

# Appendix Two

## Natural Character Areas

### Guide to Using this Appendix

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This appendix describes both the overall natural character of the Marlborough Sounds across terrestrial, freshwater and marine environments, as well as the natural character of each of the 11 land and eight marine natural character areas.

### When to use this Appendix

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Appendix Two is referred to in the assessment criteria for all consents across all zones.

This appendix identifies the known core biophysical and ecological components that make up the natural character of the Marlborough Sounds. Consideration of the effect of any plan change and consent applications on the natural character of the Marlborough Sounds must therefore have regard to these descriptions.

Consideration of the effect of activities on these core components is therefore required in:

- i) the preparation of plan change and resource consent applications Assessment of Environment Effects;
- ii) decisions on those plan changes and consents; and
- iii) the development of appropriate consent conditions, mitigation options and environmental offsets, where these are deemed to be appropriate.

### How to use this Appendix

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The overall character of the terrestrial, freshwater and marine systems that function within the area covered by the plan is described in terms of known biophysical and ecological characteristics that typify the Marlborough Sounds area.

The same characteristics are used to describe the natural character of the particular areas across the 11 land and eight marine systems. The boundaries to these areas are clearly mapped (Sheet 106) Each natural character area contributes to the overall natural character of the Marlborough Sounds area. Sustainability of the characteristics of individual natural character areas is therefore important in sustaining the overall natural character of the Marlborough Sounds.

The core ecological and biophysical components of each of the natural character descriptions are described in terms of the parameters listed in Table 1 below. These parameters condense the natural character components described in Chapter One of the New Zealand Coastal Policy Statement.

**Table 1**  
**Core Ecological and Biophysical Components**  
**of Natural Character**

- Collective Characteristics
- The Physical Environment
  - Landform/Geological patterns and features
  - Dynamic features and processes, including climate
  - Water
- The Biological Environment
  - Predominant indigenous vegetation
  - Distinctive biota, communities and habitats
  - Potential for Restoration

Descriptions of the landscape and seascape experience in each part of the plan area, whilst often an important contribution to natural character, have not been included.

## **Definitions of Terms Used**

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**Distinctive indigenous biota:**

Describes the indigenous flora and fauna that is special to a particular natural character area, but is not necessarily confined to that area.

**Endemic:**

Refers to species of plants and animals which are unique to an area or animals which may migrate but breed only in the area.

## Overall Natural Character of the Marlborough Sounds - Terrestrial

### Collective Characteristics

A highly distinctive landform of partially drowned valleys. An intricate, complex indented coastline with numerous promontories, bays and islands. A diverse range of ecosystems determined by a wide range of geology, landforms, climate and biota. Distinctive mineral belt ecosystems. A strong maritime influence and high exposure to the strong winds of Cook Strait. Exceptional biodiversity. Over 50% is in indigenous vegetation cover. Extensive areas of intact upland forest, and a few large tracts of lowland and coastal forest. Distinctive alpine and coastal communities. A collection of island refuges for nationally threatened native species. Gondwanaland remnants with highly distinctive native animal species such as tuatara; numerous endemic species (confined to Marlborough Sounds) and species reaching their distributional limits. Extensive wild and scenic areas.

### A. The Physical Environment

#### 1. Landforms/Geology

Largely sedimentary and metamorphic rocks regionally arranged in broad, more or less parallel bands aligned southwest - northeast.

Sedimentary strata, of predominantly indurated sandstones (greywacke), confined to the western parts of Pelorus catchment and Sound.

Metamorphic rocks are schists of varying degrees of development. Weakly schistose rocks, with limited alignment of their minerals into plates and limited separation of those minerals into discrete layers (foliation), comprise much of Pelorus Sound and eastern Queen Charlotte Sound. Strongly schistose rocks, with well-developed foliation into quartz layers, comprise much of the Wakamarina catchment and central parts of the Sounds including eastern parts of Mt Stokes massif.

The geology of the western part of the Sounds, including D'Urville Island, is dominated by the Nelson/Marlborough mineral (ophiolite) belt, and comprises ultramafic rocks and melanges of various rock types in an ultramafic matrix. These have originated deep within the earth and are extremely nutrient-poor but have unusually high concentrations of magnesium and iron and the trace elements nickel, copper, cobalt, chromium and manganese. Such high concentrations of these elements have altered the earth's magnetic field along the belt.

Also associated with the belt are rare outcrops of serpentinitic breccia, argillite and limestone.

Due to regional submergence, alluvium is generally uncommon in the Sounds proper, being largely confined to relatively small pockets behind embayment heads. Nevertheless, it is quite extensive further inland, and is a very important valley floor component of the Pelorus, Wakamarina and Kaituna catchments.

The various rock types in the Sounds have played a large part in determining the pattern and characteristics of many landforms, differences in rates and types of erosion, differences in relief, drainage patterns, and biotic assemblages and patterns.

Soils include: hill country strongly leached to podzolised stony steepland soils and podzols from indurated greywacke; argillite; schist and associated solid fluvial debris. Alluvial soils in restricted locations with high fertility; mineralised soils from ultrabasic rocks with strong nutrient imbalances; highly enriched soils of seabird islands; and skeletal soils of the exposed coastal margins.

Overall, the Sounds are a rare and nationally important landform. This is the largest and most well-developed example of a ria coastline in New Zealand, formed as a result of both subsidence and sea level rise, to produce a profoundly incised and intricately indented coastline with attenuated, fragmented blocks of land largely surrounded by sea.

The 70 km wide, 150 km long wedge of erosion-resistant greywacke and schist that makes up North Marlborough has been shunted northward into Cook Strait by the Alpine Fault. Submarine subsidence of the Wanganui Basin has tilted the wedge downwards to the northeast, and has combined with post-glacial sea level rise to create a partially-drowned landscape. River valleys and terraces have been inundated to become sounds, inlets and bays; ridges have become peninsulas and headlands; islands created as ridgelines have sunk below sea level; major river systems have changed direction and course (eg; Pelorus River); the penetrating influence of the marine environment on coastal erosion, regional climate and biological systems has been profound.

The major landforms that contribute to the natural character of the region include: the two steep-flanked main mountain ranges (Bryant and Richmond); various steep-sided, isolated mountain massifs (eg. Mts Stokes, Stanley and Robertson) (v&s); extensive river valleys (Pelorus, Rai, Wakamarina, Kaituna) with well developed fluvial landforms (alluvial terraces and fans, floodplains, deltas, wetlands, estuaries) and diversity of river types (eg; meandering, intrenched); the distinctive topography of the western ultramafic areas (including Patuki and Croisilles melanges) (v&s); a multitude of capes, headlands, peninsulas and points; an extensive and complex labyrinth of waterways; narrow sea channels, passages, reaches, arms, harbours and embayments (v&s); discrete marine-created landforms: barrier beaches, boulder banks and lagoons, tombolos, spits, cusped forelands, dunelands (mainly in the western sounds) (v&s); well-developed coastal cliffs especially in the Outer Sounds; numerous islands and rock stacks (v&s). (v&s = visually and scientifically important).

Nationally important geological features include: Matarau Point beach ridge foreland; Greville Harbour boulder spit; serpentinitic breccias along parts of the western coast; Dun Mountain and Patuki melange ultramafic geologies and landforms.

Internationally and nationally important areas for soils and soil processes include forested areas of: Pelorus headwaters; Pelorus Bridge; Endeavour Inlet head and Tennyson Inlet - Nydia Bay; and indigenous vegetation on the mineral belt along the Bryant Range and on D'Urville Island.

## **2. Dynamic Features and Processes, Including Climate**

That very diverse, highly variable climate ranges from warm and maritime dry-temperate in the Outer Sounds, to wet and cold alpine along the Richmond and Bryant Ranges.

Rainfall varies from around 800 mm in the Outer Sounds to over 2000 mm along the ranges. Rainfall generally increases with increasing altitude and distance from the outer coast, as well as from the eastern Sounds to the western Sounds.

The area is notable for occasional high intensity rainfall events, especially in western and southern parts. Droughts are generally not common but areas with low elevation and low rainfall, mainly in the Outer Sounds, are predisposed to summer drought, especially on north and west faces.

Overall, maritime influence is very high, with decreasing influence away from Cook Strait. Much of the Sounds is surrounded by sea although the maritime influence is ameliorated by the relatively sheltered nature of the Inner Sounds.

Temperature ranges are relatively narrow in areas with high maritime influence, but are very wide away from the coast, especially in sheltered inland valleys where days can be very warm, but where evening cold air drainage and ponding are pronounced and frosts severe. The Outer Sounds and many parts of the Inner Sounds are largely frost-free.

Exposure to winds and storms ranges from severe in the Outer Sounds and at high altitudes (especially ridges, ranges and summits), to minimal in sheltered bays and inland valley systems. The Inner Sounds are notable for its sheltered bays and waterways, while the Outer Sounds are notable for their high wind velocities, especially through the Cook Strait narrows. In the Outer Sounds, the effects of storm surges and high energy wave action on landforms, erosion processes, and biotic communities are profound.

Fog is a significant feature of the valleys of the Pelorus catchment.

Winter snow is uncommon and confined to main ranges and high summits (eg; Stokes, Robertson) and is ephemeral on all but the highest peaks of the Richmond Range.

Overall elevation is high, ranging from sea level to 1756 m (Mt Richmond); mean altitude is c. 350 m.

### **3. Natural Air Quality**

Very high natural air quality throughout Marlborough Sounds.

## **B. The Biological Environment**

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[Comprises all of Sounds Ecological District, most of Pelorus and D'Urville Ecological Districts, and parts of Para and Cook Strait Ecological Districts].

### **1. Predominant Indigenous Vegetation**

The total area of the Sounds District is 291,696 ha of which 55% is native forest, 14% is shrubland (both exotic and native), 20% is pasture and non-woody native vegetation and 11% is exotic forestry. (Note: Percentages based on interpretation of 1990 satellite images.)

Originally, over 90% of the Sounds and hinterland was covered in forest. Non-forest communities were naturally restricted to areas that were inimical to forest development due to physical and environmental constraints such as steepness, exposure, salinity, substrate type and instability, extreme water regimes (inundation/excessive drainage), and low temperatures.

They include coastal, estuarine, riparian, ultramafic, subalpine and seral shrublands; coastal, ultramafic riparian, estuarine and alpine tussocklands, herbfields and rocklands (especially on bluffs); dunelands, estuarine rushlands, and various wetland communities.

Disturbance and loss of indigenous vegetation cover correlates very well with altitude. Mid-altitude and upland forests, and alpine communities are still largely intact. Coastal and lowland forests have been extensively compromised and are fragmented or lost over much of the Sounds, especially in the drier parts; however a few exceptional areas are still intact. Alluvial communities, especially forests and wetlands, have been drastically compromised with very little remaining - almost regionally extinct.

D'Urville Island, Mt Stokes and the forests of the upper Pelorus Valley and Tennyson Inlet retain much of their indigenous cover. They make a major contribution to the natural character of the Sounds as a whole.

Lowland hill country with regenerating and old growth indigenous forest provides much natural character, despite a long history of modification and loss. The overall pattern is that natural character is better retained in the west and at higher altitudes. These western areas are representative of some of the natural character intrinsic to the Sounds and their preservation and restoration would contribute greatly to the Sounds as a whole.

Where indigenous vegetation areas exist in the east, in low altitude areas of the Pelorus catchment, and in the low relief areas of outer Pelorus Sound, they break up the predominately modified landscape and make a strong contribution to the natural character of the Sounds as a whole.

## **2. Distinctive Biota, Natural Biodiversity, Productivity**

The ecological districts that make up the Sounds are further subdivided into eleven distinct terrestrial ecosystems, each with a unique combination of geology, landforms, climate, natural communities and biota.

There is very high overall natural biodiversity due to habitat heterogeneity and the presence of island refuges.

Generally natural productivity is moderate throughout the Sounds, with limited areas of extremely high productivity (seabird islands) and of very low productivity (ultramafic areas).

The area contains over a third of New Zealand's native plants species.

## **3. Biotic Patterns**

Natural biotic patterns are strongly influenced by intricate landforms, substrate and strong climatic gradients between the Inner and Outer Sounds, eastern and western Sounds, lowlands and uplands (eg; Pelorus lowlands with moderately high rainfall/low exposure, compared to the Cook Strait narrows with low rainfall/high exposure).

Although relatively small in extent, the non-forest communities and alluvial communities of the Sounds are extremely important in adding to community and species biodiversity, many being highly distinctive and confined to the North Marlborough - Sounds - Cook Strait areas, providing vital habitat to numerous

localised species including those endemic to, or having their strongholds in the area, as well as nationally threatened species.

Nationally outstanding, unusual and distinctive community types include: Cook Strait shrublands; tussock-herbfields and herbfields; coastal, lowland and upland mineral belt communities; seabird and reptile islands; and Mt Stokes and Richmond Range alpine zones.

Also nationally important are all communities on possum-free islands, especially those dominated by mixed-broadleaf forests. D'Urville and Arapawa Islands are exceptions in this regard.

Nationally important tracts of lowland forest are located in the middle Pelorus, Tennyson Inlet - Nydia Bay, and on D'Urville Island due to their large size, intactness and uninterrupted sequences.

Intact vegetation sequences from seafloor to ridgetops elsewhere in the Sounds are also nationally important because of their rarity.

#### 4. Communities and Habitats

The area provides vital habitat important for the survival of a number of endemic and/or nationally threatened species, including: giant land snails (*Powelliphanta 'bicolor'*, *P. 'consobrina'* and *P. 'obscura'*); land snail (*Rhytida 'stephenensis'*); ngaio weevil, Cook Strait giant weta; Cook Strait click beetle; flax weevil; several species of large beetles and native slugs; Cook Strait and Brothers Island tuatara; striped gecko; Marlborough green gecko; Duvaucels gecko; speckled skink; Hamilton's frog; Maud Island frog; king shag; Hector's dolphin; *Kirkianella* "Cook Strait"; titirangi; Cooks scurvy grass; Cook Strait bristle tussock; pygmy button; Mt Stokes cushion daisy and carrot; Richmond Range cushion daisy, muttonbird groundsel; *Hebe rigidula* (including the D'Urville mineral belt hebe) and several other mineral belt species; Stephens Island hebe; Cook Strait mahoe; bamboo tussock; fierce lancewood; *Pimelea tomentosa*; *Teucrium parvifolium*; *Scutellaria novae-zelandiae*; *Poranthera microphylla*; *Brachyglottis traversii*; *Brachyglottis 'Richmond'*; *Ourisia 'Richmond'*.

Habitats associated with nationally rare and endangered species include: predator free habitats (for species such as kaka, kakariki, tuatara, Hamilton's frog, little spotted kiwi, South Island saddleback); and tupeia mistletoe riparian and alluvial communities, especially in the Pelorus catchment; maritime communities (for species such as King Shag, *Kirkianella*, bristle tussock, and fierce lancewood); coastal vegetation (for species such as large-leaved milktree and coastal sand spurge); and bird islands (for species such as Cooks scurvy grass and mutton bird groundsel).

Islands which lack one or more introduced mammalian pests are nationally rare.

The area provides very important habitat for millions of seabirds including several species of prion, shearwater, petrel and shags.

The area is nationally important for its coastal black beech/hard beech forests which are rare throughout the rest of New Zealand.

The area is covered in significant mixed broad-leaved forests of tawa, kohekohe, pukatea, nikau and karaka. These lowland and coastal forests are notable for their profusion of epiphytes, lianes, ferns and understorey species.

The area provides an important 'mixing zone' of subantarctic and northern New Zealand species, many of which reach their respective northern and southern limits here, or, in the South Island, are represented only in the Sounds.

North Marlborough is one of the national strongholds for widespread species such as hard beech, little blue penguin, fairy prion and fluttering shearwater.

Most vulnerable to disturbance and further loss are communities on predator-free islands, alluvial terraces, fans, deltas and floodplains, coastal dunes, all wetlands and estuaries and their margins, riparian margins, coastal and lowland ultramafic areas and regenerating shrublands.

There is natural movement of some species, such as seabirds and penguins, between land and sea which are still largely fully functioning.

There is also natural movement of wildlife between natural areas generally unrestricted at higher altitudes where areas are largely intact and continuous. There are constraints on natural movement of many species in lowland and coastal natural areas because of loss, contraction, fragmentation and isolation of habitats. Constraints are severe on some species in alluvial natural area remnants. Connections between natural areas of the Sounds proper, and the Pelorus hinterland are also completely severed as are those to the Mts Cullen and Robertson massifs.

## **C. Priorities and Potential for Restoration**

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Re-establishment of natural patterns of indigenous vegetation and wildlife.

Minimising threats and maximising viability of nationally and regionally rare communities and species.

Reduction of weeds and pests to the point where the indigenous elements can persist as significant components of natural character. Control of pines, old mans beard, banana passionvine, is particularly important as well as control of gorse and Spanish heath in ultramafic areas. Pigs, goats, deer and possums also have major impacts on natural character.

Eradication of introduced mammals from islands where technically feasible; establishing protocols and management practices to prevent further introductions.

Removal of conspicuous and intrusive development from areas of otherwise high natural character.

Prevention of ongoing or new activities which depress or disturb natural character.

Re-establishment of natural riparian margins.

Restoration of degraded, extremely fragmented communities, especially alluvial systems, estuarine and riparian margins, wetlands and their margins is a major priority.

Restoration of coastal and lowland forests, through the continued regeneration of secondary shrublands.



## Overall Natural Character of the Marlborough Sounds - Freshwater

### Collective Characteristics

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An abundance of small coastal streams with good water quality and instream habitat makes the area nationally significant for its native fishery values.

#### A. The Physical Environment

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##### 1. Landforms/Geological Features

Generally small contributing catchments. Abundance of small coastal streams.

##### 2. Climate

Strong climatic gradients between Pelorus hinterland (high rainfall) to the Cook Strait narrows (low rainfall) influence catchment size and summer low flows.

##### 3. Natural Water Quality

The natural water quality of the Marlborough Sounds is very high although degraded in some lowland river catchments (Rai and Kaituna).

Very clear, cool waters flow from forested catchments.

#### B. The Biological Environment

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##### Distinctive Biota, Communities and Habitats

##### Natural Biodiversity, Productivity and Biotic Patterns

High freshwater diversity due to habitat heterogeneity, and coastal proximity. Wide range of natural levels of biological productivity.

Valued trout fishery in large catchments such as the Pelorus. Very diverse native fisheries in small low-gradient coastal streams, particularly in the Outer Sounds.

Provides habitat for the survival of a number of endemic freshwater fish species. Banded kokopu, koaro, torrentfish, blue-gilled and redfin bullies widespread throughout Sounds, and limited records of giant and short jawed kokopu. Lamprey and dwarf galaxias also present in a few streams.

Riparian, wetland and estuarine habitat, water quality, unimpeded passage for migratory fish including coastal access, are all important in sustaining significant and threatened freshwater fish species found in the Marlborough Sounds (short jawed, giant and banded kokopu).

Numerous small estuaries, wetlands and streams vulnerable to disturbance.

Natural biotic patterns are complex. Strongly influenced by intricate landforms, substrate patterns, strong climatic gradients between Pelorus hinterland (high rainfall) to the Cook Strait (low rainfall).

## **C. Potential for Restoration (including priorities for restoration)**

Initiate riparian management in lower sections of streams known to contain short-jawed kokopu.

Maintain and enhance riparian vegetation in lower altitude stream areas of high native fishery values. Similarly, restore fish passage in streams where it is currently impeded.

Address impacts of subdivision (stormwater, water abstraction, fish passage, effluent soakage), forestry and farming (sediment, fish passage fertiliser runoff, gravel extraction and vegetation clearance).

Riparian management for the degraded catchments of Rai to Kaituna to address degraded water quality.

## Overall Natural Character of the Marlborough Sounds - Marine

### Collective Characteristics

The Marlborough Sounds marine environment largely retains its natural character. Bordered by Tasman Bay to the west and Cook Strait to the north-east, exposed to open ocean conditions along its south-eastern flank, yet mostly sheltered by their convoluted form, the Marlborough Sounds are uniquely structured and situated.

A number of broad and sometimes interacting environmental gradients traverse the length and breadth of the Marlborough Sounds, notably: wave exposure, tidal influence (currents, tidal height, water exchange), turbidity, sedimentation, temperature, salinity, nutrient availability, and substrate composition. The interplay of these various characteristics creates a unique marine environment notable for its broad scale variability.

The marine and terrestrial environments combine visually to form a region of distinctive natural character. Notable features include: an intricate coastline; numerous islands and off-shore rocks and stacks; wild and remote localities; exposed and sheltered waters in close proximity; and strong tidal flows.

