ <https://www.timeanddate.com/sun/new-zealand/auckland>

14/03/2024	14.0	19:41	0	0	Yes
15/03/2024	11.4	19:39	0	0	Yes
16/03/2024	10.0	19:38	0	0	Yes
17/03/2024	12.0	19:36	0	0	Yes
18/03/2024	11.5	19:35	0	0	Yes
19/03/2024	9.2	19:33	0	0	No
20/03/2024	10.3	19:32	0	0	Yes
21/03/2024	10.9	19:30	0	0	Yes
22/03/2024	12.9	19:29	0	0	Yes
23/03/2024	13.8	19:27	0	0	Yes
24/03/2024					-
25/03/2024					-
26/03/2024					-
27/03/2024	13.7	19:21	0.5	0.5	Yes
28/03/2024	12.6	19:20	0	1	Yes
29/03/2024	7.2	19:19	0	0	No
30/03/2024	9.4	19:17	0	0	No
31/03/2024	8.7	19:16	0	0	No
1/04/2024	8.9	19:14	0	0	No
2/04/2024	11.1	19:13	0	0	Yes
3/04/2024	11.7	19:11	0	0	Yes
4/04/2024	14.8	19:10	0	0	Yes
5/04/2024	10.8	19:08	0	0	Yes
6/04/2024	13.3	19:07	0	0	Yes
7/04/2024	10.8	18:05	0	0	Yes
8/04/2024	11.1	18:04	0	0	Yes
9/04/2024	14.2	18:03	0	0	Yes
10/04/2024	16.5	18:01	0	0	Yes
11/04/2024	15.9	18:00	0.5	2.5	Yes
12/04/2024	13.2	17:59	0	0	Yes
13/04/2024	12.7	17:57	0.5	1	Yes
14/04/2024	9.3	17:56	0	0	No
15/04/2024	10.1	17:54	0	0	Yes
16/04/2024	11.7	17:53	0	0	Yes
Totals	Suitable				34
	Unsuitable				6
Grand total					40

2024 Spring Data

Date	Official sunset	Min temp within 4 hrs of sunset (°C)	Max wind speed within 4hrs of sunset (m/s)	Rainfall 4hrs after dusk (mm)	Valid night?
18 October 2024	19:40	12.7	2.0	0	Yes

19 October 2024	19:41	9.1	3.1	0	Yes
20 October 2024	19:41	6.7	1.0	0	No
21 October 2024	19:42	8.0	2.9	0	Yes
22 October 2024	19:43	14.5	4.4	0	Yes
23 October 2024	19:44	9.1	3.8	0	Yes
24 October 2024	19:45	11.6	3.4	0	Yes
25 October 2024	19:46	16.7	9.4	0	No
26 October 2024	19:47	16.6	2.4	14	No
27 October 2024	19:48	11.0	3.9	0	Yes
28 October 2024	19:49	13.1	7.5	0	No
29 October 2024	19:50	11.2	4.1	0.5	Yes
30 October 2024	19:51	13.0	4.3	0	Yes
31 October 2024	19:52	11.3	4.1	0	Yes
1 November 2024	19:53	10.8	1.0	0	Yes
2 November 2024	19:54	12.3	3.9	8.5	No
3 November 2024	19:55	7.4	2.2	0	No
Totals	Suitable				11
	Unsuitable				8
Grand Total					19

Appendix D. Wetland Plant Species Lists

Table 66. Vegetation identified within Wetland 1a.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Eleocharis acuta</i>	Sharp spike sedge	Non-Endemic	OBL
<i>Helosciadium nodiflorum</i>	Water celery	Exotic	OBL
<i>Isolepis levynsiana</i>	Tiny flatsedge	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus edgariae</i>	Wiwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>compactus</i>	Soft rush	Exotic	OBL
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Ludwigia palustris</i>	Water purslane	Exotic	OBL
<i>Paesia scaberula</i>	Ring fern	Endemic	FACU
<i>Parablechnum novae-zelandiae</i>	Kiokio	Endemic	FAC
<i>Paspalum dilatatum</i>	Paspalum	Exotic	FACU
<i>Paspalum distichum</i>	Mercer grass	Exotic	FACW
<i>Ranunculus flammula</i>	Spearwort	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
<i>Trifolium repens</i>	White clover	Exotic	FACU
<i>Ulex europaeus</i>	Gorse	Exotic	FACU

Table 67. Vegetation identified within Wetland 1b.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Alectryon excelsus</i>	Titoki	Endemic	-
<i>Dacrydium cupressinum</i>	Rimu	Endemic	FACU
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
<i>Rhopalostylis sapida</i>	Nikau	Endemic	FACU

Table 68. Vegetation identified within Wetland 1c.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Alisma plantago-aquatica</i>	Water plantain	Exotic	OBL
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus edgariae</i>	Wiwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW

