Bay of Plenty Regional Council
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Whakatāne
New Zealand

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Bay of Plenty Regional Policy Statement

OPERATIVE

GEOTHERMAL RESOURCES PROVISIONS

CLEAR COPY VERSION

Prepared by

Bay of Plenty REGIONAL COUNCIL

These are the operative Geothermal Resources provisions of the second generation Bay of Plenty Regional Policy Statement, made operative on 1 October 2013.

This version supersedes the Geothermal Resources provisions contained within:

- Chapter 10 of the existing Operative Bay of Plenty Regional Policy Statement (which should be removed and recycled); and

- Council Decisions (Track Changes Version 8.0b and Clear Copy Version 8.0c) of the Proposed Regional Policy Statement, August 2012.

The remainder of the Proposed RPS is not yet operative. Amendments have occurred to other parts of the Proposed RPS and copies of all consent orders are available on the Regional Council website at ww.boprc.govt.nz. The existing operative and proposed documents should be retained until such time as all Proposed RPS provisions are formally made operative, which is expected in 2014.

Note that some provisions (particularly Methods 1, 2 and 3) will further change as a result of consent orders resolving appeals.

RESOURCE MANAGEMENT ACT 1991

BAY OF PLENTY REGIONAL COUNCIL

GEOTHERMAL RESOURCES PROVISIONS
BAY OF PLENTY REGIONAL POLICY STATEMENT

It is hereby certified that these are the Geothermal Resources provisions of the Bay of Plenty Regional Policy Statement approved by resolution of the Council on the 21st day of August 2013.

The Council has further resolved that the Policy Statement shall become Operative on the 1st day of October 2013.

The Common Seal of the **BAY OF PLENTY REGIONAL COUNCIL** was affixed hereto this 10th day of September 2013 in the presence of:

John Cronin
Chairman

Mary-Anne Macleod
Chief Executive

2.4 Geothermal resources

The geothermal resources of the Bay of Plenty Region result from the tectonic activity of the Taupō Volcanic Zone.

Geothermal systems are found in a broad band from Waimangu to the south of Rotorua to Whakaari (White Island) off the coast in the north-east of the region. The concentration of high-temperature geothermal systems in the Taupō volcanic zone is associated with the Pacific tectonic plate diving beneath the Australian plate. Magma rises above this subducting and melting plate to relatively close to the surface. Heat is transported to the surface via deep-circulating water convection cells. In impermeable areas, this occurs more by conduction. In these impermeable areas there will be high thermal gradients that could make attractive targets for enhanced geothermal system, or deep (>3.5km) system development targets. Such areas may have little or no surface expression but still have potential to supply energy for heat or electricity.

The characteristics of the near-surface systems (less than 3 km below the surface) vary. Some have substantial surface expression, while others have considerable heat potential and few surface features.

The geothermal systems have a wide range of values, not all of which are compatible. They include features, landscapes and ecologies that are rare and have internationally significant intrinsic value. This intrinsic value and the experiences of use of geothermal water via spa and hot pools forms a tourism draw-card of great economic importance to Rotorua and the wider Bay of Plenty. Some systems and their features have immense Māori cultural significance. The low-impact use of these systems has occurred for 500 years or more. Geothermal systems are also the source of considerable energy which can be used for direct heat purposes or to generate electricity. This potential for electricity generation provides an opportunity for Māori land holding entities to develop multiple owned Māori land and generate social and economic benefits as well as providing for the on-going relationship of Māori landowners with their ancestral lands and associated resources.

The challenge is to manage the resource to support the intrinsic and traditional cultural values while providing for the use of the energy resource. This is done by taking a region-wide approach to the geothermal systems in the Bay of Plenty, and providing for the different values at a regional level, rather than trying to provide for all values within each system. Managing the geothermal systems in a sustainable manner requires understanding their capacity, and allocating and managing within that capacity.

For the geothermal resource, sustainability (over a defined period of time) and renewability are affected by the level of use.

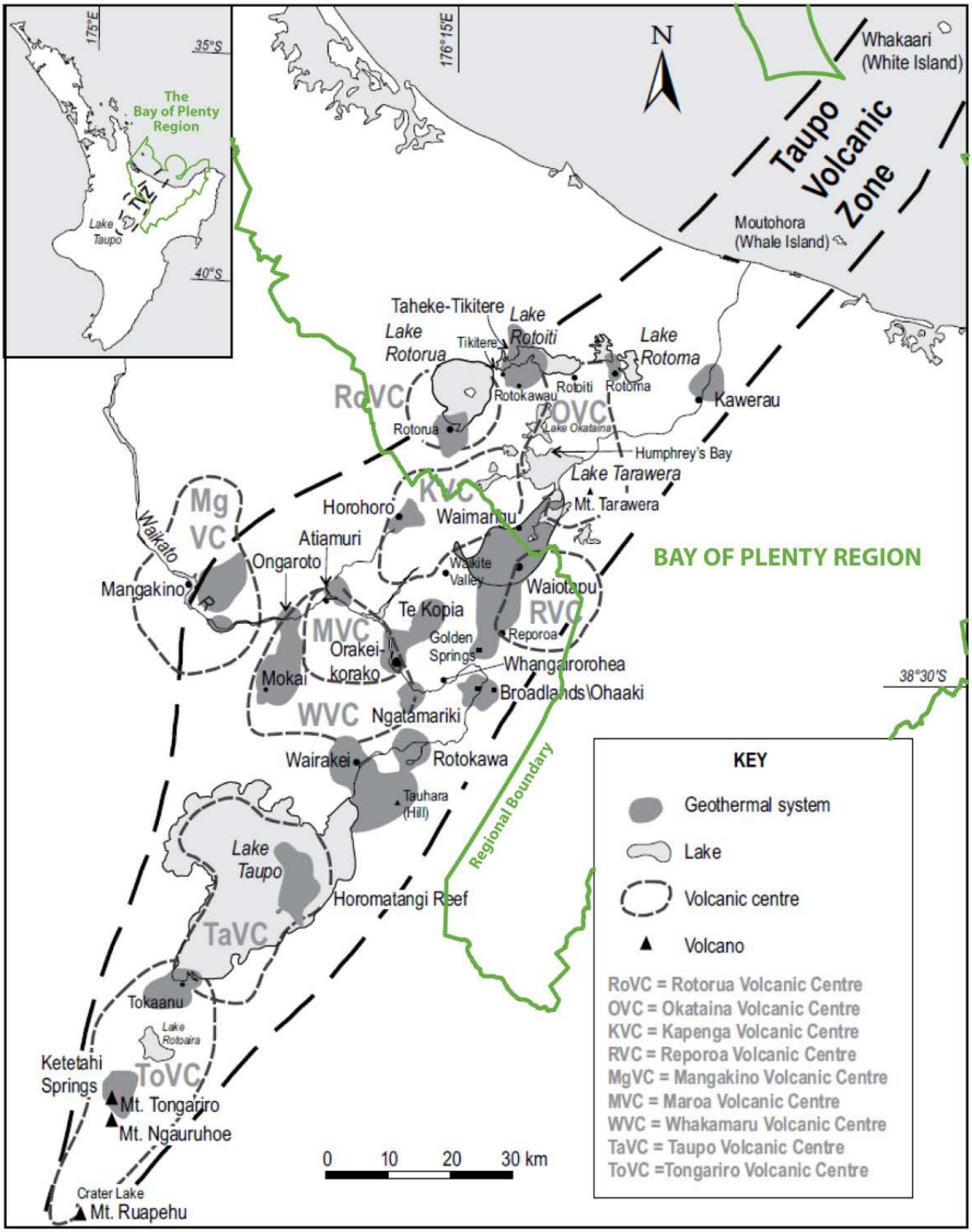
“Sustainable use” acknowledges that a reduction in enthalpy (heat energy available for use) of the accessible part of the geothermal system could occur, due to extractive use. The extraction rates required for economic use mean that the resource could be used at a rate that could deplete it over a small number of future generations, making it economically unavailable for a few generations until the heat supply recovers. Use can also affect geothermal surface features. Assessing proposals for extractive use of a geothermal system will be done on a case by case basis in terms of the definition of sustainable use.

