Bay of Plenty
REGIONAL COUNCIL

Proposed Bay of Plenty Regional Policy Statement

Section 32 report
Geothermal resources

Bay of Plenty Regional Council
Strategic Policy Publication 2010/04
November 2010

ISSN 1176 4112

Section 32 Report

Geothermal Resources

Contents

1 Introduction

This report presents the Section 32 evaluation in accordance with the Resource Management Act 1991, "Consideration of alternatives benefits and costs" for the proposed Regional Policy Statement (Regional Policy Statement) on the topic of geothermal resources. Section 32 states:

32 Consideration of alternatives, benefits, and costs

(1) In achieving the purpose of this Act, before a proposed plan, proposed policy statement, change, or variation is publicly notified, a national policy statement or New Zealand coastal policy statement is notified under section 48, or a regulation is made, an evaluation must be carried out by —

…..

(c) the local authority, for a policy statement or a plan (except for plan changes that have been requested and the request accepted under clause 25(2)(b) of Part 2 of Schedule 1); or

(3) An evaluation must examine —

(a) the extent to which each objective is the most appropriate way to achieve the purpose of this Act; and

(b) whether, having regard to their efficiency and effectiveness, the policies, rules, or other methods are the most appropriate for achieving the objectives.

….

(4) For the purposes of [[the examinations referred to in subsections (3) and (3A), an evaluation must take into account —

(a) the benefits and costs of policies, rules, or other methods; and

(b) the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the policies, rules, or other methods.

(5) The person required to carry out an evaluation under subsection (1) must prepare a report summarising the evaluation and giving reasons for that evaluation.

(6) The report must be available for public inspection at the same time as the document to which the report relates is publicly notified or the regulation is made.

1.1 Structure of this report

Section 2 of this report outlines the regionally significant issues identified and the process of identification.

Section 3 outlines the appropriateness of each objective in accordance with the purpose of the Act.

Section 4 then evaluates the most appropriate policy and method options to achieve each objective. When evaluating the policy and method options, the range of options available is outlined first, and then each option is evaluated. There are four types of options discussed in each instance.

These are:

(a) Broad direction to district and/or regional plans

This is where a regional policy gives broad direction on matters that must be provided for within district and/or regional plans. The method sets out when the provisions are to be included.

(b) Specific direction on matters to be given particular regard in resource management decision making

This is where a regional policy sets out specific matters that are to be given "particular regard" when making resource management decisions. The method sets out when these matters are to be considered. This may include resource consent decisions, decisions on notices of requirements or when making decisions about reviewing, varying, replacing or otherwise changing district and/or regional plans.

(c) Guidance options

This is where a regional policy and a method specify non-regulatory programmes or action that will be put in place. The non-regulatory methods include:

- Provision of information or guidance
- Integrating management
- Identification or investigation
- Providing support

(d) Do nothing

This is where no intervention, either regulatory or non-regulatory will occur under the RMA. “Do nothing” in this context means only in relation to ‘resource management intervention or activity’ and the status quo is not necessarily ‘do nothing’ in terms of interventions and actions under other mandates. Where there are other existing interventions in place these may continue. The status quo context does not need to be evaluated as an option in its own right as distinctive to ‘do nothing’.

Determining the most appropriate policies and methods is based on an assessment of the *effectiveness* and *efficiency* of the policy and method options, and the risks of acting or not acting when there is uncertain or insufficient information.

Effectiveness is a measure of how much influence a resource management intervention has or how successful it is in addressing the issues, in terms of achieving the desired environmental outcome. Effectiveness is a cumulative value, derived from the range of types and scope of influences or impacts of an intervention, towards achieving intended results and environmental outcomes. The effectiveness of an option cannot be assessed as an absolute value. Rather, options are appraised as to whether they exhibit the qualities that contribute to 'effectiveness' and to what degree, and a determination is made as to the cumulative effect of the pertinent attributes in terms of high, medium or low 'effectiveness'.

When evaluating the *efficiency* of the policy and method options both the benefits (social, economic and environmental) and costs (social, economic and environmental) are outlined. Each option is then deemed to be either efficient or inefficient. The following diagram outlines how this assessment is undertaken.

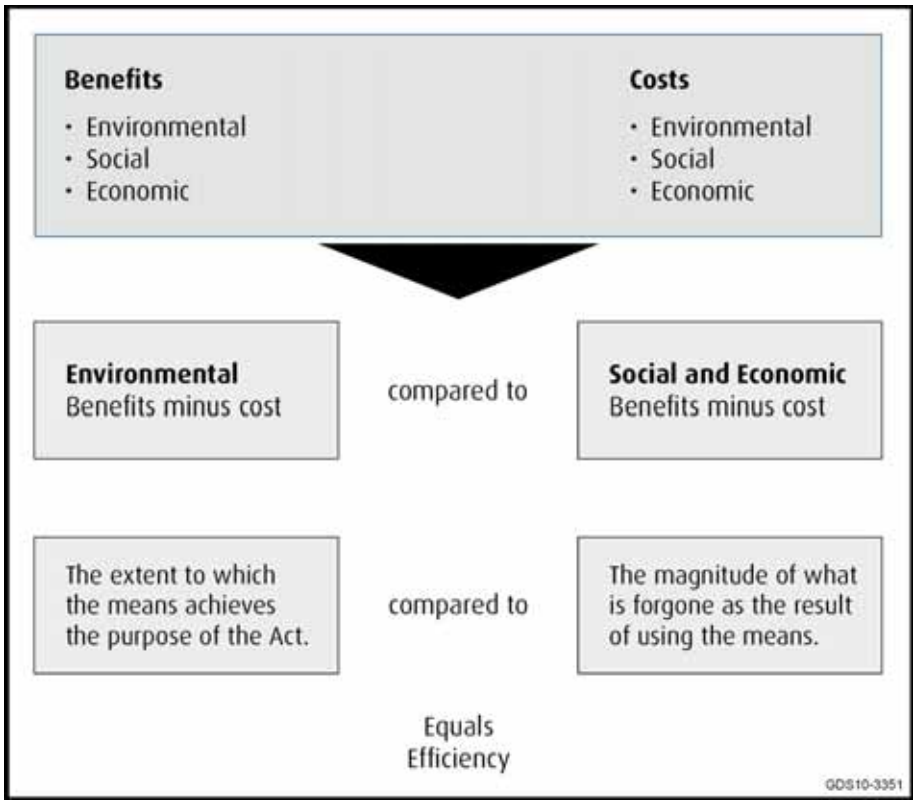

Figure 1 Deriving efficiency from benefits and costs.

The evaluation of 'efficiency' will result in either a positive or negative result in terms of efficiency. Alternatively, if efficiency is expressed as a cost/benefit ratio, it will be either greater than or less than 1. In the event the ratio is considered to be less than 1, the option can be considered efficient, in that the sum of the benefits outweigh the sum of the costs. In the event the ratio is deemed to be greater than 1, the option can be considered to be inefficient, in that the sum of the costs outweigh the sum of the benefits. It is important to note that in this evaluation of 'efficiency', absolute values for each of the variables considered pertinent (i.e. identified as either a cost or a benefit within the evaluation of the options) are not available. Rather, the analysis has endeavoured to present an accurate appraisal of the relative costs and benefits between the options, in order to determine which are efficient and which are not. A simple yes or no is used to differentiate the options as efficient or inefficient.

2 Regionally significant issues

The Regional Policy Statement review process evaluated the existing issues, and any recommended or amended issues. This was through:

- the *Regional Policy Statement Monitoring and Evaluation Report - Geothermal Chapter*
- the feedback in response to the *Regional Policy Statement Issues and Options Discussion Document (February 2008)*.

This resulted in the geothermal resource issues being separately addressed instead of being part of the energy chapter, as was the case in the discussion document. Then issues were assessed to ensure they were regionally significant and appropriate for inclusion in the Regional Policy Statement.

The resulting issues recommended for inclusion in the proposed Regional Policy Statement on *Geothermal* were:

Issue 1 Adverse effects on the intrinsic values of geothermal systems

The intrinsic values of geothermal systems – their natural features, ecologies and, cultural value are vulnerable to the effects of surrounding land use, groundwater use and use of water from the geothermal system.

