Proceedings World Geothermal Congress 2010
Bali, Indonesia, 25-29 April 2010

Sustainability and the Democratic Process

Katherine Luketina

Waikato Regional Council, PO Box 4010 Hamilton East 3247, New Zealand

Katherine.luketina@ew.govt.nz

Keywords: Sustainable management, Waikato Region, New Zealand, Policy, regulation.

ABSTRACT

For sustainable management of natural and physical resources, New Zealand is divided into 16 regions overseen by publicly elected councils. These Regional Councils are required to consult widely within their communities when developing policies and rules. Waikato Regional Council is responsible for 70% of the nation's geothermal resources. Its geothermal policies have been shaped over several years through the input of multiple stakeholders, councillors, and judiciary panels.

This paper describes the iterations that the policies of single operator/multiple operator, reinjection/injection, and sustainable use have gone through since the first version of the geothermal policy was drafted in 1997, and discusses the various stances that stakeholders adopted during the process, and the synergies and in some cases, compromises, reached. The result is a policy package, underpinned by robust scientific evidence, that ensures protection of some geothermal resources and enables sustainable use of others.

1. INTRODUCTION

Waikato Regional Council (WRC) was formed in 1989 when the Local Government Act divided New Zealand into twelve regions, each overseen by an elected council. Under the Resource Management Act 1991 (the RMA), each Regional Council has responsibility for ensuring sustainable management of natural and physical resources in its Region. Dickie and Luketina (2005) describes the local government structure and environmental legislation in New Zealand, particularly in relation to geothermal resources.

WRC, in the central North Island, is responsible for 70% of the nation's known geothermal resources. These include 15 high-temperature large system and about 30 isolated sets of hot springs (see Figure 1).

In 1997, WRC embarked upon the development of a Regional Plan to provide Objectives, Policies, and Methods including Rules for the sustainable management of natural and physical resources in the Region. This included a chapter dealing with geothermal resources.

Over the 18 years since WRC was established, its geothermal policy has evolved as result of several factors including WRC politicians and staff developing a greater understanding of the different values that people place on the geothermal resource, increased scientific evidence regarding the state of the geothermal resource and its sustainable management, and the input of various stakeholder groups including Government Departments and agencies, District and City Councils (responsible for providing public amenities and services such as libraries, roads, and water and waste water services), electricity generators, native Maori tribes (acting variously as electricity generators, landowners, and cultural custodians of the resource), tourism and other direct users, and conservation lobby groups.

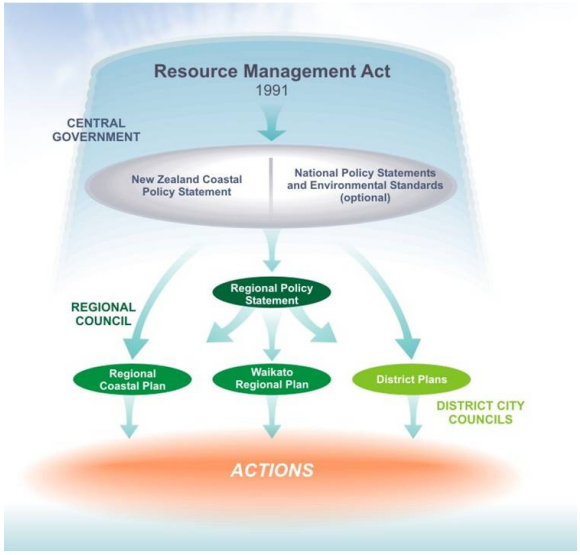
Figure 1: Geothermal Resources of the Waikato Region.

2. POLICY DEVELOPMENT FRAMEWORK

The RMA requires each Regional Council to have a Regional Policy Statement (RPS) that provides an 'overview of the resource management issues of the region and policies and methods to achieve integrated management of the natural and physical resources of the whole region'. Councils may also develop a Regional Plan. In practice, all councils have produced a regional plan, because that enables them to regulate activities by providing rules about what may or may not be done when people take, use, or discharge to natural and physical resources. The relationship between Policy Statements and Plans can be seen in Figure 2.

The process a regional council must follow in developing a regional policy statement or plan is specified in the RMA. Usually, the first step is that the council voluntarily produces a draft policy document and seeks input from stakeholders and the public. Once feedback has been processed into the draft document, the Policy Statement or

Plan is publicly proposed and anyone may make a submission on it. Submissions are heard by a Council committee, the document amended, and a Decisions version released. Appeals to the Environment Court may be made by anyone who submitted on the Plan. During the Environment Court process, mediation between the Council and appellants may be ordered by the Court to try to resolve matters. Once all appeals are settled, appellants may make a further appeal to the High Court, but only on points of law, meaning that no new evidence can be heard. Once any and all submissions and appeals are settled, the Policy Statement or Plan becomes fully Operative. As the document proceeds through the stages from Proposed to Operative, increasing weight must be given to it when considering Resource Consent applications, compared to any existing operative Policy Statement or Plan.



v

Figure 2: Environmental Regulation in New Zealand.

