

Assessment of 30 potential salt marsh rehabilitation options for Waimea Inlet

RECOMMENDED CITATION

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GLOSSARY

DOC	Department of Conservation
GIS	Geographic Information System
MfE	Ministry for the Environment
MHWS	Mean High Water Spring tide
NCC	Nelson City Council
NRSBU	Nelson Regional Sewerage Business Unit
TDC	Tasman District Council
TET	Tasman Environmental Trust
SLR	Sea Level Rise

NOTE

The current report collates the assessment of 16 estuary potential restoration options identified by TDC in the southwestern part of Waimea Inlet undertaken in 2021, and an additional 30 sites evaluated throughout the estuary in 2023. Of these, 16 assessments for sites on private land have been excluded. Hence site numbers, and Table and Figure numbering referenced in the report, are not sequential.

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Megan Southwick (Salt Ecology) prepared the underlying GIS data and base maps used in the assessment.

Assessment of 30 potential salt marsh rehabilitation options for Waimea Inlet

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SUMMARY

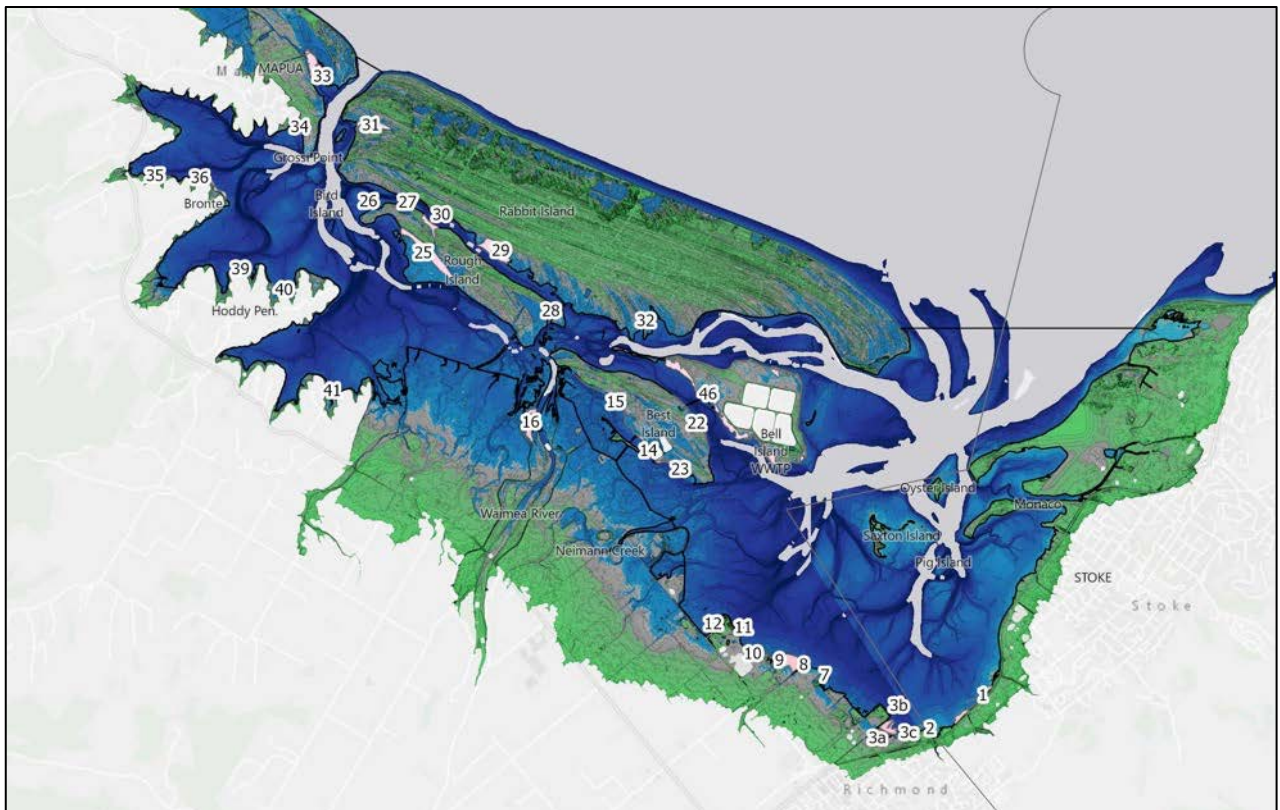
Estuary restoration initiatives are becoming increasingly common in recognition of their very high ecological and human use values (including shoreline protection), the significance of past salt marsh losses, and emerging threats related to Sea Level Rise (SLR). In 2021, Tasman District Council (TDC) engaged Salt Ecology to provide advice on a proposed short-list of 16 estuary restoration projects identified by TDC in the southwestern part of Waimea Inlet. In 2023, this work was extended to identify and evaluate restoration options at an additional 30 sites in the estuary. This report collates both these studies, but has been edited to exclude 16 assessments for sites on private land. Hence site numbers, and Table and Figure numbering referenced in the report, are not sequential.

A spatial mapping Geographic Information System (GIS) approach was applied so existing data on sea level, coastal structures and habitat features could be used to identify areas suitable for future restoration based on their potential for inundation as a consequence of predicted SLR. Sites were then scored using high-level screening criteria for determining initial site priorities, habitat features, as well as considerations regarding the implementation of restoration options (see following table for a summary of prioritisation criteria). TDC have subsequently approached Ngā iwi Te Tau Ihu to discuss the potential to develop and introduce cultural criteria to use in this process.

The highest overall ranked projects will be those that score well across all three categories based on the criteria included. There may be additional factors, not included in the assessment, that make certain sites more favourable for implementation. For example, the availability of nearby material for recontouring or shoreline protection, sites with strong community support, cultural considerations, or sites requiring additional shoreline erosion protection. Further, restoration options that are potentially more expensive or difficult to implement, or take longer for benefits to accrue, may not score as highly as other options, but may lead to the best long-term benefits. The rankings should therefore be considered a transparent and objective starting point for reaching final decisions on priority rather than a definitive ranked list of priorities.

The location of sites assessed are presented in the figure below and results of the assessment are summarised in the table on the following page. The table includes all sites assessed to date (including some completed projects) to enable relative priorities to be compared between sites.

Location of proposed estuary restoration sites in Waimea Inlet included in the current report.



At the time of report preparation (October 2023), estuary restoration projects have commenced at the following sites (listed in order of overall ranking):

- Site 18. Lansdowne Road Farm (West) - rank 3
- Site 27. Rough Island Embayment - rank 4
- Site 8. Borck Creek to Sandeman Reserve - rank 5=
- Site 7. Estuary Place - rank 7=
- Site 28. Rough Island bridge - rank 7=
- Site 16. Waimea River Delta - rank 11=
- Site 23. Best Island (South) - rank 11=
- Site 26. Bird Island - rank 11=
- Site 41. Research Orchard Road - rank 11=
- Site 14. Best Island Golf Course - rank 22=
- Site 15. Best Island - rank 28
- Site 22. Best Island (East) - rank 29=
- Site 36. Bronte (Northeast) - rank 33=

Although the focus at many of these sites is predominantly terrestrial, many also include salt marsh initiatives or would be suited for the restoration of estuarine habitat as outlined in the current report.

Based on the overall rankings presented in the Table on the preceding page (and in Table 51), the following additional sites, listed in order of overall ranking, are suggested as initial priorities to consider further:

- Site 25. Equestrian Centre Embayment - rank 1
- Site 46. Bell Island - rank 2
- Site 28. Rough Island bridge - rank 7=
- Site 9. Sandeman Reserve (Coast) - rank 11=
- Site 41. Research Orchard Road - rank 11=
- Site 30. Moturoa (Barnicoat Road) - rank 22=
- Site 33. Mapua Embayment - rank 22=
- Site 10. Sandeman Reserve (Stream) - rank 33
- Site 37. Bronte Point - rank 37=
- Site 2. Reservoir Creek (West) - rank 37=

Several higher scoring sites have not been included in the above recommendations as they are on private land and require discussion between TDC and landowners.

Some sites with relatively low scores have also been included e.g., Site 2. Reservoir Creek (West) as they represent opportunities for maximising restoration benefits not readily captured in the scoring matrix, i.e., local availability of material for reshaping the shoreline, and enhanced benefits to other restorations through erosion reduction.

It is recommended that detailed site-specific restoration plans be developed for any initiatives TDC wish to pursue, as has been done, for example, by TDC for Site 25 (Equestrian Centre Embayment).

Finally, it is noted that this assessment has focussed on the larger and most obvious restoration opportunities. There are many additional restoration opportunities that could be considered at a local scale, and which would contribute meaningful benefits to the ecological state of the estuary.

1. INTRODUCTION

1.1 BACKGROUND

Estuary restoration initiatives are becoming increasingly common in recognition of the very high ecological and human use values (including shoreline protection) provided by salt marsh and estuarine habitat, the significance of past losses of estuary salt marsh, and emerging threats related to Sea Level Rise (SLR). Within Waimea Inlet there have been many initiatives to improve and expand native vegetated terrestrial habitat, and some salt marsh, undertaken by various agencies and interest groups. These include the Department of Conservation (DOC), Tasman Environmental Trust (TET), Waimea Inlet Forum, Nelson City Council (NCC), Tasman District Council (TDC) and many private landowners (see Fig. 1 and Table 1 for known restoration sites).

In 2021, TDC engaged Salt Ecology to provide advice about the relative priority, key considerations and potential issues associated with a short-list of 16 estuary restoration projects identified by TDC within the southwestern part of Waimea Inlet. This work, reported on in Stevens and Southwick (2021), has been included in the current report at the request of TDC so all information is collated into a single report.

The 2021 project objectives were to help:

- Identify 'shovel ready' projects that could be undertaken relatively easily and quickly using proven restoration methodologies,
- Identify options to trial novel or untested methods to determine their future efficacy,
- Identify habitat for critical or important ecological communities or species that have been lost or are now rare. These include marshbird nesting and feeding habitat (bittern, crane, rail, heron), Caspian tern nesting (e.g., at the Best Island shellbanks) etc.,
- Identify a diverse mix of restoration options, e.g., expanding traditional terrestrial riparian planting, habitat creation, returning of the sea to cut-off areas, replanting of salt marsh, shoreline recontouring, beach replenishment, weed and pest control.
- Define the most cost-effective methods for achieving long-term outcomes,
- Highlight potential areas for future salt marsh expansion in response to predicted SLR so they can be protected from inappropriate development,

- Facilitate a simple way for recording and spatially displaying information on current restoration initiatives.

The outcome ranked five projects as initial restoration priorities which could be relatively easily implemented with a high level of confidence of success, and which will have ecological benefits in the short and long term. These were:

- Borck Creek to Sandeman Reserve
- Waimea River Delta
- Sandeman Reserve
- Bests Island Golf Course
- Lower Queen Street

TDC has subsequently implemented the first four of these, as well as several other estuary restoration projects within Waimea Inlet, focussing primarily on replanting terrestrial vegetation and some intertidal salt marsh around the estuary margin.

To identify and evaluate other restoration options and expand the focus of the work beyond the original southwestern part of Waimea Inlet, TDC contracted Salt Ecology in 2023 to assess sites throughout the remainder of Waimea Inlet. To enable consistent prioritisation with previously assessed sites, the same evaluation and prioritisation approach applied previously by Stevens and Southwick (2021) was used.

Initial high-level scoping of potential sites was undertaken with TDC staff in May 2023, and sites were subsequently visited to evaluate restoration options.

Several sites on private land were identified as being potentially suitable for restoration based on their physical characteristics (usually because they are within the current predicted tidal range with inundation restricted by tidal flap-gates or bunds). There is an obvious need for discussion with landowners about any restoration opportunities on private land. Consequently, these sites have not been included in the current report.

This report provides a summary of sites throughout Waimea Inlet on public land or where landowner agreement has been reached and which are potentially suitable for estuary restoration initiatives. The sites primarily target salt marsh restoration directly adjacent to, or within, the intertidal zone of the estuary. Work in this zone is particularly challenging and often requires different methods and approaches to terrestrial initiatives. This report aims to assist TDC in identifying opportunities for successful restoration within this estuarine zone.



Fig. 1a. Location of known and proposed restoration projects in and around Waimea Inlet west (source TET and TDC). See Table 1 for TET site summary. TDC restoration sites discussed in the current report are numbered with a white halo.



Fig. 2b. Location of known and proposed restoration projects in and around Waimea Inlet east (source TET and TDC). See Table 1 for TET site summary. TDC restoration sites discussed in the current report are numbered with a white halo.

Table 1. List of known restoration projects in and around Waimea Inlet (source TET 2021).

No.	Name (source TET)	Area_Ha	NZTM_East	NZTM_North
1	Nile Road Block	1.1	5433046	1605945
2	Dominion Flats	0.3	5433387	1605962
3	Trafalgar Embayment	0.2	5431997	1605920
4	Trafalgar Embayment	0.2	5431960	1605965
5	Trafalgar Embayment	0.4	5432039	1605917
6	Maisey Embayment	0.7	5429490	1607322
7	Maisey Embayment	0.2	5429400	1607460
8	Research Orchard Road	1.1	5428963	1608629
9	Research Orchard	1.3	5428982	1608554
10	Hoddy Estuary Park	1.7	5428860	1608072
11	QE II Nyce	4.7	5432640	1607617
12	Dominion Flats	4.5	5433402	1605782
13	Dominion Flats	0.3	5433343	1605939
14	Dominion Embayment	3.0	5433172	1606104
15	Bronte Peninsula NW	0.8	5431881	1606849
16	Dominion Embayment	0.3	5432574	1606564
17	Dominion Embayment	1.2	5432660	1606303
18	Dominion Embayment	0.4	5432935	1606102
19	Stringer Creek	2.3	5430562	1606272
20	Bronte Peninsula on Stringer	1.0	5431252	1606780
21	Bronte Peninsula on Stringer	0.3	5431293	1606792
22	Bronte Peninsula on Stringer	0.1	5431277	1606807
23	Neimann Creek	1.0	5427298	1611887
24	Manuka Island	3.8	5429058	1609297
25	Manuka Island	0.5	5429152	1609493
27	QEII Thawley	1.2	5432975	1606917
28	QEII Thawley	0.2	5432830	1607321
29	QEII Thawley	0.3	5433139	1606499
34	1bt 9 Stringer Embayment 22-24 Bronte	0.3	5430896	1606394
39	1BT 4 Dominion Flats	8.9	5433280	1605916
41	1bt 7 Cardno Way - Bronte Peninsular	1.5	5431876	1606802
43	1bt 1 Nyce-Pearson	2.0	5432606	1607691
44	1bt 15 Neimann Creek	0.4	5427356	1611995
45	1bt 13 Manuka Challies	0.7	5429141	1609520
48	1bt 5 Mamaku block 1 2020	0.5	5433454	1605563
51	1bt 5 Mamaku year 2 2021	0.6	5433428	1605442
52	1bt 5 Mamaku year 3 2022	0.5	5433486	1605461
53	1bt 6 Dominion Matahua	1.7	5432431	1606288
54	1bt 8 East Bronte Rd	1.0	5431188	1606682
55	1bt 10 Stringer Stream Riparian	0.4	5430518	1606107
56	1bt 9a Stringer Stream delta	1.4	5430595	1606301
57	1bt 11 Hoddy Peninsula	0.3	5430450	1607827
58	1bt 11a Hoddy Peninsula	0.4	5430387	1607981
59	1bt 12a Hoddy Estuary Park/Research Orchard Road	1.0	5429042	1608645
60	12b Hoddy Estuary Park/Research Orchard Road	0.7	5429134	1608255
61	1bt 14 Pearl Creek infill planting	3.4	5428513	1610893
62	1bt 15a Neimann Creek extension	0.2	5427192	1612082
63	1bt 16 Reservoir Creek Alliance	0.6	5424392	1616631
64	1bt 20 NCC Reservoir Creek	0.8	5424464	1616875
65	1bt 21 NCC Orphanage Stream Mouth	0.8	5425192	1617601
66	1bt 22 NCC Orchard Stream Mouth	0.3	5426551	1618019
67	1bt 23 NCC Poormans Delta	0.2	5427607	1618758
68	1bt 19 Hunter Brown	4.3	5431343	1609930
69	Rabbit Islabd	2.3	5430041	1612265
70	1bt 17 Greenslade Park	0.7	5429814	1611399
71	1bt 1Thawleys	0.3	5433209	1606676
72	Mamaku block	1.3	5433438	1605536
73	1bt 12c ROR - HEP year 2/3 plantings	0.4	5428755	1608128
74	1bt 15c Neimann Creek Wildlife Reserve	1.3	5426942	1612445
75	1bt 24 NCC Back Beach	5.7	5430021	1619928
76	Bells Island peninsula	6.1	5429436	1613035

1.2 GENERAL APPROACH

To assist in site identification, a Geographic Information System (GIS) spatial mapping approach was applied to identify areas that could be suitable for future restoration based on land subject to inundation to present-day high tides (mean high water springs, MHWS), or potentially inundated in response to predicted SLR. For the latter, outputs from a static level inundation mapping technique (sometimes referred to as a “bathtub” model) were used assuming a scenario of continuing high emissions, and median projections of SLR (specifically the RCP8.5 projection in MFE, 2017). This is the equivalent of ~0.62m of SLR above current MHWS, which is the MHWS level predicted to occur around 2085 under the scenario adopted. It also approximates a 1% AEP (annual exceedance probability) storm-tide/wave event such as that experienced during ex-tropical cyclone Fehi in February 2018.

The GIS-based approach can relatively easily and consistently identify areas most at risk from predicted tidal inundation at a region-wide scale. These areas often provide the greatest opportunity for estuary restoration benefits for the lowest relative cost but may require significant lead-in time or stakeholder engagement to be realised.

To support initial desktop evaluations and guide the selection of potential sites in the field, field maps were prepared in advance showing land potentially subject to coastal inundation, as well as existing data on shoreline armoring, property boundaries, habitat features and restoration sites.

Sites were then visited and evaluated by experienced estuarine ecologists in September 2023. At each site, a preliminary scoring framework was used to capture and evaluate site data (Table 2) and assess potential restoration options. The scoring framework was proposed by Stevens and Southwick (2021) to enable rapid characterisation and documentation of key site features in a consistent manner. The framework includes high-level screening criteria for determining initial site priorities, more detailed criteria for scoring habitat features, as well as considerations regarding the implementation of restoration options, and their subsequent upkeep. Rationale for the criteria is presented in Table 3, with an expanded narrative to guide the scoring presented in Appendix 1.

The main restoration options considered are outlined in Table 4. As restoration options are well described in the general literature, they are not described in detail in the current report.

Table 2. Preliminary restoration scoring criteria (see Appendix 1 for further detail).

Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)
PRELIMINARY HIGH LEVEL SCREENING			
1 Land ownership	Private	Crown	Council
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k
HABITAT CRITERIA			
1 Area available at site	<1ha	1-5ha	>5ha
2 Mean width of intertidal area	0-50m	50-500m	>500m
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected
4 Extent of shoreline armoring	75-100%	25-75%	<25%
5 Width of riparian buffer	Absent	0-10m	>10m
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact
8 Likely benefit to birds compared to current state	Small	Moderate	Large
9 Likely benefit to fish compared to current state	Small	Moderate	Large
IMPLEMENTATION CRITERIA			
1 Proven restoration methodology	Unproven	Demonstrated	Well established
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)
5 Site accessibility	Difficult	Moderate	Easy
6 Extent of physical site preparation required	High	Moderate	Low
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted
8 Potential adverse impact from restoration works	Significant	Moderate	Slight
9 Likely human amenity value	Low	Moderate	High
10 Time frame for establishing desired changes	Slow	Moderate	Fast

Table 3. Rationale supporting preliminary restoration scoring criteria.

PRELIMINARY HIGH LEVEL SCREENING RATIONALE	
1	Council led restoration will be more straightforward on land they already own and manage.
2	Predicted SLR will place significant pressure on existing habitats and infrastructure. Long-term management will require a focus on terrestrial areas likely to become intertidal in future.
3	Areas that previously supported salt marsh habitat are more likely to be successfully restored than areas that have never supported such habitat naturally. It is assumed that largely intact areas will not be allowed to degrade from current state.
4	Maintaining and increasing biodiversity is an important part of building coastal resilience to environmental change.
5	There are many benefits in linking with existing restoration initiatives, such as overflow effects from biodiversity improvements and halo effects from pest control.
6	Expanding existing habitat and reducing fragmentation significantly increases the likelihood of long-term planting success.
7	The presence of infrastructure (e.g., pump station, culvert, power pole, manhole, flap-gate, building, accessway) can interfere with ecological processes or create uncertainty regarding future asset security. The risk and potential costs increase with increasing asset presence and value.
HABITAT CRITERIA RATIONALE	
1	Large sites have proportionally smaller edge areas and are therefore less susceptible to documented margin effects such as weed invasion or wildlife disturbance.
2	Intertidal width has a strong influence on potential erosion (wide flats dissipate wave energy over much of the tidal cycle) and facilitate increased sediment and nutrient assimilation.
3	Physical protection from wave energy (e.g., reef areas, peninsulas, dunes, embayments) is an important determinant of salt marsh presence and stability.
4	Shoreline armoring can protect against erosion, but commonly comes at the cost of displacing natural features (in particular salt marsh). It also creates a significant barrier to the natural migration of salt marsh in response to SLR, affects drainage, and can deflect and increase wave scouring.
5	Wide plantings have proportionally smaller edge areas and are therefore less susceptible to documented margin effects such as weed invasion or wildlife disturbance. They also provide greater nutrient and sediment assimilation.
6	Past modification means there are limited areas where estuaries can migrate landward to in response to SLR. Where areas of retreat exist, they create very good opportunities for long-term restoration and increased natural resilience to change.
7	Spatially connected and diverse habitats have relatively high resilience and ecological value compared to disconnected and low diversity areas.
8	Restoration initiatives favourable to birds can include screening of human activity, redirection of activities like dog walking, planting of food sources, predator control, and creation of roost sites.
9	Restoration initiatives favourable to fish can include stream shading, stock exclusion, protecting or enhancing spawning habitat, removal of fish barriers, reduced sedimentation, and improved water quality.
IMPLEMENTATION CRITERIA RATIONALE	
1	Demonstrated methods provide a high level of confidence in success. New methods may prove useful but there is lower confidence in the outcomes.
2	A high potential for restoration failure (primarily in relation to re-vegetation) may be a barrier to restoration.
3	High initial restoration costs including planning, consenting, site works, and planting may be a barrier to restoration.
4	High ongoing maintenance costs may be a barrier to restoration.
5	Easy site accessibility will reduce costs and increase ease of working.
6	Sites requiring significant preparation will add time, cost and potential planning and consenting delays to any project.
7	Resource consenting is unlikely to be a barrier to restoration but can be time consuming and may require expert input and stakeholder agreement.
8	Adverse impacts may result from restoration activities, e.g., earthworks, machinery use, reclamation. While the net result is likely to be positive, these impacts need to be assessed which will add costs through consultation, site mitigation or consent monitoring requirements.
9	Human amenity values may be associated with some restorations but may not be a primary aim. Areas with high amenity or recreation value may promote further restoration support.
10	Long-term restoration initiatives may accrue cumulative costs and be slow to demonstrate success. This does not mean they are low-value initiatives but may require "expectation management".

Table 4. General restoration options.

Restoration options
Shoreline recontouring
Beach nourishment
Chenier ridges / islands
Reinstatement of tidal flows
Armour removal
Flap-gate removal
Dike or berm removal
Physical exclusion (e.g., fencing)
Weed control
Pest control
New salt marsh planting
Infill salt marsh planting
Riparian planting
Wetland planting

2. SITE ASSESSMENTS

This section collates the results of the 2021 assessment of 12 sites (at which restoration has subsequently commenced at sites 7, 8, 14, 15, and 16) and the results of subsequent field surveys and assessments undertaken in September 2023 for an additional 18 sites.

For each site, a brief description is provided of the key features, restoration opportunities are identified, and restoration options recommended. A summary table is presented of scores for each of the criteria groupings (i.e., Preliminary high-level screening; Habitat criteria; Implementation criteria) to enable component parts to be assessed individually, and the potential restoration footprint is shown on a site map.

It is envisaged that site specific restoration plans will be developed for prioritised projects.

Section 3 presents a combined table of scoring criteria for all sites and a ranking of relative priority. Note, the inclusion of additional sites in 2023 changes the rankings of sites assessed in Stevens and Southwick (2021).

Many of the projects initially being considered by TDC are relatively easily prioritised. However, as noted by Stevens and Southwick (2021), there is scope to refine and extend the scoring approach to facilitate more nuanced decisions regarding which options to choose. To this end, Ngā iwi Te Tau Ihu have been approached by TDC to discuss the potential to develop and introduce cultural criteria to use in this process.

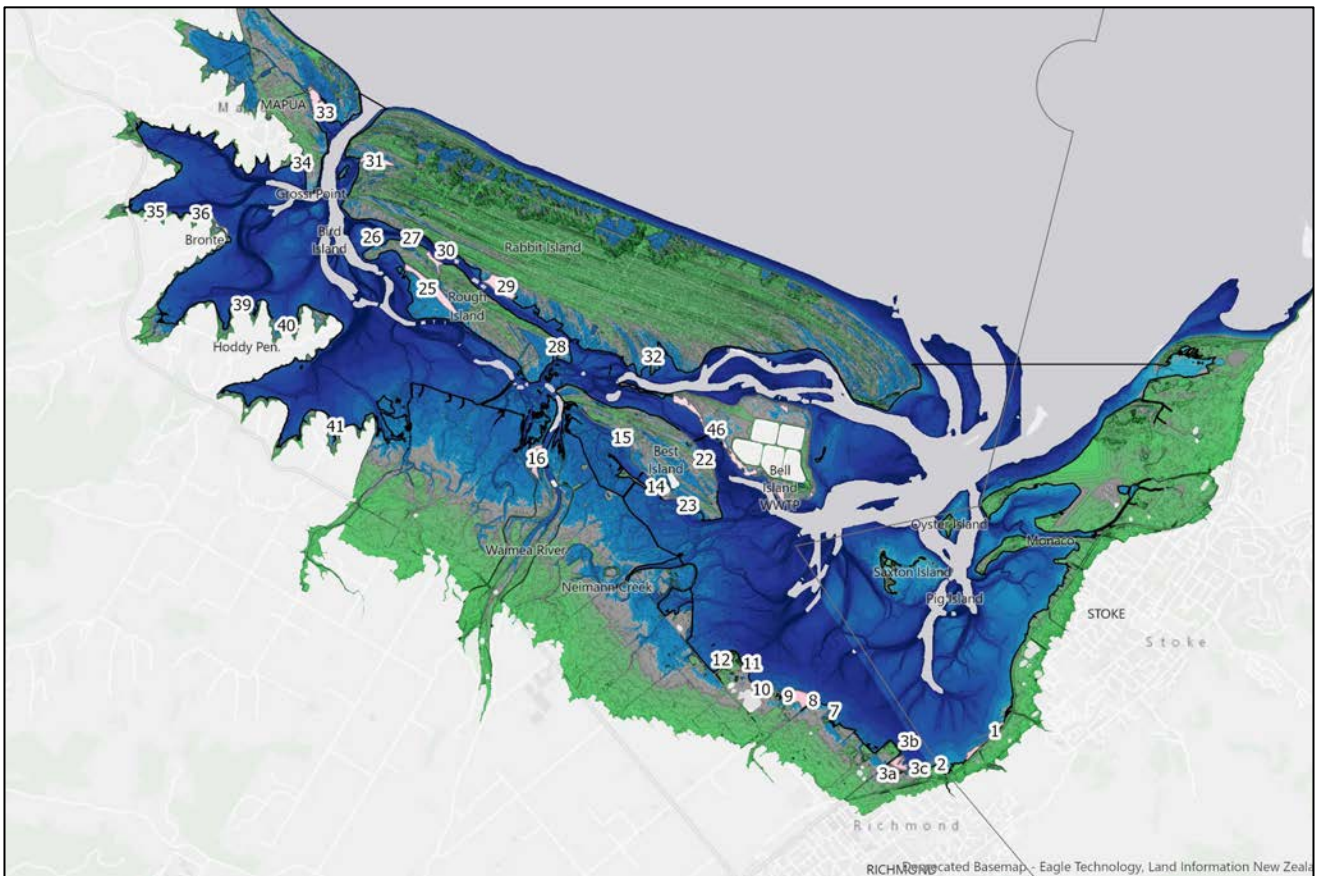


Fig. 3. Location of proposed estuary restoration sites in Waimea Inlet included in the current report.

