Orepuki coastal zone

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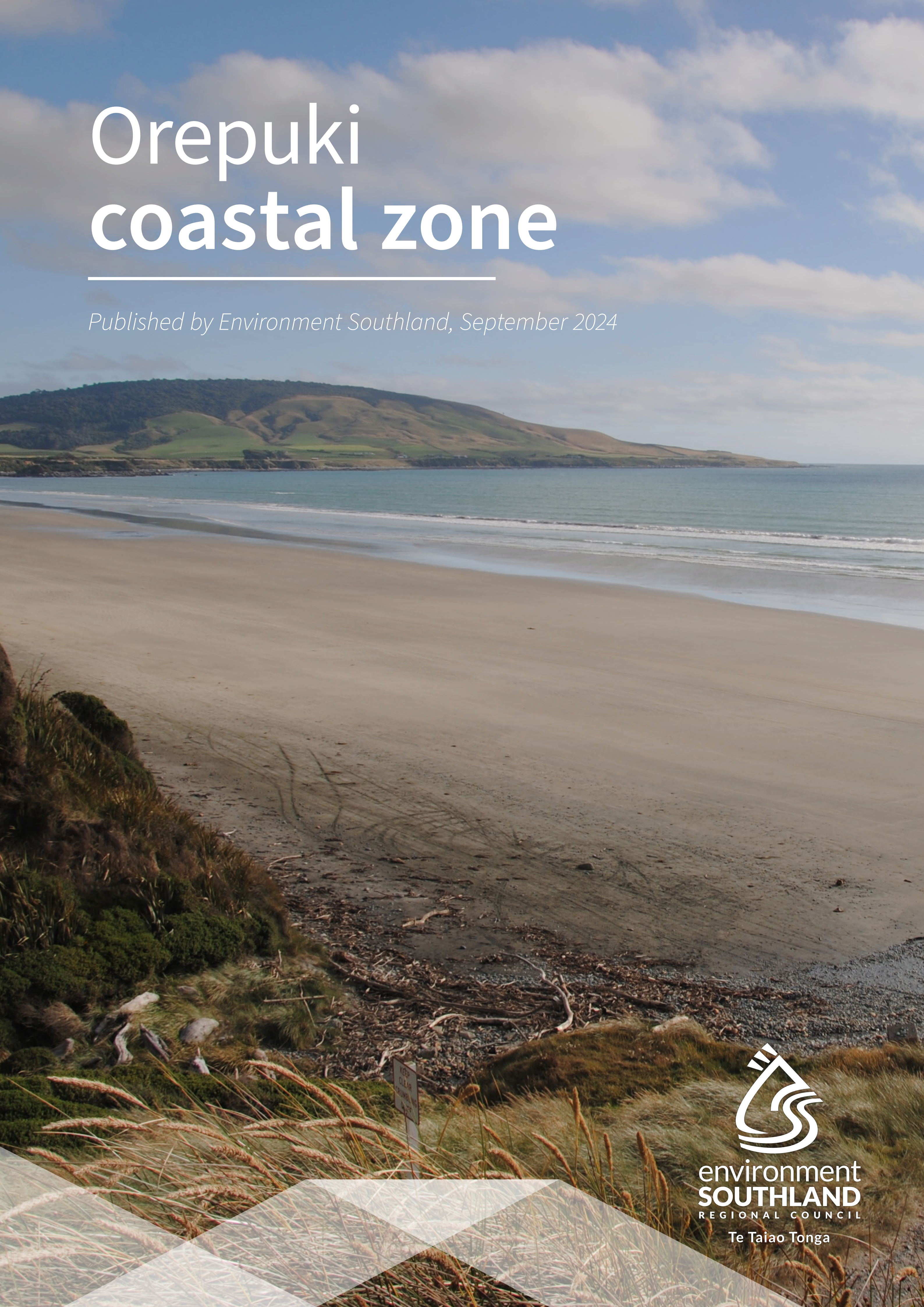

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Te Taiao Tonga

Orepuki coastal zone

This document summarises scientific information for freshwater and estuarine areas, opportunities for action and the socioeconomic context of the Orepuki coastal zone.

This is one of twelve catchment summaries prepared for the Murihiku Southland region.

We have collated and presented scientific data at the catchment scale to provide an understanding of freshwater quality and quantity challenges and their underlying factors. We have included an evaluation of the current state of freshwater within the catchment and highlighted the magnitude of change necessary to meet freshwater aspirations.

The information in this document should be considered alongside other information sources, including mātauranga Māori.

Main features

Land area: 29,000ha

Major rivers and streams: Waimemeha (Waimeamea) River, Taunoa Stream, Falls Creek, Kenny Creek, Orepuki Creek, Raurikaka Creek, Ouki Creek, Ōtūpuahiri (Pouahiri) Creek, Ōuruwera (Ourawera) Stream

Aquifers: Orepuki groundwater zone

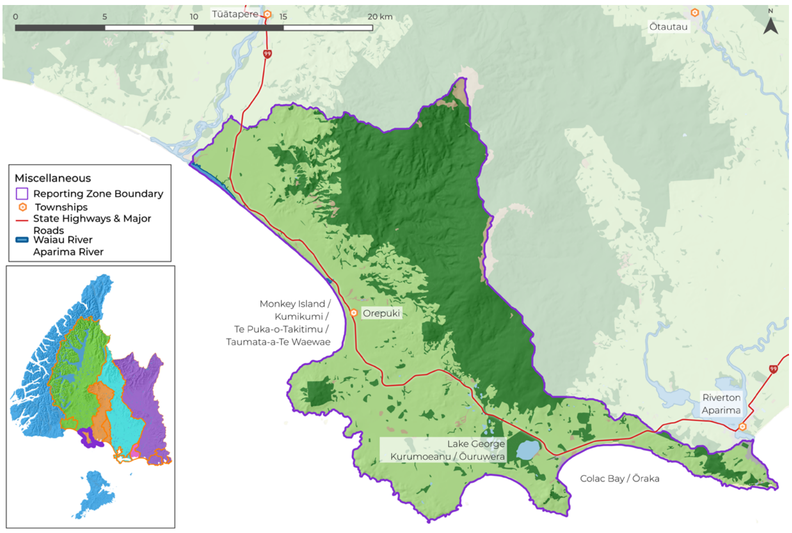
Lakes: Kurumoeanu/Ōuruwera (Lake George)

Estuaries: Jacobs River

Townships: Orepuki

Population: Approximately 900

Catchment outline



For most attributes, current state is assessed using data from the 2018 – 2022 period.

Key messages

Issues

- There is limited monitoring data available. Modelling indicates contaminant load reductions are required to achieve desired freshwater and estuary outcomes. Reductions are needed for nitrogen (24%), phosphorus (47%), sediment (20%) and *E. coli* (85%).
- Monitoring indicates some improvements are required for Lake George. Total nitrogen is in a ‘good’ state and achieves the hauora target, while total phosphorus and trophic state are ‘fair’ and phytoplankton is in a ‘poor’ state. The latter three attributes require improvement to reach the hauora target of ‘good’.
- Approximately 204ha of wetlands have been lost since 1996 in the Orepuki coastal zone area. While most remaining wetlands are at moderately low risk of being lost. Some wetlands on non-conservation land are at risk of being lost.

Opportunities for action

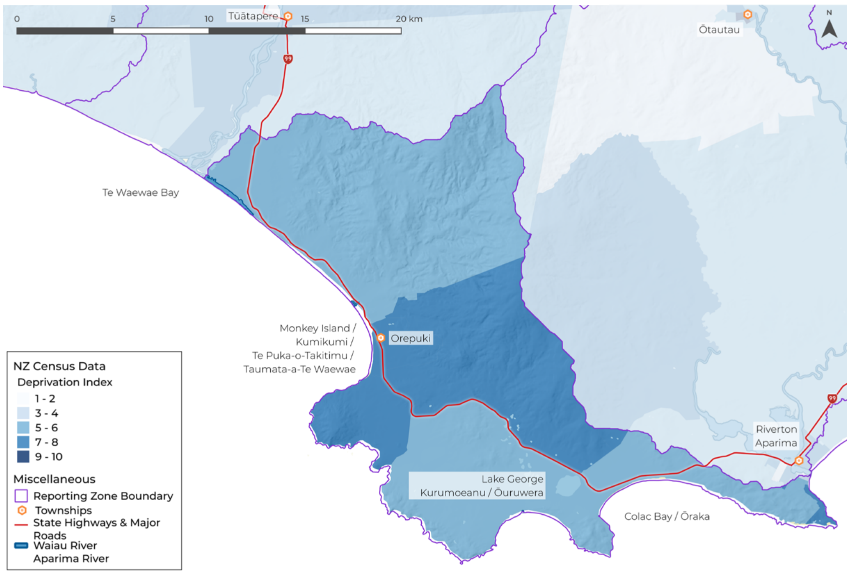
- Implement property-scale mitigations tailored to the land's physiographic characteristics, the sensitivities of the receiving environments and the outcomes sought for the catchment.
- Consider opportunities to facilitate land use change and deintensification within the Orepuki coastal zone. This may be through the development of long-term catchment plans, promotion of alternative land use options and diversification, or implementation of a regulation that provides clear mechanisms and outcomes with regard to contaminant loss reductions.

Socioeconomic context for action

The Orepuki coastal zone is predominantly rural and spread over multiple Census statistical areas (SA2). As they do not align to the catchment zone boundary, it is challenging to provide as accurate social context. Around 600 of the estimated 900 people in the Orepuki coastal zone reside in the Riverton SA2 area, with the rest either living rurally or in rural settlements in Longwood Forest. The Orepuki coastal zone makes up about one-third of the total population for both the Longwood Forest and Riverton SA2s. Some socioeconomic information relating to Riverton township is included here as parts of the town are within this zone.

Historic socioeconomic shifts later in the 20th century have shaped western Murihiku Southland and the communities in and around the Orepuki coastal zone. The impacts of neoliberal deregulation from the 1980s removed agricultural subsidies and export assistance, creating a period of austerity for many farming communities. Other industry declines, such as the timber industry decline in the Tūātapere/Longwood Forest area, led to a deterioration of socioeconomic conditions for local dependent townships, driving a population decline. The rise in dairy farming across the region in the 1990s began to improve economic, ushering in land use change and industry and demographic changes.

Social Deprivation Index



Social Deprivation Index

The Deprivation Index measures socioeconomic deprivation based on census information. It considers income, income benefits, communication access, employment, educational qualifications, home ownership, care support, living space and living conditions.

