# On-Site Wastewater Capability at Lake Tarawera

for

Bay of Plenty Regional Council

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louise feathers planning

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# Appendices:

# 1 EXECUTIVE SUMMARY

The community of Lake Tarawera is currently served by individual on-site wastewater treatment and disposal systems. The Bay of Plenty Regional Council On-Site Effluent Treatment Regional Plan (OSET Plan) identifies the community as one of the areas in the region where monitoring has at times shown levels of bacteria or nutrients which have the potential to compromise water body quality. BOPRC identified a Maintenance Zone and Future Reticulation Zone for Lake Tarawera and Rule 2(d) of the OSET Plan requires that from 1 December 2017, the discharge of treated domestic wastewater into land from an existing septic tank on-site effluent treatment system in the Maintenance Zone will be a discretionary activity, requiring resource consent. Also, Rule 11 requires that Aerated Wastewater Treatment Systems (AWTS) must meet a minimum nitrogen standard when located within 200m of the lakeshore, or require consent.

The Tarawera community are currently investigating options for reticulation of wastewater, and treatment and disposal options both locally and in Rotorua. Some funding has been procured however should reticulation not be the preferred option for the community, then the continued use of on-site systems will be required. We have been engaged to investigate whether on-site wastewater management can occur in accordance with the current regional rules and design guidelines, for properties within the Lake Tarawera community. This report summarises our findings.

The investigation has reviewed the current state of the environment reports and Council policy, completed a desk-top analysis of GIS data relating to slope, property size and groundwater depth, and undertaken a site inspection programme visiting 107 individual properties and testing soils.

It has been identified that effective and sustainable on-site wastewater treatment and disposal at Lake Tarawera is limited by a range of site constraints. The site constraint parameters identified as; the existing system type, soil type, property size, proximity to groundwater and land slope, have been assessed and all sites graded in terms of whether properties can meet the requirements of the OSET Plan and current standards. The results indicate that:

- 0.5 percent of sites are permitted (green);
- 4 percent of sites are currently authorised via resource consent or have a secondary treatment system in place, however both of these only provide short term solution and will require upgrades in the future (yellow);
- 52 percent of sites would require upgrades including new wastewater treatment systems to be authorised or permitted (orange);
- 43 percent of sites are likely to be unable to meet the required standards for on-site wastewater, due to the soil type and steep slopes limiting available disposal area (red).

The investigation colour grading shows that the majority of properties in the Lake Tarawera settlement (95%) do not meet current standards, and many of these are unlikely to be able to meet the required standards. The capability of the settlement to effectively and sustainably utilise individual on-site wastewater treatment and disposal systems is very limited and upgrades will be costly, and given the evidence of the impacts of on-site wastewater discharges, it is considered important that the settlement is reticulated.

The Tarawera community are currently investigating the provision of wastewater reticulation. Should a centralised wastewater treatment and disposal solution not be progressed, the community will remain serviced by on-site systems. The community have asked if this is a valid option. This investigation indicates that on-site systems are likely not a valid option for 43 percent of the community, with a further 56 percent of the community facing significant system upgrades in the future to meet current standards and reduce adverse environmental and public health effects on the water quality of Lake Tarawera.

TARAWERA KEY FINDINGS:

- Lake Tarawera water quality is declining and the discharges from on-site wastewater systems are contributing to increased nutrient loads which pose an environmental problem, and pathogen loads which cause a public health risk.

- Effective and sustainable on-site wastewater management is severely constrained by environmental conditions (steep slopes, poorly draining soils, high groundwater).

- Nearly 20 percent of sites inspected showed issues regarding systems improperly installed or malfunctioning.

- 43 percent of properties do not have sufficient suitable area available to install a wastewater system which will meet the nitrogen reduction requirements of the OSET Plan.

- 56 percent of properties would require a significant upgrade to their on-site systems to meet the requirements of the OSET Plan.

- Overall, retaining on-site wastewater systems will require significant upgrades and costs, and even then it may not be possible for many sites to achieve the OSET standards required to protect Lake Tarawera. Given this, it is considered important that the community is reticulated to a centralised wastewater system.

# 2 INTRODUCTION/COMMUNITY SETTING

The community of Lake Tarawera is identified as a Maintenance Zone and a Future Reticulation Zone as shown in Figure 1 below. The community is located along the north-western shore of Lake Tarawera. The dwellings extend along the lake shore, predominantly on either side of Spencer Road covering a distance of approximately 5.7 kilometres.

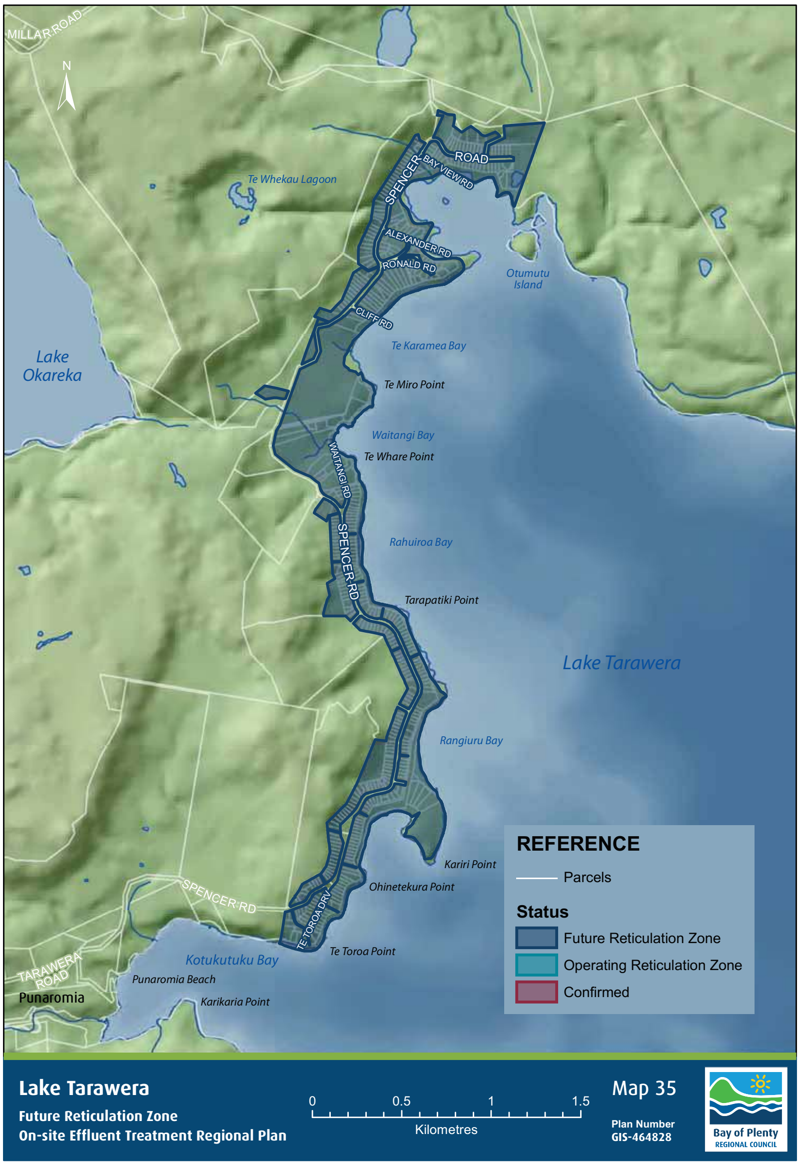


Figure 1: Tarawera Community

The community is located approximately 16 kilometres from Rotorua City and is predominantly characterised as a holiday accommodation destination. The settlement has no shops or facilities other than the Landing Café. Water supply to the dwellings is either via lake water or rain water collected on roofs. Topography of the area is varied, although generally steep with the exception of some areas along the lake shore.

Lake Tarawera is the second largest lake of the twelve Rotorua Lakes managed for water quality by the Bay of Plenty Regional Council and is summarised with the Lake Tarawera Restoration Plan[1] as:

- Lake size: 4,138 ha
- Catchment area: 14,472 ha
- Elevation: 298 m
- Average depth: 50m
- Deepest point: 87.5 m
- Formed: 5,000 years ago
- Outflow: Surface via the Tarawera River

About 390 houses are located at the lake with about 25% permanently occupied by 290 residents. The remaining 75% of houses are used as holiday accommodation. There are anecdotal reports of an emerging trend of bach owners who have been holidaying at the lake for the past few decades, retiring and living at the lake permanently. The extent and continuation of this trend is unknown and has not been investigated.