### A. The Physical Environment

#### 1. Form/Geology

Cobble/boulder and bedrock shores dominate the inter-tidal and shallow sub-tidal zones of the Marlborough Sounds. Sediments with a mixture of sand, broken shell and silt can occur below the reef zone in shallow wave-worked areas or areas with moderate-high currents. An extensive and comparatively uniform mud/silt bottom typically extends beyond, dominating the off-shore regions of the Sounds.

Exceptions to this general pattern include: off-shore reefs, rocks and stacks of the Outer Sounds; off-shore areas of coarse sand and/or pebbles in some exposed locations; mudflats in estuarine areas; pea gravel beaches in eastern Cook Strait; and a very limited array of sandy shores.

Notable coastal landforms include: estuaries and tidal flats; cusped forelands; coastal bluffs; off-shore islands, stacks, emergent rocks, and reefs; numerous headlands and bays as a result of the convoluted and intricate nature of the Sounds as a whole.

#### 2. Dynamic Features and Processes, Including Climate

Exposed eastern and northern areas of the Outer Sounds are subjected to high wind velocities funnelling through Cook Strait. The south-eastern coast is also exposed to oceanic swells from the south. Shores in these exposed localities are subjected to moderate-high seas, however, elsewhere the Marlborough Sounds are noted for their relatively sheltered conditions.

Strong tidal currents occur around the Outer Sounds, especially off headlands and through constricted channels. Moderate currents also occur off the exposed faces and headlands of the major channels within the inner and middle regions of the Sounds.

Tidal range varies from about four metres in the west to 0.5 metres in the east.

### 3. Water

Water quality is mostly very high. Notable features include: low sediment loadings in Queen Charlotte Sound and the Outer Sounds generally; moderate to high sediment levels in Pelorus Sound and Port Underwood; cooler waters in the east, warmer waters in the west; reduced salinities towards the head of Pelorus Sound; very complex and variable hydrodynamics; nutrients predominantly derived from sediment remineralisation, upwelling from Cook Strait, and river inflows; relatively poor water quality in the vicinity of Havelock and Picton.

## B. The Biological Environment

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### 1. Natural Biodiversity

Natural biodiversity of the Sounds as a whole is high as a result of the diverse range of environmental conditions traversing the Sounds. However, on a more localised scale biodiversity can range from the very diverse (eg reefs and off-shore rocks/stacks of the Outer Sounds) to the relatively simple (eg benthic communities of the more sheltered, enclosed bays). There is an overall gradient from the Inner to the Outer Sounds, with biodiversity generally increasing with proximity to the open ocean.

### 2. Productivity

Productivity is variable, but generally moderate across the plan area. Some areas are distinguished by their very high productivity (eg. estuaries and exposed parts of the outer coast) whereas other areas can have relatively low productivity (eg. enclosed, sheltered bays with limited water exchange).

### 3. Ecological Features

Ecological features which distinguish the Marlborough Sounds marine environment include: low energy rubble shores dominated by mobile and encrusting animal species and with little seaweed cover; extensive and relatively uniform mud bottom off-shore areas; high current communities in areas subjected to strong tidal currents; brachiopod dominated communities; bryozoan coral beds; horse mussel beds; off-shore reefs, rocks and stacks in the Outer Sounds; soft-bottom sponge communities; elephant fish spawning grounds; scallop beds; large tubeworm mounds in certain areas; *Macrocystis* beds in colder, sheltered eastern areas; a fish fauna noteworthy for the predominance of blue cod and spotties.

A wide range of marine mammal species inhabit or migrate through Marlborough Sounds waters. Cook Strait is an important migratory route for several large whale species, including sperm, humpback, minke and southern right whales. Orca (killer whales) are regular visitors to the Marlborough Sounds and there are small resident populations of Hector's and bottlenose dolphins. Dusky dolphins can be relatively numerous at times. New Zealand fur seals have established small haul-out colonies at various sites through the mid-Outer Sounds, with a large breeding colony present on Stephens Island.

Numerous seabirds feed through the mid-Outer Sounds including terns, shearwaters, petrels, prions, shags and gannets. King shags, endemic to the Marlborough Sounds, are restricted to only a few breeding sites in the Outer Sounds. Little blue penguins occur in good numbers throughout the Marlborough Sounds.

Tidal wetlands are found at the heads of most major bays and inlets, forming an important wetland network within the Marlborough Sounds. Most of these wetlands are relatively small, the major exceptions being Whangarae Estuary and a very significant estuarine complex centred on the Kaituna Estuary at the head of Pelorus Sound. Collectively these coastal wetlands are a crucial habitat for numerous wetland bird species.

## **C. Potential for Restoration**

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Many off-shore areas have been trawled or dredged, resulting in the disturbance of natural seabed communities. Benthic communities would gradually recover should trawling or dredging cease in any particular area.

Marine reserve establishment.

Removing conspicuous and intrusive development from areas of otherwise high natural character.

Restoration of natural riparian margins around coastal wetlands and estuaries.

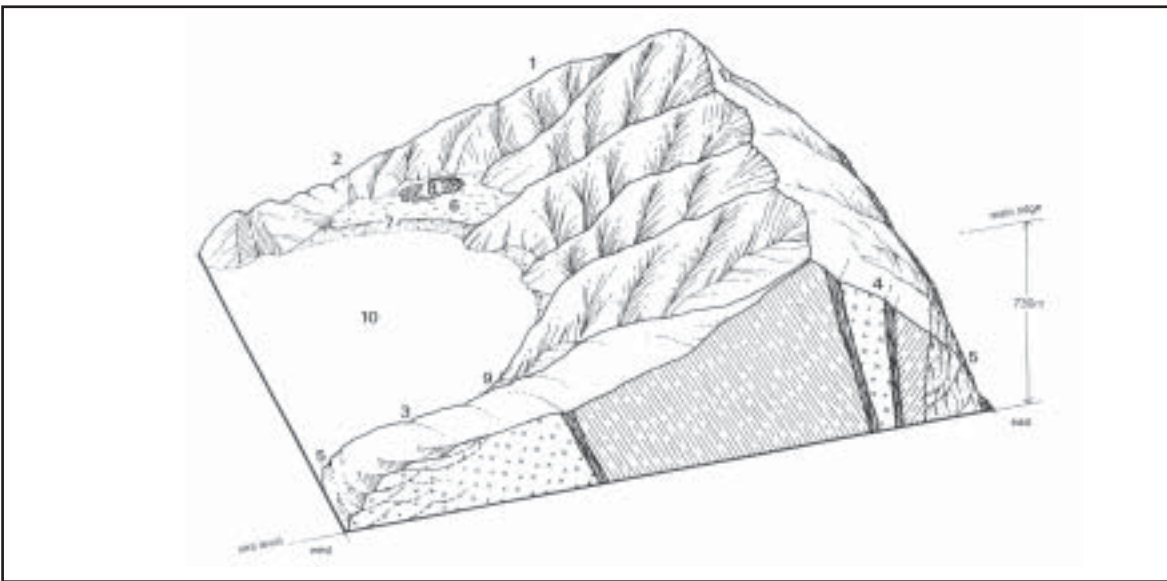
Reduction of contaminants entering the coastal marine area from point source discharges, river inflows and general run-off.



# 1 D’Urville

## Hard Beech, Manuka, Weka, Bellbird, Coastal Ultramafic-Dominated Ecosystem

Steep hills and mountains typify this land ecosystem with bluffy sea cliffs and headlands in places. At sea level lie large drowned river valley harbours featuring along their land/sea margins a varied array of coastal landforms such as inlets, spits, estuaries, beaches, lagoons and minor fans. Elevation is moderately low but rainfall moderately high in places as the landmass is being constantly buffeted on all fronts by the sea. D’Urville has a strong maritime influence and is subject to frequent sea storms. Base rocks eventuate from deep within the earth’s mantle, often erupting through the surface as dykes and sills. Some of the soils lack many essential nutrients and have toxic concentrations of trace elements creating generally inhospitable conditions resulting in unusual vegetation. D’Urville has many streams, some quite large, and extensive tracts of native vegetation.



**Table 2  
Indigenous Vegetation and Landforms - D’Urville Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	Steep to very steep upper hill and mountain slopes on sedimentary rocks >500 m elevation	Sandstone and siltstone of Rai and Greville Formations	Forest Red beech-silver beech forest. Silver beech forest with Halls totara, southern rata, miro and rimu.	Forest Red beech-silver beech forest. Silver beech forest with Halls totara, southern rata, miro and rimu.

Table 2 (cont)				
Indigenous Vegetation and Landforms - D'Urville Ecosystem				
Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2.	Moderately steep to steep lower hill slopes on sedimentary rocks 0-500 m elevation	Sandstone and siltstone of Rai and Greville Formations	<p><b>Forest</b> Kohekohe-karaka forest. Kohekohe-tawa-nikau forest. Mahoe-mixed broadleaf forest. Hard beech forest with kamahi, hinau, tanekaha in places and scattered emergent rimu. Pukatea-mahoe-nikau-supplejack-mixed broadleaf forest. Kanuka forest with ponga, fivefinger, mingimingi, <i>Gahnia</i>, heketara.</p> <p><b>Scrub</b> Rewarewa-manuka scrub. Manuaka scrub.</p> <p><b>Vineland</b> Nikau-kiekie vineland</p>	<p><b>Forest</b> Kohekohe-karaka forest. Kohekohe-tawa-nikau forest. Hard beech forest with kamahi, hinau, tanekaha in places and scattered emergent rimu. Pukatea-mahoe-nikau-supplejack-mixed broadleaf forest.</p>
3.	Rolling, moderately steep to very steep lower hill slopes on ultrabasic and serpentinitic rocks [prone to slumps and earthflows] 0-550 m elevation	Dun Mountain Ultramafic, Lee River Group gabbro, Patuki and Croisilles melanges	<p><b>Treeland</b> Mountain beech-southern rata/manuka treeland</p> <p><b>Scrub, Shrubland and Heathland</b> Manuka scrub Manuka - square rush rush-shrubland. Mountain beech-silver beech-cedar-mountain toatoa shrubland. Manuka-inaka heathland. <i>Coprosma</i>-weeping mapou-inaka shrubland.</p> <p><b>Turfland, herbfield and boulderfield</b> Herb-tussock boulderfield. Umbrella fern-comb sedge-turfland. <i>Raoulia-Epilobium</i> open herbfield.</p>	<p><b>Treeland</b> Mountain beech-southern rata/manuka treeland</p> <p><b>Shrubland and Heathland</b> Manuka - square rush rush-shrubland. Manuka-inaka heathland. Mountain beech-silver beech-cedar-mountain toatoa shrubland. <i>Coprosma</i>-weeping mapou-inaka shrubland.</p> <p><b>Turfland, herbfield and boulderfield</b> Herb-tussock boulderfield. Umbrella fern-comb sedge-turfland. <i>Raoulia-Epilobium</i> open herbfield.</p>
4.	Rolling, moderately steep to very steep low hill slopes on basic igneous rocks 0-500 m elevation	Part Brook Street Volcanic	Unknown	Unknown
5.	Steep to precipitous eroding sea cliffs, [some large scale slope failures, eg; 026/690210] 0-250 m elevation	Sandstone and siltstone of Rai and Greville Formations part Brook StStreet. Volcanics, Patuki and Croisilles melanges	<p><b>Forest</b> Akiraho-puka-wharariki-rangiora-kiekie forest on coast fringe.</p> <p><b>Scrub and Shrubland</b> Taupata-ngaio scrub and shrubland.</p> <p><b>Tussockland</b> Silver tussock and/or knot sedge tussockland.</p> <p><b>Herbfield and Rockland</b> Wharariki-rengarenga-rauhua flax-herbfield coastal fringe. Horokaka rockland.</p>	<p><b>Forest</b> Akiraho, puka-wharariki-rangiora-kiekie forest on coast fringe.</p> <p><b>Scrub and Shrubland</b> Taupata-ngaio scrub and shrubland.</p> <p><b>Tussockland</b> Silver tussock - knot sedge tussockland.</p> <p><b>Herbfield and Rockland</b> Wharariki-rengarenga-rauhua flax-herbfield coastal fringe. Horokaka rockland.</p>

**Table 2 (cont)**  
**Indigenous Vegetation and Landforms - D'Urville Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
6.	Minor prograding inlet heads and fans, eg; P25/790425 0-20 m elevation	Recent alluvium from predominantly sedimentary rocks, swamp deposits	<b>Forest and Treeland</b> Tawa-mixed broadleaf forest. Swamp maire treeland. Kahikatea-pukatea mixed broadleaf tall swamp forest. Matai, rimu, miro, kahikatea forest with scattered tawa, tanekaha, mahoe, kiekie. Rimu-matai-miro-hinau mixed broadleaf forest. <b>Shrubland</b> Manuka/baumea shrubland	<b>Forest</b> Kahikatea-pukatea mixed broadleaf tall swamp forest. Kahikatea-swamp maire-pukatea forest. Kahikatea-matai-totara-tawa forest. Matai-rimu-miro-kahikatea forest with tawa, tanekaha, mahoe, kiekie. Rimu-matai-miro-hinau mixed broadleaf forest.
7.	Barrier spits tombolos, beach ridges and dunes, eg; P25/780432, O26/628123 0-20 m elevation	Recent marine sand and gravel	<i>Raoulia</i> sand flats. Pohuehue vineland on boulder bank.	<i>Raoulia</i> sand flats. Pohuehue vineland on boulder bank. Spinifex-pingao duneland.
8.	Lagoons and estuaries, eg; P25/785437, O26/620120 0-3 m elevation	Recent fluvial and lagoonal deposits	<b>Scrub</b> Marsh ribbonwood-coastal shrub daisy - <i>Coprosma propinqua</i> estuary scrub. <b>Rushland and Reedland</b> Giant spike rush rushland. Oioi-sea rush estuarine rushland. Raupo-pukio reedland. <b>Herbfield</b> Sea primrose-remuremu-glasswort herbfield.	<b>Scrub</b> Marsh ribbonwood-coastal shrub daisy - <i>Coprosma propinqua</i> estuary shrubland. <b>Rushland and Reedland</b> Giant spike rush rushland. Oioi-sea rush estuarine rushland. Raupo-pukio reedland. <b>Herbfield</b> Sea primrose-remuremu-glasswort herbfield.
9.	Confined inlets [Okiwi Bay, Camp Bay]	Not applicable	-	-
10.	Large drowned river valley harbours [Port Hardy, Greville and Croisilles harbours] 0 m elevation	Not applicable	-	-

## A. The Physical Environment

### 1. Landforms/Geology

Ultrabasic, intermediate, and acid intrusive and extrusive geologies and serpentinitic melange (all mineral belt geology); associated sedimentary strata; minor alluvium.

Mineral belt geology, includes iron and magnesium rich minerals, but also nickel, cobalt, manganese and chromium trace elements in concentrations toxic to many species.

Steep hills and mountains, cliffs, headlands and peninsulas, harbours, inlets, spits, estuaries, beaches, dunes; minor fans, deltas and alluvial terraces; islets and islands.



Nationally important geological features: Matarau Point beach ridge gravel foreland, Greville Harbour boulder spit; serpentinitic breccias along parts of western coast.

Regionally important landforms: Pakiaka Point barrier island and lagoon; the Greville Harbour barrier dune system, and associated lagoon and swamp; French Pass partly submerged ridgeline and reef; Whangarae and D'Urville Island limestone outcrops.

Naturally prone to slips and earthflows due to predisposition of ultramafic geology to structural failure.

Coastal lagoons characteristic and regionally rare. Valley floors and stream flood plain/debris.

Low gradient streams with good pool-riffle structures.

## **2. Climate and Elevation**

Climate moist to wet; warm temperate.

Moderately low to high rainfall: 1100-2000 mm. Lowest at northern end of island. Occasional high intensity rainfall events.

Highly maritime - largely surrounded by sea. Many places frost-free. Salt spray a major coastal influence.

Generally exposed and windy; severe gales and storms occasional.

Harbours and estuaries relatively sheltered.

Moderate elevation: 0-856 m altitude range; mean altitude 250m.

## **3. Water**

Large, permanent-flowing streams with stable substrate.

Excellent water quality with stream headwaters often draining from native forest.

## **B. The Biological Environment**

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[Part of D'Urville and Sounds ecological districts]

Total area of D'Urville Ecosystem is 25,960 ha, of which 49% is native forest, 30% is shrubland (both exotic and native), 7% is pasture and non-woody native vegetation and 5% is plantation forestry.

(Note: Percentages based on interpretation of 1990 satellite images.)

### **1. Predominant Indigenous Vegetation**

Detailed in Table 2

Originally the area was predominantly indigenous forest.

Indigenous vegetation loss has been largely on lowland, maritime peninsulas, west-facing slopes and gentle topography, especially alluvium. Upland vegetation is largely intact.

Original non-forest vegetation is confined to exposed or heavily mineralised ultramafic areas, estuaries, freshwater wetlands, dunes, spits and barrier beaches, coastal bluffs, exposed islands and stacks.

## 2. Communities and Habitats

Coastal, lowland and upland ultramafic vegetation is extensive, very distinctive, an important habitat and vulnerable to disturbance and loss. Very low productivity; low species diversity but highly distinct; some communities, especially tussocklands, rocklands, shrublands and stunted forest, endemic to the mineral belt due to the tolerance by their species to high levels of trace elements, especially nickel, are nationally important. Coastal ultramafic communities are unique.

Dune, spit, beach, lagoon, freshwater wetland, estuarine and alluvial communities are very distinctive and rare in the Sounds - they are important habitats which add considerably to the biodiversity, biotic patterns, and productivity of the ecosystem.

Island communities are nationally important - distinct and rare biotic assemblages, highly productive. Some are predator-free, others free of major predators (eg; no possums on D'Urville) allowing for survival of species, communities and processes now under threat on the mainland.

Forest communities, especially with kohekohe, titoki or southern rata, are nationally important due to lack of possums.

One of the more extensive tracts of lowland forest remaining in Marlborough is found here.

Coastal shrublands are distinctive - endemic to Cook Strait.

Upland biotic patterns are still largely intact. Lowland and coastal patterns are often fragmented. Still very good connections remain between some communities, allowing for movement of biota and buffering from threats.

The area has very high native fisheries values, with diverse assemblages of native fish species. Absence of introduced freshwater fish. Good access for threatened fish species due to coastal proximity. Eel fishery in coastal lagoons.

Overall, natural biodiversity of communities and species is exceptional.

## 3. Plants

*Hebe rigidula* var. 'D'Urville' (d); *Euphorbia glauca* (r); Cooks scurvy grass (r); *Poranthera microphyllar* (r); *Craspedia* 'ultramafic' (r); *Chionochloa defracta*; bamboo tussock (r); *Rytidosperma petrosum* (r); *Spinifex sericeus* (r); *Hebe urvilleana*; *Tupeia antarctica* (r); *Knightia excelsa*; *Gahnia lacera* (r); *Lepidosperma laterale* (r); *Atriplex cinerea* (r); tanekaha; *Chionochloa beddei* (r); hutu; sand coprosma; whau (r); *Hebe elliptica* (r); *Melicytus obovatus*;

black maire (r); *Olearia serpentina*; large-leaved milktree; *Pimelea gnidia* (r); *P.longifolia* (r); raukawa; *Gingidia montana*; *Tetragonia tetragonioides* (r); *Baumea arthropphylla* (r), *Carex devia*, *Carex litorosa* (r); pingao (r); *Schoenus nitens* (r); *Corybas cheesemanii* (r); *Adiantum formosum* (r); *Pleurosorus rutifolius* (r); matagouri (r); *Bulbophyllum pygmaeum*; hangehange, *Dichelachne inaequiglumis* (r).

(d)=endemic to D'Urville Island (r)=rare in the Marlborough Sounds, or nationally threatened.

#### 4. Animals

*Powelliphanta 'obscura'* (r); long-tailed bat (r); fernbird (r); king shag (r)(e); spotless crane (r); sooty shearwater (r); fluttering shearwater; diving petrel; white-fronted tern; little blue penguin; green-spotted skink; Marlborough green gecko (r)(e); banded kokopu (r); short-jawed kokopu (r); giant kokopu (r); *Wainuia urnula nasuta* (r); D'Urville Id slug (*Pseudaneitea johnsi*) (r)(d).

((d)=endemic to D'Urville Island, (e)=endemic to Marlborough Sounds, (r)=rare in the Marlborough Sounds, or nationally threatened.)

### C. Priorities and Potential for Restoration

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#### Terrestrial Values

Upper areas more intact, with other areas extensively modified. Ultramafic areas vulnerable to fire and weed invasion, especially wilding pine and gorse.

Maintain absence of major mammal pests from islands - (eg; goats and possums from D'Urville) and eradicate others (eg; fallow deer).

Restoration of native duneland cover high priority.

Large areas of regenerating shrublands have excellent potential to develop back to lowland and coastal forests, and mature ultramafic forests and shrublands.