In the Bay of Plenty, allocation decisions must take account of potential use of the resource by several users within the same system, and take account of potential effects on the system’s Significant Geothermal Features (SGFs). Assessing the likely capacity of a geothermal system requires both monitoring of the system and modelling its likely response. Allocation of the resource to maximise its use requires a holistic understanding of the allocation parameters and impacts of all users. Without robust information a conservative management regime would be required, to provide a greater margin from potential adverse effects.

Rotorua has been built on top of what would otherwise be classified as a protected geothermal system, with many SGFs. Management of urban development to avoid exposing people to the hazards of geothermal activity and to protect geothermal features from the effects of intensive development are both required.

To manage the range of values and uses of the geothermal systems in the Bay of Plenty, the systems are classified. The purpose of the Bay of Plenty geothermal classification is to manage the region's geothermal resource sustainably by establishing different management purposes for different systems. In this way the extractive use of the resource is confined to some geothermal systems, while other systems are protected for their intrinsic values. The different classifications provide a management purpose for each geothermal management group, based on identifying the region's geothermal systems' physical characteristics.. These also determine the potential for extractive use (heat or fluid). The way in which these characteristics are considered in the classification process is set out in Policy GR 1A and Table 4A.

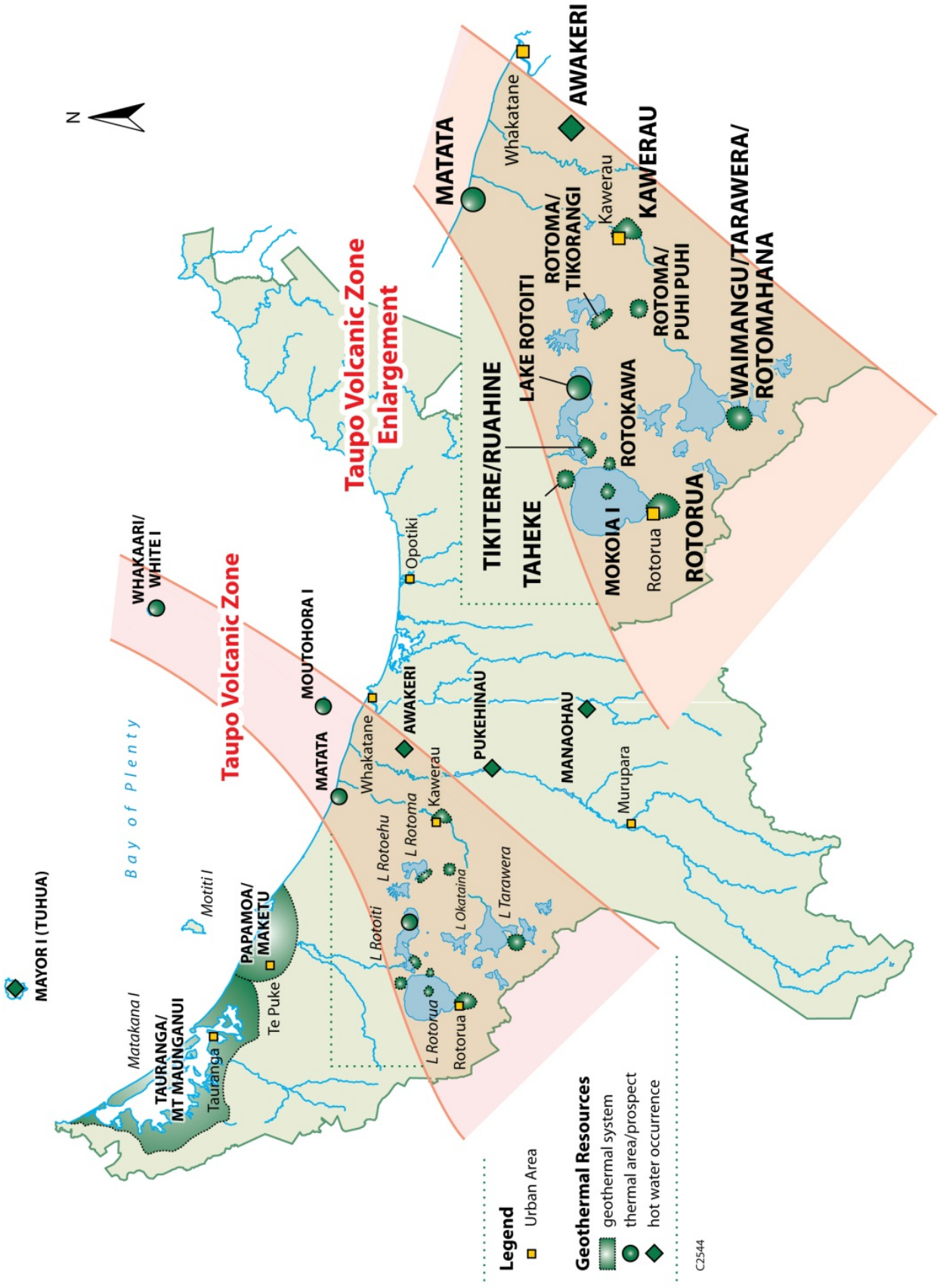
Taupō Volcanic Zone



Map 3

Map of Taupō volcanic zone. NB Accurate information on system connections and boundaries need to be sought elsewhere, as this map is indicative only. Source Environment Waikato map by L Cotterall.

Geothermal fields in the Bay of Plenty



Map 4

NB Accurate information on system connections and boundaries need to be sought elsewhere, as this map is indicative only.

2.4.1 Regionally significant geothermal issues

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.

2 Allocation of geothermal resources

Geothermal resources are regarded as a significant source of renewable electricity in New Zealand. They also have intrinsic values in their natural state; have been used for hundreds of years for cultural customary practices, as well as being a tourism attraction. There is significant potential for the use and development of geothermal energy resources in the region. Using the regional geothermal resource for energy development and protecting its other values is a difficult balance. Management of values that have been detrimentally affected is also required.

3 Lack of information

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.

4 Need for integrated management

The interconnected nature of the resource necessitates an integrated approach to the management of the regional geothermal resource at a regional and inter-regional level to allow for its sustainable management.

Table 4 Geothermal resources objectives and titles of policies and methods to achieve the objectives.

Objectives	Policy titles	Page	Method titles	Implementation	Page
Objective 8 Holistic and sustainable management of the regional geothermal resource by providing for: • protection of some systems with Significant Geothermal Features; • enabling use and development of other geothermal systems; in accordance with each system's management purpose as specified in Table 4A.	Policy GR 1A Requiring classification of geothermal systems		Method 2: Regional plan implementation	Regional council	
	Policy GR 2A: Requiring integrated management of geothermal systems		Method 2: Regional plan implementation	Regional council	
			Method 25: Provide geothermal environmental education programmes	Regional council, city and district councils	
			Method 26: Facilitate and support community based ecological restoration programmes	Regional council, city and district councils	
	Policy GR 3A: Providing for the sustainable use of geothermal resources		Method 2: Regional plan implementation	Regional council	
	Policy GR 5B: Requiring information for use of the geothermal resource		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
	Policy GR 6B: Managing geothermal use, takes and discharges		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
	Policy GR 7B: Requiring integrated geothermal system management		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
	Policy GR 8B: Requiring geothermal discharge to be in accordance with a discharge strategy		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
	Policy GR 9B: Assessing and managing effects on Significant Geothermal Features		Method 2: Regional plan implementation	Regional council	
			Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
			Method 22B: Assessment of Significant Geothermal Features	Regional council, city and district councils	

Objectives	Policy titles	Page	Method titles	Implementation	Page
	Policy GR 12B:Protecting research systems		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
Objective 9 Development and use of land and non-geothermal water is compatible with protection, development and use of geothermal systems in accordance with each system's classification management purpose.	Policy GR 4A: Protecting and managing Significant Geothermal Features and ecologies		Method 1: District plan implementation	City and district councils	
	Policy GR 10B: Using geothermal resources and non-geothermal water		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
	Policy GR 11B: Requiring information for activities over or adjacent to geothermal resources		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	
	Policy GR 12B: Protecting research systems		Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans	Regional council, city and district councils	

Part three

Policies and methods

Part three presents the policies and methods that, when implemented, will achieve the objectives of this Statement and address the regionally significant resource management issues (including the issues of significance to iwi authorities). The resource management issues and objectives are presented in the previous part two under topic headings.