Issue 2 Allocation of geothermal resources

Geothermal resources are regarded as the most significant source of renewable electricity in New Zealand. It also has high net worth in its intrinsic state as a tourism attraction. There is significant potential for the use and development of geothermal energy resources in the Bay of Plenty region for electricity and heat. Using the regional geothermal resource for energy development and protecting its intrinsic values is a difficult balance to achieve as intrinsic and extractive values can be incompatible. A lack of information and knowledge about the regional geothermal resource and effects of its use can create uncertainty for management of the resource, and it is difficult and expensive to assess the quantity and nature of the resource. The interconnected nature of the resource necessitates an integrated approach to management at a regional level to allow for the sustained use of the geothermal system, that takes account of a range of users and the intrinsic values of the system.

Further feedback was obtained from the Draft Regional Policy Statement, where 109 comments were received from 24 people or groups on the geothermal provisions of the Draft Next Regional Policy Statement. Several parties also met with BOPRC to discuss the provisions further. Changes were made to the draft geothermal provisions and reported back to the RPS subcommittee for several of its meetings. These did not seek to change the nature of the issues, although some parties considered changes to the policy responses would be appropriate.

The objectives and policies that endeavour to manage these issues do overlap, as any management of geothermal allocation also has to consider whether the allocation will result in adverse effects on the intrinsic values, and one of the big effects on intrinsic values is due to use.

Issue 3 Policy alignment throughout the Taupo Volcanic Zone

The WRC and BOPRC together manage most of New Zealand's geothermal resources, predominantly in the Taupo Volcanic Zone. The two regions have a common boundary and, on many issues have common positions. There are three geothermal systems that straddle the regional boundary and Rotorua District straddles the regional boundary.

Inter-regional collaboration, and the collaborative management of the geothermal resource between WRC and BOPRC makes good sense due to the scarcity of scientific and technical geothermal expertise and the likely pressure to develop the geothermal resource to meet New Zealand's intent to increase the proportion of renewable electricity generation, and meet the sustainability requirements of the RMA.

To this end considerable effort has been made to align the regional policy for geothermal management between the two regions. The statutory framework for management of the Waikato geothermal resource was established, with the geothermal sections of the Waikato Regional Policy Statement and Waikato Regional Plan operative since 2007 and 2008 respectively.

Preparing the Bay of Plenty second generation Regional Policy Statement provides an opportunity to reach greater policy consistency with Waikato region provisions. This objective is supported by all parties who have made comment to the draft regional policy statement on geothermal management.

Consistent management of the geothermal resource between the two Regions is believed to have value, not only because three geothermal systems span the regional boundary, but because effective use of scarce geothermal expertise will benefit from such economies of scale.

Because a decision to align policy has been made in principle by |Bay of Plenty Regional Council, and supported by those commenting on the geothermal provisions of the draft Regional Policy Statement, this has necessarily constrained the possible policy options that can be considered. This section 32 report therefore discusses the effectiveness, efficiency, costs and benefits of the policies that have already been through the robust Environment Court process associated with the development of the Waikato region's regional policy statement and does not suggest a range of alternatives to policy alignment.

3 Extent to which the objectives are the most appropriate

The proposed geothermal objectives are:

Objective 7: Protect surface expression of the Regional Geothermal Resource.

Objective 8: Holistic and sustainable management of geothermal systems.

Objective 9: Development and use of land and non-geothermal water is compatible with protection, development and use of geothermal systems

To follow is an assessment outlining the extent to which each of the geothermal objectives are the most appropriate way to achieve the purpose of the RMA.

3.1 Objective 7 – Protect surface expression of the Regional Geothermal Resource

Objective 7, to protect the surface expression of the regional geothermal resource – i.e. the geothermal surface features and geothermal ecologies - is the most appropriate way to achieve the purpose of the RMA for the following reasons:

- This objective promotes sustainable management by grouping the various geothermal systems within the region along a continuum from full protection to predominantly use. Thus the geothermal resource as a whole is managed to provide for the range of development, use and protection. By defining which geothermal systems have a predominant protection objective and which have a predominant production objective within the policies, it provides clarity to those who wish to develop the geothermal resource as to the relative status of the geothermal surface features associated with the system and their importance for protection. The last Regional Policy Statement sought that an inventory of all surface features was developed. Now the location of the surface features has been catalogued, and there is some capacity to assess what activity is likely to affect them; the focus is on managing the effects of such activities throughout the spectrum of avoid, remedy or mitigate. Many surface features or clusters of surface features have social, economic and cultural importance, so their protection satisfies all four of the wellbeing aspects, as well safeguarding life supporting capacity of the ecosystems that depend on them.
- Protecting surface expression of the Regional Geothermal Resource addresses the adverse effects on the intrinsic values of geothermal systems, which in turn is a requirement of section 6 (b), (c), (e) of the Act, to protect outstanding natural features and landscapes; and areas of significant indigenous vegetation and significant habitats of indigenous fauna, and the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga.
- It provides the direction to fulfil the regional council RMA function 30(1)(fa) "establishment of rules in a regional plan to allocate… (ii) the taking or use of heat or energy from water and (iii) the taking or use of heat or energy from the material surrounding geothermal water". Control of allocation location and quantities is required to protect the surface expression of the geothermal systems, by retaining pressure support and temperature of the systems.

- The State of the Environment Report "Bay Trends 2004" notes that the extent of geothermal ecosystems in the Bay of Plenty has declined dramatically since human settlement. Geothermal surface features have been affected by land clearance for farming and urban subdivision, large scale abstraction of minerals, and draw-off of geothermal heat and fluid from the resource via a bore or spring. The combination of identification of the geothermal surface features/geothermal ecosystems, and classification of the geothermal systems according to the level of use allows for better management of the features. Risks caused by activities close to those features can be managed. The evaluation report of the first Regional Policy Statement notes that while the condition and extent of geothermal ecologies and surface features is considered to be declining overall, there has been some recovery in the Rotorua system.

3.2 Objective 8 – Holistic and sustainable management of geothermal systems

Objective 8 is the most appropriate way to achieve the purpose of the RMA for the following reasons:

- This objective provides for use of geothermal systems in a sustainable manner. The policies that support this objective provide parameters for the allocation of the resource to ensure that it is allocated to take account of the myriad of intrinsic value and use options of the whole geothermal resource. It is designed to manage the circumstances where a number of users seek access to the same resource, and manages the adverse effects of geothermal use. Management of use of the geothermal resource is necessary to avoid the over-allocation of heat or fluid, which could lead to non-sustainable use, loss of surface feature activity, system collapse, or loss of commercial investment in plant due to over-allocation making it uneconomic to extract.
- Excessively conservative allocation regimes would also not meet the test of sustainable use, as the economic values that can be obtained from geothermal use would be unnecessarily forgone. Under RMA Section 7 particular regard must be had to: 7(b) the efficient use and development of natural and physical resources,

  7(ba) the efficiency of the end use of energy,

  7(g) any finite characteristics of natural and physical resources, and

  7(j) the benefits to be derived from the use and development of renewable energy.

  The objective identifies the need to allocate the Bay of Plenty resource in such a way that substantial use can be made of the energy capacity of the resource, without completely forgoing all the values associated with the geothermal surface features and vegetation. This is achieved through classifying the systems for differential levels of use; from no use to considerable potential for use. Then within those systems classified for use, setting clear parameters around how that use will occur to support the use occurring in a sustainable fashion.

- The relevant sub-sections of Section 30 that relate to this objective are 30(1)(e), particularly 30(1)(e)(iii) the control of the taking or use of geothermal energy. objective); and
- This objective is very relevant to the Government's stated objectives in the draft New Zealand Energy Strategy and the draft New Zealand Energy Efficiency and Conservation Strategy. The energy strategy specifically refers to there being greater potential for geothermal resources "*to provide energy in various forms and contribute to the economy and energy security*". The strategy has three areas of focus, one being to "*develop renewable energy resources…particularly from geothermal and wind resources*".

