

IN THE MATTER OF

the Resource Management Act 1991

AND

IN THE MATTER OF

applications by Rotokawa Joint Venture Limited to establish, operate and maintain geothermal power stations known as Rotokawa Stage 1 and Stage 11 at Rotokawa.

REPORT OF THE WAIKATO REGIONAL COUNCIL HEARING COMMITTEE

1 THE HEARING

In terms of the Waikato Regional Council's resolution of 27 September 2007, a Hearing Committee comprising Commissioners Dr J A Jones (Chairman) and Mr T D Nugent participated in a hearing in the Swifts Room, Suncourt Motor Hotel & Conference Centre, Northcroft Street, Taupo on 12 and 13 November 2007 for the purpose of enquiring into the application and the submissions thereto.

Monday 12 November 2007	10.30 am to 5.00pm
Tuesday 13 November 2007	1.00 pm to 5.00pm

The Chairman closed the hearing on Tuesday 13 November 2007.

A site visit was undertaken on the morning of Tuesday 13 November 2007.

2 THE APPLICATION

Rotokawa Joint Venture Limited (a company formed between Tauhara North No 2 Trust and Mighty River Power Limited) lodged resource consent applications with Environment Waikato (Waikato Regional Council) to:

116565 - Take and use up to 22,100,000 tonnes per year, at an average of 60,500 tonnes per day, with a maximum take of 70,500 tonnes per day of geothermal water and associated energy and heat from underground strata for electricity generation; and for the supply of, and use of steam, water and condensate for related and ancillary purposes and other downstream users within Area 1,

116566 - Discharge up to 22,100,000 tonnes per year, at an average of 60,500 tonnes per day, with a maximum of 70,500 tonnes per day of geothermal water, together with steam condensate, cooling water and added chemicals into underground strata through reinjection wells in Area 1,

116567 - Discharge up to 6,600,000 tonnes per year at an average of 18,000 tonnes per day with a maximum discharge of 22,000 tonnes per day of geothermal vapour and associated non-condensable gases to air from the Rotokawa Geothermal Power Development and other downstream uses,

116568 - Divert stormwater during construction and ongoing operation of the geothermal power stations and to divert and/or take ground water during construction activities,

116569 - Discharge stormwater and contaminants onto land (including in circumstances where they may enter groundwater and/or temporary non-flowing surface water via soakage and sediment retention facilities) related to construction and maintaining facilities,

116570 - Discharge up to 15,000 tonnes per day of steamline condensate, silica, geothermal water, cooling water and contaminants onto or, into land (including circumstances where they may enter groundwater),

116571 - Discharge up to 15 cubic metres per day of water including contaminants and sewage into land and underground water through septic tanks and associated soakage facilities,

116572 - Discharge up to 40 tonnes per year of pentane (or similar binary cycle fluid) to air from Rotokawa Geothermal Power Development,

116573 - Construct, operate, maintain and upgrade roads, pipelines and bridges over watercourses associated with the construction, operation and maintenance of the Rotokawa Geothermal Power Development parts of which may involve minor vegetation clearance and soil disturbance within 20 metres of Significant Geothermal Features,

116574 - Construct, operate, maintain and upgrade roads, pipelines and bridges over watercourses associated with the construction, operation and maintenance of the Rotokawa Geothermal Power Development involving vegetation clearance and soil disturbance further than 20 metres from Significant Geothermal Features,

116575 - Construct, operate and maintain roads, pipelines and bridges in, on, over or under the bed of the Parariki Stream and other unnamed tributaries of the Parariki Stream and Waikato River and to plant around stream beds and drill under stream beds, all associated with the operation of the Rotokawa Power Development,

116576 - Take and use up to 25,000 tonnes per day of geothermal water and associated energy and heat from underground strata for well testing purposes,

116577 - Discharge up to 15,000 tonnes per day of geothermal water, steam condensate and added chemicals into or onto land for well drilling, well testing or steamfield maintenance,

116578 - Discharge up to 10,000 tonnes per day of geothermal vapour and associated non-condensable gases to air associated with well drilling, well testing or steamfield maintenance,

116579 - Discharge up to 10,000 tonnes per day of freshwater, drilling muds and fluids, all containing various solids, chemicals and other contaminants (a) into soakage facilities and by seepage into underground water and (b) into underground strata during drilling and testing of wells,

116580 - Construct, operate and maintain deep geothermal wells, monitoring wells, well-pads, pipelines and roads, and to authorise well testing and drilling activities that involve drilling below the water table and earthworks further than 20 metres from Significant Geothermal Features,

116581 - Discharge up to 10,000 tonnes per day, on an intermittent and temporary basis, of fresh water, drilling muds and fluids, all containing various solids, chemicals and other contaminants into underground strata during drilling and testing of wells beneath land within Application Area 2,

116582 - Maintain and upgrade existing roads and access ways,

all in the vicinity of Rotokawa Geothermal Field

In accordance with Section 94(1) of the Resource Management Act 1991, there was limited notification of the applications, with the closing date for receipt of submissions being Wednesday 5 September 2007. On 2 October 2007 the applications were re-notified to a single party who had been inadvertently omitted from the list of parties to whom notice was originally served.

3 SUBMISSIONS

Within the prescribed submission periods eleven (11) submissions were lodged with Environment Waikato (Waikato Regional Council) by: Contact Energy Limited, KAH NZ (Trading as Bayview Wairakei Resort), Ministry of Economic Development, Te T Mita, TB Nikora, M Rangitoheriri, Tauhara North No2 Trust, LB and RL Amundsen, Broadview Holdings Limited (C Shearer, J Gooding), Waitangi Claim 803 (Nga Uri o Tahu Matua Charitable Trust) and Taupo District Council. A submission was received from the Energy Efficiency and Conservation Authority (EECA) 5 days late. Under delegated authority, the Environment Waikato staff waived the time period for this submitter under s.37 of the Act.

4 APPEARANCES

Applicant

Rotokawa Joint Venture Limited's presentation was led by its counsel, Ms Janette Campbell.

Evidence was presented by:

Dr Stuart McDonnell, Projects Development Manager for Mighty River Power Limited;

Mrs Aroha Campbell, Executive Officer of the Tauhara North No. 2 Trust;

Ms Makere Rangitoheriri, a Trustee of the Tauhara North No. 2 Trust and kaumatua of Ngati Tahu;

Mr Thomas Powell, Geoscience Manager – Geothermal, Mighty River Power Limited;

Mr Richard Holt, Consulting reservoir engineer;

Dr Michael Bruno, Consulting engineer specialising in reservoir and wellbore geomechanics;

Dr Edward Mroczek, Senior Geochemist at the Institute of Geological and Nuclear Sciences Limited;

Dr Bruce Burns, plant ecologist at Landcare Research;

Mr Gavin Fisher, air quality consultant; and

Mr Don Lyons, Managing Director of Beca Carter Hollings and Ferner Limited.

Written evidence was also received from Dr Douglas Heffernan, Chief Executive of Mighty River Power Limited who was unable to attend the hearing.

All the evidence of the applicant was provided to, and read by, us prior to the hearing. Other than Dr Heffernan and Mrs Campbell, Ms Rangitoheriri and Mr Lyon, each of the witnesses presented a summary of their evidence at the hearing and were available to be questioned by us. The latter three presented their full statements.

Submitters

Ms Rosemary Dixon, counsel for Contact Energy Ltd, appeared on behalf of that submitter.

Mr Campbell Shearer, a Director of Broadview Holdings Limited, appeared on behalf of that submitter.

Mr Tony Reihana presented evidence on behalf of Nga Uri o Tahu Matua Charitable Trust – Waitangi Claim 803.

Environment Waikato

Mr Dev Affleck presented the staff technical report. Specialist evidence was also presented by:

Dr Arnold Watson on geothermal engineering and geoscientific aspects of the applications; and

Dr Bruce Graham on the effects of discharges to air.

5 APPLICANT'S PROPOSAL

The applicant presently owns the Rotokawa Geothermal Power Station (referred to in this decision as Rotokawa I) drawing fluid and energy from the Rotokawa geothermal field. This station is operated by Mighty River Power Limited. The consents granted by the Waikato Regional Council for this operation expire in August 2013 or August 2012. The following table sets out the consents currently held.

Throughout this decision we have referred to geothermal fluid and in doing so encompass geothermal water in its various states in a geothermal system, and geothermal energy.

Table 1: List of Current Consents

Consent Number	Description	Expiry Date
920803	Take up to 15,500 tonnes per day of geothermal fluid and energy from underground strata for the purpose of generating electricity and other downstream purposes.	25/8/2013
920804	Take up to 500 cubic metres of water per day from the Waikato River for cooling water, fire fighting, washdown and general domestic purposes	25/8/2013
920805	Discharge up to 15,500 tonnes per day of geothermal fluid and condensate, and energy to underground strata for the purpose of geothermal fluid disposal associated with the taking of geothermal fluid under consent number 920803.	25/8/2013
920806	Discharge up to 2400 tonnes per day of geothermal vapour to the atmosphere for the purpose of geothermal vapour disposal associated with the taking of geothermal fluid under consent number 920803.	25/8/2013
920807	Discharge up to 1000 tonnes per day of geothermal fluid to the ground for the purpose of geothermal fluid disposal associated with the taking of geothermal fluid under consent no. 920803.	25/8/2013
920808	Take up to 3300 cubic metres per day of water from Waikato River for well drilling purposes	25/8/2013
920809	Discharge up to 3300 cubic metres per day of water and drilling additives to underground strata for well drilling purposes	25/8/2013
920810	Discharge up to 720 tonnes per day of water and drilling additives onto land for well drilling purposes.	25/8/2013
920811	Take up to 12600 tonnes per day of geothermal fluid from underground strata for well testing purposes	25/8/2013
920812	Discharge up to 7300 tonnes per day of geothermal fluid to underground strata for well testing purposes.	25/8/2013

Consent Number	Description	Expiry Date
920813	Discharge up to 6300 tonnes per day of geothermal vapour to the atmosphere for well testing purposes	25/8/2013
920814	Discharge up to 1650 tonnes per day of geothermal fluid onto land for well testing purposes	25/8/2013
971131	(a) To take up to 2,500 tonnes per day of geothermal fluid additional to the geothermal fluid which may be taken pursuant to existing Resource Consent No. 920803, with the maximum geothermal fluid which may be taken under both consents not to exceed 12,600 tonnes per day, and (b) Sufficient energy per day in addition to that which may be taken pursuant to existing Resource Consent No. 920803 so that the maximum energy which may be taken under both consents shall no exceed 17.6 terajoules per day.	25/8/2013
971132	To discharge up to 2,500 tonnes per day of geothermal fluid and condensate, and energy, to underground strata for the purpose of geothermal fluid disposal associated with the taking of geothermal fluid under application 971131, in the vicinity of Rapids Road, Rotokawa at or about map reference U17:874-836 on land comprised in Tauhara No 2 Block situated in Blks XI, XII, XV & XVI Tatua SD for the purposes of operating Rotokawa Geothermal Power Station and other downstream uses, with the maximum geothermal fluid which may be taken under this consent and Consent No. 920805 not to exceed 12,600 tonnes per day.	25/8/2013
100472	Discharge up to 100 tonnes per day of geothermal fluid, gas and steam to the atmosphere in emergency situations	26/8/2013
109586	To construct and/or alter geothermal production, reinjection and monitoring wells in the Rotokawa Geothermal Field, Rotokawa.	25/8/2013
116458	Construct, use and maintain geothermal production, re-injection and monitoring wells within the Rotokawa Geothermal system	30/06/2012
116459	Discharge up to 15 000 tonnes per day of drilling fluids, water, geothermal additives and tracer chemicals to underground strata for well drilling and testing purposes	30/06/2012
116460	Discharge up to 15 000 tonnes per day of water, drilling additives, geothermal water and stormwater to land via a soakage pond facility for well drilling and testing purposes	30/06/2012
116461	Take up to 15 000 tonnes per day of water, geothermal water and energy from underground strata for well testing and monitoring purposes	30/06/2012
116462	Discharge geothermal heat and vapour to air for well testing and monitoring purposes	30/06/2012
116463	Discharge up to 5 cubic metres per day of treated sewage to ground in association with a drilling rig camp	30/06/2012
116906	Take and use up to 15,000 tonnes of water and geothermal water and energy from underground strata for well testing and monitoring purposes	20/8/2012
116907	Discharge up to 15,000 tonnes per day of water, drilling additives, drill cuttings, geothermal water, added chemicals and stormwater to land via a soakage pond facility for well drilling and testing purposes	20/8/2012
116908	Discharge geothermal heat and vapour to the atmosphere for well testing purposes	20/8/2012
116909	Discharge up to 15,000 tonnes per day of water, geothermal water, drilling additives and tracer chemicals to underground strata for well drilling and testing purposes	20/8/2012
116910	Construction, use and maintenance of geothermal production, reinjection and monitoring wells within the Rotokawa geothermal system as defined in the Waikato Regional Plan	20/8/2012
116911	Earthworks associated with the upgrading of existing roads and the	20/8/2012

Consent Number	Description	Expiry Date
	construction of geothermal drill pads	
116912	Discharge up to 5 cubic metres per day of treated sewage to ground via 2 septic tanks (Drill Rig Camp & Base Camp)	20/8/2012
116913	Take up to 3300 cubic metres per day of water from the Waikato River for the purpose of geothermal well drilling and testing.	20/8/2012
116915	To undertake earthworks in a high risk erosion zone associated with the formation of approximately 150 m of access roading, with associated cut and fill	20/8/2012

The applicant proposes to construct a new geothermal power station (to be called Nga Awa Purua power station and referred to as such in this decision) in the near vicinity of the existing station and seeks consents required for the establishment and operation of the new station as well as renewal of relevant consents held for the existing station such that both stations would operate under one set of consents.

In essence, the applicant seeks consent to take and use up to 22,100,000 tonnes per year (at an average of 60,500 tonnes per day) with a maximum take of 70,500 tonnes per day of geothermal fluid to be used in the two power stations, and to discharge equal quantities of geothermal fluid by re-injection into the geothermal system. Associated with the use of this geothermal fluid would be the discharge to air of up to 6,600,000 tonnes per year (at an average of 18,000 tonnes per day) with a maximum discharge of 22,000 tonnes per day of steam and associated non-condensable gases. Ongoing operation of the existing Rotokawa I and the development of Nga Awa Purua power station will require the drilling of wells for both taking geothermal fluid and for re-injecting it, as well as construction of well drilling platforms, pipelines and tracks including earthworks, bridges and culverts and associated vegetation removal.

The applicant has yet to decide the exact technology that will be used to generate electricity from the geothermal fluid in the Nga Awa Purua power station, so it sought consents for the maximum environmental impact envelope that would be required. The two options put to the Hearing Committee were:

- (a) Organic Rankine Cycle (ORC) plant, which involves the transfer of heat from the geothermal fluid to pentane, and the use of the vapourised pentane to drive the turbines. With an ORC plant 100% of the geothermal fluid extracted, less the non-condensable gases, is available for re-injection.
- (b) Condensing Steam Turbine, where steam is “flashed off” or separated from the geothermal fluid and used to directly drive the turbines, and then is condensed in a wet direct contact condenser. This process results in some 33% of the geothermal fluid originally taken being lost to the atmosphere (as steam), leaving only 67% of the geothermal fluid available for re-injection.

Rotokawa I is an ORC plant. That would not alter as a result of these consents being granted.

The Rotokawa I station generates nominally 34MW of base load electricity. Nga Awa Purua station would nominally generate 130MW of base load electricity.

6 EVIDENCE PRESENTED

6.1 Applicant

Dr Heffernan's evidence covered the following matters: Mighty River Power and its role as a partner in Rotokawa Joint Venture Limited; New Zealand electricity supply and demand situation; Mighty River Power's role in meeting the demand for electricity; and the significance of the combined Rotokawa development in the context of the regional and national electricity scene.

