Before an Independent Hearings Panel
Appointed by Waimakariri District Council

under:	the Resource Management Act 1991
in the matter of:	Submissions and further submissions on the Proposed Waimakariri District Plan
and:	Hearing Stream 12: Rezoning requests (larger scale)
and:	**Carter Group Property Limited** *(Submitter 237)*
and:	**Rolleston Industrial Developments Limited** *(Submitter 160)*

Statement of evidence of Bas Veendrick (Hydrology) on behalf of Carter Group Limited and Rolleston Industrial Developments Limited

Dated: 1 March 2024

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STATEMENT OF EVIDENCE OF BAS VEENDRICK ON BEHALF OF CARTER GROUP LIMITED AND ROLLESTON INDUSTRIAL DEVELOPMENTS LIMITED

INTRODUCTION

1 My full name is Bas Veendrick and I am a Technical Director Water Resources at Pattle Delamore Partners Ltd. My qualifications are Master of Science (Hydrology) and Bachelor of Science (Earth Sciences) from Utrecht University in the Netherlands. I am a member of the New Zealand Hydrological Society.

2 I have 16 years of professional work experience as a senior hydrologist and environmental scientist. I specialise in surface water assessments including surface water – groundwater interaction and have undertaken several assessments on the effects of urban development on spring flow.

3 Since 2008, I have been employed by Pattle Delamore Partners Ltd (*PDP*), an environmental consulting firm specialising in surface water and groundwater investigations. During my employment with PDP I have carried out work and presented evidence for district and regional authorities, corporate clients and the Environmental Protection Agency. I have recently undertaken the following projects related to the effects of urban development on spring flows:

3.1 Hydrology evidence for Private Plan Change 69 to the Operative Selwyn District Plan (Lincoln South) and for an associated submission to the proposed Selwyn District Plan.

3.2 Anticipated Baseflow and Water Balance Changes resulting from Stormwater Management Plans in Christchurch. I have undertaken these assessments for Christchurch City Council for the Avon River, Halswell River, Heathcote River, Styx River and Otukaikino Creek catchments.

3.3 Effect of proposed Bellgrove Subdivision on spring flows near Rangiora.

4 I am familiar with the Submitters' request to rezone land bound by Mill Road, Whites Road, Bradleys Road (the *Site*).

5 I was involved in private plan change 31 (*PC31*) to rezone this land under the operative District Plan.

CODE OF CONDUCT

6 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. I have complied with it in preparing my

evidence. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

7 My evidence will address:

7.1 A brief overview of the hydrogeological setting of the Site, groundwater flow patterns and water table depth at and in the vicinity of the Site.

7.2 Comments on the anticipated change in groundwater recharge and spring flow as a result of the proposed rezoning request.

7.3 Comments on the potential for short-circuiting groundwater flow paths caused by hardfill, drains, and service trenches including proposed buffer zones around springs, from a hydrological perspective.

8 In addition to the desktop analysis described in my evidence, I have visited the Site to familiarise myself with the Site characteristics, including the waterways, springs and groundwater seep on the Site.

9 In preparing my evidence, I have reviewed:

9.1 The Outline Development Plan (*ODP*);

9.2 Statement of Evidence (Infrastructure) prepared by **Mr Tim Mcleod** of Inovo Ltd;

9.3 Statement of Evidence (Geotechnical) prepared by **Mr Chris Thompson** of Tetra Tech Coffey.

9.4 Statement of Evidence (Public Water Supply) prepared by **Mr Carl Steffens** of Pattle Delamore Partners Ltd;

9.5 Statement of Evidence (Ecology) prepared by **Ms Laura Drummond** of Instream Consulting Ltd;

9.6 Further submissions relevant to my expertise relating to the rezoning of the Site; and

9.7 The relevant documents from PC31.

SUMMARY OF EVIDENCE

10 I consider that the change in groundwater recharge due to the subdivision development and contributing to spring flow as a result of the rezoning request is relatively small and unlikely to be an issue of concern. This is based on the available hydrogeological and soil information which indicate a large overall spring capture zone and poorly or imperfectly drained soils on the Site. Based on these considerations it is likely that the groundwater recharge from the current (rural) development footprint is relatively small, which in turn means that changes to that recharge due to developing the Site is likely to result in only minor changes in spring flow and spring water levels.

