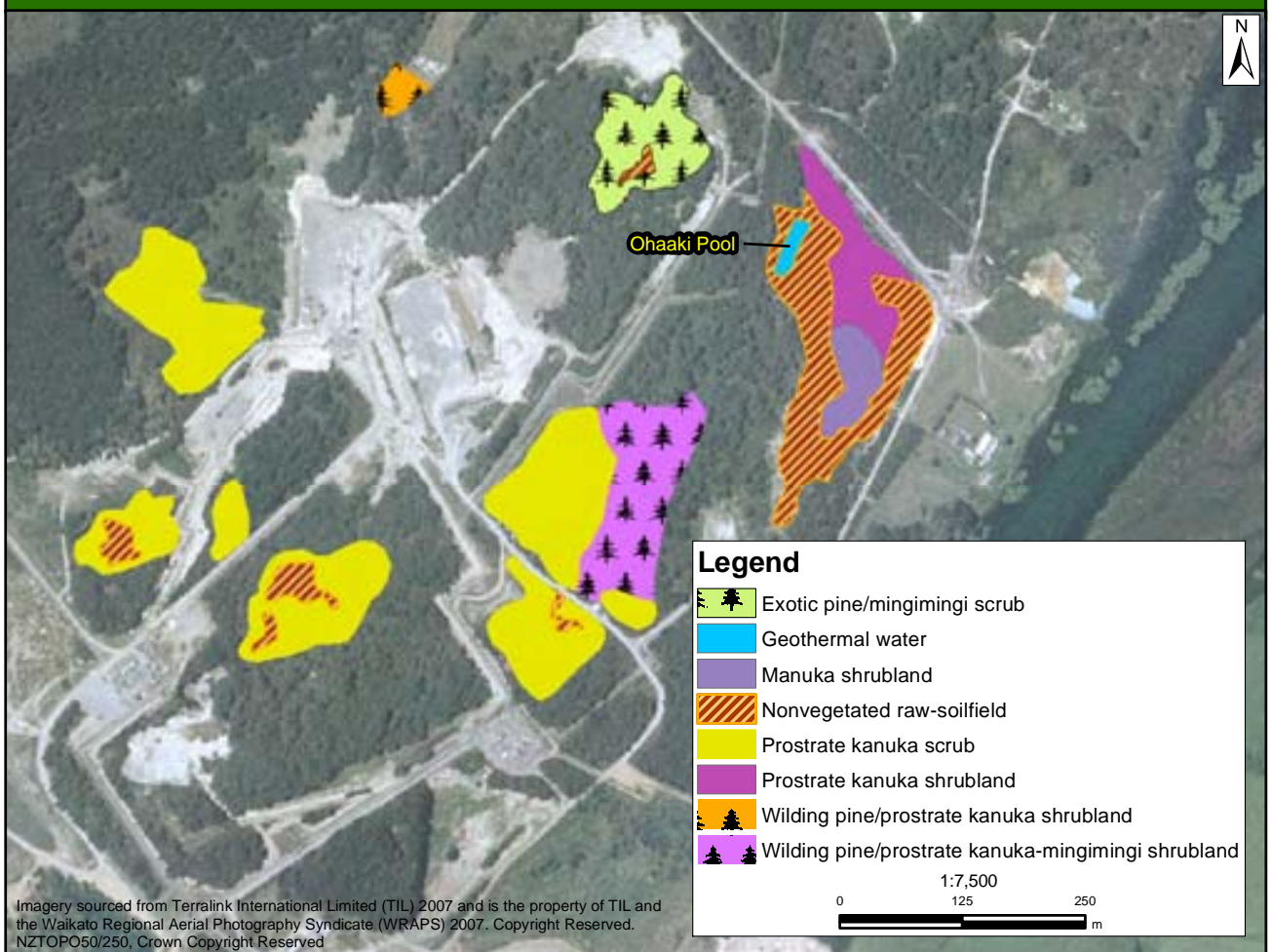