Dr McDonnell's evidence set out Mighty River Power's competence and experience in the field of geothermal power development and operation. He provided an overview of the project, including an explanation of the two technology options being considered for the Nga Awa Purua station, the cooling options, the requirements for raw water, the buildings proposed, the geothermal fluid gathering and disposal systems proposed, connection to the transmission grid, the construction activities, and well drilling activities. He then provided an overview of the management of the geothermal resource and plant emissions, before proceeding to describe the economic benefits of the proposal, with particular emphasis on the benefits of generation of these plants in terms of the electricity market and the national energy supply. He also explained how reduced greenhouse gas emissions from a geothermal power station would displace greater gas emissions from thermal generators of similar size, and the various benefits that would flow from that. Finally, Dr McDonnell referred to the consultation Rotokawa Joint Venture Ltd had undertaken, both before the lodgement of the application, and subsequent to the receipt of submissions.

Mrs Aroha Campbell provided an overview of the Rotokawa Joint Venture and the role of the Tauhara North No.2 Trust as the other partner in that joint venture. Mrs Campbell explained that the members of the Trust own the Tauhara North No.2 block that the two power stations and production wells will be located on. The Trust has 550 owners, including whanau trusts, listed on their owners' register. The Trust had taken independent advice on the technical, geothermal and construction matters and was satisfied that it was the best option for the owners and the wider community. Mrs Campbell explained the grants and initiatives made by the Trust and how it proposes to extend these with the increased financial resources available from the Nga Awa Purua development.

Ms Rangitoheriri described the ancestral relationship that Ngati Tahu have with the land and resources used for the Rotokawa I station and proposed to be used for the Nga Awa Purua station. She went on to confirm that it was appropriate to use the geothermal resource for the benefit of the members of Ngati Tahu as owners and kaitiaki of the land.

Mr Powell's evidence described the applicant's drilling, testing and production/reinjection strategy for the development for the proposed Nga Awa Purua power station, and the ongoing production and injection associated with the Rotokawa I station. Mr Powell explained the geology of the Rotokawa geothermal system, how the field has responded to production over the past 10

years, the strategy to be used in future management of the field, and the monitoring regime proposed.

Mr Holt had created a numerical model of the Rotokawa geothermal system to enable a simulation of the effects on the reservoir of the alternate strategies for use of it. He described how this model had been created and verified. He then detailed predictions of the effects of three scenarios operating for 40 years into the future. These scenarios were: Rotokawa I only operating; Rotokawa I operation with Nga Awa Purua at 100% reinjection; and Rotokawa I operating with Nga Awa Purua at 67% reinjection. His conclusions in respect of all three scenarios were that the changes in pressure and enthalpy would be minor and *“indicative of a resource subjected to a minor stress that is being operated in a manner fully consistent with long-term resource sustainability.”*

Dr Bruno presented evidence related to surface deformation as a result of the extraction of geothermal fluid from the Rotokawa geothermal field. He described the surface deformation that has been observed during the period of operation of the Rotokawa I plant, and went on to make estimations of the extent of subsidence expected to result from the ongoing operation of Rotokawa I in conjunction with the Nga Awa Purua plant. His conclusion was that the total subsidence expected between 2007 and 2050 would be in the order of 18cm, although he acknowledged that the modelling on which this prediction was based was only accurate to an order of magnitude. Nonetheless he was satisfied that any effects of subsidence would be minor.

Dr Mroczek described the surface geothermal features at the Rotokawa geothermal field, the responses of those features to production from the field to date, and their likely response to increased production in the future. His conclusion was that if shallow aquifer pressures were maintained at current levels, being stabilised by minor shallow reinjection, the surface spring flows and chemistry should not, within the bounds of natural variation, be affected by the proposal.

Dr Burns provided evidence on the terrestrial geothermal ecology at Rotokawa and summarised a literature review undertaken by a Dr Parkyn of NIWA on freshwater ecology of Lake Rotokawa and the Parariki Stream. Dr Burns concluded that the operation of Rotokawa I has had little impact on the geothermal ecosystems at Rotokawa, and, based on the modelling work of Mr Holt and the conclusions of Dr Mroczek, it is unlikely that the geothermal ecosystems would change as a result of the operation of Rotokawa I and Nga Awa Purua.

Mr Fisher presented evidence on air discharges from the operation of the stations. This was divided into discussions of the discharges of hydrogen sulphide (H₂S), other minor contaminants, and greenhouse gases. Mr Fisher noted that the general area was already subject to relatively high H₂S levels due to the emissions from natural geothermal sources. Effects due to the discharge of H₂S would lead to an increase in the extent and frequency of H₂S odour effects. However, those increases due to the Rotokawa development would only be noticeable very close to the plant, within 2-3 kilometres, and on the exposed hills to the north and east out to 5-7 kilometres. He noted that there were few

residences or occupied buildings at these locations. For all other contaminants, including mercury, ammonia, fluoride, arsenic and radon, he concluded that ground level concentrations would be 1/100th of the guideline concentrations that may result in effects. He calculated the combined development would emit a total of 0.13 Mtonnes of CO₂ per annum, and that rate is 1/7th of that for a coal fired thermal power station of the same capacity, and 1/5th of a gas fired station.

Mr Lyon provided a brief description of the proposal, the existing environment and the consents required. He concluded that the activity status of the applications, when bundled, were discretionary. Mr Lyon then assessed the effects of the proposal, relying on the evidence of the other witnesses and the Assessment of Environmental Effects provided with the application. He was satisfied that any effects from the proposal would be minor, and that they would not combine with other effects over time to create an adverse cumulative effect. Mr Lyon commented on the consultation undertaken, before turning to consider the proposal against the provisions of Part II of the Act, s104, s.104E, s.105, s.107, the Regional Policy Statement and the Regional Plan.

He considered that the identification of the Rotokawa Geothermal System as a Development Geothermal System by the Regional Policy Statement and Plan, and the management approach proposed by the applicant, meant the proposal was consistent with the philosophy of the Regional Policy Statement, and that appropriate use and extraction within the Rotokawa Geothermal System is anticipated by the classification of the system.

Mr Lyon outlined the submissions received and responded to those in opposition. He generally concurred with the staff report and was in large part satisfied with the draft conditions proposed by the staff, as amended after discussion between the applicant and the Council's officers and consultants.

6.2 Submitters

Ms Dixon presented an oral submission in support of the submission by Contact Energy Ltd. She confirmed that Contact supported the applications and that it was only interested in the air discharge consent. She made the point that the H₂S discharge at Rotokawa was a higher level than that from the Wairakei geothermal development. Contact's modelling showed cumulatively higher levels of H₂S on the outskirts of Taupo, but that those levels would not be noticeable in the context of the natural levels. She identified that Contact sought that similar conditions be imposed on the Rotokawa development in relation to H₂S discharge as were imposed on the Wairakei, Poihipi and Tauhara consents that Contact held. She confirmed that Contact was happy with the draft conditions as they stood at the time she appeared.

Mr Shearer made an oral statement in support of the submission by Broadview Holdings Ltd. He told the Committee that the submitter's land was 5-6 kilometres from the Rotokawa system, that its property has a bore to 70m used for potable and stock water supply. He expressed concerns regarding the effects on groundwater as a result of the reinjection of geothermal fluid at Rotokawa and sought a condition requiring the avoidance of pollution and the remediation of the

supply if pollution occurred, or the provision of an alternative supply. Mr Shearer also raised concerns about noise and odour with a concern that there would be an adverse effect on property values as a result of these issues. Mr Shearer also made comments about other activities undertaken by Mighty River Power in its operation of consents in association with the Waikato River hydro scheme.

Mr Reihana presented written evidence in support of the submission by Nga Uri o Tahu Matua Charitable Trust. Mr Reihana identified that he was an owner of the Tauhara North 3B block and the lead claimant in a Waitangi Tribunal claim relating to geothermal resources. He outlined the general concerns in respect of the Crown's treatment of the tangata whenua in respect of geothermal resources in the area and land dealings at Rotokawa. He told the Committee that in 1869 Ngati Tahu had a pa and cultivation at Nihoroa at the confluence of the Parariki Stream and the Waikato River, and further cultivations between the Nga-Awa-Purua rapids and the Parariki Stream. Mr Reihana sought the preparation of a full comprehensive historical report of the Tauhara North land before any development took place, and specifically sought that no structures and/or roadways crossed the Parariki Stream near or around the exit from Lake Rotokawa, or near or around the stream's entry into the Waikato.

6.3 Environment Waikato (Waikato Regional Council) Technical Report

Dr Watson presented a summary of his written report and commented on the evidence he heard during the hearing. Dr Watson identified the uncertainties arising in making predictions of reservoir conditions and subsidence due to the limited amount of knowledge owing to the short period that the reservoir resource had been used. Notwithstanding these uncertainties, Dr Watson was satisfied that a combination of monitoring and system management would provide a satisfactory basis for consent to be granted. With respect to Mr Shearer's submission regarding the potential effects on ground water at the Broadview Holdings' property, Dr Watson considered there was insufficient information to make a determinative answer, but that if the property was more than 1 km from the resistivity boundary then no contamination should occur.

Dr Graham verbally summarised his written report. He highlighted the fact that the H₂S levels predicted by Mr Fisher were similar to those experienced in some parts of the Taupo urban area at present. With respect to s.105, he considered that section to be relevant to the upper limit of H₂S discharged in a cumulative sense, and that limit will not be reached with this consent. Dr Graham recommended that continuous monitoring for H₂S levels be required, that the applicant be required to keep H₂S discharges to a practical minimum, while also specifying a combined rate of no more than 750kg/hour. He considered the effects of the discharge of the other contaminants to be minor, but that they should be included in annual compliance monitoring.

Mr Affleck orally summarised his report. He considered, subject to the imposition of conditions, that the effects of the proposal would be minor, the proposal is consistent with Council policy as set out in the Regional Policy Statement and the Regional Plan, that there was no conflict with the matters in Part II of the Act, nor anything in the submissions which raises concerns. Mr Affleck concluded that the proposal represented sustainable management of the

geothermal resource and that consent should be granted subject to draft conditions that he tabled at the hearing.

6.4 Applicant's Right of Reply

Ms Janette Campbell presented the applicant's right of reply. She commenced by having Dr McDonnell and Mr Lyons respond to a matter raised by Commissioner Nugent during the hearing in respect of the management objectives for the reservoir and the long-term sustainability of the geothermal resource.

Dr McDonnell stated that the enthalpy of the fluid could reduce to 1100kj/kg and remain commercial. He went on to state that if it took 100 years for the enthalpy to reduce to 1100kj/kg, then the resource would recover over an ensuing 100 years.

Mr Lyons suggested that General Condition 3.3 could be improved by inserting as (b) (and renumbering the draft (b) to (f)):
Allow controlled depletion while having regard to the reasonably foreseeable needs of future generations.
He considered this reflected the purpose of Development Geothermal Systems as set out in the Regional Policy Statement, and the portion of s.5 relating to the needs of future generations.

Ms Campbell reiterated the consistency of the application with the New Zealand Energy Strategy and provided us with a copy of that document. She identified that downstream use could be made of the geothermal resource without further consent provided the conditions of these consents were met. She submitted that in terms of s.105, as the receiving environment is not sensitive to the discharge of H₂S, it was not necessary to consider alternative methods of discharge. Ms Campbell corrected a misunderstanding that may have occurred from Dr Mroczek's evidence, and submitted that monitoring of surface features has been, and will continue to be, a useful tool in practicing adaptive management of the system.

Ms Campbell responded to Mr Shearer's comments regarding Mighty River Power's operation of its consents for the Waikato hydro system, rejecting any suggestion that it was an irresponsible operator. With respect to Mr Shearer's concerns regarding effects on the quality of his groundwater, she offered, on behalf of the applicant, a condition requiring monitoring of the Broadview Holding's bore by the applicant.

Ms Campbell clarified for us that any crossings of the Parariki Stream would only involve the strengthening or replacement of the two existing road crossings, and that pipework crossing the stream would be in the immediate vicinity of the existing crossings.

In response to a question from the Chair, Ms Campbell suggested that consent 116570 contain a condition equivalent to draft condition 2 for consent 116577.

7.0 EVALUATION OF THE PROPOSAL

We thank all those attending the hearing for the clear and concise manner in which the submissions and evidence was presented to us. The site visit provided a useful opportunity to understand the above ground impacts of such a power station and associated bores and pipelines. It was particularly useful visiting the drilling platform established to drill wells for reinjection. Until that visit we had not comprehended the scale of the drilling operation.

Procedural Matters

Within the raft of applications lodged there was some duplication of activities and overlapping with matters that subsequently have been certified as permitted activities under s.139 of the Act.

Applications 116573, 116574 and 116575 all sought land use consents to construct, operate, maintain and upgrade roads, pipelines and bridges over watercourses. The distinctions between applications were whether the activities were within or beyond 20m of a Significant Geothermal Feature, and over or under the bed of the Parariki Stream as opposed to other watercourses. These three applications have been treated as one and numbered 116573.

Application 116581 sought a discharge permit to discharge fresh water, drilling muds and fluids, beneath land within consent Area 2. Application 116579 sought a discharge permit to, in part, discharge fresh water, drilling muds and fluids into underground strata. These two activities overlap and the activity sought in Application 116851 has been incorporated into 116579.

Statutory Provisions Considered

The applications were lodged on 1 June 2007. The applications are therefore subject to the Act as amended by the Resource Management (Energy and Climate Change) Amendment Act 2004 and the Resource Management Amendment Act 2005.

There are several activities associated with the construction, operation and maintenance of a geothermal power station. Some of the applications have classifications that include permitted, controlled and discretionary activities. In accordance with the “bundling” principle, for the purposes of making an overall decision on these applications, the statutory tests applicable to discretionary activities in ss104 and 104B of the Act have been applied. The applicant had obtained a Certificate of Compliance under s.139 for some of the activities associated with the development. The effects of those activities were disregarded in assessing these applications.

Under s104(1) the relevant matters to consider were

- (a) the actual and potential effects on the environment of allowing the activity;
- (b) provisions of the Waikato Regional Policy Statement;
- (c) provisions of the Waikato Regional Plan and the proposed Geothermal Section of that Plan;
- (d) the New Zealand Energy Strategy to 2050, October 2007 (under s104(1)(c)).

Under s104(2A) it was necessary for us to have regard to the value of the investment in the existing Rotokawa I station and associated works when considering the consenting of those activities.

Section 104E was relevant to the extent that the use and development of this geothermal resource for electricity generation would enable a reduction in the discharge of greenhouse gases relative to the use and development non-renewable energy to generate an equivalent amount of electricity.

Under s.105, in respect of the applications for discharges to water, land and air, it was necessary for us to have regard to:

- (a) the nature of the discharge and the sensitivity of the receiving environment to adverse effects;
- (b) the applicant's reasons for the proposed choice; and
- (c) any possible alternative methods of discharge, including discharge into any other receiving environment.

Under s.107, we were precluded from granting any consent for a discharge of a contaminant or water into water or onto or into land which could result in a contaminant entering water where specified effects would occur, except in specified circumstances. Those specified exemptions included temporary discharges and discharges in exceptional circumstances, where it would be consistent with the purpose of the Act to allow them.

The following matters of national importance under s.6 are relevant, and are to be recognised and provided for in the decision:

- (a) The preservation of the natural character of ... lakes and rivers and their margins, and the protection of them from inappropriate development;
- (b) The protection of outstanding natural features ... from inappropriate subdivision, use and development;
- (c) The protection of areas of significant indigenous vegetation ...;
- (e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

The following are relevant matters under s.7 that we are to have particular regard to:

- (a) Kaitiakitanga;
- (aa) The ethic of stewardship;
- (b) The efficient use and development of natural and physical resources;
- (g) Any finite characteristics of natural and physical resources;
- (j) the benefits to be derived from the use and development of renewable energy.

Waikato Regional Policy Statement

Environment Waikato has an operative Regional Policy Statement (RPS). This is a high-level, broad-based document that contains objectives and policies aimed at managing the region's natural and physical resources. A change to the geothermal section of the RPS was made operative on 15 August 2006.

Sections of the RPS which are particularly relevant to these applications are set out below.

Geothermal Module

The Rotokawa Geothermal System is identified in the Waikato Regional Plan as a “Development System”. Objective 3.7.2.1 of the RPS sets out the policy framework for development systems.

