Ngā Wai Ariki o Rotorua He Mahere Whakahaere Pūnaha

ROTORUA GEOTHERMAL SYSTEM MANAGEMENT PLAN

DRAFT FOR CONSULTATION – AUGUST 2023

TE ARA O NGĀ WAI ARIKI

"Me timata i a Ngātoroirangi
I pikitia ake ai ki te tihi o Tongariro"

"The journey begins back in time when Ngātoroirangi
conquered Mount Tongariro"

The origin of geothermal in the central north island is encapsulated in the journey of Ngātoroirangi, (a tohunga from the Te Arawa waka), to the snowy peaks of Tongariro.

Gripped by the extreme elements of the region he called upon his sisters to send fire to keep him alive.

"Ka kinongia tana kiri e te mātao"

"The High Priest almost ceded his life for this conquest"

"Ka auē atu rā ki ōna tuāhine,
Kia haria mai te ahi i te wā kāīnga,
Kia ngata rā te hiahia"

"So he prayed to his sisters
in Hawaiki to bring him warmth"

The subterranean goddesses of fire Te Pupu & Te Hoata were sent to his rescue, journeying under the seabed to Aotearoa making intermittent land stops to look for Ngātoroirangi en route to Tongariro, leaving geothermal activity in their wake.

"Ka haruru mai te whenua ao, te whenua pō! Ka tatū mai ki tana taha.
Mahue atu i a rāua te wera me te ahi i te tahatā.
Ka mātatoru, ka māraratia.

"The sisters' journey took them over land and under water!
Whereever they rested they left some of their warmth there.
That heat got thicker and spread throughout the Bay of Plenty.

Noho iho rā te mamaoa ki Te Whakarewarewa
Te Tūnga o te ope taua ā Wāhiao e!"

Heat remained at Whakarewarewa
Standing place of the great Wāhiao and his warriors!"

Composed by the late Mauriora Kingi MNZM. This verse from the pātere Me timata e ahau i a Ngātoroirangi, encapsulates the origins of how geothermal activity came from our mythical home of Hawaiki. The names of boiling pools, stories, historic events, and sacred landmarks are specific to the geothermal valley and people of Te Whakarewarewa.[1]

1 *A glossary of terms for this pātere is included in Appendix 1*

Cover photo courtesy of Brad Scott GNS VML 259443

Descendants of Ngāti Whakaue also have waiata that reference sites of significance, and the importance of ngāwhā and geothermal from their area.

The following excerpts from songs and chants still sung today, were written by Rakapa Kahoki, a notable composer.

In E ta uru waho, a love song for her beloved, Rakapa mentions Whakahinga – a geyser west of the Utuhina stream at Ōhinemutu.

"taku nei titiro te puia i Whakahinga"

"I gaze unwearied at the Whakahinga geyser"

Rakapa wrote several songs declaring her love for Petera Tukino Te Pukuatua, one of a chiefly line of Ngāti Whakaue. It is said this song was composed before their courtship began. They were later to be married.

From Te Hau no uta, seeing Te Ruapeka - a metaphorical reference of Ōhinemutu – the home of Te Pukuatua, and our identity.

"Mau atu he kohu waiariki no Te Ruapeka"

"so I can clearly see the steam of Te Ruapeka"

An expression of her love and longing for her husband - atop the Horohoro bluffs the steam from Te Ruapeka is in sight, indicating the home of her beloved.

The love song Te Roa o te po, an allegorical composition by Rakapa, was composed upon the departure of her husband. In this segment, she envisions Petera's journey home to Rotorua.

"Ko hengi hautonga i tuku mai i te hiwi
Ngongotaha ra te hoa noa

Taku nei titiro ki te puia i Whakahinga;
Tu mai i kona ma te hautonga koe"

"At Ngongotaha yonder and all the while unwearied
My longing eyes rest on the steaming pools of Whakahinga"

As they were unable to conceive children, Rakapa's beloved Petera Tukino Te Pukuatua returned to his Ngāti Whakaue people on his own.

MOEMOEĀ – VISION

Ka ora te mauri o Ngā Wai Ariki o Rotorua – the Rotorua geothermal system is healthy.

KUPU WHAKATAKI – FOREWORD

The Rotorua geothermal system, Ngā Wai Ariki o Rotorua, is unique regionally, nationally and internationally.

Ensuring a sustainable future for Ngā Wai Ariki o Rotorua and protection of its vulnerable and irreplaceable surface features is of utmost importance and is our collective responsibility.

This Draft System Management Plan (SMP) reflects decades of research and many years of work by Council, tangata whenua, consent holders, stakeholders and the community to identify an agreed vision and management approach for Ngā Wai Ariki o Rotorua.

Some of what is proposed in the SMP is not new and reflects our understanding of what is needed to protect surface features or reflects best practice that has evolved over recent years. But we also now have an opportunity to make some changes and to look at things differently. This has meant drawing on extensive research and monitoring, identifying gaps or inequities in the way we manage the system, and striving towards partnership in management.

We hope that you will carefully consider what is proposed in the SMP, find out more from our supporting information and share your thoughts on the future of Ngā Wai Ariki o Rotorua.

– Rotorua/Ōkurei constituency Councillors Thurston, Winters and White, Bay of Plenty Regional Council Toi Moana

MIHI

Ko te whakaariki, ko te whakaariki
Esteemed Rotorua community members

Aue, tukua mai ki a piri, tukua mai ki a tata
come nearer, come closer

Kia eke mai ki te Paepaepoto o Houmaitawhiti
to hear all, including the Māori villages and communities located within.

Nau mai haere mai ki tēnei rangahau mō Waiariki ki Rotorua nei.
Welcome to this study about geothermal use and care within Rotorua township.

Haere mai i runga i ngā āhuatanga o te wā – ahakoa Te Ao Mate, te Ao Tūroa nei.
Welcome, with thoughts of your family and friends.

Mā Te Ātua tātou e manaaki, e arahi o roto i te kaupapa nei.
May *Io* (the Supreme Being) care and guide us through this process.

Māna anō ō tatou hiahia, ō tatou wāwata e whakatūtuki pai.
May *Io* also help us to achieve goals that will benefit all.

Haumi e, Hui e, Taiki e!
Enriched, Unified, and Blessed!!

– Te Aki Kā Roa Rōpū

RĀRANGI UPOKO
CONTENTS

SECTION 1

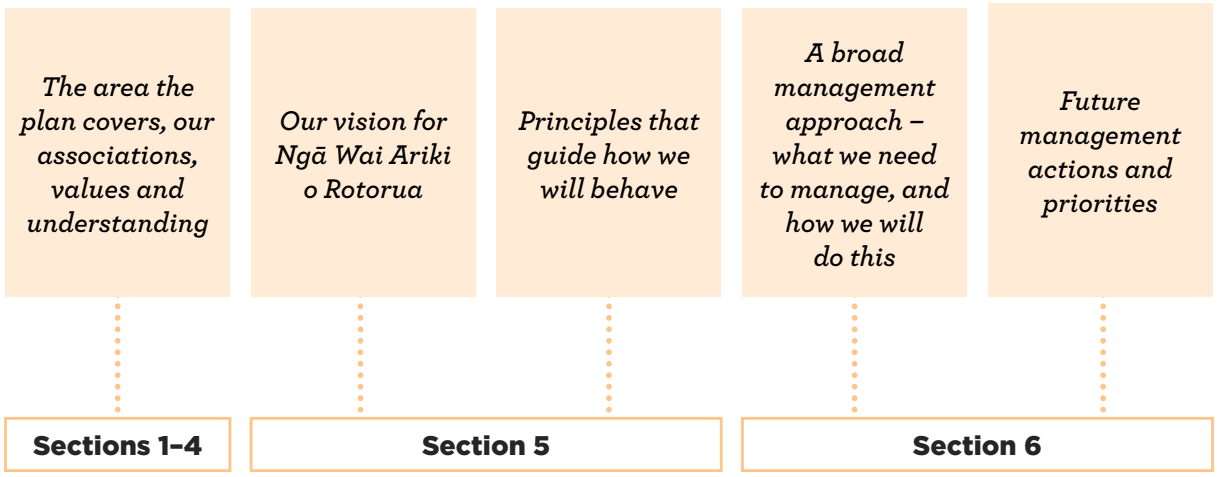
E PĀ ANA KI TĒNEI TUHINGA ABOUT THIS DOCUMENT

The Rotorua Geothermal System or Ngā Wai Ariki o Rotorua has many different social, cultural and economic values. It is revered for its beauty and life sustaining properties (cooking, bathing, heating and healing), it is one of nature's wonders and a taonga or treasure.

The system (sometimes also referred to as the geothermal field) is fragile, and all of our knowledge systems are telling us the same story – that it is still recovering from our past mistreatment. We know that the system cannot meet new pressures or unlimited and wasteful demand for geothermal water (sometimes also referred to as geothermal fluid), energy and heat. So we must ask, what does Ngā Waiariki o Rotorua need to be healthy and sustainable?

This System Management Plan has been developed as a 'care plan', a whole system and integrated approach to the sustainable management of the system, for the wellbeing of our geothermal system, our community and for future generations.

This document lays out how we will do this by identifying:



As resource managers, the Bay of Plenty Regional Council will continue to help the system heal from past overuse. We will work in partnership with tangata whenua to keep improving our management, so that we and those who come after us may continue to benefit from Ngā Wai Ariki o Rotorua.

Ka aratakina tēnei Mahere Whakahaere Pūnaha ki tēhea takiwā?

What area does this System Management Plan guide?

Bay of Plenty Regional Council has developed this System Management Plan for the area referred to as the Rotorua Geothermal System or Ngā Wai Ariki o Rotorua.

Located within the Taupō Volcanic Zone (TVZ), the Rotorua Geothermal System underlies part of Rotorua City, from the southwestern end of Lake Rotorua to the Whakarewarewa Valley. It is similar in extent to the original township formed following the 1880 signing of the Fenton Agreement[2] which is a fundamental moment in Rotorua's history.

The Rotorua Geothermal System area has been defined using information such as the location of surface features, temperature contours, resistivity and where people are accessing the shallow part of the system using geothermal wells, with most wells less than 95 mRL deep[3].

While geothermal systems within the TVZ are connected many kilometres below the surface, we describe and manage these systems separately. You can find out more about this by reading the Bay of Plenty Geothermal Systems - The Science Story report on our website. Where systems have discrete geological or hydrological characteristics, or discrete surface feature expression, we must manage them depending on these characteristics, their communities, and the type of uses they can support. Understanding this interaction is particularly important when we are using a geothermal system to extract water (both geothermal and fresh) and heat as we need to understand the effects this could have not only on the system being used but also be confident that any effects will not extend to other nearby systems.

Figure 1: Taupō Volcanic Zone

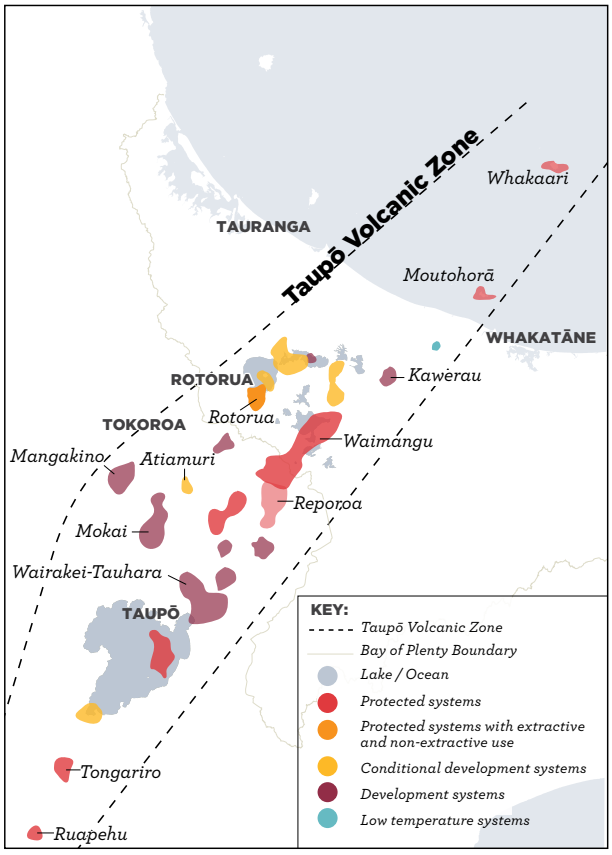
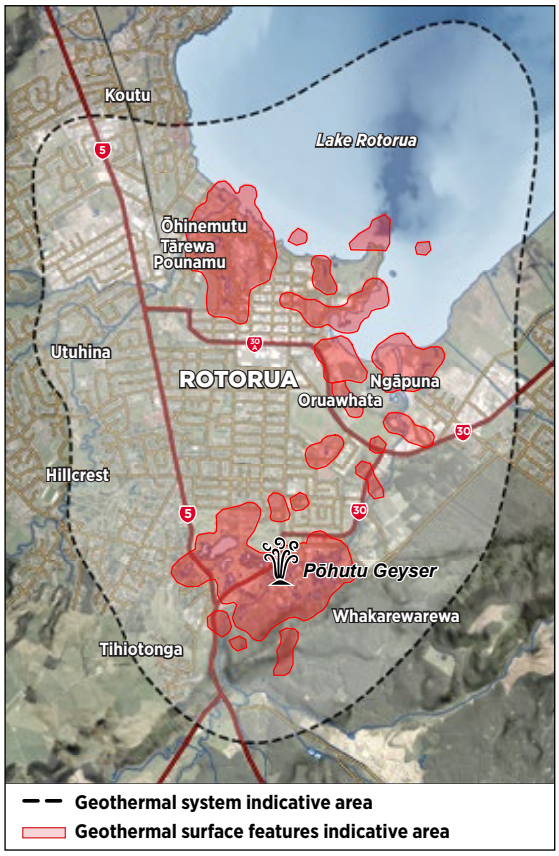