Ethnic distribution in the Orepuki coastal zone is similar to Southland District Council area. Notably, Riverton has a comparatively higher percentage of Māori than the district, with one in five people identifying as Māori (compared to one in ten in SDC). Longwood Forest also has a higher percentage of Māori, but not as high as Riverton. Most of the population in both areas were born in New Zealand, with small communities of Asian, Pacific, MELAA (Middle Eastern, Latin American, and African) and other ethnicities in the community in 2018 (Stats NZ, 2018).

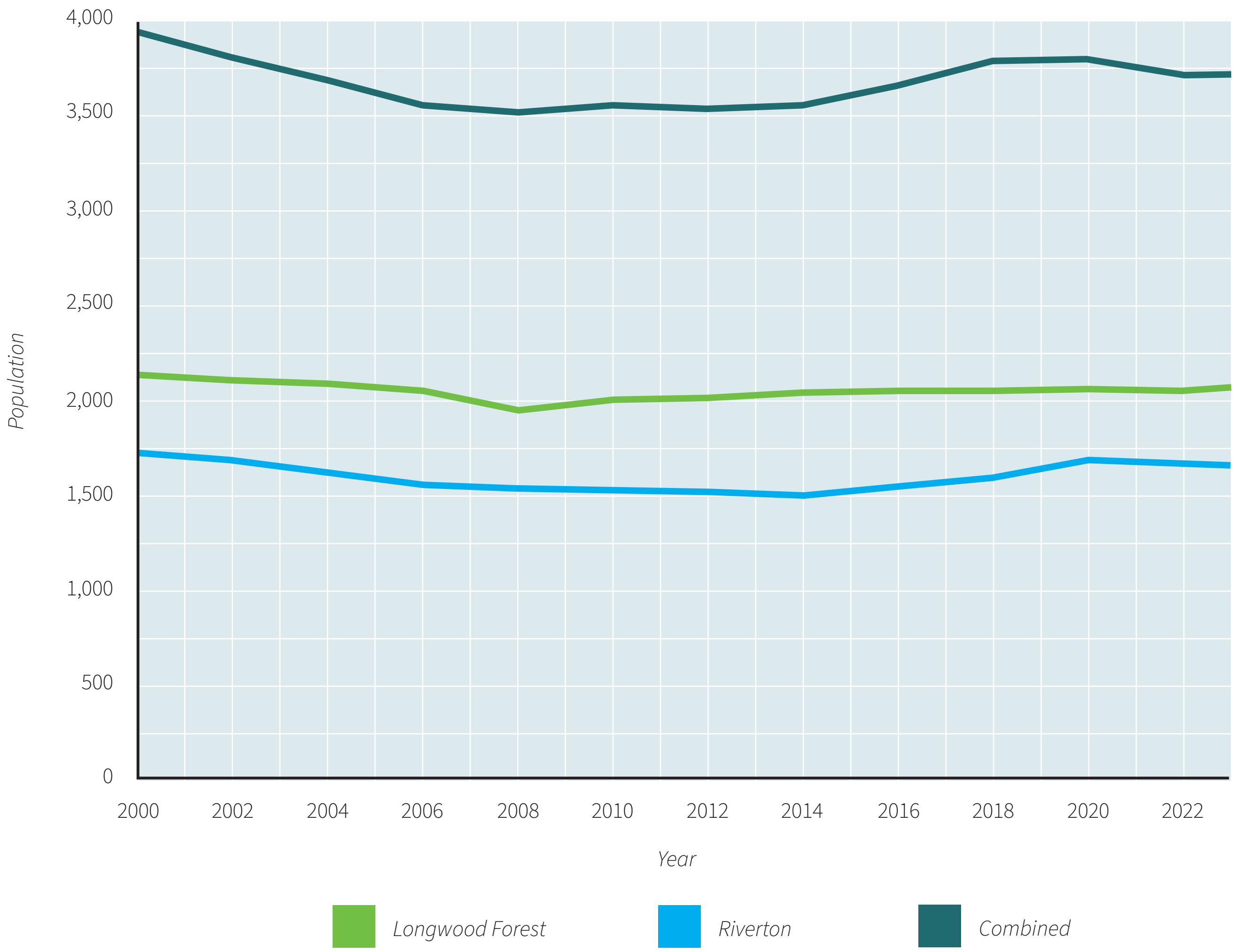
The population in Longwood Forest declined in the 1990s. However, it began to recover in 2008.

Riverton's population followed a similar period of decline, with recovery starting later in 2013. It grew rapidly, peaking in 2019-2020 and declining slightly to 2023.

The age distribution data for the two areas may provide insight into these trends. Riverton's older population (aged 60+) is proportionally much higher than the average for Southland district, while the proportion of younger people aged 0-39 is lower. Riverton is a popular retirement settlement, which may partly explain the comparatively higher levels of deprivation in Riverton, as retirement income is often limited.

The age distribution in Longwood Forest is much closer to the district averages than Riverton, with a slightly higher proportion of people aged 50-64 and a slightly lower proportion in the 30-39 age range.

Estimated population trends (Dot Loves Data, 2024)



The Orepuki coastal zone comprises two main census-based statistical areas (SA2s). Parts of these statistical areas may lay outside of the catchment. Therefore, this graph indicates general population trends across both areas, not just the catchment itself.

Although Southland district is among the least socioeconomically deprived regions in New Zealand, the Orepuki coastal zone contains some of the most deprived areas in Southland district. Deprivation trends from 2014-2023 show that Riverton has shifted between moderate to high deprivation; Longwood Forest and Riverton have experienced some increases in deprivation.

The overall deprivation levels for the Longwood Forest and Riverton SA2s are moderately high. However, as mentioned above, this may be skewed by the higher percentage of people aged over 60. Riverton has a large retirement community, which may contribute to the noticeably lower median household income and higher median sale house price. Longwood Forest has a lower median income and median sale price than the District's median values.

Inspecting deprivation at an SA1 level suggests the highest deprivation levels in the catchment are situated in more densely populated areas along Riverton Rocks and Orepuki Township. The lowest levels of deprivation are also in Riverton, but this area is closer to the mouth of the Aparima. The rest of the catchment has a moderate level of deprivation.

Summary

- The local rural economy relies heavily on intensive lowland agriculture, increasing risks from industry or regulatory changes.
- Higher-than-average deprivation levels in the more settled areas could result in less resilience and poorer wellbeing outcomes.
- Lower education attainment levels in parts of the community may reduce the capacity to adapt to economic, technological, and environmental changes.
- Established catchment groups, such as the Orepuki Catchment Group, provide a support system for members and community projects and may facilitate adaptation to external pressures and challenges.

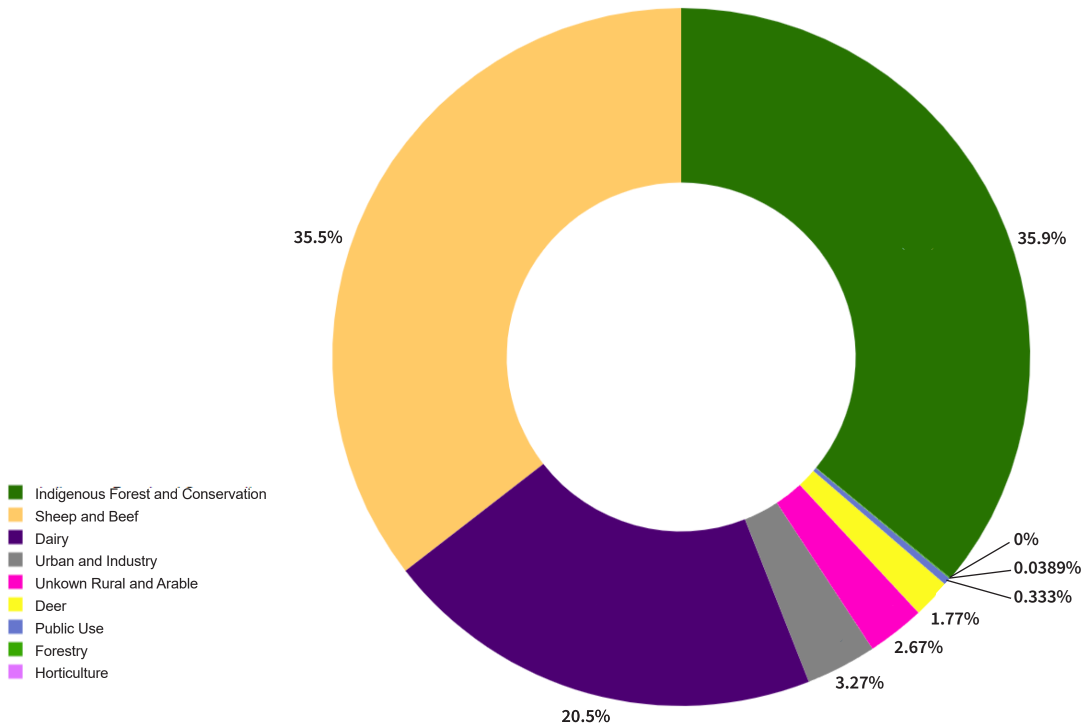
Catchment overview

The Orepuki coastal zone extends east of the Waiau River to Taramea/ Howell's Point at Riverton. It includes all the coastal area between these points and the hills on the southern side of the Longwood Range.

