TOITŪ TE HAKAPUPU
PLEASANT RIVER CATCHMENT RESTORATION PROJECT

Toitū Te Hakapupu / Pleasant River Catchment Restoration Project

Catchment Action Plan

Date: July 2025

A partnership project by:

Otago Regional Council

Kāti Huirapa Runaka ki Puketeraki

In collaboration with:

Ministry for the Environment
Manatū Mō Te Taiao
Essential Freshwater Fund
A JOBS FOR NATURE PROJECT

East Otago Catchment Group

Developed with assistance from Whirika Consulting Ltd, July 2025

Contents

A partnership project by:
Otago Regional Council
Kāti Huirapa Runaka ki Puketeraki

In collaboration with:
Ministry for the Environment
Manatū Mō Te Taiao
Essential Freshwater Fund
A JOBS FOR NATURE PROJECT
East Otago Catchment Group

About the plan

The purpose of this Catchment Action Plan is to set out a pathway to achieve the community's vision for the catchment, including actions to address challenges in the catchment. Mana whenua and community perspectives underpin our plan's direction.

This plan has been prepared as part of the Toitū Te Hakapupu / Pleasant River Catchment Restoration Project (referred to as the 'Toitū Te Hakapupu project' or 'the project'), a Jobs for Nature project funded by the Ministry for the Environment. The project runs from July 2021 to June 2025 and is being delivered by the Otago Regional Council (ORC) in partnership with Kāti Huirapa Rūnaka ki Puketeraki (Puketeraki).

This is a living document, meaning it can evolve to guide Toitū Te Hakapupu project implementation and the restoration of the catchment over the short term (until mid-2025). It will also set a pathway to guide actions in the medium (15 years) and longer term (50 – 100 years).

The values and perspectives of mana whenua (Puketeraki) and local community form the basis of the plan. These essential inputs came from discussions with representatives of Puketeraki and from their own plans including a cultural health monitoring plan. Community perspectives came from three workshops in 2023 and discussions with local landowners and stakeholders.

The results of a forestry action plan developed with a forestry working group are incorporated into this plan. This group consisted of representatives from Puketeraki, the local community, and forestry management companies, with five meetings held between May 2023 and March 2024. A risk assessment of forestry practices in relation to catchment values and objectives was created. Actions were identified and are incorporated into this plan.

The plan is also based on water quality and ecological health information collected as part of the project. Those results sit alongside a wider comprehensive overview of the natural characteristics of this catchment and land use and development within it - the '*Toitū Te Hakapupu/Pleasant River Catchment Restoration Project - Context analysis to inform catchment action plan*.' (Ahikā, 2023).

This plan is intended to be 'owned' collectively by the community, landowners and managers, Puketeraki, the ORC and other stakeholders. It informs and reflects the focus and priorities of the Toitū Te Hakapupu project. It can be utilised by landowners, community groups, local councils, and other stakeholders to focus and coordinate efforts to protect and enhance this catchment.