11 The proposed rezoning of the land has the potential to re-direct/short-circuit flow paths away from springs as a result of the construction of drains, service trenches and roads (with underlying hardfill). For example, service trenches backfilled with gravels and hardfill areas can be much more permeable than some of the surrounding natural strata and if shallow groundwater (in water bearing seams or layers) is intercepted they may act as preferential groundwater flow paths lowering the groundwater pressure and/or diverting water away from spring heads. This potentially results in reduced spring flows.

12 I understand from the evidence of **Mr McLeod** that construction methodologies are available (which have been used in recent subdivisions in Christchurch) to avoid these potential issues. These measures involve ensuring that any groundwater in the water bearing layers will not be diverted to a new exit point through the backfill. These potential measures include the use of backfill material with the same/similar permeability as the surrounding strata, using low permeability backfill material in trenches for underground services to provide a plug that avoids diversion of groundwater into a different catchment and use of directional drilling instead of trench excavation.

13 The anticipated excavated depth of service trenches is in the order of 1.0 to 1.2 m and hardfill will only be used under the roads at an excavation depth in the order of 0.6 m. To help inform where groundwater diversion mitigation measures are likely to be required (for excavation trenches and hardfill under the roads) I recommend that piezometers be installed to determine the groundwater level range and maximum groundwater levels on the Site. I have also recommended spring water level and flow measurements prior to, during and following construction.

14 The ODP text now includes:

14.1 a requirement to undertake groundwater and spring water level monitoring and spring flow investigation across the Site to inform the construction methodologies that are applied in different parts of the Site, related to shallow groundwater issues; and

14.2 a requirement to specify construction measures to ensure that shallow groundwater is not diverted away from its natural flow path for those areas where the shallow groundwater (in water bearing seams or layers) is likely to be intercepted by service trenches and hardfill areas.

15 I consider that with these measures in place, the potential adverse effects of the proposed rezoning request on hydrology (spring flow and spring water levels) can be adequately mitigated.

HYDROGEOLOGICAL SETTING, GROUNDWATER FLOW PATTERNS AND WATER TABLE DEPTH

16 The Site is located on the northern Canterbury Plains (i.e. the Waimakariri – Ashley Plains). The Canterbury Plains comprise a series of large coalescing fluvio-glacial fans built by large braided rivers (e.g. the Rangitata, Rakaia and Waimakariri) that transported detritus (gravel with sand and silt) eastwards from rapidly rising and eroding mountains in the west. Most of the gravel deposition occurred during successive glaciations, when glaciers partly occupied the inland valleys and extended to the eastern foothills (Brown, L.J., 2001[1]).

17 The GNS geological map of the area (Forsyth et al., 2008[2]) maps the near-surface geology of the Site as late Pleistocene brownish-grey river alluvium. Geotechnical investigations at the Site encountered silt and clayey silt to a depth of 0.6 to 1.5 m below ground level (bgl), and sandy gravel below this (Tetra Tech Coffey, 2021[3]). A map showing the location of the Site within the context of the northern Canterbury Plains is provided in **Appendix 1** of my evidence.

18 A review of soil information available on S-map (Landcare Research) indicates that the soil types underlying the Site predominantly consist of Ayreburn moderately deep clay, with small sections on the northern and southern parts of the Site consisting of Ayreburn deep clay and Leeston shallow clay respectively. The soils determine the rate at which rainfall and associated stormwater infiltrate into the ground and recharge the underlying aquifer. S-map indicates that the Ayreburn moderately deep and deep clay and the Leeston

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[1] Brown, L. J. (2001). Canterbury. In M. Rosen, & P. White (eds), Groundwaters of New Zealand (pp. 441-459). New Zealand Hydrological Society Inc., Wellington.

[2] Forsyth, P., Barrell, D., & Jongens, R. (2008). Geology of the Christchurch area. 1:250 000 geological map 16, Institute of Geological & Nuclear Sciences, Lower Hutt.