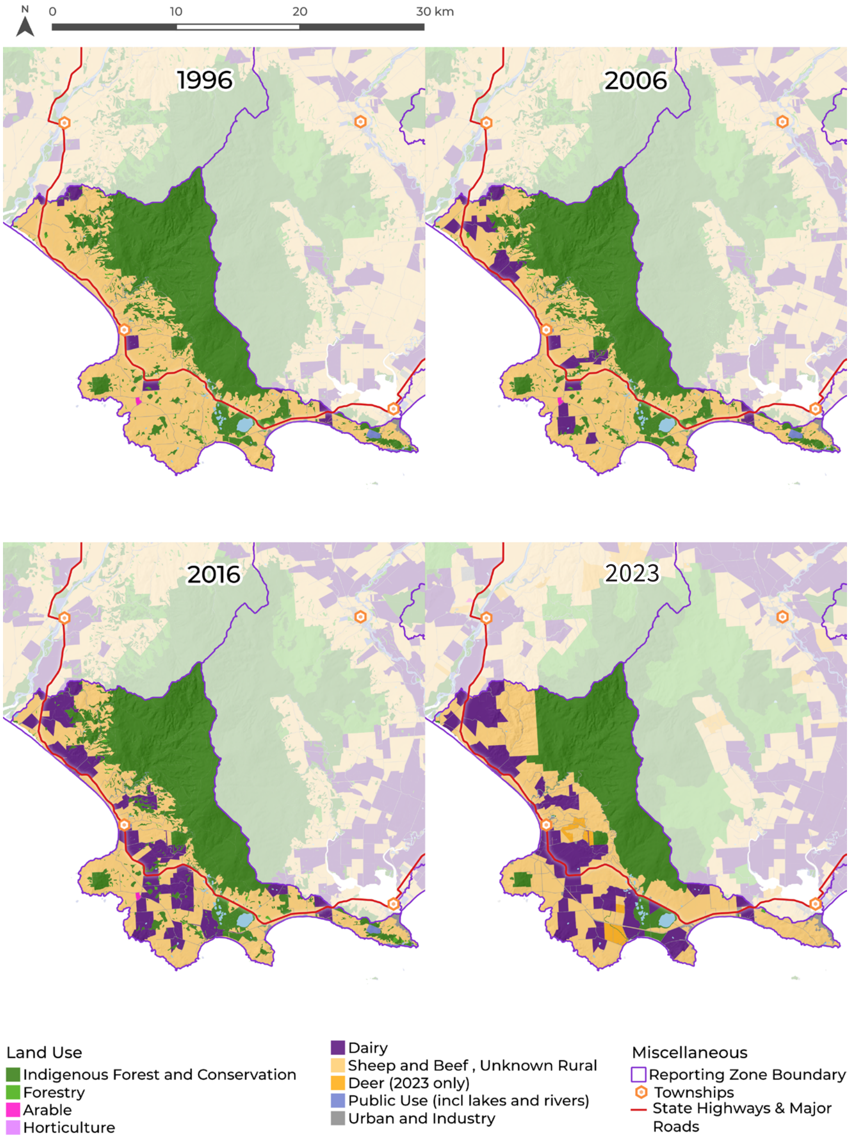
Land use

The Orepuki coastal zone covers approximately 29,000 hectares. About 17,400ha (60%) is used for farming. The second highest land use is indigenous forest and conservation land at 10,440ha (36%). Urban and Industrial land use dominates (3.3%) the rest of the available land, with a small percentage (<1%) of public use land.

Large changes in land use have occurred in the last 25 years. The map sequence below shows the growth of dairy farming in the area over this period. This increase in agricultural land use has resulted in increased pressure on natural resources.



Historic land use



Please note that these maps and figures are indicative only due to land use class aggregation and differences in mapping methods. In particular, the 2023 map uses a more simplified classification of forest and some changes shown will not reflect real forest loss.

Historic land use

	1996 to 2006	2006 to 2016	2016 to 2023	Overall 1996 to 2023
Pastoral land	No change	↑ 2%	↑ 18%	↑ 20%
Dairy	↑ 253%	↑ 135%	↑ 28%	↑ 966%
Drystock	↓ 11%	↓ 19%	↑ 13%	↓ 18%

Climate

Understanding climate at a catchment scale helps to explain spatial and temporal variation in land use, water quality and quantity.

Current climate

The Orepuki coastal zone, like most of coastal Murihiku Southland, has a cool, wet climate. Consistent rainfall and small fluctuations in seasonal mean temperatures are typical for these areas, as is a high ocean influence.

Future climate

Potential changes to the future climate of the Orepuki coastal zone have been examined in a regional study exploring scenarios for two Representative Concentration Pathways (RCPs): 4.5 and 8.5, representing lower and higher carbon emissions, respectively. These potential changes are summarised in the following table.

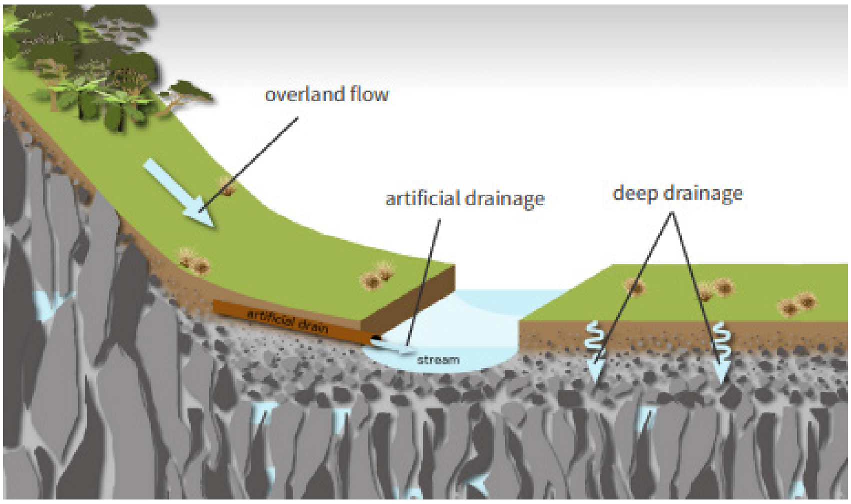
Precipitation

		RCP 4.5		RCP 8.5	
		Mid 21st century	End of 21st century	Mid 21st century	End of 21st century
Temperature	Daily mean (°C)	↑ 0.5-0.75	↑ 1-1.25	↑ 0.5-0.75	↑ 1.75-2
Temperature	Mean minimum (°C)	↑ 0-0.5	↑ 0.5-1	↑ 0.25-0.5	↑ 1.25-1.75
Temperature	Number of hot days	↑ 0-5	↑ 0-10	↑ 0-5	↑ 5-20
Temperature	Number of frosty nights	↓ 5-10	↓ 10-20	↓ 5-15	↓ 15-25
Rainfall	Annual rainfall change (%)	↑ 0-5%	↑5-10%	↑ 0-5%	↑ 15-20%
Rainfall	Number of wet days	160-166	159-169	160-165	168-160
Rainfall	5-Day maximum rainfall (mm)	↑ 0-15mm	↑ 0-15mm	↑ 0-15mm	↑ 15-30mm
Rainfall	Heavy rainfall days	32-34	32-34	31-34	34-37
Rainfall	Seasonal changes	Wetter springs	Concentrated to winter/spring	Concentrated to winter/spring	Concentrated to winter and spring

Catchment landscapes and hydrology

Water quality variations within a catchment are influenced by biogeochemical and physical processes. Understanding hydrology, geology and soil types within a catchment helps explain variations in water chemistry and water quality outcomes independent of land use.

Headwaters

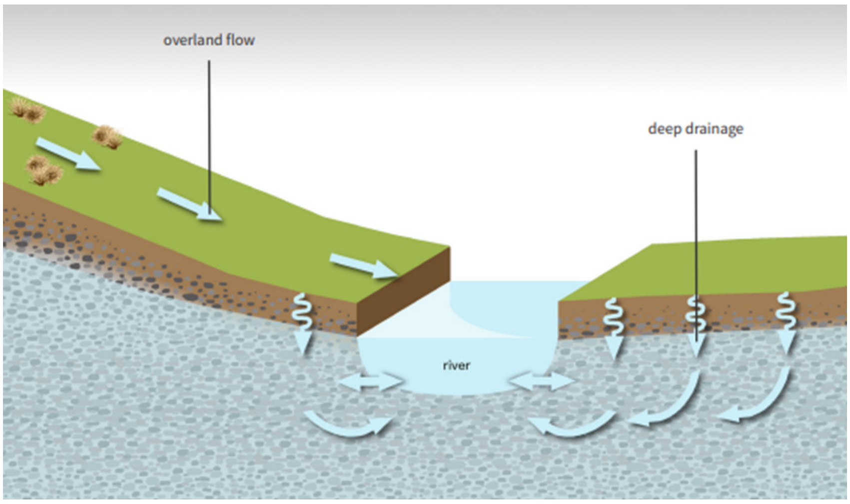


▲ *Conceptual illustration of the typical hydrological and landscape setting in the upper catchment hill country areas.*

The Ōuruwera Stream, Taunoa Stream, Waimeamea River and associated tributaries drain the southwest-facing slopes of the Longwood Ranges. Waterways in these headwaters are small (< order 4) and have median flows of less than 0.5 cumecs. The Longwood Ranges are mostly covered in native vegetation and are characterised by thin organic forest soils formed on intrusive igneous rocks belonging to the Brook Street Terrane. Relatively pristine water from these forested hills reaches the rolling agricultural pastured landscape as it moves down the catchment. Here, it mixes with localised recharge from the surrounding land. Due to interactions with agricultural landscapes, the water carries increased nutrients, sediment and *E. coli*.

Flow lag times in the headwaters are relatively short (hours/days), with limited subsurface flow pathways and steeper topography.

Mid and lower catchment areas



▲ *Conceptual illustration of the typical hydrological and landscape setting in the mid-catchment.*

Closer to the coast, the rivers and streams in this zone flow through land dominated by agriculture. Soils are a combination of deep silts with variable drainage and deep, very poorly drained peat. Nutrients, sediment and *E. coli* are conveyed to main river and stream channels via overland flow, artificial drains and some flow through soil and shallow groundwater systems.

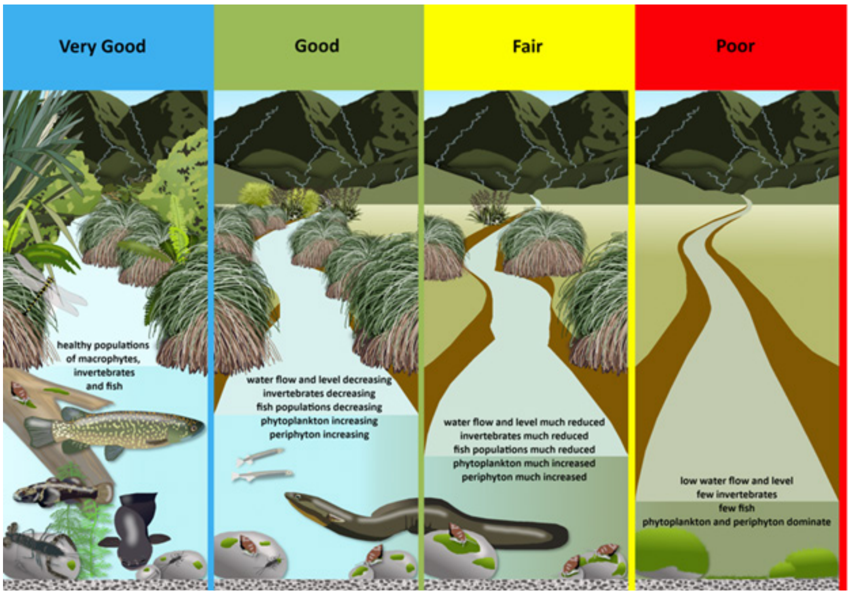
Flow pathways and lag times can vary greatly. Relatively long lag times (years) are associated with subsurface groundwater flows, while the modified surface hydrology results in short lag times for overland flow and artificial drainage networks.