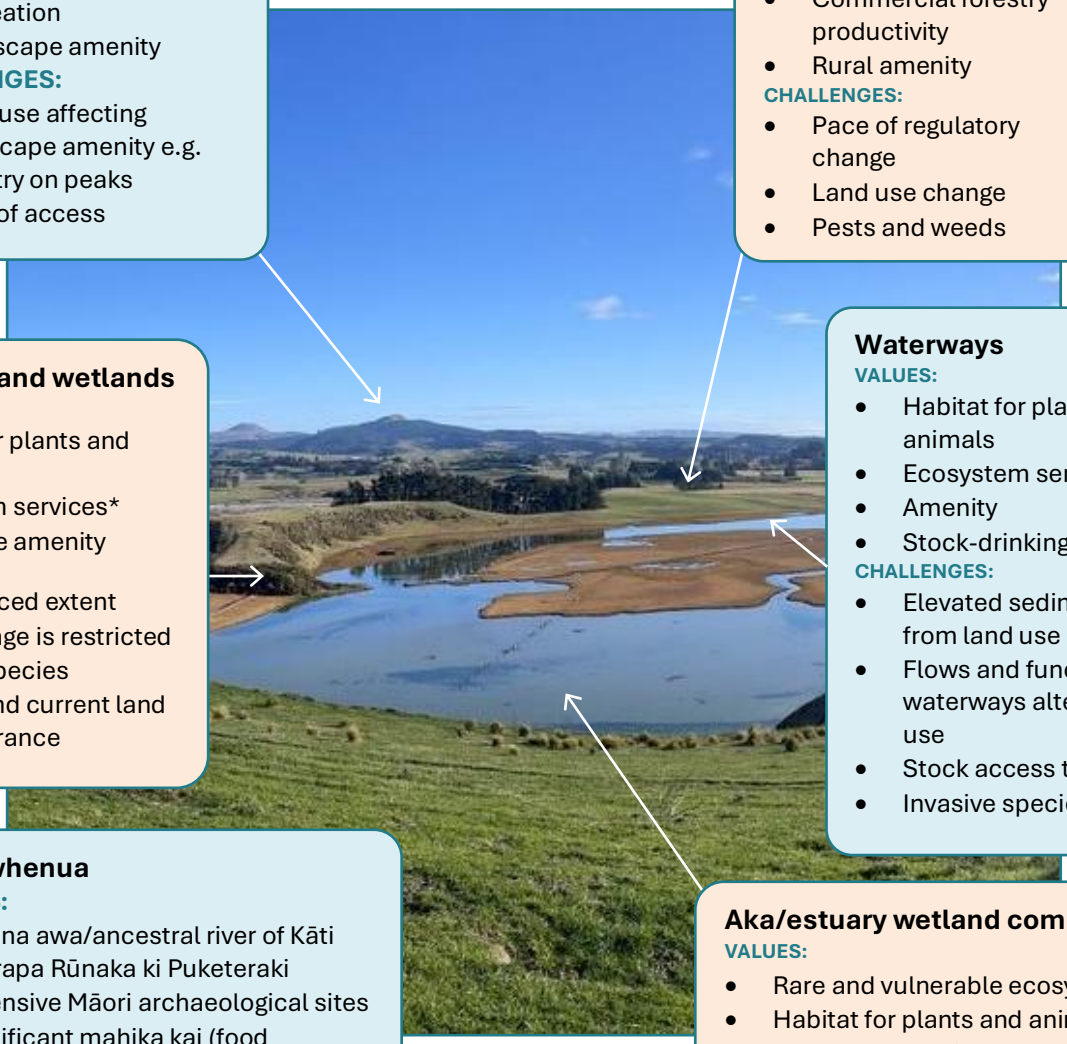
1. Te Hakapupu catchment at a glance

Distinctive peaks
VALUES:
- Culturally significant
- Recreation
- Landscape amenity

CHALLENGES:
- Land use affecting landscape amenity e.g. forestry on peaks
- Lack of access

Rural land
VALUES:
- Agricultural productivity
- Commercial forestry productivity
- Rural amenity

CHALLENGES:
- Pace of regulatory change
- Land use change
- Pests and weeds



Biodiversity and wetlands
VALUES:
- Habitat for plants and animals
- Ecosystem services*
- Landscape amenity

CHALLENGES:
- Loss/reduced extent
- Fish passage is restricted
- Invasive species
- Historic and current land use – clearance

Waterways
VALUES:
- Habitat for plants and animals
- Ecosystem services*
- Amenity
- Stock-drinking water

CHALLENGES:
- Elevated sediment inputs from land use
- Flows and functioning of waterways altered by land use
- Stock access to waterways
- Invasive species

Mana whenua
VALUES:
- Tīpuna awa/ancestral river of Kāti Huirapa Rūnaka ki Puketeraki
- Extensive Māori archaeological sites
- Significant mahika kai (food resources / gathering) sites

CHALLENGES:
- Lack of access
- Degraded waterways
- Significant depletion of mahika kai species
- Loss of kaitiakitaka and cultural inter-generational mātauraka (knowledge)
- Loss of integral cultural activity

Aka/estuary wetland complex
VALUES:
- Rare and vulnerable ecosystem
- Habitat for plants and animals
- Ecosystem services*
- Recreation
- Landscape amenity

CHALLENGES:
- Drainage and grazing
- Elevated sediment, nitrate and nutrient inputs from land use
- Modification of natural function e.g. flap-gates, embankments
- Invasive species

*Ecosystem services are the processes and outputs that nature provides us with, both direct and indirect, such as food, water, air quality, pollination, climate regulation and recreation.