3.3 Objective 9 – Development and use of land and non-geothermal water is compatible with protection, development and use of geothermal systems

Objective 9 is the most appropriate way to achieve the purpose of the RMA for the following reasons:

- This objective addresses the natural hazard aspects of geothermal systems and the effects of other activities such as groundwater take which may act to deplete the volume of geothermally heated fluid by drawing it out of the system. Section 30 (c)(iv) requires that regional councils control the use of land for the purpose of avoidance or mitigation of natural hazards. In the case of geothermal systems this includes avoiding exposing subdivision, use and development to geothermal hazards such as subsidence, hydrothermal eruptions, heated ground and toxic gases.
- Avoiding the depletion of geothermal fluid due to groundwater drawdown avoids impacts on geothermal surface features and geothermal ecologies, and on the heat and fluid available for use. This is a function under section 30 (e) the control of the taking, use, damming and diversion of water and the control of the quantity, level or flow of water in any water body. Avoiding depleting the amount of geothermal resource available contributes to sustainable us of that resource for intrinsic value purposes and for use as energy.

Final chosen objective	**Other alternatives?**	**Why <u>not</u> the most appropriate to achieve the Resource Management Act**
Objective 7 Protect surface expression of the regional geothermal resource	Alternative 1 Do not provide for natural character as this is already provided for under the Matters of National Importance section. Alternative 2 Status quo - adopt objective 10.3.1(a) from the operative RPS (1999) which seeks to protect landforms, features, ecosystems, flora and fauna Alternative 3 Seek only to preserve and enhance outstanding natural features and significant vegetation This is an assessment of alternatives to Objective 2 over and above the alternatives assessed in relation to and presented within the Section 32 reports relating to Matters of National Importance, Iwi Resource Management, Integrated Resource Management, Natural Hazards and Urban Form and Growth Management. This evaluation should therefore be considered in conjunction with those other Section 32 reports as they contain further information pertinent to addressing the regionally significant resource management issues concerning geothermal surface features.	Alternative 1 Natural character is included in the Matters of National Importance section but because natural features and significant vegetation strongly linked to management of geothermal use it is considered appropriate to also refer to it within this objective. Alternative 2 Objective 10.3.1(a) of the operative RPS is less focussed than the proposed objective. A policy decision has been that this RPS will focus on specific resource management issues Alternative 3 An objective which focuses only on outstanding natural geothermal features and significant geothermal vegetation fails to provide for opportunities to restore and enhance areas where these have been compromised. This approach also fails to recognise that natural character occurs on a continuum from pristine to modified, and that areas which have undergone modification can still be outstanding or significant.

Objective 8 Holistic and sustainable management of geothermal systems	Alternative 1 Seek to manage allocation in a sustainable and efficient manner Alternative 2 Seek only to manage the allocation in an efficient manner. Alternative 3 Status quo – adopt the approach of the operative RPS objective 10.3.2 which seeks only to manage the use development and protection, without identifying the key principles to determine the nature of the allocation regime.	Alternative 1 Advises of the principles that will drive the decisions on how allocation will be made – requiring sustainability and efficiency. Alternative 2 Fails give effect to the purpose of the Act which is the promotion of sustainable management rather than simply management. Alternative 3 Fails give effect to the purpose of the Act which is the promotion of sustainable management rather than simply management.
Objective 9 Development and use of land and non-geothermal water is compatible with protection, development and use of geothermal systems	Alternative 1 Status quo – adopt the approach of the Operative RPS 10.3.3 in focussing only on the natural hazard effects of the geothermal resource and not identifying the need to protect geothermal features from unrelated activities such as groundwater take and subdivision which may affect land use on top of the surface features Alternative 2 Seek to manage adverse effects of geothermal hazards and adverse effects of other unrelated activities on the geothermal resource.	Alternative 1 Fails to manage the risk of activities on the geothermal resource; only manages the risks posed be geothermal resource on activities. Alternative 2 Provides for adverse effects by and on the geothermal resource created by other unrelated activities.

4 Evaluation of policies and methods to achieve Objective 7

The appropriateness of the policies and methods to achieve Objective 7 are evaluated by looking at the effectiveness, the risks or acting or not acting and the efficiency of the policy and method options.

4.1 Range of policy and method options considered to achieve Objective 7

Objective 7 aims to ensure that the outstanding natural geothermal features and landscapes and significant indigenous geothermal vegetation of the Bay of Plenty are protected. Systems marked as "protection" will receive protection of all intrinsic values, but for those earmarked for sustainable use compromises will be made on which intrinsic values are protected.

The focus of this section is to establish what suite of policies and methods will best achieve Objective 7. In evaluating the effectiveness of the policies and methods, the range of options is described then the effectiveness of each of the options is evaluated.

To achieve objective 7, a suite of four policies, two regulatory and three non-regulatory methods are used. The policies provide broad directives to regional plans, set out matters for consideration by resource consents and provide guidance for improving how well people understand geothermal resource.

4.1.1 Broad Direction to regional and/or district plans

This option requires the regional council to actively protect geothermal surface expression for some geothermal systems and take a precautionary approach to use when there is scientific uncertainty about the effects of that use on geothermal surface expression.

Policy GR 1A: Protecting geothermal features.

Policy GR 2A: Requiring integrated management of geothermal systems.

Policy IR 1B: Applying a precautionary approach to managing natural and physical resources.

4.1.2 Specific Direction – particular regard in resource consents, plan changes,

This option requires that threats to surface features are taken account of when preparing consent for geothermal use.

Policy GR 5B: Requiring information for the use of the geothermal resource.

4.1.3 Guiding actions

This option supports efforts to increase the general level of understanding about geothermal surface expression, both geothermal surface features and ecologies, and to develop a classification and ranking system for outstanding natural geothermal features and landscapes and for significant indigenous geothermal vegetation.

Policy GR 4A: Protecting and managing geothermal features and ecosystems.

Method 24: Identify and Classify outstanding geothermal features.

Policy GR 2A: Requiring integrated management of geothermal systems.

Method 25: Provide geothermal environmental education programmes.

Method 26: Facilitate and support community based ecological restoration programmes.

4.1.4 Do nothing

This option of no intervention to protect both geothermal surface features and ecologies is not regarded as appropriate as it will not meet the requirements of section 6 of the RMA.

4.2 Evaluation of effectiveness and efficiency of Objective 7 policy and method options

As consistency with policy already developed by Waikato Regional Council drove policy design, the options were limited to those that were consistent with the Waikato approach.

Table 1 assesses the efficiency of the policy and method options for achieving Objective 7 by considering their environmental, economic and social costs and benefits.

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
1 Broad direction to regional and/or district plans					
Option 1 Identify and protect geothermal surface features and significant vegetation	Increases certainty as to how the region will manage outstanding natural features and significant vegetation in the different geothermal systems. Provides a consistent framework across the region. Provides process to further identify geothermal s6(b) and (c) values.	High	Social: ▪ Maintains cultural, recreational and amenity values of geothermal surface features. ▪ Provides greater certainty about the importance of these environmental values when managing geothermal fluid takes. Economic: ▪ Provides clarity about restrictions on development and where these apply. ▪ Provides certainty about where development can occur. ▪ Provides transparency as to what is required and the reasons for this. Environmental: ▪ Safeguards the health of geothermal surface features and vegetation.	Social: ▪ The highest social value may not allow for significant economic value use of the resource. Economic: ▪ Costs associated with researching and determining the connectedness of flows to surface features. ▪ Costs of monitoring resources. ▪ Foregoing value of activities due to restrictions on geothermal fluid taken. Environmental: ▪ The highest environmental value may not allow for the best economic use of the resource.	Yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
Option 2 Require integrated management of geothermal systems	Increases certainty that all potential effects on a geothermal system are considered in an integrated manner, allowing for sustainable and holistic use of the geothermal system	High	Social: ▪ Reduces conflict over resource use by categorising type of use possible per geothermal system ▪ Clarifies the social and cultural values of geothermal surface features and their use. ▪ Maintains cultural, recreational and amenity values of geothermal surface features and ecologies. ▪ Establishes clear intent of regulatory intervention. ▪ Economic: ▪ Provides consistency in the way geothermal fluid is managed. ▪ Provides certainty about where geothermal fluid is available and therefore where development can occur. ▪ Ensures the economic value of the geothermal fluid is sustained. ▪ Increases economic opportunities for geothermal fluid use, because with greater efficiency more geothermal fluid is available for others to use. ▪ Avoids administration costs for regional council because activities that do not have access to geothermal fluid do not apply for consent ▪ Avoids unnecessary application costs to the applicant when consent for the taking of geothermal fluid is unlikely to be granted.	Social: ▪ Increased conflict between competing demands, leading to potential development being stalled. Economic: ▪ Costs of monitoring resources and resource use. ▪ Foregoing activities due to restrictions on geothermal fluid taken. ▪ Costs associated with research, consultation, determining efficient use and how to implement the principles. ▪ Costs of applying technology to ensure efficient use ▪ Costs may be incurred in applying resources to measure and use geothermal fluid more efficiently. ▪ Costs of technical work to justify the amount of geothermal fluid sought. Environmental: ▪ The highest economic value may not necessarily be the best environmental use of the resource.	Yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
			Environmental: ▪ Provides greater certainty about the importance of environmental values when managing geothermal fluid extraction. ▪ Improves sustainability of resource by requiring reinjection of geothermal fluid ▪ Protects outstanding geothermal natural features and significant geothermal vegetation. ▪ Provides for the protection of some geothermal features that are more highly valued for their natural characteristics, including their biodiversity and intrinsic values, than others. ▪ Some systems with outstanding rare and vulnerable surface features have uses restricted in order to preserve the features. In some systems, small-scale extraction that is not likely to have significant adverse effects on Geothermal Surface Features is most appropriate. ▪ Allows geothermal fluid resources to recharge and surface geothermal features to function. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge. ▪ Ensures geothermal fluid is not over allocated.		

