EXPERT JOINT WITNESS STATEMENT (JWS)

Case: Application for resource consent to discharge contaminants to land, air and water associated with the proposed long-term upgrade and operation of the Featherston Wastewater Treatment Plant - *Before Commissioners for Wellington Regional Council GWRC WAR 170229 At Featherston*

Topic: Groundwater and related Wastewater and Land Treatment Expert Caucusing

Date: 18 December 2018 = date of caucusing. Amendments have been included and agreed up to the date of signing (see page 2).

Venue:
Pattle Delamore Partners Limited Offices
Level 5, 235 Broadway
Newmarket, Auckland, 1149

Witnesses Present:

Name	For
Robert Docherty	Pattle Delamore Partners Limited for Greater Wellington Regional Council
Aslan Perwick	Pattle Delamore Partners Limited for Greater Wellington Regional Council
Daryl Irvine	Pattle Delamore Partners Limited for Greater Wellington Regional Council
Jack Feltham	Pattle Delamore Partners Limited for Greater Wellington Regional Council
Katie Beecroft	Lowe Environment Impact for South Wairarapa District Council
Chris Simpson	GWS Limited for South Wairarapa District Council

Environment Court Practice Note:

It is confirmed that all present:

- Have read the Environment Court Practice Note 2014 Code of Conduct and agree to abide by it.

  And in particular

- Have read the Environment Court Practice Note 2014 in respect of Appendix 3 – Protocol For Expert Witness Conferencing and agree to abide by it.

Joint Witness Statement:

Expert Brief: - Expert brief questions as circulated 5 September 2018 from GWRC and SWDC counsel.

> ***Note:*** *That these questions were prepared prior to additional groundwater assessment work as outlined in GWS Ltd 14 December 2018 report (see below) however, these questions were utilised as the base for the Joint Witness Statement.*

Materials relied on – All experts have read the Consent Application documents including Section 92 documents (excluding Daryl Irvine who has not yet read Consent Application documents). Other material includes:

a) GWS Ltd 14 December 2018 document "Further Evaluation of Groundwater Effects Associated with the Land Application of Wastewater at Featherston" [attached]

__Note:__ that this document outlines assessment of average irrigation year mounding. No assessment of wet year scenarios or assessment of higher flows as a result of less effective I&I scenarios have yet been assessed. No Appendix B (modelling report) or any field investigation reports (for Nov, Dec 2018 LEI field work) available at the time of caucusing.

b) Meeting minutes of 25 September 2018 Pre Conferencing Discussions technical discussions between Robert Docherty, Aslan Perwick, Jack Feltham, Chris Simpson, and Katie Beecroft.

Signed:

Witness	Signature	Date
Chris Simpson		20/12/18
Katie Beecroft		20/12/2018
Jack Feltham		20/12/2018
Daryl Irvine		20/12/2018
Aslan Perwick		20/12/2018
Rob Docherty		20/12/2018

Item No.	Item	Statement of Agreed Position	Statement of Position Not Agreed	Comments
1	What are the potential risks associated with groundwater mounding? (from the irrigation activity) *[Expert brief item a)]*	- Excess mounding occurs resulting in less land discharge capacity than currently assessed for the scheme. - Excess mounding occurs resulting in ponding and/or runoff. - Excess mounding occurs reducing available soil depth for pasture root penetration which will reduce nitrogen uptake and water removal by plants, and be contrary to the Overseer modelling results reported in the AEE - Excess mounding occurs potentially causing increased mechanical/stock damage to soil due to wet soil conditions. - Excess mounding occurs causing increased discharge of groundwater to surface water (with adverse effects).		These groundwater mounding risks can potentially occur on and off site. Note: For the purposes of this JWS groundwater mounding is defined as any increase of the natural groundwater level. This includes the antecedent effect of summer irrigation drainage on winter groundwater levels. Note: Groundwater mounding as referred to throughout this JWS refers to mounding as a result of the proposed irrigation activity.