<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
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Table 69. Vegetation identified within Wetland 2a.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Callitriche stagnalis</i>	Starwort	Exotic	OBL
<i>Carex virgata</i>	Swamp sedge	Endemic	FACW
<i>Eleocharis acuta</i>	Sharp spike sedge	Non-Endemic	OBL
<i>Glyceria declinata</i>	Glaucous sweetgrass	Exotic	OBL
<i>Helosciadium nodiflorum</i>	Water celery	Exotic	OBL
<i>Isolepis levynsiana</i>	Tiny flatsedge	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus edgariae</i>	Wīwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>compactus</i>	Soft rush	Exotic	OBL
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Ludwigia palustris</i>	Water purslane	Exotic	OBL
<i>Myosotis laxa</i>	Water forget-me-not	Exotic	OBL
<i>Paesia scaberula</i>	Ring fern	Endemic	FACU
<i>Parablechnum novae-zelandiae</i>	Kiokio	Endemic	FAC
<i>Paspalum dilatatum</i>	Paspalum	Exotic	FACU
<i>Paspalum distichum</i>	Mercer grass	Exotic	FACW
<i>Ranunculus flammula</i>	Spearwort	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
<i>Trifolium repens</i>	White clover	Exotic	FACU
<i>Typha orientalis</i>	Raupō	Non-Endemic	OBL
<i>Ulex europaeus</i>	Gorse	Exotic	FACU

Table 70. Vegetation identified within Wetland 2b.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Callitriche stagnalis</i>	Starwort	Exotic	OBL
<i>Eleocharis acuta</i>	Sharp spike sedge	Non-Endemic	OBL
<i>Glyceria declinata</i>	Glaucous sweetgrass	Exotic	OBL
<i>Isolepis levynsiana</i>	Tiny flatsedge	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus edgariae</i>	Wīwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>compactus</i>	Soft rush	Exotic	OBL
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Ludwigia palustris</i>	Water purslane	Exotic	OBL

<i>Parablechnum novae-zelandiae</i>	Kiokio	Endemic	FAC
<i>Paspalum dilatatum</i>	Paspalum	Exotic	FACU
<i>Paspalum distichum</i>	Mercer grass	Exotic	FACW
<i>Ranunculus flammula</i>	Spearwort	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
<i>Rubus fruticosus</i>	Blackberry	Exotic	FAC
<i>Trifolium repens</i>	White clover	Exotic	FACU
<i>Ulex europaeus</i>	Gorse	Exotic	FACU

Table 71. Vegetation identified within Wetland 3.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Carex virgata</i>	Swamp sedge	Endemic	FACW
<i>Eleocharis acuta</i>	Sharp spike sedge	Non-Endemic	OBL
<i>Helosciadium nodiflorum</i>	Water celery	Exotic	OBL
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus edgariae</i>	Wīwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Ludwigia palustris</i>	Water purslane	Exotic	OBL
<i>Myosotis laxa</i>	Water forget-me-not	Exotic	OBL
<i>Paesia scaberula</i>	Ring fern	Endemic	FACU
<i>Persicaria hydropiper</i>	Water pepper	Exotic	FACW
<i>Ranunculus flammula</i>	Spearwort	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
<i>Ulex europaeus</i>	Gorse	Exotic	FACU

Table 72. Vegetation identified within Wetland 6a.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Ludwigia repens</i>	Water Purslane	Exotic	OBL

Table 73. Vegetation identified within Wetland 6b

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Holcus lanatus</i>	Yorkshire Fog	Exotic	FAC

<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Ludwigia palustris</i>	Water purslane	OBL	Exotic
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC

Table 74. Vegetation identified within Wetland 6c

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Juncus pallidus</i>	Giant rush	Endemic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC

Table 75. Vegetation identified within Wetland 6d

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
	Water cress		
<i>Eleocharis acuta</i>	Sharp spike sedge	Non-Endemic	OBL
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus edgariae</i>	Wiwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Juncus sarophorus</i>	Fan-flowered rush	Endemic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Myosotis laxa</i>	Water forget-me-not	Exotic	OBL
<i>Paspalum dilatatum</i>	Paspalum	Exotic	FACU
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC

Table 76. Vegetation identified within Wetland 7a.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis levynsiana</i>	Tiny flatsedge	Exotic	FAC
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Juncus edgariae</i>	Wiwī	Endemic	FACW
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC

<i>Paspalum dilatatum</i>	Paspalum	Exotic	FACU
<i>Paspalum distichum</i>	Mercer grass	Exotic	FACW
<i>Persicaria hydropiper</i>	Water pepper	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC

Table 77. Vegetation identified within Wetland 7b

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Anthoxanthum odoratum</i>	Sweet vernal	Exotic	FACU
<i>Erechtites hieraciifolius</i>	American fireweed	Exotic	FAC
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Isolepis prolifera</i>	Budding club-rush	Endemic	OBL
<i>Isolepis sepulcralis</i>	-	Exotic	FAC
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Juncus sarophorus</i>	Fan-flowered rush	Endemic	FACW
<i>Ludwigia palustris</i>	Water purslane	Exotic	OLB
<i>Paspalum distichum</i>	Mercer grass	Exotic	FACW
<i>Persicaria hydropiper</i>	Water pepper	Exotic	FACW
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC

Table 78. Vegetation identified within Wetland 8.