The lower parts of the catchments are characterised by an increasing proportion of water derived from the hilly agricultural landscape. This hydraulically modified land rapidly carries water and contaminants downgradient to streams and rivers, which flow directly to the ocean.

What are the water issues for this catchment?

Freshwater outcomes and how we measure them

Freshwater outcomes can be described on a spectrum from 'very good' to 'poor'. Using this spectrum helps us to understand the current freshwater environment state and what we might be trying to achieve in the future. This concept is depicted for rivers and streams in the image on the right.



Although many factors contribute to freshwater outcomes, we can only measure some of these to get an understanding of ecosystem health. We measure the aspects of the freshwater environment that can help us define and determine freshwater outcomes. The aspects that we measure are called 'attributes'.

Attributes (the things we measure)

Attributes can relate to the ecosystem's physical or chemical environment or biological communities, such as periphyton, macroinvertebrates and fish. The measured state of an attribute tells us about some aspects of the environmental state, and together, they build a picture of the ecosystem's overall health. The more attributes we monitor, the more precise the picture can become.

Attributes may relate to ecosystem health or human health outcomes (e.g. phosphorus or *E. coli*). Some attributes are graded using 'ABCD' categories: A (very good), B (good), C (fair) and D (poor). In some cases, *E. coli* has an additional E (very poor) grade. Other attributes have simple 'pass' or 'fail' grades.

The more attributes with a higher grade, the better the overall ecosystem health. Conversely, when many attributes have poorer grades, the overall ecosystem health is poorer.

Hauora target attribute states

In 2020, Environment Southland and Te Ao Mārama Inc (TAMI) approved in principle the use of hauora as a freshwater target to be achieved within a generation. These targets provided the basis for the Regional Forum recommendations on how freshwater aspirations may be achieved.

The concept of hauora encompasses far more than the numeric attributes and targets described here. For simplicity, a reduced number of attribute states are presented in this document as they relate to ecosystem and human health. Hauora is a state of healthy resilience and is generally associated with the A 'very good' and B 'good' attribute states. However, attribute states that support hauora can be anywhere on the scale from A 'very good' to C 'fair', depending on the natural characteristics of that freshwater environment.

The natural characteristics have been differentiated through the use of classes.

We use monitoring results to compare the current attribute state with the hauora target state for different classes in the Orepuki coastal zone.

Streams and rivers

River classes

‘River classes’ group rivers (or parts of rivers) with similar characteristics. Similarities can include natural characteristics of the rivers, such as climate, gradient and flow. River classes can also group environments with similar pressures, such as land use.

The river classes used in Murihiku Southland are: Mountain, Hill, Lowland, Spring-fed, Lake-fed and Natural State.

About two-thirds of the rivers in the Orepuki Coastal Zone are classified as Lowland. The rest are Hill, Natural State and Lake-fed.

Target states can differ between attributes and between different river classes, which may have different target states for the same attribute

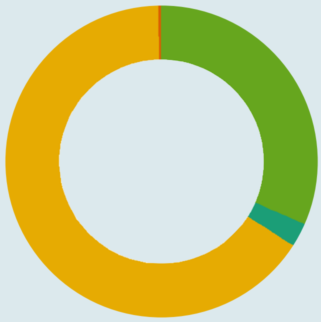
Periphyton is an example of an attribute with different target states for different river classes.

The different target states reflect the differences in natural characteristics for each river class.

- C target state: Lowland class
- B target state: Hill class
- A target state: Mountain, Spring-fed and Lake-fed classes.

Natural State waterbodies can be identified for management purposes but are assigned attribute targets according to their underlying river classification (displayed here).

Length of river network in each class



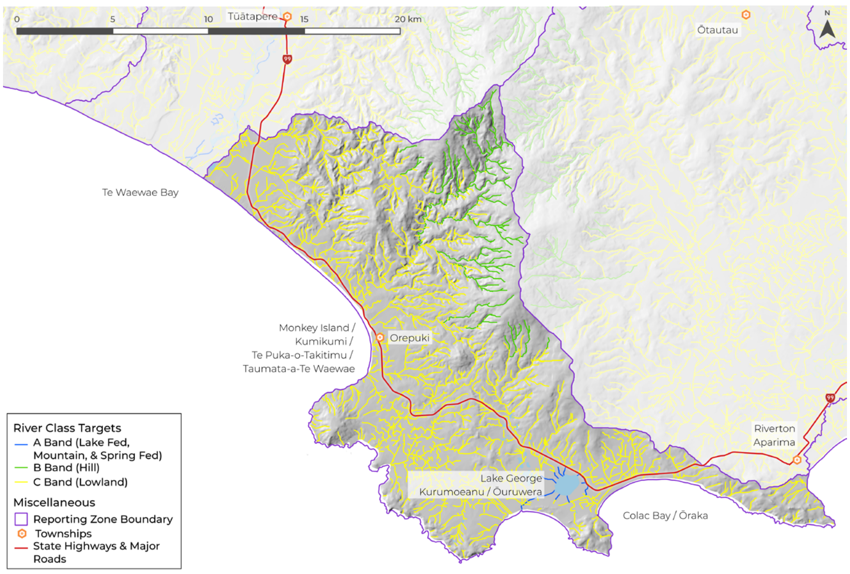
Results for the river classes

Hauora targets and current states for ecosystem and human health attributes are summarised in the table below for the catchment’s Hill, Lake-fed and Lowland river classes. Table colours correspond to the ‘ABCDE’ grading for attributes described previously. There are few monitored attributes in the rivers of the Orepuki coastal zone.

Current state is assessed using data from the 2018-2022 period.

The map shows the distribution of periphyton targets for each river class within the Orepuki coastal zone.

River class hauora targets



	Lowland		Hill		Lake-fed	
Ecosystem health attributes	Hauora target	Current state	Hauora target	Current state	Hauora target	Current state
Periphyton	C	-	B	-	A	-
Nitrate toxicity	A	-	A	-	A	-
Ammonia toxicity	A	-	A	-	A	-
Suspended fine sediment	C	-	C	-	B	-
Macroinvertebrates (MCI, QMCI)	C	C	B	-	C	-
Deposited fine sediment	A	-	A	-	A	-
Dissolved reactive phosphorus	B	-	B	-	A	-
Water temperature (summer)	C	-	C	-	B	-
Human contact attributes						
Benthic cyanobacteria	A	-	A	-	A	-
E. coli	A	-	A	-	A	-
Visual Clarity	B	-	B	-	A	-

"-" data not available.

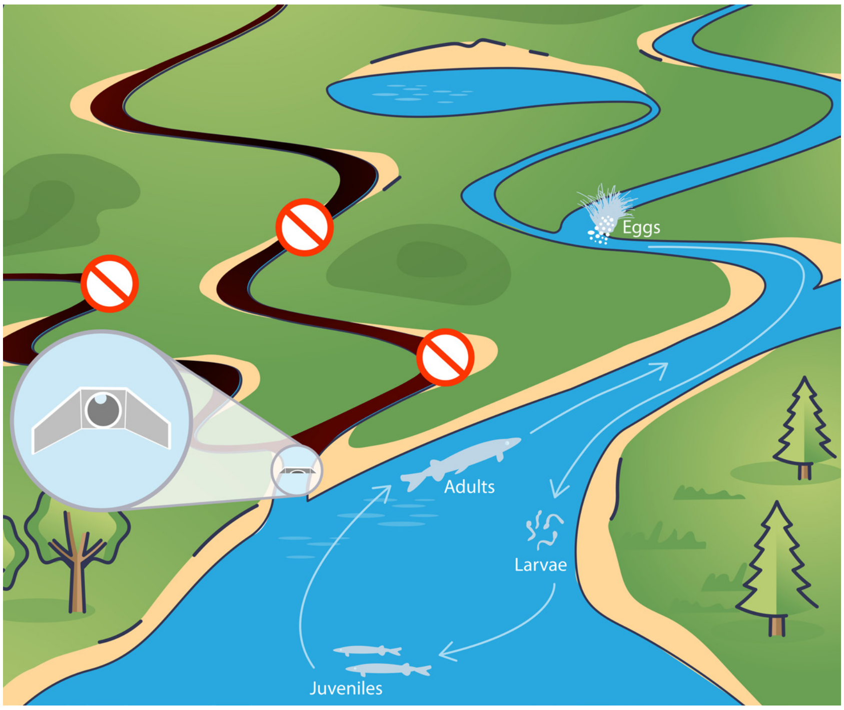
There are no long-term monitoring sites in spring-fed or mountain waterbodies in the Orepuki zone.

Modelled data is available for specific attributes. Modelling indicates contaminant load reductions are required to achieve desired freshwater and estuary outcomes. Reductions are required for nitrogen (24%), phosphorus (47%), sediment (39%) and *E. coli* (85%).

Fish passage

Fish passage barriers obstruct the passage of fish species. This particularly impacts migratory fish species that complete their lifecycles in both freshwater and the ocean, such as tuna/eels, kanakana/pouched lamprey and migratory galaxiids/whitebait. Generally, the closer a barrier is to the coast, the larger the area of habitat that becomes inaccessible to migratory fish, making it a higher priority for restoring passage. Common examples of fish passage barriers include structures like culverts, weirs and dams, while natural features such as waterfalls can also form barriers. Different fish species and life stages have varying climbing and swimming abilities, so a barrier for one species or life stage may not be a barrier for another.