Figure 1. Te Hakapupu Aka/Pleasant River Catchment at a glance

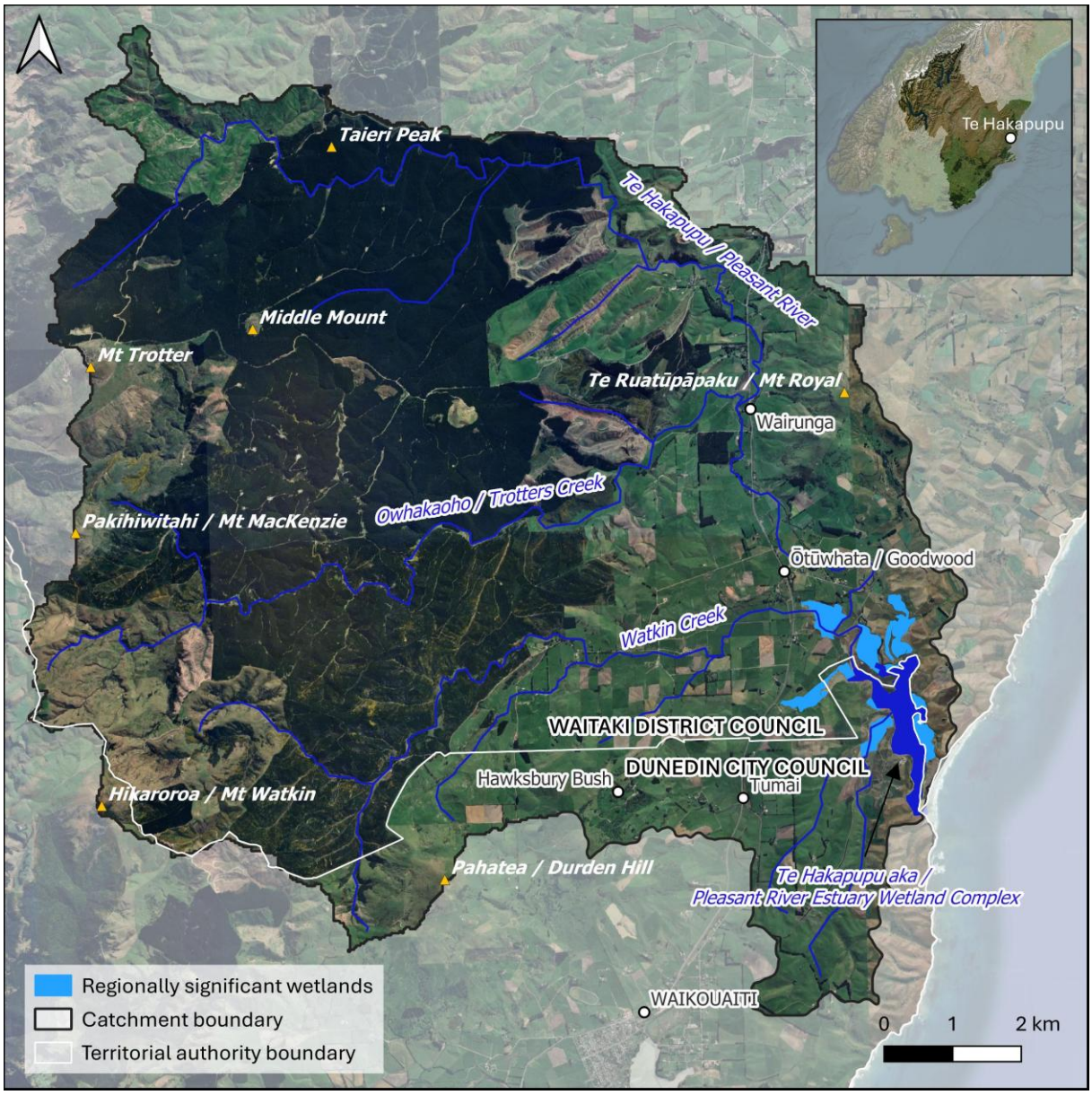


Figure 2. Te Hakapupu catchment in East Otago

2. Mana whenua

Kāti Huirapa Rūnaka ki Puketeraki holds mana whenua status in East Otago and Te Hakapupu catchment. As mana whenua Puketeraki have a kaitiakitaka obligation, arising from rakatirataka, to care for water bodies and protect their mauri from degradation. As with other catchments in East Otago, Te Hakapupu catchment was part of their network of seasonal trails and provided sources of mahika kai and mahika rākau (food and resources) as well as significant kāika mahika kai sites (food gathering places) for hapū and whānau bonding. Historically, species such as tuna

(eels), pātiki (flounders), and īnaka (whitebait) were gathered from the aka/estuary.[1] Note: Please refer to glossary for terms not defined here.

The approach taken by Kāti Huirapa Rūnaka ki Puketeraki to their water bodies throughout the rohe (area) is ki uta ki tai (mountains to sea). This reflects the whakapapa of water and the interconnectedness between water, land and its people. More detail is given about this in Appendix A and the Glossary.

3. What's distinctive about this catchment?

Key characteristics of this catchment include:

- Awa/waterways within the catchment flow into the aka/estuary wetland complex. Indigenous species within these awa/waterways include tuna/long and short-finned eel, inaka (the main whitebait species), kokopu/giant bully and banded kōkopu, bluegill bully. These awa/waterways are characterised by low flows, with occasional high flows and flooding from heavy rainfall events.
- The catchment's landscape is framed by six volcanic peaks located in or partially within the catchment.
- There are few remaining remnants of indigenous vegetation left in the catchment, with indigenous forest areas, kānuka and mānuka, tumatakuru/matagouri and grey shrub making up only 1% of the catchment's landcover.
- Plantation forestry has emerged as a land use in the last 30 years, expanding to now cover around 47% of the catchment overall. On a sub-catchment basis it is now the dominant land use: 66% of the Owhakaoho/Trotters Creek sub-catchment, 62% of the upper Te Hakapupu / Pleasant River catchment, and 27% of Watkins Creek sub-catchment).
- Low intensity sheep and beef farms make up 43.9% of the catchment area. Other land uses include deer farming, dairy farming and lifestyle blocks.

Mana whenua and community perspectives:

a. The catchment is highly valued by Puketeraki – for its trails, tīpuna awa/ancestral river, wāhi tapu, mahika kai and kāika mahika kai sites (food gathering places).
b. The catchment has a distinctive landscape with its backdrop of volcanic peaks.
c. The community values the low-intensity farming systems in the catchment and the rural amenity of the area.
d. The aka/estuary wetland complex is a special place for birds, fish and other species and for its historic sites, recreational use and amenity values.
e. People care for the biodiversity and environment of the catchment.

