Te ora o te taiao iao

State of the Environment

Te Taitokerau

Whenua

2023

Northland
REGIONAL COUNCIL
Te Kaunihera ā rohe o Te Taitokerau

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Executive summary

Our mission to create a healthy environment, strong economy and resilient communities underpins everything we do at Northland Regional Council (NRC).

Our natural environment not only provides us all with a place to live, but it also helps generate income for the region and is a place for our community to relax in and explore. The people who whakapapa to Te Taitokerau have a strong spiritual and cultural connection with the land. Without a healthy environment, the quality of all life in Northland is affected.

Te Taitokerau is a unique and special place. We're a long and narrow region at the top of the North Island, with a land area of 1.25 million hectares and a population of around 180,000. Our sub-tropical climate makes us the warmest region in the country.

This report's data covers the period from 1 January 2017 to 31 December 2022 and includes discussion in relation to 2023 weather events and legislation changes. It is structured into three key sections — land cover, soil health, and contaminated land. It draws on the scientific knowledge and data collected and collated by our council teams over several years, representing the best knowledge we have at the time of writing. Focusing on Northland, the report presents the current state of land and soil and discusses existing and emerging challenges. Additionally, it underscores the council's strategies and success stories aimed at promoting sustainable land-use practices and safeguarding both the environment and human health.

The land cover section examines the impact of various land uses and activities on the region's land, such as agriculture, production forestry, land development and environmental incidents. It also discusses the implications and opportunities of climate change for land management. The section highlights some of the projects that NRC supports or implements to improve land-use practices, restore biodiversity and improve economic development.

The soil health section explores the diversity and quality of soils in Northland, and the pressures and impacts that affect them, such as erosion, compaction, and nutrient loss. It also outlines the tools and initiatives that NRC offers to help landowners manage soil health and enhance freshwater and marine ecosystems, such as advice, funding, and land-use mapping. This section features some of the success stories that NRC participates in, such as Kaipara Moana Remediation, afforestation projects and poplar timber research.

The contaminated land section defines contaminated land according to the Resource Management Act 1991 (RMA) and describes the extent and nature of contaminated land in Northland. It also reports on the progress and outcomes of investigating and managing contaminated sites in the region. The section highlights the Hazardous Waste Amnesty Days that NRC has held since 2020 to enable safe disposal of domestic hazardous waste.

This report aims to inform and inspire collaborative efforts to help preserve Northland's unique natural environment. By fostering partnerships and incorporating mātauranga Māori, we're dedicated to ensuring that Te Taitokerau remains a region characterised by unique beauty and ecological diversity for generations to come.

Reporting on the state of our environment

Monitoring of, and reporting on, the state of the environment is a key function of regional councils. Section 35 of the RMA requires the monitoring and reporting of the overall state of the environment every three years across five different areas:

- Biodiversity and Biosecurity
- Land (addressed in this report)
- Marine (inclusive of water quality and the receiving environment)
- Freshwater
- Air quality and Climate

Rather than presenting findings for all five areas concurrently, our objective is to adopt a phased approach, disseminating reports on one or two specific areas each year.

Northland Regional Council staff planting riparian plants.

Ngā tirohanga ao Māori

Te Ao Māori perspectives

Te Tiriti partnership

NRC and Te Taitokerau Māori and Council Working Party (TTMAC) are committed to giving effect to their responsibilities to tangata whenua of Te Taitokerau under Te Tiriti o Waitangi. This is articulated in Tāiki ē, NRC and TTMAC's roadmap for giving effect to Te Tiriti obligations. Detailed actions are described in the document, and these actions form the basis for allocation of resources and budget, and for integration into council work programmes. The actions include (among other things):

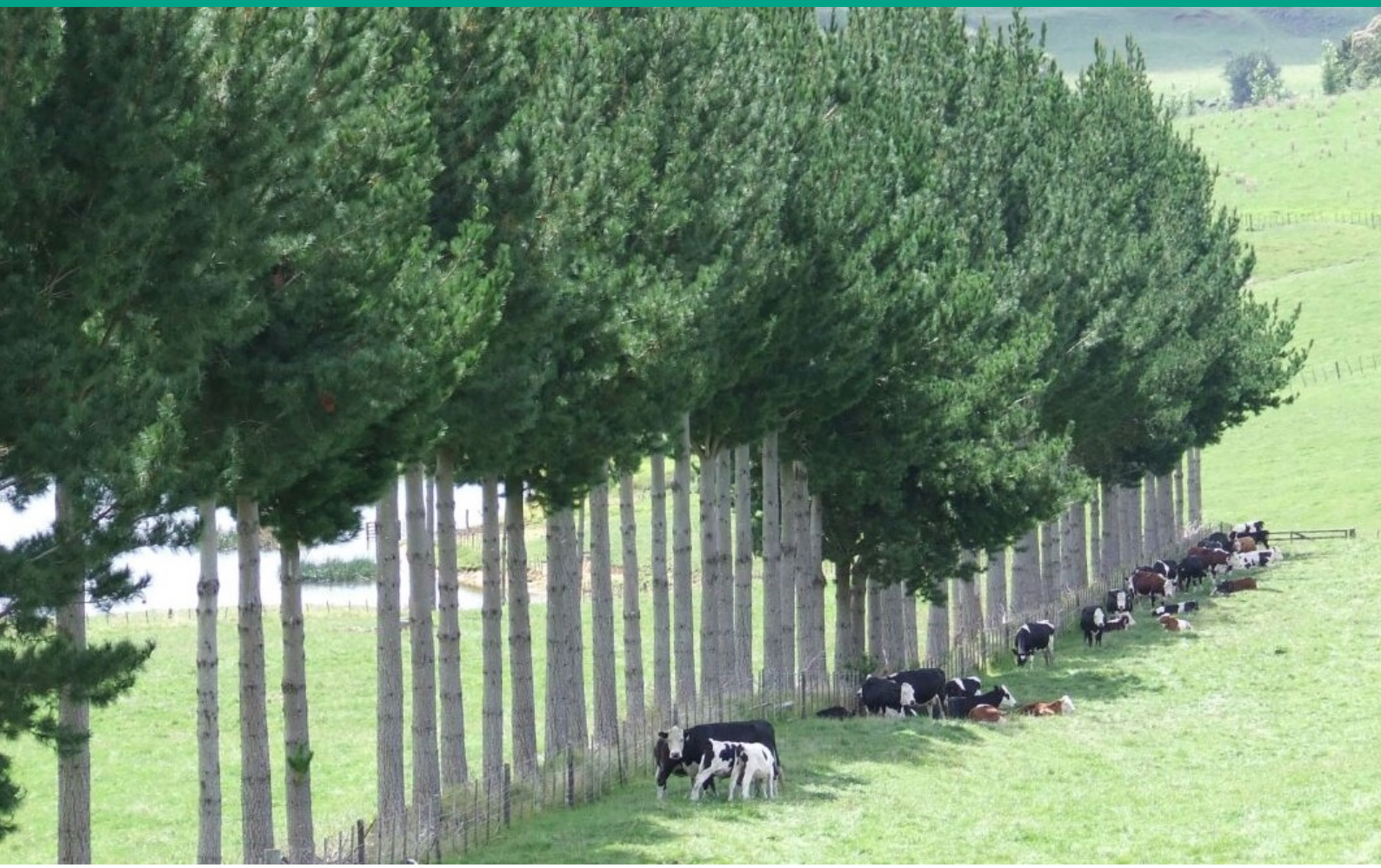
- developing and funding a culturally appropriate monitoring programme;
- supporting tangata whenua freshwater monitoring;
- supporting tangata whenua-led approaches to resilience in the face of climate change and natural hazard events;
- delivering specific projects within agreed priority areas of interest to tangata whenua and NRC;
- supporting kaitiakitanga; and
- supporting tangata whenua aspirations relating to marine environmental protection and culturally and ecologically appropriate economic development opportunities (e.g. aquaculture) within the coastal marine area.

Tangata whenua of Te Taitokerau and NRC bring their own perspectives to a range of issues, while sharing common aspirations for the environmental, social, cultural and economic future of the region. These different perspectives and the strong commitment to kaitiakitanga (guardianship and protection) of te taiao, create unique opportunities for partnering with iwi and hapū together for the benefit of the environment and of communities throughout the region.

Northland Regional Council partners with iwi and hapū on a range of environmental activities in the region, including wilding conifer control, community pest and predator control programmes, dune lake restoration and protection, environmental education programmes, and marine pest monitoring. This involves consultation, joint planning, technical support and information sharing, funding for development and update of iwi/hapū environmental management plans, and funding and technical support for tangata whenua environmental monitoring.

Flax (harakeke or kōrari) holds cultural, historical, and practical significance for Māori, serving as a vital resource for weaving, medicine, and daily life.

1 Ā-whenua
Terrestrial biodiversity and biosecurity



Te tirohanga whānui
Overview

- Almost 50% of Northland's land use is pastoral farming (agriculture).
- Land use practices can have impacts on soil stability and health. The region's livestock, forestry, horticulture, and land development can all impact Northland's environment.
- Long-term data show a downward trend in Northland's livestock numbers and area farmed, while the area used for horticulture and forestry has increased.
- The region's climate can affect how we use the land. Over the past ten years, Northland has suffered from multiple droughts and floods.
- Northland Regional Council uses the Regional Policy Statement and Regional Plan, strategic plans, mapping, and targeted funding to improve land use practices in our region.

E pēhea ana te ora ināianei?

What is the current state?

What is land used for in Northland?

Northland contains approximately 1.25 million hectares of land area, just over 5% of New Zealand. The land cover in Northland reflects the region's economy, with approximately 62% of Northland's land cover used for agriculture, horticulture, and production forestry (Figure 1). During the reporting period (2017-2022), beef cattle farms comprised the largest portion of agricultural land use by area, followed by dairy cattle farms (Stats NZ, 2021). There was relatively little change in the total land area used for agriculture, horticulture, and production forestry in 2018, compared to 2012* (Manaaki Whenua – Landcare Research, 2019).

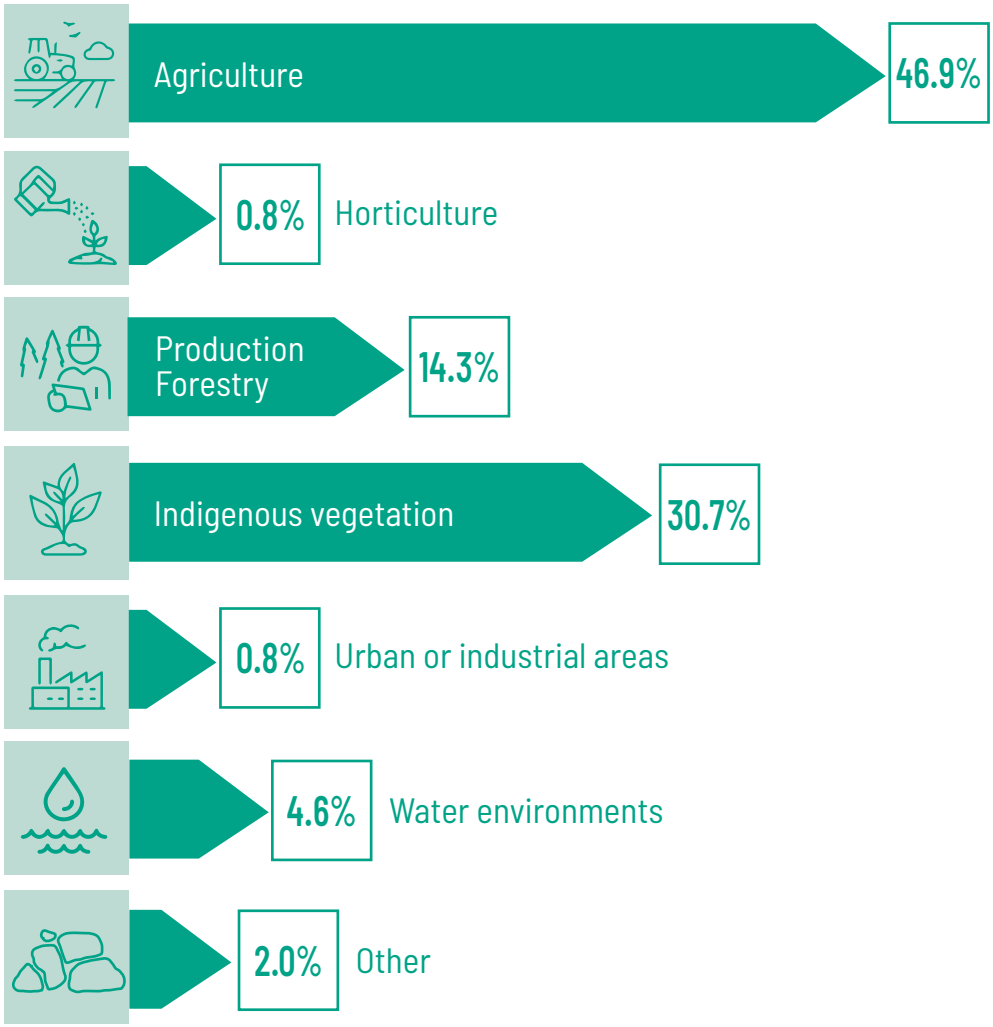


Figure 1: Northland's land use in 2018 by area, based on the Land Cover Database (Manaaki Whenua – Landcare Research, 2019).

** Maanaki Whenua maintain the New Zealand Land Cover Database (LCDB). This is a classification of New Zealand's land cover, the most recent versions published relate to 2012 and 2018.*

In the year ended March 2022, agriculture, horticulture, and production forestry sectors provided 9.5% ($894 million) of our total regional Gross Domestic Product (GDP) (Infometrics, 2023a). Over 7,800 people work in these industry sectors, representing 9.7% of total regional employment (Infometrics, 2023a). This percentage is slightly down from the 11% contribution to GDP and 11.6% contribution to employment in 2012 (Infometrics, 2023a; Infometrics, 2023b).

Indigenous vegetation, consisting of forests, shrubland, flaxland and fernland, supports native biodiversity and accounts for about 31% of Northland's land cover (Figure 1) (Manaaki Whenua, 2019). Indigenous vegetation in Northland decreased by approximately 428 hectares (0.1%) from 2012 to 2018, with the majority being converted to low and high-producing grassland (Manaaki Whenua, 2019).

Indigenous vegetation in Northland: Raupo on the bank of a lake.

He aha ngā pāpātanga?

What are the issues?

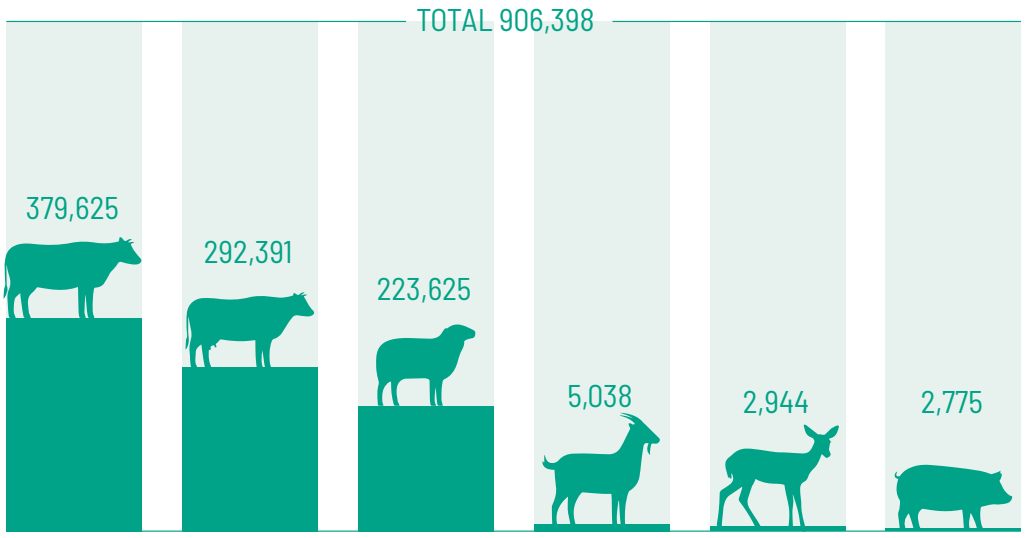
Land use and land use change

Agriculture

Farming activities can degrade soil quality by depleting nutrients and compacting soil, with off-farm effects on water quality due to nutrient, bacteria, and sediment runoff.