Whitebait lifecycle

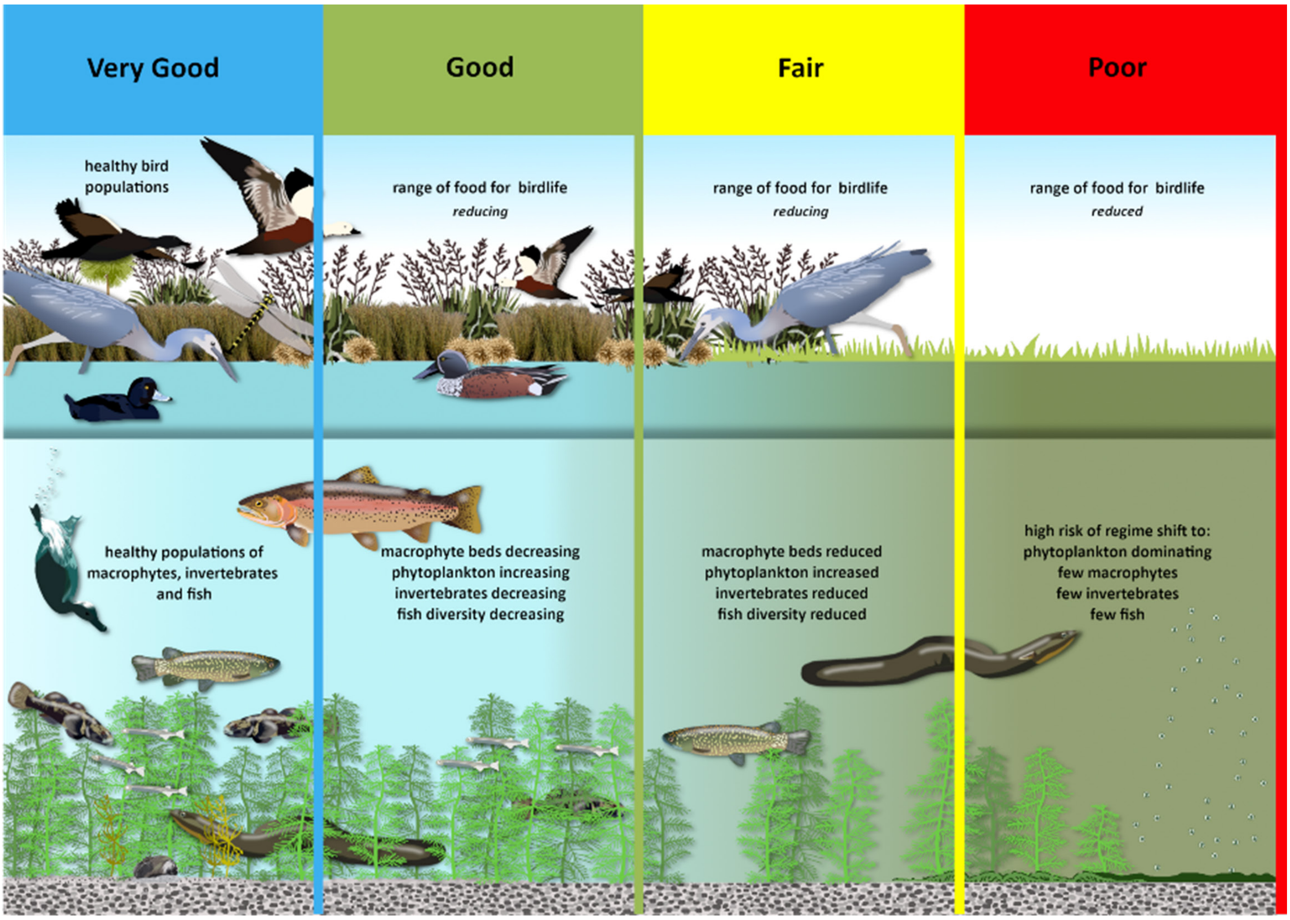


In some cases, fish barriers may be desirable to protect populations of non-migratory galaxiids that struggle to co-exist with trout. In these cases, a barrier could be installed or maintained in a specific location to prevent trout from reaching the population of non-migratory fish.

Culverts are the most common fish passage barrier in the Orepuki coastal zone. When culverts are designed and installed, consideration of fish passage and regular maintenance of structures will help improve fish passage

Lakes

Lake freshwater outcomes can be described on a spectrum from 'very good' to 'poor'. This spectrum helps us understand the current state of the freshwater environment and what we might be trying to achieve in the future. The concept is depicted for lakes in the image below.



Although many factors contribute to environmental outcomes for our lakes, we can only measure some to better understand ecosystem health. We measure the aspects of the freshwater environment that can help us define and determine freshwater outcomes.

Lake George (Kurumoeanu/Ōuruwera)

Lake George is a lowland shallow lake. Shallow lakes are usually well mixed vertically through the water column. Shallow lakes in good condition typically have healthy plant communities and good water clarity. Lowland shallow lakes generally experience more pressure from land use than shallow lakes at higher altitudes. When their condition deteriorates, this can be expressed as increased suspended sediment in the water column, loss of aquatic plants (macrophytes) and changes in the quality of lake bottom sediments

Ecosytem health

Hauora targets and the current state of monitored lakes within the Orepuki coastal zone are shown in the table.

Total nitrogen is in a 'good' state and achieves the hauora target, while total phosphorus and trophic state are in a 'fair' state and phytoplankton is in a 'poor' state. The latter three attributes require improvement to reach the hauora target of 'good'. Macrophytes are in a 'fair' state, achieving the hauora target.

	Lowland shallow lakes (Lake George)	
Ecosystem health attributes	Hauora target	Current state
Phytoplankton	B	D
Total phosphorus	B	C
Total nitrogen	B	B
Ammonia toxicity (mg/L)	A	A
E. coli	A	A
Trophic state (Trophic Level Index)	B	C
Nitrate toxicity	A	A
Macrophytes	C	C
Human contact attributes		
Planktonic cyanobacteria	A	A
E. coli	A	B

The human contact value of *E. coli* is in a 'good' state, requiring improvement to reach the hauora target of 'very good'. Planktonic cyanobacteria achieves the hauora target of 'very good'.

Groundwater

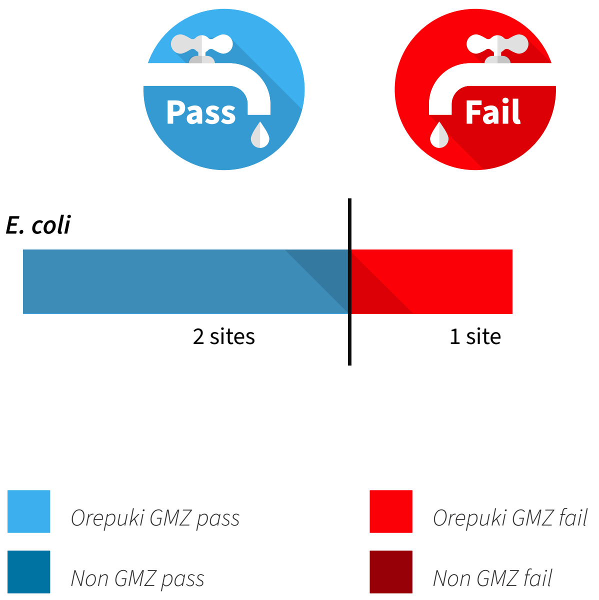
Human consumption – is it safe to drink?

Useable groundwater resources in the Orepuki Coastal Zone are limited and commonly hosted in Quaternary alluvium and marine terrace deposits. Groundwater is generally shallow (3-5m) and the median well depth is 22m.

The presence of pathogens (*E. coli*) and nitrate are the main issues affecting the suitability of potable groundwater for drinking. Target states for groundwater are based on the New Zealand drinking water standards and use a pass/fail assessment system.

Results show that the single monitored site in the Orepuki Groundwater Management Zone (GMZ) fails the standard for *E. coli*, while the two monitoring sites that are not within any GMZ both achieve the target state of 'pass' for *E. coli*.