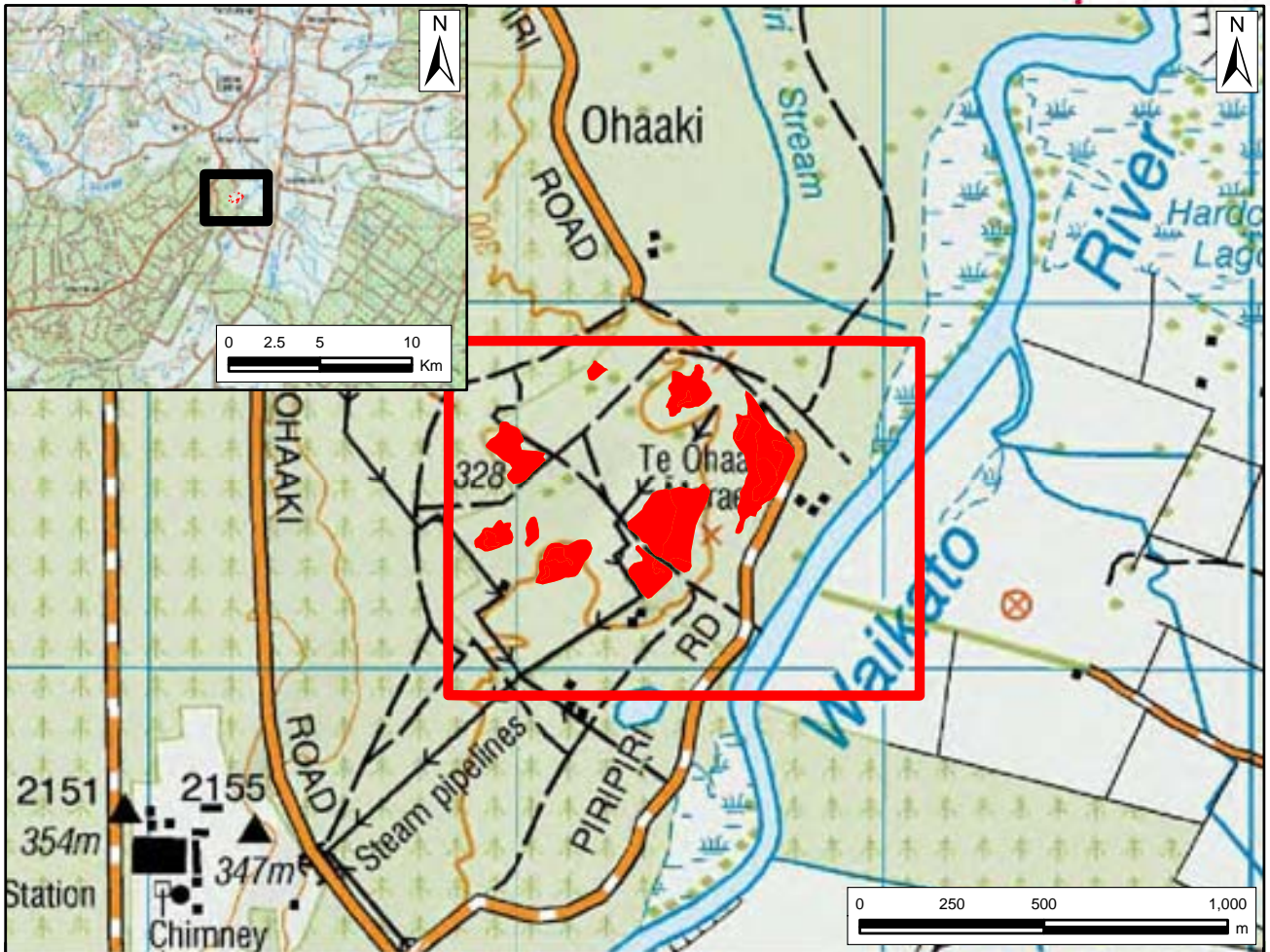