3.7.2.1 Development Geothermal Systems

Objective: Large scale take, use and discharge of geothermal energy and water enabled within Development Geothermal Systems in a manner that:

- is efficient and allows the controlled depletion of energy so as to provide for the energy needs of current and future generations;
- remedies or mitigates significant adverse effects on Significant Geothermal Features; and
- avoids, remedies, or mitigates adverse effects on other natural and physical resources including overlying structures (the built environment).

The following policies, in support of this objective are relevant here:

Policy One: Management of Use and Development in Development Geothermal Systems

Provide for large scale use and development of geothermal energy and water, promote efficient use of the resource and recognise there will be controlled depletion.

Policy Three: Reinjection / Injection

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

- i. Dispose of waste water;
- ii. Return geothermal water to that system;
- iii. Facilitate further extraction of energy from the system;
- iv. Avoid or mitigate potential differential subsidence, and remedy or mitigate the adverse effects of subsidence, particularly in the built environment
- v. Reduce the risk of hydrothermal eruptions particularly in the built environment;
- vi. Remedy or mitigate significant adverse effects on Significant Geothermal Features; and
- vii. Avoid, remedy or mitigate contamination of surface and ground waters.

Such Discharge Strategy shall also have regard to:

- i. Any likely benefits to or adverse effects on the system or its productive capacity;
- ii. The need for adaptive management and flexibility over time.
- iii. The benefits, costs and adverse effects of the Discharge Strategy;
- iv. The need to avoid or mitigate potential differential subsidence, and remedy or mitigate the adverse effects of subsidence, particularly in the built environment; and
- v. The need to reduce the risk of hydrothermal eruptions particularly in the built environment.

Policy Five: Management of Significant Geothermal Features in Development Geothermal Systems

Allow for the efficient take, use, and discharge of geothermal energy and water in Development Geothermal Systems while remedying or mitigating within the Regional Geothermal Resource, significant adverse effects on Significant Geothermal Features.

Policy Six: Adverse Effects of Take, Use, and Discharge in Development Geothermal Systems

When taking, using, or discharging geothermal energy and water in Development Geothermal Systems, avoid, remedy, or mitigate the adverse effects on non-geothermal natural and physical resources, including overlying structures (the built environment).

Section 3.7.2 deals with sustainable management of geothermal resources. The following objective and policy were relevant:

Objective: Manage the take, use and discharge of geothermal energy and fluid in a way that enables current energy needs, and the reasonably foreseeable energy needs of future generations, to be met.

Policy One: Geothermal Characteristics Valued by Tangata Whenua
Ensure that the ahi kaa (Manawhenua) relationship of tangata whenua with, and their role as Kaitiaki of, characteristics of particular Geothermal Systems, fields and surface features is recognised and provided for, once specific resource management matters of traditional and contemporary cultural significance have been identified by tangata whenua.

Air Module

3.6.3 Regional and Local Air Quality

Objective: Significant characteristics of areas of:

- a) high air quality protected
- b) degraded air quality enhanced
- c) other air quality maintained.

Policy Three: Other Air Quality

Ensure that the significant characteristics of air that is not of high or degraded quality are maintained by avoiding, remedying or mitigating the adverse effects from the discharge of contaminants.

The objective recognises air of “high”, “degraded” and “other” quality, but as yet there is no air quality mapping in terms of these categories in the region. However, the Proposed Regional Plan describes the air quality in the Taupo and Rotorua areas as being “generally acceptable” despite the presence of naturally high levels of H₂S in geothermal areas. We accept that in this area the air quality falls into the “other” category and Policy Three is therefore relevant.

3.6.4 Greenhouse Gases and Climate Change

Objective: Greenhouse gases managed in a way that is not inconsistent with Central Government Policy

Policy One: Management of Greenhouse Gases
Support Government policy in the management of greenhouse gases.

Energy

3.12.2 Efficient Energy Use

Objective: Efficient use of energy within the Waikato Region.

Policy One: Energy Efficiency and Conservation
To promote efficiency and conservation in the production, transmission and consumption of energy.

Waikato Regional Plan

The Waikato Regional Plan was notified in September 1998 and became operative in part on 28 September 2007. The outstanding parts of the Waikato Regional Plan that did not become operative are those that remain subject to variations that have not fully completed the First Schedule RMA process. The only variation that is relevant to this application is Variation 2 (geothermal module). This section of the WRP is still not resolved through the Courts.

Variation 2 – Geothermal Module

Objective 1

Where geothermal energy and water is taken, it shall be used and managed efficiently.

Policy 3: Management of Use and Development in Development Geothermal Systems

Control the depletion of energy in Development Geothermal Systems through stepped production based on reservoir modelling that:

- considers the capacity of the system as a whole; and
- considers the reasonably foreseeable needs of present and future generations; and
- promotes efficient management and use of the system.

Policy 4: Integrated System Management of Development Geothermal Systems

Each Development Geothermal System shall have an up to date approved System Management Plan that defines the objectives to be achieved in relation to the system having regard to the relevant policies in the RPS.

Policy 13: Discharge Strategy for Large Discharges of Geothermal Energy and Water in Development Geothermal Systems

For large discharges of geothermal energy and water, reinjection / injection is to be undertaken in accordance with a Discharge Strategy prepared for each Development Geothermal System.

Objective 2

In Development Geothermal Systems, significant adverse effects on Significant Geothermal Features arising from the take of geothermal energy and water to be remedied or mitigated within the Regional Geothermal Resource

Policy 6: Significant Geothermal Features in Development Geothermal Systems

Where significant adverse effects on Significant Geothermal Features in Development Geothermal Systems are to be remedied or mitigated, the remediation and mitigation may include:

- the take and return of geothermal water being managed to remedy or mitigate significant adverse effects on those Significant Geothermal Features affected, or
- adverse effects on features of the same or similar type (defined in the glossary) being remedied or mitigated to an extent commensurate with the adverse effect being caused ('like for like' mitigation).

Objective 4

Significant adverse effects on Significant Geothermal Features arising from land use and the take, use and discharge of non-geothermal water to be avoided.

Policy 10: Adverse Effects of Land Use and Take, Use and Discharge of Water on Significant Geothermal Features

Ensure that land use and the take, use and discharge of non-geothermal water avoid significant adverse effects on Significant Geothermal Features.

Objective 5

In Development Geothermal Systems, adverse effects on other natural and physical resources including overlying structures (the built environment), such as those resulting from subsidence and land instability, arising from the take, use, and discharge of geothermal energy or water to be avoided, remedied or mitigated.

Policy 11: Effects of Geothermal Resource Use on Other Natural and Physical Resources, including Overlying Structures (the Built Environment)

When taking, using, or discharging geothermal energy and water in Development Geothermal Systems, avoid, remedy or mitigate the adverse effects on non-geothermal natural and physical resources, including overlying structures (the built environment).

Where there is scientific uncertainty and a threat of serious or irreversible adverse effects on natural and physical resources including overlying structures (the built environment) adopt a precautionary approach.

Objective 7

Significant adverse effects on fresh water and land arising from the discharge of geothermal energy and water avoided.

Policy 12: Discharges of Geothermal Energy and Water onto Land and into Fresh Water

Ensure that discharges of geothermal energy and water onto land and into fresh water after efficient and appropriate use are limited such that the adverse effects are no more than minor.

Policy 13: Discharge Strategy for Large Discharges of Geothermal Energy and Water in Development Geothermal Systems

For large discharges of geothermal energy and water, reinjection / injection is to be undertaken in accordance with a Discharge Strategy prepared for each Development Geothermal System.

Objective 8

Increased knowledge about the Regional Geothermal Resource, and better understanding of the effects of using the resource and effects of other activities on the resource.

Policy 14: Information Gathering

Ensure that environmental monitoring is undertaken and information provided about the characteristics of the Regional Geothermal Resource. Ensure that high-quality data, research, and monitoring of the Regional Geothermal Resource and of the effects of its use, commensurate with the scale of any activity, are, where appropriate, independently peer reviewed and made publicly available having regard to commercial and cultural sensitivity.

The following table sets out the applications as lodged, the rules relevant to each application, and the status of the activity in each application:

Application	Relevant Rules	Activity Status
Primary Consents		
116565 Water Permit To take and use up to 22,100,000 tonnes per year (at an average of 60,500 tonnes per day) with a maximum take of 70,500 tonnes per day of geothermal water and associated energy	7.6.1.4	Discretionary
116566 Discharge Permit To discharge up to 22,100,000 tonnes per year (at an average of 60,500 tonnes per day) with a maximum discharge of 70,500 tonnes per day of geothermal water,	7.6.1.5 3.5.9.2	Discretionary Discretionary
116567 Discharge Permit To discharge up to 6,600,000 tonnes per year (at an average of 18,000 tonnes per day) with a maximum discharge of 22,000 tonnes per day of geothermal vapour and associated non-condensable gases to air	6.1.9.2	Discretionary
Construction and Operation		
116568 Water Permit To divert stormwater during construction and ongoing operation	3.6.4.13	Discretionary
116569 Discharge Permit To discharge stormwater and contaminants onto land	3.5.11.6	Controlled
116570 Discharge Permit To discharge up to 15,000 tonnes per day of steam line condensate, silica, geothermal water, cooling water and contaminants onto or into land	3.5.4.5 7.6.1.6	Discretionary Discretionary
116571 Discharge Permit To discharge up to 15 cubic metres per day of water including contaminants and sewage into land	3.5.7.7	Discretionary
116572 Discharge Permit To discharge up to 40 tonnes per year of pentane (or similar binary cycle fluid) to air	6.1.9.2	Discretionary

Application	Relevant Rules	Activity Status
116573 Land Use Consent To construct, operate, maintain and upgrade roads, pipelines and bridges over water courses which may involve minor vegetation clearance and soil disturbance within and beyond 20 metres of Significant Geothermal Features.	7.6.6.3 4.2.4.4 4.2.8.2 4.2.9.3 4.3.4.4 5.1.4.13 5.1.4.14	Discretionary Discretionary Controlled Controlled Discretionary Discretionary Controlled
Well Drilling and Testing		
116576 Water permit To take and use up to 25,000 tonnes per day of geothermal water and associated energy and heat	7.6.1.4	Discretionary
116577 Discharge permit To discharge of up to 15,000 tonnes per day of geothermal water, steam condensate	7.6.1.5 3.5.8.2 3.5.9.2	Discretionary Controlled Discretionary
116578 Discharge permit To discharge up to 10,000 tonnes per day of geothermal vapour and associated non-condensable gases to air	6.1.9.2	Discretionary
116579 Discharge permit To discharge up to 10,000 tonnes per day of fresh water, drilling muds and fluids (a) into soakage (b) into underground strata	3.8.4.4	Discretionary
116580 Land use consent To construct, operate and maintain deep geothermal wells, monitoring wells, well pads, pipelines, and roads, and to authorise well testing and drilling activities that involve drilling below the water table and earthworks, further than 20 metres from Significant Geothermal Features.	3.8.4.7 4.2.4.4 4.2.8.2 4.2.9.3	Controlled Discretionary Controlled Controlled
116582 Land use consent To maintain and upgrade existing roads and access ways.	5.1.4.14 5.1.4.13	Controlled Discretionary

Issues in Contention

The only issue truly in dispute by the end of the hearing was the potential for pollution of Broadview Holdings Ltd's bore as a result of reinjection of geothermal fluid. The applicant offered to monitor the quality of water extracted from the bore as a way of mitigating any effects. Dr Watson suggested that if the bore was more than 1km from the resistivity boundary it was unlikely to be affected. Mr Shearer marked the location of Broadview's property on a map for us. Comparing that location with the mapping of the resistivity boundary provided with the application, the property appears to be some 3km outside the resistivity boundary. We therefore do not see it necessary to impose the condition suggested by the applicant, but note that the applicant is at liberty to make an offer to monitor the quality of the well in terms proposed direct to Broadview Holdings.

Mr Reihana raised two matters. The first sought the preparation of a historic report. While such a report may provide valuable information, we do not see

such information as directly relevant to the applicant's exercise of the consents. Conditions have been proposed to deal with any archaeological remains encountered. The second related to the crossing of the Parariki Stream. The applicant is proposing crossings at the same location, or similar location, to those existing, and is not proposing to increase the number of crossings. We agree there should be limits on the number, location and type of crossing and deal with that matter below.

Main Findings of Fact

The use and development of the Rotokawa geothermal resource does, and will, provide a number of positive effects. These include:

- the provision of baseload electricity that is largely unaffected by weather patterns;
- the generation of electricity in a manner that will produce 1/5th and 1/7th the quantity of CO₂ that would be produced by gas or coal fuelled thermal generating plants respectively to generate an equivalent amount of electricity;
- the development of a resource in a way that enables the tangata whenua owners of the land to make provision for their own well-being.

Granting the consents will allow the sustainable use of a natural resource. While there is inherent uncertainty in the prediction of the behaviour of the geothermal resource as a result of the taking of geothermal fluid and the reinjection of that fluid, this level of uncertainty is no greater than that which would exist in any geothermal field at this point of development. As the resource is used, the monitoring proposed and the management of the system will increase the knowledge of the resource with a commensurate reduction in uncertainty. The imposition of conditions that require the review of monitoring results by a Peer Review Panel and the ability to review the consents on a regular basis enable the modification of how the resource is used to ensure its long-term sustainability. The ready acceptance of this "adaptive management" approach by the applicant assisted us in being satisfied that this resource will be managed in a way that allows future generations to utilise it.

We note that the various discharges of geothermal fluid proposed are all designed to minimise adverse effects on the environment. In particular, the reinjection of the bulk of the fluid within the resistivity boundary has the effect of discharging contaminated water into a receiving environment compatible with the discharge. This avoids the potential for geothermal water to contaminate freshwater resources such as the Waikato River. In addition, where discharge of geothermal water to land is proposed where it will be allowed to seep into the ground, it is in locations where the groundwater is of similar composition to the geothermal waters. Thus granting consents for the long-term discharges of geothermal water is not hindered by sections 105 or 107.

The proposal will discharge considerable quantities of non-condensable gases into the atmosphere. The only gas that could be of concern due to its nature and quantity of discharge is hydrogen sulphide (H₂S). We accept that the natural discharges of H₂S in the immediate vicinity and the general area are such that the effect of adding the discharge proposed by these applications will not be

adverse, either in isolation or cumulatively with other discharges. Although we were concerned that the condition sought by Contact Energy Ltd on the H₂S discharge that *“the consent holder shall keep hydrogen sulphide emissions discharged from the power stations to a practicable minimum”* was unenforceable, we were reassured by the acceptance of this condition by the applicant.

Experience derived from operating the Rotokawa I plant has shown that shallow reinjection of geothermal fluids in this field can have effects on surface features. That same experience has led to the development of a means of managing the discharge between the shallow and deeper aquifers in a way that appears to maintain the viability of surface features within their normal range of variability. We are satisfied that ongoing use and development of this field can occur in a way that avoids effects other than minor effects on surface features.

Crossing of the Parariki Stream could potentially lead to adverse effects. Mr Reihana was particularly concerned that any crossing avoid the area at the outlet of Lake Rotokawa into the stream, and the area around the confluence of the stream and the Waikato River. There are two existing crossings of this stream that we visited on our site visit. The southern crossing is a wooden culvert and the northern a single lane wooden bridge. The applicant proposed no new vehicle crossings, but wished to have the right to upgrade, strengthen or replace the existing crossings if they proved inadequate for the nature of the loads they will need to carry. We were assured that the applicant proposed that any pipelines crossing the stream would do so in the immediate vicinity of one or both of the existing crossings. We accept that some upgrading may be required, and we agree with Mr Reihana that crossing should avoid the areas he was concerned with. So long as structures crossing the stream are focused on the two existing locations and avoid any new structures, including culverts, in the bed of the stream, we are satisfied that effects of the proposal will be minor and that the natural character of the stream and its margins will be protected from inappropriate development. We note that these locations are in excess of 500m from both Lake Rotokawa and the Waikato River.

