10 December 2015
Tabitha Manderson,
Senior Resource management Planner,
Opus International Consultants Ltd

Eketahuna Wastewater Treatment Plant

Resource Consent Application No. 2005011178.01 – Discharge permits

Response to further information requested under section 92(1) of the RMA

Dear Tabitha,

As requested, the following provides responses to the questions relative to water quality and aquatic ecology raised by Horizons Regional Council in their request for further information dated 24 June 2015.

1 DO monitoring - The application makes reference to the One Plan and NPSFM dissolved oxygen (DO) levels and states that the spot measurements taken show that the DO levels increase downstream of the discharge and may therefore decrease further at night time at the downstream point. Please confirm whether it is intended to undertake continuous DO monitoring over a set time once the upgrades are complete to show that there are no effects on DO levels. Please also comment on whether these changes in the DO levels could also be responsible (or at least one of the drivers) for the changes that have been seen in the macroinvertebrate communities downstream of the discharge.

The potential issues raised in relation to DO concentration at night relate to the production (via photosynthesis) during the day and consumption (via respiration) during the night. This means that issues associated with DO are unlikely to occur unless abundant or excessive periphyton growth occurs downstream of the discharge.
It is suggested that DO monitoring would only be required if significant increases in periphyton growth were measured downstream of the discharge following the proposed upgrades.
It is noted that the measurements to date relate to DO concentrations in the water column, whilst macroinvertebrates typically live within the substrate. DO concentrations within the interstitial space and hyporrheic zone are more likely to be directly relevant to macroinvertebrate communities. Whilst changes in DO in the water column could potentially play a role in the changes in macroinvertebrate communities measured downstream of the discharge, it would be speculative to draw such a conclusion at this stage.

2 Flow relationship - In the water quality report there has been a reliance on calculating loads from the Makakahi upstream of the WWTP, the Ngatahaka upstream of the Makakahi confluence, and the Makakahi downstream of the WWTP to work out the loads from the WWTP. This has worked on a flow relationship that has been provided from Opus to establish loads. Please provide more information on the accuracy of this derived relationship and whether any validation has been undertaken i.e. gauging undertaken in the Ngatahaka to ensure that the relationship is accurate. A number of conclusions are drawn based off this relationship so certainty that the modelled flows reflect reality is critical.

As indicated in the response from OPUS (provided separately), the flow relationship used in the report is the best available information to assess the relative contributions of the discharge vs. the Ngatahaka Stream to in-stream contaminant loads. We note that the flow relationship is based on an overall water balance. Whilst the accuracy of the flow estimates may be uncertain on individual days, the overall assessment based on a significant number of individual sampling events does, in our view, provide a useful overall estimate of the relative contributions from the different sources.

3 The water quality report shows there is a significant increase in the concentration of ammonia downstream of the discharge point (although well below the One Plan targets). Please provide comment as to whether this is the possible reason that we see more periphyton growth downstream of the discharge (preferential uptake and growth) compared to upstream and whether reductions in the ammonia component of the discharge will reduce effects on the Makakahi Stream. It is noted that currently the application seeks no reduction in the SIN component of the discharge.

The analysis of nutrient ratios indicate that the Makakahi River is mostly nitrogen limited during periods of low flows. It seems thus likely that the combined inputs of Soluble Inorganic Nitrogen (SIN) from the WWTP and the Ngatahaka Stream contribute to the increase in periphyton growth measured downstream of the discharge. We note however, that although periphyton growth does increase downstream of the discharge/Ngatahaka confluence compared with upstream, the downstream periphyton biomass and cover remain below the relevant One plan targets, increase is indicating that the increase in periphyton growth currently observed is not at levels that would cause significant adverse effects on river values as identified in the One Plan.

Overall, there is an increase in SIN concentration downstream of the discharge/Ngatahaka confluence compared with upstream. Analysis of contaminant loads indicates that this increase is mostly attributable to inputs from the Ngatahaka Creek. However, the SIN input from the discharge is primarily under the form of ammoniacal nitrogen, as opposed to the inputs from the Ngatahaka, which are primarily under the form of nitrate-nitrogen.

The relative role and possible preferential uptake of ammonia versus nitrate-nitrogen by periphyton are not well understood, and it is thus difficult to comment on this question at this stage. If preferential uptake of ammonia by periphyton was indeed established, it is possible that the smaller inputs of ammoniacal-nitrogen from the discharge could be causing a disproportionately high (i.e. for the same mass of nitrogen) effect on periphyton growth compared with the inputs of nitrate-nitrogen from the Ngatahaka Creek. It is noted that if that was the case, the ammoniacal nitrogen would be uptake very quickly by periphyton, and the effects would likely be very localised spatially.

As indicated above, the relative role and possible preferential uptake of ammonia versus nitrate-nitrogen by periphyton have not been the subject much scientific research, and are thus not well understood. An advice and research programme is however being started by Horizons, NIWA and Aquanet to investigate these aspects, with likely case studies in the Ruapehu and Manawatu Districts over the next two summers.

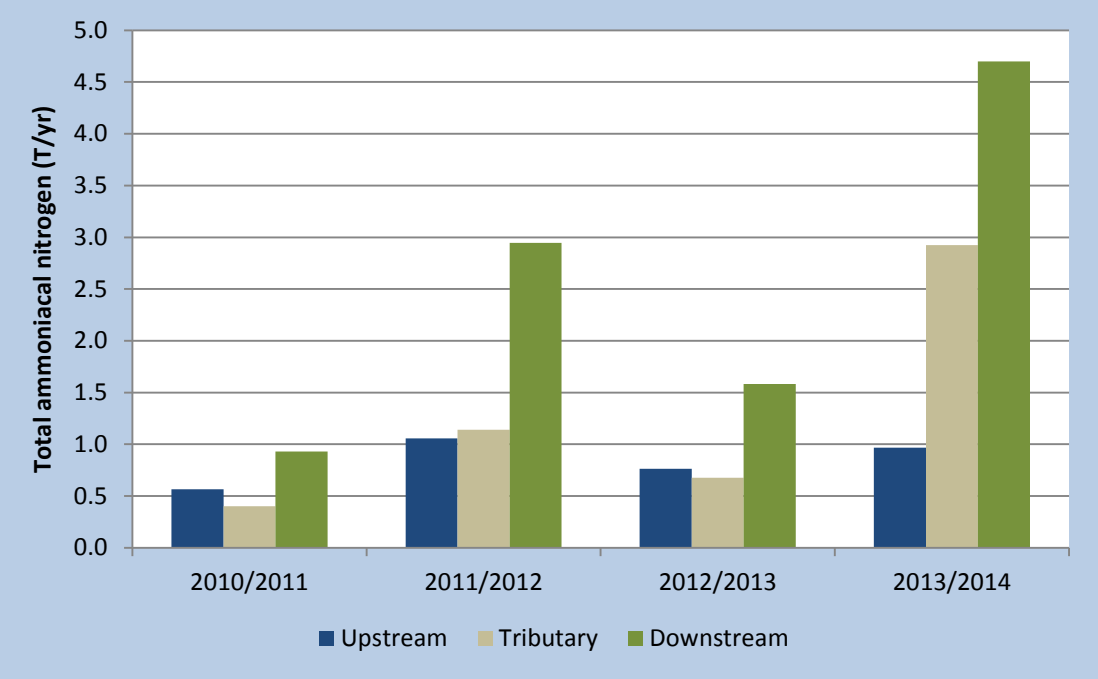
4 pH and temperature averages - The application uses averages to represent pH and temperature. Generally, concern lies around the highs for temperature and the lows and highs for pH. Averaging this data removes these highs and lows and doesn't necessarily reflect the effects that are seen in stream. If available, please provide data showing the temperature high and the pH highs and lows

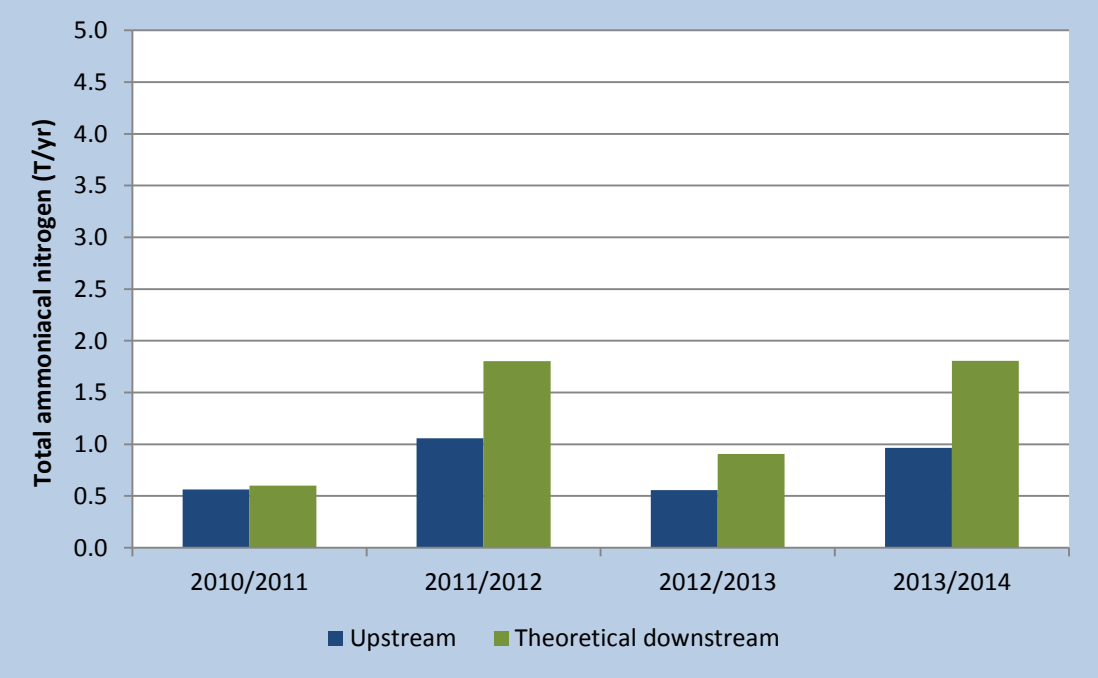
Whilst it is correct that the graphs presented in the report (figures 14 and 15) show average pH and temperature calculating over different river flow ranges, the commentary in paragraph 3.1.8 correctly refers to comparing pH data to the pH ranges prescribed within the consent conditions and the One Plan targets, and temperature data to the maximum temperature set by the One Plan target. For more detail, Appendix A provides key descriptive statistics for all water quality parameters, including low and high percentiles (5^{th}, 10^{th} , 90^{th} and 95^{th} percentiles) and minimum/maximum values for all three monitoring sites and for a range of river flow conditions.

