Review of groundwater in the Lake Rotorua catchment

Confidential

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ENVIRONMENT BAY OF PLENTY

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EXECUTIVE SUMMARY

Environment Bay of Plenty commissioned the Institute of Geological and Nuclear Sciences to complete a review of groundwater in the Lake Rotorua catchment, particularly in regard of nutrient inflows to Lake Rotorua.

The geological structure of the Lake Rotorua catchment was mostly built in four phases:

- 2 million to 220 thousand years ago when volcanic activity from Taupo Volcanic Zone calderas deposited ignimbrites in the Lake Rotorua catchment
- 220 thousand to 200 thousand years ago when the Mamaku eruption and caldera collapse formed Lake Rotorua
- 200 thousand to 60 thousand years ago when a period of relatively quiet volcanic activity ended with the Rotoiti eruption from the Okataina Volcanic Centre
- post 60 thousand years ago when numerous eruptions from the Okataina Volcanic Centre, with the most recent from Tarawera Volcano in 1886, deposited numerous tephra layers in the Lake Rotorua catchment

Major aquifers in the Lake Rotorua catchment include:

- Mamaku Ignimbrite which consists of three main subunits (lower, middle and upper)
- Huka Group sediments including sandstones and siltstones

Geophysical measurements in the catchment identify three geothermal fields:

- Rotorua, including the area Whakarewarewa and Lake Rotorua with off-shore geothermal spring discharge
- Rotokawa, including springs discharging with Lake Rotokawa and possible lake-floor discharge
- Tikitere, which discharges into Waiohewa Stream and then into Lake Rotorua. This field also discharges into Lake Rotoiti.

Geothermal sources make a significant contribution to the nitrogen and phosphorous fluxes entering Lake Rotorua but fluxes are unlikely to be as large as indicated by previous studies.

- Rotorua geothermal field contributes, via streams and lake bed springs, 19 tonnes/year total nitrogen and 2.8 tonnes/year total phosphorous to Lake Rotorua
- Tikitere geothermal field contributes, via Waiohewa Stream, 27 tonnes/years total nitrogen and 0.09 tonnes/year total phosphorous to Lake Rotorua

Groundwater quality is impacted by agricultural land use in the catchment as elevated concentrations of nitrate-nitrogen are measured. Phosphorous concentrations in groundwater appear to result from natural leaching from ignimbrite and rhyolite rocks. Most groundwaters have low concentrations of Fe and Mn and this indicates that the aquifers are predominantly oxic or only moderately anoxic.

Thirteen ‘major’ groundwater subcatchments, and ‘minor’ subcatchments, are defined in the Lake Rotorua catchment. Groundwater recharge to these catchments is estimated assuming 52% of rainfall goes to groundwater. Total rainfall recharge on the groundwater catchment of 15.82 $m^3 s^{-1}$ is consistent with a published estimate of Lake Rotorua inflow from streams and the ungauged catchment of 15.8 $m^3 s^{-1}$.

Eight subcatchments, totalling 4843 ha in area, have no associated major streams; groundwater discharge from these subcatchments will probably occur directly to Lake Rotorua through wetlands, small streams or lake-bottom springs.

Gaps in information about the groundwater resource are identified, including poor knowledge on: rainfall recharge, boundaries of the catchments of springs, groundwater and nutrient flows in the ungauged catchment and groundwater levels. An assessment of these gaps indicates that:

- information to assess groundwater flow and nutrient fluxes is inadequate in eight major subcatchments
- existing groundwater chemistry information is generally inadequate to assess groundwater nutrient fluxes

1.0 INTRODUCTION

This report presents the first draft of a review of groundwater in the Lake Rotorua catchment for Environment Bay of Plenty (EBOP) completed by the Institute of Geological and Nuclear Sciences. This report aims to assess existing groundwater information, particularly as related to Lake Rotorua pollution and the potential groundwater pathways of nutrients from the catchment to the lake.

The report reviews geology (Section 2), geophysics (Section 3), groundwater use and aquifer properties (Section 4), groundwater quality (Section 5), geothermal resources (Section 6), groundwater levels, groundwater recharge, and surface-groundwater interaction (Section 7).

A set of 13 'major' groundwater subcatchments of the Lake Rotorua catchment are defined in Section 7 and groundwater-related properties of these subcatchments are summarised in Section 8 with an assessment of knowledge gaps.

2.0 GEOLOGY

2.1 Geological history of Rotorua

The geological history of the Rotorua area is summarised into four main stages (Figure 2.1). We have taken these four stages to be the periods of most significant volcanic activity affecting the Lake Rotorua catchment. There have been other, large volcanic events that have formed the geology around Rotorua, including the formation of Kapenga Caldera to the south of Rotorua City.

Stage 1: Taupo Volcanic Zone (TVZ) Age: 2 million to 220 thousand years ago

The earliest eruptions from the TVZ are thought to have occurred around 2.1 million years ago (Carter et al., in press). Initial TVZ eruptions originated from Maroa, Whakamaru and Mangakino calderas. Deposits from these calderas are the oldest yet dated in the TVZ. The Waiotapu Ignimbrite (about 750 thousand years ago) has the oldest absolute age (determined by radiometric decay) for a TVZ pyroclastic deposit in the Rotorua area. Older ignimbrites (as yet undated) found in the Rotorua area, stratigraphically below the Waiotapu Ignimbrite, are the Akatarewa Ignimbrite and Unit X of Grindley et al. (1994).

Around 330 thousand years ago (330 ka), the Whakamaru Group Ignimbrites were erupted out of the Maroa caldera. This explosive phase of volcanism probably caused significant crustal readjustment in the north Taupo area (Wilson et al., 1995).

Eruptions from the Okataina Volcanic Centre (OVC) produced widespread pyroclastic flows from at least 300 ka; the earliest date determined so far is 380 ka from the “quartz-biotite tuffs” (Nairn, 2002). From about 300 ka to 220 ka, a series of eruptions (e.g. Matahina, Pokopoko and Onuku) from OVC have produced thick pyroclastic flows that have been deposited around the Rotorua district.

Stage 2: Rotorua Caldera Age: 220 thousand to 200 thousand years ago

Included in this stage of Rotorua activity is the Mamaku eruption associated with Rotorua Caldera collapse and the eruption of the resurgent dome complex - Mt. Ngongotaha.

The Mamaku eruption was triggered by an andesite intrusion into a pre-existing rhyolite magma chamber at a relatively shallow depth (Milner et al., 2003). The relatively hot andesite dyke caused the rhyolite magma to heat and overturn, causing increased pressure on the overlying crust. This increased pressure lead to fault rupture and created pathways for gas, and eventually magma, to rise rapidly. Numerous pyroclastic flows erupted horizontally because rapid vesiculation of the magma created a very explosive eruption that probably could not sustain a buoyant plume of ash and pumice. Constant eruption of the rhyolite magma reduced the buoyancy of the overlying crust and so that crust foundered in numerous block collapse events. The resulting pyroclastic deposit is greater than 1 km thick within the caldera. The Mamaku Ignimbrite covered approximately 3,200 km^2 with an estimated 145 km^3 of equivalent magma volume (Milner et al., 2003).

Soon after the Mamaku eruption, a lake began to form in the ring-faulted depression. This resulted in the deposition of lake sediments, consisting of fine ash and pumice – Huka Group sediments.

At some time after major collapse of the caldera, the Mt. Ngongotaha resurgent dome complex began to develop. The timing of this event is difficult to determine due to the poor quality of dates on the dome lavas. However, this dome complex was erupted some time after the Mamaku eruption and probably took between at least 10 years to grow to its present form.

Almost immediately after the Mamaku eruption, another explosive event deposited the Ohakuri Group of pyroclastic flow and fall deposits. The source of this event is from a previously unidentified caldera to the south east of Rotorua (Gravley et al., 2003). This event was possibly triggered by the significant faulting during, and following, the Mamaku eruption. Chemistry of the two deposits are similar, therefore a common parent magma may have been tapped by each of these eruptions (Gravley et al., 2003).

Stage 3: Okataina Volcanic Centre Age: 200 thousand to 60 thousand years ago

This period in geological history around Rotorua is relatively quiet. A maximum Lake Rotorua highstand was reached immediately after the Mamaku eruption. Subsequent eruptions mainly produced widely dispersed, but relatively thin, pyroclastic fall deposits from the OVC. Periodic lake level rises followed the influx of volcanic material during an eruption due to periodic damming of drainage pathways. The constant changes in lake level resulted in widespread and variably thick Huka Group sediments in the Rotorua Caldera.

The Rotoiti Eruption was a significant caldera-forming eruption at 60 thousand years ago from within the northern OVC. Numerous non-welded pyroclastic flows were produced with associated airfall. Pyroclastic flows were emplaced mainly to the north and the generation of these flows was probably due to the collapse of high, buoyant, plumes. Tephra associated with this eruptive event was carried by the prevailing westerly winds to the east of the central and northern North Island.

Stage 4: Okataina Volcanic Centre Age: Post 60 thousand years ago

No major caldera-forming eruptions have occurred from OVC in the last 60,000 years. Relatively small, yet frequent, plinian airfall deposits have been dispersed throughout the Rotorua area.

From approximately 40 ka to 30 ka, rhyolitic eruptions from the northern part of Haroharo Caldera formed a thick group of pyroclastic deposits, termed the Mangaone Subgroup (Jurado-Chichay and Walker, 2000). Nine explosive, plinian-sized eruptions have been defined based on stratigraphy and were mainly dispersed to the north and east of OVC (Jurado-Chichay and Walker, 2000).

The Oruanui Eruption has been the most explosive and largest volume Taupo Volcanic Centre eruption in its history. This event, at 26.5 ka erupted into Lake Huka causing interaction of rhyolite magma and lake water. Lake Huka had filled the tectonically-controlled depression between Taupo and Reporoa. This eruption covered approximately 10,000 km^2 in fine ash and pumice with an estimated magma volume of 320 km^2 (Wilson, 2001).

From around 25 thousand years ago, numerous plinian and sub-plinian eruptions have deposited widely-dispersed tephra and locally-dispersed tephra from buoyant ash plumes. The sources of all these eruptions have been mostly from Haroharo Caldera within the OVC. Within Haroharo Caldera, Haroharo and Tarawera Vent Zones have been the most active vents. Rare eruptions from the Okareka Embayment have impacted on the Rotorua Catchment, such as Te Rere and Rotorua tephras.

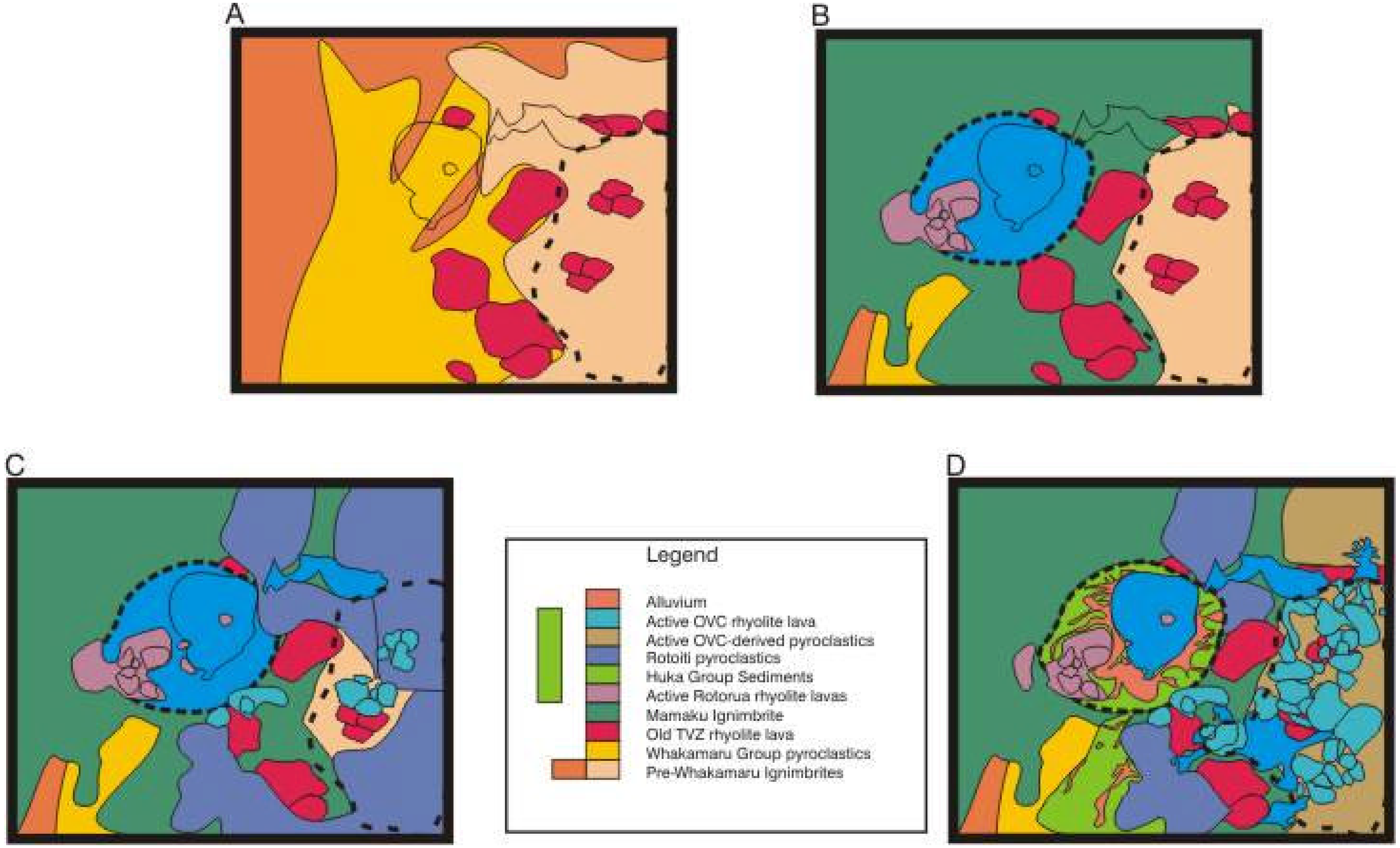

Figure 2.1 Schematic model of the four stages of volcanic geology growth in the Rotorua area. A) 2 million years to 220 thousand years at the point of transition between CVZ and Taupo Volcanic Zone (TVZ). Large eruptions from Maroa and Kapenga calderas, and the early stages of Okataina Volcanic Centre (OVC) sent large volume pyroclastic flow and fall deposits into the Rotorua area. B) The Rotorua Caldera forming Mamaku eruption between 220 and 200 thousand years ago. A widely dispersed and locally thick pyroclastic flow was emplaced. Rapid withdrawal of magma caused multiple block collapse of the crust. Resurgent dome growth occurred soon after the explosive eruption resulting in the coalesced Mt. Ngongotaha. C) Frequent eruptions from OVC between 200 and 60 thousand years ago deposited numerous non-welded pyroclastic fall and flow deposits into the Rotorua catchment. The Rotoiti eruption may have blocked the outlet from Lake Rotorua, causing lake level rise. This eruption caused partial collapse of Haroharo Caldera in OVC. D) At present, OVC is considered active, which results in periodic deposition of ash into the Rotorua Catchment.

The two most recent eruptions from the OVC have both erupted from Tarawera Volcano. The Kaharoa eruption ~ 1315 AD, was a large, explosive, rhyolitic eruption that deposited tephra as far north as Whangarei. The 1886 Tarawera eruption was an explosive, basaltic, eruption.

2.2 Lake level history of Lake Rotorua

The Rotorua depression formed with the structural collapse of Rotorua Volcano; an event that has been associated with the deposition of the voluminous Mamaku Ignimbrite that both in-fills and surrounds the depression. A group of rhyolite domes appear to have been extruded along the caldera margin and are thought to be contemporaneous with this structural collapse (Milner et al., 2002), including Hamurana, Endean, Pukehangi, and Pohaturoa Rhyolite Domes. Another group of geochemically similar intracaldera domes formed later, and includes the Ngongotaha and Rotorua City domes; these have not yet been dated.

Initial sediment inputs after the Mamaku Ignimbrite eruption sequence were probably debris flow deposits derived from the caldera wall. These deposits were interbedded with lake sediments as water began to drain into the newly formed depression. Figure 2.2 shows the modelled timeline of events that contributed to the deposition of these lacustrine sediments in the Rotorua area (Marx, in prep). This timeline of events is taken from a recently submitted MSc thesis from Otago University. There are some alternative interpretations of the lake level history including the draining of Lake Rotorua into the Okataina Volcanic Centre (Hodgson & Nairn, 2004) however this is the most recent focused study on the lake level history since Kennedy et al. (1978). Further publication from W. Esler and/or I. Nairn (pers comm.) may provide an alternative interpretation or rewrite the timing, and possibly magnitude, of lake level fluctuations.

At about 220 thousand years ago, the Rotorua Volcano erupted and the Mamaku Ignimbrite was deposited. Structural collapse during the eruption formed the Rotorua Caldera. Soon after this collapse event, numerous caldera margin rhyolite domes begin to form. Debris flows and weak pyroclastic eruptions deposited pumice and ash and interbedded lake sediments within the Rotorua Caldera.

The maximum highstand of Lake Rotorua occurred after the Mamaku eruption. Lake sediments are found at elevations ranging from 350 - 415 m above sea level (asl). This highstand probably resulted in a natural dam breach through the Hemo Gorge, as this is the only break in the Rotorua Caldera wall. The Hemo Gorge outlet may have drained Lake Rotorua into the Waikato River, as suggested by Kennedy et al. (1978).

A period of tectonic downfaulting in the Tikitere Graben in the northeast of the Rotorua Caldera probably caused Lake Rotorua to drain into the Rotoiti Channel. At around 60 thousand years ago the eruption of numerous non-welded pyroclastic flows, including the Rotoiti and Earthquake Flat eruptions, blocked the Rotoiti Channel creating a wide, natural dam. A highstand of ~370 m asl may have lasted for a long period of time, as indicated by the presence of numerous (45 - 25 ka) Mangaone Subgroup tephra deposits interbedded with lake sediments.

Natural dam breach within the Rotoiti Channel is probably brought on by downward movement in the Tikitere Graben. This probably led to the lake overtopping the dam, causing rapid erosion of the non-welded pyroclastic material. It is possible that a dam breakout occurred, which may have dropped the lake level to ~320 m asl, as indicated by the presence of littoral terraces at this elevation and ~36 ka age tephra deposits.

Approximately 36 thousand years ago, the Hauparu Tephra (a very explosive eruption with wide dispersal) may have created another natural dam in the Rotoiti Channel. This dam probably raised the lake level ~20 m. Due to the weak nature of this tephra dam, a highstand shoreline was short-lived. Failure of the dam was probably caused by piping and/or overtopping. Only weakly developed terraces are seen at this level throughout the Rotorua area. Lake level probably returned to its pre-tephra dam level of ~320 m asl.

Approximately 9 thousand years ago, lava flows were generated during the Rotoma eruptive episode. These flows probably blocked the Rotoiti Channel causing a period of lake level rise (Nairn, 2002). This resulted in a highstand ~330 m asl. Prior to this event, and subsequent highstand, Lake Rotorua is thought to have been ~277 m asl (Kennedy et al., 1978). Presumably, the level of Lake Rotorua has since gradually lowered to the present level at around 278 m asl, with gradual incision of the outlet.

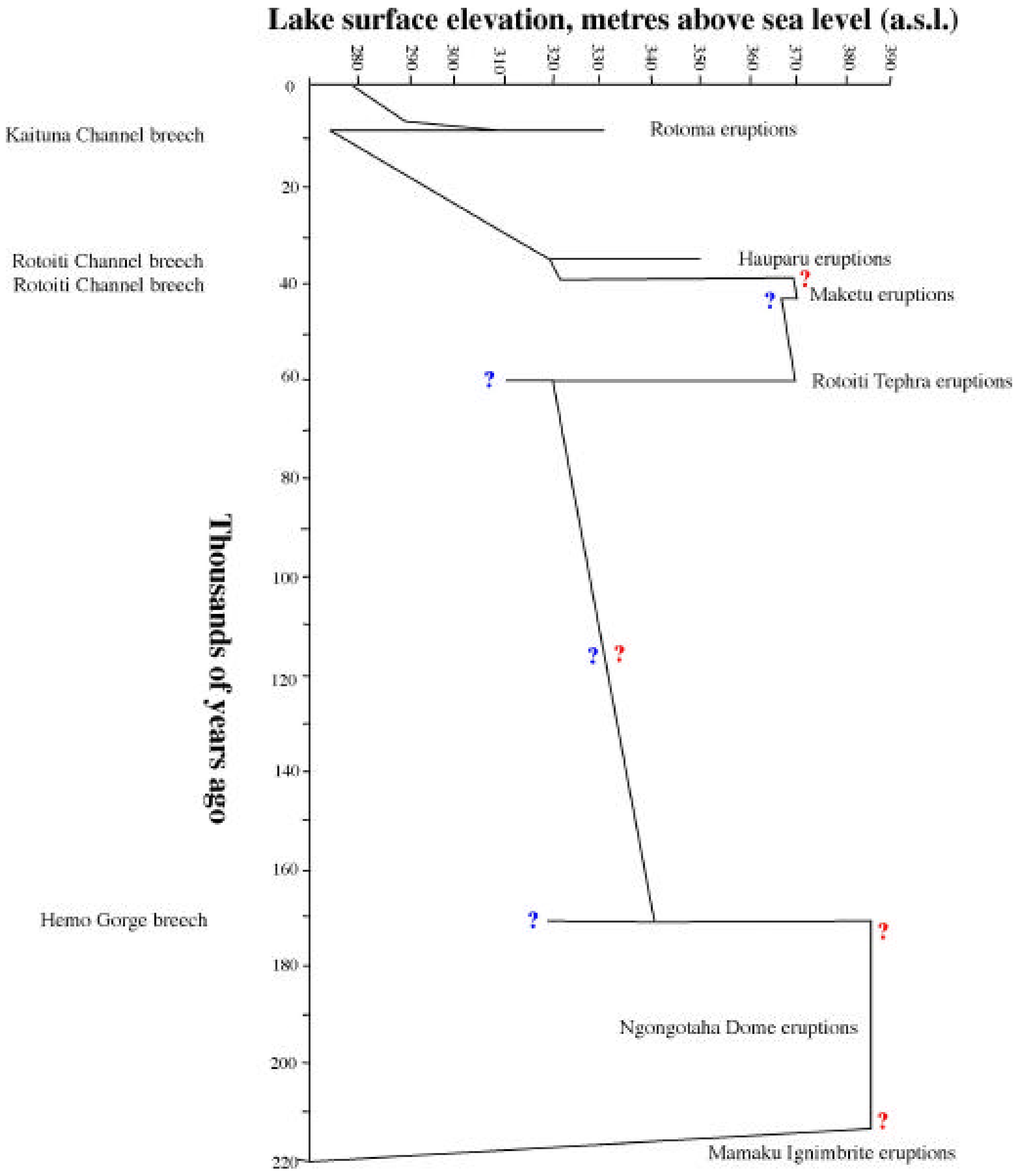

Figure 2.2 A timeline of events in the geological history of Lake Rotorua. Red question marks indicate uncertainty in time and blue question marks indicate uncertainty in elevation. The present level of Lake Rotorua is maintained at ≈278 m a.s.l. by control gates at Okere Falls, near the outfall of the Kaituna River on Lake Rotoiti (Marx, in prep).

2.3 Lithological description

The geology of the Rotorua catchment is rather complex. There are a number of distinct ignimbrite sheets, coalesced and solitary rhyolite domes, and sedimentary units. Here we describe the geological units that affect the hydrological model. We have described most units stratigraphically above the Whakamaru Group pyroclastics, as these deposits are considered to be the most likely to be aquifer sources for Lake Rotorua.

2.3.1 Whakamaru Group pyroclastics Age: ~330 thousand years ago

The Whakamaru Group of ignimbrites forms the most basal units for groundwater aquifers in the Rotorua catchment. A period of frequent explosive eruptions sent extensive ignimbrite sheets from a probable source in Maroa Caldera to the north (Wilson et al., 1995). This phase in Taupo Volcanic Zone (TVZ) volcanism resulted in major crustal readjustment in the north Taupo area. Some of the Whakamaru Group (especially the 'quartz-biotite tuffs') could have been erupted from Okataina Volcanic Centre (OVC) due to the presence of biotite and hornblende-rich units (Nairn, 2002). In the Rotorua area, drillholes have penetrated at least 100 m of Rangitaiki Ignimbrite; part of the Whakamaru Group ignimbrites (Nairn, 2002).

In general, the Whakamaru Group pyroclastics are non-welded to moderately welded with some jointing observed in the eastern margin of the Puhipuhi Basin in the OVC. The distinguishing feature of these ignimbrites is that they are dark grey, crystal-rich, with abundant, large and heavily embayed quartz crystals.

2.3.2 Pokai and Waimakariri pyroclastics Age: 270 thousand years ago

These two pyroclastic units have been combined on the geological map due to their common distribution and close age relationship. Only recent and detailed studies (e.g. Lynch-Blosse, 1998) have distinguished the geochemical, petrological and stratigraphic differences between the two units. Pokai pyroclastics were erupted from the Kapenga Caldera to the southwest of Rotorua City (Lynch-Blosse, in prep.). Waimakariri pyroclastics were erupted from a newly-defined caldera buried beneath the Mamuku Ignimbrite under the Mamaku plateau. This source is based on new gravity interpretations and physical characteristics of the deposits (Lynch-Blosse, in prep.). Both ignimbrites are stratigraphically above the Whakamaru Group ignimbrites and below the Mamaku Ignimbrite.

Pokai and Waimakariri pyroclastic deposits outcrop on the surface to the southwest of Rotorua City (Figure 2.3). The volume and distribution of the deposits is difficult to determine, but with information from groundwater and geothermal drillholes around Rotorua, a probable distribution has been developed by Lynch-Blosse (in prep). Generally, the Pokai and Waimakariri pyroclastics have been deposited to the east and north of their respective vents. These deposits are basal units of the Mamaku Plateau.

The Pokai Ignimbrite is a densely to partially welded, grey to dark grey sandy ignimbrite. It is lithic and pumice-rich but crystal poor. There appears to be only one, thick flow unit described in the literature. The Waimakariri Ignimbrite is a moderately to densely welded, sandy ignimbrite (Lynch-Blosse, in prep).

2.3.3 Onuku-Pokopoko pyroclastics Age: >220 thousand years ago

These pyroclastic units may be correlated and have been combined in Figure 2.3 (Nairn, 2002). The Onuku pyroclastics contain numerous pyroclastic flow and fall deposits with some weak soil development in between, which indicates the deposits were emplaced over many years. The source the Onuku pyroclastics is probably within OVC, based on greatest mapped thickness. The Pokopoko pyroclastics are very coarse near Lakes Okataina and Okareka, which indicates a source close by. Its source is probably from the vents within the western part of the OVC.

Limited outcrops of the Onuku-Pokopoko pyroclastics are found within the Rotorua catchment.

Onuku pyroclastics comprise moderately compacted pumice-rich pyroclastic fall and flow units. The fall units are shower-bedded and are intercalated with the locally thick pyroclastic flow units. Pokopoko pyroclastics contain moderately compacted to welded pyroclastic flow units. Most of the flow units are crystal-poor (Nairn, 2002).

The Pokopoko pyroclastics exceed 120 m in depth near lakes Okareka, Tarawera and Okataina (Nairn, 2002). The geology in groundwater drillholes at Mamaku Township, where drilling penetrated through about 15 m of Pokopoko pyroclastics (Wood, 1985), indicate that pyroclastic flows probably didn't reach too far to the west beyond the town. These deposits were subsequently buried beneath the Mamaku Ignimbrite.

2.3.4 Mamaku pyroclastics Age: 220 thousand years ago

The Rotorua Caldera was formed during a large, explosive, rhyolitic eruption. During this eruption, a voluminous and widespread pyroclastic flow was directed towards the west, north and southwest of the Rotorua Caldera (Milner et al., 2003). The resultant Mamaku Ignimbrite (and minor ash fall units) caps the gently dipping surface on the Mamaku Plateau.

The Mamaku pyroclastics thin with distance from the vent. Within the caldera, the thickness of the ignimbrite is thought to reach at least 1 km or greater, based on gravity and magnetic surveys (Rogan, 1982). To the west at Mamaku township, the Mamaku pyroclastics are approximately 50 m thick (Wood, 1985) and are the main geological unit in the Rotorua catchment. Near Kaharoa, the Mamaku Ignimbrite is at least 140 m, based on groundwater bore data (Nathan, 1975).

The Mamaku Ignimbrite consists of three main subunits; lower, middle and upper (Milner et al., 2003). The upper and lower subunits are non-welded and predominantly fine-grained. On the Mamaku plateau to the west of the caldera, the upper Mamaku Ignimbrite is seen in road cuts on SH5 as a pinkish-grey, fine grained ignimbrite. The middle subunit is strongly welded with cooling joints that are 0.5 m to 4 m wide (Milner et al., 2003).

2.3.5 Young Rotorua rhyolite lava Age: <220 thousand years ago

Due to the lack of dating on these rhyolite lavas, it is difficult to determine their relative age. However, the extrusion of these lavas must have followed the Mamaku eruption, as the domes have been erupted through the pre-existing ignimbrite sheet. The coalesced domes of Mt. Ngongotaha were probably extruded along caldera margin faults soon after the Mamaku eruption.

Young Rotorua rhyolite lavas are solely exposed to the west of Rotorua City (Figure 2.3). This restricted locality may be due to the position of rhyolite magma as it degassed or due to ascent of magma along open fault planes.

A model sequence of rhyolite lava textures is seen at the Ngongotaha quarry. Outcrops of the outer spherultic and obsidian zone, and also the inner, flow banded and massive zones can be accessed in the active quarry faces. No pumiceous carapace to the lavas is seen, probably due to the age of the dome complex as this material is easily eroded with time.

2.3.6 Rotoiti pyroclastics and Earthquake Flat Breccia Age: 62 thousand years ago

The Rotoiti pyroclastics is a composite term for the entire Rotoiti eruptive sequence, including numerous, widespread, fall deposits (Rotoehu Tephra) underlying, intercalated and overlying climactic flow deposits (Rotoiti Ignimbrite) (Nairn, 2002). These multiple flow units of the Rotoiti Ignimbrite are wholly non-welded and are up to 100 m thick north of Haroharo Caldera. Tephra dispersal indicates the Rotoiti pyroclastics were erupted from the northern part of Haroharo Caldera, within OVC. Crustal collapse within Haroharo Caldera probably occurred during and immediately after the Rotoiti eruption.

The series of non-welded pyroclastic flow units were deposited primarily to the north and west of Haroharo Caldera. These ignimbrites are generally non-welded, fine to coarse grained and crystal-rich. Some of the flows are present to the north and northeast of the Rotorua catchment. According to Kennedy et al. (1978) the emplacement of the Rotoiti Ignimbrite blocked the established drainage pathway of Lake Rotorua at Ohau Channel. This caused Lake Rotorua to fill, resulting in overtopping of the pyroclastic dam (see section 2.3). A dramatic breakout flood rapidly drained the lake by about 50 m through the current Ohau Channel, into Lake Rotoiti and the Kaituna River.

The widely dispersed and fine-grained Rotoehu Tephra is approximately 5 m thick on the eastern side of Lake Rotorua and has been found as far a field as Mayor Island, Hawkes Bay and Gisborne (Nairn, 2002).

A significant reworked component of the Rotoiti pyroclastics is very fine to fine grained and is rather variable in thickness within the Rotorua catchment.

The Earthquake Flat Breccia erupted from the Kapenga caldera to the southwest of Rotorua City. Due to the close time relationship between the Rotoiti and Earthquake Flat deposits, it is possible that the Rotoiti eruption may have caused major crustal disruption in the Rotorua region and this may have lead to the onset of the Earthquake Flat Breccia eruption. The Earthquake Flat Breccia is predominantly a composite pumiceous flow deposit consisting of numerous flow units and was emplaced widely into the Lake Rotorua catchment.

2.3.7 Huka group sediments — Age: 220 to 20 thousand years ago

Lake sediments were initially deposited immediately after the Mamaku eruption, where Lake Rotorua began to fill the caldera. A large area of these lake sediments marks the aerial extent of the post-Mamaku and post-Rotoiti Ignimbrite highstand shorelines (Marx, in prep). During these two periods of high lake levels, periodic influx of volcanic material from the frequently active OVC added volcanic ash and pumice to the lake bottom. Periods of volcanic quiescence allowed for diatomaceous silts to be deposited. The two major highstand lake levels probably forced the drainage of Lake Rotorua through the Hemo Gorge and possibly into the Waikato River (Kennedy et al., 1978; Marx, in prep.). After the lake level dropped and the Huka sediments were exposed, erosion began to incise shallow gullies into the fine sediments.

Huka Group sediments include sandstones and siltstones of reworked volcanic material with minor diatomite. An 80 m maximum thickness of Huka Group sediments has been drilled in some geothermal and groundwater wells in Rotorua. Some interbedded gravels and primary pyroclastic deposits are found within the sediments. These sediments have been locally baked and deformed at Whakarewarewa and Tikitere by geothermal activity.

2.3.8 Holocene Alluvium — Age: <20 thousand years ago to present

The most recent geological unit in the Rotorua catchment, Holocene alluvial deposits infill the gullies eroded into the Huka Group sediments after the lake level dropped about 20,000 years ago. These alluvial deposits are rather localised in the catchment and bring unconsolidated tephra and eroded and reworked Huka Group sediments into Lake Rotorua.

Generally the Holocene Alluvium consists of ash and pumice gravels derived by the erosion of the numerous pyroclastic deposits in the Rotorua Basin (Nairn, 2002).

2.4 Hydrogeology

Eight potentially important groundwater-bearing formations have been identified in the lake Rotorua catchment. These are (from oldest to youngest):

- Pokai and Waimakariri pyroclastics
- Onuku – Pokopoko pyroclastics
- Old TVZ rhyolite lava
- Mamaku pyroclastics
- Rotorua active TVZ rhyolite lava
- Rotoiti pyroclastics
- Huka Group sediments
- Holocene alluvium

The lateral continuity of the older formations (pre-Mamaku pyroclastics) in the Rotorua Caldera is considerably disrupted by offsets on caldera boundary faults. This has significant implications on groundwater flow between adjacent formations/aquifers on either side of the faults. Groundwater is likely to flow across the faults from one formation to another. Rhyolite domes that have intruded into older groundwater-bearing formations may impact on groundwater flow into the Rotorua Caldera depending on the permeability of the rhyolite. If the Rhyolite dome is impermeable, or has significantly lower permeability than the adjacent aquifer material, groundwater will flow around the dome structure. If the rhyolite dome has similar or greater permeability than the adjacent aquifer material, groundwater will flow through the dome structure. Groundwater is abstracted from fractures within some of the rhyolite domes, indicating the potential for groundwater to flow through some of the domes.

No pump tests have been undertaken on any bores in the above formations in the Lake Rotorua catchment. Therefore, aquifer hydraulic properties (transmissivity and storativity) for any of these formations are not known (Section 4).

2.4.1 Pokai and Waimakariri pyroclastics

The Pokai and Waimakariri pyroclastics occur beneath the Mamaku Plateau and in the Guthrie Graben (Fig 2.3). The formation occurs between approximately 40 m and 120 m below ground surface under the Mamaku Plateau (Fig. 2.4, Fig. 2.7) and at the ground surface in the Guthrie Graben (Fig 2.3). The formation is greater than 60 m thick (Lynch-Blosse in prep.) Groundwater in the formation flows towards the west, west of approximately Mamaku township. East of Mamaku township, groundwater potentially flows within the formation towards the catchment of Ngongotaha Stream and Lake Rotorua.

Existing drill log data provide no information on the potential confinement from the ground surface of the aquifer within the Pokai and Waimakariri pyroclastics. The aquifer is likely to be unconfined due to the potentially relatively high permeability of the overlying Onuku – Pokopoko and Mamaku pyroclastic formations.

2.4.2 Onuku – Pokopoko pyroclastics

The Onuku – Pokopoko pyroclastics overlie the Pokai and Waimakariri pyroclastics beneath the Mamaku Plateau (Fig. 2.6). East of the Rotorua Caldera, the Onuku – Pokopoko pyroclastics overlie the Matahina Ignimbrite.

Under the Mamaku Plateau, groundwater flows within the formation towards Ngongotaha Stream and Lake Rotorua (Fig. 2.6). The formation is shallowest (80 m to 90 m below ground surface) in the northwest of the Mamaku Plateau (Fig. 2.4) and appears to deepen towards the south (Fig 2.6). The formation is likely to be approximately 280 m below ground surface in the Guthrie Graben. Eastward flowing groundwater beneath the Mamaku Plateau is likely to flow from the Onuku – Pokopoko pyroclastics, across faults and into the Mamaku pyroclastics (Figs 2.4 and 2.6).

To the southeast of the Rotorua Caldera the thickness of the Onuku – Pokopoko pyroclastics increases and the formation occurs at, or near, ground surface between Lake Tarawera and Lake Rotorua (Fig. 2.4). To the north of Lake Tarawera, the Onuku – Pokopoko pyroclastics are probably less significant to groundwater transport into Lake Rotorua as the depth to the top of the formation increases (Fig 2.6). Between Lake Tarawera and Lake Rotorua, groundwater is likely to flow within the formation and discharge into aquifers within the Mamaku pyroclastic and Huka Group, across the Rotorua Caldera boundary fault (Fig 2.4). Groundwater level is indicated to be above the top of the Onuku – Pokopoko pyroclastics formation between Lake Tarawera and Lake Rotorua, indicating aquifers within the formation are fully saturated in this area.

The aquifer within the Onuku – Pokopoko pyroclastics is likely to be unconfined beneath the Mamaku Plateau (Fig. 2.4, Fig. 2.6) and between Lake Rotorua and lakes Tarawera and Okataina (Figs 2.4 and 2.5). In these locations Onuku – Pokopoko pyroclastics is overlain, to the ground surface, by relatively permeable Mamaku pyroclastics. In the Ngakuru Graben and beneath Lake Rotoiti the aquifer within the Onuku – Pokopoko pyroclastics is probably confined due to the depth below ground surface (~150 m) and low permeability layers within the overlying Huka Group and Rotoiti pyroclastic sediments (Fig. 2.6).

2.4.3 Old TVZ rhyolite lava

One old TVZ rhyolite lava dome occurs within the Rotorua Caldera (Fig 2.6) in the vicinity of Whakarewarewa. The groundwater-bearing potential of this formation is unknown, but at least one bore (638) is interpreted to draw water from the formation. Groundwater flow within the formation is likely to be through fractures.

The thickness of the dome is unknown, but the formation predates the deposition of the Mamaku pyroclastics. The Mamaku pyroclastics and Huka Group were deposited around the dome structure. Therefore, groundwater flowing within the Mamaku pyroclastics and Huka Group may flow through the fractured rhyolite.

2.4.4 Mamaku pyroclastics

The Mamaku pyroclastics overlie the Onuku – Pokopoko pyroclastics in the area surrounding the Rotorua Caldera. The Mamaku pyroclastics is the most important groundwater-bearing formation in the Lake Rotorua catchment for potential volume and transport of groundwater, due to its widespread distribution and thickness.

The thickness of the formation varies considerably within the study area. To the west of the Rotorua Caldera faults, on the eastern Mamaku Plateau, formation thickness is estimated at approximately 100 m. The thickness increases to the east, across the caldera faults, and is estimated to be approximately 1 km thick beneath Rotorua city. The formation thickness decreases east of the Rotorua Caldera and is approximately 60 m to 80 m thick at Lake Okataina.

The formation occurs at the ground surface on the Mamaku Plateau and on the eastern flanks of the Mamaku Plateau. Within the Rotorua Caldera the top of the formation is between approximately 30 m to 120 m below ground surface. The formation occurs at the ground surface east of the Rotorua Caldera.

The Mamaku pyroclastics are comprised of three ignimbrite subunits. The lower and upper subunits are non-welded and predominantly fine-grained. Groundwater flow within the lower and upper subunits is likely to be via pore space porosity. The middle subunit is strongly welded and highly fractured. Groundwater flow is likely to be within the fractures. Some groundwater bore logs indicate changes in Mamaku pyroclastic texture and hardness that may be the boundaries of the subunits. These possible subunit boundaries are shown on the geological cross-sections (Figs 2.4 to 2.6) where bore log data are available. Elsewhere on the cross-sections the Mamaku pyroclastics are displayed as a massive undifferentiated unit due to the absence of subunit boundary data.

Aquifers within the Mamaku pyroclastics are likely to be unconfined where the formation is exposed at the ground surface. Aquifers within the formation may be confined where the formation underlies significant thickness (>20 m - 30 m) of Huka Group sediments, or Rotoiti pyroclastics.

The base of the Mamaku pyroclastics is indicated to be above the piezometric surface (Figs 2.4, 2.5 and 2.6) on the top of the Mamaku Plateau. In these areas, groundwater may flow towards the Rotorua Caldera within the underlying Onuku-Pokopoko pyroclastic and/or Pokai and Waimakariri pryroclastic formations.

Within the Rotorua Caldera the Mamaku pyroclastics underlie the Huka Group sediments. Groundwater within the Mamaku pyroclastics in this area could only potentially contribute to Lake Rotorua recharge if the vertical hydraulic gradient is upwards.

To the east and south east of the Rotorua Caldera, groundwater potentially flows towards Lake Rotorua within the Mamaku pyroclastics (Fig. 2.4 and 2.5). This westerly-flowing groundwater is thought to flow from the Mamaku pyroclastics and into Huka Group before discharging into Lake Rotorua.

2.4.5 Rotorua young TVZ rhyolite lava

The Rotorua young TVZ rhyolite lavas occur as dome structures to the west of Rotorua City. These domes include Mt Ngongotaha, Mokoia, Hinemoa Point and the unnamed dome structure located approximately 2 km to the west of Paradise Valley (Fig. 2.5).

The domes post-date the deposition of the Mamaku pyroclastics. Therefore, the base of the dome structures are considered to be near the top of the Mamaku pyroclastics (Figs. 2.5 and 2.7).

Groundwater is abstracted from bores drilled into the Mt Ngongotaha rhyolite dome. One bore (209, Fig 2.5) is drilled through the base of the rhyolite and into the underlying Mamaku pyroclastics, indicating the base of the Mt Ngongotaha dome may be about 50 to 80 m below Lake Rotorua water level.

Groundwater occurrence and flow is likely to be within fractures in the low permeability rhyolite rock. The piezometric surface rises beneath Mt Ngongotaha indicating groundwater recharge occurs on the flanks of the dome, probably from rainfall infiltration. This indicates that the fracture systems propagate from the water table to the ground surface. Numerous springs occur on the flanks of Mt Ngongataha.

2.4.6 Rotoiti pyroclastics

The Rotoiti pyroclastics occur to the east and northeast of Lake Rotorua (Fig 2.3). The thickness of the deposit, near the rim of the Rotorua Caldera, is estimated to be between 50 m and 90 m (Fig. 2.6). The formation occurs at ground surface and appears to underlie the western arm of Lake Rotoiti.

The formation is entirely non-welded suggesting groundwater occurrence and flow is within pore space porosity. It is likely to be confined in places as the formation contains fine to very fine-grained deposits where the sediments have been reworked by fluvial processes. Elsewhere, the aquifer may be unconfined. Existing bore log details are insufficient to determine spatial distribution of aquifer confinement.

Groundwater bores are drilled into the Rotoiti pyroclastics indicating the formation is groundwater bearing (Fig. 2.6). Groundwater level data indicate that Lake Rotoiti contributes to groundwater via the Rotoiti pyroclastics. Lake Rotorua water is also indicated to potentially flow into the Rotoiti pyroclastics via groundwater bearing layers within the Huka Group (Fig 2.6).

2.4.7 Huka Group

The Huka Group sediments are widely distributed within the Rotorua Caldera, Paradise Valley, Hemo Gorge and Ngakuru Graben (Fig. 2.3). The thickness of the sediments is estimated to be up to approximately 80 m. The thickness varies spatially due to erosion and the paleo-topography over which the sediments were deposited.

Huka Group sediments occur at ground surface or underlie Hinuera Formation and Holocene alluvial sediments. Within the Rotorua Caldera, Huka Group sediment often directly overlie the Mamaku pyroclastics. Huka Group sediments are also likely to be in direct contact with rhyolite lava dome structures.

The Huka Group sediments are groundwater-bearing and bores draw water from aquifers within the sediments.

The sediments were deposited in and around margins of a paleo-lake and paleo-water courses. The deposits are predominantly composed of sandstone and siltstone. However, around the margins of the paleo-lake where streams discharged into the lake, and in water courses, coarser-grained sediments were deposited. Groundwater within the Huka Group is likely to occur within these coarser-grained sediments. Aquifer(s) within the Huka Group are likely to be confined from the ground surface where they are overlain by sandstone and siltstone deposits. The Huka Group sandstone and siltstone deposits probably also confine aquifers within underlying formations (rhyolite domes and Mamaku pyroclastics). Discrete aquifer(s) within the Huka Group are not identified from existing groundwater bore log data due to a lack of bore-log detail.

Groundwater recharge to aquifer(s) within the Huka Group is indicated, by cross section data, to be from the lateral discharge of groundwater from adjacent formations beneath the rim of the Rotorua Caldera (Pokai and Waimakariri pyroclastics, Onuku – Pokopoko pyroclastics, Mamaku pyroclastics) and rhyolite dome structures. Recharge of Huka Group aquifer(s) may also occur by the infiltration of rainfall where the aquifer(s) are unconfined.

2.4.8 Holocene alluvium

Holocene alluvium occurs within gullies eroded into the Huka Group sediment. The thickness of the alluvium exceeds 20 m in places. A shallow unconfined aquifer occurs within the alluvium on the margins of lakes Rotorua, Rotoiti and Tarawera. Groundwater bores abstract water from these aquifers. Within the Rotorua caldera the alluvium aquifer discharges directly into Lake Rotorua. Recharge to the aquifer is likely to be from a combination of rainfall recharge and leakage from aquifers within the adjacent Huka Group sediments. Shallow unconfined alluvial aquifers are also likely to be present in stream valleys (e.g. Paradise Valley). These aquifers will be in direct hydraulic connection with local streams.

2.5 Information gaps

The surface geology is relatively well known in the catchment. Gaps in our knowledge of the sub-surface geology exist, particularly:

- aquifer thicknesses
- groundwater divides, particularly between lakes Okataina and Rotorua and north of Lake Rotorua in the catchment of Hamurana Springs
- aquifer properties

2.6 Proposed field programme

2.6.1 Aquifer thickness and groundwater divide

1. Drill two bores between lakes Okataina and Rotorua. At least one of the bores should be drilled in the Pokopoko pyroclastics to confirm the thickness of the Mamaku pyroclastics and help define the groundwater divide.

   One bore should be located near to top of the ridge line and has estimated drill depth of 150m. Priority = HIGH.

   The other bore should be drilled to the goundwater surface to help define groundwater divide in this area. This bore should be located in the Lake Rotorua catchment and has estimated drill depth of 70 m. Priority = HIGH.

2. Drill two bores in the catchment of Hamurana Springs. The bores should be drilled at least to water table and preferably through to the base of the water-bearing formation, with the aim of identifying a groundwater divide, and assisting in the location of the groundwater catchment for Hamurana Springs. This is to be assessed after the EBOP survey of wells in the area.

   One bore should be located near to the edge of the caldera and has estimated drill depth of 150m. Priority = HIGH.

   The other bore should be located further north and has estimated drill depth of 150m. Priority = HIGH.

3. Identifying aquifer structure and thickness within the Huka Group.

   Recommend drilling three bores in Ngongataha township area where a significant drainage channel from the Mamaku pyroclastics feds into the Huka Formation. Estimated average depth of each bore is 50 m. One bore Priority = HIGH, other two bores Priority = MEDIUM.

Recommend drilling three bores in Rotorua airport area where no significant drainage channel from the Mamaku pyroclastics feds into the Huka Formation. Estimated average depth of each bore is 50 m. One bore Priority = HIGH, other two bores Priority = MEDIUM.

Recommend drilling two bores south of the Hemo Gorge to determine the thickness of the Huka Group and identify potential aquifers within the formation in this area. Estimated average depth of each bore is 50 m. One bore Priority = HIGH, other bore Priority = MEDIUM.

4. Identify thickness Rotoiti pryroclastic and aquifer structure within the formation at Ohau Channel. Drill depth is estimated at 75 m. Priority = HIGH

2.6.2 Pump tests

Six pump tests are recommended. These may use existing bores if bores are appropriately located and bore depth and screen intervals are known. Each pump test requires an observation bore located close enough for ground water pumping effects to be measured for the measurement of reliable transmissivity and storativity.

- Onuku-Pokopoko pyroclastics at Mamaku township. Priority = HIGH
- Mamaku pyroclastics northwest of Taniwha Springs. Priority = HIGH
- Huka Group at Ngongataha. Priority = HIGH
- Huka Group at south of Hemo Gorge. Priority = MEDIUM
- Rotoiti pyroclastics at Ohau Channel. Priority = HIGH
- Ngongataha rhyolite dome. Priority = HIGH

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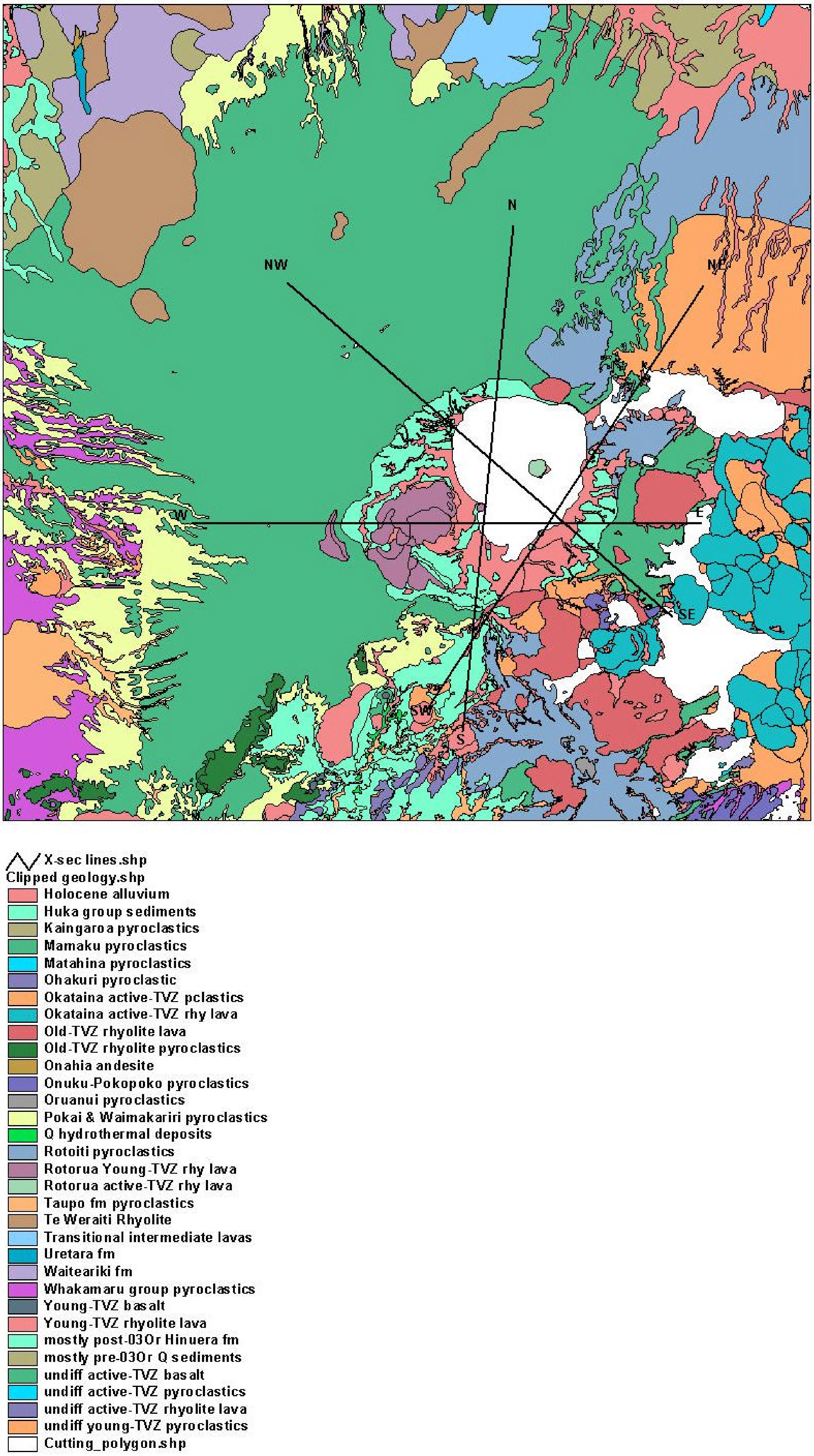


Figure 2.3 Geology map taken from the joint GNS/Crown Minerals publication "Epithermal gold in New Zealand: GIS data package and prospectivity modelling". This is a compilation of numerous published and unpublished geology maps, including: Healy et al. (1962), university graduate research, NZGS and recent geological mapping by Geological and Nuclear Sciences.

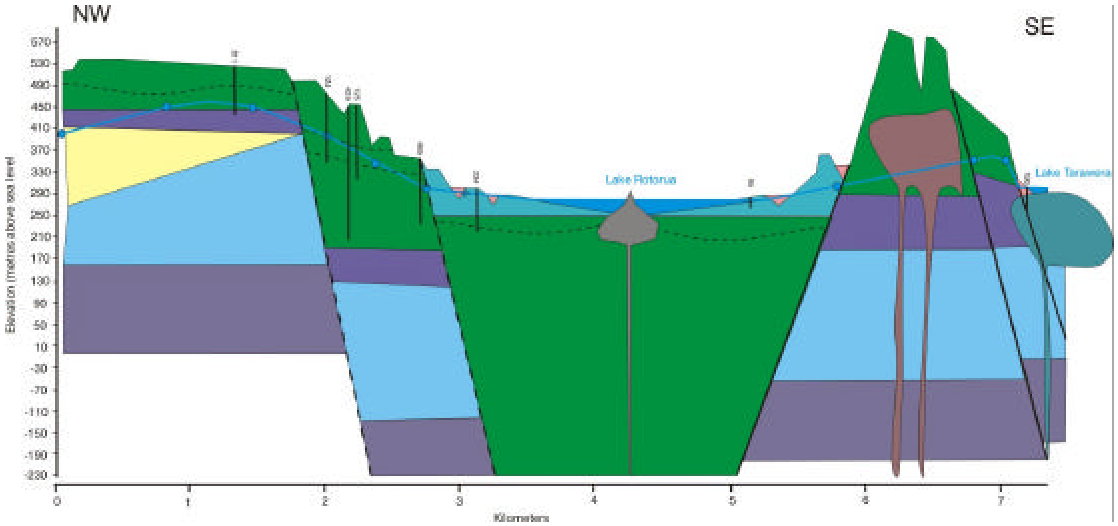


Figure 2.4 NW-SE cross-section. See Figure 2.8 for legend.

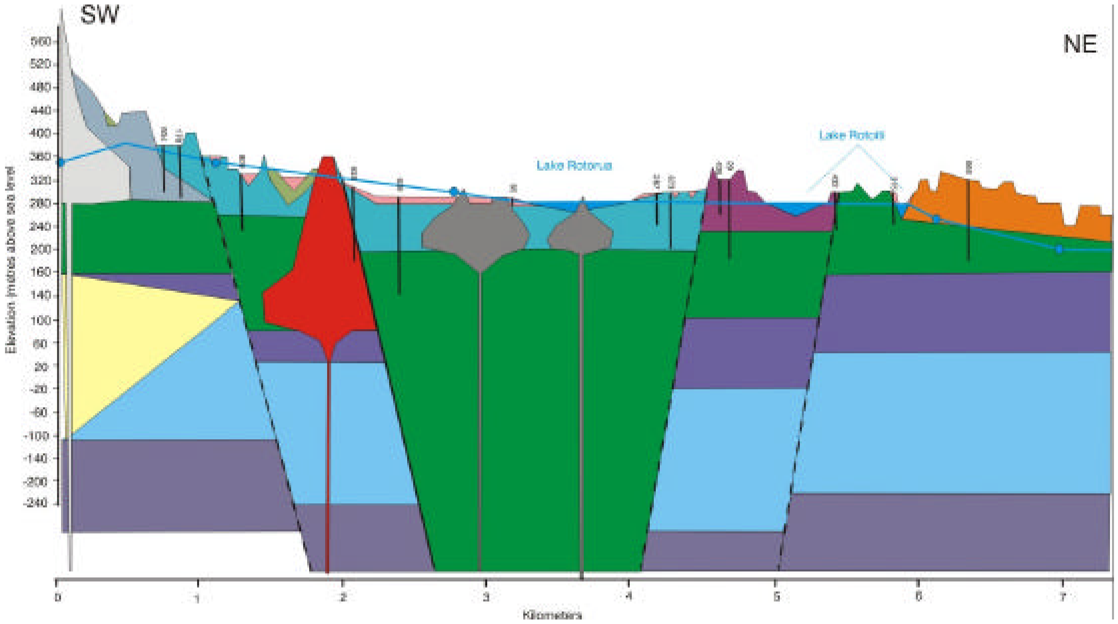


Figure 2.5 SW-NE cross-section. See Figure 2.8 for legend.

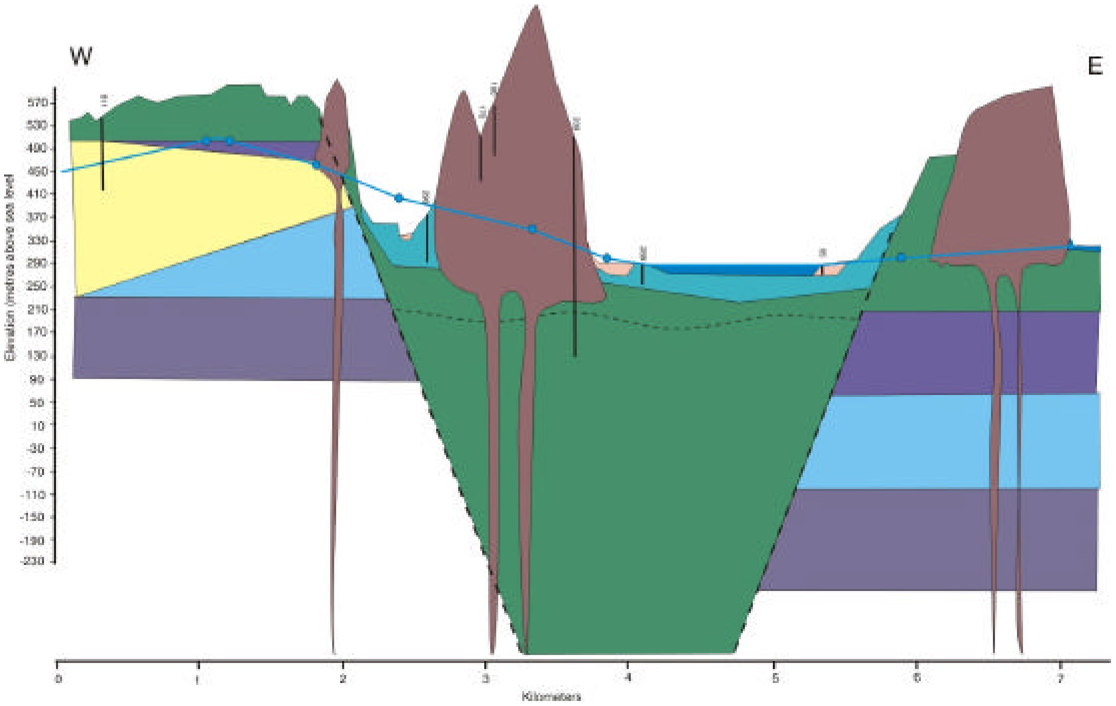


Figure 2.6 W-E cross-section. See Figure 2.8 for legend.

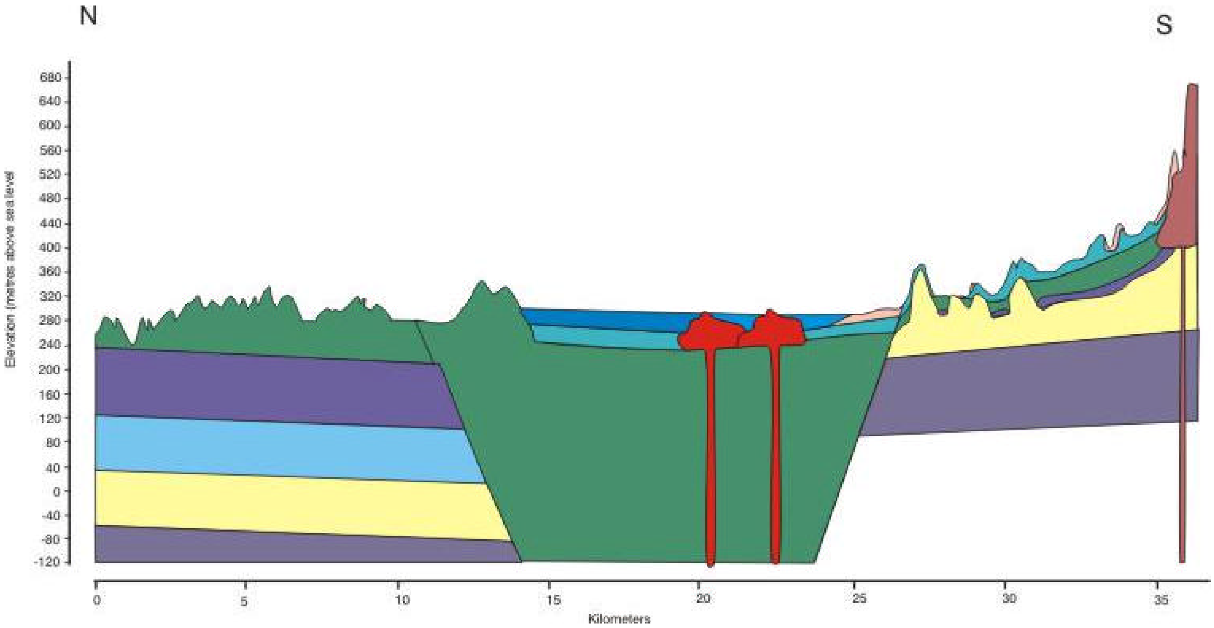


Figure 2.7 N-S cross-section. See Figure 2.8 for legend.

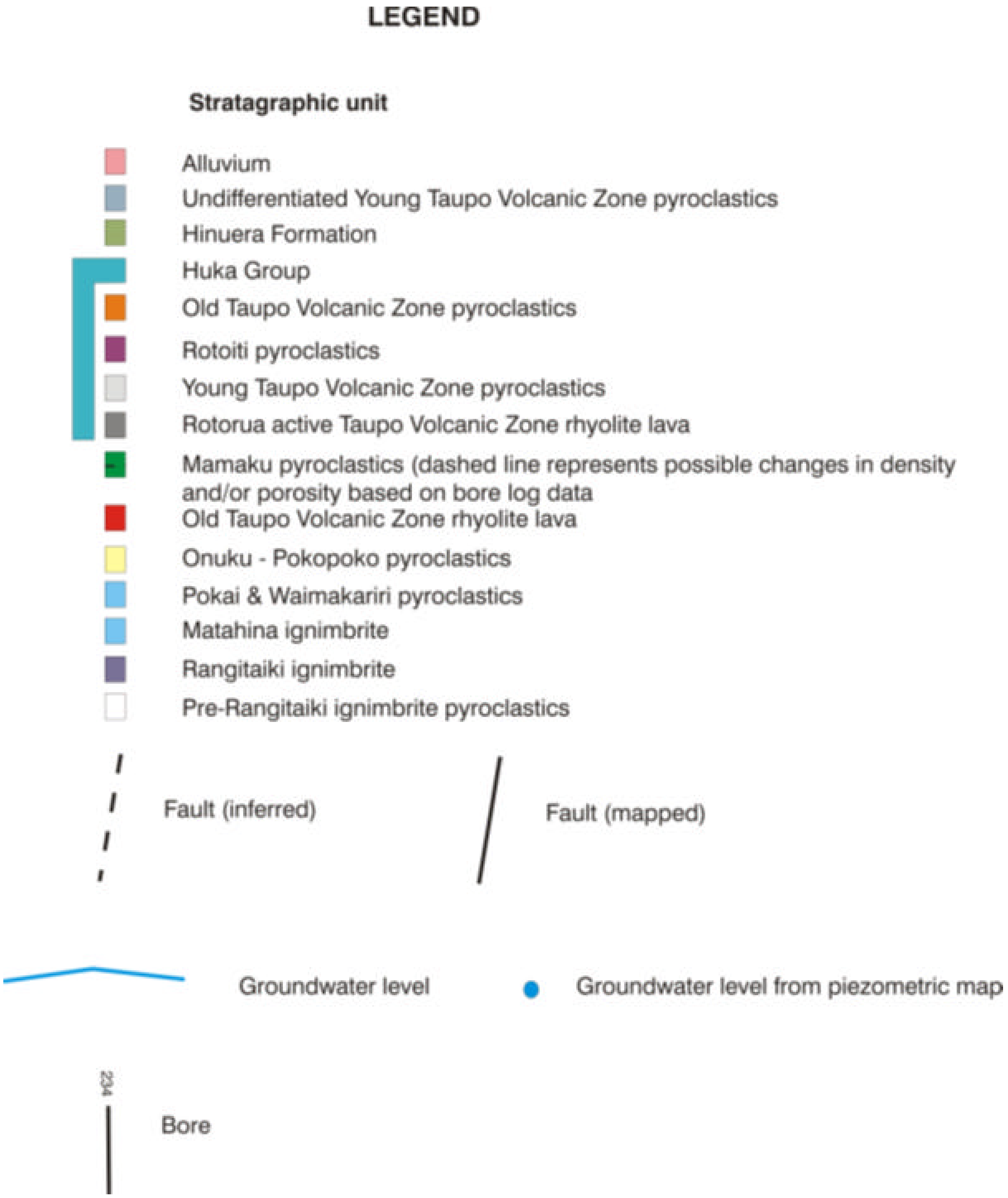


Figure 2.8 Legend for cross sections.

3.0 GEOPHYSICS

3.1 Introduction

This review of geophysical information focuses on published geophysical reports that could be used to better define depths and extents of hydrological units of potential importance to nutrient transport in the catchment. Interpretation of geophysical data is used to compliment and assist construction of geological and hydrogeological models of the Lake Rotorua catchment.

Geophysical methods have long been used to investigate sub-surface geological structures. Methods such as resistivity, gravity, magnetics, and seismic reflection are commonly used for exploration. The methods can be used in surveys of large areas to: identify anomalous ground for further investigation e.g. drilling; measure ground properties; and interpret geological structure, geological properties and fluid properties.

3.2 Resistivity

Resistivity is a geophysical method where DC electrical current is injected into the ground through an outer pair of (outer) electrodes, and the voltage difference is measured between another pair of (inner) electrodes. An apparent resistivity is calculated for each sounding. This represents an ‘average’ resistivity at a ‘penetration depth’, for each sounding. The ‘penetration depth’ at each sounding depends on the electrode spacings and the resistivity structure at each sounding. Factors that effect resistivity of the ground include:

- lithology type,
- geological structure, e.g. faults,
- water saturation,
- water temperature.

A resistivity survey generally consists of either traverses or soundings. A resistivity traverse involves occupying a number of sites using the same electrode spacing. The purpose is to observe changes in apparent resistivity over space while keeping the penetration depth approximately the same. This technique is generally used to map boundaries of contrasting resistivity at depth e.g.: boundaries of geothermal fields. A resistivity sounding involves increasing the electrode spacing at one site to obtain a vertical profile of apparent resistivity. This may yield information on structure and resistivity boundaries with depth at a site.

These factors make resistivity an ideal technique for use in geothermal areas, where large temperature differences in the ground, due to geothermal fluids, and hydrothermal alteration can result in large resistivity differences between cold ground and hot ground.

Resistivity traverses summarised by Bibby et. al. (1993a, 1993b), and, Stagpoole and Bibby (1998a, 1998b) show strong apparent resistivity contrasts around Lake Rotorua. Apparent resistivity ranges from about 3 ohm metres to over 1000 ohm metres in the greater Rotorua area. Four low-resistivity anomalies are mapped near Lake Rotorua (Figure 3.1):

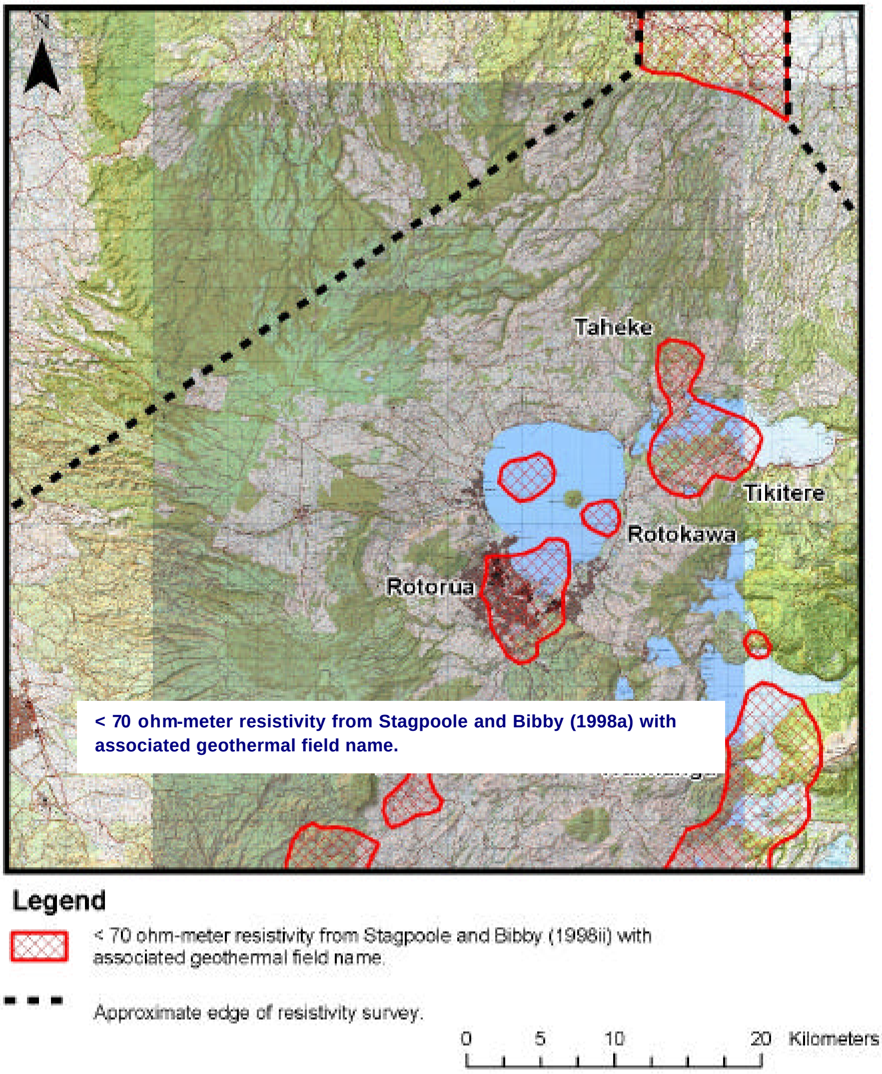
1. Rotorua geothermal field - a north-south oriented anomaly extending under Rotorua City and into the southern part of Lake Rotorua.

2. Taheke/Tikitere geothermal fields - a large area of low resistivity in western Lake Rotoiti.

3. Rotokawa Geothermal Field - low resistivity in the bed of Lake Rotorua between Mokoia Island and eastern edge of Lake Rotorua. Bibby et al. (1992) interpret this anomaly as a separate geothermal system between the Rotorua and Taheke/Tikitere geothermal systems.

4. A circular-shaped anomaly in the north-eastern part of Lake Rotorua ("West Lake Rotorua Resistivity Anomaly"). Bibby et al. (1992) interpret this anomaly as a fossil hydrothermal system because thermal features are not observed in this area

Bibby et al. (1992) associate higher apparent resistivity (>300 ohm-meter) with the Mamaku Ignimbrite and rhyolitic domes such as Mt. Ngongotaha. Interpretation of geological boundaries (laterally and with depth) using published resistivity is difficult as no resistivity soundings were completed as part of these surveys.



Scanned image from the 1:50 000 topographic map (NZMS260 series) sourced from Land Information New Zealand (Crown Copyright Reserved).

Figure 3.1. Geothermal fields in the Rotorua area identified by apparent resistivity values less than 70 ohm-metres.

The resistivity of the Rotokawa Geothermal Field was investigated by Drolia et al. (1981). Resistivity soundings on the Ngati Whakaue Trust property, in the vicinity of Rotorua airport and Lake Rotokawa, show a low apparent resistivity zone interpreted as up-flowing geothermal fluids (Figure 3.2) along two intersecting fracture zones. The fluids infiltrate laterally into permeable sediments at about 30 - 50 m depth. Resistivity profiles are difficult to interpret geologically due to the range of water temperature and hydrothermal alteration in this area.

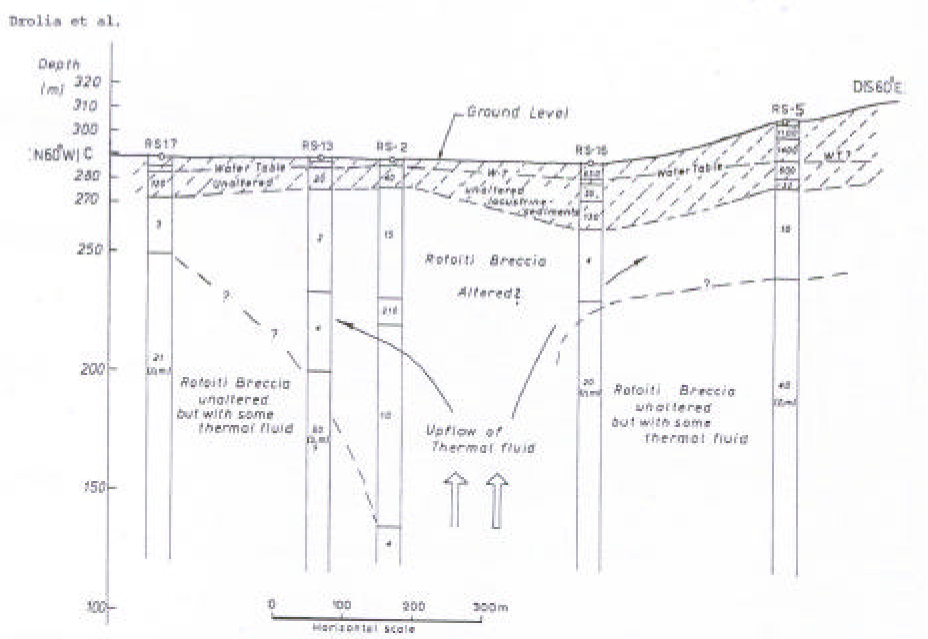


Figure 3.2 Interpreted resistivity section of Rotokawa geothermal field (Drolia et al., 1981).

Resistivity soundings by Dawson and Rayner (1979) demonstrate a geothermal outflow from the Rotorua geothermal field to the south through the Pohaturoa ridge, near the Waipa sawmill. The resistivity contours suggest that geothermal fluid flows east once it has passed through the western side of the ridge, where it gets diluted by cold groundwater. A temperature profile of a nearby bore indicates that geothermal outflow occurs to a depth of 100 m below ground level. The nature of the permeability through the ridge is not clear, however, it is suggested fluid may flow along the Te Puia fault which runs southwards through the ridge from Whakarewarewa.

3.3 Thermal infrared

The thermal infrared method measures thermal infrared radiation. Typically, infrared radiation emission is related to temperature of an object; the hotter the object, the greater the amount of infrared radiation emitted by the object. Therefore, this method can identify thermal ground and features in geothermal areas.

A thermal infrared video imagery survey flown in March 1990, identifies previously unknown hot springs to Lake Rotorua (Mongillo and Bromley, 1992). The survey was flown over the central Rotorua city area, extending about 500m over Lake Rotorua. Hot springs identified in the survey occur:

- approximately 200 m offshore from the Puarenga Stream mouth (e.g. Figure 3.3),
- in the shallow waters and on the small islands in Sulphur Bay,
- near the Utuhina Stream mouth.

These findings are important to understand the hydrogeology of Lake Rotorua because:

- additional inflows of hot water to Lake Rotorua are identified, and,
- the authors suggest these springs may be a source of the ‘missing’ chloride in chloride flux calculations by Glover (1992).

3.4 Seismic reflection

The seismic reflection method involves measuring seismic signals at the ground surface. The signals are generated by using explosives or air guns (in water). Shock waves (signals) from the source travel through the ground and get ‘bounced’ back up to the ground surface by seismic reflectors. The signals reflected back to the ground surface are measured by a series (arrays) of geophones pushed into the ground. The signals measured by the geophones (amplitude and phase) depend on the seismic properties of the materials below the array, spacing of the geophones, boundaries between geologic layers, and, discontinuities in the geology such as faults.