Part three is divided into two sections. The first contains the policies and the second sets out the methods.

Within the first section, policies are grouped according to the topic under which the policy was originally drafted and are identified as follows:

AQ = Air Quality

CE = Coastal Environment

EI = Energy and Infrastructure

GR = Geothermal Resources

IR = Integrated Resource Management

IW = Iwi Resource Management

MN = Matters of National Importance

NH = Natural Hazards

UF = Urban and Rural Growth Management

WL = Water Quality and Land Use

WQ = Water Quantity

Within these topic groups the letter following the policy number further divides policies into four types as outlined below.

(a) Policies giving direction to regional and district plans

Broad policies that must be given effect by regional or district plans (in accordance with sections 67(3) and 75(3)(c) of the Act) as set out in methods of implementation 1 and 2. These policies are identified by the letter A after the main policy number e.g. CE 3A. NB: while these policies are primarily expressed through plans, in some cases 'A' type policies may also be relevant to the assessment of resource consent applications and notices of requirement. The A policies that must be considered in the assessment of resource consent applications and notices of requirement are listed in Method 3.

(b) Specific directive policies for resource consents, regional and district plans, and notices of requirement.

These policies are identified by the letter B after the main policy number e.g. CE 6B. These are specific policies that:

- must be given effect by regional or district plans (in accordance with sections 67(3)(c) and 75(3)(c) of the Act) as set out in methods of implementation 1 and 2;

- consent authorities must have regard to, where relevant, when considering applications for resource consent and any submissions received (in accordance with section 104(1)(b)(iv) of the Act); and

- territorial authorities must have particular regard to, where relevant, when considering requirements for designations or heritage orders and any submissions received (in accordance with sections 171(1)(a)(iii) and 191(1)(d) of the Act).

NB: in some cases these policies may also be linked to Methods 1 and/or 2 to ensure they are given effect to as soon as practicable by regional and/or district plans.

(c) Policies that allocate responsibilities

These policies allocate the responsibilities for land-use controls for natural hazards, hazardous substances and indigenous biodiversity between the Bay of Plenty Regional Council and the region's city and district councils. These policies are identified by the letter C after the main policy number e.g. IR 7C.

(d) Guiding policies

These are guiding policies that outline actions to help achieve the objectives. These policies are identified by the letter D after the main policy number e.g. IW 8D.

The second section sets out the methods for implementing the policies. There are two main groups of methods:

- Directive methods to implement policies identified above as either #A, #B, or #C.
- Methods that implement the guiding policies (identified above as #D) or that support the delivery of the other policies.

Directive methods used to implement most policies are Methods 1, 2 and 3. Method 3 requires that policies shall be given effect to when preparing, changing, varying, reviewing or replacing a regional or district plan, and had regard to when considering a resource consent or notice of requirement. While Method 3 is most commonly used to implement 'B' type policies, in some cases (where listed in Method 3) it may be linked to 'A' type policies which are applicable to the assessment of resource consent applications and notices of requirement. Similarly Methods 1 and/or 2 are primarily used to implement 'A' type policies in regional and district plans but in some cases (where listed in Methods 1 and 2) these policies may also be linked to 'B' type policies to ensure they are given effect to as soon as practicable by the relevant plans. The policies linked to and intended to be implemented by Methods 1, 2 and 3 are identified in the beginning of Section 3.2.1 'Directive methods'.

A summary table is provided at the beginning of part three in which the policy titles are provided. The titles serve only as a guide, as the policies are not reproduced in full within the summary table.

In a box following each of the policies, is a cross reference to pertinent objectives and methods. These must be read in association with each policy, to appreciate the relationships between these policies and methods.

3.1 Policies

Table 12 Policy name and page number.

Geothermal Resources Policies

Policy GR 1A: Requiring classification of geothermal systems

Provide for the sustainable management of the Regional Geothermal Resource by requiring classification of geothermal systems into differing management groups, as follows:

(a) Classify geothermal systems into management groups according to the following characteristics:

(i) system temperature, which determines whether a system is classified as high temperature (Groups 1 – 4) or low temperature (Group 5), then;

(ii) existing use, which determines whether a system is classified as Group 2 (Rotorua) due to large scale existing land development on the system, or Group 4 (development) due to significant existing extractive use of the system, then;

(iii) the presence of SGFs, which is determined by applying method 22B and then;

(iv) the vulnerability of SGFs, if present, to extractive use; which determines whether a system is classified as:

1 Group 1 (Protected) or Group 2 (Rotorua) due to the presence of numerous SGFs, or SGFs with high to moderate vulnerability to extractive use; or

2 Group 3 (Conditional Development) due to the presence of some SGFs with moderate vulnerability to extractive use; or

3 Group 4 (Development) due to the presence of no SGFs or few SGFs with moderate to low vulnerability to extractive use.

(v) Group 6 refer to Policy GR 12B.

(b) Regional plans shall classify geothermal systems as follows:

(i) Groups 1, 2, 4 and 5 classification is as specified in Table 4A;

(ii) Groups 3 and 6 classification is via the Regional Plan. Where information that supports a change is provided, classification may be changed through a regional plan change process, and would result in Table 4A being updated.

Explanation

This policy sets out the process for assigning geothermal systems to different management groups, depending on their biophysical characteristics and taking into account significant existing use. This provides for sustainable management of the Regional Geothermal Resource through the use of multiple management purposes. These range from protection of some geothermal systems, through to large-scale use of the geothermal resource.

A summary as to how Policy GR 1A has been applied to each management system is set out in Table 4A. Groups for which no change from their present purpose is anticipated (those in Management Groups 1, 2, 4 and 5) are formally identified in the regional policy statement. Those for which a change in classification may occur are noted for information in the policy statement. The mechanism to change their status is through the regional plan.

Table reference: ***Objective 8****, Method 2*

Table 4A Geothermal management group descriptions and management groups 1-6

Table 4A: Geothermal management group descriptions and management groups 1-6							
Geothermal management group	Temp	Existing use	Presence of Significant geothermal features	Significant geothermal feature vulnerability to extractive use	Management purpose	Potential for extractive use	Geothermal systems
Protected systems group 1	> 70 ºC	No existing extractive use	Numerous SGFs, some with outstanding characteristics	High to moderate	Surface feature values override extractive values. Protection of the SGFs, which have outstanding natural, intrinsic, scenic, cultural, heritage and ecological values.	No potential for extractive use.	Waimangu – Rotomāhana Tarawera Whakaari (White Island) Moutohora Island (Whale Island)
Rotorua system group 2	> 70 ºC	High levels of existing use. Extractive and non-extractive	Numerous SGFs, some with outstanding characteristics	High to moderate	Surface feature values that rely on pressure and temperature maintenance override extractive values. System management that limits extractive uses to avoid, remedy or mitigate adverse effects on the outstanding natural, intrinsic, scenic, cultural, heritage and ecological values.	Limited potential for further extractive use.	Rotorua
Conditional development systems group 3	> 70 ºC	Varying levels of existing use. Mainly non-extractive	Some SGFs	Moderate	The values of SGFs have priority over extractive values. System management will provide for use and development, contingent upon the ability to avoid, remedy or mitigate significant adverse effects of development on the SGFs present in those systems.	Potential for development of extractive use (heat or fluid).	Tikitere-Ruahine Rotokawa-Mokoia Island Rotoma-Tikorangi Taheke
Development systems group 4	> 70 ºC	Varying levels of existing extractive use	Few or no SGFs	Moderate to low	System management that provides for extractive use, provided significant adverse effects on SGFs are remedied or mitigated.	Potential for development of extractive use (heat or fluid)	Kawerau Lake Rotoiti (outflow is in the bed of the lake) Rotoma-Puhi Puhi
Low-temperature systems group 5	>30 ºC < 70 ºC	Varying levels of existing extractive use	Few or no SGFs.	N/A	System management that provides for extractive use, where the adverse effects of the activity can be avoided remedied or mitigated. Discharge of geothermal fluid must be managed to avoid significant adverse effects on surface water and stormwater.	Potential for development of extractive use (heat or fluid)	Mayor Island (Tuhua) Tauranga/Mount Maunganui (Mauao) Pāpāmoa/Maketū Awakeri Pukehīnau (Rangitaiki) Manaōhau (Galatea)

Research systems group 6	Unknown	No present use	Surface features not characterised	Vulnerability not characterised	Enable research into the characteristics of the system necessary to support their reclassification. Allow takes and discharges for investigation purposes only (including those having temporary effect on geothermal features, if it can be demonstrated that they will not permanently threaten SGFs or the natural characteristics of the system).	More information required before the system can be classified into groups 1-5.	