SITE 1. WAKATU DRIVE

Planning for the Wakatu Drive (Stoke bypass) started in the 1960s with the aim to reduce congestion on Main Road Stoke. At that time, it was relatively common practice to route coastal roads through estuary margins with little regard to habitat loss or implications relating to climate change such as SLR. Although such issues were well understood by the time construction started in the late 1990's, a commitment to the earlier plans resulted in further reclamation and armouring of the estuary margin between Richmond and Monaco. Subsequent to the road construction, a narrow cycleway was also added to the seaward side of the expressway.

The road and cycleway development mean there is now very little connection between the estuary and natural terrestrial habitat, many of the smaller streams are piped or culverted (including tidal flap-gates), and freshwater flood flow paths have been interrupted. The latter has reduced the supply of coarse sediments entering the estuary, material which creates elevated fans which provide habitat for salt marsh, high tide bird roosting sites, and is the source of sediment that naturally creates beaches and helps mitigate shoreline erosion.

The roading, and associated urban developments, have also increased the potential for inputs of contaminants to the estuary from vehicles, nearby industrial areas and land disturbance in the catchment. At present there is no specific treatment of stormwater, and very little natural filtering of stormwater due to the habitat losses that have occurred.

On the coastal margin, the estuary edge is dominated by earth banks reinforced in many places by steep rip-rap walls and cobble. In these areas, salt marsh has been displaced either during construction, or from subsequent changes in substrate elevation, inundation and wave exposure.

In recent years there has been a significant amount of terrestrial riparian planting between the road edge and the estuary, and residual pockets of salt marsh remain, primarily around the stream deltas (Fig. 3).

Restoration scoring criteria are presented in Table 5.



Artificial rip-rap and cobble protection adjacent to the cycle lane and Wakatu Drive.

Opportunities/Issues

The upper shoreline comprises a relatively narrow and steep strip of cobbles and boulders to protect the roading infrastructure from erosion and which has greatly reduced the available salt marsh habitat zones.

Existing gravel substrate in the mid-tidal flats seaward of the road is currently subjected to relatively extensive fine sediment deposition.

Wave exposure is relatively high due to large fetch.

There is virtually no capacity for salt marsh to migrate inland in response to SLR. Any restoration initiatives would need to be seaward of the current road/cycleway.

Current ecological values are relatively low, therefore no significant issues are anticipated with regard to physical works associated with potential restoration.

Gravel currently removed from the incoming streams for flood control would be ideal for beach replenishment purposes.

The site is directly adjacent to a well-used cycleway and heavily used road so public exposure is high.

Vehicle access is limited by the expressway, although restricted access is possible in several places along the shoreline.

In future it is likely that maintenance work will be undertaken on the seawalls to mitigate erosion or to further improve (widen) the cycleway. When such work is being proposed it may be possible to incorporate beach reshaping into the maintenance plans, and to utilise machinery while it is on-site to undertake restoration work. Note this site is within the NCC region and there will be a need for consultation and collaboration.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	✓
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

Because of the modified upper shoreline and relatively high wave exposure, the following is recommended:

- Construct low (~20cm high) undulating Chenier ridges in the mid shore zone to reduce wave energy and create a sill to trap fine sediment and contribute to a natural reshaping of the upper shore to be more gradually sloping.
- Undertake beach reshaping and nourishment (add sediment) to the upper shore to create a wider zone for salt marsh to grow. Reshaping will dampen wave impacts and reduce erosion.
- Extend the footprint of existing salt marsh at either end of the identified zone through targeted planting of intertidal rushland to improve the spatial extent and connectiveness of existing habitat.
- Explore options to encourage Waka Kotahi-NZTA to treat stormwater through wetland/salt marsh filters and contribute to shoreline recontouring or reinstatement.

Table 5. Summary of restoration scoring criteria for Wakatu Drive.

1 Wakatu Drive				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	1
			<i>Screening Score</i>	25
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	17
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	1
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	1
5 Site accessibility	Difficult	Moderate	Easy	1
6 Extent of physical site preparation required	High	Moderate	Low	1
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	1
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	3
			<i>Implementation Score</i>	20
			<i>Overall Site Score</i>	62



Fig. 4. Site 1. Wakatu Drive – potential restoration footprint.

SITE 2. RESERVOIR CREEK

Reservoir Creek enters Waimea Inlet near the regional boundary between Nelson and Tasman. The streamway has a high-quality area of salt marsh around the creek mouth, and several large gravel mounds seaward which support a variety of salt marsh rushland and herbfield species. As the gravel beds extend further offshore, vegetation becomes sparse and dominated by herbfield. Riparian plantings have been established in several locations on the terrestrial margins (Fig. 4).

The site is located adjacent to the Great Taste Trail and there is a 100-200m wide buffer of land between the estuary and the highway suitable for terrestrial planting.

The upper shoreline comprises a relatively narrow and steep strip of gravel immediately in front of a 0.5-1m high vertical clay bank. Seaward is a near horizontal muddy intertidal flat with slightly elevated unvegetated gravel beds located 80-100m offshore. Over the past decade the shoreline has eroded and migrated ~10m landwards as a consequence of the relatively high wave energy at the site. Large rock reinforcing has been introduced to protect power poles on the shoreline (see photo below). There has been minor disturbance of the estuary bed as a result of digger access for maintenance of power poles in the estuary.

Restoration scoring criteria are presented in Table 6.



Eroding shoreline (foreground) and rock rip-rap protecting power poles in the background west of Reservoir Creek.

Opportunities/Issues

Very little salt marsh is present on the shoreline and salt marsh is unlikely to establish naturally due to the current erosion and the steep vertical face of the upper shore creating an abrupt transition from estuary to terrestrial habitat.

There is an opportunity to dampen current wave energy by placing Chenier ridges offshore on the gravel beds, and to soften the upper shoreline by reshaping and replenishment.

Wave exposure is relatively high due to large fetch.

The mid-tidal zone is currently dominated by extensive fine sediment flats and thus presents a potential source of material that may be naturally trapped by salt marsh if it was present.

There is limited potential for salt marsh to migrate inland in response to SLR due to the current height of the surrounding land, but there is potential to reshape areas to allow for a more natural transition between estuary and terrestrial areas.

Current ecological values are relatively low and therefore no significant issues are anticipated with regard to physical works associated with potential restoration.

Gravel currently removed from the nearby streams for flood control would be ideal for beach replenishment purposes.

The site is directly adjacent to a well-used cycleway and heavily used road so public exposure is high.

There is vehicle access to the site and safe working areas away from road traffic.

Note this site is partially within the NCC region and there will be a need for consultation and collaboration.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	✓
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

Because of the modified upper shoreline and relatively high wave exposure, the following is recommended:

- Construct a series of Chenier ridges in the mid shore zone to reduce wave energy and create a sill to trap fine sediment. This would ideally comprise several small low ridges (10-20cm high) situated 80-100m from the shoreline at the edge of the gravel bed (Fig.

4). Ridges should be undulating to create eddies and deflect waves in different directions, and have sufficient gaps to allow tidal water to drain, but also have sufficient coverage to trap sediment. Rocks used should be man-manageable to avoid the need for diggers entering the estuary.

- Shoreward of the Chenier ridges, plant searush at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward. This is to encourage dense stands of growth on the most exposed edge but to minimise the cost of plants overall. Planting in several patches is recommended initially to trial different planting densities and configurations.
- Following establishment of the Chenier ridges and planting of searush, reshape the upper shore to be

zmore gradually sloping. Undertake beach nourishment (add sediment) to the upper shore to create a wider zone for saltmarsh to grow. Reshaping will dampen wave impacts and reduce erosion. Plant salt tolerant species along the landward edge of the terrestrial margin (e.g. saltmarsh ribbonwood, searush, jointed wirerush) where wave run-up is expected.

- Extend the footprint of existing salt marsh at either end of the current growth through targeted planting of intertidal species to improve the spatial extent and connectiveness of existing habitat.
- Extend the existing terrestrial plantings to create continuous margin cover where possible.

Table 6. Summary of restoration scoring criteria for Reservoir Creek.

2 Reservoir Creek (West)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	3
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	75-100%	25-75%	<25%	3
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	25
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	1
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	3
			<i>Implementation Score</i>	34
			<i>Overall Site Score</i>	86

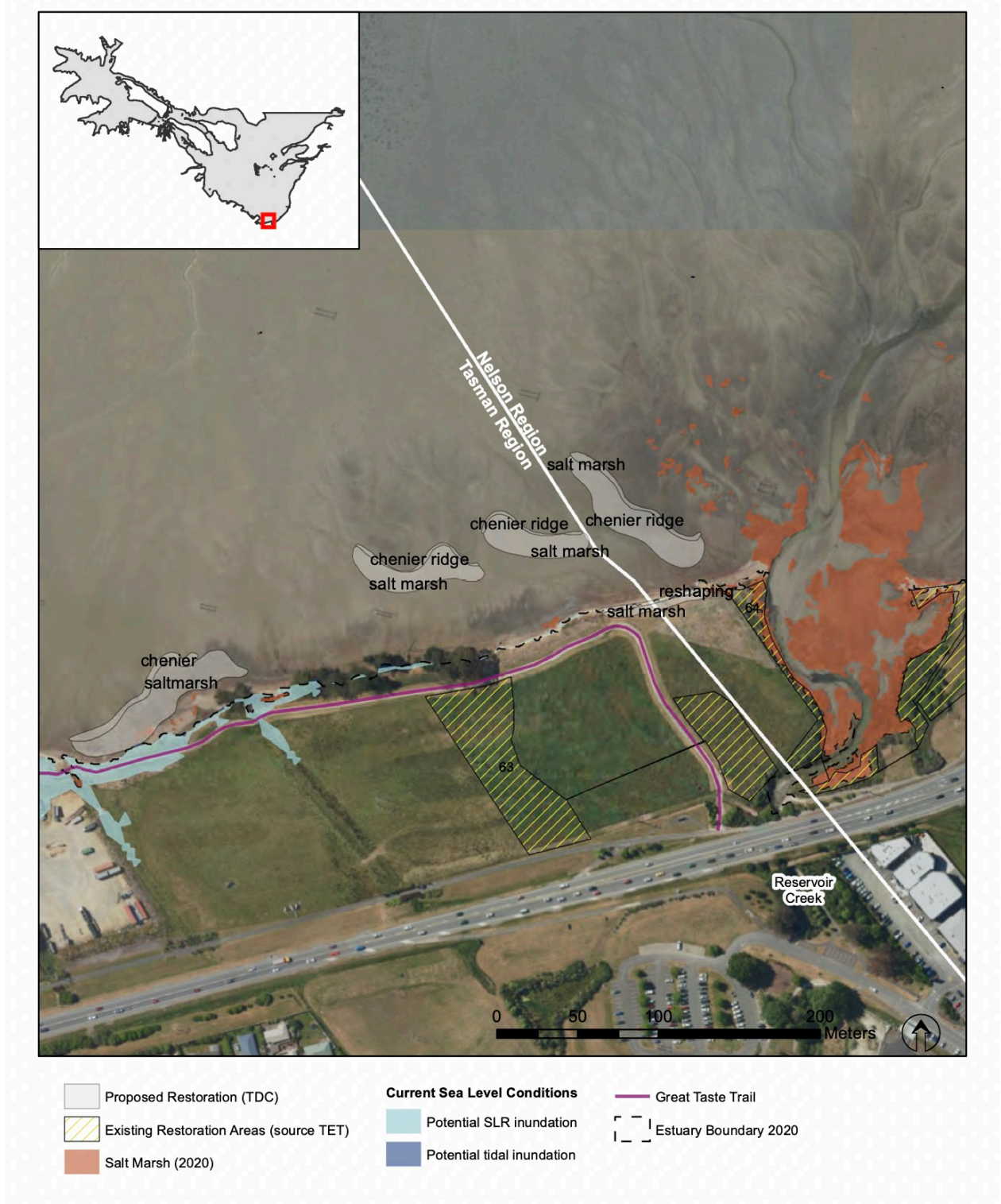


Fig. 5. Site 2. Reservoir Creek – potential restoration footprint.

SITE 3. VERCOES DRAIN AND DELTA

Vercoes Drain and Jimmy Lee Creek (Fig. 5) enter the estuary east of the refuse transfer station. The shoreline has been extensively modified through historical reclamation and drainage, with the waterways straightened and channelised. Reclamations extend to the edge of the estuary where they are protected by rock walls or concrete rubble.



Vercoes Drain delta showing herbfield growing on raised gravel beds.

Where the streams discharge, there has been a build-up of intertidal gravels over time. These areas are elevated relative to the surrounding mud flats and support patchy areas of salt marsh (predominantly herbfield and some searush). There are virtually no terrestrial plantings or salt marsh on the upper shore (see photo above).

The site is adjacent to the Great Taste Trail which is located on the edge of the shoreline. There is very little available land between the estuary and the cycleway for terrestrial planting. Surrounding land use is predominantly industrial. Restoration scoring criteria are presented in Table 7.



Vercoes Drain showing channelisation and surrounding landuse. Note the presence of salt marsh along the channel edge.

Opportunities/Issues

Very little salt marsh is present on the shoreline and salt marsh is unlikely to establish naturally due to the steep vertical face of the upper shore creating an abrupt transition from estuary to terrestrial habitat.

Wave-driven erosion appears moderate due to partial sheltering from the Beach Road transfer station reclamation, and the presence of raised gravel beds in the upper shore.

The mid-tidal zone is currently dominated by extensive fine sediment flats and thus presents a potential source of material that may be naturally trapped by salt marsh if it was present.

There is no capacity for salt marsh to migrate inland in response to SLR due to the surrounding land use. However, there is limited potential to reshape the edges of Vercoes Drain to reduce bank steepness and allow for shade trees and salt marsh to be planted.

Current ecological values are relatively low and therefore no significant issues are anticipated with regard to physical works associated with potential restoration.

Gravel currently removed from the nearby streams for flood control would be ideal for beach replenishment purposes.

The site is directly adjacent to the Great Taste trail so public exposure is high.

There is potential vehicle access to the site through adjacent industrial properties.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	✓
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

Because of the modified upper shoreline and limited land available for restoration, the following is recommended:

- Plant pockets of searush at high densities (10-15 plants/m²) on the gravel delta to see if rushland can be established in the mid-intertidal reaches.
- Protect the seaward edge of plantings with small rock Cheniers (e.g. 10cm high). Planting in several patches is recommended initially to trial different planting densities and configurations.
- Reshape the upper shore to be more gradually sloping. Undertake beach nourishment (add sediment) to the upper shore to create a wider zone for saltmarsh to grow. Plant salt tolerant species along the landward edge of the terrestrial margin (e.g. saltmarsh ribbonwood, searush, jointed wirerush).
- Reshape and ideally widen the footprint of Vercoes Drain to reduce bank steepness and allow for shading plants to be established. Gravel excavated from the mouth of Vercoes Drain can be used for beach nourishment in this area, assuming there are no issues with potential sediment contamination. Note that redevelopment of the cycleway offers potential opportunities to incorporate changes as part of any work undertaken.

Table 7. Summary of restoration scoring criteria for Vercoes Drain and Delta.

3 Vercoes Drain and delta				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	3
			<i>Screening Score</i>	25
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	3
			<i>Habitat Score</i>	19
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	1
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	3
			<i>Implementation Score</i>	28
			<i>Overall Site Score</i>	72

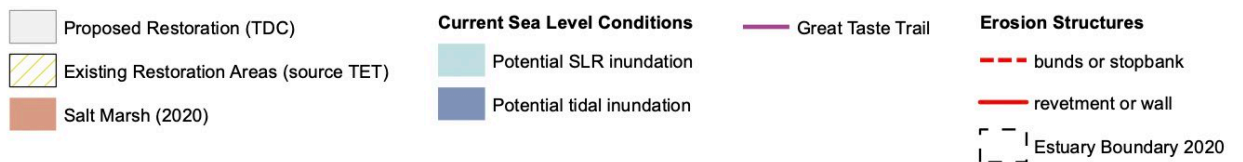
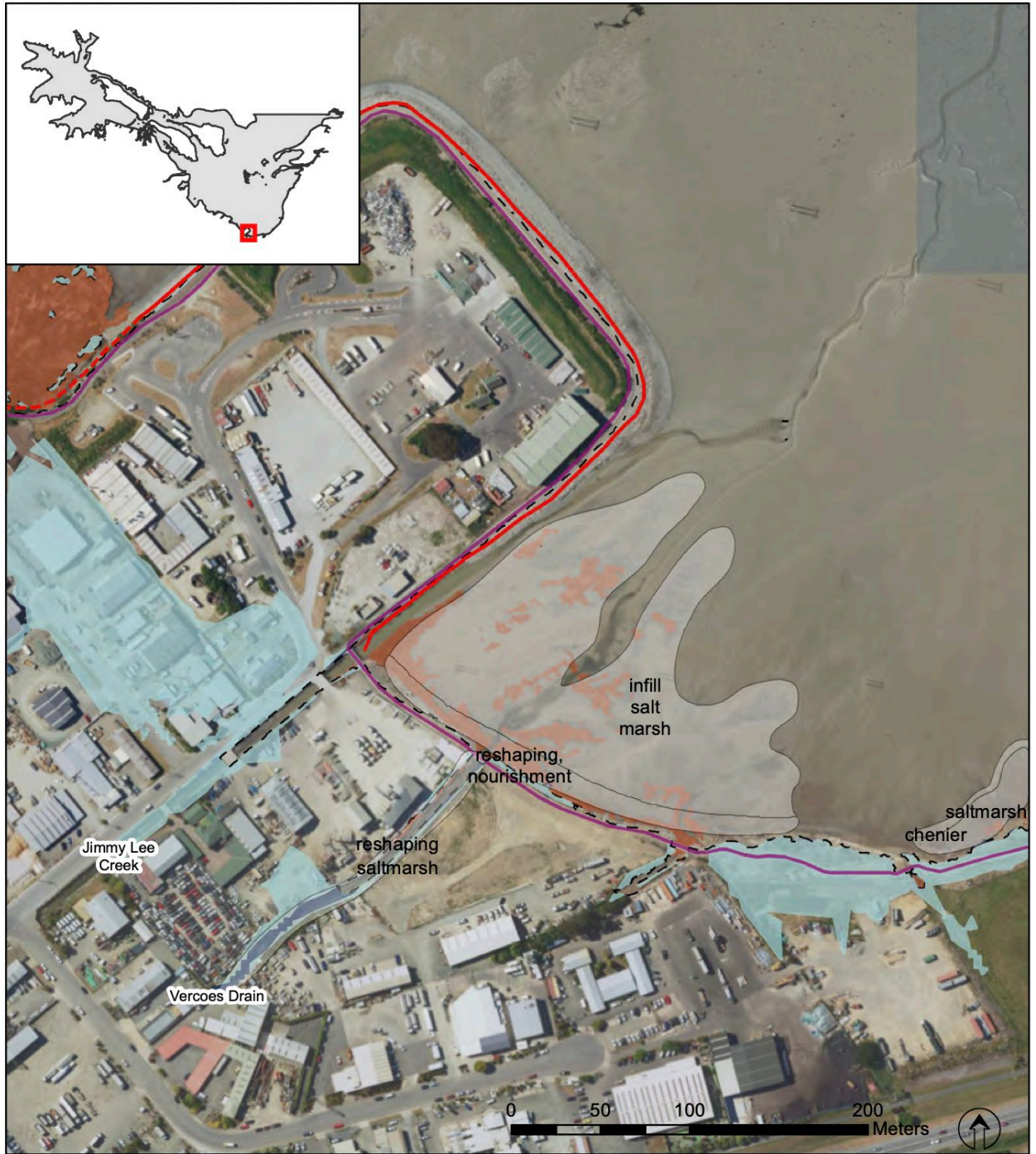


Fig. 6. Site 3. Vercoes Drain and Delta – potential restoration footprint.

SITE 7. ESTUARY PLACE

The site is a significant (~2ha) restoration area developed over recent years by TDC as a requirement of the development of Estuary Place (Fig. 7). It comprises tidal reinstatement following the removal of a section of bund and reshaping of previously reclaimed land to create a meandering streamway with relatively gently sloping sides. A smaller area of earth previously used for reclamation was also removed to re-create a small intertidal flat (see photo below). Material from the latter was used to re-contour the surrounding land. A comprehensive planting programme has followed with a mix of both salt marsh and terrestrial plants.

The area has been set aside allowing for SLR and developed as a space for various types of recreation and the Great Taste Trail passes through the middle of the site.



Tidal reinstatement through the previously banded mouth, and restoration plantings at Estuary Place



Meanders were built into the lower streamway and the edges reshaped to have a gentle slope prior to planting

The restoration is quite different to the adjacent salt marsh which provides a good indication of what it would have been like prior to reclamation. The reason the restoration is so different to the natural salt marsh is primarily because of logistical constraints and costs in removing excess earth dumped when the site was reclaimed. It provides a good example of how retaining existing salt marsh is far more straightforward and cost effective than trying to recreate it. Restoration scoring criteria are presented in Table 11.

Opportunities/Issues

The restored area is quite extensive, but predominantly terrestrial, and there is limited capacity for salt marsh to migrate inland in response to SLR due to the current site elevations.

The site is relatively sheltered from the main body of the estuary by residual bunding so erosion is likely to be relatively low.

Intertidal rushland plantings have struggled, possibly due to wide spacing of plants and limited tidal inundation.

Current ecological values are relatively low but will significantly increase over time. No significant issues are anticipated with regard to physical works associated with any further potential restoration.

The site is directly adjacent to the Great Taste trail so public exposure is high.

There is overland vehicle access to the site.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

Because most of the hard work establishing the site has already been undertaken, the following is recommended:

- Maintain existing plantings through regular weed and pest control.
- Infill plant within intertidal rushland to increase shoot densities and increase cover. This will help protect against desiccation and limit the damage from animals (rabbits and hares).
- Scrape/reshape the area seaward of the cycleway to allow for additional salt marsh planting.

- Plant additional salt tolerant rushland and herbfield species near the tidal margin.

Note that since this section was prepared in 2021, some of the recommended restoration has been initiated.

Table 8. Summary of restoration scoring criteria for Estuary Place.

7 Estuary Place				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	31
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	3
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	1
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	102

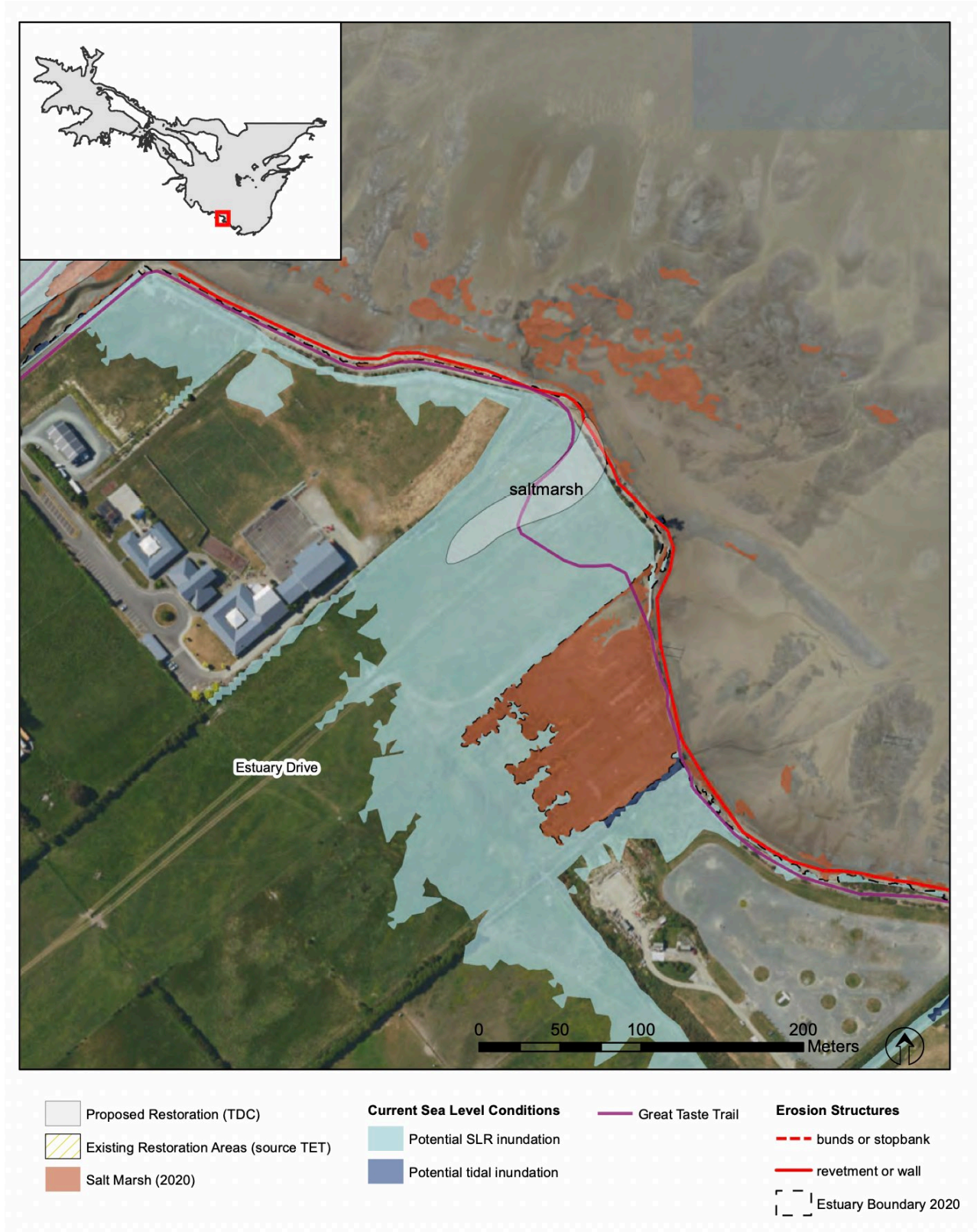


Fig. 7. Site 7. Estuary Place – potential restoration footprint.