Figure 2: Rotorua Geothermal System



2 *Signed by Te Arawa iwi representatives and Crown representative Chief Judge Fenton, the Fenton Agreement saw Ngāti Whakaue set aside land to be leased for 99 years for the creation of the township of Rotorua. (Fenton Agreement 1880)*

3 *The relative level (RL) is obtained by subtracting the depth of the bottom of the well from the topographic level of the wellhead derived from the digital terrain model (DTM) and converted to NZVD2016. The New Zealand Vertical Datum 2016 (NZVD2016) is the official vertical datum for New Zealand and its offshore islands.*

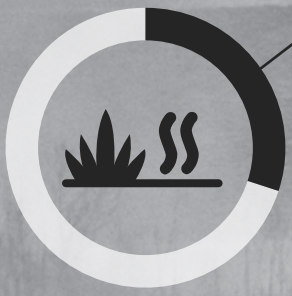
NGĀ WAI ARIKI O ROTORUA
ROTORUA GEOTHERMAL SYSTEM

~1500
recorded geothermal surface features

New Zealand's last remaining major geyser field

The birthplace of tourism in New Zealand,
with visitors from throughout the world since the 1800s

Covers a surface area of about
12km²



Approximately
30% of geothermal vegetation and habitats in Bay of Plenty

The only example in the world of
a system dying from overuse being healed through a sustainable management approach

'Geothermal taonga is used for bathing, home heating, healing and cooking, and provides for the health and wellbeing of whānau, hapū and wider communities. It is part of everyday lives, an essential component of social connectivity and a means of sharing knowledge, it plays a critical role in maintaining connection between whānau and the social fabric and cohesion within the hapū'

Ngā Wai Ariki o Rotorua: He Kohikohinga, 2021

SECTION 2

NGĀ HAUKĀINGA ME ŌNA KŌRERO HAUKĀINGA ASSOCIATION WITH NGĀ WAI ARIKI

Te haukāinga of Ōhinemutu, Ngāpuna, Te Whakarewarewa and Te Kuirau (Tārewa Pounamu) have lived with, on and around ngā wai ariki for centuries, connected through whakapapa to the whenua, the wai and wai ariki.

Each haukāinga setting is unique and each have their own stories to tell, as do the wider community who have benefitted from access to Ngā Wai Ariki o Rotorua. The following summaries have been provided by haukāinga to express these personal connections.

Ōhinemutu

Ōhinemutu, situated on the southern shores of Lake Rotorua and alongside te awa o Utuhina and Ruapeka Bay, is the stronghold of Ngati Whakaue, with its principal marae Te Papa-i-Ōuru a place for Te Arawa to meet, discuss/debate issues and events. Ōhinemutu has two other marae of prominence, Paratehoata and Te Kuirau - which also access geothermal for cooking.

Ngati Whakaue's early occupation at Ōhinemutu exhibited a communal way of life amongst this geothermal activity.

The abundance of natural resources, including the plentiful and sustained geothermal activity saw the proliferation of communal bathing pools and steam vents boxed for cooking, located alongside the Ruapeka Bay (warm lagoon). Whānau lived in, on and around this geothermal taonga for centuries and overtime understood the 'innate' medicinal properties of certain ngāwhā e.g.: the radium and bamboo baths.

The largest ngāwhā in Ōhinemutu is Waikite, (with a temperature above 70 degrees) located close to the Ruapeka and Te Papa-i-Ōuru marae atea. Multiple geothermal streams flow underground from Te Kuirau to Ōhinemutu and into either Ruapeka or te awa o Utuhina.

Back in the day, whānau whare were warmed by the heat from the ground until a time when these structures became untenable because of increasing geothermal surface features impacting the stability of the ground. The old people moved their homes to safer ground but still within the vicinity of our geothermal.

Climate change and land reclamation has significantly changed our geothermal system and landscape in Ōhinemutu.

Ōhinemutu the place and its people have waiata and mōteatea that define our whakapapa links to the geothermal.

Living in Ōhinemutu today is a lot different to our old peoples' time – living beside the Utuhina we swam, fished the cockabullies and searched for koura under the weeds, threw them in the ngāwhā to cook and took them to feast on in the baths while we warmed ourselves. Our homes did not have bathrooms or laundries, we had a shared laundry down by the bath and hot pools used by my Nanny and sisters – 5 families in total. It was in the 70's that a rōpū of whānau drilled bores for heating, bathing and cooking which saw a fair number of bores in Ōhinemutu but still some whānau do not have that luxury.

Ngāpuna

Ngāpuna is the home of Ngāti Hurungaterangi. It is named for the many springs and pools in the area. The village has many types of water: freshwater in the puna, the Puarenga and other streams, the geothermal waters in many places around the village and the lake water of Rotorua nui a Kahumatamomoe. The waters of Te Papa o Ruamoa are particularly significant and have been treasured since the time of the arrival of the Te Arawa waka to Aotearoa. There are taniwha and atua in different places. This is one of the few places in the Rotorua township that has retained its natural state.

The environment has sustained our people for generations, entrenched through our kuia Whaingārangi and the take whenua (land rights) she held. Ngāpuna was a place of richness, with kai sourced from marine and bird life as well as the plants. There were kāinga, settlements, fisheries and cultivations close to the treasured geothermal activity, springs and wetlands along the lakeshore of Rotorua. People from other hapū and iwi would travel to Ngāpuna to bathe in the healing waters. But sadly the area has been polluted by the land, air and water impacts of different industries. Ngāpuna has been adversely affected by the wastewater from the pump station, the treatment plant and the former landfill. The Puarenga Stream is polluted and has been diverted and excavated for flood protection.

The geothermal tāonga are critical in Ngāpuna. There are still areas for cooking and bathing, but they need to be protected. Living closely with the water imparts an understanding of the water systems and how it changes and heals e.g. during times of floods and observing the interconnectedness of the different puna. It is now the duty of this current generation to reclaim, restore and revitalise the land and water. We are working on the removal of pest plants and animals, the cleaning of the land and waterways and the restoration of plants. This SMP is part of the bigger taiao picture for us, which extends beyond the village of Ngāpuna, to other parts of our rohe including Owhatiura, Te Arikiroa, Oruawhata, Motutara, the Rotorua township, Whakarewarewa, Tihiotonga, Moerangi and Titokorangi. The impacts of pollution, industrialisation and land loss in Ngāpuna drives the imperative to look after and restore the remaining tāonga such as ngāwhā and puna.

Whakarewarewa

Whakarewarewa village and surrounds contain the remaining active geysers not only in Rotorua but Aotearoa. All ngāwhā are named and their mauri kept alive with specially composed chants, waiata and poi regularly performed by the haukāinga and in particular Tūhourangi Ngāti Wāhiao kapa haka, who share these stories with the world.

Ngāwhā use is still a daily ritual for whānau, the varying temperatures of the ngāwhā dictate its use, some are specific for bathing only and some for cooking. The ground is constantly warm and homes within the village are unlikely to have insulation due to the landscape and proximity to ngāwhā.

Born and bred in the pā of Te Whakarewarewa, our whānau literally have ties to the geothermal activity that have determined the way we live our lives. The ngāwhā, baths and hangi of Te Whakarewarewa define me and connect me to Papatuanuku. Living amongst them taught me to treat the taiao with respect and to observe what was happening. Any change in activity was a barometer of what was occurring in the wider, connected geothermal world.

Whakarewarewa the place, and its people of Tūhourangi Ngāti Wāhiao can claim the title of birthplace of Māori tourism because of the geothermal features following the Tarawera eruption and loss of the pink and white terraces, ostensibly one of the wonders of the world. The legacy of guided tours originates from Whakarewarewa.

Me Timata e ahau i a Ngātoroirangi, a composition from Mauriora Kingi, tells its own unique story for Whakarewarewa the place and its people Tūhourangi Ngāti Wāhiao.

Tārewa Pounamu

"The Ngāwhā in the Kuirau heat up then cool down, on a regular cycle. As kids we used to follow them around – when Parekaumoana was too hot to bathe, we'd go to another one then work our way back to Tārewa as they cooled." From Ngā Wai Ariki o Rotorua: He Kohikohinga 2021

The whare tupuna, Taharangi, was built at Tarewa in 1904. The people of Ngāti Kearoa Ngāti Tuara were increasingly moving from Horohoro to town to be closer to opportunities for work and a marae gave them an established kāinga on their ancestral land.

Tārewa Reserve was the location of the main ngāwhā at Tarewa where women used to wash their clothes. Parekaumoana was a popular pool with clear water, steaming hot. There used to be a rock where women could do washing.

The original public bath was next to the Reserve in Tārewa Road. This was the main bath for the people of Tārewa until the Council ordered it be closed in the 1980s. The high cost of geothermal wells has meant that our whānau have not had access to our wai āriki ever since. Ngāti Kearoa Ngāti Tuara are keen to find ways to regain our traditional links with our geothermal resources and enable our whānau to once again use these resources for daily living, e.g. home heating, bathing and cooking.

Wider Community

Through the generosity of our tupuna, principally Ngāti Whakaue and others from Ngāti Rangiwewehi and Uenukukōpako, agreeing to set aside land for the establishment of a township (Fenton Agreement 1880) opportunities for settlers to access and utilise the natural wonders of geothermal became available.

This is reflected today by the number of residential homes and businesses (motels etc) who have and continue to benefit from ngā wai ariki. Whilst they may not have the same whakapapa/connection to geothermal as Māori, nevertheless, they still have their respective stories to tell.

Te Ahi Kā Roa rōpū is confident the wider community users will want to ensure the protection and sustainability of the Rotorua geothermal system for future generations.

SECTION 3

E PĀ ANA KI NGĀ WAI ARIKI O ROTORUA
ABOUT NGĀ WAI ARIKI O ROTORUA

He aha Ngā Wai Ariki o Rotorua?
What is Ngā Wai Ariki o Rotorua?

The ngāwhā (features) of Ngā Wai Ariki o Rotorua are unique. Named by Māori and personified with stories passed down over generations.

These stories tell of geothermal origins, the physical and metaphysical connection of people with geothermal, and the many atua related to the natural world, including geothermal, earthquakes and volcanism. For Māori, the geothermal taonga are a living entity (not just a resource) and their tuākana or a senior member of their family. Ngā Wai Ariki o Rotorua is a taonga-tuku-iho, something handed down, and a source of pride, cultural heritage and collective wellbeing for Māori. Iwi, hapū and haukāinga have always cared for their traditionally held taonga and have an ongoing role as hunga tiaki (guardians).

Ngā āhuatanga o Ngā Wai Ariki o Rotorua
Physical characteristics of Ngā Wai Ariki o Rotorua

The Rotorua system has a deep source of magmatic heat (hot rocks and magmatic fluid), which heats deep groundwater held in rock fractures. This water is stored or moves through different hydrogeological units called geothermal aquifers (the aquifer). It reaches the surface in the form of geothermal features (ngāwhā), in such places as Whakarewarewa, Ngāpuna, Kuirau, Ōhinemutu and other areas around Lake Rotorua.

The health of the aquifer, and ngāwhā is influenced by both the water level and water temperature of the aquifer (i.e. the pressure). If we take too much water and don't put it back into the aquifer, or if we take too much energy or heat, the ngāwhā will be at risk.

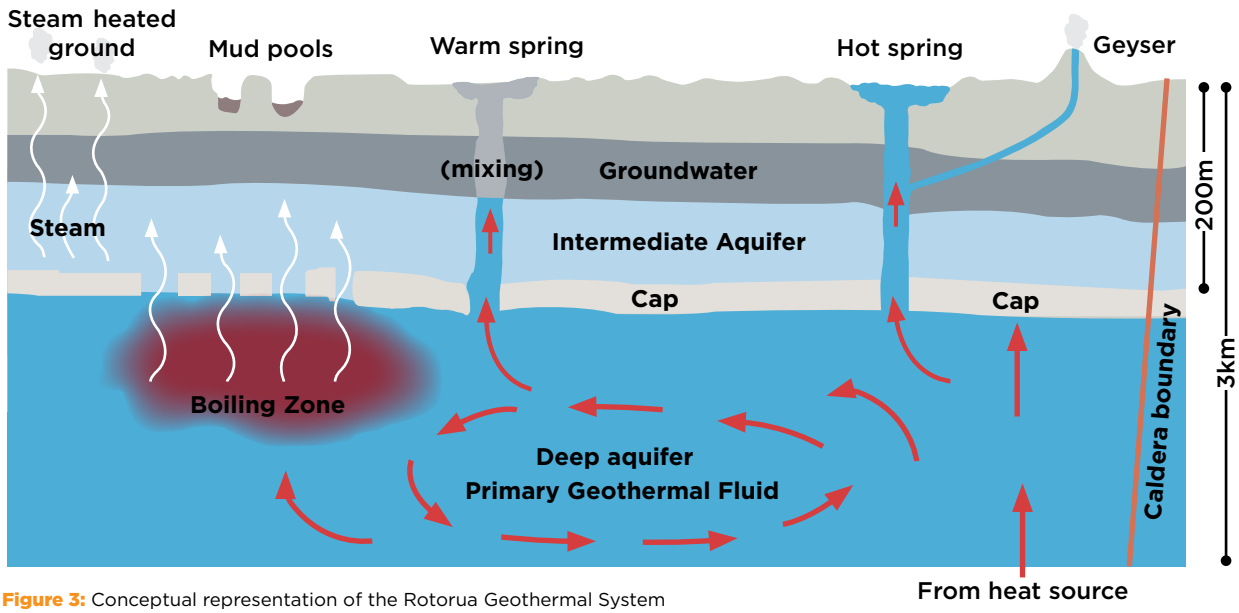


Figure 3: Conceptual representation of the Rotorua Geothermal System

Ngā whakamahinga me ngā wāriu o Ngā Wai Ariki o Rotorua

Use and values of Ngā Wai Ariki o Rotorua

Sustainable use of ngā wai ariki has always been, and still is, part of everyday life for haukāinga. It is used for bathing, cooking, healing, spiritual practices and treating material such as flax for weaving. Geothermal features, each one unique, are known for possessing different values and acknowledged in different ways as living beings through the fundamental concept of whakapapa.