Policy GR 2A: Requiring integrated management of geothermal systems

Integrated management of geothermal systems by requiring that:

(a) Development and use of land within geothermal systems is compatible with the management purpose for each system, as specified in Table 4A*;*

(b) System management plans are used for any geothermal system classified for development; and

(c) Geothermal water injection and reinjection is actively encouraged and provided for.

Explanation

This policy supports matching the degree of extractive use to the nature of the system; where those systems with many SGFs vulnerable to extractive use receive greater protection and less use than those that do not. It also requires that geothermal resource use is managed on a whole system basis, to ensure integrated management of the system which responds to changes caused by its use. Finally, the policy focus on returning water to its source reservoir is to minimise effects on freshwater and to limit other adverse effects of pressure drawdown including subsidence.

*Table reference: **Objective 8** and 11, Methods 2, 25 and 26*

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

Provide for the sustainable use of geothermal systems, by requiring that development and use within a geothermal system:

(a) may occur only if:

(i) Such use is consistent with the management purposes for each system defined in the Bay of Plenty Regional Council geothermal system classification described in Table 4A;

(ii) The system is operated under a system management plan covering the entire geothermal system where the cumulative abstractive development uses 1000 tonnes or more geothermal water per day; and

(b) has regard to:

(i) System characteristics;

(ii) Adaptive management of the system, including appropriate staging of development;

(iii) Cultural, historical, and economic values associated with SGFs;

(iv) The allocation reasonably required for the intended use;

(v) Demonstrating efficiency of use of the geothermal energy and water resource;

(vi) Avoiding, remedying or mitigating significant adverse effects on the overlying existing built structures; and

(vii) Managing the take, use and discharge of energy and/or geothermal water to:

1 avoid significant adverse effects on SGFs in group 1, 2 and 6 systems.

2 avoid, remedy or mitigate significant adverse effects on SGFs in group 3 systems.

3 remedy or mitigate significant adverse effects on SGFs in group 4 systems.

Explanation

Geothermal development in the form of extractive use of heat or water should be carried out only at a rate or level of extractive use that takes account of the other values of each geothermal system. These are defined in a broad sense through the classification of each geothermal system, and the management purposes of each group (which range from full protection of some systems to considerable extractive use in others). Policy GR 3A gives guidance on the considerations that must be made.

Where there are a large number of small users, the Regional Council will generally prepare the system management plan. Where there are a small number of large users, the Regional Council will generally require the users to prepare the system management plan.

If the system users develop the system management plan then it must be subject to regional council approval.

*Table reference: **Objectives 8**, 10 and 15, Method 2*

Policy GR 4A: Protecting and managing Significant Geothermal Features

For significant geothermal features:

(a) Ensure any new land uses and land use practices are compatible with the management purpose of the geothermal system classification;

(b) Protect the natural and biodiversity values of SGFs in geothermal management groups 1 and 2 (see Table 4A) from incompatible land uses; and

(c) Recognise and provide for cultural, historical, and economic values associated with geothermal activity in Whakarewarewa and Ohinemutu areas where hazardous areas are subject to some land use.

Explanation

Policy GR 4A requires consideration of the impact of subdivision, use and development on SGFs and their ecosystems, particularly in the Rotorua geothermal system where urban development and geothermal features coexist in close proximity.

*Table reference: **Objectives 9**, 8, 10, 11 and 15, Method 1*

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

Require, for the use of the geothermal resource:

(a) Information commensurate with the scale of the activity. Information provided on small scale applications to be relative to the threats to features and other users from consumptive or non-consumptive use;

(b) Key aspects of large scale applications to be independently peer reviewed for the regional council;

(c) Resource users to identify which information lodged with council is commercially or culturally sensitive, such that its publication or communication should be prohibited or restricted; and

(d) Comprehensive monitoring to detect significant adverse effects on SGFs.

Explanation

This policy is to clarify that to successfully manage sustainable multi-user allocation of the geothermal resource, significant information is required.

*Table reference: **Objectives 8** and 9, Method 3*

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

For geothermal use, takes and discharges have particular regard to:

(a) Allowing takes for scientific investigation or to remedy or mitigate existing adverse effects;

(b) Providing for small takes, discharges, and non-extractive uses;

(c) Allowing the continuation of existing consents, provided the exercise of such consents is not inconsistent with the relevant system management plan;

(d) Ensuring provision is made on the expiry and non-renewal of consents for site remediation, abandonment of wells, removal of buildings and structures, including pipe work, associated with the development activity;

(e) Applying conditions and, where appropriate, bonds that recognise the potential for the take, use, and discharge of geothermal energy and water to cause significant adverse effects on other natural and physical resources, including overlying structures (the built environment) for geothermal groups 2, 3, 4 and 6 (see Table 4A);

(f) Requiring the use of geothermal resources to be efficient in conserving geothermal energy and water and preferring the use of energy efficient and water efficient technologies over ad-hoc extraction for individual use, including for geothermal groups 2 and 5 (see Table 4A);

(g) The benefits to be derived from the productive use of geothermal energy or water; and

(h) The benefits to be derived from the development of multiple owned Māori land, consistent with the management purpose of the geothermal system.

Explanation

Geothermal development in the form of extractive use of heat or water should be carried out only at a rate or level that takes account of the management purposes for that geothermal system. This policy provides more guidance on the considerations that need to be made when such use is proposed.

Table reference: ***Objectives 8*** *and 9, Method 3*

Policy GR 7B: Requiring integrated geothermal system management

Require integrated system management for significant geothermal system use through a single system management plan for the entire geothermal system, which must contain:

(a) System management objective;

(b) Operational flexibility and adaptive management parameters;

(c) Modelled reservoir and subsidence predictions for geothermal systems where the cumulative take exceeds 6000T/day;

(d) A discharge strategy;

(e) Mechanisms to ensure co-operation between all consent holders for large takes within the same geothermal system and which enable utilisation of, and access to, the geothermal system by consent holders, while not precluding (without sound resource management justification) the utilisation of the system by a trade competitor or other potential user;

(f) Buffer distances between the production and injection or reinjection wells of adjacent operators in the same geothermal system;

(g) Mechanisms to remedy or mitigate significant adverse effects on SGFs, including remediation or mitigation of existing effects or protection from potential adverse effects, in any geothermal system.

(h) Measures to ensure that where the system may be linked to another system, development does not cause effects that are inconsistent with the management purposes for that other system;

(i) Research, monitoring and reporting of the system, its potentials, attributes and qualities and effects of exercising consents;

(j) Non-statutory review for minor amendments;

(k) Provisions for the use of peer review panels to assist the consent authority; and

(l) Provisions for a system liaison group to facilitate discussion with, and feedback from, stakeholders.

Explanation

Allocation decisions must be made on the basis of using the resource at a sustainable rate by several users within the same system, and take account of potential effects on SGFs of the system. Assessing the likely capacity of a geothermal system is a very expensive process requiring both monitoring of the system and modelling its likely response. To allocate the resource to maximise its use requires a holistic understanding of the allocation parameters and impacts of all users, thus a system management plan that is common to the entire system is necessary.

Table reference: ***Objectives 8*** *and 11, Method 3*

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

Require geothermal discharge, from takes that are subject to a resource consent, to be in accordance with a geothermal discharge strategy that addresses:

(a) Disposal of geothermal water;

(b) Return of geothermal water to the system;

(c) Facilitation of further extraction of energy from the system;

(d) Avoidance, remediation or mitigation of subsidence, particularly in the built environment;

(e) Minimising the risk of hydrothermal eruptions especially in the built environment;

(f) Remediation or mitigation of significant adverse effects on significant geothermal features SGFs and geothermal vegetation;

(g) Avoidance, remediation or mitigation of contamination of surface or ground water; and

(h) Investigation, research, monitoring and reporting on implementation of the discharge strategy.