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Agrostis stolonifera</i>	Creeping bent	Exotic	FACW
<i>Carex gaudichaudiana</i>	Gaudichaud's sedge	Non-Endemic	OBL
<i>Carex virgata</i>	Swamp sedge	Endemic	FACW
<i>Deparia petersenii</i>	Japanese lady fern	Non-Endemic	FAC
<i>Diplazium australe</i>	-	Non-Endemic	FACU
<i>Galium palustre</i>	Marsh bedstraw	Exotic	OBL
<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Juncus articulatus</i>	Jointed rush	Exotic	FACW
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Myosotis laxa</i>	Water forget-me-not	Exotic	OBL
<i>Parablechnum novae-zelandiae</i>	Kiokio	Endemic	FAC
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC
<i>Rumex obtusifolius</i>	Broad-leaved dock	Exotic	FAC
<i>Sonchus asper</i>	Prickly sow thistle	Exotic	FACU

Table 79. Vegetation observed within Wetland 9

Scientific name	Common name	Threat classification (de Lange <i>et al.</i> , 2017)	Rating (Clarkson <i>et al.</i> , 2021)
<i>Callitriche stagnalis</i>	Starwort	Endemic	OBL
<i>Carex virgata</i>	Swamp sedge	Endemic	FACW

<i>Holcus lanatus</i>	Yorkshire fog	Exotic	FAC
<i>Juncus effusus</i> var. <i>effusus</i>	Soft rush	Exotic	FACW
<i>Lolium perenne</i>	Perennial ryegrass	Exotic	FACU
<i>Lotus pedunculatus</i>	Lotus	Exotic	FAC
<i>Ranunculus repens</i>	Creeping buttercup	Exotic	FAC

Plot 3							
NVS code	% coverage	Species	Rating	Dom	Dominance Test		
JUNeff	59	Juncus effusus	FACW	d	(A)	1	
ANTodo	10	Anthoxanthum odoratum	FACU		(B)	1	
ISOsep	2	Isolepis sepulcralis	FAC		(A/B)%	100	
HOLLan	5	Holcus lanatus	FAC				
LOTped	3	Lotus pedunculatus	FAC				
JUNart	18	Juncus articulatus	FACW				
JUNpal	3	Juncus pallidus	FACW				
Prevalence Index							
	%						
OBL	0	x 1 =		0			
FACW	79	x 2 =		158			
FAC	10	x 3 =		30			
FACU	10	x 4 =		40			
UPL		x 5 =		0			
total	99			228 (B)			
Prevalence Index (B/A) =				2.30			

Plot 4							
NVS code	% coverage	Species	Rating	Dom	Dominance Test		
JUNeff	40	Juncus effusus	FACW	d	(A)	1	
ISOsep	2	Isolepis sepulcralis	FAC		(B)	2	
LUDpal	3	Ludwigia palustris	OBL		(A/B)%	50	
ISOpro	15	Isolepis prolifera	OBL				
HOLLan	15	Holcus lanatus	FAC				
ANTodo	22	Anthoxanthum odoratum	FACU	d			
EREhie	3	Erechtites hieraciifolius	FAC				
Prevalence Index							
	%						
OBL	18	x 1 =		18			
FACW	40	x 2 =		80			
FAC	20	x 3 =		60			
FACU	22	x 4 =		88			
UPL		x 5 =		0			
total	100	(A)		246 (B)			
Prevalence Index (B/A) =				2.46			