More recently people started taking geothermal water from the geothermal aquifer using geothermal wells. In some cases, the geothermal water is used directly for mineral bathing and then discharged to sewer, land soakage, or streams or lakes. In other cases heat is extracted from the water using a heat exchanger, and cooled water is then reinjected to the aquifer. Down hole heat exchangers pump fresh water down a well, via an enclosed pipe. The water in the pipe is heated by the surrounding hot water in the geothermal aquifer, and the heat used at the surface for space and water heating.

People sometimes think that there is an endless source of geothermal heat in Rotorua. But all uses that take water and heat from the aquifer will have an effect. The type and amount of take, where we take it from, the geothermal production system we use to take it and how we use it will determine the scale of effects.

More people started to use geothermal wells in the 1960s and '70s and much of the geothermal water taken was wasted. This resulted in a massive decline in the pressure of the geothermal aquifer and in the loss of geothermal taonga (e.g. Waikite and Wairoa geysers). These practices were changed in 1989 when the Government took over the management of the system from Rotorua City Council. Reinjection was required and takes were limited near the geyser field at Whakarewarewa, by the creation of an area called the Mass Abstraction Exclusion Zone. This led to the healthier state of the system which has been maintained by Bay of Plenty Regional Council for four decades.

Taking of geothermal water and heat is carefully controlled to protect surface features and requires a resource consent under the Rotorua Geothermal Regional Plan. Most consented takes are for space and water heating for domestic, municipal and commercial uses, and also taking of water for bathing.

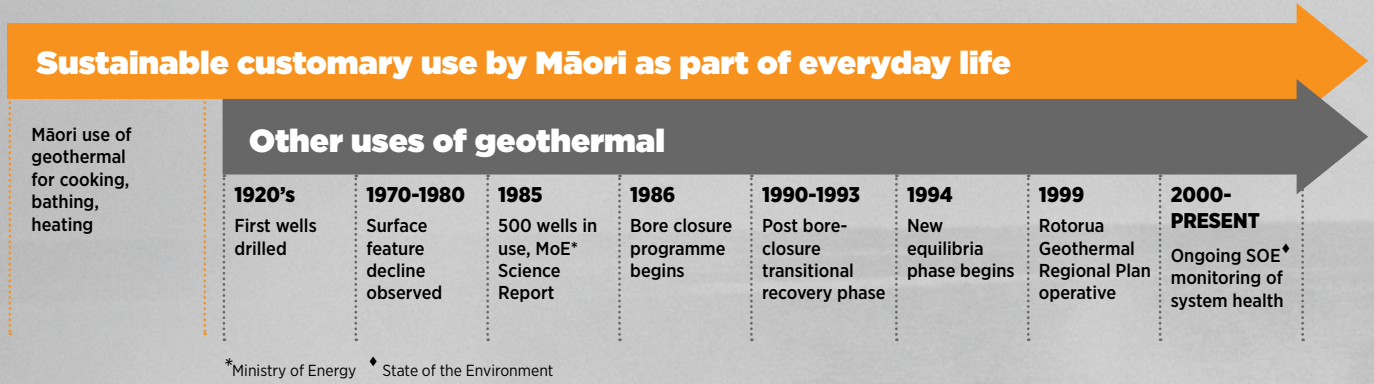
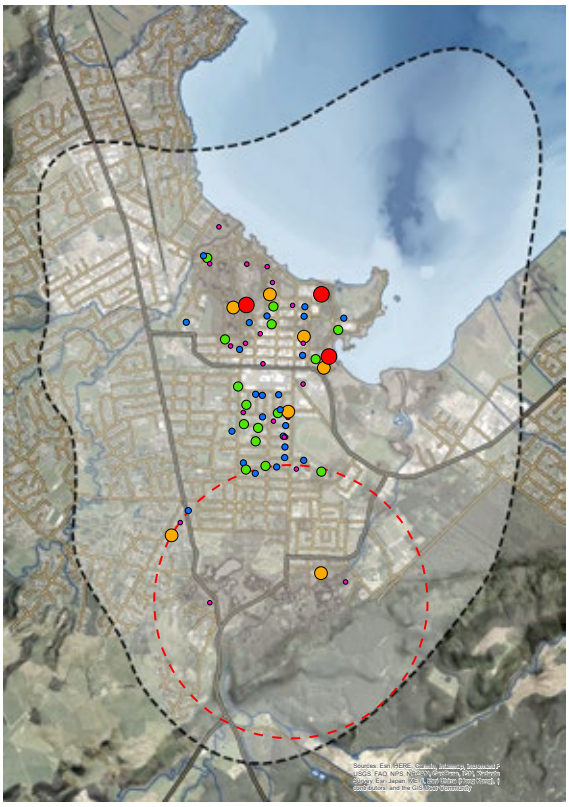
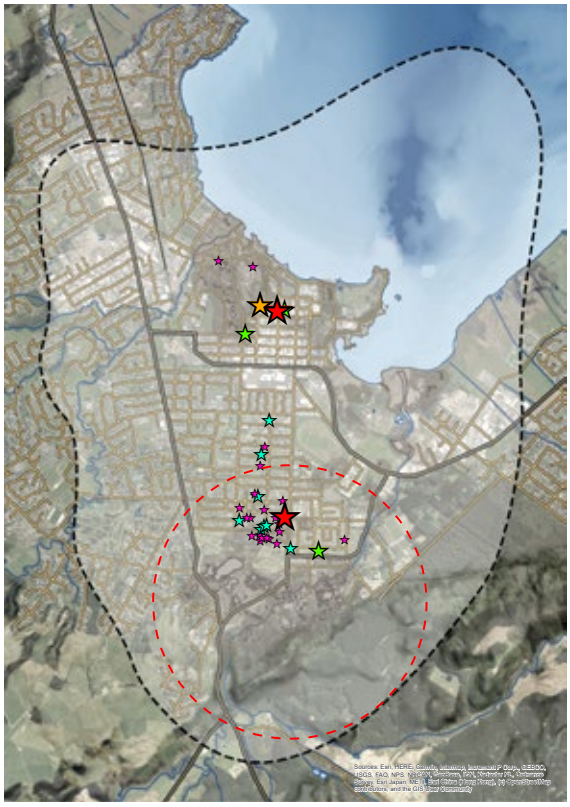


Figure 4: Size, distribution and type of takes in Rotorua



Water takes
Consented (tonnes per day)

- 0.0 - 50.0
- 50.1 - 100.0
- 100.1 - 200.0
- 200.1 - 400.0
- 400.1 - 800.0
- Mass Abstraction Exclusion Zone
- Geothermal system indicative area



Heat takes via down hole heat exchangers
Consented (kWth)

- 4 - 20
- 20.1 - 50.0
- 50.1 - 100.0
- 100.1 - 200.0
- 200.1 - 560.0
- Mass Abstraction Exclusion Zone
- Geothermal system indicative area

Quick facts about resource consents for the taking of geothermal water, heat and energy on the Rotorua Geothermal System.

110 consented takes	**~90%** reinjected
35 down hole heat exchangers	**15.5** MWth (thermal megawatts) taken from system annually
80 production injection systems	**80%** of the take is for commercial use
5 consented surface takes	**25** consented mineral pools

Te whakahaere i Ngā Wai Ariki o Rotorua i raro i te RMA

Managing Ngā Wai Ariki o Rotorua under the RMA

European settlement resulted in various forms of Government taking control of the management of geothermal in Rotorua. Most recently, the Bay of Plenty Regional Council has the responsibility for the sustainable management of geothermal under the Resource Management Act 1991 (RMA).

This includes responsibility for the allocation of geothermal water, energy and heat (s.14), and geothermal discharges to land, air and water (s.15) through regional plans and resource consents, and the review of the effectiveness of the management approach adopted in achieving sustainable management.

In exercising its functions, Council must recognise and provide for the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taonga (s.6 (e)) and take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi) (s.8).

These functions and responsibilities (s.30) are given effect to through the Bay of Plenty Regional Policy Statement (RPS), which sets out the overall framework for managing geothermal and the Bay of Plenty Regional Natural Resources and Rotorua Geothermal Regional Plans, which include policies and rules under which resource consents are granted. For tangata whenua, iwi and hapū, resource planning documents recognised by an Iwi Authority and lodged[4] with Council provide an additional mechanism for specific interests in geothermal management to be considered in Council decision-making. Council supports the development, review and updating of these documents. There are specific legislative requirements under the RMA (s.66(2A)) which place a duty on Council staff to take into account these plans.

4 *A list of the plans lodged with the Bay of Plenty Regional Council and recognised by the relevant iwi authority can be found at www.boprc.govt.nz/your-council/plans-and-policies/plans/hapuiwi-resource-management-plans*

Te matapopore mō te hauora o Ngā Wai Ariki o Rotorua
Caring for the health of Ngā Wai Ariki o Rotorua

The Bay of Plenty Regional Council monitor the health of the geothermal system as part of their Geothermal Monitoring Programme. This is described further in a video presentation which can be found on the geothermal glossary and reports page of councils' website. The main indicators of health that the council uses are the geothermal aquifer water level, its temperature (i.e. the pressure) and surface features.

Haukāinga also draw on their mātauranga to understand the health of the system, and the connection between access to the ngāwhā, its health, and the health and wellbeing of people.

This collective knowledge tells us that while the system has recovered and stabilised over the last 40 years, the loss of some ngāwhā during the 1960's and 70's may be irreversible. Others are still changing, and some are showing increased activity. We need more time to know if the system and surface features will change further. In the meantime the system is fragile and remains vulnerable to increased taking of geothermal water, energy and heat, and to climatic changes. Ongoing monitoring of the health of the system and identifying future monitoring opportunities and priorities will be a key focus going forward.

You can find more information on the health of Ngā Wai Ariki o Rotorua in these documents[5].

5 *Bay of Plenty Regional Council Environmental Summary Report: Rotorua geothermal System and Ngā Wai Ariki o Rotorua: He Kohikohinga: Haukāinga Perspectives on the Health and Wellbeing of Geothermal Taonga within Rotorua*

SECTION 4

E PĀ ANA KI TE MAHERE WHAKAHAERE PŪNAHA
ABOUT THE SYSTEM MANAGEMENT PLAN

This System Management Plan (SMP) has been prepared to give effect to the Bay of Plenty Regional Policy Statement (RPS). It has been prepared in partnership with Te Ahi Kā Roa rōpū and adopted by the Bay of Plenty Regional Council, following its obligations under the Local Government Act 2002 (LGA).

The RPS does not limit the content of the SMP or how it is developed. It sets out some content that the SMP must include, and a broad objective for the Rotorua System. This is our starting point, but the SMP builds on this by drawing on our understanding of the system and people's interactions with it, including scientific observations, te ao Māori (the Māori world view), mātauranga Māori (Māori knowledge), and community experience.

The SMP will be referenced in the Regional Natural Resources Plan (RNRP), so that its principles will be given particular regard to in the implementation of the RNRP. However, the SMP does not override the RPS, the RNRP or lawful resource consents.

The SMP also sets out how we work operationally, through specific actions and guidance documents. These operational documents and practices can change more readily, as we improve our processes, data management, reporting, research, and monitoring.