Such discharge strategy shall also have regard to:

(i) Likely benefits to, or significant adverse effects on, the system or its productive capacity;

(j) The need for adaptive management and flexibility over time; and

(k) Benefits, costs and significant adverse effects of the discharge strategy.

Explanation

Discharge of geothermal water can be hazardous if done without consideration for the effects of the discharge. Adding geothermal water to fresh water, cooling the system and creating hydrothermal eruptions are some of the issues. This policy requires that discharge is done in a way that minimises adverse impacts and to make the most use of the energy extracted from the resource.

*Table reference: **Objective 8**, Method 3*

Policy GR 9B: Assessing and managing effects on Significant Geothermal Features

(a) Assess geothermal features to determine which are significant, using Appendix F Set 7 "Geothermal features".

Note: "Geothermal features" includes vegetation, habitats and fauna.

(b) Manage effects on SGFs in accordance with the management purpose of the geothermal group in which they are classified, shown in Table 4A, as follows:

(i) Protect SGFs, by protecting natural flows of geothermal water to the surface from deep within the system, and by requiring maintenance of the conditions that maintain system pressure and temperature within group 1 and 2 systems (see Table 4A) as required to support those features.

(ii) Avoid, remedy or mitigate significant adverse effects on SGFs in group 3 systems.

(iii) Remedy or mitigate significant adverse effects on SGFs in group 4 systems.

(iv) Provide for new takes and discharges in group 1 or group 6 systems, only for scientific investigation or to remedy or mitigate existing adverse effects.

(c) In circumstances where mitigation is required under Policy GR 9B(b), it should be proportionate to the nature and scale of adverse effects.

(d) Mitigation of adverse effects on SGFs or geothermal resources can occur within the wider Taupō Volcanic Zone rather than being restricted to the Bay of Plenty region.

Explanation

Identification and assessment of the significance of geothermal features is required to ensure that the more significant features are protected through regional and district plan provisions.

Although a large number of geothermal features (1840) have been identified within the region, they have not been classified in a way that takes account of their status as taonga, customary activity, outstanding natural feature or their significance as indigenous vegetation or habitat.

The Rotorua geothermal system was over-extracted in the 1970s-90s to the detriment of the geysers and springs. This policy intends that the system temperature and pressure will be maintained or restored to avoid this happening again.

*Table reference: **Objectives 8**, 17, 18, 19 and 20, Methods 2, 3 and 22B*

Policy GR 10B: Using geothermal resources and non-geothermal water

Require conditions that address the potential adverse effects of adjacent activities that could affect, SGFs or landscapes, for activities using geothermal resources and non-geothermal water.

Explanation

Geothermal features are rare, fragile and have rare ecosystems that are especially adapted for hot ground. Residential, commercial or even public park development can regard these features as messy and unattractive. People "tidy" them or replace the vegetation with more appealing plants. This policy is to alert developers to the special values of these features. Non geothermal (groundwater) extraction can also change the water balance that contributes to the presence of geothermal features.

*Table reference: **Objectives 9** and 8, Method 3*

Policy GR 11B: Requiring information for activities over or adjacent to geothermal resources

Require information on geothermal hazard risk and conditions that assess and address that risk for activities over or adjacent to geothermal resources.

Explanation

Geothermal systems pose risks to land use development due to the possibilities for subsidence, poisonous gas, superheated steam, hot ground and hot water. Activities close to geothermal features need to assess and address these risks.

*Table reference: **Objectives 9** and 8, Method 3*

Policy GR 12B: Protecting research systems

Protect the geothermal characteristics of research systems from long term adverse effects by maintaining the natural stocks and flows of geothermal energy and water, including the flow of deep geothermal water to the surface, until they are reclassified.

Explanation

Classification as a research system is intended to be temporary, pending reclassification. Until enough is known to reclassify these systems, it is appropriate to adopt a precautionary approach and protect the geothermal characteristics. Reclassification will only occur when sufficient information about the system is obtained so that it can be reallocated to an appropriate management group.

3.2 Methods to implement policies

This section contains the methods for implementing the policies set out in section 3.1. It is divided into two main groups of methods: directive methods and guiding methods to implement the policies.

The methods are divided into five types:

- Directive
- Information and/or guidance
- Promoting coordination
- Identification and investigation
- Providing support

Under each method the key organisations who will implement the methods are identified. An asterisk * indicates the lead authority responsible for implementation, if this is designated. The delivery and timing of methods is subject to long-term council community planning and annual plan schedules.

Within section 3.2 the methods are presented in numeric order, although in the summary table below, methods are listed under key topics.

Table 14 Methods to implement policies.

3.2.1 Directive methods

Method 1: District plan implementation

District plans shall give effect to Policy GR 4A.

If a district plan does not currently give effect to these policies, then the *district council shall notify a variation or change as soon as reasonably practicable, but within two years from the date on which the Bay of Plenty Regional Policy Statement is made operative, to give effect to them as required by the Resource Management Act 1991.*

Implementation responsibility*: City and district councils.*

Method 2: Regional plan implementation

Regional plans shall give effect to Policies GR 1A, GR 2A, GR 3A, and GR 9B.

If a regional plan does not currently give effect to these policies, then Bay of Plenty Regional Council shall notify a variation or change as soon as reasonably practicable, but within two years from the date on which the *Bay of Plenty Regional Policy Statement is made operative, to give effect to them as required by the Resource Management Act 1991.*

Implementation responsibility*: Regional council.*

Method 3: Resource consents, notices of requirement and when changing, varying, reviewing or replacing plans

Policies GR 5B, GR 6B, GR 7B, GR 8B, GR 9B, GR 10B, GR 11B, GR 12B shall be given effect to when preparing, changing, varying, reviewing or replacing a regional or district plan, and had regard to when considering a resource consent or notice of requirement.

Implementation responsibility: Regional council, city and district *councils.*

Method 22B: Assessment of significant geothermal features

Identify geothermal features using Appendix A 'Definitions' Annex A and, where required, assess the significance of those features in accordance with Policy GR 9B by applying the criteria in Appendix F Set 7 of the Regional Policy Statement.

This assessment shall be undertaken by suitably qualified and experienced experts on behalf of either the Regional Council (in the context of a plan change or plan review) or an applicant that is seeking to undertake activities that may adversely affect any geothermal feature, in any management group 2, 3 or 4 geothermal system.

The methodology used to assess the significance of a geothermal feature in any system shall be clearly explained at the time that the assessment is provided (whether as part of a plan change or resource consent process) so that the assessment rationale is clear and able to be peer reviewed.

The methodology shall provide for an overall judgement to be made as to the significance of any given geothermal feature(s) having regard to an evaluation against the criteria that are set out in Set 7 of Appendix F.

The overall judgement required shall be made initially by the experts undertaking the evaluation, as part of an application for resource consent or as part of a plan change process, and by the final decision-maker.

Features identified as being significant as a result of this process will be mapped into the Council's GIS and database and may be included by way of a plan change in a regional or district plan, if that has not already occurred.

Implementation responsibility*: Regional council, district council and/or applicants and/or resource users.*

3.2.2 Guiding methods

Method 25: Provide geothermal environmental education programmes

Encourage the efficient use of geothermal resources and through geothermal environmental education programmes:

(a) Increase public understanding and awareness of geothermal resource characteristics and their vulnerabilities; and

(b) Increase public understanding of the hazards associated with geothermal sites.

Implementation responsibility: Regional council, city and district *councils.*

Method 26: Facilitate and support community based ecological restoration programmes

Promote active community participation by providing practical support for community restoration initiatives focused on the protection, restoration or rehabilitation of natural features and ecosystems.

Part four

Monitoring the Regional Policy Statement and the anticipated environmental results

This part sets out the procedures to be used to monitor the efficiency and effectiveness of the policies and methods in the Statement. It then lists the anticipated environmental results of implementing the Statement and monitoring indicators which in combination will be used to measure the extent to which the policies and methods are achieving the objectives.