1.11 OHAAKI GEOTHERMAL FIELD

List of Geothermal Sites

OHV01	Ohaaki Steamfield West
OHV02	Ohaaki Steamfield East



OHAAKI STEAMFIELD WEST

Site Number: OHV01¹
Grid Reference: NZTopo50 BF37 887 316
GPS Reference: NZTM E1888672 N5731579
Local Authority: Taupo
Ecological District: Atiamuri
Geothermal Field: Ohaaki
Bioclimatic Zone: Submontane
Tenure: Unprotected private land
Altitude: c.300-320 m
Extent of Geothermal Habitat: c.11.9 ha
Extent of Geothermal Vegetation: c.11.8 ha
Date of Field Survey: 28 January 2011

Code	Type	Landform	Extent
01.05 01.05.06	Exotic pines forest Maritime pine-radiata pine/prostrate kanuka-mingimingi forest Scattered, emergent maritime pine and radiata pine occur over prostrate kanuka. <i>Lycopodiella cernua</i> and small patches of Indian doab and Mercer grass are also present.	Hillslope	c.0.2 ha
04.01 04.01.01	Prostrate kanuka-dominant scrub Prostrate kanuka scrub Prostrate kanuka up to c.1.5 m tall forms a dense cover with scattered mingimingi and manuka, and frequent emergent radiata pine and maritime pine up to c.10 m tall. Bracken, tututu, <i>Gleichenia microphylla</i> , <i>Paesia scaberula</i> , kiokio, and <i>Histiopteris incisa</i> are also present. Small patches of nonvegetated raw-soilfield occur amongst this vegetation type with scattered <i>Lycopodiella cernua</i> , Spanish heath, fleabane, gorse, buddleia and broom present.	Low hills; hillslopes and alluvial terrace	c.5.4 ha
04.02 04.02.13	Mingimingi-dominant scrub Exotic pine/mingimingi scrub Mingimingi dominates the canopy with scattered patches of kanuka, and scattered emergent radiata pine and maritime pine. Bracken, <i>Dicranopteris linearis</i> , buddleia, whauwhaupaku, kohuhu and wheki are also present.	Hillslope	c.1.0 ha
05.01 05.01.01	Prostrate kanuka-dominant shrubland Prostrate kanuka shrubland This area comprises prostrate kanuka shrubs, up to a height of c.0.75 m, and areas of bare soil. Occasional pampas are present.	Alluvial flat	c.0.9 ha
05.01.12	Prostrate kanuka-dominant shrubland Wilding pine/prostrate kanuka-mingimingi shrubland Maritime pine is emergent over prostrate kanuka and patches of mingimingi.	Alluvial flat	c.1.6 ha

¹ Previously identified as U17/25 in Wildland Consultants (2004).

Code	Type	Landform	Extent
05.03 05.03.01	Manuka-dominant shrubland Manuka shrubland Manuka dominated shrubland with scattered prostrate kanuka, Spanish heath, blackberry, buddleia, and occasional maritime pine saplings.	Low hills, alluvial flat	c.0.5 ha
22.01 22.01.01	Geothermal water Geothermal water Geothermal pool (Ohaaki Pool).	Alluvial terrace	c.0.1 ha
28.01 28.01.01	Nonvegetated raw-soilfield Nonvegetated raw-soilfield Sinter clay, small sinter terraces (unmapped) and steaming fumaroles, fissures and bare ground with areas of prostrate kanuka, <i>Lycopodiella cernua</i> , <i>Campylopus capillaceus</i> and exotic grasses (including narrow-leaved carpet grass and tall fescue). Around Ohaaki Pool there are local patches of kanuka in association with manuka and scattered Spanish heath, pampas, and blackberry with small, isolated areas of <i>Baumea juncea</i> . ¹	Alluvial terrace	c.2.2 ha

Indigenous Flora: Prostrate kanuka, *Dicranopteris linearis* (5-10 plants) (both 'At Risk-Naturally Uncommon' in de Lange *et al.* 2009), *Campylopus capillaceus* and *Lycopodiella cernua* are all species characteristic of geothermal sites that occur here. *D. linearis* is known from only c.24 sites in New Zealand.

Fauna: Common indigenous and introduced bird species typical of the habitat are present including fantail, kingfisher, tui, grey warbler, North Island robin and pheasant. Rabbit were also recorded at the site.

Current Condition (2011 Assessment): This site has been fragmented by industrial activities and road works, with additional clearance recorded since the 2007 survey (a small area of prostrate kanuka appears to have been removed to construct a road). Small areas of geothermal vegetation remain. Overall this site comprises a relatively large area of geothermal vegetation and habitat, with significant human-induced disturbance and a major problem with pest plants (particularly exotic pines). However, most of the site still has significant ecological values.