Finally, the regional planning documents have been well tested in the Environment Court in respect of the policy direction for geothermal areas. This proposal is consistent with that policy direction. In addition, in assessing the environmental effects of the proposal the Environment Waikato reporting officer and the consultants engaged by Environment Waikato were able to draw on expertise developed over a number of years in respect of other geothermal power station developments. Their reporting and analysis, which did not conflict with the evidence presented by the applicant, greatly assisted our understanding of the proposal and the issues and confirmed the veracity of the evidence presented by the applicant's experts.

In conclusion, we are satisfied that the proposal as presented to us, subject to the conditions we have attached to the consents in accordance with s.108, amounts to sustainable management of the natural and physical resources represented by the Rotokawa Geothermal System, including the underground reservoir, the surface features, Lake Rotokawa and the Parariki Stream, and the

existing Rotokawa I power station and associated bores, pipelines and other facilities.


8.0 DECISION

Consent is hereby **granted** to the Consents set out in the attached Schedule subject to the conditions as set out in that Schedule.

The **Reasons for the Decision** are as follows:

- (a) The Rotokawa I power station has been operating for 10 years. The use, development and monitoring of the Rotokawa geothermal system over that time has shown that the field is capable of providing a sustainable energy resource with only minor effects on natural and physical resources. In addition, the investment made by the applicant in Rotokawa I is a significant investment that must be had regard to under s.104(2A). The level of knowledge gained from the operation of the existing plant has enabled modelling of the effects of increased production. While this modelling contains uncertainties, expert opinion is that monitoring and adaptive management of the field will allow production to increase with only minor adverse effects on the environment.
- (b) The further development of this geothermal system by this applicant would enable the tangata whenua owners of the land to provide for their social, economic and cultural well-being, and their health, as well as enable them to exercise their kaitiakitanga over the land and the resource.
- (c) The Rotokawa geothermal system has been identified in the Regional Policy Statement and the proposed Regional Plan as being appropriate for development.
- (d) This proposal will enable an increase in the electricity baseload capacity of New Zealand, which in itself is beneficial, while utilising a resource that is defined by the Act as renewable and has a lower rate of discharge of greenhouse gases per unit of energy produced than non-renewable resources such as gas and coal that would otherwise be required for such electricity generation. This is consistent with s7(j) and the New Zealand Energy Strategy to 2050, as well as the provisions of the Regional Policy Statement.
- (e) The infrastructure necessary to enable the use of the resource can be developed on the land in a way that will have minor adverse effects on the environment. In particular, existing surface geothermal features, including Lake Rotokawa, will not be affected by such infrastructure, and necessary crossings of the Parariki Stream can be made without diminishing the values of that stream.
- (f) Overall, the proposal represents sustainable management of natural and physical resources and is consistent with the policy direction provided by Part II of the Act and the regional statutory documents.

DATED this 28th day of November 2007

A handwritten signature in black ink, appearing to be 'J A Jones', written on a light green rectangular background.

J A Jones Chairperson

A handwritten signature in blue ink, appearing to be 'T D Nugent', written on a white background.

T D Nugent

Schedule

Rotokawa Joint Venture Limited Resource Consent Conditions

Generation/Station Operation

RESOURCE CONSENT NUMBER 116565 - MAIN GEOTHERMAL FLUID TAKE FOR ROTOKAWA I AND NGA AWA PURUA STATIONS

Consent 116565 authorises the Consent Holder to: take and use up to 22,100,000 tonnes per year (at an average of 60,500 tonnes per day) with a maximum take of 70,500 tonnes per day of geothermal water and associated energy from underground strata for electricity generation; and for the supply and use of steam, water, heat and condensate for related and ancillary purposes and other downstream uses, within Consent Area 1 (as shown in Schedule ONE) for a term to expire 35 years after the date of granting this consent, subject to the following conditions:

1. Consent 116565 is subject to compliance with the General Conditions.
2. The Consent Holder shall maintain a record of the total mass and energy of geothermal fluid extracted each day, which shall be made available to the Waikato Regional Council within 1 week of its request. The daily records shall be forwarded to Waikato Regional Council as part of the Annual Report required pursuant to General Condition 3.12.
3. The metering devices and methods used shall have a reliable calibration, which shall be maintained to an accuracy of within +/- 10% of full scale reading. Evidence of these calibrations shall be provided to the Waikato Regional Council when requested in writing.
4. Data and reports shall be provided to the Waikato Regional Council in electronic format compatible with Waikato Regional Council computer systems, with hard copies to be supplied if requested by Waikato Regional Council.
5. Each production wellhead drilled after commencement of this consent shall be completed so as to enable direct access of monitoring instruments during well production and with facility for measuring wellhead pressure. Production fluid lines shall be constructed to enable chemical sampling to be undertaken where appropriate.
6. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
7. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

8. This consent shall not be exercised until consents 920803 and 971131 (WRC numbers) have been surrendered.

Generation/Station operation

RESOURCE CONSENT NUMBER 116566 – REINJECTION FROM ROTOKAWA I AND NGA AWA PURUA STATIONS

Consent 116566 authorises the Consent Holder to: discharge 22,100,000 tonnes per year (at an average of 60,500 tonnes per day) with a maximum discharge rate of 70,500,000 tonnes per day of geothermal water, together with steam condensate, cooling water and added chemicals into underground strata through reinjection wells within Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. Consent 116566 is subject to compliance with the General Conditions.
2. The consent holder shall notify the Waikato Regional Council in writing 30 working days prior to the first commencement of reinjection/injection in any new wells.
3. Added chemicals discharged under this consent shall only be those that are added to geothermal waters for the purposes of limiting or removing scale deposition, biocidal control of organic growth, to conduct tracer tests and to enable safe and efficient ongoing maintenance and operation. Unless otherwise approved in writing by the Waikato Regional Council, added chemicals discharged under this consent shall be limited to those listed in Schedule THREE of this consent, excluding those listed in Schedule Three as Drilling Cement Additives or Drilling Fluid Additives.. In the event the Consent Holder wishes to discharge additional chemicals not contained in Schedule THREE, the Consent Holder shall provide the Waikato Regional Council with details of the additional chemicals to be used, including their Material Safety Data Sheets, the concentrations at which they are to be used and any environmental effects expected from their use. The Waikato Regional Council shall respond in writing within 10 working days of receiving a request approving or withholding approval for the application. Should approval be withheld, the Waikato Regional Council's reply shall include an explanation of the reasons for this and shall identify any additional information necessary to satisfy the Council's concerns. Should a response not be received within 10 working days of receipt, the consent holder shall be entitled to proceed in accordance with the proposed chemical use and failure to respond shall constitute approval on behalf of the Waikato Regional Council.
4. The Consent Holder shall maintain a record of the total daily mass of fluid injected into each reinjection well which shall be made available to the Waikato Regional Council within 1 week of its request. The daily records shall be forwarded to Waikato Regional Council as part of the Annual Report required pursuant to General Condition 3.12.
5. The metering devices and methods used shall have a reliable calibration which shall be maintained to an accuracy of within +/- 10% of full scale reading. Evidence of these calibrations shall be provided to the Waikato Regional Council by the Consent Holder when requested in writing.

6. Data and reports shall be provided to the Waikato Regional Council in electronic format compatible with Waikato Regional Council computer systems, with hard copies to be supplied if requested by Waikato Regional Council.
7. During the six month period following every fourth anniversary of the commencement of the Consents, in addition to General Condition 7 (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128 (1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
8. Each reinjection wellhead drilled after commencement of this consent shall be completed so as to enable direct access of monitoring instruments during reinjection and with facility for measuring wellhead pressure. Production fluid lines shall be constructed to enable chemical sampling to be undertaken where appropriate.
9. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
10. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.
11. This consent shall not be exercised until consent numbers 920805 and 971132 have been surrendered.

Generation/Station operation

RESOURCE CONSENT NUMBER 116567 – AIR DISCHARGES

Consent 116567 authorises the Consent Holder to: discharge up to 6,600,000 tonnes per year (at an average of 18,000 tonnes per day) with a maximum discharge of 22,000 tonnes per day of geothermal vapour and associated non-condensable gases to air from geothermal power stations within Consent Area 1 (as shown in Schedule ONE) and from other downstream uses for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. Consent 116567 is subject to compliance with the General Conditions.
2. The Consent Holder shall keep hydrogen sulphide emissions discharged from the power stations to a practicable minimum.
3. The Consent Holder shall undertake continuous monitoring of ambient hydrogen sulphide (H₂S) concentrations at two sites to be agreed with the Waikato Regional Council. The data shall be recorded as 10-minute averages and the results shall be reported on a fixed hourly average basis. This monitoring shall be carried out for at least six months prior to the commissioning of the new power station and continue for a period of at least three years. The monitoring shall include continuous recording of hourly wind speed and direction at the monitoring site or sites. Monitoring methods shall be in accordance with Australian Standard AS3580.4.1 – 1990 (or any subsequent update or new version of the Standard).
4. The Consent Holder shall, at the start of commissioning and yearly thereafter, measure the emissions of hydrogen sulphide (H₂S) and mercury from each power station. These measurements shall be made by analysis of total steam incoming to each station. The results of these measurements will be provided to the Waikato Regional Council in the Annual Report required pursuant to General Condition 3.12.
5. The discharge shall not result in odour, or other gaseous emissions that are objectionable at or beyond the boundary of the consent area as shown in Schedule ONE.
6. If a complaint is received by the Consent Holder regarding odour or other airborne contaminants, the Consent Holder shall notify the Council of the complaint as soon as practicable. When complaints are received, the Consent Holder shall record the following details in a Complaints Log:
 - (i) Time and type of adverse effect to which the complaint related, including details of the incident, e.g. duration, any effects noted.
 - (ii) Name, address and contact phone number of the complainant (if provided).
 - (iii) Location from which the complaint arose.
 - (iv) The weather conditions and wind direction at the time of complaint.

- (v) The likely cause of the adverse effect to which the complaint related.
 - (vi) The response made by the Consent Holder and any corrective action undertaken by the Consent Holder in response to the complaint.
7. The Consent Holder shall also record in the Complaints Log any complaints forwarded to it by the Waikato Regional Council or any Territorial Authority. The Complaint Log shall be made available to the Waikato Regional Council within 2 weeks of any request and a copy shall be forwarded to the Waikato Regional Council annually with the Annual Report.
 8. Should the Consent Holder be advised by the Waikato Regional Council that, in the opinion of a Council Officer, an objectionable discharge event or odour has occurred as a result of exercising this consent, the Consent Holder shall provide a written report to the Waikato Regional Council within ten working days of being notified of such by the Council. The report shall specify:
 - (i) The cause or likely cause of the discharge and any factors that influenced its severity.
 - (ii) The nature and timing of any measures implemented by the Consent Holder to avoid, remedy or mitigate any adverse effects associated with the discharge event.
 - (iii) The steps to be taken to prevent recurrence of similar events.
 9. During the six month period following every fourth anniversary of the commencement of The Consents, in addition to General Condition 7 (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128(1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
 10. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.
 11. This consent shall not be exercised until consent number 920806 has been surrendered.

Construction and Operation

RESOURCE CONSENT NUMBER 116568 – TAKE/DIVERT STORMWATER AND GROUNDWATER

Consent 116568 authorises the Consent Holder to: to divert and/or take groundwater during construction activities and to divert stormwater during construction activities and during the ongoing operation of all geothermal power stations in Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years from the date of granting this consent subject to the following conditions:

1. Consent 116568 is subject to compliance with General Conditions 7, 9, 10 and 11.
2. The Consent Holder shall retain an appropriately experienced person to develop a Sediment Control Plan for the Power Station Construction site. The objective of the Sediment Control Plan is to minimise the risk of sediment entering any waterway. For the purpose of providing the Waikato Regional Council with an opportunity to review the Sediment Control Plan and to ensure it satisfies the conditions of this consent, the completed Sediment Control Plan shall be forwarded to the Waikato Regional Council no less than 20 days prior to commencement of any large scale construction earth works for the Nga Awa Purua Power Station and ancillary buildings and structures. The Consent Holder shall implement the requirements of the final Sediment Control Plan to the satisfaction of the Waikato Regional Council.
3. The Consent Holder shall ensure that all exposed areas of earth resulting from construction of the power station are progressively stabilised or stabilised to effectively minimise erosion, as soon as practicable after the construction activities are completed.
4. The diversion works shall be designed to a 2% Annual Exceedance Probability standard, and in general accordance with the sediment management plan submitted with the application.
5. The Consent Holder shall be responsible for the structural integrity and maintenance of any diversion works, and for any erosion control and energy dissipation works.
6. Any structures shall be designed, constructed and maintained to a standard appropriate for their anticipated use.
7. The consent holder shall inform the Waikato Regional Council in writing at least 10 working days prior to the commencement of construction activities of the start date of the works authorised by this resource consent.
8. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for

the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.

9. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

Construction and Operation

RESOURCE CONSENT NUMBER 116569 – DISCHARGE STORMWATER TO LAND

Consent 116569 authorises the Consent Holder to: discharge stormwater and stormwater-borne contaminants onto land (including in circumstances where they may enter groundwater and/or temporary non-flowing surface water via soakage and sediment retention facilities) related to the construction and maintenance of geothermal power station facilities all in Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. Consent 116569 is subject to compliance with General Conditions 7, 9, 10 and 11.
2. The Consent Holder shall retain an appropriately experienced person to develop a Sediment Control Plan for the Power Station Construction site. The objective of the Sediment Control Plan is to minimise the risk of sediment entering any waterway. For the purpose of providing the Waikato Regional Council with an opportunity to review the Sediment Control Plan and to ensure it satisfies the conditions of this consent, the completed Sediment Control Plan shall be forwarded to the Waikato Regional Council no less than 20 days prior to commencement of any large scale construction earth works for the Nga Awa Purua Power Station and ancillary buildings and structures. The Consent Holder shall implement the requirements of the final Sediment Control Plan to the satisfaction of the Waikato Regional Council.
3. The Consent Holder shall ensure that all exposed areas of earth resulting from construction of the power station are progressively stabilised or stabilised to effectively minimise erosion, as soon as practicable after the construction activities are completed.
4. The soakage and sediment retention facilities shall be designed to a 2% Annual Exceedance Probability standard, and in general accordance with the sediment management plan submitted with the application.
5. The Consent Holder shall inform the Waikato Regional Council in writing at least 10 working days prior to the commencement of construction activities of the start date of the works authorised by this resource consent.
6. The Consent Holder shall ensure that the stormwater discharge structures associated with construction, operation and maintenance activities are operated and maintained so as to minimise as far as practicable any erosion as a result of the discharge.
7. The Consent Holder shall remedy, as far as practicable, any erosion that may occur at or adjacent to the discharge points as a result of the exercise of this consent, and in particular, within 20 working days of being so directed by the Waikato Regional Council.

8. During the six month period following every fourth anniversary of the commencement of The Consents, in addition to General Condition 7 (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128(1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
9. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
10. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

Construction and Operation

RESOURCE CONSENT NUMBER 116570 – DISCHARGE WASTE WATER TO LAND

Consent 116570 authorises the Consent Holder to: discharge up to 15,000 tonnes per day of steam line condensate, silica, geothermal water, cooling water and added chemicals onto or into land (including circumstances where they may enter groundwater) associated with construction, operation, and maintenance of geothermal power station facilities within Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years from the date of granting of this consent subject to the following conditions:

1. Consent 116570 is subject to compliance with the General Conditions.
2. Added chemicals discharged under this consent shall only be those that are added to geothermal waters for the purposes of limiting or removing scale deposition, corrosion inhibition, pH control and for the biocidal control of organic growth. Unless otherwise approved in writing by the Waikato Regional Council, added chemicals discharged under this consent shall be limited to those listed below. In the event the Consent Holder wishes to discharge additional chemicals not included below, the Consent Holder shall provide the Waikato Regional Council with details of the additional chemicals to be used, including their Material Safety Data Sheets, the concentrations at which they are to be used and any environmental effects expected from their use. The Waikato Regional Council shall respond in writing within 10 working days of receiving a request approving or withholding approval for the application. Should approval be withheld, the Waikato Regional Council's reply shall include an explanation of the reasons for this and may identify any additional information necessary to satisfy the Council's concerns. Should a response not be received within 10 working days of receipt, the consent holder shall be entitled to proceed in accordance with the proposed chemical use and failure to respond shall constitute approval on behalf of the Waikato Regional Council.