Orepuki groundwater assesment

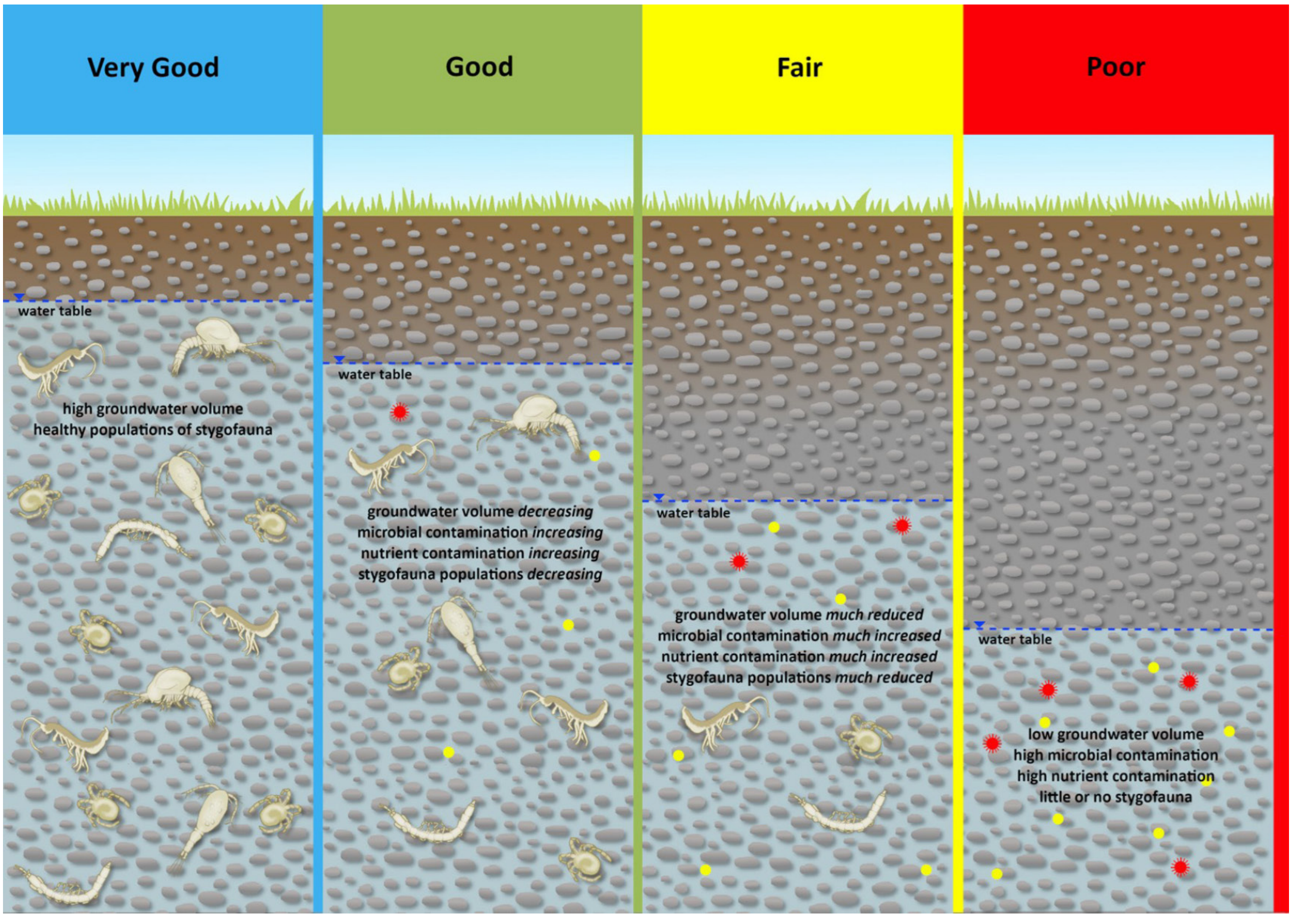


Ecosystem health

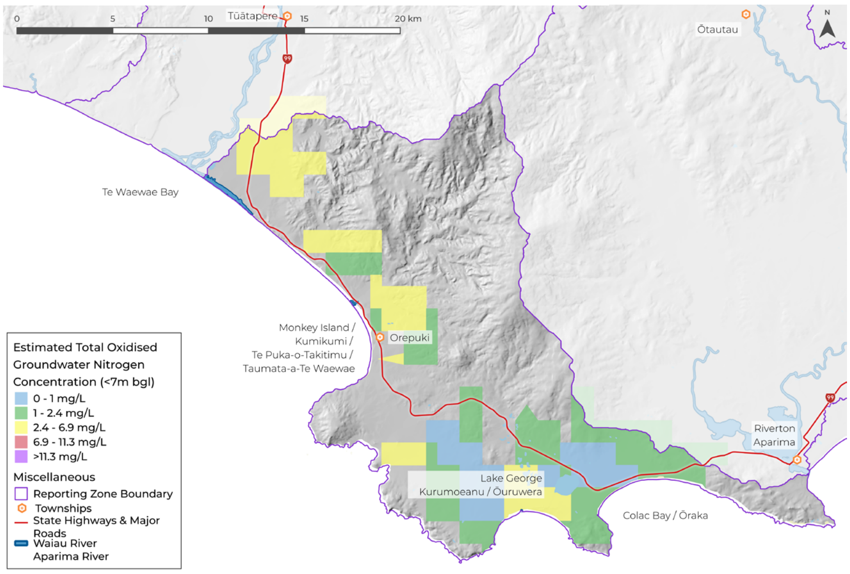
Nitrate concentrations are also used to monitor ecosystem health – for both groundwater ecosystems and connected surface waterways. Groundwater ecosystem health outcomes are represented conceptually in the figure below. Nitrate concentrations are one factor that contributes to overall ecosystem health. Nitrate concentrations related to surface water and groundwater ecosystem health outcomes are different from those used in drinking water mentioned above.

We have limited monitoring data for nitrate in the zone. Modelling and physiographic information indicate that the risk of severe nitrate contamination in the Orepuki Coastal Zone is relatively low.

Modelled nitrate concentrations are shown in the map.



Groundwater nitrogen



Wetlands – how many do we have left?

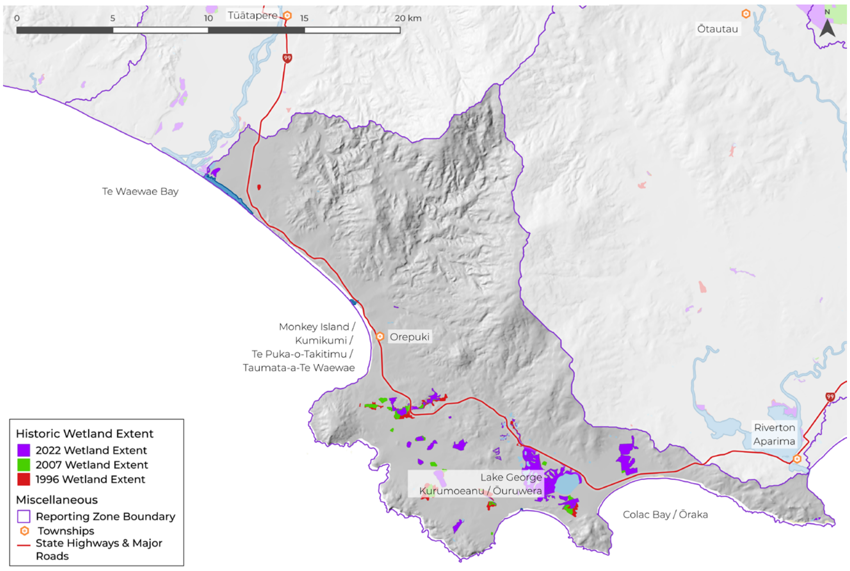
Wetlands and water quality

Wetlands are increasingly being recognised for their functional values within the landscape. For example, their ability to intercept and attenuate agricultural runoff is now recognised as an important contribution to farm nutrient management.

Wetlands purify water through sediment capture and storing nutrients in their soils and vegetation. This is particularly important for the agricultural nutrients nitrogen and phosphorus, which contribute to the eutrophication of receiving environments such as rivers, lakes and estuaries.

For the purposes of this document wetlands are generally defined as per the Southland Water and Land Plan definition.

Historic wetland extent



This map shows the wetland extent over three time periods. Wetland areas lost since 1996 and 2007 are shown as the red and green areas respectively.

The following areas were not included as wetlands in this classification:

- Wet pasture or where water ponds after rain
- Pasture containing patches of rushes less than 50% total cover
- Ponds of any kind unless associated with 0.5 or more hectares of terrestrial wetland.
- Areas of forest unless previoulsy identified as wetland.
- Areas associated with the main active flood channels of rivers.

Current state

There are currently 586ha of wetlands in the Orepuki coastal zone. Most wetlands lost are bogs, the most common wetland type in Murihiku Southland. These have been mainly converted to pasture farmland.

	1996 to 2007	2007 to 2022	Overall 1996 to 2022
Change in wetland area	↓ 15% 117 ha	↓ 13% 87 ha	↓ 26% 204 ha

Remaining wetlands

Two regionally significant wetlands are located in the Orepuki coastal zone. The Lake George wetland complex occupies an area of Department of Conservation land. Lake George and most of the surrounding shallow ponds are not natural and were formed from quarrying activities. Active current mining is still permitted on the DOC land and within the regionally significant wetland.

The other regionally significant wetland is part of the Te Waewae Lagoon. Inland from the lagoon are several restored wetlands. No wetlands have been identified in the Longwoods conservation area, and the only other wetland identified inland from Te Waewae Bay is a small swamp in a gully. However, several dozen small wetlands exist between Orepuki and Riverton, mostly fens with scrubland such as manuka and bogs with wire rush.

Of the remaining wetlands not on conservation land, there was a moderately low risk of losing more wetlands in the near future.

	1	2	3	4	5
Risk of Loss (1 = low, 5 = high)	3%	40%	36%	18%	3%

Coastal monitoring

Coastal monitoring in the Orepuki coastal zone is focused on the human contact attributes of *Enterococci* spp. including *Enterococci* at popular bathing sites. *Enterococci* is graded as 'good' for the monitored popular bathing sites. For sites that are not popular bathing sites, there is limited data that indicates a 'poor' state for *Enterococci*. Both attributes fail to achieve the hauora target of 'very good'.

There are many factors that contribute to coastal outcomes. However, we are only able to measure some of these to get an understanding of ecosystem health. We measure the aspects of the coastal environment that can help us define and determine environmental outcomes. These are described on a spectrum from 'very good' to 'poor'. Using this spectrum helps us to understand the current environment state and what we might try to achieve in the future.

The ecosystem health attributes of metal concentrations in sediment are not monitored in the Orepuki coastal zone.

	Open coast	
Ecosystem health attributes	Hauora target	Current state
Total arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc in sediment	B	No data

Human health attributes		
Pathogens – *Enterococci*	A	D
Pathogens – *Enterococci* at popular bathing sites	A	A

Water quantity – how much do we have, and how much are we using?

Surface water allocation

Surface water takes are managed through two types of allocation blocks. A primary allocation block restricts the amount of water that can be taken during low flows (allocation available is 30% of Q95). A secondary allocation block restricts the amount of water that can be taken when flows are above mean or median levels, depending on the time of year (10% of mean flow from December to March and 10% of median flow from April to November).

Stream depletion occurs when groundwater is abstracted in an area that is hydraulically connected to nearby surface waterways, reducing stream flow. As a result, it has to be accounted for in both surface water and groundwater allocation management. Under the Southland Water and Land Plan, we are required to manage surface water allocation at any point of a surface water network, so allocation totals change along rivers to reflect the balance between the natural addition of water and the abstraction of water.

The following allocation figures do not include permitted take estimates.

The only continuous flow monitoring location in the Orepuki coastal zone is the Waimeamea River at the Young Road site. There is only one consented surface water abstraction on this waterway, a take of 2l/s for a dairying operation. However, several small surface water abstractions on other small waterways in the Orepuki coastal zone, such as the Ōuruwera Stream, Raurikaka Stream and Falls Creek, are also for mining or dairy purposes.

	Primary allocated (l/s	Primary allocation (% of limit)
Waimeamea River at Young Road	2.0	1.2

Site	Primary allocation (l/s)		Secondary allocation – Summer - 1 Dec - 31 Mar (l/s)			Secondary allocation – remainder of year - 1 Apr - 31 Nov (l/s)		
	Minimum flow (Q95,l/s)	Most consecutive days below Q95	Mean (l/s)	Average days below mean (Summer period)	Most consecutive days below mean (Summer period)	Median (l/s)	Average days below median (remainder of year period)	Most consecutive days below median (remainder of year period)
Waimeamea River at Young Road	554	14.9 (2018)	1,780	105	40 (2016)	1,108	118	28 (2020)

There is only one abstraction from the Waimeamea River, the allocation status for this waterway is very low, at 1.2% of its limit.

Monitoring data from the 2022/2023 season provided by consent holders indicate that surface water use is 22.4-62.5% of the total volume allocated for dairy operations. A lack of water use data means that an estimate of water use for mining operations in this zone is not possible.

	Surface water use (%)
Dairy	22.4-62.5
Mining	Unknown

Groundwater allocation

Most groundwater allocation thresholds are set using a proportion of annual rainfall recharge to aquifers, varying depending on the aquifer type.

In the Orepuki coastal zone, there is one Groundwater Management Zone, the Orepuki Groundwater Management Zone, which is 1.6% allocated.

Most allocated groundwater is consented for dairy (78%), with the only other consented use being mining (22%).

Monitoring data from the 2022/2023 season provided by consent holders indicates that groundwater use is less than 40% of the total volume allocated for dairy, with no information available to estimate groundwater use in mining operations.

	Groundwater use (%)
Dairy	37.0
Mining	Unknown

How much do we need to reduce contaminants to achieve a state of hauora?