Wilding pines have been controlled in some areas but they remain prominent in parts of the site.

**Threats/Modification/
Vulnerability:**

Invasive pest plants (2011 Assessment): Assessment of exotic plant species at this site concurs with previous survey results. Wilding pines are the most prominent invasive species, with a cover of 5-25% and some areas now classed as forest rather than scrub or shrubland. Also present are blackberry, broom, pampas and gorse (each with 1-5% cover). Temperatures are cooling at this site (D. Bowden, Contact Energy, pers. comm. 2011), which is resulting in increased

¹ At the time of the field survey the southern parts of this site (E1888564 N5731359) were flooded by water from the Waikato River.

opportunities for exotic species to invade. Over the last four years some of the larger infestations of wilding pines and pampas have been controlled in and around the borefield by the Waikato Regional Council.

*Human impacts
(2011 Assessment):*

Geothermal extraction and related earthwork operations present ongoing threats to the geothermal features and vegetation of this site. Temperatures are cooling (D. Bowden, Contact Energy, pers. comm. 2011), wilding pines are continuing to establish, and geothermal vegetation has been cleared to make way for roads and infrastructure. Plantation management and harvesting operations are a potential threat to geothermal vegetation where it is adjacent to pine plantations.

*Grazing
(2011 Assessment):*

Grazing is not an issue at this site.

*Adjoining land use
(2011 Assessment):*

Geothermal power plant operations; plantation forestry; Waikato River.

Site Change:

Recent change:

Some wilding pine control has been undertaken at the site since 2004, however there are many areas in which pine encroachment is continuing to expand in extent.

An area of prostrate kanuka has been cleared for access tracks and laying of pipe.

A population of prostrate kanuka has established on bare ground near the marae, in an area that was previously mapped as nonvegetated raw-soilfield.

Historical:

In 1941 there was bare ground and low shrubland in the vicinity of this site, which may reflect more geothermal vegetation and habitat in the area (Historical photos: SN 172 Run 1167 Photos 7-9, 1941). Merrett & Burns (1998a) compared and interpreted aerial photographs from 1941 to 1996 and found that the total area of geothermal vegetation reduced between 1941 and 1981, with many areas colonised by wilding pines. In 1996, there was an increase in the extent of geothermal vegetation, probably as a consequence of fallen pines and recolonisation by prostrate kanuka. The density of weed species has steadily increased at this site since 1984.

The Ohaaki Power Station was commissioned in 1989. Prior to the development of field, the large boiling pool to the northeast of the site (Ohaaki Ngawha) was the most significant feature of the field, with its turquoise-blue water and extensive sinter terrace (Vaile 1939). When development commenced, the extraction of geothermal fluid made the water level at Ohaaki Ngawha drop. This changed the quality of the sinter terrace and allowed vegetation to establish on it. Most other features at Ohaaki have dried up because of the extraction of geothermal fluid. Before development, several types of geothermal features were present at Ohaaki including:

- several mud pools heated by steam;
- hot pools isolated from ground water by a layer of mineralised earth, also heated by steam;
- hot springs producing chloride water and deporting sinter.

Most of these features have since dried up and are now hot dry ground. However, the area of steaming ground has expanded. There is steam rising through the graves in the urupa to the northwest of the site, and the ground has opened up in places (<http://www.waikatoregion.govt.nz/Environmental-information/Geothermal-resources/Geothermal-systems-map/Ohaaki/> : Accessed 30 June 2011).

Land development has had significant impacts at the site, and some features are threatened by flooding of, and inundation by, the Waikato River (http://www.nzgeothermal.org.nz/nz_geo_fields.html#Ohaaki_Broadlands : Accessed 30 June 2011).

Environmental monitoring of this area over ten years prior to, and during, the development of the Ohaaki power project shows that significant changes to geothermal features have occurred in response to water draw-off for geothermal power generation. In the northwestern thermal area, all pools are now dry (other than Ohaaki Ngawha where the water level is artificially maintained) and geothermal vegetation is establishing on the exposed ground (Bromley *et al.* 1997). In some areas ground temperatures have decreased, but in others ground temperatures have increased, resulting in an increase in the extent of thermotolerant vegetation (Merrett & Burns 1998a).