Appendix F: Freshwater Macroinvertebrate Data

PHYLUM	CLASS: Order	Family	Taxa	Taxa MCI hb	Taxa MCI sb	SB	SB	HB
						Stream 4	Stream 5	Stream 6
ANNELIDA	OLIGOCHAETA		Oligochaeta	1	3.8	4		3
	HIRUDINEA		Glossiphonia sp.	3	1.2	1		
MOLLUSCA	GASTROPODA	Hydrobiidae	Potamopyrgus antipodarum	4	2.1	4	5	603
		Physidae	Physella fontinalis	3	0.1	1		
		Ancylidae	Gundlachia sp.	3	2.4			3
	BIVALVIA	Sphaeriidae	Pisidium hodgkini	3	2.9	1		
ARTHROPODA	ARACHNIDA: Acari (mites)		Acari	5	5.2	6	1	30
	CRUSTACEA: Ostracoda		Ostracoda	3	1.9	3		1
	Amphipoda		Paracalliope fluviatilis	5	5.5	359	235	
	Decapoda		Paraneopros planifrons	5	8.4	2		
	Odonata	Zygoptera	Xanthocnemis zealandica	5	1.2	13		19
	Ephemeroptera		Atalophlebioides cromwelli	9	4.4			1
			Zephlebia spp	7	8.8			7
	Trichoptera	Hydroptilidae	Oxyethira albiceps	2	1.2	3	1	
		Hydrobiosidae	Hydrobiosis parumbripennis	5	6.7	11	32	
			Psilochorema sp.	8	7.8			4
		Polycentropodidae	Polypsectropus puerilis	8	8.1			2
		Oeconesidae	Oecones sp.	9	6.4			9
	Hemiptera	Corixidae	Sigara sp.	5	2.4	2		
	Coleoptera	Scirtidae	Scirtidae	8	6.4		12	1
		Hydrophilidae	Enochrus tritus	5	2.6			3
	Diptera		Limonia sp.	6	6.3		3	
		Hexatomini	Paralimnophila skusei	6	7.4	2	3	5
			Hexatomini	5	6.7		1	
		Simuliidae	Austrosimulium australense gp	3	3.9	15		1
		Chironomidae	Chironomus	1	3.4	5		
			Polypedilum	3	8		11	
			Orthocladinae	2	3.2	18		
			Tanypodinae	5	6.5	4		
			Limnophora sp.	3	4.5		3	
		Culicidae	Culex sp.	3	1.2		1	
		Dixidae	Paradixa sp.	4	8.5		2	
	Collembola	Collembola	Collembola	6	5.3		1	
		TOTALS:	NO. TAXA			18	14	15
			NO. EPT TAXA			2	2	5
			NO. INDIVIDUALS			454	311	692

Appendix G: RECCE Plots and Results

Five 20m x20m RECCE plots were laid out in each of the four key areas of indigenous vegetation within the Sutton Pit extent (Figure 29). These areas are:

1. Taraire, tawa podocarp forest (WF9- 1) within SEA_T_1117
2. Gully forest (WF9-2)
3. Taraire, tawa podocarp forest (WF9-3) within SEA_T_ 5323
4. Kānuka scrub/forest (VS2 SEA_T_5323)
5. Rock forest (RF)

One reference plot was established within SEA_T_5349 amongst rock forest at Kaarearea Paa that has been deer-fenced for 15 years to compare understorey recovery, seedling and sapling regeneration with grazed areas. Two further reference plots, one for WF9 and one for VS2 were established in Kirks' Bush, Papakura and in the Hunua Ranges within representative vegetation types with no grazing and with a basic level of pest control.

Four further plots were established within areas of representative vegetation where offset enhancement of degraded areas of rock forest, WF9 and VS2 forest are planned.

In each plot key ecological measures of forest structure were recorded as follows:

- Average top height
- Per cent cover within standard RECCE tier heights 1 -7, including canopy, subcanopy, understorey, groundcover and epiphytes.
- Species present in each tier and their per cent cover
- Total species richness
- Groundcover species richness
- Basal area of all trees >10 cm dbh²⁰
- Seedlings <15cm in height (ephemeral).
- Seedlings > 15cm in height (established)
- Sapling (>135cm height, <2.5cm dbh) count
- Sapling species richness

Parameters such as canopy height, % cover in forest tiers, basal area and species richness provide a snapshot of the forest structure, biomass and diversity and hence the ecological values of the vegetation.

Seedling and sapling data provide insight into the intensity of browse pressure and seed predation by pests such as possums, ungulate browsers and rats. Small seedlings < 15cm in height are considered “ephemeral”, easily succumbing to periods of drought and failing to recruit into the understorey or eventually the canopy. Larger seedlings are considered “established” and more likely to persist to become saplings and eventually reach the canopy (although % survival is often naturally low). A lack of larger seedlings and saplings indicates browsing pressure where the young plants are being eaten, or the fruit, flowers and seeds of mature plants are being eaten by possums and rats, resulting in recruitment failure and disruption of other key ecological processes such as pollination and dispersal. This in turn negatively affects habitat values for native fauna.

²⁰ Diameter at breast height

Table 80. RECCE plot locations.