Lake Tarawera is a popular lake, providing a variety of recreational uses for residents and visitors:

- Water activities – kayaking, sailing, water-skiing, ski-biscuiting, jet-skiing, swimming.
- Fishing – Lake Tarawera has a well-stocked trout fishery.
- Walking, tramping and camping – there are several walking and tramping tracks around Lake Tarawera with camping grounds located at The Outlet, Humphries Bay and Hot Water Beach.
- Tourist attractions – the Buried Village of Te Wairoa, Hot Water Beach, trout fishing and an ascent of Mount Tarawera attract visitors to the lake.
- General activities – parks and reserves adjacent to the lake provide public facilities such as boat ramps, playgrounds and public toilets.

The Restoration Plan also acknowledges the importance of the lake to the iwi and hapu of Lake Tarawera, represented by Te Arawa Lakes Trust, Tuhourangi Tribal Authority and Ngati Rangitihi. Concerns expressed by these groups include ensuring lake water quality does not decline further, the health of waterways, discharge of contaminants and overuse of freshwater resources.

[1] Tarawera Lakes Restoration Plan BOPRC Environmental Publication 2014/12

# 3 STATE OF THE ENVIRONMENT

To support the Bay of Plenty Regional Council's ongoing implementation of the OSET Plan and ongoing progress reporting several relevant documents have been generated within the past few years.

## 3.1 Tarawera Lakes Restoration Plan (December 2015)

This plan was implemented in response to the Trophic Level Index (TLI) of Lake Tarawera reaching 3.0 and hence exceeding the target of 2.6, which indicates declining water quality. The main cause of the declining water quality (indicated by a high TLI) is an increase in nitrogen and phosphorus flowing from the catchment. To solve the problem, the plan recommends that the level of nutrients entering the lake needs to be reduced to a sustainable load. This involves calculating how many nutrients are flowing to the lake from each source, and estimating the reduction required to achieve the target.

The most recent nutrient budget indicates that phosphorus is more of a concern than past nutrient budgets may have signalled. The reports recommendation was to focus resources on reducing phosphorus, while capping nitrogen, to ensure further water quality decline does not occur.

The key actions identified by the Plan are as follows:

1. Reticulation of sewage (reduction of 2,828 kg/year of nitrogen and 283 kg/year of phosphorus)
2. Better management of agricultural land- use (inner catchment)
3. Control of nitrogen fixing plants (reduction of 230 kg/year of nitrogen)
4. Better management of agricultural land-use (outer catchment)

## 3.2 BOPRC Rotorua Lakes Water Quality Report 2014/2015 (March 2016)

The annual state of the environment reporting[2] or the Rotorua Lakes with respect to Lake Tarawera indicates the following:

*Lake Tarawera TLI = 3.1 (target 2.6). The water quality has deteriorated significantly since 2002 driven by an increase in nitrogen, phosphorus and a recent decline in water clarity. Cyanobacteria blooms occasionally occur during summer.*

Lake Tarawera is considered to be on the cusp of oligotrophic (low nutrient content) and mesotrophic (medium levels of nutrients), but water quality is deteriorating and cyanobacteria blooms occasionally occur during summer. It has a TLI value of 3.1, which is worse than the RWLP target of 2.6.

[2] Rotorua Lakes Water Quality Report 2014/2015 BOPRC Environmental Publication 2016/06

### 3.3 University of Waikato – Modelling the impact of sewage reticulation on water quality of Lake Tarawera (April 2016)

In 2016 the Lake Tarawera Ratepayers Association commissioned a study to assess the potential impacts of sewage reticulation on lake water quality. The question posed by the Ratepayers Association was: *What is the effect of sewage reticulation on lake water quality in Lake Tarawera, with a focus on faecal indicator bacteria (FIB) and contribution to nutrient loads?*

The study utilised a mass balance approach for nutrient loads and also investigated *E. coli* concentrations from tap water samples collected from public toilet sites around the lake. In terms of the public health findings the report noted:

*The counts of faecal coliforms recorded from water samples collected from selected locations within the catchment, indicate some faecal contamination of drinking water source or distribution system.*

The study noted there were some issues with aspects of the data used in the analysis however it stated that it is quite clear that the majority of drinking water samples analysed during the 15-year period at Lake Tarawera catchment were non-compliant (see Figure 2 below), warranting the need for efforts aimed at reducing potential sources of faecal contamination within the catchment, including considerations for sewage reticulation.

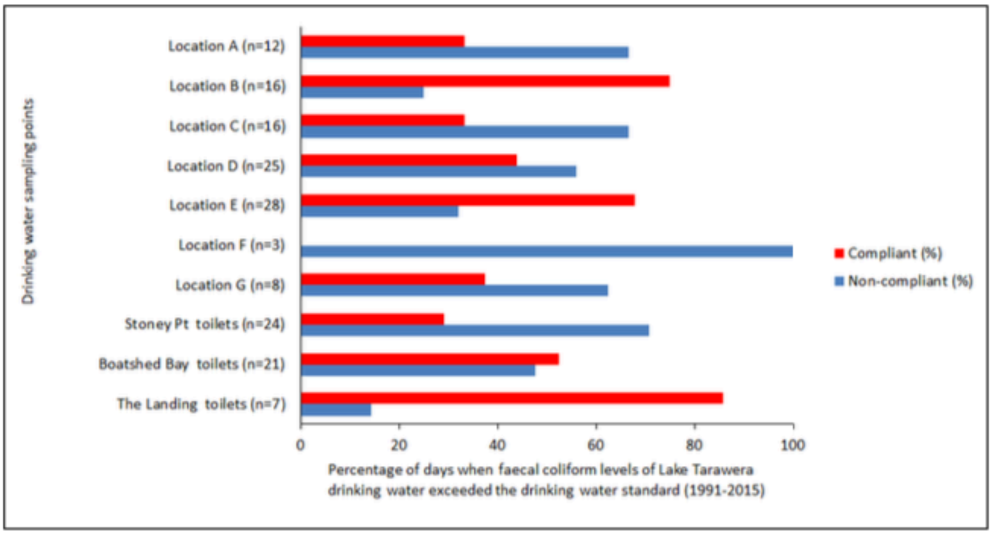


**Figure 2: Microbiological compliance and non-compliance levels of drinking water at Lake Tarawera (1991-2016).**

In terms of nutrient loads, the study determined that a wastewater reticulation system will reduce nutrient loading by 3 to 5%. Modelling of the reticulation of wastewater nutrient loads revealed that the impact on lake water nutrient concentrations is minor, as wastewater represents a small component of overall Nitrogen (N) and Phosphorus (P) loads to Lake Tarawera. Nevertheless, much of the load to the lake is from sources that are difficult to mitigate (e.g. geothermal, other lakes). Further, time lags in response of the nutrient loads to the lake may be lower due to the proximity of current wastewater inputs to the lake shore (as opposed to diffuse inputs from land use on the upper reaches of the catchment).

Therefore, the report noted that implementation of a reticulated sewage system as part of an overall plan to reduce loading of N and P into Lake Tarawera may be a desirable management initiative as it could make a contribution to improving manageable sources of nutrients from the lake catchment.

# 4 OSET AT LAKE TARAWERA

## 4.1 Background: Sustainable On-site Wastewater Treatment and Disposal

The sustainability of an on-site wastewater system is dependent upon a number of key factors. These are identified in the current guideline documents relating to on-site wastewater – the Australian/New Zealand Standard 1547:2012 On-Site domestic wastewater management and the Auckland Council Technical Publication 58 On-site Wastewater Systems Design and Management Manual 2004. These guidelines include key principles for achieving effective implementation and performance of on-site wastewater systems. These include:

- Ensuring a comprehensive pre-design site and soil evaluation is undertaken;
- Ensuring a realistic and conservative design flow volume based on a 'worst case' peak flow;
- Selecting a treatment system suited to both the facility to be served and the site conditions determined by the evaluation;
- Selecting a land disposal system loading rate appropriate to soil conditions and environmental constraints;
- Ensuring a comprehensive assessment of potential environmental effects on the environment from the land disposal of wastewater is completed;
- Ensuring that the system is installed in accordance with the design and the manufacturers' and/or suppliers' specifications; and
- Ensuring that the whole process of on-site wastewater system management incorporates informed operation and preventative maintenance procedures to ensure the system's satisfactory long term performance.

<u>Environmental effects of on-site wastewater discharges:</u>

The application of treated wastewater to land can result in impacts on groundwater and surface water quality, soil structure and vegetation, and in the event of failure or other problems, has the potential to adversely affect both public health and the amenity value of land.

