# Before the Independent Commissioners of the Northland Regional Council (NRC)

In the Matter of	the Resource Management Act 1991
And	
In the Matter of	applications by members of the Aupōuri Aquifer Water Users Group for new groundwater takes from the Aupōuri Aquifer subzones: Other, Waihopo, Houhora, Motutangi, Waiparera, Paparore, Sweetwater.

Statement of Supplementary Evidence of

#### Jon Williamson

for the Aupōuri Aquifer Water Permit Applicants

Dated: 31 August 2020

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# 1. Introduction

- 1. This document comprises brief supplementary evidence responding to Evidence in Chief submitted by:
  - (a) Mr. Kenneth Alexander on behalf of the Ministry of Education; and
  - (b) Mr James Blyth, Mr David West and Mr Tim Baker on behalf of the Department of Conservation.

## 2. Ministry Of Education

- 2. As outlined in Mr Alexander's evidence paragraph 3.3, the Ministry of Education (MoE) operate seven schools in the Aupōuri Aquifer area that rely on groundwater as their main source of potable water, including:
  - (a) Ngataki School;
  - (b) Pukenui School;
  - (c) Waiharara School;
  - (d) Paparore School;
  - (e) Awanui School;
  - (f) Pukepoto School; and
  - (g) Ahipara School.
- 3. Of these seven schools only two bores (Waiharara and Ngataki Schools) are registered within the Northland Regional Council's (NRC) bore database, although it is possible the remaining five bores may have been registered during the submissions process and hence subsequent to WWLA last accessing the database during the resource consent application process.
- 4. I concur with Mr Alexander's statements in paragraph 4.1 and 6.1 of his Evidence which states:

"Management of groundwater resources should take into account that, although individual consents pumping from deeper aquifers may cause very small changes in the level of the water table in shallow aquifers, over time those deeper abstractions can eventually affect the water table level and change recharge or discharge components of the system, such as stream and spring flows. The magnitude and location of these changes is dependent on the location of the groundwater takes, their depth, and the hydrogeological properties of the system."

The analysis my team has undertaken with the Aupouri Aquifer Groundwater Model was designed to analyse and report on precisely the items Mr Alexander mentioned above.

5. Mr Alexander focuses his review on evaluating whether the proposed conditions and groundwater monitoring plans in the NRC Staff Report meet the conditions requested by the

Ministry in November 2019 to help safeguard the quantity and quality of the water supply for the seven rural schools (paragraph 3.3).

- 6. Mr Alexander's analysis concludes that amendments to the relevant Groundwater Monitoring and Contingency Plans (GMCP) are required for Ngataki School, Waiharara School and Ahipara School, hence my comments will focus on these recommendations.
- 7. Whilst all of the applicants agree that community water supplies should not be disrupted by the proposed take, given significant costs of installing bores, instrumentation and the monitoring labour itself, I request exercise of a degree of caution around simply adding further monitoring requirements. Careful consideration should be given to:
  - (a) the actual degree of risk, and
  - (b) knowledge of historical performance of any water supplies.
- 8. With regard to b) above, it is my opinion that the MoE should have supplied as part of their submission documentation on the bore construction, integrity of the infrastructure, and records of actual water usage from these bores and water quality performance or compliance against the NZ Drinking Water Standards. It is also my understanding that many of these schools utilise roof water for toilet flushing, hand basins and garden watering purposes, while the bores provide drinking water.
- 9. In the absence of this information from the MoE's submission and Mr Alexander's evidence, particularly relating to bore condition/integrity and past water quality performance, the inference being made is that the bores are perfect and meet the full water requirements of each school, whereas that may in fact not be the case. For example, Awanui School is situated in an area that the Aupōuri Aquifer Groundwater Model (AAGWM) predicts to have saline conditions at very shallow depths (Figure 1), and this area is not known for good quality groundwater, hence I am surprised that the school use the bore. Another example that is fairly common in rural NZ are bores that suffer water quality issues due to poor construction particularly relating to sanitary seals, rather than changes in the aquifer *per se*.
- 10. The point being that this baseline information will be needed to evaluate whether any future issues with the school bore water supplies are attributable to the exercising the proposed consents.



Figure 1. Model generated position of the saline interface in Awanui area during dry times.

- 11. Paragraph 4.5 of Mr Alexander's evidence discusses the assessment of bore interference effects that was undertaken in the applicant's AEE (Appendix A) and indicated "The assessment has not specifically assessed effects on the shallow aquifer from which six of the seven school bores draw water from". Mr Alexander is correct and I apologise for the obvious confusion, but nevertheless the table presented in Appendix A provided the drawdown effect in the deep aquifer at each bore location contained within the NRC bore database, regardless of whether the bore is shallow or deep. In this regard, the original analysis was conservative in that bores screened in the shallower units will have lesser effect than that shown in the table.
- 12. To resolve this confusion, I have amended the original table from Appendix A of the AEE, and updated it with listed bore owner and the predicted drawdown in the relevant aquifer, as provided in **Attachment A**. In addition, I have also undertaken drawdown assessments for

the additional bores (not listed in the NRC Database) at the assumed locations, as summarised in **Table 1**. The key findings from analysis of this data are:

- (a) The predicted worst-case drawdown for bores for Ngataki, Awanui, Pukepoto and Ahipara Schools is less than 0.2 m, which would be indistinguishable from seasonal oscillation;
- (b) Waiharara and Paparore School could be expected to experience during the driest summers between 0.5 to 2 m and 1 to 4.3 m, respectively. However, both schools have bores in the deeper aquifer, hence the drawdown represents a very small proportion of the available drawdown.
- 13. The predicted drawdown for the deep aquifer is only a small fraction of the available drawdown, hence unlikely to warrant further monitoring over and above that in the proposed GMCP's.

School	Depth of Bore	Model	Draw Sc	Comment	
	(m)	Layer	2	3	
Ngataki School	18.1	1	0.16	0.02	Registered
Pukenui School	30	2	0.57	0.47	Unregistered
Waiharara School	83	4	0.56	2.24	Registered
Paparore School	94	4	1.14	4.29	Unregistered
Paparore School	101	6	1.16	4.31	Unregistered
Awanui School	30	3	0.11	1.83	Unregistered
Pukepoto School	42	3	0.01	0.11	Unregistered
Ahipara School	10	1	0	0.01	Unregistered
Ahipara School	20	3	0.01	0.09	Unregistered

Table 1. Summary of drawdown in school bores.

14. the level of drawdown anticipated for each of these school bores is extremely small as shown in **Table 1** and therefore I disagree with the recommendations of additional monitoring.

### 3. Department Of Conservation

#### 3.1. Mr James Blyth

- 15. Mr Blyth's evidence was focussed on a "detailed" review of the wetland water balance modelling I undertook and attached to my evidence, and a "high-level" review of my Evidence In Chief mainly focussed on the comments I made by the ecological consultants working for NRC. The reason both these reports were covered in my Evidence In Chief was to support my view that the wetland is primarily rainfall fed, with only minor groundwater input or output (in comparison to rainfall).
- 16. I found Mr Blyth's evidence somewhat contradictory and incorrect in a number of places and would prefer not to go into detail on this. Rather I will present some high-level considerations for the Commissioners and would be very pleased to expand or address any specific questions the Commissioners may have.
- 17. As an experienced modeller it is easy to point out model deficiencies, however what takes more skill is to recognise a model for what it has been designed or setup for, and be able to consider whether the model is "fit for purpose".
- 18. In the case of the water balance model I developed for the Kaimaumau Wetland, the purpose as stated in the introduction section of the report was to:
  - (a) undertake a water level analysis on the Kaimaumau Wetland;
  - (b) provide an understanding of the magnitude of impact of pumping on the wetland water levels; and
  - (c) determine the likely effects on the wetland that can be attributed to drought (the 2019/2020 summer) alone.
- 19. The stated purpose was not to explicitly represent individual sites in a spatial sense. This would require a more complex model than that developed. In fact, the conclusion of the wetland modelling report addresses Mr Blyth's criticism where it states:
  - (a) "The model is not spatially explicit to any one point in the wetland, rather a simulator of relative water levels within the wetland."; and
  - (b) "The model has been successful at replicating measured water level fluctuation, acknowledging site specific differences that will always be impossible to replicate exactly with a model that is not spatially explicit and uses interpolated rainfall. The calibration was strongest at gauges that were not influenced by drain flows."

