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Ohaaki Geothermal Power Station – Renewing Resource Consents Comparison with Greenfield Development

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ABSTRACT

The resource consents/environmental permits authorising the operation of Contact Energy's Ohaaki Geothermal Power Plant, located in New Zealand, approximately 26 km north east of Taupo Township, expired on 31 October 2013. To enable continued operation of the plant applications for new consents were lodged 6 months before the existing consents expire, (by 30 April 2013). The consent applications were lodged on 10 April 2013, a hearing held in September and consents granted in October 2013.

The challenges of obtaining resource consents/environmental permits for an existing power plant, compared with a 'greenfield' proposal, are explored, including costs and time frames. Determination of the baseline for assessing the effects of proposed future operations for an existing and greenfield site are also discussed.

Key issues for the Ohaaki consenting process include the impact the development and operation of the power plant has had on the relationship between the tangata whenua and their ancestral lands and taonga, capacity of the reservoir, subsidence, water takes and discharges from and to the Waikato River, and discharges of separated geothermal water to the Waikato River. Technical assessment of effects reports to support the applications include reservoir modelling, sustainability, subsidence, surface and shallow geothermal effects, groundwater effects, Waikato River environment in the vicinity of Ohaaki, terrestrial ecology, archaeology, air quality, and wetland mitigation.

1. INTRODUCTION

1.1. History

The Ohaaki Geothermal power plant, owned by Contact Energy Ltd, is located approximately 26 km north-east of Taupo township in the North Island of New Zealand (Figure 1). Ohaaki was identified as a geothermal prospect in the early 1960s. The field discovery well BR2 completed in 1966 had temperatures of 280°C and a production capacity of more than 14 MWe. The resource capacity in the early 1990s was assessed at about 120 MWe, however, estimates ranged from 20 MW to 200 MW.

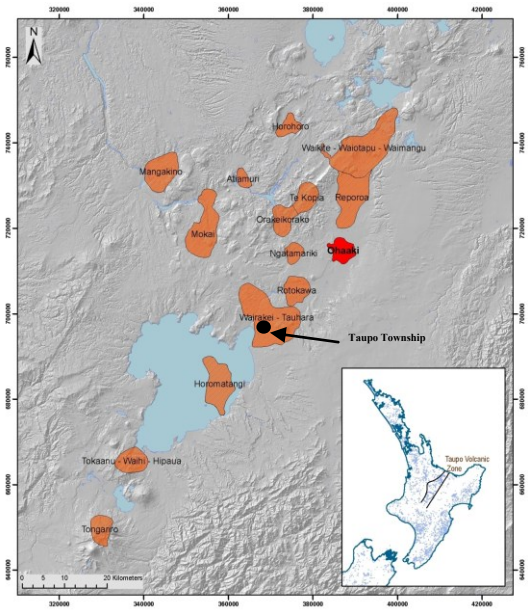

Figure 1 - Location of Ohaaki Geothermal System

Government approval for the construction of Ohaaki was given in 1982 and the plant was fully commissioned in 1989 with an installed capacity of 116 MW (gross) utilising both high pressure and intermediate pressure steam turbines. Land overlying the

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Ohaaki Geothermal System includes land in private, Crown and Maori ownership. The government entered into a memorandum of agreement with the Maori land owners, Ngati Tahu, to lease land on the west bank of the Waikato River. The Power Station and some steamfield facilities are located on this leased land.

At the time of investigations the field was predicted to run down at a rate of about 14% and other effects were predicted such as subsidence and effects on thermal features. In particular inundation of the Marae and effects on the Ohaaki pool (Ngāwha) were predicted as declining water levels had been observed during field testing.

Between 1993 and 1999 output steadily declined due to a combination of well performance, reservoir and energy market conditions, the latter making drilling of makeup wells economically unattractive relative to other investment opportunities. Contact Energy acquired the Ohaaki power plant, when it was established in the late 1990s and since 1999 the plant has generated around 40 MW net of renewable electricity. (Contact Energy, April 2013).

The Ohaaki geothermal system covers a surface area of about 12 km^2 and is transected by the Waikato River. The system boundary is defined in the Waikato Regional Plan (Figure 2). Ohaaki is classified in the Waikato Regional Plan as a 'Development Geothermal System'. The key aspect of this classification is that it has an associated policy regime that seeks to enable the large-scale use and development of the geothermal system (including for electricity generation purposes).