2	What is an acceptable (in terms of risk and nature of effect) magnitude, (i.e. water level relative to ground level), duration, and frequency of groundwater mounding both on and off the proposed land application site? *[Expert brief item b)]*	- Groundwater mounding that results in Vadose zone thickness reduction to less than 0.6m is considered unacceptable under any conditions [Onsite].		- Acceptable offsite groundwater mounding effects have yet to be considering following further modelling and uncertainty analysis by the Applicant.
3	Over what land area might this mounding occur and how does it alter over different inflow, irrigation and climatic scenarios? *[Expert brief item c)]*		- This has yet to be received from the Applicant so cannot yet be agreed upon. - Awaiting further information/assessment from the Applicant, including modelling report, assessment of wet year scenario, and assessment of lower I&I reduction scenario [see Item 6].	
4	What is the likelihood of unacceptable mounding at Stage 1B, 2A and 2B. *[Expert brief item d)]*		- This has yet to be reviewed and agreed upon. - Awaiting further information/assessment, including modelling report and assessment of wet year scenario, assessment of lower I&I reduction scenario, and consideration of Stage 1B (prior to I&I reduction) mounding.	

			[see Item 6]	
5	Is the level of certainty with respect to potentially unacceptable mounding at each stage adequate and acceptable to allow an assessment of effects? *[Expert brief item e)]*		Insufficient data presented to date to enable PDP to assess effects due to mounding.. [See Item 4 statement]	
6	What additional information is required to address residual uncertainty to an acceptable level, and is it that information obtainable? *[Expert brief item f)]*	- Field investigation summary document (from Nov-Dec 2018 works) [LEI] is required to support the hydrogeological assumptions adopted for the modelling work particularly the thickness of gravel geology, presence/absence of finer grained soil layers, and overall groundwater level and flow conditions. - Groundwater Modelling Technical Report "Appendix B" to GWS 14 December 2018 document "Further Evaluation of Groundwater Effects Associated with the Land Application of Wastewater at Featherston" [GWS] is	Sensitivity analysis is required based on a less effective I&I reduction scenario occurring (below the currently assessed 35% flow reduction due to I&I remediation works). This has yet to be agreed on.	

		required so that sufficient technical information on how the model has been set-up and used for mounding predictions can be reviewed. - Mounding, storage volume and surface water discharge assessment for Wet Year scenario and lower I&I reduction scenario [LEI & GWS].		
7	To what extent can the potential for unacceptable mounding be addressed by discharge management via a management plan or other adaptive management techniques? *[Expert brief item g)]*	Agree that there are management options available to mitigate/manage potential groundwater mounding effects. However, the potential effectiveness of management options cannot be assessed at this stage. Outcomes of Items 6 required. [See Item 6]	- Groundwater mounding effects yet to be reviewed and agreed upon. - PDP requires further information/assessment to enable agreement on the ability to address the potential for mounding through management. This includes the modelling report and assessment of wet year scenario, assessment of lower I&I reduction scenario, and consideration of Stage 1b (prior to I&I reduction) mounding. [see Item 6]	

8	What effect would the management of discharge to land, to avoid unacceptable discharge effects (i.e. mounding), have on the direct discharge to surface water and/or dam storage i.e. would it result in an increase (as compared to what is proposed at these stages) to direct discharge to the stream (increased rates, volumes or loads) with particular attention to times of below median flow, and/or the required storage volumes? *[Expert brief item h)]*	It could lead to increased storage volume being required or increased volumes being discharged to stream, or higher loading to selected land areas.	- Groundwater mounding effects yet to be reviewed and agreed upon. - Awaiting further information/assessment, including modelling report and assessment of wet year scenario, assessment of lower I&I reduction scenario, and consideration of Stage 1b (prior to I&I reduction) mounding. [see Item 6]	

9	What is an acceptable risk with respect to maximum pathogen magnitude and migration from the proposed discharge. This should include (but not be limited to) development of a suitable 'envelope of effects' with regard to potential pathogen migration and associated mitigation/management measures. *[Expert brief item i)]*	- Adoption of Norovirus as on indicator pathogen. - Adoption of a 5-year average groundwater travel time to provide an envelope of effects; agreed to be appropriate and conservative (for groundwater pathway). - Agree that risk assessment for pathogen risk will be required by ESR (or similar) for all identified receptors within the envelope of effects.	Awaiting further information from letter drop to the property neighbours as well as information outlined in Item 6 (for final 5-year travel time envelope of effects to be reviewed and agreed).	Pathogen risks to surface water or associated surface water users/receptors is to be covered by other experts.