Once a Policy Statement or Plan is operative, any new process to change its content is called a 'change'. If the document is not yet operative, such a process is called a 'variation'.

3. HISTORY OF WAIKATO REGIONAL GEOTHERMAL POLICY DEVELOPMENT

Following the 1989 creation of Regional Councils and the 1991 introduction of the Resource Management Act 1991, Waikato Regional Council produced a rudimentary Transitional Regional Plan under the Transitional Provisions of the RMA. Development of the Waikato Regional Policy Statement (RPS) commenced in 1991 and this became operative in 2000. As the RPS is the overarching policy document for the region, it needed to be substantially completed before development of the Regional Plan could commence. The Regional Plan was Proposed in 1997 and a Decisions version released in 2001.

The Geothermal Chapter of the Decisions version of the Plan reflected the evolution of Council's ideas over the years of managing the geothermal resource. Compared to the RPS and earlier version of the Plan, it included a greater awareness of the value and fragility of geothermal surface features and their associated ecosystems, and the value of geothermal resources as a tourist attraction. It provided a greater emphasis on the roles of District Councils in managing land uses that affect the geothermal resource. It required sustainability of energy extraction and efficiency of use. It included controls on surface discharge of geothermal fluid and encouraged reinjection to limit subsidence and other adverse effects.

Some appeals against the Geothermal Chapter of the Plan asserted that there were inconsistencies between the management approaches in the Plan and the Policy Statement. Others appeals would have required a variation to the Regional Plan to resolve, as there was insufficient scope in the submissions received on the proposed plan to make the necessary changes under the existing appeal process. As a consequence, in March 2003, Council resolved to vary the Plan and change the Policy Statement, in order to provide an integrated framework for the management of geothermal resources in the Region. Council preferred to change the Policy Statement to reflect its current stance than to resolve the inconsistencies by adjusting the Plan to fit the existing Policy Statement. This resulted in the whole process starting again for the geothermal chapters of both the Policy Statement and Plan, while the resolution of appeals on the rest of the Plan took a different path.

Draft versions of the Geothermal Chapters for the Policy Statement and Plan were released for comment in May 2003, and the documents were proposed in August 2003. There were 44 submissions. The Decisions version was released in June 2004, and there were 7 appeals. The Environment Court divided the matters in the appeals into A and B matters. The A matters were heard by the Court in late 2005. Mediation of some of the B matters was undertaken in mid-2006, and the unresolved B matters were heard by the Court in August 2006, at the end of which the full content of the Policy Statement Geothermal Chapter was sealed by the Court. An appeal was made to the High Court on the Plan's Geothermal Chapter. This was heard in September 2007 and the Court's decision rejecting the appeal was released in December 2007. This resolved the content of the Waikato Regional Plan Geothermal Chapter, almost exactly ten years after the process started.

Environment Waikato invested a total of $1.4million dollars over three years and five months into the revised policy and plan package for the management of geothermal resources. This included the costs to the regional council of:

- Resource investigations and associated contracts,
- Policy design, consultation with affected parties
- Funding the complete RMA first schedule process, including the following project stages and milestones.

A brief timeline of the project is as follows:

1989	WRC created
Oct 1991	Resource Management Act commenced
Dec 1992	Draft RPS
Oct 1993	Proposed RPS
Dec 1997	Draft WRP
Sept 1998	Proposed WRP
Sept 1999	Decisions RPS
Oct 2000	RPS operative
Oct 2001	Decisions WRP
March 2003	Council resolution to proceed with change and variation
May 2003	Draft released for consultation
August 2003	RPS Change and variation proposed
Feb. 2004	Hearings concluded

June 2004	Council Decision released
late 2004 – mid-2005	Facilitated meetings with appellants
Sept. 2005	8½ weeks Environment Court hearing
April 2006	Environment Court interim Decision
Mid 2006	5 weeks Court facilitated mediations
August 2006	RPS Consent order signed & sealed
August 2006	2 weeks Environment Court Hearing
Nov. 2006	Environment Court Decision released
Dec 2007	High Court Decision released
Dec 2007	RPS geothermal section operative
Nov 2008	WRP geothermal section operative

The process has benefited by the timely and high quality contributions of all stakeholders involved. In recognition of the policy package's visionary approach, in May 2008 it was awarded the New Zealand national prize in the World Energy Globe Awards at the European Parliament in Brussels. It was one of the few projects competing with the many representing physical construction projects and new innovations in technology. It was seen as providing the 'soft infrastructure' that allows such physical projects to happen, and as providing a model for other countries with geothermal, and indeed other energy, resources.

4. MAJOR STAKEHOLDERS

Stakeholders include Maori landowners and those with tangata whenua status, District and City Councils, conservation groups, geothermal power companies, other users of geothermal resources such as motel, hotel, and swimming pool proprietors, tourism ventures and direct heat industrial users, and several government departments and agencies.