Plot number (refer Figure 22)	Plot	NZTM/Lat, long
Impact plots		
1	Taraire, tawa podocarp forest (WF9-1) within SEA_T_1117	E1777991 N5890275
3	Non-SEA Gully forest (WF9-2)	E1776967 N5890244
6	Taraire, tawa podocarp forest (WF9-3) within SEA_T_5323	E1777934 N5889899
2	Kānuka scrub/forest (VS2) within SEA_T_5323	E177601 N5908360
4	Non-SEA Rock forest (RF)	E1776904 N5889859
Reference plots		
5	Kaarearea Paa rock forest within SEA_T_5349	E1776925 N5889560
11	WF9 Reference Kirk's Bush SEA	S37°04.404' E 174°50.475'
12	VS2 reference Mangatawhiri Dam	S37°05.767' E175°09.035'
Offset plots		
7	Taraire, tawa podocarp forest (WF9 offset 1) within SEA_T_5323	S37°05.785' E175°02.434'
10	Taraire, tawa podocarp forest (WF9 offset 2) within SEA_T_5323	E1777774 N5889396
8	Non-SEA Rock forest	S37°07.665' E175°00.016'
9	Kānuka scrub/forest (VS2) within SEA_T_5323	E1778102 N5889695

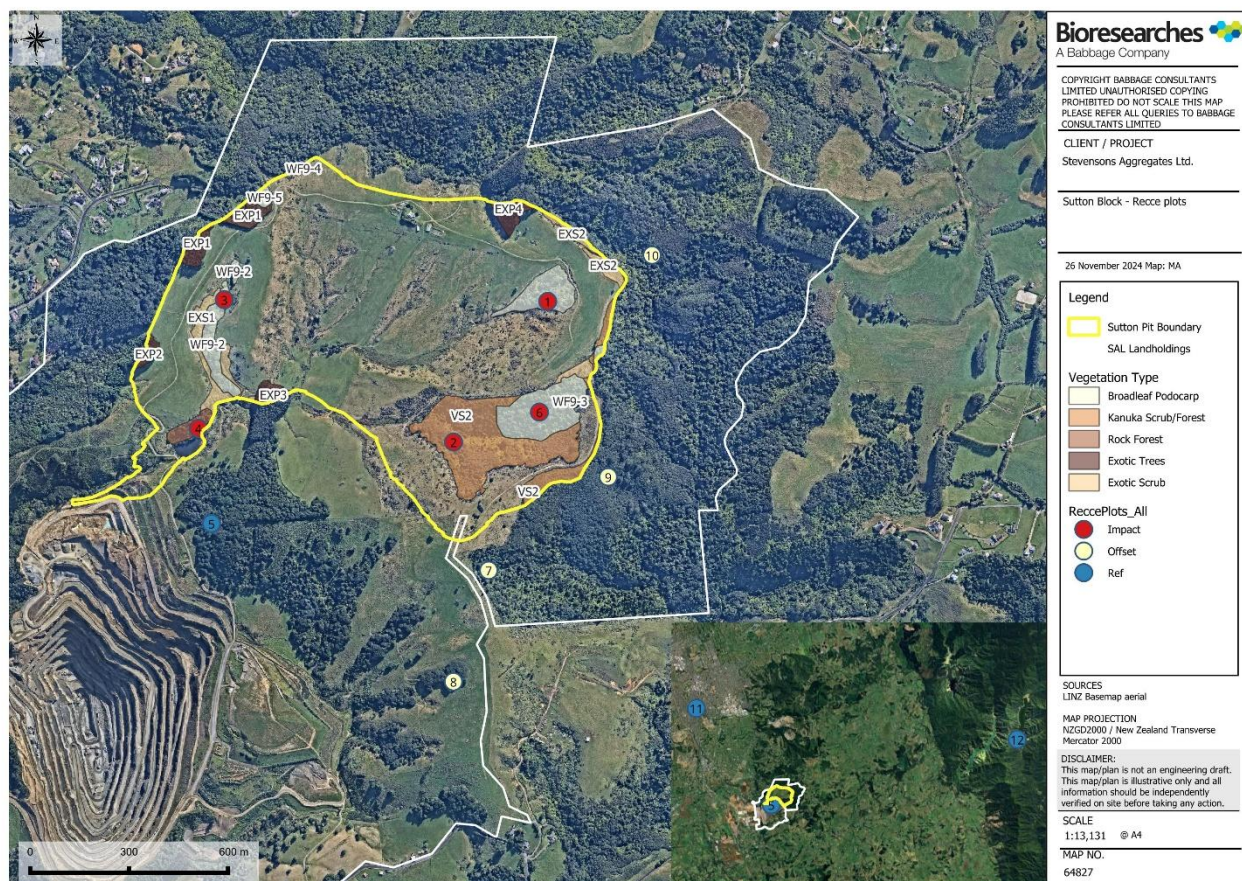


Figure 29. RECCE plot locations within the SPQZ.

Summary of results

RECCE plot measurements are summarized in Table 81 below. All plots within the Sutton Pit Project area are grazed and native ground cover is very sparse. The understory tier includes species present from 0.3 - 5 m height and cover were generally made up of tree ferns and those small trees in the 2 - 5 m height range that were above the browse height of cattle. Very little cover is present in the 0.3 – 2m height range.

For the WF9 forest, tree density, basal area and species richness were all within a typical range for this forest type. WF9-1 has a broken canopy, reflected in a lower canopy % cover. Kānuka scrub/forest had typically high density of trees and lower canopy height.