On-site wastewater land disposal systems add organic matter, nutrients, and microorganisms to the subsoil and groundwater. If sufficient free draining soil is provided between the land application area and the highest seasonal groundwater table, then the natural biological processes within the soil "treat" the applied wastewater residuals discharged. This results from the soils ability to degrade and stabilise organic matter, as well as filtering and providing for the die off of wastewater microorganisms (including pathogenic intestinal bacteria and viruses). These processes minimise potential effects on groundwater quality. Where groundwater level is high, and the necessary depth of dry soil is not available, contamination of groundwater with pathogens and nutrients can result.

Nutrients, such as phosphates, are often absorbed well by finer soils such as clay-loams and clays, but nitrogen derivatives, such as ammonia and nitrates, may only be partially absorbed and removed via plant uptake. Where nutrients such as nitrogen compounds are of environmental significance, (for example nitrate effects on groundwater used for potable purposes), they may have to be managed by the provision of additional pre-treatment of the wastewater prior to discharge to land, as in the OSET plan, where a minimum treatment level of 15 $gN/m^3$ for wastewater prior to discharge to the environment in the near-shore and Maintenance Zones is required.

Where a land disposal system is too small, overloading may result in effluent breakout onto the surface. Breakout is indicative of system "failure" and has the potential to lead to environmental and public health effects. Methods of improving the potential for on-site system performance include reducing the wastewater flow, increasing the land disposal system size by using more conservative design loading factors, increasing the level of treatment or installing a more appropriate land disposal system that is tailored for the site constraints.

<u>OSET Plan</u>

The OSET Plan was developed in 1994 and became operative in 1996. The OSET Plan was reviewed in 2006 after 10 years. The 2006 version of the Plan introduced;

- "Advanced" systems to reduce the quantity of nutrients discharged to the environment. Advanced systems were seen as a way of overcoming a wide range of problems. Subsequent experience has shown that not all of these expectations have been achieved. Advanced systems are now referred to as Aerated Wastewater Treatment Systems or AWTS.
- A performance criteria for AWTS systems to be installed in Rotorua Lakes catchments of 15 grams per cubic metre of Total Nitrogen.
- 'Maintenance Zones' were identified. These are localities where monitoring showed septic tanks were performing poorly. It was intended that septic tanks would be serviced regularly until they were replaced by reticulation.
- Dates by which reticulation or system upgrades were to be completed. Consistently the dates set in the Plan were not met and have been extended.

The original date set for Tarawera was 2014 and this was subsequently extended to 2015. The current date is 1 December 2017.

## 4.2 Identified Constraints at Lake Tarawera

A range of constraints have been identified which limit the ability of individual sites in the Lake Tarawera community to achieve sustainable on-site wastewater treatment and disposal.

### 4.2.1 Existing Systems

The majority of treatment systems in the settlement were expected to be septic tanks, with some Aerated Wastewater Systems (AWTS) as permitted activities and some septic tank systems authorised by BOPRC Resource Consent.

When the first baches were constructed at Lake Tarawera they would have been served by a small septic tank. Over the years typical dwelling size has increased, often an unlimited water supply has been provided and water use habits have changed. This has resulted in increased water use and associated wastewater production.

The purpose of a septic tank is to allow sludge and scums to form within the tank. This reduces the quantity of contaminants in the outflowing wastewater and allows the contaminants retained in the septic tank to break down through anaerobic processes. Effective septic tank operation is closely related to tank size.

Due to increased understanding of bacterial processes, the minimum acceptable standard for septic tank operational (liquid) capacity has now increased to 3,000 litres for a new three-bedroom house, and 3,500 litres for a new four-bedroom house. It was expected that many Lake Tarawera septic tanks will not reach these minimum recommended capacities. The quantification of this constraint is part of the investigation.

### 4.2.2 Soil Type

On the evening of 10 June 1886 Tarawera began to erupt and as part of the eruption sequence, fine silts which had accumulated in Lake Rotomahana were ejected in a hydrothermal eruption. These silts are referred to as Rotomahana Mud and the unit is thought to cover most of the properties in the community to varying depths. The mud was believed to be poorly drained and hence on-site disposal may not possible or require unreasonably large areas. The soakage potential of the soil required investigation and hence the field investigation undertaken has included conducting percolation tests at a selection of sites across the community.

It is considered possible that local drainlayers and wastewater system installers were aware of the restrictions of the soakage ability of the Rotomahana Mud, which has led to the installation of a high proportion of soak holes. The soak holes, given the nature of their design (generally over 1m deep) may be constructed through the base of the Rotomahana Mud unit and discharge into the better drained volcanic deposits below. However this effectively injects primary treated wastewater into soil where it will gain only limited further treatment, and in some cases possibly directly into groundwater, which then flows into Lake Tarawera.

### 4.2.3 Property Size

Tarawera is considered a community in transition from a traditionally holiday home location to a satellite suburb of Rotorua. Some properties still have a small bach that was built in the 1940's with large curtilage areas which could accommodate a wastewater disposal area. Others have been redeveloped with large homes, outbuildings for storage and extensive driveways. This leaves little area for wastewater disposal. The investigation seeks to analyse property sizes with regard to suitable wastewater disposal area.

### 4.2.4 Proximity to Groundwater

It is known that some properties and the associated wastewater disposal area are only slightly above lake level. The wastewater systems on these properties are not expected to have the required separation between the base of the disposal system and groundwater level. The quantification of these sites was part of the investigation.

### 4.2.5 Land Slope

From general observations, it is noted that many properties have small flat areas where the house has been located and the balance area is very steep. There is evidence of slope instability, including relic landslides, in the Tarawera area. It is generally accepted that the maximum slope for the disposal of wastewater is 15 degrees. The investigation seeks to confirm that there is a sufficient area of suitable contour land to contain a wastewater disposal area on each site.

# 5 LAKE TARAWERA INVESTIGATION

## 5.1 Methodology

The implications of the site constraints identified in section 4 to sustainable on-site wastewater disposal at Lake Tarawera were investigated by a combination of desk-top data analysis and field investigations.

The existing GIS data from BOPRC was utilised as follows:

1. Based on existing contour data, a series of maps were generated which show areas greater than 15 degrees in slope, see Figure 3 below for an example.
2. These maps in conjunction with aerial photography were used to generate a 'first pass' of sites identified as having less than 250m$^2$ of available disposal area. This area was based on previous reports for other communities with different soil types.
3. Soil maps from BOPRC were generated showing the two mapped soil types of Rotomahana hill soils (coarse sandy loam) **'RHsl'** (green) and Rotomahana shallow sandy loam **'Rsl'** (purple), see Figure 4 for an example.
4. Property size was obtained through Prover, an internet property information service.
5. Properties potentially affected by high groundwater tables were identified using the BOPRC GIS contours maps, setting the lake level at 298m and including any site which has land area less than 301m Relative Level (RL). This is based on the potential for low-lying sites to have soak hole disposal areas.

The information gathered as above was used to locate five areas within the Lake Tarawera community which were potentially affected by the different constraints. Areas were selected for individual site inspections to ensure that each constraint was observed – for example, one area was selected due to potentially high groundwater and RHsl soils, another because of steep slopes and Rsl soils.

Ten locations for soil investigation boreholes were selected to ensure an even distribution across the two mapped soil types and along the length of the settlement to determine how varied the soil types were. Of these boreholes 4 were scheduled to include a falling head percolation test to confirm percolation rates and soil category.