For the final stage of the policy development, the seven appellants to the Environment Court and some of their main concerns are as follows:

- Geotherm Group Ltd, a privately-owned existing multiple operator on the Wairakei-Tauhara System. They appealed against the Single Operator policy, and supported full reinjection to limit pressure drawdown and improve sustainability.
- Taupo District Council. Nine of the Region's 15 geothermal systems lie within the Taupo District. Taupo town, built over the Wairakei-Tauhara Geothermal System and beside Lake Taupo, is subject to some development-induced subsidence. Taupo District Council sought mandatory 100% reinjection to limit subsidence and supported the Single Operator Policy, so that effects could be more easily managed.
- Mighty River Power Ltd, a state-owned enterprise operating the hydro-electric dam system on the Waikato River and with interests in several geothermal power developments. They supported reinjection but sought some flexibility in reinjection regimes, and supported the single operator policy.
- Contact Energy Ltd, a publicly listed company, and owner of the Wairakei Power Station. They sought policies and rules enabling large-scale discharge of geothermal fluid to surface water, land use activities in proximity to Significant Geothermal Features, and a multiple operator policy.
- Rotorua District Council, which was concerned primarily to change the status of Te Kopia Geothermal System from Research to Protected. This appeal was resolved by negotiation between parties before reaching court. Trustpower had submitted that Te Kopia should be allowed to be developed, but later chose not to pursue development of the system. Rotorua District Council and Department of Conservation then provided Waikato Regional Council with sufficient evidence regarding the international significance and vulnerability of the geothermal features and vegetation, outside of the court process, to convince WRC that the system should be reclassified as Protected.
- Ngati Kurauia and Lake Rotoaira Forest Trust, a Maori tribe and its associated forestry company, with interests in protecting and developing the Tokaanu Geothermal System. This appeal was also resolved following changes to the wording of some parts of the policy documents to provide greater recognition of tangata whenua stewardship rights, and changes to the rules for Limited Development Systems to more easily enable sustainable use.
- Watercare Services Limited, the company set up by several city councils in the Auckland area to manage its water and waste services. They were concerned about the effect on drinking water quality of geothermal discharges to the Waikato River.

5. GEOTHERMAL MANAGEMENT CONCEPTS

Several of the concepts running through the geothermal policy documents attracted much attention from stakeholders. Input from Council staff and the Hearing Committee, the stakeholders, and the Court drove substantial evolution of these concepts over the ten years of policy development. These concepts included:

- Classifying geothermal systems for different uses.
- Mapping of geothermal system boundaries.
- Identification of Significant Geothermal Features.
- Single operator/multiple operator.
- Sustainability and Allocation over time.
- Reinjection/Injection.
- Reverse Sensitivity.

5.1 Classifying Geothermal Systems for Different Uses

From the start, with the draft Plan in 1997, it was seen necessary to allocate some geothermal systems for protection of surface features while allowing large-scale development in others. Allocation was to be based primarily on the existence of deep chloride springs that formed sinter terraces at the surface outflow, these being the features most sensitive to development. Geothermal systems with such features were to be protected, and those with only steam features would be available for large-scale development. If not enough was known about a geothermal system to classify it for protection or development, it would remain unclassified. Five systems were Protected, six were classified as Development, and four were unclassified.

This system of allocation was refined in subsequent iterations of the plan and RPS. There are now five system types, being:

Development Systems, in which large-scale development is enabled. There are seven Development Systems: Four of them (Wairakei-Tauhara, Ohaaki, Mokai, Rotokawa) have been developed and interest has been shown in the other three (Horohoro, Ngatamariki, and Mangakino).

Limited Development Systems, in which development is allowed as long as there are no significant adverse environmental effects, including to Significant Geothermal Features. The two systems in this category are Tokaanu-Waihi-Hipaua and Atiamuri.

Research Systems: this classification replaces the old tautological 'unclassified' classification, and includes known systems about which not enough is known to place them in another system, and any undiscovered systems. WRC undertakes to change the classification of a Research System if sufficient evidence is provided to warrant a change. There is only one known system in this category, Reporoa.

Protected Systems: The criteria for these have widened to include any features (not just chloride springs) that are particularly sensitive to development, any systems largely or wholly within a National Park or a World Heritage Area, and any system that has an outflow to a Protected System. Because only a Minister of the Crown, District Councils, and the Regional Council may seek a change to a RPS, Protected Systems are named in the RPS rather than in the Plan. This protects the systems from challenge of their status by other parties, and the consequent cost to the regional ratepayer of the cost of defence of the policy. There are five protected systems: Horomatangi, Orakeikorako, Te Kopia, Tongariro, and Waikite-Waiotapu-Waimangu.

Small Systems, a classification which covers the approximately 30 isolated sets of hot and warm springs not connected to any large high-temperature resource. Sustainable small uses are allowed in these systems.