10	What level of assessment is required to provide a sufficient degree of certainty regarding the presence, location, vulnerability, and overall risk to relevant human and environmental receptors? This should include (but not be limited to) the potential presence of water supplies e.g. boreholes on neighbouring properties that are not recorded in the GWRC borehole database; but are still being utilised for Permitted Activity take purposes and in particular domestic supply. *[Expert brief item j)]*	[See Item 9 statements]	[See Item 9 statements]	
11	Is there further information that is required? *[Expert brief item k)]*	[See Item 9]	[See Item 9]	

12	What amount of subsurface hydrogeological investigation has been undertaken to assess and characterise the groundwater and soil conditions and how do these vary across the site on a seasonal basis? *[Expert brief item l)]*		- Field investigations conducted in November and December 2018 include characterisation of the unsaturated/near surface soil conditions and groundwater depth. This has yet to be circulated by Applicant for review. Approximate locations of depth to groundwater measurements are provided in the attached groundwater evaluation report. - Awaiting further information/assessment from the Applicant, including modelling report and assessment of wet year scenario, assessment of lower I&I reduction scenario, and consideration of Stage 1b (prior to I&I reduction) mounding. [see Item 6]	
13	To the extent that there are any information gaps or uncertainties, can these be addressed via monitoring and adaptive management? *[Expert brief item m)]*		- This has yet to be reviewed and agreed upon. - Awaiting further information/assessment, including modelling report and assessment of wet year scenario, assessment of lower I&I reduction scenario, and consideration of Stage 1b (prior	

			to I&I reduction) mounding. [see Item 6]	

14th December 2018

South Wairarapa District Council
PO Box 6
Martinborough 5741

Attention: Lawrence Stephenson

Subject: Further Evaluation of Groundwater Effects Associated with the Land Application of Wastewater at Featherston

1. Background

Following from the technical discussion held between PDP, LEI and GWS undertaken on the 25th September 2018, it was agreed that further information would be obtained for the project to assist in satisfying the GWRC that the resultant environmental effects would be acceptable. More specifically, a higher resolution of-site characterisation has been requested with respect to the site topography and depth to groundwater; confirmation of aquifer permeability; and groundwater level seasonal fluctuations. In addition to the site characterisation, further assessment of the pathogen loading in the wastewater and potential risks to human health after land disposal was requested. This letter report presents this information and provides the preliminary results of further assessment.

We note that at the time of preparing this document, some further information is yet to be gathered and processed as part of this assessment. This assessment is, therefore, subject to change arising from additional information, discussions with PDP and there may potentially be further changes responding to any points raised in the s42A report.

2. Additional Information

2.1 Site Topography

In October 2018 Wairarapa Aerial Imaging Ltd commenced a drone survey of the land application areas obtaining high resolution contours at 10 cm intervals and aerial images. The raw survey data of the area is shown in Figure 1 of the attachments. The site survey data was then reduced to eliminate background noise from trees, buildings and other features as shown in Figure 2.

2.2 Site Investigations

Further site investigations were undertaken by LEI on the 7th November and 13th to 14th December with the objective of validating the depth to the water table. In addition to the site-specific investigations, the depth to groundwater from surrounding wells was incorporated into the data set. Figure 4 of the attached shows the depth to groundwater at all of the points in the data set used to date. These data were then used to develop an interpolated water table elevation map of the area which is provided in Figure 4. Within the boundaries of the site, the

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 576 0093
Email: GWS@xtra.co.nz
Web Page: www.gwsconsulting.co.nz

water table elevation map represents the approximate seasonal high water table given the measurements were made in November and December. Further monitoring at piezometers within the site will continue over the summer season to capture the seasonal trends and validate the assumption that seasonal variation is in the order of 1 m.