- 20. The area I used for the wetland of 3,461 ha was matches the area simulated as wetland boundary conditions in the AAGWM. Comparing Figure 2 of Mr Blyth's evidence with Figure 7 of the WWLA wetland modelling report shows an obvious area of discrepancy in the northeast, as highlighted in Figure 3.
- 21. The impact of reduction in area would have on the model included a commensurate reduction in rainfall and evaporation volume calculated in the water balance model. The model would require slight recalibration to obtain similar water level matches, but I do not envisage any significant change in simulated trends or model accuracy. The modelled water balance from a volumetric perspective would be reduced, however relative proportions for each water balance components should remain similar.
- 22. With regard to the accuracy of the water level calibration and verifications, while no formal calibration statistics were provided (as pointed out by Mr Blyth), depending on the model objectives it is not always necessary to undertake this task with every modelling project. In this project I was seeking to match water levels in a qualitative sense, acknowledging that I was using a spatially unexplicit model to represent or visualise the response at various sites.
- 23. As an experienced modeller, it is my opinion that the model was able to replicate responses across a wide array of locations remarkably well, acknowledging there will always be some "under and overs" for a range of reasons I will not go into here.
- 24. The real value of the modelling work was the demonstration of effect on simulated water levels through the sensitivity testing of the depth and/or head dependent parameters such as peat porosity, evaporation and shallow groundwater seepage. This exercise provided a good sense of the volumetric magnitude of the various water balance components necessary to maintain water levels as measured, and in my opinion further strengthened the arguments that the wetland is predominantly rainfall fed with very little groundwater interaction.
- 25. This is further supported by recent monitoring and lab testing data obtained since the MWWUG hearing, which has greatly reduced the residual uncertainty that prevailed at the time of the MWWUG Hearing. For example:
  - (a) Radon data documented in a WWLA memo dated 17 May 2019 (see Attachment B) from analysis at the end of a three-month drought period indicated that the water from the wetland massif is radon free and hence is rainfall derived.
  - (b) Monitoring of water levels in the wetland massif show very similar temporal trends across significant distances of the wetland (Figure 2), while shallow groundwater levels outside the wetland shows a much slower recessional trend during drought than in the wetland (Figure 3). This suggests the water levels in the wetland are

supported by rainfall only, while shallow groundwater levels outside the wetland are supported by groundwater throughflow from upgradient areas and potentially upward seepage from beneath.



Figure 2. Comparison of water levels at two sites in the wetland massif drought 2019-2020 drought.



Figure 3. Comparison of shallow groundwater to wetland water levels during 2019-2020 drought.



Figure 4. Kaimaumau wetland water level area discrepancy (amended from Figure 7, WWLA (2020)).

#### 3.2. Mr David West

- 26. I have reviewed the evidence of Mr West and would like to comment on various concerns he raises, as follows:
  - (a) Unmapped water bodies (paragraph 16);
  - (b) Ephemeral wetlands<sup>1</sup> (paragraph 18 and 19); and
  - (c) Springs (paragraphs 20 to 23).

#### **Unmapped Water Bodies**

- 27. Mr West discusses unmapped wetland and indicates some consideration needs to be given effects on them. However, I have no idea how is an applicant supposed to assess something that is unmapped or worst-case imaginary.
- 28. Given the work NRC and Freshwater Ecosystems of New Zealand (FENZ) have done in identifying and protecting the most significant water bodies in the area (paragraph 27 and 28), the presumption is that any other wetland areas of significance size would have been identified.
- 29. Typically, farmers are aware of these sensitive ecosystems on their properties and responsible farmers are fencing them off. For example, Te Rarawa and Ngai Takoto iwi (two of the applicants) have placed numerous dune lake and wetland areas into QEII or other covenants on their Sweetwater Farm. The total area covenanted is approximately 250 ha of the 2,500-ha total farm area.
- 30. The argument surrounding unmapped water bodies is so light in detail it seems to be a strategic broadcast that is designed to encumber the applicants with more arduous consent conditions. I think this issue should be rejected outright as no linked has been demonstrated between potential effect and the location of Department of Conservation's interest

#### **Ephemeral Wetlands**

31. By definition, a water body that is ephemeral dries up naturally on a seasonal basis. The only time ephemeral water bodies hold water are during extended wet periods (winter) and temporarily after heavy rain.

<sup>&</sup>lt;sup>1</sup> Ephemeral wetlands are depressional wetlands (i.e., dips or hollows) that temporarily hold water either after heavy rains or in early spring or early summer (<u>https://www.nzpcn.org.nz/ecosystems/plant-</u> communities/wetlands/ephemeral/#:~:text=Ephemeral%20wetlands%20are%20depressional%20wetlands,following%20long%20periods%20of %20drought.)

- 32. Given that the heaviest groundwater pumping to meet peak irrigation needs occur during the height of summer when these ephemeral wetlands are usually naturally dry, I do not think there are a relevant consideration under these resource consent applications.
- 33. Ephemeral wetlands should be treated in the same manner as ephemeral streams with regards to depletion effects from pumping. Under Policies H.4.1 and H.5 of the pRPN ephemeral stream are not subject to minimum flows and therefore do not require stream depletion effects assessment.

#### Springs

- 34. There are many small springs at the base of sand dunes and within low-lying areas. The springs are associated with excess shallow groundwater (high groundwater table) and an extensive network of land drainage (as covered in my Evidence for the MWWUG) has been developed to convey this water to the coast.
- 35. The AEE prepared to support the applications have assessed the effect on shallow groundwater and therefore by virtue, the effect on springs. The maximum impact during driest time has been assessed to be a very low percentage (<5%) of the mean annual low flow (MALF), while the pRPN permits reduction in MALF of up to 10-20%, although many of the smaller streams are ephemeral and therefore exempt from minimum flow requirements.
- 36. It is my view that the Groundwater Monitoring and Contingency Plans already in operation for the MWWUG, and proposed to be augmented with additional monitoring bores for the areas outside MWWUG, is extensive and the issues raised by Mr West are not detailed enough to warrant additional monitoring.

#### 3.3. Mr Tim Baker

- 37. Mr Baker seems to be in general agreement with aquifer conceptualisation and assessment of effects in the AEE and the Officer's report. There are two comments I would like to make:
  - (a) The need for test pumping as a condition of consent (paragraph 36); and
  - (b) Effects on dune lakes (paragraph 61).

#### **Test Pumping**

38. Mr Baker discusses the need for test pumping to prove that the new bores will behave and have similar effects to the old ones. During the application process for the Sweetwater Station resource consent in 2010, SKM successfully argued that new test pumping was not required to support a resource consent application because numerous tests in the shellbed aquifer had already been undertaken and each time the test results were similar. Since this time, the FNDC bores have been test pumped, three test pumping exercises were undertaken by WWLA for the MWWUG applications, and testing was undertaken by WWLA for the new Sweetwater bore. Each time the results provide aquifer hydraulic parameter results within a similar range, hence I do not see that it is now necessary to require owners of new bores to undertake long duration test pumping exercises (>1 day). However, I do think it is prudent that an 8-hour step test be undertaken, which provides the owner baseline information on hydraulic performance that can be used in the future to diagnose bore performance issues.

#### Effect on Dune Lakes

- 39. In my experience the majority of dune lakes that are at elevations above 10 mAMSL have water levels that are significantly greater than shallow groundwater levels in the surrounding aquifer. For example:
  - Lake Waiparera, located in the middle of the study area near Waiharara has an average lake stage of 33.8 mAMSL, while the observed shallow groundwater level measured in an adjacent bore is around 7 mAMSL;
  - (b) Lake Heather, located at the northern end of Sweetwater has an average lake stage of 37 .4 m, while the shallow groundwater level is around 12 mAMSL;
  - (c) Lake Rotoroa, located at Sweetwater just to the south of Lake Heather has an average stage of 32.6 mAMSL, while the shallow groundwater level is around 16 mAMSL.
- 40. The conceptual understanding from this is that the dune lakes are perched above the shallow aquifer system, and because of this understanding, any impact in the shallow aquifer will not translate into an effect on the lake.