5.2 Mapping of Geothermal System Boundaries

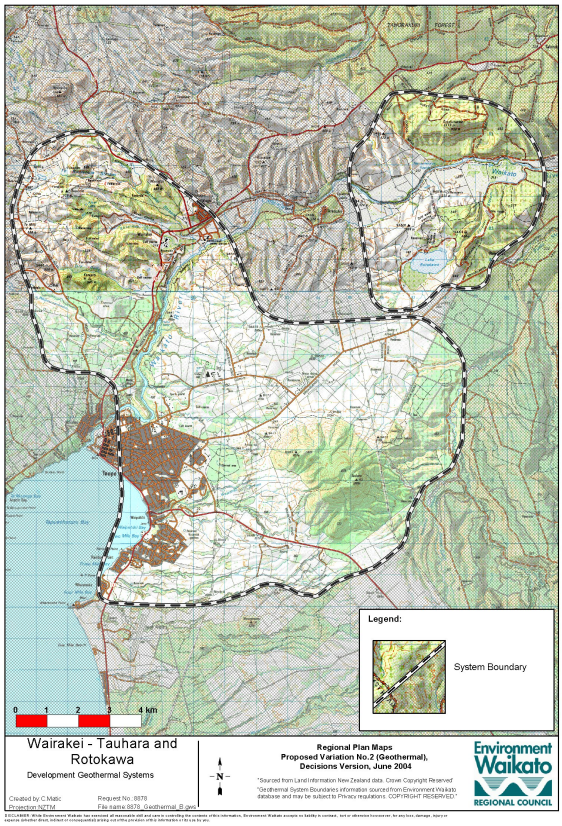


Figure 3: Wairakei-Tauhara and Rotokawa Geothermal Systems.

Development and Protected Geothermal Systems were originally to be mapped in the Plan, using resistivity contours and the presence of geothermal outflows. In the final version all but the Small Systems are mapped in the Plan, using all available existing relevant information, including geophysical and geochemical surveys, geology and drilling information and the presence of surface features including existing outflows and altered ground. Very little research has been conducted on small systems and some of them are ephemeral.

The Objectives, Policies, and Rules of the geothermal policy documents apply within the mapped boundaries of the systems. Provision is made for WRC to undertake a Plan change if new evidence shows the boundary should be changed.

Figure 3 shows the map of the Wairakei-Tauhara and Rotokawa Geothermal Systems. Figure 4 shows the final rules framework for each system type.

5.3 Identification of Significant Geothermal Features

The first proposed version of the Plan in 1998 had a list of 49 features, including areas containing several springs, that were classified as Significant Geothermal Features on the basis of vigorous sinter deposition, flowing geothermal water, heated land, sinter formed by earlier geothermal outflows, and geothermal ecosystems.

Some submitters argued that the list was arbitrary, so in the Decisions version the list was replaced by a definition. Significant Geothermal Features were now all features that fitted into the categories of geysers, mud pools, fumaroles, recent sinters, geothermal springs, seeps, and streams, geothermal lakes, and geothermal ecosystem. Each category carried a definition.

Appellants then argued that the categories included practically all geothermal surface manifestations, not just significant ones. In answer to this, for the 2003 Variation, WRC embarked on an exercise to develop scientifically defensible categories of Significant Geothermal Features based on rarity and vulnerability to adverse effects from extractive uses or other uses of surrounding land and water (Keam *et al.*, 2005).

The list contained the following categories: geysers; springs vigorously depositing sinter; recent sinter; significant geothermal habitat; mud geysers; molten sulphur-producing springs; superheated fumaroles; geothermal wetlands, lakes pools and streams; and hydrothermal eruption craters. In addition, by request of stakeholders during the drafting of Variation 2, the category of Culturally Significant Feature was added to ensure protection of any features that did not meet the scientific criteria but were valued for spiritual, historical or other cultural reasons. Similarly, although the original ranking excluded mud pools, stakeholders requested that these be included. This merely involved reducing the cut-off point for inclusion that was based on a numerical rating, as they had only narrowly missed out in the first place.

Court-directed mediation during the appeal process resulted in the splitting up of the geothermal habitat class into the three classes of:

- Geothermal habitat on heated ground or cooled acid ground;
- Habitat dependent on geothermally-altered atmosphere; and
- Geothermally-influenced aquatic habitat.