Management Requirements:

Wilding pine and other pest plant species control should be ongoing.

Monitoring of steamfield management and the vegetation response to changing temperatures should be ongoing, including monitoring the *Dicranopteris linearis* population.

Future infrastructure developments on the site should aim to avoid the remaining areas of geothermal vegetation.

Significance Level:

Regional (Table 1 - Criteria 3, 5, 9; Table 2 - Factors 12, 14).

Significance Justification:

This site is of regional significance because it is a relatively large example of a nationally uncommon vegetation type (geothermal), contains a large population of an „At Risk’ species (prostrate kanuka), and a small population of *Dicranopteris linearis*, another „At Risk’ species.

Notes:

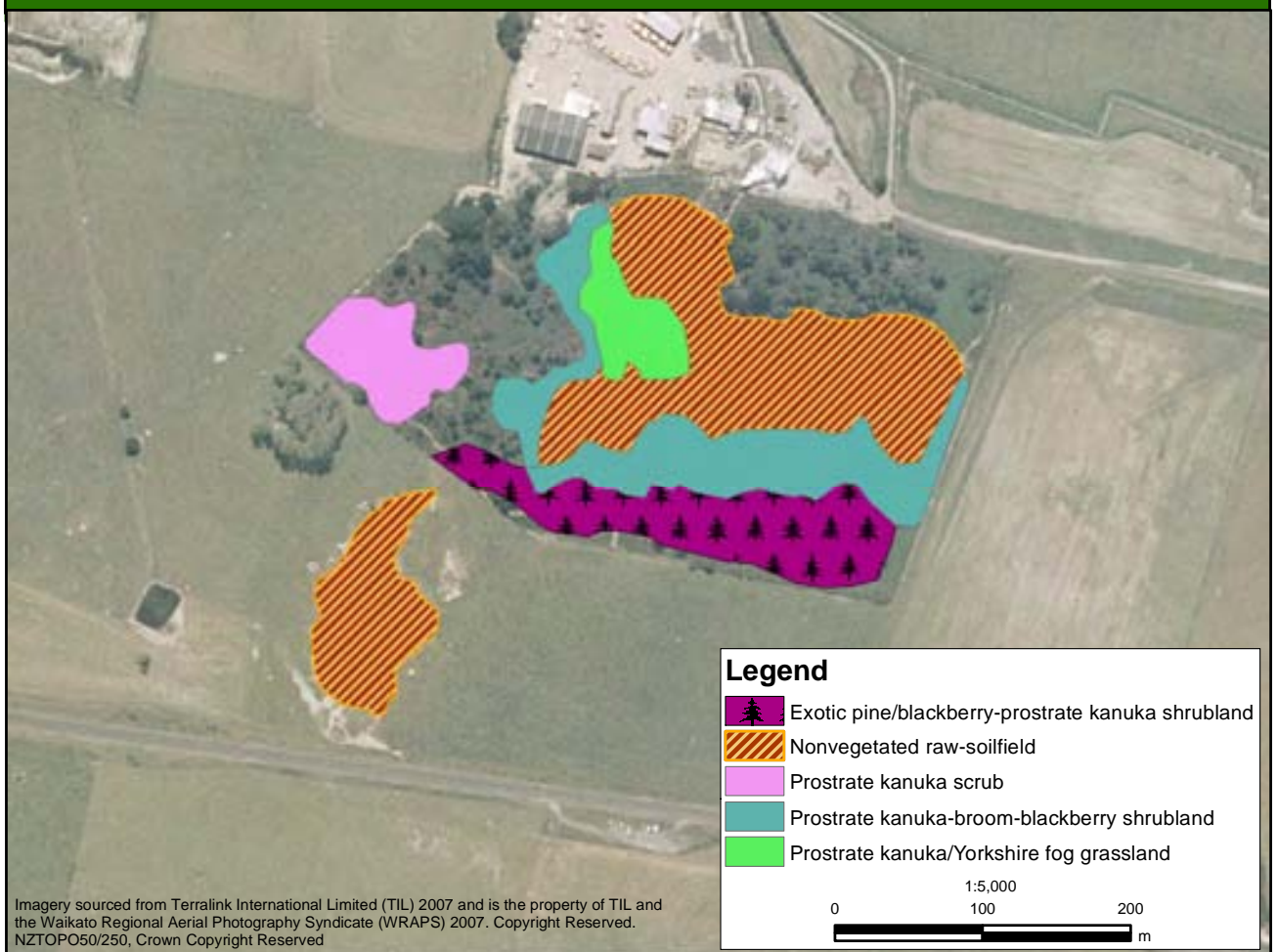
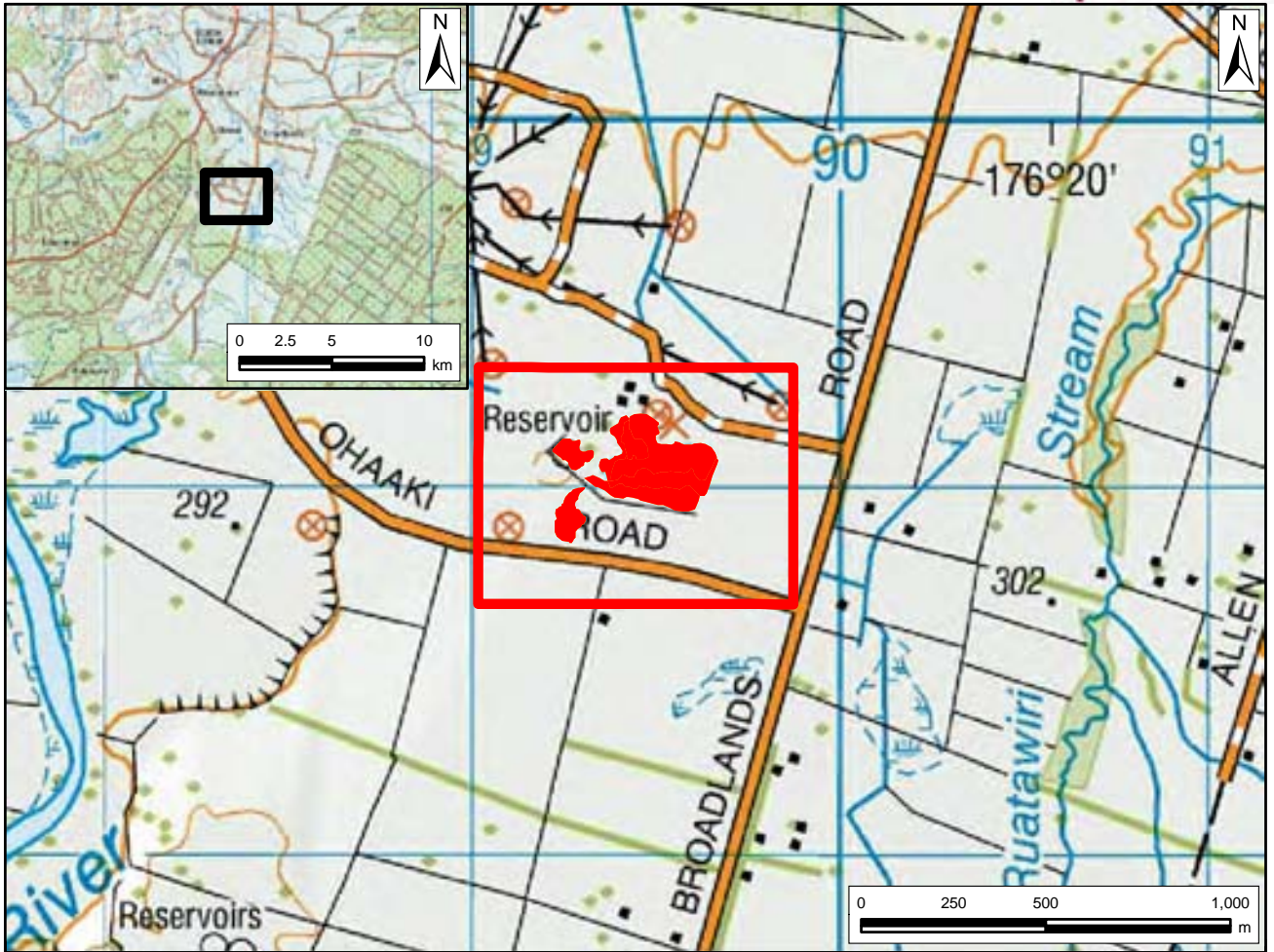
Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region. He ranked Ohaaki Ngawha, which occurs in this site, as Category C - the third highest category.