4.1 Procedures for monitoring

4.1.1 Integrated monitoring

The Bay of Plenty Regional Council has a Natural Environment Regional Monitoring Network (NERMN). NERMN enables the Regional Council to monitor the state of, and trends in, the environment. NERMN includes the following modules:

- Air
- Coastal dynamics
- Coastal and estuarine ecology
- Freshwater ecology
- Freshwater wetlands
- Geothermal groundwater
- Non-geothermal groundwater
- River and stream channel
- Surface hydrology
- Sustainable land management
- Terrestrial indigenous biodiversity
- Water quality.

NERMN does not include monitoring of social, economic, cultural or historic heritage values. These are addressed by other monitoring indicators. Identified monitoring indicators (additional to NERMN) include:

- Regional and district plan reporting structures including section 35 (Resource Management Act, 1991) monitoring reports.
- Complaints databases (regional, city and district councils).
- Socio-economic reporting.
- Routine perception surveys.
- Consultation with specific stakeholders e.g. infrastructure providers.
- Consultation with iwi and hapū authorities, including on the use of matauranga Maori for monitoring adverse effects on natural resources and human health.
- Five-yearly geothermal inventory.
- Annual development trend reports (western Bay of Plenty sub-region).
- Regular monitoring and review of the Regional Land Transport Strategy.
- Specific actions or indicators (e.g., surveys of mangrove distribution and nitrogen input to specified Rotorua Te Arawa lakes).

Several pieces of legislation require monitoring of natural and physical resources. The Act requires local authorities to monitor a number of factors, including the state of the environment and the effectiveness and efficiency of policies, rules or other methods in council policy statement or plans.

Local authorities are also required to monitor and report on community outcomes under their long-term council community plan prepared under the Local Government Act 2002. The sustainable growth management strategy for the western Bay of Plenty sub-region contains indicators to monitor growth and measure interrelationships between economic, environmental, social and cultural aspects of community wellbeing. The Regional Transport Strategy is also monitored and reported on annually.

4.1.2 State of the environment reporting

State of the environment reporting is a key component of monitoring the effectiveness of Regional Policy Statement policies and methods. The Bay of Plenty Regional Council prepares state of the environment reports that assist with measuring whether the objectives of the Statement, regional plans and strategies are being achieved.

State of the environment reporting includes regular monitoring of resources, such as water quality at selected sites for specific indicators at regular intervals, and targeted investigations. It also includes surveys and interviews with people and organisations on their perceptions of the quality of the environment.

When developing monitoring programmes, local authorities should emphasise measuring indicators that

enable assessment of Regional Policy Statement objectives and anticipated environmental results. Indicators will need to be developed and monitored for those objectives and anticipated environmental results not monitored at present.

4.1.3 The efficiency and effectiveness of the Regional Policy Statement and regional and district plans

The Regional Council and the region's city and district councils are required to prepare and make publicly available the results of monitoring the efficiency and effectiveness of policies, rules and other methods. This requirement applies to the Statement, regional plans and district plans and must be reported on at intervals of no more than five years.

The results of monitoring regional and district plans policies, rules and other methods will also be used to evaluate this Statement.

4.1.4 Resource consents

Information on resource consents is necessary to assess whether this Regional Policy Statement's objectives are being met. The process of applying for resource consents, and considering those applications, provides information on the resources being used, where the use takes place, the magnitude of use, how often it occurs and the limits on use (conditions). The Bay of Plenty Regional Council and the region's city and district councils are required by the Act to monitor the exercise of resource consents. This information will also be used to monitor the Statement.

4.2 Objectives, anticipated environmental results and monitoring indicators

The following table sets out the objectives, anticipated environmental results and monitoring indicators of the Statement. They relate to the 10-year life of the Statement, unless otherwise specified. An "objective" is a desirable and achievable condition or position towards which effort is directed. "Anticipated environmental results" are the expected effects on the environment of implementing the policies and methods. They describe specific environmental states. Because of the complex nature of environmental systems, not all effects of implementing policies and methods are foreseeable. "Monitoring indicators" are used to measure whether the objectives are being achieved and whether the environmental results align with those that were anticipated.

Table 15 Objectives, anticipated environmental results (AER) and monitoring indicators.

Objectives	Anticipated environmental results (AER)	Monitoring indicators
Geothermal resources		
Objective 8 Holistic and sustainable management of the regional geothermal resource by providing for: • protection of some systems with Significant Geothermal Features; • enabling use and development of other geothermal systems; in accordance with each system's management purpose as specified in Table 4A.	Geothermal features are retained and maintained or enhanced in state/condition. Healthy geothermal ecosystems and maintenance of biodiversity.	Compare 5 yearly survey with baseline survey information of geothermal inventory: Cody 1997 Identify and classify sites of outstanding geothermal features using criteria consistent with those in Regional Policy Statement Appendix F sets 2 and 3 in plan change and resource consents processes. Compare 5 yearly survey with baseline survey information geothermal ecologies = Wildlands 1996, 2003.
	Sustainable use of geothermal systems - pressure and temperature within acceptable range for known system behaviour. Resource use efficiency.	Integrated system management provisions in all geothermal consents for large takes. Discharge strategies in all geothermal consents for large discharges. Consent compliance reporting.
Objectives	**Anticipated environmental results (AER)**	**Monitoring indicators**
Objective 9 Development and use of land and non-geothermal water is compatible with protection, development and use of geothermal systems in accordance with each system's classification management purpose.	Geothermal features are retained and maintained or enhanced in state/condition.	Relevant district plans contain provisions that assess risk to geothermal features and protect them from development. Compare 5 yearly survey with baseline survey information of geothermal inventory: Cody 1997. District plan provisions and resource consent conditions are assessed to determine whether they have taken account of geothermal risk and damage to surface features.

Appendix A – Definitions

Significant geothermal features (SGFs): Geothermal features include active and relic geothermal features and habitats including vegetation and fauna. "Significant Geothermal Features" are those that have been identified as geothermal features through the use of the feature descriptors of Appendix A – Definitions Annex A, and, then identified as significant through the application of the criteria of Appendix F Set 7 – Geothermal features, in accordance with Method 22B of this Regional Policy Statement.

Sustainable use: For geothermal resource use purposes, "sustainable use" requires a case by case consideration of the resource for its extractable energy use values.

In the context of a proposal for extractive use, determining sustainable use will consider:

- the level and certainty of scientific information on the particular system;
- the size of the geothermal energy resource;
- the rate at which the energy within the geothermal system is proposed to be extracted, and the timeframe over which any proposed rate of take of geothermal energy is predicted to be able to be sustained, informed by modelling for a period of at least 50 years (the depletion rate is a matter for decision makers to determine when an application is being considered);
- the predicted quantity of energy available for extractive use at the end of 50 years.
- the predicted length of time that the geothermal system will take to recover once extractive use ceases;
- the overall management of the geothermal resource, including the depth and locations of the proposed take and return of geothermal fluid, and the impacts of such management on the longevity of the resource; and
- once extractive use has commenced, how closely observed changes to the geothermal resource affecting its productive capacity and longevity match the modelled or predicted effects, by review of the data and other information collected. This information could include: pressure, temperature, chemistry, surface water flow or level and vegetation monitoring indicating the state of the geothermal resource, including identified changes to geothermal features.

Annex A: Geothermal feature types and definitions

Active geothermal systems are often expressed at the ground surface by a wide variety of surface geothermal features. As shown in Table 16, surface feature fluids are part of a complex continuum. These range from those fed directly by primary geothermal fluids (similar to those at depth), to mixtures with other ground water fluids, to those mixed with fluids derived from condensed steam, to those features fed only by steam. The surface expression ranges from high energy discharges (such as eruptions and large overflows), through medium energy discharges (minor overflows), to lower energy discharges (such as evaporating ponds). The steam dominated features range from warm ground heated by weak, diffuse steam discharges, through to boiling temperature and super-heated fumaroles.

As with all natural environments there are some special cases where the influence of chemistry, gas and heat, has created features that are not easy to characterise, and so do not easily fit into classification systems. Examples are feature sub-types that include the presence of molten sulphur, or excessive amounts of carbon dioxide. These sub-types are often associated with mixtures of different types of geothermal fluids, including condensed steam, various dissolved minerals and gases. They can be considered as variants and are classified as 'other' in the first part of this glossary.