Geothermal Fluid / Reinjectate / Condensate Additives

Description	Typical Product Name	Primary Application
Sulphuric Acid		Antiscalant
Sodium Polyacrylate		Antiscalant
Biocide	Blulab 6002	Biogrowth inhibitor
Corrosion Inhibitor	Blulab 9350	Corrosion inhibitor
Sodium Hydroxide		Condensate pH control

3. The discharges authorised by this consent, shall be limited to the following:

- (a) discharges of all geothermal water and condensate from the entire pipeline system, including separators, in the event of a power station shutdown
 - (b) Discharge of remaining water, silica, and other debris after pipeline system cleaning, including separators, silencers, cooling water systems, and drains.
 - (c) Discharge of water and contaminants to the ground associated with maintenance and operational activities including steam traps, other discharge from wells and pipelines during start-up, water blasting, sand blasting, general cleaning, hand held and ground-based motorised spraying activities and the discharge of pump gland water.
 - (d) Discharge of groundwater associated with construction and operational activities onto and into the land.
 - (e) Automatic discharge of steam line condensate onto and into land from pipeline steam traps and drains during the operation of the power station.
4. There shall be no direct discharge of any contaminants to surface waters.
 5. All discharges to land of solid materials shall be managed to ensure that any consequential discharge of contaminants to water is minimised to the maximum practicable extent.
 6. Soakage or settling ponds shall be sited and constructed so as to avoid indirect contamination of surface waters via subsurface flow, to avoid disruption of Significant Geothermal Features as identified in any relevant proposed or operative regional plan, and where practicable, to avoid other areas of thermotolerant vegetation.
 7. Notwithstanding any other provision of this consent, there shall be no direct discharge of a hazardous substance to any water, nor shall there be any discharge of contaminants onto land which indirectly causes or may cause an adverse effect on aquatic life.
 8. During the six month period following every fourth anniversary of the commencement of The Consents, in addition to General Condition 7 (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128 (1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
 9. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

Water/Sand blasting

10. The owner or occupier of any neighbouring property or dwelling within 200 metres of the work site shall be advised in writing of any dry abrasive blasting, including information about the dates and locations of any works, no more than 2 weeks and no less than 48 hours before the commencement of work.
11. The sand and any other material used for the activity shall contain less than 5% free silica on a dry weight basis.
12. As far as practicably achievable, all contaminated material and other associated debris that is discharged to land from the activity shall be collected and stored in a manner that does not become windblown after blasting has been completed each day. On completion of the works the contaminated material and other associated debris shall be disposed of to a facility that has authorisation to accept the contaminants in the debris.
13. Effective measures shall be taken to prevent as far as practicable, the discharge of any hazardous particulate, floatable, or suspended material to any water body.
14. The discharge shall not result in any objectionable effects on persons or property beyond the boundaries of the site. Without limiting the generality of the preceding requirement, this consent shall not be exercised when wind speed at the site of the works exceeds 15 knots.

Agrichemical spraying

15. This consent authorises only ground-based application of agrichemicals. Aerial spraying of agrichemicals is not authorised by this consent.
16. All applications of agrichemicals shall be in accordance with the manufacturer's instructions and the NZ Standard 8409:1999 Code of Practice for the Management of Agrichemicals or equivalent.

Construction and Operation

RESOURCE CONSENT NUMBER 116571 – DISCHARGE TREATED SEWAGE TO LAND

Consent 116571 authorises the Consent Holder to: discharge up to 15 cubic metres per day of water including contaminants and sewage into land and underground water through septic tanks and associated soakage facilities, within Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. The total maximum quantity of discharge from all discharge systems under this consent shall not exceed 15 cubic metres per day.
2. Any new effluent treatment and disposal system shall meet the following parameters;
 - (a) The maximum hydraulic loading rate at which effluent can be applied to the land shall not exceed 50 millimetres per day.
 - (b) The maximum concentration of nitrate–nitrogen in the final discharge shall not exceed 10 g/m³.
 - (c) The effluent disposal field shall be designed and placed to ensure that there is a minimum separation distance of at least 600 millimetres of unsaturated soil between the bottom of the effluent disposal field lines and the top of the ground water at all times.
3. There shall be no overland discharge of effluent from any part of the effluent treatment disposal systems.
4. Surface stormwater and runoff shall be directed away from the effluent disposal field areas. If necessary the Consent Holder shall provide suitable drainage to ensure there is a clear flow path so that surface water avoids the area.
5. Any new works shall be supervised by a suitably experienced and qualified person.
6. If the Waikato Regional Council so requests in writing and following consultation with the Consent Holder, the Consent Holder shall construct sampling bore hole(s) within the area, and/or down gradient of, the effluent disposal fields. The bore depth, location and the provision of access for sampling shall be subject to the approval of the Waikato Regional Council.
7. Treatment tanks shall be de-sludged as necessary and in particular within one month of receipt of notice in writing from the Waikato Regional Council to do so. The sludge waste shall be disposed of off-site in an approved wastewater sludge disposal area.

8. The activities authorised by this resource consent shall be undertaken in such a manner that they do not produce an objectionable odour at or beyond the boundary of the consent area as shown in Schedule ONE.
9. During the six month period following every fourth anniversary of the commencement of this consent the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128(1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
10. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
11. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

Construction and Operation

RESOURCE CONSENT NUMBER 116572 – DISCHARGE PENTANE TO AIR

Consent 116572 authorises the Consent Holder to: discharge up to 40 tonnes per year of pentane (or any other similar specified hydrocarbon that has substantially similar properties) from geothermal power station facilities within Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. The Consent Holder shall take all practicable steps to minimise losses of pentane (or similar binary cycle fluid) to the atmosphere.
2. During the six month period following every fourth anniversary of the commencement of this consent the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128(1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
3. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
4. This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

Construction and Operation

RESOURCE CONSENT NUMBER 116573 – STRUCTURES/ACTIVITIES ON LAND AND IN THE BEDS OF WATERWAYS

Consent 116573 authorises the Consent Holder to: to construct, operate maintain and upgrade roads, pipelines and bridges over water courses and to drill under water courses associated with the construction, operation, and maintenance of geothermal power station facilities and to undertake activities in or on the beds of water courses, including clearing vegetation, planting and disturbing soil. This consent also authorises the aforementioned activities occurring within and beyond the 20 metre buffer zone from a Significant Geothermal Feature as defined by the operative Waikato Regional Plan or any subsequent revision. All the aforementioned activities are authorised within Consent Areas 1 and 2 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

General

1. For the avoidance of doubt the activities included under this consent do not include any activity which is a permitted activity under the Waikato Regional Plan or any subsequent revision, and the relevant permitted activity rule is operative pursuant to s19(1) of the Resource Management Act 1991.
2. Consent 116573 is subject to compliance with the General Conditions. For the avoidance of doubt, all earthworks, vegetation clearance and soil disturbance activities undertaken under this consent are subject to General Condition 10.
3. This consent does not authorise activities on or in any Significant Geothermal Feature as defined by the operative Waikato Regional Plan or any subsequent revision.
4. This consent authorises the upgrading, reconstruction and maintenance of those crossings on the Parariki Stream as exist at the time of the granting of this consent provided that any reconstruction shall be sited no more than 15 metres from the original crossing locations. With the exception of the aforementioned, this consent does not authorise any new bridges or culverts over or in the Parariki Stream.
5. In addition to the provisions contained in the conditions of this consent, the activities are subject to the following thresholds;
 - (a) The placement, alteration, extension and use of any culvert is limited to locations where the catchment size upstream of the culvert does not exceed 500 hectares.
 - (b) Roading and tracking activities occurring within high risk erosion areas shall not exceed 2000 m in length.

- (c) Soil disturbance activities occurring within high risk erosion areas shall not involve disturbing more than 1000 cubic metres of soil (solid measure) or 2.0 hectares in area.
 - (d) Vegetation clearance in a high risk erosion area shall not exceed five hectares, excluding planted production forests and plant pests (as specified in the Waikato Regional Council's Regional Pest Management Strategy).
 - (e) Vegetation clearance in a high risk erosion area which is within five metres on either side of the banks of a water body, shall not exceed 100 metres in length per kilometre of that water body.
 - (f) The erection, reconstruction, placement, alteration or extension of any bridge shall not include pier(s) in the bed of a watercourse.
6. The design of any new structure or facility over a water course shall comply with the conditions of this consent. For the purpose of providing the Waikato Regional Council with an opportunity to review the design of any new structure or facility over a water course and to ensure the design satisfies the conditions of this consent, the completed design shall be forwarded to the Waikato Regional Council no less than 20 days prior to commencement of any construction works. The Consent Holder shall undertake the construction in accordance with the final Sediment Control Plan to the satisfaction of the Waikato Regional Council.
7. The Consent Holder shall provide the Waikato Regional Council written notice no less than 10 days prior to any exercise of this consent within 20 metres of a Significant Geothermal Feature as defined within the current Waikato Regional Plan. For the avoidance of doubt, this condition does not derogate from the provisions of any certificate of compliance obtained by the consent holder.
8. All structures shall be maintained in a structurally sound condition at all times.
9. All structures shall be designed, constructed and maintained to a standard appropriate for their anticipated use.
10. This consent will lapse on the thirty fifth anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

Bridges

- 11. Bridges shall be designed so that a two percent Annual Exceedance Probability (1 in 50 year flood event) shall not cause any increase in upstream water levels on neighbouring properties.
- 12. The soffit of any new bridge shall be at least 0.5 metres higher than the top of the banks of the river bed.
- 13. The waterway area and floodplain within 5 metres of the structure shall be maintained clear of obstructions.
- 14. The bridge shall be fixed in place to prevent it from being washed away in a flood.

15. Any erosion occurring as a result of the structure shall be remedied as soon as practicable.

Culverts

16. Any culvert shall be designed so that a two percent Annual Exceedance Probability (1 in 50 year) flood event shall not cause any increase in upstream water levels on neighbouring properties.
17. The culvert shall provide for the safe passage of fish both upstream and downstream.
18. Culverts shall be maintained free of debris so as to ensure that flood flows are not impeded.
19. Culverts shall provide a spillway to ensure safe passage of flood flows where the two percent Annual Exceedance Probability flood will overtop the embankment over the culvert.

Pipelines

20. The locations of new pipeline crossings of the Parariki Stream shall be on or adjacent to existing road crossings.
21. Where the pipeline is attached to a lawful structure, no part of the pipeline shall extend below the existing soffit of the structure.
22. The structure shall be located so as not to obstruct the passage of floodwaters.

Well Testing and Drilling

RESOURCE CONSENT NUMBER 116576 – TAKE GEOTHERMAL FLUID

Consent 116576 authorises the Consent Holder to: take and use up to 25,000 tonnes per day of geothermal water and associated energy and heat from underground strata for well testing purposes, within Consent Area 1 (as shown in Schedule ONE) for a term to expire 35 years after date of granting this consent subject to the following conditions:

1. Consent 116576 is subject to compliance with the General Conditions.
2. The maximum volume of water taken shall not exceed 25,000 tonnes in any 24 hour period.
3. Best practice methods shall be used to measure the well discharge rate in general accordance with the requirements of the Waikato Regional Council and/or the recommendations of the Peer Review Panel.
4. The Consent Holder shall inform the Waikato Regional Council in writing at least 10 working days prior to the commencement of well testing activities of the start date of well testing authorised by this consent.
5. For each day that well testing occurs, the Consent Holder shall maintain an accurate record of the following:
 - (a) The date on which the consent was exercised.
 - (b) The number of hours over which water was taken on that date.
 - (c) The total volume of water taken on that date including an estimated volume of any fluid discharged vertically during well clearing.

These records shall be made available to Waikato Regional Council staff within 1 week of any request in writing received by the Consent Holder.

6. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
7. This consent will lapse on the thirty fifth anniversary of the date of granting unless it is given effect to prior to that date.

Well Testing and Drilling

RESOURCE CONSENT NUMBER 116577 – DISCHARGE GEOTHERMAL FLUID AND ASSOCIATED CONTAMINANTS

Consent 116577 authorises the Consent Holder to: discharge up to 15,000 tonnes per day of geothermal water, steam condensate, and added chemicals into or onto land in association with well drilling and testing, or steam field maintenance activities within Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. Consent 116577 is subject to compliance with the General Conditions.
2. Added chemicals discharged under this consent shall only be those that are added to geothermal waters for the purposes of limiting or removing scale deposition, biocidal control of organic growth, to conduct tracer tests and to enable safe and efficient ongoing maintenance and operation. Unless otherwise approved in writing by the Waikato Regional Council, added chemicals discharged under this consent shall be limited to those listed in Schedule THREE of this consent. In the event the Consent Holder wishes to discharge additional chemicals not contained in Schedule THREE, the Consent Holder shall provide the Waikato Regional Council with details of the additional chemicals to be used, including their Material Safety Data Sheets, the concentrations at which they are to be used and any environmental effects expected from their use. The Waikato Regional Council shall respond in writing within 10 working days of receiving a request approving or withholding approval for the application. Should approval be withheld, the Waikato Regional Council's reply shall include an explanation of the reasons for this and shall identify any additional information necessary to satisfy the Council's concerns. Should a response not be received within 10 working days of receipt, the consent holder shall be entitled to proceed in accordance with the proposed chemical use and failure to respond shall constitute approval on behalf of the Waikato Regional Council.
3. There shall be no discharge into or onto land which directly or indirectly causes or may cause an adverse effect on aquatic life.
4. The Consent Holder shall maintain a record of the daily volume of geothermal fluid discharged from the well tests which shall be made available to the Waikato Regional Council within 1 week of any request in writing being received by the Consent Holder.
5. During the six month period following every fourth anniversary of the commencement of The Consents, in addition to General Condition 7 of The Consents (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128 (1) of the Resource Management Act 1991, for the purpose of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.

6. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
7. This consent will lapse on the thirty fifth anniversary of the date of granting unless it is given effect to prior to that date.

Well Testing and Drilling

RESOURCE CONSENT NUMBER 116578 – DISCHARGE TO AIR

Consent 116578 authorises the Consent Holder to: discharge up to 10,000 tonnes per day of geothermal vapour and associated non-condensable gases to air from activity associated with well drilling, well testing, or steam field maintenance within Consent Area 1 (as shown in Schedule ONE) for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. Consent 116578 is subject to compliance with the General Conditions.
2. The Consent Holder shall keep hydrogen sulphide emissions discharged from the activities authorised by this consent to a practicable minimum.
3. The Consent Holder shall keep a record of periods of discharge of geothermal steam through well silencers during output testing which shall be made available to the Waikato Regional Council within 1 week of any request in writing being received by the Consent Holder.
4. The discharge shall not result in odour, or other gaseous emissions that are objectionable at or beyond the boundary of the consent area as shown in Schedule ONE.
5. If a complaint is received by the Consent Holder regarding odour or geothermal vapour, the Consent Holder shall notify the Waikato Regional Council of the complaint as soon as practicable. When complaints are received, the Consent Holder shall record the following details in a Complaints Log:
 - (i) Time and type of adverse effect to which the complaint related, including details of the incident, e.g. duration, any effects noted.
 - (ii) Name, address and contact phone number of the complainant (if provided).
 - (iii) Location from which the complaint arose.
 - (iv) The weather conditions and wind direction at the time of complaint.
 - (v) The likely cause of the adverse effect to which the complaint related.
 - (vi) The response made by the Consent Holder and any corrective action undertaken by the Consent Holder in response to the complaint.
 - (vii) Any future actions proposed as a result of the complaint.
6. The Consent Holder shall also record in the Complaints Log any complaints forwarded to it by the Waikato Regional Council or any Territorial Authority. The Complaint Log shall be made available to the Waikato Regional Council within 2

weeks of any written request and a copy shall be forwarded to the Waikato Regional Council annually with the Annual Report required pursuant to General Condition 3.12.