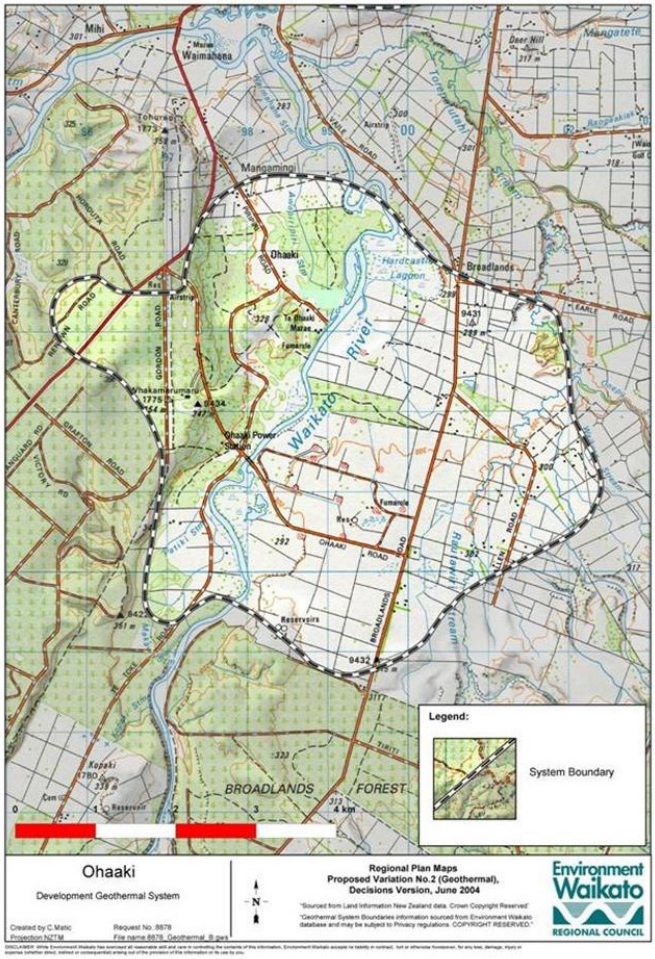

Figure 2 – Waikato Regional Council Plan Boundary for the Ohaaki Geothermal System

1.2. Ngāti Tahu

Ngāti Tahu are the tangata whenua (people of the land) of the Ohaaki area and have a deep and long-standing relationship with the Ohaaki geothermal resource. The land overlying the western steamfield area is subject to a long-term lease from Ngāti Tahu for geothermal development.

There are a number of cultural sites located on the west bank of the Waikato River including, Te Ohaaki Marae (meeting house), urupā (cemetery), the Ohaaki Ngāwha (thermal pool) and Te Kohatu ō Momonatanga (also known as the fertility rock). In addition the Waikato River is a resource of cultural, social, economic and spiritual importance to Ngāti Tahu and other iwi. Ngati Tahu have prepared cultural impact assessments and provided detail of the overall effects the Ohaaki development has had on them. This has provided the basis of discussions, through time, on means to avoid, remedy and/or mitigate relevant adverse effects.

1.3. Resource Consent Background

In 1978 Crown water rights were granted for the abstraction and reinjection of 103,200 tonnes per day of geothermal fluid sufficient to operate the plant at the fully installed capacity, 116 MW. Those rights expired in October 1998 and new esource consents authorising the abstraction of and reinjection of up to 60,000 tonnes of geothermal fluid per day were granted, under the Resource Management Act 1991 (RMA), for a term of 15 years, expiring in October 2013. Other consents required for the operation of Ohaaki were granted by consent authorities at this time. The main aspects of concern to Maori at the time of the 1998 consent renewal were subsidence affecting the Ohaaki Marae, effects on the Ngāwha and bathing pools, effects on Urupa (burial sites) and effects on other cultural sites, and changes to surface geothermal features, including the Ohaaki Ngāwha and thermotolerant vegetation.

Other issues addressed included changes to pressures and temperatures in the reservoir, effects of reinjection, increased seismic activity, ground collapse and encroachment of the Waikato River onto subsiding land including effects on wetlands. These issues were addressed in technical reports and mitigation including a memorandum of understanding with Ngati Tahu. Mitigation for degradation of thermotolerant vegetation and mitigation for inundation of wetlands was agreed with various parties. Consents for a term of 15 years were granted on 29 October 1998.