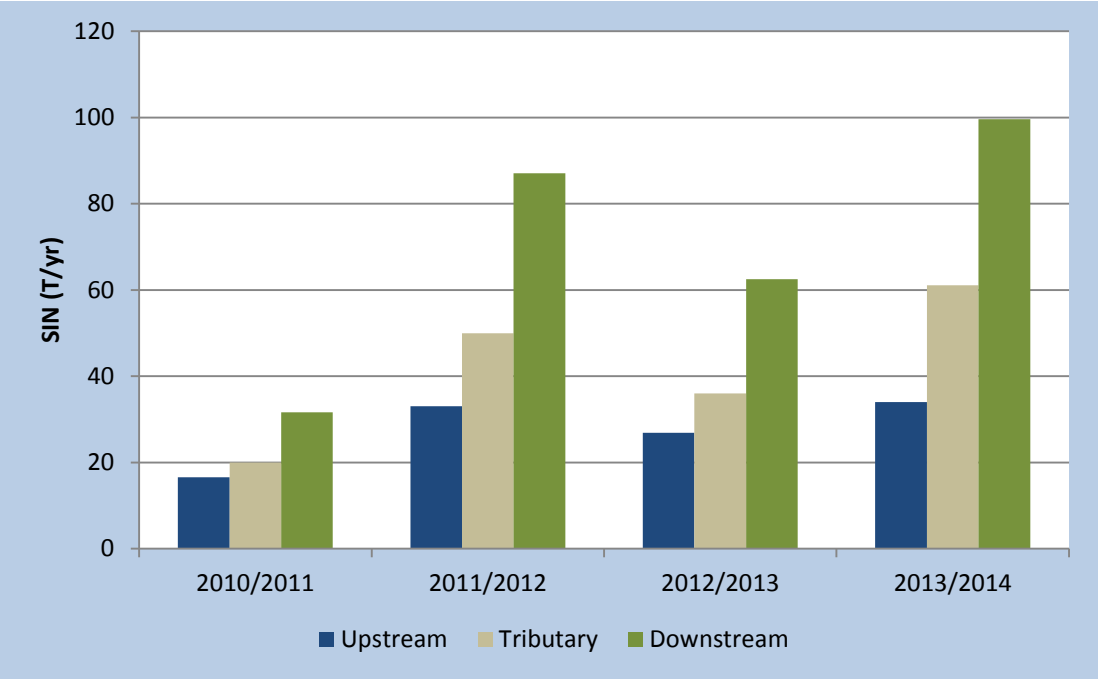
5 Loads in appendix C

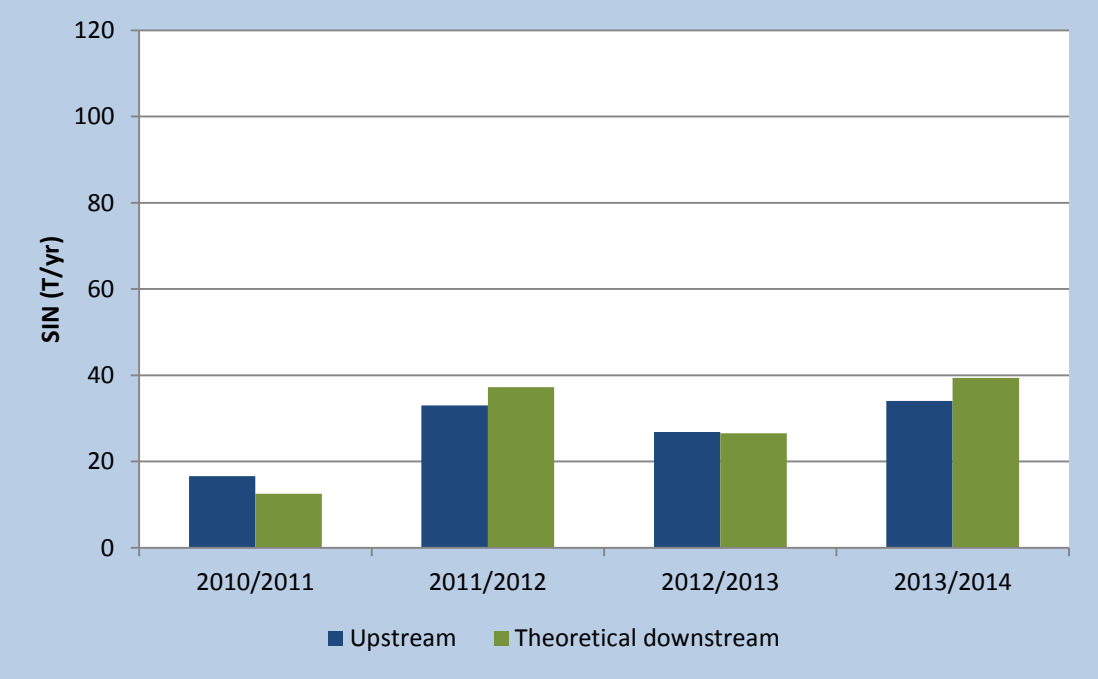
Thank you for pointing the discrepancies in annual loads presented in Appendix C. we can confirm these were due to an error, for which we apologise. Corrected graphs are shown below.

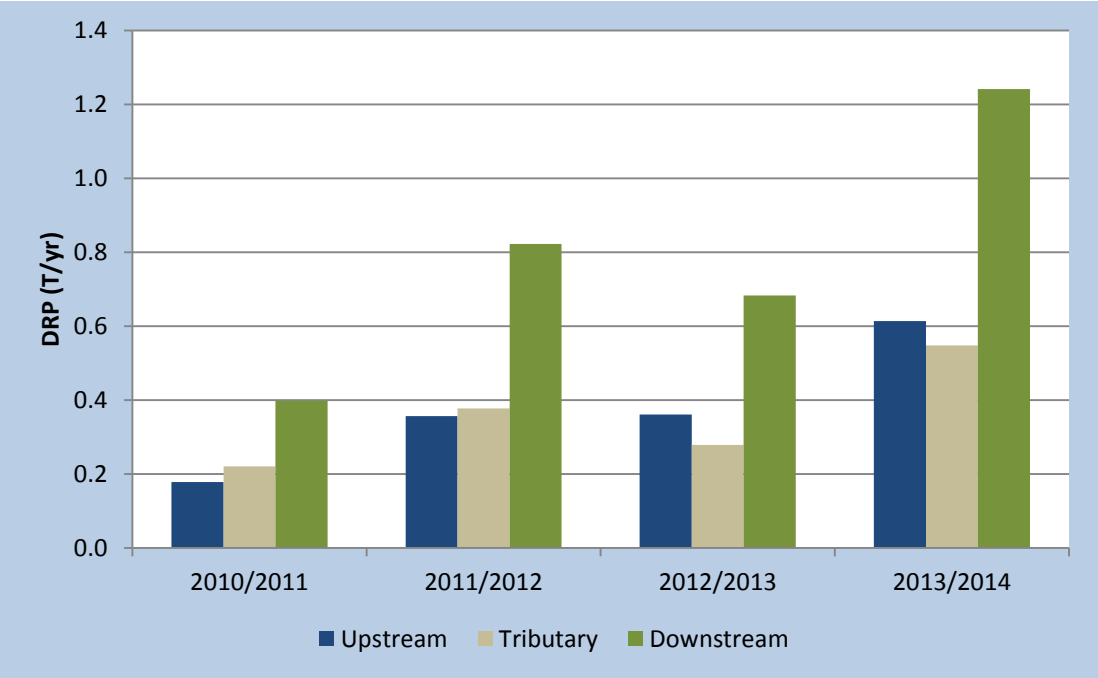
Appendix C: Total Ammoniacal Nitrogen, Soluble Inorganic Nitrogen (SIN) and Dissolved Reactive Phosphorus (DRP) annual loads in tonnes/year for sites upstream and downstream of the Eketahuna WWTP discharge point as well as within the Ngatahaka Creek tributary (2010 - 2014).

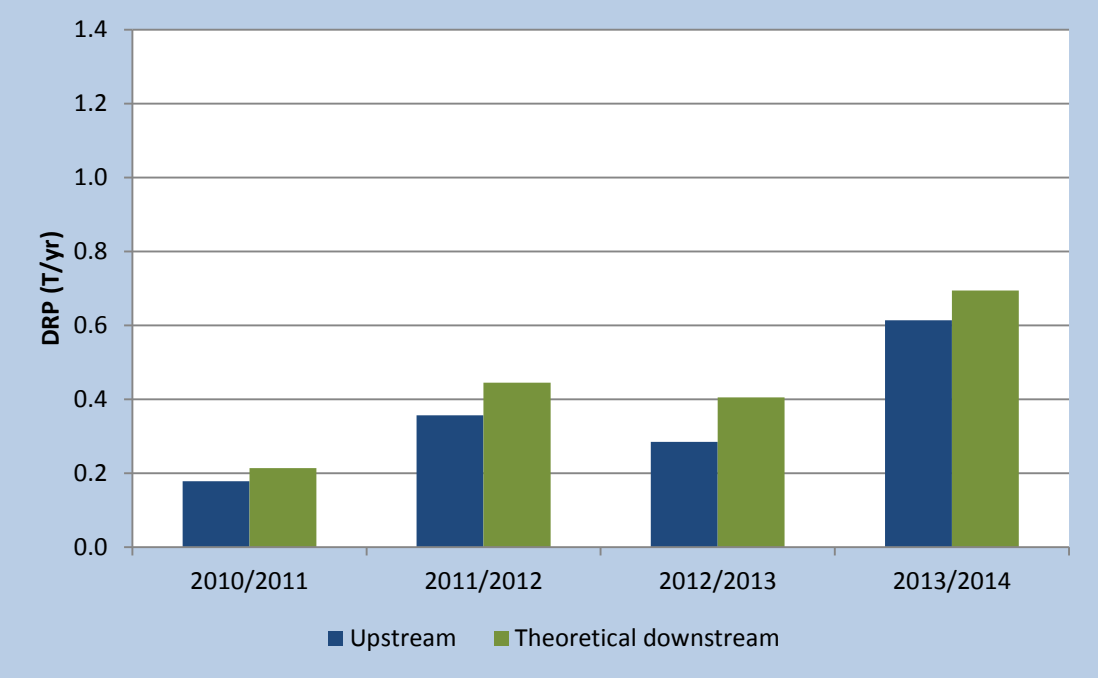





120
100
80
60
40
20
0
SIN (T/yr)
2010/2011
2011/2012
2012/2013
2013/2014
Upstream
Tributary
Downstream


120
100
80
60
40
20
0
SIN (T/yr)
2010/2011
2011/2012
2012/2013
2013/2014
Upstream
Theoretical downstream


1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
DRP (T/yr)
2010/2011
2011/2012
2012/2013
2013/2014
Upstream
Tributary
Downstream


1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
DRP (T/yr)
2010/2011
2011/2012
2012/2013
2013/2014
Upstream
Theoretical downstream

Opus International Consultants Ltd
Palmerston North Office
L4, The Square Centre, 478 Main Street
PO Box 1472, PN Central,
Palmerston North 4440
New Zealand

t: +64 6 350 2500
f: +64 6 350 2525
w: www.opus.co.nz

11 December 2015

Fiona Morton
Senior Consultant Planner
Horizons Regional Council
Private Bag 11025
Manawatu Mail Centre
Palmerston North 4442

5-P0531.05

Dear Fiona

Response to Further Information Request APP-2005011178.01 - Eketahuna Wastewater Treatment Plan

In response to the further information request and subsequent correspondence dated 23 November 2015, please find set out below the response to the information request. The Tararua District Council (TDC) response is set out below each of the information request points.

Surface Water

- UV treatment triggers - The application states that UV treatment will be implemented if necessary following implementation of other upgrades.

Please define what the trigger is for this upgrade i.e. when is it considered necessary and the proposed timeline.

TDC RESPONSE

TDC confirm that a UV treatment system is to be installed at Eketahuna.

- Lamella and UV treatment systems - Two of the proposed treatment systems (the UV and the Lamella) have different flow capabilities. The Lamella can handle up to 22 l/s and the UV 6 l/s.

Please confirm if these different flow capabilities make any difference to be able to treat the volumes of effluent that are expected through the plant.
Please confirm whether the UV treatment facility has the capacity to treat up to the peak wet weather flow of 3,200 m3/day as 6 l/s equates to approximately 520 m3 per day.

TDC RESPONSE

As noted in the application, TDC are currently in the process of significant upgrades to the pipe network system. Once this is substantially completed TDC will be in a better position to better quantify peak wet weather flows. This will be used to determine UV treatment management at the plant.

It is likely there will be refinements to the final design, including final sizing of units. Accordingly flow rates of different processes to be installed may be altered.

- Expected effluent quality - The application provides no detail on what the expected effluent quality will be like as a result of the proposal. However, it does state that upgrades at Woodville and Pahiatua will provide some guidance on what can be achieved. The monitoring from these two plants should be completed (according to the application).

With this in mind, please provide an update on what the proposal is expected to achieve based on this information as it becomes essential in predicting potential effects or improvements of any upgrades.

TDC RESPONSE

A testing regime has commenced at Pahiatua, a summary of results is shown in the additional column in the Table below (additional column added to Table 3 of original information)

Table 1: Filtered and edited effluent concentration data* (5/10/10-18/02/14)

Parameter	Mean Concentration (mg/L)		Value below which data removed in edited data	Post tertiary results to date (mg/l)
	Filtered Data	Edited Data		
Ammoniacal Nitrogen	4	4	1	16
DRP	0.7	2	0.3	Not measured
E Coli	284	886	50	93
Nitrate	2	2	-	0.3
Nitrite	0.04	0.04	-	0.1
Total Coliforms	19,197	29,417	200	Not measured
Total Nitrogen	7	7	-	18
Total Oxidised Nitrogen	2	2	-	0.4
Total Phosphate	0.9	3	0.5	1.3
Total Suspended Solids	8	36	10	16
Turbidity	8	8	-	Not measured
Volatile Matter	6	22	7.5	Not measured

* It has subsequently been identified that the effluent data used in the first two columns of Table 3 was largely taken from an incorrect source, making the data inappropriate for use in making direct comparisons with post upgrade data.

16 effluent sample results have been received. There are between 13 and 16 results for each of the requested parameters. There are also 14 sets of sample results for the effluent passing between Pond 2 and Pond 3. The Sample Point 7 results, post upgrade, are summarised in Table 3 above.

Because the pre-upgrade data has subsequently been identified as being of incorrect origin, and there is insufficient post upgrade data to be certain of effluent quality, no summary is made here of the improvements being rendered by the tertiary upgrades.

Anticipated effluent quality improvements resulting from the upgrades are summarised in Table 2 below.