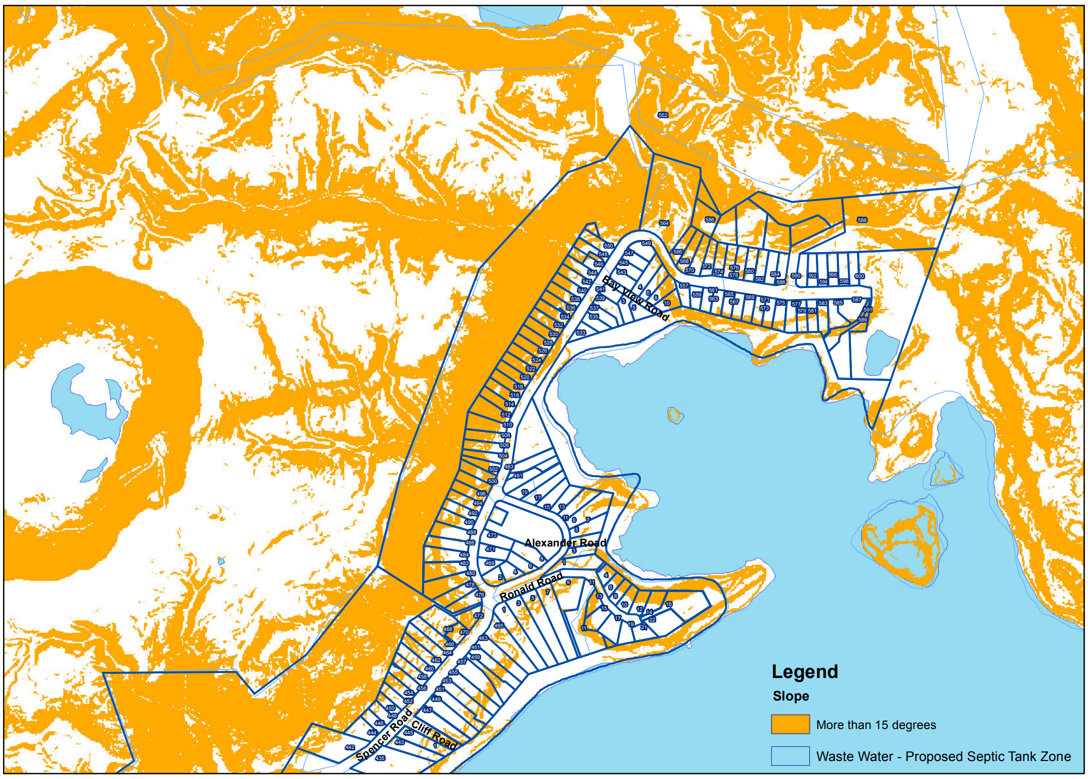


Figure 3: Slope Map

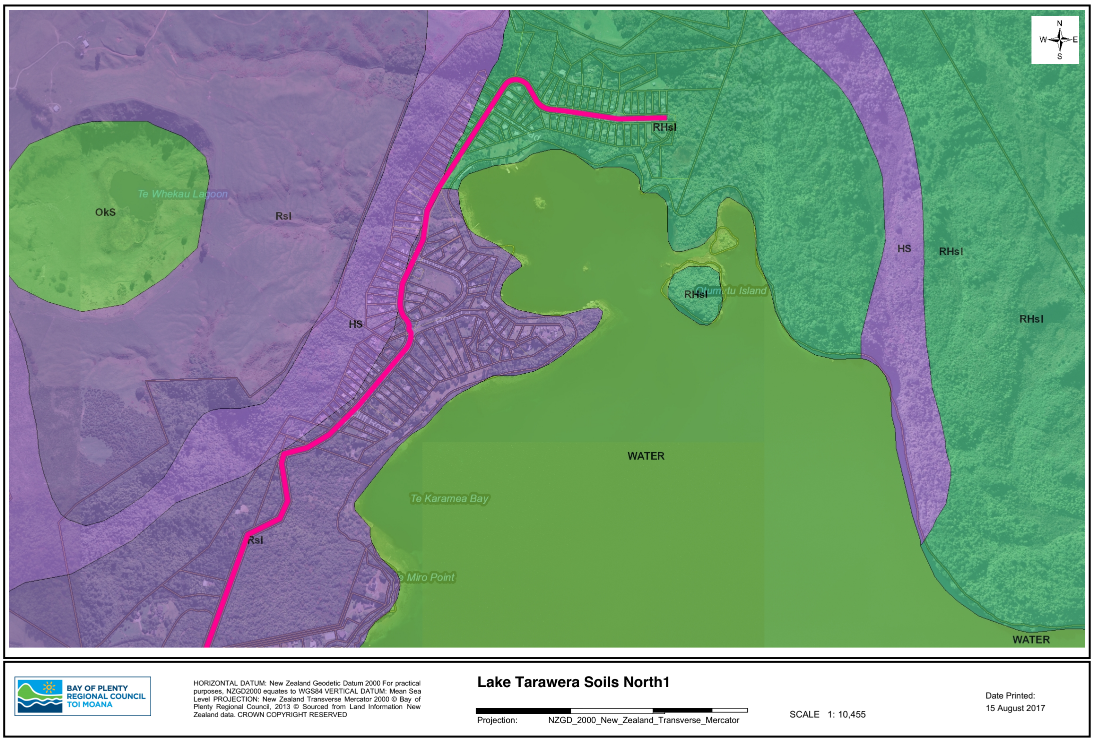


Figure 4: Soil Map

## 5.2 Desk-Top Results

### 5.2.1 Existing Systems:

Data was provided from the maintenance zone data set managed by BOPRC. This data indicated the following:

a) There are 391 on-site wastewater systems within the Maintenance Zone (including public toilet systems).
b) There are 11 consented sites.
c) There are 9 AWTS systems (3%) (one of which is a consented site).
d) There are 382 septic tanks (97%) (9 of which are consented sites).
e) There are 75 soakage trench disposal systems (19%).
f) There were 5 properties which indicated a dripper irrigation system, although the treatment system on these sites was noted to be a septic tank. Effective disposal via dripper irrigation requires a much high quality wastewater than that produced by a septic tank or the dripper emitters will clog. Therefore, it is unlikely that these are septic to drip systems.
g) There are 177 soak hole disposal systems (45%).
h) There are 134 systems where the disposal system is unknown (34%).
i) Of those sites with a known septic tank size, 276 were less than 3,000 litres in capacity, while 71 were greater than 3,000 litres in size.

### 5.2.2 Soil Type

The 'Rotomahana Mud' unit is described by BOPRC soil reports[3] as a "greyish sandy loam to loamy sand layer at the surface." The material is noted as being partially hydrothermally altered lake sediments from Lake Rotomahana, along with ash deposits from the eruption of Mt Tarawera. It is considered an unusual deposit as it is a tephra-fall deposit that contains approximately 20% clay, and the literature [4]notes that where this soil is farmed and it rains the pasture can turn to mud very quickly.

Waikato Regional Council soil scientist Haydon Jones describes the Rotomahana Mud unit at Lake Rerewhakaaitu as a greyish brown silt loam, underlain by a gravelly scoria sand which is the Tarawera tephra, and then a black sandy loam which is the soil formed on the Kaharoa tephra prior to the Tarawera eruption.

In terms of the distribution of the Rotomahana mud, it is generally accepted that the deposit rained out over much of the Bay of Plenty, and in the Tarawera vicinity the deposit ranges from 150mm to 700 mm in depth.

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3 Soils of the Bay of Plenty Volume 1 EBOP Environmental Publication 2010/11-1 June 2010

4 Introduction to Tephra-Derived Soils, North Island, New Zealand Prof David Lowe University of Waikato 2016

### 5.2.3 Property Size

As at September 2017, the land information database Prover identifies that the majority of the property sizes in the Lake Tarawera settlement are generally of urban scale, with 70% being less than 1,500m$^2$ as shown in the table below:

**Table 1: Tarawera Property Sizes**

| Property Size Increment | Number of Properties | % of total |
|---|---|---|
| <1000m$^2$ | 13 | 3% |
| 1000-1200m2 | 132 | 34% |
| 1200-1500 | 127 | 32% |
| 1500-2500 | 75 | 19% |
| >2500 | 45 | 11% |

While the Bay of Plenty Regional Plan does not restrict on-site wastewater discharges on the basis of lot size, it notes that lot areas in the order of 1,000m$^2$ becomes quite limiting for the use of septic tank effluent systems. Requiring a minimum lot size is a recognised method of managing cumulative effects. The Waikato Regional Plan limits new septic tank systems to lots larger than 2,500m$^2$, while the Auckland Plan relies on a ratio which effectively limits septic tanks to lots greater than 3,000m$^2$.

## 5.3 Field Investigation Results

On Tuesday 12th and Wednesday 13th September 2017 the field investigation programme was completed by Trisha Simonson of Louise Feathers Planning Ltd and Jacqui Mackle of BOPRC.

### 5.3.1 Soil Investigation

Eleven boreholes were drilled in the settlement at varying locations. The soil type was logged and photographs of the soil columns are included in Appendix 1.

<u>Borehole results:</u>

Based on the literature review outlined in section 5.2.2, the Rotomahana Mud was identified in 9 of the 11 boreholes drilled. One borehole intersected the Tarawera tephra unit only and could not be progressed beyond 500mm depth due to large volcanic clasts or erupted blocks. A further borehole did not intercept the Rotomahana Mud unit on the lake shore reserve, instead encountering coarse washed sands.

Where intersected, the Rotomahana Mud comprised a light brownish grey slightly clayey silt, and was overlain by a thin topsoil of 50-100mm. The unit varied in thickness form 400mm to 900mm and was often underlain by a paleosol or relic topsoil layer covered by the eruptive material. The paleosol was also observed in a road cutting on Spencer Road. See Figures 5 and 6.