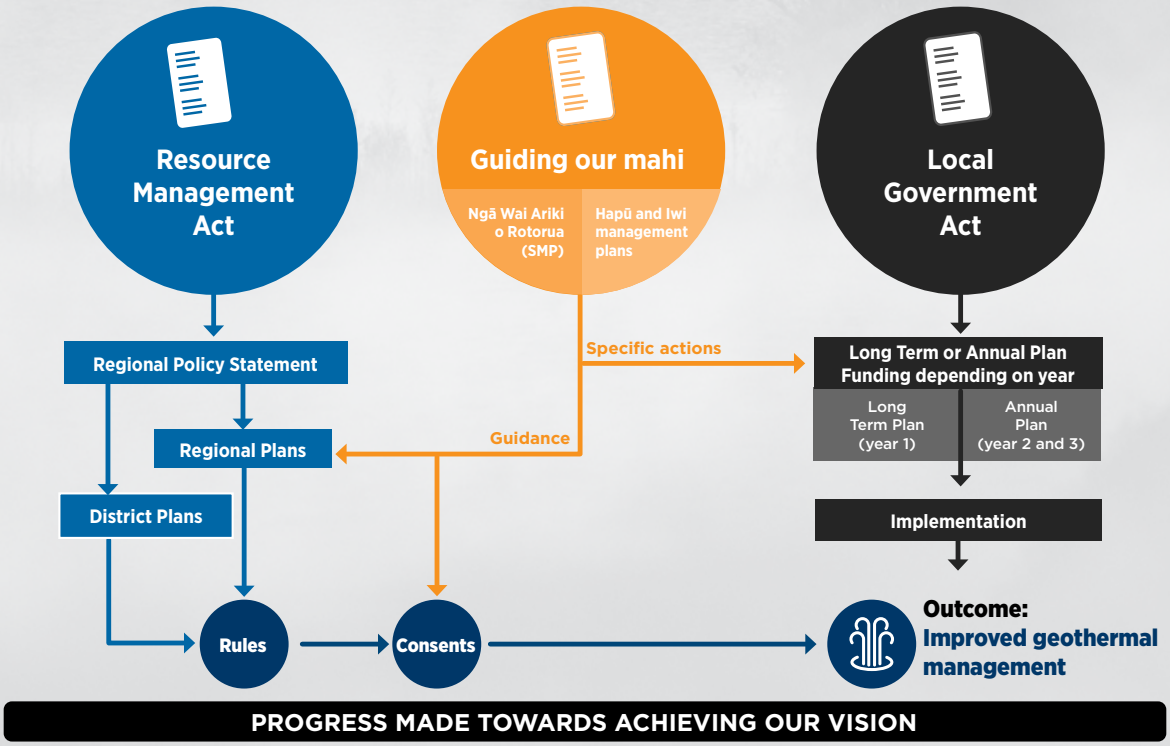


Figure 5: Relationship to other planning documents

Te whakawhanaketanga o te Mahere Whakahaere Pūnaha
How the SMP was developed

Bay of Plenty Regional Council (BOPRC) has led the development of the System Management Plan (SMP), alongside tangata whenua through the establishment of a haukāinga working group, engagement with iwi entities, and engagement more widely through multiple hui-a-iwi. This reflects the evolving partnership between BOPRC and tangata whenua.

The unique position of tangata whenua was acknowledged with early and ongoing input through hui-a-iwi in Ōhinemutu, Ngāpuna, Tārewa and Whakarewarewa. A haukāinga working group Te Ahi Kā Roa rōpū worked closely beside Council over four years to contribute a te ao Māori and haukāinga perspective. Their report, Ngā Wai Ariki o Rotorua: He Kohikohinga (2021) developed key concepts, some of which are reflected in the SMP.

Wider community views were also gauged from key stakeholders, such as resource consent holders, and the Rotorua Lakes Council through workshops.

This input has guided the structure, draft vision, principles for how we will behave and the overall management approach in the SMP.

Figure 6: System Management Plan development and engagement process

SECTION 5

HE ANGA WHAKAMUA
OUR FUTURE FOCUS

Moemoeā Vision

Ka ora te mauri o Ngā Wai Ariki o Rotorua
– the Rotorua geothermal system is healthy.

This vision builds on the overall management purpose of protecting surface features which is set out in the Regional Policy Statement. It is based on restoring and preserving the balance between geothermal, the wider environment and people.

Within this vision is a hierarchy of responsibilities: we provide first for the mauri or health of the geothermal system and ngāwhā – sustaining their natural, physical and cultural values. We then provide for ongoing intergenerational and sustainable customary uses.

After this, where sustainable, we provide for extractive uses for communal or community purposes that enhance social outcomes and contribute to health and wellbeing. Only then do we use geothermal for individual or communal economic gain (i.e. energy savings).

This vision reflects that the systems health is stable, but that surface features are still changing and more improvement (e.g. of some geysers) may still be possible. Further change does not mean increased geothermal or volcanic activity, but signals that some features may still be returning to their natural state. Increased take from the system may hinder further change.

Tapatoru – He kura toiora nō Te Arawa
Tapatoru – A Te Arawa philosophy of being well

Through a te ao Māori lens we see Ngā Wai Ariki o Rotorua, as a living being that has mauri. For this mauri (the living spirit) to be healthy, we look to these aspects, as a whole:

- **Tinana – the physical well-being** e.g. where to test and drill, possible positive and negative effects, reinjection
- **Hinengaro – intellectual and heart based well-being** e.g. scientific research on the location, temperature, depth and size of the geothermal system
- **Wairua – the spiritual well-being** e.g. social and health benefits of using wai ariki - intergenerational bathing and cooking

The tinana of a healthy geothermal system much like a human body has veins, that instead of blood has geothermal waters flowing through them. When healthy, the system expels energy 'sweats' in the form of geysers and eruptions and like breath on a cool day has plumes of steam escaping from its body.

The hinengaro of a geothermal system when under attack protects what it can at the expense of other parts of its body and will shield the "heart" to protect vital organs.

And finally if the wairua or the spirit of a geothermal system isn't protected, we see illness both internally and externally. We may see parts of its body slowly change and weaken, such as, less energy expelled

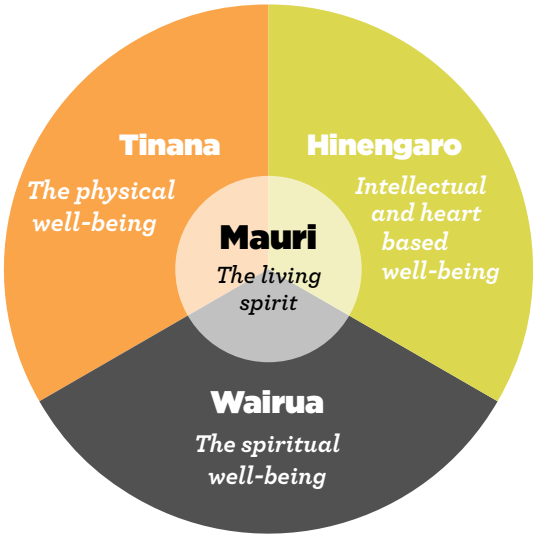


Figure 7: Te mauri of te wai ariki

from ngāwhā or in a worst-case scenario death, similar to some of the geysers and pools that have never returned to live within our Rotorua geothermal system, their veins collapsed with no water running through them.

To have a healthy geothermal system, all three, tinana, hinengaro, wairua – body, mind and soul must be taken care of. All three must be healthy or the mauri, the living spirit of the system, will be at risk.

Mātāpono – Ā mātou whanonga
Principles – how we will behave

People who live in Rotorua have a relationship with geothermal which is informed by their history, different knowledge and values, and in many cases is also intergenerational. We draw on this knowledge to learn from our past mistakes, to inform and make good decisions going forward.

Partnership

This SMP begins to lay a foundation for partnership in management of Ngā Wai Ariki o Rotorua. Our responsibilities to Treaty Partnership is reflected in the way the SMP has been developed, in our future management approach, and in the way we will behave in implementing this SMP.

We recognise that mātauranga Māori, and the expertise of mana whenua and haukāinga adds greater value to our decisions and our work. Included in this recognition is the rebuilding of mutual respect and trust through openness and sharing of knowledge, and supporting enhanced participation by mana whenua and haukāinga through adequate resourcing, along with capacity and capability building. Existing and new Treaty settlements will be respected and honoured, and we will continue to progress towards improved and shared decision making in management of Ngā Wai Ariki o Rotorua. The contribution of te ao Māori and mātauranga Māori will be actively sought, valued and will help inform our decisions. These new opportunities are a starting point, and set a path for partnership and shared decision making to evolve.

Interconnectedness

The Māori worldview is that the mauri of all water is the same, including freshwater, geothermal and seawater, although different atua. Also, geothermal from Whakaari through to Tongariro is interconnected. This is part of the wider holistic view for Māori, where all parts of the natural world are connected through whakapapa (genealogy). Our conceptual understanding formed through scientific studies of the Rotorua geothermal system and other systems in the Taupō Volcanic Zone likewise identifies this interconnection.

The RMA recognises interconnectedness and the need to manage things in an integrated way, hence the development of this SMP.

For the Rotorua geothermal system, this means we must consider that use in one part of the system may affect another part of the system, and other parts of the taiao (environment) or in some circumstances another geothermal system. We must also consider the wellbeing of people and communities as well as the health of the geothermal system.

Sustainability, balance and reciprocity

This means working within natural limits of the environment and the geothermal system, being precautionary and not taking risks with our geothermal taonga. It includes restoring what is taken and taking action to offset effects. It is about making decisions for future generations, making decisions for our mokopuna or grandchildren.

Intergenerational relationships

Haukāinga have lived with an ever-changing geothermal environment for hundreds of years. Mātauranga Māori acknowledges the cumulative and intergenerational effect of past events on current use of geothermal taonga. Damage to surface features and loss of access to geothermal has affected their relationship with geothermal and traditional practices. They have lost mana and rangatiratanga over their taonga tuku iho, their heritage. We now need to provide opportunities for reconnection with ngā wai ariki and to restore manaakitanga (care and respect) and kaitiakitanga.

Collective knowledge

Our approach is to value and draw on our different knowledge and world views, be adaptive and to seek and be responsive to new information.

Science explores physical processes of the geothermal system (e.g., chemistry, geology, thermodynamics), the effects of taking geothermal fluid, energy and heat, and how we can manage the system in an integrated and sustainable way.

Mātauranga Māori is a living, interactive knowledge gained from being immersed within and connected to an environment. It is understanding natural rhythms of geothermal taonga and the use of tohu or indicators, to notice changes over time (e.g., appearance and behaviour).

Fairness and equity

The Rotorua Geothermal System is valued by the community for its natural values, as a source of energy (e.g. reduced heating costs), and for health and wellbeing (e.g. bathing). It is used domestically and commercially, as well as for community and municipal uses.

For haukāinga geothermal is part of everyday life, but access has been reduced in some places, especially the use of geothermal wells for heating and bathing, largely due to increased costs. This has impacted social cohesion and spiritual wellbeing. The first in first served approach under the RMA limits future opportunities for equitable access.

The first ‘use’ of geothermal is the amount needed to maintain and enhance its mauri. There is not endless resource for all, so Council needs to prioritise uses that benefit the most people and honour our responsibilities under Te Tiriti o Waitangi to ensure fair access to this taonga by tangata whenua.

Responsiveness and adaptiveness

We need to be able to respond to new information and unforeseen circumstances and have systems that allow us to identify these challenges and readily adapt. This is especially important as we face climate uncertainty and an evolving partnership landscape, and grow and embed new knowledge in our decision making (e.g. mātauranga Māori).

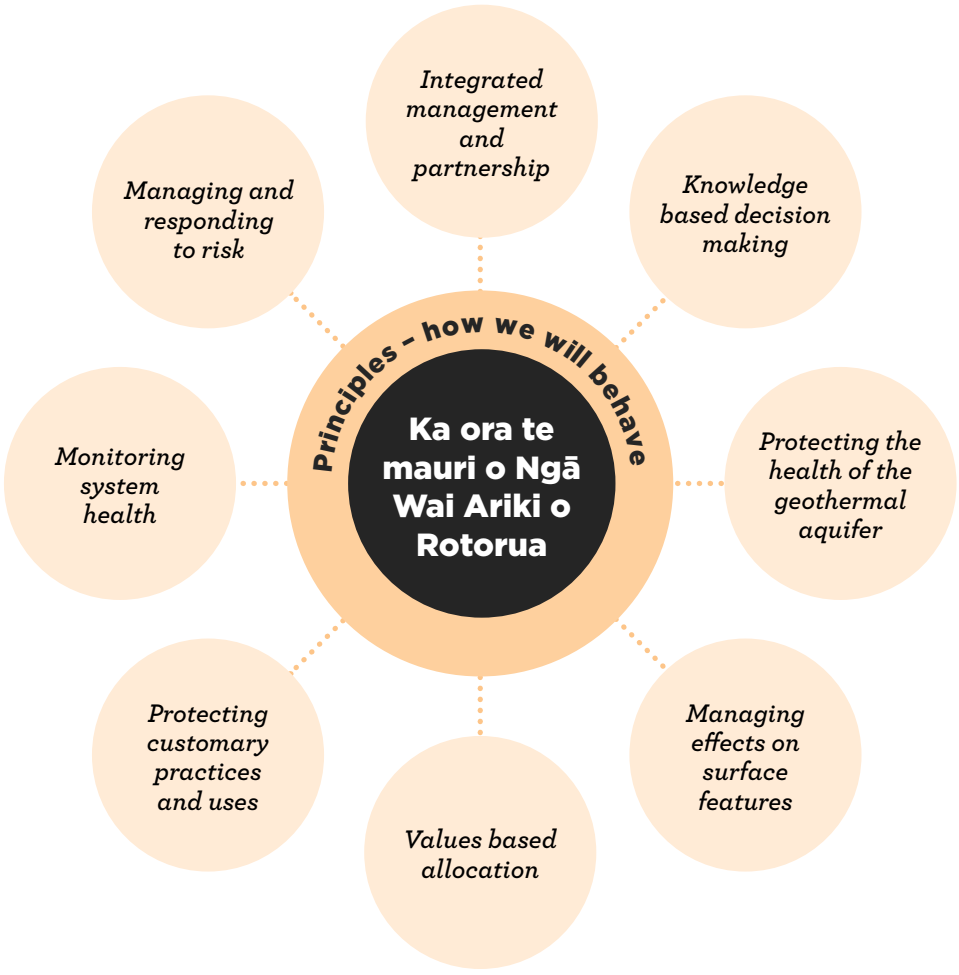

Te Waimirimiri

SECTION 6

TE KAUAWHI A TE HUNGA WHAKAHAERE MANAGEMENT APPROACH

This section outlines a pathway to achieve the vision, Ka ora te mauri o Ngā Wai Ariki o Rotorua - the Rotorua geothermal system is healthy. Our approach and the steps that will be taken to achieve sustainable management are listed here and described in more detail in supporting documents.