Northland region had 906,398 recorded livestock in 2022, with beef cattle accounting for 42% of the region's livestock. Dairy cattle and sheep were also large contributors, while pigs, goats, and deer accounted for about 1% of Northland's total livestock numbers in 2022 (Table 1).

Table 1: Livestock numbers in Northland as of June 2022. Source: Stats NZ, 2023.



Between 1990 and 2022, sheep, dairy, and beef cattle numbers in Northland decreased (Figure 2). The decline in dairy cattle numbers corresponds with a decline in land used for dairy farming (Figure 3).

The decline in cattle numbers reflects broader shifts in land utilisation.

On a national scale, Northland had some of the largest percentage reductions in livestock numbers between 2017 and 2022. Sheep numbers in Northland had a 32% reduction, while dairy cattle had a reduction of 23%. National reduction rates were 8% and 6%, respectively (Stats NZ, 2023).

Despite a reduction in livestock, the region's soil quality monitoring programme has detected an increase in soil compaction at dairy and drystock sites, with the latest round of sampling finding the soil in a reasonably stable, more compacted state compared to when it was first sampled in 2001.

Changes in land use or climatic conditions, such as major droughts and floods can cause variations in livestock numbers. Improved farming practices can also reduce livestock numbers, with less livestock per hectare yielding the same or more production (Ministry for Primary Industries, 2012).

During the 2018-2020 drought at Takou Bay

Two months after 2018-2020 drought at Takou Bay

Over the past ten years, there has been a steady decline in the number of dairy herds, dairy cows, and the effective area (ha) used for dairy production in Northland (Stats NZ, 2019a; Infometrics, 2022).

According to Infometrics 2022 there has been less than a 1% drop in milk solids production despite about 13% fewer cows being milked in the 2021-22 season on about 17% less land in comparison to the 2000s. This is reflected in the reduced number of dairy farm effluent discharges and a considerable reduction in dairy farm effluent significant non-compliance incidents (Figure 4).

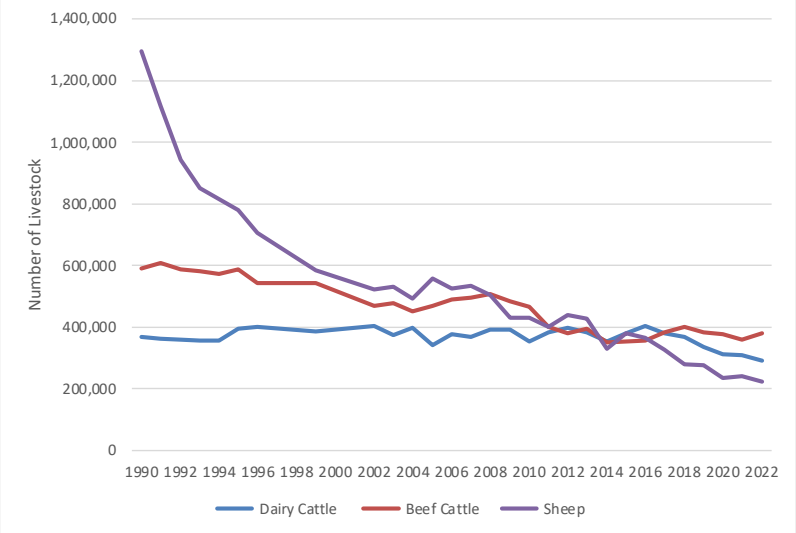


Figure 2: Livestock numbers in Northland between 1990 to 2022, for main livestock categories. Source: Stats NZ, 2023.

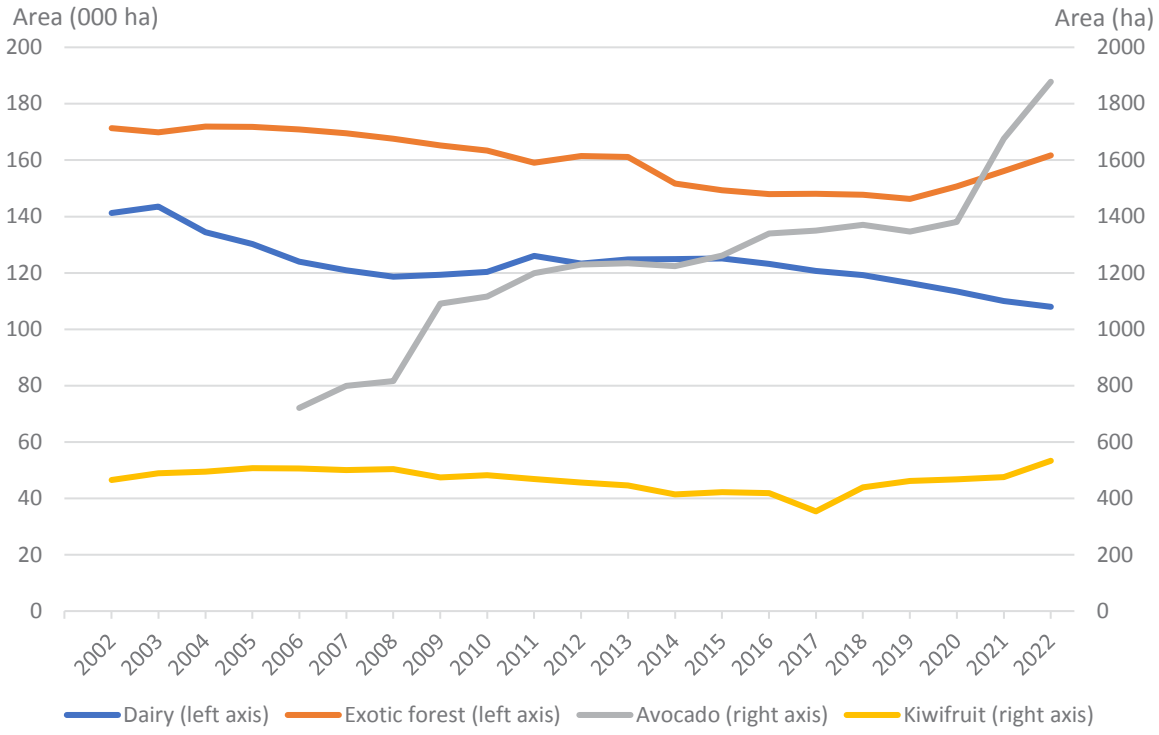


Figure 3: Area (hectares) of dairy farming, exotic forestry, avocado and kiwifruit growing in Northland from 2002 to 2022. Refer to left axis for dairy and exotic forestry and right axis for avocado and kiwifruit growing. Source: Stats NZ, 2023; Infometrics, 2022; Ministry for Primary Industries, 2002 – 2022.

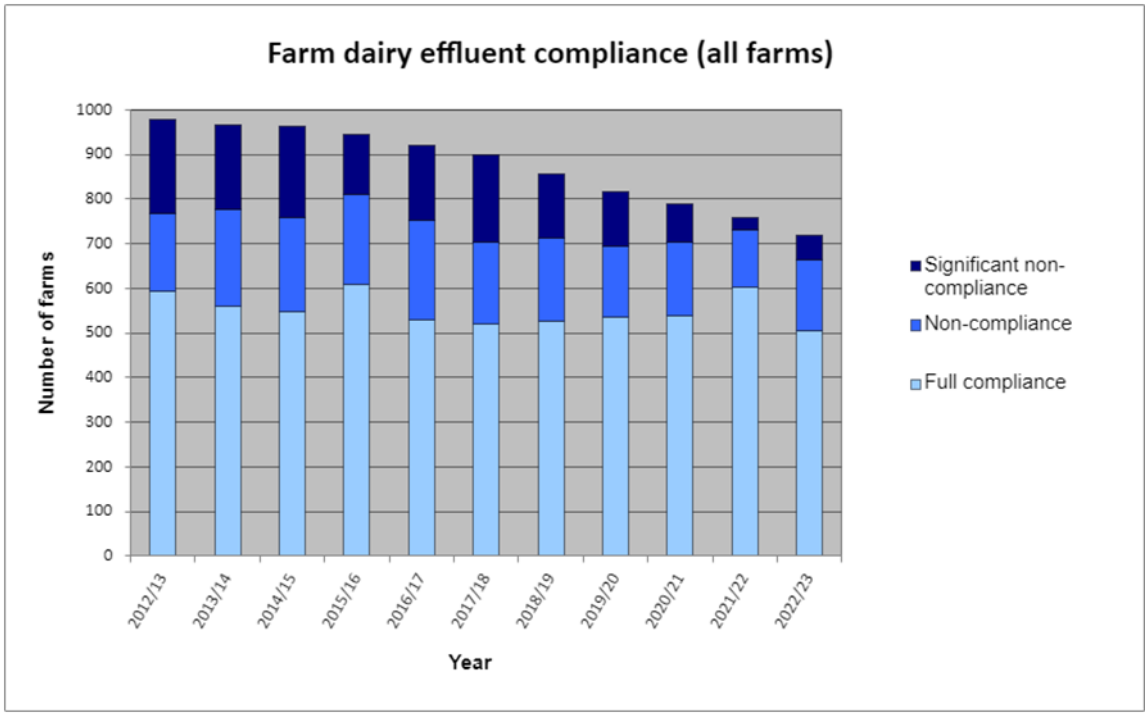


Figure 4: Compliance of dairy farm effluent discharges in Northland, 2012/13 to 2022/23.

Horticulture

Without careful management, horticultural activity can degrade soil and freshwater health through use of fertilisers, agrichemicals, and compaction of soil. Horticulture can also affect the movement and loss of soil through land disturbances such as tilling.

The region's climate and suitable soil conditions make it viable for crops such as kūmara, avocado and kiwifruit. In recent years, horticulture has been a steadily growing industry in Northland, with the total horticultural area increasing from 5,300 ha in 2017 to 5,800 ha in 2022 (Stats NZ, 2023). The main driver of growth is the development of new avocado orchards, with a 34% increase in crop area between 2017 and 2022 (Stats NZ, 2023). Land used for kiwifruit production has not changed much, other than a small reduction in 2017. Access to highly productive soil and adequate water supply have been the biggest barriers to horticultural expansion.

Lemon crops are part of the steadily growing horticulture industry in Northland.

Forestry

Plantation forestry is typically sited on hill country with little topsoil and fertility. The clear-fell harvesting of plantation trees can cause erosion issues due to soil exposure and disturbance. 'Slash', a by-product of harvesting trees, has become a topical issue with recent significant climatic events washing it into rivers and harbours. However, the loss of slash into waterways is not a significant issue in Northland when compared to the Gisborne Region (Te Tai Rāwhiti). Furthermore, slash contains a large amount of the stand's nutrient content and as it decomposes, makes those nutrients available to plants. Slash management plans are important in managing the risks from slash and erosion post-harvest.

After declining since 2002, there has been a steady increase in land used for production forestry in Northland since 2019 (Figure 3). The increased production forestry area in recent years is due to catchup planting after a sustained period of tree harvesting and an increased interest in planting pine (Pinus radiata) for carbon units. Log exports from Northport increased from around one million m^3 in 2003 to 2.5 million m^3 in 2014, reaching a record level of just under three million m^3 in 2021 (Ministry of Primary Industries, 2023).

Plantation forestry on sand country near Dargaville.

Fertiliser use

Compared to the rest of New Zealand, Northland's soils are highly weathered, resulting in low fertility acid soil. To maintain nutrient levels for plant growth and production, regular applications of phosphorus and lime are required. But the overuse of fertiliser can increase soil salt levels and impact beneficial microorganisms. Excessive fertiliser application can result in nutrient runoff into streams or groundwater, potentially causing excessive plant and algal growth, negatively impacting freshwater systems and human health.

Superphosphate is the main fertiliser used, accounting for about 38% of Northland's total fertiliser application in 2022. In the early 2000s, around 160,000 tonnes of fertiliser was applied annually, whereas less than 90,000 tonnes (44% reduction) was applied in both 2021 and 2022 (Stats NZ, 2023). Lime can be used on soil to make existing nutrients more readily available by raising soil pH levels, reducing the need for additional nutrient inputs. Reduced fertiliser use may be related to lower stock numbers, recurring extreme weather events, and market volatility. Recurring extreme weather events and market volatility affect the viability of farms, which in turn, can affect land use. Improved knowledge of application rates and techniques may also be influencing fertiliser use.

Land development

Only 10% of Northland's land is classed as highly productive land (Class 1, 2 and 3 land in the Land Use Capability classification); these areas are highly prized for their food production capabilities (Lynn, 2009). The way this land is utilised is important due to its limited availability.

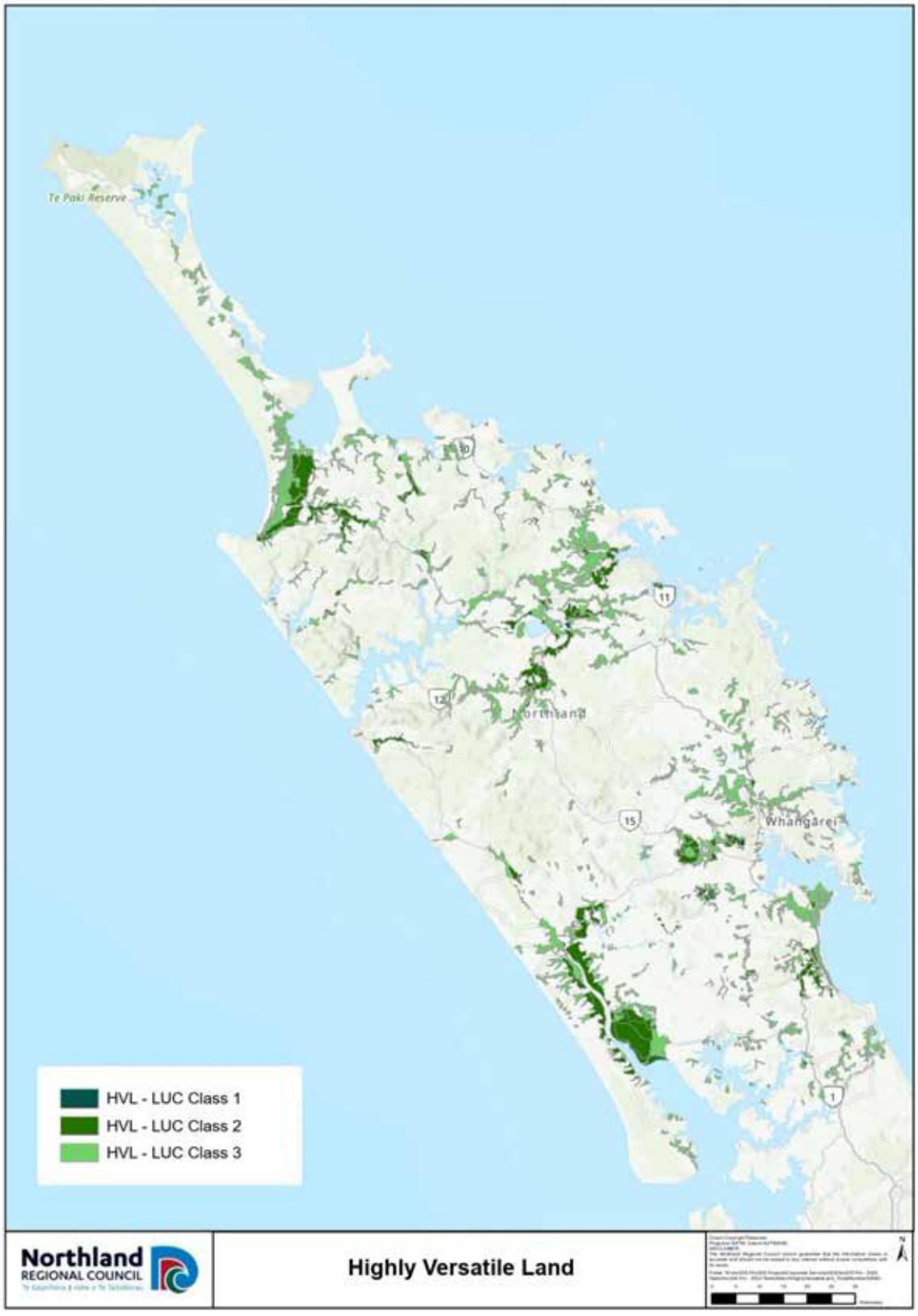


Figure 5. Highly versatile land (Classes 1, 2 &3) in the Northland region. Source Lynn (2009).