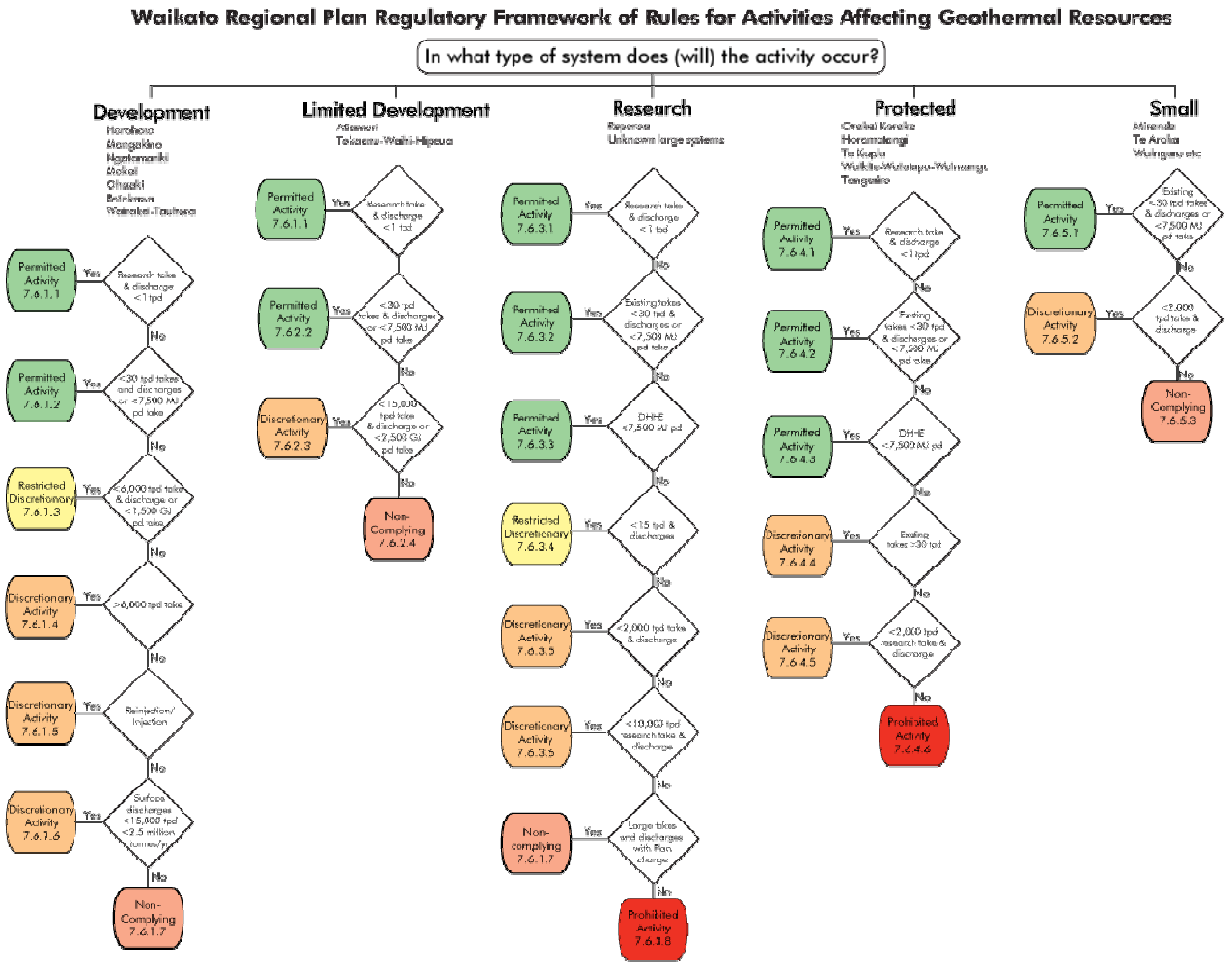


Figure 4: Waikato Regional Plan Regulatory Frameworkof Rules for Activities Affecting Geothermal Resources.

Geothermal surface features that are not considered significant include any heated, steaming, or altered ground that does not support a geothermal ecosystem, fumaroles that discharge steam at 100 degrees or less, geothermal springs that do not deposit sinter, and ancient sinter deposits.

To provide certainty to developers, features in Development Geothermal Systems and Limited Development Geothermal Systems that meet those definitions are mapped in the Plan, and the policies and rules for those systems relate only to them. These systems have been well-studied and it is assumed that sufficient is known about them to map all features, although it is acknowledged that variations or changes to the Plan are needed every few years to keep up with the dynamic nature of geothermal features, which can lead to changes in the area a feature covers, springs running dry, and new features forming. Figure 5 shows the Lake Rotokawa Significant Geothermal Feature, in the Rotokawa Geothermal System.

In other systems there are no maps and instead the definitions of the feature types are used for identification. This is for several reasons. In some systems, features are remote and access is dangerous due to unstable ground and other hazards, making mapping unfeasible. Because of the rugged terrain, it is expected that some features are as yet undiscovered. Also a lower level of threat to the features is envisaged because of the protection they receive through the RPS and Plan, so mapping is not necessary to provide certainty to users, and can be undertaken case-by-case.

In Protected Systems, geothermal features that do not meet the definition of Significant Geothermal Features are also given some measure of protection. As well, in a separate section of the Plan, rules provide some additional protection from drilling practices to geothermal features that produce or contain surface geothermal water, whether or not they fit the definition of Significant Geothermal Feature. These features are termed Geothermal Water Features.

5.4 Single Operator / Multiple Operator

In 1993, the Proposed RPS contained policies requiring a single developer for each geothermal system. In 1999, the Decisions version made an exclusion for the Wairakei-Tauhara Geothermal System, where a single tapper policy was to be encouraged rather than required. This single tapper policy was implemented in the initial draft version of the Plan. Takes of more than 500 tonnes per day in Development Geothermal Systems were allowed as long as the take was made by a ‘Unit Company representing

owners of subsurface exclusive access to at least 75% of the land'. The Unit Company was required to provide sufficient information to enable assessment and appropriate management of adverse effects. It was also required to have an agreed management plan with the Maori tribe who held traditional guardianship over the resource, known as tangata whenua (people of the land).