Table 2 Summary of anticipated effluent quality improvement

Process Upgrade	Affected Effluent Parameters	Anticipated Improvement*	Confidence Rating (1-10, low-high)	Reason for Confidence Rating
Inlet screen	Gross Solids	Protection of downstream mechanical equipment	10	No Numeric
Lamella Clarifier	TSS,	TSS – 50%	4	No pilot results
	TN,	TN – 60% of 3mg/l	4	Filtered data indicates 3mg/l Organic N in SS. But TSS not reliable
	DRP,	DRP to approx. 0.7mg/l**	7	Essentially tunable with coagulant
		Small reduction in faecal indicator bacteria by physical removal.	7	Experience with other solids removal processes.
Drum Filter	TSS, TN, TP	30% of Clarifier carry over. Small TSS particles will go straight through filter.	4	Vague Kaeo pilot trials. No trials on low TSS effluent & therefore no indication of %age less than 20 micron.
UV Disinfection	Bacteria, Viruses, Protozoa	2 - 3 Log_{10} Inactivation	6	Based on a good tertiary effluent but not specified dose.

* Based on Table 1 numbers above

** Depending upon chemical dose rate and clarifier up flow rate.

Further testing is required between treatment systems to allow the results to be interpreted and applied to other sites. This is scheduled to occur over the coming months. The following testing programme is to be adhered to –

- Influent
  - » Take 24 hour composite samples every 6 or 8 days (in order to sample on a different day each week) for a month or two, then monthly for the balance of a year.
  - » Sample $cBOD_5$, TKN, TP. Alkalinity.
- Normal Operation and Consent Compliance
  - » Sample full list of analytes fortnightly at discharge (after UV disinfection) by grab sampling (Sample Point 7
  - » Sample between each unit process (ponds, clarifier, filter) monthly. Sample Points 4, 5, 6

The full list of effluent analytes to be sampled (except in between unit processes as detailed above) is as follows:

- Analytes by Composite & Grab Samples

- » $cBOD_5$
- » Ammonia
- » TKN
- » TN
- » DRP
- » TP
- » TSS

- Analytes by Grab Samples only
  - » UVT%
  - » pH
  - » E.coli

A minimum of months of testing will be undertaken.

- DO monitoring - The application makes reference to the One Plan and NPSFM dissolved oxygen (DO) levels and states that the spot measurements taken show that the DO levels increase downstream of the discharge and may therefore decrease further at night time at the downstream point.

Please confirm whether it is intended to undertake continuous DO monitoring over a set time once the upgrades are complete to show that there are no effects on DO levels. Please also comment on whether these changes in the DO levels could also be responsible (or at least one of the drivers) for the changes that have been seen in the macroinvertebrate communities downstream of the discharge.

TDC RESPONSE

Please see the attached response from Aquanet consulting ltd that addresses this point.

- Flow relationship - In the water quality report there has been a reliance on calculating loads from the Makakahi upstream of the WWTP, the Ngatahaka upstream of the Makakahi confluence, and the Makakahi downstream of the WWTP to work out the loads from the WWTP. This has worked on a flow relationship that has been provided from Opus to establish loads.

Please provide more information on the accuracy of this derived relationship and whether any validation has been undertaken i.e. gauging undertaken in the Ngatahaka to ensure that the relationship is accurate. A number of conclusions are drawn based off this relationship so certainty that the modelled flows reflect reality is critical.

TDC RESPONSE

The approach adopted and summarised in the Appendix to the report was essentially developed from an earlier study by Horizons (Watson, 1994 & 1997). These reports were:

Watson, M. 1994: Estimates of average annual one day low flow for rivers and streams receiving effluent from Tararua District Council landfills and sewage systems. Manawatu Wanganui Regional Council 94/INT/61.
Watson, M. 1997: Estimates of flow in rivers and streams receiving effluent from Tararua District Council sewage facilities. Manawatu Wanganui Regional Council 97/INT/88.

It would be possible to compare the various gaugings used to develop the relationships with the corresponding flow estimates. However, there is a bit of circularity in any such argument. It might be possible to get any new gaugings and use these to compare the results. Irrespective of what is done there is actually no alternative at this stage. The approach adopted is consistent with that 'deemed acceptable' for a number of years (20 plus).

- The water quality report shows there is a significant increase in the concentration of ammonia downstream of the discharge point (although well below the One Plan targets).

Please provide comment as to whether this is the possible reason that we see more periphyton growth downstream of the discharge (preferential uptake and growth) compared to upstream and whether reductions in the ammonia component of the discharge will reduce effects on the Makakahi Stream. It is noted that currently the application seeks no reduction in the SIN component of the discharge.

TDC COMMENT

Please see the attached response from Aquanet consulting ltd that addresses this point.

- DRP treatment at low flows - The application refers to only treating for DRP at low flows (although no definition of low flows is given) as this is when the discharge is proposed to have the most influence. However, if looking at Figure 7B it would suggest that at all flows below the 20th FEP the discharge raises DRP in the receiving environment. There is concern that only treating for DRP at low flows will not be effective in reducing effects.

Please confirm the low flows used in the application and provide an assessment of the predicted reduction in effects based on the proposal to only treat DRP at low flows.

TDC COMMENT

It is not the intention to only treat DRP during low flows.

- pH and temperature averages - The application uses averages to represent pH and temperature. Generally, concern lies around the highs for temperature and the lows and highs for pH. Averaging this data removes these highs and lows and doesn't necessarily reflect the effects that are seen in stream.

If available, please provide data showing the temperature high and the pH highs and lows.

TDC COMMENT

Please see the attached response from Aquanet consulting that addresses this point.

- Low SIN, DRP and ammoniacal nitrogen loads - In Appendix C of the water quality report, tonnes/year have been established for SIN, DRP, and ammoniacal nitrogen. After analysing the data there appears to be very low loads in 2010/11 and 2012/13 compared to 2011/12 and 2013/14.

Please provide discussion around the likely reasons for the low loads in 2010/11 and 2012/13 compared to 2011/12 and 2013/14.

TDC COMMENT

Please see the attached response from Aquanet consulting that addresses this point.

- Testing for DRP removal - The Opus engineering report (2011), which covers DRP removal, refers to the need to undertake onsite jar testing and dosing trials to confirm dose rates to see what level of DRP removal can be achieved.

Please confirm if the work recommended by the Engineering Report has this work been undertaken. If not, please advise whether it is intended for the onsite jar testing and dosing trials work to be carried out and if so, the proposed timeline for this work to be completed.

TDC COMMENT

The recommendations in the Opus 2011 report related to a different treatment system, which is not application to the proposed design upgrades. The report was included to demonstrate alternatives that had been considered. Accordingly, onsite jar testing has not yet been undertaken. Testing work will be undertaken on the pilot system.

- De-sludging - In reference to sludge management, the 2011 Opus Engineering Report recommended that sludge disposal options start to be considered as the facultative pond needed to be de-sludged prior to the average depth reaching 0.8m, with the average depth in 2011 being 0.9m.

Please confirm if the de-sludging recommendation has been actioned. If not, please advise whether this work will be carried out and if so, the proposed timeline for de-sludging to occur. Please also advise if this will be an ongoing commitment.

TDC COMMENT

Desludging has been undertaken at the Eketahuna site, this was done in October 2015 and desluding was done using biobags.

The decision to desludge is an operational one, TDC make the comment that desludging would occur if needed in the future but it is inappropriate to determine when desludging would be undertaken to a fixed date.

Land

The proposal includes an application to discharge treated wastewater from the base of the ponds into land where it may enter water, however this is not discussed further in the AEE. It is unclear from the application whether the ponds are intended to be lined or not. Please clarify:

☐ Whether the ponds are to be lined or not.

If the ponds are proposed to be lined, please confirm:

☐ The timeframe for lining;

☐ The lining material that will be used;

☐ Whether the lining will achieve the permitted activity standards of One Plan Rule 14-

In the event that the ponds are not proposed to be lined, please provide the following information to enable MWRC's Consulting Scientist, Dave Horne to undertake a review of the effects from the discharge to land from the ponds:

☐ Confirmation of the permeability of the ponds to assist in establishing the level of wastewater leaked from the ponds; or

☐ In the event that the pond permeability is not able to be established, please provide the following:

o Daily inflows and outflows records from the wastewater ponds for as long a period as possible (the more comprehensive the data set, the better);

o Pond dimensions (length, width, depth, batter etc).

TDC RESPONSE

TDC confirm that the ponds are to be relined with a synthetic liner in March 2017, noting that it take 2-3 weeks to draining each pond and weather conditions need to be appropriate.

The synthetic liner would meet the permeability standard.

Groundwater

- An assessment of shallow groundwater flow direction, including seasonal changes in flow direction (if they occur);

☐ The hydraulic properties of shallow strata at the site and general conditions in the vicinity; and

☐ Given the likely connection between shallow groundwater and the Makakahi River an assessment of the potential effects of contaminant transport from the ponds via groundwater will be required if the findings of the groundwater flow assessment indicates a connection with the Makakahi River.

TDC RESPONSE

Limited information is available that would enable a robust response to the above question, but note as a general comment that should there be a connection to the Makakahi effects would be picked up via river monitoring. It is understood that this question related predominantly to the application for the discharge from the existing

ponds, the proposal is to now line the ponds thus the effect from the discharge would be relatively short. Accordingly, no further investigation into this is proposed at this stage.

Other

- Discharge location - The application refers to moving the discharge point 100 metres downstream to avoid the influence of the Ngatahaka Stream. The discharge location as proposed is likely to be in the middle of the gorge which will make monitoring upstream and downstream of the discharge impossible.

Please provide a map and more details on where the discharge structure will be placed.

TDC COMMENT

The precise location of the discharge point is still being established, as there are a number of factors to take into account – including monitoring locations and access to the site. The intent is to do more investigation over the summer period and Dr Olivier Aussiell be involved in the site selection.

Once site selection has been finalised this detail will be forwarded to Horizons. This will also determine whether or not consent will be required.

- Discharge structure - It is unclear whether the new discharge structure is also meant to have a rock filter associated with it.

Please provide the design details of the new discharge structure including an assessment against the One Plan rules to determine whether a separate resource consent is required for the structure.

TDC COMMENT

The decision regarding location of the discharge point will determine whether an additional consent application is required. A rock filter structure is proposed but it's exact location is not yet known. If preferred, a consent application can be quickly prepared bearing in mind it is the location relative to the bed that would determine if consent is actually required, if consent was deemed not to be required once location is known the consent could either be withdrawn or a certificate of compliance issues.

- Conditions - On page 32 of the Opus Engineering Report (2011) there is a proposed set of conditions.

Please confirm if these are still proposed conditions given the proposed upgrades and the fact that this report was prepared in 2011 or is there an updated version of conditions?

TDC COMMENT

The Opus Engineering Report (2011) was included as part of the consideration of alternative, therefore the proposed conditions in that report are not applicable to this application. Draft conditions would be informed by the more detailed assessment of

effluent quality and would therefore be prepared after the additional testing regime from Pahiatua and from consultation.

- Alternatives - Mention is made of a report that was commissioned to look into the suitability of land disposal, however on page 34 of the application it is stated that land treatment is not considered to be practical.

Please provide further detail on the alternatives considered and the reasons these were discounted. If available, please provide a copy of the land treatment report that was commissioned to look into the suitability of land disposal.

TDC COMMENT

Please find attached an additional report looking at land treatment options referred to in the consent application.

- Timeline for addressing inflows associated with cracked pipes - The application makes reference to the earthquake in early 2014 cracking/breaking many of the pipes in the network and that there is a process going forward to replace/mend these by the end of 2015. The 2011 engineers report also refers to the very high inflow rates that the Eketahuna STP has compared to other towns and suggests that they need to be reduced to improve the treatment level and lower the costs of treatment at the plant reinforcing the need for inflow reductions

Please confirm if there is a plan to address inflows into the plant going forward e.g. a % reduction in flows over xx time.

TDC COMMENT

As noted in the application pipes in the network are in the process of being replaced, this would have the impact of addressing the effects mentioned in the 2011 report and reduce inflow. The focus has been on replacing pipework, by the end of February/mid-March the mains should be relined/replaced, manholes re-haunched and replaced where necessary. There will be a flowmeter on the inflow line which will provide accurate results on inflows in time (over the winter period).

Regards

Tabitha Manderson
Senior Resource Management Planner

EKETAHUNA WASTEWATER

LAND IRRIGATION

PRELIMINARY INVESTIGATION

TARARUA DISTRICT COUNCIL

wai waste
environmental consultants ltd
Consulting Engineers

May 2015

Author
David Veale
CONSULTING ENGINEER
Wai Waste Environmental Consultants Ltd
Consulting Engineers

15 May 2015

Acknowledgements to

Front Cover Photo

Photo:

For more information contact

Wai Waste Environmental Consultants Ltd
Cnr Denmark and Miller Streets
P O Box 73
DANNEVIRKE

Phone 06 374 8592
Fax 06 374 8597
Mobile 027 311 1938
david@waiwaste.co.nz

Quality Record	Name	Date	Signature
Prepared By:	D Veale	May 2015	
Authorised By:	D Watson	May 2015	

CONTENTS

1.0 Executive Summary

Wai Waste Environmental Consultants Ltd has been engaged to undertake a preliminary investigation in to the potential for land irrigation of effluent from the Eketahuna wastewater ponds during summer low flow conditions in the Makakahi River.