From 1996 to 2018, 1,665 ha of land in Northland was converted to developed land, e.g., roads, and urban areas (Manaaki Whenua, 2019). While this is only a small area of Northland's land cover, building on highly productive land can disproportionately impact primary production due to the limited availability of the land class. Peri-urban pressures such as reverse sensitivity can occur when landowners moving into a rural area are unprepared for some of the activities undertaken as part of standard agricultural or horticultural practices and the associated smells and noise.

Land is highly prized in Northland for its food production capabilities.

Flood and drought events

Northland has seen numerous flooding and drought events of significance in recent years. Both flooding and droughts have economic and environmental effects, including infrastructure damage, reduction in grass growth, fodder production and cropping yield. These impacts flow onto livestock industries with reduced milk volumes and sheep and beef yielding lower weights. There can also be a reduction of stock numbers that can negatively impact the following year's lambing and calving numbers.

Cyclones Hale and Gabrielle caused widespread flooding in Northland during the summer of 2023. Some parts of the region experienced over 400% of the median January rainfall (Figure 6), in part due to Cyclone Hale. The cyclones had long-lasting effects on the region due to slips, infrastructure damage and elevated water tables.

Most of Northland's urban areas are near rivers and harbours, which can be prone to flooding and coastal inundation. Built urban areas have more impermeable surfaces, (e.g., roads, carparks, and buildings) increasing the risk and effect of flooding, which have economic and social costs.

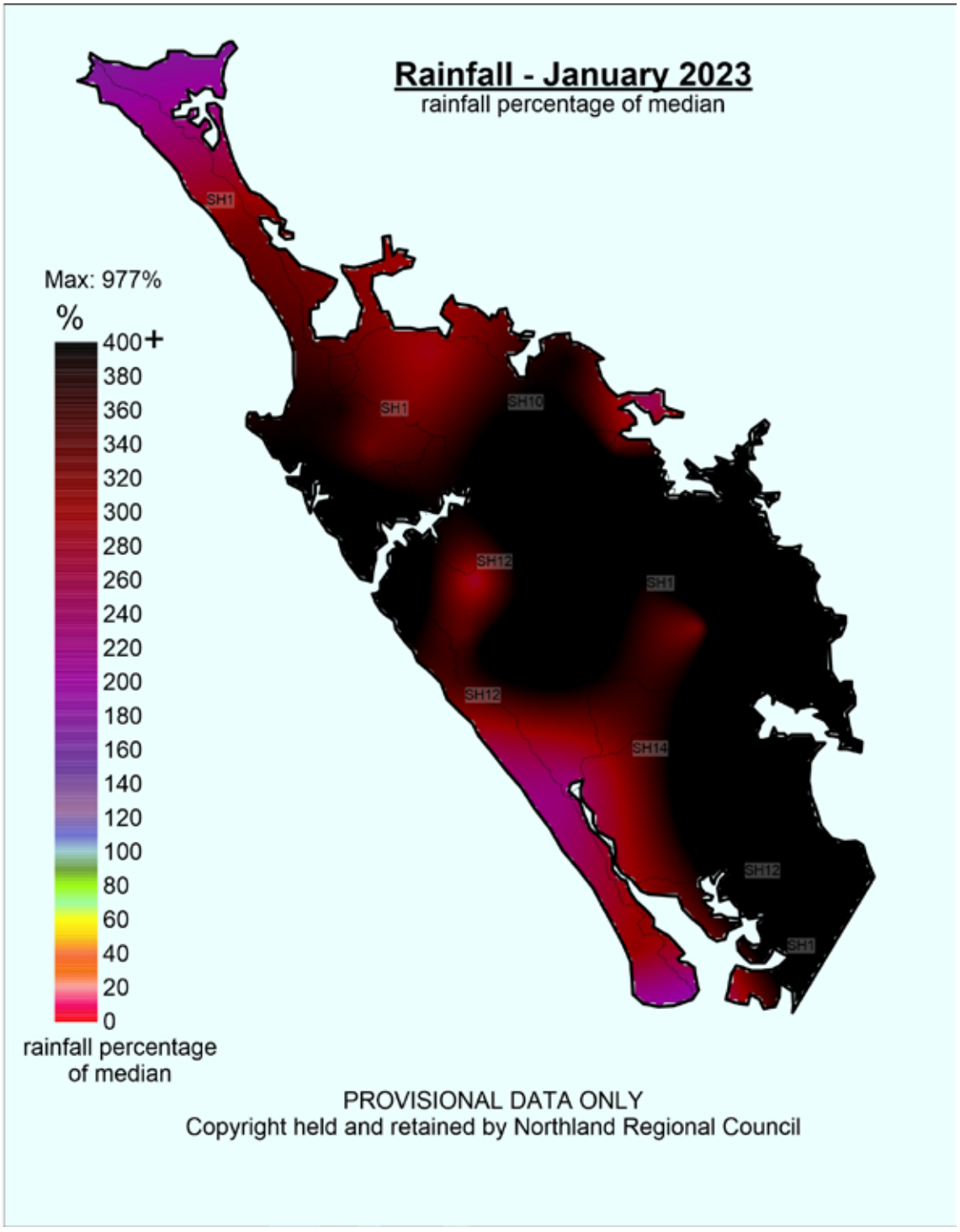


Figure 6. Rainfall in January 2023 as a percentage of the historical median rainfall for January. Source: NRC

In the last 15 years, seven droughts have been declared in Northland. A drought starting in July 2018 extended to June 2020, the longest drought on record for Northland and the second most severe. The drought is estimated to have negatively impacted Northland GDP by up to $60 million (Ministry for Primary Industries, 2021). Areas of the region received no rainfall during February 2020 (Figure 7).

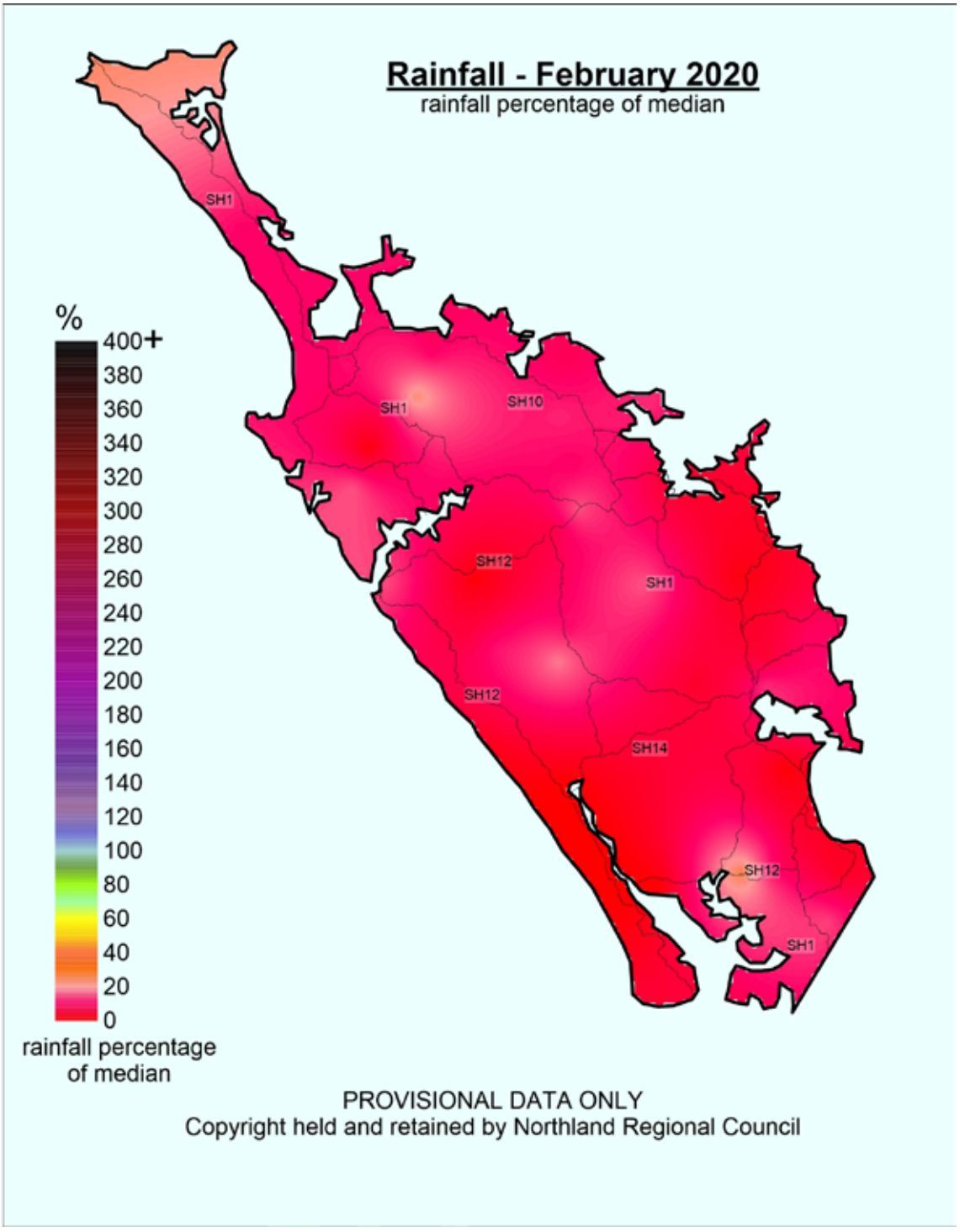


Figure 7. Rainfall in February 2020 as a percentage of the historical median rainfall for February. Source: NRC

Land disturbance consents

Land use consents for land disturbance indicate some of the activities that can result in soil loss. A consent is required when the land use or disturbance activity does not meet the permitted activity rules under a Regional or Proposed Regional Plan for Northland, for example, where earthworks volumes or areas will exceed the permitted activity thresholds. Consents are sought for earthworks, vegetation clearance, and structures (Table 2).

On average, 128 land use consents were issued or renewed annually between 2017 and 2020, rising to an average of 186 in 2021 and 2022. An increase in consents for earthworks, vegetation clearance and culverts in 2021 and 2022 is possibly a result of the National Environmental Standards for Freshwater 2020 regulations coming into force.

Table 2. Land use consents issued or renewed in Northland by type from 2017 – 2022.

Land use consent type	2017	2018	2019	2020	2021	2022
Bridge	1	1	0	4	3	0
Culvert	3	5	7	6	11	12
Deposit material	4	6	4	1	2	1
Earthworks	53	56	59	78	93	118
Extraction	12	10	13	6	0	4
Other (forestry activities)	1	6	7	4	9	10
Reclamation	1	2	0	0	0	1
River works	6	6	7	4	5	7
Structure	31	19	18	17	15	18
TLA land use (transfer of power)	7	3	5	4	3	1
Vegetation clearance	8	9	5	12	23	37
Total consents issued or renewed	127	123	125	136	164	209

From January 2017 to December 2022, there were 3,891 compliance monitoring events related to land use administered by the Northland Regional Council, of which 3,465 (89%) were fully compliant (Table 3). The small number of significant non-compliance for land use consents is likely due to increased environmental awareness among consent holders, forestry companies, and earthworks operators. This has been achieved through the Council's enforcement action on non-compliance and educational initiatives, such as workshops, field days, site visits, and publications. All significant non-compliances are followed up by enforcement officers and/or have formal enforcement action taken.

Table 3: Compliance for land use resource consents for all monitoring events between 01/10/2017 – 31/12/2022

Degree of Compliance	Number of consents
Full compliance	3465
Low-risk non-compliance	270
Moderate non-compliance	148
Significant non-compliance	8
Total monitoring activities	3891

Right of photo: Coconut matting used for riverbank protection.

Environmental incidents

Environmental incidents reported to Northland Regional Council are categorised by the resource affected. Incidents that potentially affect land resources include:

- Oil, diesel, or hazardous substance discharges, which can significantly impact soil quality.
- Earthworks and vegetation clearance, which can cause a range of environmental issues, such as increased erosion, habitat loss and fragmentation.

Incidents are categorised by the level of impact they have had on the environment. Most incidents (96.5%) reported between January 2017 and December 2022 were considered to have had no or a minor effect on the land environment (Figure 6). The low rate of moderate and significant incidents is likely a result of increased environmental awareness through the regional council's advocacy and education.

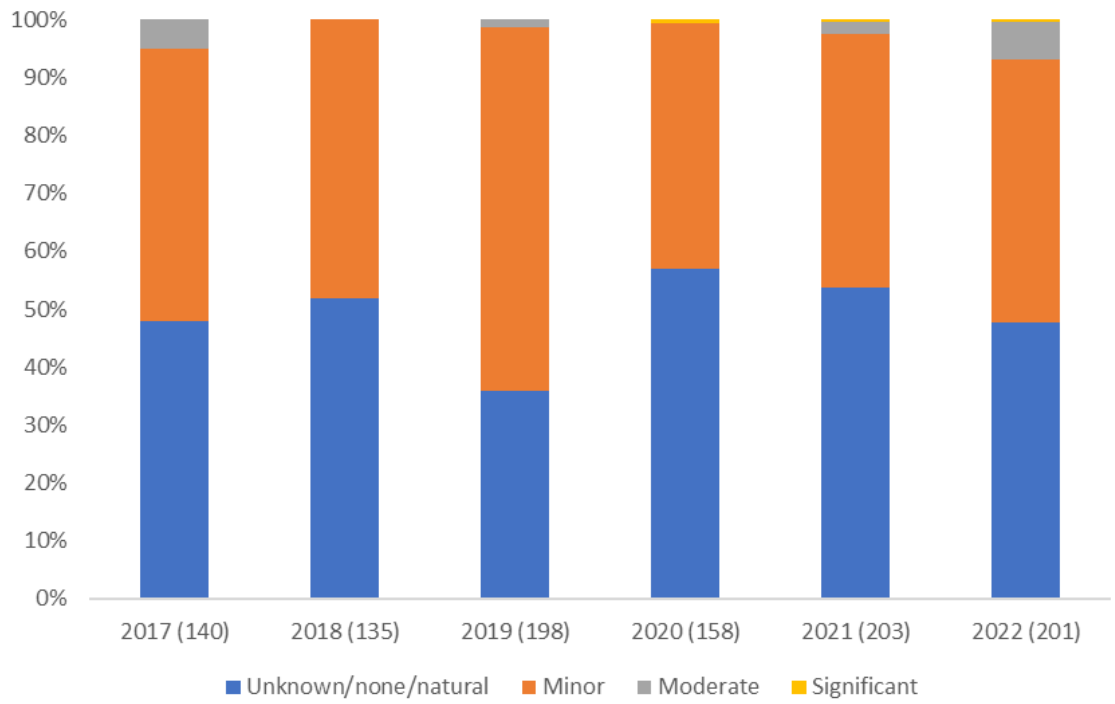


Figure 8: Environmental incidents where the resource affected was land, 2017 -2022. Number in brackets indicate the number of incidents for that year.