Priority to manage wild animal threats, especially pigs and deer, which are destroying *Powelliphanta* snail and its habitat.

#### Freshwater Values

Maintain and enhance wetland and associated riparian vegetation in lower gradient streams, lagoons, freshwater wetlands, and habitat of threatened species.

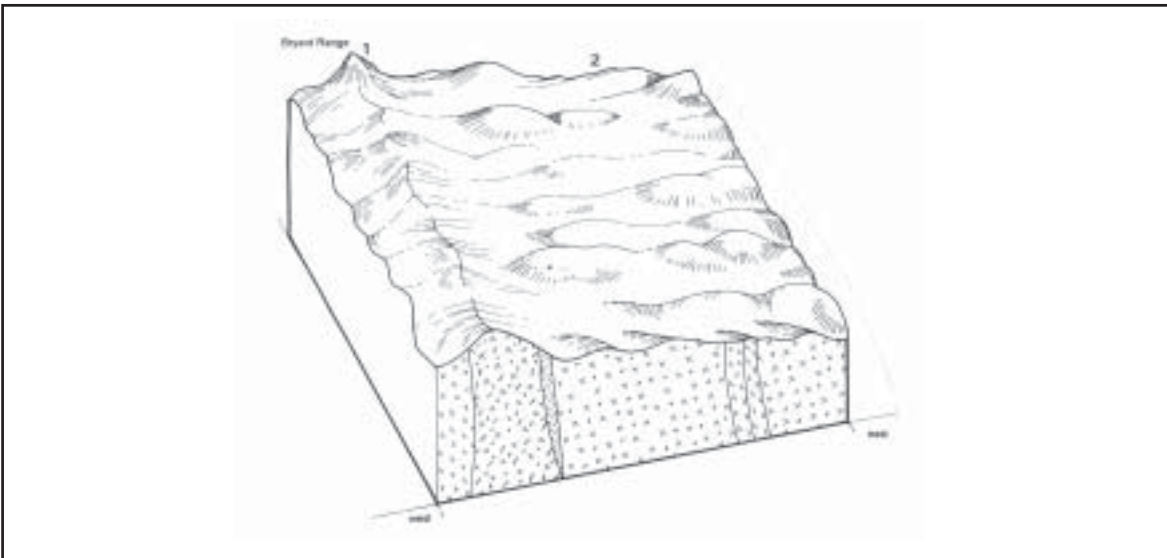
Address impacts of subdivision (stormwater, effluent soakage, water abstraction), forestry and farming (sediment and fertiliser run-off), and roading activity (gravel extraction/instream works/fish passage).



## 2 Bryant

### Pahautea, Southern Rata, Mountain Beech, Rifleman, Tit, Inland Ultramafic Ecosystem

Only the mountain summit crestline and eastern slopes of the Bryant Range plus a few isolated chunks of faulted blocks of nutrient-poor, mineral-rich, mantle rocks nearby make up this system. On the mid to upper slopes, an uneven hummocky character caused by mass earthflows is prominent with numerous rocky outcrops as the bones of the earth poke through. Elevation is high and the climate wet with no maritime influence but exposed conditions on the tops. The poor-nutrient soils with high concentrations of trace elements as allowed unique stunted vegetation to evolve; still mostly intact in its natural state.



**Table 3  
Indigenous Vegetation and Landforms - Bryant Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	Steep to very steep upper mountain slopes and summit ridges on ultrabasic rocks 700 - 2325 m.a.s.l.	Dun Mountain Ultramafic, Lee River Group gabbro	<p><b>Forest and Treeland</b> Mountain beech-southern rata-mountain toatoa forest and treeland.</p> <p><b>Shrubland</b> Wharariki-mountain tauhinu-mountain wineberry flax-shrubland.</p> <p><b>Tussockland</b> Mineral belt snow tussockland.</p> <p><b>Sedgeland</b> Mixed sedgeland (Schoenus, Carex, Carpha) on seepages.</p> <p><b>Rockland</b> Herb-tussock-rockland Hebe-coprosma shrub-rockland.</p>	<p><b>Forest and Treeland</b> Mountain beech-southern rata-mountain toatoa forest and treeland.</p> <p><b>Shrubland</b> Wharariki-mountain tauhinu-mountain wineberry flax-shrubland.</p> <p><b>Tussockland</b> Mineral belt snow tussockland.</p> <p><b>Sedgeland</b> Mixed sedgeland (Schoenus, Carex, Carpha) on seepages.</p> <p><b>Rockland</b> Herb-tussock-rockland Hebe-coprosma shrub-rockland.</p>

Landform Components	Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2. Strongly rolling to moderately steep irregular hummocky mid to upper mountain slopes on serpentinitic rocks [earthflows a feature] 200 - 1214 m.a.s.l.	Patuki and Croisilles melanges	<b>Forest and Treeland</b> Rimu/hard beech-black beech-lancewood forest. Mountain beech-cedar-halls Halls totara-bog pine treeland. <b>Shrubland</b> Inaka-mineral belt shrub daisy shrubland. Manuka shrubland.	<b>Forest and Treeland</b> Rimu/hard beech-black beech-lancewood forest. Mountain beech-cedar-halls Halls totara-bog pine treeland. <b>Shrubland</b> Inaka-mineral belt shrub daisy shrubland. Manuka shrubland.

## A. The Physical Environment

### 1. Landforms/Geology

Ultrabasic intrusives and serpentinitic melange (mineral belt). Includes iron and magnesium rich minerals, but also nickel, cobalt, manganese and chromium in concentrations toxic to many species.

The ecosystem is centred on the Pelorus-Rai catchment portion of Nelson-Marlborough ultramafic belt.

Summits along the Bryant Range are variously broad and undulating in south, to narrow and steep in the north. Upper slopes steep in the north and variable in the south with some very gentle topography.

Midslope topography generally hummocky with gentle knolls and some narrow steep faces. Flights of alternating steep and gentle slopes.

Mass earthflows producing extensive, gently-sloping 'ramps'. Natural earthflow events due to predisposition of ultramafic rocks to structural failure. The source of earthflows often marked by bluffs. Occasional large outcrops of resistant rock.

A cluster of lakelets (Dew Lakes) on the broad, flat crest of the Bryant Range.

Internationally important geological features: Dun Mountain, large area of sheared and faulted ultramafic rocks, including dunite and olivine.

Nationally important geological features: Patuki tectonic melange, consisting of blocks of various rock types in an ultramafic matrix.

Regionally important geological features: 3 km long Alfred Stream earthflow.

Moderate-sized watercourses with gentle to steep gradients depending on landforms, and with a parallel-linear arrangement.

### 2. Climate and Elevation

Cool temperate to cold, moist to wet climate. Winter frosts typical especially on gentle slopes. Temperature inversion and cold air drainage into valleys very pronounced. Wide annual temperate range. No ameliorating effects from the sea. Mild summer temperatures. Droughts rare. Very high incidence of fog in Pelorus valley which extends up into ecosystem.

Relatively high rainfall: 1700-2000 mm. Highest along the Bryant Range. Occasional very intense rainfall events.

Southeast aspect - slopes generally sheltered from strong winds and storm events. Ridge crests very exposed to prevailing westerly winds and storms. Winter snow on Bryant Range is occasional and ephemeral.

No maritime or coastal influence.

Relatively high elevation: 80-1214 m altitude range; mean altitude 600m.

### **3. Water**

#### **Permanent Flowing Streams**

Generally, very good water quality with most areas draining intact catchments. Localised high impacts from forestry.

## **B. The Biological Environment**

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[Part of Pelorus Ecological District]

### **1. Predominant Indigenous Vegetation Detailed in Table 3**

Total area of Bryant ecosystem is 10,537 ha, of which 81% is in native forests, 13% is shrubland, 5% is plantation forestry and 1% is pasture.

(Note: Percentages based on interpretation of 1990 satellite images.)

Originally, predominantly a mosaic of tall and short-statured forest and shrublands - correlating with degree of influence of ultramafic substrate, topography and natural disturbance. Tussocklands, rocklands and low-statured shrublands on bluffs, slips, outcrops and the crest of the Bryant Range where ultramafic and climatic influences are high.

Ecosystem still largely intact with the exception of the lower altitude parts of Tinline and Heringa Streams, and Maungatapu, Rai and Ronga Saddles. Regenerating shrublands in some of these areas.

### **2. Communities and Habitats**

Very distinctive, low-fertility forest, shrublands and tussocklands on ultramafic substrate (Nelson/Marlborough mineral belt) supporting locally endemic ultramafic species, and nationally or regionally rare species; some communities, especially tussocklands, rocklands, shrublands and stunted forest, endemic to the mineral belt due to the tolerance by their species to high levels of trace elements, especially nickel; some of these communities have their stronghold in Bryant ecosystem; upland forest unusual in Marlborough for supporting pink pine and southern cedar upland softwoods and associates more typical of northwest Nelson; high density of southern rata in places - nationally important.

Extensive lowland podocarp-beech-broadleaf forests; part of the largest tract of lowland forest in north Marlborough; a particularly high density of rimu in places - regionally important.

Ecosystem characterised by its moderate to low biodiversity due to it being largely upland, the naturally infertile and toxic nature of the substrate, and lack of coastal and alpine communities. Non-forest communities especially, make an important biodiversity contribution.

Natural processes and dynamics largely intact (including natural earthflow events). Open and low-statured communities vulnerable to fire and invasion by weeds, especially wilding pines and gorse.

Biotic patterns largely intact, transparent and complex. Excellent examples of influence of substrate and topography on vegetation patterns - nationally important.

Low native fish diversity. Too far inland and elevated for most migratory species except eels.

### 3. Plants

Mineral belt shrub-daisy (*Olearia serpentina*) (m); mineral belt snow-tussock (*Chionochoa defracta*) (m); *Poranthera microphylla* (r); *Myosotis monroi* (r)(m); *Hebe* aff. *carosula* (r)(m); *Pimelea suteri* (r); *Pimelea* aff. *sericeovillosa* (r)(m); *Poa acicularifolia* ssp. *ophitalis* (r)(m); *Colobanthus* 'serpentine' (m); *Bulbophyllum pygmaeum*; *Astelia graminea*; southern cedar (r); pink pine (r); red tussock; *Hydrocotyle dissecta*.

(m)=endemic to Nelson/Marlborough mineral belt (r)=rare in the Marlborough Sounds, or nationally threatened.

### 4. Animals

Nelson green gecko (r); *Powelliphanta 'consobrina'* (r); falcon, kaka.

(r)=rare in the Marlborough Sounds, or nationally threatened.

## C. Priorities and Potential for Restoration

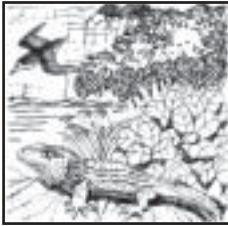
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### Terrestrial Values

Manage weed spread threats, especially gorse and wilding pines. Manage wild animal threats, especially pigs and goats which are destroying *Powelliphanta* and its habitat.

Excellent potential for allowing successional shrublands to regenerate back to mature ultramafic forest and shrubland communities, especially in lower altitudes.

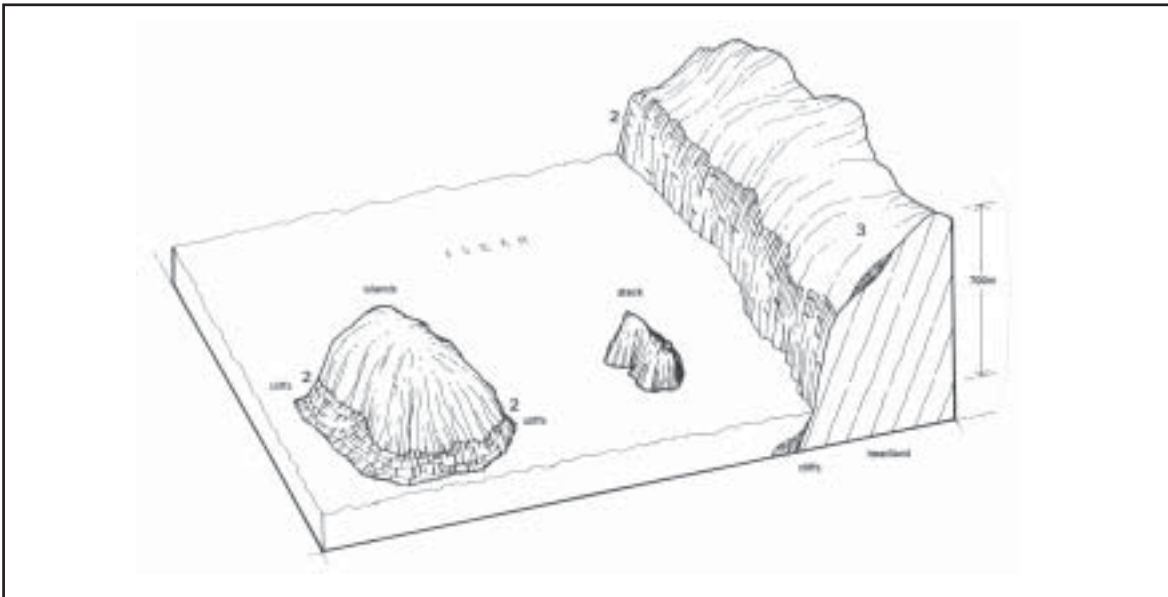
Freshwater values: Priority to control effects of land disturbance activities on downstream values and maintain/restore riparian communities where disturbed.



### 3 Cook Strait

#### Taupata, Ngaio, Rengarenga, Tuatara, Diving Petrel, Exposed, Dry, Maritime Ecosystem

Highly exposed maritime land ecosystem. High coherence of cliff face landforms with a collection of jagged stacks and harsh rocky islands. Steep, exposed and daunting sea cliffs, peninsulas and headlands. Wild and scenic sea coast. Dry climate coupled with small catchment areas and few streams. Elevation is low and rocks are predominantly a range of schists and sedimentary strata. Exposure and maritime influence is extreme. Brutal exposure to the elements has shaped a unique Cook Strait vegetation. The sheer nature and the topography and inaccessibility has left some areas, especially islands, predominantly in a natural state. High aesthetic coherence of pastoral landcover. A number of island sanctuaries (Stephens, Chetwodes, Titi and Brothers Islands). Stephens Island tuatara. King Shag stack roosts. Many rare species.



**Table 4  
Indigenous Vegetation and Landforms - Cook Strait Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	<p><b>Steep to very steep dissected cliff bounded islands</b></p> <p>0-280 m. elevation</p>	<p>Predominantly weakly to strongly developed Marlborough Schist</p>	<p><b>Forest</b> Ngaio-taupata forest. Kohekohe-karaka-nikau forest. Kohekohe-broad-leaved milktree forest.</p> <p><b>Vineland</b> Pohuehue vineland.</p> <p><b>Herbfield</b> Silver tussock-muttonbird groundsel tussock-herbfield.</p>	<p><b>Forest</b> Ngaio-taupata forest. Kohekohe-karaka-nikau forest. Kohekohe-broad-leaved milktree forest.</p> <p><b>Herbfield</b> Silver tussock-muttonbird groundsel tussock-herbfield.</p>



Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2.	<b>Very steep to precipitous sea cliffs with extensive rock outcrop</b> 0-200 m. elevation	Predominantly weakly to strongly developed Marlborough Schist; sedimentary rocks	<b>Shrubland</b> Cook Strait kowhai shrubland. Taupata shrubland. <b>Herbfield and Rockland</b> Sea blite-horokaka herbfield. Herb-rockland. <b>Tussockland</b> Silver tussockland.	<b>Shrubland</b> Cook Strait kowhai shrubland. Taupata shrubland. <b>Herbfield and Rockland</b> Sea blite-horokaka herbfield. Herb-rockland. <b>Tussockland</b> Silver tussockland.
3.	<b>Steep to very steep sinuous headlands with extensive rock outcrop, and very steep coastal hill and mountain slopes</b> 0-753 m. elevation	Predominantly weakly to strongly developed Marlborough Schist; sedimentary rocks	<b>Forest</b> Ngaio-taupata forest. Kohekohe forest. Cook Strait mixed broadleaf forest. <b>Shrubland and Flaxland</b> Cook Strait shrublands. Cook Strait kowhai shrubland. Taupata-ngaio shrubland. Wharariki flaxland. Tauhiru Shrubland. <b>Herbfield and Rockland</b> Herb-rockland.	<b>Forest</b> Ngaio-taupata forest. Kohekohe forest. Cook Strait mixed broadleaf forest. <b>Shrubland and Flaxland</b> Cook Strait shrublands. Cook Strait kowhai shrubland. Taupata-ngaio shrubland. Wharariki flaxland. <b>Herbfield and Rockland</b> Herb-rockland.
4.	<b>Precipitous stacks</b> 0-100 m. elevation	Predominantly weakly to strongly developed Marlborough Schist; sedimentary rocks	<b>Herbfield and Rockland</b>	<b>Herbfield and Rockland</b>

## A. The Physical Environment (Cook)

### 1. Landforms/Geology

Weakly to strongly developed schists; sedimentary strata; minor igneous rocks. No alluvium and limited colluvium.

Very steep landforms. A collection of jagged stacks and rocky islets, steep cliff bounded islands, steep and exposed sea cliffs, and headlands and peninsulas.

Coastal landforms developed as a result of high wave energy.

Soils shallow, stony, skeletal, moderately fertile.

Cliffs and very steep slopes particularly erosion-prone.

Regionally important geological features: Fighting Bay schist sea cliffs.

Streams are usually steep with unstable beds and a lack of good pool-riffle structures. Distinct lack of low gradient stretches, stream flood plains or debris fans.

### 2. Climate and Elevation

Dry, temperate climate; low rainfall: 800-1200 mm. Drought conditions common. No extremes of temperature. Frost-free. Very limited cold air drainage and ponding.

Maritime influence is extreme. Salt spray is a major influence over the whole ecosystem. Large swells and storm surges typical.

High wind velocities, especially through the Cook Strait narrows. Gale conditions frequent.

Low elevation: 0-560m altitude range; mean altitude 100 m.a.s.l.

### **3. Water**

Reasonable water quality as most agricultural farming extensive in nature.

Some streams ephemeral, especially during summer months.

## **B. The Biological Environment**

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[Part of Cook Strait Ecological District]

Total area of Cook Strait ecosystem 6,659 ha of which; 15% is in native forest and 20% is in shrubland (both native and exotic), 52% is in pasture, native non-woody vegetation; and 13% is in plantation forestry.

(Note: Percentages based on interpretation of 1990 satellite images.)

### **1. Predominant Indigenous Vegetation Detailed in Table 4**

Mostly cleared except for some bluff communities and islands. Now in extensive pasture cover.

Originally a mixture of broad-leaved forests, especially kohekohe forest, and on exposed, dry, very steep or rocky sites: stunted forest, windshorn scrub and shrublands, tussocklands and herbfields - especially succulents. Compared to other land ecosystems, a high proportion of non-forest communities.

### **2. Communities and Habitats**

Island communities nationally important - distinct and rare biotic assemblages; vulnerable to disturbance and loss and difficult to recover. Vital habitat for threatened species due to lack of introduced predators. Several species now confined to Cook Strait ecosystem.

Unique animal and plant communities dependent on seabirds - nationally important. Their high fertility/high acid guano input from the marine environment, and major physical effects of burrowing and trampling. Highly productive and high nutrient turnover. Seabirds have a major influence on community composition, structure and processes.

Shrublands, herbfields and tussockland communities are highly distinctive - endemic to Cook Strait; important habitats.

Eastern flanks of Arapawa Island support some of the best remaining examples of Cook Strait mixed broad-leaved forest - nationally important, especially as possum-free.

Frequent swells and surges have a profound influence on coastal communities.

Exceptional biodiversity for a maritime land ecosystem. Moderate natural biodiversity relative to other land ecosystems - limited by extreme environmental conditions and narrow range of landforms, altitude, and water regimes.

Several otherwise southern and subantarctic species occur here at their northern limits.

Lack of introduced freshwater fish. Good fish access from sea but unsuitable in stream habitat due to steep topography and lack of low gradient stream areas.

Coastal location of streams facilitate good access for juvenile whitebait (eg; banded kokopu). Low native fish diversity.

### 3. Plants

*Kirkianella 'glauca'* (r)(c); muttonbird groundsel (r); Cooks scurvy grass (r); fierce lancewood (r); *Anemanthele lessoniana* (r); *Sophora* 'Cook Strait'; *Carex trifida* (r) sea blite; *Melicytus obovatus*; large-leaved milktree; *Atriplex buchananii* (r); *Carex testacea*; *Scandia geniculata* (r); *Hebe* aff. *urvilleana* (c); Cook Strait bristle tussock (r); *Hebe 'parviflora'* (r); *Puccinellia walkeri* (r); *Crassula moschata*; *Acipylla squarrosa*; *Craspedia uniflora* var. *maritima*; rengarenga.