7. Should a discharge occur that results in a complaint and is, in the opinion of a suitably qualified Council officer, objectionable, the Consent Holder shall provide a written report to the Waikato Regional Council (the "Council") within five days of being notified of such by the Council. The report shall specify:
 - (i) The cause or likely cause of the discharge and any factors that influenced its severity.
 - (ii) The nature and timing of any measures implemented by the Consent Holder to avoid, remedy or mitigate any adverse effects.
 - (iii) The steps to be taken in future to prevent recurrence of similar events.
8. During the six month period following every fourth anniversary of the commencement of The Consents, in addition to General Condition 7 (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128(1) of the Resource Management Act 1991, for the purposes of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
9. This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
10. This consent will lapse on the thirty fifth anniversary of the date of granting unless it is given effect to prior to that date.

Well Testing and Drilling

RESOURCE CONSENT NUMBER 116579 – DISCHARGE MUDS ETC TO LAND

Consent 116579 authorises the Consent Holder to: discharge up to 10,000 tonnes per day of fresh water, drilling muds and fluids, all containing various solids, chemicals and other contaminants (a) into soakage facilities and by seepage into underground water within Consent Area 1 as shown in Schedule ONE and (b) into underground strata, during drilling and testing of wells, within Consent Areas 1 and 2 as shown in Schedule ONE for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1. Consent 116579 is subject to compliance with the General Conditions.
2. The maximum discharge shall not exceed:
 - (a) 10,000 tonnes per day discharge of water during injection testing.
 - (b) 4,500 tonnes per day discharge of water during completion testing.
 - (c) 10,000 tonnes per day discharge of drilling fluids into land and underground water (for example, in the event of down hole losses during drilling).
 - (d) 600 tonnes per day discharge of drilling fluids, but not including stormwater, onto land and from there by seepage into underground water.
3. Soakage and settling ponds for drilling wastes and well-testing discharges shall be maintained so as to ensure adequate soakage at all times.
4. Any contaminated stormwater generated on the drilling site which may otherwise discharge to surface water shall be diverted into the soakage pond.
5. There shall be no direct discharge of any contaminants to surface waters.
6. All discharges to land of solid materials shall be managed to ensure that any consequential discharge of contaminants to water is minimised.
7. Notwithstanding any other provision of consent 116579, there shall be no discharge into soakage facilities which indirectly causes or may cause an adverse effect on aquatic life.
8. Soakage or settling ponds shall be sited, where practicable, to avoid areas of thermotolerant vegetation.
9. The consent holder shall incorporate in its drilling fluids those materials which are contained in Schedule THREE of this consent. In the event the Consent Holder wishes to use additional chemicals not contained in Schedule THREE, the Consent Holder shall provide the Waikato Regional Council with details of the additional chemicals to be used, including their Material Safety Data Sheets, the concentrations at which they are to be used and any environmental effects

expected from their use. The Waikato Regional Council shall respond in writing within 10 working days of receiving a request approving or withholding approval for the application. Should approval be withheld, the Waikato Regional Council's reply shall include an explanation of the reasons for this and shall identify any additional information necessary to satisfy the Council's concerns. Should a response not be received within 10 working days of receipt, the consent holder shall be entitled to proceed in accordance with the proposed chemical use and failure to respond shall constitute approval on behalf of the Waikato Regional Council. No chromium or hydrocarbon based products shall be used.

10. The Consent Holder shall ensure that any soakage and settling ponds and any discharges of contaminants to land or ground shall be located no closer than:
 - (a) 50 metres from a Significant Geothermal Feature as defined in the Operative Waikato Regional Plan (September 2007) and any revision to that Plan.
 - (b) 20 metres from the bed of the Waikato River.
 - (c) 20 metres from the bed of any of the Parariki Stream.
 - (d) 30 metres from any waahi tapu as identified in any district plan, in the NZ Archaeological Association's Site Recording Scheme, or by the Historic Places Trust except where Historic Places Trust approval has been obtained.
 - (e) 100 metres from any existing dwelling, unless the owner of the dwelling, and the owner of the land on which the dwelling lies, provide written approval to the specific discharge event.
11. Any geothermal water discharged to land as a result of geothermal well discharge testing shall be either:
 - (a) discharged to a soakage pond which is sized to ensure that there is no overland discharge, or
 - (b) discharged to the ground as a result of atmospheric discharge testing of a geothermal well.
12. Data and reports shall be provided to the Waikato Regional Council in electronic format compatible with Waikato Regional Council computer systems, with hard copy to be supplied if requested by Waikato Regional Council.
13. During the six month period following every fourth anniversary of the commencement of The Consents, in addition to General Condition 7 of The Consents (Review), the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of this consent under section 128(1) of the Resource Management Act 1991, for the purposes of requiring the Consent Holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.

14. This consent will lapse on the thirty fifth anniversary of the date of granting unless it is given effect to prior to that date.

Well Testing and Drilling

RESOURCE CONSENT NUMBER 116580 – WELL DRILLING, ROADING AND RELATED EARTHWORKS

Consent 116580 authorises the Consent Holder to: drill deep geothermal wells, monitoring wells, and to construct well pads, pipelines and roads and to undertake well testing and drilling activities that involve drilling below the water table and undertake earthworks, further than 20 metres from a Significant Geothermal Feature, within Consent Areas 1 and 2 (as shown in Schedule One), for a period to expire 35 years after the date of granting this consent subject to the following conditions:

1 General

1.1 Consent 116580 is subject to compliance with the General Conditions.

2 Drilling

2.1 Wells shall be contained within the vertical boundaries of Consent Areas 1 and 2 as shown in Schedule ONE and no well drilled by the Consent Holder for the purposes of the exercise of this consent shall deviate outside those areas.

2.2 The Consent Holder shall notify Waikato Regional Council in writing of its intention to drill any new well not less than 10 days prior to commencing drilling. This notice shall include details of the location of drilling, approximate intended depth, approximate casing depth, depths of expected circulation losses (i.e. where faults can be expected), the aquifer that the well is intended to access (if known), likely well yield, and purpose of the bore. The notice shall include details of specific measures proposed to ensure compliance with the conditions of this consent. This shall specifically include the measures by which contamination of land and water as a result of spillages or other release of contaminants will be avoided, remedied or mitigated.

2.3 All drilled holes/wells shall be constructed, maintained and/or abandoned so that they shall not cause cross-contamination between hydraulic units (aquifers) in any water including ground water and geothermal water.

2.4 Materials used for well construction shall be of such quality and strength to enable the well to be completed without casing or seal leakage during construction or subsequent well operation.

2.5 Drilling, construction, and maintenance activities shall be undertaken generally in accordance with the Code of Practice for Deep Geothermal Wells (NZS 2403:1991) or any subsequent replacement standard or other recognised best drilling practice.

2.6 The disposal and containment of drilling wastes during and following completion of the drilling operations shall be as outlined in Mighty River Power's report on

Geothermal Drilling Mud Environmental Assessment and Management dated June 2005.

- 2.7 Within 1 month of commencement of this consent, the Consent Holder shall procure a bond in the sum of \$500,000 to secure performance of conditions 2.13 and 2.14 of this consent. The bond shall be in favour of the Waikato Regional Council and shall be prepared at the applicant's expense in a form to be approved by the Council. The bond shall either be a cash bond, held in trust by Waikato Regional Council, or (at the option of the Consent Holder) a bond secured by a guarantor acceptable to the Council. A recognised bank trading in New Zealand shall be deemed to be an acceptable guarantor.
- 2.8 The bond may be varied, cancelled or renewed at any time by mutual agreement between the consent holder and the Waikato Regional Council. In particular, at any time either the consent holder or the Waikato Regional Council may request the amount of the bond be increased or decreased in order to ensure that it appropriately reflects the cost of adequate closure of all bores authorised by this consent, including adjustments to that cost in accordance with any change in the Construction Cost Index. Under this condition, such change may only be made if there is a material change in the estimated cost of abandonment, and no alteration to the amount of the bond may be made except by agreement between both the consent holder and the Council.
- 2.9 In addition to the provisions of condition 2.8 above, the amount of the bond may be reviewed by Waikato Regional Council within a month of the fourth anniversary of the grant of this consent and every four years thereafter to ensure that it fully covers the cost of adequate closure of all bores authorised by this consent and for the purpose of adjusting the amount of the bond in accordance with any change in the Construction Cost Index. Such an adjustment shall be made only if there is a material change in the estimated cost of abandonment. This review and the possible imposition of a new bond amount shall be undertaken by serving notice in accordance with Section 128 of the Resource Management Act 1991 or its subsequent amendments, and shall include consideration of existing securities; the credentials and securities of the company; and compliance with this resource consent.
- 2.10 The bond shall be discharged or released when the work required under conditions 2.13 and 2.14 of this consent is completed to the satisfaction of the Council.
- 2.11 If any possibility of pressure control difficulties or a defect in a well is detected during drilling, monitoring or other operations, then the Consent Holder shall determine the nature of the possible issue in accordance with clause 605.3 of the Code of Practice for Deep Geothermal Wells (NZS 2403:1991) or any subsequent replacement or other relevant standard and advise the Waikato Regional Council.
- 2.12 The Consent Holder shall ensure that ground surface drilling locations (denoted by the location of well head cellars) for any new wells shall be no closer than:
 - (a) 20 metres from the bed of any lake or river or stream.

- (b) 100 metres from any Significant Geothermal Feature as identified in the Waikato Regional Plan (September 2007) and any revision to that Plan.
- (c) 30 metres from any public road.
- (d) 100 metres from an existing potable ground water supply where the owner's consent has not been obtained.
- (e) 30 metres from any waahi tapu as identified in any district plan, in the NZ Archaeological Association's Site Recording Scheme, or by the Historic Places Trust except where Historic Places Trust approval has been obtained.
- (f) 100 metres from any existing dwelling, unless the owner of the dwelling, and the owner of the land on which the dwelling lies, provides written approval to the placement of the bore.

2.13 Abandonment activities shall be undertaken generally in accordance with the Code of Practice for Deep Geothermal Wells (NZS 2403:1991) or any subsequent replacement standard or other recognised best drilling practice. Permanent abandonment shall include filling the production casing with cement plugs which are continuous over the length of the casing, and shall ensure that contamination of subsurface fresh water aquifers is prevented.

2.14 Following completion of drilling the drill site shall be rehabilitated to the satisfaction of the Waikato Regional Council.

3 Earthworks and Tracking Associated with Construction of Geothermal Well Pads

3.1 Any earthworks and tracking associated with the construction of well pads and access roads is subject to compliance with General Conditions 7, 9, 10 and 11.

4 Administrative

4.1 This resource consent is granted by the Waikato Regional Council subject to its officers or agents being permitted access to the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.

4.2 This consent will lapse on the seventh anniversary of the date of commencement, as defined by section 116 of the Resource Management Act 1991 unless it is given effect to prior to that date.

RESOURCE CONSENT NUMBER 116582 – EARTHWORKS ASSOCIATED WITH ROAD MAINTENANCE

Consent 116582 authorises the Consent Holder to: maintain and upgrade Rapids Rd and the site access road between locations at or about grid references NZMS 260-U17:838 821 and NZMS 260-U17:838 905-839 for a period to expire 35 years after the date of granting this consent subject to the following conditions.

1. Consent 116582 is subject to compliance with General Conditions 7, 9, 10 and 11.
2. Works shall be supervised by a suitably experienced and qualified person.
3. This consent will lapse on the thirty fifth anniversary of the date of the grant unless it is given effect to prior to that date.

GENERAL CONDITIONS

All General Conditions apply to resource consents 116565, 116566, 116567, 116570, 116573, 116576, 116577, 116578, 116579, 116580 – “The Consents”

General Conditions 7, 9, 10 and 11 apply to resource consents 116568, 116569, and 116582

DEVELOPMENT OPERATIONS – ROTOKAWA I AND NGA AWA PURUA POWER STATIONS AND ASSOCIATED STEAMFIELD

1. PEER REVIEW PANEL

- 1.1 A Peer Review Panel shall be established to exercise the powers and functions specified in General Condition 1.7 below. The Waikato Regional Council shall facilitate the role and function of the Peer Review Panel by providing reasonable organisational and administrative support for the duration of the consent, the reasonable costs of which shall be borne by the Consent Holder.
- 1.2 The membership of the Peer Review Panel will be approved by the Chief Executive Officer of Waikato Regional Council by either of the following two methods;
 - (a) By appointing the same members of the Peer Review Panel established by the Waikato Regional Council for the consents relating to the Rotokawa Geothermal System that were operating immediately prior to the commencement of The Consents.
 - (b) Alternatively, by appointing a Peer Review Panel that shall (as far as practicable) consist of three independent technical experts with recognised experience in geothermal resource monitoring, reservoir management or related environmental effects. The appointment of the Peer Review Panel members and the replacement of Peer Review Panel members shall be undertaken as follows:
 - i. The Waikato Regional Council and the Consent Holder shall mutually agree on a list of no less than six potential candidates for the panel (or less than six if agreed by both parties).
 - ii. The Waikato Regional Council shall then choose the Peer Review Panel members (or member) from the agreed candidate list. Prior to appointing any Peer Review Panel members, the Waikato Regional Council shall seek comment from the Consent Holder on whether the panel as a whole will have the appropriate range of skills to undertake its functions.
- 1.3 Membership of the Peer Review Panel shall be reviewed by Waikato Regional Council on a three yearly basis. Notwithstanding the three yearly reviews, the Chief Executive Officer of the Waikato Regional Council may, at his/her discretion, terminate the membership of all or any of the Peer Review Panel members at any

time, and appoint replacement members pursuant to General Condition 1.2(b). The Consent Holder may at any time request the Chief Executive Officer of the Waikato Regional Council to review the membership of the Peer Review Panel and may suggest replacement members pursuant to General Condition 1.2(b).

- 1.4 In the event that any member of the Peer Review Panel resigns from the Panel the Chief Executive Officer of Waikato Regional Council may appoint a replacement member pursuant to General Condition 1.2(b).
- 1.5 The Peer Review Panel may recommend to Waikato Regional Council that other specialists be seconded or that technical studies be commissioned from time to time for the proper execution of its functions. The decision on whether to act on such a recommendation will rest with the Chief Executive of the Waikato Regional Council after consulting with the Consent Holder, and the reasonable costs associated with acting on such a recommendation will be met by the Consent Holder.
- 1.6 The Peer Review Panel shall determine its own processes and procedures for conducting its meetings, as it sees fit. During the time between the commencement of The Consents and the commissioning of the Nga Awa Purua¹ Power Station the Peer Review Panel shall meet at 12 monthly intervals. During the period within the first two years following the commissioning of the Nga Awa Purua Power Station the Peer Review Panel shall meet not less than once every 6 months, and thereafter at 12 monthly intervals. The Peer Review Panel shall also meet at any time as may be specifically requested by Waikato Regional Council. In the event that The Consents are not replaced with new consents after their expiry date, the Peer Review Panel shall meet no less than every 2 years to review monitoring reports and data resulting from the monitoring program undertaken after expiry of the consents and at other times as required by Waikato Regional Council to fulfil its functions until the Remediation Expiry Date (refer to General Condition 8).
- 1.7 The role of the Peer Review Panel shall be to assist Waikato Regional Council in the supervision and monitoring of the exercise of The Consents. Without limiting the generality of this role, the general functions of the Peer Review Panel, in addition to those specified elsewhere in the conditions of these consent, shall include:
 - (a) Reviewing monitoring reports and data and reporting to Waikato Regional Council any matters of concern and making recommendations as to suggested changes to monitoring of the resource and the effects arising from resource use.
 - (b) Reviewing the Rotokawa Geothermal System Management Plan (including the Discharge Strategy), annual reports and other plans and reports as appropriate and making recommendations to Waikato Regional Council with respect to the same where appropriate.

¹ Nga Awa Purua is the name given to the new Rotokawa Stage II Power Station

- (c) Reviewing predictions of changes to reservoir conditions and predictions made by the consent holder of consequential effects of resource use.
- (d) Following the assessment of monitoring results over time, recommending a review of the reservoir model and recommending changes and enhancements to the model as it deems necessary in the circumstances.
- (e) Recommending to Waikato Regional Council that a review of conditions pursuant to section 128 of the Resource Management Act be undertaken for purposes including:
 - (i) Remedying or mitigating significant adverse effects relevant to the exercising of The Consents.
 - (ii) Amending any monitoring requirements in General Condition 5.
 - (iii) Any other matters it considers appropriate in fulfilling its role to assist Waikato Regional Council in the supervision and monitoring of the exercise of The Consents".
- (f) Recommending to Waikato Regional Council that the Consent Holder undertake surveys or other investigations for the purposes of inquiring into any adverse effects arising from the exercise of the consents or predicted to arise.
- (g) Reviewing monitoring reports and data resulting from the monitoring programme undertaken by the Consent Holder after expiry of the consents until the Remediation Expiry Date.