2.3 Vadose Zone Thickness

The depth to the water table, also known as the vadose zone, has been calculated by subtraction of the topographic elevation surface (Figure 2) from the water table elevation surface (Figure 4). A preliminary interpretation of the vadose zone thickness is provided in Figure 5 of the attachments. In summary, these data show a thickening of the vadose zone to the north, east and west as the land surface increases in elevation. The thickness of the vadose zone ranges from approximately 2 m to 4 m in these parts of the site. Within the central part of the site, the vadose zone thickness is indicated to reduce to <2 m and on average is indicated to be approximately 1.2 to 1.5 m thick. At the southern end of the site the thickness is indicated to reduces to <1 m and adjacent to Abbots Creek and the Otauira Stream is indicated to be <0.6 m in thickness. As shown in Figure 6 these areas correlate to observed areas where near-saturated conditions are observed in topographic low points.

This distribution of vadose zone thickness is consistent with that assumed during earlier phases of evaluation. As noted above, the vadose zone thickness represents the approximate minimum thickness following winter conditions and a great thickness can be expected under summer conditions.

2.4 Aquifer Permeability

During site investigations rising head testing was attempted at two of the existing monitoring wells near the wastewater treatment plant, however the capacity of the pump was insufficient to lower the water level enough to create a measurable response. This is, in part due to the highly permeability nature of the gravels. Further site specific testing is proposed to be undertaken to verify the aquifer permeability value, however based on the field observations from test pits and well testing, the permeability value of $1x10^{-4}$ m/s used in this assessment is still considered reasonable given the highly gravelly nature of the soils in the unsaturated zone and in the aquifer.

2.5 Bore Security Evaluation

A mail drop was made by SWDC to properties within an envelope ranging from 1 km to 2 km from at land disposal area seeking confirmation of the number of bores and construction details from which groundwater is taken. The envelope is based on the distance Norovirus can travel in groundwater and still be viable (potentially infectious), which is stated to be 5 years (Seitz et. al, 2011). The effects assessment that follows defines the extent of the 5 year envelope. The purpose of the mail drop was to identify any bores in use that are not recoded in the GWRC database.

For the purpose of this project, any water bores identified within the risk envelope that are <30 m depth (i.e. in the unconfined aquifer) are deemed insecure and the water cannot be used for

4 Katote Close, The Gardens
Manurewa
Auckland 2105
Phone: 09 576 0093
Email: GWS@xtra.co.nz
Web Page: www.gwsconsulting.co.nz

potable purposes in the future. We note that under the MoH definition (MoH, 2000), bores in unconfined aquifers are deemed insecure in any case and those that are in gravel aquifers with shallow soils are particularly susceptible to potential pathogen contamination.

2.6 Characterisation of Influent and Effluent Pathogen Loading

This is presently in progress and will provide input to the viral risk assessment to follow by ESR.

3. Effects Assessment

3.1 Potential Risks

The potential risks to groundwater associated with the land application of wastewater are as follows:

- Excess mounding occurs resulting in less land discharge capacity accounted for by the scheme.
- Excess mounding occurs resulting in ponding and runoff into surface waters.
- Groundwater impacted by viable pathogens is ingested from bore water used for domestic supply.
- Groundwater with viable pathogens discharges to surface waters creating a recreational contact risk.

In order to evaluate these potential risks, a numerical groundwater model was constructed in Modflow (v 4.6). This model is an advancement on that previous used and incorporates the new surface topography data; the interpolated water table map based on field measurements within and surrounding the site; and site specific permeability values obtained though field testing of the piezometers. The Attachment B Modelling Report provides further details. Overall, the model is considered to be more realistic and has a greater level of certainty than the first version.

3.2 Excess Mounding

The groundwater model was run under the proposed irrigation scheme and areas where <0.6 m vadose zone can be identified as shown in Figure 7. The modelled affected areas are coincident with those areas where the vadose zone thins adjacent to Abbots Creek and the Otauira Stream. The model results show these areas are relatively small, however it means that these areas could not be irrigated at the proposed rate throughout the entire season as runoff to surface waters could occur. Proposed conditions of the consent are designed to prevent ponding and surface run off occurring.