Canopy percent cover ranged between 50 and 75 percent for all plots and the sparse subcanopy was generally composed of nīkau and tree ferns. Groundcover species richness was moderate for some plots; however, the abundance of these species was very low. All WF9 and RF plots retained a range of epiphytic ferns and species of climbing rātā, however only WF9-1 and WF9-3 contained large epiphytic asteliads.

The rock forest impact plot had a lower plot basal area than WF9 plots or the RF reference plot, however the number of trees in each WF9 or RF plot was not markedly different, ranging from 12 - 17. Overall species richness was lower for rock forest plots than for the tairāre plots and this was particularly so for the grazed rock forest. This observation is consistent with the harsher environmental conditions in the rock forest and difficulty for plants to establish amongst the boulders. The effects of fencing to exclude livestock, deer and goats were very clear for the Kaarearea Paa reference plot where the understory and ground tiers have

recovered and there are many more larger seedlings and saplings. The seedling/sapling population is heavily dominated by two species (kawakawa and karaka) at present and this is possibly due to the lower palatability of these two species.

Grazed plots within the Sutton Pit Project area supported very few saplings (Table 82). Seedling numbers were moderate for the taraire plots when extrapolated, however virtually all seedlings seen in the plot were <5 cm high. Kānuka plot seedlings were also very small (<15 cm) and any larger seedling were less palatable species (tōtara and twiggy coprosma). Compared to the reference plots, all plots within the Sutton Pit footprint are depauperate in saplings and larger seedlings (>15 cm).

Plots outside the Sutton footprint within SEA-T_5323 are subject to some browsing by pest browsers but not to livestock grazing. There is a deer shooting programme in place for the wider landscape but the frequency of control is not known. Recce plot data was comparable to the impact plots except that the understorey layer was generally thicker. There were many more larger seedlings per plot however and a modest number of saplings, reflecting periodic browsing pressure from feral ungulates. Seedling and sapling counts within the reference plots were significantly higher than for the enhancement plots.

The RF offset enhancement area is not fenced and is grazed by livestock. It is dominated by a few large puriri and taraire and has a large basal area. Species richness is low and there are no larger seedlings or any saplings, with only a few small seedlings <15cm.

Table 81. RECCE plot summary of data for Sutton pit

Biodiversity type	Plot number (refer Figure 22)	Mean top height/m	% canopy cover	Canopy tree count/plot	Canopy species richness	Total canopy tree basal area/m ² ha ⁻¹ (trees > 10cm dbh)	Total species richness/count	Groundcover species richness/count	Sub canopy % cover 5 -12m	Understorey % cover 0.3 – 5m	Ground cover % cover <0.3m	Aspect
Impact plots												
Taraire, tawa podocarp forest (WF9-1)	1	16m	50	13	6	53.29	30	17	20	3	<1	W
Gully Forest (WF9-2)	3	18m	75	14	4	46.65	26	14	12	5	3	WSW
Taraire, tawa podocarp (WF9-3)	6	14	70	12	2	39.0	28	19	6	6	<1	S
Kānuka scrub/forest (VS2)	2	9	50	45	1	n/a	21	16	n/a	10	<1	NW
Rock forest (RF)	4	16	60	4	2	32.49	17	3	8	11	<1	ESE
Reference Plots												
Rock forest reference (Kaarearea Paa SEA)	5	18	57	4	2	46.67	21	11	15	57	8	NE
Taraire, tawa podocarp forest (WF9) Kirk's Bush Reserve.	WF9 REF	18-20	65	16	3	52.97	22	17	20	45	2	flat
Kānuka scrub/forest (VS2) Hunua Ranges	VS2-REF	12	55	46	4	34.18	28	20	n/a	27	10	E



Table 82. Summary of seedling and sapling data within Sutton Pit.

Biodiversity type	Plot number	Saplings /plot	Number/hectare	Sapling diversity/plot	Seedlings (<15cm)/plot	Number/hectare	Seedlings (>15cm)/plot	Number/hectare
Sutton Pit Impact plots								
Taraire, tawa podocarp forest	1	0	0	0	4,000	100,000	0	0
Taraire, tawa podocarp forest	6	1	25	1	1,400	35,000	178	4,444
Kānuka scrub/forest	2	1	25	1	1,311	32,777	200	5,000
Rock forest	4	0	0	0	400	10,000	0	0
Reference plots								
Reference Rock Forest	5	280	7,000	6	1,500	37,500	600	15,000
Reference WF9	WF9 REF	48	1,200	4	1,022	25,550	711	17,775
Reference VS2	VS2-REF	138	3,450	8	422	10,555	578	14,444



Table 83. Summary of seedling and sapling data for enhancement vegetation outside the Sutton pit.