Landforms derived from previous phases of surface geothermal activity, and which are no longer actively discharging geothermal heat or fluids, are labelled remnant landform features. They are also part of a continuum. Such landforms and habitats associated with them can be considered separately from active features because the predominant consideration in terms of their management is control of land use rather than management of geothermal fluid utilisation. But they may contribute to the significance of an area, (and potentially to hazards which are considered separately) so they still need to be considered as part of overall management.

Geothermal systems and the various surface feature types provide habitats for geothermal species. Those species may form part of a wider ecosystem(s). Habitats are largely dependent on the heat associated with and the presence of the discharged fluids, but are also influenced by the fluid type, chemistry, atmospheric conditions and terrain.

Geothermal ecosystems are driven more fundamentally by heat and moisture than by habitat. The boundary between geothermal and

non-geothermal ecosystems can be defined by the presence or absence of geothermal heat as a primary ecosystem driver, plus a secondary driver of moisture including atmospheric conditions. Tertiary ecosystem drivers include chemical composition (most clearly in ecosystems in hydrothermally altered soils) and landforms where microhabitats may be important. Temperature and moisture gradients are fundamental, and they may be dynamic.

Table 16 Geothermal features: main types and associated habitats.

Table 16 - Geothermal features : main types and associated habitats				
Discharge energy High ↕ Low	1. Geysers	4. Intermittent or active hydrothermal eruption craters	7. Mud geysers	10. Fumaroles
	2. Flowing springs	5. Mixed springs	8. Ejecting mud pots	11. Steaming ground
	3. Non flowing pools	6. Mixed pools	9. Mud pools	12. Heated ground
	Primary geothermal fluid	*Mixed/diluted geothermal fluid*	*Mixed/diluted steam heated fluid*	*Steam Fed*

Geothermally-influenced aquatic habitat

Geothermal habitat on heated/acid dry ground

Habitat dependent on geothermally-altered atmosphere overlays all types (warm air, frost-free)

Table 17 Geothermal feature descriptors.

Table 17: Geothermal feature descriptors			
A – Active geothermal features (physical attributes)			
Feature Type	Description	Example of Feature	Description of Example
1. Geyser	Any naturally occurring geothermal spring or pool that occasionally or frequently erupts, producing a cyclic, intermittent or continuous discharge of two-phase fluid (water and steam or other gases), vigorous enough to jet liquid water into the air above a static water level or vent opening. The area of a geyser comprises that of the spring basin and the area covered by water composed of the undiluted discharge from the geyser, and by any sinter deposits created by that discharge.	Cyclic / intermittent geyser	Relatively large discharge, >1 m height
		Crypto-geyser	Intermittently discharging geothermal features which do not project water into the air. Intermittency is generally exhibited by regularly fluctuating water levels and discharge rates
		Small geyser (sput)	Relatively small, intermittent spouter
		Soda-geyser	Driven by CO_2 discharge rather than boiling
2. Flowing spring (primary fluids)	Any naturally occurring geothermal spring, whose discharge consists of undiluted (primary) geothermal fluids typically containing a high level of dissolved minerals, which deposits sinter on exposed surfaces covered by its outflow. The area of a spring depositing sinter comprises that of the spring basin, together with the area covered by any surface water composed of the undiluted outflow from the pool and any	Spouting spring	Vigorously boiling and overflowing
		Chloride spring	Neutral pH mineralised water of deep origin, dominant dissolved anion is chloride, commonly deposits sinter
		Acid chloride spring	Chloride water made acid by geothermal steam or by mixing with acid sulphate water, may deposit sinter

	sinter deposits created by that outflow.		
3. Non-flowing pool (primary fluids)	Any naturally occurring basin (typically lined with sinter) containing primary geothermal fluids (typically highly mineralised). The area of a pool comprises that of the basin, together with the area covered by any variation of the water level.	Chloride pool	Neutral pH mineralised water of deep origin, dominant dissolved anion is chloride, commonly deposits sinter
4. Intermittent or active hydrothermal eruption crater	Any large, naturally-occurring eruption of boiling liquid, steam and soil or rock, that occurs very occasionally or intermittently from a boiling hot spring, pool or vent, and is driven by rapid expansion of a steam-water column, through a vent, typically triggered by a rapid pressure drop near the surface, when fluid is at boiling temperature conditions. The fluid origin can be steam-heated ground water or a mixture of primary fluid, steam and heated groundwater. The area of a hydrothermal eruption includes the area of its vent, crater walls and rim. Hydrothermal eruption features will show a history of eruptions.		
5. Mixed spring (with mixed chemistry)	Any naturally occurring geothermal spring that has a natural outflow. The chemistry of the fluid indicates a mixed origin for the source fluids. Sub-types include acid-chloride, acid-sulphate and sodium-bicarbonate springs. The area of a spring comprises that of the spring basin, together with the area covered by any surface water composed of the undiluted outflow from the pool and any deposits created by that outflow.	Acid sulphate spring	Shallow origin acidic water formed by oxidised geothermal steam, dominant dissolved anion is sulphate
		Bicarbonate spring	Shallow origin water with dissolved CO_2 dominant dissolved anion is bicarbonate, generally dilute
		Mixed spring	Mixed water of various origins, may be mixed with groundwater
6. Mixed pool (with mixed chemistry)	Any naturally occurring geothermal basin or pool that contains geothermal fluids of chemically mixed origin, but that is not discharging liquid through an overflow. Examples of sub-types are acid-chloride, acid-sulphate and sodium-bicarbonate pools. The area of a pool comprises that of the pool basin, together with the area covered by any variation of the water level.	Acid sulphate pool	Shallow origin acidic water formed by oxidised geothermal steam, dominant dissolved anion is sulphate
		Bicarbonate pool	Shallow origin water with dissolved CO_2 dominant dissolved anion is bicarbonate, generally dilute
		Mixed pool	Mixed water of various origins, may be mixed with groundwater
7. Mud geyser	Any naturally-occurring geothermally-heated mud pool, that occasionally or frequently erupts. The eruption produces an intermittent or continuous discharge caused by steam or other gases passing through the mud pool. The activity is vigorous enough to forcefully raise liquid mud by ejecting it into the air above a static mud level. The area covered by these features includes the mud pool, its banks, and any significant mud formations, like 'volcanoes' built up by the ejection of mud from the pool.	Mud-volcano	Spouting mud splatter, builds sustained "volcano" features
		Ejecting/ geysering mud	Intermittent, steam-fed, large, violent
8. Ejecting mud pot	Any naturally occurring basin of turbid mud, heated by geothermal processes (typically an underlying steam vent), which occasionally or frequently ejects a small amount of mud. Such mud features are often ephemeral, and can change over time from one sub-type to another in response to natural variations in rainfall, mud	Non-discharging mud pots	Steam-heated pool, often turbid
		Mud cone	Small volcanic-like cone of mud splatter around its vent

	consistency, and the permeability of the vent to the underlying feed of steam. The area of a mud pot comprises that of the pool itself, its banks, and any mud formations built up by the ejection of mud from the pool.		
9. Mud pool	Any naturally occurring basin of turbid water and mud, heated by geothermal processes, but typically affected by rainfall, and therefore may dry out in summer. The area of a mud pool comprises that of the pool itself, its banks, and any mud formations.	Non-discharging mud pots	Steam-heated pool, often turbid
10. Fumarole	Any naturally occurring vent, whose discharge consists of steam and other gases of geothermal origin. Sometimes mixing with air. The area of a fumarole consists of the vent and any surface accumulating mineral deposits derived from its gases.	Super-heated fumarole	Vent temperature greater than local boiling temperature, may have large flow rate and noisy emission
		High temperature fumaroles	Vent temperature at or near local boiling temperature
		Minor fumaroles	small, irregular, transient, steam vents
		Sulphur-depositing fumaroles	A subtype where emitted H_2S gas changes to native sulphur at the vent outlet.
11. Steaming ground	Any naturally occurring area discharging steam, diffusively passing through surface soils, with local boiling point temperatures at less than 0.2m depth, and night-time ground surface temperatures greater than 15 ^{o}C above ambient.	Diffuse steam	Weak, diffuse emissions, not always visible
12. Heated ground	Any naturally occurring area with surface soils radiating heat from underground geothermal sources where the boiling point depth is greater than 0.2m deep and the night-time surface temperature is greater than 5 ^{o}C above ambient.		
13. Other (variants, sulphur or CO_2 discharge)	***13a Molten sulphur mobilising spring*** - A hot spring which passes through elemental sulphur-bearing rock at a temperature that can melt the sulphur (>119 °C) and bring it towards the surface. It may pool at the bottom of a deep liquid-filled vent or lake bed, or form solid sulphur deposits at ambient surface conditions. ***13b Kaipohan*** - Cold gas discharge, consisting mostly of CO_2 of deep geothermal origin, with no associated steam discharge, but of sufficiently large flow-rate to influence vegetation. ***13c Gas Seep***	Sulphur depositing fumarole	Deposits sulphur around vent
		Molten sulphur depositing	Deposits molten sulphur
		Kaipohan	Diffuse ambient temperature gas emission, influences vegetation
		Gas seep	Vent of geothermal gas, generally at ambient temperature
B - Remnant geothermal landforms			
Feature Type	Description	Example of feature	Description of example
1 Hydrothermal eruption crater	Any naturally occurring remnant crater, now dormant/extinct, but originally produced by the explosive boiling of geothermal water without the direct involvement of near-surface magma, and by the consequent ejection of material derived from the soil/rock matrix. The area of a remnant hydrothermal eruption crater comprises that of the crater and its rim,	extinct vents	Pre-historic hydrothermal eruption craters