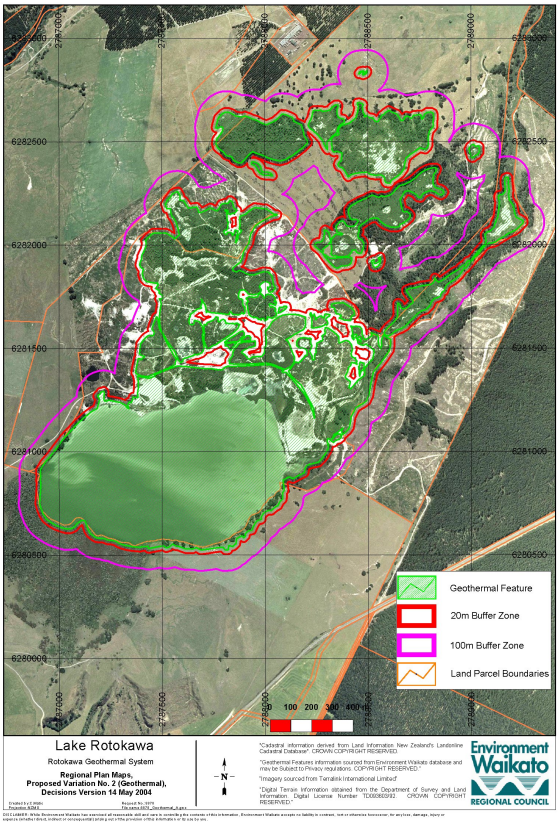


Figure 5: Lake Rotokawa Significant Geothermal Feature.

In the Proposed Plan (1998), these requirements had changed due to the practicalities of implementing such a scheme, and legal issues regarding the definition of a 'unit company'. Now the application had to be made by 'a person or body representing owners or parties who hold the legal rights to subsurface access to at least 65% of the land within the Development Geothermal System Boundary'. This body had to allow access or compensation for those who had access to the rest of the system. Not only did they have to have an agreed management plan with the relevant Maori tribe, they also had to allow them participation in the development.

In the decisions version of the Proposed Plan and the draft version of the subsequent Variation, these conditions were removed as they were considered too restrictive. Any application for takes of more than 30 tonnes per day from a Development Geothermal System could now be considered.

In the Proposed Variation, to ensure sustainable management of the geothermal system, the requirement was added that any 'large' take in a Development Geothermal System over 1000 tonnes per day needed a System Management Plan.

In the decisions version of the Proposed Variation (2003), the definition of a 'large' take was increased to 6000 tonnes per day. As well as needing a System Management Plan, the development had to be overseen by an independent Peer Review Panel, and there could be only one body undertaking a large take on each Development System. The body was now termed a 'Single Operator' rather than a 'Single Tapper' in alignment with the policy direction that the operator would do more that just tap the resource, but would manage the resource holistically, including ensuring use and discharge was part of the overall sustainability strategy.

The Environment Court ruled against the single operator policy and enabled multiple large users on a Development Geothermal System. Where there are multiple operators, it requires that WRC must impose a statutory requirement for a Multiple Operator Agreement whereby the operators "coordinate and cooperate through agreements such as steamfield management agreements and field operation protocols. These agreements need to address such matters as: efficient and beneficial use of the resource; mechanisms for conflict resolution; and accountability for adverse effects.

The System Management Plan must include processes for preparation, amendment and review, and provide for operational flexibility and adaptive management.

There is to be provision for a wider liaison forum to be set up for each system. This "would be separate from the Peer Review Panel and would enable formalised and regular ongoing communication with third parties and other stakeholders, in particular territorial authorities. The Peer Review Panel's reports would be made available to this forum.

The Court also made it clear that WRC was to adopt an active role in the management of the system, actively overseeing the operation of the Peer Review Panel.

5.5 Sustainability and Allocation Over Time

Methods to achieve sustainability of Development Geothermal Systems were not specifically addressed in the earlier versions of the RPS. It was considered that technological improvements in drilling methods would be able to keep up with the demand for high-enthalpy fluid. In the corresponding early versions of the Plan, it was identified that unsustainable or inefficient take could result in premature resource depletion. A Peer Review Panel was required to assist Council to "manage the sustainable development of the Development Geothermal System". The 1998 Proposed Plan required a System Development Plan including proposed stages of development. The Peer Review Panel was to be established only if WRC decided it was necessary.

In 2001 the decisions version introduced the requirement for developments to be undertaken in a way and at a rate which maintains the flow of this fluid within the geothermal system for future generations.

Following the decision to review the geothermal sections of the RPS and WRP, sustainability of take and use became an explicit objective of the policy documents. The Peer Review Panel was a policy mechanism for achieving this but there was no requirement for a System Management Plan in the draft version. This was reinstated in the proposed version, and developments had to be sustainable for at least 100 years. Developers submitted that the 100-year rule was too restrictive and did not take into account the relative size of geothermal systems. In response, the

Decisions version contained a Policy with a more flexible requirement to control the rate and volume of takes in Development Geothermal Systems by applying a social discount rate that considers the reasonably foreseeable needs of future generations, staging development of the resource, and promoting efficient management of the system.