SITE 8. BORCK CREEK TO SANDEMAN RESERVE

The Borck to Sandeman section is a large (~4ha) low-lying area of salt marsh largely cut off from the estuary by bunds constructed along the foreshore. The remaining salt marsh is in a compromised state due to limited inundation, historical modification and stock grazing. Tidal flows reach the site through small pipes under the earth bund, while flow paths within the salt marsh have been channelised in an attempt to drain the area (see photos below).



Grazed salt marsh cut off from the sea by a large earth bund (right) and channelising to drain water



Rushland and herb field currently within paddocks used for grazing stock

Borck Creek enters the coast to the east. This streamway has been significantly enhanced through channel widening and planting over the past decade and is regaining much of its ecological value lost from past channelisation. It is currently separated from the site by a large bund, but this could be opened to enhance connectivity.

The site connects to the Sandeman Reserve to the west where restoration enhancement has also been undertaken (see following section).

Restoration scoring criteria are presented in Table 12.

Opportunities/Issues

The available area is extensive, retains residual populations of most salt marsh species, and there is capacity for salt marsh to migrate inland in response to SLR. The site is within the range of predicted SLR inundation, and parts are within the current tidal range.

Land use is limited to low density grazing and there is little infrastructure that will be affected by restoration. Noting this, there is a sewage pump station at the back of the site that could potentially require protection from tidal inundation in the future.

The site is relatively sheltered from the main body of the estuary by bunds so erosion is likely to be relatively low. However, a small exposed part of the bund supporting the cycleway is currently prone to erosion. Re-routing the cycleway to the inland boundary of the area is considered feasible.

Current ecological values are moderate but will significantly increase over time. No significant issues are anticipated with regard to physical works associated with any further potential restoration.

There is vehicle access to the site but the site is not near main roads so is ideal for school groups to become involved in restoration.

The Great Taste trail follows two sides of the site and so public exposure is high.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	✓
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

This represents the one of the most promising sites for tidal reinstatement in this part of the estuary. There is extensive remaining salt marsh that is expected to flourish if tidal exchange is increased, and grazing pressure is removed. The following is recommended:

- Remove stock and fencing.
- Significantly increase culvert size or open bunds to reinstate tidal flows at east and west ends of the site.
- Maintain existing salt marsh through weed and pest control.
- Infill plant within the rushland to increase shoot densities and increase cover. This will help protect against desiccation.

- Open the eastern side of the site to improve connection to Borck Creek particularly for flood flows to create a delta system with sediment retention.
- Investigate re-routing the cycleway to the inland side of the site.

Note that since this section was prepared in 2021, much of the recommended restoration has been initiated.

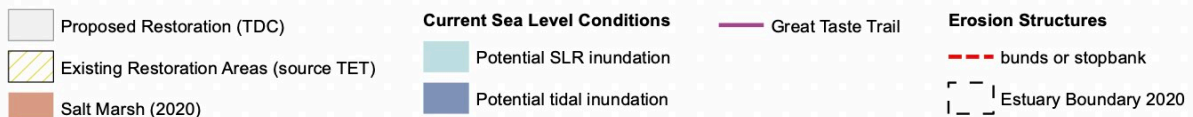
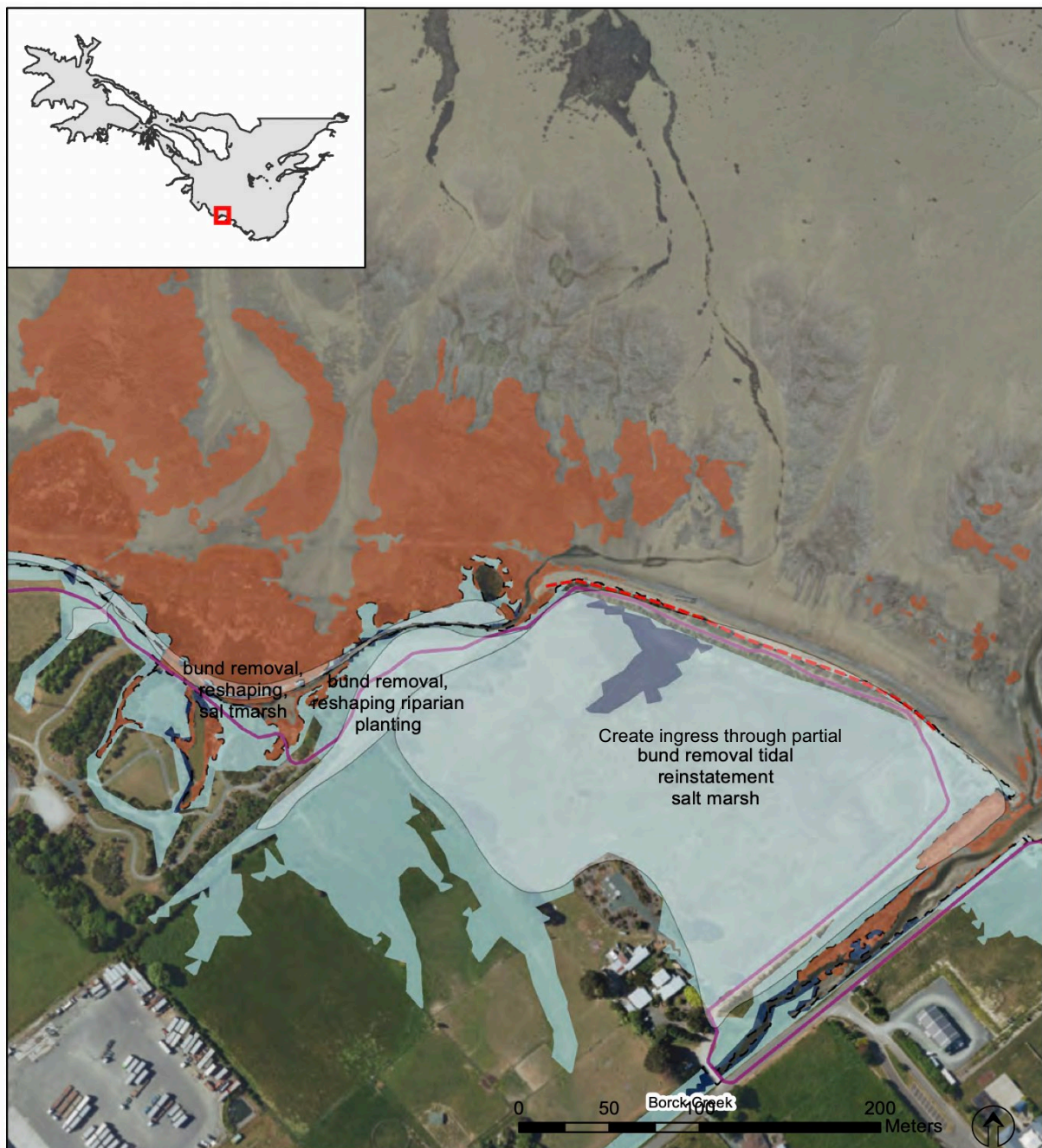


Fig. 8. Site 8. Borck Creek to Sandeman Reserve – potential restoration footprint.

Table 9. Summary of restoration scoring criteria, Borck Creek to Sandeman Reserve.

8 Borck Creek to Sandeman				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	3
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	21
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	92

SITES 9 AND 10. SANDEMAN RESERVE

Sandeman Reserve comprises ~3ha of well-maintained council reserve east of the MDF plant (Fig. 9). The reserve has walking tracks, amenity plantings and several restored wetland areas. A small stream flows along the east of the site.

The reserve is cut-off from the estuary by a drainage channel and bund that runs along the shoreline. There is a stand of pine trees growing on the bund (see photo below). Water quality in the drainage channel is frequently poor due to flows being trapped and water becoming stagnant.



Pine trees growing on an earth bund seaward of a drainage channel running parallel to the shore.

Relatively wide and intact beds of salt marsh, and gravelfields interspersed with soft muds, are present seaward of the bund.

There are several possible restoration options at the site, all reasonably small and readily achievable. Restoration scoring criteria are presented in Table 13 for the coastal margin, and Table 14 for the streamway.

Opportunities/Issues

The available area is extensive, retains residual populations of most salt marsh species, and there is capacity for salt marsh to migrate inland in response to SLR.

Many parts of the site are within the range of predicted SLR inundation, and parts are within the current tidal range.

Low lying areas are likely to undergo natural restoration with limited intervention needed.

The bund and drainage channel running parallel to the shore appear to serve no obvious purpose and could

be modified to improve drainage and water flow. Tree removal will impact current shag roosting.

Currently tidal flows to the site are restricted by pipes, bunds and drains.

The site is relatively sheltered from the main body of the estuary by salt marsh and gravel beds so erosion is unlikely to be significant.

There is little infrastructure that will be affected by restoration.

Current ecological values are moderate but will significantly increase over time. No significant issues are anticipated with regard to physical works associated with any further potential restoration.

There is vehicle access to the site but the site is not near main roads so is ideal for school groups.

The Great Taste Trail passes through the middle of the site so public exposure is high.

The site has already been substantially improved by previous council work.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	✓
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Significantly increase culvert size or open bunds to reinstate tidal flows at both east and west ends of the site.
- Remove a section of bund at NZTM 1614515E, 5425488N to flood adjacent low lying land (currently with residual salt marsh).
- Remove pine trees and other weeds on the seaward side of the site.
- Infill plant areas where salt marsh species are present but not well established.

- On the margins of the stream to the east of the site, re-shape banks to a shallower gradient, and plant vegetation to shade the waterway.
 - Maintain existing salt marsh through weed and pest control.
 - Open the bund at the north-eastern end of the site to facilitate tidal ingress and connect to the adjacent Borck to Sandeman restoration.
- Note that since this section was prepared in 2021, some of the recommended restoration has been initiated.

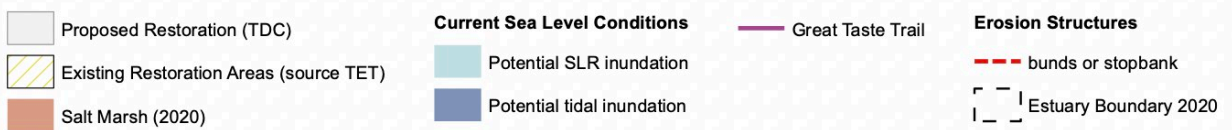
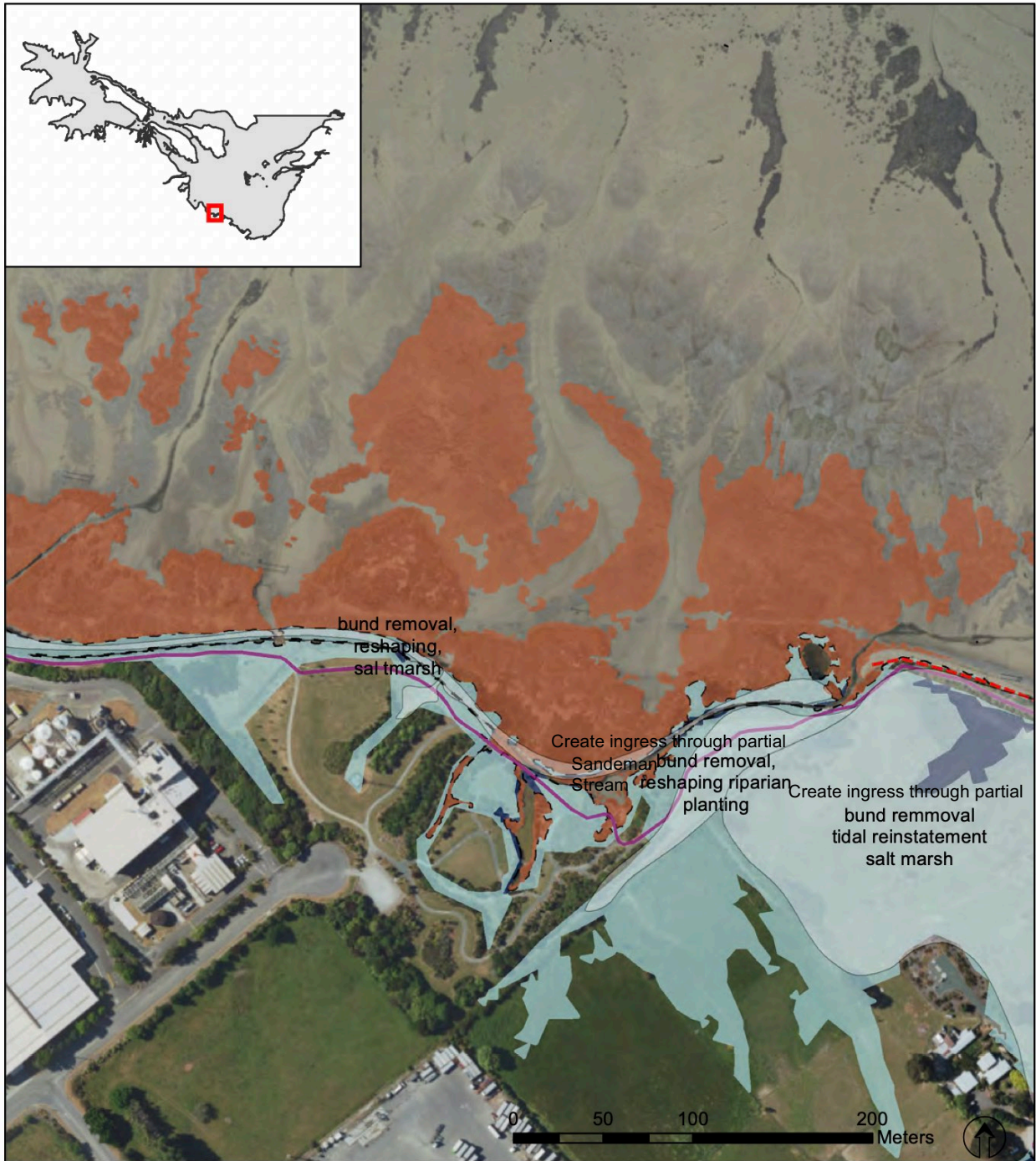


Fig. 9. Sites 9 and 10. Sandeman Reserve – potential restoration footprints.

Table 10. Summary of restoration scoring criteria, Sandeman Reserve (Stream).

9 Sandeman Reserve (Stream)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	33
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	3
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	3
			<i>Implementation Score</i>	42
			<i>Overall Site Score</i>	102

Table 11. Summary of restoration scoring criteria, Sandeman Reserve (Coast).

10 Sandeman Reserve (Coast)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	3
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	21
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	92

SITE 11. BARK PROCESSORS EAST

The estuary margin to the north and east of the Bark Processors site is dominated by a steep armoured rock wall that protects the reclaimed land from erosion, and a large earth bund landward that screens the industrial sites beyond. The Great Taste trail runs along the top of the rock wall.

Seaward, the mid-tidal zone is dominated by extensive fine sediment flats and nuisance macroalgal growths indicating a source of nutrient enrichment is present in this part of the estuary (Fig. 10).

Wave energy is potentially relatively high due to the large fetch and exposure to sea breezes from the north/north-east.

Very little salt marsh is present on the shoreline and salt marsh is unlikely to establish widely due to the steep vertical face of the upper shore creating an abrupt transition from estuary to terrestrial habitat. The upper rock wall is dominated by weeds and the terrestrial margin is planted in native shrubs. There is no capacity for salt marsh to migrate inland in response to SLR due to the surrounding land use.

Restoration scoring criteria are presented in Table 15.



Muddy unvegetated intertidal flats seaward of a steep rock bund.

Opportunities/Issues

The estuary margin is highly modified and has low ecological value.

The site is relatively exposed to the main body of the estuary so wave energy is likely to be relatively high.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is limited vehicle access to the site.

The Great Taste trail passes through the middle of the site so public exposure is high.

The site is not significantly different in terms of water depth or exposure to the nearby Sandeman Reserve which supports extensive salt marsh habitat.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	
Riparian planting	
Wetland planting	

Recommended Actions

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Construct a Chenier ridge in the mid shore zone to reduce wave energy and create a sill to trap fine sediment. This would ideally comprise several small low ridges (10-20cm high) situated 50-80m from the shoreline.
- Ridges should be undulating to create eddies and deflect waves in different directions, and have sufficient gaps to allow tidal water to drain, but also have sufficient coverage to deflect waves and trap sediment.
- Rocks used should be man-manageable to avoid the need for diggers entering the estuary.
- Shoreward of the Chenier ridges, plant searush at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward. This is to encourage dense stands of growth on the most exposed edge but to minimise the cost of plants overall. Planting in several patches is recommended initially to trial different planting densities and configurations. Match plant heights with those at the adjacent Sandeman Reserve area.

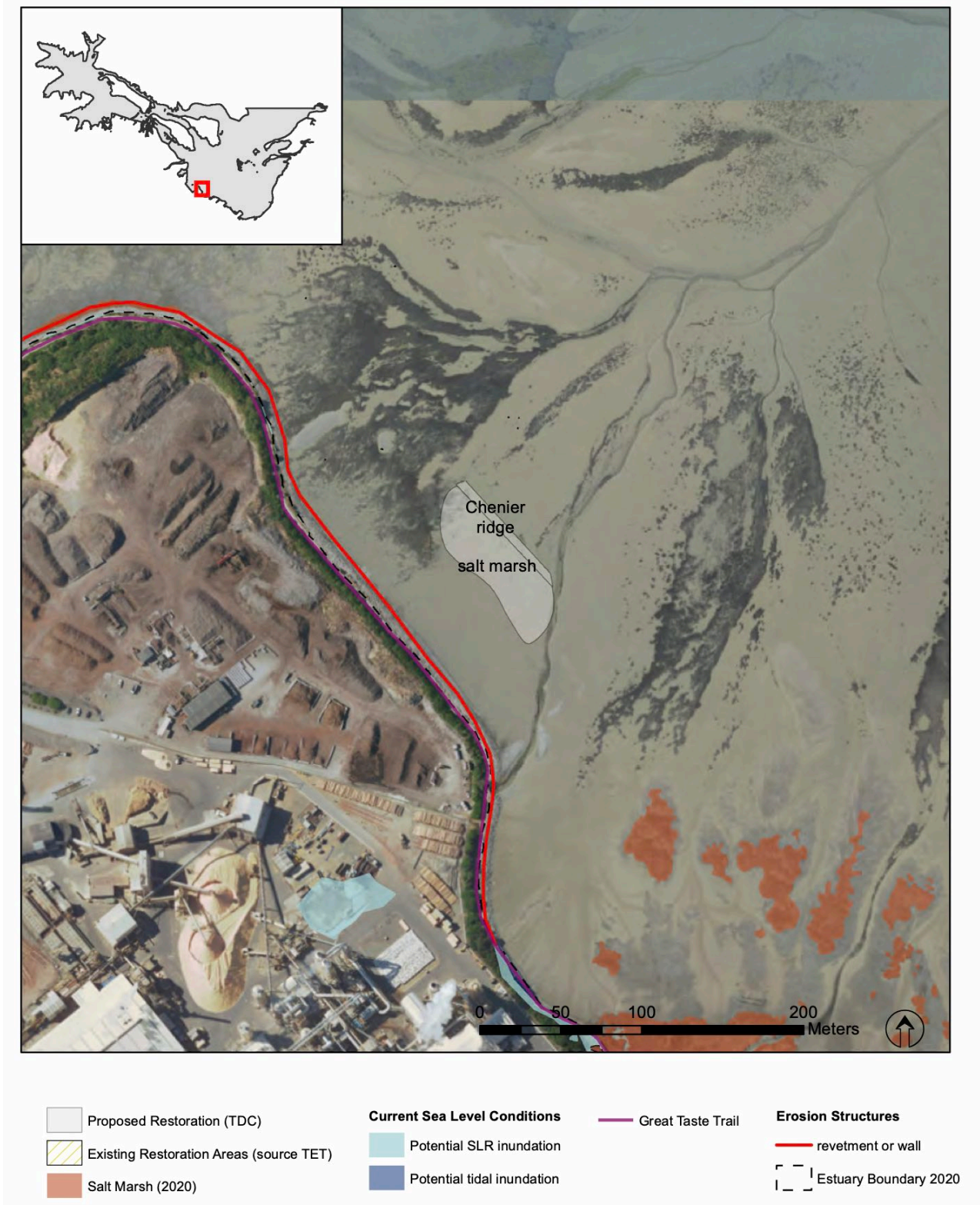


Fig. 10. Site 11. Bark Processors East – potential restoration footprint.

Table 12. Summary of restoration scoring criteria, Bark Processors East.

11 Bark Processors East				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	23
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	19
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	1
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	1
			<i>Implementation Score</i>	32
			<i>Overall Site Score</i>	74

SITE 12. BARK PROCESSORS EAST

The estuary margin to west of the Bark Processors site is dominated by a steep armoured rock wall that protects the reclaimed land from erosion, and a large earth bund landward that screens the industrial sites beyond. The Great Taste Trail runs along the top of the rock wall.

A large area of reclamation was removed from the estuary ~15 years ago, the footprint of which is still visible in the intertidal flats (Fig. 11). There has been very limited recolonisation of the declamation area by salt marsh.

The mid-tidal zone is dominated by mixed gravel and fine sediment flats.

Wave energy appears relatively low on the sheltered western edge of the Bark Processors reclamation.

A few small pockets of salt marsh are present on the shoreline (e.g. glasswort, grey salt bush) although salt marsh is unlikely to form expansive beds due to the steep vertical face of the upper shore. The upper rock wall is dominated by weeds and the terrestrial margin is planted in native shrubs. There is no capacity for salt marsh to migrate inland in response to SLR due to the surrounding land use.

Restoration scoring criteria are presented in Table 16.



Mixed gravel and sand flats with a narrow band of salt marsh seaward of a steep rock bund.

Opportunities/Issues

The estuary margin is highly modified and has low ecological value.

The site is relatively sheltered from the main body of the estuary so wave energy is likely to be relatively low.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is limited vehicle access to the site.

The Great Taste trail passes through the middle of the site so public exposure is high.

The site is not significantly different in terms of water depth or wave exposure to nearby salt marsh habitat.

The site is within the current tidal range of the estuary.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	
Riparian planting	
Wetland planting	

Recommended Actions

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Construct a Chenier ridge in the mid shore zone to reduce wave energy and create a sill to trap fine sediment. This would ideally comprise several small low ridges (10-20cm high) situated 20-30m from the shoreline.
- Ridges should be undulating to create eddies and deflect waves in different directions, have sufficient gaps to allow tidal water to drain, but have sufficient coverage to deflect waves and trap sediment.
- Rocks used should be man-manageable to avoid the need for diggers entering the estuary.
- Reshape the upper shore to a shallow gradient with mixed sand and gravel substrate.
- Shoreward of the Chenier ridges, plant searush at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward. This is to encourage dense stands of growth on the most exposed edge but to minimise the cost of plants overall. Planting in several patches is recommended initially to trial different planting densities and configurations. Match plant heights with those in adjacent areas.

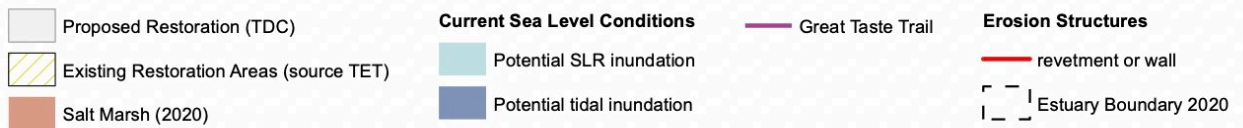
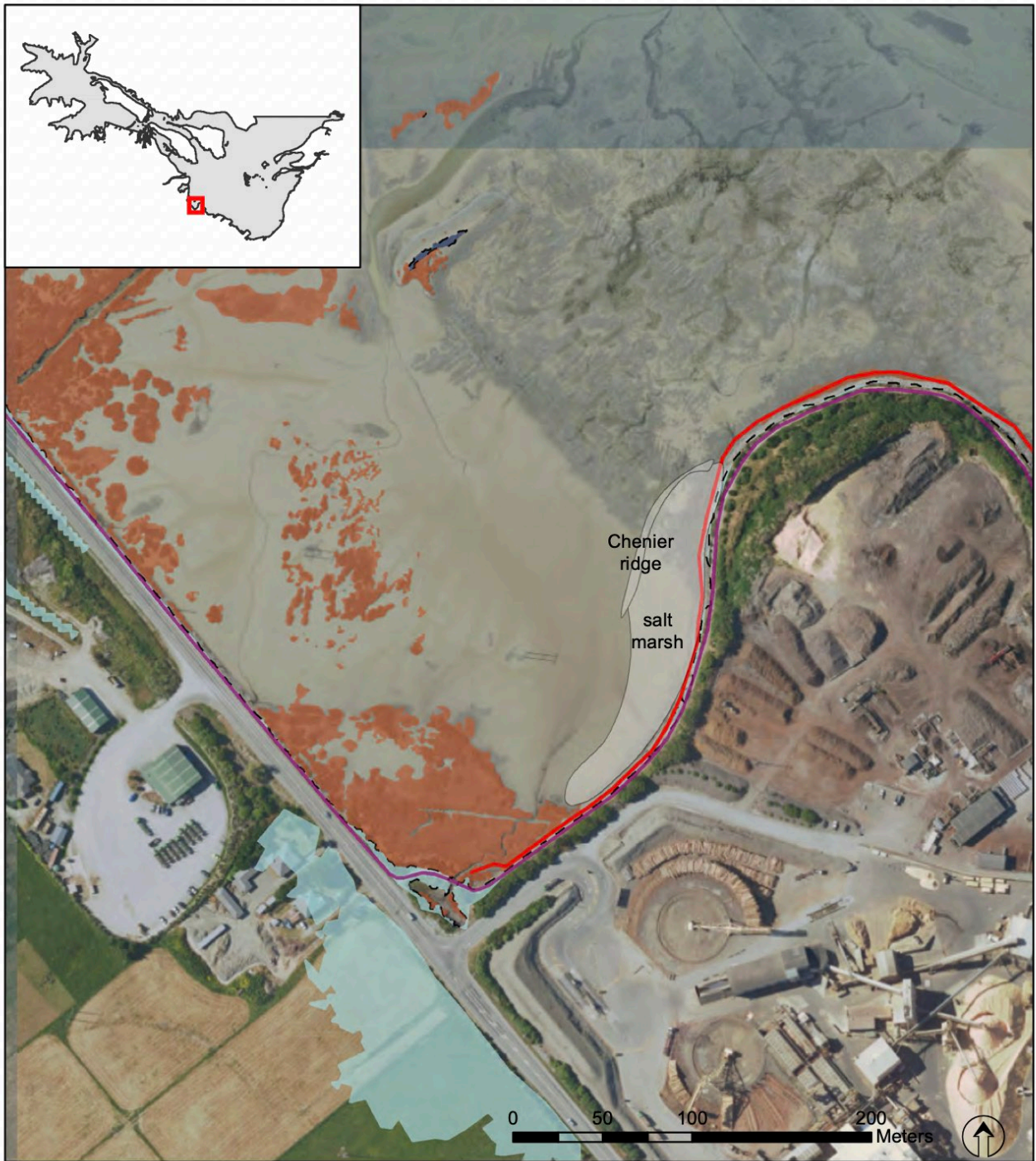


Fig. 11. Site 12. Bark Processors West – potential restoration footprint.