1.8 The Peer Review Panel shall review the Annual Report to be provided in October each year by the Consent Holder under General Condition 3.12 and, within two months of receipt of the Annual Report, shall meet with the Consent Holder and provide a written report to Waikato Regional Council with Peer Review Panel comments and recommendations on the Consent Holder's Annual Report.

1.9 The Consent Holder shall provide the Peer Review Panel with baseline monitoring reports and all other resource data, information and reports and surveys including modelling results and data that the Peer Review Panel considers relevant to their work.

1.10 All reasonable costs incurred by the Peer Review Panel are to be borne by the Consent Holder including for the period after expiry of The Consents until the Remediation Expiry Date (refer to General Condition 8).

1.11 All Peer Review Panel reports and recommendations shall be submitted to the Waikato Regional Council.

2. KAITIAKITANGA AND COMMUNITY

2.1 The Consent Holder shall forward a copy of the Annual Report and the Annual Peer Review Panel Report to the following;

- (a) Te Runanga o Ngati Tahu – Ngati Whaoa
 - (b) Taupo District Council
 - (c) Department of Conservation
- 2.2 The Consent Holder shall meet with the Department of Conservation on an annual basis. The purpose of the meeting shall be to present and discuss the Annual Report and solicit feedback on development-related matters. Minutes from the meeting shall be recorded and forwarded to WRC and the Peer Review Panel within 3 weeks of the meeting.

3. SYSTEM MANAGEMENT PLAN, MODELLING AND ANNUAL REPORTING

- 3.1 The Consent Holder shall manage its consented activities on the Rotokawa Geothermal System and undertake geothermal reservoir management:
- (a) In accordance with the conditions of the consents; and
 - (b) In accordance with a Rotokawa Geothermal System Management Plan approved by Waikato Regional Council,.
- 3.2 Within 3 months after the commencement of The Consents, the Consent Holder shall provide to Waikato Regional Council, for its approval, a draft System Management Plan for the Rotokawa Geothermal System (the “System Management Plan”). The overall purpose of the System Management Plan is to define the proposed manner in which the Rotokawa geothermal resource is to be used as a source of energy and how the effects of such use are to be measured and mitigated against in the context of it being a “Development Geothermal System” as defined in the Waikato Regional Policy Statement dated 15 August 2006 and Proposed Waikato Regional Plan dated 15 August 2006.
- 3.3 The specific objectives of the System Management Plan are to :
- (a) Demonstrate that the geothermal resource will be used in an efficient and sustainable manner.
 - (b) Allow controlled depletion whilst having regard to the reasonably foreseeable needs of future generations.
 - (c) State the field developments proposed for the next 4 years.
 - (d) Define the procedures for ensuring compliance with consents.
 - (e) Identify any effects of reservoir use that are anticipated, and the monitoring programme designed to quantify these effects.
 - (f) Prioritise the possible effects and propose methods for avoiding, remedying and mitigating them.
 - (g) address any other relevant matters contained in Policy Four of the Proposed Waikato Regional Plan Variation 2 (15 August 2006).
- 3.4 The System Management Plan is to include as a discrete part a Geothermal Discharge Strategy, the conditions relating to which are set out in General Condition 4 .

- 3.5 Notwithstanding any more frequent changes to the Geothermal Discharge Strategy as permitted by General Condition 4, the System Management Plan shall be reviewed every four years after the preparation of the first Plan under The Consents, or more frequently if so directed by the Waikato Regional Council, acting on the advice of the Peer Review Panel.
- 3.6 As a minimum, the System Management Plan shall provide the following information for the next four years:
- (a) Proposed new wells, workovers and abandonments.
 - (b) Other proposed steam field developments eg. pipelines, changes to infrastructure, earthworks, activities relating to water ways etc.
 - (c) Proposed significant changes to fluid production, and output or operations of the power stations.
 - (d) The Geothermal Discharge Strategy.
 - (e) Mitigation and Emergency Management procedures.
 - (f) Other information as required in accordance with General Condition 3.3.
- 3.7 In approving the System Management Plan the Waikato Regional Council shall consult with the Consent Holder and seek the advice of the Peer Review Panel which may recommend such changes to the System Management Plan as it deems appropriate.
- 3.8 The Consent Holder shall review the System Management Plan and shall make amendments necessary to achieve the purpose of the plan in general accordance with recommendations made from time to time by the Waikato Regional Council after taking advice from the Peer Review Panel.
- 3.9 The Consent Holder shall maintain a geothermal reservoir computer model for the Rotokawa Geothermal System, at least as detailed as the model discussed in the Consent Application dated June 2007. The Peer Review Panel may, following the assessment of monitoring results over time, recommend a review of the model and recommend changes and enhancements to the model as it deems necessary in the circumstances. The Consent Holder shall make necessary amendments to the model as mutually agreed with the Waikato Regional Council and in general accordance with the recommendations of the Peer Review Panel.
- 3.10 Every four years following commencement of The Consents, or more frequently if directed by the Waikato Regional Council, the Consent Holder shall present a Reservoir Model Review at the time of presenting its System Management Plan. The Reservoir Model Review shall:
- (a) Compare current values and past trends in distributions of pressure, temperature and fluid state, as indicated by well measurements and any other measurements, with the values predicted in the previous Reservoir Model Review to occur, or in the case of the first such review, as predicted at the time of the consent applications.
 - (b) Provide new predictions for the following 4, 10, 25 and 50 years.

- 3.11 If the reservoir computer model outlined in General Condition 3.9 is not performing (“performing” in this context relates to how closely modelled changes in reservoir pressure and temperature match with measured data) to the satisfaction of the Waikato Regional Council acting on the advice of the Peer Review Panel, the Consent Holder shall revise the model to improve the match to the satisfaction of the Waikato Regional Council. Subject to the model performing to the satisfaction of the Waikato Regional Council, the Consent Holder shall run projections of the models for the next 4, 10, 25, and 50 years, incorporating realistic production and reinjection scenarios.
- 3.12 The Consent Holder shall produce an Annual Report by the end of October each year that describes the state of the Rotokawa Geothermal System using new resource and monitoring information collected during the course of the preceding financial year (i.e. from July to June). The report shall be to the satisfaction of the Waikato Regional Council and shall contain at least the following information:
- (a) Generation information from the Rotokawa Power Stations operated by the Consent Holder including:
 - (i) Annual generation (GWh).
 - (ii) Station availability (%).
 - (b) Production information from all wells operated by the Consent Holder including:
 - (i) Field layout changes and well outages.
 - (ii) Summary of annual and daily fluid production including:
 - Annual and daily total mass take of fluid from reservoir (tonnes).
 - Annual and daily total energy extracted from reservoir (petajoules / terajoules).
 - (iii) Critical analysis of production well chemistry data collected.
 - (c) Information on reinjection within the Rotokawa Geothermal System including:
 - (i) Description of reinjection operations, depths and locations.
 - (ii) Summary of annual and daily fluid reinjection volumes to the reservoir (tonnes) and depth range.
 - (iii) Summary of reinjection flows (t/hr), temperatures and well head pressures (bar g).
 - (iv) Summarised results of any tracer testing undertaken.
 - (d) Other well information including:
 - (i) Summary and critical analysis of data (e.g. downhole pressures) collected from monitor wells.
 - (ii) Summary and critical analysis of data (water levels) collected from groundwater monitor wells.
 - (e) Summary of well drilling activities, well workovers and well abandonments.

- (f) Comparison of trends in reservoir pressure, temperature and fluid state with predictions in the previous report of the Reservoir model.
- (g) Summary of seismic data collected.
- (h) Update (if any) on the reservoir model including any future predictions made.
- (i) Summary of any other surveys or interpretive reports conducted in accordance with the Monitoring Programme or as directed by Waikato Regional Council pursuant to General Condition 5.3
- (j) Summary of levelling data collected.
- (k) Planned drilling and major maintenance activities for the following year.
- (l) Summary of any complaints received by the Consent Holder and actions undertaken with respect to them.

4. GEOTHERMAL DISCHARGE STRATEGY

- 4.1 In accordance with General Condition 3, the Consent Holder shall, include, as a discrete part of the System Management Plan, a Geothermal Discharge Strategy which shall define the manner in which all geothermal water taken under these consents, and any water contaminated with geothermal water, is to be disposed of. The primary consideration in formulating this or any changes to the Geothermal Discharge Strategy shall be the reinjection permitted under consent no. 116566 which is to be undertaken in a manner that represents the best practicable balance of the following considerations, the order of listing of which is not an indication of priority:
- (a) Maximising the thermodynamic efficiency of use and the sustainable life of the resource as a source of energy.
 - (b) The economic use of all installations built for the purpose of using the resource from both national and Consent Holder's points of view.
 - (c) Managing the wellhead pressure in any pumped reinjection well so as to minimise the risk of induced seismic activity.
 - (d) Minimising the effects on any Significant Geothermal Features.
 - (e) Avoiding contamination of ground water bodies.
- 4.2 The Consent Holder shall undertake its operations in accordance with the Discharge Strategy approved by the Waikato Regional Council.
- 4.3 The Consent Holder may, at any time, propose to the Waikato Regional Council changes to the Geothermal Discharge Strategy.
- 4.4 The Waikato Regional Council may, on the advice of the Peer Review Panel, require or allow changes to the Discharge Strategy. Prior to requiring or allowing any change(s) to the Discharge Strategy, the Waikato Regional Council shall consult with the Consent Holder, and may consult with any other persons who, in

the opinion of the Waikato Regional Council, may be adversely affected by the change(s).

5. RESOURCE MONITORING

- 5.1 The Consent Holder shall ensure that a driller's log is maintained and a geological log is made of any shallow monitor wells it has drilled to monitor or extract groundwater.
- 5.2 For each new geothermal well drilled as part of The Consents the Consent Holder shall collect and provide to Waikato Regional Council, within 3 months of the completion of drilling, the following information:
- (a) Well location, site diagram, drilling method, size, depth, diameter and directional profile.
 - (b) Construction details and casing details.
 - (c) The start and completion dates of well drilling.
 - (d) Confirmation that the physical condition of the well, and well casing is in compliance with NZS2403:1991.
 - (e) A summary driller's log and summary geological log. This requirement shall not apply where, due to practical constraints (e.g. loss of circulation), this information cannot be obtained.
 - (f) Subsurface geology.
 - (g) Where it is obtained, geophysical information regarding the density, porosity, permeability and conductivity of strata as well as temperature and water quality.
 - (h) Unless Waikato Regional Council agrees in writing that this need not be undertaken, temperature and pressure profiles with the well shut, collected not less than three times in the first four weeks after completion of drilling.
 - (i) Output enthalpy and mass flow rate of any discharge tests carried out;.
 - (j) Stable chemistry of the well fluid during any discharge tests;.
 - (k) Sites of higher permeability (feed zones, depths of circulation losses) and nature of fluid discharged from these sites, if known.
- 5.3 Where practicable the Consent Holder shall undertake and document such investigations or surveys, or where reasonable, collect and provide such information as is requested by Waikato Regional Council in relation to any trends in the Rotokawa Geothermal System or effects arising from its use.
- 5.4 The Consent Holder shall undertake the monitoring and surveys described in Monitoring Programme contained in Schedule TWO of The Consents (or any subsequent update).
- 5.5 The Consent Holder may, at any time, propose to the Waikato Regional Council changes to the Monitoring Programme. An alteration in the Monitoring Programme described in Schedule TWO may be approved by the Waikato Regional Council if, after taking advice from the Peer Review Panel, in its view the Monitoring Programme is no longer appropriate or necessary but requires an increase or

decrease in the type, frequency and location of any part of the Monitoring Programme.

- 5.6 Within 12 months prior to the expiry of the consents, the Consent Holder shall undertake the measurements and descriptions specified below and deliver to the Waikato Regional Council on or before the date of expiry of The Consents, a report on the Consent Holder's current knowledge of the state of the Rotokawa Geothermal System:
- (a) Gravity (unless previously surveyed within 6 years prior to the expiry of the consents)
 - (b) Geology (structural features, lithology, and stratigraphy).
 - (c) Reservoir fluid chemistry and hydrothermal alteration
 - (d) Ground water (chemistry, water levels).
 - (e) Vertical and horizontal levelling (unless previously a full survey has been undertaken within 2 years prior to the expiry of the consents)
 - (f) Vegetation (unless previously surveyed within 2 years prior to the expiry of the consents)
 - (g) Heat Flow (unless previously surveyed within 2 years prior to the expiry of the consents)
 - (h) Surface features (scope to be agreed with the Waikato Regional Council) including springs and steam vents (chemistry, mass and temperature),
 - (i) Flora and fauna (unless previously surveyed within 2 years prior to the expiry of the consents)
- 5.7 After expiry of the consents or cessation of taking of deep geothermal fluid, and until the Remediation Expiry Date, the Consent Holder shall continue to undertake subsidence monitoring and monitoring of surface geothermal features as outlined in the Monitoring Programme contained in Schedule TWO of the Consents (or any subsequent update).
- 5.8 The Consent Holder shall include monitoring information collected during the year and interpretations in the Annual Report.

6. MULTIPLE OPERATOR MECHANISMS

- 6.1 The Consent Holder shall consult with any subsequent operator on the Rotokawa Geothermal System who is required to prepare a mechanism addressing the matters included under Policy 5 of the Proposed Waikato Regional Plan Variation 2 (as at 15 August 2006) ("the Policy 5 mechanism").
- 6.2 The objective of the consultation is to document measures and procedures for managing the operational relationship between operators on the Rotokawa Geothermal System, and specifically to integrate the activities of any new Consent Holder with the activities of the holder of The Consents.
- 6.3 If necessary to achieve the objective of condition 6.2 the Consent Holder shall participate in any dispute resolution processes that may be contained in resource consents held by any subsequent operator on the Rotokawa Geothermal System.

- 6.4 Nothing in any Policy 5 mechanism prepared under any resource consents held by a subsequent operator shall absolve the Consent Holder from its legal obligations to comply with all conditions in The Consents.
- 6.5 Subject to condition 6.6, to the extent that the Consent Holder's participation is required to give effect to the Policy 5 mechanism which is the result arrived at following consultation/dispute resolution under condition 6.1 and/or 6.3, it shall provide such participation.
- 6.6 Nothing in any Policy 5 mechanism shall derogate from the rights granted to the Consent Holder under these resource consents.

7. REVIEW

- 7.1 During the six month period following every fourth anniversary of the commencement of The Consents, the Waikato Regional Council may, following service of notice on the Consent Holder, commence a review of these General Conditions under section 128(1) of the Resource Management Act 1991, for the following purposes:
- (a) To deal with any adverse effects on the environment which may arise from the exercise of the consents and which it is appropriate to deal with at a later stage.
 - (b) To review the effectiveness of the conditions in avoiding, remedying or mitigating any adverse effects on the environment from the Consent Holder's activities and, if considered appropriate by Waikato Regional Council, to deal with such effects by way of further or amended conditions.
 - (c) To align the requirements of monitoring, reservoir management planning, peer review and reporting conditions with those of other consents exercised within the Rotokawa Geothermal System where that would better promote efficiency and best resource management practice.
 - (d) To review the effectiveness and efficiency of the conditions in ensuring the sustainable management of the geothermal resource, in the event that resource consents for large-scale, deep geothermal extraction and/or discharge in the Rotokawa Geothermal System are granted to a person or persons other than the Consent Holder.
 - (e) To incorporate such conditions or changes to conditions as may be recommended by the Peer Review Panel.
 - (f) To review such conditions to maintain consistency with the Waikato Regional Policy Statement and Proposed Waikato Regional Plan.
 - (g) To review the effectiveness of the conditions in avoiding, remedying or mitigating adverse effects which may occur or continue to occur in the event or likelihood of shut-down or scale-down of geothermal production operations on the Rotokawa Geothermal System.