The proposed means of mitigating the loss of disposal capacity would be to reduce the rate and or duration of irrigation at this location. Any disposal capacity lost could be regained by increasing the rate of application in areas where greater vadose zone thickness is present. Alternatively, additional capacity could be gained if additional land becomes available. In doing this, the risk associated with ponding and surface water runoff is also managed.

4 Katote Close, The Gardens
Manurewa
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3.3 Pathogens in Groundwater

While the effluent will be treated to a high standard prior to land application, there is a residual risk that viable viruses could travel in groundwater beyond the site boundaries. Further, where water bores exist in close proximity to the site boundaries, flow paths can be captured while the bores are pumping and, where used for drinking purposes, potentially viable viruses could be ingested. Norovirus, in particular, is considered to be a conservative tracer virus as it can potentially survive in groundwater for up to 5 years and is highly infectious.

The Modflow model was used to assess the likely limits that groundwater could travel in a 5-year period. The model scenario included wastewater application at the proposed rate and simulated the bores being pumped at the same time. Figure 8 provides a model output showing this extent. This information shows that on the Hodder Farm southern block, groundwater would largely be intercepted by Donald's Creek as shallow flow paths and the extent of travel is limited.

This observation is qualified by the interpretation that this does not necessarily mean there is no risk to shallow bores south of Donald's Creek as deep flow paths could still exist under pumped conditions. Further, it is possible the shallow bore in close proximity to Donald's Creek may result in infiltration of surface water which, in theory, could contain viable pathogens. For these reasons, groundwater from bore S27/0019 could potentially be impacted by treated wastewater.

Bore S27/0010 is an irrigation bore and according to GWRC records takes water from an artesian aquifer (i.e. confined aquifer) and is somewhat protected from shallow groundwater in the unconfined aquifer system. We would, however, comment that the degree of protection that exists is largely determined by the quality of the bore construction which is not known. For this reason, it is possible that groundwater from bore S27/0010 could be impacted by treated wastewater although this is considered a low possibility.

As shown in Figure 8, the Hodder Farm central and northern blocks show that bores S27/0840, S27/0812, S27/0023, S27/0026, S27/0027 and S27/0063 are at the periphery of the 5 year travel envelope and could, therefore, potentially be impacted by wastewater.

Given this assessment indicates a level of risk to these bores, some kind of monitoring and/or mitigation is required. This could take the form of a moratorium on potable use of groundwater, requiring an another supply to be sourced for domestic use. Alternatively, treatment of groundwater to achieve a potable standard at the point of use could be considered. Given that most of the affected bores are on the outer periphery of the 5 year travel envelope and that the actual risk of the water supply being impacted is very low, monitoring of the groundwater water quality could also be considered at the site boundary and at the points of use. As groundwater moves very slowly, any potential changes in water quality could be identified prior to it impacting the water supplies.

While previous work has indicated removal of most pathogens would occur prior to groundwater discharging, the adoption of Norovirus as a tracer means there is a potential risk

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 576 0093
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that this virus could travel through short flow paths, entering surface waters. This risk is addressed by other experts, however, we would comment that this risk could be monitored within the effluent stream prior to land application and in groundwater at the disposal field boundary. This approach would assist in identify if a Norovirus outbreak had occurred and, given the slow travel times (<2 m/d) in groundwater through the 20 m buffer zone, would provide advance warning of potential risks through recreational contact with surface waters.

4. Other Matters Raised

We note that there are three matters raised in the meeting notes of 25th September that have yet to be addressed. These are the “wet year scenario” results, the implications of the groundwater assessment on other assessments and further discussion on the implications to an adaptive management approach. These have yet to be undertaken due to time constraints and it is proposed that these items will be advanced over the coming months.

5. Conclusions

Overall, this assessment has validated the results of previous work undertaken. The focus of this work has been to understand the magnitude of groundwater mounding that might occur, relative to the depth of vadose zone that is available over different parts of the site. In this regard, there are small localised areas in the southern block of Hodder Farm where vadose zone depth is limiting to irrigation at the proposed rate and frequency and this could be remedied with adaptive management through balancing application rates, frequency or land areas in other parts of the scheme.