Merrett & Burns (1998a) suggest that the study area would rank in the Protected Natural Areas Programme as a level 2 priority for protection, and commented that “the conservation of thermotolerant vegetation at Ohaaki is moderately significant to the goal of maintaining adequate representative examples of the full range of natural vegetation present in the Atiamuri Ecological District.”

This site was called Ohaaki Steamfield 1 in Beadel & Bill 2000.

References:

Beadel & Bill 2000; Bromley *et al.* 1997; Given 1996; Merrett & Burns 1998a; Merrett *et al.* 2003; Vaile 1939; Wildland Consultants 2004.



OHAAKI STEAMFIELD EAST

Site Number: OHV02¹
Grid Reference: NZTopo50 BG37 895 291
GPS Reference: NZTM E1889483 N5729076
Local Authority: Rotorua
Ecological District: Atiamuri
Geothermal Field: Ohaaki
Bioclimatic Zone: Submontane
Tenure: Part unprotected private land, part protected (QEII)
Altitude: 305 m
Extent of Geothermal Habitat: c.6.8 ha
Extent of Geothermal Vegetation: c.6.8 ha
Date of Field Survey: 28 January 2011

Code	Type	Landform	Extent
04.01 04.01.01	Prostrate kanuka-dominant scrub Prostrate kanuka scrub Prostrate kanuka scrub dominates this area with occasional patches of manuka scrub. Mingimingi, monoao, Spanish heath, broom and bracken are present on the margins with scattered emergent radiata pine and maritime pine, and small areas of raw-soilfield and moss patches are also present.	Geothermal basin	c.0.5 ha
05.01 05.01.13	Prostrate kanuka-dominant shrubland Prostrate kanuka-broom-blackberry shrubland Occasional maritime pine and radiata pine are emergent over prostrate kanuka, broom and blackberry. Yorkshire fog, lotus, fleabane and gorse are also present.	Geothermal basin	c.1.5 ha
05.13 05.13.02	Blackberry-dominant shrubland Exotic pine/blackberry-prostrate kanuka shrubland Scattered maritime pine and radiata pine occur over blackberry, broom, Spanish heath, gorse, and manuka, with patches of prostrate kanuka in thermal areas.	Geothermal basin	c.1.2 ha
08.01 08.01.02	Yorkshire fog-dominant grassland Prostrate kanuka/Yorkshire fog grassland Scattered patches of prostrate kanuka occur throughout Yorkshire fog grassland. Fleabane, grey willow and bracken occur on the margins.	Geothermal basin	c.0.4 ha
28.01 28.01.01	Nonvegetated raw-soilfield Nonvegetated raw-soilfield In the south of this site, geothermal bare ground is surrounded by Indian doab. Within the portion of this site that is protected by a QEII covenant, geothermal clays support scattered plants of prostrate kanuka, fleabane, lotus and Yorkshire fog.	Low hills	c.3.1 ha

Indigenous Flora: Prostrate kanuka, „At Risk-Naturally Uncommon’ (de Lange *et al.* 2009) is present at this site. Arrow grass, generally a coastal species which occasionally occurs inland, has been recorded at the site in the past (Burns 1997a).

¹ Previously identified as U17/14 in Wildland Consultants (2004).

Fauna: Common indigenous and introduced bird species typical of the habitat are present including spur-winged plover, chaffinch, Californian quail, house sparrow and fantail.

Cat sign was noted during this survey.

Current Condition (2011 Assessment): Given (1989a) and Burns (1997a) noted that the quality of this site had deteriorated due to rubbish disposal, effluent from the lucerne drying plant polluting the ponds, and an increase in adventive weeds. Geothermal wastewater is no longer discharged into this site from the former lucerne-drying plant but the landowner is investigating options for reinjection. There is no longer open geothermal water here.