Table 13. Summary of restoration scoring criteria, Bark Processors West.

12 Bark Processors West				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	21
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	1
			<i>Implementation Score</i>	36
			<i>Overall Site Score</i>	84

SITE 14. BEST ISLAND GOLF CLUB (SOUTH)

The Best Island Golf Course site is located along the south-western side of Best Island (Fig. 13). To the north-west an access road, in place since before the 1970's, runs along the southern edge of the golf course and in many places is below MHWS. The road was used as access to the rock revetment project undertaken by council a few years ago to protect from erosion from the Waimea River.

The north-west access road is now no longer needed and has recently been decommissioned. Part of the decommissioning requires site reinstatement of a displaced strip of upper tidal salt marsh ~200m long x 5m wide (1000m²). This is within an area known as being important for banded rail.

Although there are ongoing legal and public access considerations for TDC to resolve regarding the complete removal of the road, the sections that run through the salt marsh zone are ready to be prepared (soil ripping) and planted.

The site margins have been modified and Fig. 13 shows how low-lying the area is with areas shaded dark blue within the current potential tidal elevation of the estuary, and pale blue areas within the potential SLR inundation zone, although barriers may limit tidal ingress.

Initial work by TDC has removed some pine trees and planted narrow strips of salt marsh along the upper shore (see photo below).



Grassland and weeds growing among salt marsh plantings adjacent to the Golf Course entrance.

Restoration scoring criteria are presented in Table 18.

Opportunities/Issues

The site is narrow and has been significantly modified and steepened and reinforced in places, but remains connected to the main body of the estuary.

The site is sheltered and not subjected to significant wave energy.

Despite past modification, the site retains moderate ecological value due to the residual salt marsh and enhancement work undertaken to date.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is good vehicle access to the site.

Pest browsing and desiccation of plants has been an issue with existing restoration plantings.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Undertake infill planting to further enhance the existing plantings.
- Continue with ongoing weed removal and pest control. Consider exclusion fencing (for vehicles).
- Rip and plant decommissioned road areas in the northwest.

Note that since this section was prepared in 2021, the recommended restoration work has been initiated.

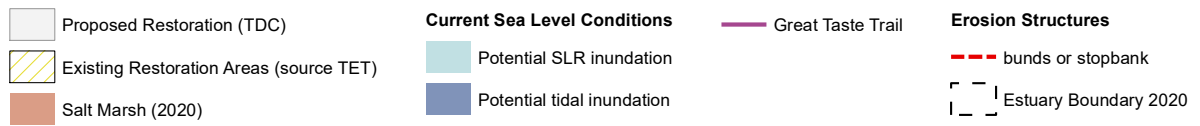


Fig. 13. Site 14. Best Island Golf Club (South) - potential restoration footprint.

Table 14. Summary of restoration scoring criteria, Best Island Golf Club (South).

14 Best Island Golf Club (South)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	31
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	40
			<i>Overall Site Score</i>	98

SITE 15. BEST ISLAND (SOUTHWEST)

The site is located along the south-western side of Best Island (Fig. 14) and forms part of the access road to the Best Island residential areas. The road runs along the top of the shore and is occasionally tidally inundated.

The site margins have been modified and reinforced with rock barriers to protect against erosion or inundation. Fig. 14 shows how low-lying the area is with areas shaded dark blue within the current potential tidal elevation of the estuary, and pale blue areas within the potential SLR inundation zone, although barriers may limit tidal ingress.

Restoration scoring criteria are presented in Table 19.

Opportunities/Issues

The site is narrow and has been significantly modified and often steepened and reinforced but remains connected to the main body of the estuary.

The site is sheltered and not subjected to significant wave energy.

Despite past modification, the site retains moderate ecological value due to the residual salt marsh present.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is good vehicle access to the site.

Adjacent land (owned by the NRSBU) on the inland side of the road has excellent potential to be used for salt marsh creation and there is a great opportunity for creating marshbird (including bittern) habitat around the existing rectangular ponds on the island.

Pest browsing and desiccation of plants has been an issue with existing restoration plantings.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	✓
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Undertake infill planting to further enhance the existing plantings.
- Continue with ongoing weed removal and pest control. Consider exclusion fencing (for vehicles).
- Investigate options for further enhancement on NRSBU land.

Note that since this section was prepared in 2021, some of the recommended restoration work has been initiated.

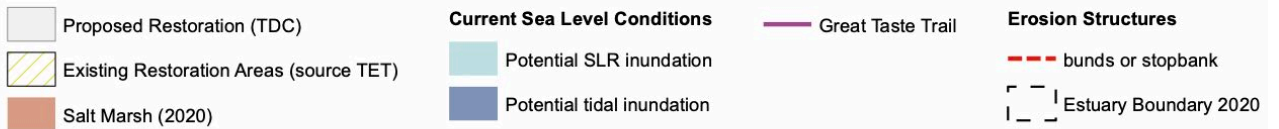
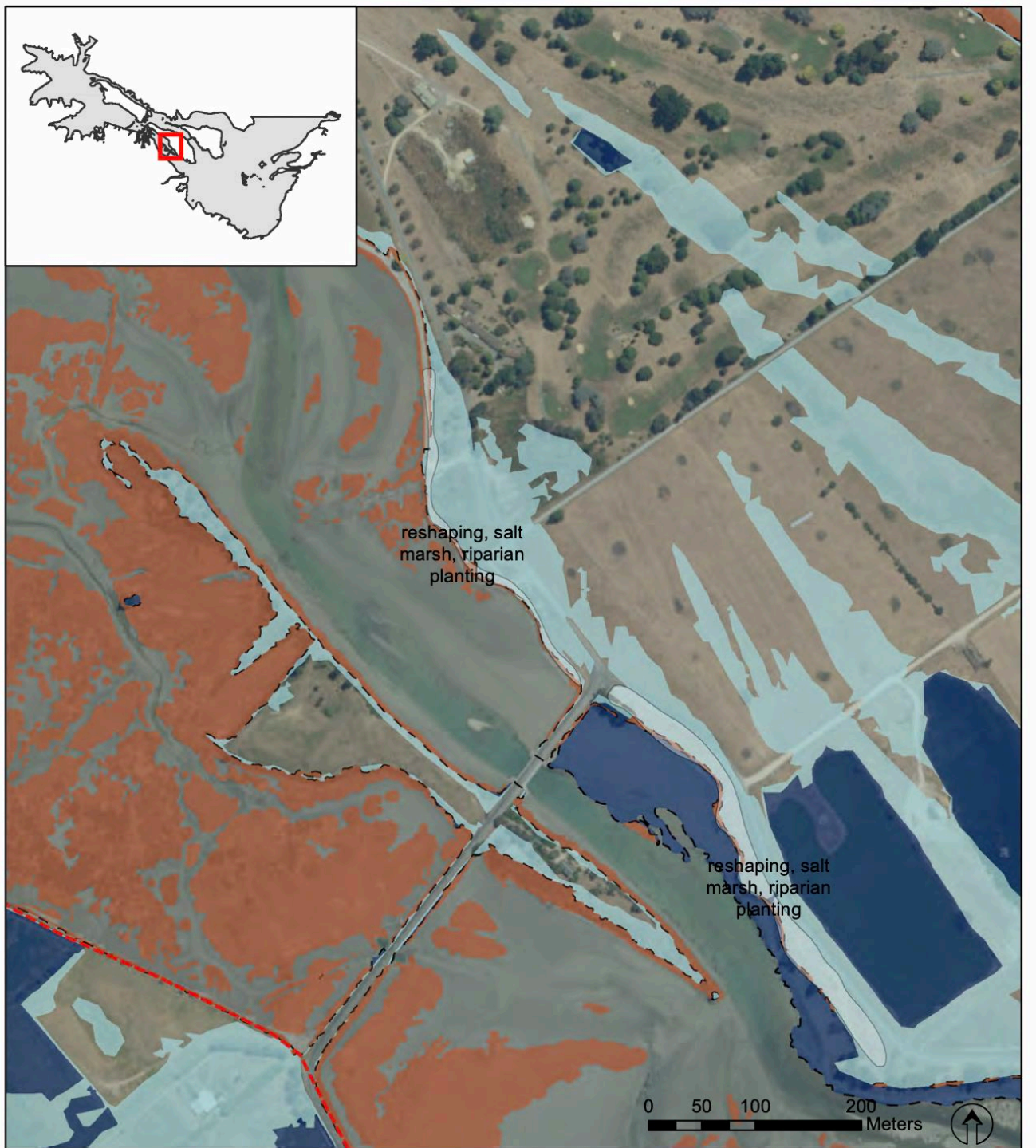


Fig. 12. Site 15. Best Island - potential restoration footprint.

Table 15. Summary of restoration scoring criteria, Best Island.

15 Best Island				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	3
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	42
			<i>Overall Site Score</i>	96

SITE 16. WAIMEA RIVER DELTA

This site was not able to be viewed during the field visit and the assessment is based on previous knowledge of the area and information provided by Trevor James (TDC).

There is a large area of undeveloped land on the Waimea Delta (Fig. 15) that is within the flood control stopbanks. Large parts of this area remain in salt marsh, but slightly higher areas are dominated by introduced grass and weeds, while wetter areas retain pockets of freshwater vegetation including stands of raupō (bullrush). There is huge potential to re-establish freshwater wetlands, natural delta processes (including sediment removal and inanga spawning) and habitat for a variety of marshbirds in this area.

Restoration scoring criteria are presented in Table 20.

Opportunities/Issues

The site area is large, freshwater dominated, and remains connected to the main body of the estuary.

It is not subjected to wave energy but may be occasionally impacted by flood flows.

It retains a moderate ecological value due to the past modification of the site, primarily disruption to natural water flows.

The site is within the current tidal range and is surrounded by low-lying land within the range of predicted SLR inundation.

There is extensive capacity for salt marsh to migrate inland in response to SLR.

There is no infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is off-road vehicle access to the site.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	✓

Recommended Actions

In light of the extensive scope for restoration, the following is recommended:

- Reshape channel areas to increase freshwater and tidal ingress to the area.
- Extend the footprint of existing salt marsh through targeted planting of intertidal species to improve the spatial extent and connectiveness of existing habitat to the new zones.
- Create shallow ponded areas (akin to rice paddies) to restore freshwater wetlands suitable for planting with key species (e.g. raupō).
- Implement weed removal and pest control as appropriate.

Note that since this section was prepared in 2021, the recommended restoration work has been initiated.

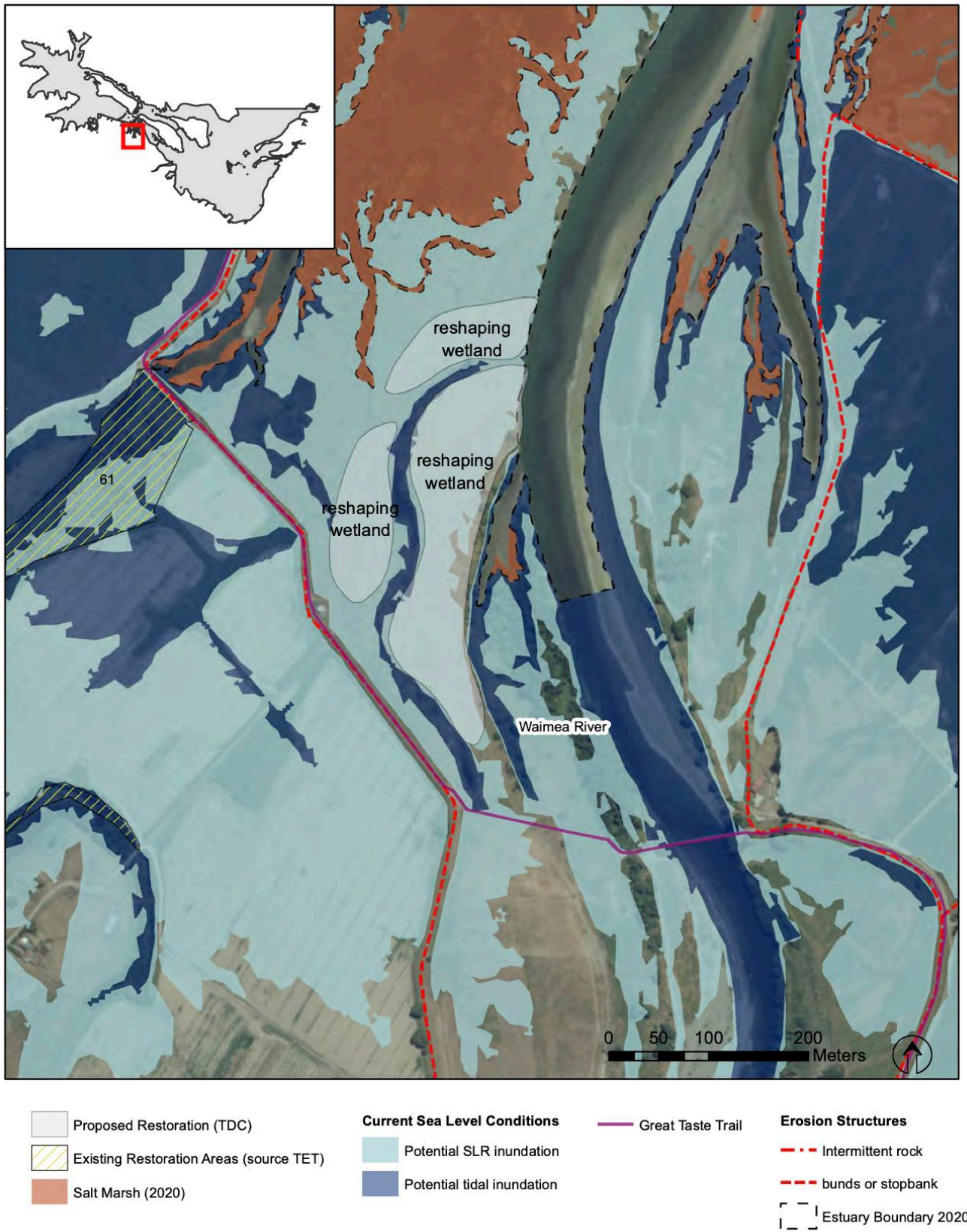


Fig. 13. Site 16. Waimea Delta - potential restoration footprint.

Table 16. Summary of restoration scoring criteria, Waimea Delta.

16 Waimea Delta				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	31
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	5
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	5
9 Likely benefit to fish compared to current state	Small	Moderate	Large	5
			<i>Habitat Score</i>	39
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	1
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	1
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	32
			<i>Overall Site Score</i>	102

SITE 22. BEST ISLAND (EAST)

The site is located along the south-eastern side of Best Island (Fig. 21) and is accessed from the road leading to Bell Island. The land is owned by NCC and the NRSBU have already commenced planting part of the site.

The terrestrial margin is relatively steep and, in places, is eroding or armoured with hardfill. The estuary edge is largely intact, and a narrow strip of salt marsh (primarily herbfield) extends along the length of the site. Approximately 600m of the northern terrestrial margin

(immediately south of the golf course) has recently been cleared of weeds and planted, comprising a mix of terrestrial plants and infill rushland plantings along the upper intertidal zone. The latter appear to have been only partially successful.

Another 350m of the site to the south has yet to be restored and is currently planted in exotic species or covered in weeds. It offers a simple opportunity to extend the existing restoration.

Restoration scoring criteria are presented in Table 26.

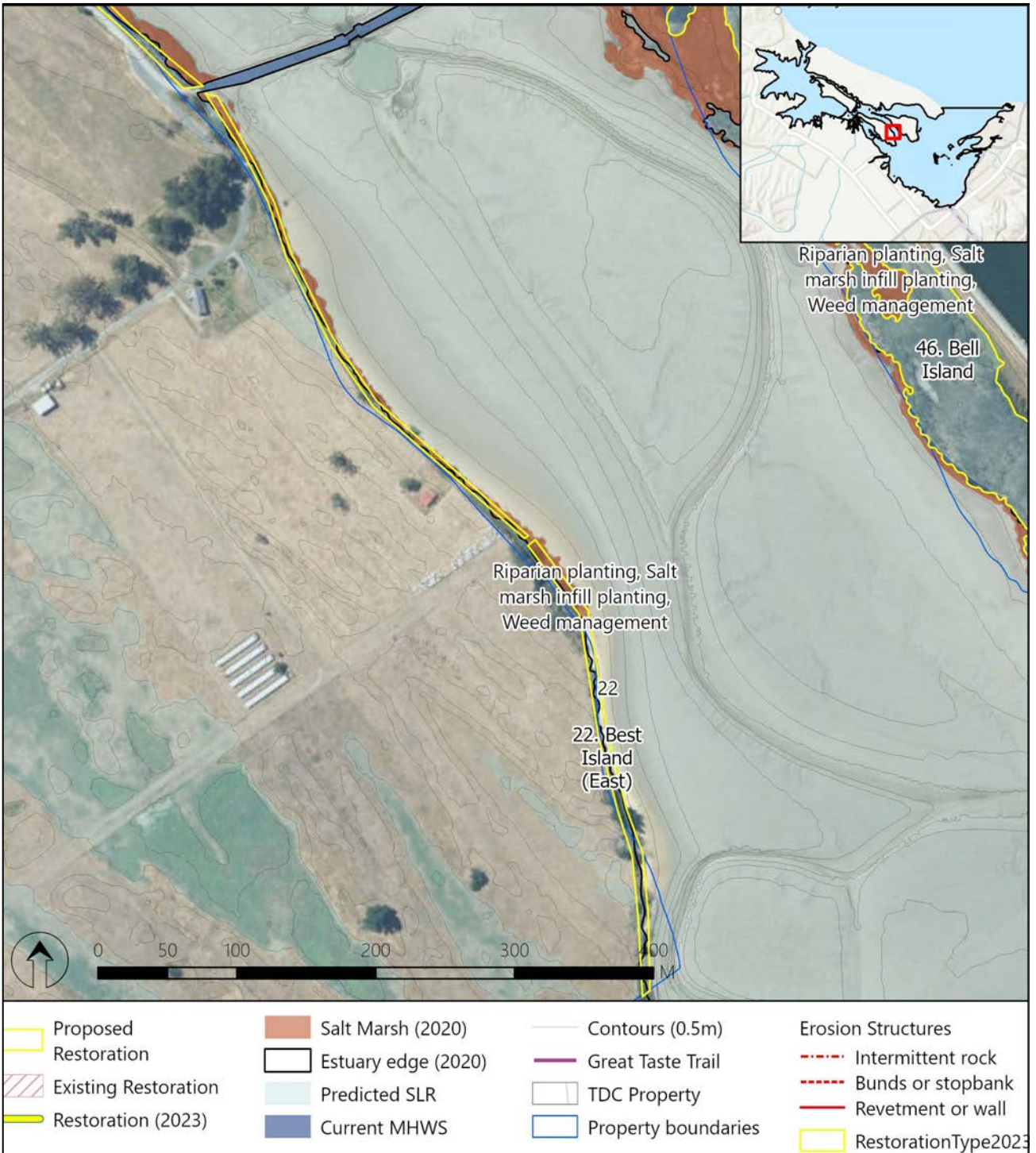


Fig. 14. Site 22. Best Island (East) – potential restoration footprint.



Mixed terrestrial and salt marsh (rush plantings) along the eastern side of Best Island.

Table 17. Summary of restoration scoring criteria for Best Island (East).

22 Best Island (East)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	> \$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	29
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	3
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	1
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	21
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	94



Patchy salt marsh adjacent to exotic ice plant covered margin.

Opportunities/Issues

The proposed site is the narrow coastal margin which has been significantly modified and often steepened and reinforced but remains connected to the main body of the estuary. There is opportunity for a larger terrestrial restoration to be undertaken if desired on adjacent land owned by NCC.

The site is sheltered from the main body of the estuary by Bell Island and is not subjected to significant wave energy. Exposure is greatest at the southern end of the site.

The site retains moderate ecological value due to the residual salt marsh present. However, there is limited capacity for salt marsh to migrate inland in response to SLR without significant shoreline reshaping (not proposed).

Land use is currently limited to low density grazing and there is little infrastructure that will be affected by restoration. No significant issues are anticipated with regard to physical works associated with any potential restoration.

There is good vehicle access to the site.

Existing restoration has commenced through planting of the terrestrial margin and intertidal rushland species along the north of the site. Pest browsing and desiccation of plants appears to have been an issue with existing restoration plantings.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Spray weeds, in particular exotic ice plant, along the terrestrial margins of the salt marsh and plant with salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees.
- Extend the footprint of existing salt marsh through targeted planting of intertidal rushland to increase shoot densities and cover, and improve the spatial extent and connectiveness of existing habitat, primarily to the south of the site.
- Plant pockets of searush at high densities (10-15 plants/m²) to see if rushland can be established in the upper-intertidal reaches. Planting in several patches is recommended initially to trial different planting densities and configurations.
- Continue ongoing weed removal and pest control.
- Investigate restoration options on NRSBU land.

Note that some of the recommended restoration work has been initiated as part of the MfE funded 1 billion trees project and NRSBU have a master plan for native planting for around Best and Bell islands.

SITE 23. BEST ISLAND (SOUTH)

The site is located along the southern side of Best Island (Fig. 22) on land is owned by NCC.

On both sides of the road, salt marsh is growing in drainage channels with tidal flows restricted by the presence of culverts with flap-gates. The area is highly modified, although the estuary edge is largely intact, with a narrow strip of salt marsh (primarily herbfield and some rushland) extending along the length of the site.

The area adjoins a large herbfield in front of established housing to the south. The estuary edge of the terrestrial margin is relatively steep and, in places, is eroding or armoured with hardfill, while the terrestrial edge is impacted by vehicles driving and parking among herbfield. Approximately 700m of the margin immediately south of the golf course has been cleared of weeds and planted in a mix of terrestrial plants, and many areas are protected by post and rope fencing.

Restoration scoring criteria are presented in Table 27.

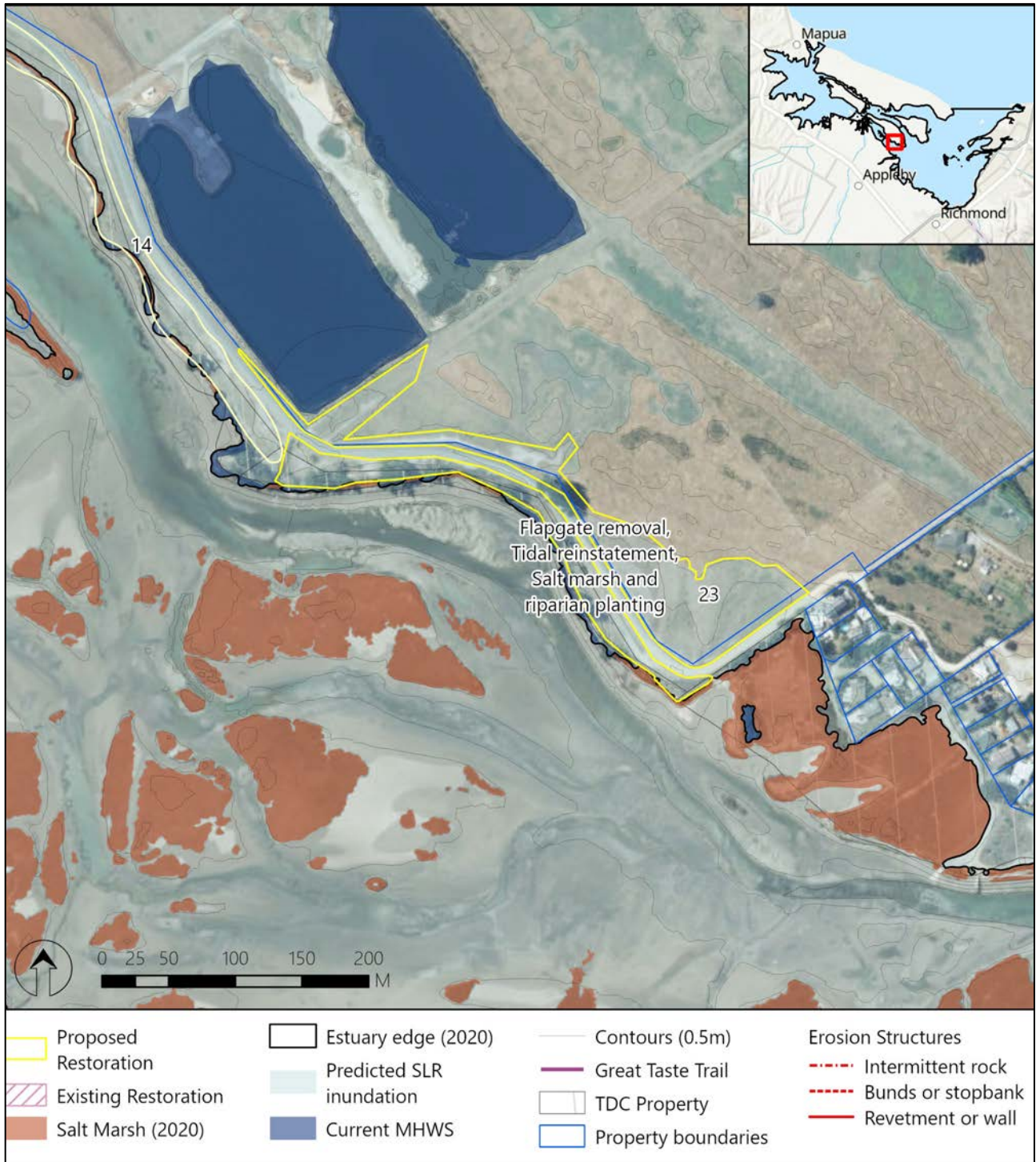


Fig. 15. Site 23. Best Island (South) – potential restoration footprint.