The System Management Plan will be implemented through a detailed Action Plan to be developed following approval of the SMP. It will outline the priorities, timeframes, resources, and partners in delivery of each action identified. The Action Plan will be an operational document that will be updated to reflect continuous improvement.



Te whakahaere tahi me te rangapū
Integrated management and partnership

An integrated and partnership approach to the sustainable management of the system must draw on different knowledge sets, recognise the interconnectedness of people's wellbeing with the health of this taonga, and embed a Māori perspective on the mauri of the system. This will include people with the right skills contributing their knowledge and participating in the implementation of this SMP.

Our approach	How we will do it
• Implementation of the System Management Plan in partnership with tangata whenua • An integrated approach, drawing on te ao Māori and mātauranga Māori to report on te mauri o ngā wai ariki and progress towards achieving our vision • Continual development and improvement of a partnership model for management of Ngā Wai Ariki o Rotorua • Enhanced participation by iwi, hapu and haukāinga through adequate resourcing, along with capacity and capability building	• Establish a **Rotorua Geothermal Governance Group**[6] to oversee implementation of the System Management Plan, with elected representatives from BOPRC and representatives from iwi, hapū and haukāinga, and providing for contributions from key stakeholders (e.g., Rotorua Lakes Council) • Develop an **Action Plan**, to be reviewed annually by the **Geothermal Governance Group** • Develop a publicly accessible **Annual Report** on the overall health of the system, integrating a Māori perspective and mātauranga Māori expertise • Actively seek opportunities for iwi, hapū and haukāinga to participate in management of the geothermal system, to build capability through internships, scholarships, wananga and training in monitoring programmes • Develop a partnership vision and strategy for management of the Rotorua System, including options for joint decision making and transfer of powers • Support the development of, and have regard to, iwi hapū management plans that address tangata whenua aspirations for geothermal

Some questions to think about

- Tell us what you think about our suggested approach to **integrated management**
- Do you think that a Rotorua Geothermal Governance Group can be an effective forum to implement the SMP?
- How do you think haukāinga, hapū and iwi should be represented on the Governance Group?
- Do you support the investigation of options for joint decision making and transfer of powers for Ngā Wai Ariki o Rotorua? What do you think this should address, who should be involved and where are the priorities?

6 *The representation and form of this group will be confirmed, and a Terms of Reference agreed, following approval of the System Management Plan.*

Te whakahaumaru i ngā tikanga, kawa me ngā whakamahinga
Protecting customary practices and uses

Using ngāwhā to sustain health and wellbeing has taken place for hundreds of years. These practices, such as diverting a small amount of water from ngāwhā for bathing, using steam to cook, using ngāwhā for dying harakeke or preparing rongoa, are managed by haukāinga, according to their tikanga. They are small scale, don't take water or heat directly out of the aquifer and the effects are minor (e.g. diversions, or discharges to streams or Lake Rotorua). If ngāwhā are healthy, these practices will continue to be healthy.

The RMA protects these customary practices, with no need for a resource consent where these are for communal benefit, follow tikanga Māori, and have no adverse effects. Haukāinga hold mātauranga on these practices, on how geothermal is used, and how much needs to be 'reserved' for customary practices to thrive. Customary practices are also an important tohu of the social and cultural wellbeing of communities.

Where use for customary purposes could have an adverse or cumulative effect, these effects are managed through the resource consent process. For example, communal uses that are larger in scale, and use non-traditional methods to extract water and heat from the aquifer (ie. a geothermal well), can impact surface features, or the interconnected aquifer. These effects need to be considered in a transparent and consistent way, and with a 'whole system' perspective.

'Geothermal taonga is used for bathing, home heating, healing and cooking, and provides for the health and wellbeing of whānau, hapū and wider communities. It is part of everyday lives, an essential component of social connectivity and a means of sharing knowledge, it plays a critical role in maintaining connection between whānau and the social fabric and cohesion within the hapū'

Ngā Wai Ariki o Rotorua: He Kohikohinga 2021

Our approach	How we will do it
• Protection and enhancement of customary practices • Management of the health of the aquifer and effects on surface features, to protect customary practices • Tikanga around customary use of ngāwhā determined by haukāinga as hunga tiaki • Mātauranga on customary practices held by haukāinga, and used to inform management where appropriate	• Support haukāinga to build and retain mātauranga on the customary practices within their villages, including types of use, level of use, and possible effects on the environment • Provide support for iwi and hapū management plans that outline tikanga for customary practices, such as tapu and rāhui, and recognise these in planning documents • Facilitate and enable resource consents to support haukāinga aspirations for sustainable geothermal use within their villages • Support projects by haukāinga, or community groups, to enhance the mauri of surface features (e.g. restoration of the natural environment near baths, removing litter, replanting). • Identify cost effective options to enable haukāinga to access geothermal for customary communal purposes (e.g. reduced resource consent fees) • Support for haukāinga to develop tohu to measure and communicate cultural wellbeing, progress towards achieving enhanced access to geothermal, and how this is related to te mauri o ngā wai ariki • Provisions in Regional Plan to protect and prioritise sustainable customary uses, and limit uses within **Sensitive Management Areas** where these could affect customary practices • Consider transfer of functions, for resource consent and compliance processes, within the villages. • Promote use of group discharge consents to manage cumulative effects of multiple discharges to the environment

Some questions to think about

- Tell us what you think about our suggested approach to **protecting customary practices**
- Do you agree with the way we have defined the distinction between **customary practices** and **customary uses**, and their different scale of effects?
- What support, if any, do haukāinga need to build mātauranga on customary practices in their villages and developing tohu that tell a story about progress towards protecting these practices?

Te whai mōhiotanga mō ia tatūnga
Knowledge based decision making

Geothermal systems are complex and the quality of our information about the system determines our management precision. We are continuously building our collective knowledge by monitoring trends in the health of the system, using mātauranga Māori, science, and mathematical modelling to predict future changes. This knowledge can be used to try new ways of doing things, and revise current thinking, accepting that a precautionary, but adaptive approach is needed where there is uncertainty.

Our approach	How we will do it
• Decision making based on collective sources of knowledge and expertise and based on the best available information at the time • Reflection of mātauranga Māori in managing the effects of use on te mauri o ngā wai ariki • Continued growth in knowledge and understanding of the system • Greater transparency and sharing of information with the community about the management of the system • Ongoing monitoring of the health of the system (See *'Te aroturuki ki te hauora o te pūnaha – Monitoring system health' on page 39)*	• Development of an Annual Report, that draws on long term monitoring data, te ao Māori perspective and mātauranga Māori, modelling, actual use data, and consenting information, for consideration by the **Geothermal Governance Group** (see *'Te whakahaere tahi me te rangapū Integrated management and partnership' on page 30*) • Regional plan provisions that require sufficient information to support resource consent applications, including the effects of resource consents on the health of the system and input from tangata whenua on the effects of use on wellbeing • Develop and maintain publicly accessible information about geothermal, through websites, factsheets, and an online data portal • Own and regularly update a publicly accessible geothermal reservoir model, and regularly model take and discharge scenarios to determine sustainable levels of take • Work with īwi, hapu, haukāinga, whare wananga and tertiary institutions to develop joint research projects on Ngā Wai Ariki o Rotorua • Identify priority areas for research and support research applications where these contribute to our understanding of Ngā Wai Ariki o Rotorua and its sustainable management • Commit to educational outreach programmes on the values of Ngā Wai Ariki o Rotorua • Continue to enable research into system boundaries, the deep aquifer and system connectivity, and the effects of use on surface features • Respond to emerging monitoring requirements, such as monitoring and forecasting the impact of climate change. • See *'Te aroturuki ki te hauora o te pūnaha – Monitoring system health' on page 39*

Some questions to think about

- Tell us what you think about our suggested approach to **knowledge-based decision making**
- What do you think are priority areas for geothermal research in Rotorua?
- What sort of information would you like to have better access to, and how would you like to access it?

Te whakahaumaru i te hauora o te puna ngāwhā

Protecting the health of the geothermal aquifer

The geothermal aquifer water level and temperature (i.e. pressure) drives the health of surface features. All geothermal takes can affect aquifer pressure. If too much water is taken from the aquifer and not put back, the aquifer water level will drop. If too much heat is taken too quickly, the water in the aquifer can cool, reducing the pressure. Effects of use vary within and across the system – a take in one area may affect another, and changes can travel quickly through the system.

Our vision Ka ora te mauri o Ngā Wai Ariki o Rotorua means taking only what we can without causing damage. Our safe operating space is where we may see short-term and minor fluctuations in the system (e.g. rainfall), but the overall trend is maintenance or enhancement of pressure. The system limit is the tipping point, where there is a risk the system might collapse. We do not know exactly where this limit is, but monitoring indicators warn us when we are approaching this limit (see *'Te whakahaere me te whakautu i ngā tūraru – Managing and responding to risk' on page 41*).

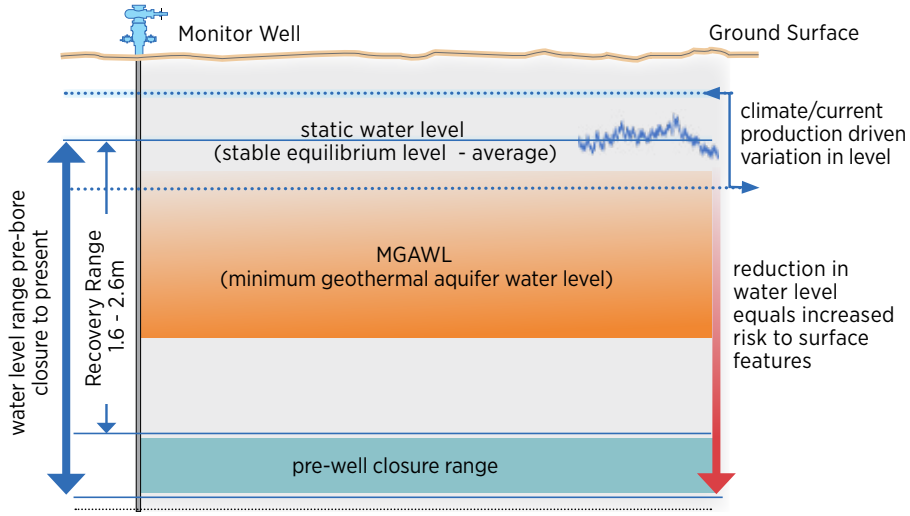


Figure 8: Aquifer water levels and the lower limits of our safe operating space, indicated by Minimum Geothermal Aquifer Water Levels

The Regional Council has carried out geothermal reservoir modelling and reviewed monitoring data to help determine the safe operating space for Rotorua Geothermal System. It is not the complete answer, but it gives us solid guidance that keeping use at or close to current levels will ensure the aquifer stays healthy. Allowing an increase in use will lead to changes in pressure, and potentially surface features. Any significant increase in take will lead to unacceptable risk.