Currently, the wastewater is discharged directly from the oxidation ponds in to the Makakahi River under all flow conditions. To improve water quality, particularly during low flow conditions, the option of irrigating all wastewater to land is being explored.

The wastewater discharge flows have been highly variable from the Eketahuna oxidation ponds due to stormwater infiltration issues associated with damage to infrastructure sustained during the Eketahuna Earthquake. Council is undertaking a repairs and maintenance upgrade project to mitigate the volume of stormwater infiltration in to the wastewater network.

During the summer months when low flows are experienced in the Makakahi River the average daily discharge from the ponds is approximately 400m^3. On a total nitrogen basis the volume of effluent produced over a 120 day irrigation period would require a minimum of 2ha of land. On a conservative hydraulic loading basis the minimum land area required would increase to 8ha.

A review of the land surrounding the Eketahuna oxidation ponds identified several site constraints in terms of possible irrigation sites, primarily due to the topography, proximity of small property titles the State Highway and the rail network.

A preferred site has been identified, however the site has risk around its suitability for effluent disposal which may make any resource consent process onerous particularly around possible odour management and the potential for odour drift in to the outskirts of Eketahuna Township.

Four sites were identified as potentially suitable for effluent irrigation, although each of the four sites has site specific constraints. A preferred site has been identified however the site has risk around its suitability for effluent disposal which may lead to any resource consent process being onerous particularly around odour management and the potential for odour drift to the outskirts of Eketahuna Township.

A rough order of costs has been completed to provide an estimate to establish an irrigation network at site one which is $805,000 excluding possible land purchase which would add a further $1.2M - $1.8M.

Several risks are associated with each of the identified sites including long term landownership, potential legal easements, un-sustainable soil conditions, and a potentially onerous resource consent process.

Due to the limited number of potential sites and site specific constraints identified in the desktop study it is recommended that a more detailed analysis be undertaken, including detailed modelling with the Town Effluent Calculator (TEC) as well as detailed site investigations, to determine whether land irrigation is a cost effective solution. This will enable an in-depth cost benefit analysis to be completed to assist with site and/or treatment option selection. It is considered likely that a combination of land irrigation and surface water discharge could be feasible, which modelling with TEC and site specific investigations would identify.

2.0 Scope of Work

Wai Waste Environmental Consultants Ltd has been engaged to undertake a preliminary investigation in to the potential for land irrigation of the discharge from the Eketahuna wastewater ponds during low flow conditions in the Makakahi River.

Currently, the wastewater is discharged in to the Makakahi River under all flow conditions. To improve water quality, particularly during low flow conditions, the option of irrigating all wastewater to land is being explored.

This preliminary investigation in to land irrigation during low flow conditions quantifies wastewater flows, nutrient concentrations and identifies potential sites with favourable soils in close proximity to the existing wastewater ponds that would be suitable for land irrigation of this scale.

3.0 Introduction

To restore the health of the Manawatu River the Ministry for the Environment established the 'Fresh Start for Freshwater Clean-up Fund' project which investigates and funds projects that will benefit and improve water quality. Several municipal wastewater to surface water discharges have been the focus of investigations to identify opportunities for potential environmental improvements, with Eketahuna township discharge being one.

Eketahuna is a small town located within the Tararua District with a population of approximately 450 persons. The town is located at the foot hills of the Tararua Ranges which lie to the west, and on the eastern bank of the Makakahi River. The township is perched on the terrace approximately 25 metres above the entrenched Makakahi River. Several surface drains surround the township. The average annual rainfall in Eketahuna is relatively high at 1500mm. Figure 1 demonstrates the locality and topography of the surrounding area.

The current wastewater treatment operation comprises 2 oxidation ponds with an aerator located within the first pond, with effluent discharged in to the Makakahi River. Council is in the process of evaluating upgrade options to the current treatment operation, including a stepped screen, installation of chemical dosing, drum filters, UV disinfection, rock filters and /or clarifiers or tephra filters. The oxidation ponds have a total operational volume of 6,000m^3. Figure 2 demonstrates an aerial map of the oxidation pond layout.

The above mentioned discharge operates under resource consent 103346. A consent renewal process is underway, however the application is likely to be modified once the final optimisation design has been confirmed.

There is no significant industry discharging wastewater in to the municipal network.

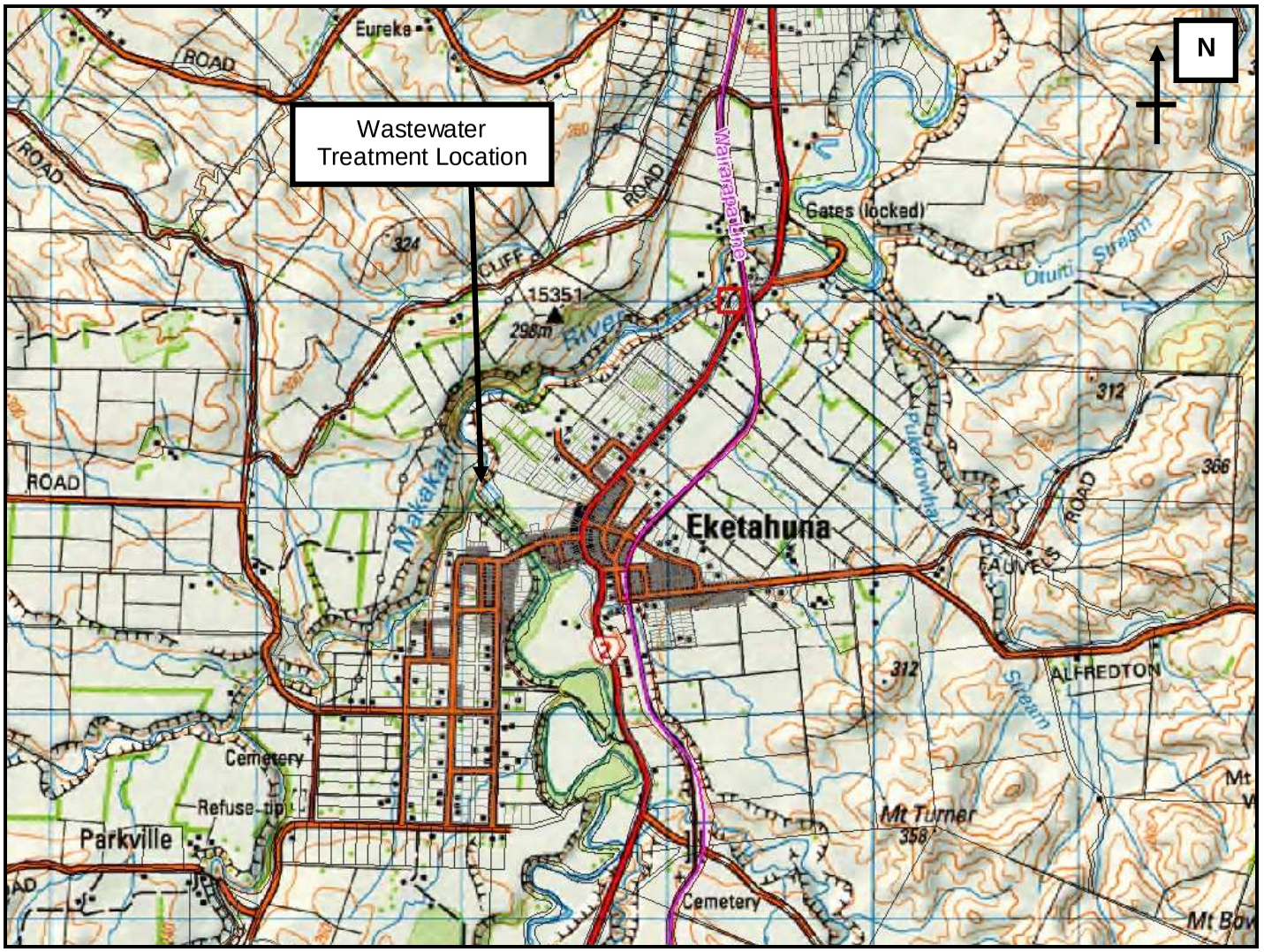


Figure 1. Eketahuna Wastewater Treatment Location Plan.

Figure 2. Eketahuna Oxidation Ponds.

4.0 Wastewater Evaluation

The flow records from the outlet of the maturation pond from December 2013 to June 2014 have been used as a basis for determining potential flow volumes for land application during low flow conditions within the Makakahi River, typically occurring between the months of January and May, due to a lack of more recent flow data being available.

A review of the flow discharge data from the oxidation ponds from December 2013 through to June 2014 provides the following data summary for the months of low river flows typically being January through to May.

Month	Monthly Total Discharge (m^3)	Average Daily Flow (m^3/d)
December 2013	34,592	1,116
February 2014	23,927	825
March 2014	29,830	962
April 2014	15,390	513
June 2014	22,976	741

Table 1. Discharge volumes December 2013 – June 2014.

Stormwater infiltration into the wastewater network has been exacerbated by damage sustained to the infrastructure following the magnitude 6.2 Eketahuna earthquake on 20 January 2014. Ongoing repairs and maintenance to the infrastructure is continually reducing the stormwater infiltration volumes entering the wastewater network.

The land irrigation analysis has been based on an average daily flow of 400m^3 which is considered to be a reasonable volume for the purposes of identifying potential land irrigation requirements for the period of low flow conditions in the Makakahi River.

For the purposes of evaluating potential land irrigation sites and land requirements, an irrigation duration of 120 days has been selected which is considered sufficient to cover extended periods when low flows are experienced.

Using an average daily flow of 400m^3 over a four month irrigation period provides an estimated 48,000m^3 of effluent for irrigation.

A full evaluation utilising the Town Effluent Calculator (TEC) has not been undertaken due to the proposed operational improvements to the wastewater network which will have an impact on effluent quality and quantity. Should land irrigation be considered feasible, it is recommended a detailed analysis be completed utilising the TEC to finalise and/or optimise land irrigation design.

5.0 Land Area Requirements

The topography of the land surrounding the oxidation pond site is described as relatively flat on various terrace elevations with numerous surface drains and streams draining some of the heavier soils.

A review of soil maps of the potential land application sites are typically described as moderately to well sorted alluvial flood plain gravel with minor sand and/or silt for the alluvial terraces adjacent to the Makakahi River. The upper terraces away from the Makakahi River are described as poorly to moderately sorted gravel with minor sand or silt; sometimes weathered, underlying a terrace surface and/or overlying loess/paleosol couplets. These soils are classified as medium to poor respectively in terms of suitability for long term land treatment of effluent. The soil classification and sustainable design irrigation rates would need to be confirmed through the detailed site investigations should land irrigation be adopted. The soil maps are included as Appendix A for reference.

Test results indicate the average total nitrogen concentration within the wastewater effluent is 5.6g/m^3 however this is likely to be diluted due to elevated stormwater infiltration. Based on a total nitrogen concentration of 6g/m^3 with a likely typical limitation of 150kgN/ha/year, on a nitrogen basis a minimum of 2.0 hectares of land would be required for effluent irrigation. A summary of wastewater effluent test results is included as Appendix B.

If the total effluent volume was applied over 2.0 ha this would equate to a depth of 2400mm over a 4 month irrigation period (20mm/day), which is considered high for the soil types surrounding the oxidation pond site and the potential soil deficits likely in this high rainfall area. This would not only result in irrigation during non-soil moisture deficit times but also increase the risk of ponding and/or runoff in to surface drains. The irrigation depth should be matched to soil conditions and crop uptake rates.

Based on a more conservative hydraulic loading rate of an average of 5mm per day the irrigation area required would increase to 8 hectares. A more detailed analysis of soil types and soil moisture deficits may demonstrate that a higher hydraulic loading rate can be applied sustainably without risk of ponding and/or runoff, and hence reduce the overall irrigation area required.

6.0 Irrigation Methods

Two types of irrigation methods have been considered including fully automated travelling irrigators (linear and centre pivot) and irrigation pods. The fully automated travelling irrigators would be preferred so that if necessary programming could allow for irrigators to adhere to exclusion zones including passing over surface drains and/or around boundary or residential exclusion zones. The technology and equipment components are reflected in the high capital costs, however operational costs would be considered lower compared to pod irrigation. Appropriate screens are required to be maintained to mitigate nozzle blockages.

Pod irrigation is well suited to areas that are odd shapes that centre pivot or linear irrigators cannot access. The pod irrigation capital costs are considerably lower than for travelling irrigators, however the operational costs with continual shifting would be considerably higher and difficult if crops are to be grown.

A further alternative is to have telescopic irrigation nozzles, however the capital cost would be high and limitations around ground cultivation would be required.

7.0 Potential Irrigation Sites

A review of aerial photographs overlain with property titles identifies limited potential irrigation sites in close proximity to the oxidation ponds. The surrounding area has several constraints in terms of available irrigation areas including small property holdings, numerous surface drains, state highway network, rail network, dairy land and residential dwellings.