Tidal drainage channels and salt marsh on the land side of the Best Island access road.



Pipe and flap gate restricting tidal flows to the site.

Table 18. Summary of restoration scoring criteria for Best Island (South).

23 Best Island (South)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	33
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	3
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	25
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			Overall Site Score	102



Salt marsh herbfield growing along the side of Best Island access road.



Salt marsh rushland and herbfield growing along the fence line adjacent to the model boat ponds.

Opportunities/Issues

The site comprises a narrow strip on both sides of the access road. This area has been significantly modified and often steepened and reinforced on the coastal edge, but remains connected to the main body of the estuary. There is opportunity for a larger terrestrial restoration to be undertaken if desired on adjacent land owned by NCC.

The site is sheltered from the main body of the estuary and is not subjected to significant wave energy.

The site retains moderate ecological value due to the residual salt marsh present. However, there is good capacity for salt marsh to migrate inland in response to SLR with reinstatement of tidal flows.

Land use is currently limited to low density grazing and there is little infrastructure that will be affected by restoration. No significant issues are anticipated with regard to physical works associated with any potential restoration.

There is good vehicle access to the site.

Existing restoration has commenced through planting of the terrestrial margin and intertidal rushland species along the north of the site. Pest browsing and desiccation of plants appears to have been an issue with a subset of the existing restoration plantings.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	✓
Dike or berm removal	
Physical exclusion (e.g., fencing)	✓
Weed control	✓
Pest control	✓
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Protect existing salt marsh by exclusion fencing to minimise vehicle and stock damage.
- Remove culvert flap-gates to allow regular tidal exchange to the site. When practicable, lower culvert heights and increase culvert sizes to maximise tidal flows.
- Spray weeds, in particular exotic ice plant, along the terrestrial margins of the salt marsh and plant with salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees – noting extensive plantings are already in place.
- Continue existing riparian planting, alongside weed removal and pest control.
- Investigate further restoration options on NCC (NRSBU) land including re-location of the existing road.

SITE 25. EQUESTRIAN CENTRE EMBAYMENT

This site is located between the access road to Hunter Brown Reserve, and the equestrian centre. The area was historically a ~75m wide x 900m long intertidal arm of the estuary before the installation of a road causeway across the entrance and flap-gate restricted tidal ingress (Fig. 24). Approximately 7.5ha remains within the current tidal range, although only the seaward-most area (~1.5ha) appears to be regularly inundated by seawater due to the very small diameter pipe and flap

gate present through the causeway (see photos on following pages). The lower section of the site supports open intertidal flats and surrounding salt marsh, while the upper tidal section is dominated by introduced grasses and weeds, although residual salt marsh is also present. The reinstatement of saltwater flows is expected to see a relatively rapid return to salt marsh dominated species, and the site appears well suited to many wetland bird species including fernbird and bittern. Restoration scoring criteria are presented in Table 29.

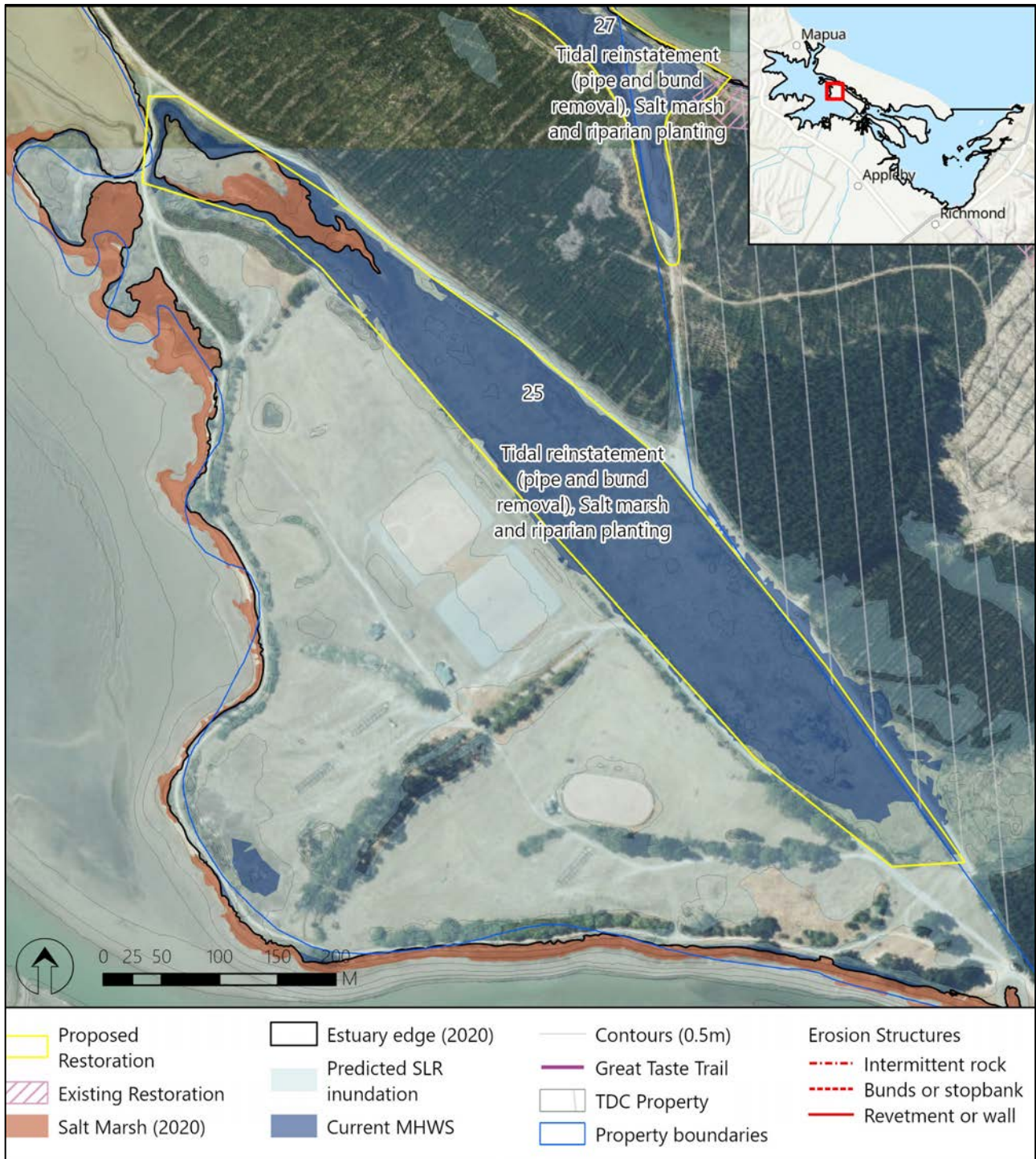


Fig. 16. Site 25. Equestrian Centre Embayment – potential restoration footprint.



Tidal embayment and salt marsh on the landward side of the causeway.



Upper wetland area now largely cut off from tidal flows with terrestrial grasses and weeds growing in former salt marsh.

Table 19. Summary of restoration scoring criteria for Equestrian Centre Embayment.

25 Equestrian Centre Embayment				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	29
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	5
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	5
9 Likely benefit to fish compared to current state	Small	Moderate	Large	3
			<i>Habitat Score</i>	41
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	3
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	5
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	114



Earth causeway separating the estuary from the embayment.



Small pipe and flap gate restricting tidal flows to the site.

Opportunities/Issues

This represents an ideal site for removal of the causeway and tidal reinstatement. Most of the site is within the current tidal range, and surrounding land is within the SLR inundation zone expected in the next 50-60 years.

The available area is relatively extensive, has functional intertidal estuarine habitat, and retains residual populations of most common salt marsh rushland, herbfield and estuarine shrub species. The residual salt marsh is expected to flourish if tidal exchange is increased, particularly as there is no grazing pressure present and most of the site is fenced. There is capacity for salt marsh to migrate inland in response to SLR and land available for riparian planting.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Current ecological values are moderate and can be expected to significantly increase over time.

This site represents one of relatively few low-lying areas where natural salt marsh migration could occur in response to SLR without substantial impacts on existing infrastructure.

Issues regarding physical works associated with any potential restoration relate primarily to removal of the existing causeway and access road. Current usage appears to be low and there is alternative access from the equestrian centre. Material removed from the causeway may be able to be disposed of on adjacent council land.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	✓
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Remove the causeway to allow unrestricted tidal exchange to the site. This will likely result in the rapid natural re-establishment of salt marsh species, and improvements in estuarine function, including benefits to fish (increased spawning areas) and birdlife.
- Extend the footprint of existing salt marsh through targeted planting of intertidal rushland to improve the spatial extent and connectiveness of existing habitat.
- Spray weeds and tall fescue grassland along the terrestrial margins of the salt marsh and plant with salt tolerant coastal species e.g. salt marsh ribbonwood, flax, cabbage trees.
- Maintain low-lying land (e.g., avoid infilling by dumping of hardfill etc.) to maximise future restoration opportunities.
- Initiate targeted weed and predator control.

SITE 26. BIRD ISLAND

This site is located at the western end of Rough Island (Fig. 25). It comprises ~1.3ha of terrestrial land surrounded by existing salt marsh (primarily herbfield).

Terrestrial restoration initiatives have commenced with planting and extensive mulching of several areas and weed management. The main barriers to restoration appear to be harsh growing conditions, including browsing by rabbits/hares, and the presence of introduced grasses and weeds. There is an opportunity

to develop the site to optimise bird roosting and nesting habitat, with human disturbance limited in part by access only being possible at low tide.

Restoration scoring criteria are presented in Table 30.

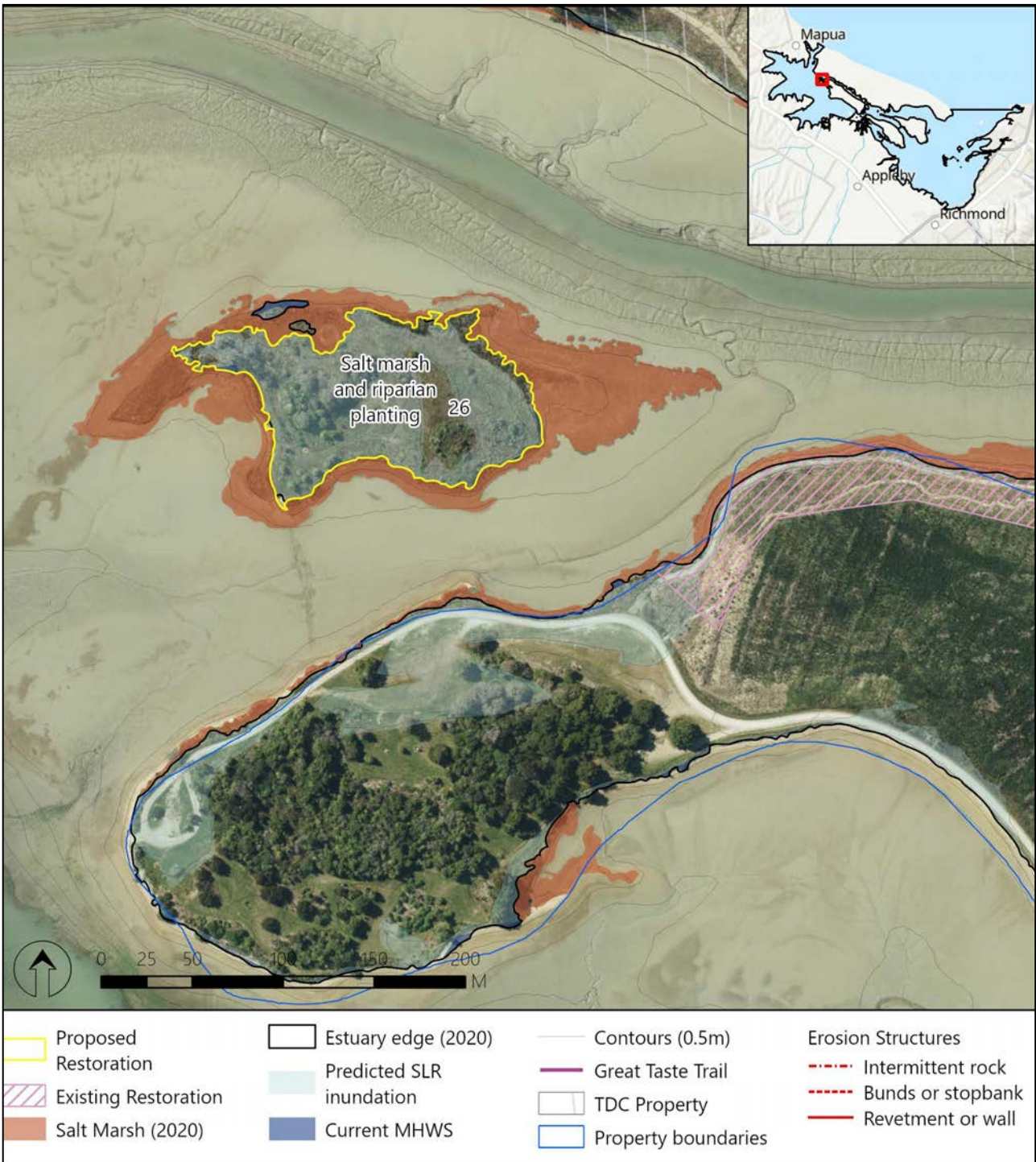


Fig. 17. Site 26. Bird Island – potential restoration footprint.



Riparian plantings along the terrestrial edge of the island.



Intact salt marsh (mainly herbfield) surrounds most of the island.

Table 20. Summary of restoration scoring criteria for Bird Island.

26 Bird Island				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	29
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	33
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	1
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	3
			<i>Implementation Score</i>	40
			<i>Overall Site Score</i>	102



Terrestrial grasses and weeds require active management while riparian plantings establish.

Opportunities/Issues

This low-lying island site is largely within the SLR inundation zone expected in the next 50-60 years.

The available area is relatively extensive, has functional intertidal estuarine habitat, and retains residual populations of most common salt marsh rushland, herbfield and estuarine shrub species. Natural salt marsh migration is expected to occur in response to SLR without need for active intervention, noting there is limited capacity for terrestrial species under predicted SLR scenarios.

There is no grazing pressure present.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Current ecological values are moderate and can be expected to increase over time.

The site has a long history of planting. Coarse substrate means plant establishment is very difficult even when holes are excavated and filled with compost/topsoil and, consequently, there are very high mortality rates.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Plant salt tolerant species along the landward edge of the terrestrial margin (e.g., saltmarsh ribbonwood, searush, jointed wirerush) where wave run-up is expected.
- Initiate targeted weed and predator control.

SITE 27. ROUGH ISLAND EMBAYMENT

This site is located on the northern side of Rough Island within a narrow tidal arm separating it from Rabbit Island. It comprises ~1.8ha of land below MHWS that is currently cut-off from the estuary by an earth bund (Fig 26). The bund has a walking/cycling track that runs along the length of the island (see photos on following pages). To the northern end of the site is a large pond that covers ~1/3rd of the site and which receives limited tidal exchange via a centrally located and perched pipe.

Raised earth bunds have recently (early 2023) been constructed along the coastal margin, and along the southern side of the pond, to prevent uncontrolled tidal inundation.

The terrestrial margins immediately surrounding the site have recently been planted in natives which back onto plantation forestry. Low-lying land in the south of the site supports residual salt marsh and has not been replanted to date.

Restoration scoring criteria are presented in Table 31.

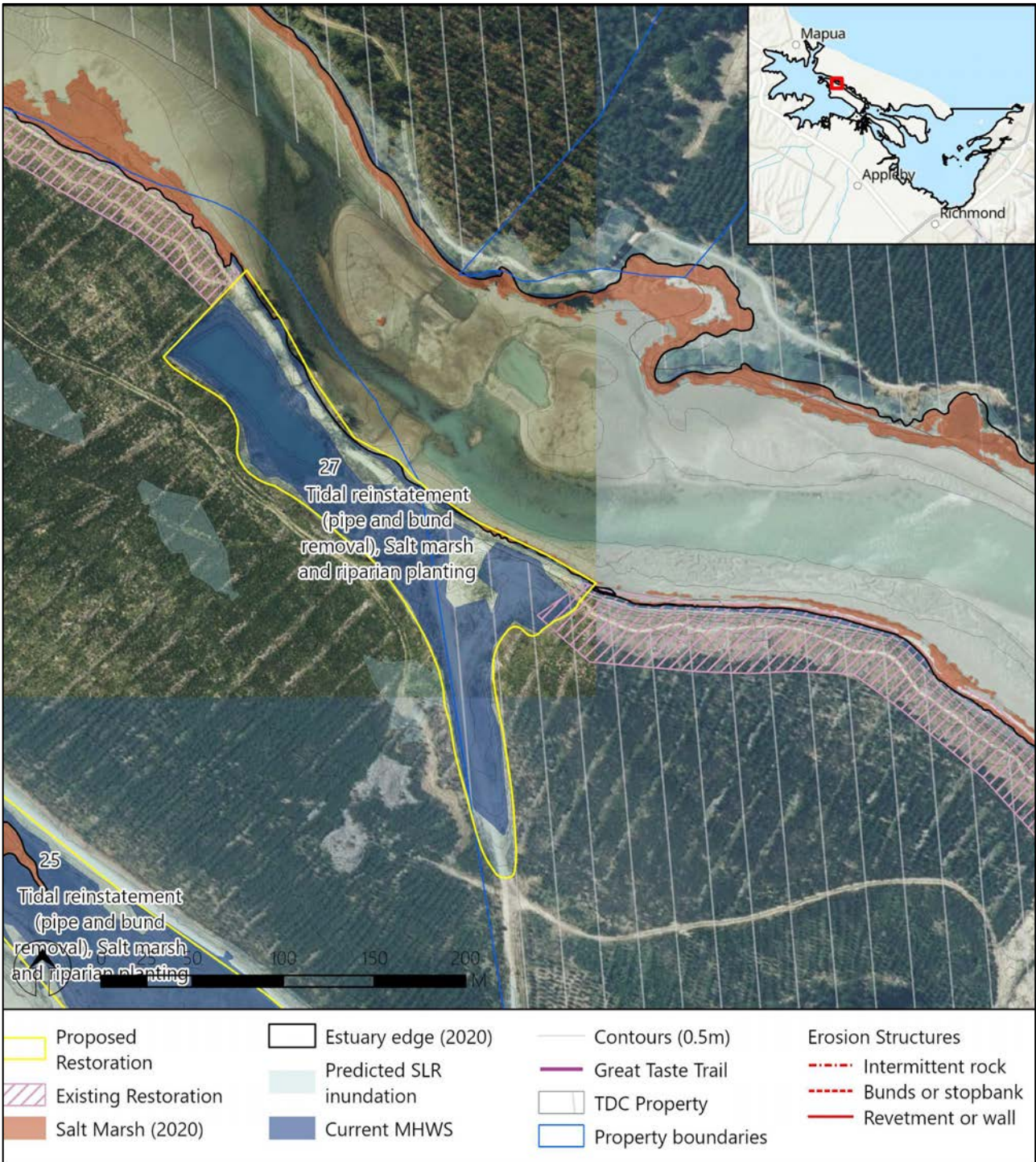


Fig. 18. Site 27. Rough Island Embayment – potential restoration footprint.



Current embayment with riparian plantings along the terrestrial edge.



Riprap reinforced culvert and berm at culvert discharge point.

Table 21. Summary of restoration scoring criteria for Rough Island Embayment.

27 Rough Island Embayment				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	35
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	3
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	5
9 Likely benefit to fish compared to current state	Small	Moderate	Large	3
			<i>Habitat Score</i>	31
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	3
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	42
			<i>Overall Site Score</i>	108



Coastal berm and walkway/cycleway with new (early 2023) raised berm to prevent tidal inundation on the seaward edge.



Recently constructed bund at the south of the embayment to prevent tidal inundation of low-lying land.

Opportunities/Issues

This represents an ideal site for tidal reinstatement, including removal of shoreline bunding and shoreline recontouring for salt marsh planting. The site is relatively extensive with much of it within the existing tidal range and requiring active intervention to prevent tidal inundation. The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

The site has been extensively modified and, outside of the existing tidal embayment, most of the area is bare land used previously for forest harvesting activities. There is no permanent infrastructure present, no grazing pressure, and there will be no displacement of existing usage other than a shared cycle and walking path that currently follows the coastal berm. It would be straightforward to re-route this behind the proposed area of tidal reinstatement.

Current ecological values are low but can be expected to increase significantly over time, partly as existing restoration plantings establish, and also as a consequence of any additional restoration undertaken.

Low-lying parts of the site retain functional intertidal estuarine habitat and residual populations of some common salt marsh herbfield species.

Due to the high level of past modification, natural salt marsh migration in response to SLR is expected to be slow without infill planting.

Weed and pest control likely need ongoing attention.

There has been recent investment in repairing the culvert and raising the shoreline bunding to protect the coastal accessway so removal is unlikely to be supported.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	✓
Flap-gate removal	
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Discontinue active work to protect against tidal inundation (e.g., the construction of berms).
- Remove the causeway/berm to allow unrestricted tidal exchange to the site and recontour the shoreline to reflect a natural gradient. This will result in rapid improvements in estuarine function, including benefits to fish (increased spawning areas) and birdlife.
- Extend the footprint of existing salt marsh through targeted planting of intertidal rushland to improve the connectiveness of existing habitat. Plant at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward.
- Spray weeds and tall fescue grassland along the terrestrial margins of the salt marsh and continue existing planting of salt tolerant coastal species e.g. salt marsh ribbonwood, flax, cabbage trees.
- Initiate targeted weed and predator control.

SITE 28. ROUGH ISLAND BRIDGE

This site is located on the northern side of Rough Island near the bridge to Rabbit Island (Fig 27). It comprises ~0.2ha of salt marsh with tidal flows restricted by a small pipe that has allowed the previously open tidal access to be made into a small causeway. An access bridge present at the site also provides walking and cycle access at high tide (see photos on following pages).

Most of the site is within fenced areas, although a small area of herbfield is present near the great taste trail and is being impacted by foot and bike traffic.

The terrestrial margins immediately surrounding the site have recently been planted in natives which back onto plantation forestry.

Restoration scoring criteria are presented in Table 32.

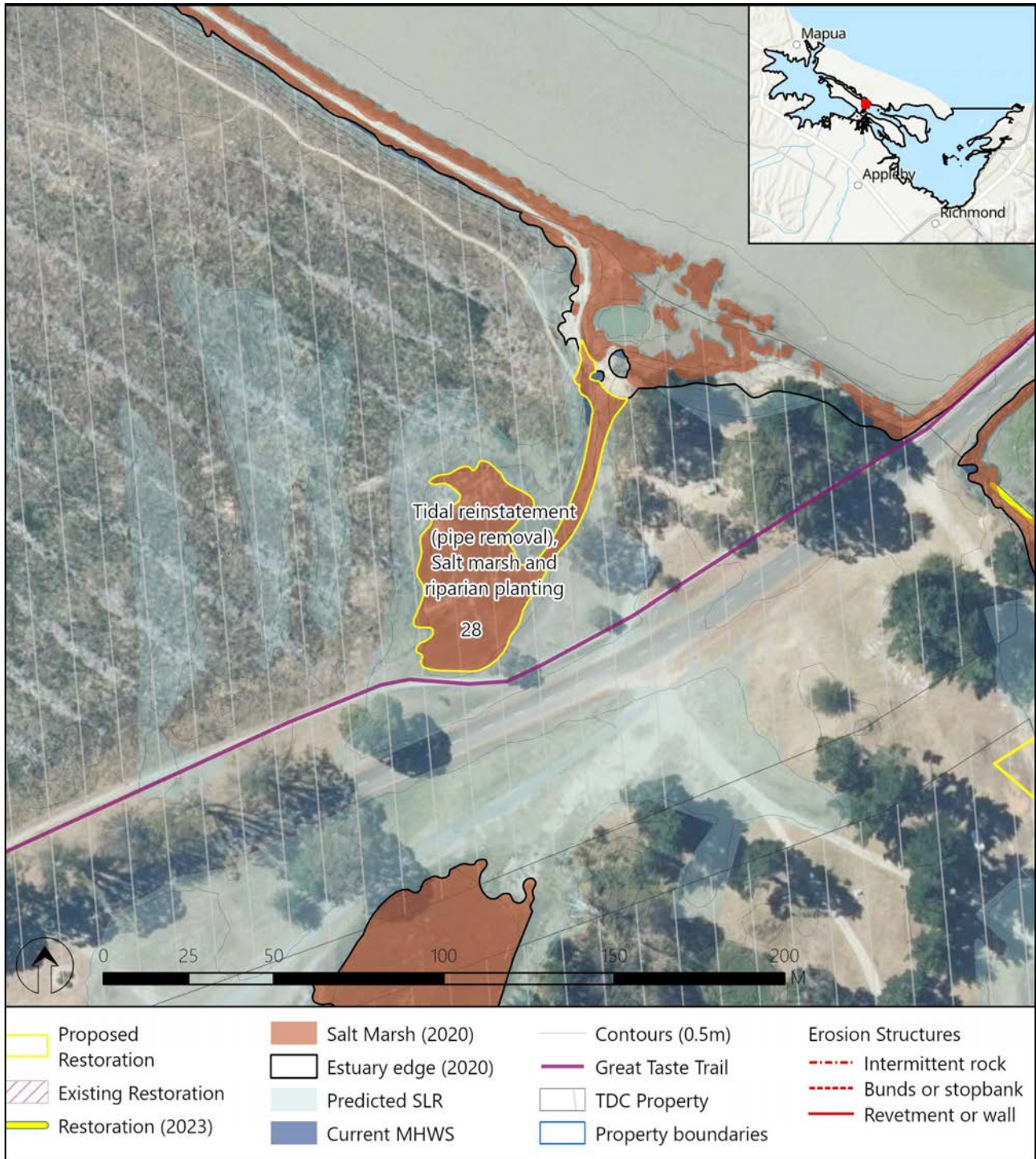


Fig. 19. Site 28. Rough Island bridge – potential restoration footprint.