#### J.L. Williamson

#### 31 August 2020

# Attachment A. Updated Bore Interference Analysis

IRISID	x	Y	Purpose	Depth of Bore (m)	Model Layer	Drawdo Scer	own (m) nario	Common name
1.00.210515	1618308	6121233	Monitoring	100.3	6	<b>4</b> 14 23	<b>3</b> 19 53	
LOC.210432	1618225	6121604	Not	97.5	6	12.11	17.18	Sweet H20 Limited & Far North District
LOC.210433	1618225	6121604	Exploration	99	6	12.11	17.18	Sweet H20 Limited
LOC.210513	1618159	6121280	Not	95.6	6	10.37	15.65	Sweet H20 Limited & Far North District
LOC.314089	1617450	6119000	Irrigation	95	6	8.40	13.05	Sweet H20 Limited & Far North District
LOC.210514	1617927	6121289	Monitorina	101	5	5.95	11.27	construction
LOC.210504	1618677	6121528	Exploration	31.2	2	3.31	3.19	Sweet H20 Limited & Far North District
LOC.210530	1617843	6119772	Monitoring	15	1	1.65	0.34	GNS Lignite investigation at Sweetwater
LOC.210522	1617851	6119772	Irrigation	91	6	5.12	10.05	Landcorp Farming Ltd & Te Runanga O Te Rarawa, Sweetwater Station (MW6) REG.031144.01
LOC.200228	1617682	6121552	Not specified	29	1	1.99	0.10	Landcorp Farming Ltd & Te Runanga O Te Rarawa, Sweetwater Station (PB6) REG.031049.01
LOC.200226	1617605	6121325	Not specified	105.5	6	4.93	10.05	NRC
LOC.200227	1617528	6121482	Exploration	29.5	1	1.76	0.10	NRC
LOC.209689	1619022	6121671	Domestic and Stock	13	1	1.53	0.26	NRC
LOC.200199	1618935	6121888	Domestic	27	2	2.52	2.85	Grant Morey, 25 Bird Road, Awanui
LOC.201606	1619617	6120296	Stock	64.5	6	4.03	8.56	Petricevech
LOC.209755	1617597	6119793	Monitoring	98	6	3.98	8.96	Sweetwater Landcorp Sand Hills Road
LOC.210505	1618820	6122238	Exploration	28	1	1.50	0.13	Landcorp Farming Ltd, Sweetwater Station
LOC.201424	1618734	6122288	Irrigation	82	5	3.87	8.45	GNS Lignite investigation at Sweetwater (1997)
LOC.201010	1618839	6120489	Not specified	Not specified	-	3.79	8.92	Sweetwater Orchards
LOC.209756	1617594	6119410	Monitoring	93	6	3.64	8.44	Lands and Survey
LOC.209757	1617067	6118436	Monitoring	89	6	3.60	8.06	Landcorp Farming Ltd, Sweetwater Station
LOC.313516	1617620	6118810	Not specified	Not specified	-	3.59	8.09	Landcorp Farming Ltd, Sweetwater Station
LOC.209710	1619026	6122344	Domestic	78	6	3.48	7.99	construction
LOC.209511	1618033	6122535	Domestic	101	6	3.10	7.42	Stefan Schmucki, 247 Sweetwater Road, Kaitaia
LOC.209754	1616759	6120571	Monitoring	99	6	2.87	8.09	LM & RM Job, Lake Ngatu
LOC.201581	1619560	6120189	Domestic	65	6	2.82	7.30	Landcorp Farming Ltd, Sweetwater
LOC.201607	1619560	6120189	Stock	65.5	6	2.82	7.30	Sweetwater Landcorp (3) Sandhills Road Kaitaia
LOC.201011	1619239	6120290	Not specified	Not specified	-	2.79	7.61	Sweetwater Landcorp Sandhills Road Ahipara
LOC.210507	1619440	6120307	Exploration	38.7	3	2.13	7.07	Lands and Survey
LOC.201012	1619539	6120191	Not specified	Not specified	-	2.70	7.26	GNS Lignite investigation at Sweetwater (1997)
LOC.201558	1618283	6122816	Domestic	40	1	1.39	0.09	Lands and Survey
LOC.201580	1618343	6119088	Exploration	72.5	5	2.56	7.01	W N Beazley Sweetwater RD Awanui
LOC.201583	1618343	6119088	Not specified	44.5	3	2.20	6.84	Sweetwater Landcorp (No 2) Sandhills Road Kaitaia
LOC.201584	1618343	6119088	Not specified	32	2	1.65	2.71	Landcorp Sweetwater station
LOC.209499	1617696	6127997	Irrigation	107	6	2.54	4.78	Landcorp Sandhills Road. R D 3 Awanui
LOC.209586	1612784	6142645	Domestic	92.8	5	3.76	5.48	Millpara Avacados Ltd., Far North road
LOC.201472	1618932	6122888	Stock	14.3	1	0.85	0.10	Firenze Limited and A B Smyth

IRISID	x	Y	Purpose	Depth of	Model	Drawdown (m) Scenario		Common name
	~	-		Bore (m)	Layer	2	3	-
LOC.311405	1618539	6123040	Domestic	101.5	5	2.22	6.14	W Steed Kaitaia
LOC.209587	1617118	6128179	Exploration	117	6	2.30	4.37	construction
LOC.200332	1612979	6142360	Stock	89	5	2.84	4.47	King Orchards, Waiharara (four bores 8 piezos)
LOC.201390	1619839	6120392	Stock	6.5	1	0.35	0.05	Shane Blucher Far North Road Mototangi
LOC.306709	1611801	6142975	Not specified	Not specified	-	2.13	4.04	Sweetwater Station
LOC.308495	1611801	6142975	Not specified	Not specified	-	2.13	4.04	
LOC.308749	1611801	6142975	Irrigation	114	6	2.13	4.04	
LOC.200060	1610771	6144056	Irrigation	68	3	1.71	3.89	Soltysik-Freeman Family trust, 8 Harbour view Road, RD 4, Kaitaia (REG.036909.01)
LOC.210508	1610310	6144290	Irrigation	118.2	6	2.09	4.10	Brown
LOC.209323	1610591	6144271	Irrigation	106	6	2.08	4.10	Beedy Farms, 110A Hukatere Road, RD4, Kaitaia 0484
LOC.200208	1610722	6144033	Not specified	64.9	3	1.71	3.88	Ross Mutton, Hukatere Road
LOC.200312	1611216	6143980	Irrigation	88.5	4	1.87	3.90	Northland Catchment Commission
LOC.209608	1617567	6129061	Irrigation	93.7	5	1.84	4.10	R and K Wallace R D 4 Hukatere RoadKaitia
LOC.312724	1617571	6129063	Monitoring	94	5	1.84	4.10	King Avacado Ltd., Far North Road , Paparore
LOC.201013	1619838	6120592	Not specified	Not specified	-	2.05	6.48	King Orchards Ltd., Peizo SKM104 a&b (REG.016760.01)
LOC.209606	1616633	6128443	Irrigation	124.8	5	1.79	3.75	Lands and Survey
LOC.312720	1616628	6128445	Monitoring	122	5	1.79	3.75	King Avacado Ltd., Far North Road, Paparore (1 Production and nested piezo)
LOC.209605	1617092	6128147	Irrigation	103.7	5	2.00	4.07	King Avacado Ltd, Far North Road, Paparore
LOC.312715	1617096	6128144	Monitoring	100	5	1.92	4.00	King Orchards Ltd., Waihara Peizo SKM101a&b (REG.016760.01)
LOC.209186	1619513	6122588	Stock	32.2	2	1.08	2.14	Milan Jurlina, Spains Rd Awanui
LOC.311427	1610411	6144157	Irrigation	109	5	1.97	3.99	Ross Mutton, Far North Avo, 86 Hukatere Road, Pukenui (REG.037898.01)
LOC.200050	1610576	6144053	Domestic	39	2	1.19	1.04	Wenizell
LOC.200255	1610514	6143937	Irrigation	109.6	5	2.04	4.05	J Beedy
LOC.200061	1610675	6144453	Irrigation	50	2	1.24	1.05	Brown
LOC.200147	1610775	6144153	Not specified	60.6	2	1.20	1.04	B Browne
LOC.209241	1610876	6143953	Irrigation	48	2	1.16	1.04	Ross Mutton, Hukatere Rd.
LOC.209562	1610945	6144743	Irrigation	105	6	1.97	3.95	Roger Jones, 97 A Burnage Road, Houhora
LOC.210501	1619782	6121219	Exploration	46	3	1.57	6.27	GNS Lignite investigation at Sweetwater (1997)
LOC.201510	1619755	6121701	Domestic and Stock	28.7	3	1.64	6.15	D Devan Kunicich Road, Awanui
LOC.201389	1619241	6119690	Stock	12	2	0.92	2.13	Sweetwater Station
LOC.308834	1611997	6143025	Irrigation	108	6	1.95	3.85	
LOC.200174	1610974	6144653	Domestic and Irrigation	45	2	1.16	1.02	Dimitri Edmonds
LOC.201522	1619031	6123138	Domestic and Stock	88.3	5	1.91	5.76	Marcel Liseuring Sweetwater Road
LOC.314182	1610293	6145502	Not specified	Not specified	-	1.94	3.82	construction
LOC.209607	1616878	6128841	Irrigation	124.8	5	1.80	3.82	King Avacado Ltd, Far North Road , Paparore
LOC.312723	1616870	6128835	Monitoring	124	5	1.79	3.80	King Orchards Ltd., Waihara Peizo SKM103a&b (REG.016760.01)
LOC.200059	1610823	6143757	Irrigation	55	2	1.11	1.02	Wally Colville