	and may contain a wetland.		
2 Sinter deposits	Any silica or carbonate sinter body that has received natural sinter deposition. Subtypes are recent and fossil sinters. Recent sinter was historically active based on photos or other records, but is no longer receiving natural sinter deposition. Fossil sinter was active at some stage prior to human occupation of the area when it received natural sinter deposition from discharging geothermal fluids, based on geological evidence. The area of a recent sinter body consists of that of all interconnected sinter in a single occurrence.	recent sinter	Historically active, based on photos or other records, but now dormant deposits
		epithermal (fossil) sinter	Old sinters resulting from pre-historic (prior to human occupation of the area) discharges. Based on geological evidence
3 Remnant tomos	Any shallow depressions, small holes or collapses (known as tomos) of natural geothermal origin that have cooled off and are no longer associated with active thermal vents.	thermal tomos	Old depressions in cooled steam zones
4 Hydrothermally altered clays	Deposits of thermal clay (such as kaolinite and smectite) originating from surface thermal activity that has since cooled off.	recent clays	Deposits from historically active but now dormant features
		epithermal clays	Pre-historic (on a geological time scale) thermal clay deposits
5 Other remnant landforms	Other geothermal landforms exhibiting historic or pre-historic geothermal processes		
C - Geothermal habitats - affected by extraction and land use			
Feature Type	Description	Habitat type	Typical species found in habitat
A. Geothermally influenced aquatic habitats	Any area of naturally occurring aquatic habitat of thermo-tolerant, thermophilic or otherwise extremophilic indigenous species, which may form part of an ecosystem(s), in a water body influenced by natural geothermal input.	Wetland/ pond, thermal swamp	Thermally dependent algae and vascular plants including frost sensitive ferns, species of baumea rushes unique to geothermal areas, indigenous invertebrates, and fish dependent on geothermal conditions.
		Warmed water	Thermally dependent algae, aquatic bryophytes, frost sensitive ferns, arsenic tolerant snails, ephydrid flies and other indigenous macroinvertebrates.
		Hot water	Thermal microbes- thermophilic bacteria
		Acid water	Acidophilic bacteria
		Steaming micro-climate, high temperature	Thermal bryophytes

Appendix F – Criteria for assessing matters of national importance in the Bay of Plenty region

For the avoidance of doubt the criteria sets that apply will only be triggered by the relevant policies and methods listed under each criteria set heading.

Table 19 Appendix F – Set 7 – Geothermal features.

Policy GR 9B
Methods 2, 3 and 22B

Appendix F Set 7 Geothermal Features	
For the avoidance of doubt the criteria sets that apply will only be triggered by the relevant policies and methods listed under each criteria set heading. The criteria in each of the criteria sets below are not tests or standards which, if any one or more are met, will necessarily result in a conclusion that the place, feature or landscape (as the case may be) is significant or a matter of national importance. Instead, the criteria are factors to be considered and evaluated in order to reach an overall judgement as to the significance of any given feature(s). *NB Set 5 criteria 5.1 to 5.7 do not apply to the assessment of the significance of geothermal features, as Set 7 criteria apply to such assessments.*	
For Geothermal geological features: ***(See Appendix A (Definitions) - Annex A, Table 16 and Table 17, Parts A and B)***	***For geothermal vegetation or habitat of indigenous fauna*** ***(See Appendix A (Definitions) - Annex A, Table 16 and Table 17, Part C)***
Natural science factors	
Representativeness 7.1 The extent to which the natural feature is a good example of a geothermal feature type or group of features in close association, and/or the processes that formed it/them, in the Taupō Volcanic Zone.	*Representativeness* 7.12 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area contributes to the full range of associations of indigenous species representative, typical or characteristic of the natural biodiversity of the geothermal resource of the Taupo Volcanic Zone.
Diversity and pattern 7.2 The extent to which a group of associated features contain a wide variety of geothermal features, reflecting the diversity of geothermal feature types in the Taupō Volcanic Zone or present a distinctive and unusual juxtaposition of features (e.g. along a physical, chemical or hydrological gradient).	*Diversity and pattern* 7.13 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area contains a high diversity of indigenous ecosystem or habitat types, or changes in species composition, reflecting the existence of diverse natural features (for example landforms, soil types or hydrology), or communities along an ecological gradient (e.g. a soil temperature gradient).
Rarity 7.3 The extent to which the feature is unique or rare in the context of the Taupō Volcanic Zone.	*Rarity* 7.14 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area supports an indigenous species or associations of indigenous species threatened or rare nationally or regionally. NB the relative significance would be judged on the number of such species present and their threat status.
Distinctiveness 7.4 The extent to which a feature in a geothermal area is one of the largest remaining examples of its type in the Taupō Volcanic Zone, while exhibiting high thermal output.	*Distinctiveness* 7.15 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area is one of the largest remaining examples of its type within the Taupo Volcanic Zone.
	7.16 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area is significantly reduced in area and is degraded but retains key natural ecosystem functions (for example hydrology).

	Ecological context 7.17 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area contributes to the ecological viability of adjoining significant natural areas and biological communities, by providing or contributing to an important ecological linkage or network, or providing a buffer from adjacent land uses.
	7.18 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area provides habitat for threatened indigenous species at key stages of their life cycle.
Resilience 7.5 The extent to which the feature is resilient to natural changes.	*Viability and sustainability* 7.19 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area is of sufficient size and compact shape and that it has the capacity to maintain its ecological viability over time, to adapt to natural changes and to resist changes initiated by external agents.
	7.20 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area supports intact habitats and healthy functioning ecosystems.
Vulnerability 7.6 The extent to which the feature is vulnerable to fluid extraction.	
Aesthetic values	
Memorability 7.7 The extent to which the geothermal feature(s) is striking or visually spectacular due to its recognisable and memorable qualities.	
Naturalness 7.8 The extent to which the geothermal feature(s) appears largely uncompromised and is an intact natural system, free from human modification, intervention or manipulation.	*Naturalness* 7.21 The extent to which indigenous vegetation or habitat of indigenous fauna on a geothermal area is in a natural state or healthy condition, or is in an original condition.
Transient values 7.9 The extent to which transitory natural changes in the appearance of the geothermal feature contribute to its natural science values or aesthetic appeal.	
Associative values	
Shared and recognised values 7.10 The extent to which it is a geothermal feature that is valued for its historical, recreational, educational or scientific values.	*Shared and recognised values* 7.22 The extent to which the geothermal vegetation or habitat is valued for its historical, recreational, educational or scientific values.
Māori values 7.11 The extent to which a geothermal feature(s) is clearly special or widely valued by Tangata Whenua by reason of traditional values (including consideration of the criteria in Set 4 Māori culture and traditions) and/or contemporary association values.	*Māori values* 7.23 The extent to which geothermal vegetation or habitat is clearly special or widely valued by Tangata Whenua by reason of traditional values (including consideration of the criteria in Set 4 Māori culture and traditions) and/or contemporary association values.