The land to the west of the Makakahi River is predominantly dairying and is therefore not considered suitable for irrigation of municipal wastewater due to industry regulations. The land immediately to the north and east of the oxidation ponds is occupied by the Eketahuna Golf Course and is not considered suitable for irrigation of municipal effluent.

Applying appropriate separation distances of 150m from dwellings, 50m from property boundaries, and 20m from water ways and bores further restricts effective irrigation areas. Considering the above, four sites have been identified as possible land irrigation sites which are demonstrated in Figure 3.

The sites have been identified via desktop study only with no field investigations and/or landowner consultation. Should land irrigation be considered practical and appropriate field investigations and landowner consultation would be required to confirm site availability and site specific constraints which would be completed as part of a detailed design and analysis.

7.1 Potential Site One

Potential Site One is located approximately 800m south-east of the oxidation ponds located on the lower terrace between Stanly Street and State Highway 2. The site is currently utilised as a dry stock operation which could be enhanced by effluent irrigation.

The titled area of this block is 14.6ha and has the Makakahi River on the western property boundary as well as other surface drains, which reduces the effective area to a little more than 2.7 ha with all separation distances taken in to account. The proximity of residential dwellings has a significant effect on reducing the effective area at this site.

The predominant westerly wind direction could have the potential for odour drift on to the outskirts of Eketahuna Township which could lead to consenting issues.

The titled area would suit a mixture of linear travelling and pod irrigation. Site One is slightly higher in elevation than the oxidation ponds (200m RL) at an estimate 210-215m RL above mean sea level, and is demonstrated in Figure 4.

This site would likely be subject to inundation during large flood events associated with the Makakahi River.

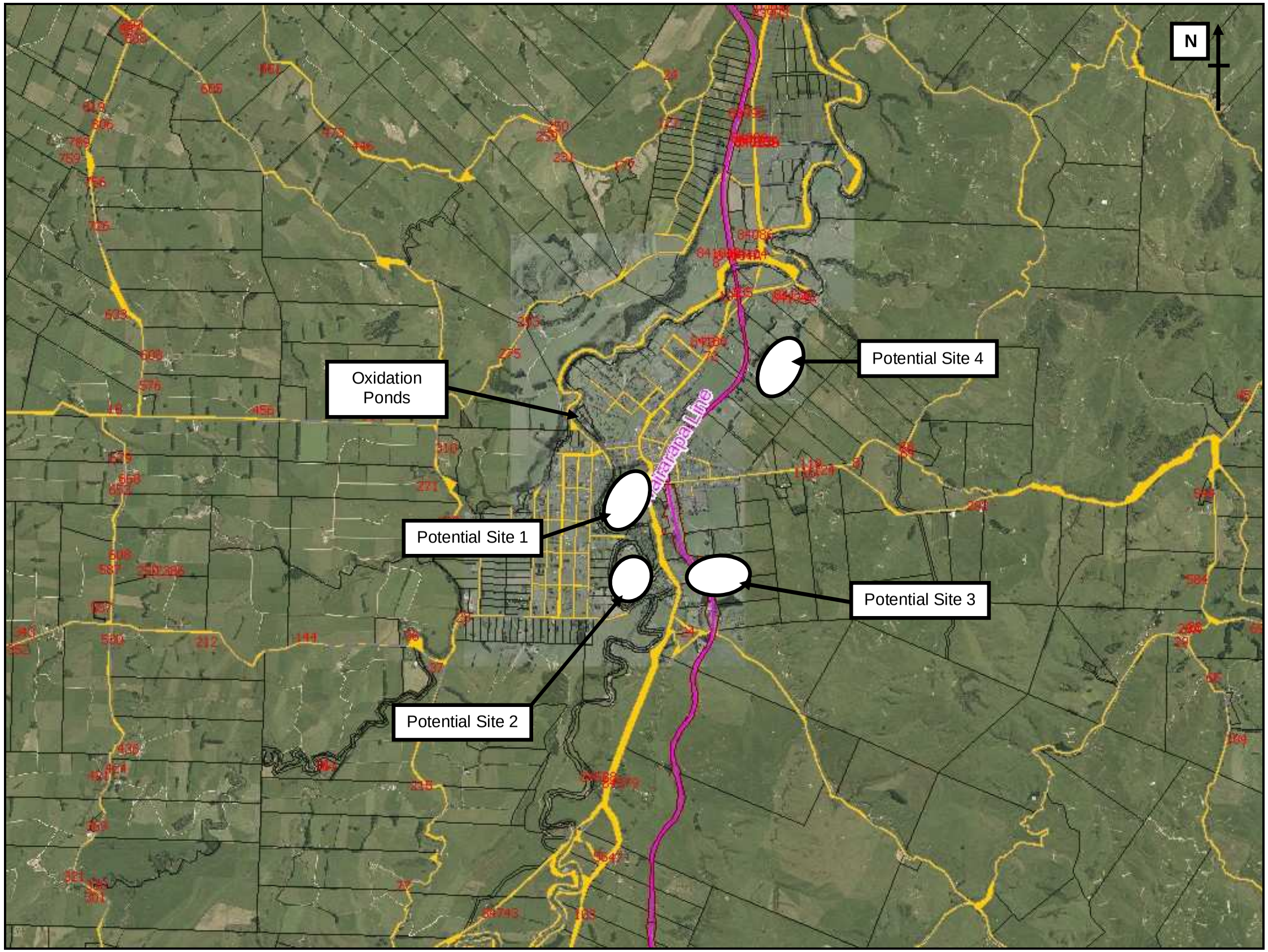


Figure 3. Potential Land Irrigation Sites.

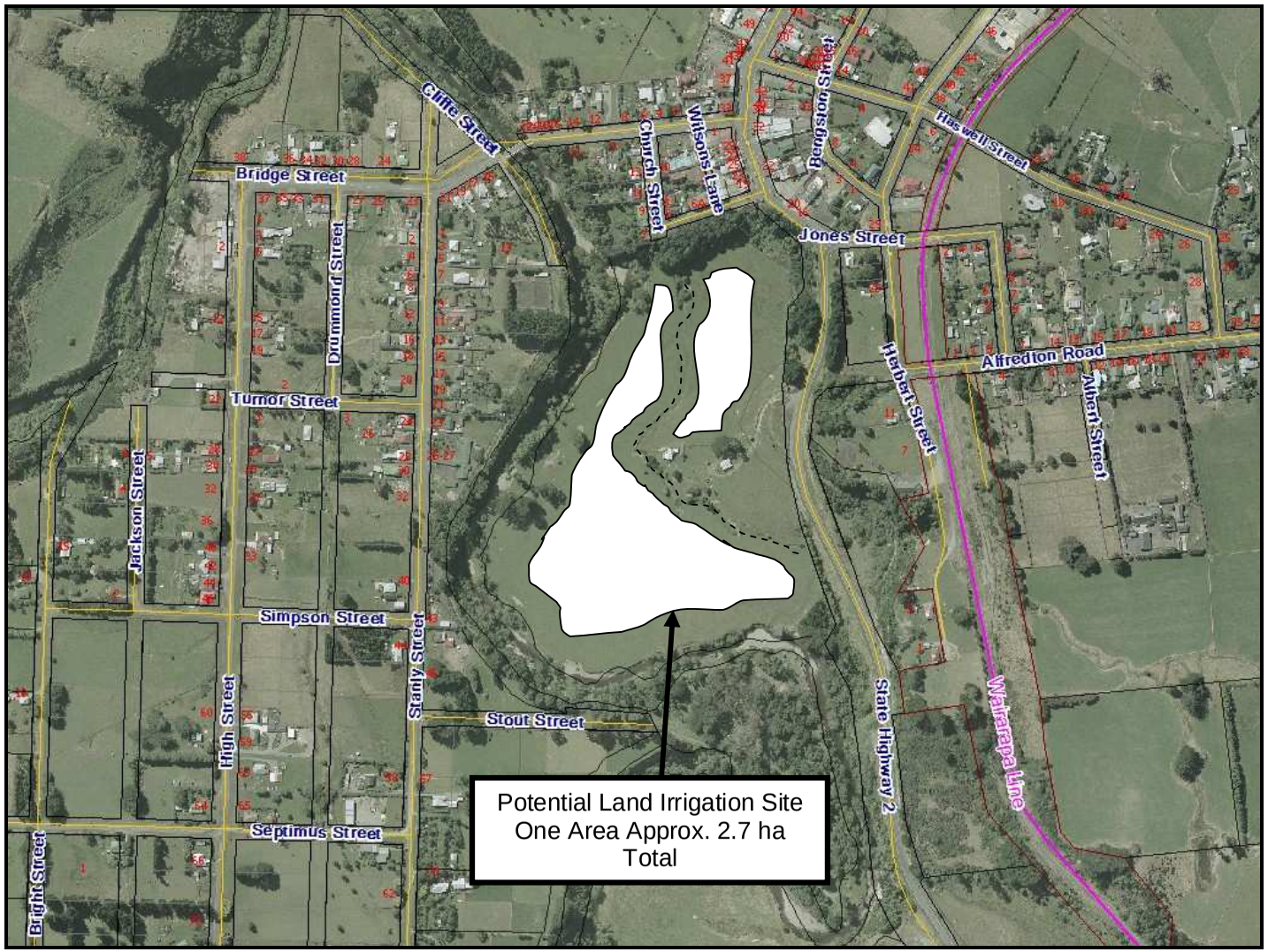


Figure 4. Potential Site One for Effluent Irrigation.

7.2 Potential Site Two

Potential Site Two is located approximately 1.3km south-east of the oxidation ponds located on the lower terrace between Stanly Street and State Highway 2. The site is currently utilised as a dry stock operation which could be enhanced by effluent irrigation.

The titled area of this block is 9.5ha and has the Makakahi River surrounding the property boundaries as well as other minor surface drains, which reduces the effective area to a little more than 3.8 ha with all separation distances taken in to account.

The predominant westerly wind direction is unlikely to have the potential for odour drift on to the outskirts of Eketahuna Township, however an easterly wind direction would likely have the potential for odour drift on to dwellings located on Stanly Street which could lead to consenting issues.

The titled area would suit a mixture of linear travelling and pod irrigation. Site Two is slightly higher in elevation than the oxidation ponds (200m RL) at an estimated 215m RL above mean sea level, and is demonstrated in Figure 5.

This site would also likely be subject to inundation during large flood events associated with the Makakahi River.

7.3 Potential Site Three

Potential Site Three is located approximately 1.6km south-east of the oxidation ponds and is spread over 3 sites which are located between State Highway 2 and Wairarapa Railway Line and east of the Wairarapa Railway Line. The site is currently utilised as a dry stock operation which could be enhanced by effluent irrigation.

The titled area of these blocks total 29ha and has the Wairarapa Railway Line passing through the middle as well as other minor surface drains, which reduces the effective area to a little more than 8 ha with all separation distances taken in to account.

This site is in a rural environment with minimal residential dwellings in close proximity and as such is unlikely to have the potential for odour issues on neighbouring properties.

The titled area would suit a mixture of linear travelling and pod irrigation. Site Three is slightly higher in elevation than the oxidation ponds (200m RL) at an estimated 220 - 240m RL above mean sea level, and is demonstrated in Figure 5. Potential pumping costs would be high with this site due to the elevation differences and the composition of 3 irrigation blocks to make up the required land area. The Wairarapa Rail Line adds another complexity in terms of consultation with NZ Rail as well as getting infrastructure beneath the rail line network.