Burning of tyres contaminates soil

Response

By improving our land use practices, Northland can improve the health of our soils and the quality of our freshwater and marine ecosystems. Work that property owners and land developers do to improve soil health and minimise soil erosion reduces the quantity of sediment flowing into our rivers and harbours. NRC employs various strategies to promote good land-use practices. The Regional Policy Statement and relevant regional planning documents regulate activities that can affect land and water quality, while strategic plans, targeted funding, and land-use mapping are non-regulatory tools that aid in improving land-use practices. Chapter two of this report details ways the council is helping landowners manage soil health through advice and funding.

NRC Land Management advisors provide advice and funding assistance to landowners for environmental protection projects.

National and Regional Policies

Healthy land and water are essential to supporting the wellbeing of our communities. The Regional Policy Statement (RPS) 2016, updated in 2018, includes policies to manage peri-urban pressures when subdividing rural land. The RPS and the National Policy Statement for Highly Productive Land (NPS-HPL) 2022 provide direction to ensure that our land with the most productive soils is available for primary production, e.g., agricultural, and horticultural land use. The NPS-HPL provides guidance to councils on how to manage subdivision, development, and use of highly productive land. There are provisions for district councils to approve subdivisions or undertake plan changes to allow for housing on HPL, but only if certain tests are met, including there being no less productive land available.

Environmental management planning, environmental monitoring, and climate change adaptation

In the 2023 / 2024 financial year, $20,000 was available for tangata whenua to apply for grants for environmental monitoring, including air, water, and soil monitoring as well as mātauranga Māori where desired by applicants. Due to the high level of interest by numerous applicants, NRC identified supplementary funds and signed grant agreements totalling nearly $139,000 by December 2023. NRC has also allocated substantial funds, and is providing technical assistance, to support multiple tangata whenua environmental planning initiatives and activities, with a focus on increasing climate change resilience. This included targeted support to around 35 marae entities to help them to improve their flood resilience.

Mana Whakahono ā Rohe agreements

NRC is working with a number of iwi and hapū to establish Mana Whakahono ā Rohe (MWAR) agreements that create opportunities to participate in resource management decision-making. An MWAR is a legally binding arrangement that creates a structured relationship between tangata whenua entities and councils under the RMA. NRC is committed to fostering enduring relationships and connections with iwi and hapū, leading to better quality outcomes, including:

- supporting iwi/hapū mātauranga, and understanding iwi/hapū expectations and aspirations and priority areas of concern
- supporting iwi/hapū-led projects and establishing shared projects
- improving processes
- more efficiently using council and iwi/hapū resources.

Ngā Taumata o te Moana – climate change strategy

In 2019, Climate Adaptation Te Tai Tokerau (CATT) was established, forming a partnership between tāngata whenua representatives, the regional council and the three district councils. In 2022, Northland Regional Council adopted Ngā Taumata o te Moana – Our strategy for tackling climate change.

Within Ngā Taumata o te Moana, NRC has committed to actions that will:

- Adapt to the effects of climate change by building the resilience of communities and natural systems.
- Reduce emissions by reducing the council's use of fossil fuels and encouraging our region to transition to a net-zero emissions economy.
- Remove carbon by enhancing natural processes that capture and store carbon.

Some of the proposed actions to achieve a climate-resilient Northland society, such as tree planting and wetland restoration, will support improved land use and soil conservation outcomes.

Fence and flax alongside wetland, reflecting restoration efforts and the commitment to climate resilience and sustainable land use.

Flood Protection and Control Strategy

Both flooding and droughts have economic and environmental effects on land use including affecting grass growth, fodder production, and cropping yield. The development of a flood protection strategy is important for Northland due to the high risk of river flooding, which is the region's most significant natural hazard (Northland Regional Council, 2018). Under the Local Government Act 2002, councils must create an infrastructure strategy that covers a minimum of 30 years. The NRC's Flood Protection and Control Strategy 2018-2028 aims to achieve the following goals:

- Identify significant infrastructure issues over the period of this strategy.
- Identify the principal options for managing those issues and the implications of those options.
- Outline how the regional council intends to manage its flood protection and control assets, and the possible scenarios for managing these assets.

Five flood schemes in the Northland region have a projected combined operational and new capital expenditure of approximately $55 million over 30 years from 2018 to 2047 (Northland Regional Council, 2018).

An example of this work is the construction of the Hopua te Nihotetēā detention dam, which holds back floodwaters reducing flooding downstream in central Whangārei. The dam, completed in early 2016, can hold up to 1.27 million cubic metres of floodwater during heavy rain, which is then released slowly over a couple of days.

Hopua te Nihotetēā detention dam in Whangārei. Source: NRC website

Land use and soil mapping

Manaaki Whenua Landcare Research (MWLR) has prepared a high-resolution land use classification for the Northland region (Figure 9), drawing on a variety of national and regional datasets. The in-depth classification of land use aimed to establish a baseline snapshot of the region, with ongoing modelling updates from different datasets.

Land cover database (ver.5) – mainly showing "High producing exotic pasture" cover in Mangere catchment.

Land use information for Northland (ver.1) by MWLR – showing detailed land use categories of pastoral land cover in Mangere catchment.

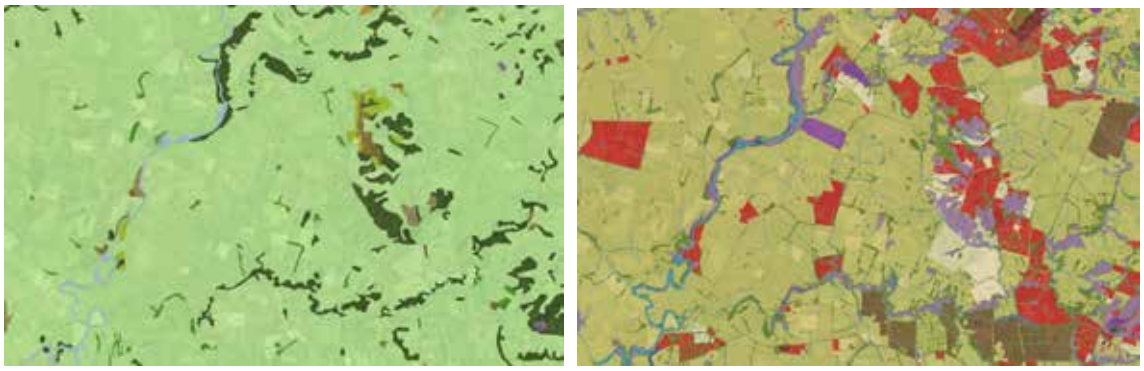


Figure 9: Comparison between national scale Land cover database (LCDB) and high-resolution regional Land use information for Northland by MWLR

The National Policy Statement for Highly Productive Land 2022 mandates that regional councils generate maps of highly productive land by October 2025 for inclusion in the Regional Policy Statement. This is being facilitated by high resolution soil mapping (S-map) which includes updates to the boundaries of land identified as highly productive (Land Use Capability units 1-3).

NRC land management advisors soil sampling on highly productive land

He aha kei tua?

What is the outlook?

Climate change

Climate change will impact what can be grown in Northland. It will also impact productivity due to increased temperatures, and more frequent extreme weather events, including droughts, storms, and heavy rainfall events resulting in accelerated soil loss and damage to critical infrastructure. New pest plants and diseases may be established in Northland.

NRC established a Climate Change team in 2022, which is driving the region's climate strategy and implementation of climate change actions.

Water use

Land use plays a pivotal role in the management of freshwater resources. River flows and water levels in lakes, aquifers, and wetlands play a critical role in structuring ecological communities, maintaining water quality, and supporting ecosystem function and habitat, both directly and indirectly. While the use of water for domestic, agricultural, and industrial purposes provides a range of services and economic benefits, it can also have detrimental impacts on the natural flow and water level regimes of freshwater bodies and is often in conflict with sustaining aquatic ecosystem health.

The implementation of large-scale water storage projects can offer a solution to these challenges. By storing water during periods of high flow, these projects can help maintain the health and well-being of water bodies during low flows and allow farmers to continue to sustain their farming activities in times of drought. Moreover, these water storage projects can enhance the utilisation of land. With a reliable water supply, land can be used more effectively for agricultural, industrial, and domestic purposes. This not only provides economic benefits but also helps mitigate the detrimental impacts on natural water flow and level regimes caused by these activities.

The National Policy Statement for Freshwater Management requires Te Mana o te Wai to be applied to freshwater management. Te Mana o te Wai requires that the health and well-being of water bodies and freshwater ecosystems be put first – council must satisfy itself that this obligation is met prior to providing for other uses, such as human needs or the social and economic well-being of people.

The existing allocation limits for rivers and groundwater in Northland are based on a proportion of the flow in the river and the annual recharge into the groundwater systems. River flow and aquifer recharge is influenced by the land cover. Large scale changes in land cover in a catchment or groundwater area for an aquifer reduce water available for allocation and may result in over allocation. A few Northland catchments, and groundwater systems are fully allocated in Northland for a variety of consumptive uses, including horticulture and water supply to towns, cities, and industry. Impacts of reduced water flow and levels can include elevated water temperatures and depleted oxygen levels, increased algal growth, and reduced habitat for aquatic flora and fauna.

Livestock drinking water

He rangahau whakapūaho

CASE STUDY 1

Water storage and use project

In 2015, the Northland Strategic Irrigation Infrastructure Study pinpointed two crucial regional locations - one near Kaikohe in the Mid North and the other on the northern Pōuto Peninsula, south of Dargaville. The Te Tai Tokerau Water Trust was subsequently established in 2020 to oversee the construction of water storage and distribution schemes in these areas. Upon completion, these new facilities will offer greater assurance to landowners in both areas and contribute to developing approximately 7,000 hectares of new horticultural land.

Matawii reservoir near Kaikohe, Credit: taitokerauwater.com/mid-north.

The construction of the Matawii reservoir near Kaikohe began in 2020, with the filling process starting in March 2023. The reservoir will:

- Store 750,000 m3 of water.
- Cover an area of 18 ha.
- Provide a backup municipal water supply for Kaikohe.
- Provide water to local businesses, including Ngawha Innovation and Enterprise Park.
- Support the development of the primary sector in the region.

A second project in the Kaikohe area is in the planning process. The Otawere reservoir will have the capacity to hold up to four million m3 of water.

The first stage of the Te Waihekeora reservoir, located on the Pōuto Peninsula, is now in operation, providing water to nearby orchards. The project's second stage is currently underway. Once completed, the reservoir will have a storage capacity of 3.3 million m^3 of water, potentially supporting the development of 1,000 hectares of new horticulture.

Artist's impression of a completed Te Waihekeora reservoir on the Pōuto Peninsula. Source: taitokerauwater.com/kaipara

He rangahau whakapūaho

CASE STUDY 2

Waimā Waitai Waiora

Tāngata whenua, Northland Regional Council, and other stakeholders have shared responsibility to restore the unique biodiversity of the Kaipara Moana catchment from the upper Wairua River near Whangārei down the Wairoa River to the Kaipara Harbour. By using mātauranga Māori the Waimā Waitai Waiora project helped landowners in the catchment develop sustainable land and freshwater practices. Improving the catchment's degraded freshwaters can restore the waters' mauri (life force or essence), providing a healthy ecosystem for future generations.

Waimā Waitai Waiora has helped:

- Develop farm environment plans with landowners to identify, prioritise, and adopt sustainable land management practices.
- Provide subsidies to assist with fencing, and wetland enhancement.
- Establish freshwater quality monitoring sites in the catchment.
- Establish a new hapū coordinator role at Northland Regional Council.
- Implement planting of over 350,000 trees.
- Helped to conduct Te Kawa Wairoa research project.

Major findings of the Te Kawa Wairoa research project are that Crown efforts in the ecological or social restoration of the Wairoa River have fallen short (Royal, 2022). In part, economic growth pressures have been key drivers of the river's degradation, and a kaitiaki network run by Tangata Whenua is best placed to achieve improvements in the health of the Wairoa River (Royal, 2022).

The Waimā Waitai Waiora project has helped to implement the planting of over 350,000 plants in the Northern Kaipara Moana catchment area. Source: waimawaitaiwaiora.co.nz

He rangahau whakapūaho

CASE STUDY 3

Ōtiria-Moerewa flood scheme

The Ōtiria-Moerewa areas have experienced multiple flooding incidents in the past decade, including during Cyclone Gabrielle in February 2023. These settlements are located on a floodplain, and during floods, the old Pokapū Road Bridge, which spanned the Waiharakeke River, blocked the swollen river's natural flow path, causing water to be diverted towards the settlements. Housing, marae, sports clubs, a retirement village, and businesses have all been affected by flood damage.

In partnership with hapū and the local community, NRC has undertaken a three-stage programme at the cost of approximately $5.1m that will reduce the severity of typical flooding events by about 75%. The stages include:

- **Stage 1:** The downstream construction of an 80 m-long spillway, completed in 2022.
- **Stage 2:** Construction of a new bridge at Pokapū Road, spanning 60m across the Waiharekeke River, opened in October 2023.
- **Stage 3:** Excavation of an 800m long spillway, earthworks to tie the new bridge into the wider scheme and remove the old Pokapū Road bridge. Sections of the old bridge will be recycled and used at the Whangārei Quarry Gardens to replace a bridge lost during Cyclone Gabrielle. Stage 3 is due for completion in late 2023.

The Ōtiria-Moerewa flood scheme was funded from targeted rates, NRC and central government through Kānoa - Regional Economic Development and Investment Unit. The project has demonstrated what successful partnerships between mana whenua and local government can achieve when working together to achieve a solution.

Construction of the new Pokapū Road bridge in Ōtiria, Northland. Source: https://www.nrc.govt.nz/news/2023/july/new-bridge-beams-in-place-as-part-of-otiria-moerewa-floodworks/

2 Te oranga o te one
Soil health and erosion

Te tirohanga whānui
Overview

Soils provide essential services to life in Northland by filtering water, recycling nutrients, and storing carbon (Collins et al., 2014). The primary industries in Northland rely on soil to produce food, fibre, and timber. The region's climate, topography, historic vegetation, and mixed geology have created a diverse range of soils. Physical factors, such as underlying geology, slope, and drainage, can determine the quality of the soil and the best use for each land area.

The Northland region has a diversity of soil types that come under pressure through different land uses and weather events. Northland Regional Council responds to these pressures through policy settings around land use and both regulatory and non-regulatory functions to conserve and protect the region's soil resource.

E pēhea ana te ora ināianei?

What is the current state?

What is the state of soil quality in Northland?

The region encompasses diverse landforms and soil types, including active sand dunes along the coast, old greywacke and volcanic peaks and hills inland. Northland soils can be broadly categorised into several types (Table 1), with a majority composed of mature, strongly leached heavy clays. Soil characteristics must be carefully managed for agricultural needs as they can vary significantly within small areas of Northland.

Table 1: A broad categorisation of Northland soil types.