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
Option 3 Apply a precautionary approach to managing natural and physical resources	Requires that sufficient information is supplied to support development of a geothermal system without creating unexpected effects	High	Social: ▪ Provides transparency as to what information is required and the reasons for this. ▪ Establishes clear intent of regulatory intervention. ▪ Provides greater certainty and consistency for the management of geothermal fluid. Economic: ▪ Emphasises importance of sustainable and efficient allocation of available geothermal fluid to users. ▪ Provides clarity to applicants on the importance of ensuring geothermal fluid is available before applying for consent. ▪ Ensures the economic value of the geothermal fluid is sustained. ▪ Environmental: ▪ Ensures a reliable and accessible amount of geothermal fluid is available. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge. ▪ Ensures geothermal fluid is not over allocated. ▪ Allows adaptation to changing environmental circumstances.	Social: ▪ Possible reductions in short term economic development as projects are staged to ensure over allocation does not occur Economic: ▪ Costs associated with researching and determining the limits. ▪ Costs of monitoring resources and resource use. ▪ Foregoing activities due to restrictions on geothermal fluid taken. ▪ Costs associated with research, consultation, determining efficient use and how to implement the principles. ▪ Costs of applying technology to ensure efficient use ▪ Costs may be incurred in applying resources to measure and use geothermal fluid more efficiently. ▪ Costs of technical work to justify the amount of geothermal fluid sought. Environmental: ▪ The highest economic value may not necessarily be the best environmental use of the resource.	Yes
2 Specific direction Matters to be given particular regard when making resource management decisions					
Option 4 information to enable integrated system management for geothermal resources	This policy requires that information provided for proposed uses of the system is commensurate with the likely	High	Social: ▪ Clarifies the social and cultural values of geothermal surface	Economic: ▪ Costs associated with researching and determining the limits.	Yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
	effects of that use.		features and their use ▪ Ensures that the taking and use of geothermal fluid is sustainable and efficient. ▪ Ensures a reliable and accessible amount of geothermal fluid is available. <u>Economic:</u> ▪ Emphasises importance of sustainable and efficient allocation of geothermal fluid. ▪ Provides greater clarity and certainty to the applicant, local authority and potential submitters about the matters that shall be given regard to when managing geothermal fluid. ▪ Provides clarity to applicants on the importance of ensuring geothermal fluid is available before applying for consent. ▪ Provides consistency in the way geothermal fluid is managed. ▪ Provides certainty about where geothermal fluid is available and therefore where development can occur. ▪ Provides information on the actual amount of geothermal fluid taken which allows better assessment of how much geothermal fluid remains available to other users. ▪ Ensures the economic value of the geothermal fluid is sustained.	▪ Costs of monitoring resources and resource use to measure and use geothermal fluid more efficiently. ▪ Foregoing costs to activities due to restrictions on geothermal fluid taken. ▪ Costs associated with research, consultation, determining efficient use and how to implement the principles. ▪ Costs of applying technology to ensure efficient use ▪ Costs of technical work to justify the amount of geothermal fluid sought.	

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
			▪ Ensures efficient use of geothermal fluid because resource users are granted volume or heat energy based on the amount they really need. ▪ Provides information on the actual amount of geothermal fluid taken which allows better assessment of how much geothermal fluid remains available to other users. ▪ Provides opportunities for geothermal fluid to be distributed amongst a greater number of users. ▪ Promotes efficient allocation and greater use of the resource by a wider number of users. <u>Environmental:</u> ▪ Provides greater certainty about the importance of environmental values when managing geothermal fluid extraction to protect outstanding geothermal natural features and significant geothermal vegetation. ▪ The flows and limits can be monitored and assessed. ▪ Allows geothermal fluid resources to recharge and surface geothermal features to function. ▪ Allows adaptation to changing environmental circumstances. ▪ Improves sustainability of resource by requiring reinjection of geothermal fluid ▪ Ensures geothermal fluid is not over allocated.		

4.3 Results of evaluation as to the most appropriate policy and method options to achieve Objective 7

Table 2 summarises the effectiveness and efficiency of the policy and method options and outlines the selection of the most appropriate ones to achieve Objective 7. This selection takes into account the risks of acting or not acting if there is uncertain or insufficient information. The proposed policies and methods that reflect this selection are also listed.

Table 2 Selection of most appropriate of policies and methods to achieve Objective 7

Policy and method options	Effective-ness	Efficiency	Selected option(s)	Proposed policies and methods
1 Broad Directions to regional and/or district plans				Policy # and methods #, # or N/A
Option 1 Direction to identify and protect geothermal surface features and significant vegetation	High	Yes	√	**Policy GR 1A**
Option 2 Direction to require integrated management of geothermal systems	High	yes	√	**Policy GR 2A**
Option 3 Direction to apply a precautionary approach to managing natural and physical resources	high	yes	√	**Policy IR 4A**
2 Specific direction Matters to be given particular regard when making resource management decisions				Policy # and methods #, # or N/A
Option 4 consideration to require an integrated system for geothermal management	high	yes	√	**Policy GR 7B**
3 Guiding actions				Policy # and methods #, # or N/A
Option 5 classify sites	high	yes	√	**Method 24**
Option 6 Education programmes	moderate	maybe	√	**Method 25**
4 Do nothing				Policy # and methods #, # or N/A
	low	Low	X	

4.4 Risk of acting or not acting

The information about geothermal resources is only certain and sufficient for some geothermal systems within the region. The nature of the actions proposed through the Regional Policy Statement is in accord with the need (in many cases) to find out more about the geothermal resource in order to allocate it equitably, sustainably and efficiently. The risk of not providing an allocation framework (not acting) is that the conflicts around the appropriate use of the resource stymie development (sub-optimal allocation) or result in irreparable damage to highly valuable geothermal surface features (over-allocation). I.e. the risks of not acting not only put the Council in breach of its obligations under the RMA s6, but would also have significant negative social, environmental and economic consequences.

4.5 Selection of most appropriate policy and method options to achieve Objective 7

4.5.1 Discussion on selected options

A suite of policies is necessary to deal with the regionally significant issues for geothermal management as they affect the surface features and ecologies of the resource, and manage the range of impacts resulting from the allocation of geothermal fluid.

Allocation occurs between use and non-use (intrinsic value), and several users of the same resource. Use type can affect quantity of fluid and heat available (re-injection of fluid provides pressure support to the system enabling a greater use of fluid or heat before detrimental effects on the system occur). All of these can affect the surface features, which are also dynamic, so will also change of their own accord

RMA – Geothermal	
Resource proving	Gathering information on the location (3D) and capacity of the resource
Resource allocation principle	Sustainable use, multiple users with access to the same resource
Resource allocation process	Must enable multiple users to get access to the resource, in principle
Resource allocation effects	Must account for effects of fluid and heat allocation on surface features and ecologies
Environmental effects of processes such as drilling and construction	Accounts for all environmental externalities of processes
Treaty implications Impacts of geothermal process on other users (hazards)	Taonga of resource

Options 1 - 3 direct the regional councils to accurately identify the surface features and ecologies of the geothermal systems in the Bay of Plenty in order to avoid adverse effects on their environmental social and cultural values. There may be cost implications such as conflict between competing demands for the fluid and energy resource that underlies the surface features and financial/time costs associated with researching and determining the appropriate take and discharges; if the system classification allows take at all.