Regional contaminant modelling

We have undertaken contaminant modelling to help us better understand water quality across Murihiku Southland. This modelling utilises monitoring data to estimate water quality in all waterbodies (excluding Fiordland and Islands). This expanded view of water quality allows us to estimate the reductions in contaminant load and concentrations required to achieve the identified target attribute states and to test the impact of different land use scenarios.

For this work, we focused on four main contaminants of concern: nitrogen, phosphorus, sediment, and *E. coli*. Actions taken to reduce the impact of these contaminants on our freshwater systems will have benefits for ecological and human health outcomes.

How much do contaminant loads need to be reduced?

Load is a measure of the total mass of a contaminant (in kg or tonnes) coming from a given area past a given point over time. For example, the total amount of nitrogen delivered to the sea by a river in one year.

We use loads to quantify contaminants here because they describe the amount of contaminants lost over a whole catchment area. It is the land that consequently needs to be managed to reduce those loads. It is important to remember that concentrations (e.g., the mass of the contaminant per litre of water in the waterbody in kg/L) must also be considered. Concentrations in waterbodies are affected by the size of the contaminant load lost from land and the amount of water available to dilute that load. Hence, water takes and climate can affect concentrations too.

Concentrations are the relative amount of contaminant present in a given volume of water at that time. Concentrations are important because they have direct relevance to toxicity attributes as well as ecological processes.

This modelling considers draft targets for the following attributes:

Rivers
Periphyton biomass, nitrate toxicity, dissolved reactive phosphorus, visual clarity, suspended sediment, *E. coli*.

Lakes
Total nitrogen, total phosphorus, phytoplankton.

Estuaries
Macroalgae.

This modelling accounts for loads and concentrations required to achieve target states everywhere for all the above attributes.

Estimated load reductions for the Orepuki coastal zone are presented in the table. Load estimates were calculated using sites with ten years of data and ralates to the 2017 year.

Contaminant	Total Load (2017 - Best estimate*)	Percentage load reduction required to achieve hauora (Best estimate*)
Total Nitrogen	226 Tonnes/Year	↓ 24% (22-27)
Total Phosphorus	7 Tonnes/Year	↓ 47% (40-56)
Sediment	4,500 Tonnes/Year	↓ 20%
E. coli	6 peta *E.coli*/Year	↓ 85% (77-90)

These values represent our best estimate. Levels of uncertainty are indicated by the 90% confidence interval shown in brackets where available.

What options do we have to reduce nutrient and sediment loads?

We have modelled different scenarios to indicate how far each may go toward achieving the estimated load reductions required. We have also bundled multiple scenarios to test the effect of combining multiple strategies.

This work is not intended to assess individual properties or activities. Rather, it generalises land use so that we can make some broad catchment scale assessments of the impact of different actions. This can also help give information about the differences between possible allocation approaches.

The results for each of the scenarios modelled are presented below. Explanations of each scenario can be found in our published reports. The coloured table cells indicate how far each scenario achieves the required load reductions.

We have also modelled phosphorus and suspended sediment load reductions under different mitigation options. These results are not presented here for simplicity, but broadly show:

- Implementation of scenarios 5 and 15 (over page) are estimated to achieve the phosphorus reductions required. Furthermore, scenario 14 was estimated to achieve reductions within the uncertainty of the required estimate. The range of reductions across all scenarios was between 0-55%
- Implementation of the existing rules and regulations relating to sediment was estimated to achieve a 7% reduction in suspended sediment load. This is less than the 20% reduction required to support hauora.

ID	Scenario	Reduction in nitrogen load (%)	Remaining deficit from target (%)
Individual methods			
1	100% adoption of established farm Good Management Practice (GMP) mitigations	13	11
2	Adoption of all established and developing farm mitigations	29	0
3	Wetlands returned to the same area as existed in 1996	3	21
4	Establishment of wetlands in a way that treats all surface runoff from agricultural land	36	0
5	Establishment of large community wetlands in inherently suitable areas	47	0
6	All wastewater point sources are discharged to land rather than directly to water	0	24
7	Reducing land use intensity on flood prone land	0	24
8	Reducing land use intensity on public land	5	19
9	Destocking (10% reduction drystock, 20% reduction dairy)	22	2
10	Riparian planting (full shading of streams <7m wide)	1 (indirect effect on periphyton)	23
Bundled methods			
11	1996 wetlands returned, wastewater discharged to land (3 + 6)	3	21
12	Established and developing farm mitigations, 1996 wetlands, wastewater to land (2 + 3 + 6)	31	0
13	Established and developing farm mitigations, 1996 wetlands, wastewater to land, repurposing public land (2 + 3 + 6 + 8)	34	0
14	Established and developing farm mitigations, 5% wetlands, wastewater to land, repurposing public land (2 + 4 + 6 + 8)	54	0
15	Established and developing farm mitigations, community wetlands, wastewater to land (2 + 5 + 6)	63	0
16	Established farm mitigations, wastewater to land, plantain on dairy farms, 1996 wetlands, repurposing of ES land, forestry expansion (1 + 6 + 3 + new individual methods)	19	5

Required reductions likely achieved *Within uncertainty range* *Deficit remaining*

The results in the table above indicate that several of the individual mitigation scenarios we tested could achieve the reductions required to support a state of hauora. Reductions in nitrogen load are relatively small in this zone and could be achieved through various mitigation strategies. However, load reductions required for phosphorus, sediment and *E. coli* are much larger and will likely require more widespread changes to land use.

Reducing load from pastoral land across the catchment

In addition to the above, we looked at different nitrogen load reduction scenarios for dairy and drystock farms. The purpose of this work was to help show the reductions that could be achieved via reductions in loss from drystock and dairy land.

The table shows the load reduction achieved for each combination of simulated reductions. The coloured table cells indicate how far each combination achieves the required load reductions. For example, we can see that a 40% reduction in loss from dairy farms in combination with a 20% reduction from drystock farms is predicted to result in an approximately 30% reduction in TN load for the whole catchment.

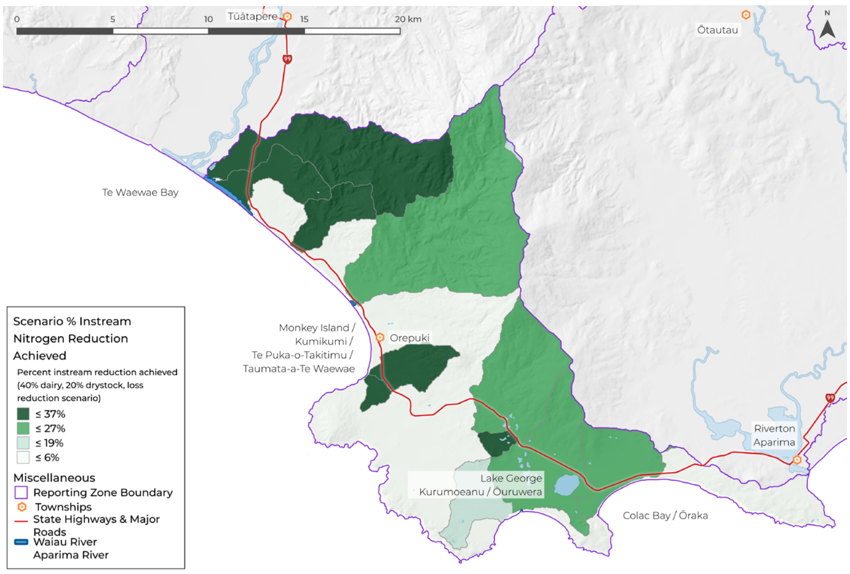
Basin-wide mean % TN reduction, relative to baseline

Drystock loss rate reduction (%)						
80%	22%	34%	47%	59%	71%
60%	17%	29%	41%	54%	66%
40%	11%	23%	36%	48%	60%
20%	6%	18%	30%	42%	55%
0%	0%	12%	25%	37%	49%
	0%	20%	40%	60%	80%

Dairy loss rate reduction (%)

Required reductions likely achieved (green) · *Within uncertainty range* (orange) · *Deficit remaining* (red)

Instream nitrogen reduction achieved (%)



This map shows how the percentage nitrogen reductions achieved vary spatially across the sub-catchments. For example, if all dairy land reduced nitrogen losses by 40% and drystock by 20%, the largest instream reductions would be achieved in the darker green sub-catchments.

Opportunities for action

We have put together opportunities for action in the Orepuki coastal zone to reduce contaminant loads and improve the state of freshwater.

The catchment

There are extensive areas of land contributing high contaminant loads in this catchment.

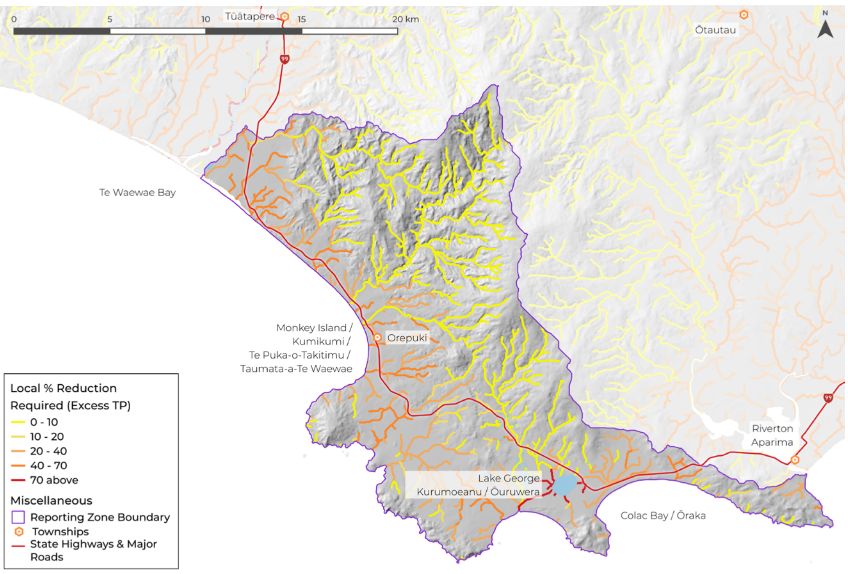
Scale of the problem

The map below shows modelled excess phosphorus load patterns, which demonstrates the spatial scale of the reductions required. Excess loads depend on the modelled concentrations and all the defined targets, both local and downstream. The critical excess map indicates the magnitude of phosphorus load reductions required to achieve river and lake targets in the zone.