[1] **https://kahurumanu.co.nz/atlas**

4. A special place: Te Hakapupu Aka/Pleasant River Estuary Wetland Complex

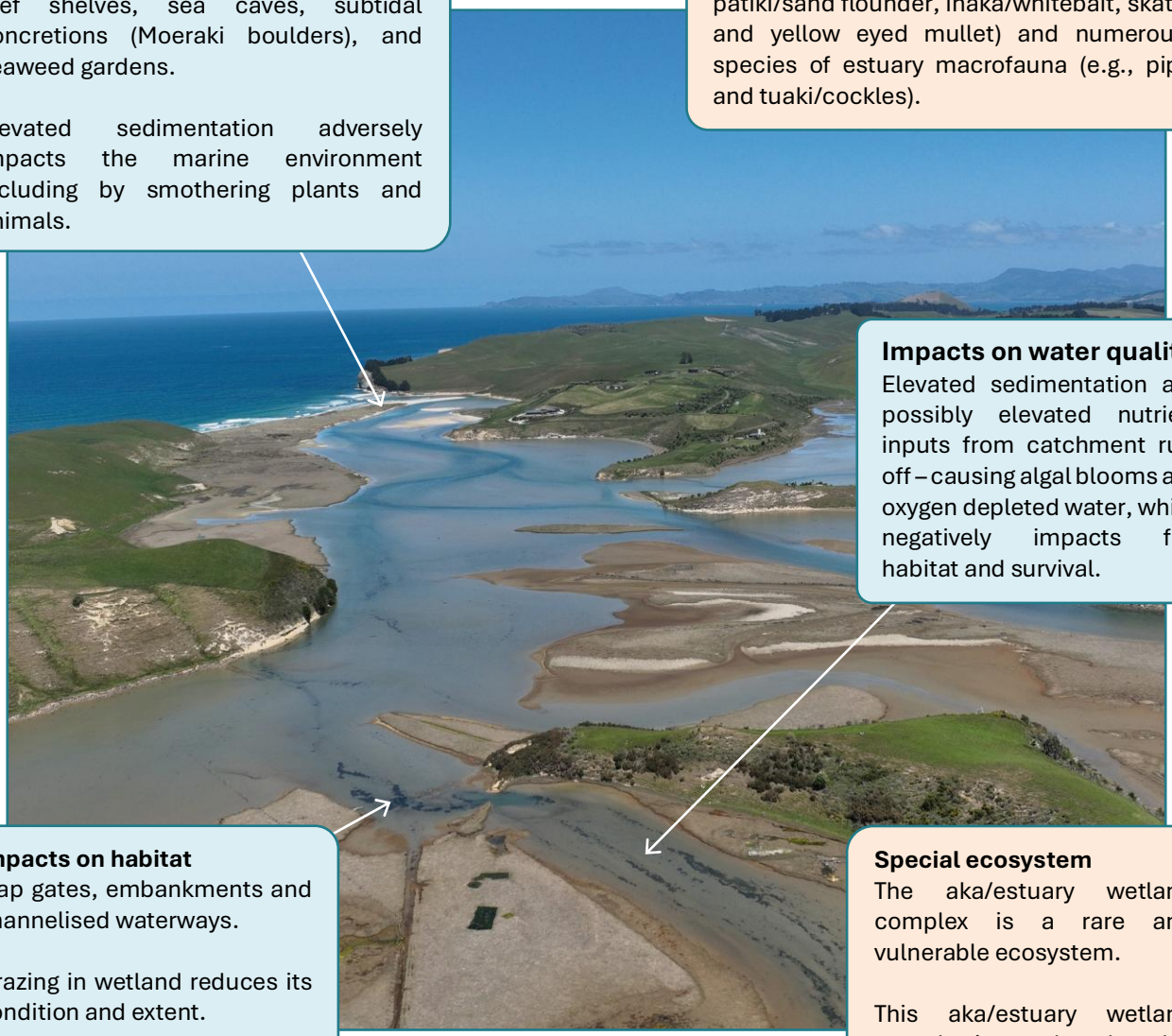
Marine reserve
Protects connection between waterways, estuary and marine habitats.

Links to rare examples of volcanic rock reefs, estuaries, kelp forests, exposed reef shelves, sea caves, subtidal concretions (Moeraki boulders), and seaweed gardens.

Elevated sedimentation adversely impacts the marine environment including by smothering plants and animals.

Diverse species
Home to many birds (e.g., bar-tailed godwit, banded dotterel, matukuku moana/white-faced heron).

Habitat for fish species (e.g. kahawai, pātiki/sand flounder, inaka/whitebait, skate and yellow eyed mullet) and numerous species of estuary macrofauna (e.g., pipi and tuaki/cockles).



Impacts on water quality
Elevated sedimentation and possibly elevated nutrient inputs from catchment run-off – causing algal blooms and oxygen depleted water, which negatively impacts fish habitat and survival.

Impacts on habitat
Flap gates, embankments and channelised waterways.

Grazing in wetland reduces its condition and extent.

Weeds and pest animals are impacting indigenous plants.

Special ecosystem
The aka/estuary wetland complex is a rare and vulnerable ecosystem.

This aka/estuary wetland complex is greatly reduced in area, and is now about 2% of its historic size.

Figure 3. Overview of Te Hakapupu Aka/Pleasant River Estuary Wetland Complex

5. Challenges in this catchment

5.1 Key challenge: elevated sediment inputs into awa/waterways

The key challenge facing Te Hakapupu catchment is the elevated level of sediment entering awa/waterways and the aka/estuary within the catchment. This is causing degradation of these awa/waterways, including by smothering habitat, decreasing invertebrates and food supply. This issue has been highlighted by monitoring work and has also been identified as a key concern of mana whenua, the local community and other stakeholders.

Information about the causes of the elevated level of sediment entering awa/waterways within the catchment are outlined below, along with other challenges facing the catchment.

5.2 Challenges linked to inherent and inherited factors

The following inherent (underlying characteristics) and inherited (caused by past activities) characteristics of the catchment create challenges:

1. **The geology of the catchment**: the presence of siltstone, sandstone and schist means that much of the catchment is vulnerable to erosion, including mass movement (slumping, landslides), rill and gully erosion, sheet erosion (e.g., washing/blowing away of exposed surface soils) and streambank erosion.
   Impacts:
   - Increased risks of erosion and sedimentation with elevated sediment inputs into awa/waterways and the aka/estuary which degrade habitat for freshwater species.