Given groundwater mounding will be kept below the land surface, there is no risk of run-off occurring from the land treatment areas, and this is further managed through consent conditions that prevent ponding and runoff from occurring.

Adopting Norovirus as a pathogen tracer results in a 5 year travel envelope in groundwater. As a consequence, there are a number of shallow water bores that are potentially exposed to viral risk if the water is used for potable purposes. Monitoring and or mitigation of this risk is, therefore, required and a number of options are available in this regard as discussed previously.

Similarly, with Norovirus as a tracer, it may be possible for viable viruses to enter surface waters. The potential risks associated with this are discussed by others and we consider this risk could be managed through monitoring of water quality.

We note that in review of the submissions received in relation to groundwater effects, public concerns over vadose zone depth (high water table) and effects to groundwater quality were raised. In our opinion, we consider these concerns to have been adequately address through the works that has been undertaken to date. Further work is proposed to be undertaken to satisfy any residual concerns, validate assumptions and develop proposals to monitor or mitigate effects as part of the consent conditions.

4 Katote Close, The Gardens
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Web Page: www.gwsconsulting.co.nz

6. Recommendations

This assessment identifies the following recommendations:

- Confirm that the scheme can provide the additional disposal capacity required by adaptive management to compensate for those areas of limited vadose zone depth.
- Following receipt of the bore survey, review potentially effects groundwater users and develop a proposal for monitoring or mitigation of the potential effects.
- Undertake a risk assessment of the potential for Norovirus effects to recreational water use and, if deemed necessary, develop a proposal for monitoring of water quality and risk management.

7. Closure

Should you have any further questions please contact the undersigned.

Chris RJ Simpson
B.Sc, M.Sc, CEnvP

Director - Hydrogeologist

For and on behalf of GWS Limited

List of Attachments

Attachment A   Figures
Attachment B   Modelling Report (This report is not appended and is pending further information inputs, model scenario runs and uncertainty analysis).

4 Katote Close, The Gardens
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Auckland 2105

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Web Page: www.gwsconsulting.co.nz

Figure 1 Raw Drone Survey Showing 30 cm Contours

Figure 2 Processed Survey Data 50 cm Contours

Figure 3 Depth to Water Table Data (meters)