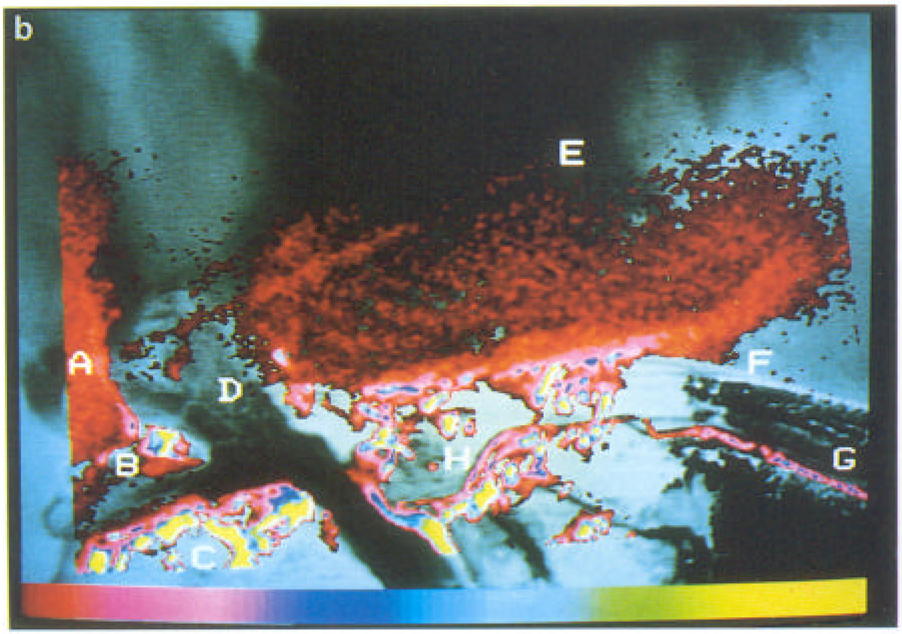


Figure 3.3 Thermal infrared image of the Puarenga Stream mouth area (about 300 m by 180 m). Mongillo and Bromley (1992) interpret this image thus: “The pink to red patch extending upwards from the lakeshore between D and F illustrates the large scale seepage present along the shoreline over a distance of about 170 m. The surface temperature in the seepage at F is 3-5^{o}C warmer than that of the nearby ‘ambient’ lake temperature. Other seepage locations occur near B and D, while much of that at A appears to have originated further to the left. The relatively cool Puarenga Stream flows into Lake Rotorua at D, thus explaining the lower temperatures there”.

Lamarche (1991) used seismic reflection to investigate the geological structure of the southeast boundary of the Rotorua caldera. The survey had a northeast/southwest array along Long Mile Road and a northwest/southeast line along Rifle Range Road – Te Ngae Road, Rotorua (Figure 3.4). Three geological layers are interpreted from both arrays:

• Ground level - 100 m depth	Pumice sands
• 100 m - 190 m depth	Siltstone/carbonaceous sandy mudstones
• 190 m - 330 m* depth	Mamaku Ignimbrite

* The 330 m reflector is a highly speculative

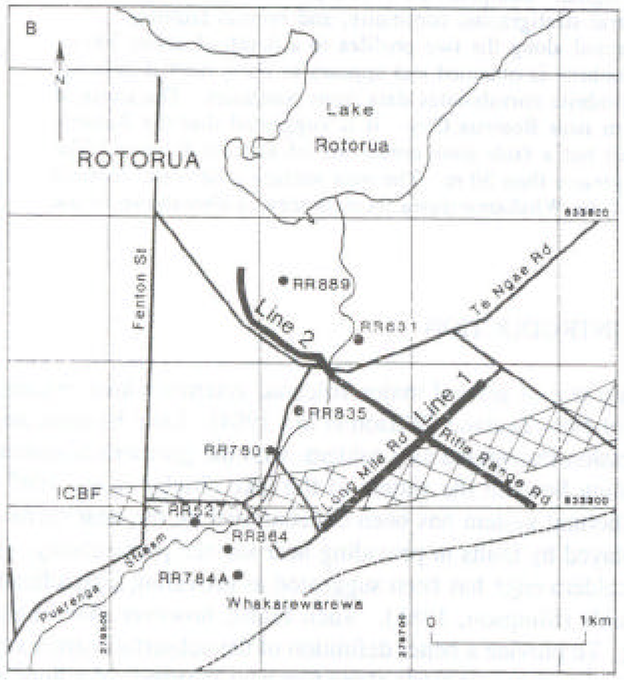


Figure 3.4 Location of seismic lines 1 and 2. Numbers refer to boreholes. Hatched zone indicates the area where the Inner Caldera Boundary Fault (ICBF) was mapped in various references (e.g. Simpson, 1985). The outer caldera boundary is indicated by a thick dashed line (Lamarche, 1992).

The Mamaku Ignimbrite is thicker to the northwest (nearer Rotorua city) than the southeast. Interpretation of the seismic data has the Mamaku Ignimbrite dipping to the northwest. A number of faults along each seismic line are also identified. The faults probably aid hot water flow in this area. This is consistent with a hydrological model of the Rotorua geothermal system (Simpson, 1985) where hot geothermal fluid rises along the northeast/southwest trending Ngapuna fault near Lamarche's study area.

Interpretation of a waterborne seismic reflection survey of southern Lake Rotorua (Davy, 1992) (Figure 3.5) identifies areas in the lake bed where geothermal gases rise to the lake surface. Some information on lake bed structure could be obtained from this survey, for example identification of a layer (Horizon D) dipping underneath the lake (Figure 3.6). The gas-free area of the lake floor lacks a 'strong correlation with the high heatflow area' (Davey, 1992) and, it suggested that gas migration is 'blocked at depth in the area east of G-G' by an impervious layer' (Davey, 1992).

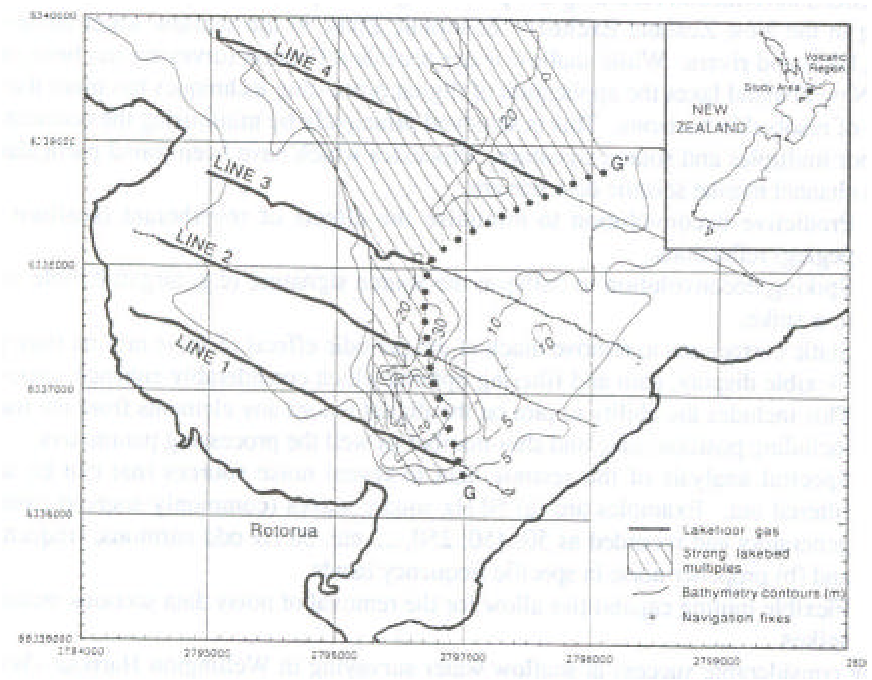


Figure 3.5 The areas where gas is interpreted in lakefloor sediments are west of line G-G' (Davy, 1992).

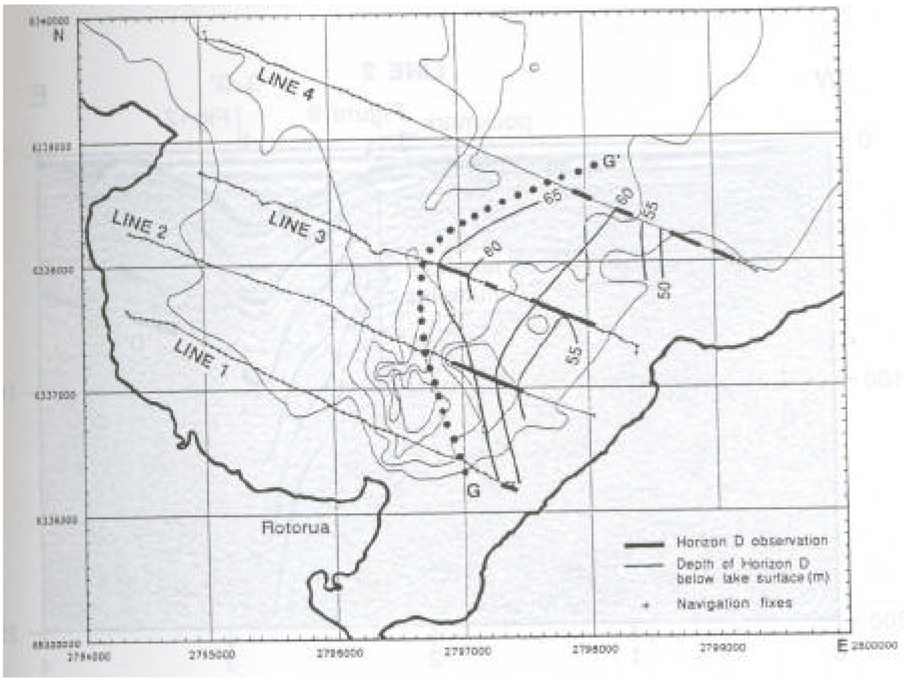


Figure 3.6 Contoured seismic reflection horizons. Where the deepest reflector was observed has been marked and the depth (m) below the lake surface to that horizon contoured assuming a 1500 m/s velocity for the water and a 2000 m/s velocity for the sediments (Davy, 1992).

3.5 Gravity and magnetics

Gravity differences measured on the earth's surface can be attributed to factors including: gravitational effect of the earth, earth's rotation, the earth's shape and the earth's material (density profile). Theoretical gravity values can be calculated for a 'reference ellipsoid' (mathematical model for the earth) if the location and elevation are known. Gravity anomalies are identified by calculating the difference between measured gravity and theoretical gravity. When appropriate data reduction techniques are employed, the remaining gravity anomalies imply gravity differences due to changes in rock density in the earth. The magnitude and distribution of the gravity anomalies can be modelled to obtain density models of the earth.

Regional Bouguer gravity anomaly maps (Woodward and Ferry, 1973) and regional total force magnetic anomaly maps (Hunt and Whiteford, 1979) show both positive and negative anomalies in the greater Rotorua area.

Rogan (1980) interpreted Department of Scientific and Industrial Research regional gravity data and aero-magnetic data collected by Gerard and Lawrie (1955) for the Taupo – Rotorua – Okataina region. She found that the magnetic and Bouguer gravity anomalies for these are coincident, and generally corresponded to known calderas in volcanic areas. The anomalies are interpreted as calderas in-filled with volcanic sediments such as ignimbrite, rhyolite or sediments.

Magnetic and gravity anomalies around Lake Rotorua are small compared to anomalies around the Okataina and Taupo areas. The Rotorua caldera is estimated to have non-magnetic material approximately 1 km thick overlying low density, low magnetic material greater than 1 km thick on the western part of Lake Rotorua, extending to the Mamaku Plateau. Rogan (1980) suggests that the non-magnetic material is volcanic sediments, and the low density material may be hydrothermally altered ignimbrites or acidic magma, sediments or unwielded tephras. She suggests the Rotorua Caldera is probably between 1 and 1.5 km deep in this area.

Hunt (1992) reinterprets gravity data used by Rogan and includes new gravity measurements. Hunt's more detailed residual gravity map shows:

1. a gravity low west of Lake Rotorua to have 3 minima
2. a gravity high approx 2 km south of Lake Rotorua
3. a pronounced gravity high at Rotokawa
4. a broad gravity low extending northwards from Kapenga (approximately 10 km south of Rotorua).
5. a gravity high at Taheke.

Hunt (1992) only interprets two of the three anomalies in the Rotorua City area. One anomaly of residual gravity minima is associated with two buried rhyolite domes between Pukeroa Hill and Whakarewarewa. The other gravity anomaly is interpreted as sediments (on Mamaku Ignimbrite) greater than 1 km deep bordering a buried rhyolitic dome in Linton park. The third gravity anomaly is probably associated with the Mt Ngongotaha rhyolite dome.

3.6 Other

Whiteford (1992) measured heat flow at 48 locations in the lake bottom sediments of Lake Rotorua. Heat flows greater than 2 W m^{-2} (Figure 3.7) are observed in two areas in the lake: immediately north of Rotorua associated with the Rotorua geothermal field and west of Rotokawa associated with the Rotokawa geothermal field.

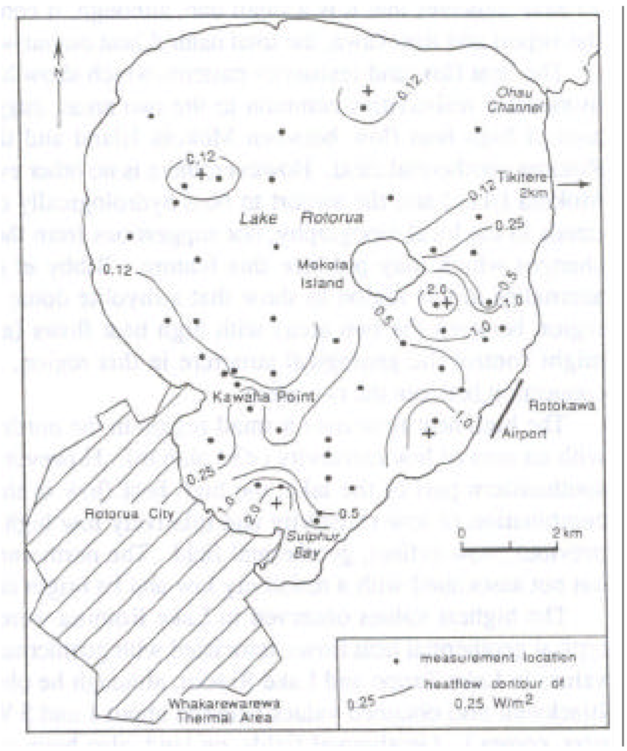


Figure 3.7 Contoured heat flow values for Lake Rotorua (after Whiteford, 1992).

Flow of cold groundwater into the Rotorua geothermal field is observed in the central Rotorua City area using down-hole temperature measurements (Iles, 1982). A low temperature anomaly approximately 400 m wide at about 15 - 60 m depth below ground near the corner of Eruera Street and Tutanekai Street is interpreted by Iles (1982) as a cold groundwater plume flowing from the west. It is suggested some water from this plume flows down into the hotter part of the geothermal system immediately below this area. These groundwater flows probably flow through the lacustrine sediments and may enter Lake Rotorua through this area.

Hillyer (1983) concludes a similar result to Iles (1982) using petrology and stratigraphy from seven boreholes in an area approximately 1 km south of the Iles (1982) study area. Cold groundwater flowing in from the west mixes with hot geothermal water at approximately 80 m depth.

Hot, warm and cold-water zones of the Rotorua geothermal field are identified by Department of Scientific and Industrial Research et al. (1985), Figure 3.8.

3.7 Summary

Geophysical studies of the Rotorua area are focused on the geothermal system. Therefore, most of these studies focus on defining geothermal systems and are very limited in their extent. Geophysical studies that encompass larger areas were found to be more general in their interpretations. From the published information obtained, most geophysical studies could provide limited information which could assist GNS to better define groundwater aquifer extents and aquifer thicknesses. However, some information from four geophysical methods pertinent to the nutrient study can be used to assist with a hydrogeological model.

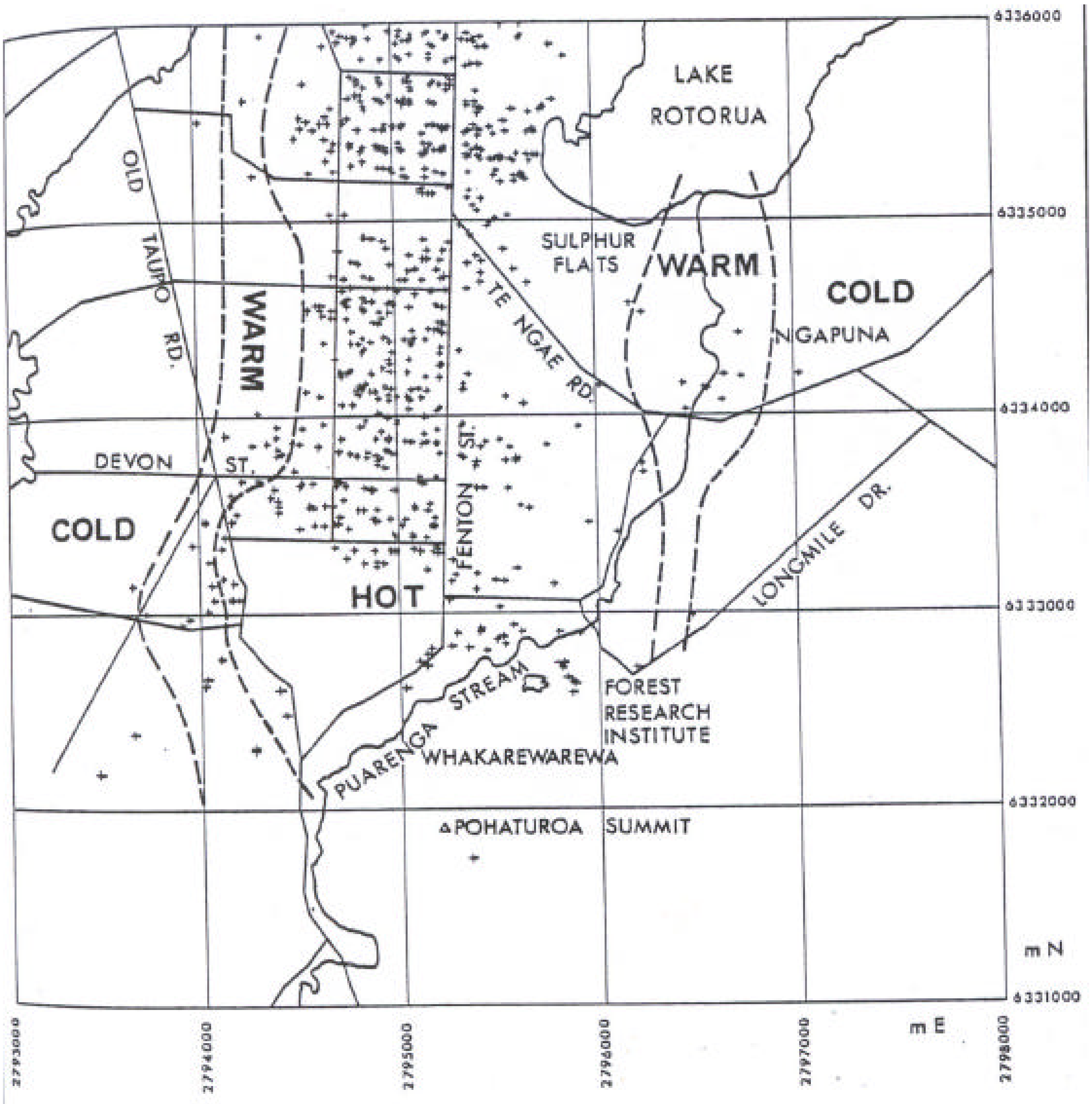


Figure 3.8 Hot, warm and cold-water zones in the Rotorua geothermal field (Department of Scientific and Industrial Research et al. 1985).

Investigations using the resistivity technique show:

- the central, eastern and Lake Rotorua areas have geothermal aquifers which allow fluid flow into Lake Rotorua.
- plumes of hot water are rising and moving west through an aquifer 30 - 50 m depth at Rotokawa, on the western side of Lake Rotorua.
- a low resistivity anomaly in the western side of Lake Rotorua may be an extinct hydrothermal system. This may be on a fault which may also allow passage of cold water from the lake.

The thermal infrared method indicates the location of hot spring areas in the Rotorua Geothermal Field. These spring locations indicate the location of permeable pathways in the formation.

2) Seismic reflection measurements show:

- to the east of Rotorua city:
  - three geological boundaries near the caldera boundary.
  - a number of faults, that probably aid water flow.
  - the Mamaku ignimbrite dipping, and thickening, towards the west.

- seismic interference interpreted to be from gas bubbles occurs from the bottom of Lake Rotorua (southern end).

3) Gravity measurements, in some cases in combination with magnetic data, show:

- in general, gravity and magnetic anomalies coincide with the locations of calderas in the Taupo – Rotorua – Okataina region.
- the gravity anomalies are interpreted as due to calderas filled in by volcanic sediments.
- the western part of Rotorua (Mamaku Plateau) is estimated to have 1.5 km of non-magnetic, low density rocks. These are likely to be sediments and ignimbrites.
- gravity anomalies can be attributed buried rhyolite domes in the central Rotorua City area.

- sediments are estimated as greater than 1 km deep at Linton Park, Rotorua City.

4) Down-hole temperatures and/or petrology show two areas in Rotorua city where plumes of cold water are infiltrating into the geothermal field from the west. The plumes occur at depths between 15 m and 80 m.

3.8 Future work

Groundwater aquifer extents and aquifer thicknesses are two variables required to develop accurate groundwater flow models. These variables also influence nutrient mass calculations. In order to better define the extent and thicknesses of aquifers around Lake Rotorua, GNS recommends several seismic reflection surveys be conducted. Seismic reflection is the only geophysical method GNS recommends because:

- it is the best geophysical method to identify different geological layers.
- fault traces that may influence groundwater flow can also be obtained from the seismic record.

GNS recommends that at least 4 seismic reflection lines be run:

- a line running north from Lake Rotorua and over the ranges to the north to verify water table and geological structures associated with the groundwater subcatchment of Hamurana Springs.
- a line running east/west from Lake Rotorua over the Mamaku Plateau to estimate the thickness of the Mamaku Ignimbrite.
- a line running north/south starting at Hemo Gorge (south Rotorua) to Earthquake Flat to determine the geological structure in the region.
- a line running east/west from the eastern shore of Lake Rotorua towards Lake Okataina to determine the thickness of surficial sediments and the Mamaku Ignimbrite.

These lines will better define the geological extents of key geological formations and provide new data on formations, assist determining groundwater divides and help identify possible groundwater flows from the lakes to the east of Lake Rotorua. The northern end of the 3rd line is proposed as Hemo Gorge to avoid most of the seismic 'noise' associated with the Rotorua geothermal system.

Additional lines that could be considered include:

- additional lines running from Lake Rotorua extending several kilometres on the north-western part of the lake to better define geological structures around Hamurana and Taniwha springs.
- a northeast/southwest line starting from the south east shore of Lake Rotorua extending several kilometres.
- lake-borne seismic survey west of Mokoia Island to identify any possible fault lines in the lake bed associated with the relic geothermal system.

The seismic surveys should be compared to borehole data to get the best possible interpretations. This may require deep drillhole(s) to be drilled.

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4.0 GROUNDWATER USE AND AQUIFER PROPERTIES

4.1 Introduction

Groundwater use and aquifer properties in the Lake Rotorua catchment are reviewed in this section.

4.2 Groundwater use

Environment Bay of Plenty (EBOP) records 100-200 groundwater wells in the catchment of Lake Rotorua. EBOP records show that 16 consents to use groundwater were issued in the period 1991 to 2003 in the Rotorua district (Gordon pers. comm., Table 4.1). It seems likely that many users of groundwater are not consented by EBOP, given the disparity between the numbers of wells and the numbers of consents. Unconsented groundwater use is probably at low rates and includes domestic supply and agricultural activities.

Table 4.1 Consents to use groundwater in the Rotorua region (Gordon pers. comm.).

Class	**Number of consents**
Agriculture	4
Commercial and industrial	3
Domestic and municipal	4
Horticulture	4
Other	1
Total	**16**

Significant use of springs is made for municipal and commercial water supply in the following areas:

- Hamurana - rural water supply
- Taniwha - rural water supply, Ngongotaha supply and connection to Rotorua City
- Paradise - bottled water, for sale at Paradise Springs
- Utuhina - Rotorua City water supply, Central Water Supply Zone
- Waipa - Rotorua City water supply, Eastern Water Supply Zone
- Waipa - Waipa Mill supply

The land use in the catchment behind the springs is of concern to Rotorua District, for example Sigma Consultants (1993) report a decline in the quality of Taniwha Springs water between 1964 and 1986 as 'evidenced by an increase in nitrate-N from 0.2 to 1.3 g/m^3.' They report 'an increase in the intensity of pastoral land use', which comprises the majority of the natural catchment' of Taniwha Springs, and suggest an increase in the number of septic tanks and 'the advent of dairy shed waste treatment systems' contribute to the decline in spring water quality.

Significant use is also made of springs for non-water supply purposes:

- Hamurana - significant tourist of attraction
- Paradise - significant tourist attraction
- Hatchery - provides water for a trout hatchery
- Fairy and Rainbow - significant tourist attractions

4.3 Aquifer properties

No hydraulic tests of hydraulic conductivity, transmissivity, specific capacity, drawdown, etc., are recorded in the EBOP database. The absence of pump test data, and detailed bore log data, means that a reliable assessment of aquifer type (unconfined, semi-confined or confined) cannot be made for most of the Lake Rotorua catchment.

This section reviews measurements of the hydraulic characteristics of ignimbrite formations in the Taupo Volcanic Zone. Comments on the likely aquifer properties of the important hydrogeological units in the Lake Rotorua region (identified in Section 2) are included.

4.3.1 Review of the water-bearing properties of ignimbrite

Tracey (1986) carried out an unsuccessful pump test in a well intersecting the Whakamaru Ignimbrite, near Tokoroa. He found that bore inflows were not sufficient to maintain relatively low pumpage rates. Bell (1988) estimated the permeability of the Whakamaru Ignimbrite as 1/1000 that of the Waiotapu Ignimbrite.

Tracey (1986) estimates the range in hydraulic conductivity of the Waiotapu Ignimbrite, Tokoroa as 8 to 250 m day^{-1} , and the range in transmissivity as 286 to 6917 m^2 day^{-1}. He estimated specific storage as 2.55 to 4830 x 10^{-6} m^{-1}.

WVA (1987) estimate a hydraulic conductivity of the Marshall Ignimbrite, Tokoroa, as 0.2 m day^{-1} from a pump test analysis.

Gordon (2001) estimates the transmissivity of the Matahina Ignimbrite as in the range 6000 to 12000 m^2 day^{-1} near Otakiri. He also reports transmissivity as 16 to 6000 m^2 day^{-1} in ignimbrite in the Rangitaiki Plains.

Gordon (2001) reports the transmissivity of ignimbrite in the Te Puke-Maketu basin in the range 350 to 800 m^2 day^{-1}.

4.3.2 Properties of pyroclastic and rhyolitic units in the Lake Rotorua catchment

In the absence of information on the hydraulic properties of pyroclastic and rhyolitic formations, it is predicted that:

- groundwater flow in these formations is mostly through fractures
- transmissivity is very variable
- groundwater storage, on a volumetric basis, is quite low

The possible implications of these predictions are:

- groundwater flow velocities are likely to be relatively high in areas of high topographic gradient and high recharge
- vertical seepage of groundwater from the soil to the saturated zone is relatively unimpeded by the formation
- the aquifers are vulnerable to pollution as they have low storage and therefore low dilution volumes

4.3.3 Properties of the Huka Group sediments and Holocene alluvium

Information on the hydraulic properties of these formations is absent, so it is predicted that:

- hydraulic conductivity is typical of sedimentary aquifers
- groundwater flow velocities are typically metres per day, where groundwater gradient is appreciable
- porosity is typical of sedimentary aquifers, 20% to 30%

The possible implications of these predictions are:

- groundwater flow velocities are likely to be moderate in areas of high topographic gradient
- vertical seepage of groundwater from the soil to the saturated zone is likely to be at rates lower than in the pyroclastic aquifers
- these sediments provide a permeable pathway for seepage from land to streams and also to Lake Rotorua
- the aquifers are vulnerable to pollution because the aquifers are generally thin and so the thickness of saturated lithology does not provide large dilution

4.4 Information gaps

Groundwater use statistics are not readily available. This information will be useful in the monitoring of resource use in the future.

The hydraulic properties of the aquifers in the Lake Rotorua region are unknown.

4.5 Recommended future work

It is recommended that:

- EBOP collate use statistics from the groundwater consent holders, particularly the large groundwater users (e.g. Rotorua District Council)
- EBOP estimate use for non-consented groundwater users

- the hydraulic properties of formations, e.g. hydraulic conductivity/transmissivity, drawdown characteristics, and porosity/storage coefficient are measured in tests. Tests of the major groundwater formations (Section 2) should be completed. A number of tests of the properties of the Huka Group sediments and Holocene alluvium should be completed near Lake Rotorua so as to measure the hydraulic properties of the boundary between the catchment and the lake for assessments of groundwater discharge to Lake Rotorua.

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5.0 GROUNDWATER QUALITY

5.1 Nutrients in waters of the Lake Rotorua catchment

5.1.1 Groundwaters

5.1.1.1 Nitrogen

Concentrations of nitrogen as nitrate (NO_3-N), nitrite (NO_2-N) and ammonia (NH_4-N) are usually low in groundwaters in the Rotorua area. O'Shaughnessy and Hodges (1992) and Hodges (1994a, 1994b) reported that most volcanic aquifers in the EBOP region feature concentrations of NO_3-N, NO_2-N and NH_4-N that are usually less than 2 g/m^3, 0.002 g/m^3, and 0.05 g/m^3, respectively. In a survey of nitrate concentrations in groundwaters around Lake Rotorua, Grinsted and Wilson (1978) reported that most bores were in the range 1-5 g/m^3 NO_3-N. Grinsted and Wilson (1978) noted that shallow groundwaters from bores in the vicinity cowsheds were most likely to exceed 5 g/m^3 NO_3-N, whereas groundwaters from deep bores, especially those with a noticeable smell of H_2S, were most likely to have less than 1 g/m^3 NO_3-N. Grinsted and Wilson (1978) reported an inverse correlation between nitrate concentration and distance from Lake Rotorua (Table 5.1), and concluded that agricultural practices around the lake were having an impact on nitrate concentrations in groundwater. In a survey of nitrate concentrations in shallow groundwaters of the Bay of Plenty region, Gordon (2002) reported an average concentration of 3.3 g/m^3 NO_3-N with 81% of the 295 bores sampled having NO_3-N concentrations below 5.7 g/m^3 (i.e. less than ½ the drinking water guideline value; New Zealand Ministry of Health, 2000). The results of Gordon (2002) are quite comparable to the results of Grinsted and Wilson (1978), even though the two surveys were conducted more than 25 years apart, and Gordon (2002) did not include the Rotorua area and targeted wells less than 20 m deep.

Nitrogen compounds are introduced into groundwaters by both natural and human activities. In the soil zone, organic nitrogen is produced by microbial fixation, and then cycled through NH_4-N, NO_3-N, N_2 and intermediary forms (Chapelle, 1993). Because organic nitrogen is often a limiting nutrient for plant growth, concentrations of inorganic forms of nitrogen are usually less than 2 g/m^3 in unimpacted groundwaters. Indeed, Daughney and Reeves (2003) estimated the 50th and 95th percentiles in NO_3-N in New Zealand groundwaters not impacted by development to be 0.7 g/m^3 and 3.5 g/m^3, respectively. Nitrogen compounds are also introduced into groundwater in the Rotorua area by various human activities, and may exceed the drinking water guideline values of 11.3 g/m^3 NO_3-N (health-related) and 1.24 g/m^3 NH_4-N (aesthetic) (New Zealand Ministry of Health, 2000) in areas used for sewage treatment or agriculture (Grinsted and Wilson, 1978; Tomer et al., 1996; Magesan et al., 1998; Park, 1999; Gordon, 2002; Park, 2003; Menneer et al., 2004). In terms of various agricultural practices, Menneer et al. (2004) report that the potential for NO_3-N leaching follows the order forestry < sheep/beef/deer farming < arable/mixed cropping < dairy farming < vegetable cropping. In cropping systems, the majority of leached nitrogen is derived from fertiliser and crop residues that remain in the soil following harvest, whereas for grazing systems, the majority of leached nitrogen originates as deposited urine (Menneer et al., 2004).

Table 5.1 Relationship between nitrate concentration in groundwater and distance from the shore of Lake Rotorua for the northwestern section of the lake's catchment (Grinsted and Wilson, 1978).

Distance from shore of Lake Rotorua (km)	No. of samples	Mean NO_3 Conc.	S.D.
0.1 - 2.0	10	2	1.9
2.1 - 4.0	9	1.1	0.7
4.1 - 6.0	7	0.6	0.4
6.1 - 8.0	6	0.6	0.3
8.1 - 10.0	3	0.5	0.2

5.1.1.2 Phosphorus

Concentrations of phosphorus in groundwaters in volcanic aquifers of the Rotorua area are typically between 0.1 and 0.4 g/m^3 PO_4-P. Groundwater bores sampled through the EBOP regional monitoring network have an average of 0.15 g/m^3 PO_4-P (O'Shaugnessy and Hodges, 1992; Hodges, 1994a, 1994b). Morgenstern et al. (2004) reported groundwater and spring water PO_4-P concentrations of 0.02-0.59 g/m^3. Concentrations of PO_4-P in Rotorua groundwaters are relatively high compared to aquifers with other lithologies in other parts of New Zealand (Daughney and Reeves, 2003; Morgenstern et al., 2004).

Phosphorus is introduced into groundwater primarily through water-rock interaction. As for other major elements such as K, F and Si, P is typically enriched in rhyolite and ignimbrite relative to other rock types (Cox et al., 1979; Langmuir, 1997; Faure, 1998). As a result, groundwater PO_4-P concentrations would be expected to increase during progressive water-rock interaction in aquifers with these volcanic lithologies, as shown by Morgenstern et al. (2004). In the Rotorua area, phosphorus is also introduced into groundwater through agricultural practices (Menneer et al., 2004) and wastewater treatment (Tomer et al., 1996; Magesan et al., 1998; Park, 1999, 2003). Menner et al. (2004) note that little is known about the leaching of P associated with various agricultural practices, but in general, P loss is much less significant than N loss, and the former occurs primarily via runoff whereas the latter occurs primarily via infiltration. The soils of the Rotorua area usually contain allophane, which effectively adsorbs phosphorus and prevents its leaching to groundwater (Tomer et al., 1996; Magesan et al., 1998; Park, 2003). As a result, it is likely that the majority of phosphorus in the groundwaters of the Rotorua area is derived from natural water-rock interaction, rather than wastewater infiltration or agricultural activity.

5.1.1.3 Overview of groundwater chemistry aside from nitrogen and phosphorus

In terms of major ion chemistry, most groundwaters in the study area have Na as the dominant cation and HCO_3 as the dominant anion (O'Shaugnessy and Hodges, 1992; Hodges, 1994a, 1994b; Gordon, 2001; Morgenstern et al., 2004). This pattern of major ion chemistry reflects the dominance of ignimbrite and rhyolite aquifers in the Rotorua area. Ignimbrite and rhyolite aquifers typically have low Ca- and Mg-mineral content, and notably they are usually completely devoid of Ca and Mg carbonate minerals, which are readily soluble and thus lead to the dominance of Ca and Mg over Na in many sedimentary aquifers (e.g. shellbeds, sands, gravels). In addition, rhyolite and ignimbrite aquifers are expected to weather to produce clay minerals such as Na-montmorillonite (Hodges, 1994b). Such clay minerals, where present, likely contribute to the removal of Ca and Mg from recharge waters and their replacement by Na through the process of ion exchange (Freeze and Cherry, 1979; Langmuir, 1997). The dominance of HCO_3 as the major anion is also expected for ignimbrite and rhyolite aquifers. These types of aquifers are typically devoid of soluble salt minerals such as gypsum and halite, which, if present, would contribute to the concentrations of SO_4 and Cl upon progressive water-rock interaction. Exceptions to the general dominance of Na and HCO_3 can be found at a small number of sites in the study area that tap sand or gravel aquifers containing carbonate minerals, where Ca is the dominant cation, and at a limited number of geothermally influenced sites, where Cl is the dominant anion.

In terms of the chemistry of other major elements, many groundwaters in the study area feature high concentrations of K, F and SiO_2 relative to groundwaters from other parts of New Zealand (Morgenstern et al., 2004). Again, the common occurrence of high concentrations of these elements is linked to the dominance of ignimbrite and rhyolite aquifers around the Rotorua area. Ignimbrites and rhyolites are enriched in K, F and SiO_2 relative to other rock types (Cox et al., 1979; Langmuir, 1997; Faure, 1998), and progressive water-rock interaction would be expected to lead to relatively high concentrations of these elements in groundwater.

Most groundwaters in volcanic aquifers in the study area have low concentrations of Fe and Mn, but groundwaters in some sedimentary aquifers can contain significant amounts of these elements (Hodges, 1994a, 1994b). The presence of dissolved Fe and/or Mn in a groundwater is generally indicative of reduced (i.e. anoxic conditions); this in turn suggests that most volcanic aquifers in the Rotorua area are oxic or only moderately anoxic. The onset of anoxic conditions in aquifers is tied the activity of micro-organisms, which consume oxygen during the metabolism of organic matter. Ignimbrite and rhyolite aquifers contain virtually no intergranular organic material, and so they may remain oxidised for long periods of time, such that Fe and Mn are not solubilised (Daughney, 2003). The conversion of nitrate to more reduced species such as nitrate, nitrogen gas and ammonium is also controlled by microbial metabolism, such that nitrate is the dominant form in oxic conditions, whereas ammonium dominates under anoxic conditions (Chapelle, 1993). In accordance with thermodynamic predictions (Langmuir, 1997), NO_3-N generally does not coexist with significant concentrations of Fe or Mn. The persistence of oxic conditions in the aquifers of the Rotorua area and the relatively low concentrations of Fe, Mn and NH_4-N have been confirmed by Morgenstern et al. (2004).

Groundwaters within volcanic aquifers throughout the study area are characterised by relatively low values of pH and conductivity (O'Shaugnessy and Hodges, 1992; Hodges, 1994a, 1994b; Morgenstern et al., 2004), compared to groundwaters in aquifers with other lithologies (Daughney and Reeves, 2003). pH values for groundwaters in volcanic aquifers across the study area are typically $6 < pH < 7$, whereas other aquifers in the EBOP region, and across New Zealand in general, are usually between 6.5 and 7.5. The pH values of most groundwaters in New Zealand are buffered by carbonate equilibria; in volcanic aquifers with negligible carbonate mineral content, groundwater pH values are expected to be more acidic

(Drever, 1988; Langmuir, 1997). Electrical conductivity values of groundwaters within the study area are usually between 6 and 14 mS/cm, and are correlated to the concentrations of major ions such as Na, K, HCO_3 and Cl (O'Shaugnessy and Hodges, 1992; Hodges, 1994a, 1994b). Sites with some geothermal influence (temperature ca. 20-35ºC) have higher conductivities and higher concentrations of Cl relative to HCO_3 (note that most sites with groundwater temperatures above 30ºC are excluded from EBOP's non-geothermal groundwater monitoring network).

The concentrations of trace metals and organic substances are not routinely monitored in groundwaters within the study area, but a limited amount of information does exist. Several trace elements have been analysed in groundwaters through the EBOP regional monitoring network (Hodges, 1994b). The available data suggest that arsenic concentrations in rhyolite and ignimbrite aquifers are correlated to other indicators of geothermal influence, such as temperature, conductivity, and concentrations of major elements such as Na, K, Cl and F. Rosen (1998) and Gordon (2002) also suggested that arsenic, where detected in groundwater, would be indicative of geothermal influence. Elevated boron concentrations can be associated with peat deposits (Gordon, 2002), or with certain industrial activities (Tonkin & Taylor, 2000). The concentrations of cadmium, copper, lead and zinc show little relationship to geothermal character (Hodges, 1994b), but may instead be related to industrial contamination.

Morgenstern et al. (2004) determined the age of groundwater from seven springs and five bores, through analysis of concentrations of tritium, CFCs and SF_6. Eight of the twelve sites were characterised by old groundwaters, with Mean Residence Time (MRT) greater than 60 years and corresponding fractions of young water (yf) between 1% and 44%. The remaining four sites had MRT from 14 to 54 years and corresponding yf values between 51% and 95%. Morgenstern et al. (2004) demonstrated that the younger waters had significantly higher concentrations of NO_3-N, K, and SO_4, presumably due to land use intensification. Conversely, the older waters had significantly higher concentrations of PO_4-P, Na, F and SiO_2, all of which presumably accumulate in solution due to progressive water-rock interaction.

5.1.2 Rainfall

Nitrogen and phosphorus concentrations in rainfall in the Rotorua region have been investigated by Fish (1976). At the time of this investigation, rainfall contained, on average, 0.022 g/m^3 NO_3-N, 0.084 g/m^3 NH_4-N, and 0.006 g/m^3 PO_4-P (for the purpose of this review, dissolved reactive phosphorus and orthophosphate (PO_4) are assumed to be equal). In addition to these inorganic species, the rainfall around Lake Rotorua was observed to contain an additional 0.085 g/m^3 organic N and 0.002 g/m^3 organic P. These nutrient concentrations are fairly representative of marine and coastal rain, which typically contains 0.03-0.17 g/m^3 NO_3-N and 0.01-0.11 g/m^3 NH_4-N (Langmuir, 1997). NO_3 is introduced into rain from natural processes, including lightning, which produces NO_3 from N_2, and biological decay, which produces NO_2 which is subsequently converted into NO_3 in the presence of oxygen. NH_4 is also introduced into rain from natural sources, particularly from biological decay, which produces NH_3 which then dissolves in rainwater as NH_4^+. Both NO_3 and NH_4 are also introduced into rain by human activities, including the application of fertilisers and the burning of fossil fuels. Fish (1976) concluded that rainfall should account for a small but significant proportion of nitrogen and phosphorus input into Lake Rotorua (ca. 15% and 5%, respectively) (see also Section 5.1.4).

5.1.3 Stream water

Nitrogen and phosphorus concentrations in streams of the Rotorua area have been intensely investigated over several decades (Fish, 1975; Hoare 1980a, 1980b, 1982, 1987; Rutherford et al., 1989; Williamson et al. 1996). Concentrations of nutrients in streams draining into Lake Rotorua have also been monitored by EBOP from 1991-1995 and from 2002-2003. All of these investigations have recently been summarised by Rutherford (2003). Rutherford (2003) notes that it is difficult to compare nutrient concentrations reported in these various studies, because:

- Analytical methods and detection limits for nitrogen and phosphorus have changed significantly over the last several decades
- The studies were conducted over periods with different stream flow rates and different amounts of rainfall recharge. The concentrations of some forms of nitrogen and phosphorus are correlated to stream flow rate (e.g. particulate and organic forms), whereas

the concentrations of some other forms of these nutrients are independent of flow rate (e.g. dissolved NO_3-N, NH_4-N, PO_4-P).

- The streams drain catchments with different land use, land use may have changed in some areas over the past 30 years, and the time lag between land use change and observed change in stream nutrient concentration is unconstrained and likely varies between catchments.

Despite these complications, Rutherford (2003) summarised the available stream nutrient concentration data (Table 5.2), and offered the following generalisations:

- Although stream nutrient concentrations are quite variable across the study area, approximate levels are as follows: $0.09 < NO_3\text{-N} < 1.42$ g/m^3, $0.00 < NH_4\text{-N} < 2.03$ g/m^3, $0.02 < PO_4\text{-P}$ (i.e. DRP) < 0.12 g/m^3. The average concentrations, across all streams and sample collection dates, were 0.77 g/m^3, 0.22 g/m^3 and 0.06 g/m^3 for NO_3-N, NH_4-N and PO_4-P, respectively.
- Soluble nutrient concentrations (dissolved NO_3-N, NH_4-N and PO_4-P) are independent of stream flow rate.
- In most streams, NH_4-N concentrations are low and insignificant relative to NO_3-N concentrations. The only exception is for the Waiohewa stream, which receives NH_4-N input from the Tikitere geothermal field (see also Section 6).
- Concentrations of particulate and organic nitrogen and phosphorus vary with stream flow rate, presumably due to entrainment of particulate material, but the pattern of concentration relative to flow rate is not consistent, even within a single stream. However, the total annual volume of flood flow is small (<10%) relative to base flow, and so particulate and organic forms of nitrogen and phosphorus account for an accordingly small proportion of the total stream load.
- Eight of the nine major streams investigated show consistent increases in NO_3-N concentration over time, most likely due to intensification of land use. There is probably a substantial time lag between the land use change and the resulting increase in NO_3-N observed in streams, but the length of the time lag is presently unconstrained and may differ significantly between catchments.
- There are no consistent time trends in the concentrations of NH4-N, PO4-P, or organic or particulate forms of P or N.

Table 5.2 Summary of mean nutrient concentrations in streams in the Lake Rotorua area (Rutherford, 2003; refer to this reference for standard deviations and numbers of samples analysed). For each determinand, the columns 1, 2, 3 and 4 show results from Fish (1975), Hoare (1980a), EBOP 1991-1995, and EBOP 2002-2003, respectively. Note that dissolved phosphorus concentrations in these references are reported as DRP, but in this review, orthophosphate (PO$_4$-P) and DRP concentrations are assumed to be equal.

Site		PO4-P (g/m3)				TP (g/m3)				NH4- N (g/m3)				NO3-N (g/m3)				TKN (g/m3)			
Name	**Code**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Awahou	AWA	0.066	0.062	0.078	0.070		0.072	0.078	0.068	0.010	0.015	0.014	0.010	0.640	0.907	1.133	1.070		0.120	0.130	0.101
Hamurana	HAM	0.081	0.077	0.090	0.093		0.086	0.083	0.086	0.000	0.015	0.012	0.011	0.310	0.461	0.680	0.643		0.090	0.075	0.007
Ngongotaha	NGO	0.035	0.032	0.038	0.039		0.056	0.063	0.050	0.020	0.025	0.028	0.017	0.300	0.528	0.721	0.796		0.170	0.313	0.215
Puarenga	PUA	0.090	0.031	0.053	0.046		0.083	0.098	0.068	0.100	0.088	0.080	0.073	0.090	0.191	0.451	0.891		0.360	0.390	0.320
Utuhina	UTU	0.071	0.041	0.055	0.056		0.076	0.070	0.065	0.050	0.049	0.041	0.038	0.410	0.707	0.732	0.751		0.280	0.267	0.233
Waiohewa	WHE	0.059	0.022	0.032	0.035		0.089	0.153	0.047	1.500	1.569	2.027	1.276	0.650	1.209	1.155	1.416		2.110	2.617	1.007
Waingaehe	WNG	0.110	0.092	0.125	0.106		0.129	0.194	0.104	0.300	0.026	0.023	0.007	0.340	0.673	1.013	1.297		0.190	0.509	0.121
Waiteti	WTT	0.040	0.033	0.038	0.039		0.056	0.042	0.071	0.200	0.025	0.031	0.021	0.490	0.786	1.247	1.250		0.160	0.155	0.370
Waiowhiro	WWH		0.037	0.069	0.044		0.058	0.101	0.037		0.055	0.052	0.018		0.987	0.837	0.940			0.417	

5.1.4 Lake Rotorua

5.1.4.1 Nutrient concentrations

Nitrogen and phosphorus concentrations in Lake Rotorua have been studied intensively for several decades (for a summary, see Rutherford 1989, 2003). The water quality of the lake is affected by internal processes, as well as by nutrient loads from springs, streams and groundwater, and as such, a detailed description of the water quality data from Lake Rotorua is beyond the scope of this review. Rutherford (2003) notes that nutrient levels have been increasing over the last few decades, and associated water quality parameters have been shifting accordingly (Table 5.3).

Table 5.3 Average water quality of Lake Rotorua (from Rutherford, 2003).

	1965	1976-77	1981-82	1984-85
Total Phosphorus (g/m3)		0.024	0.048	0.073
Total Nitrogen (g/m3)		0.310	0.519	0.530
Chlorophyll (mg/m3)		5.5	37.8	22.6
Peak Chlorophyll (mg/m3)		28	62	58
Secchi Disk (m)	2.5-3	2.3	1.9	1.7
Deoxygenation (g/m3/day)		0.4	0.7	0.9

5.1.4.2 Lake Rotorua nutrient budget

Estimates of the nutrient budget of the Lake Rotorua catchment, or components of it, have been made by Fish (1975), Hoare (1980a, 1987), and Williamson et al. (1996). Rutherford (2003) used these investigations to estimate nutrient loads to Lake Rotorua for 2002 (Table 5.4). Although many aspects of the nutrient budget of the lake are still poorly constrained, the following general conclusions can be made:

- Nitrogen and phosphorus inputs to the lake are dominated by soluble species (NO_3-N, NH_4-N, PO_4-P), and because concentrations of these species do not vary with stream flow rate (see Section 1.3), the annual loads can be estimated by multiplying average stream flow rates by average stream nutrient concentrations.
- Concentrations of particulate and organic forms of nitrogen and phosphorus do vary significantly with flow rate, but these forms represent a small fraction of the total nitrogen and phosphorus loads to the lake. Some reports suggest that particulate forms of nitrogen and phosphorus settle relatively rapidly once they reach the lake, so may not be available and thus can be neglected in the lake's overall nutrient budget.

- The load of NO_3-N from the catchment via streams to the lake has increased over the past few decades, due to increasing concentrations of NO_3-N in stream baseflow. The increase in NO_3-N concentration in stream baseflow is presumably related to changes in land use within the catchment, but the time lag between land use change and the corresponding increase in stream baseflow concentration is unknown.
- The load of NH_4-N from the catchment via streams to the lake has remained low and constant over the past few decades, and is derived primarily from geothermal sources (see also Section 6).
- The load of PO_4-P from the catchment via streams to the lake has remained constant over past few decades.
- Sewage has accounted for a significant fraction of nitrogen and phosphorus loads into Lake Rotorua over the past few decades. During the 1970's and 1980's, sewage nutrient load increased steadily in response to expansion of Rotorua and its reticulation system. Land disposal of sewage in the Whakarewarewa Forest began in 1991, in an effort to reduce nutrient loads to the Lake. Initially, the scheme appeared to be successful, and nutrient loads to the lake decreased from 1991-1993. However, from 1994-2003 the nutrient load to the lake increased again, indicating that the wastewater required about two years to travel from the land disposal area to the nearest streams.
- Various processes operating entirely within the lake can cause re-release of particulate-bound inorganic nitrogen and phosphorus. These internal nutrient loads are generally associated with stratification of the lake during the summer.

Table 5.4 Nutrient input loads into Lake Rotorua (from Rutherford, 2003). 1976-77 values were measured by Hoare (1980a); other values were estimated by Rutherford (2003).

Phosphorus Input	**1976-77**	**1984-85**	**2002**
Treated sewage (t/y)	7.8	33.8	1
Streams (t/y)	34	34	34
Internal (t/y)	0	35	ND
Total (t/y)	42	103	35

Nitrogen Input	**1976-77**	**1984-85**	**2002**
Treated sewage (t/y)	73	150	32
Streams (t/y)	485	415	660
Internal (t/y)	0	>260	ND
Total (t/y)	558	>825	692

5.2 Water quality monitoring data from the Lake Rotorua area

5.2.1 Sources of water quality monitoring data

The water quality data considered in this report have been compiled from several sources, several of which are housed within different databases:

- EBOP Natural Environment Regional Monitoring Network (NERMN Database) (74 sites)
- EBOP ad hoc groundwater quality monitoring programmes (58 sites)
- EBOP river water quality monitoring programmes (28 sites)
- EW baseline groundwater monitoring programme (112 sites)
- EW ad hoc groundwater monitoring programmes in the Rotorua region (90 sites)
- GNS National Groundwater Monitoring Programme (NGMP) (6 sites within EBOP)
- GNS investigations in the Rotorua lakes area (bores, springs, streams) (39 sites)

5.2.2 Locations and characteristics water quality monitoring sites

Table 5.5 lists the names, locations and characteristics of the 409 monitoring sites considered in this review, and Figures 5.1-5.4 show the locations of the monitoring sites immediately around Lake Rotorua. Of all 205 EBOP monitoring sites considered in this review, 139 sites (68%) are groundwater bores, 24 sites (12%) are springs, and 42 sites (20%) are streams or rivers; of the 204 monitoring sites within the EW region, 198 sites (97%) are groundwater bores, and 6 sites (3%) are streams or rivers (Table 5.6). In both regions, the majority of groundwater monitoring sites are from aquifers with unknown lithology.

The names of the analytical parameters from the above-mentioned data sources are listed and compared in Table 5.7. Four important points related to compilation of water quality data from different databases must be mentioned. First, there are 37 determinands considered in this review that have different names or abbreviations in one or more of the databases described above. For example, chloride is abbreviated as ‘CL’ in the EBOP NERM database, but it is listed as ‘Chlorine’ in the database for the EBOP ad-hoc monitoring results. Second, even within a single database, some results pertain to filtered samples, whereas other results pertain to unfiltered samples. Typically, analyses of filtered samples are assumed to yield data describing ‘dissolved’ concentrations or results, whereas analyses of unfiltered samples are assumed to yield data describing ‘total’ concentrations.

Table 5.5 Names, locations and characteristics of water quality monitoring sites considered in this review. 'ID#' is a unique identification number created for the purpose of this review; 'Alternate ID' and 'Alias' are names or numbers used by the supplier of the data. 'Type' categorises monitoring sites as bores, streams (riverWQ) or springs. 'RC' is the regional council in which the monitoring site is located; 'Source' describes the institution that supplied the data; 'Project' describes the programme or purpose of the data collection (see Section 5.2.1). The 'In Area?' column shows whether or not the monitoring site is located within the study area immediately around Lake Rotorua (a box with easting/northing corners of 276000/6313600, 282000/6376500). Spring catchments, surface water catchments, groundwater catchments, and ungauged catchment areas are described in Section 7.

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
2	70		bore	2780000	6374200	222.5	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
3	71		bore	2802300	6374000	542.5	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
21	137		bore	2804800	6348300	57.3		EBOP	EBOP	EBOP-ADHOC	Y				
39	168		bore	2803700	6347400	53	Consolidated Schist	EBOP	EBOP	EBOP-ADHOC	Y				
65	226		bore	2798900	6337200	19.5	Sand	EBOP	EBOP	EBOP-ADHOC	Y		Waitawa	S1	Area3
67	228		bore	2802200	6342400	39	Undifferentiated Alluvial	EBOP	EBOP	EBOP-ADHOC	Y		Pohue Bay	E1	Area3
78	305		bore	2810000	6371000	335	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
80	410	W & H Bowyer	bore	2811100	6367000	196.6	Pumice Material	EBOP	EBOP	EBOP-NERM	Y				
89	432		bore	2788300	6368700	178.3	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
101	643	A & S Wakefield	bore	2819490	6371720	9	Sand	EBOP	EBOP	EBOP-NERM	N				
106	3669		bore	2804040	6348180	40	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
111	951	Paengaroa North K Trust	bore	2810900	6371200	114.3	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
132	1074		bore	2811600	6366700	195.1	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
134	1079		bore	2782400	6373100	115.8	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
136	1084		bore	2806500	6371600	109.7	Gravel	EBOP	EBOP	EBOP-ADHOC	Y				
138	1087		bore	2782300	6372100	283.5	Andesite	EBOP	EBOP	EBOP-ADHOC	Y				
141	1092		bore	2809500	6369400	121.9	Gravel	EBOP	EBOP	EBOP-ADHOC	Y				
142	1095		bore	2781400	6369200	121.9	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
146	1111		bore	2815500	6367000	78	Sand	EBOP	EBOP	EBOP-ADHOC	Y				
156	1138		bore	2811900	6366600	193.5		EBOP	EBOP	EBOP-ADHOC	Y				
204	1354		bore	2811800	6368500	46.3	Pumice Material	EBOP	EBOP	EBOP-ADHOC	Y				
206	1384		bore	2782700	6368500	182.9	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
208	1446		bore	2788700	6344600	87	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y		Waiteti	W3	
210	1471		bore	2794500	6374100	76.2	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
211	1474		bore	2790300	6372800	116	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
215	1501		bore	2786900	6372200	162.8	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
221	1520	W.Tapsell	bore	2814780	6374110	74	Gravel	EBOP	EBOP	EBOP-NERM	Y				
230	1535		bore	2806860	6373720	32	Sand	EBOP	EBOP	EBOP-ADHOC	Y				
234	1561	Dunroamin Nurseries	bore	2792910	6345900	73.1	Rhyolite	EBOP	EBOP	EBOP-NERM	Y		Awahou Point	W4	Area1
242	1586	K.J & G. Crawford	bore	2804280	6373420	30.5	Undifferentiated Alluvial	EBOP	EBOP	EBOP-NERM	Y				
248	1652		bore	2812200	6372400	97.5	Gravel	EBOP	EBOP	EBOP-ADHOC	Y				
270	2022		bore	2781200	6367800	135	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
274	2030		bore	2803600	6343800	159	Pumice Material	EBOP	EBOP	EBOP-ADHOC	Y				
278	2102		bore	2779790	6340730	113	Undifferentiated Alluvial	EBOP	EBOP	EBOP-ADHOC	Y		Waiteti		
280	2109		bore	2803800	6343800	137	Gravel	EBOP	EBOP	EBOP-ADHOC	Y		Pohue Bay	E1	
286	2118	Te Ngae Nursery	bore	2802000	6341500	24	Pumice Material	EBOP	EBOP	EBOP-NERM	Y		Waiohewa	E2	Area3
298	2136		bore	2803900	6342500	36	Gravel	EBOP	EBOP	EBOP-ADHOC	Y		Waiohewa	E2	
299	10164		bore	2775060	6384640	178		EBOP	EBOP	EBOP-ADHOC	N				
300	2138		bore	2802000	6323000	19	Pumice Material	EBOP	EBOP	EBOP-ADHOC	Y				
305	2344	Waimapu Packhouse	bore	2786380	6373390	123.4	Undifferentiated Volcanic Rock	EBOP	EBOP	EBOP-NERM	Y				
319	2426		bore	2770600	6369500	68	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
324	2442		bore	2807100	6370300	102.5	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
325	2557		bore	2781000	6365700	137	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
326	2576		bore	2778200	6342300	110	Pumice Material	EBOP	EBOP	EBOP-ADHOC	Y				
330	2590		bore	2809400	6372600	17.37	Pumice Material	EBOP	EBOP	EBOP-ADHOC	Y				
332	2593		bore	2803700	6346600	79	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
333	2594		bore	2788600	6341500	110	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y		Waiteti	W3	
334	2596		bore	2788400	6369000	60	Ignimbrite	EBOP	EBOP	EBOP-ADHOC	Y				
337	2708	E.K. Hickson	bore	2811400	6368100	60		EBOP	EBOP	EBOP-NERM	Y				
349	2822	P & L Donovan	bore	2816220	6368110	121.9		EBOP	EBOP	EBOP-NERM	Y				
351	2824		bore	2805400	6372700	95	Undifferentiated Alluvial	EBOP	EBOP	EBOP-ADHOC	Y				
353	2827		bore	2799800	6369400	219.5	Undifferentiated Volcanic Rock	EBOP	EBOP	EBOP-ADHOC	Y				
361	3004		bore	2816100	6368500			EBOP	EBOP	EBOP-ADHOC	Y				

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
362	3008		bore	2795600	6368700			EBOP	EBOP	EBOP-ADHOC	Y				
363	3013		bore	2804500	6371400			EBOP	EBOP	EBOP-ADHOC	Y				
364	3015		bore	2803800	6374100	201		EBOP	EBOP	EBOP-ADHOC	Y				
369	3045	G.S.R. Allen	bore	2810590	6374180	5.48		EBOP	EBOP	EBOP-NERM	Y				
384	3287		bore	2817700	6355600	90	Undifferentiated Alluvial	EBOP	EBOP	EBOP-ADHOC	Y				
409	3470	J.W Lepper	bore	2791350	6343100			EBOP	EBOP	EBOP-NERM	Y		Waiteti	W3	Area1
418	3566	G & D Thacker	bore	2817400	6365100	122	Ignimbrite	EBOP	EBOP	EBOP-NERM	Y				
434	3674		bore	2807300	6345600	38	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
435	3675		bore	2807500	6345700	45	Rhyolite	EBOP	EBOP	EBOP-ADHOC	Y				
436	3676		bore	2802300	6343490	56	Pumice Material	EBOP	EBOP	EBOP-ADHOC	Y		Pohue Bay	E1	Area3
439	4000	P & G Ludgate	bore	2802640	6343400	26		EBOP	EBOP	EBOP-NERM	Y		Pohue Bay	E1	Area3
440	4003	Pickernell Bore	bore	2802530	6343420	26		EBOP	EBOP	EBOP-NERM	Y		Pohue Bay	E1	Area3
442	4005		bore	2803300	6340140	180		EBOP	EBOP	EBOP-ADHOC	Y		Rotokawa	E3	
444	4007	D & R Pemberton	bore	2789360	6344720			EBOP	EBOP	EBOP-NERM	Y		Waimehia	W3	
640	10158		bore	2787950	6342860	89		EBOP	EBOP	EBOP-ADHOC	Y		Waiteti	W3	
641	10162		bore	2804000	6319500	221		EBOP	EBOP	EBOP-ADHOC	Y				
666	3690		bore	2809930	6349470	119		EBOP	EBOP	EBOP-ADHOC	Y				
668	3702		bore	2803100	6370630	195.18		EBOP	EBOP	EBOP-ADHOC	Y				
672	3685		bore	2804800	6343300	84		EBOP	EBOP	EBOP-ADHOC	Y		Waiohewa	E2	
706	4993		bore	2810430	6373840	108		EBOP	EBOP	EBOP-ADHOC	Y				
764	1173.2		riverWQ	2766500	6351300			EW	EW	EW-ADHOC	Y				
765	1174.4		riverWQ	2762300	6368300			EW	EW	EW-ADHOC	Y				
766	1287.7		riverWQ	2761600	6328100			EW	EW	EW-ADHOC	Y				
767	1323.1		riverWQ	2795700	6317100			EW	EW	EW-ADHOC	Y				
768	279.1		riverWQ	2766300	6350300			EW	EW	EW-ADHOC	Y				
769	683.4		riverWQ	2795500	6316600			EW	EW	EW-ADHOC	Y				
778	64.247		bore	2762700	6369100	73.2		EW	EW	EW-ADHOC	Y				
779	64.271		bore	2761200	6366800	13.7		EW	EW	EW-ADHOC	Y				
780	64.29		bore	2762100	6366000	49		EW	EW	EW-ADHOC	Y				
783	64.393		bore	2760600	6364000	93.8		EW	EW	EW-ADHOC	Y				
786	64.551		bore	2762800	6370000	125		EW	EW	EW-ADHOC	Y				
787	64.552		bore	2763500	6366700	28.5		EW	EW	EW-ADHOC	Y				
788	64.559		bore	2760400	6369400	30		EW	EW	EW-ADHOC	Y				
789	64.57		bore	2760500	6368600	14		EW	EW	EW-ADHOC	Y				
791	64.647		bore	2760500	6365200	8.23		EW	EW	EW-ADHOC	Y				
792	64.658		bore	2763400	6366200	9.5		EW	EW	EW-ADHOC	Y				
794	64.865		bore	2762000	6367700	70		EW	EW	EW-ADHOC	Y				
795	64.938		bore	2760700	6368500	10.3		EW	EW	EW-ADHOC	Y				
796	64.942		bore	2760900	6366900	13.4		EW	EW	EW-ADHOC	Y				
797	64.996		bore	2760600	6366300	34.5		EW	EW	EW-ADHOC	Y				
799	66.24		bore	2790000	6316800	55		EW	EW	EW-ADHOC	Y				
800	66.28		bore	2788400	6321100	43		EW	EW	EW-ADHOC	Y				
801	66.29		bore	2785000	6350000	170		EW	EW	EW-ADHOC	Y	S102		W4	
804	66.42		bore	2790700	6326500	60		EW	EW	EW-ADHOC	Y				
806	66.46		bore	2797500	6318400	195		EW	EW	EW-ADHOC	Y				
807	66.47		bore	2793000	6328200	46		EW	EW	EW-ADHOC	Y		Puarenga	S2C	
808	66.5		bore	2787100	6321600	73		EW	EW	EW-ADHOC	Y				
809	66.53		bore	2793000	6328200	97		EW	EW	EW-ADHOC	Y		Puarenga	S2C	
810	66.57		bore	2789500	6317600	55		EW	EW	EW-ADHOC	Y				
811	66.65		bore	2775100	6339600	122		EW	EW	EW-ADHOC	Y				
812	66.67		bore	2797000	6323700	65.3		EW	EW	EW-ADHOC	Y				
813	66.69		bore	2779200	6339700	75		EW	EW	EW-ADHOC	Y				
814	66.7		bore	2785000	6350000	89		EW	EW	EW-ADHOC	Y	S102		W4	
820	67.116		bore	2760600	6332800	70		EW	EW	EW-ADHOC	Y				
825	67.138		bore	2761000	6358400	85		EW	EW	EW-ADHOC	Y				
828	67.142		bore	2760500	6323400	100		EW	EW	EW-ADHOC	Y				
836	67.16		bore	2762200	6322100	56		EW	EW	EW-ADHOC	Y				
839	67.165		bore	2761800	6338100	128		EW	EW	EW-ADHOC	Y				
842	67.171		bore	2766600	6319600	114		EW	EW	EW-ADHOC	Y				
844	67.175		bore	2760600	6336800	100		EW	EW	EW-ADHOC	Y				
847	67.184		bore	2760300	6339800	140.2		EW	EW	EW-ADHOC	Y				
849	67.189		bore	2760800	6358000	88		EW	EW	EW-ADHOC	Y				
851	67.198		bore	2764200	6326600	65		EW	EW	EW-ADHOC	Y				
861	67.21		bore	2767700	6321400	25		EW	EW	EW-ADHOC	Y				
870	67.22		bore	2761600	6324000	62		EW	EW	EW-ADHOC	Y				
923	67.276		bore	2764900	6319900	73.76		EW	EW	EW-ADHOC	Y				
932	67.299		bore	2761300	6323800	90		EW	EW	EW-ADHOC	Y				
937	67.317		bore	2763500	6326500	142		EW	EW	EW-ADHOC	Y				
938	67.32		bore	2765200	6325900	166		EW	EW	EW-ADHOC	Y				
943	67.338		bore	2760900	6358400	54		EW	EW	EW-ADHOC	Y				

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
950	67.362		bore	2760700	6337100	177		EW	EW	EW-ADHOC	Y				
954	67.373		bore	2765500	6342100	98		EW	EW	EW-ADHOC	Y				
956	67.377		bore	2767500	6331600	96		EW	EW	EW-ADHOC	Y				
960	67.389		bore	2766000	6354000	186		EW	EW	EW-ADHOC	Y				
961	67.39		bore	2764500	6359500	60.9		EW	EW	EW-ADHOC	Y				
962	67.392		bore	2763200	6328100	195		EW	EW	EW-ADHOC	Y				
966	67.402		bore	2761400	6352400	112		EW	EW	EW-ADHOC	Y				
972	67.421		bore	2762200	6329000	64.3		EW	EW	EW-ADHOC	Y				
991	67.47		bore	2760200	6359400	53		EW	EW	EW-ADHOC	Y				
993	67.478		bore	2764800	6320300	102		EW	EW	EW-ADHOC	Y				
999	67.495		bore	2762600	6326700	59.5		EW	EW	EW-ADHOC	Y				
1002	67.506		bore	2763700	6326700	77		EW	EW	EW-ADHOC	Y				
1003	67.507		bore	2765500	6352500	135		EW	EW	EW-ADHOC	Y				
1010	67.526		bore	2759900	6321300	100		EW	EW	EW-ADHOC	N				
1012	67.528		bore	2759900	6321300	88		EW	EW	EW-ADHOC	N				
1013	67.529		bore	2759900	6321300	72		EW	EW	EW-ADHOC	N				
1015	67.531		bore	2764200	6351500	111.3		EW	EW	EW-ADHOC	Y				
1017	67.535		bore	2762800	6324900	70		EW	EW	EW-ADHOC	Y				
1018	67.538		bore	2764300	6346900	180		EW	EW	EW-ADHOC	Y				
1020	67.572		bore	2760500	6336500	80		EW	EW	EW-ADHOC	Y				
1028	67.6		bore	2761400	6322900	50		EW	EW	EW-ADHOC	Y				
1042	67.97		bore	2760200	6356100	79		EW	EW	EW-ADHOC	Y				
1043	67.99		bore	2765200	6350300	60		EW	EW	EW-ADHOC	Y				
1046	72.1036		bore	2760400	6361900	95		EW	EW	EW-ADHOC	Y				
1047	72.112		bore	2762300	6364100	107		EW	EW	EW-ADHOC	Y				
1048	72.1121		bore	2761800	6329800	80		EW	EW	EW-ADHOC	Y				
1049	72.113		bore	2760800	6331900	132		EW	EW	EW-ADHOC	Y				
1050	72.1245		bore	2760600	6333600	240		EW	EW	EW-ADHOC	Y				
1052	72.1436		bore	2761400	6333600	217		EW	EW	EW-ADHOC	Y				
1053	72.1444		bore	2765900	6324500	201		EW	EW	EW-ADHOC	Y				
1055	72.193		bore	2761700	6355100	36		EW	EW	EW-ADHOC	Y				
1056	72.256		bore	2763800	6322600	32		EW	EW	EW-ADHOC	Y				
1057	72.444		bore	2760800	6369900	82.5		EW	EW	EW-ADHOC	Y				
1058	72.483		bore	2761500	6321700	53		EW	EW	EW-ADHOC	Y				
1059	72.533		bore	2762100	6366000	70		EW	EW	EW-ADHOC	Y				
1060	72.593		bore	2761400	6331500	168		EW	EW	EW-ADHOC	Y				
1061	72.606		bore	2763300	6328300	156		EW	EW	EW-ADHOC	Y				
1062	72.613		bore	2768300	6321700	103		EW	EW	EW-ADHOC	Y				
1063	72.614		bore	2767500	6321500	85		EW	EW	EW-ADHOC	Y				
1064	72.619		bore	2760200	6365900	13.5		EW	EW	EW-ADHOC	Y				
1065	72.685		bore	2760500	6327500	106.5		EW	EW	EW-ADHOC	Y				
1067	72.925		bore	2766600	6319600	117		EW	EW	EW-ADHOC	Y				
1271	BOP110120		riverWQ	2794700	6331300			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1272	BOP160158		riverWQ	2794700	6331200			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1273	BOP270076		riverWQ	2795500	6329200			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1274	BOP270093		riverWQ	2794750	6331100			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1275	BOP270094		riverWQ	2795350	6330050			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1276	BOP270108		riverWQ	2795250	6330250			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1277	BOP270075		riverWQ	2795200	6330000			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1278	BOP110057		riverWQ	2794700	6331400			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2A	
1279	BOP110058		riverWQ	2796200	6333400			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2A	
1280	BOP160113		riverWQ	2795400	6332800			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2A	
1281	BOP160157		riverWQ	2794600	6331200			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1282	BOP160159		riverWQ	2794800	6331200			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1283	BOP160160		riverWQ	2795000	6332500			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2A	
1284	BOP210005		riverWQ	2797500	6330200			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2B	
1285	BOP210006		riverWQ	2798300	6330400			EBOP	EBOP	EBOP-RWQ	Y	S112	Puarenga	S2B	
1286	BOP210007		riverWQ	2798200	6329600			EBOP	EBOP	EBOP-RWQ	Y	S112	Puarenga	S2B	
1287	BOP800148		riverWQ	2798300	6329400			EBOP	EBOP	EBOP-RWQ	Y	S112	Puarenga	S2B	
1288	BOP290127		riverWQ	2795000	6331400			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2A	
1289	BOP330016		riverWQ	2797700	6330100			EBOP	EBOP	EBOP-RWQ	Y	S112	Puarenga	S2B	
1290	BOP330017		riverWQ	2795300	6331100			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2B	
1291	BOP160152		riverWQ	2793140	6328930			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1292	BOP160154		riverWQ	2792900	6330000			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1293	BOP160155		riverWQ	2794100	6330800			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1294	BOP160214		riverWQ	2793200	6329080			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1295	BOP210154		riverWQ	2794000	6336600			EBOP	EBOP	EBOP-RWQ	Y		Utuhina	S3A	
1296	BOP160151		riverWQ	2793000	6329900			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1297	BOP160153		riverWQ	2792900	6329900			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	
1298	BOP290040		riverWQ	2792800	6329800			EBOP	EBOP	EBOP-RWQ	Y		Puarenga	S2C	

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
1299	1	G.F & A.J. van Beek	bore	2774660	6385800	12.1	Undifferentiated Alluvial	EBOP	EBOP	EBOP-NERM	N				
1300	51	Ngapeke Orchard	bore	2794080	6382070	67	Ignimbrite	EBOP	EBOP	EBOP-NERM	N				
1301	94	G.D. Cain	bore	2780290	6387570	164.6	Rhyolite	EBOP	EBOP	EBOP-NERM	N				
1302	196	I.Taylor	bore	2838310	6305070	19	Undifferentiated Alluvial	EBOP	EBOP	EBOP-NERM	N				
1303	466	I.B.Rogers	bore	2849350	6351290	16.8	Sand	EBOP	EBOP	EBOP-NERM	N				
1304	490	V & A.Muller.	bore	2840400	6357200	73	Undifferentiated Alluvial	EBOP	EBOP	EBOP-NERM	N				
1306	845	A.Bonner	bore	2852250	6352330	173	Sand	EBOP	EBOP	EBOP-NERM	N				
1307	851	T & A Cook	bore	2768800	6394900	97.5	Undifferentiated Volcanic Rock	EBOP	EBOP	EBOP-NERM	N				
1308	925	J. van der Hulle?	bore	2844400	6350300	32	Gravel	EBOP	EBOP	EBOP-NERM	N				
1309	1018	D & J Mockford (Black Rose Orc	bore	2812000	6374480	359	Ignimbrite	EBOP	EBOP	EBOP-NERM	Y				
1310	1319	Ngati Manawa Trust	bore	2835080	6296870	51.8		EBOP	EBOP	EBOP-NERM	N				
1311	1393	C & M. Babington	bore	2768600	6404700	326.1	Ignimbrite	EBOP	EBOP	EBOP-NERM	N				
1312	1605	Penetito Trust	bore	2845130	6340950	61	Gravel	EBOP	EBOP	EBOP-NERM	N				
1313	1686	Western Bay Golf Club	bore	2777300	6391190	182.9	Gravel	EBOP	EBOP	EBOP-NERM	N				
1314	1690	Mangatarata Orchard	bore	2810280	6374740	97.5	Ignimbrite	EBOP	EBOP	EBOP-NERM	Y				
1315	2076	Whakatane Airport	bore	2854600	6356700			EBOP	EBOP	EBOP-NERM	N				
1316	2088	Parker	bore	2844100	6356800	13.5		EBOP	EBOP	EBOP-NERM	N				
1317	2093	Dominion Salt Co.	bore	2791360	6389420	6		EBOP	EBOP	EBOP-NERM	N				
1318	2303	A. Harris	bore	2770200	6399000	262	Ignimbrite	EBOP	EBOP	EBOP-NERM	N				
1320	2330	D.W. Noble	bore	2772920	6405440	118.87	Undifferentiated Sediment	EBOP	EBOP	EBOP-NERM	N				
1321	2342	Faith Bible College	bore	2795870	6382190	194.5	Ignimbrite	EBOP	EBOP	EBOP-NERM	N				
1323	2362	P.A.Bell	bore	2791630	6384220	210.3	Rhyolite	EBOP	EBOP	EBOP-NERM	N				
1324	2393	M.Thompson	bore	2784480	6385120	146.3	Rhyolite	EBOP	EBOP	EBOP-NERM	N				
1325	2509	Eternal Springs	bore	2840930	6348890	319.5	Gravel	EBOP	EBOP	EBOP-NERM	N				
1326	2707	E.K. Hickson	bore	2807520	6379440	10	Gravel	EBOP	EBOP	EBOP-NERM	N				
1327	2728	R.S & S.R Steiner	bore	2802830	6381400	81	Sand	EBOP	EBOP	EBOP-NERM	N				
1328	2829	R & S Bagshaw	bore	2770650	6414140	216.41		EBOP	EBOP	EBOP-NERM	N				
1329	2840	D & H Enright	bore	2775500	6390600	167.6		EBOP	EBOP	EBOP-NERM	N				
1330	2847	BOPRC 3B. MOT Testing Station	bore	2792370	6387990	5.2	Sand	EBOP	EBOP	EBOP-NERM	N				
1331	2913	Z.Jansen	bore	2843450	6307250	22	Gravel	EBOP	EBOP	EBOP-NERM	N				
1332	3034	D & J Mockford (Black Rose Orc	bore	2811970	6374600	8.5		EBOP	EBOP	EBOP-NERM	Y				
1333	3036	Otara Orchard	bore	2888720	6342660	30		EBOP	EBOP	EBOP-NERM	N				
1334	3039	Riverloch Farms	bore	2885700	6339700	30		EBOP	EBOP	EBOP-NERM	N				
1335	3044	Fernland Spa	bore	2785700	6383700	244		EBOP	EBOP	EBOP-NERM	N				
1336	3272	L.Dickson	bore	2794280	6388220	375		EBOP	EBOP	EBOP-NERM	N				
1337	3301	Ohope Golf Club	bore	2872660	6348980	12	Undifferentiated Alluvial	EBOP	EBOP	EBOP-NERM	N				
1338	4001	Rotoma Holiday Camp	bore	2821500	6345100	55		EBOP	EBOP	EBOP-NERM	N				
1339	4002	Opotiki Holiday Park	bore	2886200	6346600	60		EBOP	EBOP	EBOP-NERM	N				
1340	4364	Fernland Spa	bore	2785700	6383800			EBOP	EBOP	EBOP-NERM	N				
1342	4582	G & C Rosser	bore	2793910	6382080	350		EBOP	EBOP	EBOP-NERM	N				
1344	S109	Waitapu Spring (Barlows Sp.)	spring	2786000	6339200			EBOP	EBOP	EBOP-NERM	Y	S105	Ngongataha	W2B	
1345	S108	Waitapu Spring (Barlows Sp.)	spring	2786000	6339200			EBOP	EBOP	EBOP-NERM	Y	S105	Ngongataha	W2B	
1346	S107	Waitapu Spring (Barlows Sp.)	spring	2786000	6339200			EBOP	EBOP	EBOP-NERM	Y	S105	Ngongataha	W2B	
1347	S106	Waitapu Spring (Barlows Sp.)	spring	2786000	6339200			EBOP	EBOP	EBOP-NERM	Y	S105	Ngongataha	W2B	
1348	S105	Waitapu Spring (Barlows Sp.)	spring	2786000	6339200			EBOP	EBOP	EBOP-NERM	Y	S105	Ngongataha	W2B	
1349	68	Lindemann Orchard Ltd.	bore	2766400	6402700			EBOP	EBOP	EBOP-NERM	N				
1350	66	P.E & L.J. Sargent	bore	2771800	6392300			EBOP	EBOP	EBOP-NERM	N				
1351	Braemar Springs		spring	2838700	6352600			EBOP	EBOP	EBOP-NERM	N				
1352	EBOP-noname1		bore	2779500	6341500			EBOP	EBOP	EBOP-NERM	Y				
1353	EBOP-noname2		bore	2779970	6340590			EBOP	EBOP	EBOP-NERM	Y		Ngongataha	W2B	
1354	EBOP-noname3		bore	2779970	6340590			EBOP	EBOP	EBOP-NERM	Y		Ngongataha	W2B	
1355	EBOP-noname4		bore	2779970	6340590			EBOP	EBOP	EBOP-NERM	Y		Ngongataha	W2B	
1356	EBOP-noname5		bore	2779700	6340660			EBOP	EBOP	EBOP-NERM	Y		Waiteti		
1357	EBOP-noname6		bore	2778080	6341310			EBOP	EBOP	EBOP-NERM	Y				
1358	EBOP-noname7		bore	2779830	6340190			EBOP	EBOP	EBOP-NERM	Y		Ngongataha		
1359	EBOP-noname8		bore	2779710	6340680			EBOP	EBOP	EBOP-NERM	Y		Waiteti		
1360	EBOP-noname9		bore	2779790	6340720			EBOP	EBOP	EBOP-NERM	Y		Waiteti		
1361	EBOP-noname10		bore	2780370	6339930			EBOP	EBOP	EBOP-NERM	Y		Ngongataha	W2B	
1362	EBOP-noname11		bore	2823600	6367600			EBOP	EBOP	EBOP-NERM	N				
2020	20	BEEK	bore	2853600	6351900	9	sed. unknown	EBOP	GNS	GNS-NGMP	N				
2021	21	ALLEN	bore	2811000	6374300	10	sed. volcanic	EBOP	GNS	GNS-NGMP	Y				
2055	55	OHOPEGC	bore	2872700	6348900	7.4	sed. carbonate	EBOP	GNS	GNS-NGMP	N				
2056	56	ETERNAL SPRINGS	spring	2840900	6349000	319.5	sed. volcanic	EBOP	GNS	GNS-NGMP	N				
2057	57	FERNLANDSPA	bore	2785700	6383680	176.8	rhyolite	EBOP	GNS	GNS-NGMP	N				
2058	58	PEMBERTON	bore	2789350	6347000	134.1	ignimbrite	EBOP	GNS	GNS-NGMP	Y	S102	Awahou	W4	
3001	Hamurana Spring @ water intake		spring	2795621	6347367			EBOP	GNS	GNS-RotLakesCR	Y	S101	Hamurana	N3	
3002	Taniwha Spring @ old well		spring	2791832	6345487			EBOP	GNS	GNS-RotLakesCR	Y	S102	Awahou	W4	Area1
3003	Trout Hatchery Spring @ weir		spring	2788810	6339920			EBOP	GNS	GNS-RotLakesCR	Y	S104	Ngongataha	W2F	