You can learn more watching the technical video presentations or reading the technical reports available on our website **www.boprc.govt.nz/environment/geothermal/geothermal-glossary-and-reports**

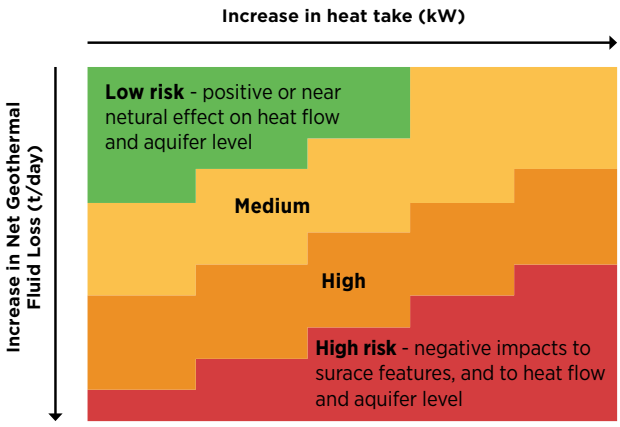


Figure 9: The risk profile of taking geothermal water and heat

Our approach	How we will do it
• Management of the take and use of geothermal water, heat and energy to protect surface features • Build on the potential for continued recovery of the aquifer pressure by working to maintain (or reduce) actual take of geothermal water, heat and energy • Improved efficiency in the taking of geothermal water, heat and energy • A precautionary approach where there is uncertainty and high risk	• Provisions in the regional plan to require reinjection (except where this would cause greater environmental effects), and avoid loss of geothermal water from the system • Provisions in the regional plan to manage consented take at current consented levels, and seek to maintain actual take at, or close to current levels, while: – Providing for continuation of existing consented uses – Providing for **priority uses** (See *'Values based allocation' on page 38 and 'Te whakahaumaru i ngā tikanga, kawa me ngā whakamahinga – Protecting customary practices and uses' on page 31)* where these will not significantly increase consented or actual take – Avoiding any new geothermal takes where these are of a size, or in a location that they have the potential to adversely affect te mauri o ngā wai ariki • Minimise the effects of take and use on the aquifer, receiving environment and surface features, by promoting low impact and efficient production systems and by applying **Production Guidelines** • Minimise effects of discharges on the aquifer, receiving environment and surface features by applying **Discharge Guidelines** • Require efficiency assessments and audits as part of consent applications by applying **Efficiency Guidelines.** • Use an Allocation Tool to match allocation with realistic energy demands of the end use, and limit over-allocation and resource banking • Establish a Resource Accounting Tool to accurately track, record and report on consented and actual use of geothermal • Take a precautionary approach to use in parts of the system where there is limited information, by treating parts of the system deeper than 100mRL (NZVD2016[7]) as a Research System that provides for further exploration and additional information gathering • Assess the impact of resource consent applications for the take and use of geothermal energy, or of freshwater, in proximity to Rotorua, where this use might impact Ngā Wai Ariki o Rotorua • Follow best practice standards for well construction, maintenance and abandonment, and setbacks between geothermal wells and structures, to avoid uncontrolled discharges. See the factsheet on our website www.boprc.govt.nz/environment/geothermal/hazards • As a minimum, require reservoir modelling of potential effects of resource consent applications for takes over 10% of the total take of geothermal water or heat

Some questions to think about

- Tell us what you think about our suggested approach to **protecting the health of the aquifer**
- Do you agree with the steps we are proposing to maintain, but not grow the existing level of take i.e. keep actual take close to current levels?
- Do you support a move to more reinjection, but seeking treatment of bathing water and reinjection of this water rather than disposal to the lake, streams or land (not including customary bathing practices)?

7 *The relative level (RL) is obtained by subtracting the depth of the bottom of the well from the topographic level of the wellhead derived from the digital terrain model (DTM) and converted to NZVD2016. The New Zealand Vertical Datum 2016 (NZVD2016) is the official vertical datum for New Zealand and its offshore islands.*

Te whakahaere i ngā whakaaweawe o ngā ngāwhā
Managing effects on surface features

Geothermal surface features include hot pools, springs, geysers and mudpools, as well as the geothermal vegetation that surrounds them. You can read more about geothermal surface features on councils' website.

These features are affected by taking of geothermal water, heat and energy from the geothermal aquifer. They can also be affected by changing climate and by land uses such as earthworks, damming and diversion, dumping, infill and clearing of unique geothermal vegetation. Building intensification, industrialisation and infrastructure development can also affect the geothermal landscape, as seen in places like Ngāpuna and Arikikapakapa.

The surface features in Rotorua are irreplaceable. Some features, such as geysers are highly significant individually, but collectively all features create the geothermal landscape of Rotorua. Our vision Ka Ora o Te Māuri o ngā wai ariki puts these features first. We will do this by managing the health of the aquifer (see *'Te whakahaumaru i te hauora o te puna ngāwhā Protecting the health of the geothermal aquifer' on page 34*) but also by taking more care in areas where there are many surface features, as shown in Figure 10.

You can find out how these areas were identified by reading the report – Proposed Rotorua Management Areas Review on our website.

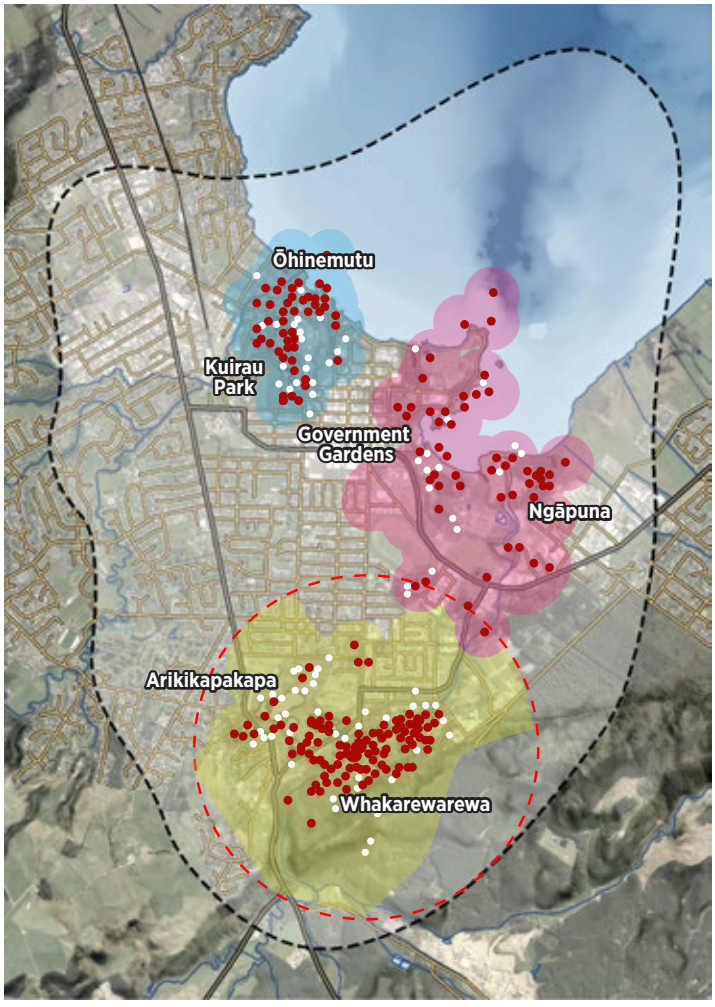


Figure 10: Sensitive Management Areas, showing the areas where there are a high number of surface features and associated customary practices

KEY

- Mass Abstraction Exclusion Zone
- Geothermal system indicative area
- Kuirau Management Area
- Ngāpuna Management Area
- Whakarewarewa Management Area
- Significant Geothermal Feature
- Geothermal Surface Feature

Our approach	How we will do it
• More care in areas where there are a high number of surface features (i.e. Sensitive Management Areas[8]) • Criteria in the Regional Policy Statement (RPS) to determine the significance of features and identify the effects of different uses on different types of surface features (you can see Appendix F in the RPS) • Best practice to manage local effects from taking geothermal water, heat and energy, and discharges of geothermal water close to surface features • Urban planning that takes into account geothermal hazards and the values of geothermal surface features, including in subdivisions, infilling and infrastructure developments • Information on surface features and their values to the community is actively shared where appropriate	• Regional plan provisions that manage local effects of taking geothermal water, heat and energy, and discharges of geothermal water on surface features • Promote low impact and efficient production systems and apply **Production Guidelines** • Minimise effects of discharges on the aquifer, receiving environment and surface features by applying **Discharge Guidelines** • Consider the spatial distribution of takes and limit the density of takes in Sensitive Management Areas, and where cumulatively these takes could have local effects. • Regional and district plan provisions that avoid interference with, or destruction of the physical structure of features or landscapes by controlling stormwater discharges, structure, earthworks, vegetation clearance, deposition and fill and damming and diversion • Carry out significance assessments of surface features and maintain a publicly accessible Geothermal Surface Feature Database • Where requested, support for iwi, hapu and haukāinga to identify and hold information on the cultural significance of features in their rōhe, and protocols for this information to be protected, accessed and used in decision making • Consider the opportunity to enhance ngāwhā in resource consent applications (e.g., mitigation of effects from an activity by restoring ngāwhā) • Work with tangata whenua to develop guidance for restoring and enhancing features and provide support to projects by iwi, hapū and haukāinga, or community groups, to enhance the mauri of surface features • Advocate for the inclusion of Sensitive Management Areas in urban planning and spatial planning, and for avoidance of the effects of land use activity on surface features through input into district council consenting processes (e.g. infrastructure, earthworks, stormwater) • Reduce impacts on significant surface features, and minimise the risk of geothermal hazards, by seeking a minimum setback of 20 m, and ideally 100 m between: – geothermal wells and surface features – geothermal wells and infrastructure – structures and surface features • Avoid the transfer of, or combining of existing consents that result in large high impact takes in Sensitive Management Areas

Some questions to think about

- Tell us what you think about our suggested approach to **managing effects on surface features**
- Do you support the identification and use of sensitive management areas?
- What do you think are the main landuse risks to surface features (e.g. earthworks, rubbish, clearance etc)? How can we support enhancement of ngāwhā?

8 *The mass abstraction exclusion zone in Whakarewarewa is an example of a sensitive management area that is already established*

Te tuari ā wāriu
Values based allocation

Ngā Wai Ariki o Rotorua is a valuable taonga, but vulnerable to overuse. We know that the system is already nearly fully allocated (see *"Te whakahaumaru i te hauora o te puna ngāwhā Protecting the health of the geothermal aquifer' on page 34*). This means we need to think carefully about how we allocate future use of geothermal water, heat and energy.

The benefit gained from geothermal uses varies. Some use (such as bathing) underpins cultural wellbeing and social cohesion, other uses provide a direct economic benefit through energy saving to an individual or business (space heating of a business).

We recognise the need for renewable energy sources to combat climate change. But this should not come at the cost of a unique and irreplaceable taonga. For some uses, such as electricity generation and space heating, there are alternative sources of renewable energy, while for other uses, such as geothermal bathing, there are none.

Our approach	How we will do it
• Recognise that the protection of te mauri of Ngā Wai Ariki o Rotorua takes precedence over use of geothermal as a renewable energy source and consider alternatives where necessary • A values-based approach for the taking of geothermal water, heat and energy, where te mauri of ngā wai ariki and sustainable intergenerational customary practices are protected as a priority	• Work to achieve equitable and value-based allocation by prioritising sustainable allocation of geothermal as follows: – Te mauri o ngā wai ariki – Sustainable customary practices of using ngāwhā – Geothermal takes for customary communal use (e.g. marae and papakāinga) – Geothermal takes for community or communal health and wellbeing facilities (e.g., public pools, churches, hospitals, non-profit organisations etc.) – Geothermal takes for individual and group domestic space and water heating and commercial uses through direct heat • Provisions in Regional Plan that reflect a values-based allocation approach by providing a consenting pathway for priority uses and that limit the transfer of consented take from communal and community uses to commercial use. • Develop protocols to assess the benefits of the proposed end use of geothermal • Avoid inefficient high impact uses of geothermal (e.g., electricity generation)

Some questions to think about

- Tell us what you think about our suggested approach to **values based allocation**
- Do you support the hierarchy of prioritisation, which puts the surface features and customary practices first, and makes direct heat for individual or commercial use lower priority?
- What types of uses do you think are for community or communal health and wellbeing?

Te aroturuki ki te hauora o te pūnaha
Monitoring system health

Monitoring system health is a fundamental part of management. We build a picture of system health by monitoring many different attributes, including aquifer pressure and chemistry, heat flow, and surface features. Monitoring can detect unexpected sudden changes or longer term trends, and there is sometimes a time-lag before changes in the aquifer are seen at the surface.

It can be difficult to measure what is causing change in the aquifer and surface features. Aquifer water levels are affected by geothermal takes, but also by climate. Inefficient uses, a significant increase in use, and long periods of low rainfall can all affect the aquifer water level.

For these reasons, our monitoring needs to be long term, consistent, robust and focus on the attributes that tell us most about the outcomes we are seeking. It also needs to include social and cultural indicators that will tell us how we are progressing towards our Vision.

Watch the video presentation on the geothermal glossary and reports page of our website to learn more about the Bay of Plenty Regional Council Geothermal Monitoring Programme.

Figure 11: Types of monitoring carried out by Bay of Plenty Regional Council

What we monitor	Monitoring wells	Surface features	Environmental data	Consents and compliance data
Water level	●	●		
Temperature	●	●		
Chemistry	●	●		
Flow		●	●	
Heat flow		●	●	
Visual changes		●		
Groundwater	●			
Air temperature			●	
Rainfall			●	
Use				●

Our approach	How we will do it
• Long term and robust monitoring of key attributes, including aquifer pressure and surface features • New social and cultural attributes to measure system health and progress towards our Vision • Haukāinga led mātauranga Māori monitoring of te mauri o ngā wai ariki and monitoring of customary practices and uses of the system • Improved accounting of the type and level of use of geothermal	• Maintain and resource a State of the Environment Geothermal Monitoring Programme • Long term monitoring of the health of a minimum of 30 geothermal surface features, for key attributes of heat flow, temperature, flow and chemistry • Maintain a minimum of four geothermal monitoring wells to continuously measure geothermal pressure, and investigate opportunities for new monitoring wells in parts of the system where there are knowledge gaps (e.g. in the deep part of the system) • Build on the Geothermal Monitoring Programme to include features with high cultural values, by supporting haukāinga to develop a mātauranga Māori monitoring approach tailored to suit their area of interest, and their needs, and implemented following their tikanga • Build on the Geothermal Monitoring Programme to include monitoring of sensitive 'sentinel' features such as geysers, new geophysical attributes and social and cultural indicators • Improve accounting of the type and level of use by requiring continuous metering of geothermal takes for consents representing 75% of the take on the system. • Support haukāinga to monitor changes in social connectivity values associated with the ability to access geothermal for customary practices within their villages, and to develop protocols for using this information to inform management • Regular review of the State of the Environment Geothermal Monitoring Programme so that it is fit for purpose

Some questions to think about

- Tell us what you think about our suggested approach to **monitoring system health**
- What support do haukāinga need, if any, to develop a mātauranga Māori monitoring approach that helps inform management decisions?
- What monitoring information would you like to learn more about? What other monitoring should Council be doing?