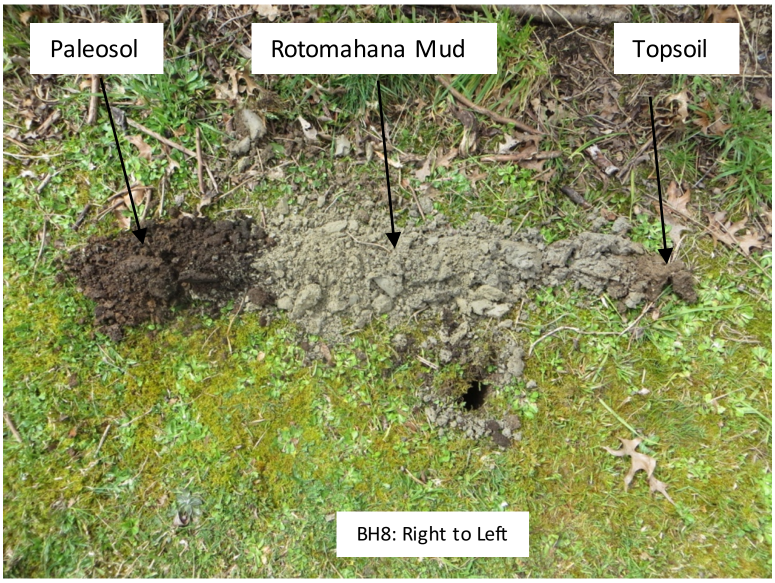



Figure 5: Borehole showing Rotomahana Mud and paleosol.

Figure 6: Rotomahana mud and paleosol in Spencer Road

Groundwater was encountered in two boreholes drilled within lower lying areas closer to the lake shore. These boreholes intercepted groundwater at 800mm and 1000mm depth.

Distribution of Rotomahana Mud

While the BOPRC soil maps indicate two different soil types across the Tarawera Settlement, it is concluded from the borehole investigation that the 'Rotomahana Mud' unit is present in both mapped areas.

Percolation tests

Four boreholes were utilised to complete standard falling head percolation tests. The holes were filled with water and left overnight and then refilled and the drop in level measured regularly across the following day for a period of 5 hours.

**Table 2: Percolation Test results**

| Soakage Test ID | Percolation Rate mm/hr | Indicative permeability m/day |
|---|---|---|
| ST1 | 2 | 0.048 |
| ST2 | 21 | 0.5 |
| ST3 | 5.6 | 0.134 |
| ST4 | 5 | 0.12 |

Excluding the test undertaken within ST2 which is thought to have been below the Rotomahana Mud unit, the average permeability of the soil was measured at 0.1 m/day and the worst case was 0.05m/day. This is consistent with rates for poorly draining clay soils and the corresponding soil category outlined in the Australian/New Zealand Standard for On-site domestic wastewater management (AS/NZS1547:2012) would be category 6.

Category 6 soils are not considered suitable for use with conventional trench and bed soakage disposal systems. Table M1 within AS/NZS1547:2012 recommends a design irrigation loading rate of 2 mm/day for dripper irrigation systems in category 6 soils.

Revision of Required Lot Area for Wastewater Disposal

On the basis of the borehole testing, soil characterisation and percolation tests, it is apparent that the Rotomahana Mud unit has poor soakage characteristics, and hence a revision to the required area for wastewater disposal was appropriate. On the basis of a 4-bedroom dwelling using lake water supply, a design daily flow of 1,200 litres per day would be generated per dwelling. Using the recommended loading rate of 2 mm/day, this equates to a required disposal area of 600m$^2$ per site. While this is considered a conservative scenario as not all dwellings will be four-bedroom houses, this is countered by the fact that no reserve area has been factored into the required disposal area.

### 5.3.2 Site Inspections

A total of 107 properties or 27% of Lake Tarawera properties were inspected. The findings of the inspections were:

- It was confirmed that a significant number of sites (40%+) inspected contained steep slopes and only small level areas, generally occupied by dwellings, driveways, outdoor living areas and the like.
- Approximately 17% of properties inspected had an issue with their wastewater systems which was not considered best practice or not acceptable for example;
    - odour,
    - wastewater breakout,
    - inappropriate location of field or tank near waterway,
    - broken septic tank lids,
    - a collapsing tank,
    - recently replaced disposal field,
    - septic tanks and/or disposal field under driveways, decks and houses.
- Approximately 64% of dwellings sourced their water supply directly from Lake Tarawera. Only occasional water treatment systems were observed.
- There were a range of properties on which multiple dwellings and outbuildings were located, further limiting available land area for disposal.
- On a few sites (5%), the wastewater treatment system could not be located at all, which may be indicative that it is not being regularly serviced.
- While on most sites the septic tank location could be confirmed by observing the mushroom vent, the majority of tanks did not have an obviously locatable lid.
- On 27% of the sites it was difficult to establish the location of type of disposal system.
- There were four AWTS systems observed which were not on the BOPRC records.
- Where home owners were present, most of them noted that their system had been serviced within the previous year.

# 6 OSET COLOUR GRADING

As noted in Section 5, the Lake Tarawera community is affected by a range of limiting factors which restrict effective and sustainable on-site wastewater disposal, including:

1. The majority of wastewater treatment systems (97% of properties) comprise old and mostly undersized septic tanks (75% less than the recommended 3,000 litres minimum volume).
2. The presence of a soil type which is not suited to wastewater disposal, particularly of primary treated wastewater (septic tanks) (AS/NZS Category 6).
3. Small property sizes (70% less than 1,500m$^2$).
4. Poor separation to groundwater levels in the lower lying areas of the community (groundwater levels as high as 800mm below the ground surface).
5. Steep sloping ground on many sites which limits the area available for wastewater disposal (are greater than 15 degrees).

These constraints have been assessed for every property in the Lake Tarawera maintenance zone and each property has been assigned a colour category of 'Green', 'Yellow,' 'Orange' or 'Red'. The colour category will help determine what on-site effluent treatment options are available for an individual property, if a Council sewerage reticulation scheme does not proceed. If Council sewerage reticulation is agreed to then the colour grading becomes irrelevant.

The colour grading is based on available information and site visits (where completed) about the existing wastewater system, and site characteristics including depth of groundwater, area available on the section, slope and proximity to surface water. The findings from the site visits confirmed that the information sourced from the GIS and BOPRC maintenance zone data was accurate and where sites were not visited the desktop data alone has been used to generate the colour grade.

The basis and implications of the colour categories is explained below, with the number of Lake Tarawera properties in each category shown in brackets.

**Green: Permitted Nitrogen Removing Systems (2 properties) = Acceptable**

The existing wastewater system comprises a permitted Nitrogen Removing Aerated Wastewater Treatment System (AWTS-NR) (2).

**Yellow: AWTS and Consented Septic Tank Systems (16 properties) = Short Term Acceptable**

The existing wastewater system either comprises a septic tank authorised by a Resource Consent (9), or is an Aerated Wastewater Treatment System (AWTS) (7). The consented systems are authorised for the time being however the term of the consents is limited and on expiry it is expected that the sites will require an upgrade in the future. The AWTS systems are an improvement in terms of treatment quality compared with a septic tank, however these systems are not nitrogen–removing systems and therefore will not meet the OSET Plan permitted activity rules without further upgrades.

**Orange: Upgrade work required (204 properties) = Need Significant Upgrades**

Some type of upgrade is required for these 204 properties, which are constrained by the system type (septic tanks) and either high groundwater levels and/or poorly draining soils. These sites may have sufficient area for a wastewater disposal system. Possible solutions include, for example:

- Installing an approved nitrogen-removing aerated wastewater treatment system with 600m$^2$ of drip line (no resource consent required);
- Upgrading the existing septic tank system or installing a new septic tank system and obtaining a resource consent, however this solution would not meet the required nutrient removal and is not likely to be acceptable in the long term;
- Installing a 'mound' system (where high ground water conditions, or limited area is available), and obtaining a resource consent. The dimensions of a mound system for a three-bedroom dwelling are about 7.5 m x 8.3 m, and for a four-bedroom dwelling are 7.5 m x 10 m. Mounds are about 1.2 m high. Refer AS/NZS 1547:2012. A mound could occupy a significant portion of the usable section and for many people this will be an unattractive option.