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
3004	Te Waireka @ bottling plant intake		spring	2786200	6336000			EBOP	GNS	GNS-RotLakesCR	Y		Ngongataha	W2B	
3005	Barlows Spring @ water intake		spring	2786036	6339206			EBOP	GNS	GNS-RotLakesCR	Y	S105	Ngongataha	W2B	
3006	2116		bore	2788852	6347137	124	Rhyolite	EBOP	GNS	GNS-RotLakesCR	Y	S102	Awahou	W4	
3007	1202		bore	2783712	6347247	124	Rhyolite	EBOP	GNS	GNS-RotLakesCR	Y		Waiteti	W3	
3008	1561	Dunroamin Nurseries	bore	2792917	6346011	73.1	Rhyolite	EBOP	GNS	GNS-RotLakesCR	Y		Awahou Point	W4	Area1
3009	Dr. Irvin		bore	2792871	6346460			EBOP	GNS	GNS-RotLakesCR	Y		Awahou Point	W4	Area1
3010	3691		bore	2790581	6346727	118.5		EBOP	GNS	GNS-RotLakesCR	Y	S102	Awahou	W4	
3011	JROYAL		bore	2803342	6332487			EBOP	GNS	GNS-RotLakesCR	Y				
3012	3901		bore	2803320	6332567	43	Gravel	EBOP	GNS	GNS-RotLakesCR	Y				
3013	10424		bore	2802307	6333413			EBOP	GNS	GNS-RotLakesCR	Y			S1	
3014	Spring 2		spring	2802307	6333413			EBOP	GNS	GNS-RotLakesCR	Y			S1	
3015	Utuhina Spring (main)		spring	2791553	6333538			EBOP	GNS	GNS-RotLakesCR	Y		Utuhina	S3C	
3016	Fairy Spring (Te Waiowhero)		spring	2792809	6338784			EBOP	GNS	GNS-RotLakesCR	Y		Waiowhiro	W1B	
3017	Awahou Stream @ Central Rd bridge		riverWQ	2791850	6345240			EBOP	GNS	GNS-RotLakesCR	Y		Awahou	W4	Area1
3018	Utuhina Spring #1		spring	2791550	6333528			EBOP	GNS	GNS-RotLakesCR	Y		Utuhina	S3C	
3019	Utuhina Spring #2		spring	2791546	6333531			EBOP	GNS	GNS-RotLakesCR	Y		Utuhina	S3C	
3020	Taniwha Spring @ water intake		spring	2791832	6345487			EBOP	GNS	GNS-RotLakesCR	Y	S102	Awahou	W4	Area1
3021	Rainbow Spring		spring	2792562	6338681			EBOP	GNS	GNS-RotLakesCR	Y		Waiowhiro	S3A	
3022	Hamurana Spring #1		spring	2795763	6347294			EBOP	GNS	GNS-RotLakesCR	Y	S101	Hamurana	N3	
3023	Hamurana head spring		spring	2795914	6347325			EBOP	GNS	GNS-RotLakesCR	Y	S101	Hamurana	N3	
3024	Hamurana Spring #3		spring	2795836	6347293			EBOP	GNS	GNS-RotLakesCR	Y	S101	Hamurana	N3	
3025	Utuhina Stream @ Lake Rd		spring	2794235	6336495			EBOP	GNS	GNS-RotLakesCR	Y		Utuhina	S3A	
3026	Ngongotaha Stream @ Ngongotaha Rd		riverWQ	2791915	6341700			EBOP	GNS	GNS-RotLakesCR	Y		Ngongataha	W2A	Area1
3027	Waiteti Stream @ Ngongotaha Rd		riverWQ	2791582	6342872			EBOP	GNS	GNS-RotLakesCR	Y		Waiteti	W3	Area1
3028	Awahou Stream @ Hamurana Rd		riverWQ	2792233	6345372			EBOP	GNS	GNS-RotLakesCR	Y		Awahou	W4	Area1
3029	Hauraki Stream @ Hamurana Rd		riverWQ	2793747	6346449			EBOP	GNS	GNS-RotLakesCR	Y		Hauraki	N1	Area1
3030	Hamurana Stream @ Hamurana Rd		spring	2796323	6346919			EBOP	GNS	GNS-RotLakesCR	Y		Hamurana	N2	
3031	Waiohewa Stream @ Te Ngae Rd		riverWQ	2801911	6341607			EBOP	GNS	GNS-RotLakesCR	Y		Waiohewa	E2	Area3
3032	Waingaehe Stream @ Te Ngae Rd		riverWQ	2800327	6336820			EBOP	GNS	GNS-RotLakesCR	Y		Waingaehe	S1	
3033	Puarenga Stream @ Te Ngae Rd		riverWQ	2796442	6334000			EBOP	GNS	GNS-RotLakesCR	Y		Puarenga	S2A	
3034	Kauaka Stream @ Waipa State Mill Rd		riverWQ	2794716	6331155			EBOP	GNS	GNS-RotLakesCR	Y		Puarenga	S2C	
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge		riverWQ	2794645	6331200			EBOP	GNS	GNS-RotLakesCR	Y		Puarenga	S2C	
3036	Waipa Stream @ Hemo Gorge		riverWQ	2795024	6331402			EBOP	GNS	GNS-RotLakesCR	Y		Puarenga	S2A	
3037	Awahou spring #1		riverWQ	2791151	6345435			EBOP	GNS	GNS-RotLakesCR	Y		Awahou	W4	
3038	Awahou upstream		riverWQ	2791131	6345455			EBOP	GNS	GNS-RotLakesCR	Y		Awahou	W4	
3039	Ngongataha stream @ Paradise springs		riverWQ	2786362	6336406			EBOP	GNS	GNS-RotLakesCR	Y		Ngongataha	W2A	
30001	1367-19		bore	2703690	6364890			EW	EW	EW-GWMP	N				
30002	60-12		bore	2754900	6481100			EW	EW	EW-GWMP	N				
30003	60-124		bore	2751370	6481020			EW	EW	EW-GWMP	N				
30004	60-167		bore	2763340	6448160			EW	EW	EW-GWMP	N				
30005	60-316		bore	2734620	6458960			EW	EW	EW-GWMP	N				
30006	60-345		bore	2758990	6456140			EW	EW	EW-GWMP	N				
30007	60-348		bore	2763890	6462970			EW	EW	EW-GWMP	N				
30008	60-352		bore	2750200	6471700			EW	EW	EW-GWMP	N				
30009	60-4		bore	2753610	6493800			EW	EW	EW-GWMP	N				
30010	60-407		bore	2744200	6495000			EW	EW	EW-GWMP	N				
30011	60-480		bore	2733090	6465270			EW	EW	EW-GWMP	N				
30012	60-483		bore	2765030	6439770			EW	EW	EW-GWMP	N				
30013	61-113		bore	2683140	6438790			EW	EW	EW-GWMP	N				
30014	61-126		bore	2660600	6429200			EW	EW	EW-GWMP	N				
30015	61-135		bore	2666700	6436700			EW	EW	EW-GWMP	N				
30016	61-143		bore	2685320	6428740			EW	EW	EW-GWMP	N				
30017	61-208		bore	2666750	6436030			EW	EW	EW-GWMP	N				

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
30018	61-221		bore	2687600	6425300			EW	EW	EW-GWMP	N				
30019	61-23		bore	2686600	6438200			EW	EW	EW-GWMP	N				
30020	61-245		bore	2680000	6428700			EW	EW	EW-GWMP	N				
30021	61-258		bore	2682100	6435100			EW	EW	EW-GWMP	N				
30022	61-280		bore	2684200	6428800			EW	EW	EW-GWMP	N				
30023	61-54		bore	2683400	6438500			EW	EW	EW-GWMP	N				
30024	61-59		bore	2679100	6428500			EW	EW	EW-GWMP	N				
30025	61-85		bore	2665200	6435900			EW	EW	EW-GWMP	N				
30026	61-93		bore	2686100	6428900			EW	EW	EW-GWMP	N				
30027	62-5		bore	2714570	6368910			EW	EW	EW-GWMP	N				
30028	63-201		bore	2765600	6416600			EW	EW	EW-GWMP	N				
30029	63-240		bore	2759200	6418300			EW	EW	EW-GWMP	N				
30030	63-328		bore	2766800	6421500			EW	EW	EW-GWMP	N				
30031	63-43		bore	2722900	6425100			EW	EW	EW-GWMP	N				
30032	63-57		bore	2741465	6420005			EW	EW	EW-GWMP	N				
30033	63-65		bore	2767450	6431570			EW	EW	EW-GWMP	N				
30034	63-74		bore	2722650	6430710			EW	EW	EW-GWMP	N				
30035	63-78		bore	2767000	6416500			EW	EW	EW-GWMP	N				
30036	63-8		bore	2767530	6431280			EW	EW	EW-GWMP	N				
30037	64-108		bore	2746600	6380400			EW	EW	EW-GWMP	N				
30038	64-111		bore	2740580	6384580			EW	EW	EW-GWMP	N				
30039	64-117		bore	2756660	6384490			EW	EW	EW-GWMP	N				
30040	64-12		bore	2749570	6386340			EW	EW	EW-GWMP	N				
30041	64-120		bore	2750980	6365660			EW	EW	EW-GWMP	N				
30042	64-20		bore	2753090	6373770			EW	EW	EW-GWMP	N				
30043	64-43		bore	2754800	6371100			EW	EW	EW-GWMP	N				
30044	64-46		bore	2755780	6378030			EW	EW	EW-GWMP	N				
30045	64-50		bore	2759510	6379630			EW	EW	EW-GWMP	N				
30046	64-511		bore	2754400	6374100			EW	EW	EW-GWMP	N				
30047	64-7		bore	2745180	6390620			EW	EW	EW-GWMP	N				
30048	64-70		bore	2755530	6389900			EW	EW	EW-GWMP	N				
30049	64-831		bore	2751900	6381800			EW	EW	EW-GWMP	N				
30050	65-4		bore	2699900	6343300			EW	EW	EW-GWMP	N				
30051	65-6		bore	2709100	6335800			EW	EW	EW-GWMP	N				
30052	65-8		bore	2713600	6326200			EW	EW	EW-GWMP	N				
30053	66-58		bore	2804800	6299600			EW	EW	EW-GWMP	N				
30054	66-6		bore	2794600	6314300			EW	EW	EW-GWMP	N				
30055	66-92		bore	2801700	6301890			EW	EW	EW-GWMP	N				
30056	66-93		bore	2801700	6301890			EW	EW	EW-GWMP	N				
30057	66-96		bore	2805346	6295825			EW	EW	EW-GWMP	N				
30058	67-11		bore	2753600	6362000			EW	EW	EW-GWMP	N				
30059	67-15		bore	2757900	6350800			EW	EW	EW-GWMP	N				
30060	67-38		bore	2759240	6324460			EW	EW	EW-GWMP	N				
30061	67-4		bore	2758240	6324390			EW	EW	EW-GWMP	N				
30062	67-404		bore	2759600	6329170			EW	EW	EW-GWMP	N				
30063	67-435		bore	2758700	6336100			EW	EW	EW-GWMP	N				
30064	67-483		bore	2758330	6326150			EW	EW	EW-GWMP	N				
30065	67-55		bore	2759190	6339530			EW	EW	EW-GWMP	N				
30066	67-573		bore	2756640	6339680			EW	EW	EW-GWMP	N				
30067	67-83		bore	2759640	6334200			EW	EW	EW-GWMP	N				
30068	68-301		bore	2765617	6280398			EW	EW	EW-GWMP	N				
30069	68-317		bore	2760584	6281129			EW	EW	EW-GWMP	N				
30070	68-320		bore	2774909	6274792			EW	EW	EW-GWMP	N				
30071	68-661		bore	2777100	6267600			EW	EW	EW-GWMP	N				
30072	68-912		bore	2783000	6276400			EW	EW	EW-GWMP	N				
30073	68-964		bore	2750601	6253247			EW	EW	EW-GWMP	N				
30074	69-163		bore	2715510	6379400			EW	EW	EW-GWMP	N				
30075	69-1709		bore	2722530	6374470			EW	EW	EW-GWMP	N				
30076	69-173		bore	2718200	6386900			EW	EW	EW-GWMP	N				
30077	69-19		bore	2719500	6375100			EW	EW	EW-GWMP	N				
30078	69-248		bore	2719200	6377900			EW	EW	EW-GWMP	N				
30079	69-295		bore	2723700	6371600			EW	EW	EW-GWMP	N				
30080	69-365		bore	2712400	6402120			EW	EW	EW-GWMP	N				
30081	69-374		bore	2721100	6374500			EW	EW	EW-GWMP	N				
30082	69-62		bore	2722693	6374153			EW	EW	EW-GWMP	N				
30083	69-81		bore	2699220	6370780			EW	EW	EW-GWMP	N				
30084	69-97		bore	2724200	6381500			EW	EW	EW-GWMP	N				
30085	70-21		bore	2724000	6366100			EW	EW	EW-GWMP	N				
30086	70-22		bore	2723900	6365800			EW	EW	EW-GWMP	N				
30087	70-31		bore	2729435	6366902			EW	EW	EW-GWMP	N				

ID#	Alternate ID#	ALIAS2	Type	Easting	Northing	Depth	Geology	RC	Source	Project	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
30088	70-36		bore	2727600	6370500			EW	EW	EW-GWMP	N				
30089	70-44		bore	2724630	6363600			EW	EW	EW-GWMP	N				
30090	70-47		bore	2730200	6368900			EW	EW	EW-GWMP	N				
30091	70-50		bore	2725075	6366593			EW	EW	EW-GWMP	N				
30092	70-56		bore	2720510	6365940			EW	EW	EW-GWMP	N				
30093	70-65		bore	2703030	6363450			EW	EW	EW-GWMP	N				
30094	70-74		bore	2703970	6354600			EW	EW	EW-GWMP	N				
30095	70-76		bore	2742990	6357390			EW	EW	EW-GWMP	N				
30096	71-1		bore	2713600	6321900			EW	EW	EW-GWMP	N				
30097	71-26		bore	2699300	6321600			EW	EW	EW-GWMP	N				
30098	71-3		bore	2693700	6322200			EW	EW	EW-GWMP	N				
30099	71-4		bore	2692700	6316000			EW	EW	EW-GWMP	N				
30100	71-5		bore	2697700	6318600			EW	EW	EW-GWMP	N				
30101	72-1008		bore	2754600	6284400			EW	EW	EW-GWMP	N				
30102	72-1011		bore	2767461	6275810			EW	EW	EW-GWMP	N				
30103	72-1069		bore	2744056	6277506			EW	EW	EW-GWMP	N				
30104	72-1072		bore	2744279	6260255			EW	EW	EW-GWMP	N				
30105	72-1081		bore	2742200	6254584			EW	EW	EW-GWMP	N				
30106	72-1082		bore	2742928	6256557			EW	EW	EW-GWMP	N				
30107	72-1087		bore	2744279	6260225			EW	EW	EW-GWMP	N				
30108	72-1089		bore	2744056	6277506			EW	EW	EW-GWMP	N				
30109	72-1223		bore	2763970	6421150			EW	EW	EW-GWMP	N				
30110	72-356		bore	2768500	6282100			EW	EW	EW-GWMP	N				
30111	72-392		bore	2760908	6281338			EW	EW	EW-GWMP	N				
30112	72-431		bore	2752822	6280632			EW	EW	EW-GWMP	N				

Table 5.6 Number of water quality monitoring sites considered in this review, divided by regional council and feature type.

RC	Source	Type	Total
EBOP	EBOP	bore	126
		riverWQ	28
		spring	6
	EBOP Total		160
	GNS	bore	13
		riverWQ	14
		spring	18
	GNS Total		45
EBOP Total			205
EW	EW	bore	198
		riverWQ	6
	EW Total		204
EW Total			204
Grand Total			409

The databases considered in this review include both dissolved and total concentrations for several determinands, including calcium, potassium, iron, magnesium, manganese, sodium, phosphorus, silicon and many trace elements. Third, even within a single database, for some determinands, results from unfiltered samples are further qualified based on the method(s) used for digestion. For example, results from unfiltered samples digested with strong acid may be described as 'total concentrations', whereas results from unfiltered samples exposed to dilute acids may be described as 'acid-soluble concentrations'. Fourth, results for several determinands can be expressed in different units in different databases. This is a concern for determinands such as conductivity, (expressed in mS/cm or µS/cm), dissolved oxygen (expressed in mg/kg or as a percentage of the air-saturated value), and the concentrations of trace elements (expressed in mg/kg or µg/kg). Moreover, the concentrations of several analytes can be expressed in different forms (e.g. NO_3 vs. NO_3-N, NH_4 vs. NH_4-N, PO_4 vs. PO_4-P, SiO_2 vs. Si).

Table 5.7 Names and abbreviations of analytical parameters from all data sources considered in this review. Parameters with a 1 in the ‘Note’ column were combined into a single field, after conversion of units if necessary. If any sample had a result in more than one field in the source database, the median value was used in the new combined column. Only the ‘combined’ data field was processed for statistics. Parameters with a 2 in the ‘Note’ column were not considered in this review, because too few analytical results were available.

Compiled Name	NERM Name	Ad-Hoc Name	Units	Method Description
MRT			years	Mean Residence Time (tritium/CFC/SF6)
yf			%	Young fraction (40 yr) (tritium/CFC/SF6)
BR;	BR;	Bromide	g/m3	APHA standard methods GRA
CAS;	CAS;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
CA; g/m3	CA; g/m3	Calcium	g/m3	Boiling Nitric Acid Digestion, ICP-OES
CL; g/m3	CL; g/m3	Chlorine	g/m3	0.45um filtered sample. Ion Chromotography. APHA 4110 B
F; g/m3	F; g/m3	Fluorine	g/m3	0.45um filtered sample. Ion Chromotography. APHA 4110 B
FeS	FeS;	Iron	g/m3	0.45um filtered sample. ICP-MS ultratrace with dynamic reaction cell. APHA 3125 B
FeAS		Fe_AS	g/m3	ICP-MS after dilute HNO3 extraction
FeT	FeT; g/m3	Iron_total	g/m3	0.22um Filtered Phenanthroline colorimetry.
FeTR;	FeTR;		mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS. US EPA 200.2
KS;	KS;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
K; g/m3	K; g/m3	Potassium	g/m3	Boiling Nitric Acid Digestion, ICP-OES
MGS;	MGS;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
MG; g/m3	MG; g/m3	Magnesium	g/m3	Boiling Nitric Acid Digestion, ICP-OES
MgT; g/m3	MgT; g/m3		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
MNS	MNS;	Manganese	g/m3	ICP-MS
MN	MN;		g/m3	ICP-OES following boiling nitric acid digestion
MNT; g/m3	MNT; g/m3		mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS. US EPA 200.2
MNTR;	MNTR;	Mn_TR	g/m3	0.45um filtered sample. ICP-MS APHA 3125B
NAS;	NAS;		g/m3	Boiling Nitric Acid Digestion, ICP-OES
NA; g/m3	NA; g/m3	Sodium	g/m3	APHA Method 4500-NH3 D, Phenol-hypochlorite colorimetry.
NH4N; g/m3-N	NH4N; g/m3-N		g/m3-N	
NH4		NH4	g/m3	Total oxidised nitrogen. Flow injection analyser. APHA 4500 NO3-I
NNN; g/m3	NNN; g/m3	NNN	g/m3	Azo Dye colorimetry, FIA, APHA 4500-NO3 I
NO2; g/m3-N	NO2; g/m3-N	NO2	g/m3	Salicylate colorimetry. In House method.
NO3; g/m3-N	NO3; g/m3-N	Nitrate_nitrogen	g/m3-N	APHA Method 4500-N-B UV spectrophotometric method

Compiled Name	**NERM Name**	**Ad-Hoc Name**	**Units**	**Method Description**
NO3UV;	NO3UV;		g/m3	Kjeldahl digestion, phenyl hypochlorite colorimetry (FIA), APHA 4500-N org D.(modified)
TKN; g/m3-N		TKN	g/m3	Persuklphate digestion, auto cadmium reduction. FIA
TN; g/m3-N		TN	g/m3	Molybdenum blue colorimetry, FIA , APHA 4500-P G
DRP; g/m3-P	DRP; g/m3-P		g/m3-PO4	Analysed by Ion Chromatography
PO4;	PO4;		g/m3	Phosphate as P by Ion Chrmotography
PO4-P; g/m3	PO4-P; g/m3	Phosphate	g/m3	APHA standard methods GRA
TDP; g/m3-P	TDP; g/m3-P		mg/kg-P	Kjeldahl Phosphorus Plant Tissue
TP; g/m3-P	TP; g/m3-P	TP	g/m3	0.45um filtered, ICP-OES
SIS	SIS;		g/m3-SiO2	Calculated, soluble silicon x 2.14
SIO2S;	SIO2S;	Silicate	g/m3-SiO2	Molyddosilicate/ascorbic acid reduction
SIDR; g/m3-SiO2	SIDR; g/m3-SiO2		g/m3	APHA Method 4500-SI E. Low Range. Molybdenum Blue Colorimetry
SIT; g/m3-SiO2	SIT; g/m3-SiO2	Si_T	g/m3-SiO2	Colorimetric, heteropoly blue complex. FIA. APHA 4500SiO2 E
SiR; g/m3	SiR; g/m3	Si_DR	g/m3	APHA 3125 B. ICP-OES
Si; g/m3	Si; g/m3	Silicon	g/m3	Total Recoverable Silica by ICP-MS
SITR;	SITR;		g/m3	0.45um filterd sample .APHA 4110 B. Ion Chromotography
SO4; g/m3	SO4; g/m3	Sulphate	g/m3	0.45um filterd sample .APHA 4110 B. Ion Chromotography
SO4_turb		SO4_Turb	g/m3	APHA standard methods
ALKT; g/m3-CaCO3	ALKT; g/m3-CaCO3	Calcium_carbonate	g/m3-HCO3	APHA standard methods
ALK;	ALK;			
HCO3; g/m3-HCO3	HCO3; g/m3-HCO3	AlkGNS	g/m3	Calculation from alkalinity and pH. APHA 4500-CO2 D
Bicarb; g/m3		Bicarbonate	pH	Solution pH at 20'C, APHA 4500-H+
PH; pH	PH; pH	pH	mS/m	YSI Datalogger
COND; mS/m @25C	COND; mS/m @25C	Conductivity	Deg.C	pH analysis temperature
TEMP; Deg_C	TEMP; Deg_C	Temperature	%	Measued by NIWA,
DO; g/m3	DO; g/m3	Disolved_oxygen		
ORP		ORP	g/m3	0.45um filtered sample. ICP-MS APHA 3125B
ALS	ALS;		g/m3	ROYSET O-1987 FIA NZIEHFS
ALT; g/m3	ALT; g/m3		g/m3	
ALR;	ALR		g/m3	Total Recoverable Aluminium by ICP-MS
ALUM		Aluminium	g/m3	Total Recoverable Aluminium by ICP-MS
ALTR;	ALTR;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
ASS	ASS;		mg/kg	Microwave digestion, hydride generation AAS
AST	AST; g/m3	Arsenic	mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS.(low level) US EPA 200.2
ASTR;	ASTR;	As_TR	g/m3	0.45um filtered sample. ICP-MS APHA 3125B
BS;	BS;		g/m3	ICP-MS
B; g/m3		Boron	g/m3	Nitric Acid Digestion, ICP-MS, APHA 3125 B
BT	BT;		mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS(low level). US EPA 200.2
BTR	BTR;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
CDS	CDS;		mg/kg	Microwave digestion, AAS
CDT; g/m3	CDT; g/m3		mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS.(low level) US EPA 200.2
CDTR;	CDTR;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B

Compiled Name	NERM Name	Ad-Hoc Name	Units	Method Description
COS	COS;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
CRS	CRS;		mg/kg	Microwave digestion, AAS
CRT	CRT; g/m3	Chromium	mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS. US EPA 200.2
CRTR;	CRTR		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
CUS	CUS;		mg/kg	Microwave digestion, AAS
CUT	CUT; g/m3	Copper	mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS. US EPA 200.2
CUTR;	CUTR;		g/m3	0.45um membrane filtered, permanganate/persulphate digestion. Analysis by FIMS
HgS; g/m3	HgS; g/m3		mg/kg	Acid digestion, cold vapour AAS.
HGT; g/m3	HGT; g/m3		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
LIS	LIS;		g/m3	Ion exchange chromatography
LI; g/m3		Lithium	g/m3	Total Recoverable Lithium by ICP-MS. Ultratrace method
LITR;	LITR		g/m3	0.45um filtered in clean room, ICP-MS, ultra trace method
MOS	MOS;		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
NIS	NIS;		mg/kg	Microwave digestion, AAS
NIT; g/m3	NIT		mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS.(low level) US EPA 200.2
NITR;	NITR		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
PBS	PBS;		mg/kg	Microwave digestion, AAS
PBT; g/m3	PBT; g/m3	Lead	mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS.(low level) US EPA 200.2
PBTR;	PBTR;		g/m3	0.45um filtered. Hydride gen. AAS. APHA 3114 B (modified)
SES	SES;		g/m3	Total recoverable Selenium by ICP-MS
SETR;	SETR		ug/L	Analysed by NZPARI
SRT;	SRT		g/m3	Distillation, Segmented flow colorimetry. (Does not detect 4-methylphenol. B&L Method 127-71W
Ta		Tantalum	g/m3	Total Recoverable Vanadium by ICP-MS
VATR; g/m3	VATR		g/m3	0.45um filtered sample. ICP-MS APHA 3125B
ZNS; g/m3	ZNS; g/m3		mg/kg	Microwave digestion, AAS
ZNT; g/m3	ZNT; g/m3	Zinc	mg/kg-DW	Nitric/hydrochloric acid digestion ICP-MS. US EPA 200.2
ZNTR; g/m3	ZNTR; g/m3	Zn_TR	g/m3-CO2	CO2 to pH 8.3 (as CaCO3) APHA standard methods GRA
CO2		Carbon_dioxide	g/m3	Calculation from alkalinity and pH. APHA 4500-CO2 D
Carbonate; g/100g			mg/m3	Select Ion GC-MS Waikato University
PCP; g/m3		PCP	g/m3	Acetone/hexane extraction, GC-ECD analysis
TCP;		TCP	/L	0
Ecoli; n/100mL	Ecoli; n/100mL	E_Coli	MPN/100g	APHA Method 9230B Confirm BHI+6.5% NaCl
ENT; n/100ml	ENT; n/100ml	Ent	cfu/100mL	APHA Method 9222D +resuscitation step on TSA agar 35C for 3 hr
FC; n/100ml	FC; n/100ml	Faecal_coliforms	mg/m3	Selected Ion GC-MS & GC-FID Waikato University
PlateC		Plate_count	mg/kg-DW	Tributyltin (as Sn).Tropolone/hexane microwave extraction, GC-MS
TColiforms		Total_colforms	/m	Absorbance 254nm
A254F;		A254F	/m	Spectrophotometer, 1cm pathlength
A270F; /cm		A270F	/m	Spectrophotometer, 1cm pathlength

Compiled Name	**NERM Name**	**Ad-Hoc Name**	**Units**	**Method Description**
A270UF; /cm		A270UF	/m	Spectrophotometer, 1cm pathlength
A340F; /cm		A340F	/m	Spectrophotometer, 1cm pathlength
A340UF; /cm		A340UF	/m	Spectrophotometer, 1cm pathlength
A360F;		A360F	/m	Spectrophotometer, 1cm pathlength
A400F		A400F	/m	Spectrophotometer, 1cm pathlength
A440F; /cm		A440F	/m	Spectrophotometer, 1cm pathlength
A440UF; /cm		A440UF	/m	Spectrophotometer, 1cm pathlength
A740F; /cm		A740F	/m	Spectrophotometer, 1cm pathlength
A740UF; /cm		A740UF	0	Absorbance 740nm, 4 cm cell- filtered sample
A780F		A780F	0	Colour coefficient at 440nm Analysed at NIWA
Acarina		ACARINA	g/m3-CaCO3	APHA 2310, Titrimetric
ACIDITY; g/m3-CaCO3	ACIDITY; g/m3-CaCO3		m	Black disc sighting range performed vertically
BLACKD		BDisk	g/m3	APHA Method 5210B 2 Dilutions, seeded
BOD5; g/m3		BOD5	0	Colour Coefficient at 340nm on filtered sample
C340F;		C340F	0	Colour Coef.-340nm-Unfiltered
C340UF;		C340UF	0	Colour Coefficient at 440nm on filtered sample.
C440F;		C440F	0	Colour Coef.-440nm-Unfiltered
C440UF;		C440UF	mg/kg	Dichromate/sulphuric acid dig. High Range. APHA 5220D
COD; g/m3	COD; g/m3		CU	APHA standard methods GRA
COLOUR; n/a		Colour	g/m3	Filtered Sample, catalytic oxidation. IR detection, APHA5310 B
DOC		DOC	%	Malvern Mastersize-S (Laser Diffraction Size Analaysis) >2060 micron. Results volume based
HardT		HardT	o/oo	YSI Datalogger
SALN; o/oo	SALN; o/oo		/L	MIRINZ 13.2 (Microbioligical Methods for the Meat Industry 3rd ed, 2000)
SALM; 0=Abs1=Pre	SALM		g/m3	APHA Method 2540D
SS; g/m3		Sus_solids	g/m3	Calculation from electrical conductivity.
TDS		TDS	g/100g-DW	Acid pretreatment to remove carbonates. Elementar combustion Analyser
TOC		TOC	mEquiv/L	Calculation: sum of anions as mEquivalents/ L
Total Anions; mEquiv/L			mEquiv/L	Calculation: sum of cations as mEquivalents/ L
Total Cations; mEquiv/L			NTU	Greenspan Field Turb Sensor
TURB; NTU	TURB; NTU		NTU	Greenspan Field Turb Sensor
Turb1680		Turb1680	NTU	Greenspan Field Turb Sensor
Turb-A		Turb-A	NTU	Greenspan Field Turb Sensor
Turb-N		Turb-N	m3/s	Flow data received from NIWAR Undefined Method
FLOW; m3/s	FLOW; m3/s		m	Recorder Tower Internal Level
LEVEL; m	LEVEL; m			

The median concentration of each analyte was calculated at each monitoring site (Table 5.8), because it is less sensitive to extreme values in the dataset than the mean and thus provides a more resistant measure of central tendency (Helsel and Hirsch, 1992). Estimation methods are often required for calculation of median values for water quality data, because the dataset typically includes censored values reported as being less than some detection limit. In this analysis, a log-probability regression method (Helsel and Cohn, 1988) was employed to calculate the median (see also Daughney and Reeves, 2003). This method provides a reasonable estimate of the median even when up to 70% of the available results are reported as being below some detection limit. Table 5.8 uses the parameter abbreviations and units given in Table 5.7.

Table 5.8a Median values of analytes on a per-site basis, determined using the log-probability regression method of Helsel and Cohn (1988). ND indicates that insufficient data were available to perform the analysis. The parameter abbreviations and units are listed in Table 5.7.

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
2	70	ND	ND	ND	ND	0.44	21.00	ND	0.35	ND	ND	ND	ND	2.90	ND	0.52	0.01	ND	ND	6.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	5.40	ND	ND
3	71	ND	ND	ND	ND	0.30	99.00	ND	ND	ND	ND	ND	ND	6.40	ND	0.07	0.05	ND	ND	98.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.69	7.20	ND	ND
21	137	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39	168	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
65	226	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
67	228	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
78	305	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
80	410	ND	ND	ND	7.50	3.50	10.20	0.29	0.25	ND	0.08	101.64	3.35	1.07	3.42	1.01	5.13	ND	24.15	7.20	0.07	0.00	0.00	0.00	ND	0.01	0.01	76.30	6.65	20.80	6.75	ND	15.30
89	432	ND	ND	ND	ND	2.38	21.27	ND	0.04	ND	ND	ND	ND	5.55	ND	1.38	0.01	ND	ND	21.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.37	6.50	ND	ND
101	643	ND	ND	ND	15.90	14.30	28.10	0.33	8.76	6.70	0.39	232.93	5.68	7.10	10.22	10.55	12.70	ND	57.75	60.00	0.09	0.00	0.04	0.00	ND	0.35	0.42	72.99	14.40	43.50	6.60	0.50	16.25
106	3669	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
111	951	ND	ND	ND	27.90	31.20	21.80	0.26	1.15	2.93	0.54	284.96	2.60	3.35	9.74	10.05	1.73	ND	60.30	63.50	0.15	0.00	0.00	0.00	ND	0.10	0.33	91.18	0.25	48.65	6.90	4.40	24.80
132	1074	ND	ND	ND	ND	1.00	52.00	ND	ND	12.70	ND	108.75	ND	ND	ND	7.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.45	6.64	7.00	20.00
134	1079	ND	ND	ND	ND	0.91	30.10	ND	ND	ND	ND	ND	ND	2.20	ND	0.50	ND	ND	ND	25.80	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.80	6.80	7.00	18.70
136	1084	ND	ND	ND	ND	0.06	21.15	ND	0.04	ND	ND	ND	ND	3.54	ND	0.04	0.04	ND	ND	13.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.21	6.80	ND	ND
138	1087	ND	ND	ND	ND	0.16	35.30	ND	0.15	ND	ND	ND	ND	2.50	ND	1.08	0.05	ND	ND	12.79	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.92	6.40	ND	ND
141	1092	ND	ND	ND	ND	1.86	45.80	ND	ND	ND	ND	ND	ND	363.00	ND	5.09	0.02	ND	ND	37.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.90	6.00	ND	ND
142	1095	ND	ND	ND	ND	1.55	75.80	ND	0.08	ND	ND	ND	ND	6.93	ND	2.46	0.01	ND	ND	15.94	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.65	6.15	ND	ND
146	1111	ND	ND	ND	ND	0.70	14.00	ND	0.10	ND	ND	4.60	ND	1.60	ND	0.40	0.10	ND	ND	11.00	ND	ND	ND	ND	ND	ND	ND	ND	10.00	0.94	6.10	ND	ND
156	1138	ND	ND	ND	ND	9.20	18.00	ND	21.00	ND	ND	ND	ND	4.00	ND	9.70	30.00	ND	ND	32.00	ND	ND	1.00	ND	ND	ND	ND	ND	ND	3.15	6.70	ND	ND
204	1354	ND	ND	ND	ND	0.26	24.68	ND	0.37	ND	ND	ND	ND	3.72	ND	0.70	0.02	ND	ND	14.38	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.06	6.70	ND	ND
206	1384	ND	ND	ND	ND	2.42	8.00	ND	0.10	ND	ND	ND	ND	2.11	ND	0.36	ND	ND	ND	7.78	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.80	6.80	ND	ND
208	1446	ND	ND	ND	ND	2.90	7.10	ND	0.23	ND	ND	ND	ND	2.10	ND	1.50	0.34	ND	ND	10.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.87	6.10	ND	ND
210	1471	ND	ND	ND	ND	5.20	7.00	ND	0.04	ND	ND	ND	ND	2.80	ND	2.90	0.03	ND	ND	13.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.41	6.60	ND	ND
211	1474	ND	ND	ND	ND	6.80	7.00	ND	1.70	ND	ND	ND	ND	5.30	ND	28.20	0.05	ND	ND	13.90	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.36	6.70	ND	ND
215	1501	ND	ND	ND	ND	8.00	7.00	ND	1.60	ND	ND	36.30	ND	12.00	ND	3.00	2.90	ND	ND	12.00	ND	ND	1.00	ND	ND	ND	ND	ND	ND	0.83	7.50	ND	ND
221	1520	ND	ND	ND	7.93	7.80	26.60	0.14	0.02	0.10	0.00	124.63	7.96	7.45	6.42	5.30	0.00	ND	51.80	45.80	0.00	0.00	1.82	2.02	ND	0.07	0.07	96.73	2.15	31.20	6.50	4.55	22.00
230	1535	ND	ND	ND	ND	4.00	11.00	ND	3.25	ND	ND	22.99	ND	3.00	ND	2.00	0.57	ND	ND	25.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.70	7.30	ND	ND
234	1561	ND	ND	ND	2.98	2.94	5.00	0.07	0.02	0.10	0.03	39.39	2.60	2.70	1.99	1.84	0.00	ND	9.90	8.91	0.00	0.00	0.52	0.55	ND	0.08	0.09	69.72	1.30	8.40	6.60	6.90	13.30
242	1586	ND	ND	ND	3.10	3.10	8.50	0.13	0.03	0.28	0.15	35.63	3.51	3.40	2.03	1.80	0.21	ND	12.20	12.15	0.02	0.00	0.26	0.22	ND	0.03	0.04	86.67	4.80	10.60	6.40	0.95	17.40
248	1652	ND	ND	ND	ND	ND	ND	ND	3.35	ND	ND	275.88	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.10	ND	ND
270	2022	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
274	2030	ND	ND	ND	ND	152.00	152.00	ND	ND	ND	ND	251.36	ND	ND	ND	80.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.80	7.79	ND	ND
278	2102	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
280	2109	ND	ND	ND	ND	40.00	128.00	ND	1.73	ND	ND	185.13	ND	ND	ND	30.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.92	6.34	ND	ND
286	2118	ND	ND	ND	6.33	ND	5.70	0.15	0.02	ND	ND	34.49	2.92	ND	2.32	ND	0.00	ND	11.35	ND	0.01	0.00	2.27	2.25	ND	0.15	0.16	79.20	10.20	11.80	6.60	ND	14.20
298	2136	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
299	10164	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
300	2138	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
305	2344	ND	ND	ND	2.67	2.90	6.90	0.06	0.02	0.17	0.29	33.82	4.99	5.30	1.50	1.30	0.00	ND	9.51	10.15	0.00	0.00	0.16	0.19	ND	0.03	0.02	89.11	2.35	8.60	6.10	6.45	17.00
319	2426	ND	ND	ND	ND	0.17	28.00	ND	0.03	ND	ND	ND	ND	2.05	ND	2.49	0.01	ND	ND	8.79	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.99	6.40	ND	ND
324	2442	ND	ND	ND	ND	3.80	3.50	ND	0.17	ND	ND	ND	ND	4.90	ND	1.90	0.04	ND	ND	14.30	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.43	5.70	ND	ND
325	2557	ND	ND	ND	ND	2.10	7.10	ND	0.22	ND	ND	ND	ND	4.20	ND	1.20	0.00	ND	ND	10.30	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.81	6.50	ND	ND
326	2576	ND	ND	ND	ND	3.00	1.80	ND	0.09	ND	ND	ND	ND	5.00	ND	1.30	0.01	ND	ND	11.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.01	6.30	ND	ND
330	2590	ND	ND	ND	ND	14.40	17.70	ND	0.03	ND	ND	ND	ND	7.74	ND	3.60	0.01	ND	ND	21.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.29	6.10	1.00	18.90
332	2593	ND	ND	ND	ND	14.00	14.20	ND	2.26	ND	ND	ND	ND	3.80	ND	9.20	0.67	ND	ND	29.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.74	6.50	ND	ND
333	2594	ND	ND	ND	ND	2.90	7.10	ND	0.01	ND	ND	ND	ND	2.50	ND	2.70	0.02	ND	ND	9.90	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.97	6.30	ND	ND
334	2596	ND	ND	ND	ND	0.10	8.90	ND	0.04	ND	ND	ND	ND	3.90	ND	0.50	0.01	ND	ND	7.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.95	5.90	ND	ND
337	2708	ND	ND	ND	ND	71.00	44.20	ND	ND	0.80	ND	176.66	ND	5.10	ND	10.00	ND	ND	ND	25.00	ND	ND	1.02	ND	ND	ND	ND	ND	25.00	48.20	7.90	1.60	16.30
349	2822	ND	ND	ND	7.79	7.95	19.65	0.38	4.48	4.13	0.42	176.66	4.20	4.20	7.58	7.70	0.94	ND	47.60	50.15	0.03	0.00	0.00	0.00	ND	0.16	0.25	91.20	0.51	34.28	6.55	3.20	18.10
351	2824	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
353	2827	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
361	3004	ND	ND	ND	ND	4.40	10.00	ND	0.05	ND	ND	ND	ND	2.30	ND	1.80	0.02	ND	ND	16.00	ND	ND	1.00	ND	ND	ND	ND	ND	ND	1.25	7.00	ND	ND
362	3008	ND	ND	ND	ND	0.46	28.00	ND	0.13	ND	ND	ND	ND	1.76	ND	0.32	ND	ND	ND	5.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.40	6.90	ND	ND
363	3013	ND	ND	ND	ND	4.40	57.00	ND	0.10	ND	ND	37.51	ND	7.70	ND	4.90	0.10	ND	ND	28.00	ND	ND	ND	ND	ND	ND	ND	ND	11.00	2.67	6.10	2.00	18.40
364	3015	ND	ND	ND	ND	4.00	34.00	ND	ND	0.10	ND	12.10	ND	ND	ND	6.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.30	ND	ND
369	3045	ND	ND	ND	12.05	12.90	35.75	0.13	0.03	0.04	0.09	67.00	9.20	9.40	5.22	5.70	0.01	0.02	22.15	23.45	0.00	0.00	0.42	0.38	ND	0.02	0.03	82.64	8.40	26.15	6.42	4.60	15.60
384	3287	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
409	3470	ND	ND	ND	2.26	ND	4.50	0.31	5.17	ND	ND	50.70	1.93	ND	1.57	ND	1.17	ND	11.95	ND	0.94	0.00	0.00	0.01	ND	0.26	0.57	40.40	0.25	10.10	6.70	ND	12.70
418	3566	ND	ND	ND	7.75	ND	16.25	0.19	0.03	ND	ND	29.58	7.26	ND	3.62	ND	0.00	ND	17.15	ND	0.01	0.00	10.20	10.20	ND	0.16	0.16	84.60	5.10	19.90	6.60	ND	15.10

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
434	3674	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
435	3675	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
436	3676	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
439	4000	ND	ND	ND	7.54	6.75	9.40	0.05	0.03	0.04	0.05	30.61	5.15	6.51	2.31	2.20	0.00	ND	10.30	10.50	0.00	0.00	3.16	2.89	ND	0.04	0.03	83.15	9.25	13.20	6.30	8.80	15.40
440	4003	ND	ND	ND	5.67	ND	4.70	0.06	0.02	ND	ND	29.65	4.27	ND	2.22	ND	0.01	ND	9.72	ND	0.03	0.00	3.13	2.68	ND	0.04	0.04	83.95	11.80	10.93	7.00	ND	14.60
442	4005	ND	ND	ND	ND	10.00	16.00	ND	0.25	ND	ND	25.60	ND	ND	ND	10.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.10	6.18	ND	ND
444	4007	ND	ND	ND	3.07	3.20	5.40	0.03	0.02	0.01	ND	31.17	1.69	1.70	1.96	1.90	0.00	0.00	9.97	10.20	0.00	0.00	1.50	1.55	ND	0.08	0.08	68.76	1.40	8.80	6.48	8.38	12.90
640	10158	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
641	10162	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
666	3690	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
668	3702	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
672	3685	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
706	4993	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
764	1173.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.01	ND	ND	0.18	0.12	0.02	0.03	ND	ND	0.56	7.10	10.20	10.60
765	1174.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	0.46	0.15	0.03	0.04	ND	ND	0.70	7.10	9.90	13.10
766	1287.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	0.67	ND	ND	ND
767	1323.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.01	ND	ND	0.54	0.06	0.07	0.07	ND	ND	0.66	7.20	10.30	12.00
768	279.1	ND	ND	ND	ND	1.60	5.30	ND	ND	ND	ND	17.00	ND	2.50	ND	0.75	ND	ND	ND	7.50	0.01	ND	ND	0.60	0.10	0.04	0.05	ND	ND	0.46	7.30	ND	11.90
769	683.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.01	ND	ND	0.58	0.21	0.16	0.17	ND	ND	3.80	8.00	8.50	20.80
778	64.247	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
779	64.271	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
780	64.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
783	64.393	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
786	64.551	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
787	64.552	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
788	64.559	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
789	64.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
791	64.647	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
792	64.658	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
794	64.865	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
795	64.938	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
796	64.942	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
797	64.996	ND	ND	ND	ND	1.55	6.45	ND	ND	0.64	ND	18.50	ND	3.85	ND	0.77	ND	ND	ND	8.50	<0.01	ND	0.98	ND	ND	ND	ND	ND	1.80	0.73	6.15	ND	16.10
799	66.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
800	66.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
801	66.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
804	66.42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
806	66.46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
807	66.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
808	66.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
809	66.53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
810	66.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
811	66.65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
812	66.67	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
813	66.69	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
814	66.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
820	67.116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
825	67.138	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
828	67.142	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
836	67.16	ND	ND	ND	ND	ND	4.60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	7.20	ND	14.20
839	67.165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
842	67.171	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
844	67.175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
847	67.184	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
849	67.189	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
851	67.198	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
861	67.21	ND	ND	ND	ND	1.55	4.10	ND	0.31	ND	ND	21.00	ND	2.80	ND	0.84	0.05	ND	ND	7.90	ND	ND	ND	0.22	ND	0.02	0.06	79.00	ND	0.61	6.45	ND	13.15
870	67.22	ND	ND	ND	ND	ND	4.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.30	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.51	6.30	ND	13.10
923	67.276	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
932	67.299	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
937	67.317	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
938	67.32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
943	67.338	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
950	67.362	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
954	67.373	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
956	67.377	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
960	67.389	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
961	67.39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
962	67.392	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
966	67.402	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
972	67.421	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
991	67.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
993	67.478	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
999	67.495	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1002	67.506	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1003	67.507	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1010	67.526	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1012	67.528	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1013	67.529	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1015	67.531	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1017	67.535	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1018	67.538	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1020	67.572	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1028	67.6	ND	ND	ND	ND	ND	5.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.60	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	6.50	ND	13.60
1042	67.97	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1043	67.99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1046	72.1036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1047	72.112	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1048	72.1121	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1049	72.113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1050	72.1245	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1052	72.1436	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1053	72.1444	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1055	72.193	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1056	72.256	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1057	72.444	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1058	72.483	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1059	72.533	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1060	72.593	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1061	72.606	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1062	72.613	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1063	72.614	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1064	72.619	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1065	72.685	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1067	72.925	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1271	BOP110120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.50	12.80
1272	BOP160158	ND	ND	ND	ND	ND	3.60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	0.39	0.40	0.26	0.04	0.06	ND	ND	ND	ND	10.70	8.30
1273	BOP270076	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	0.48	0.20	0.05	0.06	ND	ND	ND	ND	ND	ND
1274	BOP270093	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	ND	0.60	0.26	ND	0.06	ND	ND	ND	ND	ND	ND
1275	BOP270094	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	0.62	0.21	ND	0.06	ND	ND	ND	ND	ND	ND
1276	BOP270108	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	0.80	ND	0.04	0.25	ND	ND	ND	7.00	ND	ND
1277	BOP270075	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	ND	0.31	0.32	0.04	0.04	ND	ND	ND	ND	ND	ND
1278	BOP110057	ND	ND	0.05	5.25	ND	4.30	0.05	0.01	ND	ND	33.00	4.10	ND	2.40	ND	0.00	ND	10.10	ND	0.03	ND	0.33	0.16	0.25	0.05	0.08	57.50	1.50	0.72	6.85	9.50	10.90
1279	BOP110058	ND	ND	ND	3.09	ND	46.75	ND	ND	ND	0.78	26.31	6.30	ND	1.74	ND	ND	ND	46.60	ND	0.07	0.00	0.65	0.93	0.27	0.05	0.06	85.00	26.25	24.55	6.70	9.30	15.90
1280	BOP160113	ND	ND	ND	ND	ND	19.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.08	ND	0.28	0.88	0.41	0.04	0.06	ND	ND	24.60	6.75	9.30	17.30
1281	BOP160157	ND	ND	ND	ND	ND	4.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.06	ND	ND	ND	0.22	0.06	0.08	ND	ND	ND	ND	10.60	10.50
1282	BOP160159	ND	ND	ND	ND	ND	4.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.06	ND	0.42	ND	0.32	0.04	0.07	ND	ND	ND	ND	10.50	11.05
1283	BOP160160	ND	ND	ND	ND	ND	4.30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04	ND	0.34	0.48	0.33	0.03	0.06	ND	ND	6.80	7.10	10.20	10.95
1284	BOP210005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.10	ND	0.29	ND	0.31	0.03	0.06	ND	ND	ND	7.10	10.70	10.50
1285	BOP210006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	ND	ND	0.30	ND	0.04	ND	ND	ND	ND	ND	ND	ND
1286	BOP210007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	ND	0.15	ND	0.16	0.08	0.09	ND	ND	ND	ND	ND	ND
1287	BOP800148	ND	ND	ND	ND	1.70	6.50	ND	ND	ND	ND	27.00	ND	1.90	ND	1.10	ND	ND	ND	14.20	0.01	ND	ND	0.21	ND	0.07	0.02	ND	8.90	ND	ND	ND	ND
1288	BOP290127	ND	ND	ND	ND	1.60	9.40	0.20	ND	ND	0.20	37.51	ND	2.30	ND	1.10	ND	ND	ND	13.00	0.00	0.00	0.12	1.44	0.25	0.07	0.08	ND	8.50	13.50	7.20	9.90	12.70
1289	BOP330016	ND	ND	ND	ND	ND	5.90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	ND	0.16	ND	0.07	0.07	0.10	ND	ND	5.80	7.30	10.00	12.50
1290	BOP330017	ND	ND	ND	ND	ND	5.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04	ND	0.19	0.29	0.22	0.04	0.08	ND	ND	8.50	7.30	9.80	12.40
1291	BOP160152	ND	ND	ND	ND	ND	13.85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	1.14	0.25	0.05	0.07	ND	ND	ND	7.00	ND	ND
1292	BOP160154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1293	BOP160155	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	0.47	1.19	0.19	0.02	0.03	ND	ND	ND	7.10	10.70	8.95
1294	BOP160214	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1295	BOP210154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1296	BOP160151	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1297	BOP160153	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1298	BOP290040	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	0.57	0.22	0.23	0.02	0.03	ND	ND	ND	ND	10.30	8.50
1299	1	ND	ND	ND	26.60	29.00	22.00	0.21	0.03	3.45	0.80	158.51	3.50	3.80	10.34	11.50	0.20	0.25	28.10	31.29	1.09	0.00	0.03	0.01	0.17	0.15	0.55	65.90	29.00	39.00	7.38	1.35	16.80
1300	51	ND	ND	ND	23.75	16.60	18.30	0.21	2.18	0.72	ND	105.92	3.56	3.90	9.01	6.70	0.20	0.22	29.10	26.85	1.03	ND	0.02	0.02	ND	0.15	0.34	71.80	22.60	33.43	6.76	2.09	17.95
1301	94	ND	ND	ND	8.23	7.45	16.10	0.21	0.07	0.31	0.46	81.31	3.50	3.60	4.57	4.70	0.00	ND	21.50	23.56	0.01	ND	0.36	0.13	ND	0.18	0.18	98.87	3.00	19.35	6.75	4.30	20.60
1302	196	ND	ND	ND	6.48	5.25	5.10	0.31	0.12	0.90	0.30	58.62	1.90	2.41	4.00	3.85	0.23	ND	9.50	9.40	0.06	ND	0.00	0.00	ND	0.18	0.45	53.29	2.90	11.40	7.07	3.10	14.80
1303	466	ND	ND	ND	8.17	74.90	9.65	0.31	0.08	5.60	0.36	309.76	2.50	4.70	4.72	5.13	0.31	ND	11.15	26.40	3.14	0.00	0.01	0.00	ND	0.22	0.97	69.41	1.00	41.95	7.00	0.25	16.95

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
1304	490	ND	ND	ND	65.50	3.10	8.30	0.54	1.06	2.74	0.63	52.88	3.75	1.50	4.98	2.05	0.32	ND	24.20	14.85	0.09	0.00	0.01	0.01	ND	0.07	0.33	71.30	0.50	10.45	7.00	1.60	15.50
1306	845	ND	ND	ND	2.95	27.47	14.50	0.36	0.93	1.20	0.28	385.39	1.68	5.10	2.13	11.03	0.15	ND	14.75	117.80	0.48	0.00	0.01	0.00	ND	0.33	0.60	82.00	1.15	61.60	7.20	0.75	28.00
1307	851	ND	ND	ND	22.45	6.95	11.25	0.35	0.34	5.82	0.47	80.16	5.08	4.40	10.05	5.75	0.13	ND	95.95	15.70	0.04	0.00	0.00	0.00	ND	0.16	0.13	94.69	2.00	16.20	6.85	3.25	19.75
1308	925	ND	ND	ND	6.68	25.56	37.05	0.14	4.47	8.29	6.79	340.01	3.95	3.80	5.79	9.67	0.59	ND	14.90	86.50	0.59	0.00	0.00	0.00	ND	0.14	0.27	85.30	1.15	64.55	6.20	0.25	19.65
1309	1018	ND	ND	ND	23.60	13.90	42.35	0.33	23.90	4.08	0.55	346.06	3.69	10.89	9.53	10.55	1.04	ND	80.20	108.42	0.11	0.01	0.01	0.02	ND	0.11	0.21	107.21	0.25	64.50	6.58	0.83	31.60
1310	1319	ND	ND	ND	16.30	10.90	9.48	0.35	1.71	0.78	0.36	127.66	8.48	4.01	12.20	6.13	0.27	ND	102.00	22.00	0.39	0.00	0.01	0.00	ND	0.91	1.42	135.10	0.52	22.75	7.00	3.15	15.75
1311	1393	ND	ND	ND	13.80	0.25	9.10	0.30	0.42	0.02	0.04	79.50	3.50	2.60	6.87	0.13	0.80	ND	23.25	33.50	0.27	0.00	0.04	0.05	ND	0.41	0.63	62.20	0.93	16.80	7.75	1.25	26.50
1312	1605	ND	ND	ND	0.22	2.72	8.40	0.34	0.03	0.06	0.01	35.09	2.60	3.05	0.09	1.60	0.00	ND	36.40	11.20	0.00	0.00	0.04	0.01	ND	0.17	0.17	93.72	2.30	9.30	6.45	2.40	16.10
1313	1686	ND	ND	ND	2.37	1.30	43.70	0.28	0.03	0.74	0.36	73.57	2.90	4.85	1.58	1.29	0.00	ND	11.80	76.00	0.01	0.00	0.11	0.11	ND	0.14	0.16	79.30	3.40	32.60	7.20	0.95	22.20
1314	1690	ND	ND	ND	1.22	18.55	21.50	0.35	0.63	3.20	0.42	240.79	3.89	7.45	1.35	8.80	0.08	ND	73.50	60.70	0.08	0.00	0.00	0.00	ND	0.22	0.21	99.80	2.58	38.38	7.42	6.00	26.95
1315	2076	ND	ND	ND	16.80	10.06	18.40	0.37	0.33	0.03	0.01	113.38	6.20	2.60	8.20	4.93	0.59	ND	55.45	14.10	0.09	0.00	1.89	0.01	ND	0.06	0.19	98.86	3.80	37.30	6.98	6.90	20.35
1316	2088	ND	ND	ND	3.90	109.45	24.05	0.10	0.03	9.67	ND	32.07	3.45	11.00	1.39	16.00	0.00	ND	10.85	97.45	0.01	0.00	0.47	0.50	ND	0.07	0.06	70.15	3.50	10.00	6.85	0.28	18.50
1317	2093	ND	ND	ND	80.90	42.00	162.00	0.27	0.08	0.93	0.40	177.51	8.80	7.90	8.82	7.20	0.34	ND	76.00	233.00	1.92	ND	1.40	0.49	ND	0.04	1.33	49.86	6.75	96.90	6.67	1.40	16.00
1318	2303	ND	ND	ND	14.65	0.88	13.00	0.21	0.05	0.05	0.04	275.88	8.55	17.15	1.66	0.38	0.02	ND	207.50	114.00	0.53	0.00	0.55	0.00	ND	2.34	2.40	41.40	0.44	49.40	7.35	0.20	35.00
1320	2330	ND	ND	ND	3.31	6.75	21.70	0.05	0.07	0.02	0.03	52.03	6.95	5.40	1.12	2.30	0.04	ND	49.10	20.45	0.00	0.00	0.00	0.07	ND	0.04	0.02	87.10	3.90	17.20	6.85	4.10	18.40
1321	2342	ND	ND	ND	5.89	9.05	21.00	0.07	0.03	0.03	0.03	75.81	5.50	4.00	2.64	6.00	0.00	ND	21.00	19.50	0.00	0.00	0.07	0.10	ND	0.08	0.08	82.65	5.15	19.55	6.90	7.30	21.10
1323	2362	ND	ND	ND	8.34	7.10	17.00	0.14	0.02	1.10	0.24	94.50	4.24	5.58	5.92	3.20	0.00	ND	19.40	28.00	0.13	0.00	0.12	0.09	ND	0.20	0.21	93.35	3.50	20.70	7.00	0.43	29.15
1324	2393	ND	ND	ND	6.73	5.15	18.00	0.24	0.25	0.02	0.00	98.68	5.25	5.73	3.34	4.42	0.55	ND	29.60	32.90	0.12	0.00	0.02	0.02	ND	0.18	0.21	115.00	2.80	22.00	7.12	3.85	29.00
1325	2509	ND	ND	ND	2.75	2.80	6.70	0.18	0.03	0.01	0.05	35.00	2.65	2.85	1.50	1.60	0.00	0.00	11.00	11.60	0.00	0.00	0.19	0.20	ND	0.10	0.10	88.20	3.35	9.15	6.75	8.07	18.10
1326	2707	ND	ND	ND	2.49	79.70	88.00	0.12	0.03	0.05	0.02	147.62	2.40	4.04	1.38	11.71	0.02	0.00	11.35	25.00	0.01	ND	0.38	0.33	ND	0.03	0.02	47.33	17.40	63.10	7.70	6.10	16.30
1327	2728	ND	ND	ND	82.60	17.20	101.00	0.04	0.02	3.70	0.40	140.97	7.49	11.80	20.60	6.10	0.02	ND	115.00	75.40	0.00	0.01	0.05	2.36	ND	0.02	0.03	36.20	26.00	63.80	6.80	1.25	18.45
1328	2829	ND	ND	ND	5.14	0.25	17.20	0.19	6.92	0.08	0.25	103.09	10.80	3.70	2.14	0.24	0.12	ND	79.70	50.40	0.00	0.00	0.02	0.05	ND	0.15	0.19	79.10	3.08	22.95	8.20	5.15	31.05
1329	2840	ND	ND	ND	0.19	4.75	9.40	0.17	0.24	0.03	0.02	42.77	3.65	2.90	0.27	1.60	0.01	ND	47.70	14.30	0.00	0.00	0.10	0.09	ND	0.07	0.06	65.06	2.50	10.55	6.60	7.65	18.95
1330	2847	ND	ND	ND	4.58	28.50	55.00	0.04	0.02	15.60	0.56	41.99	3.03	11.65	1.72	9.25	0.00	ND	13.00	36.00	1.31	0.00	0.05	0.06	ND	0.03	0.02	66.90	24.00	10.85	6.10	0.23	19.50
1331	2913	ND	ND	ND	6.53	6.35	7.60	0.20	4.75	0.20	0.00	52.03	5.64	2.40	2.29	3.20	0.06	ND	19.50	7.80	0.01	0.00	0.21	0.08	ND	0.06	0.07	40.75	4.30	11.10	6.75	9.60	13.40
1332	3034	ND	ND	ND	7.74	1.00	14.40	0.20	0.01	0.13	0.04	82.10	2.28	7.25	3.37	0.92	0.00	ND	8.28	69.50	0.00	0.00	2.24	0.37	ND	0.14	0.15	42.39	8.80	29.25	6.75	2.75	17.75
1333	3036	ND	ND	ND	3.04	14.00	11.90	0.17	0.03	4.70	0.60	87.00	6.40	2.66	1.36	6.15	0.00	ND	40.70	14.47	0.17	0.00	3.35	3.84	ND	0.27	0.35	82.26	1.00	20.80	6.50	0.90	15.80
1334	3039	ND	ND	ND	11.90	8.90	6.15	0.18	1.47	0.04	0.05	42.96	2.04	1.43	5.37	2.51	0.33	ND	13.20	5.60	0.00	0.00	0.20	0.00	ND	0.03	0.02	41.08	4.00	11.20	6.50	4.95	15.45
1335	3044	ND	ND	ND	10.30	12.50	293.00	0.68	0.10	0.63	0.26	182.71	1.06	14.80	2.75	7.40	0.00	0.54	6.03	236.00	0.08	0.00	0.09	0.00	ND	0.07	0.09	25.00	0.30	125.40	7.35	0.40	42.45
1336	3272	ND	ND	ND	10.80	ND	346.00	0.85	0.36	ND	ND	235.35	10.00	ND	6.75	ND	ND	ND	260.00	ND	0.17	ND	ND	0.00	ND	0.10	0.13	82.60	1.40	143.50	7.61	ND	40.60
1337	3301	ND	ND	ND	15.55	18.00	40.00	0.10	0.03	0.03	ND	98.62	3.70	3.70	9.64	11.30	0.00	0.00	30.60	32.00	0.01	0.00	2.40	3.05	ND	0.11	0.12	37.50	12.00	33.68	8.20	3.42	15.95
1338	4001	ND	ND	ND	13.50	12.00	308.40	0.54	0.03	10.53	0.77	187.55	3.21	23.55	8.43	7.80	0.00	0.00	26.45	198.10	0.39	0.01	0.01	1.75	ND	0.15	0.25	36.25	16.63	94.90	5.65	1.00	31.80
1339	4002	ND	ND	ND	14.40	44.00	238.75	0.53	9.72	1.19	0.48	147.62	20.65	8.20	7.83	13.00	2.92	ND	241.50	68.15	0.13	0.01	0.03	0.00	ND	0.08	0.11	161.00	39.10	94.75	6.85	4.30	16.50
1340	4364	ND	ND	ND	21.00	9.70	199.00	0.43	0.44	0.59	ND	136.00	6.30	7.00	6.83	7.40	0.38	0.53	115.00	159.00	0.02	0.00	0.01	0.00	ND	0.06	0.11	41.09	0.25	87.38	7.46	0.80	37.00
1342	4582	ND	ND	ND	0.03	ND	0.25	0.25	0.01	ND	ND	ND	0.03	ND	0.01	ND	0.00	ND	0.12	ND	0.00	0.00	0.01	0.01	ND	0.00	ND	0.05	0.25	92.70	ND	0.25	36.40
1344	S109	ND	ND	ND	9.20	9.50	196.00	0.49	0.50	0.46	ND	134.05	6.30	7.50	6.50	6.80	0.49	0.50	149.00	143.00	0.02	ND	0.01	ND	ND	ND	ND	ND	0.18	93.87	7.06	ND	22.95
1345	S108	ND	ND	ND	8.28	ND	18.70	0.13	0.03	ND	ND	89.54	3.40	ND	5.24	ND	0.00	ND	23.90	ND	0.01	0.00	0.12	0.12	ND	0.17	0.20	ND	4.00	21.70	6.80	ND	26.70
1346	S107	ND	ND	ND	8.45	ND	22.30	0.07	0.08	ND	ND	75.99	4.10	ND	4.86	ND	ND	ND	23.50	ND	0.04	0.00	0.09	0.09	ND	0.11	0.16	88.81	2.00	20.50	6.50	ND	22.30
1347	S106	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	93.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	22.75	6.80	ND	25.50
1348	S105	ND	ND	ND	2.14	ND	3.84	0.08	0.00	ND	ND	26.26	2.70	ND	1.35	ND	0.00	ND	6.90	ND	0.01	ND	ND	0.50	ND	0.07	0.08	59.49	1.67	6.50	6.40	ND	11.10
1349	68	ND	ND	ND	2.37	4.95	7.50	0.09	0.01	0.02	0.01	76.96	2.70	2.03	1.45	2.40	0.00	ND	11.10	22.25	0.00	0.00	0.16	0.06	ND	0.11	0.11	83.37	1.70	13.90	7.45	6.00	19.05
1350	66	ND	ND	ND	5.09	2.85	9.55	0.11	0.02	0.21	ND	75.02	1.92	4.70	2.34	1.10	0.00	ND	22.35	37.25	0.00	0.00	0.05	0.06	ND	0.12	0.11	89.20	1.80	15.00	7.50	1.00	22.10
1351	Braemar Springs	ND	ND	ND	8.79	3.85	37.80	0.35	0.00	0.04	0.05	321.26	26.40	5.35	1.65	0.92	0.03	ND	290.00	68.15	0.27	ND	0.02	0.01	ND	0.12	0.12	118.98	3.20	88.40	7.43	1.10	36.45
1352	EBOP-noname1	ND	ND	ND	3.63	ND	9.00	0.13	0.03	ND	ND	27.83	3.40	ND	1.46	ND	0.00	ND	11.30	ND	0.00	0.01	0.62	0.63	ND	0.06	0.07	ND	8.00	10.10	6.50	ND	17.10
1353	EBOP-noname2	ND	ND	ND	3.44	ND	8.20	0.10	0.03	ND	ND	27.83	3.10	ND	1.34	ND	0.00	ND	11.00	ND	0.00	0.00	0.63	0.63	ND	0.06	0.06	67.82	7.00	9.90	6.80	ND	16.90
1354	EBOP-noname3	ND	ND	ND	3.38	ND	9.30	9.30	0.01	ND	ND	30.61	3.57	ND	1.45	ND	0.00	ND	11.50	ND	0.00	0.00	0.64	0.64	ND	0.07	ND	75.30	9.10	10.45	6.87	ND	16.90
1355	EBOP-noname4	ND	ND	ND	3.58	ND	8.70	0.13	0.01	ND	ND	31.46	3.50	ND	1.54	ND	ND	ND	11.90	ND	0.02	ND	ND	0.56	ND	0.11	0.09	76.00	8.20	10.10	6.90	ND	17.10
1356	EBOP-noname5	ND	ND	ND	9.34	ND	10.70	ND	ND	ND	ND	25.05	3.40	ND	3.50	ND	ND	ND	ND	11.80	0.01	ND	ND	9.31	ND	0.03	ND	ND	4.50	17.10	5.50	ND	12.50
1357	EBOP-noname6	ND	ND	ND	5.35	ND	4.40	ND	ND	ND	ND	34.36	4.90	ND	1.88	ND	ND	ND	ND	11.10	0.00	ND	ND	2.67	ND	0.02	ND	ND	12.80	12.40	5.70	ND	13.10
1358	EBOP-noname7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1359	EBOP-noname8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1360	EBOP-noname9	ND	ND	ND	4.51	ND	4.70	ND	ND	ND	ND	55.66	5.60	ND	1.73	ND	ND	ND	ND	12.10	0.01	ND	ND	1.76	ND	0.07	ND	ND	4.50	11.80	6.00	ND	11.60
1361	EBOP-noname10	ND	ND	ND	4.05	ND	6.90	ND	ND	ND	ND	25.53	3.10	ND	1.50	ND	ND	ND	ND	7.70	0.01	ND	ND	1.76	ND	0.02	ND	ND	3.70	9.10	5.80	ND	12.30
1362	EBOP-noname11	ND	ND	ND	4.31	ND	5.15	ND	ND	ND	ND	33.09	3.40	ND	1.56	ND	ND	ND	ND	8.95	0.01	ND	ND	1.73	ND	0.02	ND	ND	4.40	9.80	5.80	ND	12.70
2020	BEEK	ND	ND	0.03	30.00	ND	20.90	0.20	2.80	ND	ND	167.00	3.80	ND	12.00	ND	0.25	ND	31.00	11.00	1.09	0.00	0.00	2.10	ND	0.04	ND	66.70	20.90	0.38	7.45	ND	15.35
2021	ALLEN	ND	ND	0.06	12.90	ND	33.20	0.09	0.04	ND	ND	67.45	9.40	ND	5.60	ND	0.02	ND	23.00	ND	<0.01	0.00	0.58	ND	ND	0.02	ND	81.00	6.15	0.26	6.40	ND	ND
2055	OHOPEGC	ND	ND	0.12	18.00	ND	39.50	0.10	0.03	ND	ND	98.00	3.70	ND	10.70	ND	0.00	ND	31.00	ND	<0.01	0.01	2.20	ND	ND	0.10	ND	35.00	12.00	0.31	8.07	ND	ND
2056	ETERNAL SPRINGS	ND	ND	0.02	2.90	ND	6.60	0.15	0.00	ND	ND	35.00	2.90	ND	1.60	ND	0.00	ND	11.60	ND	<0.01	<0.005	0.18	ND	ND	0.08	ND	82.94	3.40	0.09	6.72	ND	ND
2057	FERNLANDSPA	ND	ND	0.67	9.80	ND	197.50	0.45	0.60	ND	ND	136.00	7.10	ND	7.40	ND	0.52	ND	152.00	ND	0.02	<0.005	0.00	ND	ND	0.08	ND	80.80	0.11	0.84	7.43	ND	ND
2058	PEMBERTON	ND	ND	0.00	3.20	ND	5.25	0.02	0.01	ND	ND	31.00	1.70	ND	1.90	ND	<0.02	ND	9.90	ND	<0.01	<0.005	1.50	ND	ND	0.07	ND	66.25	1.40	0.08	6.52	ND	ND
3001	Hamurana Spring @ water intake	145	18	<0.10	3.1	ND	4.7	0.06	<0.02	ND	ND	39	2.5	ND	2.1	ND	<0.0005	ND	9.7	ND	<0.01	<0.002	0.735	ND	<0.1	0.096	0.094	68	1.4	0.67	6.97	6.6	11.67
3002	Taniwha Spring @ old well	64	44	<0.10	3.5	ND	5.3	0.05	<0.02	ND	ND	35	1.9	ND	2.2	ND	<0.0005	ND	9.6	ND	<0.01	<0.002	1.41	ND	0.1	0.067	0.127	55	1.6	0.72	6.85	7.6	12.04
3003	Trout Hatchery Spring @ weir	54	51	<0.10	2	ND	5.3	0.13	<0.02	ND	ND	21	3.3	ND	1.2	ND	<0.0005	ND	7.1	ND	<0.01	<0.002	0.945	ND	<0.1	0.045	0.042	63	3	0.51	7.17	9.7	10.96
3004	Te Waireka @ bottling plant intake	30	79	<0.10	2.4	ND	4.3	0.06	<0.02	ND	ND	26	4.4	ND	1.2	ND	<0.0005	ND	8.2	ND	<0.01	<0.002	1.75	ND	<0.1	0.033	0.024	66	2.3	0.61	7.09	9.3	11.85
3005	Barlows Spring @ water intake	73	30	<0.10	2.3	ND	4.4	0.06	<0.02	ND	ND	27	2.7	ND	1.5	ND	<0.0005	ND	6.9	ND	<0.01	<0.002	0.567	ND	<0.1	0.083	0.084	60	1.4	0.46	6.98	10.1	10.77
3006	2116	135	1	<0.10	2.3	ND	4.4	0.08	<0.02	ND	ND	34	0.21	ND	1.3	ND	<0.0005	ND	10.4	ND	<0.01	<0.002	0.223	ND	<0.1	0.081	0.074	77	1.4	0.5	7.04	9.9	11.48
3007	1202	26	84	<0.10	2.9	ND	4.3	0.03	<0.02	ND	ND	25	1.9	ND	1.4	ND	<0.0005	ND	7.9	ND	<0.01	<0.002	1.4	ND	0.1	0.029	0.025	42	3	0.56	6.51	7.4	11.88
3008	1561	112	8	<0.10	3.2	ND	4.7	0.05	0.07	ND	ND	39	2.6	ND	2.2	ND	0.0019	ND	10.2	ND	<0.01	<0.002	0.606	ND	<0.1	0.091	0.203	70	1.3	0.72	6.86	6.4	12.26
3009	Dr. Irvin	ND	ND	<0.10	12.5	ND	13	0.05	<0.02	ND	ND	26	5.5	ND	6.6	ND	0.0007	ND	10.6	ND	<0.01	<0.002	13.7	ND	<0.1	0.048	0.033	54	1.4	1.99	6.33	5.2	13.63