Applications to renew the 1998 resource consents were lodged on 11 April 2013. Lodging applications for new consents six months before expiry of the 1998 consents allows the plant to continue to operate in the event that a decision on the consent applications was not made before their expiry i.e. 29 October 2013. Following a hearing by commissioners appointed by the Waikato Regional Council consents were granted on 24 October 2013 for a term of 35 years.

1.4. Operating History

The plant operated at full capacity from 1989 until 1993 using available steam supply capacity. Between 1993 and 1999 output steadily declined, due to a combination of well performance, reservoir and energy market conditions. Since 1999 output has stabilised at around 40 – 45 MW net.

1.5. Plant description

The Ohaaki Power Plant has an installed capacity of 105 MW (gross) however it currently operates at about 40 MW (net). The Plant comprises separation of geothermal fluid at the steamfield into high pressure (HP) steam (≈ 10 bara) and intermediate pressure (IP) steam (≈4.5 bara). The separated geothermal fluid is reinjected into ground on the margins of the reservoir. Steam is transmitted to the condensing steam turbine generators with the cooling water circuit providing water for the condensation process. The cooling water and condensate are pumped into the natural draft cooling tower where the water is cooled and returned to the condenser to repeat the cycle. Surplus condensate is reinjected back into the ground through condensate reinjection wells. Gasses are extracted from the condenser and discharged into the cooling tower plume. Cooling water for transformers and ancillary plant is taken from the Waikato River and discharged back into the river via oil separation ponds. A photograph of the plant is shown in Figure 3 and a simplified schematic process diagram in Figure 4.

Figure 3 – Ohaaki Power Station

2. RESOURCE CONSENTING/ENVIRONMENTAL PERMITTING OHAAKI (AN EXISTING PLANT) COMPARED WITH A GREENFIELD PLANT

The following is a comparison of the resource consenting/environmental permitting process for Ohaaki, an existing geothermal power plant, with a similar process for a greenfield plant. Consenting/permitting processes include an assessment of consents required, technical assessment of effects reports to support consent applications, time and cost.

2.1. Assumptions:

The following assumptions are made in the comparison of obtaining resource consents for Ohaaki with a greenfield plant:

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- Ohaaki is classified as a 'development geothermal system' in the Waikato Regional Plan. It is assumed that the geothermal system for the greenfield plant has the same classification.
- The greenfield plant is a similar size to Ohaaki with the same or similar inputs and outputs.
- The greenfield plant has a wet cooling tower and uses some river water for auxiliary cooling similar to Ohaaki. It should be noted that the Waikato River is fully allocated and it is highly unlikely that river water would be available for cooling. It is more likely that a dry cooling system would have to be used.
- The investigation phase for the greenfield plant has been completed.
- Rights to access or use the land required for the greenfield plant have been secured. Securing access to land is key to the viability of a project and can take many years, failing to secure land access will be the end of the project. Further, long time frames and high costs of securing land access may compromise the viability of a proposed project. In addition if there are likely to be effects on geothermal and cultural sites then gaining agreement with and approval from tangata whenua will be unlikely.
- The cost of land is not included in the greenfield cost assessment.
- Mitigation costs and cost of complying with conditions, e.g. monitoring, will follow the consenting process.