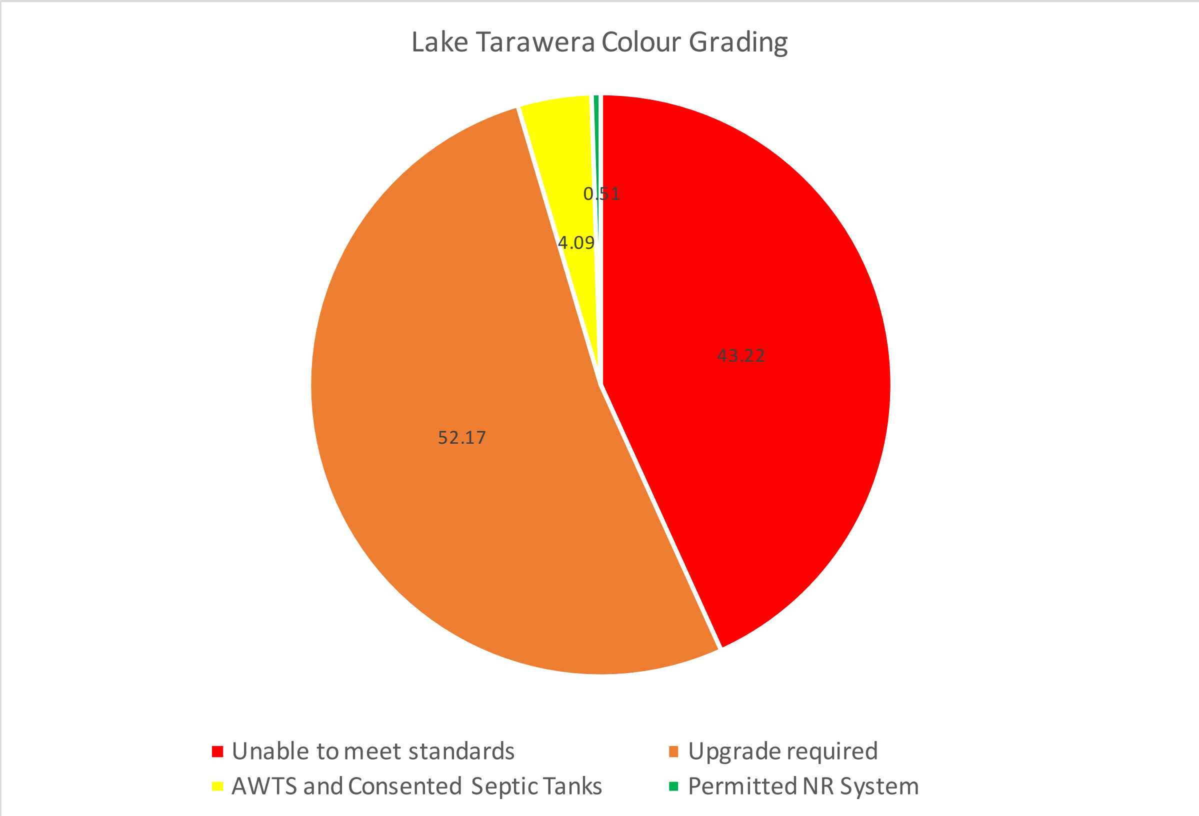
For 'Orange' properties, a detailed site assessment and wastewater design proposal will be required as part of a Resource Consent application. Each application would be assessed on its own merits, and may be declined. Some restrictions on wastewater volumes may apply. These restrictions could be met by retrofitting low water use fixtures and limiting occupation of the property.

**Red: Unable to meet the standard required (169 properties) = No Solution Available**

There is insufficient or unsuitable area available on the property to install a wastewater system that meets the current requirements of the OSET Plan and wastewater design guidelines.

## 6.1 Colour Grading Summary

The pie chart below shows the total number of Lake Tarawera properties assigned to each colour category.



# 7 OSET PLAN

The Resource Management Act requires that all discharges to land or water or air must be authorised. The OSET Plan achieved this by making all existing wastewater systems a 'permitted activity'. This permitted activity status for systems in the Lake Tarawera community will end on 1 December 2017. From that date, properties will need to;

- Connect to reticulation; OR
- Install a Nitrogen-reducing Aerated Wastewater Treatment System as a permitted activity; OR
- Obtain a Resource Consent for a septic tank based system (that meets modern standards) as a discretionary activity.

If a decision is made to install a Council sewerage reticulation system, then this may take a year or more to design and construct. A 'bridging' resource consent may be required for septic tank systems from December 2017 until a connection can be made to the Council sewer. If a Council sewerage reticulation system is agreed to then no physical upgrade work of septic tanks will be required unless a serious failure develops (or in some cases where an expansion of the house is proposed).

If a decision is made NOT to install a reticulation system, there are two options for the 220 Lake Tarawera properties that are graded as yellow and orange (prices below are indicative only):

i) A Nitrogen-reducing AWTS could be installed, on suitable properties, as a permitted activity.
   - Median price of an AWTS is around $16,000.
   - Annual operating costs are around $750.

ii) An alternative would be to apply for a Resource Consent to retain and upgrade a septic tank based system, however Resource Consent applications may be declined as septic tank treatment will not meet the requirements of the OSET Plan or the New Zealand Standard due to the lower level of wastewater treatment quality achieved by a septic tank. The costs of this solution would vary between properties.
   - Upgraded septic tank, filter, pump and mound would be around $11,000. New septic tank and trenches would be around $10,500.
   - Retain septic tank and replace soak hole with trenches would be around $6,000.
   - The annual operating cost of a septic tank is around $200.
   - The costs do not include preparation and processing of a resource consent application.

For the 169 'Red' coded properties it has not been possible to identify a feasible on-site solution to date. With further investigation, it may be possible to design an on-site solution but this would be difficult and expensive to implement. Such a solution may also limit water and property use.

Some properties have such severe limitations in terms of available disposal area and soil type that on-site wastewater disposal may not be a feasible or viable option, requiring properties to operate on a pump-out basis. Pumping out wastewater for discharge to a remote location for treatment and disposal is an expensive and unsustainable solution.

# 8 CONCLUSION

The properties located at Lake Tarawera are constrained in terms of effective and sustainable on-site wastewater disposal by the following:

a) The majority of wastewater treatment systems (97% of properties) comprise old and mostly undersized septic tanks (75% less than the recommended 3,000 litres minimum volume).
b) The presence of a soil type which is not suited to wastewater disposal, particularly primary treated wastewater (septic tanks) (AS/NZS Category 6).
c) Small property sizes (70% less than 1,500m$^2$).
d) Poor separation to groundwater levels in the lower lying areas of the community (groundwater levels as high as 800mm below the ground surface).
e) Steep sloping ground on many sites which limits the area available for wastewater disposal (are greater than 15 degrees).

A limited programme of soil testing has confirmed the presence of the Rotomahana Mud soil type across the settlement. Percolation testing has confirmed that the soil type is poorly drained, hence is not suited to conventional disposal methods and that a large disposal area would be required for each site to achieve sustainable on-site wastewater disposal via dripper irrigation. The other alternative of a mound disposal system is expensive and may limit use and further development of a property. Site inspections of 107 properties, or 27 percent of the settlement confirmed that the above constraints do exist and these constraints limit effective wastewater disposal in a significant amount of properties. A proportion of systems inspected (17%) were already noted to be deficient in some way.

The constraints are considered to be limiting effective on-site wastewater treatment and disposal and hence contributing to nutrient and pathogen loads being discharged to Lake Tarawera. This is adversely affecting Lake water quality, and potentially causing a health risk to residents, as the site visits confirmed approximately 64% of dwellings inspected source their drinking water from Lake Tarawera.

Colour grading of each property in relation to the constraints indicates that:

- 0.5 percent of sites are permitted (green);
- 4 percent of sites are currently authorised via resource consent or have a secondary treatment system in place, however both of these only provide short term solution and will require upgrades in the future (yellow);
- 52 percent of sites would require upgrades including new wastewater treatment systems to be authorised or permitted (orange);
- 43 percent of sites are likely to be unable to meet the required standards for on-site wastewater, due to the soil type and steep slopes limiting available disposal area (red).

The investigation colour grading shows that the majority of properties in the Lake Tarawera settlement (95%) do not meet current standards, and many of these are unlikely to be able to meet the required standards. The capability of the settlement to effectively and sustainably utilise individual on-site wastewater treatment and disposal systems is very limited, and given the evidence of the impacts of on-site wastewater discharges, it is considered important that the settlement is reticulated.

The Tarawera community are currently investigating the provision of wastewater reticulation. Should a centralised wastewater treatment and disposal solution not be progressed, the community will remain serviced by on-site systems. The community have asked if this is a valid option. This investigation indicates that on-site systems are likely not a valid option for 43 percent of the community, with a further 56 percent of the community facing significant system upgrades in the future to meet current standards and reduce adverse environmental and public health effects on the water quality of Lake Tarawera.