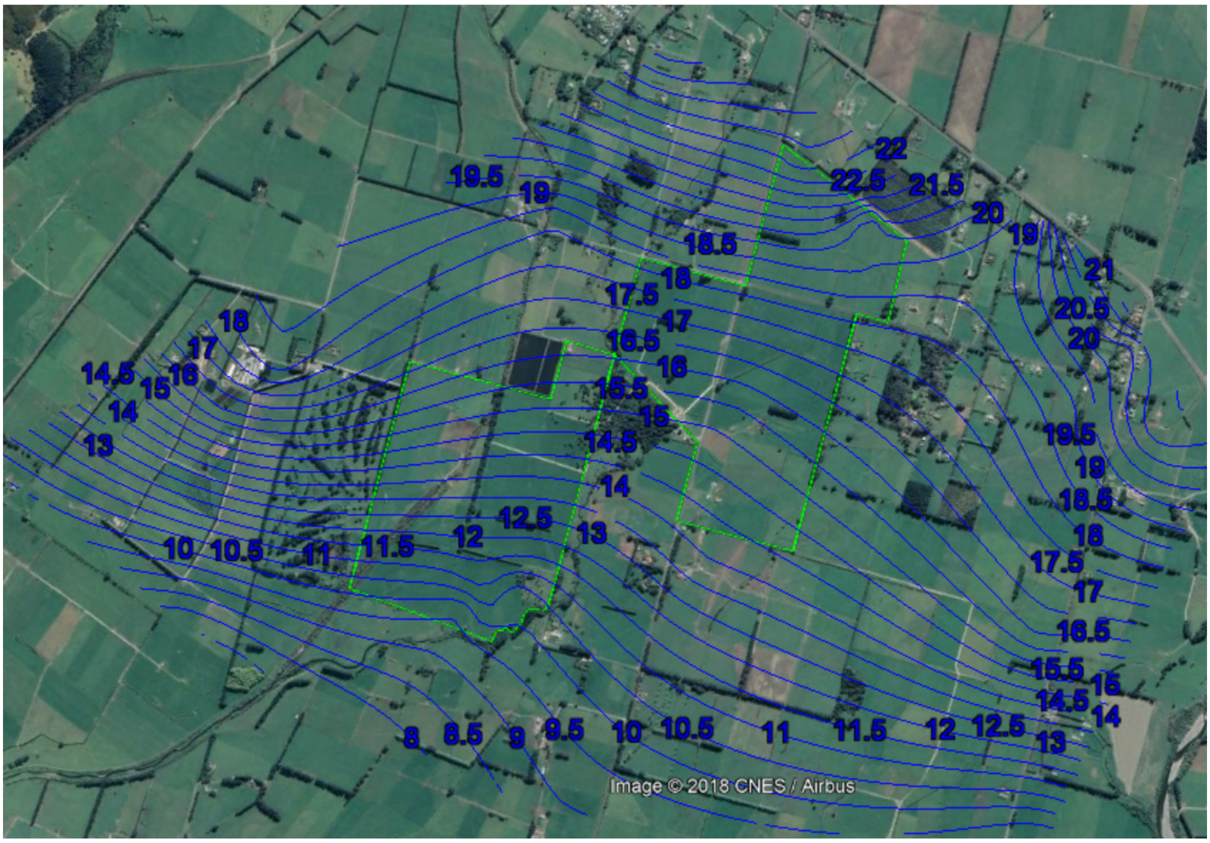

Figure 4 Interpolated Water Table Elevation Surface

Figure 5 Vadose Zone Thickness Map (meters)