2. **Historic land development:** indigenous vegetation clearance including removal along riparian margins and steep erosion prone land; drainage of wetlands and cultivation.
   Impacts:
   - Increased risks of erosion and sedimentation – including streambank erosion, with elevated sediment inputs into awa/waterways and the aka/estuary.
   - Significant loss of biodiversity (with less than 1% of indigenous biodiversity remaining).
   - Significant loss of mahika kai (food resources) species such as tuna (eels), pātiki (flounders), and inaka (whitebait) and mahika rākau (plant resources) species such as raupō (bulrush), harakeke (flax), tūtū (native shrub) and toetoe.
   - Significant loss of wetland extent (including the aka/estuary wetland complex – with the remaining wetland estimated to be 2% of its original size).

3. **Climatic conditions:** Annual rainfall is low, (around 600-650 mm) and the catchment can become dry during the summer with very low instream flows and related impacts on instream habitat. The area can also experience sudden heavy rainfall events.
   Impacts:
   - Low flows can reduce instream habitat for freshwater species
   - Heavy rainfall events can cause landslips and erosion and increase sedimentation in awa/waterways and can damage infrastructure.

4. **Oxygen depleted ground water seeps:** Streams in some parts of the catchment may be influenced by anoxic ground water seeps (groundwater with depleted dissolved oxygen levels). The impact of these seeps is exacerbated by low flow conditions.
   Impact:
   - Adverse effects on fish and instream species.

5. **Historic modification of awa/waterways:** including culverts, embankments, flap-gates and straightening.
   Impacts:
   - Culverts limit the movements of migratory fish, disrupting their access to food, refuge and spawning areas.
   - Embankments and flap-gates impact natural functioning of awa/waterways e.g. reduced water volume and flushing flows within the aka/estuary arms.
   - Straightened awa/waterways can reduce instream habitat and result in faster flows that cause increased streambank erosion.

6. **Pests and weeds:** Some introduced animals and plants have become pest species.
   Impacts:
   - Weeds dominate and degrade biodiversity remnants and restoration plantings.
   - Pest animals such as deer, pigs and Canadian geese can cause damage to farm crops, indigenous plant species and streambanks (resulting in elevated sedimentation in awa/waterways). Pest animals can also contribute to increases of *E.coli* in awa/waterways.
   - Weed species such as willows or alders within awa/waterways may act as silt traps or create blockages within a channel, potentially exacerbating flooding of adjacent land.

7. **Combined**: land development (including private ownership), biodiversity and mahika kai loss, modification of awa/waterways and aka/estuary wetland complex.
   Impact:
   - Degraded biodiversity and loss of access means mana whenua no longer have access to sites and resources which enable cultural traditions to be sustained, and the wider community have lost access to/or reduced quality of recreation sites and food gathering opportunities.

5.3 Challenges linked to current land use

Current land use activity also creates challenges for the catchment. These include:

Forestry:

- large amounts of sediment can enter awa/waterways and the aka/estuary due to harvest and replanting (including associated earthworks).
- a lack of public access into forestry estate.
- high populations of pest species such as deer and pigs.
- expansion of forestry within the catchment may extend low flow periods or reduce instream flows.

Farming:

- stock access to awa/waterways results in:
  - damage to streambanks (increasing sedimentation in awa/waterways), poor instream habitat, degraded or destroyed spawning habitat
  - an increase in contaminants (including *E.coli*) in awa/waterways.
- run-off from poorly managed winter grazing practices can increase sedimentation in awa/waterways.

Appendix B gives more information about the challenges caused by land use within this catchment, and the results of monitoring of awa/waterways and the aka/estuary wetland complex.

What mana whenua and the community are concerned about:

a. The impacts of land use on awa/waterways, primarily due to erosion and sedimentation from stock and forestry and the lack of riparian protection.
b. The increased amount of forestry in the catchment and the associated risk of sediment entering awa/waterways and the aka/estuary.
c. Mahika kai resources have been significantly degraded by the effects of land development and practices on water quantity and water quality.
d. Forest owners and managers don't live in the catchment, creating a feeling of decreased social connection and concern as to whether owners/managers feel a sense of care for the catchment's environment.
e. The lack of access to parts of the catchment – including to peaks located within the forestry estate, awa/waterways and the aka/estuary wetland complex.
f. Biodiversity loss and management of pest species – including animals and weeds.
g. The community feels there is a lack of knowledge and implementation of good land use practices, especially by forestry companies.

6. The vision for the catchment

The vision for Te Hakapupu/Pleasant River Catchment:

He puna waiora, he whenua haumako /
A flourishing catchment and community

Outcomes to achieve this vision are:

1: Awa/waterways and the aka/estuary wetland complex are healthy.

2: Biodiversity within the catchment is thriving.

3: Kāti Huirapa Rūnaka ki Puketeraki values and role as kaitiaki are recognised and upheld.

4: Productive land use supports a thriving and connected community.

7. Achieving the vision

Objectives and corresponding actions have been developed to achieve these outcomes and are outlined below. Some of the key methods that can be used to measure progress towards the outcomes are also outlined below. More detailed targets and indicators have also been set for several of the actions and can be shared on request.

Outcome 1: Awa/Waterways in the catchment and the aka /estuary wetland complex are healthy.

Objective 1A. Sediment, nutrient and contaminant inputs to awa/waterways are reduced and water quality is improved.