Biodiversity type	Plot number	Saplings /plot	Number/hectare	Sapling diversity	Seedlings ≤15cm /plot	Number/hectare	Seedlings>15cm /plot	Number/hectare
Enhancement plots								
Broadleaved podocarp forest	10	1	25	1	2,800	70,000	467	11,666
Broadleaved podocarp forest	7	4	100	2	1600	40,000	356	8,889
Kānuka scrub/forest	9	1	25	1	1311	32,775	200	5000
Rock forest	8	0	0		111	2778	0	0



Appendix H: Bird records from the desktop review and site investigations

Desktop review

A review of various databases (DOC fauna (accessed 7 October 2020), iNaturalist and New Zealand eBird databases (accessed 27 September 2023)) was completed within a 5 km radius of the site, and for the eBird database, within grid square AE69²¹. Table 84 presents the results of this review; however exotic birds, and coastal/marine birds (as there is a lack of nearby coastal or marine habitat for these species) are excluded from the table.

Table 84. Indigenous bird species identified during the desktop review

Common name	Scientific name	National threat classification (Robertson <i>et al.</i> , 2021)
Australasian harrier, kāhu	<i>Circus approximans</i>	Not Threatened
Banded rail, moho pererū	<i>Gallirallus philippensis assimilis</i>	At Risk - Declining
Black shag, kawau tuawhenua	<i>Phalacrocorax carbo novaehollandiae</i>	Threatened - Nationally Vulnerable
Grey duck, pāpera	<i>Anas superciliosa</i>	Threatened - Nationally Vulnerable
Grey teal, tētē moroiti	<i>Anas gracilis</i>	Not Threatened
Grey warbler, riroriro	<i>Gerygone igata</i>	Not Threatened
Kererū, New Zealand pigeon,	<i>Hemiphaga novaeseelandiae</i>	Not Threatened
Morepork, ruru	<i>Ninox novaeseelandiae novaeseelandiae</i>	Not Threatened
Little black shag, kawau tūi	<i>Phalacrocorax sulcirostris</i>	At Risk - Naturally Uncommon
Little shag, kawau paka	<i>Microcarbo melanoleucos brevirostris</i>	At Risk - Relict
New Zealand Dabchick, weweia	<i>Poliiocephalus rufopectus</i>	Threatened - Nationally Increasing
New Zealand Kingfisher, kōtare	<i>Todiramphus sanctus vagans</i>	Not Threatened
New Zealand Pipit, pīhoihoi	<i>Anthus novaeseelandiae novaeseelandiae</i>	At Risk - Declining
North Island Fantail, pīwakawaka	<i>Rhipidura fuliginosa placabilis</i>	Not Threatened
North Island kākā	<i>Nestor meridionalis septentrionalis</i>	At Risk - Recovering
North Island kōkako	<i>Callaeas wilsoni</i>	Threatened - Nationally Increasing
Pied shag, kāruhiruhi	<i>Phalacrocorax varius varius</i>	At Risk - Recovering
Pūkeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened
Silvereye, tauhou	<i>Zosterops lateralis</i>	Not Threatened
Spotless crane, pūweto	<i>Zapornia tabuensis tabuensis</i>	At Risk - Declining
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened
Tūi	<i>Prothemadera novaeseelandiae novaeseelandiae</i>	Not Threatened
Welcome swallow, warou	<i>Hirundo neoxena neoxena</i>	Not Threatened
White-faced heron	<i>Egretta novaehollandiae novaehollandiae</i>	Not Threatened

Incidental observations

Table 85 lists the bird species incidentally recorded within the project area during site investigations.

²¹ <https://ebird.org/atlasnz/block/blkAE69>

Table 85. Bird species incidentally recorded throughout the project area.

