Eastland
Generation

2020 Community Report Covering Consents to Take and Discharge Geothermal Fluid from the Kawerau Geothermal System (67161 & 67340)

Contents

1 Purpose

This Community Report is written in partial fulfilment of the requirements of Resource Consent 67340 (section 17), Resource Consent 67161 (section 16) and the Kawerau System Management Plan (section 7.14.2) to "establish and service a Community Liaison Group for the duration of this consent and ..... provide feedback and comment on environmental issues related to the exercise of this consent and its associated geothermal abstractions, injections and discharges." The information cited in this report is from reservoir and environmental monitoring results for the calendar year 2020.

2 Background

Eastland Generation Ltd. is a geothermal energy supplier to two Kawerau geothermal power plants Geothermal Developments Ltd (GDL) and Te Ahi O Maui (TAOM). Geothermal steam enables our customers to use a renewable source of energy, reduce industrial green-house gas (GHG) emissions, and contribute to the decarbonisation of the New Zealand economy.

Resource consents authorise and set the conditions for GDL and TAOM's supply of geothermal fluid from the Kawerau geothermal system for power generation.

In partial fulfilment of Eastland's responsibilities as a sustainable geothermal operator, consent holder and community member, this community report has been prepared to provide updates on Eastland's activities and to summarise the monitoring and scientific information and reports gathered in 2020.

3 Consent Compliance

Eastland's geothermal fluid take from the Kawerau Geothermal System complies with its resource consents

GDL and TAOM's geothermal fluid takes are limited to a consented volume based on the sustainable take that the Kawerau geothermal system can support.

In 2020, GDL and TAOM used 100% of their consented volumes, following an agreement with NTGA to use part of its consents.

4 Reservoir Trends

Trends observed in the reservoir are as expected

4.1 Reservoir pressure is generally increasing

The reservoir pressure of a geothermal system changes at a rate influenced by the volume of geothermal fluid produced and the volume of fluid recharge from both natural recharge water and reinjected water. The Kawerau geothermal system has one of the smallest pressure changes related to the scale of geothermal development in New Zealand. The small pressure change has been maintained even after more than 60 years of continuous operation.

In 2020, the reservoir pressure was generally increasing in the Kawerau geothermal system. This means that the volume of geothermal fluid taken was effectively replenished by natural recharge and reinjected water.

4.2 Reservoir enthalpy (reservoir temperature) is decreasing at a stable rate

The enthalpy of the geothermal fluid produced describes the amount of thermal energy, in kilojoules, per kilogram of produced geothermal fluid. A higher enthalpy means a higher amount of thermal energy available for use. In Kawerau, the enthalpy trend is used to determine whether the geothermal reservoir is being produced at a sustainable rate.

In 2020, the enthalpy changes observed in the GDL and TAOM production wells are in line with the expected sustainable enthalpy changes. Eastland continues to collaborate with the rest of the geothermal system tappers to monitor and review strategies to ensure that the overall enthalpy trends remain sustainable.

4.3 Chemistry trends indicate increasing reinjection fluid returns in addition to natural recharge

The chemistry trends of the produced geothermal fluid provide an indication of underground reservoir processes. Understanding these processes helps in developing reservoir management strategies. Additionally, information from chemistry trends ensures the safe and reliable operations of our geothermal energy supply network, e.g., indicators of increasing risk for mineral deposition, corrosion, etc.

In 2020, chemistry trends indicate that GDL and TAOM wells have some returns from reinjection together with a higher proportion of natural recharge. This is consistent with long-term trends showing the influence of both natural recharge and reinjection on Kawerau production wells. The changes in chemistry trends continue to be monitored to ensure no adverse long-term effect on the enthalpy of the reservoir.

In 2020, TAOM conducted a tracer test which confirmed that TAOM injection is sustainable in the medium term. The long-term strategy is to transfer TAOM injection to wells even further from the production area to improve long-term sustainability. The GDL production well has shown no evidence of impacts from GDL injection.