The landowner has recently mulched a track through the blackberry and has started to fell wilding pines. An area of pines (outside of the site) has been felled and cleared and this area will be part of a site-wide restoration/planting programme the landowner wishes to undertake. To ensure that this will successfully protect and enhance the natural values of the site the landowner will require some advice and/or assistance. A restoration plan to guide this process should be prepared.

The site is currently in relatively poor condition, with abundant pest plants and recent human disturbance, however values are likely to be improved if management of site threats is undertaken.

**Threats/Modification/
Vulnerability:**

Invasive pest plants (2011 Assessment): Weeds are abundant, particularly blackberry, pines, Spanish heath, and broom which together cover c.50% of the site. Hot spots appear to be resistant to weed invasion as long as the indigenous vegetation remains free from disturbance. A single mature lodgepole pine (with cones) is present in this site.

Human impacts (2011 Assessment): Ohaaki Power Station draws water from the underlying geothermal resources and this may potentially affect features dependent on geothermal heat. However, to date there is no evidence of cooling or heating of the site (Burns 1997a; Merrett & Burns 1998a).

Geothermal wastewater dumping into this site has ceased in the last four or five years, but reinjection options are being considered.

Tracks cut through the site to gain access for weed control have, on the whole, been located through blackberry, but prostrate kanuka seedlings were noted along the newly formed track and may continue to grow on the disturbed sites.

Grazing (2011 Assessment): Most of this site is fenced to exclude domestic livestock but one area of nonvegetated raw-soilfield is in a grazed paddock.

Adjoining land use (2011 Assessment): This site is mainly surrounded by farmland with the Ohaaki Thermal Kiln operation on the northern margin.

Site Change:*Recent change:*

With no geothermal wastewater entering the centre of this site, and no geothermal water present, vegetation changes have occurred since the site was last mapped in 2004. Prostrate kanuka has become established on part of what was previously nonvegetated raw-soilfield.

Blackberry appears to have increased in its dominance, particularly in the southern half of the site (the fenced portion).

Historical:

In 1941 (Historical photos: SN 172 Run 1169 Photos 27-29, 1941) the site appeared to be in a considerable better ecological condition. The western part of the site was not farmed and appears to be in shrubland. Exotic trees were not a major component of the site in 1941, and there were no impacts from the industrial site to the north. The eastern part of the site appeared to be in pasture, whereas part of this area is now fenced to exclude stock. The scrub vegetation appears very similar in character to geothermal and non-geothermal habitat, so the exact reduction as a percentage loss of geothermal vegetation at the site is difficult to determine. The vegetation present is likely to be of a significantly higher quality due to the lack of pest plants and industrial waste. A crude estimate is that it is likely that there was *c.* 10-25% more geothermal vegetation and habitats at this site in 1941 than in 2007. The extent of nonvegetated raw-soilfield is also greater.

Management Requirements:

Adventive weeds that need to be controlled at this site include wilding pines, blackberry, Spanish heath and gorse. The existing, recently-formed tracks could be used to provide access for weed control and planting, but they should be allowed to be naturally reduced in width as the prostrate kanuka re-establishes.

Ideally, the site requires a long term restoration implementation plan to ensure that weed control and planting operations are appropriate, and that the ecological values of the site are protected and enhanced.

Options for injecting geothermal water will probably also need to be assessed by engineers and geologists.

Significance Level:

Regional (Table 1 - Criteria 2, 3, 5; Table 2 - Factors 1, 14).

Significance Justification:

Ohaaki Steamfield East is of regional significance because it is partially protected by a QEII National Trust covenant and is a relatively large example of a nationally uncommon habitat type. It contains a good population of an 'At Risk' species (prostrate kanuka).

Notes:

Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region, and in this study, this site was classed as Category B - the second highest category.

This site was called Ohaaki Steamfield 2 in Beadel & Bill 2000.

References:

Beadel 1986; Beadel & Bill 2000; Burns 1997a; Given 1989a & 1996; Merrett & Burns 1998a; Merrett *et al.* 2003; Wildland Consultants 2004.