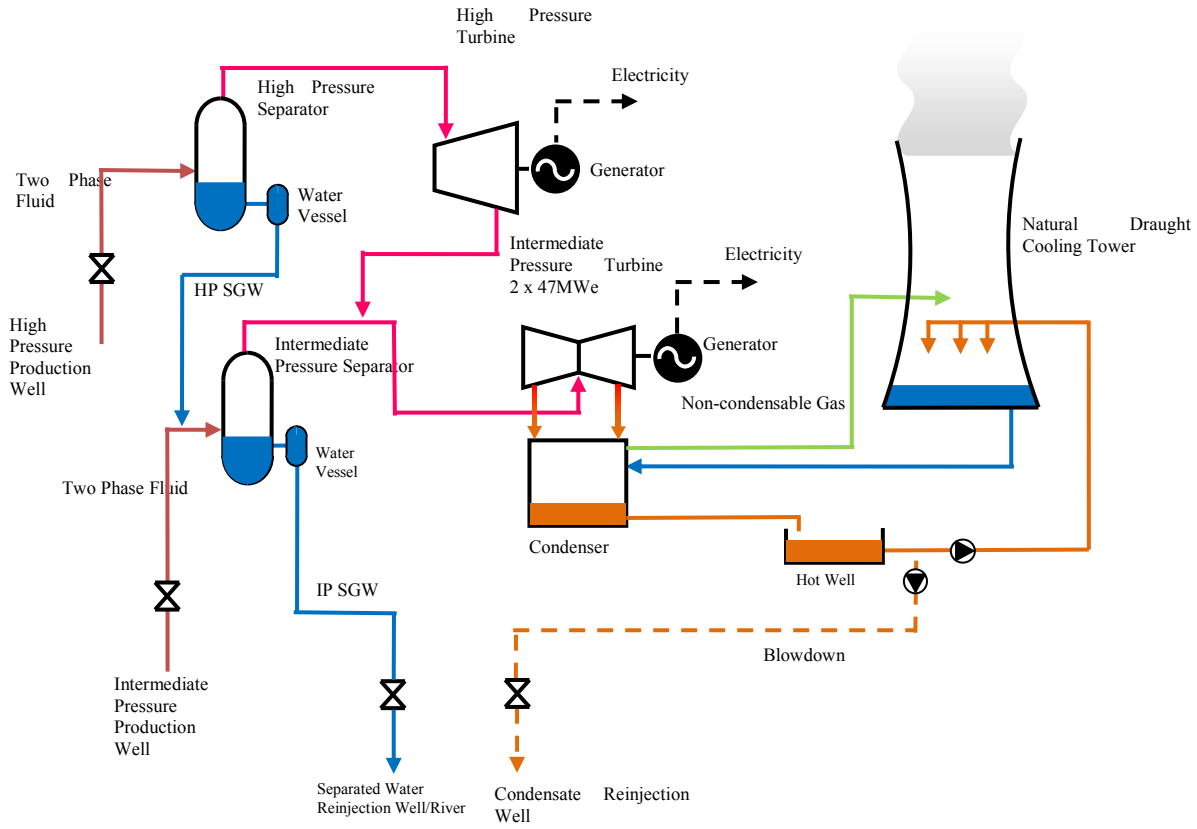

Figure 4- Ohaaki Power Plant - Simplified Schematic Diagram (SKM, 2013)

2.2. Consents Required

Resource consents/environmental permits required for the existing Ohaaki power Plant compared with resource consents/environmental permits required for a Greenfield geothermal plant are set out in Table 1.

Note – Actual resource consent requirements for a greenfield plant will depend on the site and the requirements of the regional and district plans. Consenting authorities with jurisdiction in the Ohaaki area are:

- The Waikato Regional Council – responsible for discharges to air, water takes from and discharges to the Waikato River, take and discharge of geothermal fluid, discharges to ground, stormwater discharges, structures in, on, under or over the Waikato River, earthworks.

- The Taupo District Council and the Rotorua District Council – responsible for land use (the Ohaaki land is designated for Geothermal Power), noise, traffic, visual.

Table 1 – Consents / Permits required for Existing and Greenfield Plant

Consent / Permit Required	Existing Plant (Ohaaki)	Greenfield Plant
Take and use of geothermal water and energy from the geothermal system.	Required.	Required.
Take and use of water from the Waikato River.	Required for filling the cooling tower, ancillary plant cooling and drilling.	Required for power plant cooling (if a wet cooling system is used) and drilling.
Diversion of stormwater and take and/or diversion of groundwater.	Required – stormwater system in place.	Required for construction and operation.
Discharge separated geothermal water and condensate into ground (reinjection).	Required – includes discharge into a fumarole area.	Required – will be reinjection only i.e. no surface discharges.
Discharge stormwater, geothermal water, condensate, drilling fluids onto and into land.	Required for power plant and steamfield operations and for drilling.	Required for power plant and steamfield operations and for drilling.
Discharge of cooling water and steam condensate to the Waikato River.	Required for discharge of water used for cooling.	Required for discharge of cooling water.
Discharge of geothermal water to the Waikato River.	Required due to the design of the plant.	Not required – with current technology the plant would be designed so that all geothermal water is reinjected.
Discharge of cooling water and condensate to land via emergency discharge pond.	Required in the event of a plant upset or emergency situation.	Required in the event of a plant upset or emergency situation.
Discharge of antiscalants into land via wells.	Required for well maintenance.	Required for well maintenance.
Discharge of water / treated sewage to ground.	Required for operation.	Required for construction and operation.
Discharge separated geothermal water into the Ohaaki Ngāwha (also known as the Ohaaki Pool).	Required to maintain the water level in the Ngāwha.	Not required – if there are going to be material effects on Ngawha then unlikely that consents would be granted or if granted likely to be for a small scale development, so that effects could be quantified.
Discharge geothermal water from the Ohaaki pool to the Waikato River.	Required to maintain a water flow through the Ngāwha (pool).	Not required.
Discharge of debris to the Waikato River from water intake screen cleaning.	Required.	Required.
Land Use for structures in, on, under or over the Waikato River. Also includes deviation of wells under the river.	Required for water intake/discharge structure, roads, bridges, cables, pipes, wells etc.	Required for water intake/discharge structure, roads, bridges, cables, pipes, wells etc.
Land Use consent for earthworks, excavation and land clearance within 5m of the bed of the Waikato River.	Required for operation and maintenance.	Required for construction, operation and maintenance.
Discharge of tracers into reinjection wells.	Required for steamfield understanding and management.	Required for steamfield understanding and management.
Discharge of drilling fluid additive into ground.	Required for drilling and well workovers.	Required for drilling and well workovers.
Discharge geothermal gasses to atmosphere.	Required for discharges from the steamfield and power plant.	Required for discharges from the steamfield and power plant.