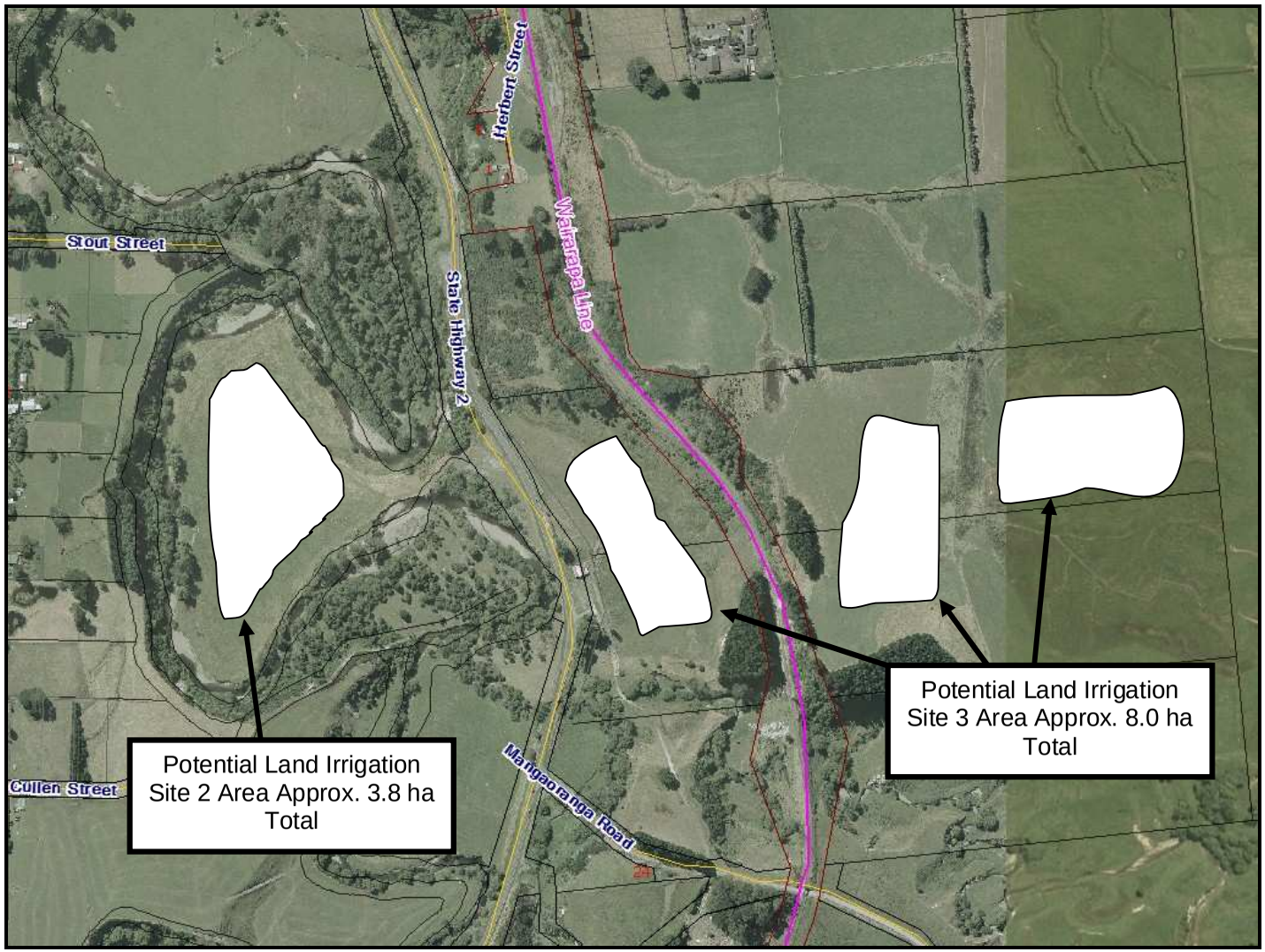


Figure 5. Potential Site Two and Three for Effluent Irrigation.

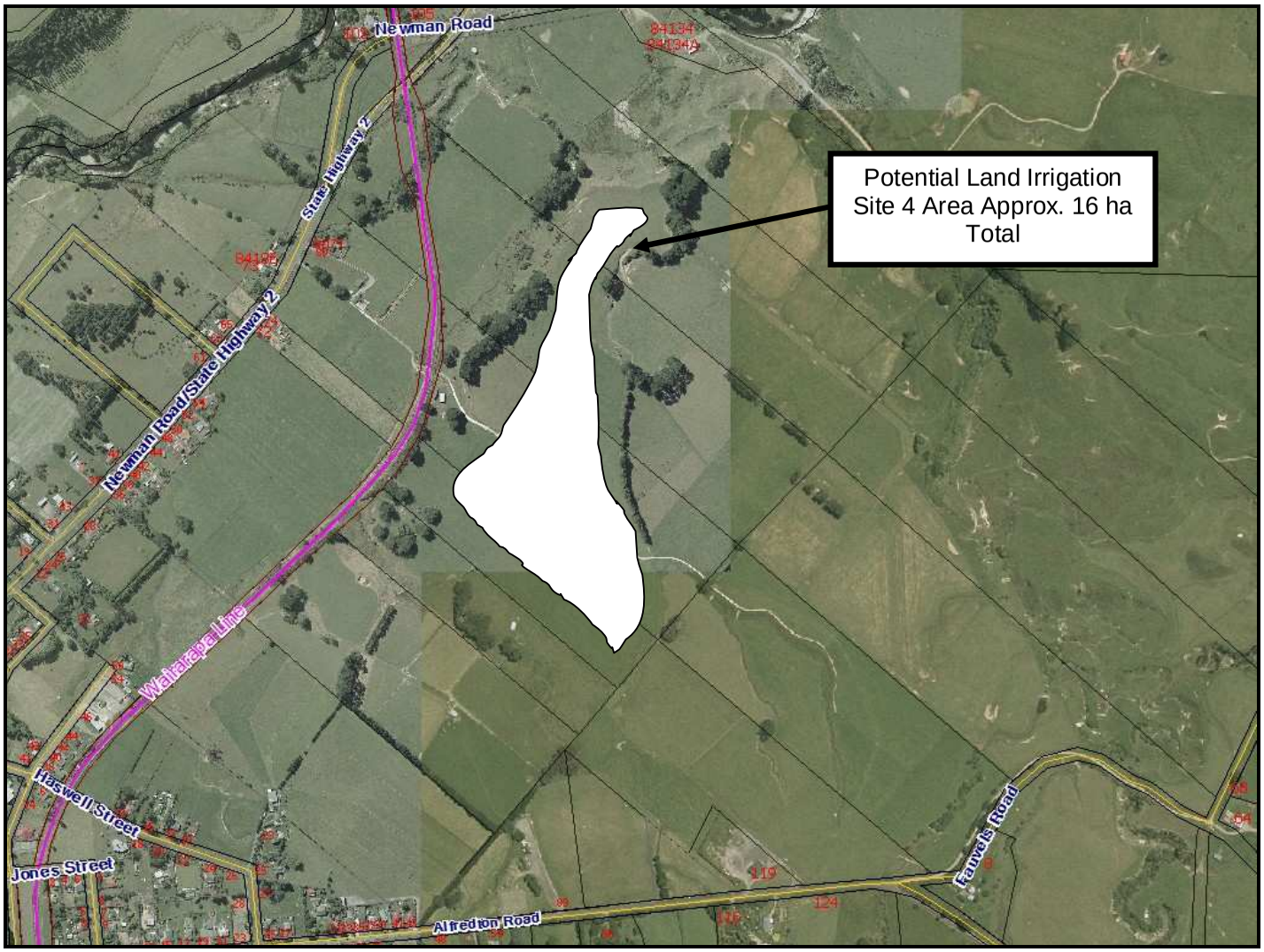


Figure 6. Potential Site Four for Effluent Irrigation.

7.4 Potential Site Four

Potential Site Four is located approximately 1.7km north-east of the oxidation ponds and is located east of the Wairarapa Railway Line. The site is currently utilised as a dry stock operation which could be enhanced by effluent irrigation.

The titled area of these blocks total 50ha and has sever surface drains, which reduces the effective area to approximately 16 ha with all separation distances taken in to account.

This site is in a rural environment with minimal residential dwellings in close proximity and as such is unlikely to have the potential for odour issues on neighbouring properties. However an easterly wind may generate odour issues for those dwelling on State Highway 2 to the west of the potential land irrigation site.

The titled area would suit a mixture of linear travelling and pod irrigation. Site Four is slightly higher in elevation than the oxidation ponds (200m RL) at an estimated 220m RL above mean sea level, and is demonstrated in Figure 6. Potential pumping costs would be high with this site due to the elevation differences and the composition of 3 irrigation blocks to make up the required land area. The Wairarapa Rail Line adds another complexity in terms of consultation with NZ Rail as well as getting infrastructure beneath the rail line network.

7.5 Optimal Site

As previously discussed, the land area surrounding the oxidation ponds has several constraints in terms of being utilised for effluent irrigation. Each of the four potential sites identified have limitations, however the preferred site is Site Four primarily due to the additional land area availability and topography.

Provided odour generation is mitigated and site specific soil conditions including moisture deficit levels are appropriate, Site Four would be considered the most suited to effluent irrigation.

Further investigation and landowner consultation is required to identify if this property is suited to effluent irrigation.

8.0 Statutory Considerations

In order to progress any potential land irrigation of municipal wastewater from the Eketahuna oxidation ponds, further detailed investigations are required including detailed design and confirmation of site conditions.

In order to identify and establish potential land application areas typical statutory considerations that would likely be included as resource consent conditions have been considered. Environmental, social and cultural considerations require further evaluation should the potential for land irrigation of municipal effluent be considered feasible.

9.0 Feasibility

It is difficult to compile a feasibility analysis for land irrigation of the municipal wastewater from the Eketahuna oxidation ponds due to a number of uncertainties.

However, assuming Site Four is the preferred site (subject to confirmation of soil and site conditions and landowner approval), a rough order of costs has been compiled to provide an indication of potential capital costs, and has been summarised in Table 2.

Item	Description	Cost Estimate
1.	Detailed Investigation & Design	$20,000
2.	Resource Consent (Notified)	$25,000
3.	Legal Documentation	$15,000
4.	Pipe Network Including Pumps (Railway Line & State Highway Crossings)	$450,000
5.	Travelling Irrigators & Control Equipment (power supply)	$190,000
	Sub Total	**$700,000**
6.	Contingency – 15%	$105,000
	Total RoC	**$805,000**

Table 2. Rough Order of Costs Estimate.

Based on a desktop study a Rough Order of Costs estimate to establish an effluent irrigation system at Site Four is $805,000. This does not include landownership and relies on the landowner agreeing to utilise the effluent. Should landownership be required potentially for the 50 ha title a further $1.2M - $1.8M would need to be added to the above estimate. A full cost benefit analysis would be required to further quantify the economics of this project.

10.0 Risk Assessment

The risks associated with applying municipal wastewater from the Eketahuna oxidation ponds include limited control over landownership (unless land is purchased), and a resource consenting process which may impose tight consent conditions.

To mitigate the landownership risk land would either need to be purchased outright or a long term lease arrangement entered in to. It may be difficult to find a landowner willing to form a partnership to allow effluent irrigation.

The resource consent process could be onerous due to irrigation site constraints and proximity to Eketahuna Township.

Some of the soil types within the Eketahuna area have limited irrigation properties and potentially limited soil moisture deficits due to the high rainfall, which could cause management issues if sufficient land area is not available for irrigation.

Legal easements will be required which some landowners may be reluctant to agree to and/or oppose.

11.0 Conclusions and Recommendations

The wastewater discharge flows are highly variable from the Eketahuna oxidation ponds due to stormwater infiltration issues associated with damage to infrastructure sustained during the Eketahuna Earthquake. Council is undertaking a repairs and maintenance upgrade project to mitigate the volume of stormwater infiltration in to the wastewater network.

During the summer months when low flows are experienced in the Makakahi River the average daily discharge from the ponds is approximately 400m^3. On a total nitrogen basis the volume of effluent produced over a 120 day irrigation period would require a minimum of 2ha of land.

On a conservative hydraulic loading basis the minimum land area required would increase to 8ha. A review of the land surrounding the Eketahuna oxidation ponds identified several site constraints in terms of possible irrigation sites, primarily due to the topography, proximity of small property titles the State Highway and the rail network.

A preferred site has been identified however the site has risk around its suitability for effluent disposal which may make any resource consent process onerous particularly around possible odour management and the potential for odour drift in to the outskirts of Eketahuna Township.

With the limited number of potential sites and site constraints it is recommended that a more detailed analysis be undertaken, including TEC modelling and detailed site investigations, should land irrigation be considered a cost effective solution. This will enable an in-depth cost benefit analysis to be completed to assist with site and/or treatment option selection. It is considered likely that a combination of land irrigation and surface water discharge could be feasible, which the TEC modelling would identify.

12.0 Applicability and Limitations

This report has been prepared solely for the use of Tararua District Council for the purpose of investigating and identifying potential land irrigation sites in close proximity to the Eketahuna Oxidation Ponds for the purposes of irrigating effluent during low flow conditions in the Makakahi River. The report has been prepared for the purpose of providing an initial assessment of the potential sites available for effluent irrigation.

This report has been in the form of a desktop study and has utilised publicly available information, information provided by others including Tararua District Council and Horizons Regional Council. Wai Waste Environmental Consultants Ltd cannot and does not accept any responsibility for errors and omissions in, or the currency of sufficiency of the provided information.

Should conditions be exposed during development that differ significantly from those expected then Wai Waste Environmental Consultants Ltd should be contacted immediately in order to review and if necessary amend any recommendations accordingly.