Geothermal features and ecosystems are rare and of much scientific interest. They are fragile and almost impossible to restore once damaged. Geothermal activity has high economic worth, and is an important tourist attraction in the Bay of Plenty.

Geothermal biota and animals make significant contributions to biotic diversity, intellectual curiosity, the gene pool, scenery and aesthetic enjoyment. Thermally tolerant plants, animals and micro-organisms also have intrinsic qualities.

The extent and variety of natural characteristics of the regional geothermal resource provide a wide range of benefits. Conflicts exist where use of the resource diminishes the intrinsic characteristics e.g. active surface features, bathing pools. As the extent and variety of intrinsic features is reduced, this restricts the range of benefits available in future. To maintain the extent and variety of the intrinsic geothermal characteristics, Significant Geothermal Features are protected in groups 1-3 geothermal systems from adverse effects arising from the extraction of energy and fluid from these systems.

Adjacent and overlying land uses can have adverse effects on characteristics of the geothermal resource. For example, land drainage can alter water levels thus affecting surface features. Forestry in geothermal areas can lead to geothermal features being damaged by harvesting processes. Surface features in built-up areas can be altered be being constrained to a smaller area than the geothermally heated ground, and geothermal ecologies replaced with exotic plants. Allowing livestock, vehicles or walking access to geothermal features can lead to a range of adverse effects including the crushing of fragile sinters and rare native plants, animals and micro-organisms. Geothermal tourism can lead to littering and vandalism. Building access roads, or paths for the tourists to walk on, can lead to contamination of pools and sinter by paving materials such as gravel. Native vegetation, including thermophilic species can be destroyed or contaminated with adventive exotic species. In some cases features are drained in order to preserve the paths that lead to or near them.

One way to reduce the threats to, and adverse effects on, these characteristics by members of the public is through education, and the establishment of care groups. It is also important to ensure that information and data about the Region's geothermal characteristics is available to the public, environmental groups and the geothermal community.

Managing geothermal takes is particularly important as increasing demand is placed on the energy component of the resource therefore putting it at risk of being allocated for those values alone.

The geothermal resource is a valuable resource as a source of energy, heating, bathing and minerals. It is also highly valued for its intrinsic and cultural characteristics, and attracts many tourists. The complexity of the geothermal resource means that anticipating the effects of take, use and discharge is very difficult and much remains unknown.

A precautionary approach is required. When allowing for take, use and discharge of the geothermal resource, taking a precautionary approach recognises that knowledge of the system is incomplete and taking precautions to reduce possible serious adverse effects is prudent. The precautionary approach is well-established in RMA practice, and is a fundamental principal of sustainable development, as stated in Principle 15 of Agenda 21, the report by the United Nations Conference on Environment and Development, Rio de Janeiro, 1992. Central to principle 15 is the element of anticipation, reflecting a requirement that effective environmental measures need to be based upon actions which take a long-term approach and which might anticipate changes on the basis of scientific knowledge.

Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing action to avoid potentially serious or irreversible harm to the environment.

With the environmental values and ecosystem health protected through Options 1 - 3, Option 4 then follows on from this, to guide allocation of the available fluid and energy.

Details of allocation regimes are discussed under the suite of options associated with objective 8, which establish an allocation regime that is sustainable and allocates in an efficient manner and therefore must be given regard to when allocating water.

Further regulatory direction to regional plans is provided in Option 4.

5 Evaluation of policies and methods to achieve Objective 8

The appropriateness of the policies and methods to achieve Objective 8 are evaluated by looking at the effectiveness, the risks or acting or not acting and the efficiency of the policy and method options.

5.1 Range of policy and method options considered to achieve Objective 8

Objective 8 aims to ensure that the allocation of geothermal fluid and heat is done in a manner that promotes sustainable use and efficiency.

The focus of this section is to establish what suite of policies and methods will best achieve Objective 8. In evaluating the effectiveness of the policies and methods, the range of options is described, then the effectiveness of each of the options is evaluated.

To achieve objective 8, a suite of five policies and two regulatory methods are used. The policies provide direction to regional plans and set out matters for consideration for resource consents.

5.1.1 Broad Regulatory direction to regional and/or district plans

This option requires the regional council to provide for the sustainable use of the geothermal resource by using principles of efficiency, sustainability and consideration of all factors that are likely to be affected by the active use of the resource.

Policy GR 3A: Providing for the sustainable use of geothermal resources.

5.1.2 Specific direction – particular regard in resource consents, plan changes,

This suite of policies requires that a geothermal system is regarded holistically in making any resource allocation, by having a whole-of-system management plan. It requires that such allocation is efficient and sustainable. It requires that takes are made on the basis of sound information about the resource and that a complete discharge strategy is used to minimise the effects on the resource for others uses.

Policy GR 6B: Managing geothermal use, takes and discharges.

Policy GR 7B: Requiring integrated geothermal system management.

Policy GR 8B: Requiring geothermal discharge in accordance with a discharge strategy.

Policy GR 9B: Protecting significant features by maintaining geothermal systems.

5.1.3 Do nothing

This option of no intervention to allocate the geothermal fluid or energy is not regarded as appropriate as it will not meet the regional council obligations under section 30(1)(e) of the RMA.

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
1 Broad Directions to regional and/or district plans					
Option 1 direction to provide for the sustainable use of geothermal resources.	This policy gives direction to ensure the resource is used in accordance with the principles of efficiency, and considering the geothermal system and its values as a whole.	High	Social: ▪ Reduces conflict over resource use by categorising type of use possible per geothermal system. ▪ Maintains cultural, recreational and amenity values of geothermal surface features and ecologies. Economic: ▪ Emphasises importance of sustainable and efficient allocation of available geothermal fluid to users. ▪ Provides clarity to applicants on the importance of ensuring geothermal fluid is available before applying for consent. ▪ Establishes clear intent of regulatory intervention. ▪ Provides certainty about principles to be used when allocating geothermal fluid. ▪ Provides consistency in the way geothermal fluid is managed. ▪ Ensures the economic value of the geothermal fluid is sustained. ▪ Avoids administration costs for regional council because activities that do not have access to geothermal fluid do not apply for consent ▪ Avoids unnecessary application costs to the applicant when consent for the taking of geothermal fluid is unlikely to be granted. Environmental: ▪ Improves sustainability of resource by requiring reinjection of geothermal fluid. ▪ Protects outstanding geothermal natural features and significant geothermal vegetation.	Social: ▪ Possible reductions in short term economic development as projects are staged to ensure over allocation does not occur. Economic: ▪ Costs associated with researching and determining the limits. ▪ Costs of monitoring resources and resource use. ▪ Foregoing activities due to restrictions on geothermal fluid taken. ▪ Costs associated with research, consultation, determining efficient use and how to implement the principles. ▪ Costs of applying technology to ensure efficient use. ▪ Costs may be incurred in applying resources to measure and use geothermal fluid more efficiently. ▪ Costs of technical work to justify the amount of geothermal fluid sought. ▪ Environmental: ▪ The highest economic value may not necessarily be the best environmental use of the resource.	yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
			▪ Ensures a reliable and accessible amount of geothermal fluid is available. ▪ Allows geothermal fluid resources to recharge and surface geothermal features to function. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge. ▪ Ensures geothermal fluid is not over allocated.		
2 Specific direction Matters to be given particular regard when making resource management decisions					
Option 2 information for integrated system management for geothermal		High	<u>Social:</u> ▪ Reduces conflict over resource use by categorising type of use possible per geothermal system. <u>Economic:</u> ▪ Emphasises importance of sustainable and efficient allocation of available geothermal fluid to users. ▪ Provides clarity to applicants on the importance of ensuring geothermal fluid is available before applying for consent. ▪ Establishes clear intent of regulatory intervention. ▪ Ensures that the taking and use of geothermal fluid is sustainable and efficient. ▪ Provides consistency in the way geothermal fluid is managed. ▪ Provides certainty about where geothermal fluid is available and therefore where development can occur. ▪ Ensures the economic value of the geothermal fluid is sustained.		Yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
			▪ Increases economic opportunities for geothermal fluid use, because with greater efficiency more geothermal fluid is available for others to use. <u>Environmental:</u> ▪ Improves sustainability of resource by requiring reinjection of geothermal fluid. ▪ Ensures a reliable and accessible amount of geothermal fluid is available. ▪ The flows and limits can be monitored and assessed. ▪ Allows geothermal fluid resources to recharge and surface geothermal features to function. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge. ▪ Ensures geothermal fluid is not over allocated.		
Option 3 requiring discharge in accordance with a geothermal discharge strategy.		High	<u>Social:</u> ▪ Provides greater clarity and certainty to the applicant, local authority and potential submitters about the matters that shall be given regard to when managing geothermal fluid. ▪ Provides information on the actual amount of geothermal fluid taken which allows better assessment of how much geothermal fluid remains available to other users. ▪ Provides consistency in the way geothermal fluid is managed. ▪ Provides transparency as to what information is required and the reasons for this. ▪ Establishes clear intent of regulatory intervention.		Yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
			▪ Provides certainty about principles to be used when allocating geothermal fluid. ▪ Ensures that the taking and use of geothermal fluid is sustainable and efficient. <u>Economic:</u> ▪ Ensures the economic value of the geothermal fluid is sustained. ▪ Increases economic opportunities for geothermal fluid use, because with greater efficiency more geothermal fluid is available for others to use. ▪ Provides opportunities for geothermal fluid to be distributed amongst a greater number of users. <u>Environmental:</u> ▪ Provides greater certainty about the importance of environmental values when managing geothermal fluid extraction. ▪ Proves sustainability of resource by requiring reinjection of geothermal fluid. ▪ Protects outstanding geothermal natural features and significant geothermal vegetation. ▪ Allows geothermal fluid resources to recharge and surface geothermal features to function. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge. ▪ Ensures geothermal fluid is not over allocated.		