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Consent / Permit Required	Existing Plant (Ohaaki)	Greenfield Plant
Land Use consents for well drilling.	Not required – consents exist.	Required for drilling of wells.
Well drilling and testing discharges.	Not required – consents exist.	Required for drilling and testing of wells.
Earthworks consent.	Not required – no significant earthworks planned.	Required for construction earthworks.
Land Use consents for switchyard and transmission lines and associated structures.	Not required – existing infrastructure.	Required from the appropriate district Council. This could be difficult given that many properties will be affected
Power station and steamfield structures.	Not required – steamfield structures are existing.	Required – depending on District Plan requirements.

2.3. Base-line for Environmental Impact Assessments

An assessment of environmental effects associated with a proposed activity is required to assess the effects "on the environment". Determination of the baseline against which effects are to be assessed is required. The baseline includes the physical environment as it currently exists and also the environment as it might be modified by permitted activities under a district plan and the implementation of resource consents that have been granted where it appears likely that these consents will be implemented (Contact Energy, 2013).

Thus in the case of a greenfield plant, effects would be assessed against an environment unaffected by geothermal development. In the case of Ohaaki the base-line is effectively the environment that would be if consents were not granted. The baseline includes any changes to the environment from the commencement of investigations of the Ohaaki system to date, other changes from third party activities and any other changes that will continue following expiry of the existing consents.

The effects to be assessed for the 2013 Ohaaki assessment of environmental effects (AEE) and applications were the effects resulting from operation of Ohaaki for a further 35 years when viewed alone (the difference between effects from proposed activities and base-line levels) and cumulatively (the total effect of proposed activities and past effects of Ohaaki operations) (Contact Energy, 2013).

Thus determination of the base-line for a greenfield plant is more straight-forward than the determination of the base-line for an existing plant, which is more complex. In addition, where effects are known they may be addressed by mitigation, or other actions, and these activities may result in an improvement over the existing baseline, which is a potential advantage for an existing plant.

2.4. Technical Report Requirements

Table 2 sets out the technical reports required for the assessment of environmental effects, which supports the applications for resource consents/environmental permits and shows the reports required for the 1998, 2013 applications and for a greenfield application.

Table 2 Technical Reports required to support resource consent / environmental permit applications

Aspect	Reporting Requirements			
	1998 Resource Consent Process (Fluid take 60,000 tpd)	2013 Resource Consent Process (Fluid take 40,000 tpd)	Greenfield Plant (assume a portion of the assessed reservoir capacity)	Comment
Project description	Project description included in the AEE.	Detailed project description prepared including a description of drilling activities. (Sinclair Knight Mertz, 2013).	Project description covering plant options being considered and including a description of drilling activities.	Technical description of the project used for input into the technical reports.
Local and regional planning rules and requirements.	Planning assessment included in the AEE. No land use consents from District Councils required.	Planning Assessment prepared. No land use consents from District Councils required. (Chrisp, 2013)	Planning assessment required to show consents that will be required. Land use consents will be required where the proposed land use does	Assessment of the District and Regional Plans to determine consent/permit requirements.

