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Recovery of Rotorua geothermal field, New Zealand: Progress, issues and consequences

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Abstract

Recovery of most surface features in many parts of the Rotorua geothermal field (RGF) has continued as water levels rose and pressures increased following bore closures that began in 1986. However, the pattern of recovery of features is very variable, even within a relatively small area, with no apparent consistency as to location or type of feature. Most features in the Whakarewarewa Thermal Area that were affected by the pre-1986 pressure drawdown have recovered, but some have not. More puzzling is the behaviour of a few features (such as Waikorohihi and Mahanga geysers) that initially showed recovery, but later ceased activity. Chemical data indicate that for some features there has been an increase in the amounts of deep fluid reaching the surface, but in others there has been no change. Examination of seismic records suggests that the unusual behaviour is not related to local seismic activity. The recovery of many thermal features has been beneficial from a tourist and environmental viewpoint. However, there have been some detrimental occurrences. Following the decline and disappearance of thermal features before the bore closures, the vents of some features were inadvertently filled in and the land around them reclaimed and used for buildings or services. As water levels recovered after the closures, discharge to the surface recommenced, causing damage to buildings and associated services, resulting in several houses being damaged or forced to be relocated. In all cases, however, the discharges were from historically active vents. The data suggest that while most natural

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thermal features may recover from the effects of geothermal exploitation some may not, and in the case of Rotorua there does not appear to be any pattern or explanation for such non-recovery.

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1. Introduction

The Rotorua Geothermal Field (RGF) is recognised internationally as an example of a geothermal system that has been extensively exploited at shallow depth (30–200 m), but not at greater depths (500–1500 m). It is unique in that over-exploitation was recognised and then subsequently addressed by a change of management policy. The RGF lies within the Rotorua Caldera and the Taupo Volcanic Zone and is renowned for its local geothermal manifestations including the geysers and hot springs at Whakarewarewa and Ohinemutu–Kuirau (Fig. 1). In the 1960s and 1970s, mass flows from Rotorua wells increased about twofold. During these times the level of natural hydrothermal activity in Rotorua declined to reach what was becoming critically low levels by the mid-1980s (Lloyd, 1979; Cody and Lumb, 1992). Ironically, during the early 1980s public sensitivity to the intrinsic and tourism values of New Zealand's few remaining geysers increased dramatically, even as the geysers and hot springs in Rotorua progressively failed due to extraction of geothermal fluids via well drawoff. A realisation that these geysers and hot springs might soon be lost led to establishment of the Rotorua Geothermal Monitoring Programme (RGMP) in 1982. This ultimately led to an enforced bore closure programme that began in 1986 (O'Shaughnessy, 2000), and resulted in well drawoff being reduced by ~60% during 1987–1988. Soon after, during 1988–1991, pressures increased by about 10–20 kPa (0.1–0.2 bar) and recovery of some surface features was observed.

Considerable work has been done on the Rotorua Geothermal System. The results of the RGMP are summarised in Ministry of Energy (1985), while other aspects of the field are covered in a special issue of *Geothermics* (volume 21, no. 1/2, 1992). The results of monitoring under the Rotorua Geothermal Regional Plan (RGRP) are reported by Grant-Taylor and O'Shaughnessy (1992), and Gordon et al. (2001). Scott and Cody (2000) described and discussed recovery of surface features following aquifer water level and pressure rises that followed the bore closures of 1987–1988. This paper reviews the resultant recovery of surface features and discusses the associated impacts, together with the success and extent of this recovery, and also its social consequences. Some as yet unexplained changes, which are exceptions to the general trends, are also recorded.

2. Field management

2.1. Rotorua Geothermal Regional Plan

In July 1999 the Rotorua Geothermal Regional Plan was approved and became operative, under the jurisdiction of Environment Bay of Plenty (Environment B.O.P.), with the

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