Te whakahaere me te whakautu i ngā tūraru
Managing and responding to risk

Ngā Wai Ariki o Rotorua is vulnerable, so it is essential that we identify early signs of stress in the system and adjust our behaviour where needed. Māori have long observed, recorded and forecast changes in ngāwhā, their response then guided by tikanga and kawa. Haukāinga can contribute this knowledge as hunga tiaki, to advise how the system is changing, when there is cause for concern, and what our response should be.

Alert systems can also serve as early warning that the system has changed and may be stressed. They also signal the need for a response by the resource manager. Currently the Bay of Plenty Regional Council only relies on aquifer pressure to identify the lower limit of our safe operating space, by including **Minimum Geothermal Aquifer Water Levels** in the Regional Plan, and a staged response to limit use when these limits are reached. Other attributes such as surface feature behaviour, and mātauranga Māori tohu should also inform when and how we respond to risk.

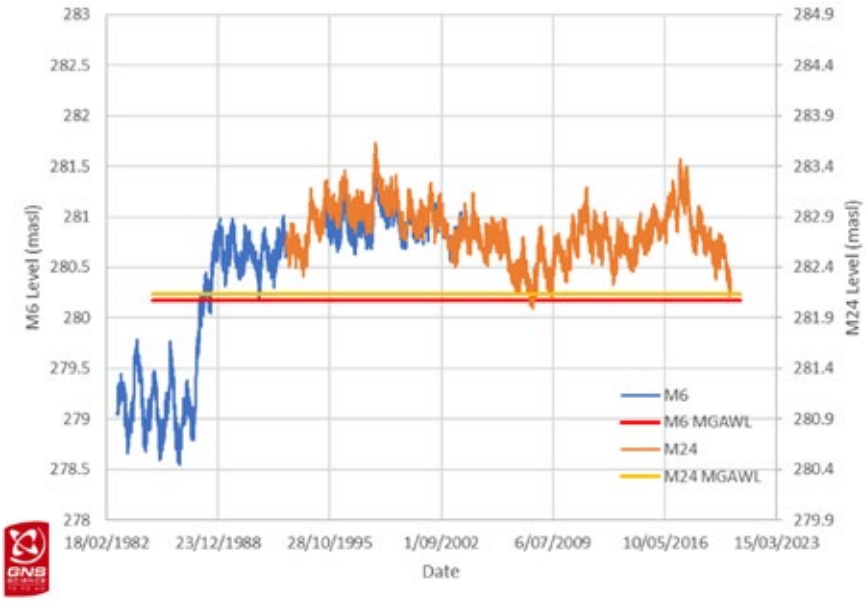


Figure 12: The fluctuating geothermal aquifer water level in relation to Minimum Geothermal Aquifer Water Levels in two monitoring wells

Our use of the ngāwhā was guided by tikanga and kawa, our cultural protocols and norms that were handed down to us by our forefathers. These protected both the ngāwhā and the physical and spiritual wellbeing of the users, as well as helped pass along knowledge of how particular ngāwhā acted under certain conditions, such as rain, flooding or long dry periods

(Manley 2019, from Ngā Wai Ariki o Rotorua: He Kohikohinga 2021)

Our approach	How we will do it
• A transparent and robust approach to monitoring and reporting on system stress • Mātauranga Māori guiding tohu and tikanga Māori in managing risk to the system • A precautionary approach to responding to signs of stress in the system • Avoiding risk from uncontrolled discharges	• Use Minimum Geothermal Aquifer Water Levels as the key indicator of the lower limit of our Safe Operating Space • Maintain and continuously monitor a minimum of three Minimum Geothermal Aquifer Water Levels within geothermal monitoring wells, and regularly review these, to reflect best practice • Regional plan provisions that embed a staged response to increased risk to the system: including voluntary reductions in taking of water, heat and energy; and a temporary or long-term reduction in take (a rāhui) through conditions of resource consent or a consent review • Develop and implement a new Risk and Response Framework that includes additional attributes and guidance on a staged response, including cultural tohu, additional monitoring of unanticipated changes, and efficiency measures • Support for haukāinga in the development of tohu that are relevant in their local area and communication of tikanga in how these are to be used and shared to manage risk • Improved information, education and reporting on the health of the system, and early signs of stress including a protocol for alerting and working with tangata whenua when the system is stressed • Consider using bonds (against land title) on the construction of geothermal wells, as a tool to apportion responsibility for long term management of adverse effects from wells

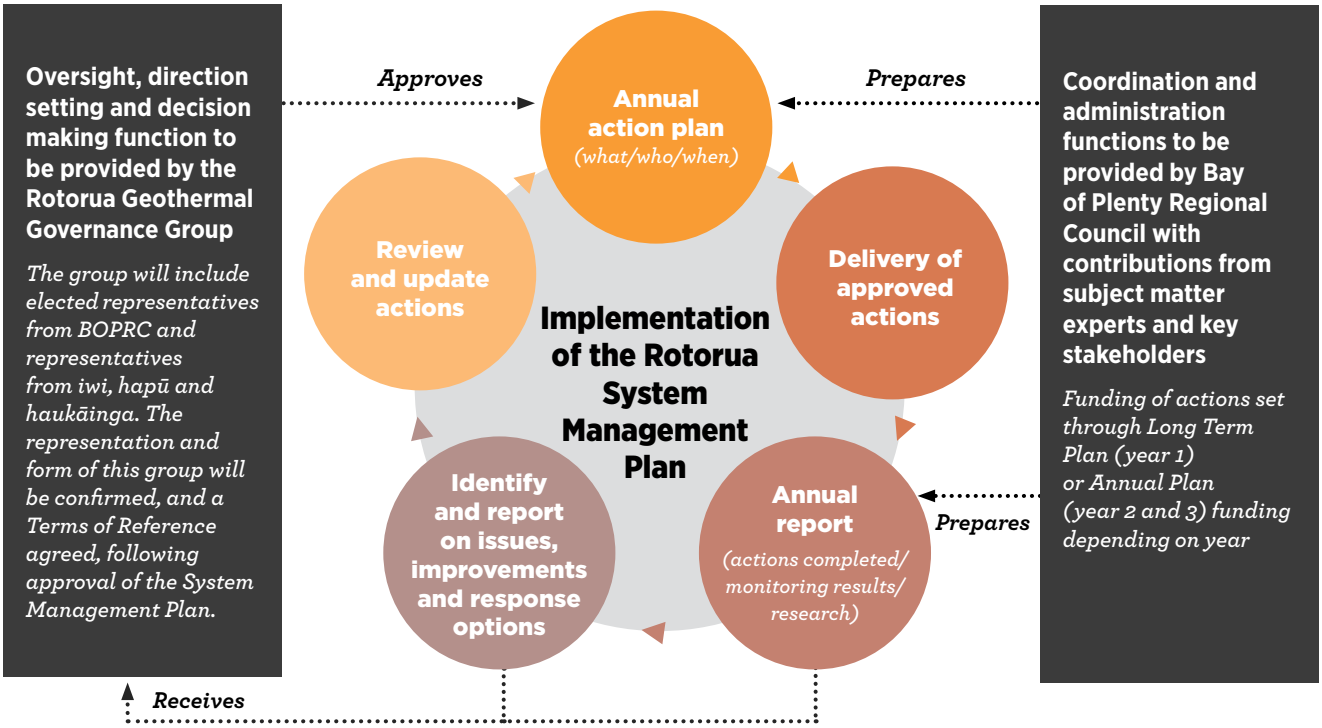
Some questions to think about

- Tell us what you think about our suggested approach to **managing and responding to risk**
- Do you support Council taking a precautionary approach, and reducing takes if the system becomes stressed?
- Do you support Council introducing bonds for geothermal wells to make sure the costs of well failures are picked up by the well owner or land owner, rather than the rate payer?

Te whakamahinga me te arotakenga o te Mahere Whakahaere Pūnaha
Implementation and Review of the System Management Plan

The SMP will be reviewed every ten years (to fit the regional plan review cycle) by Bay of Plenty Regional Council (or any future geothermal management entity).

Figure 13: System Management Plan implementation process



KUPUTAKA | GLOSSARY

Terms in italics are as defined in the Resource Management Act 1991

Ahi kā	Continuous occupation - title to land through occupation by a group, generally over a long period of time. The group is able, through the use of whakapapa, to trace back to primary ancestors who lived on the land. Also referred to as the home fires or burning home fires of occupation.
Ahi Tipua	A term to describe geothermal or volcanic activity. It originates from the journey of Te Hoata and Te Pupu from Hawaiki to Tongariro.
Atua	Ancestor with continuing influence, god, demon, supernatural being, deity, ghost, object of superstitious regard, strange being - although often translated as 'god' and now also used for the Christian God, this is a misconception of the real meaning. Many Māori trace their ancestry from atua in their whakapapa and they are regarded as ancestors with influence over particular domains. These atua also were a way of rationalising and perceiving the world. Normally invisible, atua may have visible representations. (from Te Aka Māori Dictionary)
Customary uses	The use of geothermal for customary wellbeing, regardless of the method of extraction, including for home heating, cooking, wellness (also see customary practice)
Customary practice	The use of geothermal using traditional sustainable practices in accordance with tikanga, excluding the use of geothermal wells (also see customary uses)
Discharge	*To emit, deposit, and allow to escape. For geothermal this usually relates to discharge of water or gas*
Down hole heat exchanger	A device installed down a geothermal bore to remove heat from a geothermal system without removing geothermal fluid, using fresh water circulated through a heat exchanger at depth (from the Regional Natural Resources Plan).
Efficiency	For the purposes of measuring efficiency of geothermal resource use (section 7 RMA) efficiency has several dimensions. Efficiency includes the comparison of the overall benefit to society (economic efficiency) of competing uses (allocative efficiency), productive efficiency, and the ability of productive efficiency to increase over time through technology improvements and better understanding of the resource (dynamic or innovative efficiency) (from RPS).
Geothermal aquifer	A permeable geological formation, group of formations, or part of a formation, beneath the ground, capable of receiving, storing, transmitting and yielding geothermal water. Groundwater is heated at depth by surrounding heated rocks and may also receive input from magmatic fluids. Geothermal heat and hot water is transported within and between different hydrogeological units by convection, advection and/or conduction.
Geothermal aquifer pressure	The force exerted by water (including steam) across a geothermal aquifer, dependent on water level and temperature. Pressure response is influenced by recharge, and the replacement of water as it is abstracted and reinjected, as well as changes to boiling zones and volumes of non-compressible gases. Usually measured in bar
Geothermal aquifer water level	The piezometric surface of an unconfined geothermal aquifer, defined by the interface between the vadose zone and the saturated zone. In New Zealand Vertical Datum 2016, Geodetic Guidance (linz.govt.nz).

Geothermal energy	*Energy derived or derivable from and produced within the earth by natural heat phenomena; and includes all geothermal water*
Geothermal feature	Includes natural and relic features, and as defined in Annex A of the Bay of Plenty Regional Policy Statement (from RPS)
Geothermal hazard	Hydrothermal eruptions, dormant surface features, natural gases, subsidence and tomos from geothermal systems (from RPS)
Geothermal mass	A measure of the quantity of matter in the geothermal water, usually expressed in tonnes. The volume of geothermal water may change significantly with temperature and pressure changes during use. Mass rather than a volume (e.g. litre or m3) more accurately defines a quantity of geothermal water being used.
Geothermal water	*Water heated within the earth by natural phenomena to a temperature of 30 degrees Celsius or more; and includes all steam, water, and water vapour, and every mixture of all or any of them that has been heated by natural phenomena* Note: Geothermal water is generally a liquid when under pressure, no matter its temperature, but as it comes to the surface and reaches atmospheric pressure, it may turn from a liquid to a gas (steam) if over 100 degrees Celsius.
Geothermal well	A geothermal bore (hole) drilled into the geothermal system, intended to take or reinject geothermal water, steam and/or energy, or to investigate or monitor the geothermal resource. When used in the context of 'bore' the meaning remains the same.
Geothermal system (sometimes also referred to as a geothermal field)	A system defined by scientific investigation comprising geothermal energy stored as geothermal water or steam and the rocks confining them and associated water, steam and gas emissions and the geothermal surface features resulting from these emissions and is believed to have no hydrological connection to another system (from RPS).
Haukāinga	Home. Local people of a marae, home people. Also known as hunga kāinga (from He Kohikohinga)
Hunga tiaki	Te Arawa term with the same general meaning as kaitiaki
Joule	A unit of energy. One kilojoule equals 1000 joules and one megajoule is equivalent to one million joules.
Kaitiaki/ kaitiakitanga	*Means the exercise of guardianship by the tangata whenua of an area in accordance with tikanga Māori in relation to natural and physical resources; and includes the ethic of stewardship*
Mauri	The essential life force, energy or principle that tangata whenua believe exists in all things in the natural world, including people. Tangata whenua believe it is the vital essence or life force by which all things cohere in nature. When mauri is absent there is no life. When mauri is degraded, or absent, tangata whenua believe this can mean that they have been remiss in their kaitiakitanga responsibilities, and this affects their relationship with the atua (Māori gods). Mauri can also be imbued within manmade or physical objects (RPS).
Mātauranga Māori	Māori customary knowledge, traditional knowledge or intergenerational knowledge (from the New Zealand Coastal Policy Statement)
Minimum Geothermal Aquifer Water Levels	Minimum Geothermal Aquifer Water Levels refer to a water level in the geothermal aquifer, monitored using geothermal monitoring wells, that indicates the lower limit of the aquifer's safe operating space. The levels indicate the point at which surface features are likely to be at risk
Ngāwhā	A hot or boiling pool, including hot springs and mud holes (from He Kohikohinga)