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
3010	3691	94	16	<0.10	3.9	ND	4.6	0.05	<0.02	ND	ND	58	0.49	ND	2.7	ND	0.009	ND	15.8	ND	<0.01	<0.002	0.847	ND	<0.1	45	0.065	62	1.4	1.04	6.78	5.6	12.53
3011	JROYAL	14	95	<0.10	7	ND	5.3	0.03	<0.02	ND	ND	31	6	ND	2.6	ND	<0.0005	ND	7.5	ND	<0.01	<0.002	3.84	ND	0.1	0.015	<0.004	60	5.7	0.99	6.16	6.8	12.7
3012	3901	170	1	<0.10	0.33	ND	5.4	0.1	0.43	ND	ND	27	0.7	ND	0.17	ND	0.0008	ND	14.5	ND	0.02	<0.002	0.1	ND	<0.1	0.585	0.587	75	4.7	0.55	6.88	9	12.6
3013	10424	150	1	<0.10	2.5	ND	3.6	0.14	3.78	ND	ND	49	2.7	ND	1	ND	0.162	ND	11.4	ND	0.32	<0.002	0.012	ND	1.3	0.021	1.32	74	0.13	0.64	7.09	0.2	13.6
3014	Spring 2	ND	ND	<0.10	2.5	ND	2.2	0.03	<0.02	ND	ND	21	5.9	ND	1.4	ND	0.0021	ND	9.6	ND	0.02	<0.002	1.8	ND	1.6	0.041	0.093	81	14.6	0.7	6.75	10	10.2
3015	Utuhina Spring (main)	ND	ND	0.05	2.50	ND	4.00	0.06	0.01	ND	ND	32.00	2.10	ND	1.50	ND	0.00	ND	8.90	ND	0.01	ND	0.41	ND	ND	0.08	ND	73.00	2.30	ND	ND	ND	ND
3016	Fairy Spring (Te Waiowhero)	ND	ND	0.05	2.00	ND	4.90	0.11	0.01	ND	ND	18.70	2.70	ND	0.87	ND	0.00	ND	6.60	ND	0.01	ND	0.83	ND	ND	0.03	ND	61.00	2.60	ND	ND	ND	ND
3017	Awahou Stream @ Central Rd bridge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3018	Utuhina Spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3019	Utuhina Spring #2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3020	Taniwha Spring @ water intake	ND	ND	0.05	4.00	ND	5.30	0.04	0.01	ND	ND	33.00	2.10	ND	1.90	ND	0.00	ND	9.10	ND	0.01	ND	1.39	ND	ND	0.06	ND	59.00	1.90	ND	ND	ND	ND
3021	Rainbow Spring	ND	ND	0.05	2.20	ND	4.90	0.08	0.01	ND	ND	19.70	2.80	ND	0.90	ND	0.00	ND	6.60	ND	0.05	ND	0.87	ND	ND	0.05	ND	57.00	2.70	ND	ND	ND	ND
3022	Hamurana Spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3023	Hamurana head spring	ND	ND	0.05	2.90	ND	4.70	0.05	0.01	ND	ND	32.00	2.20	ND	1.60	ND	0.00	ND	8.50	ND	0.01	ND	0.78	ND	ND	0.07	ND	60.00	1.70	ND	ND	ND	ND
3024	Hamurana Spring #3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3025	Utuhina Stream @ Lake Rd	ND	ND	0.05	3.40	ND	14.00	0.41	0.23	ND	ND	35.00	3.70	ND	1.10	ND	0.04	ND	17.30	ND	0.06	ND	0.69	ND	ND	0.03	ND	68.00	7.60	ND	ND	ND	ND
3026	Ngongotaha Stream @ Ngongotaha Rd	ND	ND	0.05	2.60	ND	4.70	0.06	0.21	ND	ND	22.00	3.00	ND	1.10	ND	0.02	ND	6.30	ND	0.02	ND	0.74	ND	ND	0.03	ND	46.00	2.30	ND	ND	ND	ND
3027	Waiteti Stream @ Ngongotaha Rd	ND	ND	0.05	3.30	ND	5.30	0.04	0.17	ND	ND	28.00	2.60	ND	1.40	ND	0.02	ND	8.00	ND	0.01	ND	1.22	ND	ND	0.03	ND	50.00	2.20	ND	ND	ND	ND
3028	Awahou Stream @ Hamurana Rd	ND	ND	0.05	3.60	ND	5.20	0.05	0.01	ND	ND	35.00	2.00	ND	1.80	ND	0.00	ND	9.40	ND	0.01	ND	1.21	ND	ND	0.07	ND	58.00	1.60	ND	ND	ND	ND
3029	Hauraki Stream @ Hamurana Rd	ND	ND	0.05	5.50	ND	5.00	0.04	1.20	ND	ND	37.00	3.90	ND	1.60	ND	0.09	ND	6.20	ND	0.02	ND	0.19	ND	ND	0.03	ND	52.00	1.90	ND	ND	ND	ND
3030	Hamurana Stream @ Hamurana Rd	ND	ND	0.05	3.00	ND	4.60	0.05	0.01	ND	ND	34.00	2.30	ND	1.60	ND	0.00	ND	9.00	ND	0.02	ND	0.70	ND	ND	0.08	ND	62.00	1.70	ND	ND	ND	ND
3031	Waiohewa Stream @ Te Ngae Rd	ND	ND	0.05	7.40	ND	7.20	0.11	0.20	ND	ND	14.50	3.50	ND	3.50	ND	0.22	ND	14.10	ND	1.80	ND	1.16	ND	ND	0.03	ND	65.00	40.00	ND	ND	ND	ND
3032	Waingaehe Stream @ Te Ngae Rd	ND	ND	0.05	4.20	ND	7.70	0.21	0.01	ND	ND	40.00	3.10	ND	3.40	ND	0.01	ND	13.50	ND	0.01	ND	1.31	ND	ND	0.10	ND	81.00	10.30	ND	ND	ND	ND
3033	Puarenga Stream @ Te Ngae Rd	ND	ND	0.13	4.50	ND	43.00	0.41	0.44	ND	ND	19.20	6.90	ND	1.70	ND	0.12	ND	42.00	ND	0.10	ND	0.99	ND	ND	0.03	ND	83.00	37.00	ND	ND	ND	ND
3034	Kauaka Stream @ Waipa State Mill Rd	ND	ND	0.05	3.60	ND	6.90	0.05	0.49	ND	ND	30.00	3.30	ND	1.50	ND	0.08	ND	8.90	ND	0.03	ND	0.70	ND	ND	0.03	ND	64.00	2.80	ND	ND	ND	ND
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	ND	ND	0.05	3.10	ND	4.30	0.12	0.52	ND	ND	30.00	2.60	ND	1.50	ND	0.09	ND	8.50	ND	0.02	ND	0.56	ND	ND	0.03	ND	65.00	3.70	ND	ND	ND	ND
3036	Waipa Stream @ Hemo Gorge	ND	ND	0.05	4.60	ND	19.50	0.13	0.32	ND	ND	38.00	5.30	ND	2.30	ND	0.07	ND	24.00	ND	0.04	ND	1.92	ND	ND	0.03	ND	58.00	16.50	ND	ND	ND	ND
3037	Awahou spring #1	ND	ND	0.05	3.90	ND	5.30	0.04	0.01	ND	ND	35.00	1.80	ND	1.80	ND	0.00	ND	9.60	ND	0.01	ND	1.37	ND	ND	0.06	ND	55.00	1.30	ND	ND	ND	ND
3038	Awahou upstream	ND	ND	0.05	3.70	ND	5.40	0.05	0.02	ND	ND	30.00	2.30	ND	1.60	ND	0.01	ND	8.20	ND	0.01	ND	1.56	ND	ND	0.05	ND	45.00	1.60	ND	ND	ND	ND
3039	Ngongataha stream @ Paradise springs	ND	ND	0.05	2.30	ND	4.50	0.08	0.10	ND	ND	22.00	4.20	ND	0.83	ND	0.03	ND	6.50	ND	0.01	ND	0.78	ND	ND	0.03	ND	58.00	2.60	ND	ND	ND	ND
30001	1367-19	ND	ND	0.03	6.45	ND	ND	<0.05	0.01	ND	ND	30.50	2.70	ND	5.00	ND	<0.005	ND	8.35	ND	<0.01	ND	ND	4.50	ND	ND	ND	32.00	10.40	13.55	6.40	ND	15.15
30002	60-12	ND	ND	0.02	32.00	23.50	9.10	0.05	0.02	ND	<0.01	118.46	1.20	ND	1.65	1.09	0.01	<0.005	7.40	4.80	<0.01	0.02	1.07	0.31	ND	ND	ND	13.00	2.10	19.00	7.99	ND	16.00
30003	60-124	ND	ND	ND	ND	96.05	10.70	ND	ND	ND	0.03	269.01	ND	ND	ND	3.49	ND	0.01	ND	10.60	ND	ND	2.59	ND	ND	ND	ND	ND	32.30	50.25	7.70	ND	ND
30004	60-167	ND	ND	ND	ND	5.62	14.85	ND	ND	ND	0.54	93.33	ND	ND	ND	7.02	ND	0.42	ND	30.40	ND	ND	<0.05	ND	ND	ND	ND	ND	1.85	19.60	7.25	ND	ND
30005	60-316	ND	ND	ND	ND	31.55	36.40	ND	ND	ND	0.14	152.50	ND	ND	ND	9.38	ND	<0.005	ND	35.30	ND	ND	0.48	ND	ND	ND	ND	ND	18.95	38.35	6.90	ND	ND
30006	60-345	ND	ND	ND	ND	2.61	18.65	ND	ND	ND	<0.01	18.30	ND	ND	ND	1.58	ND	<0.005	ND	12.80	ND	ND	1.60	ND	ND	ND	ND	ND	2.35	11.20	5.90	ND	ND
30007	60-348	ND	ND	ND	ND	4.17	17.60	ND	ND	ND	0.14	24.40	ND	ND	ND	2.87	ND	<0.005	ND	14.50	ND	ND	1.25	ND	ND	ND	ND	ND	7.80	13.50	6.30	ND	ND
30008	60-352	ND	ND	ND	ND	21.60	13.90	ND	ND	ND	0.02	141.52	ND	ND	ND	8.10	ND	0.22	ND	22.10	ND	ND	<0.05	ND	ND	ND	ND	ND	2.40	25.50	7.90	ND	ND
30009	60-4	ND	ND	ND	ND	18.55	37.00	ND	0.08	ND	<0.01	45.14	ND	ND	ND	3.00	ND	<0.005	ND	23.00	ND	<0.002	2.15	2.52	ND	0.10	ND	ND	16.20	24.30	6.45	ND	14.80
30010	60-407	ND	ND	ND	ND	4.10	25.00	ND	ND	ND	0.04	14.64	ND	ND	ND	2.81	ND	<0.005	ND	16.90	ND	ND	3.09	ND	ND	ND	ND	ND	6.75	14.45	6.35	ND	ND
30011	60-480	ND	ND	ND	ND	45.75	28.60	ND	ND	ND	0.05	241.56	ND	ND	ND	13.80	ND	0.05	ND	57.55	ND	ND	1.79	ND	ND	ND	ND	ND	63.45	57.65	7.20	ND	ND
30012	60-483	ND	ND	ND	ND	32.80	12.15	ND	ND	ND	0.07	100.04	ND	ND	ND	3.48	ND	<0.005	ND	5.95	ND	ND	2.20	ND	ND	ND	ND	ND	6.00	22.80	8.15	ND	ND
30013	61-113	ND	ND	ND	ND	3.90	18.35	ND	<0.02	ND	0.89	6.10	0.75	ND	ND	3.22	ND	0.06	ND	13.00	ND	ND	5.24	5.50	ND	ND	ND	ND	3.20	13.00	5.40	ND	15.40
30014	61-126	ND	ND	ND	ND	17.60	59.15	ND	ND	ND	0.11	30.50	ND	ND	ND	10.75	ND	0.01	ND	26.60	ND	ND	6.65	4.61	ND	0.05	ND	ND	18.40	31.60	6.50	ND	15.40
30015	61-135	ND	ND	ND	ND	7.08	17.25	ND	ND	ND	0.01	32.33	ND	ND	ND	5.30	ND	<0.005	ND	18.25	ND	ND	8.14	6.04	ND	ND	ND	ND	3.00	15.20	6.80	ND	17.00
30016	61-143	ND	ND	ND	ND	11.30	16.90	ND	ND	ND	0.07	13.42	ND	ND	ND	10.80	ND	<0.005	ND	20.00	ND	ND	23.30	17.00	ND	ND	ND	ND	1.20	23.40	5.90	ND	14.90
30017	61-208	ND	ND	ND	ND	12.10	57.20	ND	ND	ND	0.63	53.68	ND	ND	ND	13.00	ND	0.01	ND	44.30	ND	ND	16.15	15.80	ND	0.04	ND	ND	7.80	41.30	6.30	ND	15.50
30018	61-221	ND	ND	ND	ND	6.57	18.65	ND	ND	ND	0.05	37.82	ND	ND	ND	6.58	ND	<0.005	ND	13.30	ND	ND	4.24	3.73	ND	ND	ND	ND	2.20	16.05	6.45	ND	14.75
30019	61-23	ND	ND	ND	ND	4.26	15.70	ND	ND	ND	0.01	18.30	ND	ND	ND	4.61	ND	<0.005	ND	12.60	ND	ND	5.84	ND	ND	ND	ND	ND	1.80	14.40	6.30	ND	15.60
30020	61-245	ND	ND	ND	ND	2.61	24.50	ND	ND	ND	0.07	3.05	ND	ND	ND	2.15	ND	0.06	ND	12.65	ND	ND	0.15	0.43	ND	ND	ND	ND	10.15	11.05	5.05	ND	16.40
30021	61-258	ND	ND	0.08	12.20	ND	ND	0.04	<0.05	ND	ND	106.14	2.00	ND	10.40	ND	<0.02	ND	16.00	ND	<0.01	ND	ND	2.10	ND	ND	ND	53.00	2.70	23.00	7.20	ND	14.80
30022	61-280	ND	ND	ND	ND	6.22	18.30	ND	ND	ND	0.05	25.62	ND	ND	ND	7.81	ND	<0.005	ND	16.60	ND	ND	11.10	9.78	ND	0.02	ND	ND	1.80	19.20	6.20	ND	16.25
30023	61-54	ND	ND	ND	ND	1.65	12.55	ND	ND	ND	<0.01	11.59	ND	ND	ND	4.16	ND	<0.005	ND	13.50	ND	ND	6.84	4.58	ND	<0.004	ND	ND	1.80	10.80	5.90	ND	14.80
30024	61-59	ND	ND	ND	ND	2.36	18.00	ND	ND	ND	0.08	12.20	ND	ND	ND	2.82	ND	0.01	ND	13.75	ND	ND	4.08	4.02	ND	ND	ND	ND	3.00	12.20	5.90	ND	14.90
30025	61-85	ND	ND	0.12	8.00	8.40	31.00	<0.05	0.01	ND	<0.1	40.26	1.40	ND	8.20	7.90	<0.005	<0.02	23.00	20.00	<0.01	0.00	7.80	9.00	ND	0.01	ND	32.00	3.00	24.00	6.40	ND	15.70
30026	61-93	ND	ND	0.34	34.00	0.20	75.25	0.02	0.02	ND	<0.01	45.14	2.70	ND	33.00	0.31	<0.005	<0.005	26.00	2.20	<0.01	ND	0.12	34.00	ND	ND	ND	36.00	1.70	60.85	6.34	ND	15.00
30027	62-5	ND	ND	ND	ND	9.91	21.50	ND	ND	ND	<0.01	39.04	ND	ND	ND	5.78	ND	<0.005	ND	8.75	ND	ND	3.74	8.55	ND	ND	ND	ND	14.95	23.45	6.20	ND	15.10
30028	63-201	ND	ND	ND	ND	3.30	11.20	ND	ND	ND	7.34	34.16	ND	ND	ND	1.24	ND	0.61	ND	9.90	ND	ND	<0.05	ND	ND	ND	ND	ND	<0.5	8.05	6.30	ND	15.20
30029	63-240	ND	ND	ND	ND	13.20	12.25	ND	ND	ND	<0.01	77.47	ND	ND	ND	5.11	ND	<0.005	ND	12.15	ND	ND	0.14	ND	ND	ND	ND	ND	2.30	16.45	7.75	ND	14.30
30030	63-328	ND	ND	ND	ND	7.98	12.50	ND	ND	ND	0.01	53.07	ND	ND	ND	3.75	ND	<0.005	ND	12.00	ND	ND	0.08	ND	ND	ND	ND	ND	2.90	13.20	7.25	ND	16.30
30031	63-43	ND	ND	ND	ND	2.45	17.55	ND	0.09	ND	0.19	38.43	ND	ND	ND	6.65	ND	<0.005	ND	23.90	ND	ND	6.63	0.40	ND	ND	ND	ND	3.05	10.95	5.90	ND	16.10
30032	63-57	ND	ND	ND	ND	11.70	19.00	ND	0.33	ND	0.37	40.26	ND	ND	ND	10.40	ND	0.01	ND	14.90	ND	ND	12.20	10.10	ND	ND	ND	ND	14.70	25.55	6.50	ND	15.80
30033	63-65	ND	ND	ND	ND	4.60	37.00	ND	<0.04	ND	0.19	15.86	ND	ND	ND	3.97	ND	0.02	ND	26.45	ND	0.00	3.90	5.16	ND	<0.004	ND	ND	8.80	19.40	6.05	ND	15.75
30034	63-74	ND	ND	ND	ND	37.50	29.55	ND	ND	ND	1.41	188.49	ND	ND	ND	8.22	ND	0.25	ND	26.75	ND	ND	<0.05	ND	ND	ND	ND	ND	8.10	31.85	7.75	ND	16.50
30035	63-78	ND	ND	ND	ND	1.72	17.70	ND	ND	ND	1.32	8.54	ND	ND	ND	1.11	ND	<0.005	ND	11.45	ND	ND	1.57	ND	ND	ND	ND	ND	2.20	8.90	5.80	ND	15.30
30036	63-8	ND	ND	ND	ND	7.04	38.45	ND	ND	ND	0.02	42.09	ND	ND	ND	3.49	ND	<0.005	ND	26.70	ND	ND	0.36	ND	ND	ND	ND	ND	8.15	21.45	6.75	ND	ND
30037	64-108	ND	ND	ND	ND	10.00	20.00	ND	<0.04	ND	0.05	14.64	ND	ND	ND	5.40	ND	<0.005	ND	17.90	ND	ND	16.50	16.00	ND	0.01	ND	ND	4.90	23.30	5.80	ND	15.80
30038	64-111	ND	ND	ND	ND	9.68	16.60	ND	ND	ND	1.60	121.39	ND	ND	ND	2.83	ND	0.35	ND	38.25	ND	ND	<0.05	ND	ND	ND	ND	ND	0.55	22.95	7.50	ND	18.10
30039	64-117	ND	ND	ND	ND	18.60	29.80	ND	0.75	ND	0.04	32.94	ND	ND	ND	8.50	ND	<0.005	ND	15.85	ND	ND	16.10	13.40	ND	0.02	ND	ND	48.35	38.30	6.30	ND	15.60

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
30040	64-12	ND	ND	ND	ND	10.45	23.10	ND	0.79	ND	0.69	20.74	ND	ND	ND	6.28	ND	0.03	ND	19.90	ND	ND	3.40	3.69	ND	0.05	ND	ND	45.40	23.70	6.00	ND	15.40
30041	64-120	ND	ND	0.06	13.40	16.60	14.70	0.03	0.01	ND	0.01	34.77	5.35	ND	4.95	6.24	<0.005	<0.005	12.50	13.70	<0.01	ND	12.55	8.00	ND	ND	ND	76.00	11.60	18.95	6.40	ND	15.20
30042	64-20	ND	ND	ND	ND	13.35	24.50	ND	0.11	ND	0.01	23.18	ND	ND	ND	6.28	ND	0.03	ND	13.60	ND	ND	6.02	5.38	ND	0.05	ND	ND	20.60	20.35	6.00	ND	15.20
30043	64-43	ND	ND	ND	ND	9.21	14.00	ND	<0.04	ND	0.02	31.72	ND	ND	ND	4.81	ND	<0.005	ND	13.10	ND	ND	7.78	8.29	ND	0.05	ND	ND	9.70	17.90	6.30	ND	15.35
30044	64-46	ND	ND	ND	ND	13.00	23.50	ND	<0.04	ND	<0.01	28.06	ND	ND	ND	6.26	ND	<0.005	ND	14.10	ND	ND	4.57	5.36	ND	0.07	ND	ND	27.20	22.00	6.20	ND	14.80
30045	64-50	ND	ND	ND	ND	17.90	35.80	ND	<0.04	ND	<0.01	29.28	ND	ND	ND	8.96	ND	<0.005	ND	15.80	ND	ND	11.60	6.97	ND	0.04	ND	ND	13.80	25.70	6.30	ND	15.20
30046	64-511	ND	ND	0.05	8.30	7.14	8.40	0.03	0.00	ND	<0.01	47.58	6.10	ND	4.00	3.36	<0.02	<0.005	14.05	12.80	<0.01	0.00	2.01	4.80	ND	ND	ND	79.00	9.60	16.00	6.50	ND	15.50
30047	64-7	ND	ND	ND	ND	17.30	21.05	ND	ND	ND	<0.01	28.06	ND	ND	ND	10.16	ND	<0.005	ND	17.00	ND	ND	17.00	24.60	ND	ND	ND	ND	29.95	35.85	6.00	ND	14.85
30048	64-70	ND	ND	ND	ND	8.35	22.70	ND	<0.04	ND	<0.01	36.60	ND	ND	ND	5.90	ND	3.57	ND	13.05	ND	ND	1.05	1.50	ND	0.10	ND	ND	20.50	19.40	6.20	ND	15.80
30049	64-831	ND	ND	ND	ND	8.28	10.75	ND	ND	ND	0.07	40.87	ND	ND	ND	4.44	ND	<0.005	ND	9.35	ND	ND	2.55	ND	ND	ND	ND	ND	5.85	13.05	6.75	ND	15.20
30050	65-4	ND	ND	ND	ND	6.92	20.15	ND	ND	ND	0.24	25.62	ND	ND	ND	3.60	ND	<0.005	ND	17.20	ND	ND	7.54	6.81	ND	0.04	ND	ND	1.35	16.80	6.30	ND	15.10
30051	65-6	ND	ND	ND	ND	3.29	11.00	ND	ND	ND	0.56	29.28	ND	ND	ND	1.69	ND	0.01	ND	11.80	ND	ND	1.74	1.33	ND	ND	ND	ND	1.85	9.50	6.40	ND	15.40
30052	65-8	ND	ND	ND	ND	4.20	6.60	ND	ND	ND	0.13	21.96	ND	ND	ND	1.75	ND	<0.005	ND	7.00	ND	ND	0.78	0.64	ND	0.01	ND	ND	8.00	7.30	6.25	ND	15.40
30053	66-58	ND	ND	ND	ND	2.16	2.60	ND	ND	ND	3.76	26.84	ND	ND	ND	0.95	ND	0.10	ND	5.85	ND	ND	0.11	0.12	ND	ND	ND	ND	1.20	4.90	6.90	ND	11.70
30054	66-6	ND	ND	ND	ND	10.20	27.60	ND	ND	ND	0.05	20.74	ND	ND	ND	4.41	ND	0.09	ND	25.15	ND	ND	15.90	17.05	ND	ND	ND	ND	17.45	28.90	5.80	ND	12.80
30055	66-92	ND	ND	ND	3.26	3.34	4.55	ND	ND	ND	0.88	250.10	1.70	ND	0.89	0.93	ND	0.17	88.80	85.15	ND	ND	<0.05	0.00	ND	3.14	ND	ND	<0.5	39.20	7.70	ND	21.00
30056	66-93	ND	ND	ND	9.32	10.00	9.75	ND	ND	ND	0.03	46.36	5.60	ND	3.28	4.34	ND	0.35	24.70	14.20	ND	ND	1.61	2.54	ND	0.02	ND	ND	13.20	15.50	6.50	ND	16.50
30057	66-96	ND	ND	ND	ND	2.48	2.80	ND	ND	ND	1.03	30.50	ND	ND	ND	0.87	ND	<0.005	ND	6.55	ND	ND	<0.05	ND	ND	ND	ND	ND	1.10	5.80	8.15	ND	12.75
30058	67-11	ND	ND	ND	ND	20.70	13.60	ND	<0.04	ND	0.01	35.38	ND	ND	ND	5.27	ND	<0.005	ND	12.05	ND	ND	12.50	6.47	ND	ND	ND	ND	29.55	24.20	6.20	ND	15.45
30059	67-15	ND	ND	ND	ND	5.10	11.35	ND	<0.04	ND	0.02	30.50	ND	ND	ND	2.85	ND	<0.005	ND	10.60	ND	ND	3.47	3.83	ND	ND	ND	ND	4.80	12.60	6.30	ND	14.50
30060	67-38	ND	ND	ND	ND	10.20	18.10	ND	ND	ND	0.38	65.88	ND	ND	ND	3.89	ND	0.07	ND	17.30	ND	ND	2.58	ND	ND	ND	ND	ND	5.40	16.65	6.60	ND	13.70
30061	67-4	ND	ND	ND	ND	10.30	21.90	ND	ND	ND	0.08	57.34	ND	ND	ND	3.89	ND	<0.005	ND	18.60	ND	ND	4.78	1.99	ND	ND	ND	ND	3.80	23.10	6.40	ND	12.65
30062	67-404	ND	ND	ND	ND	15.55	24.35	ND	ND	ND	0.20	30.50	ND	ND	ND	5.85	ND	<0.005	ND	16.35	ND	ND	14.10	ND	ND	ND	ND	ND	6.65	24.55	6.30	ND	13.50
30063	67-435	ND	ND	ND	ND	5.33	18.20	ND	ND	ND	2.40	30.50	ND	ND	ND	2.00	ND	0.33	ND	18.40	ND	ND	7.95	ND	ND	ND	ND	ND	4.40	19.30	6.60	ND	14.60
30064	67-483	ND	ND	ND	ND	10.25	22.45	ND	ND	ND	0.20	96.99	ND	ND	ND	3.85	ND	0.20	ND	28.05	ND	ND	<0.05	ND	ND	ND	ND	ND	3.15	21.95	6.85	ND	12.50
30065	67-55	ND	ND	ND	ND	1.28	4.90	ND	ND	ND	<0.01	17.08	ND	ND	ND	0.65	ND	<0.005	ND	5.50	ND	ND	0.53	ND	ND	ND	ND	ND	1.50	5.30	6.80	ND	13.90
30066	67-573	ND	ND	ND	ND	3.11	8.70	ND	ND	ND	<0.01	19.52	ND	ND	ND	1.42	ND	<0.005	ND	8.20	ND	ND	2.69	ND	ND	ND	ND	ND	<0.5	8.80	6.40	ND	13.80
30067	67-83	ND	ND	ND	ND	7.07	12.10	ND	ND	ND	<0.01	30.50	ND	ND	ND	2.87	ND	<0.005	ND	11.00	ND	ND	4.92	ND	ND	ND	ND	ND	2.50	13.70	6.50	ND	13.40
30068	68-301	ND	ND	ND	ND	4.75	4.40	ND	<0.02	ND	0.09	34.16	ND	ND	ND	3.14	<0.0005	<0.005	ND	11.30	ND	ND	2.34	2.19	0.30	0.13	ND	ND	8.85	10.80	6.80	ND	11.85
30069	68-317	ND	ND	ND	ND	6.11	10.15	ND	<0.02	ND	0.01	29.28	ND	ND	ND	3.04	<0.0005	<0.005	ND	13.25	ND	ND	5.02	4.84	<0.1	0.09	ND	ND	7.10	13.60	6.70	ND	11.90
30070	68-320	ND	ND	ND	ND	21.60	17.50	ND	0.04	ND	2.61	21.35	ND	ND	ND	11.55	0.24	0.25	ND	21.10	ND	ND	21.25	23.00	0.10	0.01	ND	ND	42.45	32.60	6.65	ND	14.20
30071	68-661	ND	ND	ND	ND	6.78	7.50	ND	ND	ND	0.02	36.60	ND	ND	ND	3.07	ND	<0.005	ND	13.50	ND	ND	1.91	ND	ND	ND	ND	ND	10.85	12.50	6.70	ND	12.50
30072	68-912	ND	ND	ND	ND	11.65	8.85	ND	ND	ND	<0.01	36.60	ND	ND	ND	4.94	ND	<0.005	ND	17.05	ND	ND	6.69	ND	ND	ND	ND	ND	25.15	19.35	6.35	ND	11.80
30073	68-964	ND	ND	<0.1	5.50	5.37	5.00	0.04	0.38	ND	0.28	45.14	2.80	ND	3.20	2.98	0.01	<0.005	7.15	6.50	<0.01	ND	0.13	0.08	<0.1	0.02	ND	56.00	7.60	9.95	6.47	ND	13.45
30074	69-163	ND	ND	ND	ND	34.50	25.10	ND	ND	ND	0.06	41.48	ND	ND	ND	6.02	ND	0.03	ND	11.30	ND	ND	16.60	ND	ND	ND	ND	ND	29.90	35.90	6.70	ND	14.50
30075	69-1709	ND	ND	0.07	10.35	ND	ND	0.07	0.00	ND	ND	65.88	3.60	ND	5.30	ND	<0.02	ND	20.00	ND	<0.01	ND	ND	4.70	ND	ND	ND	34.00	14.35	20.00	6.80	ND	15.25
30076	69-173	ND	ND	ND	ND	35.30	41.60	ND	ND	ND	0.02	13.42	ND	ND	ND	8.93	ND	0.11	ND	13.65	ND	ND	20.95	13.20	ND	0.02	ND	ND	72.60	47.55	5.70	ND	14.90
30077	69-19	ND	ND	ND	ND	17.40	14.45	ND	ND	ND	13.30	48.80	ND	ND	ND	7.21	ND	0.83	ND	11.95	ND	ND	3.81	5.80	ND	0.03	ND	ND	16.90	21.05	6.40	ND	14.40
30078	69-248	ND	ND	ND	ND	17.80	15.60	ND	ND	ND	1.85	34.16	ND	ND	ND	8.74	ND	0.03	ND	9.90	ND	<0.002	5.25	4.69	ND	ND	ND	ND	32.90	21.25	6.30	ND	14.35
30079	69-295	ND	ND	ND	ND	18.20	18.40	ND	ND	ND	0.02	47.58	ND	ND	ND	10.50	ND	<0.005	ND	10.70	ND	ND	7.86	ND	ND	ND	ND	ND	39.20	29.70	6.70	ND	14.00
30080	69-365	ND	ND	ND	ND	21.80	29.00	ND	ND	ND	0.06	31.72	ND	ND	ND	11.60	ND	0.06	ND	15.00	ND	ND	6.83	6.70	ND	0.01	ND	ND	61.80	34.00	6.25	ND	15.80
30081	69-374	ND	ND	ND	ND	38.40	22.10	ND	ND	ND	<0.01	24.40	ND	ND	ND	9.95	ND	<0.005	ND	16.60	ND	ND	27.20	7.63	ND	ND	ND	ND	12.00	24.30	6.20	ND	14.00
30082	69-62	ND	ND	ND	ND	10.01	13.80	ND	ND	ND	0.01	31.11	ND	ND	ND	7.41	ND	<0.005	ND	11.45	ND	ND	2.47	ND	ND	ND	ND	ND	31.40	19.00	6.45	ND	14.60
30083	69-81	ND	ND	ND	ND	7.64	24.45	ND	ND	ND	0.01	16.47	ND	ND	ND	4.26	ND	<0.005	ND	14.90	ND	ND	6.81	7.40	ND	0.03	ND	ND	10.60	20.15	5.70	ND	15.70
30084	69-97	ND	ND	ND	ND	6.59	12.20	ND	ND	ND	0.17	24.40	ND	ND	ND	3.13	ND	0.01	ND	13.10	ND	ND	2.27	3.48	ND	ND	ND	ND	13.80	14.45	5.90	ND	15.35
30085	70-21	ND	ND	ND	ND	21.50	9.30	ND	<0.02	ND	0.05	48.80	5.50	ND	ND	8.33	ND	0.00	ND	11.70	ND	ND	12.40	8.74	ND	ND	ND	ND	27.05	26.10	6.50	ND	14.50
30086	70-22	ND	ND	ND	ND	21.60	19.15	ND	<0.02	ND	0.01	37.82	7.25	ND	ND	11.20	ND	<0.005	ND	15.30	ND	ND	15.00	12.90	ND	ND	ND	ND	31.50	29.40	6.10	ND	15.50
30087	70-31	ND	ND	ND	ND	18.40	23.80	ND	ND	ND	<0.01	45.14	ND	ND	ND	7.39	ND	<0.005	ND	13.90	ND	ND	7.71	ND	ND	ND	ND	ND	20.40	26.10	7.30	ND	14.60
30088	70-36	ND	ND	ND	ND	16.60	16.40	ND	<0.04	ND	<0.01	28.06	ND	ND	ND	7.28	ND	<0.005	ND	16.60	ND	ND	8.90	6.70	ND	0.04	ND	ND	36.05	23.55	6.30	ND	14.95
30089	70-44	ND	ND	ND	ND	21.45	17.20	ND	0.09	ND	2.96	48.80	ND	ND	ND	9.92	ND	<0.005	ND	21.50	ND	ND	19.70	14.55	ND	0.03	ND	ND	22.70	30.90	6.40	ND	14.90
30090	70-47	ND	ND	ND	ND	22.50	29.90	ND	0.05	ND	0.01	35.38	ND	ND	ND	6.52	ND	<0.005	ND	9.00	ND	ND	4.41	6.29	ND	0.02	ND	ND	31.40	25.20	6.50	ND	15.50
30091	70-50	ND	ND	ND	ND	24.05	21.20	ND	ND	ND	0.02	61.00	ND	ND	ND	9.57	ND	<0.005	ND	12.70	ND	ND	16.25	ND	ND	ND	ND	ND	12.35	31.40	6.85	ND	14.30
30092	70-56	ND	ND	ND	ND	25.30	27.15	ND	<0.04	ND	0.54	40.87	ND	ND	ND	12.40	ND	0.01	ND	14.80	ND	ND	14.75	8.57	ND	0.03	ND	ND	28.15	28.20	6.50	ND	15.20
30093	70-65	ND	ND	ND	ND	8.14	16.60	ND	ND	ND	<0.01	20.74	ND	ND	ND	5.18	ND	<0.005	ND	11.35	ND	ND	2.57	2.67	ND	0.02	ND	ND	23.30	16.20	5.80	ND	15.20
30094	70-74	ND	ND	ND	ND	4.37	7.60	ND	ND	ND	<0.01	19.52	ND	ND	ND	2.28	ND	<0.005	ND	7.20	ND	ND	3.03	2.87	ND	0.01	ND	ND	5.40	9.80	6.15	ND	15.50
30095	70-76	ND	ND	ND	ND	4.72	11.10	ND	0.06	ND	<0.01	27.45	ND	ND	ND	2.56	ND	<0.005	ND	11.30	ND	ND	4.11	3.33	ND	0.05	ND	ND	1.85	11.80	6.30	ND	15.30
30096	71-1	ND	ND	ND	ND	4.08	7.50	ND	ND	ND	<0.01	27.45	ND	ND	ND	2.29	ND	0.01	ND	8.20	ND	ND	2.85	1.68	ND	0.05	ND	ND	3.60	8.90	6.35	ND	13.85
30097	71-26	ND	ND	ND	ND	55.65	7.90	ND	<0.04	ND	7.14	181.78	ND	ND	ND	2.60	ND	0.02	ND	8.00	ND	ND	0.65	0.54	ND	ND	ND	ND	5.30	30.60	7.70	ND	13.85
30098	71-3	ND	ND	ND	ND	73.40	7.50	ND	<0.04	ND	0.03	228.14	ND	ND	ND	2.21	ND	<0.005	ND	7.90	ND	ND	1.69	0.01	ND	ND	ND	ND	8.75	13.60	7.50	ND	13.60
30099	71-4	ND	ND	ND	ND	69.35	7.75	ND	<0.04	ND	0.09	211.06	ND	ND	ND	3.67	ND	<0.005	ND	6.05	ND	ND	2.27	1.66	ND	ND	ND	ND	5.55	36.20	7.50	ND	14.40
30100	71-5	ND	ND	ND	ND	41.00	8.25	ND	<0.04	ND	0.02	134.20	ND	ND	ND	3.39	ND	<0.005	ND	9.85	ND	ND	<0.05	0.02	ND	ND	ND	ND	19.20	28.10	7.90	ND	14.10
30101	72-1008	ND	ND	ND	ND	6.11	2.90	ND	<0.02	ND	8.13	21.96	ND	ND	ND	3.35	0.01	0.15	ND	5.60	ND	ND	1.88	3.83	1.80	ND	ND	ND	12.40	8.65	6.30	ND	14.40
30102	72-1011	ND	ND	ND	ND	5.32	5.60	ND	<0.02	ND	0.17	42.70	ND	ND	ND	2.97	<0.0005	<0.005	ND	14.50	ND	ND	2.90	2.96	0.10	ND	ND	ND	7.60	12.60	6.80	ND	12.30
30103	72-1069	ND	ND	ND	ND	5.27	2.55	ND	<0.02	ND	5.36	39.04	ND	ND	ND	1.96	0.00	0.05	ND	3.40	ND	ND	2.56	ND	ND	ND	ND	ND	23.00	15.90	6.45	ND	13.00
30104	72-1072	ND	ND	ND	ND	7.16	3.80	ND	0.49	ND	2.51	50.02	ND	ND	ND	2.05	1.04	0.91	ND	8.40	ND	ND	<0.05	0.00	0.30	ND	ND	ND	<0.5	9.50	7.10	ND	12.40
30105	72-1081	ND	ND	ND	ND	2.99	4.60	ND	2.93	ND	4.91	28.06	ND	ND	ND	0.93	0.17	0.13	ND	5.95	ND	ND	0.05	0.06	0.20	ND	ND	ND	1.20	6.50	6.30	ND	12.80
30106	72-1082	ND	ND	ND	ND	3.94	4.10	ND	<0.02	ND	0.02	25.62	ND	ND	ND	1.22	0.00	<0.005	ND	5.80	ND	ND	1.21	0.75	0.10	ND	ND	ND	2.80	6.90	6.40	ND	13.35
30107	72-1087	ND	ND	ND	ND	4.18	3.80	ND	<0.02	ND	0.32	24.40	ND	ND	ND	1.07	<0.0005	0.02	ND	7.55	ND	ND	1.78	1.85	0.30	ND	ND	ND	5.10	8.00	6.70	ND	12.70
30108	72-1089	ND	ND	ND	ND	17.30	8.90	ND	ND	ND	0.25	52.46	ND	ND	ND	6.97	ND	<0.005	ND	17.00	ND	ND	11.20	ND	ND	ND	ND	ND	25.30	24.30	6.60	ND	12.40

Feature_ID	ALIAS	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
30109	72-1223	ND	ND	ND	ND	3.85	11.85	ND	ND	ND	0.05	33.55	ND	ND	ND	1.55	ND	0.01	ND	11.30	ND	ND	0.11	ND	ND	ND	ND	ND	2.40	9.85	6.55	ND	16.40
30110	72-356	ND	ND	ND	ND	4.68	3.95	ND	<0.01	ND	0.91	36.60	ND	ND	ND	2.28	ND	0.01	ND	10.20	ND	ND	1.51	1.52	0.10	0.05	ND	ND	5.90	9.60	6.60	ND	12.00
30111	72-392	ND	ND	ND	ND	10.00	13.75	ND	0.40	ND	0.16	26.84	ND	ND	ND	5.26	0.04	<0.005	ND	14.50	ND	ND	9.15	7.86	<0.1	ND	ND	ND	14.60	18.20	6.70	ND	12.30
30112	72-431	ND	ND	ND	ND	4.28	4.00	ND	<0.02	ND	<0.01	31.72	ND	ND	ND	2.31	<0.0005	<0.005	ND	7.50	ND	ND	1.26	1.30	<0.1	0.11	ND	ND	3.35	8.20	6.75	ND	12.00

Table 5.8b Medians minor.

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
2	70	ND	ND	ND	ND	ND	8.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E+01	ND	6.5E-01	ND
3	71	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2E+02	ND	5.0E-02	ND
21	137	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39	168	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
65	226	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
67	228	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
78	305	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
80	410	2.6E-04	3.0E-05	9.0E-04	2.5E-04	2.5E-04	ND	2.9E-03	4.0E-05	4.0E-05	3.0E-02	1.2E-03	3.8E-04	6.0E-04	2.3E-03	5.0E-04	ND	3.4E-01	ND	1.2E+00
89	432	ND	ND	ND	ND	ND	2.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E+01	ND	2.2E-01	ND
101	643	2.0E-05	7.0E-05	8.0E-04	1.8E-04	3.2E-03	ND	1.4E-01	4.0E-05	2.1E-04	1.6E-01	1.2E-03	5.0E-04	4.5E-05	5.1E-04	5.0E-04	ND	2.5E-03	ND	6.4E-03
106	3669	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
111	951	2.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	5.0E-01	4.0E-05	4.0E-05	1.4E-04	1.3E-01	6.0E-04	3.8E-04	5.0E-05	5.0E-06	5.0E-04	2.4E+02	8.1E-03	5.0E-01	4.3E-03
132	1074	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6E+02	ND	ND	ND
134	1079	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0E+01	ND	ND	ND
136	1084	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0E+01	ND	7.0E-02	ND
138	1087	ND	ND	ND	ND	ND	2.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E+01	ND	1.4E-01	ND
141	1092	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4E+02	ND	4.9E-01	ND
142	1095	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4E+01	ND	8.5E-02	ND
146	1111	ND	ND	ND	ND	ND	1.0E-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0E+01	ND	1.4E-01	ND
156	1138	ND	ND	ND	ND	ND	2.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4E+02	ND	5.1E+00	ND
204	1354	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.5E+01	ND	2.2E-01	ND
206	1384	ND	ND	ND	ND	ND	4.7E-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7E+01	ND	7.0E-02	ND
208	1446	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4E+01	ND	2.0E-02	ND
210	1471	ND	ND	ND	ND	ND	1.0E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.0E+01	ND	4.0E-02	ND
211	1474	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.6E+01	ND	1.7E-02	ND
215	1501	ND	ND	ND	ND	ND	3.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.7E+01	ND	5.3E-01	ND
221	1520	2.0E-05	5.0E-06	1.0E-04	1.8E-04	6.0E-04	ND	1.4E-04	4.0E-05	1.3E-04	3.4E-02	4.0E-04	5.0E-04	3.9E-04	1.1E-04	5.0E-04	ND	2.4E-02	ND	4.7E-02
230	1535	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0E+01	ND	1.7E-01	ND
234	1561	2.0E-05	5.0E-06	1.0E-04	2.5E-04	1.1E-03	ND	1.3E-04	4.0E-05	1.0E-05	1.2E-02	1.0E-04	3.8E-04	5.0E-05	3.0E-05	5.0E-04	ND	3.5E-02	ND	1.6E-02
242	1586	2.2E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	5.0E-05	4.0E-05	9.0E-05	2.9E-03	6.0E-04	3.8E-04	7.5E-05	1.5E-04	5.0E-04	ND	5.4E-02	ND	2.7E-01
248	1652	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.6E+02	ND	ND	ND
270	2022	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
274	2030	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2E+02	ND	ND	ND
278	2102	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
280	2109	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5E+02	ND	ND	ND
286	2118	ND	ND	1.0E-04	2.5E-04	1.2E-03	ND	ND	4.0E-05	ND	2.1E-02	2.0E-04	5.0E-04	5.0E-05	ND	ND	ND	6.5E-03	ND	ND
298	2136	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
299	10164	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
300	2138	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
305	2344	2.2E-05	5.0E-06	1.0E-04	2.5E-04	3.8E-04	ND	1.3E-04	4.0E-05	1.0E-05	7.1E-03	1.0E-04	3.8E-04	5.0E-05	6.5E-04	5.0E-04	ND	2.3E-02	ND	1.4E-02
319	2426	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E+01	ND	4.0E-02	ND
324	2442	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0E+00	ND	3.0E-02	ND
325	2557	ND	ND	ND	ND	ND	2.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2E+01	ND	1.2E-01	ND
326	2576	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9E+01	ND	5.0E-02	ND
330	2590	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.0E+01	ND	1.0E-02	ND
332	2593	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E+02	ND	1.0E-01	ND
333	2594	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.8E+01	ND	3.0E-02	ND
334	2596	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E+01	ND	8.0E-02	ND
337	2708	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
349	2822	2.0E-05	1.0E-05	6.0E-04	2.5E-04	2.5E-04	ND	1.3E-04	4.0E-05	3.5E-03	1.9E-01	3.0E-04	3.8E-04	5.0E-05	3.0E-05	5.0E-04	ND	1.3E-02	ND	1.1E-02
351	2824	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
353	2827	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
361	3004	ND	ND	ND	ND	ND	2.2E-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.6E+01	ND	2.2E-01	ND
362	3008	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.0E+01	ND	1.0E-02	ND
363	3013	ND	ND	ND	ND	ND	1.0E-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E+01	ND	1.0E-01	ND
364	3015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.3E+01	ND	ND	ND
369	3045	2.0E-05	2.0E-05	1.0E-04	2.5E-04	2.3E-03	ND	2.8E-03	4.0E-05	1.6E-04	6.2E-03	1.0E-04	5.0E-04	5.0E-04	6.4E-04	5.0E-04	ND	4.3E-02	ND	6.7E-02
384	3287	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
409	3470	ND	ND	1.0E-04	2.5E-04	2.5E-04	ND	ND	4.0E-05	ND	1.9E-02	1.0E-04	2.5E-04	5.0E-05	ND	ND	ND	5.0E-04	ND	ND
418	3566	ND	ND	1.0E-04	2.5E-04	2.5E-04	ND	ND	4.0E-05	5.0E-05	6.7E-03	4.0E-04	3.8E-04	5.0E-05	ND	ND	ND	4.0E-03	ND	ND
434	3674	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
435	3675	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
436	3676	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
439	4000	7.0E-05	5.0E-05	1.0E-04	1.0E-04	4.5E-03	ND	5.9E-03	ND	1.9E-04	3.8E-03	1.0E-04	5.0E-04	1.2E-04	6.3E-04	5.0E-04	ND	2.6E-01	ND	7.6E-01
440	4003	ND	ND	1.0E-04	2.5E-04	7.8E-04	ND	ND	4.0E-05	ND	4.5E-03	ND	2.7E-02	3.5E-04	ND	ND	ND	9.9E-02	ND	ND
442	4005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.6E+01	ND	ND	ND
444	4007	2.0E-05	ND	1.0E-04	2.5E-04	2.5E-04	ND	ND	4.0E-05	ND	1.1E-02	1.0E-04	5.0E-04	5.0E-05	ND	5.0E-04	ND	8.0E-03	ND	ND

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
640	10158	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
641	10162	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
666	3690	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
668	3702	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
672	3685	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
706	4993	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
764	1173.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
765	1174.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
766	1287.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
767	1323.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
768	279.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
769	683.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
778	64.247	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
779	64.271	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
780	64.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
783	64.393	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
786	64.551	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
787	64.552	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
788	64.559	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
789	64.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
791	64.647	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
792	64.658	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
794	64.865	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
795	64.938	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
796	64.942	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
797	64.996	ND	ND	ND	ND	ND	3.5E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7E-02
799	66.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
800	66.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
801	66.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
804	66.42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
806	66.46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
807	66.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
808	66.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
809	66.53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
810	66.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
811	66.65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
812	66.67	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
813	66.69	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
814	66.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
820	67.116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
825	67.138	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
828	67.142	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
836	67.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
839	67.165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
842	67.171	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
844	67.175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
847	67.184	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
849	67.189	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
851	67.198	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
861	67.21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E-02	ND
870	67.22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
923	67.276	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
932	67.299	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
937	67.317	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
938	67.32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
943	67.338	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
950	67.362	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
954	67.373	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
956	67.377	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
960	67.389	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
961	67.39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
962	67.392	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
966	67.402	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
972	67.421	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
991	67.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
993	67.478	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
999	67.495	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1002	67.506	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1003	67.507	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
1010	67.526	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1012	67.528	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1013	67.529	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1015	67.531	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1017	67.535	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1018	67.538	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1020	67.572	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1028	67.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1042	67.97	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1043	67.99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1046	72.1036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1047	72.112	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1048	72.1121	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1049	72.113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1050	72.1245	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1052	72.1436	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1053	72.1444	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1055	72.193	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1056	72.256	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1057	72.444	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1058	72.483	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1059	72.533	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1060	72.593	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1061	72.606	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1062	72.613	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1063	72.614	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1064	72.619	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1065	72.685	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1067	72.925	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1271	BOP110120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1272	BOP160158	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1273	BOP270076	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1274	BOP270093	ND	ND	ND	ND	ND	5.0E-04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1275	BOP270094	ND	ND	ND	ND	ND	5.0E-04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1276	BOP270108	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1277	BOP270075	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1278	BOP110057	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1279	BOP110058	ND	ND	ND	ND	ND	ND	1.0E-04	ND	5.0E-05	ND	ND	ND	ND	2.3E-04	ND	ND	ND	ND	3.3E-03
1280	BOP160113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1281	BOP160157	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1282	BOP160159	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1283	BOP160160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1284	BOP210005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1285	BOP210006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1286	BOP210007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1287	BOP800148	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1288	BOP290127	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-02	ND
1289	BOP330016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1290	BOP330017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1291	BOP160152	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1292	BOP160154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1293	BOP160155	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1294	BOP160214	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1295	BOP210154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1296	BOP160151	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1297	BOP160153	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1298	BOP290040	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1299	1	2.0E-05	5.0E-06	1.0E-04	1.8E-04	2.5E-04	ND	5.0E-05	ND	1.4E-04	1.3E-02	3.0E-04	5.0E-04	4.5E-05	5.0E-06	5.0E-04	ND	5.0E-04	ND	3.5E-04
1300	51	ND	ND	3.0E-04	8.8E-04	8.8E-04	ND	ND	4.0E-05	ND	1.3E-02	ND	7.6E-04	1.5E-04	ND	ND	ND	1.2E-02	ND	ND
1301	94	2.0E-05	5.0E-06	ND	1.0E-04	1.8E-03	ND	5.2E-03	ND	1.0E-05	ND	ND	ND	4.0E-05	5.2E-03	5.0E-04	ND	ND	ND	1.0E-02
1302	196	2.0E-05	7.5E-06	ND	1.0E-04	2.0E-04	ND	1.8E-02	ND	1.5E-04	ND	ND	ND	4.0E-05	1.2E-03	5.0E-04	ND	2.8E-03	ND	4.3E-02
1303	466	2.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	9.0E-05	4.0E-05	1.1E-04	9.0E-03	7.0E-04	3.8E-04	5.0E-05	5.0E-06	5.0E-04	ND	2.8E-03	ND	1.6E-02
1304	490	2.0E-05	1.0E-05	1.0E-04	2.5E-04	2.5E-04	ND	8.0E-05	4.0E-05	2.3E-04	3.5E-02	1.0E-04	3.8E-04	5.0E-05	1.5E-04	5.0E-04	ND	2.0E-02	ND	2.3E-03
1306	845	2.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	3.0E-05	4.0E-05	8.7E-04	2.2E-02	1.0E-04	3.8E-04	5.0E-05	5.0E-06	5.0E-04	ND	1.9E-03	ND	3.1E-03
1307	851	2.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	1.0E-05	4.0E-05	2.1E-03	2.3E-01	1.0E-04	3.8E-04	5.0E-05	5.0E-06	5.0E-04	ND	3.5E-03	ND	6.3E-02
1308	925	2.2E-05	5.0E-06	1.0E-04	1.8E-04	2.5E-04	ND	3.0E-05	4.0E-05	4.4E-04	5.7E-03	2.0E-04	5.0E-04	1.0E-04	5.0E-05	5.0E-04	ND	9.0E-03	ND	1.2E-02
1309	1018	2.0E-05	5.0E-06	1.0E-04	6.0E-04	2.5E-04	ND	9.6E-04	4.0E-05	3.9E-04	4.2E-01	1.0E-04	3.8E-04	5.0E-05	3.0E-05	5.0E-04	ND	6.0E-03	ND	1.7E-01
1310	1319	2.0E-05	5.0E-06	1.0E-04	1.8E-04	2.5E-04	ND	2.0E-05	4.0E-05	4.0E-05	2.2E-01	7.0E-04	5.0E-04	1.0E-04	5.0E-06	5.0E-04	ND	1.0E-01	ND	3.1E-03
1311	1393	2.0E-05	5.0E-06	1.0E-04	2.5E-04	5.5E-04	ND	4.3E-04	4.0E-05	9.0E-05	1.4E-02	1.2E-03	3.8E-04	2.0E-04	3.0E-04	5.0E-04	ND	1.7E-02	ND	6.8E-02

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
1312	1605	2.2E-05	5.0E-06	1.0E-04	3.3E-04	2.3E-04	ND	4.0E-05	4.0E-05	1.0E-05	4.2E-02	1.9E-03	5.0E-04	4.5E-05	6.0E-05	5.0E-04	ND	1.8E-02	ND	7.4E-03
1313	1686	ND	1.0E-05	1.0E-04	2.5E-04	4.3E-04	ND	2.3E-04	4.0E-05	3.0E-04	7.6E-03	2.0E-04	5.0E-04	5.0E-05	2.3E-03	ND	ND	4.0E-03	ND	2.8E-02
1314	1690	4.2E-05	5.0E-06	3.0E-04	2.5E-04	5.2E-04	ND	4.0E-05	4.0E-05	1.4E-04	9.4E-02	1.0E-02	2.5E-04	1.8E-03	5.0E-05	5.0E-04	ND	2.3E-02	ND	9.3E-03
1315	2076	3.5E-05	5.0E-06	1.0E-04	1.0E-04	2.5E-04	ND	1.8E-03	4.0E-05	7.4E-04	1.2E-01	9.0E-04	5.0E-04	5.5E-04	1.8E-04	5.0E-04	ND	1.0E-03	ND	1.5E-02
1316	2088	ND	ND	1.0E-04	2.5E-04	2.7E-03	ND	ND	4.0E-05	ND	2.0E-02	3.0E-04	5.0E-04	2.8E-04	ND	ND	ND	3.4E-02	ND	ND
1317	2093	2.0E-05	7.0E-05	ND	1.0E-04	2.0E-04	ND	3.8E-03	ND	3.8E-04	ND	ND	ND	4.0E-05	2.2E-03	5.0E-04	ND	1.8E-03	ND	4.1E-02
1318	2303	2.0E-05	5.0E-06	1.0E-04	2.0E-04	5.0E-04	ND	4.5E-04	ND	9.2E-04	3.5E-03	1.3E-03	5.0E-04	7.5E-05	8.0E-05	5.0E-04	ND	2.0E-03	ND	6.5E-04
1320	2330	5.0E-05	4.0E-05	1.0E-04	8.8E-04	1.1E-03	ND	1.1E-03	4.0E-05	1.2E-03	1.1E-01	9.0E-04	5.0E-04	3.2E-04	1.3E-03	5.0E-04	ND	1.0E-03	ND	7.1E-01
1321	2342	2.2E-05	5.0E-06	1.0E-04	1.8E-03	4.7E-04	ND	4.0E-05	4.0E-05	1.3E-04	4.9E-03	1.0E-04	3.8E-04	4.0E-04	1.2E-04	5.0E-04	ND	1.0E-01	ND	2.6E-02
1323	2362	2.2E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	5.0E-05	4.0E-05	9.0E-06	1.3E-02	1.0E-04	3.8E-04	4.0E-04	2.0E-05	5.0E-04	ND	2.4E-02	ND	2.4E-01
1324	2393	ND	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	2.2E-04	4.0E-05	1.0E-05	4.0E-02	7.0E-04	3.8E-04	5.0E-05	3.4E-04	ND	ND	3.4E-01	ND	1.6E-01
1325	2509	2.0E-05	5.0E-06	1.0E-04	1.0E-04	2.5E-04	ND	1.9E-04	ND	1.0E-05	2.3E-02	1.3E-03	5.0E-04	5.0E-05	1.9E-04	5.0E-04	ND	4.6E-02	ND	1.3E-01
1326	2707	2.0E-05	5.0E-06	3.0E-04	1.8E-04	5.0E-04	ND	1.8E-04	4.0E-05	1.7E-04	2.2E-02	ND	7.6E-04	4.5E-05	4.0E-05	5.0E-04	ND	6.9E-02	ND	1.1E-02
1327	2728	2.2E-05	5.0E-06	1.0E-04	2.5E-04	4.3E-04	ND	5.9E-04	4.0E-05	5.2E-03	5.3E-03	1.0E-04	3.8E-04	8.0E-05	1.0E-04	5.0E-04	ND	9.5E-03	ND	4.0E-01
1328	2829	2.2E-05	5.0E-06	1.0E-04	3.3E-04	2.5E-04	ND	1.4E-04	4.0E-05	1.1E-03	1.4E-02	1.4E-03	5.0E-04	6.0E-04	6.8E-04	5.0E-04	ND	8.1E-02	ND	1.7E-02
1329	2840	2.2E-05	5.0E-06	1.0E-04	1.8E-04	4.0E-04	ND	2.0E-04	4.0E-05	1.0E-05	1.1E-02	2.4E-03	5.0E-04	8.0E-04	3.8E-04	5.0E-04	ND	6.0E-03	ND	3.0E-01
1330	2847	2.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	1.4E-04	4.0E-05	2.5E-04	8.2E-03	1.0E-04	5.0E-04	1.5E-04	6.8E-04	5.0E-04	ND	2.1E-01	ND	9.5E-02
1331	2913	2.5E-05	5.0E-06	1.0E-04	5.7E-04	6.0E-04	ND	3.4E-03	4.0E-05	1.0E-05	6.0E-04	ND	5.0E-04	4.0E-04	8.0E-05	ND	ND	5.0E-02	ND	5.1E-02
1332	3034	2.0E-05	1.0E-05	1.0E-04	1.0E-04	1.0E-03	ND	2.1E-03	4.0E-05	3.0E-04	7.8E-03	3.0E-04	5.0E-04	2.0E-04	2.2E-04	5.0E-04	ND	1.4E-02	ND	1.2E-02
1333	3036	ND	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	1.1E-04	4.0E-05	4.8E-04	4.3E-03	5.0E-04	5.0E-04	7.5E-05	3.0E-05	ND	ND	7.5E-04	ND	9.4E-02
1334	3039	2.0E-05	5.0E-06	1.0E-04	1.8E-04	2.5E-04	ND	4.0E-05	4.0E-05	1.0E-05	5.1E-03	ND	2.5E-04	4.5E-05	2.0E-05	5.0E-04	ND	3.3E-02	ND	6.6E-03
1335	3044	4.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	2.8E-04	4.0E-05	5.3E-04	1.5E-03	2.5E-03	5.0E-04	5.0E-05	2.0E-05	5.0E-04	ND	5.0E-03	ND	1.4E-03
1336	3272	2.5E-05	ND	1.0E-04	2.5E-04	9.0E-04	ND	ND	4.0E-05	ND	5.3E-01	ND	2.5E-04	5.0E-05	ND	ND	ND	1.0E-02	ND	ND
1337	3301	2.2E-05	ND	1.0E-04	2.5E-04	3.0E-04	ND	ND	4.0E-05	ND	6.9E-03	1.5E-03	5.0E-04	5.0E-05	ND	5.0E-04	ND	5.0E-04	ND	ND
1338	4001	ND	5.0E-06	8.0E-04	2.5E-04	1.9E-02	ND	2.1E-04	4.0E-05	7.5E-04	6.7E-03	ND	1.4E-04	5.0E-05	5.0E-06	ND	ND	4.5E-03	ND	9.5E-03
1339	4002	6.0E-05	5.0E-06	5.0E-04	1.8E-04	2.5E-04	ND	2.4E-04	4.0E-05	2.4E-04	1.8E+00	3.0E-04	2.5E-04	5.0E-05	8.0E-05	5.0E-04	ND	1.0E-02	ND	4.7E-02
1340	4364	2.0E-05	ND	1.0E-04	2.5E-04	2.5E-04	ND	ND	4.0E-05	ND	1.9E-02	9.5E-04	5.0E-04	5.0E-05	ND	5.0E-04	ND	2.0E-03	ND	ND
1342	4582	ND	ND	1.0E-04	2.5E-04	2.5E-04	ND	ND	ND	ND	1.0E-04	ND	2.5E-04	5.0E-05	ND	ND	ND	5.0E-04	ND	ND
1344	S109	ND	ND	5.0E-04	1.5E-03	1.5E-03	ND	ND	ND	ND	2.5E-01	ND	1.5E-03	2.5E-04	ND	ND	ND	1.0E-01	ND	ND
1345	S108	ND	ND	1.0E-04	ND	ND	ND	ND	ND	ND	2.4E-02	2.0E-04	5.0E-04	ND	ND	ND	ND	4.1E-01	ND	ND
1346	S107	ND	ND	1.0E-04	ND	2.5E-04	ND	ND	ND	ND	1.4E-02	ND	5.0E-04	2.0E-04	ND	ND	ND	4.0E-01	ND	ND
1347	S106	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1348	S105	2.0E-05	ND	ND	1.0E-04	1.0E-04	ND	ND	ND	ND	ND	ND	ND	4.0E-05	ND	5.0E-04	ND	2.5E-04	ND	ND
1349	68	2.0E-05	5.0E-06	1.0E-04	2.5E-04	2.5E-04	ND	1.8E-04	4.0E-05	9.0E-05	6.8E-03	1.0E-04	3.8E-04	7.5E-05	4.0E-05	5.0E-04	ND	2.3E-02	ND	6.5E-02
1350	66	2.5E-05	ND	1.0E-04	3.4E-03	2.5E-04	ND	ND	4.0E-05	ND	2.1E-02	3.0E-04	3.8E-04	5.0E-05	ND	ND	ND	4.0E-02	ND	ND
1351	Braemar Springs	2.0E-05	1.0E-05	ND	1.0E-04	6.0E-04	ND	5.1E-04	ND	7.0E-05	ND	ND	ND	5.9E-04	7.2E-04	5.0E-04	ND	1.4E-01	ND	4.6E-01
1352	EBOP-noname1	ND	ND	1.0E-04	ND	ND	ND	ND	ND	ND	2.0E-02	4.0E-04	5.0E-04	ND	ND	ND	ND	5.0E-04	ND	ND
1353	EBOP-noname2	ND	ND	1.0E-04	ND	2.5E-04	ND	ND	ND	ND	2.0E-02	ND	5.0E-04	5.0E-05	ND	ND	ND	5.0E-04	ND	ND
1354	EBOP-noname3	ND	ND	1.0E-04	2.5E-04	2.5E-04	ND	ND	ND	ND	2.1E-02	ND	2.5E-04	5.0E-05	ND	ND	ND	5.0E-04	ND	ND
1355	EBOP-noname4	ND	ND	1.0E-04	2.5E-04	9.0E-04	ND	ND	4.0E-05	ND	2.2E-02	ND	2.5E-05	5.0E-05	ND	ND	ND	2.0E-02	ND	ND
1356	EBOP-noname5	ND	ND	ND	ND	ND	9.3E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.6E-02	ND
1357	EBOP-noname6	ND	ND	ND	ND	ND	1.9E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.5E-02	ND
1358	EBOP-noname7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1359	EBOP-noname8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1360	EBOP-noname9	ND	ND	ND	ND	ND	1.2E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0E-03	ND
1361	EBOP-noname10	ND	ND	ND	ND	ND	2.5E-04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.0E-03	ND
1362	EBOP-noname11	ND	ND	ND	ND	ND	6.8E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.8E-02	ND
2020	BEEK	ND	ND	ND	ND	ND	1.0E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-02	ND
2021	ALLEN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2055	OHOPEGC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2056	ETERNAL SPRINGS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2057	FERNLANDSPA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2058	PEMBERTON	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3001	Hamurana Spring @ water intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3002	Taniwha Spring @ old well	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3003	Trout Hatchery Spring @ weir	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3004	Te Waireka @ bottling plant intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3005	Barlows Spring @ water intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3006	2116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3007	1202	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3008	1561	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3009	Dr. Irvin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3010	3691	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3011	JROYAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3012	3901	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3013	10424	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3014	Spring 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3015	Utuhina Spring (main)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3016	Fairy Spring (Te Waiowhero)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
3017	Awahou Stream @ Central Rd bridge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3018	Utuhina Spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3019	Utuhina Spring #2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3020	Taniwha Spring @ water intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3021	Rainbow Spring	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3022	Hamurana Spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3023	Hamurana head spring	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3024	Hamurana Spring #3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3025	Utuhina Stream @ Lake Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3026	Ngongotaha Stream @ Ngongotaha Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3027	Waiteti Stream @ Ngongotaha Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3028	Awahou Stream @ Hamurana Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3029	Hauraki Stream @ Hamurana Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3030	Hamurana Stream @ Hamurana Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3031	Waiohewa Stream @ Te Ngae Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3032	Waingaehe Stream @ Te Ngae Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3033	Puarenga Stream @ Te Ngae Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3034	Kauaka Stream @ Waipa State Mill Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3036	Waipa Stream @ Hemo Gorge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3037	Awahou spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3038	Awahou upstream	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3039	Ngongataha stream @ Paradise springs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30001	1367-19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30002	60-12	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30003	60-124	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30004	60-167	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30005	60-316	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E-02
30006	60-345	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.0E-03
30007	60-348	ND	ND	ND	ND	ND	ND	4.7E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.4E-02
30008	60-352	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30009	60-4	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5E-02
30010	60-407	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30011	60-480	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.0E-03
30012	60-483	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4E-01
30013	61-113	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-02
30014	61-126	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30015	61-135	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.0E-01
30016	61-143	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6E-02
30017	61-208	ND	ND	ND	ND	ND	ND	1.2E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.1E-02
30018	61-221	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.5E-03
30019	61-23	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.0E-03
30020	61-245	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E-03
30021	61-258	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30022	61-280	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7E-02
30023	61-54	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30024	61-59	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E-03
30025	61-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.002	ND	ND	ND	ND	ND	ND	ND	ND	9.0E-02
30026	61-93	ND	ND	ND	ND	ND	ND	9.0E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.8E-02
30027	62-5	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.6E-02
30028	63-201	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E+00
30029	63-240	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.5E-01
30030	63-328	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4E-01
30031	63-43	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.9E-02
30032	63-57	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30033	63-65	ND	ND	ND	ND	ND	ND	4.8E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9E-02
30034	63-74	ND	ND	ND	ND	ND	ND	9.0E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.1E-02
30035	63-78	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2E-02
30036	63-8	ND	ND	ND	ND	ND	ND	6.0E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E+00
30037	64-108	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2E-02
30038	64-111	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-01
30039	64-117	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6E-02
30040	64-12	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30041	64-120	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30042	64-20	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E-03
30043	64-43	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30044	64-46	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5E-02
30045	64-50	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E-03
30046	64-511	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
30047	64-7	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.0E-03
30048	64-70	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.0E-03
30049	64-831	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30050	65-4	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.1E-02
30051	65-6	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30052	65-8	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30053	66-58	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30054	66-6	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2E-02
30055	66-92	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30056	66-93	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E-02
30057	66-96	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30058	67-11	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.9E-02
30059	67-15	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.1E-02
30060	67-38	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2E-02
30061	67-4	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6E-01
30062	67-404	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.1E-02
30063	67-435	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0E-03
30064	67-483	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.6E-02
30065	67-55	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9E-02
30066	67-573	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30067	67-83	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30068	68-301	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.2E-03
30069	68-317	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30070	68-320	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5E-02
30071	68-661	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30072	68-912	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7E-02
30073	68-964	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30074	69-163	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.4E-02
30075	69-1709	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30076	69-173	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E-01
30077	69-19	ND	ND	ND	ND	ND	ND	6.0E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-01
30078	69-248	ND	ND	ND	ND	ND	ND	5.9E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.4E-02
30079	69-295	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0E-03
30080	69-365	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7E-02
30081	69-374	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0E-03
30082	69-62	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4E-02
30083	69-81	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-02
30084	69-97	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1E-02
30085	70-21	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2E-02
30086	70-22	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.3E-02
30087	70-31	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30088	70-36	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0E-03
30089	70-44	ND	ND	ND	ND	ND	ND	2.1E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.6E-02
30090	70-47	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30091	70-50	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4E-02
30092	70-56	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0E-03
30093	70-65	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0E-03
30094	70-74	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.5E-03
30095	70-76	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30096	71-1	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-02
30097	71-26	ND	ND	ND	ND	ND	ND	1.4E-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5E-01
30098	71-3	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30099	71-4	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8E-01
30100	71-5	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0E-02
30101	72-1008	ND	ND	ND	ND	ND	ND	1.1E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0E-02
30102	72-1011	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30103	72-1069	ND	ND	ND	ND	ND	ND	3.4E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.6E-02
30104	72-1072	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.0E-03
30105	72-1081	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30106	72-1082	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005
30107	72-1087	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0E-03
30108	72-1089	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.5E-02
30109	72-1223	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.9E-02
30110	72-356	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8E-01
30111	72-392	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8E-01
30112	72-431	ND	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.005

Table 5.8c. Medians other.

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
2	70	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	71	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21	137	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39	168	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
65	226	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
67	228	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
78	305	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
80	410	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
89	432	15.84	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
101	643	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
106	3669	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
111	951	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
132	1074	71	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
134	1079	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
136	1084	33.44	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
138	1087	264	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
141	1092	104.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
142	1095	261.15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
146	1111	18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
156	1138	56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
204	1354	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
206	1384	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
208	1446	13.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
210	1471	17.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
211	1474	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
215	1501	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
221	1520	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
230	1535	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
234	1561	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
242	1586	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
248	1652	411	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
270	2022	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
274	2030	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
278	2102	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
280	2109	61	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-68.27102804	ND	ND	ND	ND
286	2118	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
298	2136	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
299	10164	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
300	2138	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
305	2344	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
319	2426	146	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
324	2442	32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
325	2557	7.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
326	2576	20.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
330	2590	33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
332	2593	56.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
333	2594	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
334	2596	3.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
337	2708	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
349	2822	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
351	2824	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
353	2827	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
361	3004	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
362	3008	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
363	3013	13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
364	3015	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
369	3045	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
384	3287	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
409	3470	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
418	3566	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
434	3674	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
435	3675	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
436	3676	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
439	4000	ND	0	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
440	4003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
442	4005	34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
444	4007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
640	10158	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
641	10162	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
666	3690	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
668	3702	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
672	3685	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
706	4993	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
764	1173.2	ND	0	ND	0	ND	ND	0	ND	ND	0	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	0.269522674	ND
765	1174.4	ND	0	ND	0	ND	ND	0	ND	ND	0	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	0	ND
766	1287.7	ND	0	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	ND	ND
767	1323.1	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	0	ND
768	279.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
769	683.4	ND	0	ND	0	ND	ND	0.001296947	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND
778	64.247	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
779	64.271	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
780	64.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
783	64.393	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
786	64.551	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
787	64.552	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
788	64.559	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
789	64.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
791	64.647	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
792	64.658	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
794	64.865	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
795	64.938	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
796	64.942	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
797	64.996	27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
799	66.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
800	66.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
801	66.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
804	66.42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
806	66.46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
807	66.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
808	66.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
809	66.53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
810	66.57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
811	66.65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
812	66.67	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
813	66.69	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
814	66.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
820	67.116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
825	67.138	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
828	67.142	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
836	67.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
839	67.165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
842	67.171	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
844	67.175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
847	67.184	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
849	67.189	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
851	67.198	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
861	67.21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
870	67.22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
923	67.276	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
932	67.299	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
937	67.317	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
938	67.32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
943	67.338	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
950	67.362	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
954	67.373	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
956	67.377	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
960	67.389	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
961	67.39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
962	67.392	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
966	67.402	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
972	67.421	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
991	67.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
993	67.478	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
999	67.495	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1002	67.506	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1003	67.507	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1010	67.526	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1012	67.528	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1013	67.529	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1015	67.531	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1017	67.535	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1018	67.538	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1020	67.572	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1028	67.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1042	67.97	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1043	67.99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1046	72.1036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1047	72.112	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1048	72.1121	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1049	72.113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1050	72.1245	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1052	72.1436	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1053	72.1444	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1055	72.193	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1056	72.256	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1057	72.444	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1058	72.483	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1059	72.533	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1060	72.593	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1061	72.606	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1062	72.613	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1063	72.614	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1064	72.619	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1065	72.685	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1067	72.925	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1271	BOP110120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1272	BOP160158	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1273	BOP270076	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1274	BOP270093	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1275	BOP270094	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1276	BOP270108	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1277	BOP270075	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1278	BOP110057	ND	-1290.55	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
1279	BOP110058	ND	9.692082467	0	0	0	0	0	0	ND	0	0	0	0	0	ND	ND	0	ND	-0.151787002	ND	ND	0
1280	BOP160113	ND	0	0	0	0	0	0	ND	ND	0	ND	0	0	0	ND	ND	0	ND	0	ND	ND	0
1281	BOP160157	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1282	BOP160159	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1283	BOP160160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1284	BOP210005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1285	BOP210006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1286	BOP210007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1287	BOP800148	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1288	BOP290127	ND	0	-33.33630952	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1289	BOP330016	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1290	BOP330017	ND	0	-1.489698507	-46.87700535	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	0	ND	0	ND	ND	0
1291	BOP160152	ND	0	ND	-2348.035714	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1292	BOP160154	ND	-456.5625	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1293	BOP160155	ND	-64.52655766	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1294	BOP160214	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1295	BOP210154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1296	BOP160151	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1297	BOP160153	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1298	BOP290040	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	ND
1299	1	ND	0	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1300	51	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1301	94	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1302	196	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	-1.764361714
1303	466	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1304	490	ND	ND	-0.529347826	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1306	845	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
1307	851	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1308	925	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1309	1018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1310	1319	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1311	1393	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1312	1605	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1313	1686	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1314	1690	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1315	2076	ND	ND	-0.080486999	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1316	2088	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1317	2093	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
1318	2303	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1320	2330	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1321	2342	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1323	2362	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1324	2393	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1325	2509	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1326	2707	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1327	2728	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1328	2829	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1329	2840	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1330	2847	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1331	2913	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1332	3034	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1333	3036	ND	ND	-99.29610656	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1334	3039	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1335	3044	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1336	3272	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1337	3301	ND	ND	0	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1338	4001	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1339	4002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1340	4364	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1342	4582	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1344	S109	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1345	S108	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1346	S107	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1347	S106	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1348	S105	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1349	68	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1350	66	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1351	Braemar Springs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1352	EBOP-noname1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1353	EBOP-noname2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1354	EBOP-noname3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1355	EBOP-noname4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1356	EBOP-noname5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1357	EBOP-noname6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1358	EBOP-noname7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1359	EBOP-noname8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1360	EBOP-noname9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1361	EBOP-noname10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1362	EBOP-noname11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2020	BEEK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2021	ALLEN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2055	OHOPEGC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2056	ETERNAL SPRINGS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2057	FERNLANDSPA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2058	PEMBERTON	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3001	Hamurana Spring @ water intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3002	Taniwha Spring @ old well	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3003	Trout Hatchery Spring @ weir	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3004	Te Waireka @ bottling plant intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3005	Barlows Spring @ water intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3006	2116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3007	1202	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3008	1561	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3009	Dr. Irvin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3010	3691	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
3011	JROYAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3012	3901	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3013	10424	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3014	Spring 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3015	Utuhina Spring (main)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3016	Fairy Spring (Te Waiowhero)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3017	Awahou Stream @ Central Rd bridge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3018	Utuhina Spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3019	Utuhina Spring #2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3020	Taniwha Spring @ water intake	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3021	Rainbow Spring	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3022	Hamurana Spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3023	Hamurana head spring	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3024	Hamurana Spring #3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3025	Utuhina Stream @ Lake Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3026	Ngongotaha Stream @ Ngongotaha Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3027	Waiteti Stream @ Ngongotaha Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3028	Awahou Stream @ Hamurana Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3029	Hauraki Stream @ Hamurana Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3030	Hamurana Stream @ Hamurana Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3031	Waiohewa Stream @ Te Ngae Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3032	Waingaehe Stream @ Te Ngae Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3033	Puarenga Stream @ Te Ngae Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3034	Kauaka Stream @ Waipa State Mill Rd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3036	Waipa Stream @ Hemo Gorge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3037	Awahou spring #1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3038	Awahou upstream	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3039	Ngongataha stream @ Paradise springs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30001	1367-19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30002	60-12	<1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	168	ND	ND	ND	ND
30003	60-124	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	337	ND	ND	ND	ND
30004	60-167	9.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	131.5	ND	ND	ND	ND
30005	60-316	31.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	257	ND	ND	ND	ND
30006	60-345	40.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	75.5	ND	ND	ND	ND
30007	60-348	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	90	ND	ND	ND	ND
30008	60-352	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	171	ND	ND	ND	ND
30009	60-4	27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	157	ND	ND	ND	ND
30010	60-407	10.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	97	ND	ND	ND	ND
30011	60-480	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	386	ND	ND	ND	ND
30012	60-483	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	153	ND	ND	ND	ND
30013	61-113	37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	84	ND	ND	ND	ND
30014	61-126	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	228	ND	ND	ND	ND
30015	61-135	8.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	119.5	ND	ND	ND	ND
30016	61-143	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	196	ND	ND	ND	ND
30017	61-208	34.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	279	ND	ND	ND	ND
30018	61-221	17.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	112	ND	ND	ND	ND
30019	61-23	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	96	ND	ND	ND	ND
30020	61-245	46.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	78	ND	ND	ND	ND
30021	61-258	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	236.45	ND	ND	ND	ND
30022	61-280	26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	134.5	ND	ND	ND	ND
30023	61-54	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	87	ND	ND	ND	ND
30024	61-59	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	82	ND	ND	ND	ND
30025	61-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	161	ND	ND	ND	ND
30026	61-93	13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	ND	ND	ND	ND
30027	62-5	27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	103	ND	ND	ND	ND
30028	63-201	28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	57	ND	ND	ND	ND
30029	63-240	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	110.5	ND	ND	ND	ND
30030	63-328	5.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	88	ND	ND	ND	ND
30031	63-43	21.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	124	ND	ND	ND	ND
30032	63-57	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	172	ND	ND	ND	ND
30033	63-65	12.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	147.5	ND	ND	ND	ND
30034	63-74	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<2	ND	213.5	ND	ND	ND	ND
30035	63-78	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	59.5	ND	ND	ND	ND
30036	63-8	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	143.5	ND	ND	ND	ND
30037	64-108	29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	155	ND	ND	ND	ND
30038	64-111	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4	ND	154	ND	ND	ND	ND
30039	64-117	18.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	257.5	ND	ND	ND	ND

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
30040	64-12	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	157	ND	ND	ND	ND
30041	64-120	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	160	ND	ND	ND	ND
30042	64-20	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	148	ND	ND	ND	ND
30043	64-43	21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	121	ND	ND	ND	ND
30044	64-46	22.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	145.5	ND	ND	ND	ND
30045	64-50	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	182	ND	ND	ND	ND
30046	64-511	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9	ND	182.5	ND	ND	ND	ND
30047	64-7	25.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	196.5	ND	ND	ND	ND
30048	64-70	34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	131	ND	ND	ND	ND
30049	64-831	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9	ND	87	ND	ND	ND	ND
30050	65-4	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	120.5	ND	ND	ND	ND
30051	65-6	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	71	ND	ND	ND	ND
30052	65-8	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	59.5	ND	ND	ND	ND
30053	66-58	16.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	37.5	ND	ND	ND	ND
30054	66-6	41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	186.5	ND	ND	ND	ND
30055	66-92	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	277	ND	ND	ND	ND
30056	66-93	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	104	ND	ND	ND	ND
30057	66-96	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	38.5	ND	ND	ND	ND
30058	67-11	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	170	ND	ND	ND	ND
30059	67-15	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	89	ND	ND	ND	ND
30060	67-38	29.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	122	ND	ND	ND	ND
30061	67-4	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	128	ND	ND	ND	ND
30062	67-404	27.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	164.5	ND	ND	ND	ND
30063	67-435	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	129	ND	ND	ND	ND
30064	67-483	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	147.5	ND	ND	ND	ND
30065	67-55	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	36	ND	ND	ND	ND
30066	67-573	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	59	ND	ND	ND	ND
30067	67-83	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	92	ND	ND	ND	ND
30068	68-301	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.65	ND	72	ND	ND	ND	ND
30069	68-317	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.95	ND	91	ND	ND	ND	ND
30070	68-320	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.95	ND	218.5	ND	ND	ND	ND
30071	68-661	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	83.5	ND	ND	ND	ND
30072	68-912	27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	129.5	ND	ND	ND	ND
30073	68-964	17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	ND	62	ND	ND	ND	ND
30074	69-163	13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	241	ND	ND	ND	ND
30075	69-1709	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30076	69-173	30.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	339	ND	ND	ND	ND
30077	69-19	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	142	ND	ND	ND	ND
30078	69-248	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	154	ND	ND	ND	ND
30079	69-295	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	199	ND	ND	ND	ND
30080	69-365	20.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	235	ND	ND	ND	ND
30081	69-374	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	266	ND	ND	ND	ND
30082	69-62	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	127	ND	ND	ND	ND
30083	69-81	48.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	127.5	ND	ND	ND	ND
30084	69-97	17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	96	ND	ND	ND	ND
30085	70-21	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	174	ND	ND	ND	ND
30086	70-22	37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	208	ND	ND	ND	ND
30087	70-31	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	175	ND	ND	ND	ND
30088	70-36	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	166.5	ND	ND	ND	ND
30089	70-44	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	218	ND	ND	ND	ND
30090	70-47	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	162	ND	ND	ND	ND
30091	70-50	19.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	210.5	ND	ND	ND	ND
30092	70-56	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	222	ND	ND	ND	ND
30093	70-65	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	115	ND	ND	ND	ND
30094	70-74	18.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	65.5	ND	ND	ND	ND
30095	70-76	22.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	82	ND	ND	ND	ND
30096	71-1	22.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	56.5	ND	ND	ND	ND
30097	71-26	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	212	ND	ND	ND	ND
30098	71-3	14.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	270.5	ND	ND	ND	ND
30099	71-4	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	255.5	ND	ND	ND	ND
30100	71-5	3.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	183.5	ND	ND	ND	ND
30101	72-1008	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.85	ND	58	ND	ND	ND	ND
30102	72-1011	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.5	ND	85	ND	ND	ND	ND
30103	72-1069	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9	ND	106.5	ND	ND	ND	ND
30104	72-1072	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.4	ND	64	ND	ND	ND	ND
30105	72-1081	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	43.5	ND	ND	ND	ND
30106	72-1082	17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.15	ND	46	ND	ND	ND	ND
30107	72-1087	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	53	ND	ND	ND	ND

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
30108	72-1089	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9	ND	161	ND	ND	ND	ND
30109	72-1223	15.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	66	ND	ND	ND	ND
30110	72-356	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	64.5	ND	ND	ND	ND
30111	72-392	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.95	ND	122	ND	ND	ND	ND
30112	72-431	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	55	ND	ND	ND	ND

Table 5.9a Historical record of sample collection and analysis at each site. The ‘From’ and ‘To’ columns show the dates of collection of the oldest and most recent sample at each site, respectively. The ‘#’ column shows the total number of samples that have been collected at each site, the ‘# CBE Calc’ column shows the number of samples collected for which the Charge Balance Error can be calculated, the ‘# CBE OK’ column shows the number of samples for which the Charge Balance Error is within acceptable limits, and the remaining columns show the number of samples from each site that have been analysed for each parameter. The parameter abbreviations are explained in Table 5.7.