Small tidal pool and salt marsh at the seaward edge of the site.



Small pipe and causeway restricting tidal access to upstream salt marsh. Footbridge in background.

Table 22. Summary of restoration scoring criteria for Rough Island bridge.

28 Rough Island Bridge				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	1
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	5
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	29
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	48
			<i>Overall Site Score</i>	104



Existing salt marsh and tidal pool at the seaward edge of the site.

Opportunities/Issues

This represents an ideal site for increasing tidal exchange through removal of an undersized pipe and small causeway within an existing restoration area.

The estuarine part of the site is largely intact and requires little in the way of improvement beyond increasing tidal exchange. Surrounding terrestrial areas have already been replanted in natives and are fenced to prevent public access.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Existing usage at the site is limited to a shared cycle and walking path that currently crosses the tidal drainage channel. There are two current accessways, a small bridge and a piped causeway. Although the existing bridge provides an alternative route if the causeway was removed, it is relatively narrow and there is a chance that bikes would bypass it and ride through the salt marsh if it were not fenced. Replacement of the existing bridge with a more bike-friendly one is recommended.

Current ecological values are moderate but can be expected to increase over time, partly as existing restoration plantings establish, and also as a consequence of any additional restoration undertaken.

Low-lying parts of the site retain functional intertidal estuarine habitat and residual populations of most common salt marsh species.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

- Remove the small pipe and causeway to allow regular tidal exchange to the site.
- Exclusion fencing a small area of salt marsh adjacent to the Great Taste Trail is also recommended (see photo below).



Tidally inundated herbfield located between the fenced restoration plantings and the Great Taste Trail. Vehicle, bike and foot traffic impacts are evident.

SITE 29. MOTUROA (SOUTHWEST)

This site is located on the southwest side of Moturoa/Rabbit Island along the edge of the sheltered tidal inlet adjacent to Rough Island (Fig 28). There has been extensive riparian planting along the southwest side of Moturoa either side of the site. The site comprises a 7.3ha area perched high in the tidal elevation. Several elevated ribs are present through the site where pine slash was previously piled (see map below and photos on following pages).

Most of the site is well established in glasswort herbfield with occasional shore tussocks. Rushland is scarce, and weeds (including gorse and broom) and grasses are common at the terrestrial margin and in elevated areas.

The Great Taste Trail follows the edge of the estuary and the terrestrial margin immediately surrounding the site has recently been planted in natives which back onto plantation forestry.

Restoration scoring criteria are presented in Table 33.



Fig. 20. Site 29. Moturoa (Southwest) – potential restoration footprint.



Herbfield (glasswort) perched high in the tidal range next to the Great Taste cycle trail.



Elevated ribs of pine slash with pine tree stumps in herbfield.

Table 23. Summary of restoration scoring criteria for Moturoa (Southwest).

29 Moturoa Southwest				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	1
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	25
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	5
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	31
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	100



Existing salt marsh and cycle trail at the terrestrial edge of the site.

Opportunities/Issues

The site requires relatively little intervention with much of the terrestrial margin recently planted in natives (2022/23), and low-lying parts of the site retaining functional intertidal estuarine habitat with residual populations of most common salt marsh species.

There is some localised pine slash in parts of the upper tidal range that could be relatively easily removed if it begins to degrade salt marsh quality.



The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Current ecological values are moderate but can be expected to increase over time, partly as existing terrestrial restoration plantings establish, and also as a consequence of weed management and any additional salt marsh restoration undertaken.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

- Plant pockets of searush at high densities (10-15 plants/m²) to see if rushland can be established in the upper-intertidal reaches and to provide a local seed source for natural regrowth. Planting in several patches is recommended initially to trial different planting densities and configurations.
- Initiate targeted weed and predator control.
- If TDC require 50m setbacks for forestry pine replanting after harvest, in future consider realigning the Great Taste Trail closer to the terrestrial margin to allow for a wider band of salt marsh to be established.

SITE 30. MOTUROA (BARNICOAT ROAD)

This site is located on the southwest side of Moturoa/Rabbit Island along the edge of the sheltered tidal inlet adjacent to Rough Island (Fig 29). The site comprises a 0.9ha area perched high in the tidal elevation. An old causeway passes through the centre of the site creating a raised sill 30-50cm high which traps water behind it, restricting drainage.

Pine trees growing the southeast of the site (evident in Fig. 16 below) have recently been cleared from the site.

Most of the site is well established in glasswort herbfield with occasional shore tussocks. Weeds, including gorse, broom and grasses are common at the terrestrial margin.

The Great Taste Trail follows the edge of the estuary and the terrestrial margin immediately surrounding the site is in plantation forestry.

Restoration scoring criteria are presented in Table 34.

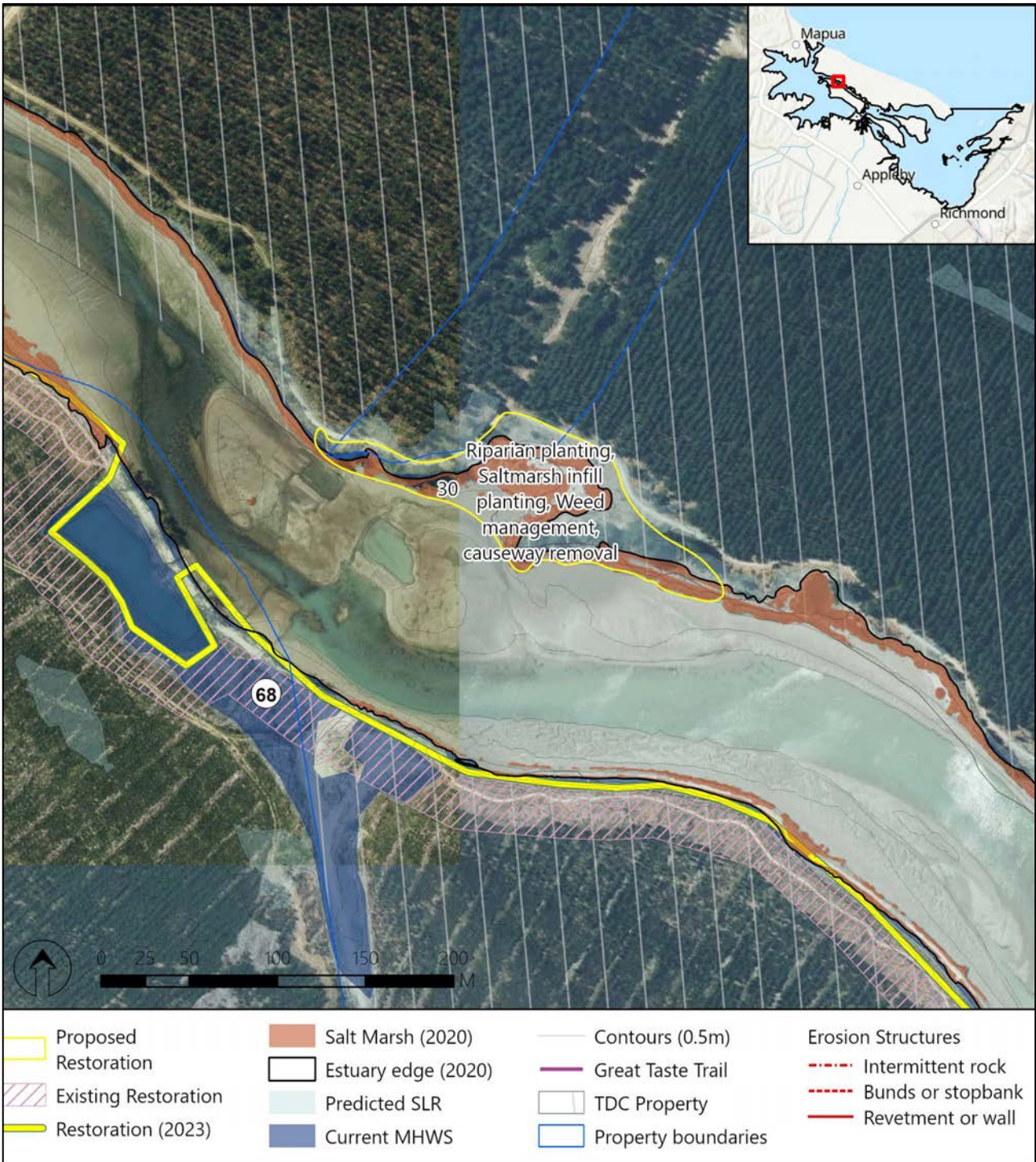


Fig. 21. Site 30. Moturoa (Barnicoat Road) – potential restoration footprint.



Herbfield (glasswort) growing on the elevated causeway passing through the middle of the site.



Gorse and grasses dominate the upper shoreline.

Table 24. Summary of restoration scoring criteria for Moturoa (Barnicoat Road).

30 Moturoa (Barnicoat Road)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	1
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	98



Tidal water and pine slash trapped behind the historical causeway. The grassy area to the left of the picture has recently been cleared of mature pine trees.

Opportunities/Issues

The site is well suited for a continuation of the extensive terrestrial margin planting of natives which has been undertaken nearby.

There is some localised pine slash in parts of the upper tidal range that could be relatively easily removed if it begins to degrade salt marsh quality (see photo above).

The low-lying parts of the site retain functional intertidal estuarine habitat with residual populations of most common salt marsh species.

Some degradation of habitat is evident where water ponds behind the historical causeway. It would be relatively straightforward to widen the drainage channel to improve tidal exchange to this part of the estuary (see photo below).



Ponded tidal water draining through the historic causeway.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Current ecological values are moderate but can be expected to increase over time, partly as existing restoration plantings establish, and also as a consequence of weed management and any additional salt marsh restoration undertaken.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Increase tidal exchange by widening the drainage channel through the historical causeway.
- Extend the footprint of existing salt marsh through targeted planting of intertidal rushland to improve the spatial extent and connectiveness of existing habitat. Planting in several patches is recommended initially to trial different planting densities and configurations.
- Initiate targeted weed and predator control.
- It is expected that the planting of the terrestrial margin in natives will continue in this section of the estuary.
- If TDC require 50m setbacks for forestry pine replanting after harvest, in future consider realigning the Great Taste Trail closer to the terrestrial margin to allow for a wider band of salt marsh to be established.

SITE 31. MOTUROA (BULLIVENT)

This site is located on the west side of Moturoa/ Rabbit Island along the edge of the Mapua Channel entrance to Waimea Inlet. It is located behind Bullivent Island which offers a high degree of protection. The site comprises a ~2.8ha (450m long x 60m wide) intertidal arm historically reclaimed from the estuary (Fig 30). The embayment is within the current MHWS elevation but receives no obvious tidal flow as it is blocked by a

causeway (earth bund) across the entrance, which the Great Taste Trail follows.

Near the coastal margin there are residual patches of rushland, but most of the site is in tall fescue, sedges and broom. Exotic shrubs have recently been cleared from parts of the terrestrial margin.

The site is contained on all sides by roads and the terrestrial margin immediately surrounding the site is in plantation forestry.

Restoration scoring criteria are presented in Table 35.



Fig. 22. Site 31. Moturoa (Bullivent) – potential restoration footprint.



Elevated causeway blocking the site from tidal exchange.



Residual rushland in foreground, although sedges and grasses dominate the site.

Table 25. Summary of restoration scoring criteria for Moturoa (Bullivent).

31 Moturoa (Bullivent)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	5
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	1
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	1
8 Likely benefit to birds compared to current state	Small	Moderate	Large	5
9 Likely benefit to fish compared to current state	Small	Moderate	Large	3
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	3
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			<i>Overall Site Score</i>	98



The site offers large potential for re-establishment of salt marsh habitat.

Opportunities/Issues

This represents an ideal site for removal of the causeway and tidal reinstatement. Most of the site is within the current tidal range, and surrounding land is within the SLR inundation zone expected in the next 50–60 years.

Current ecological values are relatively low but can be expected to increase quickly over time, partly as a consequence of natural weed management through saltwater inundation, and as a consequence of restoration planting.

Removal of the entrance causeway would require either a re-routing of the Great Taste cycle trail to the inland side of the site (existing roads are in place to facilitate this), or bridging or culverting the entrance.

The site is also well suited for a continuation of the extensive terrestrial margin planting with natives that has already been undertaken nearby along the Great Taste cycle trail.

There is sewerage infrastructure on the true left (south side) of the site which may influence decisions on tidal reinstatement.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Remove the causeway/berm to allow unrestricted tidal exchange to the site.
- Extend the footprint of existing salt marsh through targeted planting of intertidal rushland to improve the spatial extent and connectiveness of existing habitat.
- Spray weeds and tall fescue grassland along the terrestrial margins of the salt marsh.
- Plant salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees along the terrestrial margin.
- Maintain low-lying land (e.g., avoid infilling by hardfill dumping) to maximise future restoration opportunities.
- Initiate targeted weed and predator control.
- If TDC require 50m setbacks for forestry pine replanting after harvest, in future consider realigning the Great Taste Trail closer to the terrestrial margin to allow for a wider band of salt marsh to be established.

SITE 32. MOTUROA (SOUTHEAST)

This site is located on the southeast side of Moturoa/Rabbit Island north of Bell Island (Fig 31). The site comprises a small (0.2ha) area of searush perched high in the tidal elevation and partially cut off from the estuary by a forestry access road.

The site includes most of the commonly found salt marsh species, but tall fescue has begun to establish throughout the rushland due to a restriction of tidal flow with the site only partially inundated on spring tides.

Pine trees are growing on three sides of the site (evident in Fig. 18 below).

The terrestrial margin on the adjacent coastline has been recently planted in natives.

Restoration scoring criteria are presented in Table 36.

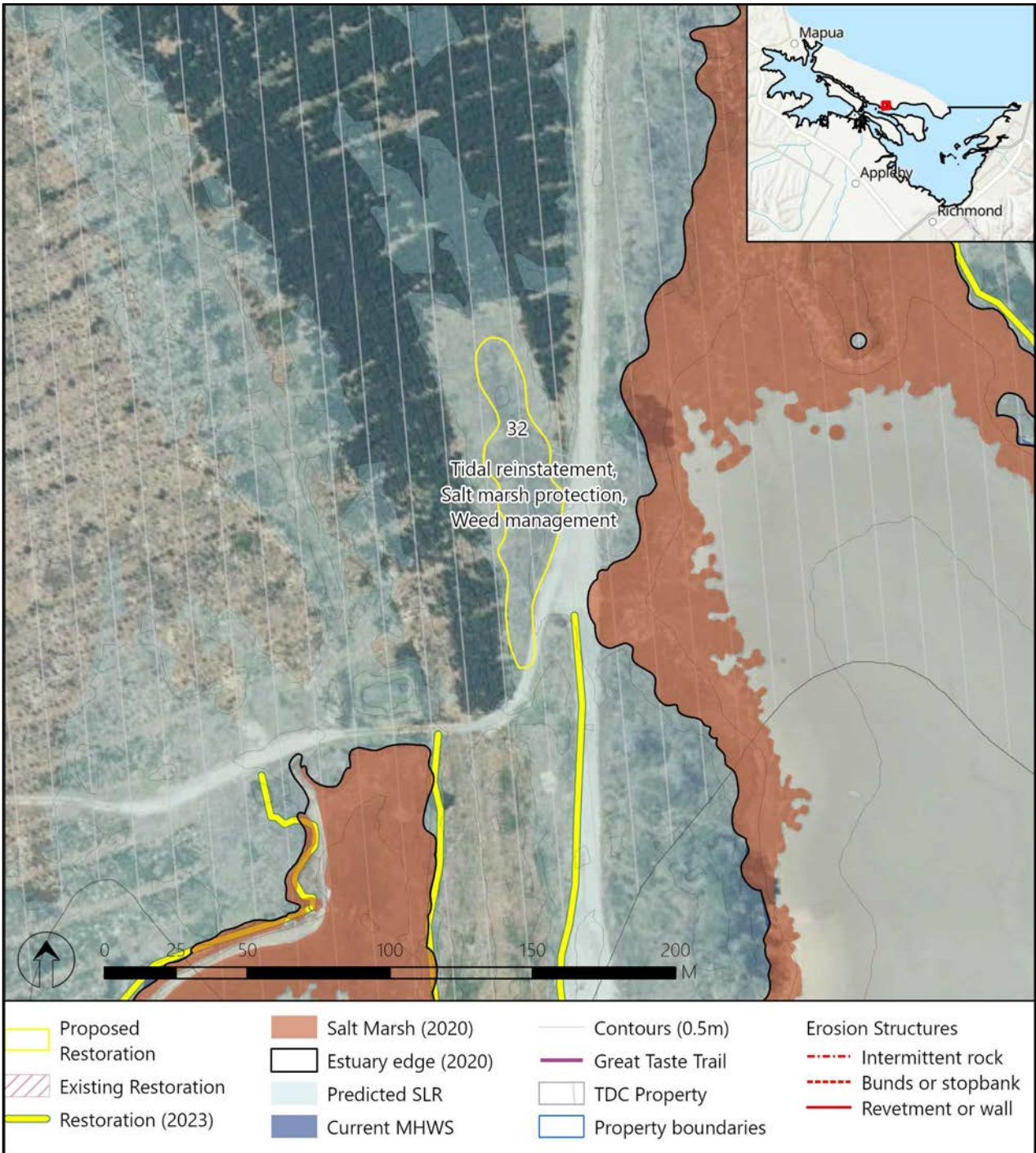


Fig. 23. Site 32. Moturoa (Southeast) – potential restoration footprint.



Dense rushland surrounded by pine forest. Note tall fescue establishing within the salt marsh.



Roadway blocking site from regular tidal inundation. Note fresh deposits of sand from spring tide inundation.

Table 26. Summary of restoration scoring criteria for Moturoa (Southeast).

32 Moturoa Southeast				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	1
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	3
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			Overall Site Score	98



Rushland and recent restoration plantings adjacent to the proposed site.

Opportunities/Issues

This site is best suited for a relatively minor shift in management of seawater flows to improve natural functioning of the existing salt marsh and to limit the expansion of terrestrial weeds and grasses within the through saltwater inundation.

The low-lying parts of the site retain functional intertidal estuarine habitat with residual populations of most common salt marsh species.

There is good connectivity to adjoining saltmarsh and limited public access to this area makes it a potentially important site for birds.

Should terrestrial grasses become dominant, the area could potentially be viewed as a terrestrial habitat and the opportunity to retain this high value habitat may be lost.

The site is well suited for a continuation of the extensive terrestrial margin planting with natives that has already be undertaken nearby.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

Current ecological values are moderate but can be expected to increase over time, partly as restoration plantings establish, and also as a consequence of weed management and any additional salt marsh restoration undertaken.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	
New salt marsh planting	
Infill salt marsh planting	
Riparian planting	✓
Wetland planting	

Recommended Actions

- Create an open drainage channel through the access road to allow unrestricted tidal exchange to the site.
- Plant the landward edge of the terrestrial margin plant with salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees.
- Increase the width of the riparian margin following pine harvesting.
- Highlight the presence and importance of the rushland habitat to ensure its protection from reclamation.
- If TDC require 50m setbacks for forestry pine replanting after harvest, in future consider realigning the roading further inland to allow for a wider band of salt marsh to be established.

SITE 33. MAPUA EMBAYMENT

This site is located on the northern side of the causeway to the Mapua leisure park (Fig 32). Three culverts connect the embayment to the main part of the estuary, although two of these have flap-gates and, consequently, tidal exchange is restricted with the upper part of the site more strongly freshwater influenced than it would be in a natural state.

Nuisance macroalgae appear to be a common feature within the embayment.

The 5.1ha site includes most of the commonly found salt marsh species, with limited need for salt marsh restoration within the embayment.

Terrestrial restoration initiatives have recently commenced along the west and north sides of the site.

Earth bunds are present on the north and east terrestrial margins, and pampas grass is relatively common.

Restoration scoring criteria are presented in Table 37.



Fig. 24. Site 33. Mapua Embayment – potential restoration footprint.



Herbfield and rushland salt marsh within the embayment. Nuisance algal mats in the foreground.



Flapgates on causeway culverts restrict tidal exchange to the embayment (note 2 of 3 flap gates are closed in photo).

Table 27. Summary of restoration scoring criteria for Mapua Embayment.

33 Mapua Embayment				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	1
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	5
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	3
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	48
			<i>Overall Site Score</i>	102



Terrestrial restoration plantings adjacent to rushland near a small stream input.

Opportunities/Issues

This represents an ideal site for improving natural tidal flows. Most of the site is within the current tidal range, and surrounding land is within the SLR inundation zone expected in the next 50-60 years.

The available area is relatively extensive, has functional intertidal estuarine habitat, and retains residual populations of most common salt marsh rushland, herbfield and estuarine shrub species.

Because tidal flows have been significantly modified by the causeway and flap-gates, freshwater and terrestrial species have expanded into parts of the salt marsh. Earth bunds have also been constructed in the past to limit tidal inundation.

The residual salt marsh is expected to flourish if tidal exchange is increased, primarily due to the natural suppression of terrestrial weeds by seawater inundation. There is also capacity for salt marsh to migrate inland in response to SLR.

The site is very sheltered from the main body of the estuary so erosion is expected to be negligible.

There is good connectivity to adjoining terrestrial restorations and limited public access to the salt marsh area makes it a potentially important site for birds.

Current ecological values are relatively high and can be expected to increase over time.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	✓
Dike or berm removal	✓
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	
New salt marsh planting	
Infill salt marsh planting	
Riparian planting	✓
Wetland planting	

Recommended Actions

- Manage the culvert flap-gates to allow regular tidal exchange to the site (e.g., only close when high rainfall is expected). When practicable, lower culvert height and increase culvert size and number to maximise tidal flows.
- Consider removing or modifying the earth bunds to facilitate better tidal exchange to the north and east of the site.
- Continue ongoing riparian planting with salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees and targeted weed and predator control.

SITE 34. GROSSI POINT (WEST)

This site is on the southern shoreline of the former Fruitgrowers Chemical Company (FCC) site to the west of Grossi Point (Fig 33). Historically part of the estuary, the area was reclaimed from the estuary for use as an industrial landfill.

Following the FCC site closure, the site underwent extensive rehabilitation with affected terrestrial areas now capped and maintained in grassland cover. It is

assumed that terrestrial plantings are restricted to maintain the integrity of the site capping.

The proposed restoration site is seaward of these areas and comprises ~0.3ha of salt marsh adjacent to a narrow band of terrestrial flax restoration plantings (see photos on following page).

Rushland is relatively extensive in the narrow stream channel (see Fig 20 below), and riparian plantings are well established to the west.

Restoration scoring criteria are presented in Table 38.

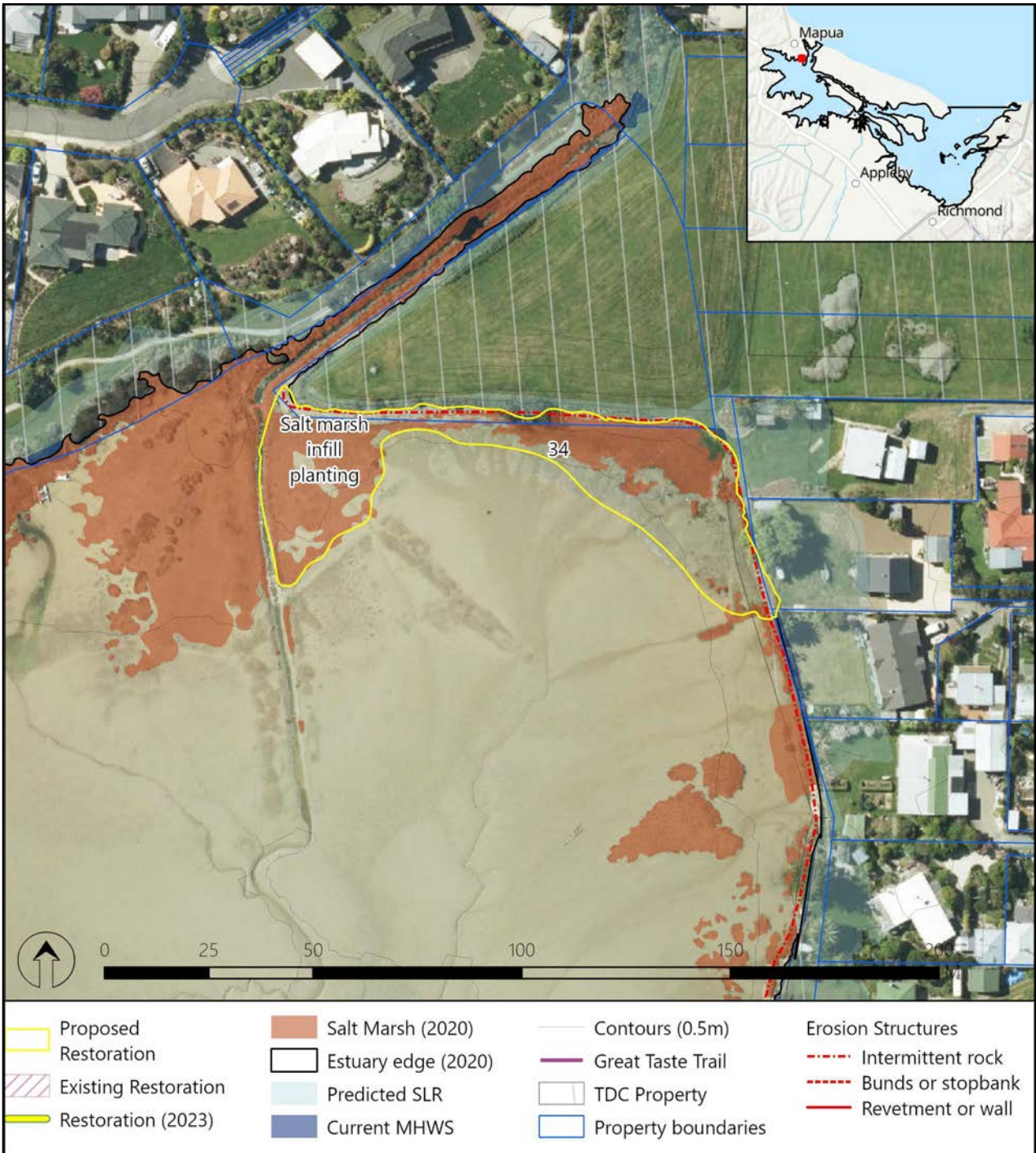


Fig. 25. Site 34. Grossi Point (West) – potential restoration footprint.



Narrow band of flax planted along the terrestrial margin.



Scattered rushland among herbfield.

Table 28. Summary of restoration scoring criteria for Grossi Point (West).

34 Grossi Point (West)				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	3
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	25
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	3
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	3
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	21
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	48
			<i>Overall Site Score</i>	94



Narrow cobble shore next to herbfield and occasional rush.