IRISID	x	Y	Purpose	Depth of Bore (m)	Model Layer	Drawdo Scer 2	own (m) nario 3	Common name
LOC.200184	1610215	6145090	Not specified	110	6	1.92	3.87	Bill Hopkins
LOC.200151	1611026	6144893	Irrigation	66	3	1.61	3.71	L Bedard
LOC.315067	1610416	6145474	Domestic	90.5	5	1.85	3.72	construction
LOC.200335	1610275	6144351	Irrigation	105.5	5	1.87	3.87	Grant White, Gumboot Road, Houhora
LOC.209600	1617709	6129216	Stock	83.3	5	1.72	4.06	Ivan Stanisich, Paparore Road, Waiharara
LOC.209245	1611262	6143751	Irrigation	92.6	5	1.80	3.82	Rob Freeman, Hukatere Rd, Houhura
LOC.200148	1611277	6143655	Stock	67	3	1.48	3.63	Whalers Rd, Houhora
LOC.200044	1611320	6143725	Not specified	40.7	2	1.00	1.00	R Freeman
LOC.209264	1611345	6144535	Irrigation	86	5	1.79	3.75	W Colville, Whalers Road, Houhora
LOC.307989	1611796.73 9	6142884.82 8	Not specified	Not specified	-	1.83	3.72	activity location
LOC.200233	1611028	6143838	Irrigation	48	2	1.10	1.02	R Wallace
LOC.201478	1618003	6133379	Stock	7	1	0.22	0.02	J Matijevich Waiharara
LOC.315389	1612998	6142496	Not specified	Not specified	-	1.80	3.43	construction
LOC.317160	1613023	6142453	Irrigation	94	6	1.80	3.43	Construction Mapua Avocadoes Ltd Third PB3 (REG.038611.01)
LOC.209780	1618687	6123328	Domestic	105	5	1.81	5.52	John Kenderdine, 61 A Sweetwater Road, Lake Ngatu
LOC.210166	1611339	6144277	Irrigation	68	3	1.52	3.69	Houhora Avacardos
LOC.200237	1610477	6143752	Stock	50	2	1.08	1.00	Paker
LOC.201548	1617991	6118248	Stock	18	2	0.80	2.21	Landcorp, Sandhills Rd, Awanui
LOC.200149	1610610	6143652	Irrigation	55	2	1.07	1.00	Hickey
LOC.315389	1612506	6141783	Not specified	Not specified	-	1.75	3.39	construction
LOC.201540	1611236	6144864	Not specified	6	1	0.69	0.02	Construction Mapua Avocadoes Ltd Third PB3 (REG.038611.01)
LOC.200303	1611475	6144155	Irrigation	102	6	1.69	3.67	Clay Sinclair Partnership Hukatere Road,Pukenui
LOC.200215	1617853	6130056	Stock	76	4	1.14	3.70	M Frost
LOC.209670	1611559	6143858	Commercia I Water Supply	88	4	1.67	3.68	Chris Hensley, 29 Hukatere Road, Pukenui
LOC.200150	1611610	6143937	Irrigation	67	3	1.39	3.54	Clark
LOC.209172	1611566	6143905	Domestic and Stock	87.5	5	1.65	3.64	Chris & Rhonda Hensley, Pukenui
LOC.200189	1610471	6145551	Domestic	54	2	1.09	0.91	Burnage Rd, Houhora
LOC.200317	1610803	6143530	Irrigation	92	5	1.67	3.66	Rob Freeman Hukatere Rd, R D 4Houhora
LOC.210528	1617811	6114690	Irrigation	6	1	0.36	0.33	Landcorp Farming Ltd & Te Runanga O Te Rarawa, Sweetwater Station (MW5a) REG.031144.01
LOC.201479	1619841	6122499	Domestic	26	2	1.03	2.10	D Smith Spains Road, Awanui
LOC.209637	1611272	6144952	Domestic and Stock	95.6	6	1.58	3.42	PA Courtenay, 63 Burnage Road, Houhora.
LOC.200320	1611273	6144954	Domestic and Irrigation	86	5	1.61	3.47	Ongare Trust Burnage Road, Hourhora
LOC.317728	1611772	6143277	Not specified	Not specified	-	1.58	3.53	at Whalers Road
LOC.201480	1611776	6143656	Domestic and Irrigation	11	1	0.15	0.00	Auburn Flowers and Produce Ltd Motutangi
LOC.200334	1611776	6143656	Irrigation	95.1	6	1.57	3.54	Kwan Developments Whalers RoadHouhora
LOC.209227	1611673	6143325	Domestic and Irrigation	106	5	1.54	3.52	Richard Roscoe, 212A Whalers Rd, Hourhora
LOC.210499	1619903	6122293	Exploration	35.6	3	1.31	5.41	GNS Lignite investigation at Sweetwater (1997)

IRISID	х	Y	Purpose	Depth of	Model	Drawdown (m) Scenario		Common name
				Bore (m)	Layer	2	3	
LOC.200209	1611323	6145092	Not specified	100.3	6	1.51	3.32	NRC
LOC.209534	1617970	6129035	Stock	82.5	5	1.52	3.92	Jim West, 591 Paparore Road, RD 4 Kaitaia
LOC.200066	1611776	6143756	Domestic and Irrigation	11	1	0.07	0.00	Auburn Flowers & Produce Ltd
LOC.315398	1609921	6147194	Not specified	Not specified	-	1.49	3.33	Bore
LOC.200081	1617702	6127677	Not specified	68.6	2	0.92	1.35	Northland Catchment Commission
LOC.209581	1617696	6127678	Monitoring	33	1	0.58	0.08	Northland Regional Council Corner Ogle Drive/ Far North Road
LOC.200324	1611573	6144755	Irrigation	74.1	3	1.28	3.28	Dagg Orchards Whalers RoadHouhora
LOC.313697	1612552	6142994	Not specified	Not specified	-	1.45	3.24	construction
LOC.306105	1618376	6129421	Irrigation	95	6	1.44	3.97	bore
LOC.200063	1611272	6145154	Not specified	6.7	1	0.64	0.02	LoGiacco
LOC.210268	1617991	6133256	Stock	94.5	5	1.05	2.88	Aron Bainbridge Heath Road, Kaimuimui
LOC.200217	1617214	6129579	Stock	85.3	3	1.07	3.39	Yelavich
LOC.209033	1619754	6122661	Domestic	75.1	5	1.52	5.47	Apache Family Trust Spains Road Awanui
LOC.201014	1619933	6122491	Not specified	8.5	1	0.86	0.25	D Martinovich
LOC.210276	1619882	6122486	Stock	60.1	5	1.53	5.54	Dave Grey Spains Road, Awanui
LOC.316126	1610002	6147264	Not specified	Not specified	-	1.40	3.13	construction
LOC.304125	1609975	6147378	Not specified	Not specified	-	1.40	3.13	ACTIVITY LOCATION
LOC.305545	1610005	6147426	Domestic and stock	91	6	1.40	3.13	Bruce Fullam, Elangamite drive, off lamb road, Pukenui, Houhora (REG.036608.01)
LOC.315389	1612346	6142423	Not specified	Not specified	-	1.39	3.16	construction
LOC.317161	1612622	6141745	Irrigation	108	6	1.38	2.99	Construction Mapua Avocadoes Ltd Third PB3 (REG.038611.01)
LOC.209774	1610005	6143884	Domestic	108	5	1.36	3.30	Adams Family Trust, Gumboot Road Houhora
LOC.200288	1611372	6145154	Irrigation	86	5	1.40	3.16	Paul Lo-Giacco
LOC.313307	1612425	6142123	Irrigation	109	6	1.35	3.05	construction PB1
LOC.209575	1616796	6112205	Stock	51.5	3	0.74	1.71	Landcorp Farming Ltd, Sandhills Road, Kaitaia
LOC.310308	1617846	6133480	Irrigation	101	5	1.13	2.89	Ivan Stanisich, 40 Kaimaumau Road, Awanui (REG.037465.01)
LOC.210404	1611786	6144633	Domestic	79	5	1.32	3.16	Brain Lowry, 82 Whalers Road, Pukenui
LOC.200249	1609768	6146749	Domestic	32	2	0.99	0.81	Lamb Rd, Houhora
LOC.200177	1617803	6133379	Stock	37	2	0.47	0.97	Waiharara
LOC.200045	1617313	6129879	Domestic	15	1	0.65	0.04	M Frost
LOC.200289	1617313	6129879	Stock	105	5	1.15	3.38	M Frost
LOC.200078	1617313	6129879	Stock	45	2	0.81	1.25	T Jones
LOC.201507	1618514	6129183	Irrigation	62.3	5	1.24	3.75	T Haywood Paprore Road, Waiharara
LOC.210161	1608940	6148550	Not specified	Not specified	-	1.27	4.50	Landcorp Farming Ltd.
LOC.311745	1609890	6143900	Not	Not	-	1.27	3.18	construction
LOC.200231	1612377	6143358	Domestic and Stock	46.5	2	0.73	0.87	A & F Clark
LOC.200213	1609569	6146648	Stock	110	6	1.26	3.35	E Clark
LOC.201546	1619902	6122666	Domestic and Irrigation	Not specified		1.26	5.03	Godfrey TK Spains Rd, Awanui