(c)=endemic to Cook Strait ecosystem (r)=rare in the Marlborough Sounds, or nationally threatened.

### 4. Animals

Nationally high concentration of rare, relictual and endemic fauna vulnerable to predation and/or collection.

Cook Strait tuatara (c); Brothers Islands tuatara (c); king shag (r)(c); fluttering shearwater; fairy prion; diving petrel; sooty shearwater; flesh footed shearwater; white-faced storm petrel; little blue penguin; Hamiltons frog (r)(c); speckled skink (r); Duvaucels gecko (r); striped gecko (r)(e); green-spotted skink; Marlborough green gecko (r)(e); flax weevil (r); ngaio weevil (r)(c); Cook Strait click beetle (e); Cook Strait giant weta (r);

*Mecodema punctellum* (r)(c); *M. c.*

*costellum* (r); *Odontria nesobia* (r)(e); peripatus, *Rhytida 'stephenensis'* (r); kakariki (yellow-crowned parakeet) (r); South Island robin; slug (*Pseudaneitea schauinslandi*) (r)(e).

(c)=endemic to Cook Strait ecosystem (e)=endemic to Marlborough Sounds (r)=rare in the Marlborough Sounds, or nationally threatened.

## C. Priorities and Potential for Restoration

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### Terrestrial Values

Much of the natural cover of the ecosystem is gone. The severe maritime climate impedes the recovery of indigenous vegetation.

Maintenance of predator-free status of islands and facilitation of eradication of predators from others.

Maintenance of shrublands to provide the vital first stage in forest restoration.

Recognition of importance of mainland peninsulas as potential "mainland island" restoration areas.

Integrity of wild landscape experience vulnerable to signs of modification and disruption eg; land or sea structures and plantation forestry.

Active revegetation on the most important islands vital for restoration.

### Freshwater Values

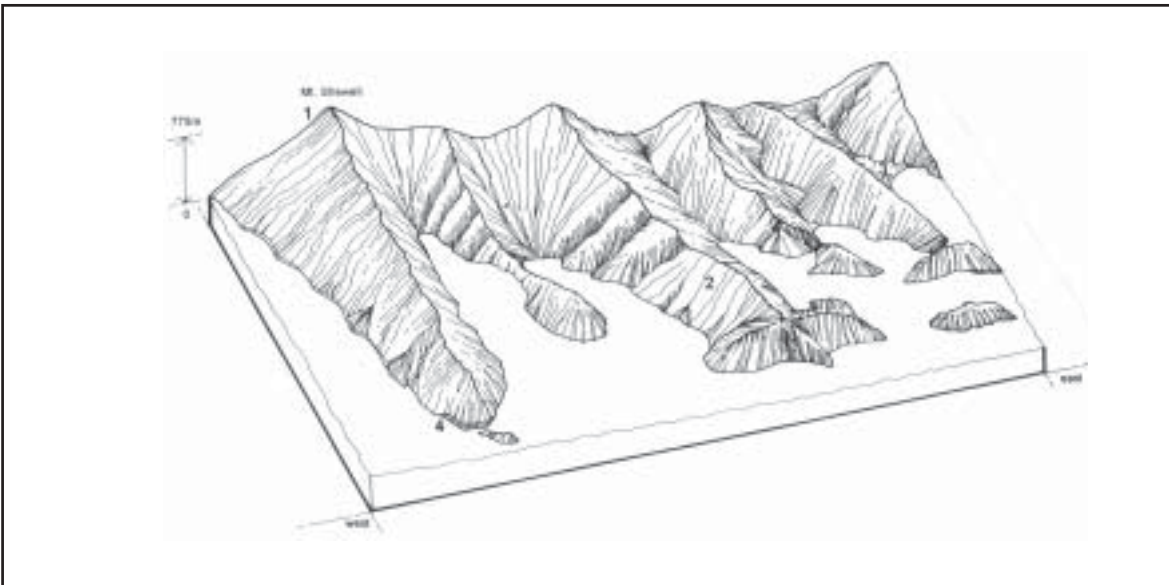
Restoration of freshwater habitat constrained by topography, and few areas worthy of restoration.



## 4 Bulwer

### Kohekohe, Wharariki, Blue Penguin, Western Sounds, Dry, Non to Weakly Schistose Ecosystem

Steepish dissected, climatically dry coastal hill slopes stretch fingers at random into the sea, forming many bays and coves, the landmass itself being the most submerged of the Marlborough land ecosystems. Inside these splayed fingers the sea abuts the land abruptly, with few beaches. Rocks are sedimentary and weakly developed schist. Maritime influence and exposure is high, elevation generally low. Fragmented vegetation patterns, with much scrubland.



**Table 5  
Indigenous Vegetation and Landforms - Bulwer Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	Steep to very steep upper hill and mountain slopes 500-775 m. elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<b>Forest</b> Silver beech-hard beech-miro forest, Mt.Mt Shewell Summit. Rimu-red beech-miro, kamahi forest. <b>Tussockland</b> Silver tussockland.	<b>Forest</b> Silver beech-hard beech-miro forest, Mt Shewell Summit. Rimu-red beech-miro, kamahi forest.

<b>Table 5 (cont)</b>				
<b>Indigenous Vegetation and Landforms - Bulwer Ecosystem</b>				
Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2.	<b>Moderately steep to steep lower hill slopes</b> 0-600 m. elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<b>Forest</b> Kohekohe-tawa-nikau forest (with karaka in places). Kohekohe forest. Hard beech-kamahi forest with scattered emergent rimu. Secondary broadleaf forest (mahoe, wineberry, mamaku, putaputaweta, pigeonwood). Kamahi-hinau-miro forest. Mamaku tree-fernland. <b>Scrub cover and vineland</b> Manuka scrub with Pinus radiata emergent in places. Kiekie vineland.	<b>Forest</b> Kohekohe-tawa-nikau forest (with karaka in places). Hard beech-kamahi forest with rimu. Kamahi-hinau-miro forest. Pukatea-tawa mixed broadleaf forest.
3.	<b>Minor prograding inlet heads and fans</b> eg. P26/733188 0-20 m. elevation	Recent alluvium from predominantly sedimentary and schist rocks, minor swamp deposits	-	<b>Forest</b> Kahikatea-pukatea-nikau forest. Kahikatea-pukatea-tawa-kohekohe forest.
4.	<b>Dry headlands, promontories. Minor steep to precipitous eroding sea cliffs</b> 0-200 m. elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<b>Forest</b> Hard beech-kamahi forest with rimu. Black beech forest. Akiraho-Wwharariki-fivefinger flax-treeland coastal forest and shrubland. <b>Vineland and rockland</b> Kiekie vineland. Herb-rockland (just above sea level).	<b>Forest</b> Akiraho-Wwharariki-fivefinger flax-treeland, coastal forest and shrubland. Kiekie vineland. Hard beech-kamahi forest with rimu. Black beech forest. <b>Vineland</b> Kiekie vineland.

## A. The Physical Environment

### 1. Landforms/Geology

Sedimentary strata and weakly developed schists; very limited alluvium and colluvium. A few headlands of serpentinitic melange (mineral belt).

Step to moderately steep coastal hill slopes, inlets, beaches, minor fans. Very indented coastline with prominent peninsulas and headlands.

Excessively drowned landscape partly due to sea floor subsidence.

Streams generally small and steeply graded.

## 2. Climate and Elevation

Moderately dry, warm-temperate to maritime climate. Many places frost-free. Limited cold air drainage and ponding.

Moderate to low rainfall: 1200-1500 mm. Summer drought common.

Moderate to low elevation: 0-775 m altitude range; mean altitude 200 m.

High maritime influence. Salt spray a major coastal influence. Generally, exposed and windy, although some sheltered bays.

## 3. Water

Summer low flows and a few streams ephemeral in summer.

Some water quality degradation arising from surrounding uses (forestry and subdivision).

## B. The Biological Environment

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[Part of Sounds Ecological District]

Total area of Bulwer ecosystem is 15,234 ha of which; 22% is in native forest, 35% is in shrubland (both native and exotic), 9% is in pasture and non-woody indigenous vegetation, and 4% is in plantation forestry.

(Note: Percentages based on interpretation of 1990 satellite images.)

### 1. Predominant Indigenous Vegetation Detailed in Table 5

Originally all forested except for rock and gravel shore fringe communities, bluffs, exposed, rocky or dry headlands, and estuaries at inlet heads. Small amount of remaining forest largely confined to upper slopes or south-facing aspects. Indigenous vegetation lost over most of the coastal and lower altitude zones, especially north and west-facing aspects. Kohekohe and mixed broadleaf forests which were once dominant, are now greatly diminished.

### 2. Communities and Habitats

Island communities (especially Maud Island) distinctive, rare and nationally important due to predator-free status. Vital habitat to endangered biota.

Communities on Tennyson Inlet islands are possum-free; some very distinct, especially coastal herbfields which support nationally threatened species - nationally important.

Moderately high natural biodiversity due to island contributions and warm temperature nature of ecosystem providing for northern species.

### 3. Moderate Productivity

Biotic patterns disrupted and fragmented, especially over the warmer and drier aspects, and coastal zone.

Undisturbed natural gradients between terrestrial and marine ecosystems uncommon due to marine farming.

Good habitat for migratory fish species. Large areas still unsurveyed but potential for high native fish diversity. Good access for threatened native fish species due to coastal proximity.

### 4. Plants

*Arthropodium cirratum*; *Danhatchia australis* (r); rewarewa; large-leaved milktree; wharangi; *Adiantum viridescens* (r); *Arthropteris tennella*; *Lastreopsis velutina*, Cooks scurvy grass(r)

(r)=rare in the Marlborough Sounds, or nationally threatened.

### 5. Animals

Maud Island frog (r)(b); striped gecko (r)(e); little blue penguin; *Powelliphanta 'obscura'* (r); Cook Strait click beetle (r)(e); *Odontria nesobia* (r)(e); *Rhytida 'stephenensis'* (r); Trios slug (*Reflectopallium delli*) (r)(b?), Cook Strait giant weta (r).

(b)=endemic to Bulwer ecosystem (e) =endemic to Marlborough Sounds (r)=rare in the Marlborough Sounds, or nationally threatened.

## C. Priorities and Potential for Restoration

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### Terrestrial Values

Very low levels of indigenous vegetation cover remain compared with original cover, and other land ecosystems. North and west-facing communities largely gone. Priority to protect, expand and connect fragments.

Maintenance of shrublands provides excellent opportunity for forest restoration, especially in coastal, and warm north and west-facing situations, and on alluvium.

Maintenance of predator-free status of islands, especially Maud Island.

### Freshwater Values

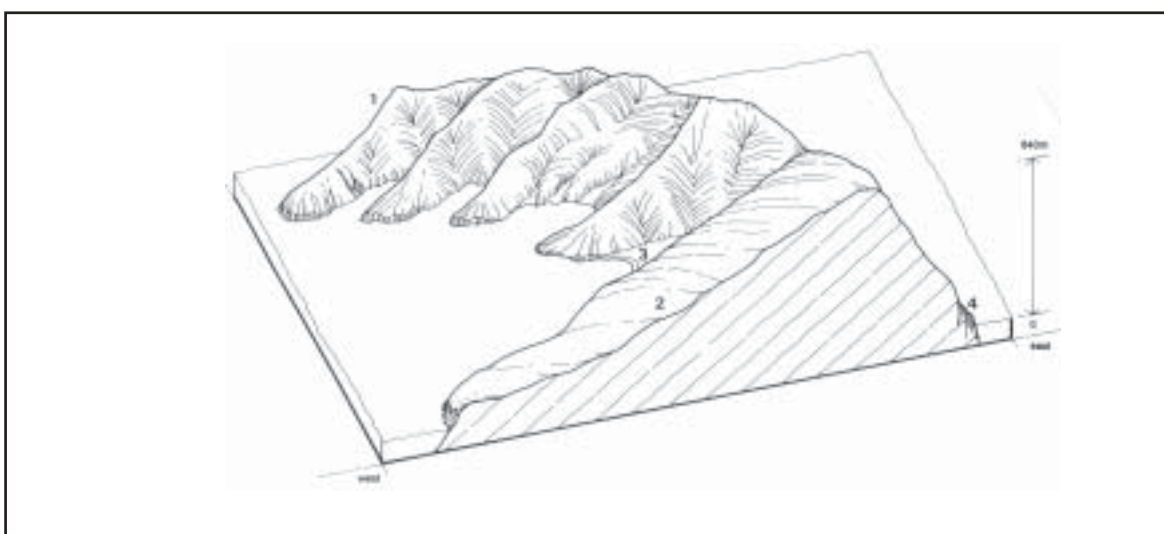
Effects of subdivision and land disturbance need to be managed (water abstraction, fish passage, sedimentation, vegetation clearance). Maintain and enhance riparian vegetation in lower gradient stream areas.



## 5 Arapawa

### Tauhinui, Black Beech, Fluttering Shearwater, *Powelliphanta 'bicolor'*, Eastern Sounds, Dry, Weakly Schistose Ecosystem

Steep to moderately steep dry dissected coastal hill slopes are a feature of this land ecosystem with several islands, a highly indented coast, and confined coastal inlets, beaches and undulating to rolling prograding inlet heads and minor fans filling the valley floors. Baserock is weakly developed schist with minor sedimentary layers, with a valley overlay of alluvium in places. Exposure and maritime influence is generally high due to landmass being surrounded by sea, the elevation low. Fragmented vegetation patterns, with much scrubland.



**Table 6  
Indigenous Vegetation and Landforms - Arapawa Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	<b>Steep to very steep upper hill and mountain slopes</b> 500-640 m elevation	Siliceous, weakly developed Marlborough Schist, minor Pelorus Group sedimentary rocks	<b>Forest</b> Red beech forest. Kamahi-hinau-toro-miro-mountain totara-southern rata forest.	<b>Forest</b> Red beech forest. Kamahi-hinau-toro-miro-mountain totara-southern rata forest.
2.	<b>Moderately steep to steep lower hill slopes</b> 0-500 m elevation	Siliceous, weakly developed Marlborough Schist, minor Pelorus Group sedimentary rocks	<b>Forest</b> Kohekohe-nikau-tawa forest. Tawa-hinau-mixed broadleaf forest. Kohekohe-mahoe-broad-leaved milktree forest. Hard beech-kamahi-hinau-miro forest. Kanuka/Manuka-fivefinger-mingimingi-shining karamu forest. Black beech forest. <b>Scrub</b> Manuka scrub.	<b>Forest</b> Tawa-hinau-mixed broadleaf forest. Kohekohe-nikau-tawa forest. Kohekohe-mahoe-broad-leaved milktree forest. Hard beech-kamahi-hinau-miro forest. Black beech forest.



Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
3.	<b>Minor prograding inlet heads and fans</b> [eg. P27/090905, Q27/253084] 0-20 m elevation	Recent alluvium from predominantly weakly developed schists, minor swamp deposits	<b>Shrubland</b> Marsh ribbonwood-coastal shrub daisy estuary scrubland. <b>Forest</b> Tawa-titoki mixed broadleaf forest. Tawa-kamahi-mamaku mixed broadleaf forest.	<b>Shrubland</b> Marsh ribbonwood-coastal shrub daisy estuary scrubland. <b>Forest</b> Kahikatea-pukatea-matai-tawa-titoki forest.
4.	<b>Steep to precipitous eroding sea cliffs,</b> minor component 0-250 m elevation	Siliceous, weakly developed Marlborough Schist, minor Pelorus Group sedimentary rocks	<b>Scrub and herbfield</b> Coastal bluffs herbfield. Wharariki-tauhinu-coastal shrub daisy-akiraho scrub. Rengarenga lily cliff herbfield.	<b>Scrub and herbfield</b> Coastal bluffs herbfield. Wharariki-tauhinu-coastal shrub daisy-akiraho scrub. Rengarenga lily cliff herbfield.

## A. The Physical Environment

### 1. Landforms/Geology

Weakly developed schist geology and minor sedimentary strata. Very minor pockets of alluvium.

Steep to moderately steep hill slopes; many inlets; minor beaches, fans and alluvium. Very indented and dissected coastline due to excessive marine submergence, resulting in numerous headlands, peninsulas and deeply recessed bays.

Several islands of various sizes, (including Arapawa, Blumine, Pickersgill and Long Islands) separated from the mainland and each other by narrow passages.

Regionally important geological feature: Long Island gravel cusped foreland.

Steep, small to moderate-sized stream catchments. Some low-gradient stream stretches and few freshwater wetlands (eg. Port Underwood).

### 2. Climate and Elevation

Dry, temperate climate. Many areas frost-free. Limited cold air drainage and ponding.

Moderately low rainfall: 1200-1400 mm. Summer drought common and drought possible any time of year. Summits moist.

High maritime influence - surrounded by sea. Salt spray a major coastal influence in exposed situations - especially Port Underwood and Outer Queen Charlotte Sound.

Exposure variable. Outer Queen Charlotte Sound and Port Underwood exposed to strong winds and occasional gales. Inner Queen Charlotte, Tory Channel and associated bays generally sheltered. Summits of higher peaks very exposed and wind-shorn.

Low elevation: 0-640 m altitude range; mean altitude 170 m.a.s.l.

### **3. Water**

Reasonable water quality in most catchments.

Summer low flows. Some streams ephemeral in dry spells.

## **B. The Biological Environment**

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[Part of Sounds Ecological District]

Total land area of Arapawa ecosystem is 12,962 ha of which; 15% is in native forest, 29% is in shrubland (both native and exotic), 34% is in plantation forestry and 22% is in pasture and non-woody indigenous cover.

(Note: Percentages based on interpretation of 1990 satellite images.)

### **1. Predominant Indigenous Vegetation Detailed in Table 6**

Originally, predominantly forested, except for rock and beach shoreline fringes, bluffs, and estuarine embayment heads. Now, mostly cleared of indigenous forest and that which remains is in small scattered pockets, generally at higher elevations and steeper slopes, or on islands. Fan and alluvial forest almost entirely gone. Other than on the smaller islands, coastal forest is almost entirely gone.

Freshwater wetlands naturally rare in this ecosystem. A few still remain - swamp forest gone.

Regenerating shrublands now a significant component of the landscape.

### **2. Communities and Habitats**

Dry beech forest and mixed broadleaf forests of this ecosystem are distinctive and regionally important.

Possum not present on any islands; deer absent from Arapawa Island.

Island communities with absence of major introduced mammals regionally and nationally important; some of these such as Kohekohe forest, are now becoming threatened on the mainland.

Freshwater wetlands, especially in Port Underwood, a rare and distinctive part of the ecosystem.

Generally, low to moderate productivity due to environmental constraints, especially dry conditions.

Moderate biodiversity due to range of island, coastal, lowland, sheltered/exposed communities. Limited range of landforms, altitude and geology.

Biotic patterns very fragmented and difficult to interpret, with little connection and intact gradation amongst various communities. Dynamics and process functioning is incapacitated or severely compromised in many natural areas.

Smaller islands very important for their uninterrupted natural sequences from ridge top to sea floor, and relatively intact coastal communities.

Freshwater low gradient stretches have the potential to support diverse native fish populations. Good access for threatened native fish species due to coastal proximity.

### 3. Plants

*Hoheria 'tararua'* (r); *Olearia solandri*; *Wharangi*; *Hebe 'paviflora'* (r); *Pimelea tomentosa* (r), sand spurge (r), *Tupeia antarctica* (r); large-leaved milktree; red mistletoe, raukawa.

(r)=rare in the Marlborough Sounds, or nationally threatened.

### 4. Animals

*Powelliphanta 'bicolor'* (r)(e); little-spotted kiwi (r); Eastern Sounds carabid beetle (*Megadromus* sp.) (r)(e); *Wainuia urnula nasuta* (r).

((e)=endemic to Marlborough Sounds (r)=rare in the Marlborough Sounds, or nationally threatened.)

## C. Priorities and Potential for Restoration

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### Terrestrial Values

Only isolated fragments exist at present. Priority to protect and connect fragments; excellent potential for regeneration of shrublands back to forest. Shrublands prone to pine invasion.

Priority to restore coastal communities, and fan/alluvial communities.

Maintain predator-free nature of islands, and the absence of major mammal pests from islands (eg; deer and possums from Arapawa).