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
2	70	11/82	11/82	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
3	71	07/82	07/82	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
21	137			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	168			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	226			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	228			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	305			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	410	04/94	04/04	6	5	4	0	0	0	4	1	5	5	5	0	1	5	4	1	4	1	4	0	4	1	5	2	3	5	0	6	6	3	4	5	6	0	5
89	432	10/84	10/84	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
101	643	03/91	04/04	10	4	4	0	0	0	4	3	9	7	4	3	1	10	4	4	4	4	3	0	4	4	7	2	4	5	0	8	8	2	8	10	10	2	10
106	3669			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	951	11/81	04/04	11	5	5	0	0	0	5	4	10	8	6	2	1	10	5	4	5	4	4	0	5	4	9	2	4	4	0	9	9	4	8	10	10	2	9
132	1074	12/87	12/87	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
134	1079	08/85	04/86	2	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	1	1
136	1084	09/85	09/85	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
138	1087	10/85	10/85	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
141	1092	12/85	12/85	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
142	1095	01/86	04/86	2	0	0	0	0	0	0	2	2	0	1	0	0	0	0	2	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	2	2	0	0
146	1111	02/86	02/86	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0
156	1138	04/87	04/87	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0
204	1354	03/86	03/86	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
206	1384	07/85	07/85	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
208	1446	03/90	03/90	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
210	1471	12/89	12/89	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
211	1474	01/90	01/90	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
215	1501	09/83	09/83	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0
221	1520	04/91	04/04	9	4	4	0	0	0	4	4	9	6	4	3	1	9	4	4	4	4	2	0	4	4	7	2	5	6	0	8	7	3	8	9	9	2	9
230	1535	10/85	10/85	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
234	1561	04/91	04/04	10	5	5	0	0	0	5	4	10	6	5	3	1	10	5	3	4	4	4	0	5	4	9	3	6	4	0	7	8	4	8	9	9	3	10
242	1586	03/91	03/04	10	5	4	0	0	0	4	3	9	7	5	3	1	10	4	4	4	3	4	0	4	4	8	3	7	5	0	9	9	3	9	9	9	2	10
248	1652	12/86	12/86	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
270	2022			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	2030	03/85	03/85	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
278	2102			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	2109	06/87	09/87	2	0	0	0	0	0	0	1	2	0	2	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
286	2118	01/97	04/04	4	4	4	0	0	0	4	0	4	4	4	0	0	4	4	0	4	0	3	0	4	0	4	2	3	4	0	4	3	3	4	4	3	0	3
298	2136			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	10164			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	2138			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	2344	03/91	03/04	10	5	5	0	0	0	5	3	9	6	4	2	1	10	4	4	5	4	2	0	5	4	8	3	6	6	0	8	8	4	8	9	9	2	9
319	2426	02/86	02/86	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
324	2442	01/90	01/90	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
325	2557	12/90	12/90	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
326	2576	05/91	05/91	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
330	2590	01/92	01/92	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1
332	2593	02/92	02/92	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
333	2594	03/92	03/92	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
334	2596	04/92	04/92	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
337	2708	03/91	03/91	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1
349	2822	03/91	04/04	10	5	4	0	0	0	5	4	10	8	5	2	1	10	5	4	5	4	4	0	5	4	9	2	3	7	0	9	8	3	8	8	10	2	6
351	2824			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	2827			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	3004	03/87	03/87	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0
362	3008	04/86	04/86	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
363	3013	02/87	02/87	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1
364	3015	11/74	12/76	2	1	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
369	3045	04/91	04/04	33	6	5	0	0	0	6	18	24	11	6	15	1	23	5	15	4	16	5	12	6	16	14	3	16	7	0	14	7	4	21	31	25	21	27
384	3287			2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	3470	01/97	04/04	5	5	3	0	0	0	5	0	5	4	5	0	0	4	4	0	5	0	4	0	4	0	4	3	3	4	0	5	5	3	4	4	4	0	3
418	3566	02/97	04/04	4	4	3	0	0	0	4	0	4	4	4	0	0	4	3	0	4	0	3	0	4	0	4	3	3	3	0	4	3	3	4	4	4	0	3
434	3674			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	3675			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	3676			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	4000	04/91	02/98	8	3	2	0	0	0	3	4	8	5	2	3	1	8	2	4	3	3	2	0	3	4	7	2	6	4	0	5	6	2	6	7	8	2	8
440	4003	06/03	04/04	2	2	1	0	0	0	2	0	2	2	2	0	0	2	2	0	2	0	1	0	2	0	2	1	1	2	0	2	2	2	2	2	1	0	2
442	4005	08/85	08/85	1	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
444	4007	04/96	04/04	28	6	5	0	0	0	6	15	21	7	6	7	0	20	6	13	6	8	3	13	6	13	14	2	15	6	0	5	4	4	17	22	20	18	21
640	10158			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
641	10162			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
666	3690			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
668	3702			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
672	3685			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
706	4993			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
764	1173.2	02/96	05/04	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	0	0	100	96	98	97	0	0	99	98	98	100
765	1174.4	04/96	05/04	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	0	0	98	95	98	96	0	0	97	97	98	100
766	1287.7	02/96	05/04	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	0	0	0	94	0	0	0
767	1323.1	08/96	05/04	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0	93	91	90	86	0	0	91	94	93	94
768	279.1	06/76	01/01	43	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	1	1	1	1	0	0	1	1	0	27
769	683.4	12/98	05/04	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	0	0	66	64	62	61	0	0	65	65	66	95
778	64.247	01/95	01/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
779	64.271	12/93	12/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
780	64.29	06/95	06/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
783	64.393	02/93	02/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
786	64.551	05/95	05/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
787	64.552	03/94	03/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
788	64.559	03/93	03/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
789	64.57	02/95	02/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
791	64.647	03/94	03/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
792	64.658	03/95	03/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
794	64.865	07/96	07/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
795	64.938	08/98	08/98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
796	64.942	08/98	08/98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
797	64.996	06/00	09/02	3	0	0	0	0	0	0	2	2	0	0	2	0	2	0	2	0	2	0	0	0	2	1	0	2	0	0	0	0	0	2	2	2	0	1
799	66.24	08/92	08/92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
800	66.28	10/95	10/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
801	66.29	03/93	03/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
804	66.42	05/92	05/92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
806	66.46	01/94	01/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
807	66.47	03/93	03/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
808	66.5	04/94	04/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
809	66.53	01/94	01/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
810	66.57	08/92	08/92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
811	66.65	08/94	08/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
812	66.67	07/96	07/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
813	66.69	05/94	05/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
814	66.7	02/93	02/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
820	67.116	10/96	10/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
825	67.138	09/93	09/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
828	67.142	01/93	01/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
836	67.16	01/88	01/88	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1
839	67.165	05/92	05/92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
842	67.171	01/95	01/95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
844	67.175	11/92	11/92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
847	67.184	07/94	07/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
849	67.189	03/94	03/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
851	67.198	12/91	12/91	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
861	67.21	05/95	10/97	6	0	0	0	0	0	0	1	3	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	0	4	0	1	1	1	0	6	6	0	6
870	67.22	01/88	01/88	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1
923	67.276	01/70	01/70	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
932	67.299	02/96	02/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
937	67.317	03/93	03/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
938	67.32	12/91	12/91	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
943	67.338	01/94	01/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
950	67.362	01/93	01/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
954	67.373	05/93	05/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
956	67.377	03/91	03/91	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
960	67.389	03/94	03/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
961	67.39	04/92	04/92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
962	67.392	07/96	07/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
966	67.402	01/96	01/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
972	67.421	05/93	05/93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
991	67.47	04/94	04/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	67.478	02/94	02/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
999	67.495	01/96	01/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1002	67.506	09/96	09/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1003	67.507	11/96	11/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1010	67.526	04/96	04/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1012	67.528	04/96	04/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1013	67.529	05/96	05/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1015	67.531	02/85	02/85	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1017	67.535	08/97	08/97	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1018	67.538	07/97	07/97	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1020	67.572	08/98	08/98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1028	67.6	01/88	01/88	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1
1042	67.97	02/94	02/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1043	67.99	01/94	01/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1046	72.1036	03/02	03/02	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1047	72.112	03/02	03/02	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1048	72.1121	10/01	10/01	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1049	72.113	11/01	11/01	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1050	72.1245	05/02	05/02	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1052	72.1436	05/03	05/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1053	72.1444	05/03	05/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1055	72.193	06/00	06/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1056	72.256			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1057	72.444	11/00	11/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1058	72.483	01/01	01/01	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1059	72.533	02/01	02/01	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1060	72.593	10/00	10/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1061	72.606	11/00	11/00	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1062	72.613	12/00	12/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1063	72.614	12/00	12/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1064	72.619	11/00	11/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1065	72.685	02/98	02/98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1067	72.925	11/96	11/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1271	BOP110120	04/00	04/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
1272	BOP160158	08/84	11/00	17	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	4	2	10	10	9	0	0	0	0	7	7
1273	BOP270076	12/94	12/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0
1274	BOP270093	11/96	11/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0
1275	BOP270094	11/96	11/96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0
1276	BOP270108	08/97	03/99	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	1	2	0	0	0	1	0	0
1277	BOP270075	12/94	12/94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0
1278	BOP110057	08/84	11/00	42	4	4	0	0	4	4	0	11	3	3	0	0	4	4	0	4	0	3	0	4	0	13	0	5	2	10	12	7	4	4	3	5	10	36
1279	BOP110058	08/96	06/04	100	1	1	0	0	0	1	0	2	0	0	0	1	1	1	0	1	0	0	0	1	0	94	1	1	90	78	95	87	1	2	94	94	95	100
1280	BOP160113	10/86	03/04	67	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	2	4	3	8	2	0	0	4	6	21	43
1281	BOP160157	08/84	08/88	9	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	4	3	4	0	0	0	0	5	6
1282	BOP160159	09/86	03/99	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	4	0	5	5	4	0	0	0	0	2	2
1283	BOP160160	10/86	12/93	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	3	3	3	0	0	1	1	2	2
1284	BOP210005	07/90	03/99	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	2	2	2	0	0	0	1	1	1
1285	BOP210006	07/90	07/90	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0
1286	BOP210007	07/90	07/90	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	0	0
1287	BOP800148	01/90	01/90	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	1	0	1	1	0	1	0	0	0	0
1288	BOP290127	10/98	11/00	6	0	0	0	0	0	0	1	2	1	0	0	1	1	0	1	0	1	0	0	0	1	3	1	3	1	2	4	3	0	1	1	2	1	1
1289	BOP330016	11/91	08/97	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1	0	0	1	1	1	1
1290	BOP330017	08/84	03/99	17	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	6	3	12	11	10	0	0	2	2	9	9
1291	BOP160152	10/00	11/00	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	2	2	0	0	0	1	0	0
1292	BOP160154	09/86	08/88	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1293	BOP160155	09/86	11/00	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	7	2	6	7	6	0	0	0	1	2	2
1294	BOP160214	10/00	11/00	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1295	BOP210154	01/98	01/98	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
1296	BOP160151	08/88	08/88	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1297	BOP160153	11/93	12/93	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1298	BOP290040	08/88	03/99	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	1	2	4	2	0	0	0	0	2	2
1299	1	04/91	04/04	33	3	3	0	0	0	4	17	21	12	3	14	1	19	3	14	4	16	4	12	3	14	22	2	18	6	1	15	8	3	14	23	26	20	23
1300	51	04/91	04/96	6	2	2	0	0	0	2	2	4	2	2	2	0	4	2	2	2	2	1	1	2	2	2	0	2	1	0	3	2	1	4	6	4	2	6
1301	94	03/91	03/95	6	1	1	0	0	0	1	4	5	3	1	3	1	4	1	3	1	4	1	0	1	4	5	0	4	2	0	3	4	1	5	6	6	2	6
1302	196	04/91	04/04	10	1	1	0	0	0	1	6	6	7	1	4	2	6	1	6	1	6	1	0	1	5	8	0	3	3	0	9	9	1	6	6	8	3	6
1303	466	03/91	04/04	10	5	5	0	0	0	4	4	10	7	3	3	1	6	5	4	5	4	2	0	4	4	9	3	6	6	0	9	9	4	9	10	10	2	8
1304	490	03/91	04/04	11	4	3	0	0	0	4	3	9	6	5	3	1	6	4	3	4	4	3	0	4	4	5	3	6	6	0	8	7	3	9	6	10	3	11
1306	845	03/91	04/04	11	4	3	0	0	0	4	4	10	8	5	3	1	6	4	4	4	4	4	0	4	4	5	3	6	4	0	9	9	4	8	6	10	2	7
1307	851	03/91	03/04	10	5	3	0	0	0	4	4	10	7	4	3	1	6	4	4	4	4	4	0	4	4	5	3	3	6	0	9	5	4	9	6	10	2	6
1308	925	03/91	04/04	10	4	3	0	0	0	3	4	8	6	3	2	1	10	4	3	3	4	2	0	3	4	8	2	4	6	0	8	7	3	8	10	9	2	10
1309	1018	04/91	04/04	10	5	3	0	0	0	4	4	10	7	5	2	1	9	4	4	4	4	3	0	5	4	6	3	5	7	0	9	8	3	8	9	10	2	10
1310	1319	04/91	04/04	10	4	3	0	0	0	4	4	6	7	4	3	1	6	3	4	3	3	2	0	3	4	8	2	4	4	0	8	5	2	8	6	10	2	6
1311	1393	03/91	03/04	10	5	5	0	0	0	4	3	9	8	5	2	1	6	5	3	4	3	2	0	4	4	8	2	7	7	0	8	8	3	9	10	10	2	6
1312	1605	03/91	04/04	10	3	3	0	0	0	3	4	9	7	3	2	1	5	4	4	3	4	2	0	3	4	7	2	6	3	0	6	6	3	8	9	6	2	6
1313	1686	03/91	03/04	9	3	3	0	0	0	2	3	8	6	2	2	1	8	3	4	3	4	2	0	3	3	8	2	2	6	0	8	8	2	6	9	9	2	9
1314	1690	03/91	04/04	9	4	4	0	0	0	4	4	9	7	4	3	1	5	4	4	3	4	2	0	4	4	8	2	3	5	0	7	8	2	8	8	8	1	8
1315	2076	03/91	04/04	10	4	3	0	0	0	4	4	7	8	4	2	1	9	3	3	4	4	3	0	4	4	8	2	6	4	0	6	6	4	9	9	8	3	10
1316	2088	03/91	04/96	7	3	3	0	0	0	3	2	6	3	2	3	0	4	3	3	3	3	2	0	2	2	4	2	4	5	0	4	4	2	6	4	6	2	7
1317	2093	04/91	05/02	7	0	0	0	0	0	1	3	6	3	1	2	1	6	1	2	1	3	1	0	1	3	5	0	3	3	0	4	5	1	4	6	6	1	4
1318	2303	03/91	03/04	10	4	3	0	0	0	4	3	5	6	4	2	1	10	4	4	4	4	4	0	4	3	5	2	4	5	0	9	9	2	5	7	10	2	9
1320	2330	03/91	03/04	10	4	2	0	0	0	4	4	9	4	4	2	1	7	4	3	4	4	2	0	4	4	6	2	3	6	0	5	5	3	8	7	10	2	6
1321	2342	04/91	03/04	10	5	5	0	0	0	3	4	10	7	4	2	1	6	3	3	3	3	2	0	5	4	9	3	5	6	0	9	7	4	8	10	9	2	10
1323	2362	04/91	06/04	10	5	4	0	0	0	4	3	9	8	4	3	1	10	5	4	4	3	2	0	4	4	9	3	5	7	0	9	9	4	9	10	9	2	10
1324	2393	03/91	02/98	8	4	3	0	0	0	4	4	8	6	4	2	1	8	4	4	4	4	3	0	4	4	7	3	4	3	0	7	7	3	8	8	8	2	7
1325	2509	03/91	04/04	34	6	6	0	0	0	4	17	23	17	4	10	1	23	4	16	4	16	7	12	4	16	15	5	18	8	0	14	11	5	20	27	28	20	27
1326	2707	04/92	03/04	9	3	2	0	0	0	2	3	7	6	2	3	1	7	2	4	2	4	2	1	2	4	7	0	4	3	0	7	4	2	6	9	7	2	8
1327	2728	03/91	03/04	10	5	5	0	0	0	5	4	8	6	4	3	1	10	5	3	5	4	3	0	5	4	5	3	5	6	0	9	9	3	9	9	9	2	10
1328	2829	03/91	03/04	10	4	3	0	0	0	3	3	6	7	4	2	1	7	3	3	4	4	2	0	3	4	5	2	5	6	0	7	7	3	6	6	9	2	6
1329	2840	03/91	05/04	10	4	4	0	0	0	3	4	5	5	4	2	1	6	4	3	3	3	2	0	3	3	7	2	6	5	0	6	4	3	8	6	7	2	6
1330	2847	04/91	03/04	11	6	6	0	0	0	4	3	11	8	4	3	1	11	4	4	4	4	3	0	4	4	10	4	7	7	0	10	9	3	10	6	11	2	11
1331	2913	04/91	04/04	9	3	2	0	0	0	3	4	7	6	3	3	1	7	2	4	2	4	1	0	3	4	5	1	4	6	0	8	7	2	6	7	6	2	9
1332	3034	04/91	04/04	10	5	4	0	0	0	4	3	10	7	5	3	1	10	4	4	4	4	2	0	4	4	9	2	6	4	0	9	9	4	9	10	10	2	10
1333	3036	04/91	04/04	9	3	3	0	0	0	3	3	8	5	2	3	1	9	3	3	3	4	2	0	3	4	7	2	4	5	0	7	7	2	4	9	9	3	9
1334	3039	04/91	06/04	10	5	3	0	0	0	5	4	10	7	5	2	1	7	5	3	5	4	4	0	5	3	5	2	4	4	0	8	5	4	9	10	9	2	10
1335	3044	03/91	03/04	13	7	5	0	0	0	7	5	13	10	7	4	1	13	4	5	5	3	3	1	4	5	12	5	8	5	0	11	11	3	7	13	11	2	8
1336	3272	03/97	06/04	3	1	1	0	0	0	1	0	1	1	1	0	0	2	1	0	1	0	0	0	1	0	2	0	0	2	0	2	2	1	1	3	1	0	3
1337	3301	05/96	04/04	28	8	7	0	0	0	6	15	19	12	5	12	0	18	5	11	6	12	4	12	6	12	20	5	17	9	0	8	6	5	16	22	22	17	20
1338	4001	04/91	06/04	9	2	2	0	0	0	2	5	7	5	2	4	1	7	2	5	2	5	1	1	2	5	4	1	3	2	0	5	4	2	6	9	5	3	9
1339	4002	04/91	04/04	10	5	4	0	0	0	4	3	10	8	4	2	1	10	4	3	3	3	3	0	4	4	9	2	5	5	0	9	9	3	9	10	10	3	6
1340	4364	05/96	06/03	25	7	4	0	0	0	7	14	18	10	6	11	0	19	7	10	5	11	5	11	7	11	21	5	15	5	0	8	8	5	14	20	22	15	15
1342	4582	02/97	06/02	3	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	1	0	1	0	1	0	1	1	1	1	0	1	0	1	1	3	0	3	3
1344	S109	05/96	05/96	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	1	1	1	0	1
1345	S108	01/97	01/97	1	1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	0	1	1	0	1	1	1	0	1
1346	S107	02/98	02/98	1	1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	0	0	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1
1347	S106	06/03	06/03	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
1348	S105	04/04	04/04	1	1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1
1349	68	03/91	03/04	10	5	2	0	0	0	4	4	9	6	5	2	1	6	5	4	3	3	4	0	5	4	8	3	6	5	0	6	7	4	7	9	9	2	10
1350	66	03/91	05/96	6	4	4	0	0	0	4	2	6	4	4	2	0	6	4	2	4	2	2	0	4	2	5	3	4	4	0	3	4	3	5	5	6	1	6
1351	Braemar Springs	03/97	04/04	4	1	1	0	0	0	1	2	2	3	1	1	1	4	1	2	1	2	1	0	1	2	2	0	2	2	0	4	3	1	3	4	4	1	4
1352	EBOP-noname1	08/00	08/00	1	1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	0	1	1	0	1	1	1	0	1
1353	EBOP-noname2	08/00	08/00	1	1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1
1354	EBOP-noname3	09/00	09/00	1	1	0	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	0	1	0	1	1	1	1	0	1
1355	EBOP-noname4	11/00	11/00	1	1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	1	0	0	0	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1
1356	EBOP-noname5	08/00	08/00	1	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1
1357	EBOP-noname6	08/00	08/00	1	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1
1358	EBOP-noname7	08/00	08/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1359	EBOP-noname8	08/00	08/00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1360	EBOP-noname9	08/00	08/00	1	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1
1361	EBOP-noname10	08/00	08/00	1	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1
1362	EBOP-noname11	04/03	04/03	2	0	0	0	0	0	2	0	2	0	0	0	0	2	2	0	2	0	0	0	0	2	2	0	0	2	0	2	0	0	2	2	2	0	2
2020	BEEK	04/91	06/03	45	40	40	0	0	18	38	0	37	14	40	0	0	37	37	0	40	0	31	0	33	2	22	9	33	2	0	15	0	38	43	39	40	0	4
2021	ALLEN	04/91	06/03	46	45	45	0	0	23	41	0	46	19	41	0	0	42	42	0	41	0	33	0	44	0	15	12	44	0	0	9	0	45	42	42	43	0	0
2055	OHOPEGC	06/96	06/03	27	25	25	0	0	23	25	0	26	21	26	0	0	23	23	0	26	0	25	0	27	0	17	2	27	0	0	19	0	23	27	27	27	0	0
2056	ETERNAL SPRINGS	06/96	06/03	28	26	26	0	0	21	22	0	24	23	22	0	0	24	24	0	23	0	24	0	24	0	22	2	23	0	0	19	0	23	23	18	23	0	0
2057	FERNLANDSPA	06/96	06/03	28	19	19	0	0	21	23	0	24	12	22	0	0	24	23	0	23	0	23	0	23	0	28	2	24	0	0	19	0	27	24	24	28	0	0

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
2058	PEMBERTON	06/96	06/03	27	24	23	0	0	18	22	0	22	14	21	0	0	21	22	0	22	0	20	0	21	0	18	2	23	0	0	17	0	26	23	21	24	0	0
3001	Hamurana Spring @ water intake	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	0
3002	Taniwha Spring @ old well	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	0
3003	Trout Hatchery Spring @ weir	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	0
3004	Te Waireka @ bottling plant intake	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	0
3005	Barlows Spring @ water intake	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1
3006	2116	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1
3007	1202	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1
3008	1561	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3009	Dr. Irvin	07/03	07/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3010	3691	07/03	07/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3011	JROYAL	08/03	08/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3012	3901	08/03	08/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3013	10424	08/03	08/03	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3014	Spring 2	08/03	08/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1
3015	Utuhina Spring (main)	08/03	08/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3016	Fairy Spring (Te Waiowhero)	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3017	Awahou Stream @ Central Rd bridge	08/03	08/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3018	Utuhina Spring #1	11/03	11/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3019	Utuhina Spring #2	11/03	11/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3020	Taniwha Spring @ water intake	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3021	Rainbow Spring	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3022	Hamurana Spring #1	11/03	11/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3023	Hamurana head spring	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3024	Hamurana Spring #3	11/03	11/03	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3025	Utuhina Stream @ Lake Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3026	Ngongotaha Stream @ Ngongotaha Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3027	Waiteti Stream @ Ngongotaha Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3028	Awahou Stream @ Hamurana Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3029	Hauraki Stream @ Hamurana Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3030	Hamurana Stream @ Hamurana Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3031	Waiohewa Stream @ Te Ngae Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3032	Waingaehe Stream @ Te Ngae Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3033	Puarenga Stream @ Te Ngae Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3034	Kauaka Stream @ Waipa State Mill Rd	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3036	Waipa Stream @ Hemo Gorge	11/03	11/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3037	Awahou spring #1	12/03	12/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3038	Awahou upstream	12/03	12/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
3039	Ngongataha stream @ Paradise springs	07/03	07/03	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
30001	1367-19	09/97	06/04	27	0	0	0	0	23	26	0	0	11	21	0	0	27	26	0	26	0	18	0	26	0	22	0	0	26	0	0	0	25	25	26	27	0	26
30002	60-12	03/93	06/04	43	0	0	0	0	27	39	2	2	25	32	0	2	42	37	0	38	2	27	2	38	2	20	9	6	35	0	0	0	37	34	41	40	0	33
30003	60-124	12/96	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30004	60-167	11/91	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30005	60-316	05/93	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30006	60-345	09/93	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30007	60-348	03/95	12/03	5	0	0	0	0	0	0	2	2	0	0	0	2	3	0	0	0	2	0	3	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30008	60-352	07/97	03/03	2	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0
30009	60-4	02/92	12/03	17	0	0	0	0	0	0	12	15	0	4	0	2	12	0	0	0	10	0	2	0	12	0	1	3	15	0	2	0	0	2	17	16	0	15
30010	60-407	01/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30011	60-480	01/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30012	60-483	03/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30013	61-113	12/95	06/04	46	0	0	0	0	0	0	17	30	0	1	0	17	17	6	0	0	17	0	16	0	17	0	0	17	17	0	0	0	0	17	33	33	0	31
30014	61-126	04/95	06/04	32	0	0	0	0	0	0	16	30	0	0	0	15	17	0	0	0	16	0	15	0	16	0	0	16	16	0	1	0	0	16	31	31	0	29
30015	61-135	12/95	12/03	4	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	2	0	0	0	0	2	3	2	0	1
30016	61-143	12/95	12/03	15	0	0	0	0	0	0	3	9	0	0	0	2	3	0	0	0	2	0	2	0	2	0	0	2	11	0	0	0	0	3	15	12	0	7
30017	61-208	04/95	06/04	32	0	0	0	0	0	0	17	30	0	0	0	16	16	0	0	0	17	0	16	0	17	0	0	16	16	0	1	0	0	15	31	32	0	30
30018	61-221	11/81	06/04	35	0	0	0	0	0	0	16	28	0	0	0	16	9	0	0	0	16	0	16	0	15	0	0	16	18	0	0	0	0	16	34	30	0	26
30019	61-23	03/82	12/03	4	0	0	0	0	0	0	2	2	0	0	0	3	3	0	0	0	2	0	3	0	2	0	0	2	0	0	0	0	0	2	2	2	0	2
30020	61-245	12/95	12/03	4	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	2	0	0	0	0	2	4	2	0	1
30021	61-258	12/83	06/04	46	0	0	0	0	28	42	0	0	26	36	0	0	42	39	0	41	0	33	0	43	0	22	0	0	37	0	0	0	43	38	42	45	0	27
30022	61-280	04/95	03/04	27	0	0	0	0	0	0	11	24	0	0	0	10	7	0	0	0	11	0	11	0	10	0	0	11	16	0	1	0	0	11	27	26	0	24
30023	61-54	04/95	12/03	18	0	0	0	0	0	0	3	10	0	0	0	2	4	0	0	0	3	0	3	0	4	0	0	2	14	0	1	0	0	2	18	15	0	11
30024	61-59	03/96	06/04	30	0	0	0	0	0	0	14	29	0	0	0	15	11	0	0	0	16	0	12	0	16	0	0	14	13	0	0	0	0	16	29	30	0	23
30025	61-85	07/87	06/04	29	0	0	0	0	23	26	1	1	11	18	0	1	27	26	0	26	1	18	1	26	1	20	1	1	26	0	1	0	26	26	18	27	0	25
30026	61-93	07/94	06/04	41	0	0	0	0	19	26	1	6	17	21	0	1	26	26	0	26	1	16	1	26	1	21	0	1	35	0	0	0	25	16	38	35	0	35
30027	62-5	12/95	12/03	14	0	0	0	0	0	0	2	8	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	12	0	0	0	0	2	14	11	0	11

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
30028	63-201	01/82	12/03	4	0	0	0	0	0	0	3	2	0	0	0	3	3	0	0	0	3	0	3	0	3	0	0	3	0	0	0	0	0	2	2	3	0	1
30029	63-240	03/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30030	63-328	05/91	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30031	63-43	03/94	12/03	8	0	0	0	0	0	0	2	4	0	1	0	2	2	0	0	0	2	0	2	0	2	0	0	2	4	0	0	0	0	2	6	5	0	5
30032	63-57	01/94	06/04	34	0	0	0	0	0	0	17	30	0	2	0	16	17	0	0	0	17	0	17	0	17	0	0	17	14	0	0	0	0	17	32	32	0	30
30033	63-65	02/91	12/03	13	0	0	0	0	0	0	12	12	0	3	0	2	11	0	0	0	12	0	2	0	12	0	1	3	10	0	2	0	0	2	11	12	0	10
30034	63-74	01/92	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30035	63-78	09/92	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30036	63-8	01/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	0
30037	64-108	01/94	06/04	33	0	0	0	0	0	0	15	29	0	2	0	16	10	0	0	0	15	0	16	0	15	0	0	15	15	0	1	0	0	15	29	32	0	29
30038	64-111	06/02	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30039	64-117	05/93	06/04	33	0	0	0	0	0	0	17	29	0	2	0	14	17	0	0	0	17	0	10	0	16	0	0	16	16	0	1	0	0	16	31	31	0	24
30040	64-12	02/91	06/04	35	0	0	0	0	0	0	18	31	0	2	0	17	18	0	0	0	18	0	17	0	17	0	0	17	16	0	1	0	0	17	32	32	0	32
30041	64-120	12/95	06/04	73	0	0	0	0	22	26	16	29	17	19	0	13	42	32	0	26	15	19	14	26	16	21	0	16	45	0	0	0	26	39	60	57	0	60
30042	64-20	03/92	06/04	35	0	0	0	0	0	0	18	30	0	2	0	11	18	0	0	0	16	0	17	0	18	0	0	15	16	0	1	0	0	17	32	33	0	28
30043	64-43	11/92	06/04	33	0	0	0	0	0	0	17	29	0	2	0	13	10	0	0	0	17	0	16	0	17	0	0	16	16	0	1	0	0	16	31	32	0	32
30044	64-46	03/95	06/04	32	0	0	0	0	0	0	17	29	0	2	0	13	17	0	0	0	17	0	16	0	17	0	0	16	16	0	1	0	0	16	31	32	0	30
30045	64-50	12/91	06/04	35	0	0	0	0	0	0	19	31	0	2	0	16	19	0	0	0	17	0	17	0	17	0	0	18	16	0	1	0	0	18	33	34	0	31
30046	64-511	06/92	06/04	46	0	0	0	0	26	44	1	1	22	35	0	1	38	40	0	41	1	35	1	42	1	21	7	3	44	0	0	0	39	37	45	45	0	32
30047	64-7	12/95	05/04	15	0	0	0	0	0	0	2	8	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	12	0	0	0	0	2	14	11	0	10
30048	64-70	03/95	06/04	30	0	0	0	0	0	0	14	29	0	2	0	11	15	0	0	0	14	0	12	0	16	0	0	14	15	0	1	0	0	15	29	30	0	28
30049	64-831	06/02	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30050	65-4	04/95	12/03	8	0	0	0	0	0	0	2	6	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	6	0	1	0	0	2	7	7	0	7
30051	65-6	12/92	12/03	8	0	0	0	0	0	0	2	3	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	5	0	0	0	0	2	7	7	0	7
30052	65-8	04/95	01/04	9	0	0	0	0	0	0	3	5	0	0	0	2	3	0	0	0	3	0	2	0	3	0	0	2	6	0	1	0	0	2	8	8	0	9
30053	66-58	03/94	12/03	8	0	0	0	0	0	0	2	4	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	5	0	0	0	0	2	7	7	0	6
30054	66-6	01/94	06/04	33	0	0	0	0	0	0	13	29	0	0	0	16	16	0	0	0	16	0	16	0	16	0	0	16	14	0	0	0	0	16	29	31	0	29
30055	66-92	10/99	12/03	3	0	0	0	0	0	1	2	2	0	0	0	3	3	1	0	1	2	0	3	1	2	0	0	2	1	0	1	0	0	2	2	3	0	2
30056	66-93	10/99	12/03	4	0	0	0	0	0	1	2	4	0	0	0	3	4	1	0	1	2	0	4	1	2	0	0	2	1	0	1	0	0	2	3	4	0	3
30057	66-96	10/02	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	2
30058	67-11	03/95	06/04	31	0	0	0	0	0	0	16	29	0	2	0	13	16	0	0	0	14	0	14	0	16	0	0	13	14	0	0	0	0	16	30	30	0	30
30059	67-15	09/95	06/04	32	0	0	0	0	0	0	17	30	0	2	0	16	17	0	0	0	17	0	16	0	17	0	0	17	15	0	0	0	0	16	32	30	0	30
30060	67-38	01/88	12/03	4	0	0	0	0	0	0	2	3	0	0	0	2	2	0	0	0	2	0	2	0	4	0	0	2	0	0	0	0	0	2	4	4	0	3
30061	67-4	01/88	12/03	7	0	0	0	0	0	0	2	7	0	0	0	2	2	0	0	0	2	0	3	0	3	0	0	2	2	0	0	0	0	2	7	7	0	6
30062	67-404	02/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30063	67-435	12/03	12/03	1	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1
30064	67-483	02/03	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30065	67-55	05/96	12/03	2	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1
30066	67-573	11/97	12/03	2	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1
30067	67-83	12/03	12/03	1	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1
30068	68-301	07/91	06/04	15	0	0	0	0	0	0	14	14	0	2	0	12	14	0	0	0	14	1	8	0	14	0	0	14	1	1	1	0	0	14	14	14	0	4
30069	68-317	01/96	06/04	15	0	0	0	0	0	0	14	14	0	2	0	10	9	0	0	0	14	1	14	0	14	0	0	14	1	1	1	0	0	14	14	14	0	7
30070	68-320	01/45	06/04	16	1	0	0	0	0	0	14	14	0	2	0	13	14	0	0	0	14	1	14	0	13	0	0	14	1	1	1	0	0	14	14	14	0	5
30071	68-661	11/02	12/03	4	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30072	68-912	11/02	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30073	68-964	10/99	06/04	28	0	0	0	0	16	15	11	12	16	17	0	10	28	17	0	17	8	13	7	16	11	12	0	11	16	1	2	0	16	27	26	27	0	24
30074	69-163	02/03	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	3	0	2
30075	69-1709	06/92	06/04	45	0	0	0	0	29	44	0	0	25	37	0	0	45	42	0	44	0	36	0	44	0	27	0	0	43	0	0	0	43	42	44	45	0	36
30076	69-173	04/95	06/04	32	0	0	0	0	0	0	17	30	0	0	0	14	17	0	0	0	17	0	16	0	16	0	0	16	16	0	1	0	0	16	32	32	0	30
30077	69-19	05/95	12/03	16	0	0	0	0	0	0	4	10	0	0	0	2	4	0	0	0	3	0	2	0	4	0	0	2	13	0	1	0	0	2	16	11	0	13
30078	69-248	12/95	12/03	16	0	0	0	0	0	0	2	9	0	0	0	2	2	0	0	0	2	0	2	0	2	0	1	4	13	0	0	0	0	2	16	12	0	12
30079	69-295	03/03	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	3	0	2	0	0	2	0	0	0	0	0	2	2	2	0	2
30080	69-365	02/94	06/04	33	0	0	0	0	0	0	16	29	0	0	0	12	17	0	0	0	17	0	16	0	17	0	0	16	16	0	1	0	0	16	32	32	0	31
30081	69-374	12/95	12/03	15	0	0	0	0	0	0	2	9	0	0	0	3	2	0	0	0	2	0	3	0	2	0	0	2	12	0	0	0	0	2	15	12	0	12
30082	69-62	12/02	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	2
30083	69-81	03/95	06/04	32	0	0	0	0	0	0	17	30	0	0	0	14	16	0	0	0	17	0	14	0	17	0	0	16	16	0	1	0	0	16	32	32	0	32
30084	69-97	12/95	12/03	15	0	0	0	0	0	0	2	9	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	12	0	0	0	0	2	14	12	0	12
30085	70-21	12/95	06/04	45	0	0	0	0	0	0	16	30	0	1	0	14	17	6	0	0	17	0	14	0	17	0	0	17	19	0	0	0	0	16	33	33	0	32
30086	70-22	12/95	06/04	45	0	0	0	0	0	0	15	30	0	1	0	13	16	6	0	0	15	0	12	0	16	0	0	17	19	0	0	0	0	17	34	33	0	33
30087	70-31	12/03	12/03	1	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1
30088	70-36	11/94	12/02	27	0	0	0	0	0	0	11	24	0	1	0	7	11	0	0	0	11	0	10	0	11	0	0	10	16	0	1	0	0	10	26	25	0	26
30089	70-44	03/95	06/04	31	0	0	0	0	0	0	16	29	0	1	0	15	16	0	0	0	16	0	8	0	15	0	0	15	16	0	1	0	0	15	31	30	0	28
30090	70-47	03/95	06/04	33	0	0	0	0	0	0	17	31	0	2	0	11	17	0	0	0	18	0	13	0	18	0	0	17	16	0	1	0	0	17	29	33	0	33
30091	70-50	12/02	12/03	2	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	2
30092	70-56	03/95	06/04	33	0	0	0	0	0	0	17	30	0	1	0	16	16	0	0	0	16	0	15	0	17	0	0	16	16	0	1	0	0	16	32	31	0	33
30093	70-65	04/95	06/04	33	0	0	0	0	0	0	18	31	0	0	0	17	18	0	0	0	18	0	17	0	18	0	0	16	16	0	1	0	0	17	33	33	0	33
30094	70-74	04/95	06/04	33	0	0	0	0	0	0	17	30	0	0	0	14	16	0	0	0	17	0	15	0	17	0	0	16	16	0	1	0	0	15	32	32	0	31

Feature_ID	ALIAS	From	To	#	# CBE Calc	# CBE OK	MRT	yf	Br	Ca	CaTR	Cl	F	Fe	FeT	FeTR	HCO3	K	KTR	Mg	MgTR	Mn	MnT	Na	NaTR	NH4	NO2	NO3	NNN	TKN	PO4	TP	SiO2	SO4	Cond	pH	O2	Temp
30095	70-76	03/95	06/04	31	0	0	0	0	0	0	16	29	0	2	0	10	16	0	0	0	16	0	15	0	15	0	0	15	16	0	1	0	0	14	31	28	0	27
30096	71-1	05/92	12/03	9	0	0	0	0	0	0	3	6	0	0	0	2	2	0	0	0	3	0	2	0	3	0	0	2	6	0	1	0	0	2	8	8	0	8
30097	71-26	02/95	12/03	8	0	0	0	0	0	0	2	5	0	1	0	2	2	0	0	0	2	0	2	0	2	0	0	2	5	0	0	0	0	2	7	7	0	6
30098	71-3	05/93	12/03	7	0	0	0	0	0	0	2	5	0	1	0	2	2	0	0	0	2	0	2	0	2	0	0	2	3	0	0	0	0	2	4	5	0	5
30099	71-4	01/93	12/03	8	0	0	0	0	0	0	2	4	0	1	0	2	2	0	0	0	2	0	2	0	2	0	0	2	4	0	0	0	0	2	7	7	0	5
30100	71-5	10/92	12/03	7	0	0	0	0	0	0	2	4	0	1	0	2	2	0	0	0	2	0	2	0	2	0	0	2	4	0	0	0	0	2	5	5	0	6
30101	72-1008	12/01	06/04	14	0	0	0	0	0	0	9	11	0	1	0	10	11	0	0	0	11	1	10	0	11	0	0	10	1	1	0	0	0	11	10	11	0	7
30102	72-1011	12/01	06/04	11	0	0	0	0	0	0	10	11	0	1	0	10	11	0	0	0	10	1	6	0	11	0	0	11	1	1	0	0	0	11	11	11	0	7
30103	72-1069	05/02	06/04	10	0	0	0	0	0	0	8	8	0	1	0	8	7	0	0	0	7	1	7	0	8	0	0	8	0	0	0	0	0	8	8	8	0	5
30104	72-1072	06/02	06/04	9	0	0	0	0	0	0	9	8	0	1	0	9	8	0	0	0	9	1	9	0	6	0	0	6	1	1	0	0	0	6	9	8	0	7
30105	72-1081	06/02	06/04	11	0	0	0	0	0	0	8	8	0	1	0	8	9	0	0	0	8	1	8	0	8	0	0	8	1	1	0	0	0	9	5	9	0	6
30106	72-1082	06/02	06/04	9	0	0	0	0	0	0	9	9	0	1	0	7	9	0	0	0	9	1	8	0	9	0	0	9	1	1	0	0	0	9	9	6	0	8
30107	72-1087	06/02	06/04	9	0	0	0	0	0	0	7	7	0	1	0	8	8	0	0	0	8	1	8	0	8	0	0	8	1	1	0	0	0	8	9	9	0	7
30108	72-1089	06/02	06/04	9	0	0	0	0	0	0	7	7	0	0	0	5	6	0	0	0	7	0	4	0	7	0	0	7	0	0	0	0	0	7	6	7	0	6
30109	72-1223	11/88	12/03	3	0	0	0	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0	1
30110	72-356	12/98	03/04	12	0	0	0	0	0	0	10	10	0	1	0	7	10	0	0	0	10	0	9	0	10	0	0	10	1	1	1	0	0	9	10	10	0	4
30111	72-392	05/69	06/04	16	2	0	0	0	0	0	13	12	0	1	0	12	13	0	0	0	13	1	8	0	13	0	0	12	1	1	0	0	0	13	13	13	0	6
30112	72-431	06/68	06/04	16	1	0	0	0	0	0	14	14	0	2	0	12	12	0	0	0	14	1	14	0	14	0	0	14	1	1	1	0	0	14	14	14	0	7

Table 5.9b Data record minor.

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
2	70	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
3	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
21	137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	410	1	1	3	2	3	0	1	1	1	3	1	4	4	1	1	0	5	0	1
89	432	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
101	643	1	1	3	2	3	0	1	1	1	3	1	2	2	1	1	0	3	0	1
106	3669	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	951	1	1	4	2	3	1	1	1	1	3	1	4	3	1	1	1	5	1	1
132	1074	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
134	1079	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
136	1084	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
138	1087	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
141	1092	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
142	1095	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	2	0
146	1111	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
156	1138	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
204	1354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
206	1384	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
208	1446	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
210	1471	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
211	1474	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
215	1501	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
221	1520	1	1	3	2	3	0	1	1	1	3	1	2	2	1	1	0	3	0	1
230	1535	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
234	1561	1	1	4	2	4	0	1	1	1	4	1	4	3	1	1	0	3	0	1
242	1586	2	1	4	2	3	0	1	1	1	3	1	4	4	1	1	0	5	0	1
248	1652	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
270	2022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
278	2102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	2109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
286	2118	0	0	4	2	3	0	0	1	0	4	1	4	2	0	0	0	4	0	0
298	2136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	10164	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	2138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	2344	2	1	4	2	4	0	1	1	1	4	1	4	3	1	1	0	5	0	1
319	2426	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
324	2442	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
325	2557	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
326	2576	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
330	2590	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
332	2593	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
333	2594	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
334	2596	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
337	2708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	2822	1	1	3	2	3	0	1	1	1	4	1	4	3	1	1	0	4	0	1
351	2824	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	2827	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	3004	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
362	3008	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
363	3013	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
364	3015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
369	3045	1	1	4	3	5	0	1	1	1	5	1	4	5	1	1	0	6	0	1
384	3287	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	3470	0	0	4	3	3	0	0	1	0	4	1	5	3	0	0	0	3	0	0
418	3566	0	0	4	2	3	0	0	1	1	3	1	4	2	0	0	0	3	0	0
434	3674	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	3675	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	3676	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	4000	1	1	2	1	2	0	1	0	1	2	1	2	2	1	1	0	2	0	1
440	4003	0	0	2	2	2	0	0	1	0	2	0	2	2	0	0	0	2	0	0
442	4005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
444	4007	1	0	4	3	3	0	0	1	0	5	1	5	3	0	1	0	5	0	0
640	10158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
641	10162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
666	3690	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
668	3702	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
672	3685	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
706	4993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
764	1173.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
765	1174.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
766	1287.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
767	1323.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
768	279.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
769	683.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
778	64.247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
779	64.271	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
780	64.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
783	64.393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
786	64.551	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
787	64.552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
788	64.559	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
789	64.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
791	64.647	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
792	64.658	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
794	64.865	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
795	64.938	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
796	64.942	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
797	64.996	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
799	66.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
800	66.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
801	66.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
804	66.42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
806	66.46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
807	66.47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
808	66.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
809	66.53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
810	66.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
811	66.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
812	66.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
813	66.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
814	66.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
820	67.116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
825	67.138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
828	67.142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
836	67.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
839	67.165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
842	67.171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
844	67.175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
847	67.184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
849	67.189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
851	67.198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
861	67.21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
870	67.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
923	67.276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
932	67.299	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
937	67.317	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
938	67.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
943	67.338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
950	67.362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
954	67.373	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
956	67.377	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
960	67.389	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
961	67.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
962	67.392	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
966	67.402	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
972	67.421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
991	67.47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	67.478	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
999	67.495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1002	67.506	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1003	67.507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1010	67.526	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1012	67.528	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1013	67.529	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1015	67.531	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1017	67.535	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1018	67.538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
1020	67.572	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1028	67.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1042	67.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1043	67.99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1046	72.1036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1047	72.112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1048	72.1121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1049	72.113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1050	72.1245	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1052	72.1436	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1053	72.1444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1055	72.193	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1056	72.256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1057	72.444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1058	72.483	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1059	72.533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1060	72.593	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1061	72.606	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1062	72.613	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1063	72.614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1064	72.619	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1065	72.685	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1067	72.925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1271	BOP110120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1272	BOP160158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1273	BOP270076	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1274	BOP270093	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1275	BOP270094	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1276	BOP270108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1277	BOP270075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1278	BOP110057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1279	BOP110058	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1
1280	BOP160113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1281	BOP160157	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1282	BOP160159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1283	BOP160160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1284	BOP210005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1285	BOP210006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1286	BOP210007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1287	BOP800148	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1288	BOP290127	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
1289	BOP330016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1290	BOP330017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1291	BOP160152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1292	BOP160154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1293	BOP160155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1294	BOP160214	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1295	BOP210154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1296	BOP160151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1297	BOP160153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1298	BOP290040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1299	1	1	1	2	2	2	0	1	0	1	2	1	2	2	1	1	0	3	0	1
1300	51	0	0	2	2	2	0	0	1	0	2	0	2	2	0	0	0	2	0	0
1301	94	1	1	0	1	1	0	1	0	1	0	0	0	1	1	1	0	0	0	1
1302	196	1	2	0	1	1	0	2	0	2	0	0	0	1	2	1	0	1	0	2
1303	466	1	1	3	2	3	0	1	1	1	4	1	4	3	1	1	0	3	0	1
1304	490	1	1	4	2	3	0	1	1	1	4	1	4	3	1	1	0	5	0	1
1306	845	1	1	4	2	3	0	1	1	1	4	1	4	3	1	1	0	4	0	1
1307	851	1	1	4	3	3	0	1	1	1	3	1	4	3	1	1	0	4	0	1
1308	925	2	1	3	2	2	0	1	1	1	3	1	2	2	1	1	0	3	0	1
1309	1018	1	1	3	3	3	0	1	1	1	3	1	4	3	1	1	0	3	0	1
1310	1319	1	1	3	2	2	0	1	1	1	3	1	2	3	1	1	0	4	0	1
1311	1393	1	1	4	2	4	0	1	1	1	3	1	4	3	1	1	0	5	0	1
1312	1605	2	1	3	2	2	0	1	1	1	2	1	2	2	1	1	0	3	0	1
1313	1686	0	1	3	1	2	0	1	1	1	3	1	2	2	1	0	0	3	0	1
1314	1690	2	1	2	2	2	0	1	1	1	2	1	2	3	1	1	0	4	0	1
1315	2076	2	1	2	2	3	0	1	1	1	3	1	2	4	1	2	0	3	0	1
1316	2088	0	0	3	1	2	0	0	1	0	3	1	3	2	0	0	0	2	0	0
1317	2093	1	1	0	1	1	0	1	0	1	0	0	0	1	1	1	0	1	0	1
1318	2303	2	1	2	2	3	0	1	0	1	2	1	2	2	1	2	0	3	0	1
1320	2330	2	1	3	2	3	0	1	1	1	2	1	2	2	1	1	0	3	0	1
1321	2342	2	1	4	3	4	0	1	1	1	3	1	4	3	1	1	0	4	0	1

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
1323	2362	2	1	4	3	3	0	1	1	1	3	1	4	4	1	1	0	4	0	1
1324	2393	0	1	4	2	2	0	1	1	1	4	1	4	2	1	0	0	4	0	1
1325	2509	2	1	5	2	5	0	1	0	1	3	2	4	3	1	2	0	7	0	1
1326	2707	1	1	2	2	3	0	1	1	1	2	0	2	2	1	1	0	3	0	1
1327	2728	2	1	4	2	4	0	1	1	1	4	1	4	3	1	1	0	4	0	1
1328	2829	2	1	3	2	2	0	1	1	1	3	1	2	3	1	1	0	4	0	1
1329	2840	2	1	3	2	3	0	1	1	1	3	1	2	3	1	1	0	3	0	1
1330	2847	1	1	4	2	3	0	1	1	1	3	2	3	4	1	1	0	6	0	1
1331	2913	2	1	2	2	3	0	1	2	1	2	0	3	3	1	0	0	2	0	1
1332	3034	2	1	3	2	3	0	1	1	1	2	1	2	4	1	2	0	5	0	1
1333	3036	0	1	3	1	2	0	1	1	1	2	1	2	2	1	0	0	2	0	1
1334	3039	2	1	2	4	4	0	1	1	1	3	0	3	4	1	2	0	4	0	1
1335	3044	1	1	5	2	4	0	1	1	1	4	2	5	3	1	1	0	7	0	1
1336	3272	1	0	1	1	1	0	0	1	0	1	0	1	1	0	0	0	1	0	0
1337	3301	2	0	5	3	5	0	0	2	0	4	2	5	4	0	1	0	7	0	0
1338	4001	0	1	2	2	2	0	1	1	1	2	0	2	2	1	0	0	2	0	1
1339	4002	2	1	3	4	4	0	1	1	1	3	1	2	3	1	2	0	3	0	1
1340	4364	1	0	6	2	4	0	0	1	0	4	2	4	4	0	1	0	7	0	0
1342	4582	0	0	1	1	1	0	0	0	0	1	0	1	1	0	0	0	1	0	0
1344	S109	0	0	1	1	1	0	0	0	0	1	0	1	1	0	0	0	1	0	0
1345	S108	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
1346	S107	0	0	1	0	1	0	0	0	0	1	0	1	1	0	0	0	1	0	0
1347	S106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1348	S105	1	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0
1349	68	1	1	4	2	3	0	1	1	1	3	1	4	4	1	1	0	5	0	1
1350	66	1	0	4	2	3	0	0	1	0	4	1	4	2	0	0	0	3	0	0
1351	Braemar Springs	1	1	0	1	1	0	1	0	1	0	0	0	1	1	1	0	1	0	1
1352	EBOP-noname1	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
1353	EBOP-noname2	0	0	1	0	1	0	0	0	0	1	0	1	1	0	0	0	1	0	0
1354	EBOP-noname3	0	0	1	1	1	0	0	0	0	1	0	1	1	0	0	0	1	0	0
1355	EBOP-noname4	0	0	1	1	1	0	0	1	0	1	0	1	1	0	0	0	1	0	0
1356	EBOP-noname5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
1357	EBOP-noname6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
1358	EBOP-noname7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1359	EBOP-noname8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1360	EBOP-noname9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
1361	EBOP-noname10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
1362	EBOP-noname11	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0
2020	BEEK	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0
2021	ALLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2055	OHOPEGC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2056	ETERNAL SPRINGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2057	FERNLANDSPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2058	PEMBERTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3001	Hamurana Spring @ water intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3002	Taniwha Spring @ old well	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3003	Trout Hatchery Spring @ weir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3004	Te Waireka @ bottling plant intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3005	Barlows Spring @ water intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3006	2116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3007	1202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3008	1561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3009	Dr. Irvin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3010	3691	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3011	JROYAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3012	3901	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3013	10424	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3014	Spring 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3015	Utuhina Spring (main)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3016	Fairy Spring (Te Waiowhero)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3017	Awahou Stream @ Central Rd bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3018	Utuhina Spring #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3019	Utuhina Spring #2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3020	Taniwha Spring @ water intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3021	Rainbow Spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3022	Hamurana Spring #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3023	Hamurana head spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3024	Hamurana Spring #3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3025	Utuhina Stream @ Lake Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3026	Ngongotaha Stream @ Ngongotaha Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3027	Waiteti Stream @ Ngongotaha Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3028	Awahou Stream @ Hamurana Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
3029	Hauraki Stream @ Hamurana Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3030	Hamurana Stream @ Hamurana Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3031	Waiohewa Stream @ Te Ngae Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3032	Waingaehe Stream @ Te Ngae Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3033	Puarenga Stream @ Te Ngae Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3034	Kauaka Stream @ Waipa State Mill Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3036	Waipa Stream @ Hemo Gorge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3037	Awahou spring #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3038	Awahou upstream	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3039	Ngongataha stream @ Paradise springs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30001	1367-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30002	60-12	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30003	60-124	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30004	60-167	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30005	60-316	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30006	60-345	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30007	60-348	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30008	60-352	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30009	60-4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	2
30010	60-407	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30011	60-480	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30012	60-483	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30013	61-113	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	17
30014	61-126	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	9
30015	61-135	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30016	61-143	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
30017	61-208	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	11
30018	61-221	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	16
30019	61-23	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
30020	61-245	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30021	61-258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30022	61-280	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	1	11
30023	61-54	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	2
30024	61-59	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	13
30025	61-85	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
30026	61-93	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30027	62-5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30028	63-201	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3
30029	63-240	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30030	63-328	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30031	63-43	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30032	63-57	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	17
30033	63-65	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	2
30034	63-74	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30035	63-78	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30036	63-8	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30037	64-108	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	13
30038	64-111	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30039	64-117	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	1	16
30040	64-12	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	1	15
30041	64-120	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	15
30042	64-20	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	1	17
30043	64-43	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	15
30044	64-46	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	16
30045	64-50	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	1	13
30046	64-511	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30047	64-7	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30048	64-70	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	1	14
30049	64-831	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30050	65-4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2
30051	65-6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30052	65-8	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2
30053	66-58	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30054	66-6	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	15
30055	66-92	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30056	66-93	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
30057	66-96	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30058	67-11	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	16
30059	67-15	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	16
30060	67-38	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30061	67-4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2

Feature_ID	ALIAS	Cd	CdTR	Co	Cr	Cu	CuT	CuTR	Hg	HgT	Li	Mo	Ni	Pb	PbTR	Se	TaT	Zn	ZnT	ZnTR
30062	67-404	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30063	67-435	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30064	67-483	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30065	67-55	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30066	67-573	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30067	67-83	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30068	68-301	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	12
30069	68-317	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	8
30070	68-320	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	13
30071	68-661	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30072	68-912	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30073	68-964	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	11
30074	69-163	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
30075	69-1709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30076	69-173	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	16
30077	69-19	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2
30078	69-248	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30079	69-295	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
30080	69-365	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	13
30081	69-374	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
30082	69-62	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30083	69-81	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	15
30084	69-97	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
30085	70-21	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	16
30086	70-22	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	17
30087	70-31	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
30088	70-36	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	1	10
30089	70-44	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	1	11
30090	70-47	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	1	11
30091	70-50	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30092	70-56	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	16
30093	70-65	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	1	17
30094	70-74	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	1	16
30095	70-76	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	1	10
30096	71-1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2
30097	71-26	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30098	71-3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30099	71-4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30100	71-5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30101	72-1008	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	10
30102	72-1011	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	9
30103	72-1069	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	8
30104	72-1072	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	9
30105	72-1081	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	8
30106	72-1082	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	8
30107	72-1087	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	9
30108	72-1089	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	8
30109	72-1223	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
30110	72-356	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	8
30111	72-392	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	12
30112	72-431	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	13

Table 5.9c Data record other.

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
2	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
3	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21	137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	410	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
89	432	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
101	643	0	0	5	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
106	3669	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	951	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
132	1074	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
134	1079	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
136	1084	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
138	1087	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
141	1092	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
142	1095	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
146	1111	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
156	1138	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
204	1354	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
206	1384	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
208	1446	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
210	1471	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
211	1474	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
215	1501	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
221	1520	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
230	1535	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
234	1561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
242	1586	0	0	6	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
248	1652	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	2022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	2030	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
278	2102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	2109	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
286	2118	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
298	2136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	10164	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	2138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	2344	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
319	2426	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
324	2442	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
325	2557	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
326	2576	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
330	2590	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
332	2593	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
333	2594	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
334	2596	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
337	2708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	2822	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
351	2824	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	2827	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	3004	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
362	3008	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
363	3013	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
364	3015	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
369	3045	0	1	5	10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
384	3287	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	3470	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
418	3566	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
434	3674	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	3675	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	3676	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	4000	0	2	2	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
440	4003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
442	4005	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
444	4007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
640	10158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
641	10162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
666	3690	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
668	3702	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
672	3685	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
706	4993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
764	1173.2	0	23	0	20	0	0	90	0	0	95	0	0	0	0	0	3	0	0	0	0	88	0
765	1174.4	0	24	0	23	0	0	94	0	0	95	0	0	0	0	0	4	0	0	0	0	92	0
766	1287.7	0	24	0	23	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
767	1323.1	0	0	0	0	0	0	86	0	0	76	0	0	0	0	0	3	0	0	0	0	84	0
768	279.1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0
769	683.4	0	21	0	21	0	0	61	0	0	54	0	0	0	0	0	0	0	0	0	0	63	0
778	64.247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
779	64.271	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
780	64.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
783	64.393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
786	64.551	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
787	64.552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
788	64.559	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
789	64.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
791	64.647	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
792	64.658	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
794	64.865	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
795	64.938	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
796	64.942	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
797	64.996	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
799	66.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
800	66.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
801	66.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
804	66.42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
806	66.46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
807	66.47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
808	66.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
809	66.53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
810	66.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
811	66.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
812	66.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
813	66.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
814	66.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
820	67.116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
825	67.138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
828	67.142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
836	67.16	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
839	67.165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
842	67.171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
844	67.175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
847	67.184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
849	67.189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
851	67.198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
861	67.21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
870	67.22	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
923	67.276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
932	67.299	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
937	67.317	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
938	67.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
943	67.338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
950	67.362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
954	67.373	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
956	67.377	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
960	67.389	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
961	67.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
962	67.392	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
966	67.402	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
972	67.421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
991	67.47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	67.478	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
999	67.495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1002	67.506	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1003	67.507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1010	67.526	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1012	67.528	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1013	67.529	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1015	67.531	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
1017	67.535	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1018	67.538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1020	67.572	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1028	67.6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1042	67.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1043	67.99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1046	72.1036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1047	72.112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1048	72.1121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1049	72.113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1050	72.1245	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1052	72.1436	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1053	72.1444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1055	72.193	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1056	72.256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1057	72.444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1058	72.483	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1059	72.533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1060	72.593	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1061	72.606	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1062	72.613	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1063	72.614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1064	72.619	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1065	72.685	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1067	72.925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1271	BOP110120	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1272	BOP160158	0	5	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1273	BOP270076	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1274	BOP270093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1275	BOP270094	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1276	BOP270108	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
1277	BOP270075	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1278	BOP110057	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
1279	BOP110058	0	84	88	82	53	88	85	36	0	83	17	86	88	81	0	0	89	0	88	0	0	87
1280	BOP160113	0	42	50	5	2	2	2	0	0	2	0	2	2	5	0	0	5	0	4	0	0	5
1281	BOP160157	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1282	BOP160159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1283	BOP160160	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
1284	BOP210005	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1285	BOP210006	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1286	BOP210007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1287	BOP800148	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1288	BOP290127	0	3	2	2	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0
1289	BOP330016	0	5	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0
1290	BOP330017	0	2	4	3	0	0	0	0	0	0	0	0	0	2	0	0	2	0	2	0	0	2
1291	BOP160152	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1292	BOP160154	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1293	BOP160155	0	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1294	BOP160214	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1295	BOP210154	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1296	BOP160151	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1297	BOP160153	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
1298	BOP290040	0	1	3	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	1	0	0	0
1299	1	0	2	6	3	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0
1300	51	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1301	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1302	196	0	0	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
1303	466	0	1	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1304	490	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1306	845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1307	851	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1308	925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1309	1018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1310	1319	0	0	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1311	1393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1312	1605	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
1313	1686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1314	1690	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1315	2076	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1316	2088	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1317	2093	0	1	3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
1318	2303	0	0	2	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
1320	2330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1321	2342	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1323	2362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1324	2393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1325	2509	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1326	2707	0	0	2	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1327	2728	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1328	2829	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1329	2840	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1330	2847	0	1	4	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
1331	2913	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1332	3034	0	1	6	9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1333	3036	0	0	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
1334	3039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1335	3044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1336	3272	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1337	3301	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1338	4001	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1339	4002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
1340	4364	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1342	4582	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1344	S109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1345	S108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1346	S107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1347	S106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1348	S105	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1349	68	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1350	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1351	Braemar Springs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1352	EBOP-noname1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1353	EBOP-noname2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1354	EBOP-noname3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1355	EBOP-noname4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1356	EBOP-noname5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1357	EBOP-noname6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1358	EBOP-noname7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1359	EBOP-noname8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1360	EBOP-noname9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1361	EBOP-noname10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1362	EBOP-noname11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2020	BEEK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2021	ALLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2055	OHOPEGC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2056	ETERNAL SPRINGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2057	FERNLANDSPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2058	PEMBERTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3001	Hamurana Spring @ water intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3002	Taniwha Spring @ old well	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3003	Trout Hatchery Spring @ weir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3004	Te Waireka @ bottling plant intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3005	Barlows Spring @ water intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3006	2116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3007	1202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3008	1561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3009	Dr. Irvin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3010	3691	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3011	JROYAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3012	3901	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3013	10424	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3014	Spring 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3015	Utuhina Spring (main)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3016	Fairy Spring (Te Waiowhero)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3017	Awahou Stream @ Central Rd bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3018	Utuhina Spring #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3019	Utuhina Spring #2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3020	Taniwha Spring @ water intake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3021	Rainbow Spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3022	Hamurana Spring #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3023	Hamurana head spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3024	Hamurana Spring #3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3025	Utuhina Stream @ Lake Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3026	Ngongotaha Stream @ Ngongotaha Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
3027	Waiteti Stream @ Ngongotaha Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3028	Awahou Stream @ Hamurana Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3029	Hauraki Stream @ Hamurana Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3030	Hamurana Stream @ Hamurana Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3031	Waiohewa Stream @ Te Ngae Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3032	Waingaehe Stream @ Te Ngae Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3033	Puarenga Stream @ Te Ngae Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3034	Kauaka Stream @ Waipa State Mill Rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3036	Waipa Stream @ Hemo Gorge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3037	Awahou spring #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3038	Awahou upstream	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3039	Ngongataha stream @ Paradise springs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30001	1367-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30002	60-12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30003	60-124	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30004	60-167	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30005	60-316	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30006	60-345	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30007	60-348	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30008	60-352	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30009	60-4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30010	60-407	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30011	60-480	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30012	60-483	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30013	61-113	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30014	61-126	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30015	61-135	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30016	61-143	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30017	61-208	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30018	61-221	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30019	61-23	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30020	61-245	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30021	61-258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30022	61-280	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30023	61-54	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30024	61-59	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30025	61-85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30026	61-93	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30027	62-5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30028	63-201	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30029	63-240	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30030	63-328	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30031	63-43	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30032	63-57	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30033	63-65	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30034	63-74	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30035	63-78	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30036	63-8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30037	64-108	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30038	64-111	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30039	64-117	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30040	64-12	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30041	64-120	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30042	64-20	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30043	64-43	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30044	64-46	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30045	64-50	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30046	64-511	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30047	64-7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30048	64-70	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30049	64-831	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30050	65-4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30051	65-6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30052	65-8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30053	66-58	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30054	66-6	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30055	66-92	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30056	66-93	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30057	66-96	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30058	67-11	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30059	67-15	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Feature_ID	ALIAS	CO2	Ecoli	ENT	FC	A254F	A270F	A340F	A360F	A400F	A440F	A740F	C340F	C440F	BOD5	COD	DOC	SS	TDS	Turb	Turb-A	Turb-N	WatLevel
30060	67-38	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30061	67-4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30062	67-404	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30063	67-435	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30064	67-483	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30065	67-55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30066	67-573	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30067	67-83	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30068	68-301	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30069	68-317	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30070	68-320	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30071	68-661	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30072	68-912	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30073	68-964	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30074	69-163	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30075	69-1709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30076	69-173	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30077	69-19	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30078	69-248	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30079	69-295	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30080	69-365	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30081	69-374	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30082	69-62	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30083	69-81	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30084	69-97	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30085	70-21	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30086	70-22	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30087	70-31	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30088	70-36	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30089	70-44	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30090	70-47	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30091	70-50	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30092	70-56	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30093	70-65	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30094	70-74	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30095	70-76	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30096	71-1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30097	71-26	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30098	71-3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30099	71-4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30100	71-5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30101	72-1008	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30102	72-1011	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30103	72-1069	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30104	72-1072	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30105	72-1081	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30106	72-1082	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30107	72-1087	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30108	72-1089	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30109	72-1223	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30110	72-356	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30111	72-392	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30112	72-431	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

In calculation of the median values as described above, it is important to note that at some sites, few samples have been collected, and not all samples have been analysed for all parameters. Table 5.9 displays the historical record of sample collection and analysis at each site. The 'From' and 'To' columns show the dates of collection of the oldest and most recent sample at each site, respectively. The '#' column shows the total number of samples that have been collected at each site, the '# CBE Calc' column shows the number of samples collected for which the Charge Balance Error can be calculated, the '# CBE OK' column shows the number of samples for which the Charge Balance Error is within acceptable limits, and the remaining columns show the number of samples from each site that have been analysed for each parameter. In this review, Charge Balance Error (*CBE*) was calculated for each sample collected from each site, following the method of Freeze and Cherry (1979):

$$CBE = \frac{\sum zm_c - \sum zm_a}{\sum zm_c + \sum zm_a} \times 100\%$$

where z is the absolute value of the ionic valance, m_c is the molarity of the cationic species and m_a is the molarity of the anionic species. The following ionic species were considered in the calculation of CBE: Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, Mn^{2+}, NH_4^+, HCO_3^-, Cl^-, NO_3^- and SO_4^{2-}. In all cases, missing analyses and results below the analytical detection limit were assigned values of zero to permit calculation of *CBE*. The acceptable limits for the *CBE* for each sample were calculated by propagation of analytical uncertainties through the *CBE* equation. The analytical uncertainty (two standard deviations around the mean) for each ion was assumed to relate to its concentration as described by Daughney and Reeves (2003). In general, the analytical uncertainties for most ions were assumed to be between 2 and 5% over the range of concentrations relevant to the samples considered in this review, though uncertainties were assumed to increase to roughly 20% at the analytical detection limit. Using this method, the acceptable limits for *CBE* were found to be on the order of 3% for most samples, but could be as low as 1.5% and as high as 5% for samples with very high or very low concentrations of total dissolved solids, respectively. These cut-off values are in reasonable agreement with the value of ±5%, suggested by Freeze and Cherry (1979).

Four descriptors were used to summarise the amount and quality of the data record from each site (Table 5.10). First, each monitoring site was described as 'Date Type' 1, 2 or 3, to show whether it is inactive or of unknown status (most recent sample collected more than ten years ago or date of most recent sample collection unknown), recently inactive (most recent sample collected between five and ten years ago), or active (most recent sample collected within the past five years). Of the 409 monitoring sites considered in this review, 69 sites (17%) are Date Type 1, 57 sites (14%) are Date Type 2, and 283 are Date Type 3. Second, each monitoring site was described as '# Type' 1, 2, or 3, to show whether they are sampled on a one-off basis, sampled occasionally, or sampled regularly. Of the 409 monitoring sites considered in this review, 201 sites (49%) have only been sampled on one occasion, 81 sites (20%) have been sampled between two and eight times, and 127 sites (31%) have been sampled more than eight times. Third, each monitoring site was described as 'CBE Type' 1, 2, or 3, to show whether the water chemistry is poorly constrained, reasonably well constrained, or very well constrained. Calculation of CBE (Charge Balance Error) requires knowledge of the dissolved concentrations of all major ions (at least Ca, Na, K, Mg, Cl, HCO_3 and SO_4), and it is used as a check on analytical accuracy (Freeze and Cherry, 1979). Of the 409 sites considered in this review, at 351 sites (86%), 52 sites (13%), and 6 sites (1%), CBE could be calculated for fewer than two samples, for between two and eight samples, or for more than eight samples, respectively. Fourth, each monitoring site was described as 'Nutr Type' 1, 2, or 3, to show whether nutrient (NH_4, NO_3 and PO_4) concentrations are poorly constrained (analysed in fewer than two samples), reasonably well constrained (analysed in between two and eight samples), or very well constrained (analysed in more than eight samples). Of all of the monitoring sites considered, 334 (82%), 61 (15%), and 14 (3%) are 'Nutr Type' 1, 2, and 3, respectively.

Table 5.10 Descriptors used to summarise the amount and quality of the data record from each site. ‘Date Type’ 1, 2 or 3 shows whether the site is inactive or of unknown status (most recent sample collected more than ten years ago or sample collection date unknown), recently inactive (most recent sample collected between five and ten years ago), or active (most recent sample collected within the past five years). ‘# Type’ 1, 2, or 3 shows whether the site has been sampled on a one-off basis, sampled occasionally, or sampled regularly. ‘CBE Type’ 1, 2, or 3 shows whether CBE could be calculated for fewer than two samples, for between two and eight samples, or for more than eight samples, respectively. ‘Nutr Type’ 1, 2, or 3 shows whether nutrient (NH_4, NO_3 and PO_4) concentrations are poorly constrained (analysed in fewer than two samples), reasonably well constrained (analysed in between two and eight samples), or very well constrained (analysed in more than eight samples). The ‘Integrated Descriptor’ value is equal to (100 × Nutr Type) + (10 × Date Type) + (CBE Type).