IRISID	x	Y	Purpose	Depth of Bore (m)	Model Layer	Drawdown (m) Scenario		Common name
LOC.201537	1618726	6129089	Irrigation	62.3	5	1.18	3.69	Tony Hayward Maitai Orchard, Paparore
LOC.200167	1618614	6129183	Irrigation	60	5	1.18	3.71	lan Broodhurst
LOC.200248	1609968	6146849	Stock	33.5	2	0.95	0.76	N Lamb
LOC.209501	1604203	6154553	Irrigation	33	1	0.53	0.02	Kevin Thomas, 557 Kimberly Road, Ngataki
LOC.315166	1604198	6154560	Irrigation	40	2	0.62	0.97	construction
LOC.200211	1618829	6128509	Not specified	90	6	1.21	3.61	NCC
LOC.200049	1609869	6146549	Not specified	Not specified	-	1.20	3.05	Norman Wagner
LOC.209753	1616404	6119040	Monitoring	92	6	1.19	6.22	Landcorp Farming Ltd
LOC.210527	1616386	6119031	Monitoring	25	2	0.94	2.07	Landcorp Farming Ltd & Te Runanga O Te Rarawa, Sweetwater Station (MW4a), REG.031144.01
LOC.303413	1619200	6130630	Not specified	Not specified	-	1.17	3.59	
LOC.307661	1619211	6130581	Domestic and stock	93.5	6	1.17	3.59	Ross Bellingham, 4A Lamb Road, RD4, Kaitaia 0484(REG.036498.01)
LOC.200236	1609877	6143651	Domestic	43	2	0.87	0.90	Bowe
LOC.200079	1617512	6130380	Domestic	8.5	1	0.61	0.03	T Jones
LOC.201549	1617544	6117042	Not specified	14.3	1	0.46	0.35	Landcorp Sandhills Road
LOC.200229	1618859	6128533	Irrigation	79	6	1.14	3.52	Far North Farms
LOC.201550	1620335	6121526	Domestic	36.5	3	0.86	5.03	R A Liddicoat Kunicich RdAwainui
LOC.209561	1617889	6127299	Domestic and Stock	105	6	1.13	3.45	George Ujudr, 1738 Far North Road
LOC.210322	1618806	6129256	Domestic	75.5	6	1.13	3.64	Jessica Kuzemco 484 Paparore Road, Kaitaia
LOC.307751	1604094	6154583	Irrigation	37.5	1	0.53	0.02	K Thomas & D O'Conner, 565c Kimberly Road, Ngataki (REG.036289.01)
LOC.209230	1610178	6146870	Domestic	93.5	5	1.07	2.62	Herb Adams, 93 Lamb Rd, Pukenui
LOC.201367	1615897	6135772	Stock	85.3	4	1.01	2.43	Gorman
LOC.201267	1617431	6123583	Domestic	60	2	0.81	1.68	S Dalziel
LOC.209758	1617576	6116979	Monitoring	76	6	1.09	4.12	Landcorp Farming Ltd, Sweetwater Station
LOC.316695	1611066	6145958	Domestic	80.7	4	1.11	2.61	Pavlavic, 3933F SH1, Pukenui, Houhora
LOC.200080	1617611	6130680	Not specified	7.6	1	0.45	0.03	Wally Jones
LOC.200154	1617611	6130680	Stock	Not specified	-	1.04	3.22	Hilton-Jones
LOC.200082	1617703	6133479	Not specified	6.6	1	0.27	0.02	R Robertson
LOC.201426	1617703	6133479	Domestic	36	2	0.47	0.96	Ray Robertson
LOC.200070	1615697	6135772	Not specified	7	1	0.37	0.01	Mark Matich
LOC.209340	1612600	6143684	Domestic	78	5	1.00	2.74	M DENSON & N POPE, FAR NORTH ROAD, HOUHORA
LOC.200240	1617905	6132480	Stock	96	5	0.90	2.88	Matijevich
LOC.209971	1619050	6130821	Irrigation	79	6	1.00	3.40	Luca Vista Holdings Limited, Heath Rd, Waipapakauri
LOC.200292	1613486	6139963	Not specified	117.3	6	1.00	2.40	W Colville & P Sole Pukenui
LOC.209759	1617644	6114898	Monitoring	61	6	0.99	2.62	Landcorp Farming Ltd, C/O SKM Ltd., Sweetwater Station(REG.016645.01)
LOC.315063	1615707	6135699	Not specified	Not specified	-	0.98	2.38	construction
LOC.200311	1610367	6147010	Irrigation	116.2	6	0.98	2.36	P Wedding Lamb Road, Houhora
LOC.200319	1612375	6144058	Irrigation	88.5	6	0.97	2.71	R & K Wallace R D 4, Kaitaia
LOC.209232	1612816	6143569	Domestic and Stock	70.6	3	0.90	2.69	B Askew & C Billot, Far North Road, Houhora
LOC.312491	1618994	6131326	Not specified	Not specified	-	0.96	3.21	construction and groundwater take

IRISID	х	Y	Purpose	Depth of	Model	Drawdown (m) Scenario		Common name
				Bore (m)	Layer	2	3	
LOC.200192	1617702	6133678	Stock	80	4	0.88	2.62	Stanisich
LOC.200083	1617702	6133678	Not specified	8.5	1	0.23	0.01	J Stanisich
LOC.315061	1610391	6147663	Not specified	Not specified	-	0.92	2.15	construction
LOC.311385	1612759	6143681	Domestic and stock	72.8	5	0.90	2.53	Askew B & Billot K , 3689 Far North Road, Houhora (REG.0037850.01)
LOC.201500	1619142	6128372	Irrigation	79.6	6	0.91	3.24	D Inglis Paparore Rd, Awanui
LOC.317202	1612321	6144685	Domestic	68.5	3	0.76	2.44	Reid, Far North Road, Pukenui
LOC.200274	1610467	6147051	Domestic and Irrigation	50	2	0.71	0.57	Pat Wedding
LOC.210378	1614723	6139203	Domestic	89.7	4	0.70	1.96	Candy Corn Ltd., 3167 Far North Road
LOC.201363	1618110	6130981	Stock	78.5	4	0.79	3.18	Matich Bros
LOC.200321	1613986	6139865	Not specified	117	6	0.87	2.20	W Colville and P Sole Pukenui Houhora
LOC.209611	1617767	6132926	Monitoring	85	4	0.71	2.61	Ivan Stanisich, 485, Heath Road, Waiharara
LOC.314427	1618027	6132874	Domestic and stock	108	6	0.86	2.75	construction
LOC.209887	1608602	6146282	Domestic	83	6	0.85	3.14	G & D Price, 4805 D Far North Road, Houhora
LOC.209933	1608602	6146282	Stock	110.5	6	0.85	3.14	Paul & Brenda Harvey, Lamb Road, Pukenui
LOC.311386	1611031	6146536	Domestic	86	6	0.84	2.06	Bruce Askew & Karen Billot, 4037 Far North Road (REG.037851.01)
LOC.200214	1612355	6144972	Stock	76.2	5	0.86	2.32	Wagner Ltd
LOC.200201	1618104	6132880	Stock	83	4	0.73	2.66	Milich
LOC.209078	1611934	6145513	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611947	6145501	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.200339	1611948	6145499	Monitoring	6.2	1	0.00	0.00	BP Oil NZ Limited
LOC.210445	1611943	6145493	Domestic	67.8	4	0.80	2.15	Houhora Service Station, RD 4, Kaitaia
LOC.315970	1616835	6134014	Not specified	Not specified	-	0.83	2.43	construction
LOC.201366	1617436	6132318	Domestic	48.8	2	0.48	1.01	Hewett
LOC.200038	1603952	6153128	Not specified	5.8	1	0.53	0.02	D Murry
LOC.200275	1603952	6153128	Exploration	63	2	0.59	1.03	Pat Dromgool
LOC.209290	1604015	6153225	Irrigation	60	2	0.63	1.04	Grant Kokich, Rokok Ltd, Kimberley Rd, Ngataki
LOC.209231	1610577	6147231	Commercia I Water Supply	86.6	5	0.84	2.02	Pukenui Holiday Park, Lamb Rd, Pukenu
LOC.201025	1620470	6122039	Not specified	33.8	3	0.65	4.42	Northland Catchment Commission
LOC.200168	1619205	6128425	Irrigation	47	3	0.66	3.02	Dave Inglis Paparore Rd, Awanui
LOC.209510	1610600	6147316	Domestic	75.5	5	0.76	1.84	Hayley McLaine, 28 Lamb Road
LOC.201598	1616125	6135622	Irrigation	98	5	0.80	2.24	V Ireland Big Flat Road
LOC.308897	1610564	6147424	Domestic	89.7	6	0.79	1.91	Stephan Nattras, 32 Lamb Road, Pukenui (REG.037291.01)
LOC.200158	1618104	6132780	Stock	24	2	0.48	1.00	Joe Milich
LOC.209280	1614798	6138773	Irrigation	88.5	4	0.68	1.96	N & J Thompson, Turk Valley Rd, Motutangi
LOC.201579	1618054	6115390	Exploration	56	6	0.78	2.34	Sweetwater Landcorp (1) Sandhills RoadKaitaia
LOC.200338	1611971	6145456	Monitoring	5.6	1	0.00	0.00	Mobile Houhora Far North road
LOC.209078	1611954	6145502	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611974	6145471	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611975	6145490	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited

IRISID	х	Y	Purpose	Depth of	Model	Drawdown (m) Scenario		Common name
		-		Bore (m)	Layer	2	3	-
LOC.209078	1611979	6145503	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611958	6145513	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611964	6145491	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611966	6145506	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.209078	1611967	6145518	Monitoring	3.9	1	0.00	0.00	BP Oil NZ Limited
LOC.200246	1611971	6145456	Domestic	72.2	5	0.79	2.13	BP Oil NZ Limited
LOC.009561 .01.02	1611965	6145472	Not specified	Not specified	-	0.78	2.10	URS NZ Ltd: construction at Houhora Service Station (Installation of 12 Monitoring Bores)
LOC.210337	1612021	6145496	Monitoring	6	1	0.00	0.00	Allen Udjur, Main North Road, RD 4, Kaitaia
LOC.200341	1614490	6138367	Irrigation	89	4	0.62	1.94	M Bellette Turk Valley Road
LOC.210452	1612100	6145411	Domestic	76	5	0.80	2.17	Glen Edwards, 3864 Far North Road, Houhora
LOC.209173	1611590	6146004	Domestic and Stock	72	4	0.77	1.97	T Bradley, Main Road, Houhora
LOC.200176	1616197	6135873	Stock	56	3	0.66	2.16	Matich Bros
LOC.200191	1618000	6134179	Stock	59.5	3	0.65	2.43	Millich
LOC.201364	1617406	6132178	Stock	93	5	0.67	2.63	O Farnhorn
LOC.209678	1604083	6153122	Stock	61.2	2	0.63	1.04	S V Rawnsley, Kimberly Road Ngataki
LOC.210016	1610739	6147174	Domestic	79	6	0.75	1.83	Barry & Kim Kanara, 24 Fitzgerald Road, Pukenui
LOC.200326	1614554	6138575	Irrigation	116.2	6	0.75	2.04	P H & M B Wedding Lamb Rd, R D 4, Kaitaia
LOC.209599	1610609	6147637	Domestic	89	6	0.74	1.76	Alan Nunns, 4161 Far North Road, Pukenui
LOC.312831	1617046	6136940	Not specified	Not specified	-	0.74	2.03	construction
LOC.209585	1614328	6138468	Irrigation	114	5	0.68	1.99	G G Jackschik, Turk Valley Road, Mototangi
LOC.200051	1610666	6147251	Not specified	Not specified	-	0.73	1.77	C Barnes
LOC.312665	1615069	6139351	Not specified	Not specified	-	0.73	1.92	construction
LOC.308025	1611889	6145692	Not specified	Not specified	-	0.73	1.96	location
LOC.308730	1611903	6145698	Irrigation	72	4	0.75	2.00	Houhora Bowling Club, 3920 Far North Road, Pukenui (REG.037092.01)
LOC.209291	1611960	6145633	Domestic	72	5	0.74	2.01	T & C Norman, 19 A, Northwood Ave, Pukenui
LOC.210270	1616501	6116438	Domestic and stock	65	5	0.59	3.02	Glen Shroj
LOC.209284	1614800	6138422	Irrigation	90	4	0.63	1.93	J Anders & W Henderson, Turk Valley Road
LOC.200075	1616994	6136475	Not specified	6.1	1	0.14	0.00	G Petricevich
LOC.200055	1610666	6147351	Not specified	Not specified	-	0.71	1.71	V Hensly
LOC.201362	1617998	6134979	Stock	72	5	0.69	2.25	A Cox
LOC.201034	1614000	6139700	Irrigation	26	1	0.32	0.00	C Subritzky
LOC.312299	1612256	6145355	Domestic	75	5	0.74	2.03	construction
LOC.200039	1604148	6154528	Not specified	6.7	1	0.54	0.02	Owen Farnham
LOC.209500	1617306	6131788	Stock and Irrigation	93	3	0.54	2.57	Hilton Jones Farms Ltd., 2232 Far North Road
LOC.315384	1618165	6132248	Irrigation	95	5	0.69	2.72	Bore
LOC.200190	1614086	6139965	Stock	76	3	0.59	1.96	Yerkovich
LOC.200076	1617203	6133277	Not specified	10	1	0.36	0.04	R Srhoj
LOC.209644	1610530	6148125	Domestic	93.1	6	0.69	1.71	Steve Boyce, 4205 Far North Road, Pukenui
LOC.209885	1610458	6148147	Domestic	98.5	6	0.69	1.71	L A & B A Anderson, 4217A,Far North Road, Kaitaia

ופופוס	Depth of Model		Drawdo	own (m)	Common name			
IRISID	^	T	Fulpose	Bore (m)	Layer	2	3	-
LOC.200200	1617095	6136275	Stock	92	5	0.68	2.07	Petricevech
LOC.200328	1614087	6139665	Irrigation	88	3	0.58	1.95	CR & MD Subritzky Motutangi Houhoura
LOC.209336	1616532	6135732	Stock	78	4	0.67	2.13	T & D Vuksich , 2705, North Road, Waiharara
LOC.315166	1610587	6147804	Irrigation	40	2	0.62	0.97	construction
LOC.314929	1610590	6147808	Domestic	86.5	6	0.68	1.63	NCC
LOC.209708	1613781	6141064	Irrigation	79	4	0.66	2.02	NZ Watermelon Dist. Ltd., Far North Rd, Motutangi
LOC.209642	1610821	6147232	Domestic	82.2	6	0.66	1.63	Alan Broadbent ,4115 Far North Road, Pukenui Houhora
LOC.200302	1612673	6144658	Irrigation	79.5	6	0.66	2.05	E Wagener Far North Road, Pukenui
LOC.201361	1616901	6134176	Not specified	83	3	0.56	2.24	Waiharara School
LOC.201535	1616846	6135759	Stock	73	4	0.64	2.10	Vuksich Brothers Big Flat Road
LOC.209508	1611396	6146722	Domestic	74.5	5	0.62	1.42	Robbie Dennison, 402 Far North Road
LOC.209541	1617414	6135565	Domestic and Stock	72.5	5	0.65	2.13	lan Steele, 2642 Far North Road, Waihara
LOC.209170	1611769	6146025	Domestic	77	5	0.64	1.68	T & R Bradley
LOC.209031	1614902	6139537	Domestic and Stock	115.1	6	0.64	1.85	J Hinchliff Far North Road
LOC.200159	1614687	6139467	Stock	46	2	0.32	0.68	R Seymour
LOC.209618	1617253	6135602	Stock	81.5	4	0.63	2.12	R & E Radojkovich, SH 1, Waiharara
LOC.200318	1611468	6146654	Private Water Supply	74.4	5	0.65	1.46	Houhora Fire Brigade Main Road Houhora
LOC.314463	1614508	6139527	Stock	110	6	0.64	1.91	construction
LOC.200077	1617197	6135576	Not specified	13	1	0.18	0.01	R Rodaikovich
LOC.200239	1614387	6139466	Stock	73	3	0.56	1.90	Bryor
LOC.200074	1616906	6132377	Not specified	10	1	0.36	0.04	Kevin Steed
LOC.210374	1614344	6139436	Domestic and stock	113.5	6	0.63	1.93	John Herdman, 3201 Far North Road, RD4 Kaitaia 0484
LOC.300999	1614283	6139417	Domestic and stock	120	6	0.63	1.93	Craig Barbre, 3211 Far North Road, Motutangi (REG.031393.01)
LOC.210323	1617437	6134989	Domestic	85	3	0.54	2.18	Colin Sole, 2604 A Far North Road, Waiharara
LOC.314181	1610570	6148029	Domestic	82.5	5	0.56	1.41	construction
LOC.200216	1617198	6135076	Stock	85	5	0.61	2.14	Matich Bros.
LOC.209779	1610850	6147124	Domestic	94.7	5	0.69	1.71	B A Wagener, 4101 Far North Road, Pukenui
LOC.201474	1617092	6137175	Not specified	29	2	0.29	0.70	N J Covich Waiharara
LOC.201288	1615677	6122797	Private Water Supply	108	6	0.61	3.97	90 Mile Motor Camp
LOC.209620	1617112	6115915	Domestic and Stock	71	6	0.60	2.66	Fiona Susich, Sandhills Road, Ahipara
LOC.210299	1615073	6138680	Domestic and Irrigation	90	4	0.59	1.84	L Hunter & D Short, 20 Turk Valley Road, Motutangi
LOC.200331	1615089	6138668	Irrigation	87.4	4	0.59	1.84	Anderson Turk Valley Rd
LOC.200085	1619407	6131684	Not specified	Not specified	-	0.60	2.61	N Heath
LOC.200322	1603853	6153128	Stock	100	6	0.59	3.75	Te Raite Station Kimberley Road, Houhora
LOC.210233	1615512	6122353	Not specified	Not specified	-	0.59	4.16	Debbie Battcher
LOC.201005	1615435	6122378	Not specified	10	2	0.16	0.09	V Burt
LOC.209647	1615180	6139069	Domestic and Irrigation	97	5	0.58	1.78	De Bede Ltd, Far North Road, Motutangi