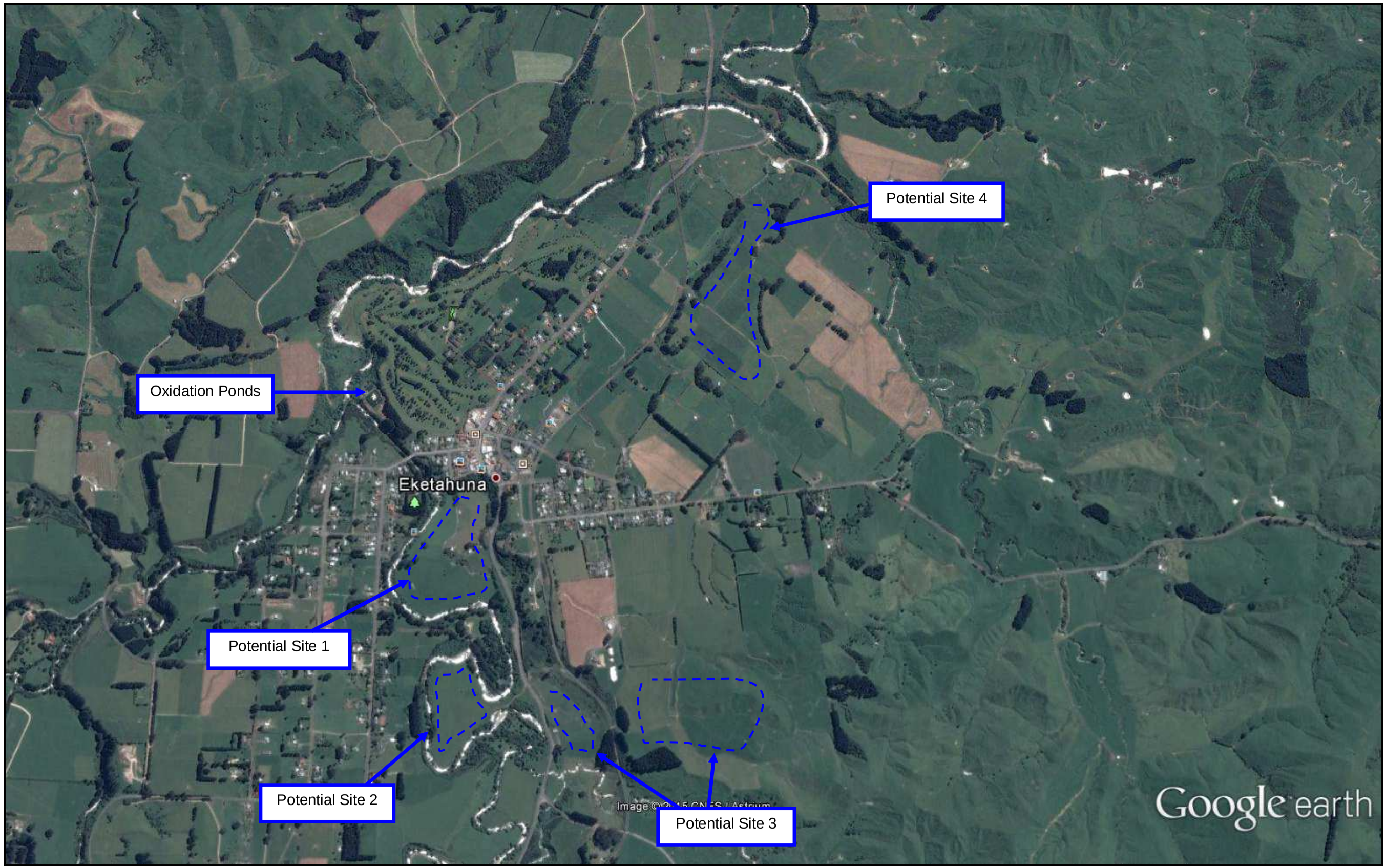
Should any third party wish to use or rely upon the contents of the report, written approval from Wai Waste Environmental Consultants Ltd must be sought. Wai Waste Environmental Consultants Ltd accepts no responsibility or liability for:

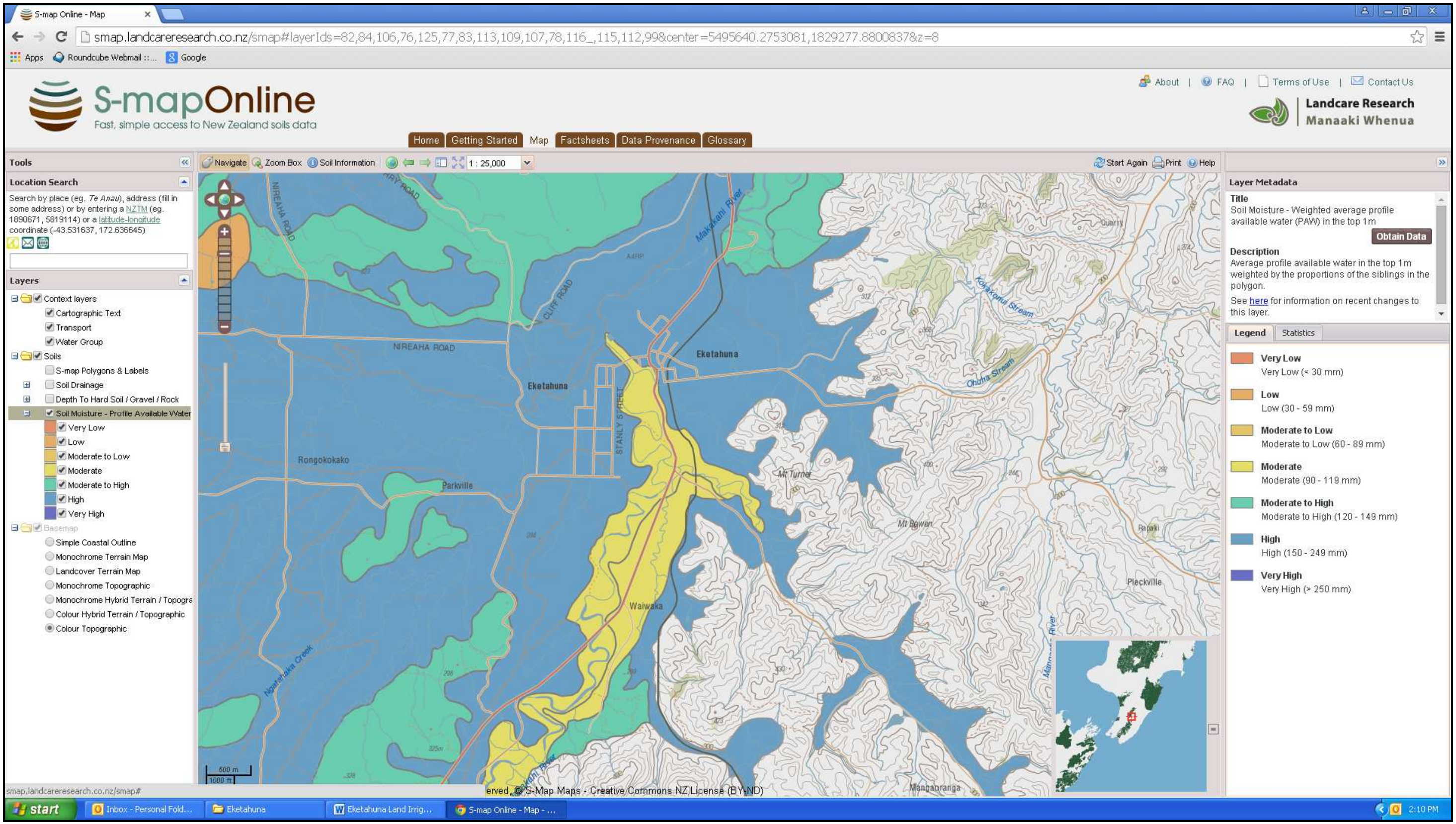
- The consequences of this document being used of purposes other than for which it was commissioned; and
- This report being used by any other party other than the organisation by whom it was commissioned.