Puia	Geyser – a boiling spring that boils up intermittently and violently (from He Kohikohinga)
Puna	Spring (of water), well, pool
Reinjection	The return of geothermal **water** into the geothermal aquifer from which it was taken (from the RPS).
Significant Geothermal Feature	Geothermal features include active and relic geothermal features and habitats including vegetation and fauna. Significant Geothermal Features are those that have been identified as geothermal features through the use of the feature descriptors of Appendix A - Definitions Annex A, and, then identified as significant through the application of the criteria of Appendix F Set 7 – Geothermal features, in accordance with Method 22 of this Policy Statement (from the RPS)
Taking of geothermal water	The activity of taking geothermal surface water, or the taking of geothermal water from the geothermal aquifer using a production well, regardless of whether it is reinjected. Does not include the extraction of geothermal heat using a down hole heat exchanger.
Gross water take	Represents the total amount of geothermal water allocated through consents or taken from the geothermal system over a period of time, normally one day, regardless of the end use or whether it is reinjected. Sometimes referred to as total water take.
Net water take	The amount of water that is not reinjected back into the geothermal system after use. This is expressed by the difference between the total daily take of geothermal water and total daily water reinjected back into an aquifer effectively interconnected with the geothermal system.
Taiao	World, Earth, natural world, environment, nature, country. (from Te Aka Maori Dictionary)
Take whenua	Land claim, land right. (from Te Aka Maori Dictionary)
Taonga	Treasure, property; taonga are prized and protected as sacred possessions of the tribe. The term carries a deep spiritual meaning and taonga may be things that cannot be seen or touched. Included for example are te reo Māori (Māori language), Wāhi Tapu, waterways, fishing grounds and mountains (from the RPS).
Taonga Tuku iho	Heirloom, treasure handed down, cultural property, heritage (from He Kohikohinga).
Wāhi tapu	Sacred place, sacred site - a place subject to long-term ritual restrictions on access or use, e.g. a burial ground, a battle site or a place where tapu objects were placed. (from Te Aka Māori Dictionary)
Wairua	Spirit (from the RPS)
Water	*(a) means water in all its physical forms whether flowing or not and whether over or under the ground* *(b) includes fresh water, coastal water, and geothermal water* *(c) does not include water in any form while in any pipe, tank, or cistern*
Waterbody	*fresh water or geothermal water in a river, lake, stream, pond, wetland, or aquifer, or any part thereof, that is not located within the coastal marine area*
Waiariki	Geothermal. Chiefly waters or water from the gods. A term to also describe a warm pool that doesn't boil (from He Kohikohinga)
Watt	A unit of power expressed in joules per second. 1 kW equals 1000 W. Usually used to quantify the amount of energy used over a period of time, e.g. kilowatts per hour kW.h.

TUHINGA TAUTOKO
SUPPORTING DOCUMENTS

The following is a list of some of the key policy and most recent technical documents that have informed the development of this SMP. A more comprehensive list of technical reports can be found on geothermal glossary and reports page of our website.

Alcaraz, S. A. 2014. 3-D Geological model of Rotorua, GNS Science Consultancy Report 2014/289. Prepared for Bay of Plenty Regional Council.36 p.

Bay of Plenty Regional Council. 2014. Bay of Plenty Regional Policy Statement. Strategic Policy Publication 2013/04.ISSN1173907.

Bay of Plenty Regional Council and GNS Science. 2021. Environmental Summary Report – Bay of Plenty Geothermal Systems The Science Story

Burnell JG. Rotorua Geothermal Reservoir Model Update. Lower Hutt (NZ) GNS Science. Prepared for Bay of Plenty Regional Council. 21p Consultancy Report 2020 - 01

Burnell JG. Modelling the Rotorua Geothermal System. Lower Hutt (NZ): GNS Science. Prepared for Bay of Plenty Regional Council. 83p Consultancy Report 2021-118 (revised Nov 2022)

Clearwater J, Franz P. Effects of Down hole Heat Exchanger and Doublet Systems on Geothermal Reservoirs. Flow State Solutions. Prepared for Bay of Plenty Regional Council. 59 pp.

Clearwater J, Franz P. Review of the Rotorua Reservoir Model. Flow State Solutions. Prepared for Bay of Plenty Regional Council. 11 pp.

Dobbie Mechanical Engineering Consultants 2021: Geothermal Energy Productive Efficiency Review. Dobbie Mechanical Engineering Consultants Report No. C2556-202102. Prepared for Bay of Plenty Regional Council. 32 pp.

GNS Science Consultancy 2022: Review of the Proposed Rotorua Management Areas. Report No CR 2022/59 LR. Prepared for Bay of Plenty Regional Council. 15 pp.

He Koha Kii Ltd. 2019. Geothermal Plan Review: Review of Iwi and Hapū Management Plans. Report prepared for the Bay of Plenty Regional Council

Rotorua Geothermal Regional Plan, 1999 Environment Bay of Plenty. Resource Planning Publication 99/02, ISSN 1170 9022.

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Sajkowski L, Houghton KM, Mountain BW, Burnell JG. 2022. Effects of reinjecting diluted mineral pool water into the Rotorua Geothermal System. Wairakei: GNS Science. 60 p. Consultancy Report 2022/18. Prepared for Bay of Plenty Regional Council.

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Scott BJ, Seward AM. 2022. Qualitative assessment and interpretation of trends in heat loss from surface features of the Rotorua Geothermal System. Lower Hutt (NZ): GNS Science. 27 p. Consultancy Report 2022/57. Prepared for Bay of Plenty Regional Council.

Scott BJ, Kissling WM, Moreau M, Sajkowski L, Burnell JG, Brakenrig T, Reeves RR. 2021. Assessing the Rotorua Geothermal System: a review of datasets. Wairakei (NZ): GNS Science. 101 p. Consultancy Report 2020/84. Prepared for Bay of Plenty Regional Council.

Seward AM, Sanders F, Mroczek EK, Reeves RR, Bromley CJ, Brakenrig T, Macdonald N, Graham DJ, Lor S. 2018. Rotorua heat flow survey 2018. Wairakei (NZ): GNS Science. 63 p. (GNS Science consultancy report, 2018/94). Prepared for Bay of Plenty Regional Council.

Te Ahi Kā Roa Rōpū. 2021. Ngā Wai Ariki o Rotorua: He Kohikohinga. Haukainga Perspectives on the Health and Wellbeing of Geothermal taonga within Rotorua

ĀPITIHANGA | APPENDICES

Appendix 1: Glossary notes for Te Ara o Ngā Wai Ariki

Line	
Title.	TE ARA O NGĀ WAI ARIKI. The Geothermal Trail of Chiefly Waters
1, 3, 6, 18, 30.	**Ngātoroirangi.** High priest of the Te Arawa canoe during the great migration from Hawaiki to Aotearoa. His supernatural abilities stemmed from the heavenly abode of Rehua. Ngātoroirangi then brought the sacred practice of incantation and ritual chants to his people.
2, 4, 6, 18.	**Tongariro.** The mountain south of Taupō which marks the southern boundary of Te Arawa canoe territory.
6.	**Tohunga.** A talented expert of a particular vocation e.g. high priest or master carver – chosen by tribal leaders or the tribe to be a leader in their particular vocation. In reference to Ngātoroirangi, the high priest of Te Arawa canoe during the great migration from Hawaiki to Aotearoa. His supernatural abilities stemmed from the heavenly abode of Rehua. Ngātoroirangi then brought the sacred practice of incantation and ritual chants to his people.
6.	**Te Arawa waka.** The name of that waka; the canoe which brought the ancestors of the Te Arawa people to Aotearoa.
15, 31.	**Hawaiki.** The ancient homeland from which Māori people migrated to Aotearoa.
16.	**Te Pupu & Te Hoata.** The subterranean goddesses of fire.
17.	**Aotearoa.** The original and Māori name for New Zealand.
25/26, 27, 32.	**Whakarewarewa. Te Whakarewarewa. Te Whakarewarewa Te Tunga o te ope taua ā Wāhiao.** *The Uprising of the Army of Wāhiao.* (A translated variation of the full name of the village). Home of the Tūhourangi Ngāti Wāhiao people. Over 300 years ago, a war party led by the fierce warrior and chief Wāhiao had gathered. Hidden by the geothermal steam they performed a Haka (war dance) before charging into battle.
26, 28.	**Wāhiao.** The illustrious chief, leader, and warrior of his people. Also the name of the wharenui (meeting house) in the village of Te Whakarewarewa.
29.	**Mauriora Kingi MNZM.** *"expert in the traditions, history and whakapapa of the Arawa people, a respected orator of the Tuhourangi Ngati Wahiao tribes and indeed the wider Te Arawa confederation".*
29.	**Pātere.** A fast-paced, rhythmic, and monotonous chant or lament, accompanied by gestures that enhance and/or depict the mood and lyrics.
29/30.	**Me timata e ahau i a Ngātoroirangi.** Originally composed for Te Roopu Ngāti Rotowhio (formerly the NZ Māori Arts & Crafts staff, now Te Puia).
33, 42, 60.	**Ngāti Whakaue.** Name of the Iwi (Tribe). The Iwi takes the name from the eponymous ancestor Whakaue-Kaipapa, son of Uenukukōpako. Whakaue was the father of many of our tūpuna (ancestors) who also went on to become the forebears of their own Iwi and hapū (subtribes).

33.	**Waiata.** A māori song or chant, usually commemorative of a significant event, landmark, voyage, person.
34.	**Ngāwhā.** Geothermal, thermal. Boiling springs, geothermal steam, mud pools, sulphur water, geysers.
36, 37, 41, 50, 59.	**Rakapa Kahoki.** Daughter of Te Wehi-o-te-rangi of the Arawa canoe, a warrior ancestor of Ngāti Whakaue; and Te Rangitopeora, a Rangatira of the Ngāti Toa tribe. Related to Ngāti Raukawa, a leader, peacemaker, and composer of exceptional ability.
37.	**E ta uru waho.** He waiata aroha mo Petera Te Pukuatua, nā Rakapa Kahoki. A love song for Te Pukuatua, by Rakapa Kahoki.
37, 39, 40, 55, 58.	**Whakahinga.** The geyser to the west of the Utuhina stream at Ōhinemutu.
38.	**Utuhina.** The name of the stream that runs along the Ōhinemutu village into Lake Rotorua.
38, 44.	**Ōhinemutu.** The ancestral village of Ngāti Whakaue on the south-west shore of Lake Rotorua. A significant feature of this locality is the geothermal activity such as the hot spring Ouru; Ruapeka, the geothermal lake between Tunohopu and Tamatekaupua; and Waikite, another volcanic feature. The name itself derives for the death of Hinetekakara, the wife of Ihenga. Koro Hamuera Mitchell has provided the following explanation: When Ihenga heard that Hinetekakara had been killed, he bowed his head and cried. 'And so, Hine, your time with me has ended.' From this statement, the name Ōhinemutu has remained to the present day.
41, 45, 51, 59.	**Petera Tukino Te Pukuatua.** Petera Te Pukuatua. Tukino. Son of the Ngāti Whakaue warrior chief Te Pukuatua. A formidable Te Arawa leader from Whakaue & Maketu. One of the chief Whakaue negotiators and a signatory of the Rotorua township agreement in 1880.
44.	**Te Hau no uta.** He waiata aroha mo Petera Te Pukuatua, nā Rakapa Kahoki. *A love song for Te Pukuatua, by Rakapa Kahoki.*
44, 46, 47, 49.	**Te Ruapeka.** The bay at Ōhinemutu, stretching from the mouth of the Utuhina stream to the top of the Muruika peninsula. Petera lived on a section of land called Ruatau, which was bounded by Ruapeka Bay.
48.	**Horohoro.** An abbreviation of Te Horohoroinga-o-nga-ringaringa-a-Kahumatamomoe, 'the washing of Kahumatamomoe's hands'. An area some fifteen kilometres south-west of Rotorua.
50.	**Te Roa o te po.** He waiata aroha mo Petera Te Pukuatua, nā Rakapa Kahoki. *A love song for Te Pukuatua, by Rakapa Kahoki.*
52.	**Rotorua.** Te Rotorua-nui-a-Kahumatamomoe (Full name). The name given to Lake Rotorua by Ihenga as a sign of respect and deference to his father-in-law, Kahumatamomoe. Also the name of the town.
54, 57.	**Ngongotaha. Ngongotahā.** The mountain of that name in Rotorua.
Acknowledgements	• **He Kohinga Moteatea o Ngati Whakaue,** na Rawiri Rangitauira • **Me timata e ahau i a Ngātoroirangi,** kaitito Mauriora Kingi

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