	v	v	Purpose	Depth of	Model	Drawdo	own (m)	Common name
IRISID	^	T	Purpose	Bore (m)	Layer	2	3	-
LOC.210305	1615513.33 3	6122512	Domestic	84	6	0.58	4.07	John Carter, 3 Rata Street, Waipapakauri
LOC.200196	1610766	6147451	Private Water Supply	75	6	0.57	1.39	Denison
LOC.304107	1611371	6146843	Not specified	Not specified	-	0.57	1.32	ACTIVITY LOCATION
LOC.200065	1611769	6146155	Not specified	17	2	0.28	0.37	C Phew
LOC.200254	1610867	6147152	Domestic	28.7	1	0.39	0.01	R Henson
LOC.201006	1615435	6122478	Not specified	6.7	2	0.16	0.09	J Usher
LOC.201412	1615535	6122578	Domestic	19.2	2	0.27	1.12	Sari Subritzky
LOC.210375	1606684	6150227	Stock	93	6	0.56	3.11	Landcorp Farming Ltd., 2 Ragiputa Road RD3 Kaitaia
LOC.200234	1610564	6148250	Domestic	59	3	0.53	1.54	C Anderson
LOC.209579	1610825	6147551	Domestic	77	6	0.55	1.32	Pukenui Lodge Motel, Pukenui, Houhora
LOC.200325	1614284	6140565	Domestic and Stock	66	3	0.47	1.80	Andy Turner Main Road, Motutangi
LOC.301443	1604340	6154522	Not specified	Not specified	-	0.54	3.42	Thomas & O'Connor, Kimberley Road, Ngataki
LOC.200086	1619607	6131685	Stock	15.8	1	0.29	0.11	Ruth Johnson
LOC.200043	1611568	6146654	Irrigation	54.2	3	0.44	1.15	B Richards
LOC.200293	1610734	6147962	Domestic	34.4	2	0.09	0.00	Bob Grange Harbour View Road, Pukenui
LOC.200244	1610664	6147951	Domestic	55.5	2	0.26	0.23	Ian Stewart
LOC.209543	1610747	6148037	Domestic	73	5	0.41	1.05	S & M Shearer, 14 Harbour View Road, Houhora
LOC.200064	1611769	6146255	Not specified	Not specified	-	0.53	1.37	D Archibald
LOC.209185	1610518	6148354	Domestic	71.5	4	0.59	1.57	V H Hensley, Farnorth Rd, Pukenui
LOC.308345	1603009	6152347	Irrigation	101	6	0.52	3.30	LOCATION
LOC.311280	1603009	6152347	Domestic and stock	101	6	0.52	3.30	Tranquility Retreats, McManus Road, Houhora (REG.037142.01)
LOC.200056	1610765	6147651	Not specified	Not specified	-	0.52	1.27	Pukenui Motels
LOC.209329	1605981	6154579	Stock	90	6	0.51	2.60	Martin Dijkstra, Far North Road, Henderson Bay
LOC.209326	1615263	6138474	Stock and Irrigation	106.5	6	0.51	1.75	Ray Seymor, Far North Road, Mututangi
LOC.210376	1616313	6115888	Domestic and stock	67	6	0.51	2.51	Chris Mansfield, Sandhills Road, Ahipara, Kaitaia
LOC.200073	1616193	6137172	Not specified	10.2	1	0.24	0.01	L Bacica
LOC.200251	1610563	6148350	Private Water Supply	34	2	0.39	0.34	V Hensley
LOC.210159	1605435	6150820	Not specified	Not specified	-	0.50	3.20	Landcorp Farming Ltd
LOC.209638	1617022	6115406	Stock	62	5	0.48	2.24	Les Henderson, Sandhills Road, Ahipara
LOC.200250	1611411	6146928	Private Water Supply	79.3	6	0.49	1.16	Houhora Big Game Sports And Fishing Club
LOC.305551	1611364	6146854	Domestic	82	6	0.49	1.16	Herbert Adam, 4051 Far North Road, Pukenui, Houhora (REG.036604.01)
LOC.317737	1603852	6152835	Not specified	Not specified	-	0.49	3.54	Construction
LOC.200062	1611668	6146554	Not specified	Not specified	-	0.49	1.16	B Ballantyne
LOC.200278	1616102	6133874	Stock	83	4	0.49	2.01	Vuhsich Bros
LOC.210277	1604072	6152792	Domestic	73	2	0.46	0.95	Harry & Dolly Tahitahi, 12 McManus Road, Houhora
LOC.200053	1610664	6148151	Not specified	Not specified	-	0.47	1.23	J Forshind
LOC.200052	1610664	6148151	Not specified	14	2	0.24	0.21	J Morecroft

IRISID	x	Y	Purpose	Depth of Bore (m)	Model Layer	Drawdown (m) Scenario		Common name	
	~	•				2	3		
LOC.200344	1610855	6147471	Domestic	75.5	6	0.47	1.14	Glen Subritzky Far North Road, Pukenui	
LOC.209860	1603948	6152245	Domestic	83.8	6	0.46	3.47	P K Foote and A M McGuigan: construction at McManus Road, Ngataki.	
LOC.314465	1611882	6146283	Not specified	Not specified	-	0.46	1.23	construction	
LOC.309604	1616179	6137507	Domestic and stock	100	5	0.47	1.74	Shay Steed, 2915 Far North Road, Waiharara (REG.037510.01)	
LOC.200329	1612771	6145258	Domestic	68.5	4	0.47	1.52	Stan Jones Heads Road, Houhora	
LOC.209535	1603752	6152281	Domestic and Stock	76.8	6	0.46	3.44	Kirk Dension, McManus Road off Kimberly Road, Houhora	
LOC.304199	1612877	6145081	Not specified	Not specified	-	0.46	1.53		
LOC.307629	1612882	6145063	Domestic	73.7	6	0.46	1.53	Denise Pederson, 76 E Houhora Heads Road, Pukenui (REG.036622.01)	
LOC.209778	1603961	6152588	Domestic	74	6	0.45	3.45	John Vaioleti, 40 McManus Road, Houhora	
LOC.201512	1615792	6137471	Domestic and Stock	77.5	4	0.44	1.72	H Griggs Main Road, Waihara	
LOC.209495	1615824	6137512	Stock and Irrigation	85.5	5	0.44	1.72	Vuksich Bros, Far North Road, Waiharara	
LOC.209580	1604082	6152474	Domestic	77	3	0.43	3.41	L & C Emile, McManus Road, Houhora	
LOC.200058	1610764	6148051	Not specified	12	1	0.00	0.00	Brian McDonald	
LOC.200069	1615689	6138470	Not specified	10.4	1	0.12	0.01	J Ware	
LOC.200316	1611668	6146654	Domestic and Stock	76	5	0.53	1.22	Bruce Malcolm Main Road, Pukenui	
LOC.200210	1611712	6146689	Not specified	79.6	6	0.43	1.00	NCC & RWB	
LOC.200197	1615742	6138418	Stock	96	5	0.43	1.63	Seymour	
LOC.200238	1610663	6148251	Domestic	33.5	2	0.24	0.21	Wilkinson	
LOC.200071	1615791	6137871	Not specified	14	1	0.16	0.01	Tom Steed	
LOC.200072	1615891	6137871	Not specified	6.3	1	0.14	0.01	Vuksich Bross	
LOC.200245	1610462	6148650	Domestic	65	5	0.45	1.46	Gaeley	
LOC.209168	1612044	6146345	Domestic	77	5	0.40	1.07	Ross Wagner	
LOC.200175	1615403	6133872	Stock	46	2	0.34	0.82	Sole	
LOC.200247	1610764	6148151	Domestic	33	2	0.08	0.00	R Wallace	
LOC.209707	1610763	6148209	Domestic	70.5	5	0.49	1.28	P & W Mold, 32B Harbour View Road, Pukenui	
LOC.209748	1603865	6154810	Irrigation	42.5	1	0.36	0.03	K W Thomas, 565 Kimberly Road, Houhora	
LOC.209496	1615374	6133352	Stock and Irrigation	96	3	0.38	1.84	Vuksich Bros, 94 Katavich Road, Waiharara	
LOC.201427	1616355	6115285	Domestic and Stock	38	4	0.18	1.70	Ron Adams	
LOC.305229	1609849	6149352	Not specified	Not specified	-	0.37	1.66		
LOC.200252	1610763	6148251	Domestic	30	2	0.07	0.00	D Bellingham	
LOC.200310	1612971	6145259	Domestic	38.5	2	0.17	0.36	Wright A S Houhora Head RdHouhora	
LOC.200315	1612971	6145259	Domestic and Stock	66	6	0.36	1.26	A S Wright Houhora Heads	
LOC.312872	1611980	6146438	Not specified	Not specified	-	0.36	0.97	construction	
LOC.314093	1610734	6148503	Domestic	66	6	0.35	1.05	construction	
LOC.200057	1610763	6148351	Not specified	19	2	0.23	0.20	Jack Farham	
LOC.200067	1611868	6146555	Not specified	Not specified	-	0.33	0.84	W Thornton	
LOC.307773	1609855	6149351	Domestic and stock	66.3	6	0.33	1.46	Bill Evans, 4355 Far North Road, Houhora (REG.036731.01)	
LOC.200170	1604451	6153630	Domestic	84.5	6	0.32	3.09	P Lennon	
LOC.209028	1612076	6146383	Domestic	77	6	0.31	0.86	Ross Wagener Waterfront Rd, Houhora	