Objective 1B. Riparian and instream habitat for freshwater and estuarine species is improved in condition.

Objective 1C. The condition of wetland areas within and around the aka/estuary wetland complex are improved.

Objective 1D. Natural functioning of awa/waterways and aka/estuary wetland complex is enhanced where there is landowner agreement.

Actions to improve water quality – with a key focus on reducing sediment inputs

1.1 **PRIORITY ACTION:** Install sediment traps in sediment hotspots on farmland and in the forestry estate, focusing on sediment capture close to the source.

1.2 **PRIORITY ACTION:** Plant trees and shrubs to stabilise land slips on farmland and in the forestry estate, to reduce erosion and sediment inputs to the awa/waterway.

1.3 **PRIORITY ACTION:** Fence and plant riparian margins (beyond regulatory requirements) where there is stream bank erosion, fish spawning habitat or run-off mitigation potential, and landowner agreement.

1.4 Land managers (forestry and farming) comply with regulations e.g. for farming: stock exclusion, winter grazing consents and for forestry: setbacks of new plantings from awa/waterways.

Actions to improve instream habitat

1.5 Fence and plant riparian margins to protect or create fish spawning and breeding habitat, based on an assessment of priority/benefit and feasibility.

1.6 Assess and upgrade culverts and fords to aid fish passage up and down awa/waterways.

Actions to restore the aka/estuary wetland complex

1.7 Based on a restoration investigation for the aka/estuary wetland complex, implement process of working with landowners to:

a. retire additional area/buffers around salt marsh areas from grazing.
b. carry out weed management within aka/estuary wetland complex.
c. alter structures affecting natural functioning of flows in the aka/estuary, focusing on flap gates in particular.

Actions to improve flow management

1.8 Enhance the function of existing wetlands, or construct wetlands to support water holding capacity during higher flows and increased water yields during periods of lower flows.

1.9 Willows and alders within awa/waterways are actively managed where they exacerbate flood risk (based on results of flood management assessment).

1.10 Re-naturalise the flow path of straightened awa/waterways where this will reduce streambank erosion and improve in-stream habitat, and will not exacerbate flood risk.

How progress towards Outcome 1 will be measured:

A. Fish surveys for target species (inaka, banded kōkopu, kōaro, giant kōkopu) – using the Fish Index of Biotic Integrity.

B. The Taxon-Independent Community Index - environmental DNA (eDNA) analysis to identify which species are present in awa/waterways.

C. Aka/estuary monitoring. This may include the following:

- Fine sedimentation monitoring
- Seagrass extent
- Macroalgal cover.

The monitoring specified above will be the key methods of measuring progress in addressing the key challenge for the catchment – the elevated levels of sediment entering awa/waterways.

Outcome 2: Biodiversity within the catchment is thriving.

Objective 2A. Existing remnants of indigenous vegetation and wetlands are protected from surrounding land uses.

Objective 2B. Indigenous vegetation in the catchment is increased.

Objective 2C. Pest species (animals and weeds) are controlled to a level that limits damage to indigenous biodiversity as well as farm land and farm operations.

Actions to protect biodiversity

2.1 Carry out a biodiversity assessment and develop a biodiversity strategy for the catchment.

2.2 Fencing off (beyond regulatory requirements) native riparian margins, wetlands and native shrubland areas to prevent disturbance from stock.

2.3 Create setbacks (beyond regulatory requirements) for earthworks, and forestry activities from wetlands and riparian margins.

Actions to increase biodiversity

2.4 Additional planting of indigenous species, focused on

a. enhancing remnants
b. potential for biodiversity corridors
c. riparian plantings
d. replacing riparian weed trees with native species e.g. willows and alders where appropriate from a flood management perspective.

2.5 Creation of biodiversity hubs and corridors with indigenous species within the forestry estate, includes enhancement of riparian zone.
2.6 Enhance wetlands through plantings and weed management.
2.7 Develop and share local native planting guides.

Actions to manage weeds and pests

2.6 Undertake weed and pest surveys to inform actions.
2.7 **PRIORITY ACTION:** Increase coordinated management of pest animals and weeds, with priority given to pest animals.

How will progress towards Outcome 2 be measured:

A. Vegetation structure and composition
B. Land under indigenous vegetation
C. Distribution and abundance of weeds and animal pests

Outcome 3: Kāti Huirapa Rūnaka ki Puketeraki values and role as kaitiaki are recognised and upheld.

Objective 3A. Mahika kai and taoka species are sufficiently abundant to support cultural practices.

Objective 3B. Mana whenua access to kāika mahika kai locations, wāhi tapu and wai tapu (culturally significant sites) is improved.

Actions to restore mana whenua values

3.1 Mahika kai, kāika mahika kai locations and taoka species habitats are prioritised for planting, stock fencing and water quality improvement actions.
3.2 Planting of raupō along Te Hakapupu awa (SH1 from around Patterson Road and upstream) and protection with fencing.
3.3 Make existing access paths to culturally significant sites known with communication to rūnaka, and information signs, including in te reo Māori, and maintain and enhance these paths.
3.4 Establish new access paths or informal access agreements to kāika mahika kai locations, wāhi tapu, wai tapu and other culturally significant sites with landowner agreement, to enable mātauraka Māori to be shared with Rūnaka members, with te reo Māori signage where appropriate.

How progress towards Outcome 3 will be measured:

A. Cultural Health Index assessment

Outcome 4: Productive land use supports a thriving and connected community.