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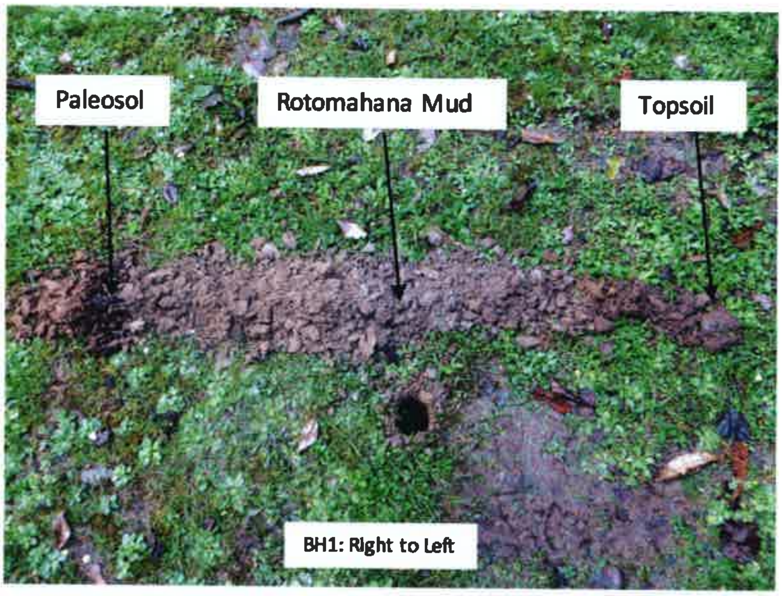
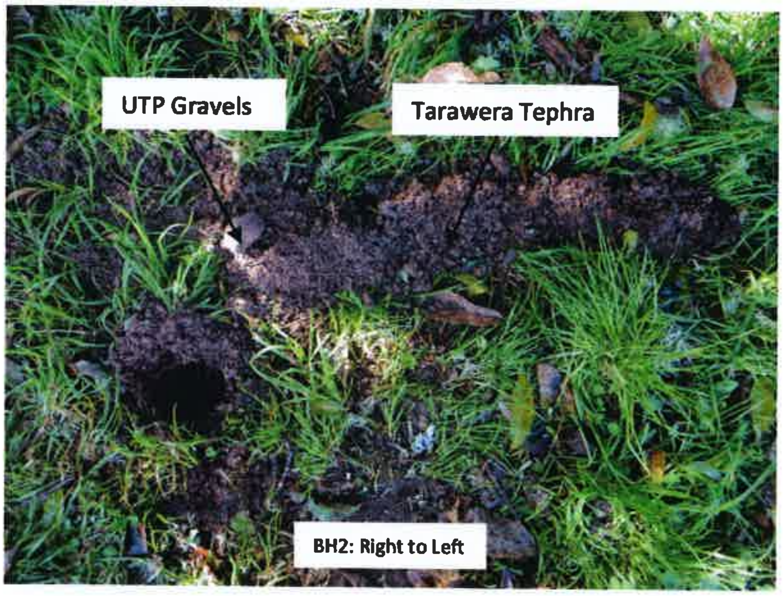
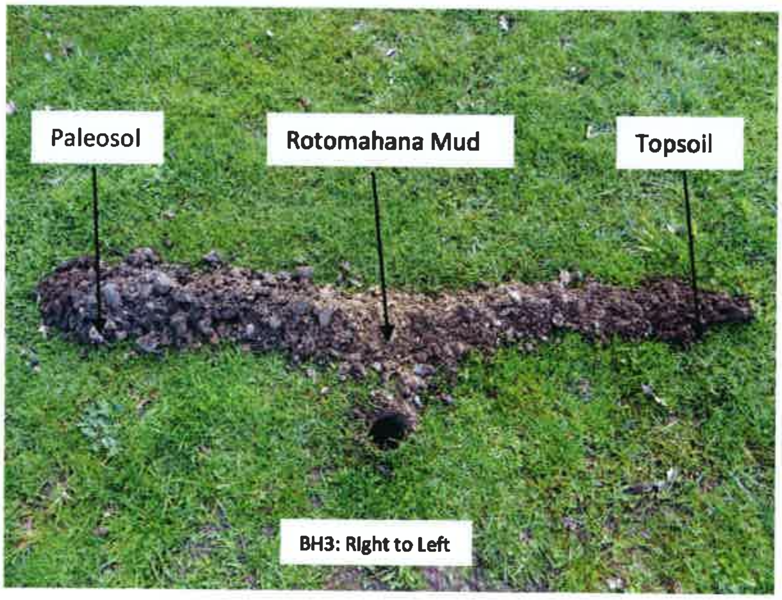
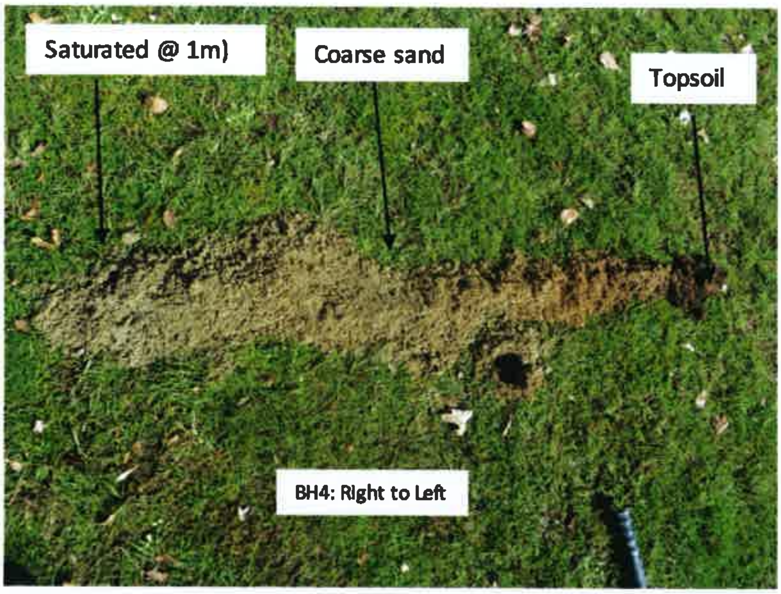
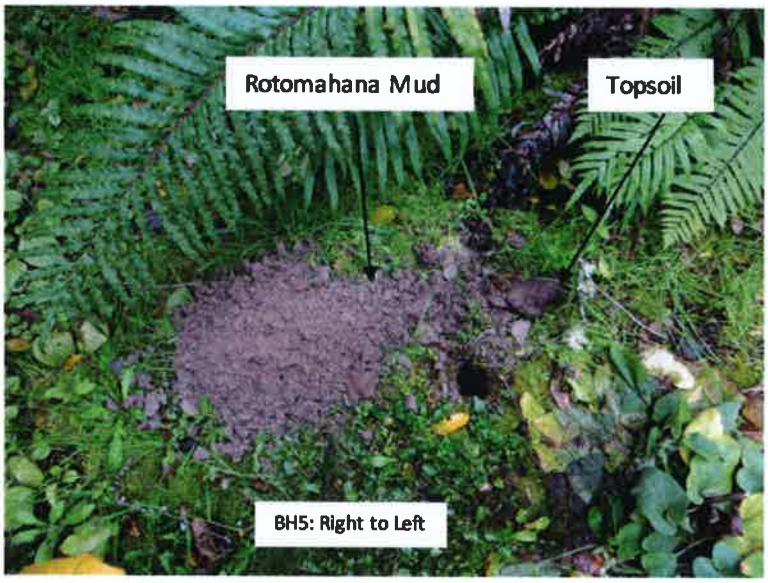
# APPENDIX 1: BOREHOLE SOIL PHOTOGRAPHS