Opportunities/Issues

The site retains functional intertidal estuarine habitat with residual populations of common salt marsh rushland and herbfield species.

Infill planting of rushland is recommended along the upper shore to facilitate increased natural erosion protection of the shoreline, and to reinstate historically reclaimed rushland habitat to increase biodiversity and ecological value.

The site would also benefit from terrestrial margin planting with natives, although there may be constraints on what is possible due to the past land use at the site.

Current ecological values are moderate but can be expected to increase over time, partly as restoration plantings establish, and also as a consequence of weed management and any additional salt marsh restoration undertaken.



Rushland is relatively extensive in the narrow stream channel along the northwest of the site.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Infill plant within intertidal rushland to increase cover.
- Plant pockets of searush at high densities (10-15 plants/m²) on the gravel delta to see if rushland can be established in the upper-intertidal reaches. Planting in several patches is recommended initially to trial different planting densities and configurations.
- Investigate the potential for extending terrestrial margin planting with salt tolerant coastal species e.g., salt marsh ribbonwood, cabbage trees.

SITE 35. BRONTE (NORTHWEST)

This site is located on the northern side of Bronte Peninsula in the western part of Waimea Inlet (Fig 34). This site is located on the western end of the peninsula between two existing terrestrial restoration initiatives and comprises a narrow strip of salt marsh (~0.3ha) adjacent to a roadway providing access to several houses. A small stream input to the east of the site supports a wider bed of salt marsh.

The site includes most of the commonly found salt marsh species, with tall fescue dominant along the terrestrial margin. There is limited scope for salt marsh restoration within the estuary itself other than near the stream input, although planting of the margin in coastal species would significantly enhance the current ecological value.

The terrestrial margin either side of this site has been recently planted in natives.

Restoration scoring criteria are presented in Table 39.

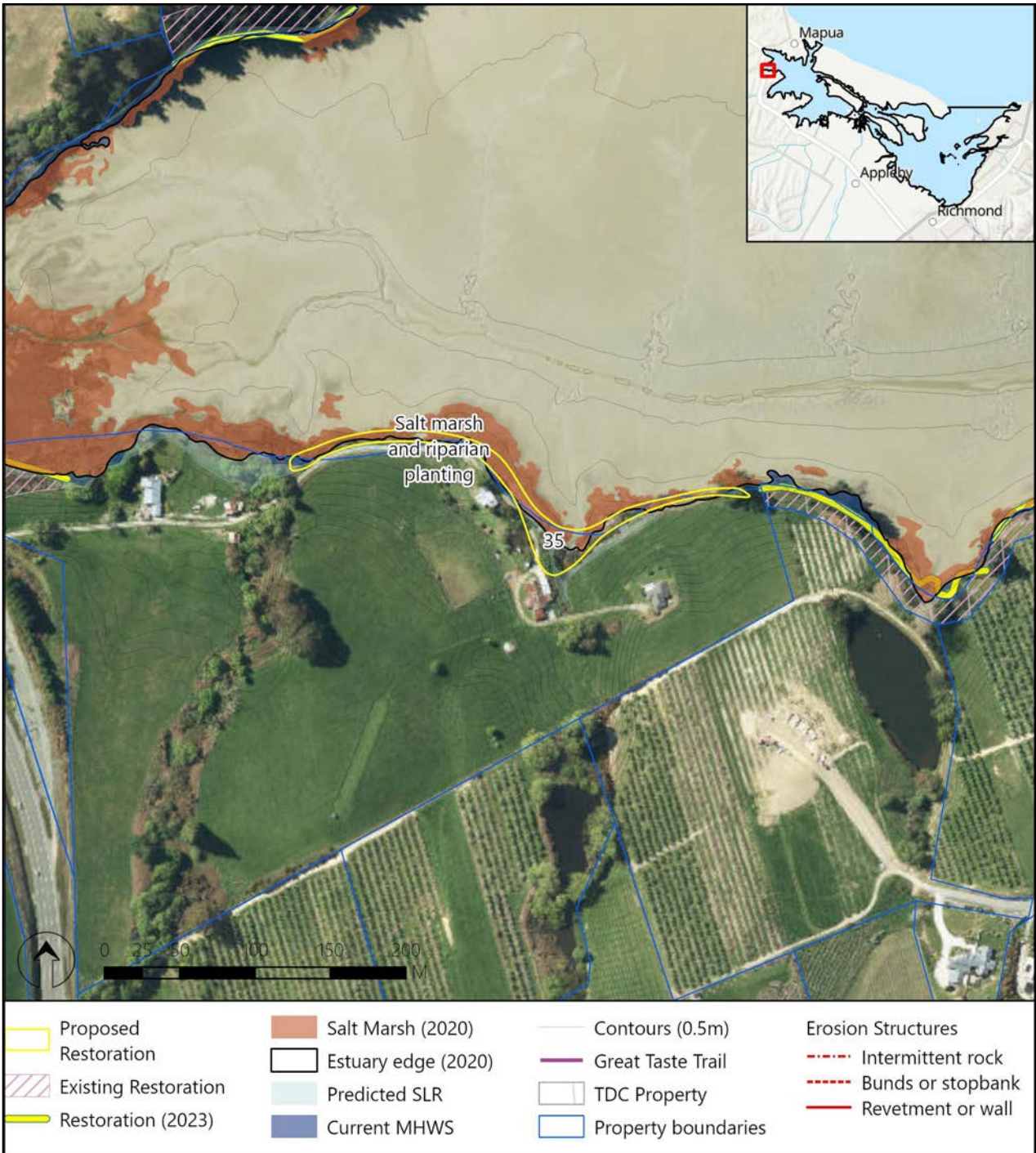


Fig. 26. Site 35. Bronte (Northwest) – potential restoration footprint.



Tall fescue adjacent to a narrow strip of salt marsh.



More extensive salt marsh near a small stream input.

Table 29. Summary of restoration scoring criteria for Bronte (Northwest).

35 Bronte northwest				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	1
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	25
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	1
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	17
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	46
			<i>Overall Site Score</i>	88



Rushland adjacent to the small stream input.

Opportunities/Issues

This site is best suited for riparian planting of salt marsh shrubs along the narrow terrestrial margin and management of weeds.

There is limited capacity for the site to naturally respond to SLR therefore any planting should focus on salt-tolerant species.

The low-lying parts of the site retain functional intertidal estuarine habitat with residual populations of most common salt marsh species.

There is good connectivity to adjoining saltmarsh and limited public access to this area makes it a potentially important site for birds.

The site is well suited for a continuation of the extensive terrestrial margin planting with natives that has already be undertaken nearby.

The site has partial exposure to wave fetch from the northeast and some shoreline erosion is evident. Infill planting of rushland may assist in nature-based mitigation of erosion.

Current ecological values are moderate but can be expected to increase over time, partly as restoration plantings establish, and also as a consequence of weed management and any additional salt marsh restoration undertaken.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Spray weeds and tall fescue grassland along the terrestrial margins of the salt marsh and plant with salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees.
- Infill plant within intertidal rushland to increase shoot densities and cover at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward.
- Consider shoreline recontouring along the road edge to soften parts of the margin previously reinforced with hardfill and to protect and provide additional habitat for salt marsh to grow.

SITE 36. BRONTE (NORTHEAST)

This site is on the north-eastern point of Bronte Peninsula in the western part of Waimea Inlet (Fig 35). It comprises ~1.2ha of salt marsh adjacent to existing terrestrial restorations. Infill planting of searush has also been undertaken as a small-scale trial (~100 plants) and appears to be successful.

The shoreline and salt marsh are eroding in many places, with wave fetch impacts appearing to be

relatively pronounced on the point, and exacerbated by a near vertical 0.5-1m edge to the upper estuary shore.

Shading from large pine trees has previously inhibited salt marsh growth in localised areas, although many of these trees have been recently removed.

The site includes most of the commonly found salt marsh species, with rushland and herbfield evenly represented.

Restoration scoring criteria are presented in Table 40.

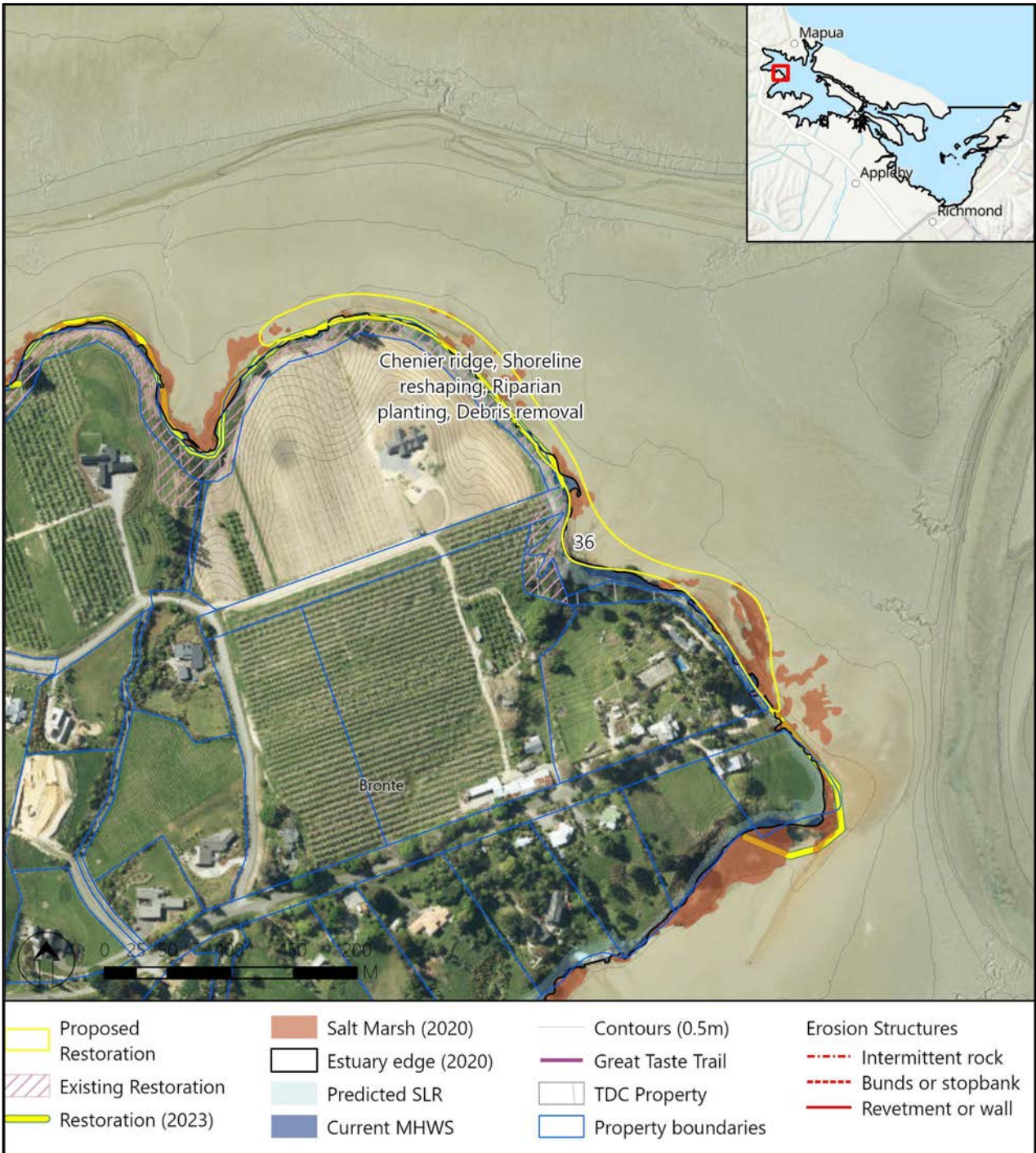


Fig. 27. Site 36. Bronte (Northeast) – potential restoration footprint.



Mixed salt marsh adjacent to a clay terrestrial margin.



Eroding clay margin with debris from recent pine felling.

Table 30. Summary of restoration scoring criteria for Bronte (Northeast).

36 Bronte northeast				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	3
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	1
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	27
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	3
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	3
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	38
			<i>Overall Site Score</i>	92



Residual rushland adjacent to shoreline where large pine trees have been recently removed.

Opportunities/Issues

This location represents a good site for the establishment of a small rock chenier to mitigate against erosion of salt marsh from wave fetch, with re-shaping of the upper shoreline to reduce help dampen wave impact and scouring.

The low-lying parts of the site retain functional intertidal estuarine habitat with residual populations of most common salt marsh species. and infill planting of salt marsh, particularly in areas previously shaded by large pine trees (see photo above), would help create a wide swath of rushland along the upper shore. Higher density plantings than those currently trialled (see photo below) are recommended to take advantage of increased erosion protection and reduced desiccation due to the presence of adjacent plants.



Widely spaced infill planting of rushland currently being trialled at the site.

The site is well suited for a continuation of the extensive terrestrial margin planting with natives that has already be undertaken, and limited public access to this area makes it a potentially important site for birds.

Current ecological values are moderate but can be expected to increase over time, partly as restoration plantings establish, and also as a consequence of weed management and any additional salt marsh restoration undertaken.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	✓
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

- Construct a chenier ridge at the seaward edge of salt marsh to reduce wave energy and create a sill to trap fine sediment, facilitating natural reshaping of the upper shore to be more gradually sloping. The chenier would ideally comprise several small low ridges (10-20cm high) situated 50-80m from the shoreline.
- Infill plant within intertidal rushland to increase shoot densities and cover at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward.
- Consider shoreline recontouring and nourishment (add mixed sand and gravel sediment) to soften parts of the margin previously reinforced with hardfill and to protect and provide additional habitat for salt marsh to grow.
- Remove woody debris from within salt marsh habitat (primarily material associated with recent tree felling where salt marsh is being smothered).

SITE 39. HODDY NORTH/ TE MARA

This site is on the north-facing side of Hoddy Peninsula near Te Mara Way in the western part of Waimea Inlet (Fig 38). It comprises ~1.1ha of raised gravel bed with very occasional patches of salt marsh adjacent to existing terrestrial restorations. It is likely that this area was previously covered in salt marsh that has been eroded.

The upper shoreline is also eroding in many places, with wave fetch impacts appearing to be relatively

pronounced, and exacerbated by a steep edge to the upper estuary shore (see photos on following page).

The wider area supports most of the commonly found salt marsh species and indicates physical erosion is the primary reason for the absence of extensive vegetation.

Restoration scoring criteria are presented in Table 43.

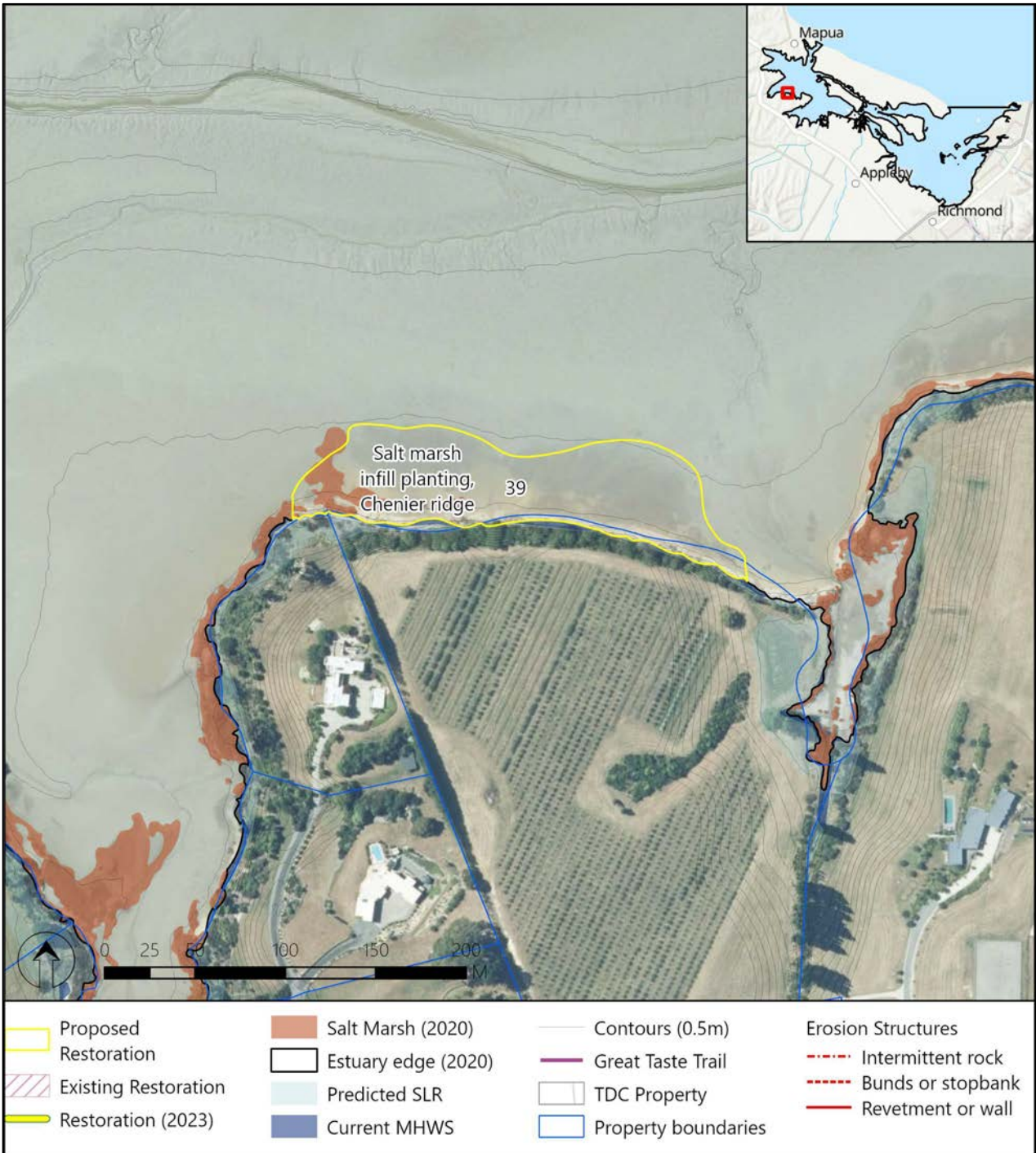


Fig. 28. Site 39. Hoddy north/ Te Mara – potential restoration footprint.



Raised gravel bed in front of eroding terrestrial margin.



Eroding terrestrial edge of the site.

Table 31. Summary of restoration scoring criteria for Hoddy north/ Te Mara.

39 Hoddy north/Te Mara				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	3
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	> \$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	33
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	3
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	34
			Overall Site Score	94



Raised gravel bed which likely supported rushland. There is potential to re-establish rushland at this site behind a rock chenier located at the seaward edge of the gravel bed.

Opportunities/Issues

Because of the naturally elevated gravel bed, this location represents a good site for the establishment of a small rock chenier to reduce wave fetch and allow salt marsh to be replanted, with potential re-shaping of the upper shoreline to help dampen wave impact and scouring.

Residual salt marsh species are present along the upper shore, and in adjacent areas, and most parts of the site retain functional intertidal estuarine habitat.

There is good connectivity to adjoining salt marsh and limited public access to this area makes it a potentially important site for birds.

Current ecological values are low but can be expected to increase over time as restoration plantings establish.

Access through private land would likely be needed to undertake work at this site.

Although more vulnerable to SLR than sites at a higher elevation, there is the potential for this to be mitigated by sediment trapping within salt marsh elevating the shore profile and reducing shoreline erosion.



Example of salt marsh growing adjacent to the site.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	✓
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	✓
Infill salt marsh planting	
Riparian planting	
Wetland planting	

Recommended Actions

Construct a chenier ridge at the seaward edge of predicted salt marsh growth to reduce wave energy and create a sill to trap fine sediment. The chenier would ideally comprise several small low ridges (10-20cm high) situated 50-80m from the shoreline.

Plant pockets of searush at high densities (10-15 plants/m²) on the gravel delta to see if rushland can be established in the upper-intertidal reaches. Planting in several patches is recommended initially to trial different planting densities and configurations.

Consider shoreline recontouring and nourishment (add mixed sand and gravel sediment) to soften parts of the margin previously reinforced with hardfill and to protect and provide additional habitat for salt marsh to grow.

SITE 40. HODDY/ WESTDALE

This site is in the eastern-most inlet on the north-facing side of Hoddy Peninsula in the western part of Waimea Inlet (Fig 39).

It comprises ~0.5ha of unvegetated patches within existing salt marsh adjacent to existing terrestrial restorations. It is likely that these areas were previously salt marsh beds that have been eroded or, in localised areas to the west, compromised by the presence of large recently removed overhanging trees, many of

which remain in the estuary (see photos on following page).

The upper shoreline is also eroding in places, with wave fetch impacts appearing to be relatively pronounced in the southwest, and exacerbated by a steep edge to the upper shore.

The wider area supports most of the commonly found salt marsh species and indicates physical erosion is the primary reason for the absence of extensive vegetation.

Restoration scoring criteria are presented in Table 44.

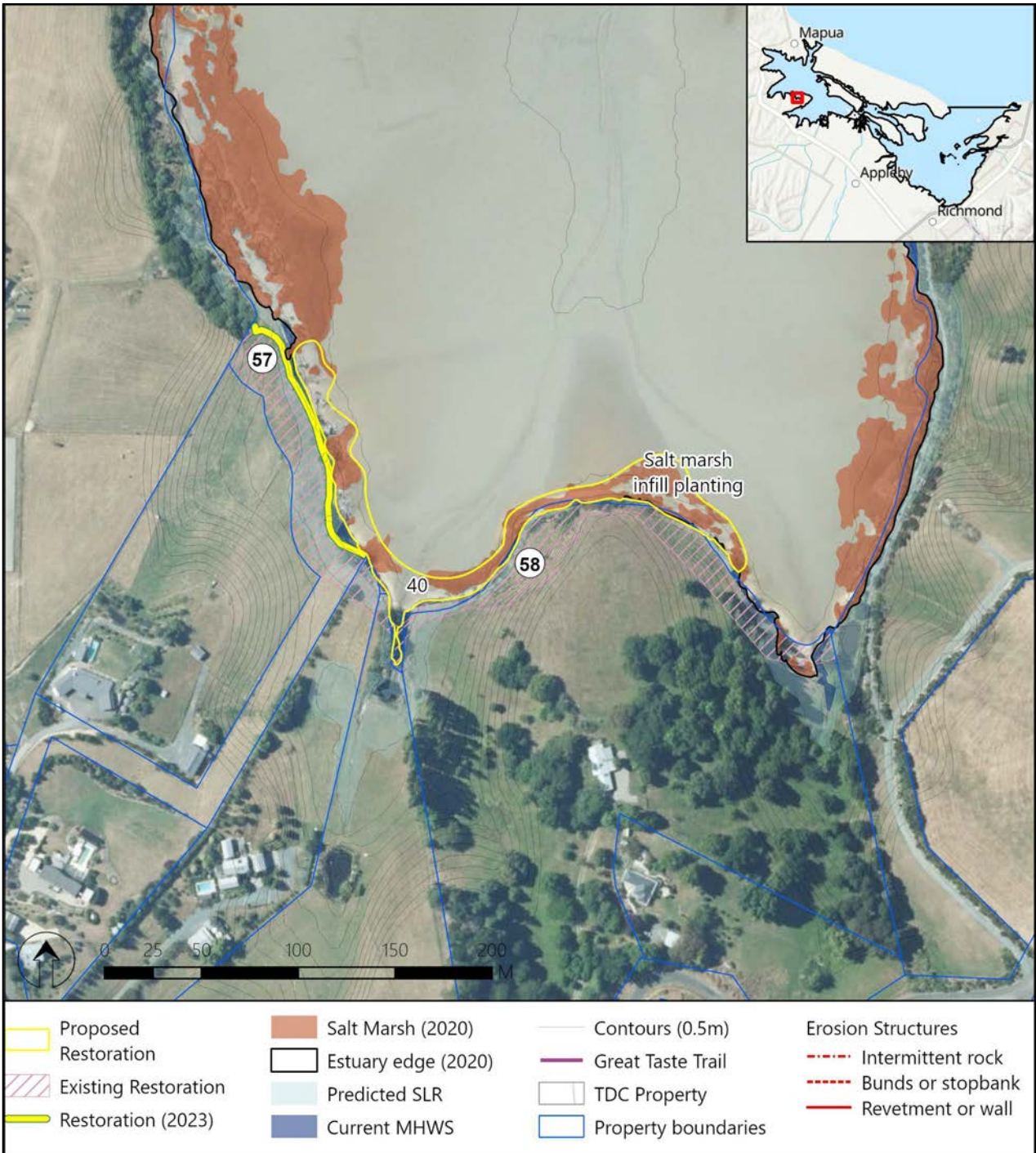


Fig. 29. Site 40. Hoddy/ Westdale – potential restoration footprint.



Remnant salt marsh with eroded beds evident in foreground.



Large trees have been felled along the estuary edge with many left in the intertidal zone.

Table 32. Summary of restoration scoring criteria for Hoddy/ Westdale.

40 Hoddy/Westdale				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	3
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	29
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	3
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	3
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	36
			<i>Overall Site Score</i>	92



Eroding shoreline where rushland is no longer growing.

Opportunities/Issues

The site retains functional intertidal estuarine habitat with residual populations of common salt marsh rushland and herbfield species. Much of the terrestrial margin has been recently planted in natives.

There is good connectivity to adjoining salt marsh and limited public access to this area makes it a potentially important site for birds.

Infill planting of rushland is recommended along the upper shore to facilitate increased natural erosion protection of the shoreline, and to reinstate eroded rushland to increase biodiversity and ecological value.

Current ecological values are moderate but can be expected to increase over time, partly as terrestrial restoration plantings establish, and also as a consequence of salt marsh infill planting.

If erosion continues, consideration could also be given to adding small rock cheniers in locations where erosion is most evident to protect plantings until they become established. Re-shaping of the upper shoreline could also be considered to help dampen wave impact.



Salt marsh adjacent to the steep upper shore margin.

Recommended Restoration Options

Shoreline recontouring	✓
Beach nourishment	
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

Infill plant within intertidal rushland to increase shoot densities and cover at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward.

If erosion continues, investigate the potential need for a small rock chenier at the seaward edge of the existing gravel bed to provide protection from wave fetch, and the need to reshape and add sediment to the upper shore to create a more gently sloping profile to dissipate wave run-up.

SITE 41. RESEARCH ORCHARD ROAD

This site is near the end of Research Orchard Road in the western part of Waimea Inlet (Fig 40). It comprises ~0.2ha of unvegetated patches within existing salt marsh adjacent to extensive existing terrestrial restorations. It is likely that these areas were previously salt marsh beds that have been eroded or potentially smothered by woody debris washing into the upper salt marsh margins (see photo on following page).