8. REMEDIATION EXPIRY DATE

- 8.1 The Remediation Expiry Date for the purposes of these conditions shall be 4 years following the expiry date of The Consents.
- 8.2 The Remediation Expiry Date, and any other consent conditions that refer to the Remediation Expiry Date, shall not apply if the activities authorised by The Consents either continue in accordance with s124 of the Resource Management Act 1991, or continue in accordance with new resource consents granted (for activities of a similar scale and nature) before the Remediation Expiry Date.

9. ADMINISTRATIVE CHARGES

- 9.1 The Consent Holder shall pay to the Waikato Regional Council any reasonable administrative charge fixed in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under section 360 of the Resource Management Act.

10. EARTHWORKS AND TRACKING

- 10.1 The Consent Holder shall implement the best practicable option so as to ensure that the risk of sediment entering naturally flowing surface waterways is minimised during the construction works.
- 10.2 Works shall be supervised by a suitably experienced and qualified person.
- 10.3 The Consent Holder shall ensure that sub-contractors are made aware of the conditions of this resource consent and ensure compliance with those conditions.
- 10.4 No hazardous contaminants (including but not limited to oil, hydraulic fluids, petrol, diesel, other fuels, paints or solvents) shall be discharged to water from construction activity or ongoing operations.
- 10.5 Unless otherwise agreed by the Waikato Regional Council, all equipment and surplus construction materials shall be removed from the site on the completion of construction, or shall be stored on site in an orderly and tidy manner.
- 10.6 Erosion and sediment control measures and other relevant operations provided for by this resource consent shall be constructed and maintained in general accordance with Waikato Regional Council Technical Publication No 2002/01 "Erosion and Sediment Control: Guidelines for Soil Disturbing Activities", May 2003.
- 10.7 Unless otherwise agreed by the Waikato Regional Council, all stormwater runoff from disturbed areas shall be directed to a settling pond prior to discharging to land or ground.

- 10.8 All surplus fill and excavated material shall be disposed of to the satisfaction of the Waikato Regional Council.
- 10.9 Organic material shall not be mixed with soil fill and/or placed in a position where it may lead to land instability.
- 10.10 Slash shall not be deposited in any ephemeral or perennial waterway or left in a position where it may enter a naturally flowing surface water body.
- 10.11 No overburden or stripped materials shall be placed within 5 metres of any watercourse unless written approval is obtained from the Waikato Regional Council before proceeding.
- 10.12 Unless otherwise agreed by the Waikato Regional Council, bare soil surfaces, and disturbed riparian margins resulting from the works shall be re-vegetated in such a manner that erosion of soil from the disturbed area is minimised. The re-vegetation shall be undertaken within 10 working days of the completion of the works.
- 10.13 The activity shall not disturb any archaeological site or waahi tapu as identified in any district plan, in the NZ Archaeological Association's Site Recording Scheme, or by the Historic Places Trust except where Historic Places Trust approval has been obtained.
- 10.14 In the event of any archaeological site or waahi tapu being discovered or disturbed while exercising this consent, the Consent Holder shall cease works immediately and the Waikato Regional Council shall be notified as soon as practicable. Works shall not recommence without the approval of Waikato Regional Council having consideration for the interests of tangata whenua and the Consent Holder and any scientific or archaeological evidence.

11 DUST CONTROL

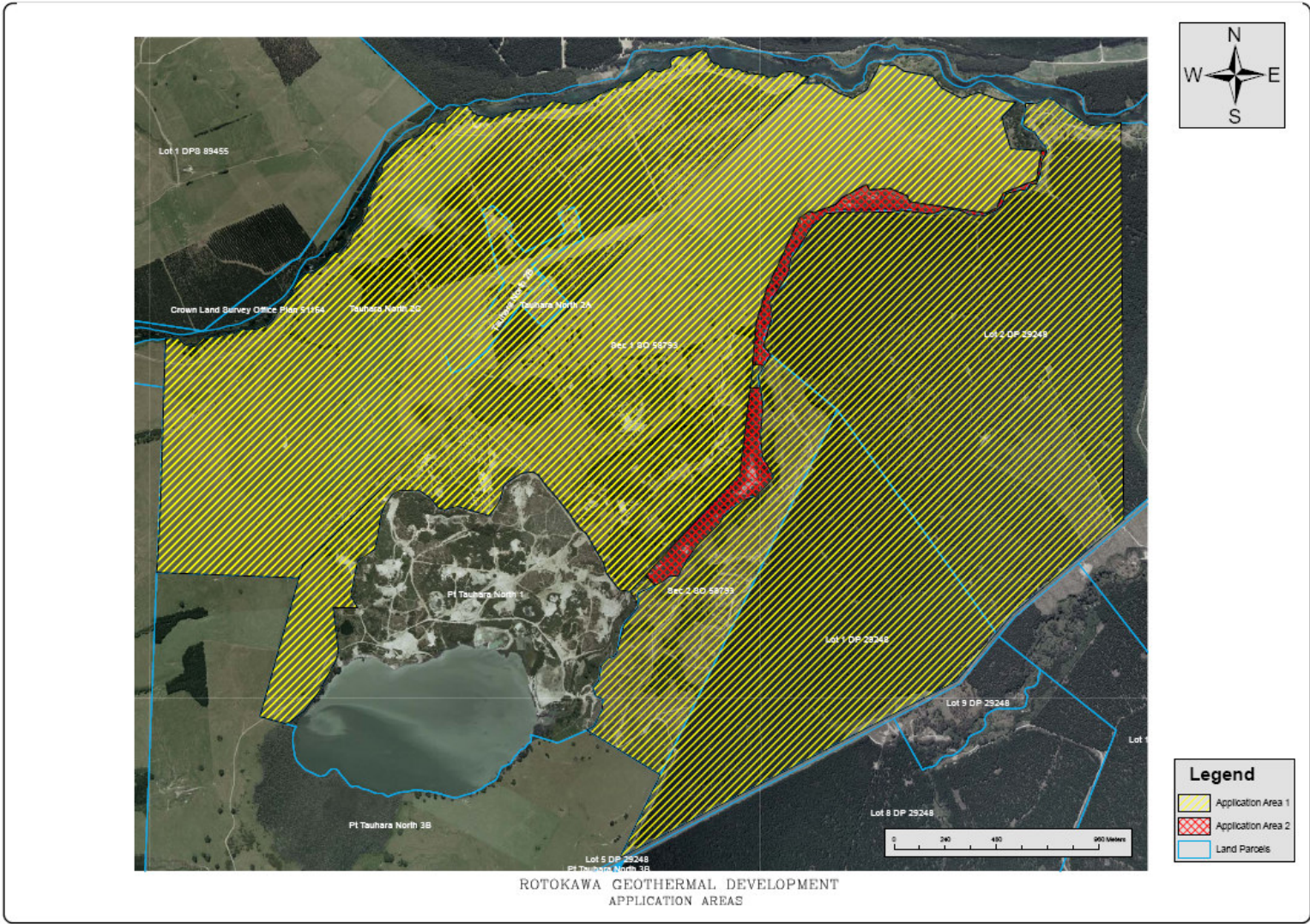
- 11.1 The Consent Holder shall ensure that dust control is carried out so that no dust nuisance occurs beyond the boundary of the work site.
- 11.2 The Consent Holder shall ensure that prior to large scale earthworks commencing, a sufficient supply of water is available to the site for dust suppression and additionally that a practicable application method capable of giving full coverage of at least 5mm of water per day to the exposed areas is available to the site at all times during the works.

12 SIGNIFICANT GEOTHERMAL FEATURES

- 12.1 In the event that the Peer Review Panel determines that a significant adverse effect on a Significant Geothermal Feature has occurred as a result of the actions of the Consent Holder, the Consent Holder will be required to remedy or mitigate the significant adverse effect(s) on either the Significant Geothermal Feature affected, or another geothermal feature of the same type in any geothermal system. The scope and type of remediation or mitigation will be determined by

the Waikato Regional Council, in consultation with the Consent Holder, the owner and or administrator of any land on which the Significant Geothermal Feature in question is located, and any other parties the Waikato Regional Council considers appropriate. The scope and type of remediation or mitigation could involve the recommended purchase of any privately owned land containing geothermal features and, subject to purchase, the protection or enhancement of such features.

SCHEDULE ONE – CONSENT AREAS



ROTOKAWA GEOTHERMAL DEVELOPMENT
APPLICATION AREAS

SCHEDULE TWO – ROTOKAWA MONITORING PROGRAMME

GEOHERMAL WELLS

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
Every new well	3 temperature and pressure surveys with well closed	One at well completion and Two before discharge
Every well	Caliper survey for corrosion monitoring	After first discharge then a minimum of once every two years thereafter unless requested by the Waikato Regional Council after taking advice from the Peer Review Panel.
Wells not used for production or reinjection unless otherwise agreed by the Waikato Regional Council after taking advice from the Peer Review Panel.	Pressure and temperature survey, or where capillary tubing is installed, pressure only.	Annually
Wells not being used for production or reinjection unless otherwise agreed by the Waikato Regional Council after taking advice from the Peer Review Panel.	Record wellhead pressure and well status (shut, open, bleeding, etc)	Well head pressure – Monthly Well Status – Continuously
Production wells	Mass flow rate from groups of wells, wellhead pressure and temperature from individual production wells	Daily
Production wells	Water and gas chemistry sampled at surface	Annually
Production wells	Discharge characteristic (mass flow rate and enthalpy)	On first discharge then at the request of the Waikato Regional Council on the advice of the Peer Review Panel
Reinjection wells	Mass flow rate, wellhead pressure and temperature	Daily

SHALLOW MONITOR WELLS

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
All shallow monitor wells (the RKM series and any new wells)	Water level Maximum temperature and its depth	6-monthly
All shallow monitor wells (the RKM series and any new wells)	Chemistry	Annually

GROUND LEVEL

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
The benchmark network in the Rotokawa field as approved by the Waikato Regional Council.	Levelling survey to detect and measure subsidence.	Every two years alternating between full surveys and partial surveys.

SURFACE HEAT FLOW

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
All thermal areas within the Rotokawa resistivity boundary	Aerial infra-red (including, subject to safety considerations, necessary ground-truthing)	5-yearly

SURFACE DISCHARGES

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
At locations specified in the surface feature monitoring plan contained within the System Management Plan and any other feature as required by the Waikato Regional Council after taking advice from the	Flow rate, Temp, pH, chemistry / gas content (depending on type of surface discharge) and photographs	Parariki Stream (at its confluence with the Waikato River) monthly unless otherwise agreed by the Waikato Regional Council after taking advice from the Peer Review Panel. All other discharges measured annually unless requested by the

Peer Review Panel.		Waikato Regional Council after taking advice from the Peer Review Panel.
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STREAMS RECEIVING GEOTHERMAL WATER

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
Parariki Stream at its exit from Lake Rotokawa	Flow rate, Temp, pH, chemistry	Monthly

LAKE ROTOKAWA

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
At the outlet of the Lake	Water Level	Monthly

FLORA AND FAUNA

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
Rotokawa thermal areas	Thermotolerant vegetation survey	5-yearly

MICROGRAVITY

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
Covering the area within the Rotokawa resistivity boundary	Microgravity	12-yearly

SEISMIC

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
At fixed locations to be approved by the Waikato Regional Council on the advice of the Peer Review Panel	Seismometer	Continuous

TRACER TESTS

LOCATIONS	MEASUREMENT TYPE	MEASUREMENT FREQUENCY
In wells selected by the Consent Holder, or by the Waikato Regional Council on the advice of the Peer Review Panel.	Injection of a chemical or isotope contained in Schedule THREE or otherwise approved by the Waikato Regional Council	As required by the Consent Holder, or, in the event of an unexpected geothermal fluid break-through event (e.g. to the ground surface or into adjacent fresh groundwater), following any request by the

		Waikato Regional Council after taking advice from the Peer Review Panel.
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SCHEDULE THREE – ROTOKAWA CHEMICALS

Drilling Cement Additives

Additive	Typical Trade Names	Application
Accelerator	Calcium Chloride	Accelerate cement thickening time
Cement	General Purpose Portland Cement	Base material for cement slurry
Extender	Blast Furnace Slag	Resistance to corrosion, reduce slurry density
Defoamer	Defoam-A	Reduces foam while mixing
Dispersant	CD-31L	Improves mixing and rheology properties
Fluid loss control	FL-67L	Fluid loss control
Free water control	A-300L	Reduce free water in cement slurry
Retarder	R-21L	Retarding of cement slurry
Free water control	AEF-100L	Reduce free water in cement slurry
Sodium silicate	A-3L	Preflush/control of minor lost circulation
Extender	Bentonite	Reduce cement density

Drilling Fluid Additives

Description	Typical Product Name	Primary Application
Anionic Acrylic Copolymer	Therma-thin, Thinpol 72L	Deflocculant
Bacterially Produced Polymer	XC-Polymer, Biozan, Xanthan gum, Guar Gum	Viscosifier and fluid loss control additive
Barium Sulphate	Barite	Increasing mud weight
Bentonite	MI-Gel, Aquagel, Rheoben NT	Viscosity and filtration control
Calcium Carbonate	Baracarb, Omycal, Circal, Calcite	Acid soluble weighting and loss circulation material
Calcium Hydroxide	Lime	Flocculant for forming lime muds
Causticised Lignite	CC-16, HT Lignite	Fluid loss control, deflocculant
Cellophane	Jelflake	Loss circulation additive
Chrome Free Lignosulphonate	Q-B11, Spersene-CF	Dispersant and fluid loss control
Citric Acid		pH control
DEFOAM - A	LD-8, Defoam A, Defoam E.	Aeration Control
DESCO (Chrome free)		Rheology control
Ester based Lubricant	EBL	Lubricant
Filming Amine	Conqor, CRW24100	Corrosion control
High Molecular Weight Polymer	Polypac, Pac-R, Drispac-R, Drispac-SL	Viscosifier and fluid loss control additive
Biocide	Idcide 20,	Prevent Bacterial decay of polymers
Isobutyl Alcohol	Enviro-spot	Stuck pipe lubricant
Lignite	Tannathin	Fluid loss control, deflocculant
Magnesium Oxide	Magox	pH control
Mica	Mica	Lost Circulation Control
Mixed Media LCM	M-I-X II, Kwik Seal, Quickseal, Fracseal, Cellplug, Frac-Attack, Sand Seal,	Lost circulation additive

Description	Typical Product Name	Primary Application
	Fibre Sweep	
PHPA	Polyplus, EZmud, JK261	Viscosifier
PIPE-FREE (ME)	Mono Ethylene Glycol	Stuck Pipe Lubricant
Sulphonated Polymer	Polythin	Rheology control
Salts	NaCl, KCl	Formation inhibition
Shredded Cellulose	Mud Fibre	Loss circulation additive
SODA ASH	Sodium Carbonate	Calcium removal
Sodium Bicarbonate	Sodium Bicarb	Ca treatment in high pH cements
Sodium Hydroxide	Caustic Soda	pH control
Sodium Sulphite	OS2	Oxygen scavenger for corrosion control
Synthetic Polymer	Durenex, Resinex	High temp rheological and fluid loss control
Walnut Shells	Nutplug	Loss circulation additive
Zinc Oxide	Zinc Oxide	H ₂ S control

Geothermal Fluid / Reinjectate / Condensate Additives

Description	Typical Product Name	Primary Application
Sulphuric Acid		Antiscalant
Sodium Polyacrylate		Antiscalant
Biocide	Blulab 6002	Biogrowth inhibitor
Corrosion Inhibitor	Blulab 9350	Corrosion inhibitor
Sodium Hydroxide		Condensate pH control

Tracer Dilution Additives (Well testing)

Description	Typical Product Name	Primary Application
1,5 or 1,6 or 2,6, or 2,7 or 2-Naphthalenedisulfonic Acid Disodium Salt, Dihydrate, 98%	None	Well testing
Sulphur Hexafluoride	None	Well testing