Objective 4A. Productive land uses within the catchment are supported to comply with regulation and apply best management practices that support the environment and the viability of their business.

Objective 4B. Opportunities for social connection are provided for the local community.

Objective 4C. There are trails and recreational opportunities within the catchment, that the local community know about and enjoy.

Actions to support productive land use

4.1 **PRIORITY ACTION:** Hold community events to inform, encourage and support farmers and forestry managers with best management practices and hold workshops to work together through challenges, with a key focus on minimising the amount of sediment entering waterways.

4.2 Provide information resources to farmers and forestry managers.

Actions to improve social connection

4.3 Hold community events such as science activities, planting days and field days.

4.4 Support relationships and communication within the community, including between forestry owners and managers, Rūnaka and landowners, via in person activities, and communications including through social media.

Actions to improve recreational opportunities

4.5 Assess potential access routes and recreation sites within catchment and develop options for their enhancement.

4.6 Forestry companies communicate with the community about how to access forestry areas.

4.7 Restore access to and the quality of food gathering, recreational, swimming and/or other human use values and areas e.g. picnic area, access to aka/estuary for kayaking, bird watching, walking.

How progress towards Outcome 4 will be measured:

A. Landowner and community perception (via feedback/survey)

8. Glossary

The meanings provided below are sourced from the glossary in the Kāi Tahu ki Otago Natural Resource Management Plan 2005, except those marked with an asterisk are sourced from Te Aka Māori Dictionary.

TERM	MEANING
aka	estuary (and within this document only, it refers also to the wetland estuary complex)
wa	river, stream
hapū	kinship group, clan, tribe, subtribe - section of a large kinship group and the primary political unit in traditional Māori society. A number of related hapū usually shared adjacent territories forming a looser tribal federation (iwi)*
kai	food*
kāika	home, village, settlement*
kaimoana	seafood*
Kāi Tahu	descendants of Tahu, the tribe
kaitiakitaka	the exercise of customary custodianship, in a manner that incorporates spiritual matters, by takata whenua who hold mana whenua status for particular area or resource
kaumātua	respected elder
mahika kai	places where food is produced or procured
mahika rākau	plant resources
mana whenua	customary authority or rakatirataka exercised by an iwi or hapū in an identified area
mātauraka	knowledge
mauri	essential life force or principle; a metaphysical quality inherent in all things both animate and inanimate. (Ngāi Tahu Fresh Water Policy)
mokopuna	grandchild, descendant
takiwā	area, region, district*
te taiao	the world, Earth, natural world, environment, nature*
tikaka	correct procedure or customs
tīpuna	ancestor
wai	water
whakapapa	genealogy
whānau	family

Appendix A: Mana whenua

Kāti Huirapa Rūnaka ki Puketeraki values are interwoven and include mauri, mahika kai, mātauraka Māori and kaitiakitaka. Mauri is a life-giving force that flows from our living world and down through whakapapa, connecting and binding together all aspects of our world. Protection of mauri is the primary resource management principle of Kāti Huirapa Rūnaka ki Puketeraki and mana whenua have a kaitiakitaka obligation, arising from rakatirataka, to care for our water bodies and protect their mauri from degradation. Kāi Tahu believe that people, flora, fauna and natural phenomena such as forest, waters, mist, wind and rocks possess a mauri or life force. Waterbodies and estuaries with an intact and strong mauri sustain healthy ecosystems and support mahika kai and other cultural values.

Many place names along the East Otago Coast originate from the waka Ārai-te-Uru. The names of the waves which wrecked the waka, plus the names of the many passengers of the waka are represented in the names of the reefs, hills, and mountains of East Otago. This includes Te Ruatūpāpaku/Mount Royal and Ohikaroroa (Hikaroroa)/Mount Watkin) - Te Ruatūpāpaku and Ohikaroroa were passengers on the Ārai-te-Uru waka.[2]

The availability, safe access to, and use of mahika kai supports and sustains connections to wāhi tīpuna, and the retention and transfer of mātauraka across the generations. Mātauraka Māori is a term that describes the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity and cultural practices. The gathering of mahika kai provides for whānau wellbeing and contributes to manaakitaka by providing kai for events like hui.

Kāti Huirapa Rūnaka ki Puketeraki whānau have noted that their values associated with the catchment are currently degraded and their cultural traditions and practices are no longer able to be fully undertaken – including due to loss of access to sites (including significant kāika mahika kai sites) and loss or lack of abundance of mahika kai species – including awa/waterways within the catchment and within the aka/estuary wetland complex. The retention and passing on of inter-generational mātauraka Māori are only possible if resources such as mahika kai and accessibility to ancestral and traditional places are still available.

[2] https://kahurumanu.co.nz/atlas. This site notes that after the Ārai-te-Uru capsized, many passengers went ashore to explore, however they needed to be back at the waka before daylight. Most did not make it back, including Te Ruatūpāpaku and Ohikaroroa, and instead transformed into many of the well-known geographical features of Te Waipounamu. During the 1879 Smith-Nairn Royal Commission of Inquiry into the Kāi Tahu land claims, Kāi Tahu kaumātua Merekihereka Hape recorded Te Ruatūpāpaku as a kāika mahika kai/food-gathering place where tuna /eels, aruhe/bracken fernroot, kāuru/cabbage tree root), tūī, and kūkupu/wood pigeon were gathered.