Soil Type	Description
Podzols	Common in Northland, especially in the hilly and forested areas. These soils are typically acidic and leached of nutrients, with a distinct layering of organic matter (O horizon), iron, aluminium (E horizon), and clay (B horizon). Podzols require careful nutrient management to optimise agricultural production.
Brown Soils	Also known as brown earths, are relatively fertile and found in some of Northland's flatter, more agriculturally productive areas. They tend to have a well-developed A horizon (topsoil) enriched with organic matter and nutrients, making them suitable for a variety of crops
Gley Soils	Often found in low-lying or poorly drained areas of Northland, particularly in places with high rainfall. They tend to have a high water table, leading to waterlogging and reduced oxygen levels in the soil. As a result, gley soils are typically low in fertility and usually require drainage for agricultural use.
Limestone Soils	Typically occur in areas where there are limestone rock formations. These soils are characterised by their alkaline pH and unique mineral composition, which can significantly influence their suitability for agriculture and plant growth. All of Northland's limestone soils are winter wet and prone to pugging and compaction.
Peat Soils	Found in some parts of Northland, particularly in wetlands and swampy areas. These soils are rich in organic matter but are also acidic and have poor nutrient-holding capacity. While these soils can be very productive, drainage work or cultivation causes oxidisation and shrinkage and can result in high CO2 emissions.
Alluvial Soils	Prevalent along riverbanks and floodplains. These soils are generally fertile and well-drained due to their proximity to water bodies. They are often used for horticulture, especially for crops like kūmara and maize.
Sandy Soils	Coastal areas of Northland have extensive sand dunes with sandy soils. These soils are typically poor in nutrients and have low water-holding capacity. Soil quality varies based on the dune's age and vegetation's influence on soil formation. These soils can support a wide range of uses provided there is sufficient water and nutrient availability.
Volcanic Soils	In some parts of Northland, volcanic soils can be found, resulting from past volcanic activity. These soils are often rich in minerals and nutrients, making them suitable for horticulture. However, their fertility can vary depending on their age and weathering.

Northland has over 200 soil types, more than any other region in the country. The region's climate, topography, historic vegetation, and mixed geology have created a complex pattern of soils.

Soil health is the ongoing capacity of the soil to be able to carry out the functions that sustain plants, animals, and humans, such as efficient nutrient cycling, regulating water flow in the water cycle, sequestering carbon from the atmosphere, supporting biodiversity and producing food (Stevenson et al., 2022).

NRC implements a soil quality monitoring programme collecting soil quality data from 29 sites chosen to represent the major soil orders and land uses within the Northland Region. The sites were first sampled in 2001 as part of the nationwide 500 Soils Project and subsequently every five years. The purpose of the programme is to monitor soil quality across different land uses and soil orders to examine the state and trends of soil quality and trace elements throughout Northland. However, the number of sites in the programme is low compared with other regions in New Zealand. Increasing the number of sites would improve the representation of the region's soil quality. Additionally, prioritising additional sites towards under-represented soil orders within each land use type would ensure a more comprehensive representation.

While there are many indicators that can potentially be used to assess soil quality NRC monitors seven core indicators, including nitrogen, phosphorus, carbon, pH and physical soil structure (Table 2), which are national soil indicators. These indicators are used to judge how suitable the soil is for a particular use as defined by comparisons to national data and expert opinion.

Based on the monitored indicators and sites, Northland soils can have localised issues, mostly dependent on land use and land use practices (Ballinger & Macdonald, 2020).

Table 2: Indicators used for soil quality assessment (Manaaki Whenua Landcare Research, 2023)

Group	Indicator	Soil quality information
Group 1 - Fertility	Olsen phosphorus (Olsen P)	Plant available phosphorus
Group 2 - Acidity	pH	Acidity or alkalinity of soil
Group 3 - Organic resources	Anaerobically mineralisable nitrogen	Availability of nitrogen reserve, a surrogate measure for soil microbial biomass
	Total carbon	Organic matter reserves, soil structure, ability to retain water
	Total nitrogen	Organic nitrogen reserves
Group 4 - Physical properties	Bulk density	Soil compaction, physical environment for roots and soil organisms
	Macroporosity	Availability of water and air, retention of water, drainage properties

Northland Regional Council staff undertaking a Visual Soil Assessment. Source: NRC

He aha ngā pāpātanga?

What are the issues?

Pressure and Impacts

Climate and land use practices can influence the quality of Northland's soils. Poor land use practices can negatively impact soil health, reducing the land's capability to support our region's cultural and economic needs, and carry out important processes, such as nutrient cycling and carbon storage.

None of the sites tested in productive land uses in Northland had all soil quality indicators in the optimum range. The sites in more intensive land uses, such as dairy and drystock, were more frequently outside the target ranges for soil quality indicators. Sites with excess nutrients and low macroporosity (a measure of spaces between soil particles) pose an elevated soil and water quality risk.

Pugging can lead to soil compaction, degrading soil quality as seen in the photo to the left,

Compaction of soils

Intensification of land use, including housing, roading, and animal stock numbers per hectare, can cause the compaction of soils. When soils become compacted (low macroporosity), it reduces the air space between soil particles, reducing the air supply to plant roots and limiting the volume of water that infiltrates the ground (Ballinger & Macdonald, 2020).

Compacted soils have the potential to:

- Increase soil erosion rates.
- Reduce pasture growth.
- Cause flooding and water quality issues due to increased surface runoff during heavy rain.
- Lower groundwater levels.

In Northland, 71% of dairy sites and 90% of drystock sites sampled between 2020-2022 (Figure 1), fell below the target range for macroporosity. A single forestry site was above the target range. Since monitoring began in 2001 average macroporosity levels at dairy and drystock sites has declined and remains in a reasonably stable, more compacted state.

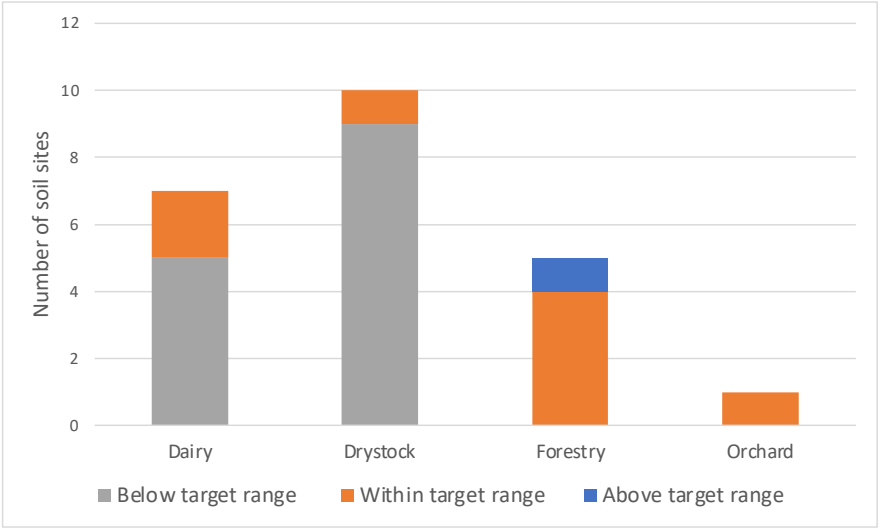


Figure : Number of sampled soil sites within the target range for macroporosity by land use, 2020-22.

Nutrients in soils

Nutrient levels in soils are an important indicator of soil productivity. Phosphorus and mineralisable nitrogen are vital nutrients for healthy plant growth. However, land use practices can negatively impact the levels of these nutrients in the soil, causing issues for soil health and the wider environment.

Phosphorus

Phosphorus is vital for the development and growth of plant life. Low levels of phosphorus can restrict growth rates and cause dieback, while high levels may cause deficiencies in minerals such as zinc and iron in soils. Elevated levels of cadmium are associated with the use of phosphorus fertilisers, with the potential to cause food safety and environmental issues (Gray & Cavanagh, 2023). Northland soils are naturally low in phosphorus. Depending on soil type and land use, agricultural land often requires the application of phosphorus fertilisers to achieve optimum pasture growth.

The Olsen P test assesses the phosphorus level in soil available for plant uptake. Of the sites monitored between 2020-2022 (Figure 2), 20% of sites in drystock farming had Olsen P levels above the target range for drystock farming (i.e., excess soil phosphorus). Meanwhile 71% of sites in dairy and 30% in drystock land use had Olsen P levels below their target range, indicating that pasture production was below optimal. This can lead to poor pasture persistence, growth, and overgrazing.

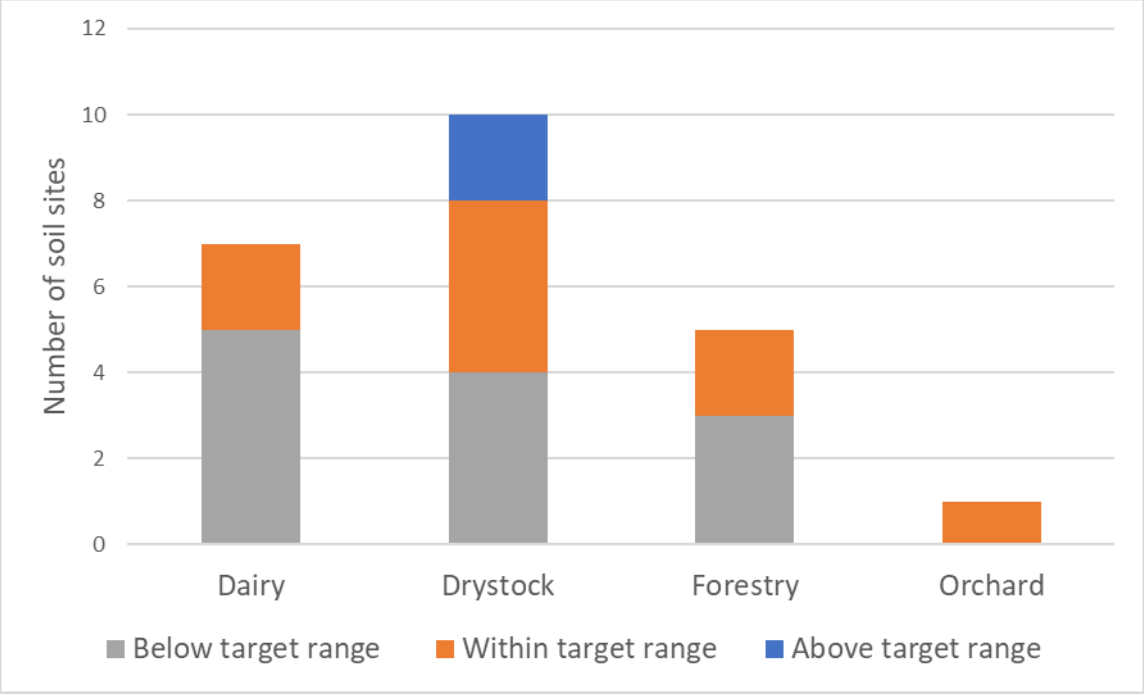


Figure : Number of sampled soil sites within target range for Olsen P by land use, 2020-22. Note that target ranges are land-use specific.

Nitrogen

Low nitrogen levels can limit plant growth, structure, and the formation of chlorophyll. In high concentrations, mineralised nitrogen in ammonium and nitrate forms can leach into freshwater, negatively affecting aquatic life. In soil, excess nitrogen can cause undesirable plant growth with the potential to reduce fruit production and encourage infestations of mites and sucking insects. High soil nitrogen levels can occur where wastewater, fertiliser and animal manure/urine are discharged to the land.

Mineralisable nitrogen levels at soil testing sites in Northland (Figure 3) show that high levels are localised, with 14% of dairy and 30% of drystock sites exceeding target ranges.

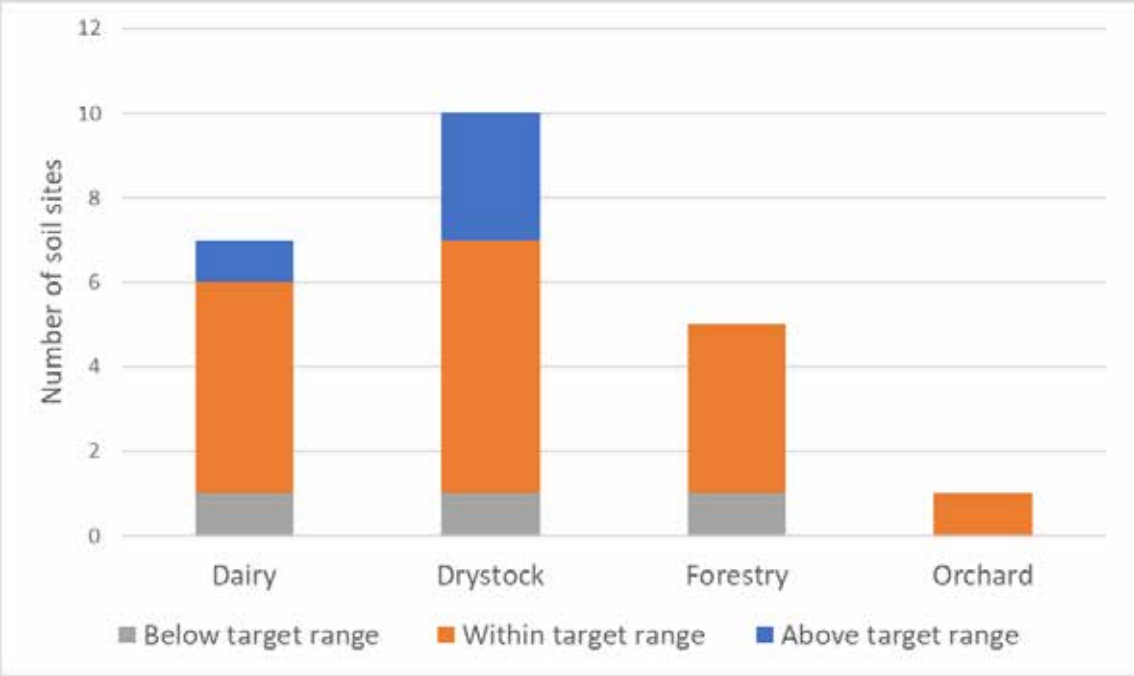


Figure : Number of sampled soil sites within target range for mineralisable N by land use, 2020-22.

Farm nutrient budgeting is critical to achieve optimum soil nutrient availability and production, without over-fertilising, which can result in nutrient run-off and leaching into waterways. Many of Northland's lowland rivers in agricultural land use have elevated nitrogen or phosphorus levels, (Nicholson & Perquin 2019). A major source of phosphorus to Northland's waterways is sediment inputs from erosion, as the phosphorus binds to the sediment.

Erosion of soils

Soil erosion is a natural process. However, the erosion rate has been accelerated by historical clearing of land for agriculture, which has led to sediment accumulation in many of Northland's harbours (Northland Regional Council, 2016). The Northland region is regularly affected by heavy rainfall, which is predicted to worsen with climate change (Pearce et al., 2016). Heavy rain and land use practices can increase the rate of soil erosion, especially in steeper hill country and stream banks. Pugging from stock, low pasture cover, deforestation, and land disturbance associated with development can all contribute to Northland's soil erosion (Ballinger & Macdonald, 2020). Northland also has large areas of weak sedimentary rock more prone to erosion, than stronger rock types like basalt (Pearson & Rissmann, 2022).

Extensive slip and gully erosion in the Kaipara Harbour catchment following Cyclone Gabrielle in 2023. Source KMR.

The erosion of soils in Northland can:

- Reduce soil fertility, negatively impacting pasture and crop yields.
- Reduce the area of useable land.
- Increase sediment loads in rivers and streams, decreasing channel capacity making them prone to flooding.
- Increase sedimentation of harbours and estuaries.
- Impact aquatic biodiversity in rivers and harbours.

Erosion has been recognised as a significant environmental issue in Northland for decades. The main types of erosion are soil slips, slumps, earthflows, stream bank erosion, and gullying. Mapping of Northland using multiple attributes such as land cover class, land use intensity, slope and ruggedness has assisted in identifying the region's catchments at high risk of erosion, that are a high priority for soil conservation (Figure 4).