Aspect	Reporting Requirements			
	1998 Resource Consent Process (Fluid take 60,000 tpd)	**2013 Resource Consent Process (Fluid take 40,000 tpd)**	**Greenfield Plant (assume a portion of the assessed reservoir capacity)**	**Comment**
			not comply.	
Geoscientific and Reservoir Engineering information covering: • Geology • Geophysics • Geochemistry • Subsidence • Surface geothermal features • Groundwater	Comprehensive report covering factual geoscientific information from the time of initial investigations (1960s) up to the time of preparation of the report (1998) relating to the Ohaaki Geothermal field.	Comprehensive report prepared covering factual geoscientific information based on knowledge gained over ~40 years of investigation and use of the Ohaaki geothermal resource.(Carey et al., 2013)	Limited report using knowledge available from the investigation phase. Probably only 2 – 4 slim bores drilled into the reservoir at this stage.	A factual report covering knowledge about the geothermal reservoir.
Reservoir modelling	Reservoir model not presented as part of the application documentation.	Detailed comprehensive model calibrated to measured effects. Model used to predict future reservoir performance. Modelling showed that the reservoir could sustain a take of 40,000 tpd for 50 years and beyond.(O'Sullivan, Clearwater, 2013)	Conceptual reservoir model based on limited data.	A reservoir model is built up over time and refined over time using production data and data from wells.
Geothermal Resource Sustainability	No specific sustainability report prepared. In the event the authorised take of 60,000 tpd was not sustainable.	Report prepared to demonstrate that the proposed level of take (40,000 tpd) is sustainable in the long term.(Carey, 2013)	Report could be prepared based on an assessment of stored heat to demonstrate that the proposed level of take is conservative in terms of the reservoir capacity.	RMA requires applicants to demonstrate sustainable use of the resource.
Subsidence	Comprehensive report and analysis including future subsidence predictions.	Comprehensive report and analysis including future subsidence predictions.(Bromley, Reeves, 2013)	Would be assessed based on data available. A base-line levelling survey and follow up surveys will be a condition of consent.	Major issue at Ohaaki identified in the investigation phase. Subsidence has affected the Ohaaki Marae and river margins.
Groundwater	No specific assessment.	Detailed groundwater assessment particularly in areas of reinjection wells. (Reeves, Zemansky, 2013)	A ground water effects assessment and conceptual model would be required.	Potential effects on groundwater from geothermal developments are an issue to be addressed.
Effects on shallow geothermal features	Report addressing the potential for the formation of Tomos (sinkholes). A repeat infrared survey and geothermal feature survey were also undertaken.	Comprehensive assessment of the effects on shallow geothermal features and a prediction of effect from ongoing operation.(Bromley, Reeves, 2013)	General outline of potential effects that could arise from extraction of fluid from the reservoir. Definitive effects will not be able to be predicted at this stage creating a level of uncertainty.	Potential effects on surface geothermal features are an issue for all geothermal developments. For a greenfield there is no certainty of the magnitude of effects. For existing developments there is a level of knowledge that can be used to predict potential future effects.

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Aspect	Reporting Requirements			
	1998 Resource Consent Process (Fluid take 60,000 tpd)	**2013 Resource Consent Process (Fluid take 40,000 tpd)**	**Greenfield Plant (assume a portion of the assessed reservoir capacity)**	**Comment**
Effects arising from take and discharge of water from and to the Waikato River. Effects of subsidence on river margins / wetlands.	Report prepared covering the effects of the operation of Ohaaki on water quality & ecology including an assessment of the effects on the margins of the river arising from subsidence. A report addressing the feasibility of alternatives for discharges of geothermal water to the river was also prepared.	Report prepared assessing effects of water take and discharges on the ecology of the Waikato River. The report also provides an assessment of the effects subsidence has had on river margins and wetlands (Rowe et al., 2013). This assessment was used as input into mitigation.	A base-line report covering water quality and river ecology will be required. An assessment of the effects of water take and discharges on the ecology and water quality of the Waikato River required.	River water quality and ecology is a major issue that has to be addressed in any application. In the case of Ohaaki subsidence has had a significant effect on river margins i.e. wetlands and lagoons. As noted in 2.1, assumptions, it will be difficult to get consents to take river water. The most likely outcome will be selection of a dry cooling option.
Terrestrial ecology	Report prepared assessing thermotolerant vegetation and effects since commencement of operations at Ohaaki. Report prepared covering terrestrial insect communities at Ohaaki.	Report prepared describing the terrestrial ecology and addressing past effects and assessing potential future effects. (Burns, 2013)	A base-line survey and description of terrestrial ecology will be required as well as an assessment of potential effects from the proposed development.	
Archaeology	Archaeology included in the AEE.	Archaeological report prepared in consultation with local Maori. Cultural sites identified and protocols developed for work close to cultural sites. (Farley, Clough, 2103)	Archaeological survey required including recommendations and protocols relating to potential disturbance of identified sites and sites to be avoided.	Geothermal developments in New Zealand are generally in areas that have been historically occupied by Maori and are therefore likely to have archaeological sites, thus agreement with local iwi (tribe)/tangata whenua is critical.
Discharges to air	A permit for discharges to air previously granted therefore no specific report required.	Report prepared assessing discharges to air including an assessment of ground level concentrations at nearby dwellings. (Noonan, 2013)	Quantification of discharges to air and an assessment of effects or ground level concentration required. Need to demonstrate compliance with performance standards.	The effects of discharges of non-condensable gases to air from geothermal plants has to be assessed to demonstrate compliance with standards.
Noise	Complies with permitted activity requirements.	Noise levels comply with permitted activity requirements.	Noise assessment required to demonstrate compliance with district plan performance standards.	Applies to construction and operational noise.
Earthworks	Not required.	Not required.	Assessment required for consents.	Earthworks for construction will be greater that permitted in District Plans.
Visual and landscape	Not required – existing structures.	Not required – existing structures.	A comprehensive landscape and visual assessment will be	The level of visual assessment and landscape detail will