### Freshwater Values

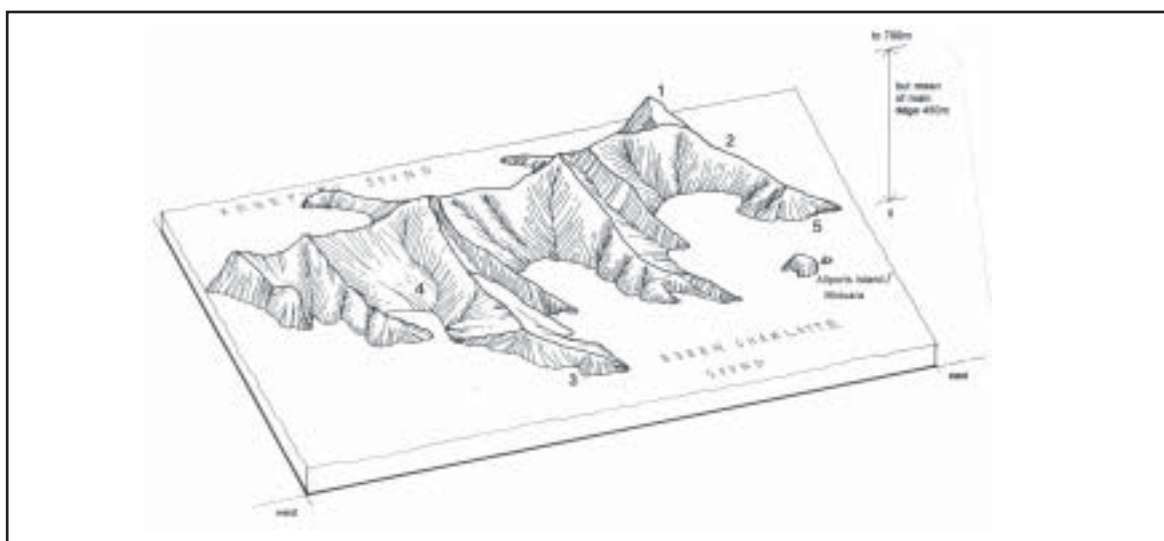
Effects of land disturbance such as tracking and forest harvesting require management to avoid effects on water quality and fish passage. Scope and value for riparian restoration in low gradient stretches. Good potential for wetland protection and buffering.



## 6 Portage

### Kanuka, Rewarewa, Pipipi, Sounds, Dry, Strongly Schistose Ecosystem

A strongly dissected long low ridge with many bays forming a gnarled finger separates two water bodies. Rocks are strongly schistose and slopes steep. Both maritime influence and rainfall are moderated. Due to the excessively drowned nature and low relief of the landmass, flats and gentle slopes are common. Slopes generally merge into the sea sometimes terminating in steep rocky shorelines but not usually with tall cliffs.



**Table 7  
Indigenous Vegetation and Landforms - Portage Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	Steep to very steep upper hill and mountain slopes, minor component 600-700 m elevation	Siliceous, strongly developed Marlborough Schist	<b>Forest</b> Red beech-silver beech-kamahimountain totara-southern rata-tree fuchsia forest.	<b>Forest</b> Red beech-silver beech-kamahimountain totara-southern rata-tree fuchsia forest.
2.	Moderately steep to steep lower hill slopes 0-600 m elevation	Siliceous, strongly developed Marlborough Schist	<b>Forest</b> Rimu-kahikatea/tawa-kohekohe-pukatea-nikau-hinau forest. Tawa-mixed broadleaf forest. Hard beech-kamahi-pongamingimingi forest on ridges and spurs. Secondary mixed broadleaf mamaku forest (mahoe, kaikomako, rangiora, heketara, mapou, fivefinger, wineberry, putaputaweta, karamu). Tawa-pukatea forest (kohekohe, nikau, kiekie in places). Kanuka forest. <b>Scrub</b> Manuka scrub stands with emergent rewarewa.	<b>Forest</b> Rimu-kahikatea/tawa-kohekohe-pukatea-nikau-hinau forest. Tawa-pukatea forest (with kohekohe, nikau-kiekie in places). Rimu/hard beech-kamahiforest. Rimu-matai-kahikatea tawapukatea forest.

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
3.	<b>Moderately steep low broad headlands</b> 0-50 m elevation	Siliceous, strongly developed Marlborough Schist	<b>Forest</b> Black beech forest	<b>Forest</b> Rimu/black beech forest
4.	<b>Minor prograding inlet heads, fans, and wetlands</b> [e.g: P27/ 877978, 870935] 0-20 m elevation	Recent alluvium from predominantly schistose rocks, minor swamp and estuarine deposits	<b>Rushland</b> Sea rush-jointed rush rushland with marsh ribbonwood.	<b>Rushland</b> Sea rush-jointed rush rushland with marsh ribbonwood.
5.	<b>Steep coastal cliffs, minor component</b> 0-100 m elevation	Siliceous, strongly developed Marlborough Schist	<b>Shrubland</b> Coastal fringe of rangiora-akiraho-Wharariki-akeake shrubland.	<b>Shrubland</b> Coastal fringe of rangiora-akiraho-Wharariki-akeake shrubland.

## A. The Physical Environment

### 1. Landforms/Geology

Strongly developed schist with pronounced foliation into layers. Schist geology responsible for the blocky nature of hillslope landforms. Minor alluvium and swamp deposits.

Moderately steep to steep Inner Sounds hill slopes. Extensive northwest-oriented faces above a weakly indented coastline in Kenepuru and Mahau Sounds, strikingly contrasted by the deeply incised coastline of headlands and recessed bays in Queen Charlotte Sound. Excessively dissected coastline due to marine submergence. Rare gently-sloped fans at bay heads, and rare alluvial fans (especially Anakiwa, and between Mahau and Kenepuru Sounds).

Wetlands naturally uncommon and confined to alluvial flats at the western, Inner Sounds end of the ecosystem.

A few small islands (Motuara, Allports, Motutapu) and rock stacks.

The eastern end of Portage ecosystem is separated from Stokes ecosystem by a major fault feature.

Slopes particularly prone to slips due to foliated geology, and intense rainfall events.

Significant eg; Mahau Sound head, Ohinetaha Bay and Umungata Streams small to moderate-sized; total lengths generally very short. Generally steep, although significant low-gradient stretches near the coast.

### 2. Climate and Elevation

Moderately dry to moist, temperate climate. Many areas frost-free. Frosts occasional on less steep sites, especially in sheltered bays. Cold air drainage and ponding is pronounced in inland western parts of the ecosystem and typical of sheltered bays.

Moderate rainfall: 1400-1600 mm. Summer droughts occasional on drier northwest-facing slopes above Kenepuru Sound. Occasional intense rainfall events.

Low elevation: 0-700 m altitude range; mean altitude 200 m.a.s.l.

Low to moderate exposure; varying degrees of shelter from strong winds and storms; bays particularly sheltered.

Moderate maritime influence - surrounded by usually calm seas. Some ameliorating effect on temperature extremes.

### **3. Water**

Some water quality problems in lower altitude areas from septic tanks.

Some streams ephemeral in dry conditions.

## **B. The Biological Environment**

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[Part of Sounds Ecological District]

Total land area in Portage Ecosystem is 12,380 ha of which; 32% is in native forest, 51% is in shrubland (both native and exotic), 12% is in plantation forestry and 6% is in pasture and non-woody indigenous cover.

(Note: Percentages based on interpretation of 1990 satellite images.)

### **1. Predominant Indigenous Vegetation Detailed in Table 7**

Originally, predominantly forested, except for rock and beach shoreline fringes, bluffs, and estuarine embayment heads. Small areas of swamp forest on alluvium.

Now, predominantly cleared of original indigenous forest although secondary forest covers significant areas in south-facing bays and headlands in Queen Charlotte Sound as well as islands. Good primary forest at eastern end of ecosystem. Generally, forest less compromised at higher elevations and steeper slopes. Fan and alluvial forest almost entirely gone. Coastal forest almost entirely gone in Kenepuru. Coastal forest well represented on headlands in Queen Charlotte Sound but lost from many bays.

Freshwater wetlands naturally rare in this ecosystem however a few still remain. Swamp forest is all but gone.

Regenerating shrublands of various stages are now a significant component of the landscape, especially above Kenepuru Sound.

### **2. Communities and Habitats**

Rare island communities and biotic assemblages, completely predator-free. Motuara Island is nationally important.

Primary podocarp-broadleaf forest between Ship Cove and Resolution Bay distinctive and regionally outstanding; intact natural sequences from ridge top to sea floor.

Primary coastal forest (eg Kumutoto Bay) regionally important.

Remaining estuarine, freshwater wetland and alluvial communities uncommon, distinctive, vulnerable and regionally rare respectively.

Biotic patterns highly modified but generally able to be interpreted. Complex human-induced patterns. Many long-standing communities connected by regenerating forest and shrublands. South-facing communities generally more intact (less past and ongoing disturbance, greater ability to recover) than north-facing communities.

Dynamics and process functioning generally healthy, although ongoing weed and wild animal threats.

Moderate natural biodiversity aided by the contribution of island biota.

Moderately low productivity partly due to low fertility of highly schistose rock; seasonally limited by drought in places.

Lower gradient streams have potential to support diverse native freshwater fish populations. Recruitment of galaxiids may be sporadic due to distance from open sea.

### 3. Plants

Rewarewa; hangehange;

*Corybas cheesemanii*; *Korthalsella salicornioides*; large-leaved milktree; white maire (r).

(r)=rare in the Marlborough Sounds, or nationally threatened.

### 4. Animals

Weka, banded kokopu, South Island saddleback, South Island robin; Maud Island frog (recently introduced) (r)(e).

( e)=endemic to Marlborough Sounds (r)=rare in the Marlborough Sounds, or nationally threatened.)

## C. Priorities and Potential for Restoration

### Terrestrial Values

Primary forest now remnant although large areas of secondary forest and regenerating shrublands provide excellent potential for forest restoration.

Maintenance of predator-free nature of islands a high priority.

Priority to restore warm, drier north-facing forests of ecosystem, as well as coastal forests fringing sheltered bays.

Retention and encouragement of restoration of rare and remnant alluvial, freshwater and estuarine communities.

### Freshwater Values

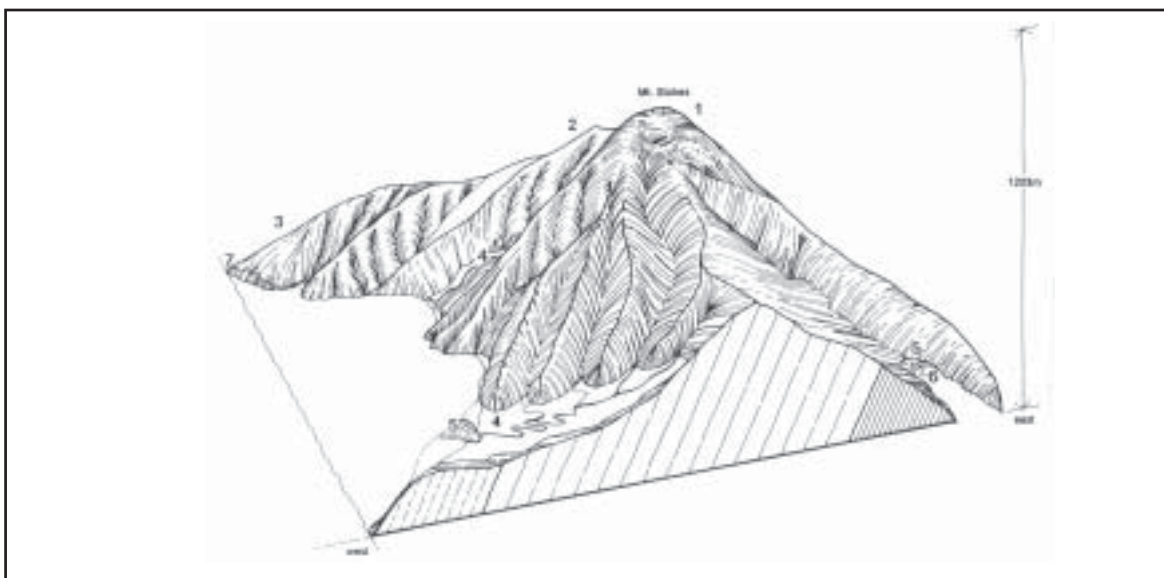
Water quality restoration needed through septic tank management.



## 7 Stokes

### Silver Beech, Stoppy-Stop, *Celmisia macmahonii*, Mohua, Sounds, Wet, Weakly to Strongly Schistose Ecosystem

Very steep to moderately steep, evenly contoured coastal hills and mountain slopes with steep and rolling upper ridge crests and summits feature here and together form the substantial Stokes massif. The coastline is characterised by several large, deeply incised inlets and prominent headlands. At the land-sea interface, confined coastal inlets and undulating to rolling prograding inlet heads are evident with alluvial flats, fans and dunes present. Foliation of schist baserock into layers ranges from weak to strong. There is a great range in height and rainfall gradient from sea level to mountain tops, which are dominating, highly exposed and sometimes covered in snow. Overall, the influence of the sea is generally high as it surrounds the landmass.



**Table 8  
Indigenous Vegetation and Landforms - Stokes Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	<b>Strongly rolling to moderately steep broad mountain summits and upland ridge crests</b> 1100-1200 m elevation	Siliceous, weakly to strongly developed Marlborough Schist	<b>Alpine Openlands</b> Shrub-tussock-boulderfield. Shrub-tussock/sedgeland. Shrub-sedge-cushionfield ( <i>Carpha alpina</i> , <i>Donatia n-z</i> , <i>Oreobolus pectinatus</i> ).	<b>Alpine Openlands</b> Shrub-tussock-/sedgeland. Shrub-sedge-cushionfield ( <i>Carpha alpina</i> , <i>Donatia n-z</i> , <i>Oreobolus pectinatus</i> ). Shrub-tussockland.
2.	<b>Steep to very steep upper hill and mountain slopes</b> 600-1100 m. elevation	Siliceous, weakly to strongly developed Marlborough Schist	<b>Celmisia Rockland Forest</b> Silver beech forest with leatherwoodstoppy-stop in places. Silver beech-red beech forest with Halls totara, southern rata, toro and toi.	<b>Celmisia Rockland Forest</b> Silver beech forest with leatherwood stoppy-stop in places. Silver beech-red beech forest with Halls totara, southern rata, toro and toi.



Landform Components	Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
3. <b>Moderately steep to steep lower hill slopes</b> 0-600 m. elevation	Siliceous, weakly to strongly developed Marlborough Schist	<b>Forest</b> Rimu/hard beech-torokamahi forest with Halls totara, miro. Tawa-mixed broadleaf forest. Kohekohe-mixed broadleaf forest. Mixed broad leaf-mamaku forest. Tauhinu-bracken shrubland.	<b>Forest</b>
4. <b>Undulating terraces, floodplains, fans and associated wetlands and deltas</b> [e.g; P27/980050, 970098] 0-20 m. elevation	Recent alluvium from predominantly schistose rocks	<b>Forest</b> (Kahikatea)/tawa-pukatea forest on alluvium. Kanuka forest on alluvium.	<b>Forest</b> Kahikatea-pukatea-nikau swamp forest. Kahikatea-pukatea-nikau swamp forest.
5. <b>Minor prograding inlet heads and fans</b> [eg; P26/980110, 030165] 0-20 m. elevation	Recent alluvium from predominantly schistose rocks; minor swamp deposits	<b>Forest - Shrubland</b> Kohekohe-mixed broadleaf forest. Kanuka forest on alluvium. Kaikomako-kahikatea-mahoe-tawa forest. Matai-titoki-tawa forest. Marsh ribbonwood shrubland. Manuka-Carex shrub sedgeland.	<b>Forest - Shrubland</b> Matai-titoki-tawa forest. Marsh ribbonwood shrubland. Manuka-cCarex shrub sedgeland. Kahikatea-matai-totara-tawa-titoki forest.
6. <b>Beach ridges and dunes</b> [eg; P26/056202] 0-20 m. elevation	Recent marine sand and gravel		Spinifex-pingao duneland
7. <b>Minor steep to precipitous eroding sea cliffs</b> 0-100 m. elevation	Siliceous, weakly to strongly schistose Marlborough Schist	Horokaka rockland. Silver tussock tussock-loamfield. Taupata-wharariki-tauhinu flax-shrubland	Horokaka rockland. Silver tussock tussock-loamfield. Taupata-wharariki-tauhinu flax-shrubland.

## A. The Physical Environment

### 1. Landforms/Geology

Weakly to strongly developed schists with correlated varying degrees of foliation into layers. Schist geology responsible for the blocky nature of some of the hill and mountain slopes and crests.

Moderate amounts of alluvium.

Ecosystem centred on Mt Stokes massif (1203 m) and the main ridge systems leading off it.

Mostly very steep to moderately steep evenly contoured hill and mountain slopes. Bluff landforms common.

Unlike surrounding ecosystems, the coastline is not excessively dissected but rather moderately to shallowly incised with several large, deeply indented inlets (Port Gore, Anakoha Bay, Endeavour Inlet). A few large and prominent peninsulas and headlands.

Fans and alluvial terraces and floodplains are frequent and well-developed compared with the rest of the Sounds - largely from fluvial deposition off Stokes massif. Some fans truncated by coastal erosion.

Infrequent or minor landforms include inter-tidal flats at the heads of major inlets (eg; Anakoha, Kenepuru), islets (Clark, Ouokaha), beaches, and dunes (Titirangi). Dunes are a regionally important landform.

Nationally important soil sequences in Endeavour Inlet.

Generally large, high gradient streams, mostly originating on Stokes massif. Streams with long, low gradient stretches on fans and alluvial flats. Meandering stream systems some of the most well-developed in the Sounds (eg; Kenepuru Head).

Infrequent coastal and subalpine wetlands.

## **2. Climate and Elevation**

Temperate to cool, moderately dry to wet climate. Temperature inversion and cold air drainage into valleys pronounced. Frosts occasional on gently landforms. Temperate range ameliorated by marine influence by more extreme at higher altitudes. Droughts uncommon.

Wide rainfall range: 1200-2000 mm. Rainfall increasing with increasing altitude. Wet on summits.

Exposed to strong winds and occasional storms but main inlets and Kenepuru Sounds more sheltered. High ridges and summits of Stokes massif very exposed to prevailing westerly winds and storms. Winter snow on massif occasional.

High elevation: 0-1203 m altitude range; mean altitude 400 m.

Maritime influence variable: significant influence where exposed to the north, but moderate influence in more sheltered inlets and calmer waters, especially of Endeavour Inlet and Kenepuru Sound.

## **3. Water**

High water quality in forested catchments and headwaters.

Some degradation in lower gradient stretches as a result of farming activity.

## **B. The Biological Environment**

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[Part of Sounds Ecological District]

Total land area in Stokes ecosystem is 27,584 ha of which; 51% is in native forest, 22% is in shrubland (both native and exotic), 51% is in plantation forestry and 3% is in pasture and non-woody native cover.

### **1. Predominant Indigenous Vegetation Detailed in Table 8**

Originally, predominantly forested, except for rock and beach shoreline fringes, coastal and inland bluffs, estuarine embayments, alpine communities, active floodplains and dune systems. Alpine and subalpine communities on Mt Stokes comprise rockland, boulderfield, tussockland, shrublands, and sedgeland and cushion bogs.

Tall alluvial forest is a significant feature of the ecosystem. Upland forests and alpine communities, bluff systems and estuaries are still largely intact. Forests of lower altitude hill slopes and toeslopes, and coastal forests severely compromised - very little of the original forests remain although a significant proportion of this is now secondary forest and regenerating shrublands.

Alluvial communities and estuarine margins are all but gone; indigenous vegetation of dunes gone.

### **2. Communities and Habitats**

Alpine and subalpine communities unique and very distinctive, supporting local endemics, species which occur nowhere else in the Sounds, and species which are otherwise confined to the North Island. The only alpine area in the Sounds

(excluding the Richmond Range) - nationally important.

Remaining alluvial, estuarine, freshwater and dune communities uncommon, distinctive, vulnerable and regionally significant. Although relatively small in extent, they contribute significantly to the biodiversity of the ecosystem.

Some tracts of upland forest distinctive, diverse and vital habitats for nationally threatened species. Distinctive stunted, windshorn forests on exposed ridges and summits.

A few large, nationally important primary coastal and lowland forest tracts remain; they contribute to intact altitudinal sequences from ridgetop to seafloor, (eg; Black Head, Big Bay, Ship Cove).

Unusual coastal shrublands in places, (eg; above Jacksons Head).

Biotic patterns disrupted in most lower altitude and coastal areas; largely intact at higher altitudes. Alluvial patterns largely lost - uninterpretable.

Dynamic process functioning generally healthy except for alluvial sites. Ongoing wild animal and weed threats.

Natural biodiversity high due to range of altitude, landform and habitat types; especially enhanced by alpine communities.

Overall productivity moderately low partly due to infertile schists. Low productivity at high altitudes.

Low gradient stream stretches which are close to the sea provide good habitat for threatened fish. High native fish diversity.