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
2	70	111	1	1	1	1	Y				
3	71	111	1	1	1	1	Y				
21	137	111	1	1	1	1	Y				
39	168	111	1	1	1	1	Y				
65	226	111	1	1	1	1	Y		Waitawa	S1	Area3
67	228	111	1	1	1	1	Y		Pohue Bay	E1	Area3
78	305	111	1	1	1	1	Y				
80	410	232	3	2	2	2	Y				
89	432	111	1	1	1	1	Y				
101	643	232	3	3	2	2	N				
106	3669	111	1	1	1	1	Y				
111	951	232	3	3	2	2	Y				
132	1074	111	1	1	1	1	Y				
134	1079	111	1	2	1	1	Y				
136	1084	111	1	1	1	1	Y				
138	1087	111	1	1	1	1	Y				
141	1092	111	1	1	1	1	Y				
142	1095	111	1	2	1	1	Y				
146	1111	111	1	1	1	1	Y				
156	1138	111	1	1	1	1	Y				
204	1354	111	1	1	1	1	Y				
206	1384	111	1	1	1	1	Y				
208	1446	111	1	1	1	1	Y		Waiteti	W3	
210	1471	111	1	1	1	1	Y				
211	1474	111	1	1	1	1	Y				
215	1501	111	1	1	1	1	Y				
221	1520	232	3	3	2	2	Y				
230	1535	111	1	1	1	1	Y				
234	1561	232	3	3	2	2	Y		Awahou Point	W4	Area1
242	1586	232	3	3	2	2	Y				
248	1652	111	1	1	1	1	Y				
270	2022	111	1	1	1	1	Y				
274	2030	111	1	1	1	1	Y				

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
278	2102	111	1	1	1	1	Y		Waiteti		
280	2109	111	1	2	1	1	Y		Pohue Bay	E1	
286	2118	232	3	2	2	2	Y		Waiohewa	E2	Area3
298	2136	111	1	1	1	1	Y		Waiohewa	E2	
299	10164	111	1	1	1	1	N				
300	2138	111	1	1	1	1	Y				
305	2344	232	3	3	2	2	Y				
319	2426	111	1	1	1	1	Y				
324	2442	111	1	1	1	1	Y				
325	2557	111	1	1	1	1	Y				
326	2576	111	1	1	1	1	Y				
330	2590	111	1	1	1	1	Y				
332	2593	111	1	1	1	1	Y				
333	2594	111	1	1	1	1	Y		Waiteti	W3	
334	2596	111	1	1	1	1	Y				
337	2708	111	1	1	1	1	Y				
349	2822	232	3	3	2	2	Y				
351	2824	111	1	1	1	1	Y				
353	2827	111	1	1	1	1	Y				
361	3004	111	1	1	1	1	Y				
362	3008	111	1	1	1	1	Y				
363	3013	111	1	1	1	1	Y				
364	3015	111	1	2	1	1	Y				
369	3045	332	3	3	2	3	Y				
384	3287	111	1	2	1	1	Y				
409	3470	232	3	2	2	2	Y		Waiteti	W3	Area1
418	3566	232	3	2	2	2	Y				
434	3674	111	1	1	1	1	Y				
435	3675	111	1	1	1	1	Y				
436	3676	111	1	1	1	1	Y		Pohue Bay	E1	Area3
439	4000	222	2	2	2	2	Y		Pohue Bay	E1	Area3
440	4003	131	3	2	1	1	Y		Pohue Bay	E1	Area3
442	4005	111	1	1	1	1	Y		Rotokawa	E3	
444	4007	232	3	3	2	2	Y		Waimehia	W3	
640	10158	111	1	1	1	1	Y		Waiteti	W3	
641	10162	111	1	1	1	1	Y				
666	3690	111	1	1	1	1	Y				
668	3702	111	1	1	1	1	Y				
672	3685	111	1	1	1	1	Y		Waiohewa	E2	
706	4993	111	1	1	1	1	Y				
764	1173.2	331	3	3	1	3	Y				
765	1174.4	331	3	3	1	3	Y				
766	1287.7	131	3	3	1	1	Y				
767	1323.1	331	3	3	1	3	Y				
768	279.1	131	3	3	1	1	Y				
769	683.4	331	3	3	1	3	Y				
778	64.247	121	2	1	1	1	Y				
779	64.271	111	1	1	1	1	Y				
780	64.29	121	2	1	1	1	Y				
783	64.393	111	1	1	1	1	Y				
786	64.551	121	2	1	1	1	Y				
787	64.552	121	2	1	1	1	Y				
788	64.559	111	1	1	1	1	Y				
789	64.57	121	2	1	1	1	Y				

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
791	64.647	121	2	1	1	1	Y				
792	64.658	121	2	1	1	1	Y				
794	64.865	121	2	1	1	1	Y				
795	64.938	121	2	1	1	1	Y				
796	64.942	121	2	1	1	1	Y				
797	64.996	131	3	2	1	1	Y				
799	66.24	111	1	1	1	1	Y				
800	66.28	121	2	1	1	1	Y				
801	66.29	111	1	1	1	1	Y	S102		W4	
804	66.42	111	1	1	1	1	Y				
806	66.46	121	2	1	1	1	Y				
807	66.47	111	1	1	1	1	Y		Puarenga	S2C	
808	66.5	121	2	1	1	1	Y				
809	66.53	121	2	1	1	1	Y		Puarenga	S2C	
810	66.57	111	1	1	1	1	Y				
811	66.65	121	2	1	1	1	Y				
812	66.67	121	2	1	1	1	Y				
813	66.69	121	2	1	1	1	Y				
814	66.7	111	1	1	1	1	Y	S102		W4	
820	67.116	121	2	1	1	1	Y				
825	67.138	111	1	1	1	1	Y				
828	67.142	111	1	1	1	1	Y				
836	67.16	111	1	1	1	1	Y				
839	67.165	111	1	1	1	1	Y				
842	67.171	121	2	1	1	1	Y				
844	67.175	111	1	1	1	1	Y				
847	67.184	121	2	1	1	1	Y				
849	67.189	121	2	1	1	1	Y				
851	67.198	111	1	1	1	1	Y				
861	67.21	121	2	2	1	1	Y				
870	67.22	111	1	1	1	1	Y				
923	67.276	111	1	1	1	1	Y				
932	67.299	121	2	1	1	1	Y				
937	67.317	111	1	1	1	1	Y				
938	67.32	111	1	1	1	1	Y				
943	67.338	121	2	1	1	1	Y				
950	67.362	111	1	1	1	1	Y				
954	67.373	111	1	1	1	1	Y				
956	67.377	111	1	1	1	1	Y				
960	67.389	121	2	1	1	1	Y				
961	67.39	111	1	1	1	1	Y				
962	67.392	121	2	1	1	1	Y				
966	67.402	121	2	1	1	1	Y				
972	67.421	111	1	1	1	1	Y				
991	67.47	121	2	1	1	1	Y				
993	67.478	121	2	1	1	1	Y				
999	67.495	121	2	1	1	1	Y				
1002	67.506	121	2	1	1	1	Y				
1003	67.507	121	2	1	1	1	Y				
1010	67.526	121	2	1	1	1	N				
1012	67.528	121	2	1	1	1	N				
1013	67.529	121	2	1	1	1	N				
1015	67.531	111	1	2	1	1	Y				
1017	67.535	121	2	1	1	1	Y				

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
1018	67.538	121	2	1	1	1	Y				
1020	67.572	121	2	1	1	1	Y				
1028	67.6	111	1	1	1	1	Y				
1042	67.97	121	2	1	1	1	Y				
1043	67.99	121	2	1	1	1	Y				
1046	72.1036	131	3	1	1	1	Y				
1047	72.112	131	3	1	1	1	Y				
1048	72.1121	131	3	1	1	1	Y				
1049	72.113	131	3	1	1	1	Y				
1050	72.1245	131	3	1	1	1	Y				
1052	72.1436	131	3	1	1	1	Y				
1053	72.1444	131	3	1	1	1	Y				
1055	72.193	131	3	1	1	1	Y				
1056	72.256	111	1	1	1	1	Y				
1057	72.444	131	3	1	1	1	Y				
1058	72.483	131	3	1	1	1	Y				
1059	72.533	131	3	1	1	1	Y				
1060	72.593	131	3	1	1	1	Y				
1061	72.606	131	3	2	1	1	Y				
1062	72.613	131	3	1	1	1	Y				
1063	72.614	131	3	1	1	1	Y				
1064	72.619	131	3	1	1	1	Y				
1065	72.685	121	2	1	1	1	Y				
1067	72.925	121	2	1	1	1	Y				
1271	BOP110120	131	3	1	1	1	Y		Puarenga	S2C	
1272	BOP160158	231	3	3	1	2	Y		Puarenga	S2C	
1273	BOP270076	121	2	1	1	1	Y		Puarenga	S2C	
1274	BOP270093	121	2	1	1	1	Y		Puarenga	S2C	
1275	BOP270094	121	2	1	1	1	Y		Puarenga	S2C	
1276	BOP270108	131	3	2	1	1	Y		Puarenga	S2C	
1277	BOP270075	121	2	1	1	1	Y		Puarenga	S2C	
1278	BOP110057	232	3	3	2	2	Y		Puarenga	S2A	
1279	BOP110058	331	3	3	1	3	Y		Puarenga	S2A	
1280	BOP160113	231	3	3	1	2	Y		Puarenga	S2A	
1281	BOP160157	111	1	3	1	1	Y		Puarenga	S2C	
1282	BOP160159	231	3	2	1	2	Y		Puarenga	S2C	
1283	BOP160160	211	1	2	1	2	Y		Puarenga	S2A	
1284	BOP210005	131	3	2	1	1	Y		Puarenga	S2B	
1285	BOP210006	111	1	1	1	1	Y	S112	Puarenga	S2B	
1286	BOP210007	111	1	1	1	1	Y	S112	Puarenga	S2B	
1287	BOP800148	111	1	1	1	1	Y	S112	Puarenga	S2B	
1288	BOP290127	231	3	2	1	2	Y		Puarenga	S2A	
1289	BOP330016	121	2	2	1	1	Y	S112	Puarenga	S2B	
1290	BOP330017	231	3	3	1	2	Y		Puarenga	S2B	
1291	BOP160152	131	3	2	1	1	Y		Puarenga	S2C	
1292	BOP160154	111	1	2	1	1	Y		Puarenga	S2C	
1293	BOP160155	231	3	3	1	2	Y		Puarenga	S2C	
1294	BOP160214	131	3	2	1	1	Y		Puarenga	S2C	
1295	BOP210154	121	2	2	1	1	Y		Utuhina	S3A	
1296	BOP160151	111	1	1	1	1	Y		Puarenga	S2C	
1297	BOP160153	111	1	2	1	1	Y		Puarenga	S2C	
1298	BOP290040	231	3	2	1	2	Y		Puarenga	S2C	
1299	1	332	3	3	2	3	N				
1300	51	222	2	2	2	2	N				

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
1301	94	221	2	2	1	2	N				
1302	196	231	3	3	1	2	N				
1303	466	232	3	3	2	2	N				
1304	490	232	3	3	2	2	N				
1306	845	232	3	3	2	2	N				
1307	851	232	3	3	2	2	N				
1308	925	232	3	3	2	2	N				
1309	1018	232	3	3	2	2	Y				
1310	1319	232	3	3	2	2	N				
1311	1393	232	3	3	2	2	N				
1312	1605	232	3	3	2	2	N				
1313	1686	232	3	3	2	2	N				
1314	1690	232	3	3	2	2	Y				
1315	2076	232	3	3	2	2	N				
1316	2088	222	2	2	2	2	N				
1317	2093	231	3	2	1	2	N				
1318	2303	232	3	3	2	2	N				
1320	2330	232	3	3	2	2	N				
1321	2342	232	3	3	2	2	N				
1323	2362	232	3	3	2	2	N				
1324	2393	222	2	2	2	2	N				
1325	2509	332	3	3	2	3	N				
1326	2707	232	3	3	2	2	N				
1327	2728	232	3	3	2	2	N				
1328	2829	232	3	3	2	2	N				
1329	2840	232	3	3	2	2	N				
1330	2847	232	3	3	2	2	N				
1331	2913	232	3	3	2	2	N				
1332	3034	232	3	3	2	2	Y				
1333	3036	232	3	3	2	2	N				
1334	3039	232	3	3	2	2	N				
1335	3044	232	3	3	2	2	N				
1336	3272	131	3	2	1	1	N				
1337	3301	232	3	3	2	2	N				
1338	4001	232	3	3	2	2	N				
1339	4002	232	3	3	2	2	N				
1340	4364	232	3	3	2	2	N				
1342	4582	131	3	2	1	1	N				
1344	S109	121	2	1	1	1	Y	S105	Ngongataha	W2B	
1345	S108	121	2	1	1	1	Y	S105	Ngongataha	W2B	
1346	S107	121	2	1	1	1	Y	S105	Ngongataha	W2B	
1347	S106	131	3	1	1	1	Y	S105	Ngongataha	W2B	
1348	S105	131	3	1	1	1	Y	S105	Ngongataha	W2B	
1349	68	232	3	3	2	2	N				
1350	66	222	2	2	2	2	N				
1351	Braemar Springs	231	3	2	1	2	N				
1352	EBOP-noname1	131	3	1	1	1	Y				
1353	EBOP-noname2	131	3	1	1	1	Y		Ngongataha	W2B	
1354	EBOP-noname3	131	3	1	1	1	Y		Ngongataha	W2B	
1355	EBOP-noname4	131	3	1	1	1	Y		Ngongataha	W2B	
1356	EBOP-noname5	131	3	1	1	1	Y		Waiteti		
1357	EBOP-noname6	131	3	1	1	1	Y				
1358	EBOP-noname7	131	3	1	1	1	Y		Ngongataha		
1359	EBOP-noname8	131	3	1	1	1	Y		Waiteti		

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
1360	EBOP-noname9	131	3	1	1	1	Y		Waiteti		
1361	EBOP-noname10	131	3	1	1	1	Y		Ngongataha	W2B	
1362	EBOP-noname11	131	3	2	1	1	N				
2020	BEEK	333	3	3	3	3	N				
2021	ALLEN	333	3	3	3	3	Y				
2055	OHOPEGC	333	3	3	3	3	N				
2056	ETERNAL SPRINGS	333	3	3	3	3	N				
2057	FERNLANDSPA	333	3	3	3	3	N				
2058	PEMBERTON	333	3	3	3	3	Y	S102	Awahou	W4	
3001	Hamurana Spring @ water intake	131	3	1	1	1	Y	S101	Hamurana	N3	
3002	Taniwha Spring @ old well	131	3	1	1	1	Y	S102	Awahou	W4	Area1
3003	Trout Hatchery Spring @ weir	131	3	1	1	1	Y	S104	Ngongataha	W2F	
3004	Te Waireka @ bottling plant intake	131	3	1	1	1	Y		Ngongataha	W2B	
3005	Barlows Spring @ water intake	131	3	1	1	1	Y	S105	Ngongataha	W2B	
3006	2116	131	3	1	1	1	Y	S102	Awahou	W4	
3007	1202	131	3	1	1	1	Y		Waiteti	W3	
3008	1561	131	3	1	1	1	Y		Awahou Point	W4	Area1
3009	Dr. Irvin	131	3	1	1	1	Y		Awahou Point	W4	Area1
3010	3691	131	3	1	1	1	Y	S102	Awahou	W4	
3011	JROYAL	131	3	1	1	1	Y				
3012	3901	131	3	1	1	1	Y				
3013	10424	131	3	1	1	1	Y			S1	
3014	Spring 2	131	3	1	1	1	Y			S1	
3015	Utuhina Spring (main)	131	3	1	1	1	Y		Utuhina	S3C	
3016	Fairy Spring (Te Waiowhero)	131	3	1	1	1	Y		Waiowhiro	W1B	
3017	Awahou Stream @ Central Rd bridge	131	3	1	1	1	Y		Awahou	W4	Area1
3018	Utuhina Spring #1	131	3	1	1	1	Y		Utuhina	S3C	
3019	Utuhina Spring #2	131	3	1	1	1	Y		Utuhina	S3C	
3020	Taniwha Spring @ water intake	131	3	1	1	1	Y	S102	Awahou	W4	Area1
3021	Rainbow Spring	131	3	1	1	1	Y		Waiowhiro	S3A	
3022	Hamurana Spring #1	131	3	1	1	1	Y	S101	Hamurana	N3	
3023	Hamurana head spring	131	3	1	1	1	Y	S101	Hamurana	N3	
3024	Hamurana Spring #3	131	3	1	1	1	Y	S101	Hamurana	N3	
3025	Utuhina Stream @ Lake Rd	131	3	1	1	1	Y		Utuhina	S3A	
3026	Ngongotaha Stream @ Ngongotaha Rd	131	3	1	1	1	Y		Ngongataha	W2A	Area1
3027	Waiteti Stream @ Ngongotaha Rd	131	3	1	1	1	Y		Waiteti	W3	Area1
3028	Awahou Stream @ Hamurana Rd	131	3	1	1	1	Y		Awahou	W4	Area1
3029	Hauraki Stream @ Hamurana Rd	131	3	1	1	1	Y		Hauraki	N1	Area1
3030	Hamurana Stream @ Hamurana Rd	131	3	1	1	1	Y		Hamurana	N2	
3031	Waiohewa Stream @ Te Ngae Rd	131	3	1	1	1	Y		Waiohewa	E2	Area3
3032	Waingaehe Stream @ Te Ngae Rd	131	3	1	1	1	Y		Waingaehe	S1	
3033	Puarenga Stream @ Te Ngae Rd	131	3	1	1	1	Y		Puarenga	S2A	
3034	Kauaka Stream @ Waipa State Mill Rd	131	3	1	1	1	Y		Puarenga	S2C	
3035	Upper Puarenga Stream @ SH5 - Hemo Gorge	131	3	1	1	1	Y		Puarenga	S2C	
3036	Waipa Stream @ Hemo Gorge	131	3	1	1	1	Y		Puarenga	S2A	
3037	Awahou spring #1	131	3	1	1	1	Y		Awahou	W4	
3038	Awahou upstream	131	3	1	1	1	Y		Awahou	W4	
3039	Ngongataha stream @ Paradise springs	131	3	1	1	1	Y		Ngongataha	W2A	
30001	1367-19	131	3	3	1	1	N				
30002	60-12	131	3	3	1	1	N				
30003	60-124	131	3	2	1	1	N				
30004	60-167	131	3	2	1	1	N				

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
30005	60-316	131	3	2	1	1	N				
30006	60-345	131	3	2	1	1	N				
30007	60-348	131	3	2	1	1	N				
30008	60-352	131	3	2	1	1	N				
30009	60-4	131	3	3	1	1	N				
30010	60-407	131	3	2	1	1	N				
30011	60-480	131	3	2	1	1	N				
30012	60-483	131	3	2	1	1	N				
30013	61-113	131	3	3	1	1	N				
30014	61-126	131	3	3	1	1	N				
30015	61-135	131	3	2	1	1	N				
30016	61-143	131	3	3	1	1	N				
30017	61-208	131	3	3	1	1	N				
30018	61-221	131	3	3	1	1	N				
30019	61-23	131	3	2	1	1	N				
30020	61-245	131	3	2	1	1	N				
30021	61-258	131	3	3	1	1	N				
30022	61-280	131	3	3	1	1	N				
30023	61-54	131	3	3	1	1	N				
30024	61-59	131	3	3	1	1	N				
30025	61-85	131	3	3	1	1	N				
30026	61-93	131	3	3	1	1	N				
30027	62-5	131	3	3	1	1	N				
30028	63-201	131	3	2	1	1	N				
30029	63-240	131	3	2	1	1	N				
30030	63-328	131	3	2	1	1	N				
30031	63-43	131	3	2	1	1	N				
30032	63-57	131	3	3	1	1	N				
30033	63-65	131	3	3	1	1	N				
30034	63-74	131	3	2	1	1	N				
30035	63-78	131	3	2	1	1	N				
30036	63-8	131	3	2	1	1	N				
30037	64-108	131	3	3	1	1	N				
30038	64-111	131	3	2	1	1	N				
30039	64-117	131	3	3	1	1	N				
30040	64-12	131	3	3	1	1	N				
30041	64-120	131	3	3	1	1	N				
30042	64-20	131	3	3	1	1	N				
30043	64-43	131	3	3	1	1	N				
30044	64-46	131	3	3	1	1	N				
30045	64-50	131	3	3	1	1	N				
30046	64-511	131	3	3	1	1	N				
30047	64-7	131	3	3	1	1	N				
30048	64-70	131	3	3	1	1	N				
30049	64-831	131	3	2	1	1	N				
30050	65-4	131	3	2	1	1	N				
30051	65-6	131	3	2	1	1	N				
30052	65-8	131	3	3	1	1	N				
30053	66-58	131	3	2	1	1	N				
30054	66-6	131	3	3	1	1	N				
30055	66-92	131	3	2	1	1	N				
30056	66-93	131	3	2	1	1	N				
30057	66-96	131	3	2	1	1	N				
30058	67-11	131	3	3	1	1	N				

Feature ID	Alias	Integrated Descriptor	Date Type	# Type	CBE Type	Nutr Type	In Area?	Spring Catchment	Surface Water Catchment	Groundwater Catchment	Ungauged Catchment Area
30059	67-15	131	3	3	1	1	N				
30060	67-38	131	3	2	1	1	N				
30061	67-4	131	3	2	1	1	N				
30062	67-404	131	3	2	1	1	N				
30063	67-435	131	3	1	1	1	N				
30064	67-483	131	3	2	1	1	N				
30065	67-55	131	3	2	1	1	N				
30066	67-573	131	3	2	1	1	N				
30067	67-83	131	3	1	1	1	N				
30068	68-301	131	3	3	1	1	N				
30069	68-317	131	3	3	1	1	N				
30070	68-320	131	3	3	1	1	N				
30071	68-661	131	3	2	1	1	N				
30072	68-912	131	3	2	1	1	N				
30073	68-964	131	3	3	1	1	N				
30074	69-163	131	3	2	1	1	N				
30075	69-1709	131	3	3	1	1	N				
30076	69-173	131	3	3	1	1	N				
30077	69-19	131	3	3	1	1	N				
30078	69-248	131	3	3	1	1	N				
30079	69-295	131	3	2	1	1	N				
30080	69-365	131	3	3	1	1	N				
30081	69-374	131	3	3	1	1	N				
30082	69-62	131	3	2	1	1	N				
30083	69-81	131	3	3	1	1	N				
30084	69-97	131	3	3	1	1	N				
30085	70-21	131	3	3	1	1	N				
30086	70-22	131	3	3	1	1	N				
30087	70-31	131	3	1	1	1	N				
30088	70-36	131	3	3	1	1	N				
30089	70-44	131	3	3	1	1	N				
30090	70-47	131	3	3	1	1	N				
30091	70-50	131	3	2	1	1	N				
30092	70-56	131	3	3	1	1	N				
30093	70-65	131	3	3	1	1	N				
30094	70-74	131	3	3	1	1	N				
30095	70-76	131	3	3	1	1	N				
30096	71-1	131	3	3	1	1	N				
30097	71-26	131	3	2	1	1	N				
30098	71-3	131	3	2	1	1	N				
30099	71-4	131	3	2	1	1	N				
30100	71-5	131	3	2	1	1	N				
30101	72-1008	131	3	3	1	1	N				
30102	72-1011	131	3	3	1	1	N				
30103	72-1069	131	3	3	1	1	N				
30104	72-1072	131	3	3	1	1	N				
30105	72-1081	131	3	3	1	1	N				
30106	72-1082	131	3	3	1	1	N				
30107	72-1087	131	3	3	1	1	N				
30108	72-1089	131	3	3	1	1	N				
30109	72-1223	131	3	2	1	1	N				
30110	72-356	131	3	3	1	1	N				
30111	72-392	131	3	3	1	1	N				
30112	72-431	131	3	3	1	1	N				

A single integrated descriptor was used to convey information about the number of samples from each site that have been analysed for nutrients (NO_3-N, NH_4-N and PO_4-P), the year in which the most recent sample was collected, and the number of samples for which CBE can be calculated (Table 5.10). This integrated descriptor calculated as:

$$Integrated\ Descriptor = (100 \times Nutr\,Type) + (10 \times Date\,Type) + CBE\ Type$$

The values of the integrated descriptor at sites close to Lake Rotorua are displayed in Figures 5.1-5.4. Of all sites considered in this review, 47% and 22% have integrated descriptor values 131 and 111, respectively (Table 5.11). This indicates that the majority of monitoring sites have only been analysed for nutrient concentrations once (along with other parameters required to calculate CBE). Although the majority of sites have been sampled within the last five years, at many sites, the most recent sample was collected more than ten years ago or the date of sample collection is unknown. Table 5.12 shows the number of sites, categorised by integrated descriptor, that are located within each surface water catchment, groundwater catchment, spring catchment and ungauged catchment area (as defined in Section 7).

Table 5.11 Total number of sites categorised by integrated descriptor (Section 5.2.2).

Integrated Descriptor	Number of Sites	% of Sites
111	92	22
121	51	12
131	191	47
211	1	0
221	1	0
222	5	1
231	10	2
232	44	11
331	5	1
332	3	1
333	6	1

Table 5.12 Number of sites categorised by integrated descriptor (Section 5.2.2) and falling into each groundwater catchment, stream water catchment, spring catchment and ungauged catchment area (Section 7).

Spring Catchment	Integrated Descriptor	Number of Sites
S101	131	4
	111	2
S102	131	4
	333	1
S104	131	1
S105	121	3
	131	3
S112	111	3
	121	1

Surface Water Catchment	Integrated Descriptor	Number of Sites
Awahou	131	8
	333	1
Awahou Point	131	2
	232	1
Hamurana	131	5
Hauraki	131	1
Ngongataha	121	3
	131	12
Pohue Bay	111	3
	131	1
	222	1
Puarenga	111	8
	121	6
	131	9
	211	1
	231	7
	232	1
	331	1
Rotokawa	111	1
Utuhina	121	1
	131	4
Waimehia	232	1
Waingaehe	131	1
Waiohewa	111	2
	131	1
	232	1
Waiowhiro	131	2
Waitawa	111	1
Waiteti	111	4
	131	5
	232	1

Ground Water Catchment	Integrated Descriptor	Number of Sites
E1	111	3
	131	1
	222	1
E2	111	2
	131	1
	232	1
E3	111	1
N1	131	1
N2	131	1
N3	131	4
S1	111	1
	131	3
S2A	131	2
	211	1
	231	2
	232	1
	331	1
S2B	111	3
	121	1
	131	1
	231	1
S2C	111	5
	121	5
	131	6
	231	4
S3A	121	1
	131	2
S3C	131	3
W1B	131	1
W2A	131	2
W2B	121	3
	131	8
W2F	131	1
W3	111	3
	131	2
	232	2
W4	111	2
	131	10
	232	1
	333	1

Ungauged Catchment	Integrated Descriptor	Number of Sites
Area1	131	9
	232	2
Area3	111	3
	131	2
	222	1
	232	1

5.3 Identification of information gaps

The overall aim of this review is to identify information gaps that hinder the construction of a nutrient flux model for the Lake Rotorua area. Construction of such a nutrient flux model requires knowledge of the volumetric flow of water into the lake, and the concentration of nutrients within the water as a function of location and time. In this section, information gaps related to the latter are listed described for the northern, eastern, southern and western areas of the Lake Rotorua catchment.

5.3.1 Northern portion of the Lake Rotorua catchment

The northern portion of the Lake Rotorua catchment includes the Hamurana surface water catchment, which coincides with groundwater catchment N3, along with the smaller groundwater catchments N1 and N2 (Section 7).

There are only five monitoring sites in the northern portion of the lake catchment, all of which have integrated descriptor values of 131 (Table 5.10), indicating that they have only been analysed for nutrients once (along with other ions required to calculate charge balance error), and the samples were all collected within the last five years. These sites are all clustered around Hamurana Spring (Figures 5.1-5.4). Using one sample, Morgenstern et al. (2004) determined that water from Hamurana spring has a mean residence time of 145 years. In accordance with the age of the water, the NO_3-N concentration was low (ca. 0.7 g/m^3), and the PO_4-P concentrations was relatively high (ca. 0.10 g/m^3). Two other samples more recently collected from Hamurana spring have also been analysed for NO_3-N and PO_4-P and have given similar results, suggesting that they are also quite old.

The complete lack of data from the upper portion of the catchment of Hamurana Spring constitutes the most important information gap related to water chemistry in the northern portion of the Lake Rotorua catchment. There is almost certainly a small component of discharge from Hamurana Spring that is younger than 145 years (Morgenstern et al., 2004), and the mean NO_3-N concentration of the spring is known to have increased over the past thirty years (Rutherford, 2003). These two observations suggest that younger groundwaters may have concentrations of NO_3-N that are significantly above the mean spring value of ca. 0.7 g/m^3, due to land use intensification specific to the Hamurana catchment. In order to constrain the effects of younger groundwaters on the present and future nutrient load to Lake Rotorua, two or more monitoring sites should be added to the upper portion of the Hamurana catchment.

The lack of data from groundwater catchments N1 and N2 also represents a significant information gap related to nutrient flux into Lake Rotorua along its northern shore. Groundwater catchments N1 and N2 encompass areas where groundwater does not pass through Hamurana Spring, but rather drains directly into the lake. All previous estimates of nutrient flux into the lake have relied on measurements made at Hamurana Spring, and thus have neglected contributions from these two areas along the lake shore. At least one monitoring site is recommended for groundwater catchment N1, and between one and three monitoring sites are recommended for catchment N2. The locations of these sites should be determined by the surrounding topography and hydrology.

5.3.2 Eastern portion of the Lake Rotorua catchment

The eastern portion of the Lake Rotorua catchment includes the Pohue Bay, Waiohewa and Rotokawa surface water catchments, which coincide with groundwater catchments E1, E2 and E3, respectively (Section 7).

There are ten monitoring sites in the eastern portion of the catchment of Lake Rotorua (nine bores and one stream). Five monitoring sites are in the Pohue Bay surface water catchment (groundwater catchment E1), four are in the Waiohewa catchment (groundwater catchment E2), and one is within the Rotokawa catchment (groundwater catchment E3) (Figure 5.1-5.4). Six of the ten monitoring sites have never been sampled for nutrients, and two of the sites have been sampled for nutrients only once. Of these eight sites, only two have been sampled within the last five years, and for the remaining six, the date of sample collection is either prior to 1987 or unknown. The remaining two sites, ID #'s 286 and 439, have been sampled for nutrients twice, the former within the last year, the latter not since 1998.

Although the geographic distribution of monitoring sites in the Pohue Bay and Waiohewa catchments is adequate, the lack of nutrient concentration data from these sites represents a significant information gap. All sites within these catchment areas should be resampled for nutrients, and preferentially also for a full suite of major elements. The only exception is site

286, which was analysed for nutrient concentrations in 2004. No age determinations have been made at monitoring sites in the Pohue or Waiohewa catchments, although a sample was recently collected by GNS from the Waiohewa Stream (Site ID # 3031) for this purpose. Additional samples for age determination should be collected from the Pohue Bay catchment near the shore of Lake Rotorua (e.g. Site 440), and from both the Pohue Bay and Waiohewa catchments at a greater distance from the lake (e.g. Sites 280 and 672). Note that nutrient flux from the lower portion of the Pohue Bay catchment has not been considered in previous investigations (Figure 5.4).

Nutrient concentrations in the Rotokawa surface water catchment (groundwater catchment E3) are completely unconstrained. Site ID # 442 has never been sampled for nutrients, and there are no other monitoring sites in the area. At least four monitoring sites should be installed in the Rotokawa surface water catchment, half of which should be along the lake shore and half of which should be situated in the upper part of the catchment. Samples from these sites should be analysed for nutrient concentrations and tritium/CFCs/SF_6, and preferably also for the concentrations of a full suite of major elements.

5.3.3 Southern portion of the Lake Rotorua catchment

The southern portion of the Lake Rotorua catchment includes the Waitawa and Waingaehe surface water catchments (which together comprise groundwater catchment S1), the Puarenga surface water catchment (groundwater catchment S2), and the Waiowhiro and Utuhina surface water catchments (which together comprise groundwater catchment S3, although part of the Waiowhiro surface water catchment also lies within groundwater catchment W1) (Section 7).

There are 43 monitoring sites in the southern portion of the Lake Rotorua catchment. By far the majority of these monitoring sites are streams (33 sites), with bores and springs constituting a minority (4 and 6 sites, respectively). There is only one monitoring site in each of the Waitawa and Waingaehe surface water catchments, a bore and a stream site, respectively. Of the 33 sites within the Puarenga surface water catchment, there are 31 stream monitoring sites and just two bores. There are five monitoring sites in the Utuhina surface water catchment, four of which are springs and one of which is a stream site. There are two monitoring sites within the Waiowhiro surface water catchment, both of which are springs, but only one of these (Rainbow Spring, Site # 3021) lies within groundwater catchment S1. Of all 43 monitoring sites in the southern portion of the Lake Rotorua catchment, 11 have never been analysed for nutrient concentrations, and 22 have only been analysed once (most within the past five years). Ten monitoring sites have been analysed for nutrients on two or more occasions, and all but one of these have been sampled within the last five years.

The poor spatial coverage of monitoring sites in the Waitawa and Waingaehe surface water catchments (i.e. groundwater catchment S1) represents a significant information gap. There are only two monitoring sites in this area, and the bore (Site ID # 65) has not been sampled for nutrients. At least three additional monitoring sites should be installed in this area, at least one of which should be along the lake shore towards the mouth of the Puarenga, and at least two of which should be situated in the upper part of the catchment. Samples from these sites should be analysed for nutrient concentrations and tritium/CFCs/SF_6, and preferably also for the concentrations of a full suite of major elements.

The spatial coverage of monitoring sites in the Waiowhiro and Utuhina surface water catchments (which together comprise groundwater catchment S3) is also rather poor and represents another significant information gap. All of the six spring monitoring sites in this area have recently been sampled for nutrients and for tritium/CFCs/SF_6. Although the age determinations are not yet available, the low NO_3-N concentrations imply that the waters presently draining from the springs are all quite old (Morgenstern et al., 2004). As such, samples taken from the springs may not be representative of NO_3-N concentrations in younger groundwaters that might be present further from Lake Rotorua. Rutherford (2003) reported that NO_3-N concentrations in the Utuhina stream have increased over the past three decades, which may be because an increasing proportion of younger groundwater is now discharging from the stream. To address the possibility that groundwaters higher in the catchment will have higher NO_3-N concentrations, at least one additional monitoring site (bores) should be installed.

The temporal coverage of monitoring data from the Puarenga catchment (groundwater catchment S2) is adequate. However, there are two sections of the catchment that are not covered by the existing monitoring sites. One of these is in the vicinity of Rotorua city, to the west of the mouth of the Puarenga stream. Groundwater from this portion of the catchment likely drains directly into Lake Rotorua, rather than passing into the lake via the Puarenga stream. At least one monitoring site, situated along the shore of the lake, should be installed to monitor nutrient flux from the northern and western parts of Rotorua city. The second area of the Puarenga catchment with poor spatial coverage is south of the southern-most stream monitoring sites. There is a fairly large area through which groundwater likely travels prior to discharge to the Kauaka and/or Tureporepo Streams. At least one monitoring site (bore) should be installed in this area, to permit monitoring of nutrient concentrations in groundwaters moving towards these streams.

5.3.4 Western portion of the Lake Rotorua catchment

The western portion of the Lake Rotorua catchment includes a portion of the Waiowhiro surface water catchment (groundwater catchment W1), all of the Ngongotaha surface water catchment (groundwater catchment W2), the Waiteti and Waimehia surface water catchments (which together comprise groundwater catchment W3) and the Awahou and Awahou Point surface water catchments (together comprising groundwater catchment W4 (Section 7).

There are 41 monitoring sites in the western portion of the Lake Rotorua catchment: 23 bores, 11 springs and 7 streams. There is only one monitoring site in the portion of the Waiowhiro surface water catchment that resides within groundwater catchment W1 (i.e. Fairy Spring, Site ID # 3016). Of the 15 sites within the Ngongotaha surface water catchment, five are bores, eight are springs and two are stream sites. There are 11 monitoring sites within the Waiteti and Waimehia surface water catchments, ten of which are bores and one of which is a stream site. There are 12 monitoring sites within the Awahou and Awahou Point surface water catchments, six bores, two springs and four stream sites. There are also two monitoring sites that fall within groundwater catchment W4 but are not assigned to a surface water catchment (Site ID #’s 801 and 814). Of all 41 monitoring sites in the southern portion of the Lake Rotorua catchment, ten have never been analysed for nutrient concentrations, and 27 have only been analysed once (more than half within the past five years). Four monitoring sites have been analysed for nutrients on two or more occasions, and all of these have been sampled within the last five years.

Although there are several monitoring sites close to the lake shore on the western side of the Lake Rotorua catchment, there are few monitoring sites located away from the lake in groundwater catchments W2, W3 and W4. Groundwater from the upper portion of catchment W2 presumably drains through either Barlows Spring or Te Waireka Spring. Morgenstern et al. (2004) reported the mean residence time of water exiting these springs to be 73 years and 26 years, respectively. Thus majority of water discharging from these springs, particularly from Barlows Spring, is relatively old, and likely predates land use intensification in this portion of the Lake Rotorua catchment. For this reason, it is advisable to install at least two monitoring sites (bores) in catchment W2, up-gradient of Barlows Spring and Te Waireka Spring (i.e. further from the lake). Similarly, nutrient concentrations in the upper portion of groundwater catchment W3 are not well constrained. Of the bores furthest from the lake (208, 333, 444 and 640), only one (444) has been sampled for nutrients. It is recommended that the other three bores should be sampled for nutrient concentrations, along with the concentrations of other major elements, and at least two should be analysed for tritium/CFCs/SF_6 to permit age determination. At least two more monitoring sites (bores) should be installed even further from the lake, to obtain nutrient concentration data for the (presumably) youngest groundwaters within catchment W3. Nutrient concentrations in the upper portion of groundwater catchment W4 are also poorly constrained. There is one monitoring site (a bore, ID # 3007) that provides some data on both nutrient concentrations and age. There are two other bores (ID # 801, 814) in the upper part of groundwater catchment W4, but they have not been analysed for nutrient concentrations. These sites are reasonably well situated to provide data relevant to the upper part of catchment W4, and so at least one of them should be analysed for nutrient concentrations (along with other major elements) and for tritium/CFCs/SF_6 to permit age determination.

5.4 Recommendations for forward work

Following the discussion in Section 5.3, a total of at least 18 additional monitoring sites should be selected and sampled, either from existing bores or from newly constructed bores, in the following locations:

- Two or more monitoring sites (bores) in the upper portion of the Hamurana catchment
- At least one monitoring site along the shore of the lake in groundwater catchment N1
- Between one and three monitoring sites along the lake shore in groundwater catchment N2

- At least four monitoring sites in the Rotokawa surface water catchment (groundwater catchment E3), half of which should be along the lake shore and half of which should be situated in the upper part of the catchment
- At least three monitoring sites in groundwater catchment S1, at least one of which should be along the lake shore between Site ID # 65 and the mouth of the Puarenga, and at least two of which should be situated in the upper part of the catchment
- At least one monitoring site, situated along the shore of the lake, in the northwest parts of Rotorua city
- At least one monitoring site south of the southern-most stream monitoring sites in the Puarenga surface water catchment to assess nutrient discharge to the Kauaka and/or Tureporepo Streams
- At least one additional monitoring site up-gradient of Utuhina Spring, in groundwater catchment S3
- Two monitoring sites in groundwater catchment W2, up-gradient of Barlows Spring and Te Waireka Spring (i.e. further from the lake)
- At least two more monitoring sites up-gradient of Site ID # 208, 333, 444 and 640, to obtain nutrient concentration data for the (presumably) youngest groundwaters within catchment W3.

Regardless of whether the sites in the above-mentioned locations are existing bores or are newly constructed, they should all be analysed for nutrients, major elements and tritium/CFCs/SF_6. In addition, as discussed in Section 5.3, the following sites should also be re-analysed some parameters:

- All sites within the Pohue Bay and Waiohewa catchments, except ID # 286, should be re-analysed for nutrients, and preferentially also for a full suite of major elements
- Additional samples for age determination should be collected from the Pohue Bay catchment near the shore of Lake Rotorua (e.g. Site 440), and from both the Pohue Bay and Waiohewa catchments at a greater distance from the lake (e.g. Sites 280 and 672)
- Site ID # 442 (groundwater catchment E3) should be sampled for nutrients, major elements, and tritium/CFCs/SF_6

- Site ID # 208, 333, and 640 (groundwater catchment W3) should be sampled for nutrient concentrations, along with the concentrations of other major elements, and at least two should be analysed for tritium/CFCs/SF_6 to permit age determination
- Either Site ID # 801 or 814 (groundwater catchment W4) should be analysed for nutrient concentrations (along with other major elements) and for tritium/CFCs/SF_6 to permit age determination.

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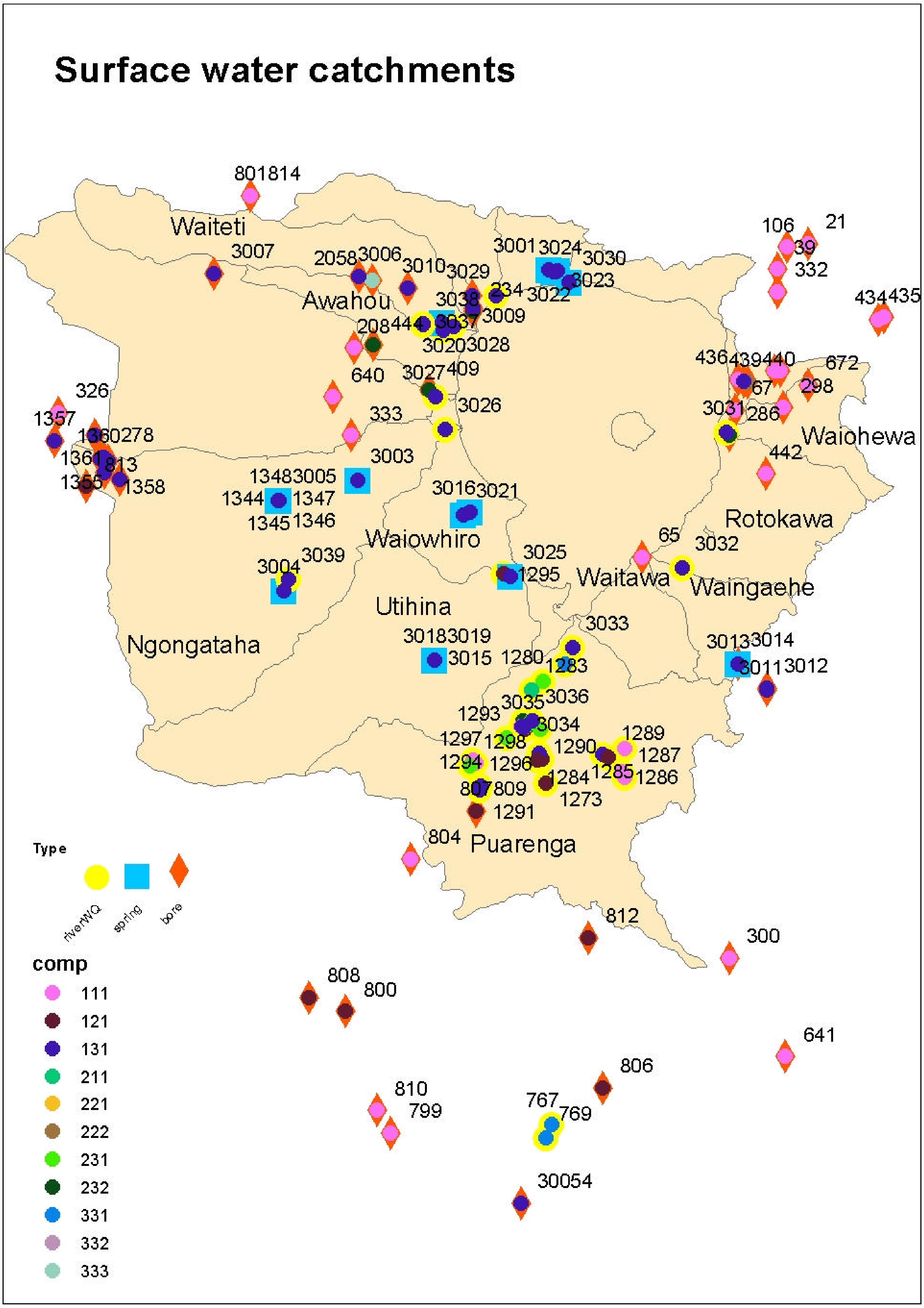

Figure 5.1 Locations of monitoring sites immediately around Lake Rotorua, relative to surface water catchment boundaries (Section 7). Site labels correspond to ID numbers given in Table 5.5. Sites are colour-coded by their integrated descriptor values (Section 5.2.2, Table 5.10) and by site type (bore, river/stream or spring, Section 5.2.2, Table 5.5).

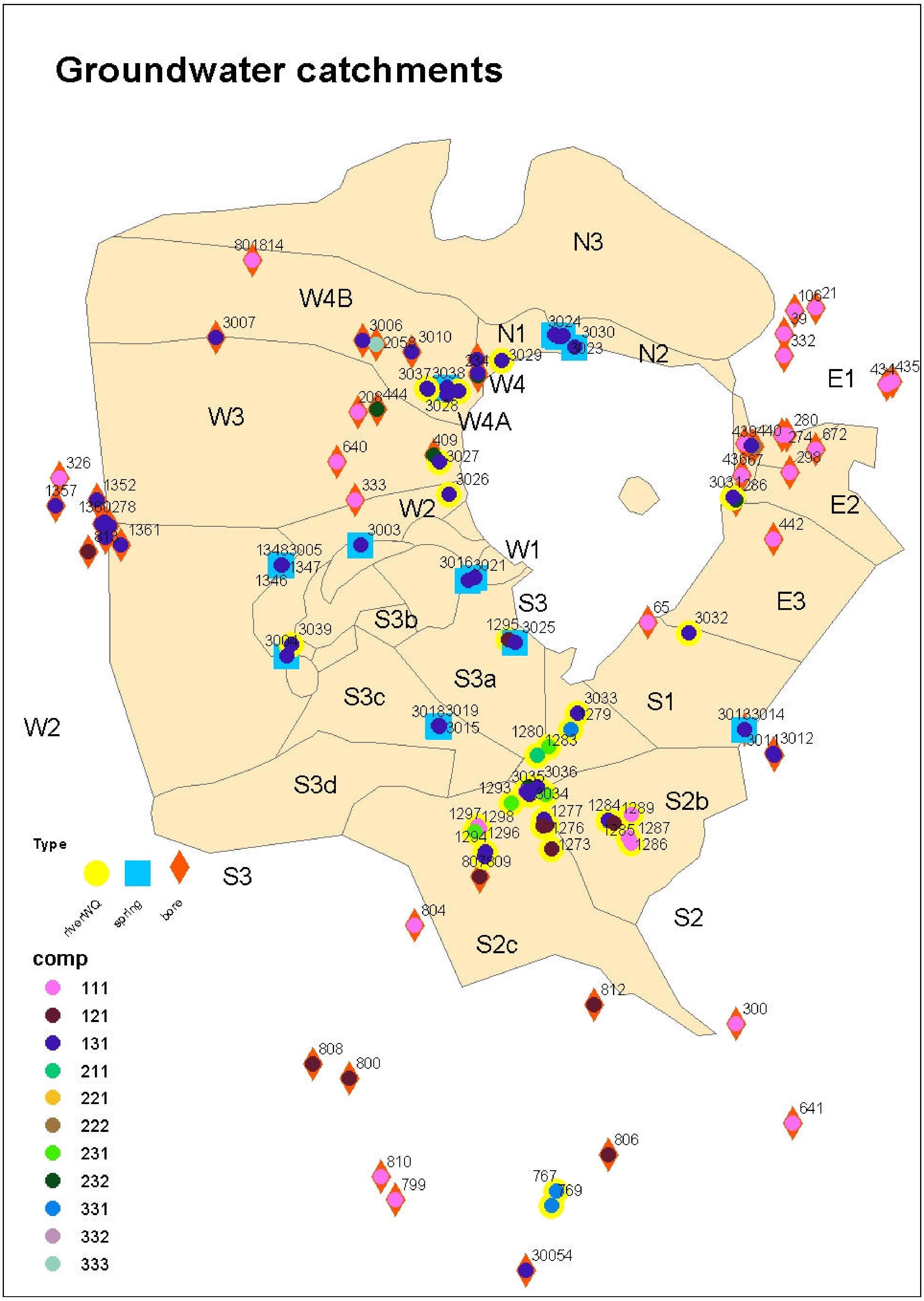

Figure 5.2 Locations of monitoring sites immediately around Lake Rotorua, relative to groundwater catchment boundaries (Section 7). Site labels correspond to ID numbers given in Table 5.5. Sites are colour-coded by their integrated descriptor values (Section 5.2.2, Table 5.10) and by site type (bore, river/stream or spring, Section 5.2.2, Table 5.5).

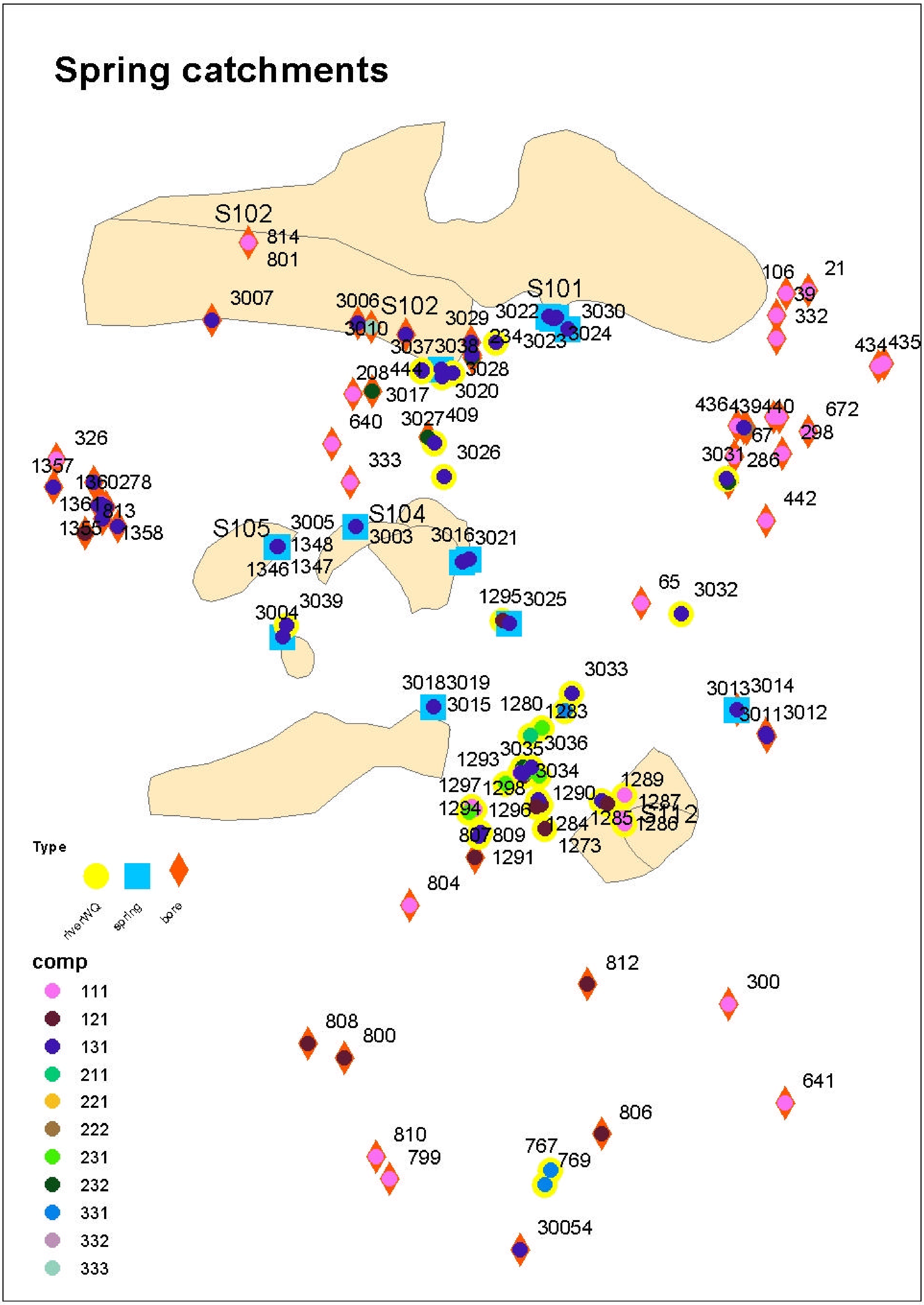

Figure 5.3 Locations of monitoring sites immediately around Lake Rotorua, relative to spring catchment boundaries (Section 7). Site labels correspond to ID numbers given in Table 5.5. Sites are colour-coded by their integrated descriptor values (Section 5.2.2, Table 5.10) and by site type (bore, river/stream or spring, Section 5.2.2, Table 5.5).

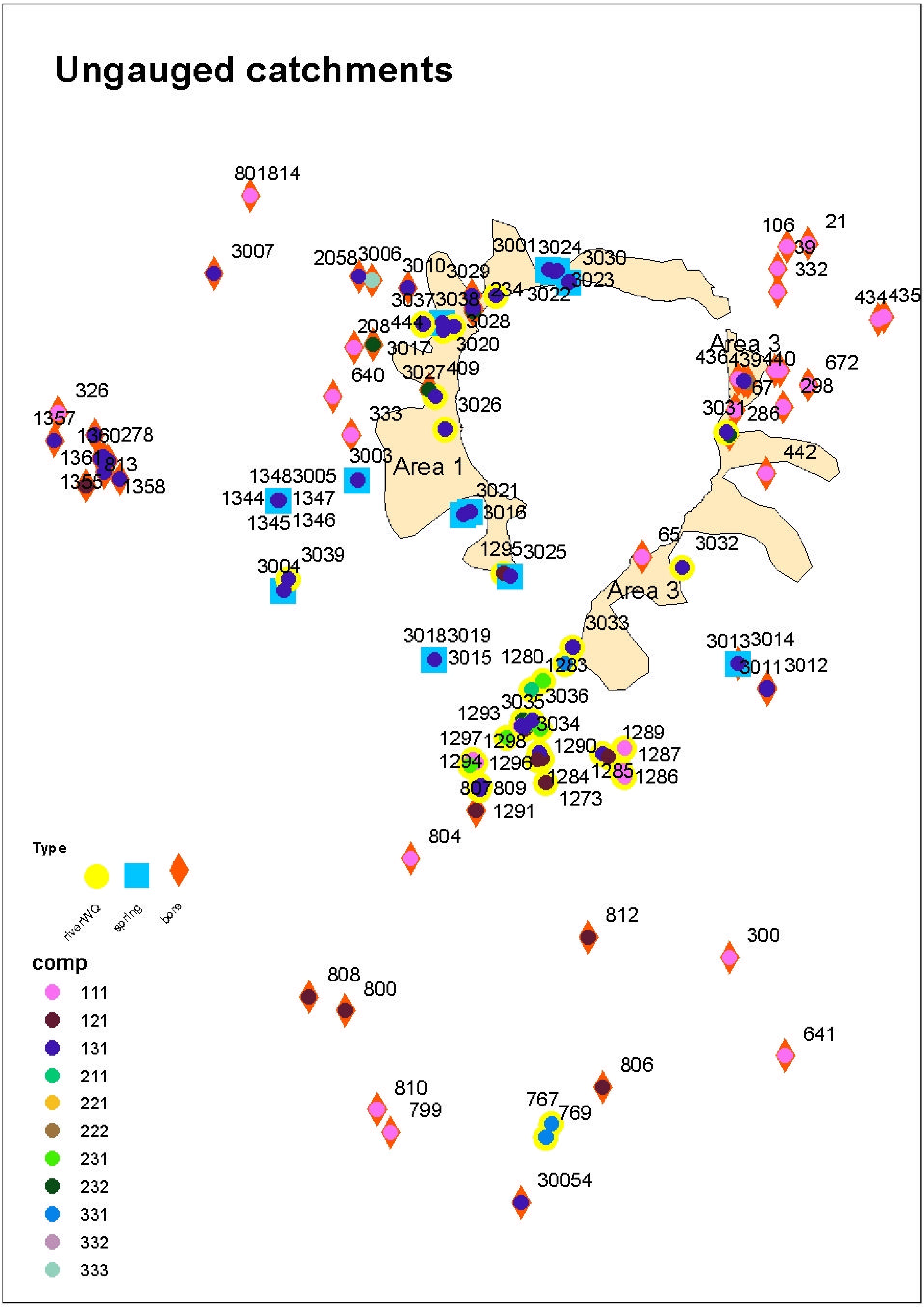

Figure 5.4 Locations of monitoring sites immediately around Lake Rotorua, relative to ungauged catchment areas (Section 7). Site labels correspond to ID numbers given in Table 5.5. Sites are colour-coded by their integrated descriptor values (Section 5.2.2, Table 5.10) and by site type (bore, river/stream or spring, Section 5.2.2, Table 5.5).

6.0 GEOTHERMAL FLUIDS DISCHARGING INTO LAKE ROTORUA

6.1 Introduction

Lake Rotorua occupies a caldera which collapsed 220,000 years ago, following the eruption of the Mamaku Ignimbrite (Wood, 1992; Houghton *et al.*, 1995). There are three identified inputs of geothermal fluids into Lake Rotorua. The first is surface flows from the Tikitere Geothermal Field, which drain naturally into the Lake Rotorua catchment via the Waiohewa Stream, on the eastern side of Lake Rotorua (Figure 6.1). Secondly is thermal discharges from Rotokawa, which is located to the east of the Rotorua Airport on State Highway 30, about 1 km north-east of the Waingaehe Stream inflow to Lake Rotorua (Figure 6.1). The Rotokawa geothermal area appears to be small and considerably cooler than the Rotorua geothermal field, with very little current information available, except for reconnaissance-level surveys conducted by Department of Scientific and Industrial Research (1974), and Drolia *et al*. (1981).

The third and largest geothermal input to Lake Rotorua derives from streams fed by the overflow of surface springs and shallow aquifers from the Rotorua Geothermal Field (Figure 6.1), which is located near the southern margin of the caldera underlying Rotorua City. The field has been much studied due to its scientific, cultural and tourism importance, and monitored over the last 20 years, due to the apparent detrimental effects that unrestricted withdrawal of geothermal fluids was having on the natural features (Allis and Lumb, 1992; Gordon *et al*., 2001).

6.2 Previous work

There are few published studies that have attempted to determine the geothermal nutrient inflows to Lake Rotorua except for client-commissioned reports. Donovan and Donovan's (2003) comprehensive report is the only study that specifically investigated total geothermal nutrient flows into Lake Rotorua. Donovan and Donovan (2003) assessed geothermal nutrient inflows into Lake Rotorua as well as the surrounding lakes, using monitoring data provided by Environment Bay of Plenty (EBOP). The high ammonia and phosphorous content in samples from the Waiohewa stream collected at the Rangiteaorere Bridge (~230 m from the

Lake, BOP120006) are such that this stream alone was estimated to contribute 90% of the geothermally-derived total nitrogen (TN) and total phosphorus (TP) into the Lake; 60.9 and 5.1 t/year respectively (Donovan and Donovan, 2003). However, failures by Donovan and Donovan to differentiate between the nitrogen fluxes from geothermal and non-geothermal sources, and to estimate nitrogen input via ungauged outflows from the Rotorua geothermal field directly into the Lake means that their estimates are not accurate.

The high nitrogen load to Lake Rotorua from Tikitere has prompted the Rotorua District Council (RDC) to propose treatment or diversion of these discharges (Dine, 2004). As part of their ongoing investigations, the Tikitere discharges (downstream, and close to source) were sampled between May and June 2004. This enabled Dine (2004) to estimate the mean TN geothermal flux into the Waiohewa catchment to be 24.5 t/year, which is less than half of Donovan and Donovan's (2003) estimate. The RDC study is continuing to ascertain variability in flow and chemical composition over a longer timeframe.

In a report to the Rotorua District Council, Burns (1999) derived inputs of nutrients carried by all of the Rotorua streams. Unfortunately, no distinction was made between nutrients derived from geothermal fluids, and those from other natural and anthropogenic inputs. In rural New Zealand, nitrogen typically enters shallow groundwater aquifers from the atmosphere, from farm sources such as animal grazing and fertilizers, and from sewage disposal, with the chemical form of the nitrogen leaching to groundwater being controlled by complex reactions of the nitrogen cycle; Close *et al.*, 2001). The approach of Burns (1999) was sophisticated compared to Donovan and Donovan's (2003) study, and of particular value is the interpretation of nutrient fluxes in the Puarenga stream. The report, however, fails to calculate or assess errors (which would have been considerable), such as those associated with the use of flow/concentration correlations of doubtful statistical validity to calculate nutrient concentrations (especially at very high flows). Burns (1999) does, however, make the point that flood flows increase the particulate phosphorous and organic nitrogen fluxes, which are typically biologically unavailable. Burns (1999) derives a TN value of 38.8 t/year gross input of inorganic nitrogen from the Waiohewa catchment, of which 32.5 t/year is inorganic nitrogen (i.e. which may predominantly be of geothermal origin) and 6.3 t/year total organic nitrogen (TON). Gross TP input was 1.5 t/year, of which 1.2 t/year was particulate phosphorous. The TN flux calculated by Burns (1999) is just over half Donovan and

Donovan's (2003) estimate, which is surprising given the data used was the same set supplied by EBOP.

The only study to have systematically investigated the compositional changes in stream discharges along the length of the Waiohewa Stream, including inorganic nitrogen transformations, was published by Williamson and Cooke (1982). Interestingly, their study showed that there is a small unmonitored flow of geothermal fluids past Tikitere, but before the confluence with the Ohuanui Stream, of about 3 t/year TIN.

Glover (1992) published an estimate of mass discharge from the Rotorua Geothermal Field, using a chloride mass balance between all the surface streams able to be gauged and sampled, and the outflow through the Ohau Channel. Glover's (1992) study was based on earlier work by Hoare (1980, 1985), but with improved field sampling and methodology. Hoare (1985) was the first to determine that there was a discrepancy between outflow and inflow chloride, which he speculated was due to a considerable inflow of geothermal fluid to the lake (other than that carried by the streams). Glover (1992) estimated the missing chloride fraction into Lake Rotorua, in 1989/90, to be 58% of the total chloride derived from the Rotorua Geothermal System. The purpose of Glover's (1992) study was to determine the heat flux, through the chloride flux, so the relatively minor components of nitrate and ammonia were unimportant to his study, and correspondingly those constituents were not analysed. Similarly, in recent Environment Bay of Plenty monitoring of heat flux from Whakarewarewa to the Puarenga stream (Gordon *et al*., 2001) there was no interest in the contribution of nitrate and ammonia from the thermal fluids.

The rationale adopted in this review of geothermally-derived inputs to Lake Rotorua, is that it is possible to use Glover's estimates for the geothermal chloride flux, combined with Environment Bay of Plenty Monitoring data, to better assess nitrogen and phosphorous fluxes to the lake from the thermal areas in the Lake Rotorua catchment.

6.3 Nitrogen and phosphorous in geothermal fluids

Before reviewing the previously cited studies in more detail, and assessing the influx of nitrogen and phosphorous to Lake Rotorua, it is instructive to briefly summarise the geochemistry of nitrogen and phosphorus species in geothermal fluids.

As fluids ascend in geothermal systems they boil and are diluted (or vice versa). For example, at the Rotorua Geothermal Field, ascending fluids are thought to boil and then to be diluted and cooled before discharge at Whakarewarewa, whilst to the west (in Kuirau Park) fluids are cooled by dilution at depth before rising and boiling. Boiling flashes off a steam phase rich in gases that can travel independently of the fluid. This steam can condense at shallow levels and mix with aerated groundwaters, with oxidation of the hydrogen sulphide to sulphuric acid producing low pH acidic pools that contain little of the deep mineralised chloride-rich fluid. The latter typically discharges as near neutral alkaline springs, but mixing often occurs between low pH steam condensed fluids and neutral fluids giving a wide variation of composition between the two end members. All these types of features occur across the Rotorua Geothermal Field, but at present only condensed steam fluids occur and discharge at Tikitere. At Rotokawa, published results reported by Glover (1974) indicate near neutral fluids in the geothermal area (except Lake Rotokawa at pH 3.2). Ellis and Mahon (1977) and Henley *et al*. (1984) provide comprehensive descriptions of geothermal water types if more understanding is required.

Geothermal fluids are reducing, and the nitrogen species present in geothermal fluids are nitrogen gas and ammonia, with essentially no organic nitrogen or oxidised species (e.g. nitrate) present. However, nitrate potentially could form in cooler geothermal stream outflows due to microbial and aerial oxidation of ammonia. Although ammonia is highly soluble, a small fraction partitions into the steam phase on boiling. At 150°C the concentration distribution ratio between vapour and liquid is 9.4, but the fraction remaining in solution after boiling may be higher depending on pH (as pH decreases a greater fraction of the total ammonia is present as non-volatile "ammonium"). In the Taupo Volcanic Zone (TVZ), fluids extracted from deep bores are low in total ammonia; generally <10 mg/L $N\text{-}NH_4$ in total discharge (water + steam) and typically <5 mg/L. Fresh aerated groundwaters typically contain similar amount of nitrogen, but as nitrate (Rosen, 2001; Thorpe *et al*., 2004).

Outside of the TVZ, at Ngawha in Northland, the deep well fluids have very high total ammonia concentrations (> 70 mg/L) as well as high boron and hydrocarbon enrichment, due to the organic-rich sedimentary aquifer rocks. Similarly, some springs at Waiotapu in TVZ are high in ammonia, and some of the features there are contaminated with "oil" due to the decomposition of organic material. However, the inference by Donovan and Donovan (2003) that geothermal waters generally have high concentrations of nitrogen (and phosphorus) is not correct.

At Rotorua, the Rotorua Geothermal Field, as well as the smaller Rotokawa thermal area, have fluids with low total ammonia contents, which are similar to the fluids discharged in many other geothermal fields in the TVZ (e.g. Kawerau, Mokai, Orakeikorako). At Tikitere ammonia contents are an order of magnitude higher. This may be due to the decomposition of organic sediments generating ammonia. Acidic pools in the Rotorua Geothermal Field are not enriched with ammonia, probably as the ammonia is stripped from the steam due to partial condensation on its passage up through the shallow aquifers. The soluble ammonia is scrubbed out as well as being fixed as non-volatile ammonium). At Tikitere, ammonia reaches very high concentrations in some pools (at >600 mg/L). Fluid compositions, however, show a wide variation in ammonia concentration, down to 0.1 mg/L (Dine, 2004; Meza, 2004; Sheppard and Lyon, 1979; Glover, 1974), which strongly suggests ammonia is generated close to the surface and localised hydrological/geological factors are influencing the steam condensate compositions, and that it is not a field-wide phenomenon.

The relatively high boron in the Tikitere discharge (e.g. B 29 mg/L, Cl 5.1 mg/L and NH3(t) 701 mg/L in Inferno Pool) also supports a close source, as boron cannot be transported by steam at the assumed Tikitere aquifer temperatures (e.g. at 200^{o}C; the distribution coefficient of boron between steam and water is 0.02). Alternative explanations, such as alkaline conditions making the ammonia more volatile at shallow depths are less likely, and do not account for the higher boron.

In contrast to nitrogen, the geochemistry of phosphorous in geothermal fluids is less complex. It exists only in the liquid phase (dissolved), is reactive and made immobile by formation of highly insoluble minerals such as apatite. Typical concentrations are less than, or close to, the detection limit (0.05 mg/L by ion chromatography) and similar to concentration levels in fresh groundwaters (Rosen, 2001; Thorpe et al., 2004). Phosphorous is not measured routinely in geothermal bore fluids and features, however EBOP routinely monitor phosphorous concentrations (dissolved reactive DRP and total phosphorous TP) in a number of thermal outflows and streams.

Burns (1999) found that for many of the streams at low flow, the TP (i.e. particulate + dissolved phosphorous) was less than DRP (e.g. Hamurana fluid; TP-DPR = -.0114 mg/L, a figure quoted with extraordinary precision). It is likely that the analyses are within analytical error, which for phosphorous are of the order of 0.01 mg/L (using autoanalyser colorimetric methods). Phosphorous was monitored by Dine (2004) as part of that Tikitere diversion study. Typically, at source, the Tikitere stream discharges were <0.05 mg/L DRP and <0.1 TP, which equates to a flux of 0.08 t/year phosphorous (Dine, 2004). At the Rangiteaorere Bridge in the Waiohewa stream, Donovan and Donovan (2003) estimated the total phosphorous flux to be 5.1 t/year, but Dine's (2004) data shows that only a fraction of this phosphorous (appears to) originates with the Tikitere geothermal discharges.

6.4 Tikitere - Waiohewa Stream

The Tikitere Geothermal Field is located between SH30 and the southern shoreline of Lake Rotoiti, north-east of Lake Rotorua, and has an area of about 10 km^2. No deep wells (>500 m) have yet been drilled at Tikitere, but a number of shallow wells were drilled there 1960s, confirming the presence of high temperature fluids at shallow depths in parts of the field. Most of the thermal activity in the Tikitere area consists of steaming and highly altered ground. Geophysical surveys have pointed to a low resistivity anomaly of about 4 km^2 in the central part of the Tikitere thermal area, associated with elevated temperatures, mineralised fluids and alteration clays, aligned in a NE-direction, which supports inferences that permeability is mostly controlled by NE-trending faults. The surface geology of Tikitere has been described by Espanola (1974), and comprises high and low permeability volcanic breccias and ignimbrites overlying a fractured greywacke basement.

Comprehensive descriptions of the fluid, gas and isotope chemistry of the thermal features and shallow boreholes at Tikitere are given in Sheppard and Lyon (1979), Klyen (1970) and

Glover (1974), which indicate that Tikitere thermal features include steam and gas-heated pools and springs. Waters from some low-lying springs have elevated chloride contents, but all have been diluted by shallow bicarbonate/sulphate, acid-condensate waters. Stable isotope studies confirm that the discharged waters are mostly of shallow meteoric origin (i.e. steam-heated groundwater). Fluid geothermometry (i.e. T_{NaKCa}) points to aquifer temperatures of 180-230°C in a mixed zone of condensate and deep mineralised fluids containing 1800 ppm Cl, and 10-15wt% CO_2; Sheppard and Lyon, 1979), overlying a two-phase zone. Some of the chloride water reaches springs near Lake Rotoiti (as well as Hells Gate bores), where it is diluted by the steam condensate and groundwater, whilst several features overflow into the Waiohewa Stream that flows in a southwest direction towards Lake Rotorua (Figure 6.1).

The summary of the Waiohewa Stream nutrient fluxes found by previous workers is listed in Table 6.1. Dine's (2004) data was collected close to the outflow from the Tikitere field, whereas the other studies are reported for river samples collected at the SH30 bridge. Williamson and Cooke (1982) found that about 10% of the total nitrogen entered the catchment in ungauged flows before the confluence of the Ohunaui Stream, so Dine's (2004) estimates of nitrogen should be increased by about this amount to give a better estimate of the geothermal flux. Dine suggests other chemical species in the Waiohewa Stream discharges present "no issues", although his report did infer silica and calcium contents could pose potential scaling problems in future stream piping/discharge disposal initiatives.

Table 6.1 Geothermal loads of total nitrogen (TN) and total phosphorous (TP) in the Waiohewa Stream.

Study	**Flow**	**TIN**	**TON**	**TN**	**DPR**	**TP**
	m^3/s			**t/year**		
Donovan & Donovan (2003) ‡	0.44			60.9		5
Burns (1999) ?	0.308	32.5	6.3	38.8	0.3	1.5
Williamson and Cooke (1982)*	0.263	30.3	4.1	34.3	0.07	0.8
Dine (2004) †**	0.02			24.5?		0.08
Mean Values: ‡ average; ? flow weighted; ** not known, * base flow measurement † Flow at Tikitere; ? no organic N						

The analyses reported by Dine (2004) show that total kjeldahl nitrogen, which measures organic nitrogen + ammonia, is similar to the total ammonia indicating little or no organic nitrogen load. In the flows containing the main geothermal discharge, with ammonia concentrations of about 50 mg/L, total oxidised nitrogen (TOXN = nitrate + nitrite) amounted to < 0.1 mg/L. It is likely nitrification is suppressed by the low pH of these discharges (~ pH 3) as suggested by Williamson and Cooke (1982).

The approach of Burns (1999) was to calculate net and gross loads of nutrients using flow-duration and flow-concentration relationships. Summing over the total duration of the record allows an estimate of the loads as well as flow-weighted mean concentrations. There are uncertainties with the method, such as poor correlations with flow of dissolved species, so it may have been preferable to assume the concentration of dissolved constituents was independent of flow rate (as assumed by Hoare, 1980, 1985). In contrast, particle and organic nitrogen show positive correlations with flow, which is expected if they are associated with sediments. Burns (1999) says that analyses of samples are not usually available for high flow, but as this only increases the concentration of particulate phosphorous and organic nitrogen, both of which are biologically unavailable, this is not a serious limitation of his approach.

The values determined by Burns (1999) and Williamson and Cooke (1982) agree reasonably well, but this could be a coincidence given the latter was derived from only one measurement. There are two main areas of discharge at Tikitere, which overflow into the Waiohewa Stream. Dine (2004) combined the loads from the two areas to give a mass load of 24.5 t/year nitrogen and 0.08 t/year phosphorous, which is in reasonable agreement with other TIN (total inorganic nitrogen) estimates once the ungauged geothermal contribution is added (~ 2.5 t/year), as well as the load in the Ohuanui and Wairewarewa Streams TIN (~3 t/year), assuming values derived by Williamson and Cooke (1982) are still correct.

There is some difficulty in understanding the discrepancy between the higher values reported by Donovan and Donovan (2003), as they used the same data set provided by Environment Bay of Plenty. The data set is published in Donovan and Donovan's (2003) report and covers the period from 6/7/92 to 22/6/95, as well as 8 values for 2002-03 which were not available to Burns (1999). However, it appears flow measurements were not undertaken at the time of sampling since the end of 1993. An average of the flows and analytical data does give the high values derived by Donovan and Donovan (2003) for the Waiohewa Stream, of 60.91 tonne (total) nitrogen/year and 5.06 tonne (total) phosphorous/year into Lake Rotorua. However, if the time-weighted mean flow calculated by Burns (1999) using the flow-duration curve is used (0.308 m^3/s), with the average concentration to end of 2003, then the fluxes are reduced to 42 t/year TN and 35 t/year TIN, respectively. Calculating a simple flow-weighed average of the data over the range where flows are available, but using the mean flow derived by Burns (1999), gives 34 t/year TN and 31 t/year TIN respectively. This means that Donovan and Donovan's (2003) result is an artefact of calculating the mean flow and mean concentrations. Using a more robust estimate of the (mean) flow and flow-weighted concentrations naturally gives better agreement with Burn's values.

The apparent high nitrogen load to Lake Rotorua from the Tikitere thermal area prompted the Rotorua District Council to undertake additional surveys between May and June 2004, which led to new estimates of mean inputs into the Waiohewa catchment of 24.5 t/year nitrogen and 0.08 t/year phosphorous (Dine 2004). However, about 10% of the total inputs enter the Waiohewa catchment in ungauged flows (Williamson and Cooke, 1982), so Dine's (2004) estimates should be increased by about this amount, in order to provide a better estimate of the geothermal flux being discharged to Lake Rotorua via the Waiohewa Stream, i.e. about 27.0 t/year total nitrogen, and 0.09 t/year total phosphorous. Dine (2004) used mean flows to determine the nutrient flux, but this is not a serious limitation as Tikitere discharges are relatively constant and stream flows were measured close to source. Burn's (1999) estimates are higher than Dine's (2004) but include all non-geothermal sources of N and P.

6.5 The Rotokawa thermal area

The thermal area at Rotokawa (0.20 km^2 areal extent), located 1 km SE of Rotorua Airport has been described by Department of Scientific and Industrial Research (1974) and Drolia *et al.* (1981), but it has otherwise received little interest from the geothermal community. Its surface thermal features are unremarkable, comprising a natural warm spring (40-45°C; discharging at 0.3 L/s into an artificial pool known as "Maori Bath"), gas (CO_2) and water discharge into the algae-infested Lake Rotokawa (in "Bubble Bay"), and a cool spring (~15°C; 3 L/s) about 1250m north of Lake Rotokawa (Glover (1974). Warm springs have also been reported to discharge into Lake Rotorua, north-north-east of the airport, but these were below the water level at the time of Glovers' survey. Hot water (maximum temperature of 115^{o}C) has been encountered by shallow boreholes used for domestic supply and greenhouse heating.

A reconnaissance survey by Department of Scientific and Industrial Research (1974) pointed to a low resistivity structure of limited extent, centred on Lake Rotokawa, caused by the presence of hot, mineralised fluids at shallow depth. The survey indicated that the low resistivity zone was confined to two elongate areas, which intersect in the "Maori Bath" area. The resistivity pattern was interpreted by Drolia *et al*. (1981), who suggested that the resistivity structure is the effect of two steeply dipping fracture zones (trending WNW and NEN respectively) which cross each other. The intersection provides pathways for thermal fluids to ascend to the surface, with 4-m ground temperature surveys and bore monitoring pointing to minor lateral outflow in a north-easterly direction.

Geochemical surveys were conducted by Glover (1974) and Drolia *et al*., (1981), based on sampled wells and thermal features. The later study suggested thermal activity had changed, as they were unable to locate some of the earlier sampled springs. The studies found that the thermal waters discharged at the surface are dilute, neutral sodium-chloride type fluids (181-187 mg/L chloride in the "Maori Bath" and 359 – 422 mg/L Cl in Lake Rotokawa, whilst the Wharenui Spring 750 m south of Maori Bath has 18-31 mg/L Cl). Although T_{NaKCa} geothermometry pointed to a source temperature of 315-350^{o}C, the deep aquifer is more likely to be 270-325^{o}C. Waters from bores in the Rotokawa area were analysed by Department of Scientific and Industrial Research (Glover, 1974), and found to contain 1.03 to <0.1 mg/L ammonia (average 0.3 mg/L NH_3), compared to 0.15 mg/L NH_3 in Maori Bath. Both studies concluded that the thermal area is of limited extent, with significant dilution of the thermal waters by cold groundwaters. It is unlikely that the Rotokawa thermal area is connected (e.g. as an outflow) to the Rotorua geothermal system, 8-10 km to the SSW.

Neither is there a clear indication of near-surface thermal waters at Rotokawa reaching Lake Rotorua, either through shallow aquifers or via overflow of the springs. Glover (1974), however, noted reports of springs discharging into the lake and suggested thermal waters might flow at shallow depths westward to Lake Rotorua. Later, Drolia *et al*. (1981) used apparent resistivity mapping and ground/downhole bore temperature data to indicate that the

Rotokawa thermal area did not extend beyond Rotorua airport towards the lake. This strongly suggests the thermal area at Rotokawa is quite constrained, and relatively isolated from Lake Rotorua. It is therefore likely that the Rotokawa Thermal Area is a negligible source of geothermally derived nutrients.

Donovan and Donovan (2003) makes no reference to the Rotokawa thermal area in their estimation of geothermal nutrients inputs to Lake Rotorua, neither in reference to possible nutrient inflow into Lake Rotokawa, or related to nutrient input to Lake Rotokawa from the discharge of geothermal fluids derived from the Rotokawa area. South of the Rotokawa thermal area, however, is the Waingaehe Stream, which was incorporated in the chemical surveys of Hoare (1985) and Glover (1992). There is no obvious hydrological connection between the Rotokawa thermal area and Waingaehe Stream, although the low flow-rate stream (245 kg/s) does contain somewhat elevated SO_4 concentrations (14.2 mg/kg SO_4, compared to 4.5 mg/kg SO_4 for the non-thermal Awahu Stream on the other side of Lake Rotorua (Glover, 1992), albeit much less than for the Puarenga and Waiohewa Streams).

6.6 The Rotorua geothermal area

6.6.1 Rotorua geothermal system – overview

The Rotorua geothermal system is one of about a dozen large active hydrothermal systems located within the central part of the TVZ, in a region characterised by catastrophic caldera-forming Quaternary rhyolitic volcanism. The Rotorua geothermal system, as defined by surface activity, shallow drillholes, geophysical (electrical resistivity) and geochemical surveys covers an area of 18-28 km^2 and occupies the southern margin of the 25 km diameter Rotorua basin, which was formed from caldera collapse associated with the eruption of the 220,000 year-old Mamaku Ignimbrite (Wilson *et al.*, 1995). Wood (1992) describes the geology of the Rotorua geothermal area, which comprises caldera-infilling pyroclastic materials, rhyolite lava flows and domes, and lake sediments. Shallow drilling of geothermal bores, for abstraction of thermal fluids for heating and direct uses has provided good stratigraphic information about the shallow geology and hydrology of the area, although little is known about the geology, structure and hydrology of the geothermal system deeper than ~300m below ground level.