Figure 6 Plan of Surface Water Flow Paths

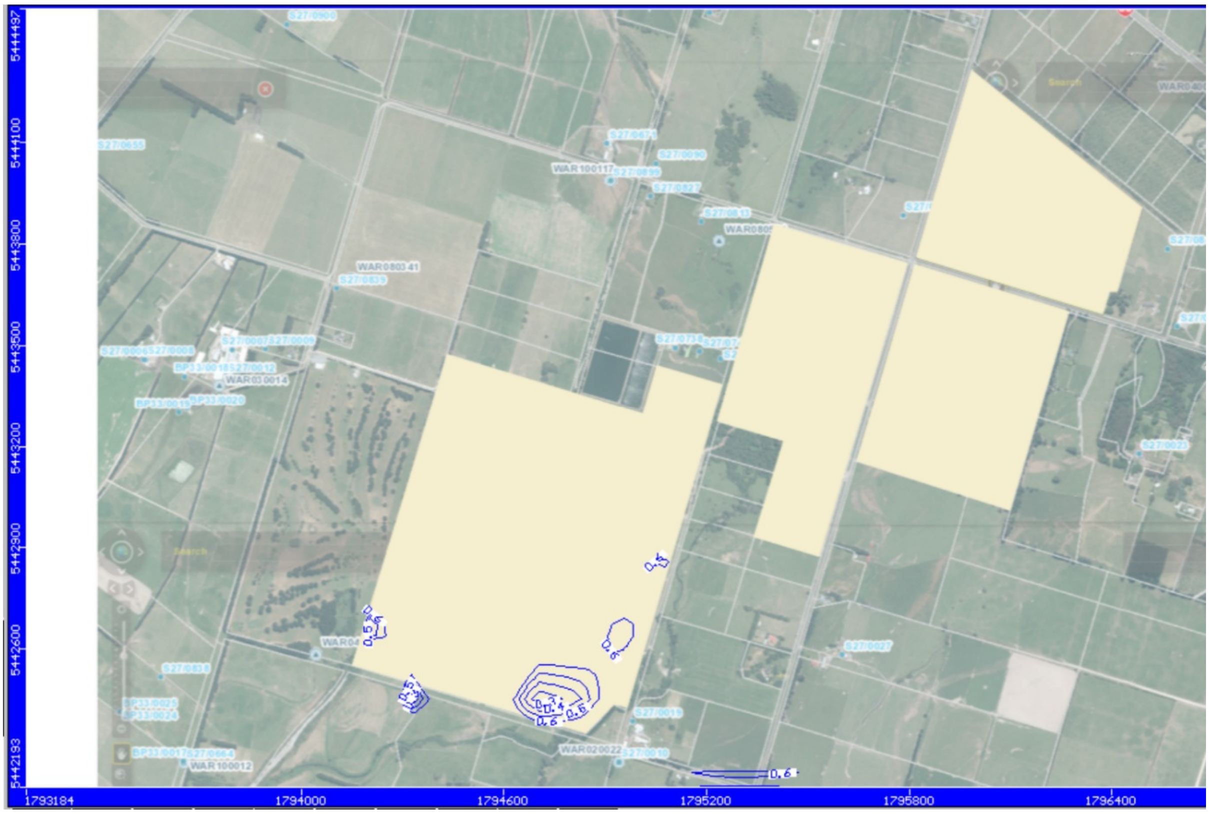

Figure 7 Depth to Water table showing Areas with <0.6 m Vadose Zone Thickness

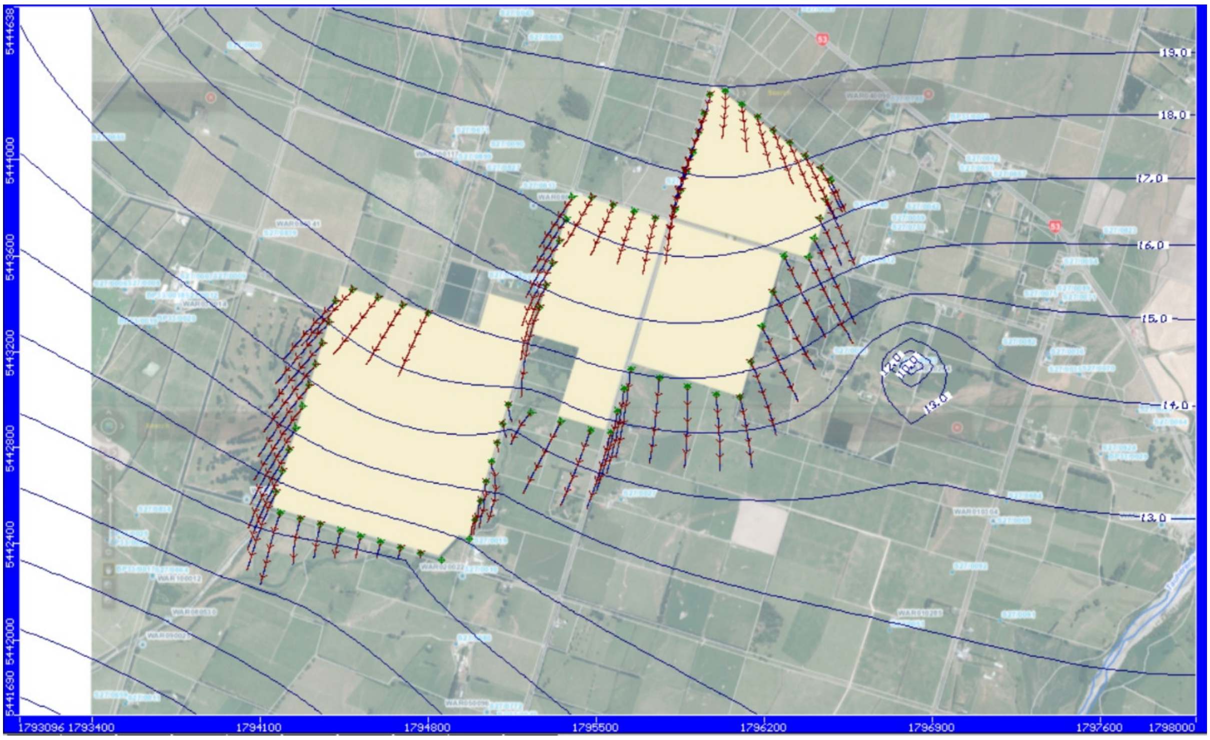

Figure 8 Flow Path Lines Showing Extent of Travel in 5 Years