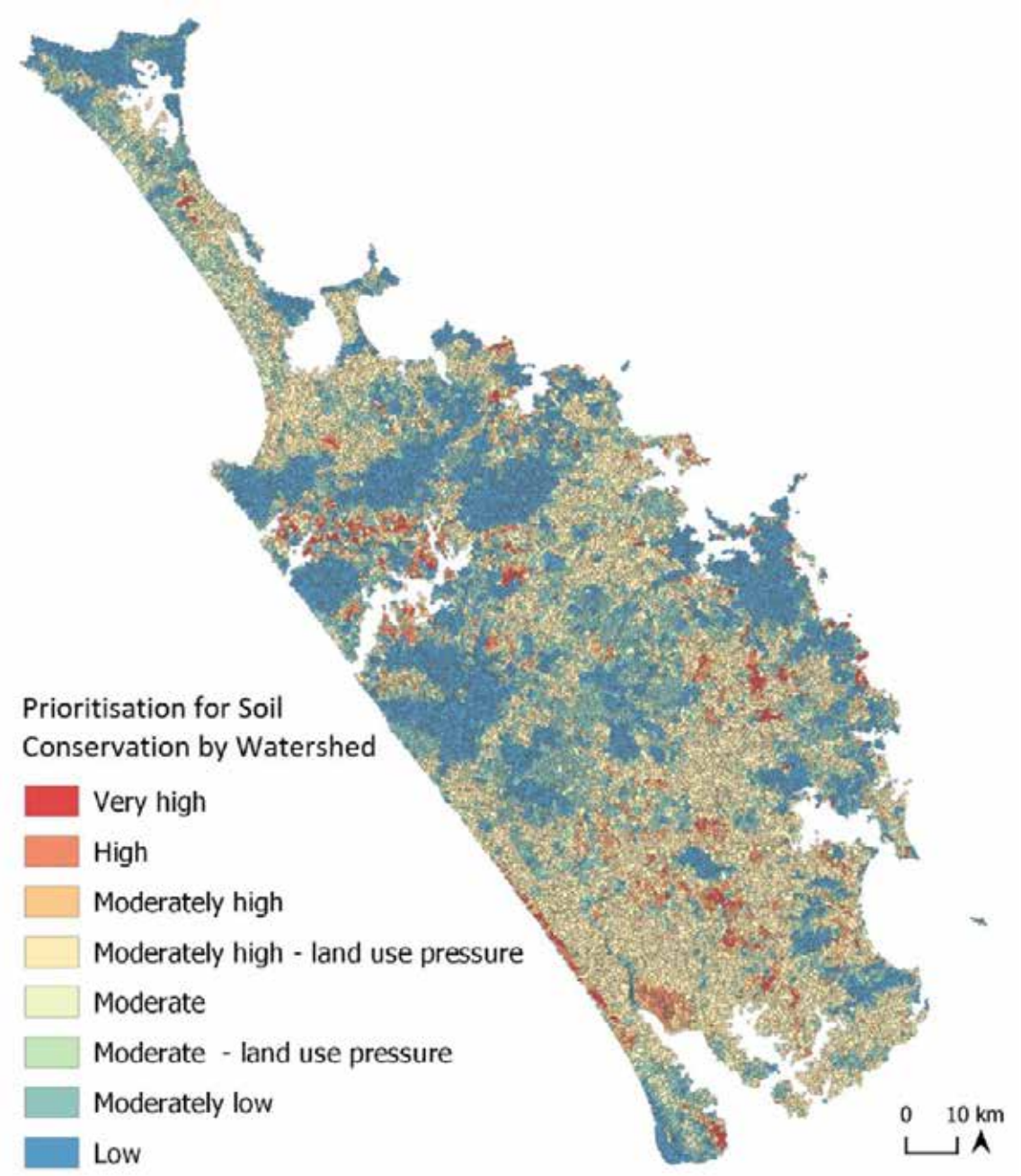


Figure : Prioritised watersheds for Northland's soil conservation strategy. Source: Pearson & Rissman, 2022.

He aha ngā mahi hei whakatika?

What is being done?

Response

NRC has a significant role in the region's soil health management, including mitigating soil erosion and sedimentation issues. Policies and rules around land use, and non-regulatory functions, such as the promotion of tree planting, are tools to help manage the pressures on Northland's soil health. Healthy soil maintained by best practice land management protects land for primary industries, facilitates the storage of soil carbon and is important for improving and maintaining water quality.

Regional policies and plans

The Regional Policy Statement (RPS) for Northland covers the management of natural and physical resources in the Northland Region and identifies significant resource management issues, including soil health. The regional council is making changes to the region's Freshwater Plan in response to the National Policy Statement for Freshwater Management (NPS – FM) 2020, which aims to significantly improve the health of our freshwater within a generation. Some of the draft changes proposed include:

- Tighter controls applied to vegetation clearance, land preparation and earthworks in areas with severe erosion risk.
- New rules requiring stock to be excluded from areas of both high and severe erosion risk.

The Draft Freshwater Plan was released for consultation in October 2023. The consultation period ended March 2024. Over that time, the new government extended the deadline for council to notify its proposed plan change, the next phase of the process, from 2024 to 2027 and has signalled its intention to revise national policy on freshwater. At this stage council will notify the plan change after 2026. In the meantime, council will continue working with tangata whenua and the primary sector to develop a balanced approach to freshwater management.

Sustainable Hill Country and Regional Priorities project

Through the Sustainable Hill-Country and Regional Priorities (SHaRP) project, NRC targeted the management of highly erodible land and promoting good land use practices. Funding from the Ministry for Primary Industries through the Sustainable Land Management Hill Country Erosion Programme was announced in July 2023, helping support the ongoing SHaRP project.

The SHaRP project helped deliver a Soil Conservation Strategy to help guide future response to erosion, as pictured, and sediment issues.

The SHaRP project helped deliver:

- Retirement of 539 ha of highly erodible land with 78 km of fencing, with $557,031 of funding
- 230 ha of new forest, of which 70 ha is native forest.
- Planting of 19,313 poplar and willow trees between 2020 and 2023.
- 391 farm plans covering 98,117 ha.
- Datasets for erosion-prone mapping of Northland's Kaipara catchment.
- Research into the properties of poplar timber.
- A Soil Conservation Strategy to help guide NRC's future response to Northland's erosion and sediment issues.

NRC supported the planting of 19,313 poplar and willow trees between 2020 and 2023.

Soil Conservation Strategy

The Soil Conservation Strategy was developed by NRC in 2023 to consolidate existing knowledge around actions and to help inform council's future response to erosion and sediment issues.

Erosion on the edge of a streambank – the Soil Conservation Strategy was developed by NRC in 2023 to help inform council's future response to erosion and sediment issues.

The strategy was developed through workshops, a comprehensive literature review, and new erosion susceptibility mapping. The strategy recommends shifts in focus to improve the progress towards achieving the outcomes in the council's document; Te Pae Tawhiti. This includes working in partnership with mana whenua, using an integrated catchment management approach to soil conservation, and optimising and increasing the level of council investment to support landowners.

The strategy will be implemented through short, medium, and long-term actions. Some of the key short-term actions identified include:

- Develop and implement a research plan that identifies knowledge gaps and looks for opportunities to collaborate and seek funding to further our understanding around mitigation effectiveness.
- Develop and implement a capability building programme for Land Management Advisors.
- Develop an engagement plan to support delivery of catchment level planning and management.
- Review existing funding arrangements and strengthen monitoring of existing funding support.
- Review existing rules and consenting processes to identify opportunities to use an integrated catchment management approach and align with identified priority areas.
- Develop and implement monitoring programmes to assess compliance and effectiveness of rules, with an initial focus on well-defined rules or permitted activities as a pilot and a high-risk activity for sediment, e.g. earthworks.
- Develop a cultural monitoring framework.

Erosion susceptibility mapping

In the initial stages of the SHaRP project, remote sensing technology and oblique photography were utilised to identify and map erosion features at a paddock scale. The process was further refined through the Kaipara Moana Remediation programme, creating catchment-wide data. The data is helping farm advisors in the Kaipara to quickly identify erosion-prone areas and prioritise efforts, such as fencing and tree planting to minimise soil movement and loss.

After successfully completing the catchment-scale project, NRC commissioned Biospatial Ltd, a Whangārei-based business, to provide the necessary datasets for conducting erosion susceptibility mapping across Northland.

Indicative erosion risk is shown in a red layer overlayed on oblique aerial imagery. Source: NRC

Extensive slip and gully erosion in the Kaipara Harbour catchment following Cyclone Gabrielle in 2023. Source KMR.

Farm Plans

The NRC land management team has prepared 432 Farm Environment Plans (FEPs) and 391 Soil Conservation Plans (SCPs) for landowners, covering 159,396 ha of farmland between January 2017 and December 2022. The plans recommend actions to improve the environmental performance of each property by identifying erosion-prone land and water quality protection measures. Some actions are required for compliance, while others are best management practices. After obtaining an FEP or SCP, landowners could apply for any targeted funding that was available.

As part of the Central Government Essential Freshwater package, farms over a certain size now require a certified Freshwater Farm Plan (FWFP). This new requirement means a FWFP will supersede the existing FEPs and SCPs. At the time of writing, the government had signalled major changes to the farm plan system, including changes to when farm plans will be required. In effect, the roll out of farm plans has been paused while the government considers changes to the system.

Between January 2017 and December 2022, the NRC land management team prepared 432 Farm Environment Plans (FEPs), covering 159,396 ha of farmland.

Riparian fencing and planting

NRC's Environment Fund, Waimā Waitai Waiora funding, Whangarei Urban Awa Project, and the Kaipara Moana Remediation (KMR) Programme have provided grants of over $10 million from January 2017 to December 2022 to landowners, hapū, and community groups to carry out environmental improvement projects. This includes funding for 1,129 km of fencing to exclude stock from the riparian margins of rivers, streams, drains, wetlands, and the coastal environment and the planting of 489,767 trees in riparian areas to reduce soil erosion and enhance biodiversity values (Table 3).

Table 3: Length of riparian fencing and number of trees planted in Northland from January 2017 to December 2022, partially funded through NRC, KMR and MfE grants.

Project/funding source	Fence length installed (km)	Allocated Fence funding	Number of trees planted	Allocated tree funding	Total funding
Waimā Waitai Waiora	71		284,270		$862,670
Kaipara Moana Remediation (Northland region only)	168	$1,384,775	163,188	$276,868	$1,661,643
Environment fund	793	$3,631,611	34,516	$3,769,669	$7,401,280
Whangarei Urban Awa	19	$260,772	7,793	$34,748	$295,520
Total	1,051	$5,277,158	489,767	$4,081,285	$10,221,113

Funding has provided 1,129 km of fencing to exclude stock from the riparian margins of rivers, streams, drains, wetlands.

Poplar and willow nursery

It can take 30-60 years for eroded areas of a hill to regain 80% of original production (Rosser & Ross, 2011). Poplars and willows are effective for erosion control due to their extensive and deep root systems. When space-planted[2] on hill country, poplars and willows can:

- reduce soil loss by as much as 90%.
- provide shelter and shade for livestock.
- promote the growth of the pasture below.

Due to the increasing demand for poplars and willows, NRC established a nursery to support Soil Conservation and Water Quality Improvement programmes. Planting of rootstock began in 2013, with the nursery producing around 7,000 three-metre-tall poles annually. From 2017 to 2022, the NRC nursery supplied 74,960 poplar and willow trees to help control erosion.

Poplars and willows are propagated by taking cuttings, which in two to three years produce 3-metre poles, unlike native trees that mostly grow from seed. NRC now supplies 1m wands and 1.5m stakes to minimise waste and maximise the production of cheaper, younger planting material.

Different poplar and willow hybrids are suitable for various environmental conditions. New hybrids are being developed that better suit Northland conditions, and these are being planted in field trials to assess their performance.

NRC established a nursery to support Soil Conservation and Water Quality Improvement programmes.

Poplars have been planted to control tunnel gullying.

[2]*Planted at wide spacings.*

He aha kei tua?

What is the outlook?

Climate change

Due to the effects of climate change, Northland is expected to experience an increase in droughts and severe rain events (Pearce et al., 2016). As a result, Northland's erosion rates and sediment yields are predicted to increase significantly by the end of the century, with potential for the total suspended sediment load flowing to Northland's coast to more than double by 2090 (Neverman et al., 2023).

As covered in Chapter 1, NRC has established a Climate Change team to implement climate change strategies and actions to help the region adapt to changing weather patterns. Water storage projects, such as Matawii near Kaikohe, will help mitigate the effects of drought, and implementation of soil conservation measures (e.g., fencing, planting, land retirement) will help manage the erosion risks associated with heavy rainfalls.

Soil conservation measures (e.g., fencing, planting, land retirement) can help manage the erosion risks associated with heavy rainfalls.

He rangahau whakapūaho tuawhā

CASE STUDY 4

Kaipara Moana Remediation

The Kaipara Moana is New Zealand's largest harbour and home to many threatened species. Decades of deforestation and land use intensification have degraded the catchment, with less than 10% of the original forest cover and 5% of wetlands remaining. This has led to a seven-fold increase in soil erosion and sediment contribution to rivers, estuaries, and the harbour (Kaipara Moana Remediation, 2022).

Kaipara Moana Remediation (KMR) is a decade-long programme. The vision is to protect, restore, and enhance the mauri of the Kaipara Moana through contributing to its environmental restoration and to recognise the fundamental significance of Kaipara Moana to the social, economic, and cultural well-being of the Kaipara Uri and all New Zealanders for present and future generations.

Intending to reduce soil loss from the Kaipara catchment into the harbour by 50%, KMR represents the largest undertaking of its kind in New Zealand. Commitment to the partnership is formalised in an MOU between Kaipara Uri, Auckland Council, Northland Regional Council, and the Crown. The Jobs for Nature fund allocated $100 million in Crown funding to the KMR programme, which is unlocked by matched funding from Auckland Council and Northland Regional Council ($10m each) and landowners ($80m).

Addressing soil loss in the Kaipara catchment will:

- Reduce siltation and degradation of the Kaipara Harbour.
- Improve freshwater quality in the catchment.
- Improve biodiversity on land and in water.
- Create resilience to climate change.
- Increase carbon sequestration.

Working with local communities, in the first two full operation years of the programme, KMR has begun the process of restoring the health and mauri of Kaipara Moana:

- 1.365 million trees planted or contracted for planting on erosion-prone hillsides and riparian areas.
- >585km of fencing completed or contracted along rivers, streams, and wetlands.
- 547 co-funded sediment reduction plans produced, covering >103,000ha.
- 57 local Field Advisors trained, many from local iwi/hapū, to work with landowners.

Community planting in the Kaipara catchment. Source: https://kmr.org.nz/

He rangahau whakapūaho tuawhā

CASE STUDY 5

Afforestation of highly erodible land

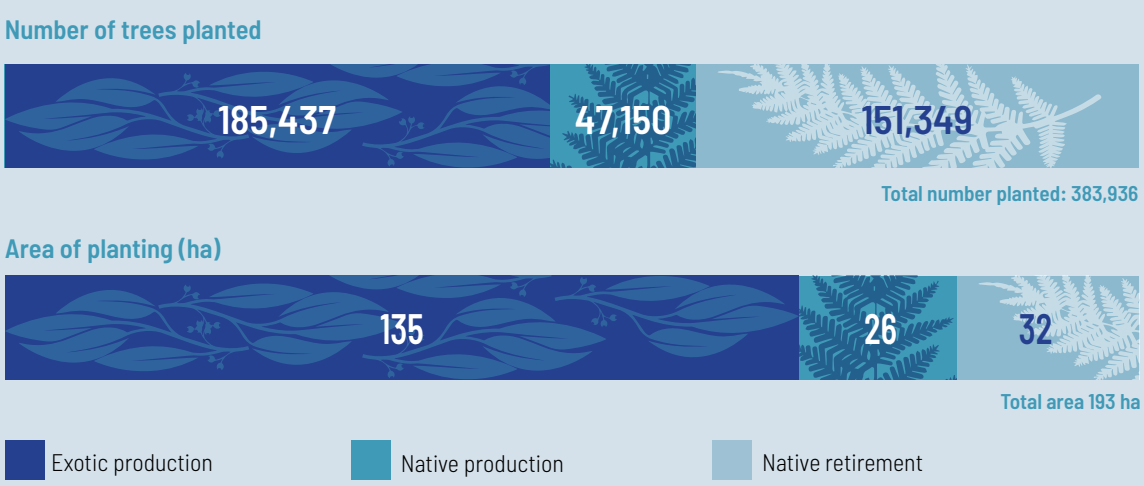
NRC has supported afforestation projects to prevent soil erosion and protect freshwater and marine systems from sedimentation. The council offers grants for planting and fencing of highly erodible land, which is partly funded by Te Uru Rākau Forestry New Zealand.