Fluid flow within the Rotorua geothermal system is largely constrained by geological structures (e.g. the Kuirau Fault was identified on the basis of surface thermal activity, high downhole bore temperatures, and rhyolite surface morphology), and by the properties of the subsurface formations (their natural porosity and permeability) and the thermal fluids.

The geysers and other geothermal manifestations of the Rotorua area have long been valued, with the active thermal area being one of New Zealand's major tourist attractions. Prior to European settlement, Maori used the thermal waters for bathing, cooking, heating and processing natural products. Geothermal drilling began in Rotorua City in the 1920s', with local residents taking advantage of the thermal waters by drilling wells to extract the fluids for domestic and commercial heating and hot water supply. During the 1970s and 1980s the extraction of subsurface fluid started to reach a level where there was concern that the geysers and hot springs would suffer a decline, or even failure. Fears that the geysers, in particular, would be lost if exploitation of the field continued at the same rate, prompted a government-enforced closure, mostly in 1987, of all wells within 1.5 km of Pohutu geyser. Chemical monitoring of the thermal features, during the early days of exploitation, and in recent times, has provided much information about the hydrology of the Rotorua geothermal system, and the chemistry of the hot mineralised fluids that mix with surface groundwaters, discharge at the surface, and flow into Lake Rotorua.

Glover (1974) compiled data for all chemical surveys undertaken in the Rotorua field up to the mid 1970s, and provided a general outline of the field hydrology, and upflow of hot chloride-type thermal fluids near Whakarewarewa. Glover inferred that the deep thermal waters mixed with a secondary flow near the Pukeroa Dome, with both being diluted with low chloride groundwaters as they flowed northwards. By 1985 additional information had been obtained from the field, recognising the structural control on fluid flow as well as additional, geochemical analyses of the bore and spring waters. This led to a general model of the Rotorua geothermal field, whereby springs at Whakarewarewa were directly fed by a 230°C deep aquifer, with other upflow zones identified at Ngapuna, and lateral flows extending north and west beneath Rotorua City.

Giggenbach and Glover (1992) suggested that the main upflow zone of deep geothermal fluid at Rotorua occurred in the eastern part of the field, and supplied the Whakarewarewa area (characterised by alkali-chloride, near boiling/boiling springs and geysers), with dilution by meteoric waters, whilst an upflow of more altered bicarbonate-rich fluid, cooled by long contact time and diluted by meteoric water, fed wells and surface features in the western part of the system. Glover (1992) indicated, from chloride budgets, that ~60% of the total output from the field discharged through the lake bottom, which implied excellent hydraulic connection between the lake floor and the geothermal aquifer.

In contrast, Stewart *et al*. (1992) proposed a model of the Rotorua geothermal field, based on water/gas isotopic and chemical data, which pointed to deep aquifer fluids rising in the east, and boiling as they approached Whakarewarewa and Ngapuna (where the hottest bore fluids are encountered). Waters discharging at the surface at Whakarewarewa (and Arikikapakapa, where acidic cold lakes and steaming ground are encountered) contain minor amounts of bicarbonate, but were diluted by groundwater, before boiling, Stewart *et al*. (1992) suggested that a component of this fluid flows below shallow lake sediments that underlie Rotorua City, where they are diluted with bicarbonate-chloride waters, before mixing with cool, near surface groundwater (and steam-heated fluids) and discharging in the Kuirau/Ohinemutu area. Graham (1992) suggested a deep origin for the primary thermal waters (at >2 km depth), with direct upwelling in the east, plus fluid flow to the west, which undergoes dilution by old groundwater. Subsequently, Glover and Mroczek (1998) examined changes in silica chemistry and hydrological connections across the Rotorua Geothermal Field, and their work pointed to two diluting fluids in the system – one at 15^{o}C and another at 150^{o}C, supporting the shallow mixing model of Stewart *et al*. (1992).

Figure 6.2 is a schematic representation of fluid flow paths in the Rotorua geothermal system, which incorporate the fluid flows proposed by Giggenbach and Glover (1992), Stewart *et al*, (1992) and Graham (1992). The figure highlights two natural spring areas; (i) Ngapuna, Whakarewarewa, and (ii) Kuirau, Ohinemutu; and how these two parts of the Rotorua system may be connected and supplied by thermal fluids. Fluid rises in the eastern part of the geothermal system, with its outflow comprising discharge to thermal features at Whakarewarewa and Ngapuna, lateral flow to the western thermal areas and extraction of fluid from geothermal wells. Shallow mixing can supply fluid to thermal features in Kuirau and Ohinemutu areas, whilst there is also likely to be an input of deep thermal fluids that have a pressure effect on the system.

6.6.2 Puarenga Stream, and other thermal contributions

The Puarenga Stream carries waters from the large rural catchment to the south of Rotorua City, non-thermal urban discharges, and the overflow of waters from the Whakarewarewa thermal area and several minor thermal areas. A few studies in the past have evaluated mass flows and chloride fluxes from the Puarenga Stream (e.g. Glover, 1992), as well as the nutrient input it carries to Lake Rotorua (Burns, 1999). By evaluating the chloride flux carried by Puarenga Stream, we are better able to assess the contribution of all geothermal fluids to the influx of nitrogen and other nutrients to the Lake Rotorua system. This is because ammonia, nitrate and phosphorous are typically only minor components (often below detection limits for the latter two) and are not usually analysed for in geothermal fluids (particularly in early studies).

During his 1992 survey, Glover collected samples and measured flow rates at sites along the Puarenga Stream and downstream of the Forest Research Institute (FRI) (i.e. Arikikapakapa Stream, at the "Dump" gauging site and near outflows from the Ngapuna Springs). Glover (1992) expanded surveys undertaken by Hoare (1985) who reported chemical fluxes through the Puarenga Stream based on samples collected between March 1978 and February 1980 (chloride measured monthly, and other constituents twice during the survey period). Fluxes were obtained by Hoare using the approach described previously for the Waiohewa Stream. Hoare (1985) assumed chloride concentrations at Puarenga Stream did not vary with stream mass flow, like his interpretations for other stream inflows to Lake Rotorua.

Glover (1992) recognised that data for the Puarenga Stream must be treated carefully, as flow measured at the FRI gauging station is made up of two components. The first represents cold groundwater, which can be measured at Hemo Gorge (before the stream enters the Whakarewarewa thermal area), and the second is the thermal inflow from Whakarewarewa. Glover (1992) clearly showed that the chloride concentrations in the Puarenga Stream decreased with increasing mass flow of water, although there was some addition of Cl-rich thermal water swept from the Whakarewarewa system by heavy rain. He concluded that this behaviour was due to upstream low chloride (5 mg/kg) waters diluting the geothermal chloride inflow, (contrary to the non-thermal Ngongotaha Stream, where chloride concentrations are independent of flow; Hoare, 1985. Glover (1992) calculated that the adjusted mean flow of the Puarenga Stream, from 1982 to 1990, was 1754 ±90 kg/s, with a chloride flux of 78 ±6.5 g/s.

A number of other thermal streams discharge into the Puarenga Stream downstream of FRI. They come from the Arikikapakapa area, the Water Treatment Plant outfall, subsurface thermal inputs, and streams draining from the Ngapuna area. Glover (1992) showed that the chloride flux between FRI and the "Dump" site was 42.5 ±7 g/s, which was about 2/3 of the contribution from the Whakarewarewa area, and therefore significant. Other discharges to the Puarenga Stream occur below the "Dump", although it was not possible for Glover to accurately measure their chloride fluxes, due to sluggish flow and poor mixing. Altogether, he estimated that 18 ±4 g/s of the chloride flux can be attributed to the minor sources and the main Ngapuna Springs. Together with the measured chloride flux (below the "Dump"), he estimated that about 60 ±8 g/s of the Cl was input below FRI.

Glover (1992) highlights the fact that the fluxes of all analysed species leaving Lake Rotorua (except Mg and Ca) are much greater than the input from land-based geothermal discharges (Glover estimated the total flux leaving Lake Rotorua to be 541 ±60 g/s chloride). In part, the apparent higher flux of species leaving the lake (compared to calculated inputs) may be explained by the influx from minor tributaries not covered in his survey, other unmeasured flows into the lake and rain. Hoare (1980) estimated that the "unmeasured flow", based on an estimation of rainfall on the lowlands around the lake, minus evaporation, to be 420 ±780 kg/s (hence little evidence for a "missing load"). As discussed by Glover (1992), the large chloride "missing load" (of 315 ±60 g/s chloride) must be associated with a water mass flow (considering the total influx to the lake from surveyed inflows is 226 ±12 g/s chloride, and total out via the Ohau channel is 541 ± 60 g/s chloride). Some of this will be by direct flow into the floor of the lake via deep geothermal aquifer(s). Overall, Glover (1992) estimated about 58% of the chloride discharge from the Rotorua system is directly injected into the lake, and much of it comes via 'sub-aqueous' vents into the lake floor, via fractures.

Glover suggested that the flow of geothermal fluids into the floor of the lake is likely to have increased following the 1986/87 period of bore closures, as aquifer pressures have increased (evidence of increased flow is provided by comparing the apparent increase in chloride flux from 1978/80 to 1989/90). Another part of the "missing load" to Lake Rotorua is likely to be through the disposal of waste thermal bore water, which is likely to reach the lake via the permeable Rotorua Tephra. Glover (1992) calculated this could provide an input of 312.5 kg/s. So, for an average chloride concentration of 400 mg/kg, this flow would account for 125 g/s of the missing 315 ±60 g/s Cl load and the rest could be natural outflow through the same aquifer.

6.6.3 Input of Nitrogen and Phosphorous to Lake Rotorua, via Thermal Streams

Donovan and Donovan (2003) estimated the geothermal inflows into Lake Rotorua to contribute 7.7% of the total phosphorous and 12.4% of the total nitrogen input in the lake. They suggested that the total input budget to Lake Rotorua was 67.3 t/year total nitrogen and 5.6 t/year total phosphorous, although the principal input of “geothermally derived phosphorus and nitrogen” was the Waiohewa Stream (receiving discharge from the Tikitere thermal area of 60.9 t/year total nitrogen, and 5.06 t/year total phosphorous). Those authors point out that thermal activity in the vicinity of Rotorua City is concentrated on the Whakarewarewa area, but with associated features being Puarenga Stream, Kuirau Park, Ohinemutu, Arikikapakapa, Mokoia Island, Waipa, Ngapuna and Government Gardens. Based on EBOP data Donovan and Donovan (2003) included in their summary, several streams that flow into the southern part of Lake Rotorua have a geothermally-induced component to their compositions, namely Puarenga Stream (receiving discharge of acid sulphate-type waters from Whakarewarewa), Ohinemutu Springs, Tunuhopu Springs, Black Stream, Sewer Stream, Pipe Stream, Polynesian Springs North and South, and Springs Outlet. These streams were also all included by Glover (1992) in his geothermal chloride flux measurements.

Excluding data from Waiohewa Stream (detailed earlier), the other geothermal sources listed by Donovan and Donovan (2003) (i.e. from the Rotorua Geothermal Field), contribute an estimated 0.42 t/year phosphorous and 1.39 t/year total nitrogen (total kjeldahl nitrogen + total nitrogen oxides), as shown in Table 6.2.

Burns (1999) also estimated the gross TN and TP fluxes from the thermal streams by multiplying observed flows by observed concentrations, giving a TP flux of 0.4 t/year and TN flux 1.33 t/year, in good agreement with Donovan and Donovan (2003). For comparison, Burns (1999) estimated a TN flux of 32.7 t/year from the Rotorua CBD and small non-thermal city streams all of which are unlikely to be of geothermal origin.

Table 6.2 Geothermal inflows to Lake Rotorua from the Rotorua Geothermal System (excludes inputs from Waiohewa Stream). Data reproduced from Table 1A of Donovan and Donovan (2003). See Figure 6.1 for the stream locations.

Geothermal Inflows	Flow (m^3/s)	Mean discharge total phosphorous (t/year)	Mean discharge total kjeldahl nitrogen + total nitrogen oxides (t/year)
Ohinemutu Springs	0.01	0.03	0.15
Tunuhopu Springs	0.01	0.04	0.15
Black Stream	0.01	0.06	0.35
Sewer Stream	0.014	0.14	0.11
Pipe Stream	0.003	0.02	0.06
Polynesian Springs S.	0.0012	0.01	0.02
Polynesian Springs N.	0.011	0.10	0.48
Springs Outlet	0.0015	0.02	0.07
Total		0.42	1.39

6.6.4 Input of Nitrogen and Phosphorous to Lake Rotorua, via Puarenga Stream

Unfortunately data from Puarenga Stream seems to have been erroneously excluded from the tabulated results of Donovan and Donovan (2003). Subtracting the listed inputs in Table 6.2, from their total flux gives an estimate of 5.0 t/year TN and 0.1 t/year TP for all remaining geothermal inputs. This can be assumed to be via the Puarenga Stream as there are no other major geothermally influenced streams flowing to the lake.

Data for Puarenga Stream has been supplied by EBOP (the same data set used by Donovan and Donovan, 2003 and Burns, 1999), and this has been used here to re-estimate the influx of nitrogen and phosphorous to Lake Rotorua via Puarenga Stream (Table 6.3). Water samples were collected at several points along the Puarenga Stream, at “Hemo” (located at U16/9470-3140) and “State Highway 5” (U16 9460-3120), which are upstream of the thermal area at Whakarewarewa (so these samples have no geothermal input and are essentially cold groundwater). Other water samples were collected within the “Whakarewarewa” area (at U16/9540-3280) and downstream of Whakarewarewa, at the “Puarenga – FRI” site (U16 9620-3340) with both having a significant geothermal component. Burns (1999) derived a weighted mean flow of 1.817 m^3/s at the FRI site in ~1992-1995, which compares favourably with Glover's (1992) estimate of 1754 kg/s. The mean flow over the same time period was 2.177 m^3/s (using the EBOP dataset); whilst incorporating additional measurements from 2001-02 lowers the calculated mean flow to 2.137 m^3/s. Thus, as for the Waiohewa catchment, differing methodology for deriving the mean flow has a great impact on the annual flux estimate of nutrients flowing to the lake via the Puarenga Stream.

The clear contribution of geothermal fluids to the Puarenga Stream at "Whakarewarewa" and "Puarenga-FRI" are shown by increased chloride contents, but there is negligible change in nitrogen and phosphorous contents in waters collected upstream or downstream of the main geothermal area. Table 6.3 shows the concentrations of chloride-rich waters to the Puarenga Stream near Whakarewarewa, as the stream flows towards Lake Rotorua (with 4.1 g/m^3 Cl in the Hemo area, but a chloride concentration of 52.8 g/m^3 at Puarenga-FRI), whereas averaged data for total phosphorous and total nitrogen contents in the stream water are little changed between the "upstream" Hemo site, and the "downstream" Puarenga-FRI sites.

Table 6.3. Mean chloride, total phosphorous, total kjeldahl nitrogen and total nitrogen oxides concentrations in Puarenga Stream, based on EBOP data provided to GNS. Samples were collected between August 1984 and June 2004 (not always from every site on the same day). Stream flows were only supplied (in EBOP data) for the Puarenga-FRI site.

Sample Location	**Chloride (g/m^3)**	**Total phosphorous (g/m^3)**	**kjeldahl (TK) Nitrogen (g/m^3)**	**Total (NO) nitrogen in oxides (g/m^3)**	**Total TK + NO nitrogen (g/m^3)**
"Hemo"	4.1	0.09	0.34	0.49	0.83
"State Highway 5"	4.3	0.08	0.33	0.41	0.74
"Whakarewarewa"	19.1	0.06	0.39	?	?
"Puarenga-FRI"	52.8	0.11	0.48	0.35	0.83

Prior to June 1991 the average geothermal flow from Whakarewarewa was 193 L/s (FRI minus Hemo) but for the period 1991 & 1993 the flow difference was significantly smaller at 121 & 127 L/s (Glover, 1993). Further gauging of the Puarenga Stream (Gordon et al., 2001) also pointed to a lower than expected measured flow at FRI. Based on flows from the Roto-a-tamaheke, Glover (1993) suggested that Puarenga Stream flows were too low, probably due to errors in flow measurements. However, Gordon (pers. comms, 2004) suggested that it was possible there was loss of river water to groundwater. Although this issue has yet to be resolved, it appears that the fraction of geothermal fluid in the river water at FRI does not exceed 7% of the time-weighted mean flow. The TN values at Hemo and FRI in Table 6.3 are the same, which implies that the geothermal fluids also have a TN content of 0.83 g/m^3. A variation in geothermal TN content of ± 0.4 g/m^3 would cause the TN concentration in the river to change by ± 0.03 g/m^3. Changes in nutrient concentrations of this order, at the low levels found in the river, would be within natural variations and any small difference upstream and downstream of the geothermal inputs would be impossible to interpret without robust data (e.g. all relevant species analysed from samples collected on the same day with river gauging, and repeated to determine likely variability and errors, especially if reliable annual estimates are required). The irregularity at which samples for "kjeldahl", "oxide" and "total nitrogen" analysis were collected and lack of flow data means that the data in Table 6.3, although indicative, cannot be reliably used to asses the geothermal nitrogen flux from Whakarewarewa.

Analyses of ammonia in the Whakarewarewa hot spring fluids are rare and phosphorous analyses are non-existent. Available analyses are listed in Table 6.4 (Mahon, 1985).

Table 6.4 Available ammonia analyses of Whakarewarewa springs.

Sample Location	**Date**	**Chloride (g/m^3)**	**Ammonia (NH_4) (g/m^3)**
Roto-a-tamaheke, East	4/5/79	742	0.4
Roto-a-tamaheke, West Outlet	4/5/79	618	0.1
Ororea	4/5/79	790	0.2
Puapua	4/5/79	562	0.33
Waikorohihi	4/5/79	562	.2
Papakura	4/5/79	533	.2
Papakura	23/5/80	520	.1
80 Spring	23/5/80	221	1.1
Ngararatuatara	23/5/80	524	1.2

Glover (1993) notes that Roto-a-tamaheke contributes about a third of the total geothermal flux to the Puarenga Stream. This suggests the average concentration of ammonia (as N) in the geothermal fluids is less than 0.89 g/m^3. However given all the uncertainties it is assumed that this value is a realistic upper limit and equates to a geothermal N flux of 3.4 t/year.

The phosphorous input is less certain as no analyses exist. An increase of 0.02 g/m^3 over the upstream value would imply a phosphorus concentration of 0.4 g/m^3 in the geothermal fluid, which seems too high and is more likely < 0.1 g/m^3 (< 0.4 t/year).

A number of chloride-bearing waters discharge downstream of the FRI site, estimated by Glover(1992) to contribute about 94% (dump site + Ngapuna) of the Whakarewarewa chloride flow. In the absence of any other data, and assuming that all the chloride is derived from geothermal fluids, and assuming a similar proportion of Cl/N as in the Whakarewarewa runoff, increases the total geothermal nutrient fluxes from the Puarenga stream to 0.8 t/year TP and 6.6 t/year TN. Given the dataset available to Donovan and Donovan (2003) it is unlikely that the additional flux below the FRI sampling site was included in their estimate of the "Puarenga" total.

The fact that much of the data used by Donovan and Donovan (2003) and Burns (1999) is now out-of-date, particularly due to the recovery of the Rotorua geothermal system, and/or incomplete (there is typically no flow data at the stream sites) should be rectified during subsequent chemical and physical (e.g. flow, temperature) monitoring programmes (Table 6.5 provides a summary of flow measurement data available to this study). The concerns underline the need for new, accurate and consistently-measured data along the Puarenga Stream, both above and below areas where geothermal inputs enter the stream, in order to estimate the amount of geothermal fluid entering the Puarenga Stream better.

For example, for Puarenga Stream, using a mean (1992-94) flow of 2.137 m^3/s, and an estimated concentration of 0.89 g/m^3 total nitrogen equates to be 60.0 t/year nitrogen (i.e., from geothermal + non-geothermal sources) entering Lake Rotorua. This is considerably higher than the 49.6 t/year estimate of total nitrogen input to Lake Rotorua by Burns (1999) using a time-weighted river flow for the Puarenga Stream.

The need for consistent methodology also applies to other streams in the Lake catchment. Where flows are relatively constant, such in the thermal streams and Whakarewarewa runoff, the annual flux derived by multiplying the observed mean flow by the mean concentration will still give reliable estimates of the fluxes.

6.6.5 Total geothermal flux from the Rotorua Geothermal System

Combining the thermal streams and total Puarenga Stream geothermal nutrient fluxes gives an estimated flux of 1.2 t/year TP and 8 t/year TN. Recalling that Glover (1992) estimated a “missing” inflow of geothermal fluid to the lake, via subsurface natural flows and re-injected bore waters from the Rotorua Geothermal systems (i.e. other than that carried by streams), of 58% of the geothermal input to Lake Rotorua, then it is possible that up to 8 x (100/42) = 19 t/year total nitrogen and 1.2 x (100/42) = 2.8 t/year total phosphorous could be entering Lake Rotorua from the Rotorua Geothermal System (i.e. geothermal component). This is less than half of the nutrient input carried by the surface streams from non-geothermal sources around the City and CBD.

Table 6.5 Stream flow data, from Hoare (1980, mean 1976 data, in L/s); Glover (1992; mean 1989-90 data, in kg/s), EBOP (unpubl. data, in m^3/s, converted to L/s); Burns (1999; time-weighted (mean) river flow data from 1991 to 1999, in L/s); “EBOP/2001” (from a heat flow study of the Whakarewarewa Geothermal field, on January 2001, in L/s); “D&D (2004; Donovan and Donovan, 2003; based on EBOP data for 1992 to 1994/5, in m^3/s, converted to L/s).

Stream Name	**Flow**	**Reference**
Puarenga	2050 kg/s	Hoare (1980)
	1754 kg/s	Glover (1992)
	1817 L/s	Burns (1999)
(average, above)	1874 L/s	
Puarenga-FRI	2137 L/s	EBOP
Te Tatua Falls	1387 L/s	EBOP/2001
Pohutu (area)	1455 L/s	EBOP/2001
Memorial Br.	1568 L/s	EBOP/2001
Puarenga-FRI	1378 L/s	EBOP/2001
Waingaehe	274 L/s	Hoare (1980)
	245 kg/s	Glover (1992)
	212 L/s	Burns (1999)
(average)	244 L/s	
Waiohewa	413 kg/s	Hoare (1980)
	374 kg/s	Glover (1992)
	308 L/s	Burns (1999)
	440 L/s	D&D (2003)
Rangiteaorere	444 L/s	EBOP
(average)	396 L/s	
Hamurana	3080 kg/s	Hoare (1980)
	3343 kg/s	Glover (1992)
	2472 L/s	Burns (1999)
(average)	2965 L/s	
Awahou	1664 kg/s	Hoare (1980)
	1973 kg/s	Glover (1992)
	1482 L/s	Burns (1999)
(average)	1706 L/s	

Stream Name	**Flow**	**Reference**
Waiteti	1391 kg/s	Hoare (1980)
	1608 kg/s	Glover (1992)
	1124 L/s	Burns (1999)
(average)	1374 L/s	
Ngongotaha	1977 kg/s	Hoare (1980)
	2175 kg/s	Glover (1992)
	2241 L/s	Burns (1999)
(average)	2131 L/s	
Waiowhiro	415 kg/s	Hoare (1980)
	343 kg/s	Glover (1992)
	337 L/s	Burns (1999)
(average)	365 L/s	
Utahina	2040 kg/s	Hoare (1980)
	1826 kg/s	Glover (1992)
	1722 kg/s	Burns (1999)
(average)	1863 L/s	
Ohinemutu Spr.	10 L/s	D&D (2003)
Tunuhopu Spr.	10 L/s	D&D (2003)
Black Stream	10 L/s	D&D (2003)
Sewer Stream	14 L/s	D&D (2003)
Pipe Stream	3 L/s	D&D (2003)
Polynesian - S	1.2 L/s	D&D (2003)
Polynesian - N	11 L/s	D&D (2003)
Springs Outlet	1.5 L/s	D&D (2003)
Ohau Channel	18770 kg/s	Glover (1992)

6.7 Estimated total gross geothermal nitrogen and phosphorus fluxes

Donovan and Donovan (2003) estimate that geothermal inflows via surface streams contribute a total of 5.6 t/year of total phosphorus and 67.3 t/year of total nitrogen to Lake Rotorua. Those authors also indicated that the principal contributor of geothermally derived phosphorus and nitrogen is the Waiohewa Stream, which they suggested contributes an estimated 60.9 tonne of (total) nitrogen and 5.06 tonne of (total) phosphorous (about 90% of the geothermally derived total nitrogen and phosphorus input into Lake Rotorua, according to Donovan and Donovan). The high nitrogen load to Lake Rotorua from Tikitere prompted the Rotorua District Council to undertake additional surveys between May and June 2004, which led to a new estimate of mean total nitrogen and phosphorous input into the Waiohewa catchment of 24.5 t/year, and 0.08 t/year respectively. However, as previously noted, Williamson and Cooke (1982) found that about 10% of the total nitrogen entered the Waiohewa catchment in ungauged flows before the confluence of the Ohunaui Stream, so Dine's (2004) estimates of nitrogen should be increased by about this amount to provide a better estimate of the geothermal flux, i.e., about 27.0 t/year total nitrogen, and 0.09 t/year total phosphorous. Until further measurements are made these values are considered to be the best available.

Geothermal fluids do inflow into the lake, and are largely responsible for chloride fluxes in the "hot" streams, of Puarenga and Waiohewa, and at Ohinemutu, Tunuhopu, Te Ngae drain, Polynesian Pools and other streams associated with the Rotorua Geothermal Field. However, phosphorous and nitrogen are generally not abundant in thermal waters (at Rotorua), and whilst the geothermal component is important, there are clearly additional sources which contribute markedly to the flux of nitrogen and phosphorous into Lake Rotorua.

Water samples collected for the Puarenga Stream at "Hemo", upstream of the thermal area at Whakarewarewa, have no geothermal input (4.1 g/m^3 Cl). However, water samples collected within the thermal area and downstream of Whakarewarewa, at the "Puarenga – FRI" site have a significant geothermal component (52.8 g/m^3), as shown by increased chloride contents, yet there is negligible change in nitrogen and phosphorous contents.

Based on Donovan and Donovan (2003) and Burns (1999), about 1.4 t/year of geothermal nitrogen input and 0.4 t/year of geothermal phosphorous is accounted for by minor thermal springs and streams at Ohinemutu, Tunuhopu etc. An analysis of the Whakarewarewa runoff and Glover's (1992) estimates for geothermal input below the FRI site gives about 6.6 t/year of geothermally derived nitrogen and 0.8 t/year phosphorous being input from the Puarenga Stream alone. Including the remaining thermal streams these fluxes increase to 8 t/year TN and 1.2 t/year TP. Using Glovers' (1992) estimate of a "missing 58%" inflow of geothermal fluid to the lake via subsurface natural flows and re-injected bore waters from the Rotorua Geothermal systems then it is possible up to 19 t/year total nitrogen and 2.8 t/year total phosphorous could be entering Lake Rotorua from the Rotorua Geothermal System, via surface and subsurface flows.

The total geothermally derived nitrogen flux to Lake Rotorua is estimated to be 46 t/year N, with the input of phosphorous about 2.9 t/year P, but taking note that the Puarenga fluxes are likely to be overestimated. This combines the estimates of geothermally derived inflow in the Tikitere/Waiohewa Stream area, and inferences of geothermal surface and subsurface flow from the Rotorua Geothermal System to Lake Rotorua. The fluxes are summarised in Table 6.6.

Table 6.6 Total estimated geothermal nitrogen and phosphorous input to Lake Rotorua

Location	**TP Flux (t/year)**	**TN Flux (t/year)**
Tikitere/Waiohewa	0.09	27.0
Rotokawa	unknown	unknown
Minor Rotorua Thermal Streams	0.42	1.39
Puarenga-Whakarewarewa	0.4	3.4
Puarenga – Downstream of FRI	0.38	3.2
Rotorua – "unmeasured"	1.7	11.0
TOTAL	**2.9**	**46**

6.8 Future work

At present, an extensive chemical data set is available for geothermal springs at Tikitere, Rotokawa, and the many thermal features (springs, pools and geysers) which comprise the Rotorua Geothermal Field, as well as selected shallow boreholes used for direct hot water supply (and other applications) by residents and businesses in the Rotorua District. However, in the context of the present study, which focuses on the input of nitrogen, phosphorous and other nutrients to Lake Rotorua, the available data is not complete and a new, detailed programme of chemical monitoring is required to assess the chemical inputs (via streams and subsurface aquifers) and develop an appropriate management plan for the lake.

Chemical and physical surveys have been undertaken in the past for thermal and non-thermal streams that discharge into Lake Rotorua. The previous works of Hoare (1985, 1990), Burns (1999), Donovan and Donovan (2003), Dine (2004) and others have provided important information on flow rates and total input of nitrogen and phosphorous to Lake Rotorua from streams with no geothermal input. However, their studies have variously failed to differentiate between the nitrogen and phosphorous fluxes from geothermal and non-geothermal sources (e.g. in Puarenga Stream), failed to estimate the input from the ungauged fraction of geothermal sources (i.e. the fluids discharging from the Rotorua geothermal field directly into the Lake, e.g. via subsurface aquifers), and/or overestimated nitrogen and phosphorous compositions in geothermal fluids (i.e. incorrectly assumed most of the nutrient inputs were derived from geothermal sources), which means that their estimates are not accurate.

In contrast, other studies (such as Glover, 1992), have focused on the chloride and heat flux of the Rotorua Geothermal Field, yet most of these geothermally-focused projects (involving the chemical analysis of springs and thermal streams) did not include nitrogen and phosphorous amongst the species analysed.

As a consequence, a lot of chemical and physical information is available for the geothermal features in the Rotorua District, and for thermal/non-thermal streams discharging into Lake Rotorua, but much of the data is now somewhat dated, and/or does not provide all the required information (flow rates *and* appropriate chemical analyses) to allow nitrogen and phosphorus input from geothermal sources to be estimated with confidence.

6.8.1 Recommended Stream Monitoring Programme

The future stream monitoring programme should be complemented by a review of historical geochemical and physical data from selected boreholes and thermal features in the Rotorua District. Any *new* public domain stream data or chemical analyses for features in the thermal areas which are independently obtained by EBOP (i.e. outside of this project) should be made available to GNS, as they will assist in determining aquifer relationships and reservoir characteristics in the Tikitere, Rotokawa and Rotorua Geothermal Fields. Indeed, recent chemical and physical monitoring of Rotorua well discharges and springs has shown that changes are continuing to occur in the hydrology of the geothermal field, following the enforced bore closure programme undertaken at Rotorua since 1986, and new data may impact on interpretations made by GNS, as this project proceeds.

In total, new physical and chemical monitoring is proposed for 20 sites (shown on Figure 6.1): 1) Hamurana; 2) Awahou; 3) Waiteti; 4) Ngongotaha and 5) Waiowhiro Streams (all non-thermal streams flowing into Lake Rotorua); 6) Ohau Channel (outflow from Lake Rotorua); 7-8) upstream and downstream sample sites in Waingaehe Stream; 9-10) in the Waiohewa Stream, above and below the confluence of the Ohunaui Stream. For the Rotorua Geothermal field: 11-14) along the Puarenga Stream (a: Hemo Gorge, upstream of the Whakarewarewa thermal area; b: at the Whakarewarewa Maori Arts Centre; c: near the Forest Research Institute downstream of the Whakarewarewa thermal area; and d: at the "Dump" downstream of the water treatment outfall); 15) the outflow from the Ngapuna Springs; 16) outflow via Utuhina Stream; 17) Spring discharge to Lake Rotorua at Ohinemutu; 18) Tunuhopu Spring discharge (via drain) to Lake Rotorua), and finally at 19-20) stream and spring discharges at Polynesian Pools/Te Ngae Drain/Black Stream area.

For all of the monitoring sites selected, physical measurements should include flow rate, temperature and conductivity, with the chemical programme including pH, total kjeldahl nitrogen, total nitrogen oxide species, and total phosphorous, as well as Li, Na, K, Ca, Mg, Cl, SO_4, B, SiO_2, NH_3 total HCO_3, H_2S, F, Fe and As.

6.8.2 Hamurana, Awahou, Waiteti, Ngongotaha and Waiowhiro Streams

The chemical and physical monitoring of surface discharge and nutrient input to Lake Rotorua via non-thermal streams should be straight-forward, with surveys being undertaken at the Hamurana, Awahou, Waiteti, Ngongotaha and Waiowhiro Streams (Figure 6.1; all regarded as "non-thermal", and previously part of surveys undertaken by Glover (1992) and others). The recommended programme for these streams will involve a set of physical measurements and water sampling being undertaken at four-month intervals; in December, April and August (in order to define long term nutrient loads better, which may vary seasonally), preferably at the same locations used in previous surveys (to facilitate comparisons with the previous studies). However, actual site selection will be decided after an examination of the stream/site location by GNS technical staff who will check for previously ungauged or hidden flows, that flow rates can be accurately assessed and that there are no slow mix waters entering the main stream at those (sample) sites.

6.8.3 Ohau Channel

Waters flowing out of Lake Rotorua, via Ohau Channel should be monitored (in December, April and August, at the same times as the non-thermal and thermal streams are measured and sampled). It is important to gauge any “missing” geothermal inputs into Lake Rotorua, which may have entered via shallow subsurface aquifers directly to the lake bottom, and this is why it is necessary to also monitor outflows from Lake Rotorua. In the past, the “missing” geothermal component was considered by Glover (1992), but his work focused on the chloride and heat flux from the Rotorua Geothermal Field, and he was not interested in nitrogen and phosphorous fluxes to the lake. In addition, the quantity and proportion of fluids entering via the floor of the Lake and through surface discharges may have substantially altered since Glover’s (1992) study due to the effects of the bore closure programme. Therefore, it will be necessary to expand the range of chemical species previously analysed for Ohau waters for the proposed monitoring programme, as well as collecting the same range of physical measurements (e.g. flow rate, temperature and conductivity) that will be undertaken in the thermal and non-thermal streams.

6.8.4 Waiohewa Stream

The Waiohewa Stream is the main outflow of thermal waters which discharge at the surface in the Tikitere thermal area, and a major contributor of nitrogen and phosphorous inputs to Lake Rotorua (Burns, 1999; Donovan and Donovan, 2003; Dine, 2004). Although these (and other) surveys have highlighted the apparent high nitrogen and phosphorous load to Lake Rotorua from the Waiohewa Stream, there remain large variability in their estimates of the total amounts of these species being input to Lake Rotorua, and it is essential that the future monitoring programme addresses these discrepancies, with monitoring being undertaken above and below the confluence of the Ohunaui Stream with the Waiohewa Stream, to ensure all possible geothermal inputs (including previous ungauged flows) into the Waiohewa Stream are accounted for.

6.8.5 Waingaehe Stream

The Waingaehe Stream waters may have a geothermal component, as the stream is located relatively close to the Rotokawa thermal area (Figure 6.1), and previous chemical samples from the stream indicate elevated chloride and sulphate species (characteristic of geothermal fluids), compared to non-thermal streams on the western side of Lake Rotorua, although the inference that geothermal fluids may be mixing with the stream water is yet to be proven. For this reason, an initial examination of the stream is required, to see if there are any small thermal tributaries entering the Waingaehe Stream. Subsequently, it will be necessary to take physical measurements (flow rate, temperature and conductivity) and water samples for chemical analysis upstream of any observed tributary with a suspected geothermal content, and at a downstream location consistent with surveys of Donovan and Donovan (2003) and others. The surveys should be undertaken at four-month intervals; in December, April and August (coinciding with surveys at the other stream sites).

6.8.6 Puarenga Stream, Ngapuna, Utuhina, Tunuhopu, Ohinemutu and Polynesian Pools

The major inflow of waters in the southern part of Lake Rotorua comes via the Puarenga Stream, Ngapuna Springs, Utuhina Stream, and surface outflows at Tunuhopu, Ohinemutu and features in the vicinity of Polynesian Pools. All of these surface discharges have a significant geothermal fluid component, particularly Puarenga Stream, as it flows through the Whakarewarewa geothermal area. So effective physical and chemical monitoring is essential to quantify the influx of nitrogen and phosphorus derived from the Rotorua Geothermal System, and how much is derived from urban inflows and the rural catchment further south of Rotorua.

The Hemo Gorge/State Highway 5 area of Puarenga Stream is located upstream of the Whakarewarewa thermal area, where there is no known geothermal fluid input into Puarenga Stream. So, flow measurements, and determination of nitrogen and phosphorous fluxes in the stream water at that location will give a good indication of nutrient input derived from the rural catchment area to the south of Rotorua City. Further measurement and sampling sites should be located in the vicinity of the Whakarewarewa Maori Arts Centre, and the Forest Research Institute, in order to estimate the amount of nitrogen and phosphorous entering the Puarenga Stream from the overflow of thermal features in the Whakarewarewa area.

Downstream samples, below the water treatment outfall and the vicinity of inflows from the Ngapuna Springs, will provide a clearer picture of chemical inputs closer to Lake Rotorua, with the new monitoring programme (conducted in December, April and August) isolating those flows as much as possible. It is also important to monitor the flow rates and water chemistry of inflows from the Tunuhopu, Utuhina, Te Ngae Drain/Polynesian Pools areas, as they also contribute to the chemical species entering Lake Rotorua.

Following the approach taken by Glover (1992), it will be necessary to assess any "missing" geothermal fluid component, which may be directly inflowing to the bottom of Lake Rotorua (e.g. along fractures), via subsurface aquifers and re-injected (waste) bore water. This task may be achieved by monitoring the chloride flux into the lake (via all known inputs to Lake Rotorua, compared to the chloride flux in waters leaving the lake via the Ohau Channel).

6.8.7 Additional Considerations

It is envisaged that the initial physical and chemical monitoring survey will take somewhat longer than subsequent surveys, as a reconnaissance visit will be required to select sample/flow measurement locations, identify any previously unrecognised inflows, and co-ordinate access with land owners (as applicable). This will probably require in the order of one week (two GNS staff). Subsequent surveys (in April, and August), are likely to involve 2 GNS staff for 3-4 days.

The stream survey data should be complemented by long- and short-term meteorological data, concerning seasonal rainfall, and more complete information (on a daily basis) in the 7-10 days immediately preceding the physical monitoring and water sampling programme, as stream flows (and chloride, nitrogen and phosphorous fluxes in the stream discharges) may be affected by heavy rainfall immediately preceding the water sampling.

In the future, greater effort should also be made on identifying errors associated with the monitoring programme, particularly with respect to the statistical treatment of the measurement data. Hydrological and chemical data are not normally distributed and require special care and understanding in their statistical interpretation (e.g. see Helsel and Hirsch, 1992).

6.9 Conclusions

1. Geothermal sources make a significant contribution to the amount of total nitrogen and total phosphorous entering Lake Rotorua, but they are unlikely to be as large as implied by previous studies, as nitrogen and phosphorous chemical species are not usually major components of geothermal fluids in thermal areas of the TVZ.

2. As part of previous investigations of the nitrogen load derived from the Tikitere area, Dine (2004) estimated that the mean total nitrogen geothermal flux into the Waiohewa catchment was 24.5 t/year (less than half of previous estimates, e.g. Donovan and Donovan, 2003). Dine (2004) also estimated the input of total phosphorus via the Waiohewa Stream to be 0.08 t/year (compared to 0.8 t/year by Williamson and Cooke, 1982; 1.5 t/year, Burns 1999; and 5 t/year, Donovan and Donovan, 2003). Taking into account that approximately 10% of the total geothermal nitrogen enters the Waiohewa catchment in ungauged flows before the confluence of the Ohunaui Stream, then values of **27.0 t/year total nitrogen**, and **0.09 t/year total phosphorous** are obtained. These values are considered to be the most reliable, as the high values derived by Donovan & Donovan (2003) were based on flawed methodology (i.e. their survey, as well Burns's (1999), included non-geothermal nutrient inputs).

3. The contribution of geothermally-derived nitrogen and phosphorous to Lake Rotorua from geothermal activity in the Rotokawa thermal area (near Rotorua airport) is unknown.

4. Although Donovan and Donovan (2003) appear to have overestimated the nitrogen load to Lake Rotorua via the Waiohewa Stream, their estimate of inputs to Lake Rotorua via (surface) thermal streams in the Rotorua City area (except Puarenga Stream) are more realistic. This is because the discharges are relatively stable and the mean flow may be used to determine the annual flux. Using our estimate of geothermal inputs in the Puarenga Stream, the total input of geothermally-derived nitrogen from the Rotorua geothermal system, to the southern part of Lake Rotorua, is approximately 8 t/year whereas the input of total phosphorous from the same sources is about 1.2 t/year.

5. Taking into account that 58% of the geothermal flows (natural flows and reinjected bore waters) to Lake Rotorua are likely to be via subsurface discharges to the lake bottom (Glover, 1992), then the input of geothermal fluids to the southern part of Lake Rotorua is likely to be **19 t/year total nitrogen** and **2.8 t/year total phosphorous**.

6. Using Dine's (2004) inferences for Tikitere/Waiohewa, Donovan and Donovan's data for the Thermal Streams, our estimate for Puarenga and Glovers' estimation of "missing" geothermal flows to Lake Rotorua, the overall input of geothermally-derived total nitrogen to Lake Rotorua is estimated to be **46 t/year** and the input of phosphorous about **2.9 t/year**.

7. There remain uncertainties about the quality of the data used in past estimates of geothermal fluid discharge and nutrient, particularly concerning measured flows, effect of elevated flow rates during floods, variations in analytical data due to poor sampling procedures (due to low flows, poor mixing etc.). There has been little regard to possible errors during statistical treatment of the measured data, which underline the need to collect sound, new, data on the flow regime and chemistry of stream waters feeding Lake Rotorua and their geothermal input.

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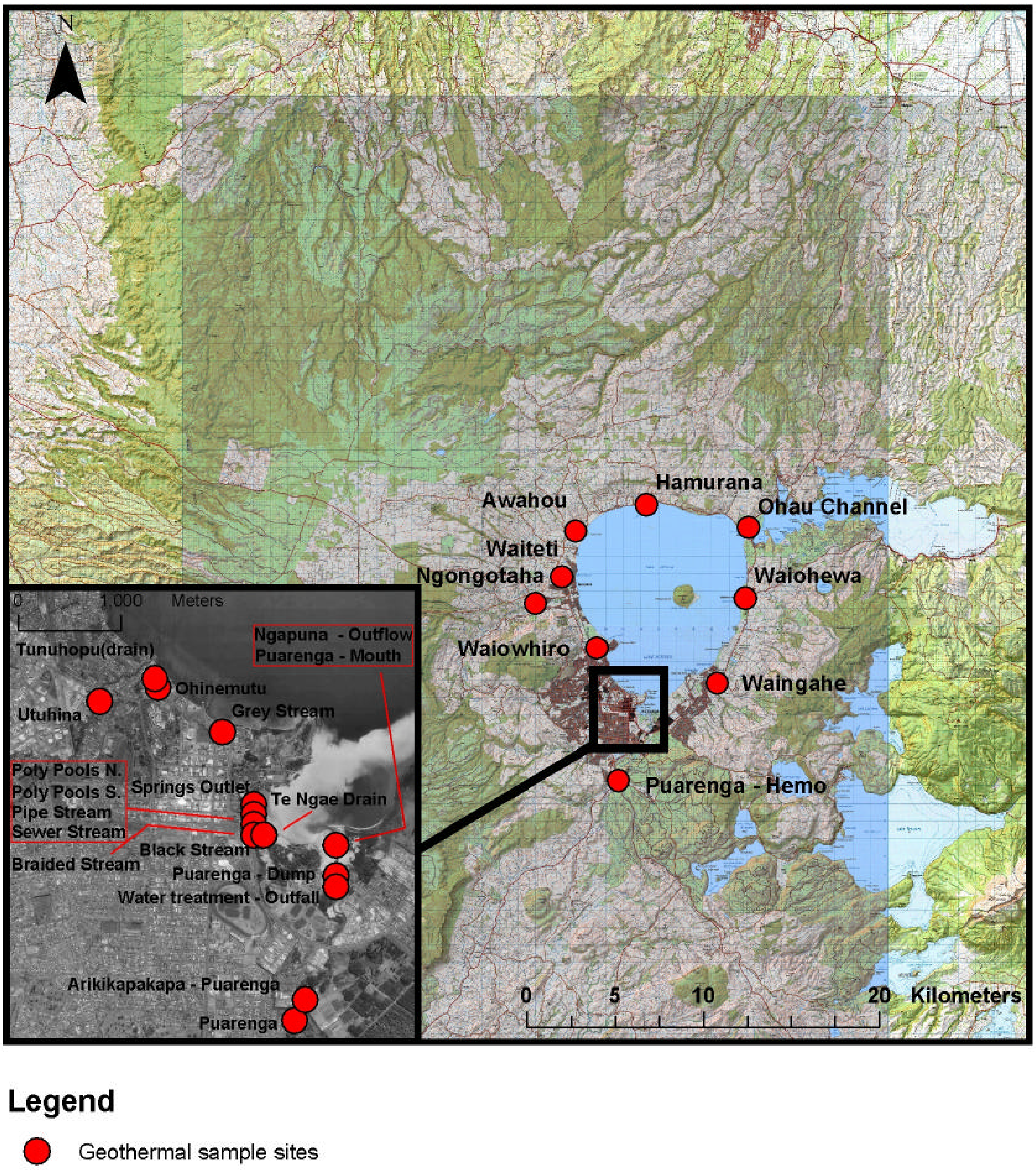

Scanned image from the 1:50 000 topographic map (NZMS260 series) sourced from Land Information New Zealand (Crown Copyright Reserved).

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Figure 6.1. Geothermal sample sites.

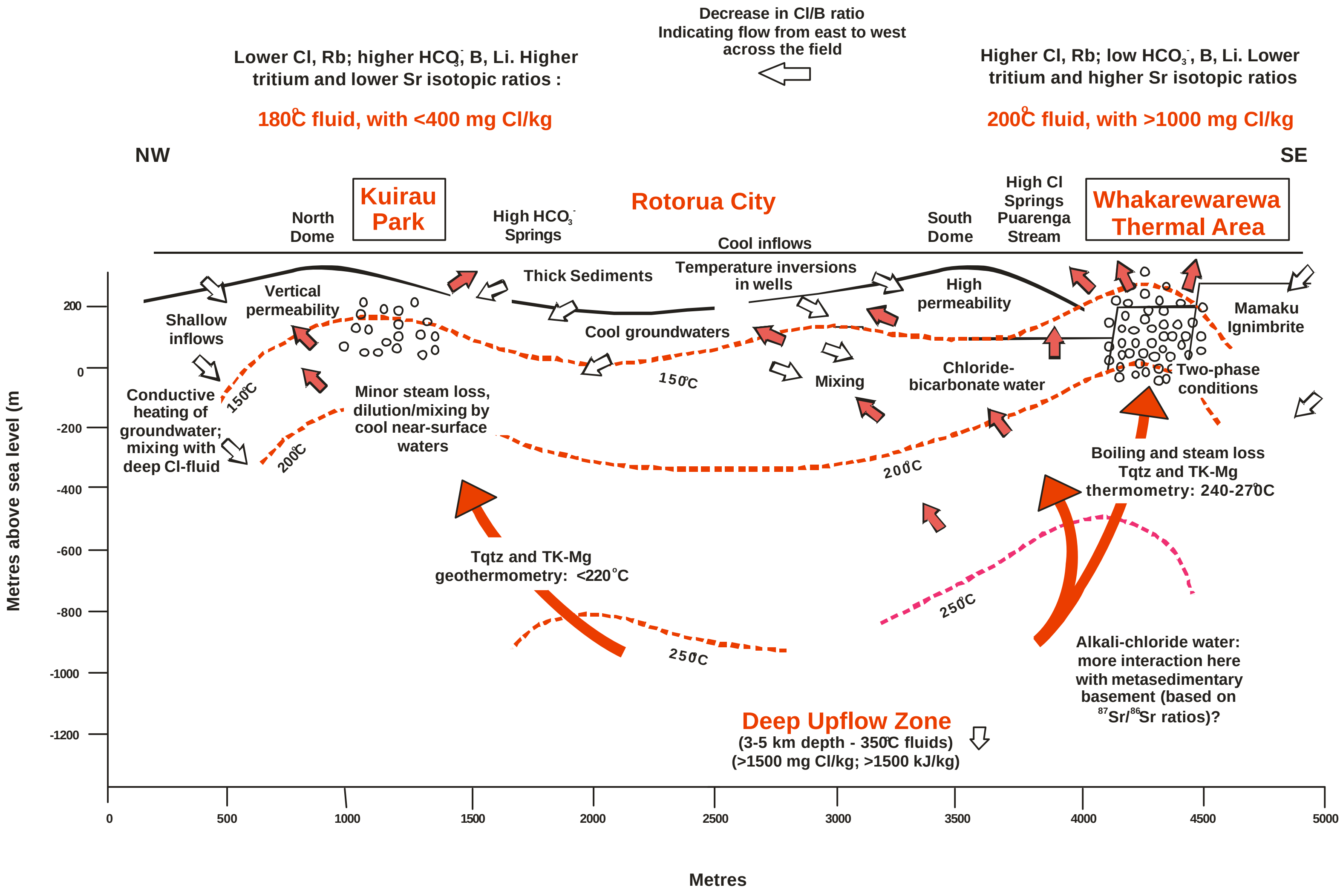

Figure 6.2 Schematic representation of the Rotorua Geothermal System, showing possible flow paths, upflow zones, and regions of fluid mixing.

7.0 GROUNDWATER SUBCATCHMENTS

7.1 Introduction

This chapter aims to identify groundwater subcatchments in the Lake Rotorua area. A model of rainfall in the area is described. The rate of recharge to groundwater from rainfall in the Rotorua catchment is estimated using results of a study on the Mamaku Plateau. The recharge rate is used to estimate the area of land in the groundwater catchment of springs.

Groundwater level contours, spring catchment maps and surface catchment maps are used to estimate the boundaries of 13 ‘major’ groundwater subcatchments in the region. These ‘major’ subcatchments are separated into smaller units where appropriate.

Groundwater flows in the Lake Rotorua catchment are assessed using the groundwater subcatchment model, the surface catchment boundaries and existing knowledge of groundwater recharge and discharge zones.

The model of groundwater subcatchments is preliminary and may be revised based on discussions with surface water hydrologists and future groundwater investigations. It is intended this work will contribute to a model of land use and water quality by defining land use areas that link to surface water monitoring sites. The model will also contribute to the estimation of nutrient discharge to Lake Rotorua. This chapter identifies information gaps in our knowledge of physical groundwater hydrology, in light of our current understanding of groundwater in the catchment.

7.2 Rainfall model

Hoare (1980) reports on rainfall measurement in the Lake Rotorua catchment in 1976. Daily rainfall was measured at 25 sites with manual raingauges, at six sites with storage gauges and at four sites with automatic gauges. The resulting rainfall map (Figure 7.1) has a maximum rainfall contour of 2200 mm yr^{-1} to the north west of the lake. Rainfall in 1976 appears to have been about average for the period 1968 to 1976 (Hoare, 1980).

7.3 Rainfall recharge

White et al. (2003) measured rainfall and rainfall recharge at four sites in Canterbury in the 1999 and 2000 calendar years. Three sites (Christchurch Airport, Winchmore and Hororata) are on coarse-grained soils, and one (Lincoln) is on fine-grained soil. Rainfall recharge was between 33% and 37% of rainfall at the sites with coarse-grained soils, and was 26% of rainfall at the site with fine-grained soils. Coarse-grained Canterbury soils are likely to have similar physical properties to the light volcanic soils in the Lake Rotorua catchment. However, rainfall recharge in the Lake Rotorua catchment is likely to be greater than rainfall recharge measured in Canterbury, because annual rainfall in the Lake Rotorua catchment (Figure 7.1) is greater than annual rainfall at the Canterbury sites (Table 7.1).

Table 7.1. Summary of rainfall, evapotranspiration (ET), and rainfall recharge at the lysimeter sites for 1999/2000 (White et al. 2003). Data are in millimetres.

Site	Calendar year 1999			Calendar year 2000			Average
	Rainfall	**ET**	**Rainfall recharge**[1]	**Rainfall**	**ET**	**Rainfall recharge**	**Recharge**[2] **%**
Christchurch Airport	684	888	230	686	931	225	33
Lincoln University	622	904	116	646	777	220	26
Winchmore	729	864	200	936	713	410	37
Hororata	907	-[3]	254	908	-[3]	396	36

[1] The annual total assuming zero rainfall recharge in January, February, and March.

[2] Observed rainfall recharge as a ratio (%) of observed rainfall at the national network site for the 1999 and 2000 calendar years.

[3] A comparison of evapotranspiration measurements around Canterbury indicates that evapotranspiration at Darfield is significantly higher than at other sites, presumably because Darfield is more exposed to drying northwest winds. Darfield evapotranspiration is 15-20 % higher than at Hororata, even though the sites are only 35 km apart.

Dell (1982a, 1982b) measures low flows in Mamaku Ignimbrite catchment to the west of the Mamaku Plateau (Figure 7.2). Specific discharge generally increases with distance down the river from the headwaters (Table 7.2). For example, specific discharge in the headwaters of the Waihou River is 6.7 L s^{-1} km^{-2} , while it is 132 L s^{-1} km^{-2} when the river is at Whites Road on the Hauraki Plains. Specific discharge estimates are generally largest at the sites on the Hauraki Plains. Specific discharge appears to increase as streams pass through the base of the ignimbrite. For example, specific discharge in the Waihou River is 14.8 L s^{-1} km^{-2} at Site 5 and 29 L s^{-1} km^{-2} at Site 6. This increase in specific discharge may indicate that groundwater is leaving the ignimbrite via spring flow in this region. This spring flow will support river base flow.

Dell (1982b) summarises his water balance study for the western Mamaku Plateau. He calculates that rainfall recharge of 990 mm is required to support the long-term baseflow of 10 m^3 s^{-1} in the rivers in the study area. With rainfall of 1896 mm per $year^{-1}$, the ET loss is 906 mm in each of 1979/80, 1980/81 and 1981/82. Therefore rainfall recharge is 52% of rainfall.

Dell (1982a) analyses runoff in the western Mamaku Plateau and concludes: ‘both quick flow and total flow are small when compared to total precipitation both as a % and absolute value’, and ‘it is apparent that most of the water entering the stream channels does so by subsurface flow’.

Soils in the area seem well able to support this rainfall recharge rate. Lynch (1975) measured infiltration rates at Kaharoa, of 132.5 mm hr^{-1} (maximum 3300 mm hr^{-1} and minimum 4.2 mm hr^{-1}) under pasture and 450.9 mm hr^{-1} (maximum 680.2 mm hr^{-1} and minimum 119.0 mm hr^{-1}) under forest using a ring infiltrometer. Selby (1970) found that infiltration rates under pasture were lower than under forest on yellow-brown pumice soil. Soils in the region can also have high porosity. For example, Knowles (1995) measures mean porosities of 64.1% to 69.6% in multiple samples of four soils (yellow-brown loam, pumice sand, yellow-brown mud and very fine sand) from the Whakarewarewa Forest.

Table 7.2 Low flow, catchment area and specific discharge at gauging sites on the west Mamaku Plateau (Dell, 1982).

River	**Site Number**	**X**	**Y**	**Low Flow ($L\ s^{-1}$)**	**Catchment Area (km^2)**	**Specific Discharge ($L\ s^{-1}\ km^{-2}$)**
Waihou	1	2768000	6344150	35	5.22	6.7
Waihou	2	2765250	6344000	35	6.56	5.4
Waihou	3	2761950	6345200	72	7.79	9.2
Waihou	4	2761000	6345850	396	20.15	19.8
Waihou	5	2760000	6346750	363	24.48	14.8
Waihou	6	2759750	6347250	728	24.98	29
Waihou	7	2757250	6349900	5000	37.80	132
Purere	1a	2760500	6349200	20	2.08	6.7
Purere	1	2758000	6350950	825	7.41	112
Waipari	1a	2570000	6347450	30	4.27	7
Waipari	1	2567700	6347900	193	6.75	29
Waipari	2	2567400	6347850	240	17.15	14
Waipari	2a	2562800	6349800	691	21.46	32
Waipari	2b	2562750	6349500	783	25.00	31
Waipari	3	2562500	6349850	981	25.60	38
Waipari	4	2561500	6350550	2193	26.25	84
Kuhatahi	1	2565800	6350500	250	16.08	16
Kuhatahi	2	2562750	6350500			
Kuhatahi	3	2561800	6350600	1300	22.00	59
Waimakariri	5	2560700	6350900	3600	49.21	73
Waimakariri	6	2759000	6352650	4700	51.49	91
Mangatapu	1	2768000	6342450	58	20.64	2.8
Mangatapu	2	2763500	6342850	66	34.13	1.9
Mangatapu	3	2761750	6343850	* 0	40.28	0
Mangatapu	4	2761050	6343750	* 0	42.00	0
Mangatapu	5	2759500	6345250	20	49.03	0.4
Oraka	1	2778050	6334550	70	2.96	2.4
Oraka	2	2770200	6336150	198	16.32	12
Oraka	3	2766400	6337750	340	46.27	7.4
Oraka	4	2761850	6341000	1200	107.58	11.2
Oraka	5	2756300	6345550	2300	132.70	17
Takapuhurihuri	1	2776550	6333200	168	6.44	26
Takapuhurihuri	2	2770350	6335550	353	20.67	17
Mangakotaha	1	2764300	6339800	166	46.55	3.6

7.4 The ungauged catchment

Water balance estimates for the Lake Rotorua catchment exclude 'about 69 km^2' of low-lying land, ephemeral streams and small wetlands near the lake (Hoare, 1980), Figure 7.3. The ungauged catchment in the Rotorua urban area (approximately 12 km^2) is not shown on Figure 7.3. The ungauged catchment will contribute flow to Lake Rotorua. For example, an area of 69 km^2 will generate a discharge of 1.9 $m^3\ s^{-1}$ to Lake Rotorua with mean rainfall of 1700 mm yr^{-1} and rainfall recharge rate of 52%. This flow would support a nitrogen flux to the lake of 61 tonnes per year if the average nitrate concentration is 2 gm m^{-3} (e.g. Grinsted and Wilson, 1978, Table 7.3).

Table 7.3. Relationship between nitrate concentration in groundwater and distance from the shore of Lake Rotorua for the northwestern section of the lake's catchment (Grinsted and Wilson, 1978).

Distance from shore of Lake Rotorua (km)	No. of samples	Mean NO_3 Conc.	S.D.
0.1 - 2.0	10	2.0	1.9
2.1 - 4.0	9	1.1	0.7
4.1 - 6.0	7	0.6	0.4
6.1 - 8.0	6	0.6	0.3
8.1 - 10.0	3	0.5	0.2

7.5 Groundwater levels and flow directions

7.5.1 Methods

A piezometric map of the study area is constructed (Figure 7.4) using existing data supplied by EBOP, water level measurements made by Rosen et al., (1998) and spot heights used by GNS around lake edges representing lake levels.

EBOP dataset: Depth to water measurements for approximately 700 groundwater bores are used to construct the piezometric map. The measurements are typically a static water level measured by the driller at the time the bore was drilled. GNS has assumed the measurements made by the drillers are accurate.

Rosen et al. (1998) dataset: Depth to water and surveyed elevations of 14 groundwater bores on the western side of Lake Rotorua are used to improve data on the western side of Lake Rotorua.

Spot heights on lakes: GNS assumes that lake level represents the piezometric surface around the lake edges. Several spot ‘points’ for major lakes in the study area are used to help constrain the piezometric map around the lakes. Table 7.4 summarises the elevations and data source of elevations for each of the key lakes.

Table 7.4. Lake elevations used in the groundwater level map.

Lake	**Elevation (metres above sea level)**	**Source**
Rotorua	281.18	EBOP (2004)
Rotoiti	280.46	EBOP (2004)
Okareka	355.20	EBOP (2004)
Tarawera	299.4	EBOP (2004)
Rotoma	319.04	EBOP (2004)
Rotoehu	298.16	EBOP (2004)
Rotokakahi (Green Lake)	395.90	EBOP (2004)
Rerewhakaaitu	436.89	EBOP (2004)
Okataina	314.90	EBOP (2004)
Tikitapu (Blue Lake)	419.50	EBOP (2004)
Rotomahana	338	B. Scott (pers. comm.)

Depth to water measurements from the EBOP dataset are converted to ‘relative level’ (RL) water levels by:

1) estimating a RL elevation at each site from a 20 m x 20 m grid, digital terrain model of the study area. GNS estimates that elevations may have errors of up to ± 20 m.

2) subtracting the 'depth to water' measurement from the RL elevation.

The RL water level dataset is then gridded with a 500 m x 500 m grid to interpolate a piezometric surface for the study area (Figure 7.4).

7.5.2 Interpretation

RL water levels range from 571 m RSL near the Horohoro cliffs (approximately 13 km southwest of Rotorua) to -85 m RSL near Paengaroa. Groundwater highs occur:

H1) along the Mamaku Plateau (groundwater RL > 450 m),
H2) approximately 6 km southeast of Rotorua (groundwater RL > 400 m) near Lake Tikitapu,
H3) approximately 15 km southeast of Rotorua (groundwater RL > 400 m) near Tumunui.

All three groundwater highs correspond to topographic highs in the study area.

Groundwater lows occur:

L1) on the west side of the Mamaku Plateau (groundwater RL < 100 m),
L2) near Paengaroa (groundwater RL < 50 m), approximately 36 km northeast of Rotorua,
L3) at the base of the Kaimai Ranges (groundwater RL < 50 m), approximately 40 km northwest of Rotorua.

The three areas where groundwater lows occur are all topographically lower than the Rotorua area.

Generally the piezometric surface follows topography. To the west of Lake Rotorua, a north/south trending groundwater divide occurs along the top of the Mamaku Plateau. Groundwater flows towards Lake Rotorua on the eastern side of the divide, and flows to the west (towards Tokoroa and Tirau) on the western side of the divide. Low flow gaugings south and west of Mamaku township (Figure 7.2) indicate a flow direction to the west. The groundwater divide probably extends north and south of Mamaku township (Figure 7.5) even though there is a lack of data along the Mamaku Plateau to the north and south of Mamaku township. This is consistent with topography.

The groundwater contours on the western and eastern sides of the Mamaku Plateau (near the base of the ignimbrite unit) are close together, and the large groundwater gradients in these areas suggest relatively high groundwater velocities.

South of Rotorua City the piezometric gradient is low, suggesting low groundwater flow velocity. A groundwater 'ridge' exists approximately 8 km south of Rotorua. The ridge takes water from groundwater highs (H2) and (H3) described above, to the east, and the Mamaku Ranges from the west. Groundwater may flow to the Waikato River catchment south of this ridge.

Piezometric surfaces to the southeast of Lake Rotorua suggest that groundwater flows into Lake Rotorua cannot be sourced from Lakes Tikitapu, Lake Rotokakahi or Lake Tarawera. Groundwater flow directions from Lake Okataina and Lake Okareka are difficult to establish from this piezometric map due to a lack of data in these areas. It is probable the groundwater flow from Lake Okareka is towards Lake Tarawera, with groundwater from Lake Okataina flowing either to the north or to the south. Caution should be used when interpreting groundwater data in these areas because contours are controlled by the lake RL spot heights and very little borehole data exists.

Groundwater appears to flow away from Lake Rotorua and Lake Rotoiti to the north, in the northeast part of Lake Rotorua and Lake Rotoiti. A relatively steep groundwater gradient from Lake Rotorua to Paengaroa sees the RL groundwater level drop from about 280 m to < 50 m. The apparent groundwater flow direction from Lake Rotorua northwards should be treated with caution because of a lack of borehole data between Lake Rotorua and Paengaroa (Figure 7.6). Groundwater level at a single borehole (EBOP bore 1237) near Lake Rotorua (northeastern end) is higher than lake level suggesting that groundwater may flow towards Lake Rotorua. More groundwater level measurements in this area are required to clarify groundwater flow directions.

7.6 Subcatchments of springs

The subcatchment of a spring is the land area that a spring draws water from. Information on this boundary and land area is useful in the assessment of effects of land use on spring flow and spring water quality. For example, assessment of the effects of groundwater abstraction on spring flow, and land use practices on spring water quality (e.g. agriculture) can be made.

Hydrogeological investigations are required to define subcatchment boundaries. These investigations typically include assessment of groundwater flow directions, using piezometric maps and modelling, groundwater dating measurements, tracer investigations and water balance assessment.

Pang et al. (1996) use a specific discharge of 21.2 L s^{-1} km^{-1}, based on observations in the Ngongotaha and Puarenga catchments (Sigma Consultants, 1993), to estimate the subcatchment boundaries and areas of springs (Table 7.5). For example, the area of the Hamurana Springs is estimated at 130 km^2, extending well outside of the surface water catchment of Lake Rotorua. The subcatchment boundary for Hamurana Springs is a zone up to approximately 10.5 km north of the springs to the Mangarewa River (a river that flows towards the Bay of Plenty) and approximately 16 km east of the springs.

Table 7.5. Springs in the Lake Rotorua catchment - flows and estimated subcatchment areas (Pang et al., 1996).

Spring number	**Spring name**	**Spring flow L s^{-1}**	**Subcatchment area km^2**
S101	Hamurana	2747	130
S102	Taniwha	1698	80
S104	Hatchery	119	6
S105	Barlows #1 and #2	239	11
S107	Paradise	56	3
S108	Fairy and Rainbow	298	14
S109	Te Ahipukahu	64	3
S110	Karamu Takina + 2 others	819	38
S111	Waipa #1	113	5
S112	Waipa #2	335	16

A specific discharge of 21.2 L s^{-1} km^{-1} is equivalent to a rainfall recharge of 669 mm $year^{-1}$. This rainfall recharge is lower than could be expected in the Lake Rotorua catchment in the opinion of the authors. The figure is equivalent to about 34% of the 1976 mm mean annual rainfall (Figure 7.1) becoming rainfall recharge in the Ngongotaha catchment. Sigma Consultants (1993) estimates of specific discharge are probably based on observations of discharge in the surface water catchment. The gauging sites where measurements were made, if they are the same as reported by Hoare (1980), are not close to the lake and therefore 'ungauged catchment' (Figure 7.2) is not included in the estimate of specific discharge. Geological strata, particularly under the Ngongotaha gauging site, are likely to allow the passage of groundwater relatively freely. Therefore, these measurements will not include the groundwater recharge that has remained in the groundwater and so will underestimate specific discharge.

Table 7.6. Springs in the Lake Rotorua catchment - flows, estimated rainfall, estimated rainfall recharge (assuming that 52% of rainfall becomes rainfall recharge), 'target' subcatchment area and actual subcatchment area.

Spring number	**Spring name**	**Spring flow L. s^{-1}**	**rainfall mm.yr -1**	**rainfall recharge mm.$year^{-1}$**	**Subcatchment area**	
					Target km^2	**Actual km^2**
S101	Hamurana	2747	2075	1079	80	75
S102	Taniwha	1698	2145	1115	48	44
S104	Hatchery	119	1881	978	4	3
S105	Barlows #1 and #2	239	1975	1027	7	6
S107	Paradise	56	2000	1040	2	2
S108	Fairy and Rainbow	298	1842	958	10	6
S109	Te Ahipukahu	64	1761	916	2	2
S110	Karamu Takina + 2 others	819	1991	1035	25	24
S111	Waipa #1	113	1619	842	4	4
S112	Waipa #2	335	1639	852	12	13

The authors prefer the estimate of rainfall recharge determined by Dell (1982) in his analysis of low flows in the Mamaku Plateau. Subcatchment areas are estimated assuming rainfall recharge of 52% of rainfall and mean rainfall within the area from a 1 km-by-1 km grid of the Hoare (1980) rainfall map (Figure 7.1). This calculation (Table 7.6) estimates the subcatchment area of Hamurana Springs, for example, as 80 km^2. This area is considerably less than the 130 km^2 estimated by Pang et al. (1996) because our estimate of rainfall recharge (1079 mm $year^{-1}$) is considerably larger than their 669 mm $year^{-1}$.

Subcatchment boundaries of springs are determined using the following process:

1) calculate ‘target’ subcatchment area (Table 7.6) using spring flow observations of Sigma Consultants (1993), estimated rainfall (Figure 7.1) and estimated rainfall recharge (52%),

2) draw an area that represents the potential catchment based on groundwater level contours (Figure 7.4), catchment boundaries, topographic gradient and geology. Groundwater level contours (Figure 7.4) are not considered when drawing a subcatchment boundary for Hamurana Springs because poor coverage of well water level measurements in the area means poor confidence in the quality of contour calculations,

3) calculate area of the subcatchments. Calculate the average rainfall in the zone from a 1 km-by-1 km model of average rainfall and recalculate ‘target’ subcatchment area,

4) compare actual area of the subcatchment with ‘target’ area for the subcatchment and adjust boundaries,

5) repeat steps 3 and 4 until end ‘target’ area is similar to actual area (Table 7.6).

Revised estimates of spring subcatchment areas (Table 7.6 and Figure 7.7) allows a number of problems with the Pang et al. (1996) map of spring subcatchment zones to be resolved:

- The Hamurana Springs subcatchment northern limit of the Mangarewa River is not required, however the revised subcatchment area of the spring still includes a significant area of land that drains to the north.
- Pang et al.’s (1996) task of mapping hydrogeologically reasonable subcatchments for the Hamurana Springs and Taniwha Springs in the north was made impossible by the large areas required. This appears to have been ‘cartographically resolved’ by plotting only approximately 20 km^2 of the Taniwha Springs area, where their model required an 80 km^2 area.
- Pang et al. (1996) required the whole area of Mt Ngongotaha to support the observed spring flow of springs S100, S108 and S109. However, it is unlikely that rainfall recharge

on the west, and southwest, of the mountain will make its way to those springs and so smaller subcatchment areas are probably appropriate.

Features of revised spring subcatchments include:

- S101 - Hamurana Springs. The area of this spring subcatchment covers the Mamaku Plateau to the north of Lake Rotorua. Very few groundwater level measurements exist in this area, so little hydrogeological control exists to assist boundary definition. The boundary of the subcatchment encloses 75 km^2 of land, as it is considered implausible to cover 80 km^2. The eastern boundary is taken almost to Lake Rotoiti and the western boundary extends to the western boundary of the catchment. This wide range is probably unlikely, pointing to rainfall recharge being larger than 52% of rainfall.
- S102 - Taniwha Springs. The Sigma Consultants (1993) estimate of flow at the main road is used as an estimate of the Taniwha Spring flows. The subcatchment area is defined by the piezometric map and boundary of Hamurana Springs. The ‘actual’ area is less than the target area, indicating that rainfall recharge may be greater than 52% of rainfall recharge.
- S104 - Hatchery Spring. This spring takes water from the northern flanks of Mt Ngongotaha. The ‘actual’ subcatchment area is less in area than the ‘target’ catchment area (Table 7.6) indicating: a) rainfall recharge is greater than 52% of rainfall, and/or b) rainfall on the mountainside is greater than the rainfall model indicates, and/or c) the actual area of land in which rain falls is greater than the area in plan view.
- S105 - Barlows #1 and #2. These springs take water from the ignimbrite aquifer to the west.
- S107 - Paradise. This spring takes water predominantly from the rhyolite unit to the south of the spring. Definition of the subcatchment area boundary follows the observation of Sigma Consultants (1993) that variability in spring flow means that the ignimbrite aquifer is an unlikely water source.
- S108 - Fairy and Rainbow Springs. These springs take water from Mt Ngongotaha. The ‘actual’ catchment is less in area than the ‘target’ catchment (Table 7.6), indicating: a) rainfall recharge is greater than 52% of rainfall, and/or b) rainfall on the mountainside is greater than the rainfall model indicates, and/or c) the actual area of land on which rain falls is greater than the area in plan view.

- S109 - Te Ahipukahu. This spring takes water from the northeastern flank of Mt Ngongotaha.
- S110 - Karamu Takina, Mawae and Ngongotaha springs. These springs take water from the Mamaku Plateau with an upper boundary of the catchment at the Lake Rotorua catchment boundary. Groundwater from alluvium and rhyolite may also contribute to spring flow.
- S111 and S112 - these springs are in the Waipa catchment. Recharge is probably from rhyolite lava domes and flows of the Kapenga Rhyolites (Nairn, 2002).

7.7 Surface water catchments

Environment Bay of Plenty (pers. comm.) records 19 catchments in the Lake Rotorua catchment (Figure 7.8 and Table 7.7). These catchments include the ‘ungauged’ catchment (Figure 7.2). The Puarenga Stream has the largest catchment area (8125 ha) and the Awahou catchment has the largest average rainfall (2131 mm yr^{-1}), Table 7.7.

The catchment of Lake Rotorua is larger than the physical catchment when catchment areas of springs (Figure 7.7) are considered. For example, the areas of Hamurana Springs (S101) and Taniwha Springs (S102) adds approximately 7500 ha to the Lake Rotorua catchment.

7.8 Groundwater subcatchments

The groundwater catchment of Lake Rotorua is divided into 13 ‘major’ subcatchments (Table 7.8) considering the following factors that may influence subcatchment boundaries:

- the western groundwater divide, including information on low-flow gaugings in the Mamaku Plateau draining to the west (Figure 7.2) and groundwater levels (Figure 7.4),
- groundwater flow directions (from Figure 7.4),
- the subcatchments of springs (Figure 7.7), and
- surface catchment boundaries (Figure 7.8).

Most of the groundwater subcatchments are associated with streams (Table 7.8) and most of these streams receive flow from springs.

Table 7.7. Area and mean rainfall of catchments in the Lake Rotorua catchment.

Catchment	**Area (ha)**	**Mean rainfall (mm yr^{-1})**
Awahou	2838	2131
Awahou Point	138	1846
Hamurana	692	1975
Hauraki	1331	2078
Mission Bay	828	2031
Mokoia Island	137	1555
Motutara	285	1587
Ngongotaha	7830	1976
Ngongotaha township	74	1667
Pohue Bay	460	1793
Puarenga	8125	1704
Rotokawa	2394	1556
Utuhina	5947	1928
Waimehia	1154	1942
Waingaehe	1058	1467
Waiohewa	1198	1636
Waiowhiro	1477	1743
Waitawa	1117	1439
Waiteti	7054	2060
Total	44137	

Codes for 13 ‘major’ groundwater subcatchments are assigned firstly a letter representing location:

- ‘N’ for groundwater subcatchments on the north of the lake
- ‘E’ for groundwater subcatchments on the east of the lake
- ‘S’ for groundwater subcatchments on the south of the lake
- ‘W’ for groundwater subcatchments on the west of the lake

Mokoia Island and the Ohau Channel are also assigned codes (Table 7.8).

These 13 major groundwater subcatchments are further divided into smaller units where appropriate (Table 7.8, Figure 7.9) and land area and mean rainfall over the subcatchments are summarised in Table 7.9. Groundwater subcatchment N3 (Hamarana Springs) has the largest land area, followed by subcatchment W3 (Waiteti Stream and part of Waimehia Stream).

7.9 Groundwater-surface water interaction

All groundwater subcatchments are recharged by rainfall. They will be recharged from streams, where streams are altitudinally above the groundwater table. Many streams in the catchment are ephemeral, reflecting the large component of rainfall soaking to groundwater. Lake Rotorua may also recharge groundwater should the lake be above groundwater level.

Groundwater will recharge streams, where groundwater levels are greater than the level of stream and spring-fed streams are common in the Lake Rotorua catchment. Groundwater will also recharge wetlands, if groundwater levels are above the ground level of the wetland; likewise groundwater may recharge the lake. For example, Gibbs and Matheson (2001) observe groundwater recharge to wetlands and groundwater recharge direct to the lake on the eastern side of Lake Rotorua. Gibbs (pers. comm.) also identifies cold-water springs in the lake bed near the eastern shore. An example of groundwater-surface water interaction is provided by stream gaugings in the Puarenga Stream in January 2001 (EBOP, pers. comm.). The Puarenga Stream increases in flow from 1387 L s^{-1} at Te Tatua Falls to 1568 L s^{-1} at Memorial Bridge, presumably reflecting geothermal fluid inputs to stream flow from Whakarewarewa. Flow in Puarenga Stream declines from Memorial Bridge to 1378 L s^{-1} at FRI, presumably because of a flow loss to groundwater.

Groundwater-surface water interactions, for each groundwater subcatchment, are summarised in Table 7.10. Inferences on groundwater-surface water interaction are drawn from published observations and hydrological features on the 1:50 000 topographic map.

Table 7.8. Characteristics of groundwater subcatchments.