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
Option 4 requiring discharge in accordance with a geothermal discharge strategy	Requiring a discharge strategy requires that the users of the resource create conditions that optimise total use of the resource by retaining the pressure of the geothermal system	High	Social: ▪ Provides greater clarity and certainty to the applicant, local authority and potential submitters about the matters that shall be given regard to when managing geothermal fluid. ▪ Provides consistency in the way geothermal fluid is managed. ▪ Maintains cultural, recreational and amenity values of geothermal surface features and ecologies. ▪ Protects against physical harm from geothermal hazard. Economic: ▪ Protects against economic harm from geothermal hazard. ▪ Provides consistency in the way geothermal fluid is managed. ▪ Provides transparency as to what information is required and the reasons for this. ▪ Establishes clear intent of regulatory intervention. ▪ Provides greater certainty and consistency for the management of geothermal fluid. ▪ Ensures the economic value of the geothermal fluid is sustained. ▪ Increases economic opportunities for geothermal fluid use, because with greater efficiency more geothermal fluid is available for others to use. Environmental: ▪ Provides greater certainty about the importance of environmental values when managing geothermal fluid extraction. ▪ Improves sustainability of resource by requiring reinjection of geothermal fluid. ▪ Protects outstanding geothermal natural features and significant geothermal vegetation. ▪ The flows and limits can be monitored and assessed.	Economic: ▪ Costs of monitoring resources and resource use. ▪ Costs of applying technology to ensure efficient use.	Yes

Policy and method options	Analysis of effectiveness	Effective-ness	Benefits (social, economic and environmental)	Costs (social, economic, environmental)	Efficient
Option 5 protect significant features by maintaining geothermal systems.	This policy also requires that pressure support of the geothermal system is retained. In this context specifically for the benefit of the geothermal surface features, and includes consideration of potential effects of pressure loss from non-geothermal groundwater adjacent to geothermal aquifers.	High	Social: ▪ Provides greater clarity and certainty to the applicant, local authority and potential submitters about the matters that shall be given regard to when managing geothermal fluid. ▪ Clarifies the social and cultural values of geothermal surface features and their use. ▪ Maintains cultural, recreational and amenity values of geothermal surface features and ecologies. Economic: ▪ Provides consistency in the way geothermal fluid is managed. ▪ Provides transparency as to what information is required and the reasons for this. ▪ Establishes clear intent of regulatory intervention. ▪ Provides certainty about principles to be used when allocating geothermal fluid. Environmental: ▪ Provides greater certainty about the importance of environmental values when managing geothermal fluid extraction. ▪ Protects outstanding geothermal natural features and significant geothermal vegetation. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge.	Social: ▪ Increased conflict between competing demands, leading to potential development being stalled. Economic: ▪ Costs associated with researching and determining the limits. ▪ Costs of monitoring resources and resource use. ▪ Litigation costs. ▪ Foregoing activities due to restrictions on geothermal fluid taken. ▪ Increased consent and application costs to adhere to provisions. ▪ Increased applicant costs for additional information.	Yes

5.2 Results of evaluation as to the most appropriate policy and method options to achieve Objective 8

Table 2 summarises the effectiveness and efficiency of the policy and method options and outlines the selection of the most appropriate ones to achieve Objective 8 This selection takes into account the risks of acting or not acting if there is uncertain or insufficient information. The proposed policies and methods that reflect this selection are also listed.

Table 2 Selection of most appropriate of policies and methods to achieve Objective 8

Policy and method options	Effective-ness	Efficiency	Selected option(s)	Proposed policies and methods
1 Broad Directions to regional and/or district plans				Policy # and methods #, # or N/A
Option 1 provide for the sustainable use of geothermal resources	High	Yes	√	**Policy GR 3A**
2 Specific direction Matters to be given particular regard when making resource management decisions				Policy # and methods #, # or N/A
Option 2 requiring an integrated system for geothermal management	High	Yes	√	**Policy GR 7B**
Option 3 Managing geothermal use, takes and discharge	High	Yes	√	**Policy GR 6B**
Option 4 requiring discharge in accordance with a geothermal discharge strategy	High	Yes	√	**Policy GR 8B**
Option 5 protect significant features by maintaining geothermal systems	High	Yes	√	**Policy GR 9B**
4 Do nothing				Policy # and methods #, # or N/A
	Low	Low	X	

5.3 Risk of acting or not acting

The information about geothermal resources is only certain and sufficient for some geothermal systems within the region. The nature of the actions proposed through the Regional Policy Statement is in accord with the need (in many cases) to find out more about the geothermal resource in order to allocate it equitably, sustainably and efficiently. The risk of not providing an allocation framework (not acting) is that the conflicts around the appropriate use of the resource stymie development or result in irreparable damage to highly valuable geothermal surface features. I.e. the risks of not acting not only put the Council in breach of its obligations under the RMA s30(1)(e), but also could have significant negative social, environmental and economic consequences.

5.4 Selection of most appropriate policy and method options to achieve Objective 8

5.4.1 Discussion on selected options

The options selected act as a suite to ensure that:

- Geothermal fluid and energy is used efficiently.
- Geothermal fluid and energy use is done in the context of sustainability i.e. rate of take and requiring reinjection.
- Use of geothermal fluid makes due consideration of adverse effects resulting from such use.

Option 1 provides regulatory direction to regional plans to ensure that plan provisions give strong guidance on all the aspects relevant to the use of the geothermal resource. This includes requiring that systems are used to the nature and extent that the existing Bay of Plenty classification system allows. NB Any additions or changes to the classification of geothermal systems will occur in a regional plan, as the process required to change regional plan provisions is more conducive than that for changing a regional policy statement. Option 2 requires operating each geothermal system holistically, identifying the characteristics of each system prior to full development (i.e. iterative development may be necessary), recognising non-use values, avoiding effects of subsidence, and using the resource efficiently.

Options 2 - 5 (suite of consideration policies for resource consents) provide a suite of polices to guide resource consent considerations, so that in making assessments of the values, philosophies for use and practice considerations, those seeking and those administering consents have sound guidance to work from.