Within the ShaRP project, from January 2017 to December 2022, $600,000 of funding supported 32 afforestation projects in Northland. This included the planting of 383,936 native and exotic trees, which created 230 ha of new forest (Figure 5).

Native retirement forests

Converting highly erodible land into permanent native retirement forests can reduce erosion rates, increase biodiversity, and improve water and soil health. There were 15 native retirement forests planted through the afforestation project between January 2017 and December 2022. The species planted were predominately mānuka, with some projects also including other native pioneer plants and a few canopy species. Native retirement forests accounted for 30% of the total afforestation area and 39% of the trees planted. The average size of these forests was 6 ha, with an average of 2,162 trees per ha and a funding rate of $3,705 per ha.

Figure 5: The areas in hectares (left) and number of trees planted (right) by afforestation forest type in Northland between January 2017 and December 2022.



CASE STUDY 5 *continued*

Native production forests

Several native tree species, tōtara, rātā/pōhutukawa hybrid, and kahikatea, are considered suitable for planting as production forests in Northland (Satchell, 2020). Five native production forests were planted since January 2017, accounting for 11% of the total afforestation project area and 12% of the trees planted, with an average of 1,813 trees planted per ha. The forests were designed for continuous cover forestry, utilising species well-suited for this purpose. Each forest was, on average, five hectares in size and had a funding rate of $4,550 per ha. The primary timber crop was tōtara, with mānuka and occasionally kānuka serving as nursery crops.

Exotic production forests

There were 12 exotic production forests planted, which accounted for 58% of the total afforestation area and 48% of the trees planted, averaging 1,374 trees per ha. The average size of these forests was 11 ha, and they received an average funding rate of $2,781 per hectare. The species planted were Eucalyptus, redwood, Japanese cedar, Norfolk pine, and cypress, suitable crops for a single tree or small group harvesting. Some of these forests also utilised mānuka as a nurse crop.

Exotic production forest of Eucalyptus with mānuka nurse crop. Source: NRC

He rangahau whakapūaho tuawhā

CASE STUDY 6

Poplar field trials and timber research

As well as being an important tool for erosion control, poplar trees have the potential to be a valuable timber crop. Poplar is grown throughout the Northern Hemisphere and South America and is prominently used as sawn timber and woody biomass (McIvor, 2023). NRC Land Management team has undertaken a four-year research project worth $95,000 to identify the key opportunities for the Kawa poplar cultivar, the most grown variety in Northland (Satchell, 2023). The research identified a range of potential applications for poplar timber, including:

- Appearance of structural products (exposed rafters and beams)
- Thermally modified weatherboards
- Thermally modified exterior door and window joinery
- Hardened flooring products
- Furniture and joinery
- Preservative-treated fence posts
- Pressure-treated decking

Growth of a two-year-old Shinsei poplar rooted cutting. Source: NRC

The results will hopefully inspire further research efforts to generate production opportunities for poplar wood products and in turn, demand for their use. If a market can be established for poplar timber in Northland, it should increase the demand for tree planting for soil conservation, decreasing erosion rates and sediment in Northland's waterbodies (Satchell, 2023).

Cabin built with Kawa poplar as part of Northland Regional Council's research into opportunities for the Kawa poplar cultivar. Source: NRC.

Research was also undertaken to determine the survival rates of the different poplar and willow clones and planting material. While planting 3 m poplar poles is standard best practice across NZ, NRC is trialling the planting of containerised rooted cuttings, 1 m wands, and 1.5-2 m stakes. The aim is to reduce the cost of planting poplars and maximise the planting material produced at the council-run poplar and willow nursery. In 2021 and 2022, a total of 7,783 poplar and willow trees were surveyed, recording survival rates of planted trees and causes of tree death.

Although more data is needed, the initial findings show that rooted cuttings and 1 m wands have better survival rates than the 3 m poles, making them a more affordable planting option for landowners, especially when livestock can be excluded from the planting area. The results have been useful to other councils with space-planting programmes and the forestry scientists developing new poplar and willow hybrids.

3 He one tāhawahawatia
Contaminated Land

Te tirohanga whānui
Overview

Contaminated land is defined under the RMA as land that has hazardous substances in or on it that are likely to have significant adverse effects on the environment, including human health. Industrial, commercial, and farming activities can result in contamination of air, water, and soil by hazardous substances, if they are not used, stored, or disposed of appropriately.

Northland Regional Council maintains a Selected Land-use Register (SLR), which is a database of potentially contaminated sites, due to their current or historical land use.

1,462 sites in the Selected Land-use Register (as of October 2023).

77 sites have been investigated and are deemed 'safe'[3]

19 sites have been remediated

49 sites are confirmed to be contaminated

Sites are concentrated around urban areas, especially Whangārei and Kerikeri-Waipapa.

Majority of sites have insufficient information to confirm contamination levels.

More than half the sites are associated with five activities/ industries – motor vehicle workshops, persistent pesticide storage or use, fuel service stations, petroleum or petrochemical industries and transport depots or yards.

[3] *This includes sites that are managed so the level of risk to the environment and people is within acceptable levels, sites where investigation has shown contamination levels are within guidelines values and/or below natural background levels or within acceptable levels for specified land uses.*

What is contaminated land?

A contaminated site is an area of land where the soil is contaminated with a hazardous substance at a concentration above natural levels and where there is or, is likely to be, a risk to human health or the environment. This contamination makes the land unsafe for some purposes. This includes contamination by hazardous substances associated with industrial, commercial, and farming businesses, such as industrial chemicals, paints, fuels, pesticides, or some cleaning products.

The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations (NES-CS) 2011 requires that potentially contaminated land be investigated where certain activities have occurred. If a site is found to be contaminated, future development options must address the contamination to ensure human health is protected.

The Ministry for the Environment (MfE) has compiled a Hazardous Activities and Industries List (HAIL), which are activities more likely than others to cause land contamination (Ministry for the Environment 2021a). The HAIL includes 53 specific land uses (activities) across nine groups, such as chemical manufacture, mineral extraction, and vehicle refuelling and servicing (Figure 1).

The Ministry for the Environment has also published several contaminated land management guidelines[4] to establish a nationally consistent approach for investigating and reporting on contaminated sites to meet the requirements of the NES-CS.

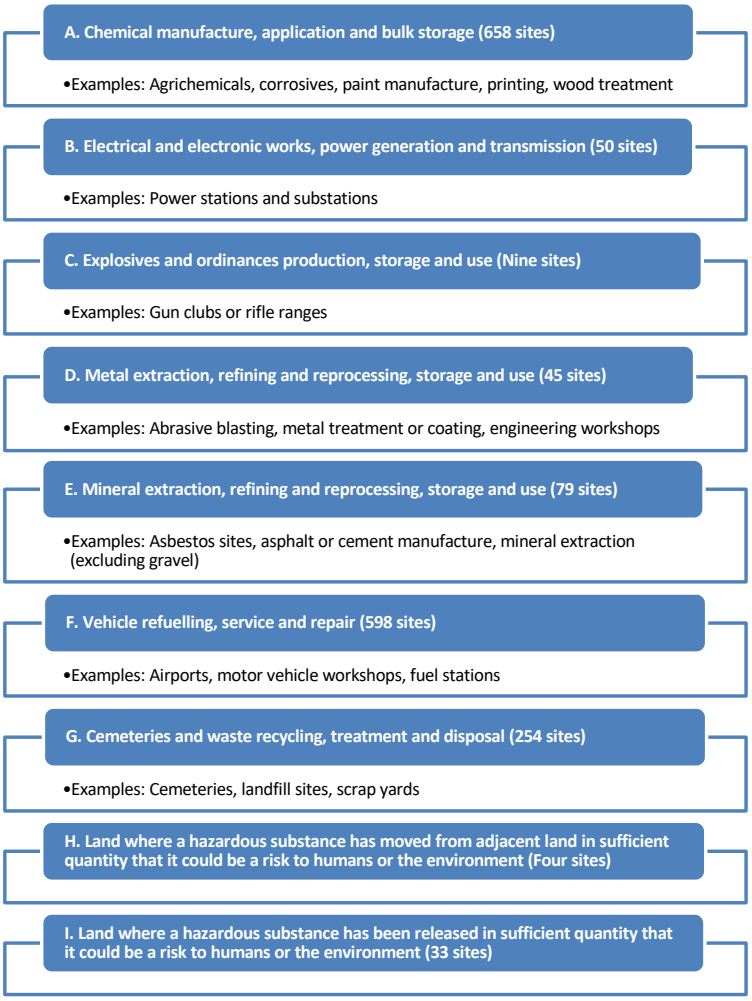


Figure 1: The nine groups in the Hazardous Activities and Industrial List (HAIL) (Ministry for the Environment, 2021b), with examples of activities or industries in each group. The number of sites on Northland's Selective Land-use Register in each group, as of 10 October 2023 is provided in brackets.

[4]*The Ministry for the Environment Contaminated land management guidelines No. 1-5. Available here: https://environment.govt.nz/publications/hazardous-activities-and-industries-list-hail/*

E pēhea ana te ora ināianei?

What are the issues?

What are the impacts of contaminated land?

Hazardous substances present in contaminated land can have adverse effects on the environment and human health, which can vary from increased risk of illness to causing disease. The primary focus of the NES-CS regulations is human health. Site investigation guidelines prescribe contaminant guideline values and contaminants of interest that are known to adversely affect human health.

Conceptual site models within site investigation reports demonstrate likely pathways between the source of contamination (in soil, water) and the receptor (humans and other environmental receptors). Examples of potential pathways are shown in Figure 2.

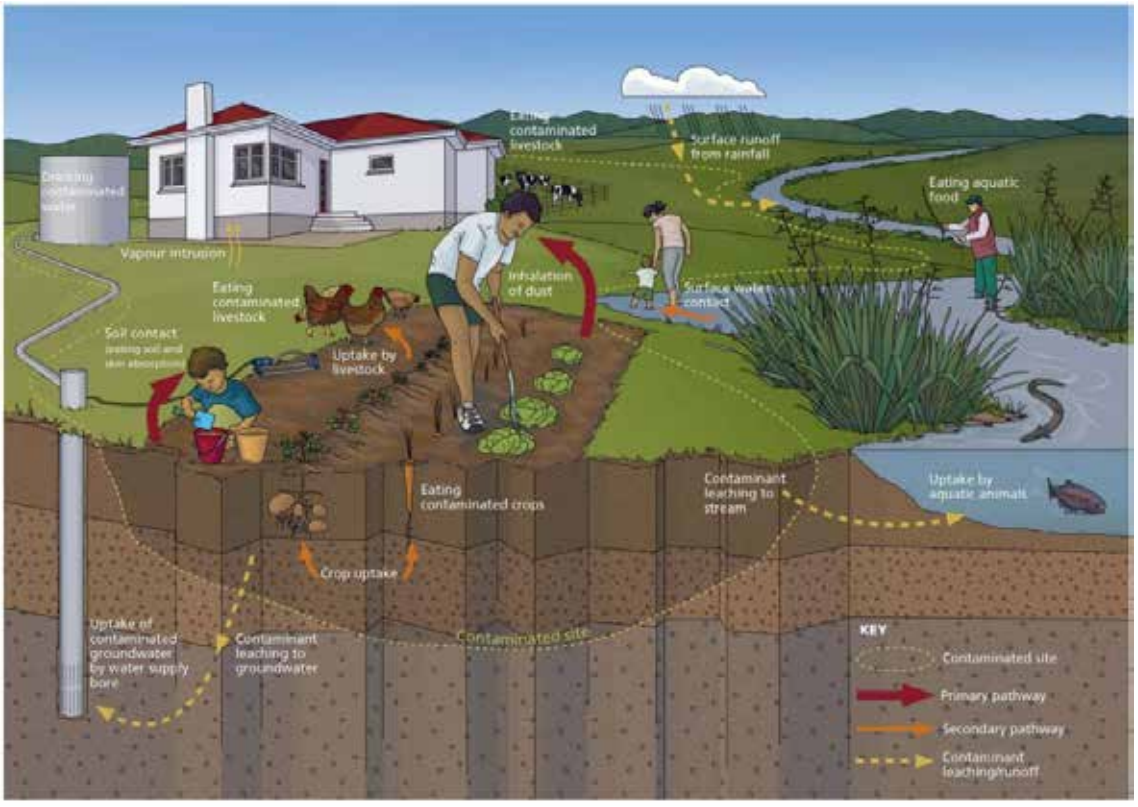


Figure 2: Pathways by which receptors (e.g., humans, other animals) can be exposed to a contaminant source (Replicated from: The Ministry for the Environment 2021c, p 25)

What is the state of contaminated land in Northland?

There are sites throughout Northland where past activities have involved the use of hazardous substances, which has made the land unsafe for some uses, such as subdivision and development.

Under the RMA, NRC has a responsibility to identify and monitor contaminated land, with the information collected held in the Selected Land-use Register (SLR) database. NRC administers the SLR on behalf of the three district councils in the region. The SLR contains information on sites that are known or suspected to have been involved in the manufacture, use, storage and/or disposal of hazardous substances, either historically or currently. A site is added to the SLR when it is considered more likely than not that an activity or industry listed in the HAIL has occurred on the site. Information on HAIL sites in Northland are currently available on the NRC website[5].

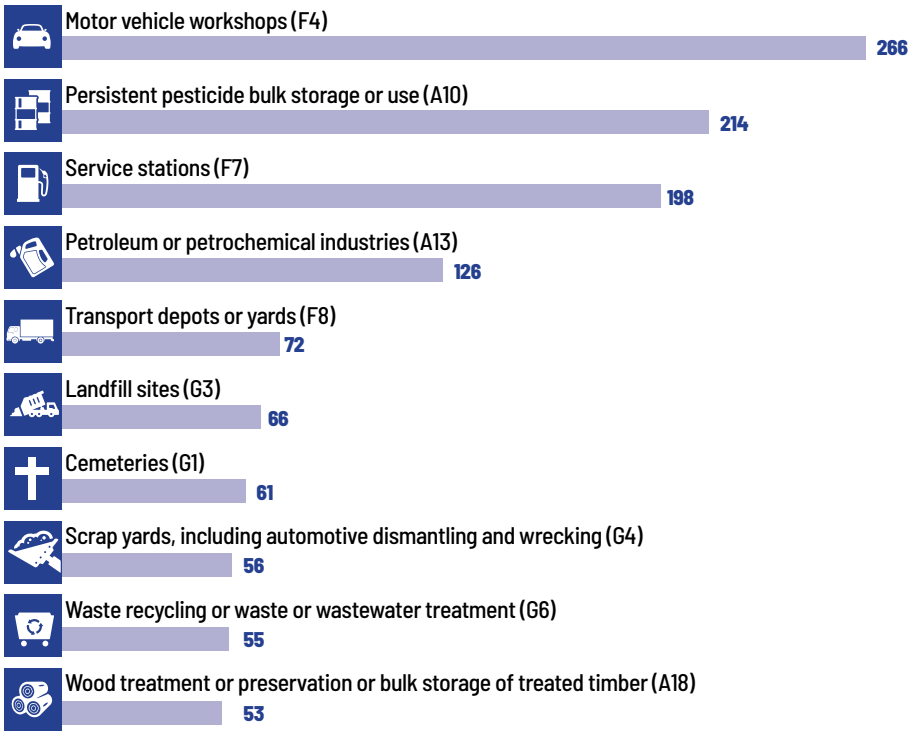
As of 10 October 2023, there were 1,462 sites recorded in Northland's SLR, which includes 466 new sites added from January 2015 to October 2023 (Table 1). It's important to note that this doesn't directly equate to the number of contaminated sites in Northland, as it includes potentially contaminated sites, remediated sites and sites which have been confirmed to not be a HAIL or contaminated site. Also, if a site is not recorded in the SLR, it doesn't guarantee that it hasn't been used for a HAIL activity in the past.