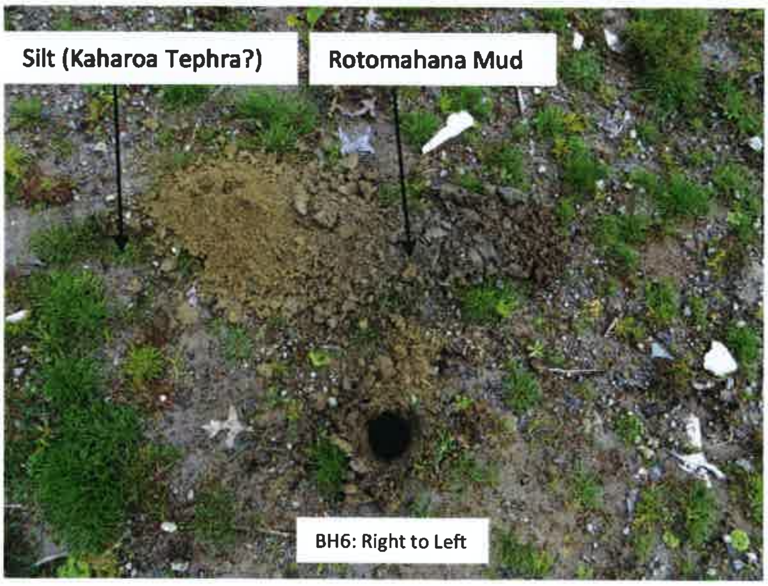

Paleosol
Rotomahana Mud
Topsoil
BH1: Right to Left

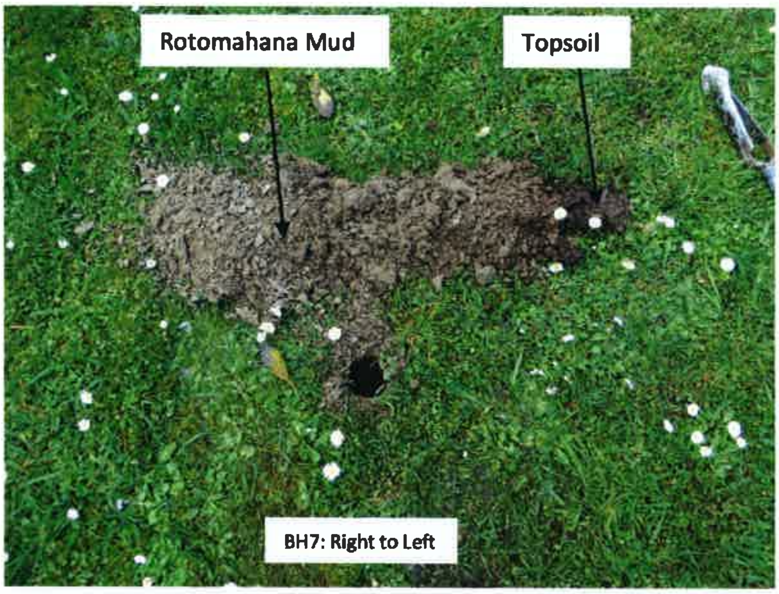

UTP Gravels
Tarawera Tephra
BH2: Right to Left

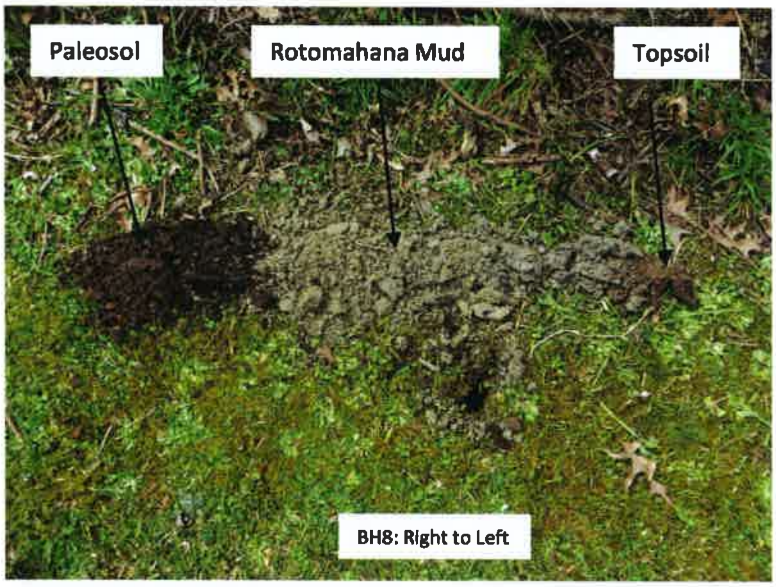

Paleosol
Rotomahana Mud
Topsoil
BH3: Right to Left

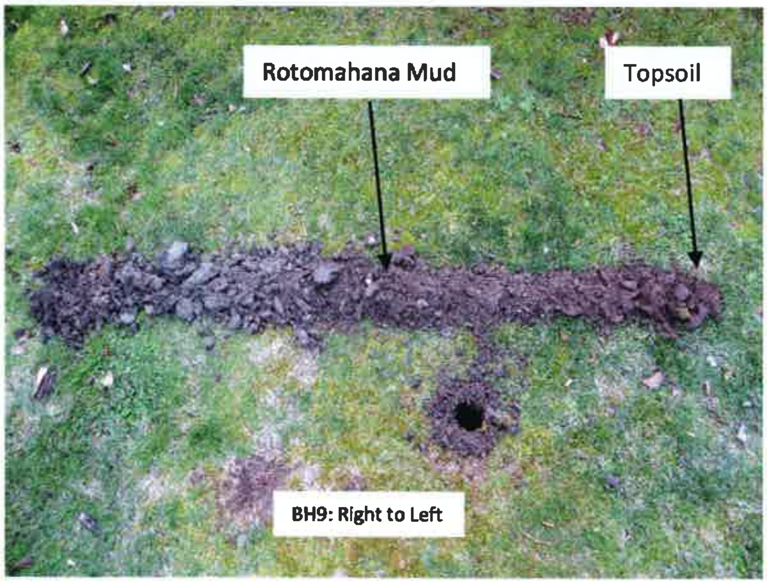

Saturated @ 1m)
Coarse sand
Topsoil
BH4: Right to Left

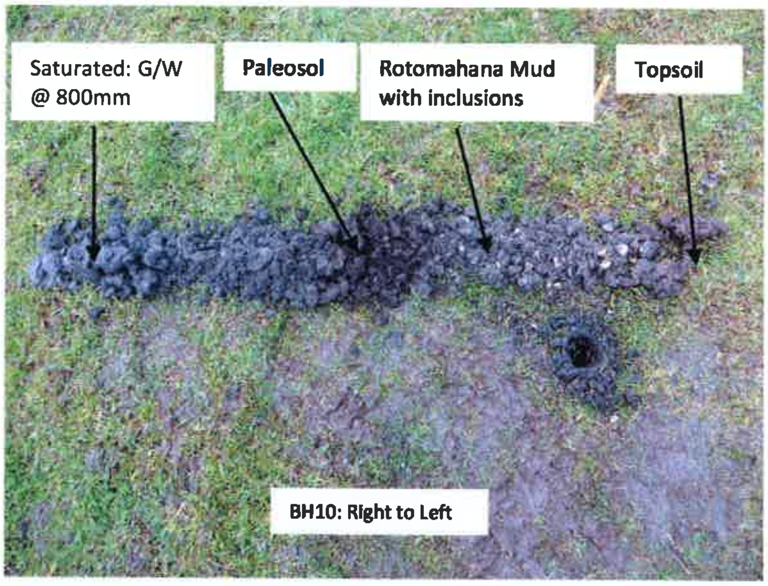

Rotomahana Mud
Topsoil
BH5: Right to Left

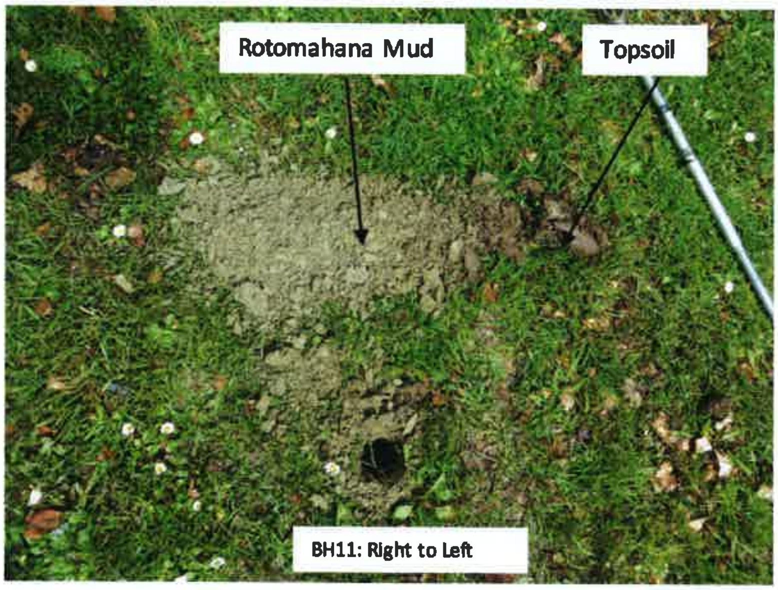

Silt (Kaharoa Tephra?)
Rotomahana Mud
BH6: Right to Left


Rotomahana Mud
Topsoil
BH7: Right to Left


Paleosol
Rotomahana Mud
Topsoil
BH8: Right to Left


Rotomahana Mud
Topsoil
BH9: Right to Left


Saturated: G/W @ 800mm
Paleosol
Rotomahana Mud with inclusions
Topsoil
BH10: Right to Left


Rotomahana Mud
Topsoil
BH11: Right to Left