Aspect	Reporting Requirements			
	1998 Resource Consent Process (Fluid take 60,000 tpd)	**2013 Resource Consent Process (Fluid take 40,000 tpd)**	**Greenfield Plant (assume a portion of the assessed reservoir capacity)**	**Comment**
			required.	depend on location.
Traffic	Road network is in place therefore no assessment required.	Road network is in place therefore no assessment required.	Traffic assessment for construction and operation required. Consents may be required for new roads.	Traffic assessment would include construction traffic, heavy loads, parking and access.
Switchyard and transmission lines and connection to the national transmission grid	Existing transmission lines – no assessment required.	Existing transmission lines – no assessment required.	The effects of the switchyard and transmission line connection will be required. The transmission line is likely to be >20 km long and will require detailed assessment.	The consent authority would expect that electricity transmission is addressed as the power station can't operate without a connection to the electricity distribution network. Experience in NZ suggests that securing a route for a transmission line is likely to be difficult.
Construction management	Not required for exiting plant.	Not required for exiting plant.	Will be required for a greenfield plant.	
Mitigation	Wetland area constructed as mitigation for loss of wetland habitat.	Mitigation for loss of wetlands on river margins.	Mitigation likely to be offered to address identified potential effects.	Offset or other mitigation will be required for effects or potential effects identified.
Management Plans:	Reports/Plans prepared: • Geothermal Field Management Plan • Use and management of hazardous substances • Environmental Management Plan • Environmental Monitoring Plan	Plans prepared: • System Management Plan for the Ohaaki Geothermal System • Hazardous substances management plan • Stormwater management plan • Erosion and sediment control management plan	All the management plans prepared for the 2013 application would be required for a greenfield development plus. • Construction management plan • Traffic management plan	
Drilling	Report covering geothermal drilling prepared.	Geothermal drilling covered in the project description.	Would be covered in the project description.	A description of geothermal drilling will be required for any consent applications.

2.5. Term of Consents

The consents granted in 1998 were for a term of 15 years. The principle reason for the relatively short term was uncertainty around subsidence and the potential effects arising from subsidence. The term of consents granted in 2103 is 35 years, the maximum allowed under the Resource Management Act. The hearing panel that considered the applications was satisfied with the subsidence analysis, predictions and mitigation and the agreement reached with Ngāti Tahu particularly regarding protection of the Ohaaki Marae from flooding.

In the case of a greenfield development there will be a lower level of data/information and predicted effects, while based on good science, will be more theoretical. Adaptive management processes worked into the consent conditions are a sound approach to management where there is some uncertainty in the potential outcomes. Additionally Peer Review panels provide review and scrutiny of the management approached recommended in the System Management Plans, which are now firmly embedded in consents associated with large-scale geothermal energy use. Given the lower level of information for a greenfield development

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consent authorities are likely to adopt a precautionary approach, which could range from declining the application, granting a conservative level of take for a shorter time frame and/or imposing stringent monitoring conditions. New Zealand examples, for greenfield developments, are; Rotoma – where the application was declined due to insufficient information, Ngawha - where a short term consent was granted for a limited development and Ngatamariki – where a 35 year was granted.