The wider area supports most of the commonly found salt marsh species and indicates physical erosion is the primary reason for the absence of extensive vegetation.

Infill trials of rushland restoration have been successful at this site (see photo on following page).

Restoration scoring criteria are presented in Table 45.

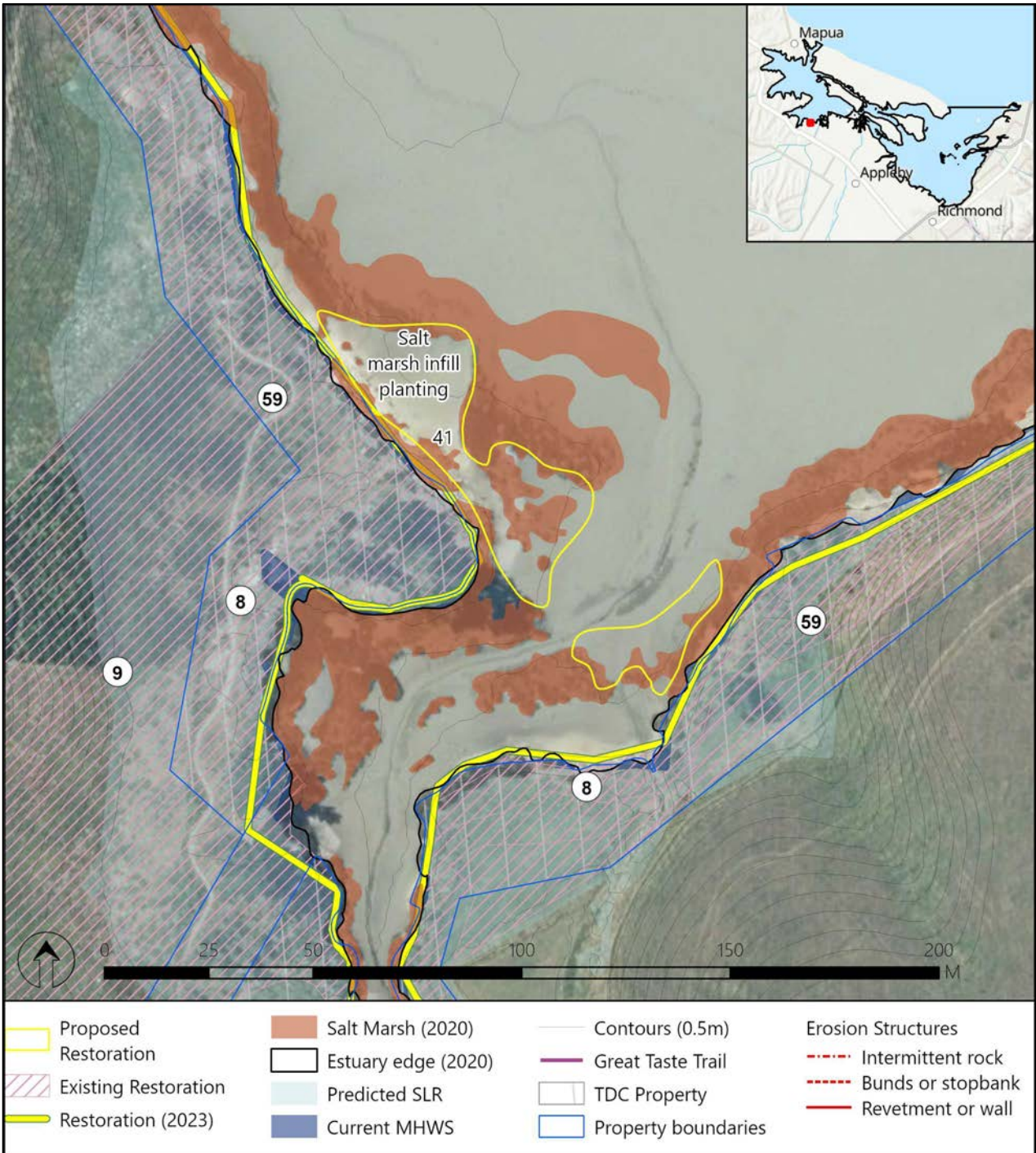


Fig. 30. Site 41. Research Orchard Road – potential restoration footprint.



Infill planting of rushland – note large woody debris near upper shoreline in background.



Large bare area within rushland which was likely previously vegetated.

Table 33. Summary of restoration scoring criteria for Research Orchard Road.

41 Research Orchard Road				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	3
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	3
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	27
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	3
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	5
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	5
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	33
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	5
5 Site accessibility	Difficult	Moderate	Easy	3
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	42
			<i>Overall Site Score</i>	102



Extensive terrestrial revegetation behind trial infill planting of rushland.

Opportunities/Issues

The site retains functional intertidal estuarine habitat with residual populations of common salt marsh rushland and herbfield species. Much of the terrestrial margin has been recently planted in natives.

There is good connectivity to adjoining salt marsh and limited public access to this area makes it a potentially important site for birds.

Ongoing infill planting of rushland is recommended along the upper shore to facilitate increased natural erosion protection of the shoreline, and to reinstate eroded rushland to increase biodiversity and ecological value.

Current ecological values are moderate but can be expected to increase over time, partly as terrestrial restoration plantings establish, and also as a consequence of salt marsh infill planting.



Salt marsh immediately downstream of the site.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	✓
Reinstatement of tidal flows	
Armour removal	
Flap-gate removal	
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	
Pest control	
New salt marsh planting	
Infill salt marsh planting	✓
Riparian planting	
Wetland planting	

Recommended Actions

Infill plant within intertidal rushland to increase shoot densities and cover at high densities (10-15 plants/m²) on the seaward edge, and at moderate densities (5-10 plants/m²) further landward.

If erosion continues, investigate the potential need for a small rock chenier at the seaward edge of the existing gravel bed to provide protection from wave fetch, and the need to reshape and add sediment to the upper shore to create a more gently sloping profile to dissipate wave run-up.

SITE 46. BELL ISLAND

The Bell Island site is the largest of those assessed (~16.6ha) and comprises a relatively narrow strip around the margins of the island (Fig 45). Much of the inland is utilised for sewage treatment with pine forestry and grazing also present.

Restoration planting and pest control commenced in 2011 on the spit in the northwest (only partially shown on Fig. 32). The north and east margins of the island are characterised by the presence of extensive terrestrial

grasses and weeds with exotic ice plant widespread. Salt marsh comprises predominantly herbfield (glasswort) and shore tussocks (see photos on following page). The southern side of the island supports a more varied mix of salt marsh, as well as remnant coastal manuka forest. In several low-lying areas, tidal inlets have established providing high value habitat (including some new areas to the north recently). A significant bird nesting and feeding area is present to the east of the island. Archaeological sites are widespread on the island.

Restoration scoring criteria are presented in Table 50.

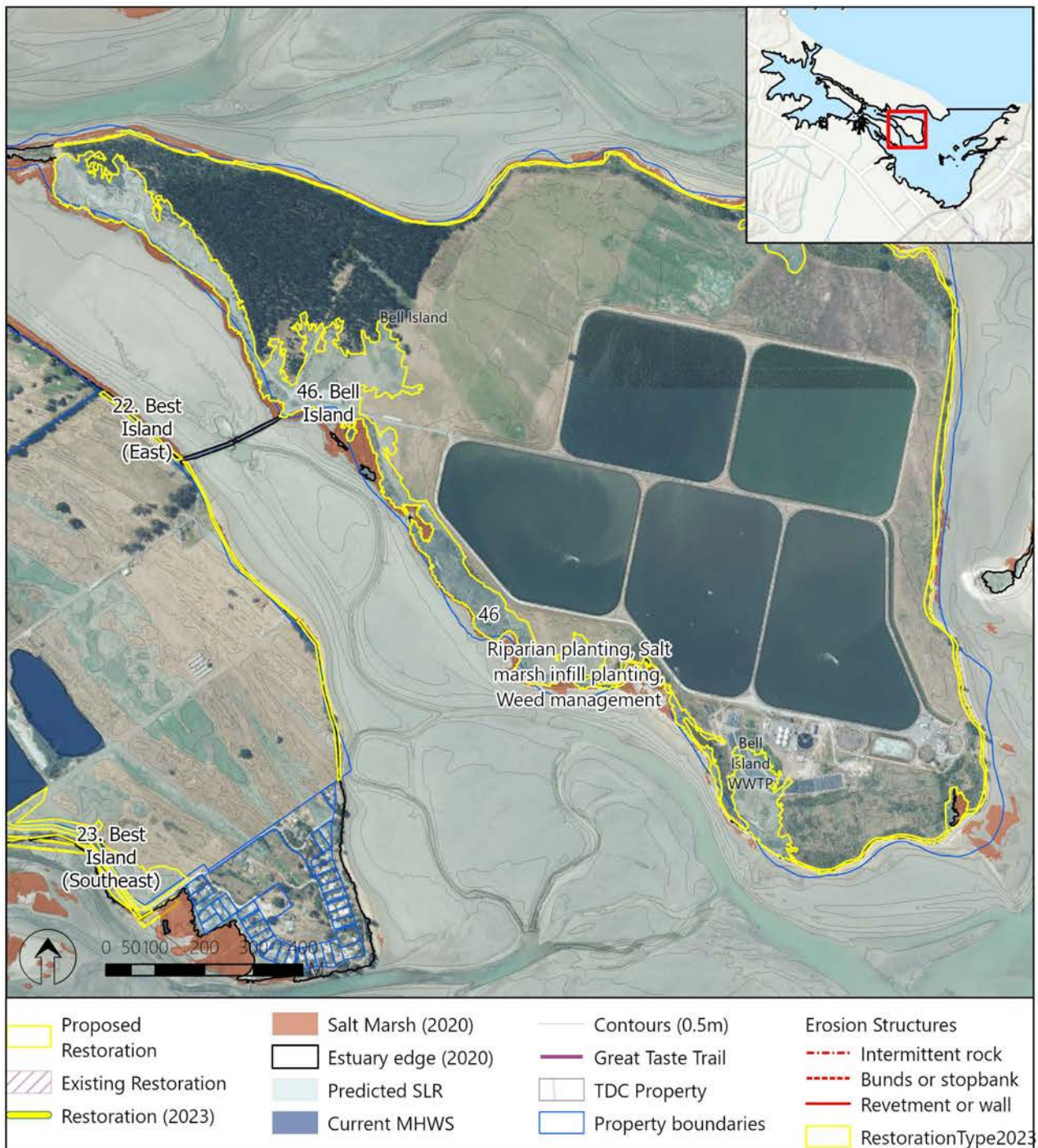


Fig. 31. Site 46. Bell Island – potential restoration footprint.



Herbfield and shore tussocks adjacent to pine forest and a weed-dominated margin on the north side of the island.



Exotic ice plant and other terrestrial weeds and grasses dominate the northern and eastern estuary margin.

Table 34. Summary of restoration scoring criteria for Bell Island.

46 Bell Island				
Salt marsh restoration prioritisation criteria (+score)	Low (1)	Moderate (3)	High (5)	Score
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Crown	Council	5
2 Tidal inundation	Terrestrial	Within current MHWS	Inundated by 2085	5
3 Extent of historic degradation	Largely intact	Modified	Heavily degraded	3
4 Biodiversity benefit	No sig. change	Some benefits	Large improvements	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining	5
7 Value of infrastructure within restoration	>\$100k	\$10-\$100k	<\$10k	5
			<i>Screening Score</i>	33
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	>5ha	5
2 Mean width of intertidal area	0-50m	50-500m	>500m	5
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	<25%	5
5 Width of riparian buffer	Absent	0-10m	>10m	3
6 Adjacent land for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact	3
8 Likely benefit to birds compared to current state	Small	Moderate	Large	3
9 Likely benefit to fish compared to current state	Small	Moderate	Large	1
			<i>Habitat Score</i>	35
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	Well established	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low	5
3 Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<10k/ha)	5
4 Likely cost of ongoing site maintenance	High (>\$10k pa)	Moderate (\$5-10k pa)	Low (<\$5k pa)	3
5 Site accessibility	Difficult	Moderate	Easy	5
6 Extent of physical site preparation required	High	Moderate	Low	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted	5
8 Potential adverse impact from restoration works	Significant	Moderate	Slight	5
9 Likely human amenity value	Low	Moderate	High	1
10 Time frame for establishing desired changes	Slow	Moderate	Fast	5
			<i>Implementation Score</i>	44
			Overall Site Score	112



A relatively localised patch of rushland is present on the eastern end of the island.



A new tidal inlet developing on the northeastern estuary margin.

Opportunities/Issues

This represents an ideal site for a variety of restoration options. Most of the site margins are within the SLR inundation zone expected in the next 50-60 years, with relatively wide areas of residual salt marsh and regionally rare coastal manuka forest to the south.

The available area is relatively extensive, retains residual populations of all key salt marsh herbfield species, and there is capacity for salt marsh to migrate inland in response to SLR. This site represents one of relatively few low-lying areas where natural salt marsh migration could occur in response to SLR without substantial impacts on existing infrastructure, noting the access road to the wastewater treatment plant includes a causeway and flap-gate that currently limits tidal flows to previously estuarine areas near the causeway.

The site is variably sheltered from the main body of the estuary and while there is localised evidence of shoreline erosion, it is possible this can be mitigated with nature-based restoration initiatives.

In several areas current ecological values are low and can be expected to significantly increase over time. Elsewhere, values are high and can be expected to be maintained. No significant issues are anticipated with regard to physical works associated with any potential restoration.



Flap-gate and causeway limiting tidal exchange to the site.

Recommended Restoration Options

Shoreline recontouring	
Beach nourishment	
Chenier ridges / islands	
Reinstatement of tidal flows	✓
Armour removal	
Flap-gate removal	✓
Dike or berm removal	
Physical exclusion (e.g., fencing)	
Weed control	✓
Pest control	✓
New salt marsh planting	✓
Infill salt marsh planting	✓
Riparian planting	✓
Wetland planting	

Recommended Actions

Remove the culvert flap-gate adjacent to the causeway to allow regular tidal exchange to residual salt marsh habitat, and exclude grazing animals from wetland and intertidal areas.

Spray weeds and grassland along the terrestrial margins of existing salt marsh and plant with salt tolerant coastal species e.g., salt marsh ribbonwood, flax, cabbage trees.

Extend the footprint of existing salt marsh on the east end of the island and northern margin through targeted planting of intertidal rushland to improve the spatial extent and connectiveness of existing habitat. Plant pockets of searush at high densities (10-15 plants/m²). Planting in patches is recommended initially to trial different planting densities and configurations.

Utilise the development of new tidal inlets to facilitate the development of new salt marsh habitat.

Maintain low-lying land (e.g., avoid infilling by dumping of hardfill etc.) to maximise future restoration opportunities.

3. SITE PRIORITISATION

Prioritisation criteria were proposed by Stevens and Southwick (2021) to collect site information in a systematic and consistent manner to help TDC in the selection of restoration options. It was not intended as a formal system for definitively ranking sites because the specific criteria used, and the endpoints sought, will have a strong influence on how different components should be weighted. For example, if ecological outcomes are of prime importance, heavier weightings could be given to habitat criteria when ranking sites.

As with the previous assessment, in order to allow options to be assessed in a variety of ways, unweighted scores and ranks have been presented for each of the criteria groupings (i.e., Preliminary high-level screening; Habitat criteria; Implementation criteria) to enable component parts to be assessed individually, along with a combined summary of overall site scores.

To help prioritise all the potential restoration options assessed (including those previously assessed), unweighted scores were summed across all categories to get a nominal overall ranking. These rankings should be considered a transparent and objective starting point for reaching final decisions on priority rather than a definitive outcome.

The highest overall ranked projects are considered to have a balance between ease of implementation, with a good chance of success and ecological benefits in both the short and long term. Each offer different outcomes and challenges and reflect a mix of easy to implement options extending current work, as well as more challenging but higher reward options that extend restoration into new areas or habitats.

At the time of report preparation (October 2023), estuary restoration projects have commenced at the following sites assessed in this report:

- Site 18. Lansdowne Road Farm (West) - rank 3
- Site 27. Rough Island Embayment - rank 4
- Site 8. Borck Creek to Sandeman Reserve - rank 5=
- Site 7. Estuary Place - rank 7=
- Site 28. Rough Island bridge - rank 7=
- Site 16. Waimea River Delta - rank 11=
- Site 23. Best Island (South) - rank 11=
- Site 26. Bird Island - rank 11=
- Site 41. Research Orchard Road - rank 11=
- Site 14. Best Island Golf Course - rank 22=
- Site 15. Best Island - rank 28
- Site 22. Best Island (East) - rank 29=

Site 36. Bronte (Northeast) - rank 33=

Although the focus at many of these sites is predominately terrestrial, many also include salt marsh initiatives or would be suited for the restoration of estuarine habitat as outlined in the current report.

4. RECOMMENDED SITES FOR FURTHER ASSESSMENT

Relative rankings presented in Table 51 reflect all 46 sites assessed, noting that sites on private land are not reported on. Based on these rankings, the following additional sites public are suggested as initial priorities to consider further:

- Site 25. Equestrian Centre Embayment - rank 1
- Site 46. Bell Island - rank 2
- Site 28. Rough Island bridge - rank 7=
- Site 9. Sandeman Reserve (Coast) - rank 11=
- Site 41. Research Orchard Road - rank 11=
- Site 30. Moturoa (Barnicoat Road) - rank 22=
- Site 33. Mapua Embayment - rank 22=
- Site 10. Sandeman Reserve (Stream) - rank 33
- Site 37. Bronte Point - rank 37=
- Site 2. Reservoir Creek (West) - rank 37=

Several higher scoring sites have not been included in the above recommendations as they are on private land and require discussion between TDC and landowners.

Some sites with relatively low scores have also been included e.g., Site 2. Reservoir Creek (West) as they represent opportunities for maximising restoration benefits not readily captured in the scoring matrix, i.e., local availability of material for reshaping the shoreline, and enhanced benefits to other (existing) terrestrial restorations through erosion reduction.

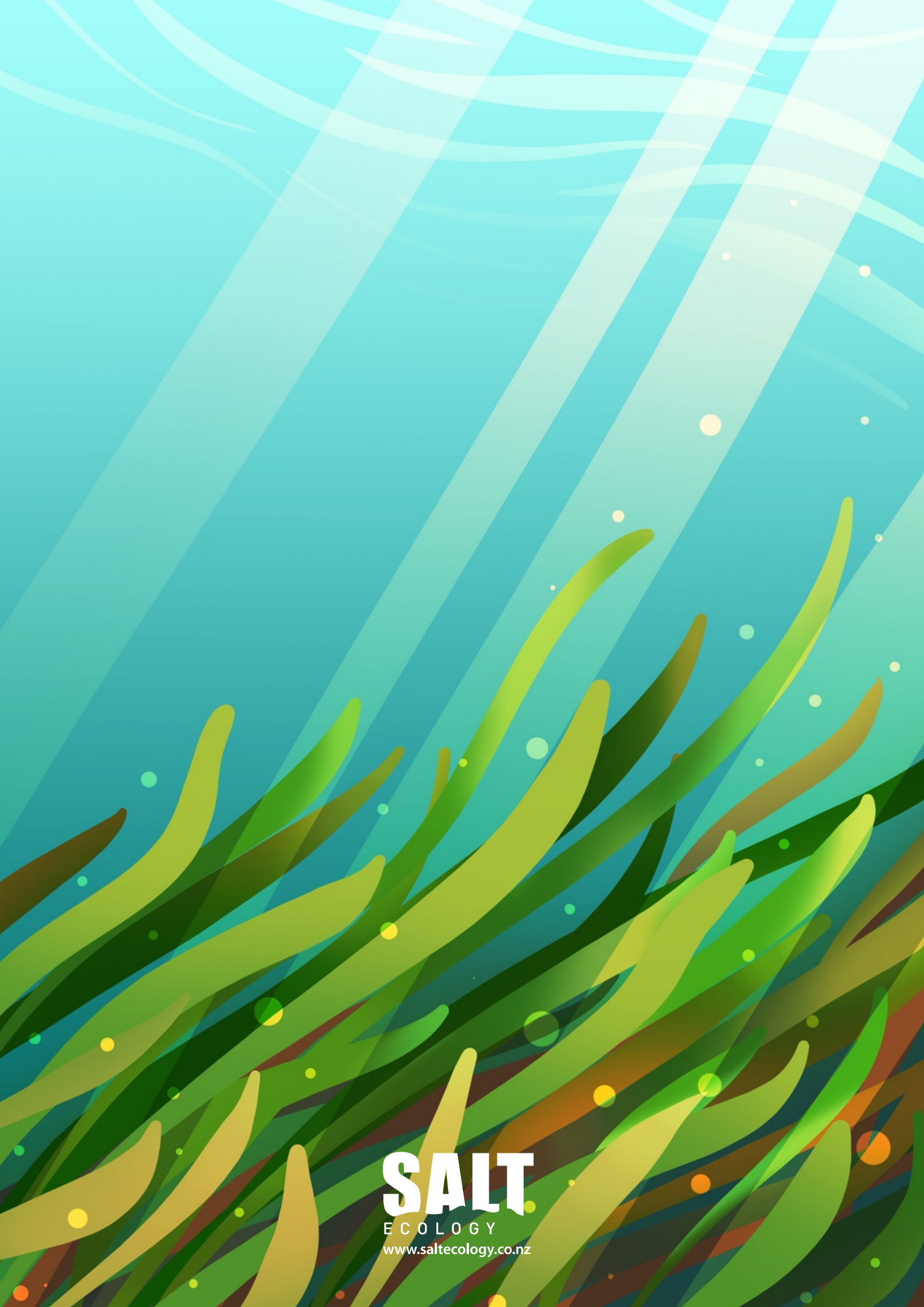
It is recommended that more detailed site-specific restoration plans be developed for any initiatives TDC wish to pursue.

Finally, it is noted that this assessment has focussed on the larger and most obvious restoration opportunities. There are many additional opportunities that could be considered at a local scale, and which would contribute meaningful benefits to the ecological state of the estuary.

APPENDICES

Appendix 1. Expanded narrative of preliminary scoring criteria

PRELIMINARY HIGH LEVEL SCREENING		1	3	5
1	Land ownership	Land with private ownership and site governance	Crown or covenanted land with defined site management objectives or approvals required, eg. Scenic reserve, QE2 covenant	Council owned and managed land
2	Tidal inundation	Terrestrial land with no predicted tidal inundation	Land within currently defined MHWS	Land within predicted 100yr SLR scenario
3	Extent of historic degradation	Natural habitat is largely intact, but can be improved	Natural habitat is modified, but most key features remain	Natural habitat is significantly degraded or absent, but was historically present
4	Biodiversity benefit	No significant change to current state	Some benefits through enhancement of existing values	Large improvements through combined enhancement of existing state and restoring lost biodiversity
5	Proximity to existing restoration initiative	Unconnected to existing or proposed restoration project	Within 500m of existing or proposed restoration project	Directly adjoining existing or proposed restoration project
6	Proximity to ecologically important vegetated area	Unconnected to existing important vegetated area (e.g. seagrass, salt marsh, wetland, indigenous forest)	Within 500m of important vegetated area (e.g. seagrass, salt marsh, wetland, indigenous forest)	Adjoining important vegetated area (e.g. seagrass, salt marsh, wetland, indigenous forest)
7	Value of infrastructure assets potentially affected within restoration	Value of infrastructure assets in footprint potentially affected >\$100k	Value of infrastructure assets in footprint potentially affected is \$10-\$100k	Value of infrastructure assets in footprint potentially affected <\$10k
HABITAT CRITERIA				
1	Area available at site	Site small (<1ha)	Site moderate (1-5ha)	Site large (>5ha)
2	Mean width of intertidal area	Intertidal width <50m	Intertidal width 50-500m	Intertidal width >500m
3	Protection from currents/waves	Site un-protected from prevailing wave energy	Site partially protected from prevailing wave energy	Site mostly protected from prevailing wave energy
4	Extent of shoreline armouring	75-100% armouring	25-75% armouring	<25% armouring
5	Width of riparian buffer	No riparian vegetation present	Riparian vegetation 0-10m wide	Riparian vegetation >10m wide
6	Adjacent land suitable for coastal retreat in response to SLR	No adjacent land suitable for coastal retreat	Adjacent land suitable for coastal retreat with land changes needed	Adjacent land suitable for coastal retreat without land changes needed
7	Degree of local habitat connectivity/diversity	Monoculture or isolated habitat areas significantly degraded from natural state	Mixed species assemblages but with limited diversity and connectivity compared to natural state	Species assemblages are relatively diverse and in close proximity
8	Likely benefit to birds compared to current state	No change or small increase in habitat area or quality	Moderate increase in habitat area or quality	Large increase in habitat area or quality
9	Likely benefit to fish compared to current state	No change or small increase in habitat area or quality	Moderate increase in habitat area or quality	Large increase in habitat area or quality
IMPLEMENTATION CRITERIA				
1	Proven restoration methodology	Novel method	Method used successfully elsewhere	Many examples of successful use, including within NZ
2	Likely risk of failure (e.g. erosion, plant desiccation)	Physical conditions at the edge of tolerances of key habitat forming species	Physical conditions mostly within tolerances of key habitat forming species	Physical conditions well within tolerances of key habitat forming species
3	Likely cost of initial restoration	High (>\$50k/ha)	Moderate (\$10-50k/ha)	Low (<\$10k/ha)
4	Likely cost of ongoing site maintenance	High maintenance costs (>\$10kpa), e.g. labour intensive, high plant losses, extensive weed control	Moderate maintenance costs (\$5-10kpa), e.g. Limited labour, low plant losses, annual weed spraying	Very little ongoing maintenance required (<\$5kpa)
5	Site accessibility	Access difficult e.g. no vehicle access to site or traffic management required	Access constraints manageable e.g. fence removal, 4wd access	No access constraints
6	Extent of physical site preparation required	Extensive works needed over >50% of site using machinery	Works needed over 10-50% of site with some machinery	Works needed over <10% of site without using machinery
7	Is resource consent likely to be required?	Notified consent required	Non-notified consent	Permitted activity with no consent required
8	Potential adverse impact from restoration works	Significant adverse impacts that may persist or which can not be readily mitigated through appropriate management	Some short-duration adverse impacts that can be mitigated through appropriate management	No significant adverse impacts
9	Likely human amenity value	No current or future recreational opportunities	Indirect and limited use (e.g. walkway/cycleway, remote view-point)	Direct and frequent use (e.g. park with multiple passive and active uses)
10	Time frame for establishing desired changes	Desired changes occur over a long timeframe (>10 years)	Desired changes occur over a moderate timeframe (5-10 years)	Desired changes occur over a rapid timeframe (<5 years)



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