### 3. Plants

*Celmisia macmahonii* var. *macmahonii* (r)(s); *Anisotome haastii* var. "Stokes" (r)(s); *Celmisia rutlandii* (r); *Hebe speciosa* (r); Raukawa; toi (*Cordyline indivisa*); *Chionochloa flavescens* ssp. *flavescens* (r); Stoppy-stop (*Olearia colensoi*) (r); *Aciphylla aurea*; *A. Squarrosa*, *Donatia novae-zelandiae* (r); *Carmichaelia odorata*; *Alseuosmia pusilla*.

(r)=rare in the Marlborough Sounds, or nationally threatened. (s)=endemic to Stokes ecosystem.

### 4. Animals

Mohua (yellowhead) (r); *Powelliphanta 'bicolor'* (r); koaro, banded kokopu (r); lamprey (r).

((r)=rare in the Marlborough Sounds, or nationally threatened.)

## C. Priorities and Potential for Restoration

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### Terrestrial Values

Lowland and coastal primary forest, now largely remnant although areas of secondary forest and regenerating shrublands provide excellent potential for restoration of these communities.

Restoration of alluvial forest, wetland, dunes and estuary fringes a high priority.

### Freshwater Values

Some potential to support short jawed kokopu if riparian vegetation of low gradient streams reinstated.

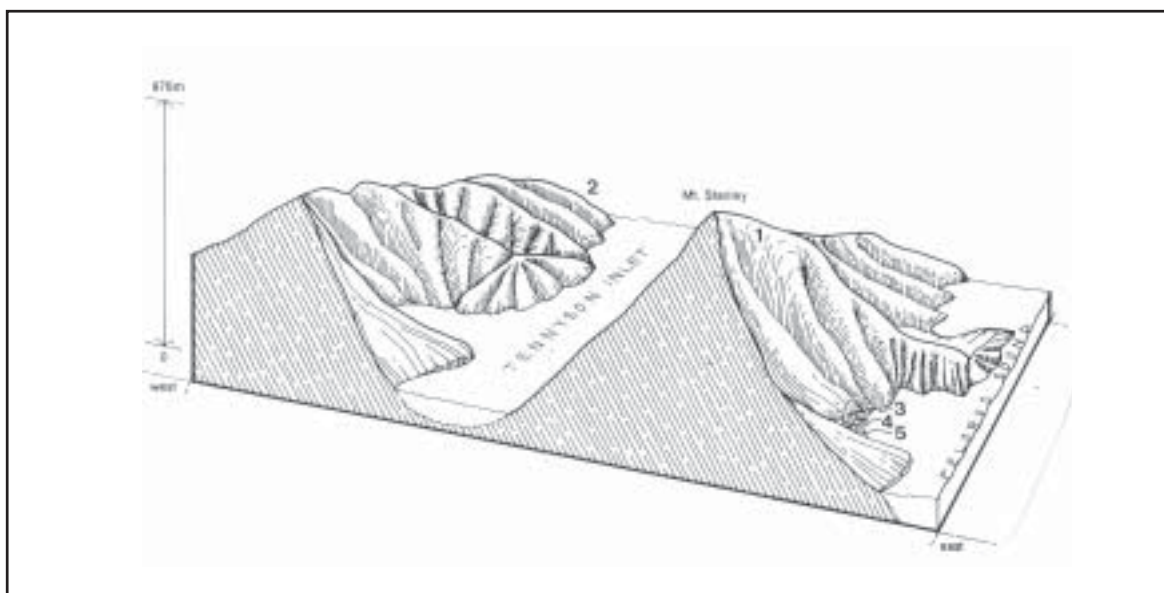
Priority to restore riparian areas for habitat and water quality in lower gradient stretches.



## 8 Nydia

### Red Beech, Supplejack, Filmy Ferns, Kakariki, Inner Sounds, Wet, Non to Weakly Schistose Ecosystem

Steep to moderately steep terrain is typical of this system with slopes plunging at similar angles into the sea. Small inlets and bays nestle within a range of fine fingers and broad headlands. Within these sheltered valleys lie fans and wetlands accumulating on the alluvium washed down from the non-schistose sedimentary strata and weakly developed schists. Elevation here is moderately high with high rainfall at the tops. Being Inner Sounds, it is relatively sheltered and enjoys a moderate maritime influence. Original forest covers much of the northern part of the ecosystem.



**Table 9  
Indigenous Vegetation and Landforms - Nydia Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	Steep to very steep upper hill and mountain slopes 600-976 m elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<b>Forest</b> Red beech-silver beech forest with kamahi and soft tree fern ( <i>Cyathea smithii</i> ). Silver beech-southern rata cloud forest on crest.	<b>Forest</b> Red beech-silver beech forest with kamahi and soft tree fern ( <i>Cyathea smithii</i> ). Silver beech-southern rata cloud forest on crest.

Landform Components	Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2. <b>Moderately steep to steep lower hill slopes</b> 0-600 m elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<b>Forest</b> Rimu/hard beech forest with kamahi, toro, ponga, and abundant scarlet rata vine. Black beech-ponga-mingi-mingi forest on headlands. Tawa-pukatea-mixed broadleaf forest with nikau, kiekie, supplejack, puka, kawakawa. Rimu-miro-tawa-hinau-mixed broadleaf forest (mahoe, pigeonwood, putaputaweta, mamaku, supplejack, kiekie). <b>Manuka</b> Manuka scrub (with emergent pines in places). Kanuka scrub & forest with ponga & mixed secondary broadleaf species. <b>Fernland</b> Bracken fernland (where most recently burnt).	<b>Forest</b> Rimu/hard beech forest with kamahi, toro, ponga, and abundant scarlet rata vine. Black beech-ponga-mingimingi forest on headlands. Rimu-miro-tawa-hinau-mixed broadleaf forest (mahoe, pigeonwood, putaputaweta, mamaku, supplejack, kiekie).
3. <b>Undulating terraces, floodplains, fans and associated wetlands and deltas</b> [e.g; P27/750966] 0-20 m elevation	Recent alluvium from predominantly sedimentary and schistose rocks		<b>Forest</b> Kahikatea-pukatea-tawa-nikau forest.
4. <b>Minor prograding inlet heads and fans and wetlands</b> [eg; P27/758030, Nydia Bay; P26/736116, Tuna Bay] 0-20 m elevation	Recent alluvium from predominantly sedimentary and schistose rocks; minor swamp deposits	<b>Forest</b> Tawa-pukatea-mixed broadleaf forest with nikau, kiekie, supplejack, puka, kawakawa. Kahikatea-pukatea-tawa-nikau forest. Kanuka scrub and forest with ponga and mixed secondary broadleaf species. <b>Scrub</b> Manuka scrub (with emergent pines in places). <b>Flax - Shrubland</b> Toetoe - <i>Coprosma propinqua</i> - manuka-harakeke wetlands at bay heads.	<b>Flax - Shrubland</b> Toetoe - <i>Coprosma propinqua</i> - manuka-harakeke wetlands at bay heads. <b>Forest</b> Kahikatea-pukatea-tawa-nikau forest. Matai-rimu-hinau-tawa forest.
5. <b>Estuaries and tidal flats</b> [eg; P27/763963] 0-3 m elevation	Recent fluvial and estuarine deposits	Oioi rushland. Sea primrose herbfield. Coastal shrub daisy-tauhinu-manuka estuarine shrubland	Oioi rushland. Sea primrose herbfield. Coastal shrub daisy-tauhinu-manuka estuarine shrubland

## A. The Physical Environment

### 1. Landforms/Geology

Sedimentary strata and weakly developed schists. Small deposits of alluvium. Mostly very steep to moderately steep Inner Sounds hill and mountain slopes. Infrequent bluffs.

Moderately dissected coastline with numerous large, deeply indented inlets, especially Tennyson Inlet and Nydia Bay. Numerous large and prominent headlands.

A few islands, islets and stacks.

Rare peninsula landform resulting from an earthflow at head of Nydia Bay.

Fans and alluvial terraces, floodplains, coastal wetlands, beaches and estuaries are infrequent and limited in extent, being confined to heads of major inlets - relatively well-developed compared to the rest of the Sounds.

Generally large, high gradient streams with long, low gradient stretches on fans and alluvial flats.

## 2. **Climate and Elevation**

Temperate to cool temperate, moderately moist to wet climate. Temperature inversion and cold air drainage into valleys pronounced. Frosts occasional on gentle landforms. Temperate range ameliorated by marine influence. Droughts very uncommon.

Rainfall range: 1600-2000 mm. Especially wet inland at higher altitudes. Occasional intense rainfall events.

Low to moderate exposure. Various degrees of shelter from strong winds and occasional storms, but bays of main inlets and particularly sheltered. High ridges and summits of very exposed to prevailing westerly winds and storms. Winter snow on summits rare.

Moderately high elevation: 0-1040 m altitude range; mean altitude 400 m.

Moderate maritime influence - surrounded by relatively calm, Inner Sounds waters.

## 3. **Water**

High water quality in forested catchments and headwaters.

Some degradation in lower gradient stretches as a result of farming activity. Also water quality problems in coastal areas from septic tanks.

## B. **The Biological Environment**

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[Part of Sounds Ecological District]

Total land area in Nydia ecosystem is 66,985 ha of which; 69% is in native forest, 4% is in shrubland (both native and exotic), 12% is in plantation forestry and 15% is in pasture and non-woody native cover.

(Note: Percentages based on interpretation of 1990 satellite images.)

### 1. **Predominant Indigenous Vegetation Detailed in Table 9**

Originally, predominantly forested, except for rock and beach shoreline fringes, estuarine embayments, active floodplains, coastal wetlands, shrublands and herbfields, and rock stacks. Tall alluvial forest was a significant feature of the ecosystem.

Upland forest communities and estuaries are still largely intact.

Original forest on lower altitude hillslopes and toeslopes, and coastal forests are largely intact in Tennyson Inlet, and Nydia Bay to Fairy Bay, but mostly gone from elsewhere in the ecosystem. Lowland and coastal forests replaced by limited secondary forest and regenerating shrublands.

Alluvial communities, including wetlands and estuarine margins, are all but gone from the larger alluvial areas; small areas of alluvial forests and beach communities still intact in Tennyson Inlet and Nydia Bay.

Island with forest and shore shrubland and herbfields.

## 2. Communities and Habitats

Remaining alluvial, estuarine, and freshwater communities uncommon, distinctive, vulnerable and regionally significant. Although relatively small in extent, they contribute significantly to the biodiversity of the ecosystem.

Some tracts of upland forest are vital habitats for nationally threatened species. Distinctive stunted, windshorn forests on exposed ridges and summits.

Tennyson Inlet and Nydia Bay support some of the largest tracts of lowland and coastal forests in Marlborough; largely intact altitudinal sequences of primary forest from ridgetops to seafloor - nationally important.

Biotic patterns largely intact at higher altitudes and partially so in lower altitude and coastal areas. Alluvial patterns very incomplete - difficult to interpret.

Natural process functioning and dynamics generally healthy except for alluvial areas and estuarine margins. Ongoing wild animal and weed threats.

Natural biodiversity moderate; enhanced by coastal, non-forest and alluvial communities.

Overall natural productivity moderate. Low productivity at high altitudes. High estuarine and alluvial productivity.

Low gradient stream stretches which are close to the sea provide good habitat for threatened fish. Moderate to high native fish diversity.

## 3. Plants

Ramarama; scarlet rata vine; supplejack; pukatea; kiekie; *Collospermum hastatum*; gully treefern (*Cyathea cunninghamii*) (r); hangehange.

(r)=rare in the Marlborough Sounds, or nationally threatened.

## 4. Animals

*Powelliphanta 'obscura'* (r); koaro, banded kokopu; spotted shag.

(r)=rare in the Marlborough Sounds, or nationally threatened.

## C. Priorities and Potential for Restoration

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### Terrestrial Values

High level of intactness in higher altitude areas and around Tennyson Inlet, Mt Stanley and Nydia to Fairy Bays. Lowland and coastal communities elsewhere a priority for restoration - areas of secondary forest and regenerating shrublands provide excellent potential for this.

Restoration of alluvial forest, coastal wetlands, and estuary fringes a high priority.

Maintaining absence of major predators on Tennyson Inlet islands.

### Freshwater Values

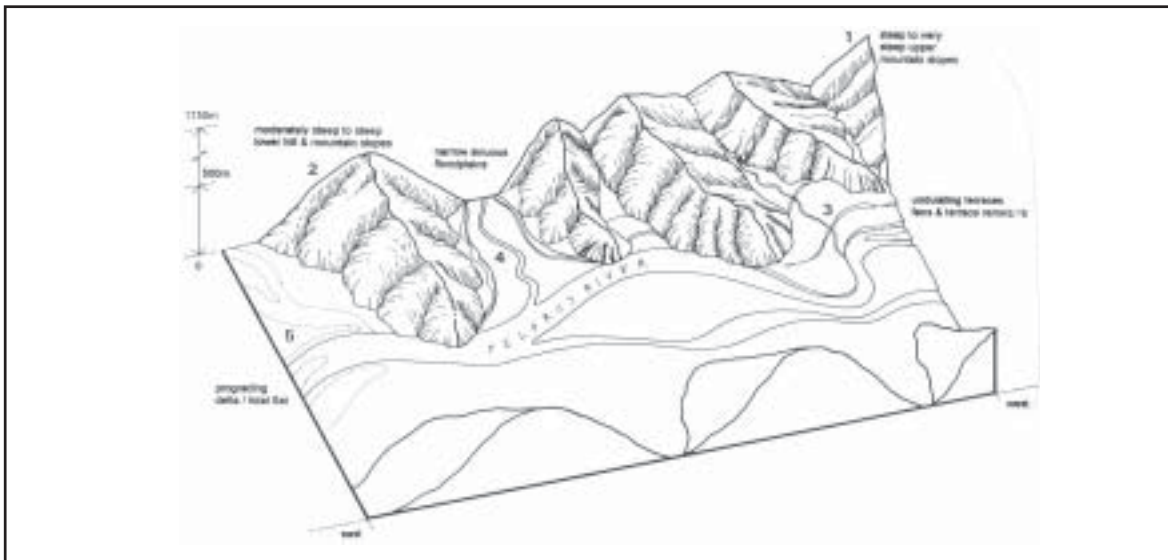
Priority to restore riparian areas for habitat and water quality in lower gradient stretches.



## 9 Pelorus

### Kahikatea, Rimu, Beeches, Alpine Tussocks, Kaka, Robin, Inland Western, Wet, Non to Weakly Schistose Ecosystem

A collection of massive mountains, very steep dissected hills and large valley systems are the predominant feature of this land ecosystem. Sedimentary strata and weakly developed schists make up the very steep to moderately steep inland hills and mountains with substantial amounts of colluvium and alluvium coating the lower slopes and valley floors. The narrow floodplains between the ranges having had a constant progression of river courses snaking across the surface, have built up a series of sinuous undulating terraces with layers of fans building up on the surface, themselves being cut into by subsequent rivers and streams. Towards the sea, narrow tidal flats mix the fresh and saline waters, deltas trying to constantly claim land back from the sea. Elevation is generally high and rainfall very high with snow on the tops in winter and the valley floors exhibiting extreme bitter frosts; there is very little maritime influence. Extensive forest tracts.



**Table 10  
Indigenous Vegetation and Landforms - Pelorus Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	Steep to very steep upper hill and mountain slopes 700-1756 m elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<p><b>Alpine Openlands</b> Mid-ribbed snow tussockland. Carpet grass turf land. Coprosma-hebe subalpine shrubland. Cushion-herb-rockland.</p> <p><b>Forest</b> Mountain beech forest (treeline). Red-silver -mountain beech forest. Red beech-silver beech-kamahi forest.</p>	<p><b>Alpine Openlands</b> Mid-ribbed snow tussockland. Carpet grass turf land. Coprosma-hebe subalpine shrubland. Cushion-herb-rockland.</p> <p><b>Forest</b> Mountain beech forest (treeline). Red-silver- mountain beech forest. Red beech-silver beech-kamahi forest.</p>



<b>Table 10 (cont)</b> <b>Indigenous Vegetation and Landforms - Pelorus Ecosystem</b>				
Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2.	<b>Moderately steep to steep lower hill and mountain slopes</b> 0-700 m elevation	Siliceous, Pelorus Group sedimentary rocks and weakly developed Marlborough Schist	<b>Forest</b> Hard beech forest with rimu emergent, kamahi, ponga. Mixed broadleaf forest. Tawa forest with mixed broadleaf species. Hard beech-silver beech forest.	<b>Forest</b> Hard beech-silver beech forest. Hard beech forest with rimu emergent, kamahi, ponga. Rimu/tawa-mixed broadleaf forest.
3.	<b>Undulating terraces, fans and terrace remnants</b> 5-150 m elevation	Pleistocene alluvium from predominantly sedimentary and schistose rocks	<b>Forest and Treeland</b> Rimu-totara-matai-black beech-tawa forest. Black beech-matai forest. Rimu/black beech forest. Silver beech-black beech-rimu forest.	<b>Forest and Treeland</b> Rimu-totara-matai-black beech-tawa forest. Black beech-matai forest. Rimu/black beech forest. Silver beech-black beech-rimu forest.
4.	<b>Narrow sinuous floodplains</b> 5-20 m elevation	Recent alluvium from predominantly sedimentary and schistose rocks	<b>Forest</b> Lowland ribbonwood-kowhai treeland. Kahikatea-matai forest. Totara-matai forest. Shrublands and herbfields Riparian flood zone shrublands and herbfields.	<b>Forest</b> Kahikatea-matai-totara forest. Lowland ribbonwood-narrow-leaved lacebark-kowhai forest. Cabbage tree-harakeke tree-flaxland. Shrublands and Herbfields Riparian flood zone shrublands and herbfields.
5.	<b>Prograding delta/tidal flat</b> [eg; P27/720930] 0-3 m elevation	Recent fluvial and estuarine deposits	Lowland ribbonwood-kowhai treeland. Oioi rushland. Marsh ribbonwood coastal shrubland.	Lowland ribbonwood-kowhai treeland. Oioi rushland. Marsh ribbonwood coastal shrubland.

## A. The Physical Environment

### 1. Landforms/Geology

Sedimentary strata and weakly developed schists with some foliation into layers; significant areas of colluvium, alluvium and estuarine deposits. Minor swamp deposits (Ronga Valley).

Extensive, very steep to moderately steep inland hill and mountain slopes and summits; many kilometres of wide, well-developed terrace systems, fans and floodplains with excellent swale and bar development in places; large delta and tidal flats. Well-developed strath terraces where rivers have cut down through bedrock, as at Pelorus Bridge.

Ecosystem centred on the Pelorus and lower Wakamarina catchments from the crest of the Richmond Range to the sea at Havelock.

Alpine landforms non-glacial. Extensive mountain bluffs and very steep faces as a result of the orientation and tectonic folding of schists.

Occasional swamps on alluvial terraces against toeslopes, and on floodplains.

Rare coldwater springs.

Regionally important geological features: Pelorus River delta system.

Large river catchment and tributaries with a range of river types including:

- Steep-gradient, dendritic watercourses in the upper Pelorus;
- Deep entrenched meander system in the middle Pelorus;
- Floodplain meanders where the river terraces are aggrading in the mid-Rai; and
- A low gradient shallow, straight-sided type in the lower Pelorus and Wakamarina.

Terraces generally have fertile soils, especially on low terraces and where fresh silts are being deposited.

## **2. Climate and Elevation**

Cool temperate to cold, moist to wet climate. Winter frosts typical - severe on valley floors. Temperature inversion and cold air drainage and ponding into valleys very pronounced. Wide annual temperature range. Little or no ameliorating effects from the sea. Droughts uncommon. Very high incidence of valley fog. Warm summer temperatures in sheltered valleys.

Relatively high rainfall: 1600-2000+ mm Highest at Pelorus and Wakamarina headwaters. Occasional very intense rainfall events.

Frequent flooding of terraces characteristic of the Rai and lower Pelorus catchments. Water ponding in swales is common.

Valleys sheltered from strong winds and storms. High ridges and Richmond Range very exposed to prevailing westerly winds and storms. Winter snow on Richmond Range frequent.

Other than estuary and delta areas, no maritime or coastal influence.

High elevation: 0-1756 m altitude range; mean altitude 480 m.

## **3. Water**

Excellent water quality (especially clarity) in Pelorus headwaters. Generally degraded in all lower reaches, (especially from eutrophication) particularly in Rai River, as a result of intensive agriculture.

## **B. The Biological Environment**

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[Part of Pelorus Ecological District]

Total land area in Pelorus ecosystem is 66,985 ha of which; 69% is in native forest, 4% is in shrubland (mainly exotic), 12% is in plantation forestry and 15% is in pasture and non-forest native cover.

(Note: Percentages based on interpretation of 1990 satellite images.)