2.6. Consultation

Consultation with all affected parties and stakeholders e.g. in the case of Ohaaki, Ngāti Tahu, Waikato Regional Council, Taupo District Council, Rotorua District Council, Department of Conservation, local land owners and resident and other interest groups, was undertaken as part of consenting activities.

Ngāti Tahu prepared a Cultural Impact Assessment covering the impact that the Ohaaki geothermal power plant has had on them. This provided a basis for consultation and for addressing cultural impacts. The Cultural Impact Assessment included issues with the Marae and other cultural sites that have occurred at Ohaaki as a result of subsidence. Subsidence was a major issue to be addressed in both the 1998 and 2013 consent processes. Subsidence would also be a potential issue for a greenfield development with uncertainty regarding predicted future subsidence based on limited information rather than measured subsidence. Subsidence and the uncertainty around subsidence is likely to be a significant issue for landowners and local iwi and will be another factor in the adoption of a precautionary approach by the consent authority. Another significant issue identified in the Cultural Impact Assessment was the effects on the Ohaaki Ngāwha (Ohaaki pool), which was drained due to lowering of pressure in the reservoir. Although this was predicted during the investigation phase, this was a significant impact for Ngāti Tahu. Work was undertaken to maintain water in the Ngāwha, however, loss of the natural state was a major issue for Ngāti Tahu addressed in the 2013 consent process. In the case of a greenfield site potential effects on surface geothermal features would be assessed based on available information and will have a level of uncertainty, which is likely to result in monitoring and reporting conditions as well as mitigation.

Comprehensive consultation is required for resource consenting / environmental permitting for both existing and for greenfield plant, however, many of the issues will be the same or similar for both.

2.7. Time and Costs

The time to undertake consultation and to prepare an Assessment of Environmental Effects and applications for the Ohaaki 2013 consent process was about 2 years. Assuming that the initial investigation phase has been completed and land access secured I estimate the time to undertake an AEE and to prepare applications for a greenfield geothermal development to be 1 to 2 years.

I estimate the cost of consenting a greenfield site to be about the same as the cost of renewing the consents for Ohaaki. This includes costs for preparation of an AEE and applications, consultation and hearing costs. I have assumed that the greenfield decision would not be appealed to the environment Court. This assumption will require agreement with most or all affected parties. A hearing in the environment court would add significantly to the costs

So the time and costs for consenting an existing geothermal power plant and a greenfield geothermal power plant, assuming the applications are prepared to a similar standard, are similar.

3. CONCLUSIONS

The following conclusions can be reached comparing resource consent/environmental permitting processes for an existing geothermal plant, such as Ohaaki, and a greenfield geothermal plant in a location with similar characteristics:

- There is a high level of detail expected and required for an existing plant compared with a greenfield plant where there is more limited information relating to the resource and no operational data. Uncertainty arising from limited data could give rise to a precautionary approach by decision makers.

- Resource consents/environmental permits required for existing and greenfield geothermal power plants are similar, however, consents required from the District Council and consents for a transmission line will be will be additional to those for an existing plant. Experience in NZ suggests that consents/permits for a transmission line will be a challenge.

- The technical effects assessments required for existing and greenfield plant are similar, however, the expected level of detail is greater for an existing plant.

- Determination of the baseline against which to assess environmental effects is more complex for an existing plant and relatively more straight-forward for a greenfield plant. For an existing plant, where the effects are better understood, there may be an opportunity to improve on the baseline environment, i.e. the environment existing at the time of the application

- Consultation requirements are similar for consenting/permitting existing and greenfield geothermal power plants. Describing or explaining something that is existing, including actual effects, to stakeholders is generally easier than explaining a conceptual proposal and potential effects that may arise.

- An existing plant with operation history requires technical assessment reports that use and explain trends from the factual data collected whereas a greenfield plant with little data and no operational data uses scientific analysis and assessment to predict potential effects/outcomes. Results from substantial amounts of factual data can potentially be harder to reconcile than from relatively little data.

- The time and costs of the consenting process are expected to be about the same. Is this reasonable where effects arising from an existing plant are largely known?

- Securing access to land required for the power plant, steamfield and transmission lines required is likely to be difficult for a greenfield plant and may well mean that the project is not progressed.

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