Table 1: Number of sites on Northland's Selected Land-use Register (SLR)

	1 January 1991 – 31 December 2014 (24 years)	1 January 2015 – 10 October 2023 (8 years)
Number of sites added	996	466
Percentage of total number of sites on SLR (1,462)	68%	32%

Most sites recorded in the SLR are located in urban or densely populated areas (Figure 3) and are related to key service industries that have the potential to cause land contamination found in these areas, such as transport depots, service stations, motor vehicle workshops and storage facilities (Table 2).

Table 2: Ten most abundant Hazardous Activities and Industries List (HAIL) categories for sites in the Northland SLR as of 10 October 2023.



[5] *https://www.nrc.govt.nz/environment/waste-and-pollution/hazardous-activities-and-industries-list/*

The highest concentrations of sites are in the Whangārei and Kerikeri-Waipapa areas. The large number of sites in Kerikeri reflects past horticultural activities and the storage or use of persistent pesticides. There has been an increase in urbanisation in this area over the past five years. As required by the NES-CS, investigations have been undertaken where land use change and associated earthworks are proposed for sites listed in the SLR.

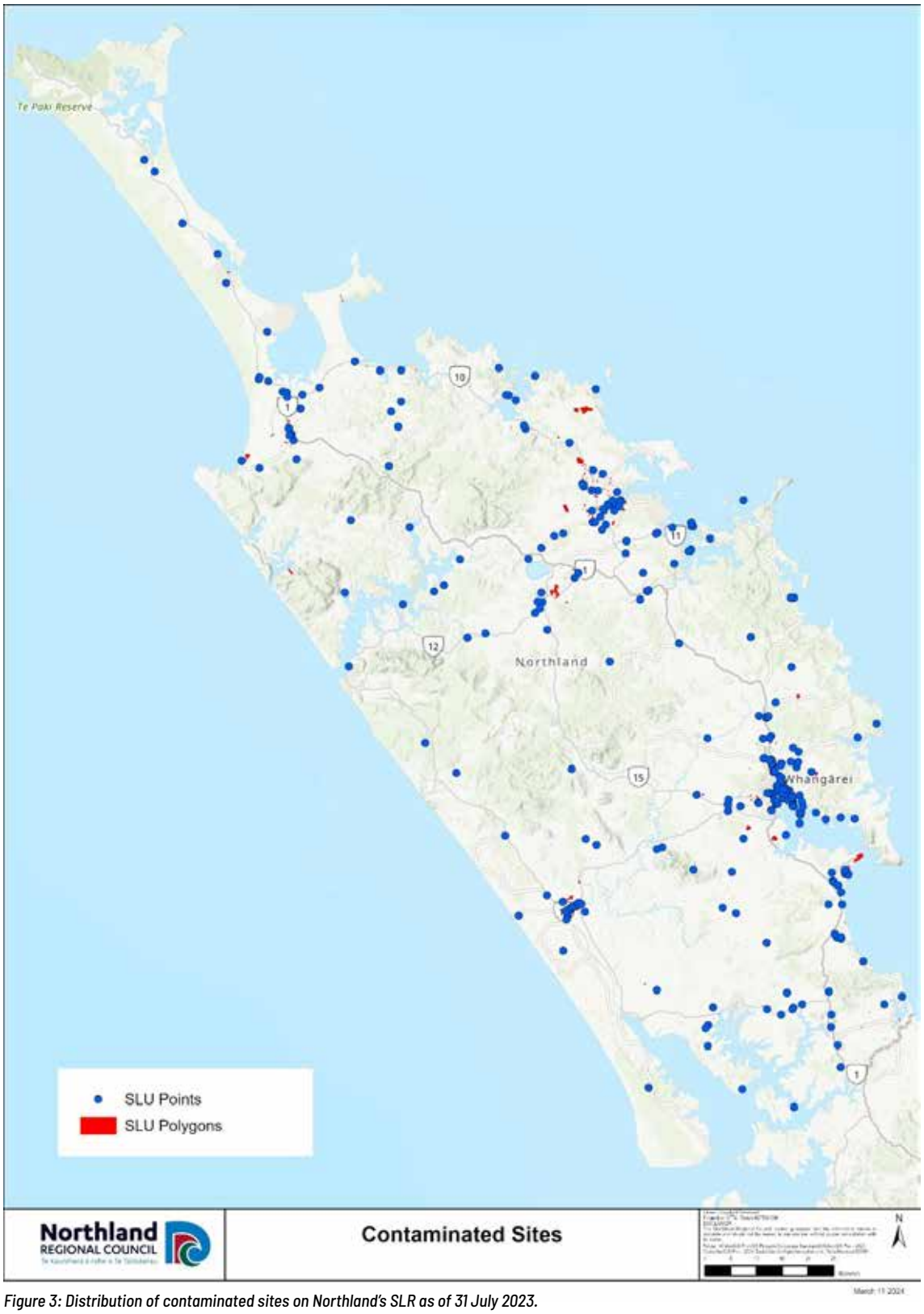


Figure 3: Distribution of contaminated sites on Northland's SLR as of 31 July 2023.

He aha ngā mahi hei whakatika?

What is being done?

NRC is required to update the SLR with current information received about existing sites in the register or where information is received for new sites. District councils are responsible for enforcing the requirements of the NES-CS, which includes appropriate investigation of land potentially affected by contaminants in soil before certain activities can occur, including earthworks, development, or land-use change. A rule in the Proposed Regional Plan for Northland requires persons or organisations initiating a site investigation to provide a copy of the site investigation report to NRC. This rule, which became operative in 2017, has improved the quality of information held in the SLR.

Council frequently receives enquiries from property owners, valuers, environmental consultants, and district councils about the status of a site. There has been a substantial increase in the number of contaminated site enquiries received by NRC annually, from 23 in 2012 to averaging over 200 annually in recent years (Figure 4).

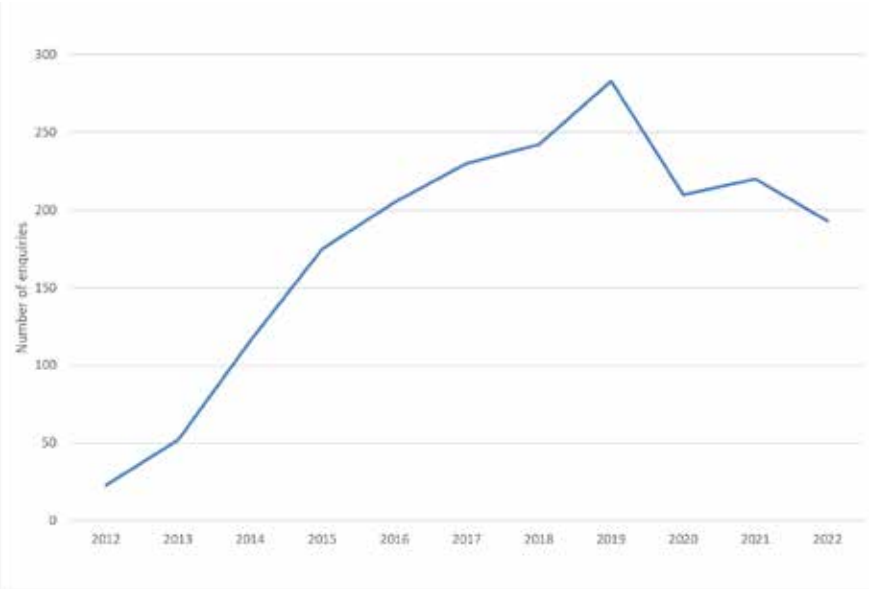


Figure 4: Number of enquiries related to contaminated land received by NRC annually.

Each site in the SLR is classified based on available information. Ministry for the Environment has changed the system used to classify sites based on the work by the Contaminated Land and Waste Special Interest Group in 2016 and was adopted by all regional and unitary member councils as shown in Table 3 below. There is a national project underway to standardise classifications and data entry on SLR databases administered by councils. NRC has made considerable progress to make information consistent with the Ministry for the Environment guidance.

Most sites in the SLR have not had a Detailed Site Investigation (DSI) or sufficient testing undertaken, thus the risk to human health and the environment is unknown. However, HAIL related activities are either occurring, have been confirmed to have occurred at some point in the past, or are considered more likely than not to have occurred. These are classified as 'Verified HAIL' or 'Verified HAIL – Risk not quantified,' which includes 1,133 sites in Northland.

A further 145 sites are classified as 'Unverified HAIL' sites because reported legacy land uses have not yet been confirmed by a site investigation. Verified HAIL and Unverified HAIL sites are potentially contaminated sites, i.e., contamination may have occurred but should not be assumed to have occurred.

Where comprehensive information is available following a DSI or sufficient testing, the classification describes the actual contamination status of the site, which is available for 145 sites in Northland as of October 2023. Of these 145 sites:

- 19 have been remediated.
- 19 are managed so the level of risk to the environment and people is within acceptable levels.
- 15 are not contaminated because guideline values were not exceeded, or contamination levels are below natural background levels.
- 43 have contamination within acceptable levels for specified land uses.
- 49 are contaminated.

Table 3: Key classification of sites[6] on Northland's SLR.

Classification	Description	Number of sites
Previous classifications		
Managed	Site has been tested and contamination exceeds guideline values, but contamination is managed	19
Remediated	Site was contaminated but has been remediated	5
Tested – Contaminated	Site has been tested and contamination exceeds guideline values	29
Tested – Not contaminated	Site has been tested and guideline values were not exceeded	8
Unverified HAIL	Anecdotal evidence suggests that a HAIL activity took place at the site, but confirmation is required	145
Verified HAIL	Sufficient evidence exists to confirm that a HAIL activity took place on the site	406
New classifications (based on Contaminated Land and Waste Special Interest Group guidance from 2016)		
Verified HAIL: At or below background – natural state	Sufficient site investigation (e.g., a DSI) has shown no hazardous substances above local background concentrations, other than those that occur naturally in the area, i.e., the site is not contaminated	7
Verified HAIL: At or below background/ suitable for land use – remediated	Contaminated site that has been investigated and remediated, so that contaminants are below background concentrations or at concentrations where any adverse effects to people and/or the environment are acceptable for the specific land use	14
Verified HAIL: Contaminated for land use – environment and/or human health	Investigation has shown the site has a hazardous substance in or on it, or in groundwater or surface water, which has and/or is reasonably likely to have significant adverse effects on the environment and/or human health	20
Verified HAIL: suitable for land use – natural state	Investigation has confirmed hazardous substances are present but any adverse effects or risks to people and/or the environment are acceptable for the specified land use	43
Verified HAIL – Risk not quantified	Insufficient information to quantify adverse effects or risks to people or the environment from known HAIL activity on site	727
Verified Non-HAIL: Admin Error / HAIL did not occur	Available information shows the site has never been associated with any of the activities or industries on the HAIL	39
Total number of sites on SLR		**1462**

[6]*More detail on the site classifications used and their definitions are available here: https://www.nrc.govt.nz/media/ezzbocbf/site-classification-definitions.pdf*

The 49 sites classified as contaminated are considered reasonably likely to have adverse effects on human health and/or the environment. These sites will need remediation depending on intended future land uses. Examples of these contaminated sites include:

- A horticultural property in Kerikeri where remnants of asbestos containing fibre cement cladding was found in a defined area where a shed once stood.
- A site in Whangārei that is being redeveloped into high density housing where arsenic and lead concentrations were found above soil guideline values because of paints and materials that were historically buried onsite.
- A pastoral site in Waipapa that has high lead and arsenic concentrations in soil, it is likely that the arsenic leached from treated timber and lead from batteries that were stored in discrete locations on the property.

Example materials that contain asbestos.

NRC staff sampling from a bore to monitor levels of contaminants in the environment.

He aha kei tua?

What is the outlook?

Future Outlook

The Ministry for the Environment published Aotearoa New Zealand's first national adaptation plan (2022) in August 2022, which covers the impacts of climate change and how the country can adapt to its effects. A key action from the plan is to evaluate the risk of climate change to closed landfills and contaminated sites. NRC is initiating a study to assess the potential risk of erosion and sea level rise to closed landfills throughout Northland.

Currently, national guidance focuses on adverse effects to human health, and doesn't prescribe testing regimes for assessing adverse effects on the environment. As a result, potential pathways for spread within the environment and effects on animals, microorganisms, or plants aren't required to be assessed as part of a site investigation.

He rangahau whakapūaho

CASE STUDY 7

Hazardous Waste Amnesty Days

Since 2020, NRC has held Amnesty Days every month or second month, allowing domestic hazardous waste in 'household quantities' to be taken to the Re:Sort centre in Whangārei to be identified, sorted, and stored safely for disposal, by trained and experienced waste management staff and/or contractors (Northland Regional Council, 2020).

Prior to November 2020, the public could take hazardous waste to the Re:Sort centre at any time during opening hours. However, as about 15% of the containers dropped off were either unlabelled and/or in poor condition, the service was changed to Amnesty Day with waste management staff present to receive the waste.

Household quantities (up to a total of 20kg or 20 litres) of chemicals are accepted between 8 am and 12 pm on scheduled Amnesty Days, including garden chemicals, sprays and powders, pool chemicals, corrosive and flammable household products, and legacy agrichemicals, such as dieldrin, lindane, DDT, 2,4,5-T and 2,4-D. This service is not intended to subsidise the disposal of chemicals for businesses or commercial premises, including farms and orchards.

The provision of this service makes it easier for people to appropriately dispose of hazardous waste, therefore, reducing the risk posed to Northland's environment and communities by hazardous substances. Over 12 tonnes of household hazardous waste have been accepted and safety disposed of through this service in the last three years (Table 4).

Table 4: Household hazardous waste accepted and safely disposed of, because of NRC Amnesty Days.

2020-21	2021-22	2022-2023	Total
3,243 kg	5,374 kg	4,228 kg	12,845 kg

Examples of household hazardous waste containers that can be taken to NRC's Hazardous Waste Amnesty days at the Re:Sort centre in Whangārei.

Ngā Whakatepenga
Conclusions

This report provides a comprehensive overview of the current state of land and soil in Northland, New Zealand, with a focus on land use, environmental pressures, and the initiatives undertaken by the Northland Regional Council (NRC) and its partners. The findings indicate that approximately 62% of the region's land is dedicated to agriculture, horticulture, and production forestry, posing challenges such as soil instability, water quality issues, and erosion.

Extreme weather events, including droughts and floods, have impacted Northland, causing damage to infrastructure, affecting productivity, and increased soil loss. Climate change is expected to exacerbate these challenges, necessitating adaptive strategies for land use. NRC monitors seven core indicators of soil quality, revealing variations influenced by land use and management practices. Intensive land uses, such as dairy and drystock farming, are associated with excess nutrients and low macroporosity, posing risks to soil and water quality.

To address these issues, NRC employs a range of strategies, both regulatory and non-regulatory, including the Regional Policy Statement, regional plan documents, strategic plans, targeted funding, land-use mapping, and advice. Collaborative efforts with various stakeholders, such as tangata whenua, central government, district councils, industry groups, and community organisations, are evident in projects like the Kaipara Moana Remediation, the Soil Health and Resilience Programme, and the Water Storage and Use Project.

NRC aims to inspire collective action for the preservation of Northland's unique natural environment and sustainable development. Through incorporating Mātauranga Māori, fostering innovation, and enhancing resilience, NRC is committed to ensuring that Te Taitokerau remains a region characterised by its distinctive beauty and ecological diversity for generations to come.

Planting hope: NRC's resilience efforts amid Northland's challenges.

NRC aims to inspire collective action for the preservation of Northland's unique natural environment and sustainable development.

Te rārangi tohutoro

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Northland
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