High phosphorus, sediment, and *E. coli* loads may be difficult to mitigate, and implementing improved management practices alone may not achieve the desired outcomes for freshwater and the estuary. Consideration should be given to the potential for large-scale catchment mitigations and changes to how land is used.

In addition, efforts to implement nature-based solutions and slow water flow will likely have multiple benefits for water quality, biodiversity, flood mitigation, and catchment resilience.

Critical excess TP load (%)



Farm scale opportunities for action

Farm-scale actions should be tailored to physiographic settings as well as catchment priorities. In the Orepuki coastal zone, load reductions are required for all major contaminants (nitrogen, phosphorus, sediment and *E. coli*).

We can use farm-scale observations, physiographic information and our understanding of water quality to help refine the most relevant actions for a given location or landscape.

Physiographic zones help us to understand better how contaminants move through the landscape. Each zone has common attributes that influence water quality, such as climate, topography, geology and soil type.

Physiographic zones differ in how contaminants build up and move through the soil, through areas of groundwater, and into rivers and streams.

Contaminants can move from the land to waterways via:

- overland flow (or surface runoff)
- artificial drainage – e.g. tile drains and mole pipe drainage
- deep drainage (or leaching) – of either nitrogen or phosphorus to groundwater
- lateral drainage (or horizontal movement through the soil) – of phosphorus and microbes

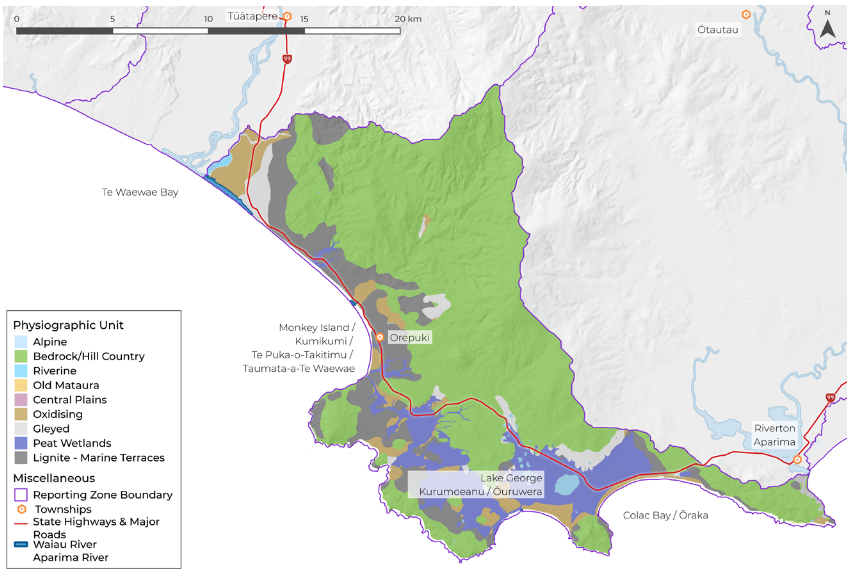
These key transport pathways for contaminants differ for each physiographic zone. Understanding differences between zones allows for targeted land use and management strategies to be developed to reduce impacts on water quality.

Widespread implementation of property actions to improve water quality can have significant co-benefits for catchment hydrology (flood risk and climate change resilience) and biodiversity outcomes.

The Orepuki coastal zone comprises five main physiographic units: bedrock/hill country, lignite/marine terraces, gleyed, oxidising and peat wetlands.

Farm-scale or more resolute physiographic information may be available in some locations. We promote using the best information available to identify farm-specific risks and solutions.

Physiographic zones



The following maps help to identify the most important actions to focus on in different parts of the catchment.

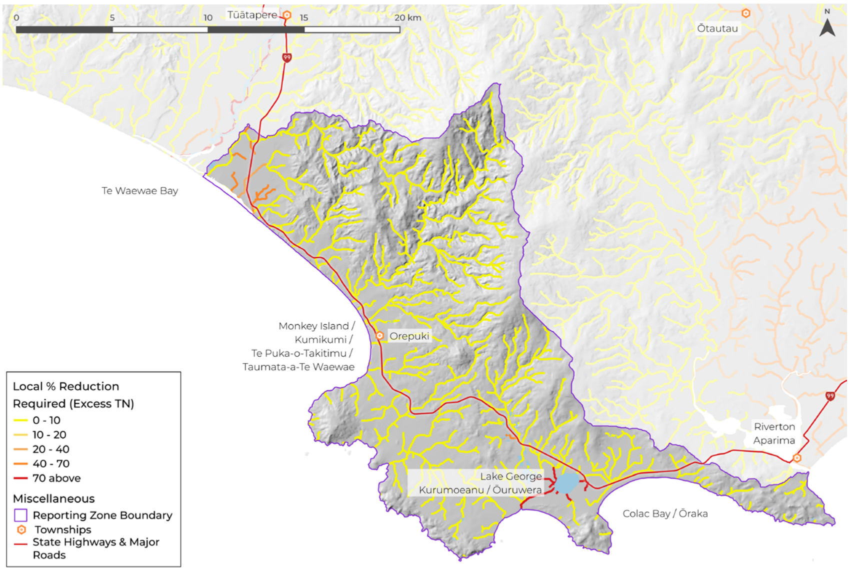
Nitrogen

Over time, reductions are required across the entire catchment area to achieve hauora targets.

This means reducing nitrogen loss should be a priority in all farm-scale mitigation planning.

Physiographic zones can help to identify what contaminant loss pathways likely need attention in different locations. The excess load map shown here indicates areas where nitrogen loss mitigation should be a particular focus in farm planning.

Critical excess TN Load (%) Riverlines



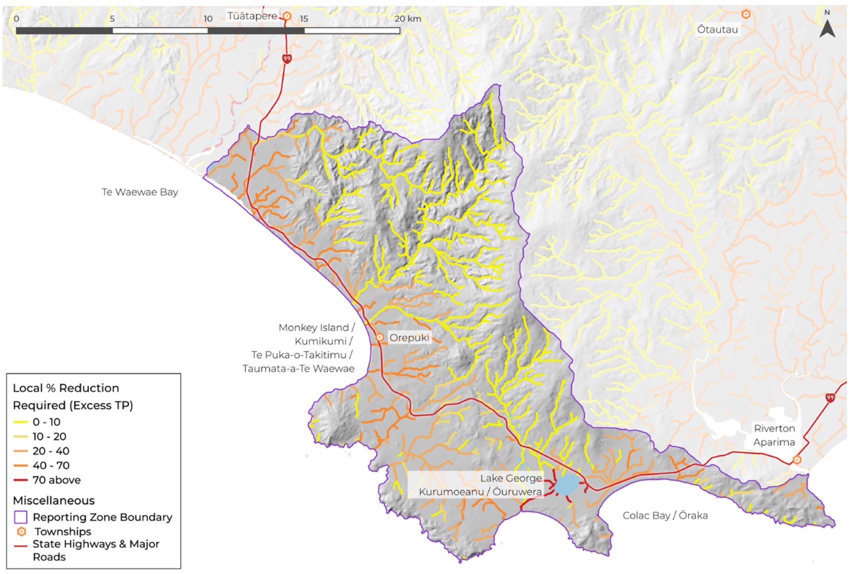
Phosphorus

Over time, reductions are required across the entire catchment area to achieve hauora targets..

This means reducing phosphorus loss should be a priority in all farm-scale mitigation planning.

Physiographic zones can help to identify what contaminant loss pathways likely need attention in different locations. As shown above, the excess load map indicates areas where phosphorus loss mitigation should be a particular focus in farm planning.

Critical excess TP Load (%) Riverlines

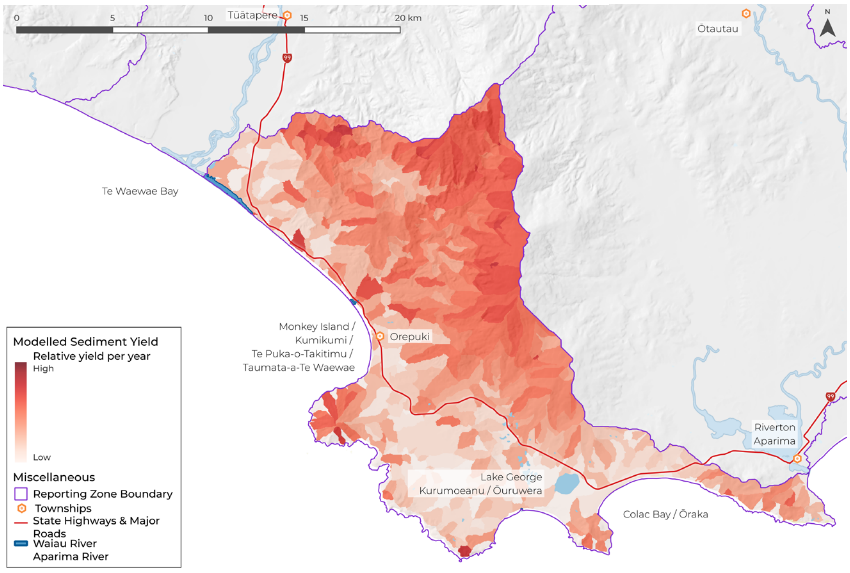


Sediment

The map (right) shows how we expect sediment loss to vary throughout the catchment. Some places in the agricultural landscape are estimated to have higher sediment loss rates. These are primarily areas with more sloping land, soils susceptible to erosion, and where stream bank erosion is likely an issue.

Sediment from agricultural land generally poses a greater threat to rivers and lakes as it is often fine grained and carries higher concentrations of nutrients. Properties within the shaded darker red areas should specifically look for opportunities and mitigations to reduce sediment loss.

Modelled sediment yield



E. coli

The risk of *E. coli* loss to water depends on landscape type, slope, stock and vegetation. Property-scale assessments should be used to mitigate the highest risk loss pathways on farms.

Groundwater opportunities for action

E. coli contamination of groundwater and groundwater drinking supplies is likely an issue in the Orepuki coastal zone.

Some actions to reduce the risk of contamination are:

- Ensure good well-head protection is in place for all bores, especially bores used for drinking water.
- Carefully consider the proximity of contamination point sources to bores. These can be things like septic tanks, stock sheds and effluent storage.
- Carefully consider effluent application on freely draining soils or soils with a high likelihood of bypass flow (cracks or conduits that may allow effluent to flow directly to groundwater).

Urban and industrial opportunities for action

- Ensure wastewater and stormwater are not cross-connected in municipal systems.
- Target improvements to on-site wastewater disposal systems to reduce the risk of human faecal contamination of freshwater.
- Urban development incorporates best practice stormwater management methods.

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