In economic theory, when using a finite resource, greater value is placed on using the resource now as opposed to later. A usual discount rate for valuing a resource is 10% per annum, that is, if you use it now it will earn you 10% more than if you use it next year. A social discount rate places greater value on the ability to use the resource later, and is usually only about 2 to 3%.

The developers appealed against the application of the social discount rate, stating that they didn't understand the concept. Through mediation an agreement was reached whereby the stated objective was 'controlled depletion of energy so as to provide for the energy needs of current and future generations. In this context, the objective is interpreted as intending that the 'the next few generations have equitable access to the same resources that we do. This echoes the purpose of the RMA, which includes the aim of 'sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations.

Beyond the next few generations, it is expected that other energy sources will have been developed. Thus, geothermal energy can be considered as a transitional source to help the Government meet its Kyoto and beyond obligations.

5.6 Reinjection / Injection

Reinjection was not mentioned in the policies of the early versions of the RPS or WRP. Discharges of geothermal water to surface water or land, or into the ground, were treated equally in the WRP Rules.

In the review of geothermal policy in 2003, reinjection went from being a non-issue to a major issue. A hierarchy of rules was introduced that encouraged reinjection in order to mitigate a range of adverse effects, including reservoir depletion, effects on surface features, subsidence, and the risk of hydrothermal eruptions. Injection outside the geothermal system was also allowed. Existing large discharges to surface water were allowed. New discharges of condensate to surface water were allowed, but new large discharges of separated water were only allowed if there were no adverse effects or if the discharge was consistent with the Policies of the WRP. Allowance was made for surface discharge by small users and cascaded users of water discharged from power stations, such as the Wairakei Prawn Farm and the Wairakei Terraces tourism venture.

Most of the submitters, and subsequently, appellants, including geothermal power companies, largely supported this policy direction. Several local authorities that draw water from the Waikato River for town supply wanted to reduce discharges of geothermal contaminants to the river.

Mighty River Power Ltd (MRP) is the operator of two geothermal power stations in the region effectively engaging in full reinjection. It also owns and operates the eight hydro-electric power stations on the Waikato River generating 1000 MW. It supported reinjection but wanted to flexibility to ensure that sufficient surface discharge was allowed for uses such as drilling and well testing. Although generation by the hydroelectric power stations benefited from the approximately 1% increased river flow caused by the large river discharge from the Wairakei Power Station operated by Contact, contaminants are an issue for water quality. MRP also sought the ability to inject used geothermal fluid outside the geothermal system.

Reinjection was also supported by two major Maori tribes with tangata whenua status over the Waikato River. They provided evidence as WRC's witnesses in the Environment Court. Through a recent Treaty of Waitangi settlement, the Waikato-Tainui tribe has become the owner of the bed of most of the Waikato River. This includes the beds of the hydro-electric lakes, most of which are registered as contaminated sites due to arsenic of geothermal origin in the sediments. The tribe's Environmental Resources Manager dealt with issues of contamination of the sediments and the aquatic ecology by geothermal arsenic, mercury, and heat, and the consequent effects on food and water taken from the river for human consumption. One of their politicians and elders discussed the spiritual and physical wellbeing of the river, an important part of the tribe's identity.

The Raukawa tribe's evidence also focused mainly on the spiritual and physical wellbeing of the river. Both tribes were concerned about the mana (spiritual power) and mauri (life-force) of the river.

Taupo District Council wanted full 100% reinjection and injection of additional fluid to make up for losses in volume due to cooling. Their concern primarily related to limiting subsidence.

Contact Energy Ltd, in contrast to other parties, sought a policy that would enable discharges to surface water. They argued that reinjection would cool the reservoir, and presented reservoir modeling evidence that this would happen with reinjection into the Wairakei borefield. Other parties pointed out that the borefield was only a small part of the Wairakei-Tauhara geothermal system and that the policies did not promote reinjection specifically into the borefield but into the system generally. Both Taupo District Council and Geotherm developed competing reservoir models for the Wairakei-Tauhara system and provided modeling evidence that conflicted with Contact's. The Environment Court ruled against Contact's appeal.

The policy now requires large operators in Development Geothermal Systems to have a Discharge Strategy to either reinject used geothermal fluid into the geothermal system or inject outside the system. The policy sits in the RPS and is worded as follows:

Reinjection / Injection

For large takes of geothermal energy and water from Development Geothermal Systems, the geothermal water remaining after use is to be reinjected / injected in accordance with a Discharge Strategy forming part of a System Management Plan which shall consider the following matters, as relevant to:

a) Dispose of waste water;
b) Return geothermal water to that system;
c) Facilitate further extraction of energy from the system;
d) Avoid or mitigate potential differential subsidence, and remedy or mitigate the adverse effects of subsidence, particularly in the built environment
e) Reduce the risk of hydrothermal eruptions particularly in the built environment;

f) Remedy or mitigate significant adverse effects on Significant Geothermal Features; and

g) Avoid, remedy or mitigate contamination of surface and ground waters.