'Major' subcatchment	**Description**
N1	Northwest edge of the lake, between the lake and the plateau
N2	Northeast edge of the lake, between the lake and the plateau
N3	Hamurana Springs (S101) subcatchment
E1	Coincides with the Pohue Bay surface catchment
E2	Coincides with the Waiohewa Stream surface catchment including the Tikitere geothermal field
E3	Coincides with the Rotokawa surface catchment including the Rotokawa geothermal field
S1	Coincides with the Waingaehe and Waitawa surface catchments
S2	Coincides with the Puarenga surface catchment and includes: S2A: The area between Lake Rotorua and ridge to the east of Hemo Gorge including the Rotorua geothermal field S2B: An area including the Whakarewarewa State Forest Park S2C: The catchment upstream of Hemo Gorge, excluding S2B.
S3	Coincides with the Utuhina Stream catchment and includes: S3A: Rotorua City urban area S3B: Part of the south flank of Mt Ngongotaha draining to S3A S3C: Area includes rhyolites and sediments S3D: Groundwater subcatchment of the S110 Springs (Figure 7.7)
W1	Coincides with the Waiowhero Stream catchment and includes: W1A: Land south of Ngongotaha township W1B: Land north of Kawaha Point W1C: Groundwater subcatchment for Spring S109 (Figure 7.7) W1D: Groundwater subcatchment for Springs S108 (Figure 7.7)
W2	Coincides with the Ngongotaha Stream catchment and includes: W2A: Valley of the Ngongotaha Stream, downstream of Paradise Valley Springs bridge W2B: Mamaku Ignimbrite draining to the Ngongotaha catchment W2C: Groundwater subcatchment for Spring S107 (Figure 7.7) W2D: Land south of Mt Ngongotaha W2E: Part of the west flank of Mt Ngongotaha draining into the Ngongotaha catchment W2F: Groundwater subcatchment for Spring S104 (Figure 7.7)
W3	Coincides with the Waiteti Stream catchment and part of the Waimehia Stream catchment
W4	Coincides with part of the Waimehia Stream catchment and Awahou Stream catchment, including: W4A: Land between Lake Rotorua and W4B W4B: Groundwater subcatchment for Spring 102
M1	Mokoia Island
O1	Possible groundwater outlet from Lake Rotorua to Lake Rotoiti through the Ohau Channel area

Table 7.9. Groundwater subcatchments - area and mean rainfall.

Groundwater subcatchment name	**Area (ha)**	**Mean rainfall (mm.yr^{-1})**
N1	411	1940
N2	444	2000
N3	7540	2064
O1		
E1	492	1793
E2	1243	1643
E3	2465	1567
S1	2230	1450
S2A	1112	1589
S2B	2697	1630
S2C	4543	1782
S3A	1949	1729
S3B	215	1987
S3C	1874	1923
S3D	2503	1996
W1A	93	1733
W1B	175	1610
W1C	248	1742
W1D	625	1843
W2A	1356	1883
W2B	5219	2003
W2C	134	2000
W2D	125	2007
W2E	555	1960
W2F	283	1881
W3	6964	2037
W4A	553	1846
W4B	4369	2145
M1	137	1555
Total	50147	

Table 7.10. Groundwater-surface interaction in each groundwater subcatchment.

Code	Groundwater recharge	Groundwater discharge
N1	rain, stream	streams and/or lake
N2	rain, stream	streams and/or lake
N3	rain, stream	Hamurana Stream to the lake
O1	rain, lake	Lake Rotoiti
E1	rain, stream	streams and/or lake
E2	rain, stream, geothermal field	streams and/or lake
E3	rain, stream, geothermal field	streams, wetland and/or lake
S1	rain, stream	streams and/or lake
S2A	rain, stream, geothermal field	streams, wetland and/or lake
S2B	rain, stream	Waipa Stream, Kauaka Stream, then to Puarenga
S2C	rain, stream	streams upstream of Hemo Gorge, then to Puarenga
S3A	rain, stream, stormwater	streams and/or lake
S3B	rain, stream	to S3A
S3C	rain, stream	streams, to S3A
S3D	rain, stream	springs, to S3A
W1A	rain, stream	stream and/or lake
W1B	rain, stream	stream and/or lake
W1C	rain, streams	stream and/or lake
W1D	rain, streams	springs, to Waiwhero Stream and then the lake
W2A	rain, stream, W2B-W2F	stream, lake
W2B	rain, streams	springs, W2A
W2C	rain	springs, W2A
W2D	rain	streams, W2A
W2E	rain, streams	streams, W2A
W2F	rain, streams	spring, W2A
W3	rain, streams	streams and/or lake
W4A	rain, streams, W4B	wetland, stream, lake
W4B	rain, streams	springs to Awahou Stream, W4A
M1	rain	springs and/or lake

Groundwater discharge through the Ohau Channel area is likely. An estimate of the groundwater flow in the area of the channel comes from:

- K (hydraulic conductivity) in range 2.7 x 10^{-1} to 1.2 x 10^{3} m day^{-1} (Knowles, 1995, for pumice, yellow-brown silt loam and fine sand at Whakarewarewa Forest)
- Holocene sediment thickness 5 - 10 m. A well near the Ohau channel records 5 m-thick sediments. Manville (pers. comm.) interprets the sediments in the channel as 10 m thick
- channel width approximately 750 m
- hydraulic gradient approximately 0.7 m/1000 m, where 0.7 is the elevation difference between Lake Rotorua and Lake Rotoiti and 1000 m is the approximate distance between the lakes.

Estimated groundwater flow through the channel, with these estimates, is in the range 0.7 to 6,300 m^3 day^{-1} or 8 x 10^{-6} to 7 x 10^{-2} m^3 s^{-1}. Groundwater flows through the Ohau Channel are therefore likely to be quite small, so are set to zero in the following tables that assess flows in groundwater subcatchments.

7.10 Groundwater flows in the Lake Rotorua catchment

Groundwater flows in each subcatchment are combined into a schematic of flows in the Lake Rotorua catchment (Figure 7.10). The links between groundwater subcatchments and the lake can be via streams (Figure 7.10 does not include stream names), wetlands, or direct discharge to the lake. An example of possible water pathways from groundwater to the lake is given in Figure 7.11 for groundwater catchment W4.

The route of direct discharge of groundwater to Lake Rotorua could be seeps through the beach and/or springs in the lake bed. No investigations of this discharge have been made except Gibbs (pers. comm.) who observed groundwater flows of 700 m^3 day^{-1} across a beach on the eastern shore of Lake Rotorua.

Generally, many of the mapped streams in the Lake Rotorua catchment are dry, and geothermal recharge is probably low, so groundwater-surface interactions in Table 10 can be simplified by assuming that rainfall is the sole source of recharge to an aquifer. The estimated total rainfall recharge for all groundwater subcatchments, Table 7.11, is 15.82 m^3 s^{-1}. Hoare (1980) estimates a total inflow into Lake Rotorua from the catchment of 15.8 m^3 s^{-1} in 1976 (major sites plus minor sites plus ungauged, Table 7.12) which is very close to the estimate of lake inflows assuming 52% of rainfall becomes groundwater recharge (Table 7.11).

Table 7.11. Estimated rainfall recharge to each groundwater subcatchment, assuming 52% of rainfall becomes groundwater recharge.

Groundwater subcatchment name	**Ratio of rainfall recharge to rainfall**	**g/w recharge from rainfall $m^3 s^{-1}$**
N1	0.52	0.13
N2	0.52	0.15
N3	0.52	2.57
O1	0.52	0
E1	0.52	0.15
E2	0.52	0.34
E3	0.52	0.64
S1	0.52	0.53
S2A	0.52	0.29
S2B	0.52	0.72
S2C	0.52	1.33
S3A	0.52	0.56
S3B	0.52	0.07
S3C	0.52	0.59
S3D	0.52	0.82
W1A	0.52	0.03
W1B	0.52	0.05
W1C	0.52	0.07
W1D	0.52	0.19
W2A	0.52	0.42
W2B	0.52	1.72
W2C	0.52	0.04
W2D	0.52	0.04
W2E	0.52	0.18
W2F	0.52	0.09
W3	0.52	2.34
W4A	0.52	0.17
W4B	0.52	1.55
M1	0.52	0.04
Total		15.82

Table 7.12. Estimates of inflows and outflows of Lake Rotorua in 1976 (Hoare, 1980).

Inflows:	Major sites	13.3
	Minor sites	0.4
	Ungauged flow	2.1
	Rainfall direct to lake	4.5
	Sum inflows	20.3
Outflows:	Ohau Channel	17.9
	Evaporation	2.0
Increase in storage:		0.4
	Sum outflows plus increase in storage	20.3

Sources of groundwater and water bodies that receive groundwater are summarised in Table 7.13. A further simplification of this model, assuming that springs fully capture all the groundwater within its subcatchment (Table 7.14), allows the definition of a simple model of groundwater and surface water flows in the Lake Rotorua catchment.

Flows in groundwater subcatchments (Table 7.15), for the model in Table 7.14, are compared with flows measured in the 'major' tributaries to Lake Rotorua measured by Hoare (1980). No measurements were made of surface flow in eight groundwater subcatchments: N1, N3, E1, E3, W1A, W1C, W4A, and M1. No significance is attached to differences between total recharge to a groundwater subcatchment and mean flow in major streams in 1980 (Hoare, 1980), because the spring flow data Sigma Consultants (1993) used to develop the model of groundwater subcatchments comes from observations made at different times[1].

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[1] Sigma Consultants (1983) report the spring flow measurements 'which are recorded by the NIWAR Environmental Data Group in Rotorua from information acquired over many years of work in the district'

Table 7.13. Sources of groundwater and discharges of groundwater, Lake Rotorua catchment.

Groundwater subcatchment	**Source 1**	**Source 2**	**Discharge water body 1**	**Discharge water body 2**	**Discharge water body 3**
N1	Rainfall		Lake		
N2	Rainfall		Lake		
N3	Rainfall		Hamurana Stream then to lake	Lake	
O1	Rainfall	Lake	Lake Rotoiti		
E1	Rainfall		Lake		
E2	Rainfall	Geothermal	Waihewa Stream then to lake	Lake	
E3	Rainfall	Geothermal	Wetland then to lake	Lake	
S1	Rainfall		Lake		
S2A	Rainfall	Geothermal	Puarenga Stream then to lake	Wetland then to lake	Lake
S2B	Rainfall		Puarenga Stream then to lake		
S2C	Rainfall		Puarenga Stream then to lake		
S3A	Rainfall	S3B, S3C	Utuhina Stream then to the lake	Lake	
S3B	Rainfall		To S3A		
S3C	Rainfall		Utuhina Stream then to the lake	S3A	
S3D	Rainfall		Utuhina Stream then to the lake	S3C	
W1A	Rainfall	W1C	Lake		
W1B	Rainfall	W1D	Lake		
W1C	Rainfall		Spring then to lake	W1A	
W1D	Rainfall		Waiwhero Stream then to lake	W1B	
W2A	Rainfall	W2B-W2F	Ngongotaha Stream then to lake	Lake	
W2B	Rainfall		Ngongotaha Stream then to lake	W2A	
W2C	Rainfall		Ngongotaha Stream then to lake	W2A	
W2D	Rainfall		Ngongotaha Stream then to lake	W2A	
W2E	Rainfall		Ngongotaha Stream then to lake	W2A	
W2F	Rainfall		Ngongotaha Stream then to lake	W2A	
W3	Rainfall		Waiteti Stream then to lake	Lake	
W4A	Rainfall	W4B	Wetland then to lake	Lake	
W4B	Rainfall		Awahou Stream then to lake	W4A	
M1	Rainfall		Lake		

Table 7.14. Simplified model of groundwater sources and discharges of groundwater, Lake Rotorua catchment. This model assumes geothermal inputs are zero and all recharge within spring subcatchments flows out of springs.

Groundwater subcatchment	Source 1	Source 2	Discharge water body 1	Discharge water body 2	Discharge water body 3
N1	Rainfall		Lake		
N2	Rainfall		Lake		
N3	Rainfall		Hamurana Stream then to lake	Lake	
O1	Rainfall	Lake	Lake Rotoiti		
E1	Rainfall		Lake		
E2	Rainfall		Waihewa Stream then to lake	Lake	
E3	Rainfall		Wetland then to lake	Lake	
S1	Rainfall		Lake		
S2A	Rainfall		Puarenga Stream then to lake	Wetland then to lake	Lake
S2B	Rainfall		Puarenga Stream then to lake		
S2C	Rainfall		Puarenga Stream then to lake		
S3A	Rainfall	S3B, S3C	Utuhina Stream then to the lake	Lake	
S3B	Rainfall		To S3A		
S3C	Rainfall		Utuhina Stream then to the lake	S3A	
S3D	Rainfall		Utuhina Stream then to the lake		
W1A	Rainfall		Lake		
W1B	Rainfall		Lake		
W1C	Rainfall		Spring then to lake		
W1D	Rainfall		Waiwhero Stream then to lake		
W2A	Rainfall		Ngongotaha Stream then to lake	Lake	
W2B	Rainfall		Ngongotaha Stream then to lake		
W2C	Rainfall		Ngongotaha Stream then to lake		
W2D	Rainfall		Ngongotaha Stream then to lake		
W2E	Rainfall		Ngongotaha Stream then to lake		
W2F	Rainfall		Ngongotaha Stream then to lake		
W3	Rainfall		Waiteti Stream then to lake	Lake	
W4A	Rainfall		Wetland then to lake	Lake	
W4B	Rainfall		Awahou Stream then to lake		
M1	Rainfall		Lake		

Table 7.15. Estimated flows in groundwater subcatchments with the simplified model of Table 7.14 and 52% of rainfall becoming rainfall recharge.

				Major Surface catchments	
				Hoare 1980	
Groundwater subcatchment	**g/w flow m^3 s^{-1}**	**Aggregated recharge**	**Aggregated recharge**	**Stream name**	**Flow mean m^3/s**
N1	0.13	N1	0.13		
N2	0.15	N2	0.15		
N3	2.57	N3	2.57	Hamurana	3.08
O1	0	O1			
E1	0.15	E1	0.15		
E2	0.34	E2	0.34	Waiohewa	0.413
E3	0.64	E3	0.64		
S1	0.53	S1	0.53	Waingaehe	0.274
S2	0.29	S2A+S2A+S2C	2.34	Puarenga	2.05
S3	0.56	S3A+S3B+S3C+S3D	2.04	Utuhina	2.04
W1A	0.03	W1A	0.03		
W1B	0.05	W1B+W1D	0.24	Waiowhiro	0.415
W1C	0.07	W1C	0.07		
W2	0.42	W2A+W2B+W2C+W2D+W2E+W2F	2.49	Ngongotaha	1.977
W3	2.34	W3	2.34	Waiteti	1.391
W4A	0.17	W4A	0.17		
W4B	1.55	W4B	1.55	Awahou	1.664
M1	0.04	M1	0.04		

Total flow in the eight ungauged subcatchments (major streams) totals 1.38 m^3 s^{-1}, or approximately 9% of the total estimated rainfall recharge. The eight subcatchments total 4,843 ha in area; all eight subcatchments border the lake, so it is likely that groundwater flow from these will go straight into the lake, or to the lake via wetlands or small streams.

Groundwater flow in all other subcatchments are partially gauged, i.e. stream gauging measurements are upstream of the lake edge, and therefore stream gauging measurements do not include all the subsurface water flow in the catchment.

The similarity of rainfall recharge estimates (15.82 m^3 s^{-1}) and the Hoare (1980) estimate of stream flow and ungauged flow (15.8 m^3 s^{-1}) could confirm the observation of Dell (1982a) that runoff is a low percentage of rainfall and is low in absolute terms. However Gibbs (pers. comm.) estimates that overland flow for the major streams in the catchment is 4.5 m^3 s^{-1}. This would indicate that rainfall recharge is lower than 52% of rainfall, if total lake inflow is

15.8 $m^3 s^{-1}$. On the other hand, it would indicate that total lake inflow is greater than 15.8 $m^3 s^{-1}$, if rainfall recharge is 52% of rainfall.

Rainfall recharge may be greater than 52% of rainfall as indicated by spring subcatchment area. For example, the land area (in plan) of spring subcatchments on Mt Ngongotaha appears to be too small to support the observed spring flow. Water flow into Lake Rotorua will be larger than current estimates should rainfall recharge be larger than 52%.

7.11 Information gaps

- Rainfall recharge.
  Rainfall recharge is estimated from observations of surface water hydrology. A rainfall recharge site (e.g. White et al., 2003) is recommended to measure recharge from rainfall. The preferred location is the Mamaku Plateau to assist in the definition of the Hamurana and Taniwha springs subcatchment boundary. Modelling of rainfall, ET, soil properties and rainfall recharge on a regional basis (e.g. White et al., 2003) is also recommended.

- Spring catchments.
  Improve definition of the subcatchment boundaries, particularly the Hamurana Springs boundary.

- ‘Ungauged’ catchment.
  Investigate groundwater flow in the ungauged catchment and develop a schematic model of groundwater-surface water-lake interaction to incorporate in a groundwater flow model.

- Groundwater-stream interaction.
  Identify locations of groundwater discharge to streams, and stream discharge to groundwater, from historical measurements.

- Groundwater discharge (direct) to Lake Rotorua.
  Model the groundwater flow in subcatchments near the lake to estimate groundwater discharge to the lake. This will require information on aquifer geometry, aquifer hydraulics, conductivity and groundwater gradient. The small streams, wetlands, lake

seeps and lake bottom springs will need to be mapped and assigned to the groundwater subcatchments, and attached to the NIWA land use model.

- Groundwater flow in subcatchments.

  Estimate groundwater flows and velocities in the subcatchments, using a groundwater flow model. This model will also be useful in assessing the effects of land use on groundwater quality.

- Groundwater discharge through the Ohau Channel.

  Investigate the physical properties of the Ohau Channel relevant to groundwater flow and recalculate groundwater flows in the area.

- Groundwater piezometric map.

  Improve knowledge of groundwater levels. Groundwater levels are poorly known in subcatchments N1, N2, N3, E3, S1, S2C, S3A, S3C, S3D and W2. Very useful information on groundwater levels and flow directions will be provided from drill holes. Priorities are: N3, aiming to identify a groundwater divide and therefore improve the estimates of Hamurana Springs subcatchment boundary; E3 and S1 to measure groundwater flow direction; and S2C to improve the estimate of the groundwater divide location.

- Groundwater subcatchments and surface catchments.

  Integrate the model of groundwater subcatchments with the model of surface catchment, considering the location of surface water recording sites, and amend the groundwater subcatchment boundaries as required.

7.12 Summary

- The Hoare (1980) model of rainfall in the Lake Rotorua catchment for 1976 is adopted as the rainfall model for this work.
- The maximum rainfall in this model is 2200 mm yr^{-1}
- Recharge from rainfall in the Lake Rotorua catchment is estimated to be 52% of rainfall, based on observations for the west Mamaku Plateau (Dell 1982a, 1982b).

- The 69 km^2 ungauged catchment of Hoare (1980) is estimated to contribute 1.9 m^3 s^{-1} of flow to Lake Rotorua, assuming a mean rainfall of 1700 mm yr^{-1} and rainfall recharge of 52%, and contribute 61 tonnes of nitrogen per year if average nitrogen concentrations are 2 gm m^{-3}
- A groundwater level map of the Lake Rotorua area shows a groundwater divide orientated approximately north-south through Mamaku township. The map indicates that groundwater is flowing towards Lake Rotorua on the western, southern and eastern sides of the lake
- The groundwater level map suggests that groundwater is travelling northwards from the northern shore of Lake Rotorua, but poor coverage of water level data means that there is poor control on the groundwater contours in this area. e.g. The northern area of the lake has only one well beyond 1 km of the lake edge
- Areas and boundaries of subcatchments of ten springs, or sets of springs, are identified based on 52% of rainfall becoming rainfall recharge
- Hamurana Spring, at 80 km^2 , has the largest subcatchment area of the springs in the region.
- Areas and boundaries of groundwater subcatchments are identified based on: the location of the western groundwater divide, the subcatchments of springs and the surface catchment boundaries.
- Possible sources of groundwater recharge and water bodies receiving groundwater discharge are identified, linkages between subcatchments are outlined, and water pathways to Lake Rotorua are summarised.
- Estimated total rainfall recharge from all groundwater subcatchments is 15.82 m^3 s^{-1} for the whole (groundwater) catchment of Lake Rotorua, assuming 52% of rainfall becomes rainfall recharge. Hoare (1980) estimates total inflow into Lake Rotorua from the catchment (major sites plus minor sites plus ungauged) to be 15.8 m^3 s^{-1}
- Surface flow has not been measured in eight groundwater subcatchments covering 4,843 ha, and it is likely that the estimated 1.38 m^3 s^{-1} flowing from this area is flowing direct to Lake Rotorua or to Lake Rotorua via wetlands or small streams.

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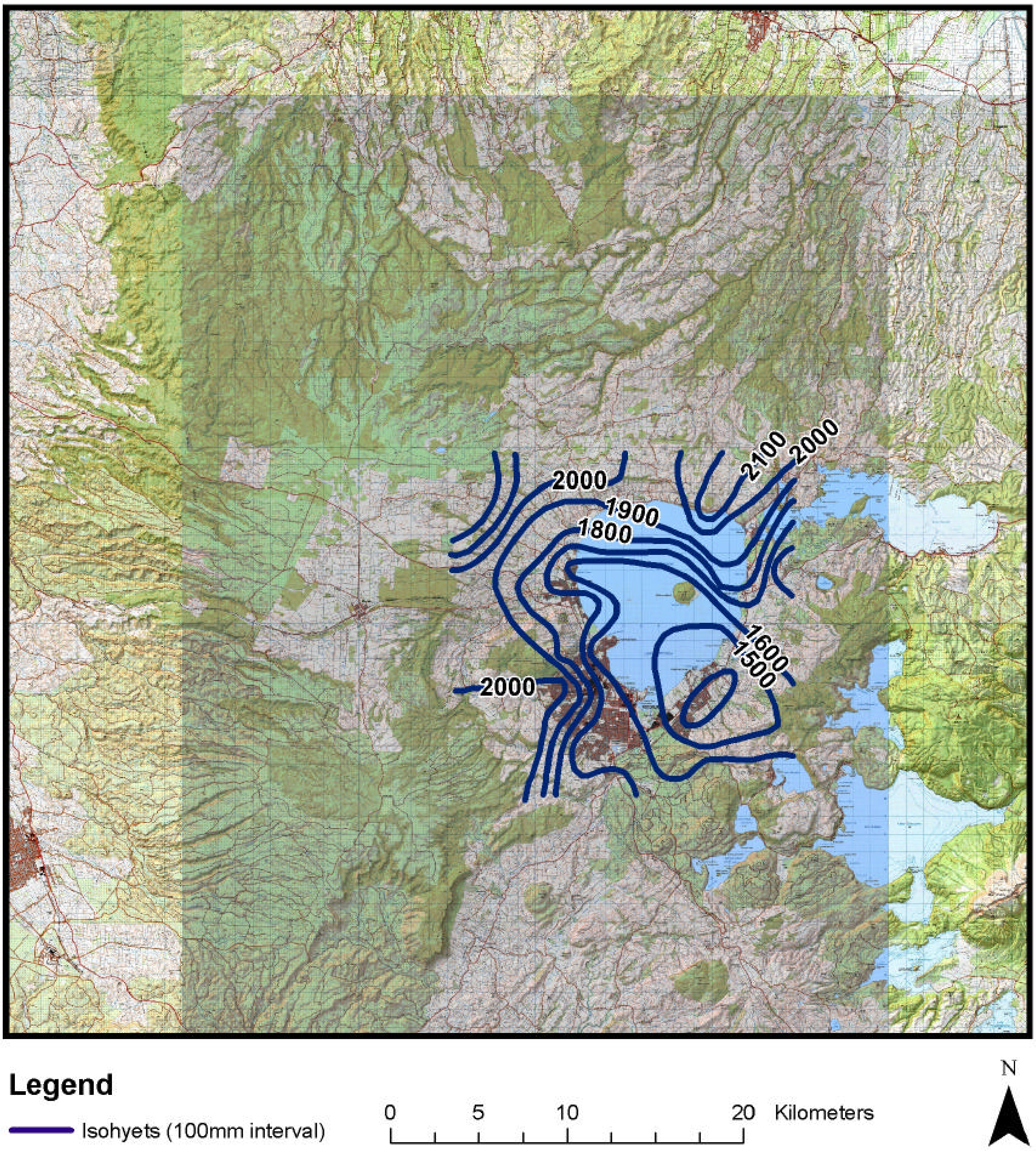

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Figure 7.1 Rainfall isohyets in the Lake Rotorua catchment, 1976 (after Hoare, 1980).

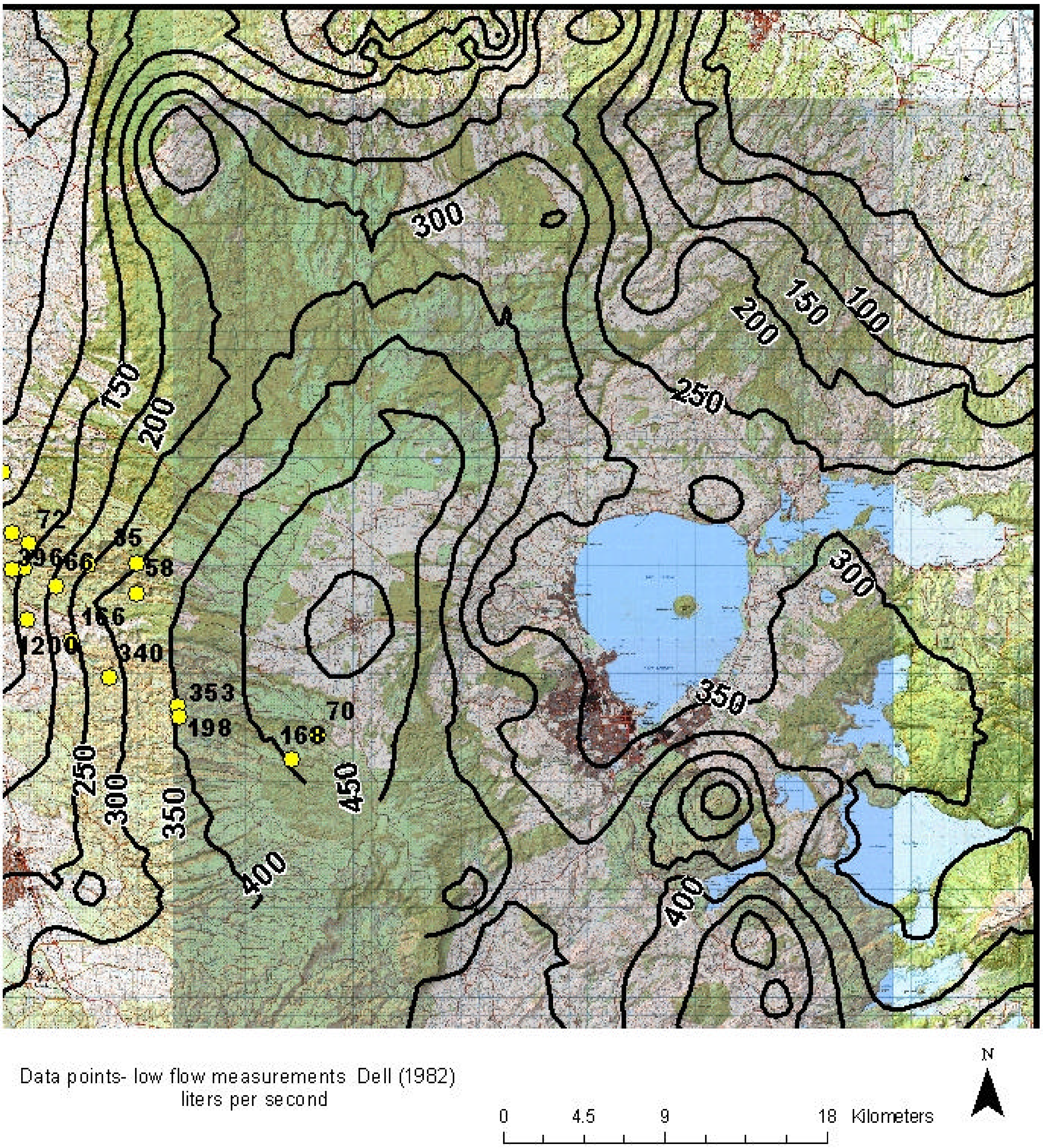

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Figure 7.2 Low-flow gaugings in the Mamaku Plateau on the western Mamaku Plateau (Dell, 1982b).

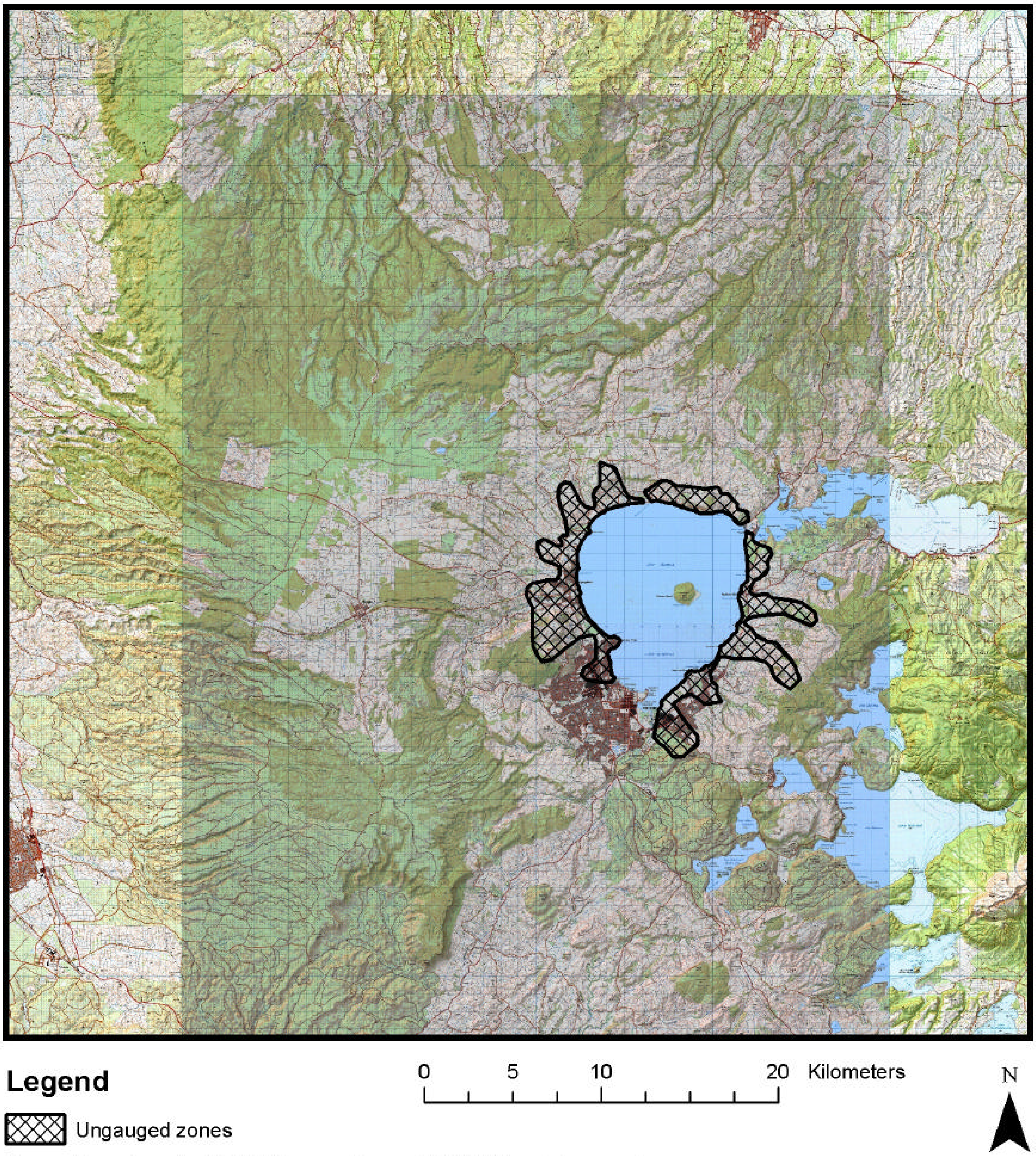

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Figure 7.3 Lake Rotorua catchment that is ungauged (after Hoare, 1980), excluding ungauged catchment in the Rotorua urban area which is not plotted.

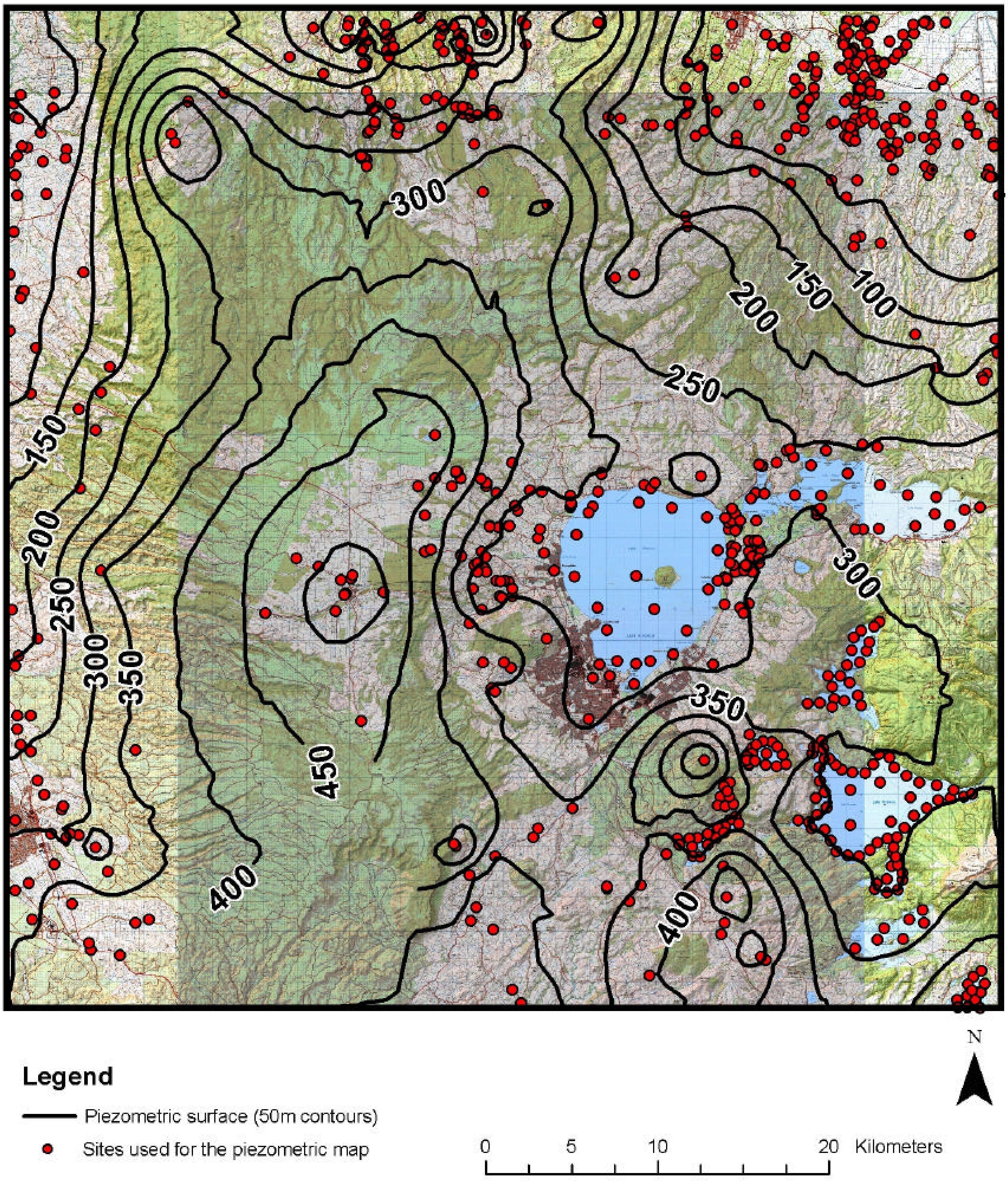

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Figure 7.4 Groundwater levels in the Lake Rotorua region.

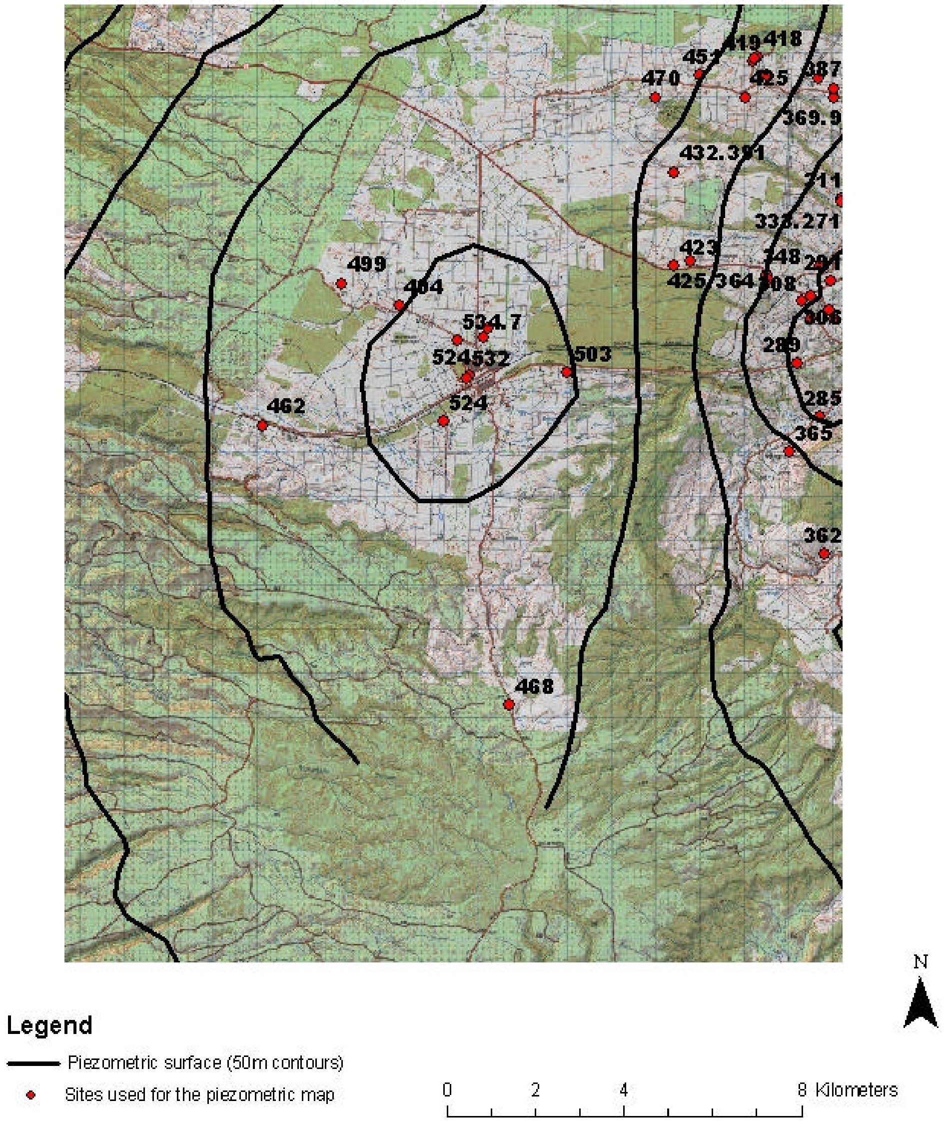

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Figure 7.5 Groundwater levels in the vicinity of Mamaku.

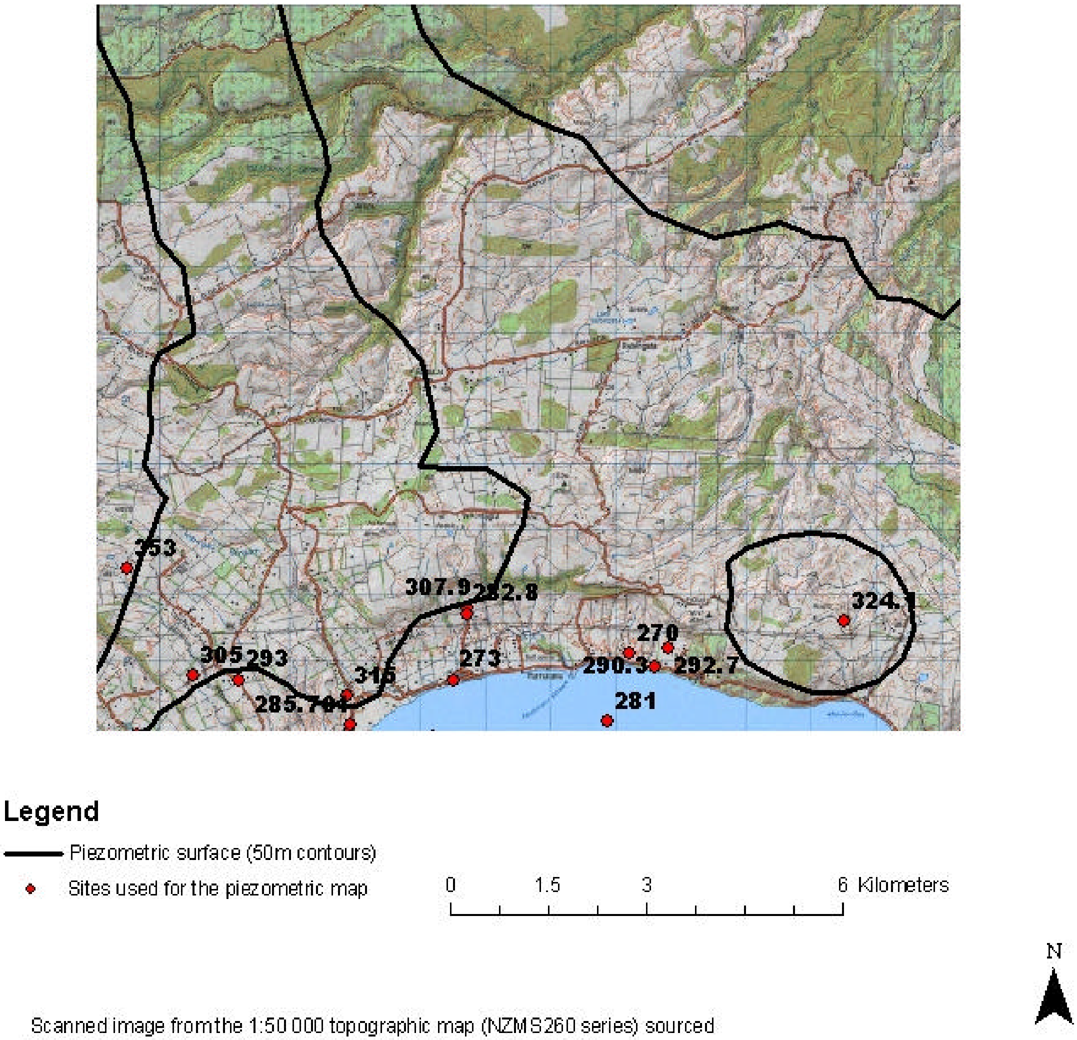

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Figure 7.6 Groundwater levels in the vicinity of north Lake Rotorua.

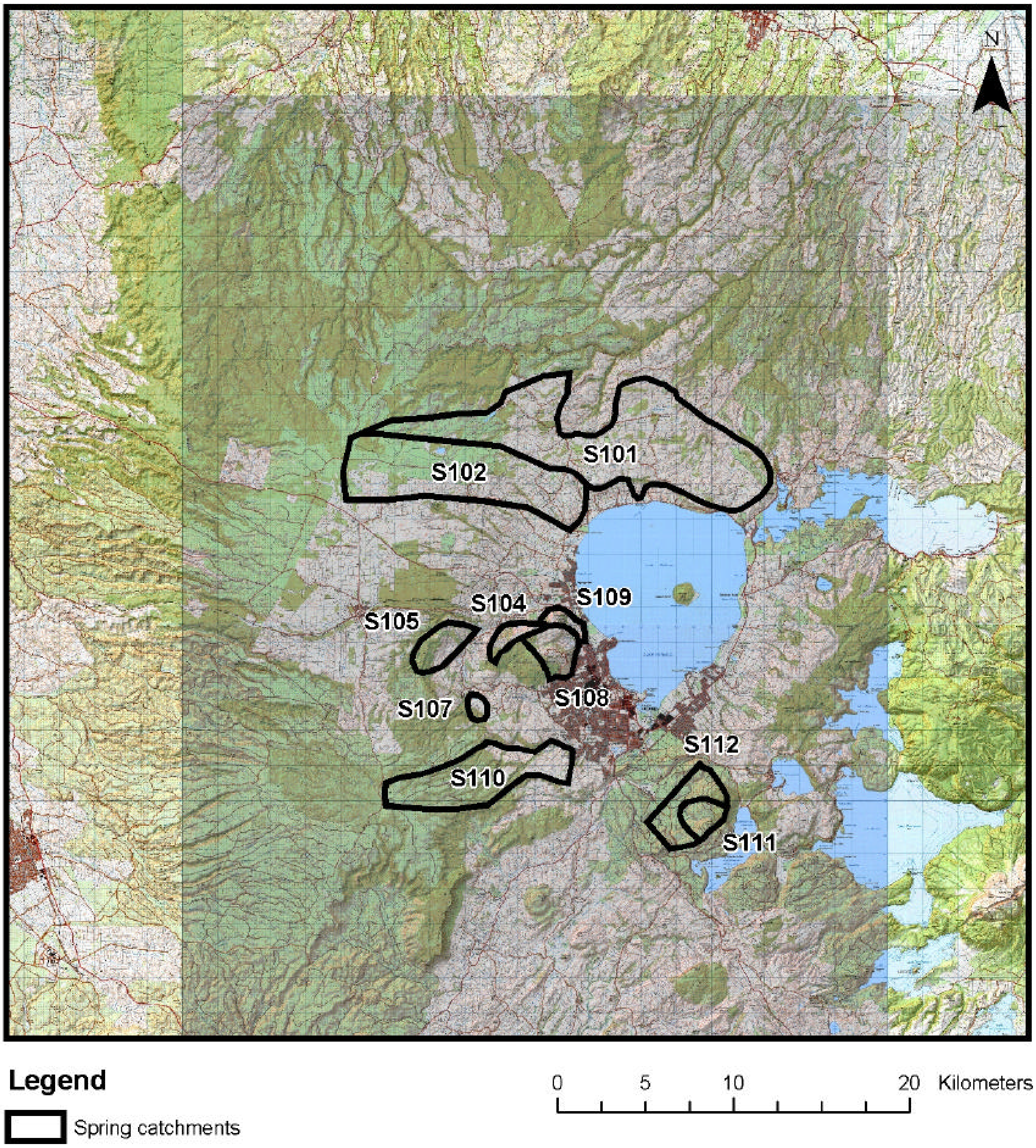

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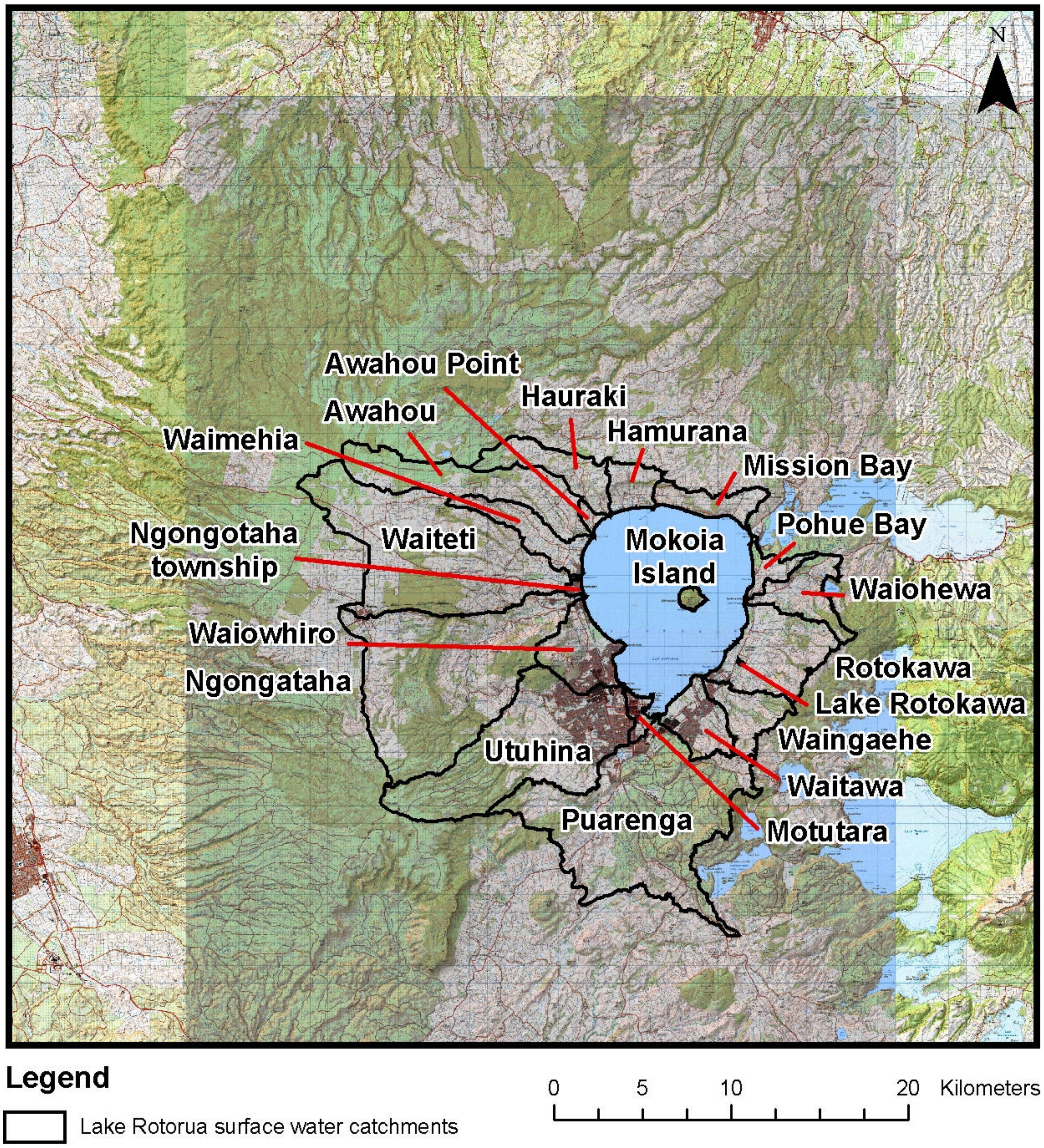
Figure 7.7 Subcatchments of springs estimated in the Lake Rotorua catchment. The numbers of springs are those used by Sigma Consultants (1993). The names of springs are in Table 5.



Lake Rotorua surface water catchment supplied by EBOP.

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Figure 7.8 Catchments in the Lake Rotorua catchment (Environment Bay of Plenty pers. comm.).

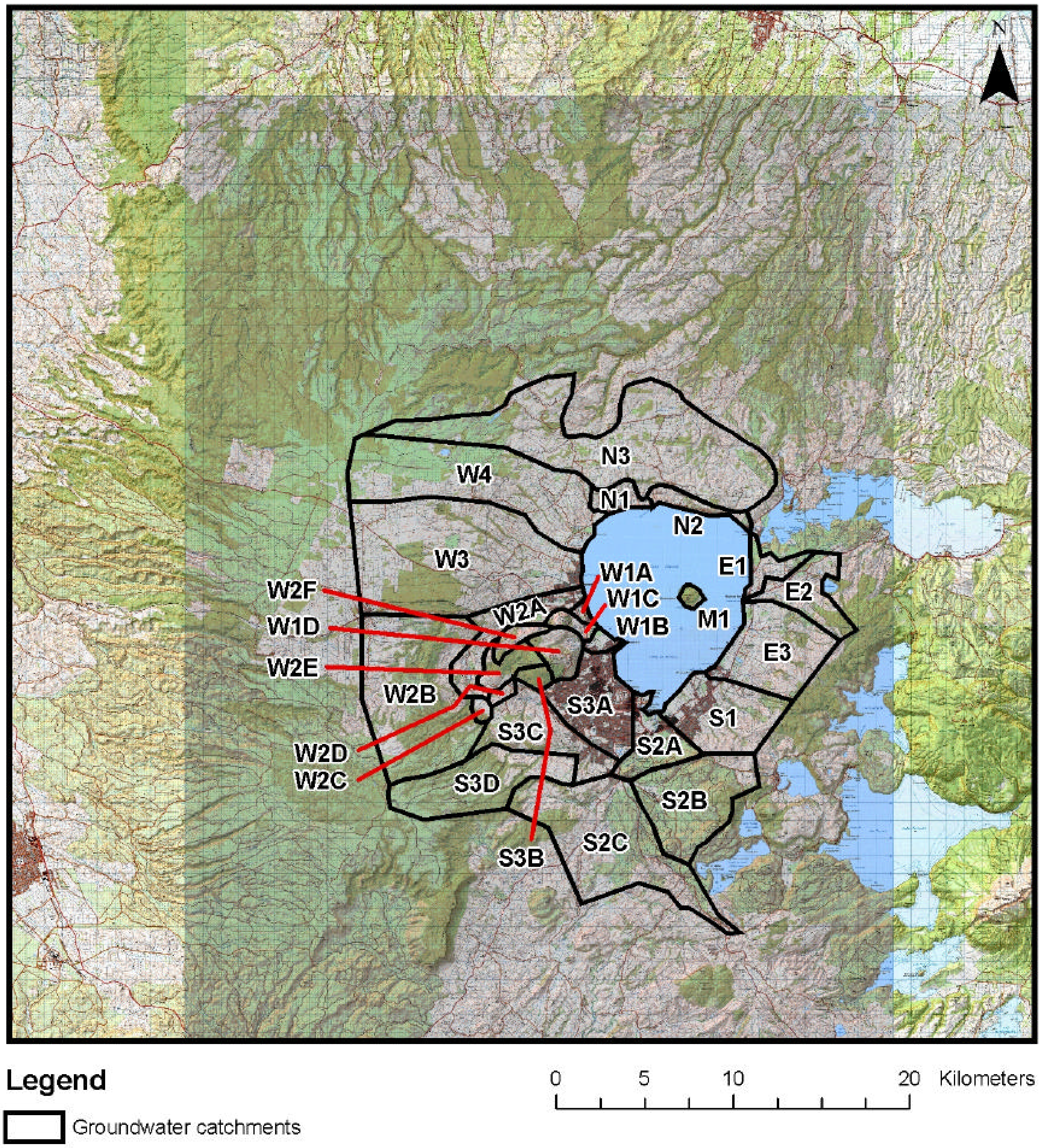

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Figure 7.9 Groundwater subcatchments of Lake Rotorua.

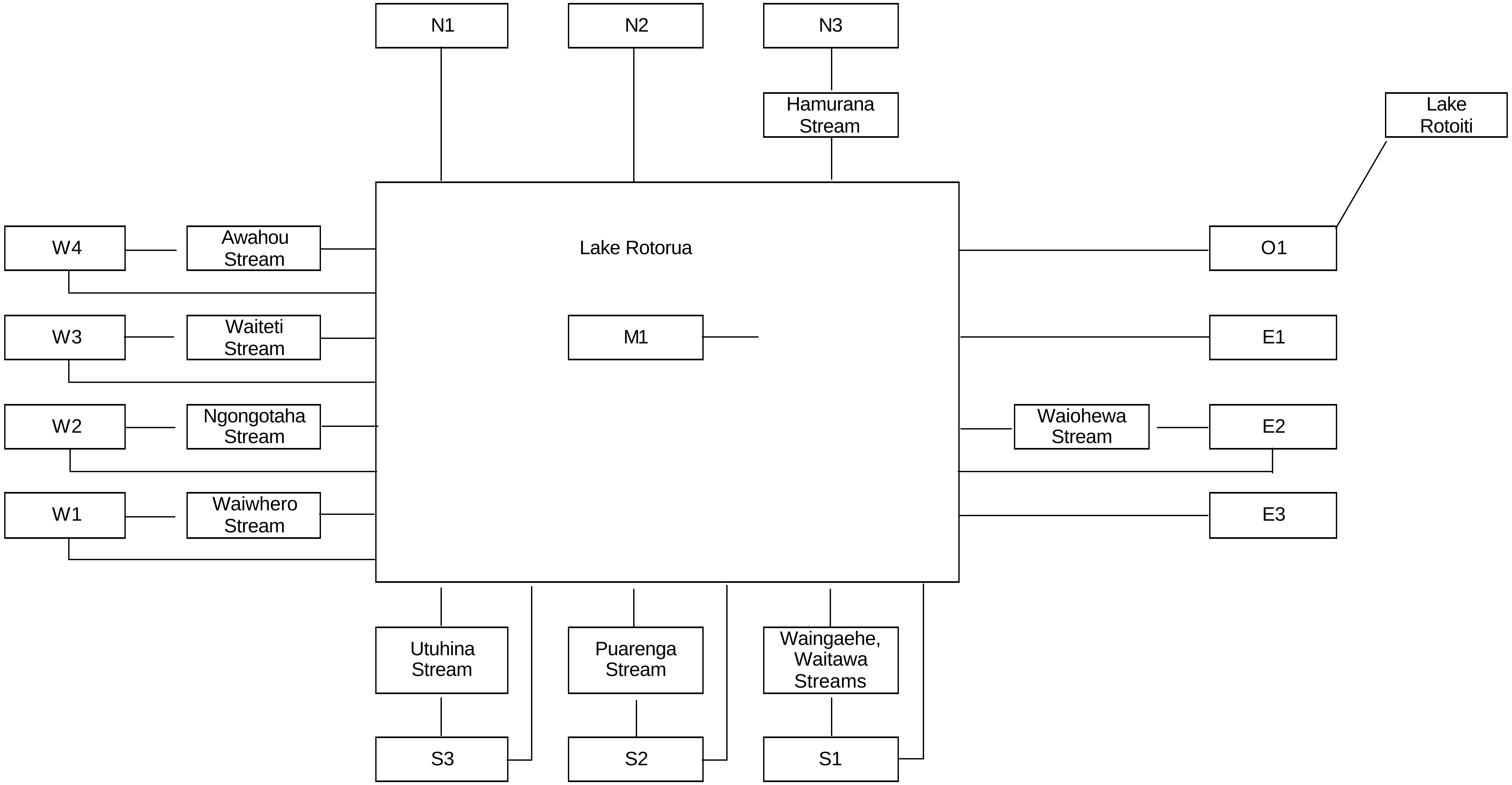

Figure 7.10 Schematic of groundwater pathways and major streams in the Lake Rotorua catchment. Potential routes of groundwater directly to the lake (e.g. from catchments W1, W2, W3 and W4) are indicated.

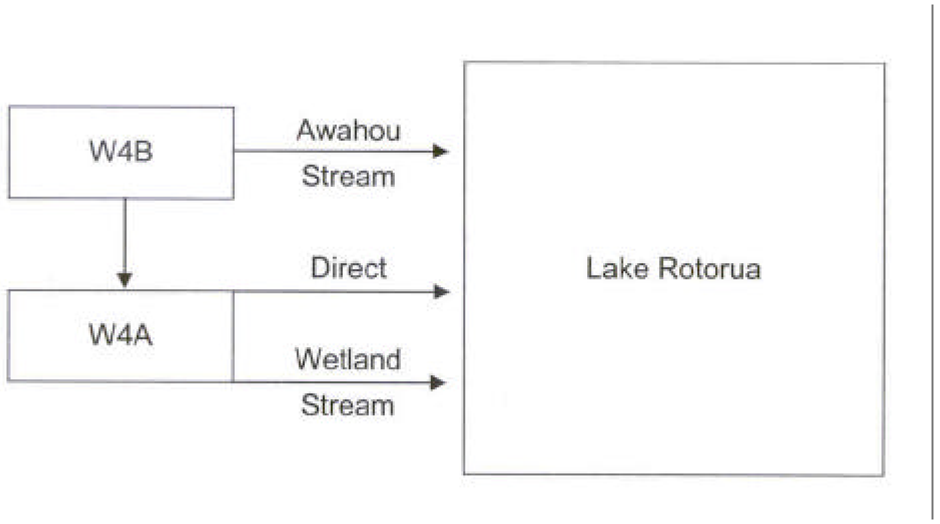

Figure 7.11 Schematic of groundwater pathways from subcatchment W4 to Lake Rotorua.

8.0 OVERVIEW OF GROUNDWATER IN THE LAKE ROTORUA CATCHMENT

8.1 Introduction

Groundwater recharge, flow and discharge within each major groundwater subcatchment are described in this section. Sources of recharge and the geological formations through which recharge occurs, and the major geological formations through which flow is occurring, are summarised. The locations of groundwater discharge from the subcatchment are also summarised.

This section also summarises existing information, in each major groundwater subcatchment, of geology, hydrogeological properties (permeability, storativity, transmissivity information, etc.), groundwater levels, groundwater flow, groundwater quality, groundwater age, degree of geothermal influence or character, and extent to which the flow within the corresponding surface catchment has been gauged.

An assessment of the quality of this information for defining the groundwater flow and nutrient flow in the Lake Rotorua catchment concludes the section.

8.2 Groundwater flow system and subcatchment properties

8.2.1 Subcatchment N1

8.2.1.1 Groundwater flow system

Rainfall recharge through Holocene alluvium and Huka Group sediments will travel towards the lake in these formations. This subcatchment may receive some recharge from the subcatchment of Hamurana Springs. Groundwater will discharge to the lake, through a combination of seeps, streams, wetlands or sub-lake surface springs.

8.2.1.2 Existing information

- Geology:	Holocene alluvium, over Huka Group sediments, over Mamaku Pyroclastics
- Hydrogeol. properties:	unknown

- Groundwater quality: no measurements
- Groundwater level: three measurements
- Groundwater flow: 0.13 m^3 s^{-1}
- Groundwater age: age date of stream pending
- Geothermal systems: nil
- Surface catchment: ungauged

8.2.2 Subcatchment N2

8.2.2.1 Groundwater flow system

Rainfall recharge through Huka Group sediments will travel towards the lake in this formation. This subcatchment may receive some recharge from the subcatchment of Hamurana Springs. Groundwater will discharge to the lake, through a combination of seeps, streams, wetlands or sub-lake surface springs.

8.2.2.2 Existing information

- Geology: Huka Group sediments, over Mamaku Pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: no measurements
- Groundwater level: three measurements
- Groundwater flow: 0.15 m^3 s^{-1}
- Groundwater age: no groundwater measurement
- Geothermal systems: nil
- Surface catchment: ungauged

8.2.3 Subcatchment N3

8.2.3.1 Groundwater flow system

Rainfall recharge to Holocene alluvium, Rotoiti pyroclastics, TVZ rhyolite lava and Mamaku pyroclastics will travel through these formations then through the Mamaku pyroclastics towards Hamurana Springs. Groundwater discharges through the springs to Hamurana Stream, and possibly through Huka Group sediments, to Lake Rotorua.

8.2.3.2 Existing information

- Geology: Holocene alluvial, over
  Rotoiti pyroclastics, over
  TVZ rhyolite lava, over
  Mamaku Pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: no measurements of in-situ groundwater quality occur on the EBOP database. Grinsted and Wilson (1978) record NO_3-N concentrations of: 0.1, 0.4, 1.3 and 4.7 mg L^{-1} in the proposed (Section 7 of this report) subcatchment of Hamurana Springs. Measurements at Hamurana Springs (Rutherford, 2003) identify an increase in nitrate concentrations over time in this spring to 0.643 NO_3-N in 2002-2003; 0.011 NH_4-N in 2002-2003 (Rutherford, 2003)
- Groundwater level: one measurement
- Groundwater flow: 2.57 m^3 s^{-1}
- Groundwater age: 145 years MRT
- Geothermal systems: nil
- Surface catchment: gauged

8.2.4 Subcatchment E1

8.2.4.1 Groundwater flow system

Rainfall recharge through Holocene alluvium, Rotoiti pyroclastics and TVZ rhyolite lava will travel through these formations, and the Mamaku pyroclastics, towards Lake Rotorua. Groundwater will discharge to the lake, through seeps, streams, wetlands or sub-lake surface springs.

8.2.4.2 Existing information

- Geology: Holocene alluvium, over
  Rotoiti pyroclastics, over
  Huka Group sediments, over
  Mamaku Pyroclastics
- Hydrogeol. properties: unknown

- Groundwater quality: two bores analysed for nutrients and one of these analysed in the last five years - 3.1 g m^{-3} NO_3-N, 0.03 g m^{-3} NH_4-N, 0.04 g m^{-3} PO_4-P
- Groundwater level: 18 measurements
- Groundwater flow: 0.15 m^3 s^{-1}
- Groundwater age: nil
- Geothermal systems: nil
- Surface catchment: ungauged

8.2.5 Subcatchment E2

8.2.5.1 Groundwater flow system

Rainfall recharge to Holocene alluvium, Rotoiti pyroclastics and TVZ rhyolite lava will travel through these formations, and the Mamaku pyroclastics towards Lake Rotorua. Groundwater will discharge to the lake, through seeps, streams, wetlands or sub-lake surface springs. Discharge from the Tikitere/Taheke geothermal system probably recharges surrounding formations and discharges from the system via the Waiohewa Stream.

8.2.5.2 Existing information

- Geology: Holocene alluvium, over
  Rotoiti pyroclastics, over
  Huka Group sediments, over
  Mamaku Pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: Two groundwater wells have been analysed for nutrients and one well has been sampled in the last five years: 2.3 g m^{-3} NO_3-N 0.008 g m^{-3} NH_4-N, 0.15 g m^{-3} PO_4-P
- Groundwater level: 10 measurements
- Groundwater flow: 0.34 m^3 s^{-1}
- Groundwater age: age date pending on Waiohewa Stream
- Geothermal systems: Tikitere/Taheke
- Surface catchment: mostly gauged

8.2.6 Subcatchment E3

8.2.6.1 Groundwater flow system

Rainfall recharge on Holocene alluvium, Rotoiti pyroclastics, Huka Group sediments, old TVZ rhyolite lava and Mamaku pyroclastics will travel through these formations to Lake Rotorua. Groundwater may travel from Lake Okataina to Lake Rotorua through the old TVZ rhyolite lava, Mamaku pyroclastics and other formations. The Rotokawa geothermal field may discharge groundwater to the lake either directly or via shallow groundwater. Groundwater will discharge to the lake through a combination of streams, seeps, springs, wetlands or sub-lake surface springs.

8.2.6.2 Existing information

• Geology:	Holocene alluvium, over Rotoiti pyroclastics, over Huka Group sediments, over Old TVZ rhyolite lava, over Mamaku Pyroclastics
• Hydrogeol. properties:	unknown
• Groundwater quality:	One bore has been sampled in the area, prior to 1984; Gibbs and Matheson (2001) measured maximum nitrogen concentrations of 2.3 g m^{-3} NO_3-N and 0.146 g m^{-3} NH_4-N in shallow groundwater near Lake Rotorua
• Groundwater level:	four measurements
• Groundwater flow:	0.64 m^3 s^{-1}
• Groundwater age:	no observations
• Geothermal systems:	Rotokawa
• Surface catchment:	partially gauged

8.2.7 Subcatchment S1

8.2.7.1 Groundwater flow system

Rainfall recharge on Holocene alluvium, Huka Group sediments, Rotorua active TVZ rhyolite lava, Mamaku pyroclastics and Onuku-Pokopoko pyroclastics will travel through these formations to Lake Rotorua. Groundwater will discharge to the lake through a combination of streams, seeps, springs, wetlands or sub-lake surface springs.

8.2.7.2 Existing information

- Geology: Holocene alluvium, over
  Huka Group sediments, over
  Rotorua active TVZ rhyolite lava, over
  Mamaku Pyroclastics
  Onuku-Pokopoko pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: no groundwater quality measurements are known in this area from the EBOP groundwater database. Grinsted and Wilson (1978) measured nitrate concentrations of 3.3, 2.0 and 0.1 mg L^{-1} in this subregion. Gibbs and Matheson (2001) measured shallow groundwater nitrogen concentrations at three localities (Hannahs Bay, Holdens Bay and Hinemoa Point) of up to 7.1 g m^{-3} NO_3-N and up to 4.3 g m^{-3} NH_4-N
- Groundwater level: two measurements
- Groundwater flow: 0.53 m^3 s^{-1}
- Groundwater age: no age measurements
- Geothermal systems: nil
- Surface catchment: partially gauged

8.2.8 Subcatchment S2

8.2.8.1 Groundwater flow system

Rainfall on the formations exposed at the ground surface upstream of Hemo Gorge will travel within these formations and probably recharge surface waters, eventually discharging into Puarenga Stream. Rainfall on the section of the subcatchment downstream of Hemo Gorge will travel in the formations to discharge to the lake through a combination of streams, seeps, springs, wetlands or sub-lake surface springs. Groundwater also interacts with hot water in the Rotorua geothermal field. Geothermal field water discharges to the Puarenga Stream upstream of Memorial Bridge and the Puarenga Stream loses flow to groundwater downstream of the Memorial Bridge. Some groundwater recharge will discharge to Lake Rotorua through the city's stormwater system.

8.2.8.2 Existing information

- Geology: Holocene alluvium, over
  Rotoiti pyroclastics, over
  Huka Group sediments, over
  Okataina active rhyolite lava, over
  Mamaku pyroclastics, over
  Pokai and Waimakariri pyroclastics, over
  Old TVZ rhyolite lava
- Hydrogeol. properties: Rotorua geothermal field – some information may be available
- Groundwater quality: Two groundwater bores have been analysed in this subcatchment but neither of these have been analysed for nutrients.
- Groundwater level: three measurements
- Groundwater flow: 2.34 $m^3 s^{-1}$
- Groundwater age: groundwater age measurements pending
- Geothermal systems: Rotorua geothermal field
- Surface catchment: mostly gauged

8.2.9 Subcatchment S3

8.2.9.1 Groundwater flow system

Rainfall recharge on Holocene alluvium, Huka Group sediments, Rotorua active TVZ rhyolite lava and Mamaku pyroclastics travels in these formations towards the lake. Groundwater recharge from the Mamaku pyroclastics discharges in the Utuhina Springs to Utuhina Stream possibly travels to the Rotorua active TVZ rhyolite lava. Groundwater discharges to the lake through a combination of streams, seeps, springs, wetlands or sub-lake surface springs. Some groundwater recharge will discharge to Lake Rotorua through the city's stormwater system.

8.2.9.2 Existing information

- Geology: Holocene alluvium, over
  Huka Group sediments, over
  Rotorua active TVZ rhyolite lava, over
  Mamaku Pyroclastics
- Hydrogeol. properties: unknown

- Groundwater quality: groundwater quality was measured recently at four spring sites. The range of concentrations is 0.4 to 0.7 g m^{-3} NO_3-N, 0.005 to 0.06 g m^{-3} NH_4-N and 0.008 to 0.03 g m^{-3} PO_4-P
- Nitrogen concentrations in recent samples of Utuhina Springs water:
- Groundwater level: eight measurements
- Groundwater flow: 1.22 m^3 s^{-1}
- Groundwater age: age measurements are pending
- Geothermal systems: nil
- Surface catchment: mostly gauged

8.2.10 Subcatchment W1

8.2.10.1 Groundwater flow system

Groundwater recharge from rainfall recharge on the geological units exposed at the ground surface in the subcatchment travels toward Lake Rotorua. Rainfall recharge on Mt Ngongotaha discharges at Fairy Springs and Rainbow Springs. Groundwater discharges to the lake through a combination of streams, seeps, springs, wetlands or sub-lake surface springs. Some groundwater recharge will discharge to Lake Rotorua through the city's stormwater system.

8.2.10.2 Existing information

- Geology: Holocene alluvium, over
  Huka Group sediments, over
  Rotorua active TVZ rhyolite lava, over
  Mamaku Pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: Fairy and Rainbow springs have nitrogen concentrations about 0.8 m g^{-3} NO_3-N and 0.005 g m^{-3} NH_4-N and phosphorous concentrations about 0.03 PO_4-P
- Groundwater level: one measurement
- Groundwater flow: 0.34 m^3 s^{-1}
- Groundwater age: age measurements are pending
- Geothermal systems: nil
- Surface catchment: partially gauged

8.2.11 Subcatchment W2

8.2.11.1 Groundwater flow system

Rainfall recharge on the exposed formations travels towards the lake. There are four springs in this catchment (Peacock, Trout Hatchery and Barlows #1 and #2) that recharge Ngongotaha Stream. Groundwater recharge will also seep to the Ngongotaha Stream. Groundwater discharge to the lake will be from Ngongotaha Stream along with a combination of seeps, springs, wetlands or sub-lake surface springs.

8.2.11.2 Existing information

- Geology: Holocene alluvium, over
  Huka Group sediments, over
  Rotorua active TVZ rhyolite lava, over
  Mamaku Pyroclastics, over
  Onuku-Pokopoko pyroclastics, over
  Matahina pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: five bores near Mamaku township have been sampled in the last five years: 0.02-0.6 m g^{-3} NO_3-N, 0.005-0.02 g m^{-3} NH_4-N, and 0.06-0.2 PO_4-P. Maximum NO_3-N concentration in springs is 1.75 g m^{-3}
- Nitrogen concentrations in recent samples from springs:

Peacock	1.75 g m^{-3} NO_3-N <0.01 g m^{-3} NH_4-N
Trout Hatchery	0.945 g m^{-3} NO_3-N, <0.01 g m^{-3} NH_4-N
Barlows	0.567 g m^{-3} NO_3-N, (0.01 g m^{-3} NH_4-N

- Groundwater level: 12 measurements
- Groundwater flow: 2.49 m^3 s^{-1}
- Groundwater age: three age dates on springs with a range 30 to 73 years MRT
- Geothermal systems: nil
- Surface catchment: Ngongotaha Stream, partially gauged

8.2.12 Subcatchment W3

8.2.12.1 Groundwater flow system

Rainfall recharge on the Holocene alluvium, Huka Group sediments and Mamaku pyroclastics will travel towards Lake Rotorua to discharge in a combination of seeps, springs, wetlands and sub-lake surface springs.

8.2.12.2 Existing information

- Geology:	Holocene alluvium, over Huka Group sediments, over Mamaku Pyroclastics, over Onuku-Pokopoko pyroclastics, over Matahina pyroclastics
- Hydrogeol. properties:	unknown
- Groundwater quality:	two wells have been sampled for groundwater quality in the last five years: 0.003 and 1.4 g m^{-3} NO_3-N; 0.005 and 0.008 g m^{-3} NH_4-N; 0.025 and 0.07 g m^{-3} PO_4-P
- Groundwater level:	26 measurements
- Groundwater flow:	2.34 m^3 s^{-1}
- Groundwater age:	well 10424 - 150 years MRT one age date pending on stream
- Geothermal systems:	nil
- Surface catchment:	partially gauged

8.2.13 Subcatchment W4

8.2.13.1 Groundwater flow system

Rainfall recharge on the Holocene alluvium, Huka Group sediments and Mamaku pyroclastics travels towards Lake Rotorua. Recharge on the Huka Group sediments and Mamaku pyroclastics discharges at Taniwha Springs and then enters Lake Rotorua via the Awahou Stream. Groundwater discharge to the lake occurs in the area below Taniwha Springs; discharge will occur through a combination of springs, seeps, wetlands and sub-lake surface springs.

8.2.13.2 Existing information

- Geology: Holocene alluvium, over
  Huka Group sediments, over
  Mamaku Pyroclastics, over
  Onuku-Pokopoko pyroclastics, over
  Matahina pyroclastics
- Hydrogeol. properties: unknown
- Groundwater quality: five bores have been sampled in the last five years: 0.5 to 13.7 g m^{-3} NO_3-N, 0.005 NH_4-N, 0.05 to 0.09 PO_4-P
- Nitrogen concentrations in the Taniwha Springs:
  at the water intake, sampled on 22/11/03 are 1.39 g m^{-3} NO_3-N and <0.01 NH_4-N
- Groundwater level: 18 measurements
- Groundwater flow: 1.72 m^3 s^{-1}
- Groundwater age: 64 years MRT, Taniwha Springs
- Geothermal systems: nil
- Surface catchment: partially gauged

8.3 Assessment of the quality of existing information

Existing information, summarised in the previous section is assessed for defining the flux of groundwater and nutrients with groundwater in the Lake Rotorua catchment. This assessment considers existing information in:

- geology
- hydrogeological properties associated with water flow e.g. as measured by pump tests
- groundwater quality, particularly measurements of groundwater nutrients in the last five years
- groundwater level
- groundwater age
- surface catchment in relation to the proportion of groundwater subcatchment monitored by surface water flow measurements

The assessment criteria are subjective and use the following scale to rate the quality of information in each category:

- A - adequate information for defining groundwater flow and nutrient flux
- B - some information for defining groundwater flow and nutrient flux
- C - inadequate information for defining groundwater flow and nutrient flux

Table 8.1 Assessment of groundwater information in the Lake Rotorua catchment.

	Groundwater subcatchment												
	N1	**N2**	**N3**	**E1**	**E2**	**E3**	**S1**	**S2**	**S3**	**W1**	**W2**	**W3**	**W4**
Geology-surface	A	A	A	A	A	A	A	A	A	A	A	A	A
Geology-subsurface	B	B	B	B	B	B	B	B	B	B	B	B	B
Hydrogeological properties	C	C	C	C	C	C	C	C	C	C	C	C	C
Groundwater quality	C	C	B	C	B	C	C	C	B	B	B	B	B
Groundwater level	B	B	C	A	A	B	C	C	B	C	A	A	A
Groundwater age (including pending measurements)	B	C	B	C	B	C	C	B	B	B	B	B	B
Surface catchment*	C	C	A	C	A	C	C	A	A	B	B	B	B

The assessment criteria are subjective and use the following scale to rate the quality of information in each category:

A - adequate information for defining groundwater flow and nutrient flux
B - some information for defining groundwater flow and nutrient flux
C - inadequate information for defining groundwater flow and nutrient flux

*1 - surface catchment substantially captures groundwater flow
2 - surface catchment partially captures groundwater flow
3 - surface flows capture no groundwater flow, surface streams do not commonly flow or surface streams are in the ‘minor’ category of Hoare (1980)

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This assessment indicates that:

- The existing groundwater chemistry information is generally inadequate to determine nutrient fluxes from subcatchments
- The information to determine groundwater flow and nutrient fluxes is inadequate for subcatchments N1, N2, N3, E1, E3, S1, S2 and W1

8.4 References

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