Appendix B: Impacts of land use

Forestry and farming

Forestry as a land use has only emerged in the catchment since the 1990s but has increased substantially to now cover about half of the catchment. The harvest and replanting of this expanded forestry estate markedly increases the risk of sediment entering the catchment's awa/waterways and aka/estuary. Comparing recent sedimentation in the catchment's awa/waterways by land use type suggests that plantation forestry harvest areas can contribute a high proportion of sediment into awa/waterways.

Pastoral farming also increases the risk of erosion and sedimentation inputs – including through stock access in riparian areas, lack of vegetative cover in riparian areas and winter gazing. Pastoral farming can also result in elevated levels of nutrients and contaminants entering awa/waterways.

What monitoring tells us about the impacts of land use on the awa/waterways

Monitoring indicates high levels of sediment deposits present in mid-Watkin Creek, whilst monitoring of the aka/estuary wetland complex indicates elevated levels of sediment enter the aka/estuary from awa/waterways. Monitoring also suggests streambank and subsoil erosion are the primary sources of sediment depositing in awa/waterways, particularly from Owhakaoho/Trotters Creek.[3]

Water quality monitoring in this catchment is limited, but it suggests that water quality varies throughout the catchment. Data collected to date has identified breaches to the national bottom line for some of the *Escherichia coli* (E. coli) guidelines for ecosystem health and also for contact recreation (swimming). Sites sampled to measure awa/waterway ecological health, include rankings of 'fair', 'poor' or 'average', with most of the monitored sites ranked as 'fair'. Sites ranked as 'poor' were largely driven by channel modification, a lack of riparian vegetation, little shade, and higher amounts of stream bank erosion. [4]

Degraded aka/estuary wetland complex

The aka/estuary wetland complex is a critical receiving environment in the catchment. The historic extent of the aka/estuary wetland complex has significantly reduced in size (to approximately 2% of its original size) but remains the largest aka/estuary wetland complex in the North Otago Freshwater Management Unit (one of the areas in which the ORC manages water

[3] Subsoils are soils underlying surface soils – these could be mobilised in a variety of ways e.g. from activities such as earthworks or roading, or as a result of landslides, slumping, or tunnel gully erosion.
[4] From ecological monitoring undertaken at ten sites during the Toitū Te Hakapupu project in 2023.

and sets freshwater objectives and limits). It is classified as a Naturally Uncommon Ecosystem (meaning historically rare) and as 'vulnerable' (ecosystem red-list criteria, International Union for Conservation of Nature) due to historic and ongoing loss in extent and decline in its ecological integrity.

This decline is due to a variety of factors including the presence of structures and embankments which impact natural flow characteristics, grazing of remaining wetland areas and the impact of weed species on indigenous plants species.

Monitoring of the aka/estuary has indicated that there are elevated nitrate and nutrient levels and sedimentation from catchment run-off, resulting in enriched muddy sediments in the aka/estuary, in part reflecting catchment land uses dominated by pastoral farming and exotic forestry.[5] This has resulted in signs of eutrophication, within the aka/estuary (i.e., excess algal growth coupled with poor sediment oxygen and muddy sediments), particularly in the side arms and upper aka/ estuary. Eutrophication is a process where the addition of nutrients in a waterbody can lead to algal blooms and oxygen depleted water, which negatively impacts fish habitat and survival.

While eutrophication was observed, the analysis of trace elements (focusing on heavy metals) carried out as part of the monitoring in the aka/estuary indicates that there are no significant contaminant sources in the catchment. This is positive as land use such as agriculture can lead to soil contamination with trace metals and other pollutants, which are associated with practices such as fertiliser application.

Reclamation, drainage and structures that impede salt marsh growth are common in the aka/estuary, including causeways, flap gates and shoreline hardening for rail infrastructure. These modifications have significantly altered aka/estuary hydrology and disrupted the natural connectivity between the land and the sea, compromising overall ecological health and ecosystem services. [6] Ongoing drainage and grazing of salt marsh habitat have also been identified as a significant issue for the health of the aka/estuary.

There is significant scope for salt marsh protection and restoration, with the largest gains likely achieved through restoring the natural connectivity (i.e., removal of flap gates, causeways), and re-flooding areas of existing or previous aka/estuary habitat, particularly in the upper aka/estuary where herb field vegetation persists. Active management to reduce catchment nutrient and sediment loads, and to prevent further salt marsh losses and enhance existing habitat will be necessary to prevent further decline, or to support enhancement of the aka/estuary. The

[5] Roberts KL, Stevens LM, Forrest BM, (2022) Broadscale intertidal habitat mapping of Pleasant River (Te Hakapupu) estuary. Salt Ecology, prepared for Otago Regional Council and Forrest BM, Roberts KL, Stevens LM (2022) Fine scale intertidal monitoring of Pleasant River (Te Hakapupu) estuary. Salt Ecology Report 093, prepared for Otago Regional Council. 29p.
[6] Roberts KL, Stevens LM, Forrest BM, (2022) Broadscale intertidal habitat mapping of Pleasant River (Te Hakapupu) estuary. Salt Ecology, prepared for Otago Regional Council

remaining areas of salt marsh will need to be protected and enhanced to prevent further losses with restoration undertaken in suitable areas.[7]

[7] Roberts KL, Stevens LM, Forrest BM, (2022) Broadscale intertidal habitat mapping of Pleasant River (Te Hakapupu) estuary. Salt Ecology, prepared for Otago Regional Council