Such Discharge Strategy shall also have regard to:

i. Any likely benefits to or adverse effects on the system or its productive capacity;

ii. The need for adaptive management and flexibility over time.

iii. The benefits, costs and adverse effects of the Discharge Strategy;

iv. The need to avoid or mitigate potential differential subsidence, and remedy or mitigate the adverse effects of subsidence, particularly in the built environment; and

v. The need to reduce the risk of hydrothermal eruptions particularly in the built environment.

The policy is implemented in the Plan by subsidiary policies, and a set of rules that enable reinjection/injection and make it difficult for surface discharges of more than 15,000 tonnes per day.

5.8 Reverse Sensitivity

Reverse sensitivity is the term used when use of a particular resource is constrained by other uses of that or other resources. With respect to geothermal development, it applies to the problems that arise when land uses such as the siting of towns or other infrastructure over a geothermal system prevent development of the system. This was recognised as an issue in the final versions of the policy documents, following representation by Taupo District Council and Contact Energy.

CONCLUSION

WRC is now well-positioned to deal with the consenting processes for the many large-scale geothermal electricity developments, currently understood to be budgeted at $NZ 2.6 billion, that are planned by electricity generation companies alone. Obtaining resource consents for renewable geothermal energy should be a much more streamlined process in the future, ensuring that geothermal systems classified for development can be utilised effectively, without impacting on the ability of future generations to enjoy the cultural, economic, environmental and social benefits of other systems.

WRC has set in place a package of robust policy and methods to ensure that the geothermal resource is not prematurely depleted through *ad hoc* development:

- Large-scale users in Development Geothermal Systems must provide a system management plan detailing rates of take and reinjection, and location of wells, to ensure that their use of the system can be maintained over several generations rather than within an economic plant life of say thirty years.

- A stepped approach to development is required, with relatively small takes initially, during which testing is conducted to determine whether the resource can sustain a larger take. Stepped development leads to lower long-term production costs than by developing the system in one step (Stefansson and Axelsson, 2005).

- System management is to be overseen by a Peer Review Panel comprising an independent body of experts whose function is to assist Environment Waikato to ensure the geothermal resource is sustainably managed in line with system objectives.

- Reinjection is preferred and encouraged through policy and a hierarchy of rules. Reinjection returns used geothermal water and a substantial body of unused heat to the system and facilitates further extraction of energy from the system.

- Technologies that are efficient in their use of energy and water are encouraged.

- Distribution by developers of geothermal energy and water to other users is encouraged, particularly for uses that have high efficiency and provide a community benefit.

In the management of the Regional Geothermal Resource, there is a need to recognise the importance of protecting the variety, and as much as is practicable, extent of the characteristics and values that are associated with the resource, as well as recognising its development potential. The management framework put forward in the Plan seeks to meet these two directions while avoiding degradation of the Regional Geothermal Resource. This is achieved by identifying the geothermal systems in the Region for different management purposes.

Key aspects of managing the Regional Geothermal Resource are ensuring that use of the resource is efficient and that the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations is not compromised. This is addressed by:

- Identifying some Protected Geothermal Systems, where the natural characteristics of the system will be protected;

- Requiring a System Management Plan for each Development Geothermal System which will promote the efficient management of takes uses and discharges in accordance with the objectives and policies in the Regional Policy Statement and the Plan;

- Ensuring that, in all other systems, use of the geothermal resource conserves geothermal energy and water as much as practicable;

- Recognising that future generations may have more and better choices than present generations as to how to meet their energy requirements, and therefore allowing controlled depletion in some geothermal systems while not compromising the ability of future generations to meet their reasonably foreseeable needs.

Another important aspect of the management of the Regional Geothermal Resource is avoiding, remedying, or mitigating adverse environmental effects. This includes not only the actual and potential effects associated with the use of the regional geothermal resource Regional Geothermal Resource, but also the effects of other activities on the Regional Geothermal Resource.

The geothermal policy documents provide clear direction in terms of regional council functions for addressing those resource management issues. This has been achieved by providing detail in relation to the nature of the resource management issues associated with geothermal resources

and providing specific objectives, policies, and methods that address those issues.

REFERENCES

Dickie, B.N., and Luketina, K.M. Sustainable Management of Geothermal Resources in the Waikato Region, New Zealand, *Proceedings* World Geothermal Congress 2005, Antalya, Turkey. International Geothermal Association (2005).

Keam, R. F., Luketina, K. M. and Pipe, L. Z. 2005. Definition and Listing of Significant Geothermal Feature Types in the Waikato Region. *Proceedings* World Geothermal Congress 2005, Antalya, Turkey. International Geothermal Association (2005).

Stefansson, V. and Axelsson, G., 2005. Sustainable Utilization of Geothermal Resources through Stepwise Development, *Proceedings* World Geothermal Congress 2005, Antalya, Turkey. International Geothermal Association (2005).