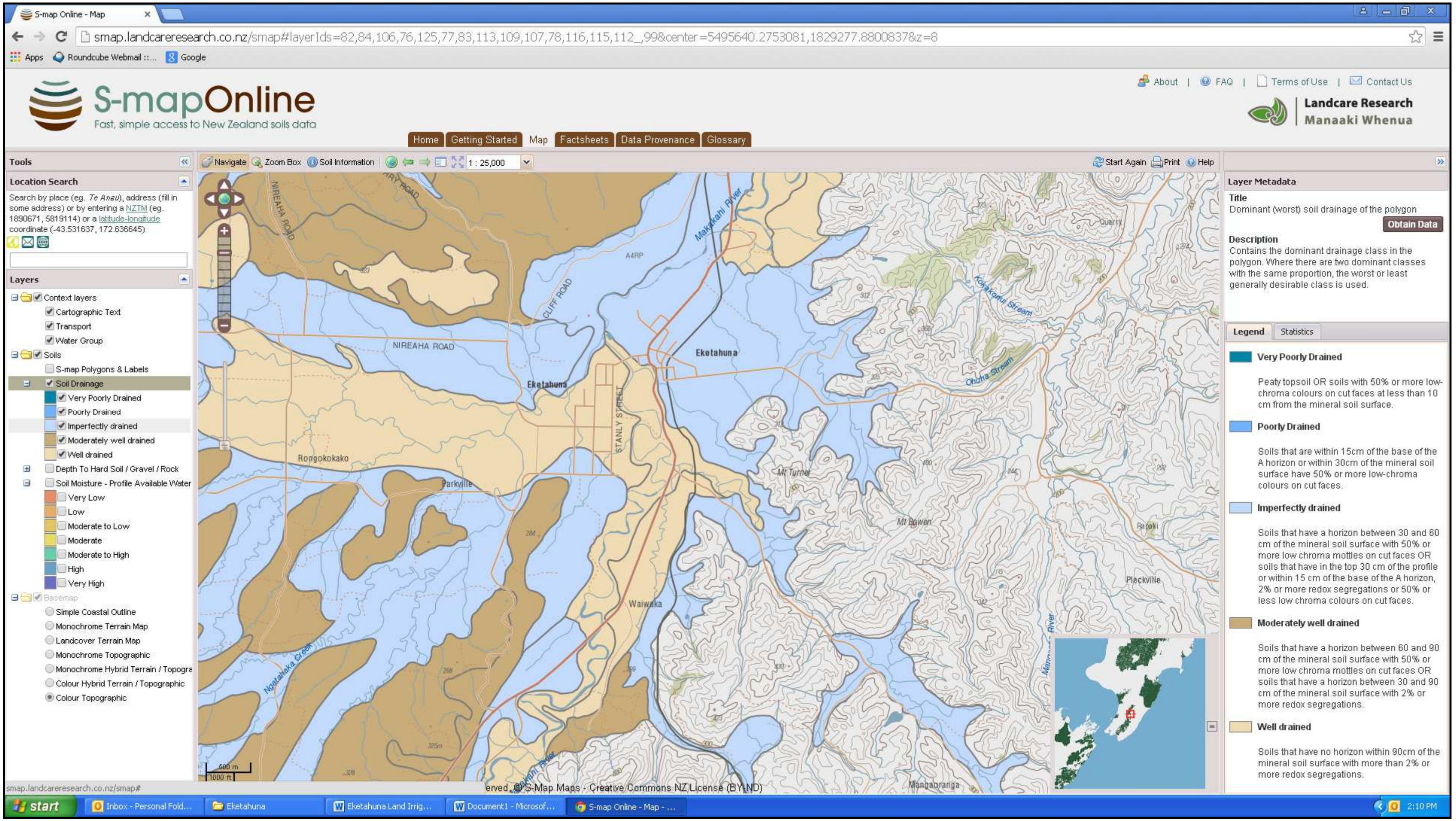
APPENDIX A

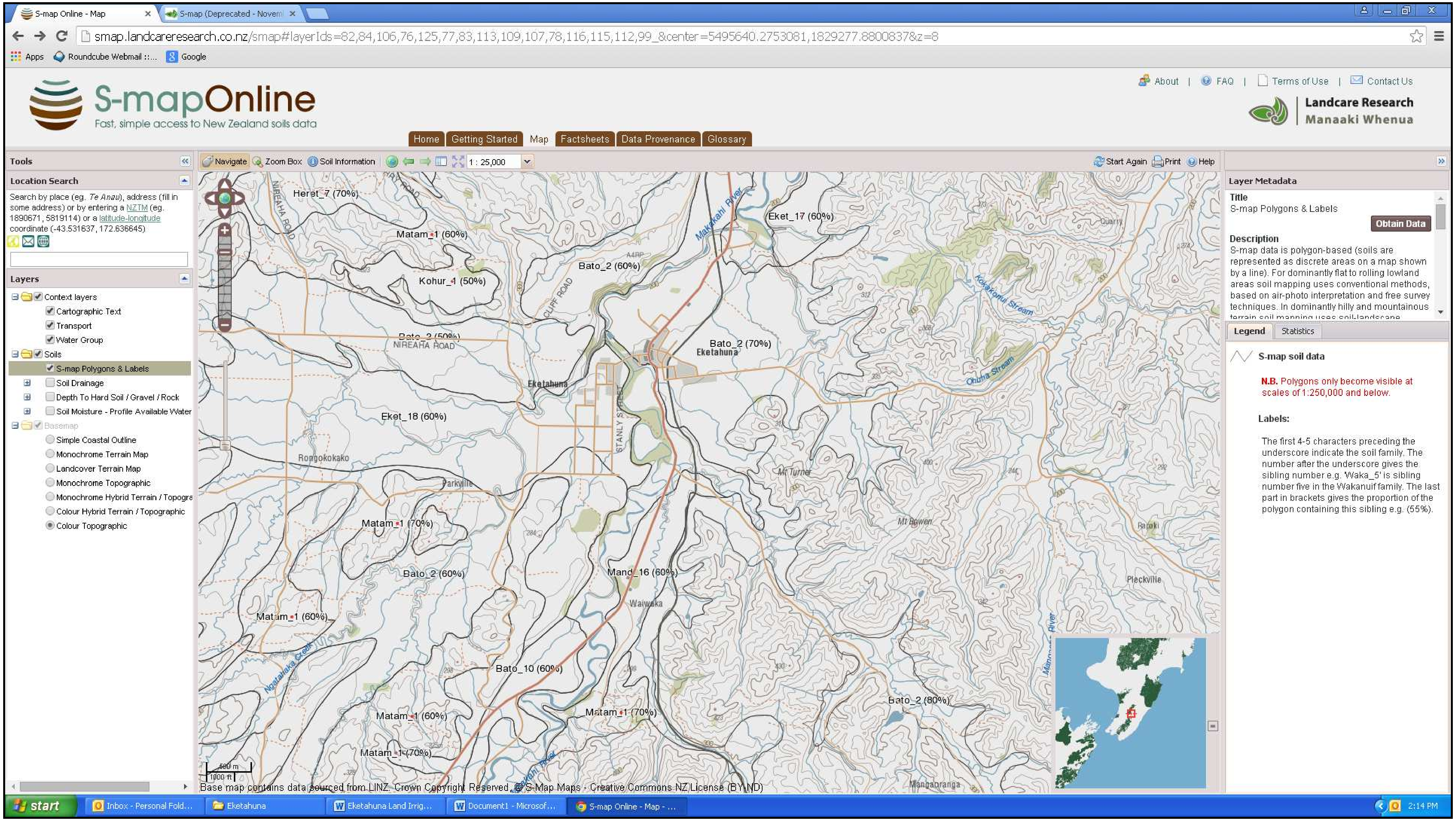
AERIAL PHOTOGRAPH AND

SOIL MAPS


Potential Site 4
Oxidation Ponds
Eketahuna
Potential Site 1
Potential Site 2
Potential Site 3
Google earth


S-map Online - Map
smap.landcareresearch.co.nz/smap#layerIds=82,84,106,76,125,77,83,113,109,107,78,116_,115,112,99&center=5495640.2753081,1829277.8800837&z=8
Apps
Roundcube Webmail ::...
Google
S-mapOnline
Fast, simple access to New Zealand soils data
About | FAQ | Terms of Use | Contact Us
Landcare Research
Manaaki Whenua
Home
Getting Started
Map
Factsheets
Data Provenance
Glossary
Tools
Navigate
Zoom Box
Soil Information
1 : 25,000
Start Again
Print
Help
Location Search
Search by place (eg. Te Anau), address (fill in some address) or by entering a NZTM (eg. 1890671, 5819114) or a latitude-longitude coordinate (-43.531637, 172.636645)
Layers
Context layers
Cartographic Text
Transport
Water Group
Soils
S-map Polygons & Labels
Soil Drainage
Depth To Hard Soil / Gravel / Rock
Soil Moisture - Profile Available Water
Very Low
Low
Moderate to Low
Moderate
Moderate to High
High
Very High
Basemap
Simple Coastal Outline
Monochrome Terrain Map
Landcover Terrain Map
Monochrome Topographic
Monochrome Hybrid Terrain / Topogre
Colour Hybrid Terrain / Topographic
Colour Topographic
NIREAHA ROAD
CLIFF ROAD
Makakahi River
Eketahuna
STANLEY STREET
Rongokokako
Parkville
Waiwaka
Ngahewaka Creek
Mt Turner
Mt Bowen
Ohuka Stream
Pleckville
Mangapranga
Layer Metadata
Title
Soil Moisture - Weighted average profile available water (PAW) in the top 1m
Obtain Data
Description
Average profile available water in the top 1m weighted by the proportions of the siblings in the polygon.
See here for information on recent changes to this layer.
Legend
Statistics
Very Low
Very Low (< 30 mm)
Low
Low (30 - 59 mm)
Moderate to Low
Moderate to Low (60 - 89 mm)
Moderate
Moderate (90 - 119 mm)
Moderate to High
Moderate to High (120 - 149 mm)
High
High (150 - 249 mm)
Very High
Very High (> 250 mm)
500 m
1000 ft
erved. (C) S-Map Maps - Creative Commons NZ License (BY-ND)
smap.landcareresearch.co.nz/smap#
start
Inbox - Personal Fold...
Eketahuna
Eketahuna Land Irrig...
S-map Online - Map - ...
2:10 PM


S-map Online - Map
smap.landcareresearch.co.nz/smap#layerIds=82,84,106,76,125,77,83,113,109,107,78,116,115,112_,99&center=5495640.2753081,1829277.8800837&z=8
Apps
Roundcube Webmail ::...
Google
S-mapOnline
Fast, simple access to New Zealand soils data
About | FAQ | Terms of Use | Contact Us
Landcare Research
Manaaki Whenua
Home
Getting Started
Map
Factsheets
Data Provenance
Glossary
Tools
Location Search
Search by place (eg. Te Anau), address (fill in some address) or by entering a NZTM (eg. 1890671, 5819114) or a latitude-longitude coordinate (-43.531637, 172.636645)
Layers
Context layers
Cartographic Text
Transport
Water Group
Soils
S-map Polygons & Labels
Soil Drainage
Very Poorly Drained
Poorly Drained
Imperfectly drained
Moderately well drained
Well drained
Depth To Hard Soil / Gravel / Rock
Soil Moisture - Profile Available Water
Very Low
Low
Moderate to Low
Moderate
Moderate to High
High
Very High
Basemap
Simple Coastal Outline
Monochrome Terrain Map
Landcover Terrain Map
Monochrome Topographic
Monochrome Hybrid Terrain / Topogre
Colour Hybrid Terrain / Topographic
Colour Topographic
Navigate
Zoom Box
Soil Information
1 : 25,000
Start Again
Print
Help
NIREAHA ROAD
CLIFF ROAD
A4RP
Makarkani River
Kokakonui Stream
Ohuna Stream
Eketahuna
STANLY STREET
Rongokokako
Parkville
Mt Turner
Mt Bowen
Waiwaka
Ngatahaka Creek
Pleckville
Manganranga
500 m
1000 ft
Layer Metadata
Title
Dominant (worst) soil drainage of the polygon
Obtain Data
Description
Contains the dominant drainage class in the polygon. Where there are two dominant classes with the same proportion, the worst or least generally desirable class is used.
Legend
Statistics
Very Poorly Drained
Peaty topsoil OR soils with 50% or more low-chroma colours on cut faces at less than 10 cm from the mineral soil surface.
Poorly Drained
Soils that are within 15cm of the base of the A horizon or within 30cm of the mineral soil surface have 50% or more low-chroma colours on cut faces.
Imperfectly drained
Soils that have a horizon between 30 and 60 cm of the mineral soil surface with 50% or more low chroma mottles on cut faces OR soils that have in the top 30 cm of the profile or within 15 cm of the base of the A horizon, 2% or more redox segregations or 50% or less low chroma colours on cut faces.
Moderately well drained
Soils that have a horizon between 60 and 90 cm of the mineral soil surface with 50% or more low chroma mottles on cut faces OR soils that have a horizon between 30 and 90 cm of the mineral soil surface with 2% or more redox segregations.
Well drained
Soils that have no horizon within 90cm of the mineral soil surface with more than 2% or more redox segregations.
smap.landcareresearch.co.nz/smap#
erved. © S-Map Maps - Creative Commons NZ License (BY,ND)
start
Inbox - Personal Fold...
Eketahuna
Eketahuna Land Irrig...
Document1 - Microsof...
S-map Online - Map - ...
2:10 PM


S-map Online - Map
smap.landcareresearch.co.nz/smap#layerIds=82,84,106,76,125,77,83,113,109,107,78,116,115,112,99_&center=5495640.2753081,1829277.8800837&z=8
S-mapOnline
Fast, simple access to New Zealand soils data
About | FAQ | Terms of Use | Contact Us
Landcare Research
Manaaki Whenua
Home
Getting Started
Map
Factsheets
Data Provenance
Glossary
Tools
Location Search
Search by place (eg. Te Anau), address (fill in some address) or by entering a NZTM (eg. 1890671, 5819114) or a latitude-longitude coordinate (-43.531637, 172.636645)
Layers
Context layers
Cartographic Text
Transport
Water Group
Soils
S-map Polygons & Labels
Soil Drainage
Depth To Hard Soil / Gravel / Rock
Soil Moisture - Profile Available Water
Basemap
Simple Coastal Outline
Monochrome Terrain Map
Landcover Terrain Map
Monochrome Topographic
Colour Hybrid Terrain / Topographic
Colour Topographic
Navigate
Zoom Box
Soil Information
1 : 25,000
Start Again
Print
Help
Heret_7 (70%)
Matam_1 (60%)
Kohur_1 (50%)
Bato_2 (60%)
Eket_17 (60%)
Bato_2 (70%)
Eketahuna
Eket_18 (60%)
Matam_1 (70%)
Bato_2 (60%)
Mand_16 (60%)
Matam_1 (60%)
Bato_10 (60%)
Matam_1 (60%)
Matam_1 (70%)
Matam_1 (70%)
Bato_2 (80%)
Makakahi River
Kokakonui Stream
Ohuha Stream
NIREAHA ROAD
CLIFF ROAD
STANLY STREET
Rongokokako
Parkville
Waiwaka
Mt Turner
Mt Bowen
Pleckville
Ngatahaka Creek
Mangaoranga
500 m
1000 ft
Base map contains data sourced from LINZ. Crown Copyright Reserved. @ S-Map Maps - Creative Commons NZ License (BY-ND)
Layer Metadata
Title
S-map Polygons & Labels
Obtain Data
Description
S-map data is polygon-based (soils are represented as discrete areas on a map shown by a line). For dominantly flat to rolling lowland areas soil mapping uses conventional methods, based on air-photo interpretation and free survey techniques. In dominantly hilly and mountainous
Legend
Statistics
S-map soil data
N.B. Polygons only become visible at scales of 1:250,000 and below.
Labels:
The first 4-5 characters preceding the underscore indicate the soil family. The number after the underscore gives the sibling number e.g. 'Waka_5' is sibling number five in the Wakanui family. The last part in brackets gives the proportion of the polygon containing this sibling e.g. (55%).
start
2:14 PM

APPENDIX B

EFFLUENT QUALITY DATA

SiteName	Date	E. coli by MPN (HRC)	Total Coliforms (HRC)	TSS (HRC)	Turbidity EPA (HRC)	Volatile Matter (HRC)	SSC (HRC)	Ammoniacal-N (HRC)	TN (HRC)	TON (HRC)	Nitrate (HRC)	Nitrite (HRC)	DRP (HRC)	TP (HRC)	Sample ID
Eketahuna STP at Secondary oxpond waste	17-01-12 11:20	18	920	44	11.2	43	52	0.12	2.8	0.26	0.24	0.019	0.19	0.49	20120130
Eketahuna STP at Secondary oxpond waste	14-02-12 11:10	230	160000	50	16	44	47	4.4	7.7	0.12	0.091	0.033	0.8	1.4	20120453
Eketahuna STP at Secondary oxpond waste	06-03-12 11:30	160	1000	10	4.65	10	12	1.2	3.6	0.99	0.96	0.036	0.072	0.26	20120735
Eketahuna STP at Secondary oxpond waste	17-04-12 11:50	52	73000	15	6.95	12	17	5.2	7.4	0.28	0.24	0.038	0.76	1.1	20121406
Eketahuna STP at Secondary oxpond waste	08-05-12 12:15	2800	24000	38	14.5	38	38	8.3	10	0.16	0.14	0.02	1	1.4	20121615
Eketahuna STP at Secondary oxpond waste	12-06-12 10:55	1700	5900	11	5.56	11	8.5	3.9	5.1	0.52	0.48	0.038	0.34	0.55	20121904
Eketahuna STP at Secondary oxpond waste	10-07-12 11:50	55	2300	8.2	3.1	7.4	8.5	2.4	4.7	0.72	0.66	0.067	0.2	0.32	20122337
Eketahuna STP at Secondary oxpond waste	14-08-12 12:30	480	5700	14	18	14	6	2.1	4.4	1	0.97	0.058	0.24	0.42	20122881
Eketahuna STP at Secondary oxpond waste	11-09-12 12:15	663		10	4.39	7	8	0.326	4.036	1.869	1.8265	0.0425	0.061	0.223	20123170