### **1. Predominant Indigenous Vegetation Detailed in Table 10**

Originally all forested except for discrete high altitude alpine areas, tidal flats and estuaries, riparian communities with the flood zone of the main rivers, active floodplains and deltas, a few valley non-forest wetlands, some bluff communities and slip sites.

Alpine and extensive mountain and upland hill country communities still largely intact. Lowland forest in the mid to upper Pelorus valley still largely intact. Lowland hill country in the Rai and lower sections of the Pelorus and Wakamarina, especially lower hillslopes, greatly compromised. Alluvial forest almost entirely gone. All low altitude non-forest communities variously altered and diminished, especially on active floodplains and deltas.

## 2. Communities and Habitats

Lowland podocarp-beech and mixed broadleaf forests in the lower altitude parts of the mid and upper Pelorus catchment (<600m), one of the largest lowland forest tracts in Marlborough - regionally important. A major national stronghold for hard beech. A major tract of upland beech forest. Stunted, windshorn forests on exposed ridges and summits.

Remnant alluvial communities regionally important including fertile podocarp and mixed broadleaf low terrace and floodplain forests and less fertile podocarp-beech high terrace forests. Very distinctive communities, especially deciduous kowhai-ribbonwood-lacebark forests, and tall mixed podocarp forests. Vital habitat for a wide range of species largely confined to fertile alluvial natural areas including nationally threatened species.

Riparian communities very distinctive, especially flood zone shrublands and herbfields on bedrock and river silts.

Alpine communities highly distinctive, and unique to North Marlborough due to suite of localised endemic species and presence of otherwise North Island species - nationally significant.

Estuarine communities extensive, very distinctive, and provide important habitats - regionally outstanding.

Overall, very high natural biodiversity due to wide range of altitude, landforms and water regimes - alluvial and alpine areas especially significant. Alluvial biodiversity vulnerable to loss.

Biotic patterns and sequences, dynamics and process functioning largely intact at higher altitudes, but severely compromised throughout most of the lower hillslopes, and almost lost in alluvial areas. Highly fragmented and very difficult to interpret alluvial patterns. Inter-tidal patterns well-preserved but sequences through to alluvial communities largely gone. Many Sounds species reach their inland limits in this ecosystem.

Natural productivity variable, ranging from high in alluvial and inter-tidal communities and decreasing to low in alpine communities.

Generally, a low abundance of native fish and a limited whitebait fishery. Trout fishery present.

## 3. Plants

Alpine: *Brachyglottis* 'Richmond' (n); *Ourisia* 'Richmond' (r)(n); *Leucogenes leontopodium*; *Celmisia cordatifolia* (r)(n); *Exocarpus bidwillii*; *Celmisia rutlandii* (n); *Hebe rigidula* (n); *Celmisia macmahonii* var. *hadfieldii* (n); *Coprosma serrulata* (r).

Alluvial/riparian: *Scutellaria novae-zelandiae* (r); *Coprosma rubra* (r); lowland ribbonwood (r); kowhai; *Teucrium parvifolium* (r); *Leptinella nana* (r); *Poranthera microphylla* (r); *Australina pusilla* (r); *Alseuosma pusilla*; *Korthalsella lindsayi* (r); swamp mahoe; *Brachyglottis traversii* (r); *Olearia*

*cheesemanii* (r); *Muehlenbeckia ephedroides* (r); *Mazus radicans* (r); scrambling fuchsia (r); *Diplazium australe* (r); *Hebe rigidula* (n); *Glossostigma elatinooides*; *Hydrocotyle hydrophila* (r), *Melicytus 'Tinline'* (r).

Estuarine: oioi; marsh ribbonwood; coastal shrub daisy, *Korthalsella salicornioides* (r); *K. clavata* (r).

Forest: *Hebe divaricata*; *Chionochloa cheesemanii*; *Melicytus lanceolatus*; ramarama; *Pittosporum divaricatum* (r).

[(n)=endemic to North Marlborough (r)=rare in the Marlborough Sounds, or nationally threatened.]

#### 4. Animals

Kakariki (yellow-crowned parakeet); blue duck; South Island robin; falcon; South Island kaka; short-jawed kokopu (r); *Powelliphanta 'consobrina'* (r); native slugs (*Pseudaneitea papillata*, *Athoracophorus bidenticulatus*).

[(r)=rare in the Marlborough Sounds, or nationally threatened.]

### C. Priorities and Potential for Restoration

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#### Terrestrial Values

High restoration priority for all alluvial communities, especially low terrace and floodplain forests. These communities are almost regionally extinct and remnants highly vulnerable to a wide range of threats. Potential for reintroduction of alluvial species that have become regionally extinct.

Potential for delta restoration to enhance estuarine margins, delta shrubland and forest communities, and whitebait spawning habitat.

Priority to create corridor to link Sounds ecosystems with inland parts of North Marlborough.

Regenerating shrublands provide excellent potential for lowland forest restoration.

#### Freshwater Values

Restore buffers and in other ways mitigate threat to freshwater wetlands. Recognise the importance of dynamic river processes such as flooding and erosion/deposition in maintaining alluvial landforms and the functioning of alluvial natural areas.

Riparian management to improve water quality is a very high priority for maintenance of valued recreational trout fishery.

Maintenance and improvement of fish passage is important for both trout and native fisheries.

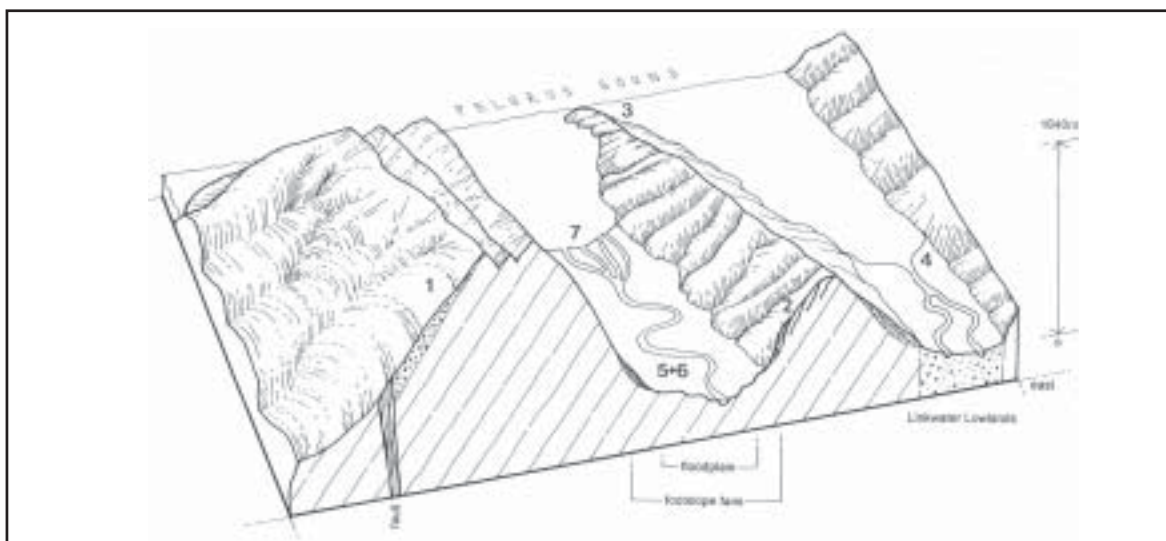
Maintenance of adequate stream and river flow is a key issue on this zone, as demand for agricultural water exists.



## 10 Kaituna

### Papauma, Kamahi, Karearea, Inland Eastern Moist to Wet, Strongly Schistose Ecosystem

Immense, broad, steep to moderately steep mountainous schist slabs with even contours and regular, minimally dissected structure are a dominant feature of this system. The grain of the land is moderately to strongly schistose with material being transported downwards as colluvium and alluvium, in some areas building up an ever-coalescing series of fans between the spurs. Elevation is high with an associated high rainfall. As the landmass only just touches the sea, the moderating effect of the sea on climate is minor. Snow is often found on these ranges and there are inhospitable frosts in the main valleys during winter. At the point where the land briefly merges with the warm waters, tidal flats and deltas provide a tentative interface and further up the valleys series of terraces remain as a legacy from the meandering rivers. Forests clothing upper slopes and ridges.



**Table 11**  
**Indigenous Vegetation and Landforms - Kaituna Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1.	<p><b>Steep to very steep upper hill and mountain slopes</b> [includes some large scale slab failures] 700-1641 m elevation</p>	<p>Siliceous, strongly developed Marlborough Schist</p>	<p><b>Alpine Grasslands</b> Carpet grass turfand (Mt Fishtail). Mid-ribbed snow tussock (Mt Fishtail). Alpine herb-rockland (Mt Fishtail). <b>Forest</b> Silver beech forest with <i>Olearia lacunosa</i>, <i>Chionochloa cheesemanii</i> (forest snow tussock). Red beech forest with putaputaweta, silver beech, southern rata, Halls totara. Silver beech-red beech forest with Halls totara.</p>	<p><b>Alpine Grasslands</b> Carpet grass turfand (Mt Fishtail). Mid-ribbed snow tussockland (Mt Fishtail). Alpine herb-rockland (Mt Fishtail). <b>Forest</b> Silver beech forest with <i>Olearia lacunosa</i>, <i>Chionochloa cheesemanii</i> (forest snow tussock). Red beech forest with putaputaweta, silver beech, southern rata, Halls totara. Silver beech-red beech forest with Halls totara.</p>

**Table 11 (cont)**  
**Indigenous Vegetation and Landforms - Kaituna Ecosystem**

Landform Components		Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2.	<b>Moderately steep to steep lower hill and mountain slopes</b> [includes some large scale slab failures] 0-700 m elevation	Siliceous, strongly developed Marlborough Schist	<b>Forest</b> Hard beech-kamahi-ponga forest with some rimu. Black beech forest with mingimingi, shining karamu. Mixed broadleaf forest with mahoe, fivefinger, tree fuschia, wineberry, putaputaweta. Tawa-titoki-white maire forest. Rimu-black beech forest. Manuka-kanuka scrub. Tawa forest with mixed broadleaf species mainly mahoe.  <b>Scrub and Tussockland</b> Tauhinu scrub. Manuka-kanuka scrub. Silver tussockland.	<b>Forest</b> Hard beech-kamahi-ponga forest with some rimu. Rimu-black beech forest.
3.	<b>Moderately steep low broad headlands</b> 0-50 m elevation	Siliceous, strongly developed Marlborough Schist	<b>Forest</b> Black beech-kowhai-akiraho forest (Mahakipawa coastal fringe). Black beech forest with mingimingi, shining karamu.	<b>Forest</b> Black beech-kowhai-akiraho forest (Mahakipawa coastal fringe). Rimu-black beech forest.
4.	<b>Broad undulating terraces, floodplains and fans</b> [eg; P27/840900] 0-20 m elevation	Recent and Pleistocene alluvium from predominantly schistose rocks	-	<b>Forest</b> Kahikatea-pukatea swamp maire forest. Kahikatea forest. Matai-totara-mixed broadleaf forest. Harakeke-cabbage tree flax-treeland.
5.	<b>Narrow undulating terraces and footslope fans</b> [Kaituna Valley] 5-120 m elevation	Pleistocene alluvium from predominantly schistose rocks	<b>Forest</b> Rimu-black beech forest	<b>Forest</b> Rimu-black beech forest. Totara-matai-white maire forest. Kahikatea-matai-tawa forest.
6.	<b>Narrow sinuous floodplains</b> 5-20 m elevation	Recent alluvium from predominantly schistose rocks -	-	<b>Forest</b> Kahikatea forest. Lowland ribbonwood-matai-totara-kowhai forest. Kahikatea-matai-tawa forest.
7.	<b>Prograding delta/tidal flat</b> [eg; P27/745910] 0-3 m elevation	Recent alluvial and estuarine deposits	Oioi rushland	<b>Shrubland and Rushland</b> Oioi rushland. Marsh ribbonwood-coastal shrub daisy-coprosma-tauhinu estuarine shrubland.  <b>Forest and Treeland</b> Kowhai-narrow-leaved lacebark, lowland ribbonwood forest.

## **A. The Physical Environment**

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### **1. Landforms/Geology**

Moderately to strongly developed schists with pronounced foliation into layers.

Significant amount of alluvium and colluvium between mountain and hill blocks.

Very steep to moderately steep, structurally controlled, hill and mountain slopes. Schist geology and its orientation is responsible for the blocky, evenly contoured nature of mountain slope landforms, less dissected topography (cf. adjacent Pelorus ecosystem) and the significant slope difference between the north and south facing slopes. Bluffs especially frequent on south faces.

Alluvial terraces and fans are well-developed, especially in the Kaituna Valley.

Significant floodplain and delta/tidal flat landforms at the mouth of the Kaituna and heads of Grove and Mahakipawa Arms. Linkwater alluvium, deposited largely from hill country to the south, has infilled the seafloor, separating Queen Charlotte and Pelorus Sounds.

Kaituna terraces formed by Pelorus River when it flowed south into the Wairau River.

A coastline of shallow indented bays and few prominent headlands.

Regionally important geological features: Kaituna river terraces and delta; Linkwater alluvial flats; Ada Creek schist geological contact.

### **2. Climate and Elevation**

Temperate to cool, moist to wet climate. Winter frosts typical - severe on valley floors. Temperature inversion and cold air drainage into valleys pronounced. Wide annual temperate range, especially in inland valleys - some ameliorating effects from the sea in the northern parts of the ecosystem. Summer droughts occasional. Frequent valley fog.

Relatively high rainfall: 1500-2000 mm. Highest in Wakamarina headwaters. Occasional intense rainfall events. Valleys sheltered from strong winds and storms. High ridges and Richmond Range very exposed to prevailing westerly winds and storms. Winter snow on Richmond Range frequent.

Limited maritime and coastal influence (Mahakipawa and Grove Arms).

High elevation: 0-1641m altitude range; mean altitude 450 m.

### **3. Water**

High water quality in forested catchments and headwaters.

Some degradation in lower gradient stretches, especially Kaituna River, as a result of intensive agriculture.

## **B. The Biological Environment**

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[Part of Pelorus, Para and Sounds ecological districts]

Total land area of Kaituna ecosystem is 35,259 ha of which; 50% is in native forest, 11% is in shrubland(both native and exotic), 11% is in plantation forestry and 28% is in pasture and non-woody native cover.

(Note: Percentages based on interpretation of 1990 satellite images.)

## **1. Predominant Indigenous Vegetation Detailed in Table 11**

Originally all forested except for discrete high altitude alpine areas, tidal flats, estuaries and deltas, some valley non-forest wetlands, some riparian and bluff communities, and slip sites.

Alpine and large tracts of mountain and upland hill country communities still predominantly intact. Lowland hill country forests and coastal communities greatly compromised - no original forest remaining. Some of this is now secondary forest and native shrublands.

Alluvial forests are almost entirely gone - includes swamp forests, fertile mixed podocarp and mixed broadleaf low terrace forests, and less fertile podocarp-beech high terrace forests. All low altitude non-forest communities variously altered and diminished, especially estuarine fringes, deltas, riparian communities and wetlands.

## **2. Communities and Habitats**

Alpine communities highly distinctive, and unique to North Marlborough due to suite of localised endemic species, species which occur nowhere else in North Marlborough, and species which are otherwise confined to the North Island - nationally significant.

Moderately large tracts of upland beech forest - stunted and very windshorn on exposed ridges and summits.

Lowland hillslope forests uncommon and regionally significant for inland distributions of warm, northern species, and regionally rare species.

Remnant alluvial and estuary fringe communities regionally important (including treelands). Very distinctive, highly productive communities, especially tall mixed podocarp forests and swamp forests. Many species for which alluvial habitat is vital are now locally extinct.

Large estuarine communities, very distinctive, highly productive, and provide important habitats.

Overall, moderately high natural biodiversity due to wide range of altitude and landforms - alpine areas especially significant. Alluvial biodiversity largely lost.

Biotic patterns and sequences, dynamics and process functioning largely intact at higher altitudes, but severely compromised and fragmented throughout most of the lower hillslopes, and lost in alluvial areas - uninterpretable. Inter-tidal patterns well-preserved but sequences through to alluvial communities largely gone.

Natural productivity variable, ranging from high in alluvial and inter-tidal communities and decreasing to low in alpine communities. Highly schistose rocks relatively infertile.

Generally, a low abundance of native fish and a limited whitebait fishery. Trout fishery present.



Freshwater quality, processes and riparian habitat is significantly compromised in some waterbodies, particularly Kaituna River. Limited native fishery values. Trout fishery present.

### 3. Plants

*Celmisia hieraciifolia*; *Olearia lacunosa* (r); *Brachyglottis* 'Richmond' (n); hangehange; white maire (r); kowhai, swamp maire (r); orange mistletoe (r).

(r)=rare in the Marlborough Sounds, or nationally threatened. (n)+ endemic to North Marlborough

### 4. Animals

Rifleman; karearea (New Zealand falcon) (r); brown creeper; *Powelliphanta* 'consobrina'(r); *P. 'bicolor'*(r).

(r)=rare in the Marlborough Sounds, or nationally threatened.

## C. Priorities and Potential for Restoration

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### Terrestrial Values

High restoration priority for all alluvial communities - almost regionally extinct, and remnants have doubtful long-term viability. Highly vulnerable to a wide range of threats. Potential for reintroduction of alluvial species that have become locally extinct.

Potential for delta restoration to enhance estuarine margins, delta shrubland and forest communities, and whitebait spawning habitat.

Lowland forest largely gone from ecosystem. Regenerating shrublands provide excellent potential for lowland forest restoration.

### Freshwater Values

No native riparian communities remaining. Riparian restoration, including ungrazed buffer strips, a major priority in rivers, streams and drains, especially Kaituna River. Appropriate drain management needed.

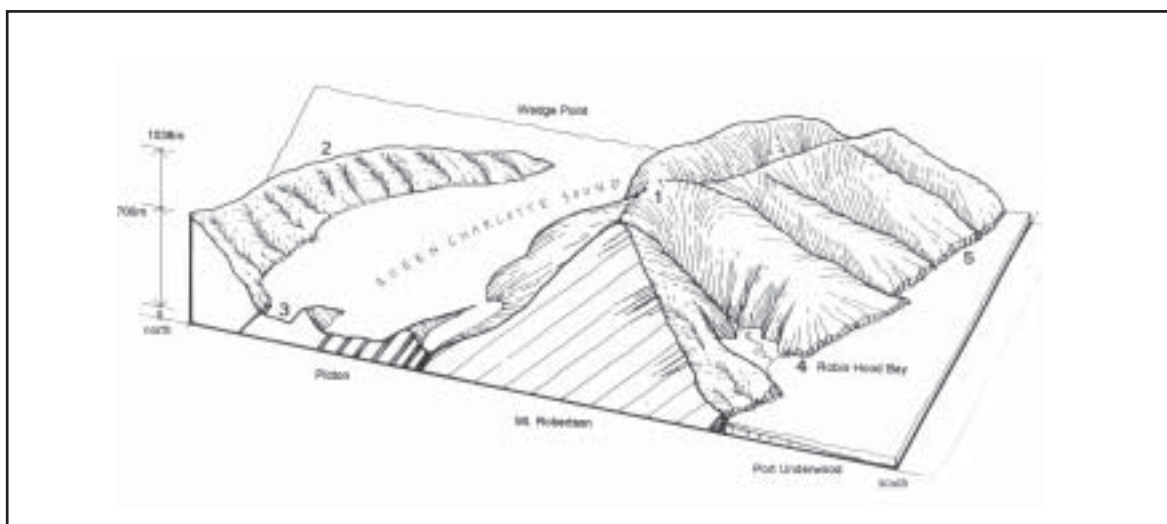
Maintenance of instream flows to provide for life-supporting capacity of streams as demand for irrigation water exists.



## 11 Robertson

### Mamaku, Horopito, Ruru, Moist, Non to Weakly Schistose Ecosystem

Very steep to moderately steep schist lumps, with a minor sedimentary contribution to the layering, comprise the hill and mountain building blocks of this land ecosystem. The rock structure is either non or only weakly schistose with colluvium and alluvium merging on the lower slopes and valley floors. Between the broad shoulders of the land lie a series of coastline fans and inlet heads particularly indented. Elevation is fairly high with a moderate rainfall and overall, only a moderate maritime influence. High exposure and infrequent snow fall around the tops. Large forest tracts on mountain flanks.



**Table 12**  
**Indigenous Vegetation and Landforms - Robertson Ecosystem**

Landform Components	Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
1. Steep to very steep upper hill and mountain slopes 600-1036 m elevation	Siliceous, weakly developed Marlborough Schist	<b>Forest</b> Red beech-silver beech-kamahi with horopito, mountain fivefinger, soft tree fern, broadleaf, and hupiro (stinkwood). Silver beech forest with southern rata and Halls totara.	<b>Forest</b> Red beech-silver beech-kamahi with horopito, mountain fivefinger, soft tree fern, broadleaf, and hupiro (stinkwood). Silver beech forest with southern rata and Halls totara.