Common name	Species name	Conservation status
Australasian harrier, kāhu	<i>Circus approximans</i>	Not threatened
Blackbird	<i>Turdus merula</i>	Introduced and naturalised
California quail	<i>Callipepla californica</i>	Introduced and naturalised
Canada goose	<i>Branta canadensis</i>	Introduced and naturalised
Chaffinch	<i>Fringilla coelebs</i>	Introduced and naturalised
Common myna	<i>Acridotheres tristis</i>	Introduced and naturalised
Common skylark	<i>Alauda arvensis</i>	Introduced and naturalised
Eastern rosella	<i>Platycercus eximius</i>	Introduced and naturalised
Grey warbler, riroriro	<i>Gerygone igata</i>	Not threatened
Kererū, New Zealand pigeon,	<i>Hemiphaga novaeseelandiae</i>	Not threatened
Magpie	<i>Gymnorhina tibicen</i>	Introduced and naturalised
Mallard duck	<i>Anas platyrhynchos</i>	Introduced and naturalised
Morepork, ruru	<i>Ninox novaeseelandiae</i>	Not threatened
New Zealand kingfisher, kōtare	<i>Todiramphus sanctus</i>	Not threatened
New Zealand pipit, pīhoihoi	<i>Anthus novaeseelandiae</i> <i>novaeseelandiae</i>	At Risk - Declining
North Island fantail, pīwakawaka	<i>Rhipidura fuliginosa</i>	Not threatened
Paradise shelduck	<i>Tadorna variegata</i>	Not threatened
Peafowl, pīako	<i>Pavo cristatus</i>	Introduced and naturalised
Pheasant	<i>Phasianus colchicus</i>	Introduced and naturalised
Pūkeko	<i>Porphyrio melanotus</i>	Not threatened
Rock pigeon	<i>Columba livia</i>	Introduced and naturalised
Shining cuckoo, pīpīwharau	<i>Chrysococcyx lucidus</i>	Not threatened
Silvereye, tauhou	<i>Zosterops lateralis</i>	Not threatened
Song thrush	<i>Turdus philomelos</i>	Introduced and naturalised
Sparrow	<i>Passer domesticus</i>	Introduced and naturalised
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened
Tūī	<i>Prosthemadera novaeseelandiae</i>	Not threatened
Welcome swallow, warou	<i>Hirundo neoxena neoxena</i>	Not Threatened

Five-minute bird counts

Five-minute bird count data are summarised in Table 86 and Table 87.

Wetland bird surveys

None of the targeted wetland or aquatic bird species were recorded from call counts, playback responses or observations from onsite vantage points.

Table 86: Summary of the five-minute bird counts carried out within and around the proposed Sutton block.

Species list	Native/ Introduced	Five-minute bird count station															Summary Statistics			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	# sites detected	Detection rate	Individ. Total	Average abundance (Mean ± St. err)
Fantail, Nth Is	Native	2	0	0	1	0	0	1	1	2	0	2	0	2	1	0	8	50	12	0.75±0.22
Kingfisher, NZ	Native	2	1	0	1	1	0	0	0	1	0	1	0	0	0	1	7	43.75	8	0.5±0.16
Pigeon, NZ/Kereru/Kupapa	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6.25	1	0.06±0.06
Plover, Spur-winged	Native	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2	12.5	2	0.125±0.09
Pukeko	Native	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	6.25	1	0.05±0.06
Shelduck, Paradise	Native	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	2	12.5	4	0.25±0.18
Silvereye	Native	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	3	18.75	5	0.31±0.18
Swallow, Welcome	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6.25	1	0.06±0.06
Tui	Native	0	0	2	0	0	0	0	0	1	0	0	0	0	0	1	3	18.75	4	0.25±0.15
Warbler, Grey	Native	2	0	1	1	1	0	1	2	4	1	2	2	1	1	2	13	81.25	21	1.31±0.25
Blackbird	Introduced	0	0	0	0	0	0	1	0	2	1	1	0	0	0	1	5	31.25	6	0.38±0.16
Chaffinch	Introduced	0	0	0	0	0	2	1	0	1	0	1	0	1	0	0	5	31.25	6	0.38±0.16
Magpie, Australian (magpie sp.)	Introduced	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	6.25	1	0.06±0.06
Pheasant	Introduced	0	1	0	0	0	0	1	1	2	0	1	0	0	0	1	6	37.5	7	0.44±0.16
Quail, California	Introduced	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	12.5	2	0.13±0.09
Rosella, Eastern	Introduced	1	2	0	1	1	1	0	0	2	1	0	0	0	2	1	9	56.25	12	0.75±0.19
Skylark	Introduced	1	1	0	0	1	1	1	1	0	0	0	0	1	0	0	7	43.75	7	0.44±0.13

Table 87: Summary information about the five-minute bird count locations and the proportion of native vs introduced species found at each station and each vegetation type.

Bird count station	Vegetation Type	Category	% Native	% Introduced
1	RF	Enhancement	81.82	18.18
2	EG	Revegetation	50.00	50.00
3	RF	Enhancement	75.00	25.00
4	RF	Enhancement	75.00	25.00
5	EG	Revegetation	66.67	33.33
6	EG	Revegetation	42.86	57.14
7	RF	Impact	42.86	57.14
8	WF9	Impact	60.00	40.00
9	VS2	Impact	52.94	47.06
10	VS2	Impact	50.00	50.00
11	VS2	Impact	62.50	37.50
12	VS2	Enhancement	100.00	0.00
13	VS2	Enhancement	60.00	40.00
14	WF13	Enhancement	50.00	50.00
15	WF9	Impact	50.00	50.00
Vegetation type average	RF		66.56	33.44
	VS2		65.09	34.91
	WF9		55.00	45.00
	WF13		50.00	50.00
	EG		53.17	46.83
	Total		61.31	38.69

APPLICABILITY AND LIMITATIONS

Restrictions of Intended Purpose

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

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on, they should be independently verified with appropriate legal advice.

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