Trends observed in the environment are consistent with expected trends

4.4 Groundwater monitoring trends are mainly influenced by surface hydrology

The groundwater system overlying and interacting with the Kawerau geothermal system is monitored using a wide network of shallow bores. Monitoring activities detect changes to the groundwater system and are used to determine whether these changes are related to the geothermal field operations over time. To detect these changes, groundwater monitoring includes water level and groundwater temperature measurements as well as six-monthly or yearly groundwater chemistry analyses. The current Kawerau groundwater monitoring program started in the 1990s. TAOM has drilled a shallow monitor well to contribute to groundwater monitoring.

In 2020, TAOM monitoring data indicated slightly declining groundwater levels and stable temperature consistent with main influence from surface hydrology (rainfall events) with no evidence of effects from geothermal operations and reinjection.

4.5 Surface thermal features continued to wane as expected

Surface thermal features in Kawerau include fumaroles, hot pools, heated ground and natural seeps. Changes to the thermal features located within the Parimahana and Te Taukahiwi o Tirotirowhetu

Scenic Reserves are monitored through photographic surveys and ground temperature measurements.

In 2020, thermal features monitoring results indicate that the geothermal activity in the monitored thermal features continued to wane as expected. The activities of the surface thermal features have been noted to naturally decline since the 1900s.

4.6 Ground surface elevation changes in the industrial area are as expected

The ground surface elevation overlying geothermal systems might change as a response to geothermal operations, either as a downward trend (subsidence) or an upward trend (swelling) due to changes in the underlying reservoir pressure and temperature. Ground surface elevation is monitored in Kawerau due to the presence of industrial equipment that are sensitive to ground surface elevation changes. Ground level monitoring includes regular measurements of elevation benchmarks over an area of approximately 50 km2. In addition, there is a higher level of monitoring around a relatively large “bowl” of slowly subsiding ground above the reservoir, within which five localised subsiding areas are of interest.

In 2020, a levelling survey was completed focused on the 3 km2 level-sensitive industrial area. It showed a steady year-on-year decline in subsidence rates in all identified long-term subsidence locations. In general, all the subsidence rates and tilt recorded are within expected ranges in the level-sensitive industrial area.

4.7 Greenhouse gas emissions continue to decline

Renewable energy from geothermal systems do release a relatively small amount of greenhouse gases (GHG) to the atmosphere, mainly as carbon dioxide (CO2) and hydrogen sulphide (H2S). The emissions from the Kawerau geothermal field is a small fraction of the emissions for an equivalent amount of energy from a fossil fuel¬-based source and is expected to decline as the system loses gas over time.

In 2020, the air emissions from Eastland's wells were similar to other wells in the Kawerau field.

5 Reservoir Model

As agreed within the Kawerau System Management Plan, a geothermal reservoir simulation computer model is maintained by all geothermal tappers in Kawerau to help manage the geothermal system in a sustainable manner. This model helps simulate physical changes in the geothermal reservoir as a response to the geothermal operations carried out by multiple consent holders and operators. It uses the latest temperature, pressure and chemistry trends as well as geological and geophysical information collected over time to update the model and improve its predictive capability.

In 2020, the numerical model KRMv5 forecast was compared with the latest production, enthalpy and pressure data. The results indicate that the numerical model is sufficiently matching the actual data. Updated forecasts from the model indicate long-term sustainable geothermal development from the system at the current consented volumes.

6 Summary

Eastland's geothermal operations continue to provide a renewable, reliable, and low-carbon energy supply to New Zealand customers. In the years since Eastland's purchase of the Geothermal Development Ltd steam field assets and power station, it has continuously improved its capability to monitor, understand, and manage its operations in the Kawerau geothermal system.

In 2020, Eastland's geothermal operations complied with the requirements of its resource consents. The relevant reservoir and environmental monitoring trends are also within the expected trends and where possible, adaptive management is being carried out to ensure a sustainable geothermal operation. Eastland also continued to invest in the Kawerau steamfield such as injection well drilling, scientific studies, and updates to the numerical reservoir model.

Eastland continues to engage and collaborate with all stakeholders to ensure that its activities in the Kawerau geothermal reservoir are carried out in a manner that is sustainable to the geothermal resource, the environment, and the community that it supports.

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