Landform Components	Geology	Remnant Native Vegetation	Past and Potential Native Vegetation
2. Moderately steep to steep lower hill and mountain slopes 0-600 m elevation	Siliceous, weakly developed Marlborough Schist	<b>Forest</b> Hard beech-black beech forest with emergent rimu, and kamahi, ponga, scarlet rata vine, heketara, crown fern. Mixed broadleaf forest of mahoe, wineberry-mamaku, fivefinger, putaputaweta, tutu. Tawa forest in gullies & flats with emergent podocarps in places (rimu, kahikatea) & pukatea, nikau, mahoe, pigeonwood, pate. Black beech forest. Pukatea-tawa-mahoe-mixed broadleaf forest.	<b>Forest</b> Hard beech-black beech forest with emergent rimu, and kamahi, ponga, scarlet rata vine, heketara, crown fern. Pukatea-tawa-mahoe-mixed broadleaf forest. Rimu/black beech forest.
3. Undulating terraces fans and floodplains 0-30 m elevation	Recent alluvium from predominantly schistose rocks, swamp deposits		<b>Forest</b> Matai-totara-kahikatea-tawa-titoki-white maire forest. Kahikatea-narrow leaved lacebark-lacebark forest.
4. Prograding inlet heads 0-10 m elevation	Recent alluvial and estuarine deposits	<b>Forest</b> Swamp maire-mixed broadleaf forest.	<b>Forest</b> Kahikatea-swamp maire forest. Matai-totara-kahikatea-tawa-titoki forest.
5. Steep rocky shorelines 0-100 m elevation	Siliceous, weakly developed Marlborough Schist	<b>Scrub and Shrubland</b> Rangiora-fivefinger-akiraho-akeake-wharariki forest. Mamaku-tauhinu-ngaio-taupata. <b>Forest and Scrub</b> Taupata shrubland.	<b>Forest, Scrub and Shrubland</b> Rangiora-fivefinger-akiraho-akeake-wharariki forest. Mamaku-tauhinu-ngaio-taupata. <b>Forest and Scrub</b> Taupata shrubland.

## A. The Physical Environment

### 1. Landforms/Geology

Weakly developed schist with limited foliation; minor sedimentary strata. Infrequent but moderately large areas of alluvium and colluvium (Picton, Waikawa, Robin Hood Bay).

Ecosystem centred on the Mount Robertson-Piripiri massif (1036 m) and the main ridge systems leading off it.

Mostly very steep to moderately steep hill and mountain slopes. Bluff landforms occasional.

Excessively dissected coastline into small bays and headlands. A few deeply indented inlets (Picton Harbour, Waikawa and Whatamango Bays) and prominent peninsulas (eg; The Snout).

Fans and alluvial terraces and floodplains are infrequent but generally substantial and well-developed compared with the rest of the Sounds - largely from fluvial deposition off Robertson massif, but also apparently fault-related.

Major faults through Picton and Waikawa.

Infrequent or minor landforms include inter-tidal flats at the heads of major inlets (eg; Whatamango Bay), islets (Mabel), rock stacks and beaches.

Generally large, high gradient streams, mostly originating on Robertson massif. Streams with long, low gradient stretches on fans and alluvial flats. Streams meandering on some of the larger, flatter terraces.

## **2. Climate and Elevation**

Temperate to cool, moist climate. Temperature inversion and cold air drainage into valleys pronounced. Light winter frosts frequent on gentle landforms; some frost-free areas. Temperate range ameliorated by marine influence but more extreme at higher altitudes. Droughts very uncommon.

Rainfall range: 1200-1600 mm increasing with increasing altitude and distance from the coast.

Generally sheltered from strong winds, especially in the main inlets, but Port Underwood bays exposed to southerlies. High ridges and summits of Robertson massif very exposed to winds from all directions. Winter snow on massif infrequent and ephemeral.

Relatively high elevation: 0-1036 m altitude range; mean altitude 350 m.

Maritime influence variable; significant influence where exposed to the south, but moderate influence in more sheltered inlets and calmer waters, especially Picton and Waikawa.

## **3. Water**

High water quality in forested catchments and headwaters.

Some degradation in lower gradient stretches; significant alteration (especially channelisation) to in-stream habitat and water quality in urban parts of Waitohi and Waikawa Streams.

## **B. The Biological Environment**

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[Part of Para and Sounds Ecological District]

Total land area of Robertson ecosystem is 11,151 ha of which; 70% is in native forest, 9% is in shrubland (both native and exotic), 13% is in pasture and 8% is in plantation forestry.

(Note: Percentages based on interpretation of 1990 satellite images.)

### **1. Predominant Indigenous Vegetation Detailed in Table 12**

Originally, predominantly forested, except for rock and beach shoreline fringes, coastal shrublands, coastal and inland bluffs, estuarine embayments, active floodplains and dune systems.

Tall alluvial forest was once a significant feature of the ecosystem.

Upland forests, bluff systems and estuaries are still largely intact.

Lowland hillslope forest intact in upper reaches of some main valleys (eg; Waitohi, Graham and Stace Rivers), but severely compromised on most slopes facing the coast, especially north faces.

Scrub (with extensive wilding pines) and second growth forest covering much of lowland hill slopes.

Some coastal shrublands still existing.

Almost no coastal forest remaining; few alluvial communities and estuarine margins remaining. Stace River alluvial remnants still relatively large.

## 2. Communities and Habitats

Upland forest tracts intact (some exceptionally so) and vital habitats for nationally threatened species. Distinctive stunted, windshorn forests on exposed ridges and summits. Good understorey structure in places.

Tracts of primary lowland hill slope forests still quite extensive - regionally important. Nationally important where they are a vital habitat for nationally threatened species.

Remaining alluvial, estuarine, and freshwater communities uncommon, distinctive, vulnerable and regionally significant. Although relatively small in extent, they contribute significantly to the biodiversity of the ecosystem.

Alluvial forest and shrubland communities are some of the most extensive in the Sounds; almost extinct in Marlborough and support regionally threatened species - regionally outstanding.

Coastal shrublands, distinctive Sounds vegetation, which reach their southern limit at Rarangi.

Biotic patterns largely intact at higher altitudes and partially so at lower altitudes. Coastal natural patterns largely lost and difficult to interpret. Intact altitudinal sequences gone.

Natural process functioning and dynamics generally healthy for upland and some lowland areas but largely broken down for coastal and alluvial areas. Also, ongoing wild animal and weed threats; major in places.

Natural biodiversity moderate; enhanced by coastal, non-forest and alluvial communities.

Overall natural productivity moderate. Low productivity at high altitudes. High estuarine and alluvial productivity.

Extremely high freshwater values in southern catchments (eg; Stace River). Excellent access and extensive low gradient stretches provide vital habitat for a very diverse native fishery, including threatened species.

## 3. Plants

*Pimelea gnidia* (r); *Hoheria angustifolia* (r); *Euphrasia cuneata*, swamp maire (r); *Hoheria populnea* var. *lanceolata* (r); *Melicytus obovatus*; pingao; *Ileostylis micranthus* (r); *Cyrtostylis reniformis* (r); *Pseudopanax colensoi*.

(r)=rare in the Marlborough Sounds, or nationally threatened.

#### 4. Animals

*Powelliphanta 'bicolor'* (r); Eastern Sounds carabid beetle (*Megadromus* sp.) (r)(e); *Wainuia urnula nasuta* (r); lamprey; dwarf galaxias; short-jawed kokopu; banded kokopu; native slug (*Pseudaneitea gravisulca*) (r) (e).

(r)=rare in the Marlborough Sounds, or nationally threatened.

(e)=endemic to Marlborough Sounds

### C. Priorities and Potential for Restoration

#### Terrestrial Values

Restoration priority for coastal (including wetland and estuarine fringes), and lowland communities - areas of secondary forests and regeneration shrublands provide excellent potential for this, as long as invasive weeds are controlled, especially banana passion vine and old mans beard.

Maintenance and restoration of alluvial forest communities a high priority.

#### Freshwater Values

Maintenance and enhancement of riparian areas along low gradient streams between coast and hillslopes to improve habitat and water quality.

Management to safeguard existing riparian margins, especially from the effects of forestry, important in low gradient stretches.

Maintenance of instream flows for life-supporting capacity of streams.

## A Marine - Eastern Cook Strait and Outer Queen Charlotte Sound

### Collective Characteristics:

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#### Mainly Exposed

Very exposed; clear, cold oceanic waters; strong currents; rich reef communities; kelp beds; sandy sediments off-shore.

### A. The Physical Environment

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#### 1. Form/Geology

Steeply sloping shores with bedrock and boulder reefs extending into relatively deep water dominate the near-shore environment. Pea gravel beaches also occur. Sandy sediments extend off-shore, with surface corrugations and ripples in exposed places.

#### 2. Dynamic Features and Processes, Including Climate

Large southerly swells drive directly onto the exposed eastern shores, creating a very high energy coastline. Arapawa Island provides some protection to the northern entrance to Queen Charlotte Sound.

#### 3. Water

Generally high water clarity, especially around Arapawa Island.

Cold oceanic waters derived from the Southern Current.

Strong tidal currents, especially off headlands, off-shore rocks/islands and near the entrance to Tory Channel.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Luxuriant beds of large brown seaweeds, mostly on exposed shores often extending into relatively deep waters. Kelps *Durvillea* spp. and *Lessonia variegata* are key species. *Macrocystis* beds occur in Outer Queen Charlotte Sound. Diverse and productive reef communities.

Sessile filter feeding animals thrive, particularly in areas of strong tidal currents.

Other notable species include the pin-cushion seastar (*Eurygonias hyclocantus*) and girdled wrasse (*Notolabrus inscriptus*).

## B Marine - D'Urville Island - Northern Cook Strait

### Collective Characteristics:

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#### Mainly Exposed

Exposed; clear, cool oceanic waters; strong currents; off-shore reefs, stacks and islands; rich reef communities; bryozoan and horse mussel beds; massive tube worm colonies.

### A. The Physical Environment

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#### 1. Form/Geology

Exposed shores are distinguished by their steeply sloping shores with extensive bedrock and boulder reefs extending into relatively deep water. The area is generally noted for the presence of numerous off-shore reefs, stacks and islands. Gravels and sands predominate off-shore of western D'Urville Island. Large sand masses occur off-shore in the larger outer bays, but mud/silt/shell remains the predominant soft bottom habitat elsewhere. A relatively narrow cobble (and in places bedrock) reef generally fringes the shores of the sheltered bays and inlets.

#### 2. Dynamic Features and Processes, Including Climate

Moderate to, in places, high exposure, though the large bays and inlets of the Outer Sounds and D'Urville Island offer a reasonable degree of protection from the open sea.

#### 3. Water

Clear oceanic waters with relatively low sedimentation levels.

Relatively cool oceanic waters, particularly east of D'Urville Island.

High current areas off headlands and between land masses. Moderate to high tidal range.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Near-shore and off-shore reefs support rich and abundant reef communities. Luxuriant stands of macro-algae extend into relatively deep water but some exposed water varieties (eg; *Durvillea* spp, *Lessonia variegata*) are noticeably absent.

High diversity of fish and invertebrate species.

The occurrence of large off-shore areas dominated by bryozoan corals and horse mussels are distinctive features of the area. The more sheltered bays and inlets support fewer conspicuous reef dwelling species and considerably less macro-algael cover.

Coastal wetlands at heads of major bays and inlets.



## C Marine - Port Underwood

### Collective Characteristics:

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#### Mainly Sheltered

Sheltered, turbid, shallow waters; extensive mud bottom with narrow cobble fringe; conspicuous marine life generally sparse; off-shore red algae beds; massive tube worm colonies.

### A. The Physical Environment

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#### 1. Form/Geology

Dominated by extensive and uniform mud/silt habitat. A narrow (20-50m) cobble reef fringes much of the shore. Most of the Port is relatively shallow (<20m).

#### 2. Dynamic Features and Processes, Including Climate

Relatively sheltered, especially from ocean swells to the south.

#### 3. Water

Turbid waters and high sedimentation levels. Moderate currents in the outer regions of the Port. Generally sheltered from ocean swells.

### B. The Biological Environment

---

#### Distinctive Biota, Communities and Habitats

##### Natural Biodiversity, Productivity and Biotic Patterns

Generally low diversity and abundance of conspicuous macro organisms on mud habitat, though off-shore red algae beds are a key feature in some bays. *Macrocystis pyrifera* and *Ecklonia radiata* are the predominant seaweed species near-shore. Enormous tube worm mounds (*Galeolaria hystrix*) at two headlands along the south-eastern coast are notable features; these are by far the largest known colonies in Nelson and Marlborough. Port Underwood is also a rock lobster nursery and was historically a Southern Right Whale calving area.

## D Marine - Tasman Bay/Admiralty Bay

### Collective Characteristics:

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#### Mainly Sheltered

Turbid, warm waters; open to the sea, but relatively sheltered; limited reef zone and conspicuous marine life generally sparse; sediments off-shore.

### A. The Physical Environment

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#### 1. Form/Geology

Relatively narrow near-shore bedrock/cobble reef zone, with sand beaches often located at the heads of bays. Extensive areas of sand/shell in places close to shore, replaced by silts in deeper off-shore areas.

#### 2. Dynamic Features and Processes, Including Climate

Generally open to the sea, yet still sheltered from large oceanic swells.

#### 3. Water

Moderate sedimentation and turbidity levels.

Relatively warm coastal waters derived from the D'Urville current and Tasman Bay.

Large tidal range exposing a wide inter-tidal zone at low water. Very strong currents in the vicinity of French Pass, though low to moderate elsewhere.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Notable for a low biomass and diversity of macro-algae which are restricted to a narrow band immediately below low water. Sub-tidal reefs relatively barren, though there is often a high diversity of fish and encrusting animals in outer rocky areas compared to other sheltered shores in the Sounds. Key indicator organisms are the barnacle *Balanus vestitus* east of French Pass, and *Stegnaster inflatus* which is particularly common in the west.

Whangarae Estuary within Croisilles Harbour is relatively unmodified and the only spit formed estuary in the Sounds.

### C. Potential for Restoration

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Restoration of riparian habitat.

## E Marine - Middle Pelorus

### Collective Characteristics:

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#### Mainly Sheltered

Waters relatively sheltered, turbid and warm; mostly muds with conspicuous sparse marine life and fringed by narrow cobble reef.

### A. The Physical Environment

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#### 1. Form/Geology

Typically a narrow (20-50m) near-shore rubble reef grading into sand/shell and mud habitats with increasing depth and distance from shore. Extensive and uniform areas of mud/silt extend beyond the near-shore zones across most of the Sound's seafloor.

#### 2. Dynamic Features and Processes, Including Climate

Relatively sheltered, with limited wave fetch in most places; Tawhitinui Reach is the major exception to this rule.

#### 3. Water

Moderate to high sediment loadings, especially towards the inner Pelorus. Waters are generally clearer beyond Tawero Point.

Relatively warm waters, particularly towards the inner Pelorus.

Moderate tidal range, with noticeable currents along the main channels and off headlands.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Low diversity and coverage of macro-algae (dominated by *Carpophyllum* spp. and *Cystophora* sp.) generally confined to a narrow zone immediately below the low water mark. Reefs appear relatively barren, with encrusting and mobile invertebrates the dominant organisms. Conspicuous surface organisms are relatively uncommon over the mud/silt bottom, though in places where environmental conditions are favourable, species such as horse mussels, scallops, brachiopods, bryozoans and hydroid trees occur, sometimes in high densities. Few and relatively small inter-tidal wetlands at the heads of large bays and inlets.

### C. Potential for Restoration

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Restoration of riparian habitat.

## F Marine - Inner Pelorus Sound

### Collective Characteristics:

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#### Mainly Sheltered

Shallow and very sheltered; turbid warm waters; very tidal with extensive mudflats; cockle beds; expansive saltmarsh; birdlife common.

### A. The Physical Environment

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#### 1. Form/Geology

Kaituna estuary dominates the head of Pelorus Sound with extensive tidal mudflats extending out to beyond Mahakipawa Arm. Mahau and Kenepuru Sounds are fringed by a very narrow cobble reef, with mud/silt habitat predominant beyond. Much of the area is tidal or very shallow.

#### 2. Dynamic Features and Processes, Including Climate

Very sheltered.

#### 3. Water

The area is strongly influenced by the Pelorus and Kaituna Rivers, resulting in a very high turbidity and sedimentation levels. Relatively poor water quality as a result of catchment management and specific discharges in the vicinity of Havelock.

Relatively warm waters with reduced salinities, particularly at the head of Pelorus Sound or during floods.

A moderate tidal range exposes extensive tidal flats in the inner reaches of the Sound. Tidal currents are strong along the main channel.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Kaituna Estuary, and neighbouring Mahakipawa Arm and Kaiuma Bay form a complex estuarine system supporting extensive and productive saltmarsh and invertebrate communities. Dense cockle beds (inter-tidal and sub-tidal) occur at various locations. The general area is important as a nursery and feeding ground for coastal fish, as well as habitat for various wildlife species. The introduced and invasive cord grass *Spartina* is a dominant feature of the Kaituna Estuary. The cobble reefs and sub-tidal mud habitats beyond the inner estuarine areas generally support a low diversity and abundance of macro-invertebrates.

### C. Potential for Restoration

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Restoration of riparian habitat.

Water quality.

*Spartina* control.

## G Marine - Tory Channel

### Collective Characteristics:

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#### Mainly Sheltered

Sheltered; clear, cool waters; strong currents; narrow cobble fringe bordered by clean sands in channel; kelp and sea lettuce.

### A. The Physical Environment

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#### 1. Form/Geology

Relatively narrow cobble (and in places bedrock) reef fringes the shore, with clean current swept sand/shell along the edge of the main channel. Larger bays and inlets are dominated by mud/silt habitat.

#### 2. Dynamic Features and Processes, Including Climate

Very sheltered.

#### 3. Water

Clear, cool oceanic waters enter Tory Channel from Cook Strait resulting in low turbidity and sedimentation levels.

Very strong tidal currents sweep along the main open ended channel. The tidal range, however, is relatively small.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Stands of the kelp *Macrocystis pyrifera* fringe the shoreline along much of the main channel, distinguishing Tory Channel from most other sheltered locations in the Sounds. Dense beds of other macro-algae (mostly sea lettuce) also occur in areas less exposed to the current. Other seaweeds are generally confined to a narrow fringe below the low water mark similar to other sheltered areas of the Sounds. Reef areas otherwise support an array of invertebrate marine life typical of sheltered areas of the Sounds.

Near-shore communities very depressed where exposed to the effects of wakes from some large vessels.

### C. Potential for Restoration

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Remedy or mitigate any adverse effects of ship operations.

## H Marine - Queen Charlotte Sound

### Collective Characteristics:

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#### Mainly Sheltered

Sheltered; waters relatively clear and cool; narrow cobble reef fringe generally with fine sediments and sparse conspicuous marine life beyond; brachiopods and red algae beds.

### A. The Physical Environment

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#### 1. Form/Geology

A narrow (20-50m) rubble/cobble near-shore reef typically grades into sand/shell and mud habitats with greater depth. Mud dominates deeper off-shore areas.

#### 2. Dynamic Features and Processes, Including Climate

Relatively sheltered, with limited wave fetch in most places.

#### 3. Water

Low to moderate turbidity and sedimentation levels; noticeably clearer than Pelorus Sound. No major rivers discharge into the Sound.

Relatively cool waters, especially in the vicinity of Tory Channel and beyond.

Relatively small tidal range resulting in a comparatively narrow inter-tidal zone. Strong currents occur at the entrance to Tory Channel and at Pattens Passage and Pickersgill Passage. Moderate currents can occur elsewhere off headlands and between land masses.

### B. The Biological Environment

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#### Distinctive Biota, Communities and Habitats

#### Natural Biodiversity, Productivity and Biotic Patterns

Low diversity and coverage of macro-algae usually confined to a narrow zone immediately below the low water mark. Encrusting and mobile invertebrates dominate reef areas. Conspicuous surface species are uncommon over the sand/shell and mud habitats, though in places where environmental conditions are favourable, species such as horse mussels, scallops, brachiopods and bryozoans occur, sometimes in high densities. Inner Sound distinguished by extensive red algae beds. *Neothyris lenticularis* (a rare brachiopod) is a distinctive inhabitant of inner Queen Charlotte Sound and East Bay. Elephant fish spawning grounds occur in a number of the inner bays. Few and relatively small estuarine wetlands at the heads of major bays and inlets.

Near-shore marine communities very depressed where exposed to the effects of wakes from some large vessels.

### C. Potential for Restoration

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Remedy or mitigate any adverse effects of ship operations.

Spartina control.