IRISID	x	Y	Purpose	Depth of Bore (m)	Model Layer	Drawdown (m) Scenario 2 3		Common name	
LOC.200054	1610763	6148451	Not specified	6	1	0.00	0.00	Dr Paton	
LOC.200340	1605647	6154733	Stock	121.5	6	0.29	2.55	Martin Dijkstra Far North Rd	
LOC.313925	1605016	6152745	Stock	46	2	0.26	0.76	Te Aupouri Commercial Development Limited	
LOC.209311	1605547	6154732	Stock	112	6	0.28	2.56	M Dijkstra, Far North Road	
LOC.209171	1612459	6146117	Domestic	79.5	4	0.29	0.88	Jacobson Family Beach, Pukenui	
LOC.314227	1603484	6154651	Not specified	Not specified	-	0.28	2.57	construction	
LOC.201597	1616268	6110687	Monitoring	3.3	1	0.15	0.05	Far North District Council Sandhills Rd, Ahipara Landfill	
LOC.210160	1605092	6152745	Not specified	Not specified	-	0.27	2.88	Landcorp Farming Ltd	
LOC.303423	1604647	6154949	Not specified	Not specified	-	0.23	2.61		
LOC.303423	1604647	6154949	Not specified	Not specified	-	0.23	2.61		
LOC.200295	1608250	6150859	Domestic and Irrigation	5	1	0.24	0.00		
LOC.316843	1605635	6154990	Stock and irrigation	90	6	0.20	2.25	Henderson Bay Avocadoes, 5126 Far North Rd, Houhora	
LOC.307657	1604716	6154912	Domestic	38	1	0.21	0.01	Dobson Rollo, 5207 Far North Road, Ngataki (REG.036499.01)	
LOC.200346	1613456	6145285	Domestic	72.2	5	0.20	0.83	Lynda Maskell Houhora Heads Road	
LOC.300133	1609936.92 4	6149570.4	Not specified	Not specified	-	0.19	1.01	Activity location AUT.036053.01.01	
LOC.301013	1609937	6149573	Not specified	Not specified	-	0.19	1.01	activity location	
LOC.302455	1609937	6149573	Stock	65	6	0.19	1.01	Bill Evans, Saleyard Avenue, Houhora	
LOC.200269	1604246	6155328	Private Water Supply	18.1	1	0.16	0.02	Ngataki School	
LOC.209328	1605693	6154483	Stock	131	6	0.18	2.42	Martin Dijkstra, Far North Road, Henderson Bay	
LOC.200298	1602248	6155022	Stock	9	1	0.14	0.03	C Petra Ngataki	
LOC.200256	1605648	6154433	Irrigation	130	6	0.13	2.42	I Stewart	
LOC.200040	1604345	6155528	Not specified	14	1	0.11	0.02	Ngataki Hall	
LOC.201003	1615269	6110585	Not specified	25.9	3	0.05	0.45	Kataia Golf Club	
LOC.200188	1605445	6154430	Irrigation	135	6	0.11	2.48	Kranenbarg	
LOC.200343	1604205	6155588	Domestic	24	1	0.11	0.02	Joan Norman Ngatiaki Rd	
LOC.200041	1607153	6152438	Not specified	17.3	2	0.09	0.45	L Wedding	
LOC.210269	1608687	6151385	Stock	64	6	0.07	0.75	George Sucich, Far North Road, Houhora	
LOC.209029	1607610	6152523	Irrigation	143	6	0.07	1.19	Antrim Fields Far North Road Houhora	
LOC.209030	1607610	6152523	Irrigation	68.3	3	0.08	1.27	Antrim Fields Far North Road. Houhora	
LOC.201481	1608956	6151044	Irrigation	14.6	2	0.08	0.20	D Urlich Waihopo	
LOC.200181	1605649	6154033	Irrigation	61	6	0.06	2.36	Wilson	
LOC.200156	1609056	6151145	Irrigation	14	2	0.03	0.11	D Urlich	

Attachment B. Radon Sampling Results (May 2019)



Subject	Radon Sampling Results in Kaimaumau Wetland and Implication for Groundwater / Surface Water Interaction					
From	Jon Williamson & Jake Scherberg (Williamson Water & Land Advisory)	Project No	WWA0026			
То	Brydon Hughes (Land & Water Peopl Time Baker (Jacobs) Hugh Robertson (DOC)	Brydon Hughes (Land & Water People); <b>Date</b> Time Baker (Jacobs) Hugh Robertson (DOC)				

#### 1. Introduction

Following the Council Hearing and the Environment Court Appeal on the Council's Decision to grant consents to 17 applicants collectively referred to as the Motutangi-Waiharara Water Users Group (MWWUG), work was initiated to satisfy requirements of the draft Groundwater Monitoring and Contingency Plan (GMCP). In particular, the GMCP requires analysis of a single round of radon samples in and around the Kaimaumau Wetland, amongst a range of other longer-term monitoring.

This memorandum summarises the results of this early radon sampling work, and is intended to provide an update on the understanding of the hydrological and hydrogeological setting of the Kaimaumau wetland. Of particular interest is the connection between water in the wetland and regional groundwater, and thereby any potential effects on wetland conditions that may arise from the proposed groundwater extraction. Several analysis methods have been applied to characterise wetland hydrology, specifically:

- Analysis of hydrological setting.
- Wetland water levels relative to groundwater levels.
- Analysis of dissolved radon concentrations.

#### 2. Hydrological Setting of Kaimaumau Wetland

By way of recap for the technical experts, the Kaimaumau Wetland extends 11 km from Rangaunu Harbour at its southern extent to Motutangi towards its northwest margin, with the Pacific Ocean to the east (**Figure 1**). The wetland is intersected by the Bacica Drain to the north and drained by the Salles and Waikaramu Drains toward the southwest, and the Pirini Drain to the southeast.





Figure 1. Location of Kaimaumau Wetland

The wetland has minimal gradient at the surface, with ground elevation ranging from 6 to 12 mAMSL. The lowest portion of the wetland according the LINZ data is located between the centre of the wetland and the Bacica drain to the north (**Figure 2**). However, it is evident from information provided by Tim Baker that a surface water discharge from the wetlands to the Motutangi Drain near its confluence with the Bacica Drain, and therefore the northern part of the wetland is confirmed as the lowest point in the wetland, as marked on **Figure 2**.

Groundwater level surveys performed in September 2018 show that water levels in the southern portion of the wetland are perched above the shallow groundwater table.





Figure 2. September 2018 groundwater level survey results compared to inferred wetland water levels.

#### 3. March 2019 Radon Sampling

As required under the GMCP, investigations were initiated into wetland water levels and radon sampling in March 2019 in the later stages of a significant drought. Radon isotope analysis was undertaken to determine the significance of groundwater input into the Kaimaumau Wetland. The presence of dissolved radon is indicative of groundwater influx, while a lack of radon indicates that the water source is exclusively rainfall.

The March 2019 sampling was the second time radon had been measured in the wetland, with the first samples collected in February 2017. The sampling locations and results are shown in **Figure 3**.





Figure 3. Surface water and groundwater radon sampling locations. Radon concentrations are shown in BqL<sup>-1</sup>.

**Figure 3** shows that from both sampling rounds, all water samples collected outside of the wetland had radon concentrations above the concentration considered to be indicative of some degree of groundwater contribution (0.5 BqL<sup>-1</sup>), whereas samples collected from drains discharging from the wetland were below this threshold. The sample collected directly from within the wetland and approximately 200 m from the drain (Site 2) in March 2019, was found to have no detectable radon, indicating it is purely rainfall derived.

Low to moderate radon concentrations, approximately 1 BqL<sup>-1</sup>, were found in the Seymour, Selwyn, and Bacica Drains upstream of the wetland. The groundwater inputs in these cases are likely to be a result of shallow aquifer groundwater due to the deep cut drain channels in the case of the Seymour Drain, and seepage from the western sand dunes in the case of the Selwyn Drain.

In the Bacica drain, which begins at the confluence of the Seymour and Selwyn drains, the radon concentration collected from the upstream location (Site 1) in March 2019 measured 0.9 BqL<sup>-1</sup>. At the downstream location (Site 3) the concentration in a sample collected on the same day had reduced to 0.4 BqL<sup>-1</sup>. The Site 3 sample location is a short distance downstream from the location where the wetland has been observed to discharge into the drain (**Figure 3**). It is likely that there are other discharges from the wetland into the drain that have not been documented.

### Memorandum



There are two possible explanations for the reduction in radon concentration as the drain passes through the wetland:

- 1) Natural degassing with travel time; or
- 2) Diluted by inputs from the rainfall derived water from the wetland effectively reducing the radon concentration in the drain.

The Pirini stream, which drains the eastern edge of the wetland, was sampled at its outflow from the wetland area and was found to have a 0.1 BqL<sup>-1</sup> radon concentration indicating no interaction with groundwater at this location.

Water samples from Salles drain, flowing southward out of the wetland, measured 0.1 BqL<sup>-1</sup> at the upstream location in the wetland. At the downstream location, outside of the wetland area, the radon concentration in the Salles Drain increased to 2.6 BqL<sup>-1</sup> indicating a groundwater input that is likely due to the deeply incised drain channel intersecting shallow groundwater. A groundwater sample from the deep aquifer in the Stanisich bore was found to have a radon concentration of 6.3 BqL<sup>-1</sup>.

In total, the results of radon sampling show that radon is present in the groundwater, however it is not detected in the wetland itself, as illustrated by the Site 2 water sample. Several drains interact with groundwater in reaches outside of the wetland, however as they flow through the wetland area they are diluted by wetland drainage water that are of low radon concentration. By contrast, the Salles Drain has a low radon concentration at its headwaters within the wetland, increasing in concentration outside of the wetland where it interacts with shallow groundwater.

#### 4. Summary and Conclusions

The second round of radon sampling was undertaken at the end of a three month drought in mid-March 2019. Results indicate that:

- water from the wetland massif is radon free indicating rainfall derived;
- water in the drain entering the wetland has low to moderate radon concentrations (<0.9 BqL) indicating some groundwater inputs presumably from seepage from the sand dunes and shallow aquifer that intersects the drain further to the west;
- radon concentration exiting the wetland has lower radon concentration (at 0.4 BqL) compared to the incoming water, reflecting dilution from water discharging from the wetland.

In summary, the baseflow in the drain on the inlet to the wetland has some groundwater input (which you would expect i.e. seepage from the sand hills and shallow groundwater on the plains), but as the drain moves through the wetland, the drain water is diluted by discharges from the wetland, which have no groundwater inputs.

We look forward to discussing your thoughts on this.

Yours sincerely,



Manifor.

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