The geothermal resource is different from other resources because resource knowledge is usually very limited – especially at the early stages of development, and geothermal systems are complex, dynamic and interconnected. As it is not possible to observe them due to many aspects of them being inaccessible, their cause and effect relationships are not usually well understood. There is also often a considerable time delay between cause and effect. These difficulties are all compounded by the economic stakes being very high - developing geothermal systems is very capital intensive.

Early stages of development will have a strong element of trial and error, and require iterative approaches. As more information is collected, system operations can be better designed to optimise efficiency. The inaccessibility of geothermal systems means that knowledge comes from surface features and from data at certain points within the system. Data is modelled, permitting tentative conclusions. As the system is developed and more data is available to test the model, knowledge increases.

Adverse effects of take, use and discharge of the geothermal resource are difficult to assign to one of multiple operators because of uncertainty around cause and effect relationships. Remedying adverse effects relies on a co-ordinated and integrated approach and understanding.

Efficient use of the regional geothermal resource involves the efficient extraction (take) from the resource and the efficient application (use) of what is taken.

Current technology means that about 10-12% of the heat and kinetic energy in geothermal fluid is converted to electricity. While cascaded use of the hot geothermal fluid can occur, thus extracting more use from the heat, for effective injection of the fluid, it must be injected at a high enough temperature that avoids significant scale deposition in the injection pipes. Injection into the periphery of the system is regarded as good practice, providing pressure support for more sustainable use of the remaining resource - sustaining reservoir pressure. It also minimises subsidence, the risk of hydrothermal eruptions, and adverse effects on geothermal surface features.

Other discharge options include injection into the ground just outside the geothermal system, or discharged elsewhere, generally to surface water. If discharged elsewhere, the energy, fluid and minerals are lost from the geothermal system and may contaminate natural and physical resources as well as affecting the fluid volume in the system.

Some geothermal systems consist of hot dry rock with little or no convective cycle bringing hot fluid to the surface. Heat can be obtained from these systems by injecting water and creating an artificial convection cycle by means of wells. While none of the systems have been identified in the Bay of Plenty, the policy needs to provide for them being discovered in future.

The policy option proposed promotes reinjection.

Option 1 promotes efficient use of geothermal systems where use is permitted, by requiring this to be considered in choosing and operating plant. Existing resource consents to take heat and energy that are not efficient can be dealt with either on expiry or lapse of the consents, or when the consent conditions are reviewed.

In some cases efficient means of using the resource may incur greater plant purchase, installation and operating costs than older, less efficient technology. This cost would be borne by the users and potential users of the resource.

Mitigation of adverse effects by remediation or protection of Significant Geothermal Features in Groups 1-3 is considered appropriate, being consistent with the principle of sustainable development, specifically the internalisation of externalities [UNCED, 1992, Principle 16].

The policy framework provide guidance to the consent process, to require all applicants to consider appropriate mitigation measures for the activity they are proposing to undertake, in situations where the adverse effects cannot otherwise be avoided or remedied. Appropriate mitigation measures for activities occurring in group 4 may include enhancement, or remediation of past adverse effects that have occurred in groups 1-3 Geothermal Systems.

6 Evaluation of policies and methods to achieve Objective 9

The appropriateness of the policies and methods to achieve Objective 9 are evaluated by looking at the effectiveness, the risks or acting or not acting and the efficiency of the policy and method options.

6.1 Range of policy and method options considered to achieve Objective 9

Objective 9 aims to ensure that geothermal hazards are managed to avoid adverse effects.

6.1.1 Broad direction to district plans

This option requires that district councils consider geothermal features and activity when designing district plan provisions that is likely to affect them. e.g. at the time of subdivision these would be considered, to ensure that resulting changes in land use do not expose the developer or user to geothermal hazard or to risk damaging or destroying geothermal features or ecologies.

6.1.2 Specific direction – particular regard in resource consents, plan changes

This option requires consideration of the impacts on geothermal features of several matters that could have adverse effects. These include effects of changing water levels adjacent to geothermal surface features to avoid drawdown that would damage or destroy them, and changes in land use do not expose the developer or user to geothermal hazard or to risk damaging or destroying geothermal features or ecologies.

6.1.3 Do nothing

This option of no intervention to manage geothermal hazards is not regarded as appropriate as it will not meet the regional council obligations under section 30 of the RMA.

6.2 Evaluation of effectiveness and efficiency of Objective 9 policy and method options

Table 1 assesses the efficiency of the policy and method options for achieving Objective 9 by considering their environmental, economic and social costs and benefits.

Policy and method options	***Analysis of effectiveness***	***Effective-ness***	***Benefits (social, economic and environmental)***	***Costs (social, economic, environmental)***	***Efficient?***
2 Specific direction Matters to be given particular regard when making resource management decisions					
Option 1: consideration of using geothermal resources and non-geothermal water	This policy requires that those contemplating other activities that could affect surface features, by developing on top of them or be affected by geothermal hazards, cannot.	High	Social: ▪ Provides transparency as to what information is required and the reasons for this. ▪ Clearly identifies scope of territorial authorities' responsibilities. ▪ Protects against physical harm from geothermal hazard Economic: ▪ Protects against economic harm from geothermal hazard ▪ Ensures the economic value of the geothermal fluid is sustained. Environmental: ▪ Protects outstanding geothermal natural features and significant geothermal vegetation. ▪ Allows adaptation to changing environmental circumstances and advances in scientific and technical knowledge.	Social: ▪ Increased conflict between competing demands, leading to potential development being stalled. Economic: ▪ Costs of monitoring resources and resource use. ▪ Costs associated with research, consultation, and how to implement the principles. ▪ Costs of technical work to demonstrate lack of interference.	Yes

Policy and method options	***Analysis of effectiveness***	***Effective-ness***	***Benefits (social, economic and environmental)***	***Costs (social, economic, environmental)***	***Efficient?***
Option 2: Consideration of activities over or adjacent to geothermal resources		High	Social: ▪ Maintains cultural, recreational and amenity values of geothermal surface features and ecologies. ▪ Provides transparency as to what information is required and the reasons for this. ▪ Establishes clear intent of regulatory intervention. ▪ Clearly identifies scope of territorial authorities' responsibilities. ▪ Protects against physical harm from geothermal hazard. Economic: ▪ Protects against economic harm from geothermal hazard. Environmental: ▪ Protects outstanding geothermal natural features and significant geothermal vegetation. ▪ Allows adaptation to changing environmental circumstances.	Social: ▪ Increased conflict between competing demands, leading to potential development being stalled. Economic: ▪ Costs associated with researching and determining the limits. ▪ Costs of monitoring resources and resource use. ▪ Litigation costs. ▪ Foregoing activities due to restrictions. ▪ Costs associated with research, and how to implement the principles. ▪ Increased consent and application costs to adhere to provisions. ▪ Increased district plan costs for introduced provisions. ▪ Increased applicant costs for additional information.	Yes
3 Guiding actions					
Option 3 Classify sites		High	Social: ▪ Improved geothermal surface feature management. ▪ People are aware of which geothermal surface features and vegetation are significant. Economic: ▪ Increases resource knowledge. Environmental: ▪ Improved geothermal surface feature management.	Economic: ▪ Costs to applicant and community for monitoring and research.	Yes

Policy and method options	***Analysis of effectiveness***	***Effective-ness***	***Benefits (social, economic and environmental)***	***Costs (social, economic, environmental)***	***Efficient?***
Option 4 Education programmes		Moderate	Social: ▪ Improved geothermal surface feature management. ▪ People are aware of the steps they can take to protect outstanding natural features and geothermal vegetation. Economic: ▪ Avoids costs associated with regulatory response. ▪ Increases resource knowledge. Environmental: ▪ Improved geothermal surface feature management.	Social: ▪ Organising groups, information provision and carrying out the works. Economic: ▪ Increasing costs to householders and ratepayers, depending upon the actions promoted. ▪ Costs to Regional Council for collating and providing information.	Maybe
4 Do nothing					
		Low	Social: ▪ Develops an alternative approach. Economic: ▪ Avoids compliance and consent costs associated with implementing the policies and/or methods. ▪ Rapid development of geothermal resource for industrial heat use including electricity generation	Social: ▪ Geothermal fluid is not used efficiently, sustainably or fairly. Economic: ▪ Conflict between regional council and the community on the use of geothermal fluid versus the protection of outstanding natural features and geothermal vegetation, as to whether there is sufficient geothermal fluid at the location to support the activity and on the meaning of efficient use of geothermal fluid. ▪ Council taken to court for mandamus - not fulfilling its mandate under the RMA. ▪ The allocation conflicts continue and result in reduced economic opportunities.	No

Policy and method options	***Analysis of effectiveness***	***Effective-ness***	***Benefits (social, economic and environmental)***	***Costs (social, economic, environmental)***	***Efficient?***
				▪ Geothermal fluid is over allocated and use is not sustainable. Capital plant investment is underutilised because resource capacity less than plant capacity (e.g. Ohaaki power station) <u>Environmental:</u> ▪ Degradation of outstanding natural features and geothermal vegetation.	

6.3 Results of evaluation as to the most appropriate policy and method options to achieve Objective 9

Table 2 summarises the effectiveness and efficiency of the policy and method options and outlines the selection of the most appropriate ones to achieve Objective 9. This selection takes into account the risks of acting or not acting if there is uncertain or insufficient information. The proposed policies and methods that reflect this selection are also listed.

Table 2 Selection of most appropriate of policies and methods to achieve Objective 9

Policy and method options	Effective-ness	Efficiency	Selected option(s)	Proposed policies and methods
1 Broad direction to regional and/or district plans				Policy # and methods #, # or N/A
Option 1: protecting and managing geothermal features and ecosystems	High	Yes	√	**Policy GR 4A**
2 Specific direction Matters to be given particular regard when making resource management decisions				Policy # and methods #, # or N/A
Option 2: consideration of using geothermal resources and non-geothermal water	High	Yes	√	**Policy GR 10B**
Option 3: consideration of activities over or adjacent to geothermal resources	High	Yes	√	**Policy GR 11B**
4 Do nothing				Policy # and methods #, # or N/A
	Low	Low	X	

6.4 Risk of acting or not acting

The information about geothermal resources is only certain and sufficient for some geothermal systems within the region. The nature of the actions proposed through the Regional Policy Statement is in accord with the need (in many cases) to find out more about the geothermal resource in order to allocate it equitably, sustainably and efficiently. The risk of not providing an allocation framework (not acting) is that the conflicts around the appropriate use of the resource stymie development or result in irreparable damage to highly valuable geothermal surface features. I.e. the risks of not acting not only put the Council in breach of its obligations under the RMA, but also could have significant negative social, environmental and economic consequences.

6.5 Selection of most appropriate policy and method options to achieve Objective 9

6.5.1 Discussion on selected options

The suite of policies for objective 9 provide for management of the land on and around geothermal resources, so that surface features are not damaged by alternative uses, and so that the natural hazards associated with geothermal activity do not cause problems for development and use unrelated to the use of geothermal resources.

The options selected to manage the effects on the geothermal resource from subdivision and other uses requires district council's to identify where surface features are when making decisions about subdivision to prevent damage to surface features and to avoid exposing uses to geothermal hazards.

The other two policies address the problems of drainage and groundwater drawdown on geothermal systems.

Appendix 1 – Criteria used to determine regionally significant issues

The criteria used for determining whether an issue was a resource management issue of regional significance were:

- The issue was a natural or physical resource management problem.
- The issue was to be of regional significance (see further criteria below).
- The issue was about achieving the purpose of the Resource Management Act, 1991 (RMA).
- The issue did not "repeat" the RMA, the New Zealand Coastal Policy Statement, any other national policy, or another issue in the Regional Policy Statement.
- The issue was explained in the context of the Bay of Plenty region.

Regional significance was determined using the following criteria:

- The issue concerns a resource which is regionally significant, and the issue requires integrated management at a regional level ; and
- There is a potential shortage of the resource and resultant allocation issues; or
- There is a significant level of conflict over the resource which is either occurring or is foreseeable over the next 10 years; or
- The resource is potentially subject to significant adverse effects at a regional level; or
- There are significant issues in terms of Part 2 of the RMA which are or are likely to arise at a regional scale (e.g. maintenance and enhancement of access along waterways); or
- The community has signalled that it regards a particular issue as being of regional significance; or
- The issue is one of national significance (e.g. preservation of natural character) and requires regional intervention; or
- The issue is one of District significance but requires regional intervention; or
- The matter is one which a National Policy Statement or National Water Conservation Order requires to be addressed.

Appendix 2 – References

Allis and Lumb ed (1992) Geothermics. International Journal of Geothermal Research and its Applications. Special issue: Rotorua Geothermal Field, New Zealand

Beadel et al. Geothermal vegetation in the Bay of Plenty region 1996

Beadel et al Geothermal vegetation in the Bay of Plenty region 2001

Baverstock K. unpublished report © 1995 Costs and Benefits of retaining 1.5 km radius

Mass Abstraction Exclusion Zone around Pohutu Geyser. Background information for Environment Court case.

Hooker M. Taylor S. (2007) Community Outcomes Survey 2006 – Analysis Report. Prepared for

BOPRC by Key Research. Strategic Policy Publication 2007/02.

BOPRC (1999) Operative Bay of Plenty Regional Policy Statement.

BOPRC (1999) Operative Rotorua Geothermal Regional Plan.

BOPRC (2006) The Ten Year Plan 2006 – 2016. Volumes 1 and 2.

BOPRC (1999) Environmental Education Strategy for BOPRC 1999-2005 – Learning for a Sustainable Environment.

BOPRC (2001) State of the Environment report. Environment Bay of Plenty, 2001.

BOPRC (2004) State of the Environment report. Environment Bay of Plenty, 2004.

BOPRC (2001) Gordon, D. O'Shaughnessy, B. Rotorua Geothermal Field Management Monitoring. ISSN 1172 - 5850

BOPRC (2005) Gordon, D. Scott, B J. Mroczek, EK. Rotorua Geothermal Field Management Monitoring Update:2005. ISSN 1175 - 9372

Burnell, J. Rotorua Geothermal Reservoir Modelling 2006: Heat exchanger Scenarios and Exclusion Zone Assessment Final Report. Industrial Research Limited July 2007

Burnell, J. and Kissling W. Rotorua Geothermal Reservoir Modelling Part 1: Model Update 2004. Industrial Research Limited February 2005

Burnell, J. Rotorua Geothermal Reservoir Modelling Part 2: Scenario Modelling. Industrial Research Limited February 2005

Cody, A.D. 2000: A Survey of Natural Geothermal Features. Prepared for Environment Bay of Plenty

Gordon, D.A., Scott, B.J., Mroczek, E.K., (2005) Rotorua Geothermal Field Management Monitoring Update: 2005. Environmental Publication 2005/12.

Gordon, D.A., O'Shaughnessy Brett W, Grant-Taylor D.G, Cody A D (2001) Rotorua Geothermal Field Management Monitoring 2001. Environmental report 2001/22.

Key Research (2007) Attitudes and Perceptions towards the environment and BOPRC 2006. Strategic Policy Publication 2007/01

Ministry for the Environment (2003) Drafting Issues, Objectives, Policies and Methods in Regional Policy Statements and District Plans, Ministry for the Environment

Ministry for the Environment (June/July 2005), 2nd Generation Plans Workbook This workbook contains supporting information and exercises to the Ministry for the Environment, NZPI and RMLA workshops series on Second Generation RMA Plans.

Ministry for the Environment (1996) The Monitoring Guide – A Practitioner's Guide to Section 35 of the Resource Management Act 1991, Ministry for the Environment.

Ministry of Economic Development (October 2007) New Zealand Energy Efficiency and Conservation Strategy – Action plan to maximise energy efficiency and renewable energy. Wellington.

Ministry of Economic Development (October 2007) New Zealand Energy Strategy to 2050 – Powering Our Future. Wellington.

O'Shaughnessy Brett W., May 1999, Use of economic instruments in management of Rotorua geothermal field, New Zealand, Geothermics 29 539 – 555).

Wildlands (2005) Geothermal Vegetation of the Bay of Plenty Region Based On The 2003 Digital Aerial Photographs. Contract Report No. 1072. Report prepared for Environment Bay of Plenty.