[3] Tetra Tech Coffey. (2021). 535 Mill Road, Ōhoka - Geotechnical Assessment Report. Report reference number 773-CHCGE288040 prepared for Rolleston Industrial Developments Ltd. Dated 1 June 2021

shallow clay are poorly drained. A map showing the soils on the Site is attached as **Appendix 2** to my evidence.

19 On the Waimakariri-Ashley Plains, groundwater is dominantly sourced from infiltrating rainwater (i.e. land surface recharge) across the inland plains upgradient of the Site, together with some seepage losses from the Ashley and Waimakariri rivers (Brown, 2001[1]). **Appendix 1** shows the general direction of groundwater movement in the overall area, indicating that groundwater generally flows to the southeast, towards the coast. Groundwater discharges into spring fed streams, including Ōhoka Stream and the Cam River/Ruataniwha. Springs mapped on the Canterbury Maps database are also shown on **Appendix 1**.

20 **Appendix 3** of my evidence shows the springs and waterways on the Site. Two main springs are mapped on the Site, known as the northern and southern springs. The northern spring is near the western boundary of the Site and is the source for the waterway described as Northern Spring Channel (Aquatic Ecology, 2021[4]). The southern spring is near the centre of the Site, located at a pond, and is the source for the waterway described as Southern Spring Channel. Another groundwater discharge point is located on the northeastern part of the Site and is described as a groundwater seep. This is the source for another small waterway north of the Northern Spring Channel.

21 The springs and springfed streams depicted in **Appendix 1** and **Appendix 3** represent regional groundwater discharge points, and as a result the source of water for the springs is likely to represent a spatially large groundwater catchment that extends a substantial distance upgradient (i.e. north-west) from the Site. Delineating the precise capture zone for springs is uncertain, however based on available piezometric contours and our conceptual understanding of the groundwaters of the Ashley-Waimakariri Plains, groundwater discharging via the springs at the Site is expected to be dominantly rainfall derived. Given the relatively high (but variable) permeability of the deeper strata that makes up much of the Canterbury Plains, and the generally deeper groundwater table upgradient of the Site, a large overall spring capture zone is expected for the springs on the Site.

22 A long-term record of groundwater table fluctuations at the Site is available from bore M35/0596, which is on the western-central part of the Site. The location of this bore is shown in **Appendix 3**. This bore has a sporadic available record of water level measurements from September 1977 to October 1986, and weekly to monthly measurements by Environment Canterbury from August 1999 to February 2024 as shown in **Appendix 4** attached to my evidence.

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[4] Aquatic Ecology Ltd. (2021). Land Use Change, 535 Mill Road, Ōhoka; Aquatic Ecology Report. AEL Report No. 192 prepared for Rolleston Industrial Developments Ltd, dated November 2021

The original depth of this bore was recorded as 9.6 m. In 2009 the depth of the bore was recorded as 2.9 m, presumably due to sediment accumulation in the bore, or collapse/blockage of the bore casing.

23 The record from M35/0596 shows that the groundwater level at this Site is generally shallow, with a mean measured groundwater level of 0.63 m bgl. The highest measured groundwater levels were 0.12 m bgl in March 2023 and 0.14 m bgl in June 2018 and the lowest levels were 1.4 m bgl in July 1999 and 1.38 m bgl in February 2017. Seasonal fluctuations are relatively small, commonly being 0.5 – 0.8 m. As expected, groundwater levels are generally highest in winter/spring and lowest in summer/autumn. It is noted that bore M35/0596 is close to the Northern Spring (approximately 60 m away), and so may be in an area of the Site that has particularly high groundwater levels.

24 During geotechnical investigations at the Site, conducted in May 2021, groundwater was encountered at a depth of 0.9 to 1.5 m bgl in test pits excavated at 11 locations across the Site (Tetra Tech Coffey, 2021[3]). In a further 11 test pits groundwater was not encountered at the base of the test pits, which ranged in depth from 0.6 – 1.7 m. The locations of these test pits, and the groundwater levels encountered, are shown in **Appendix 5** attached to my evidence. Comparison of the long-term groundwater level record from bore M35/0596 shows that the test pits were likely conducted during a time when groundwater levels were lower than the mean groundwater level (as shown in Figure 4). However, the groundwater levels from test pitting are useful in showing where the groundwater table is likely to be relatively shallow or deeper across the Site, including that there is variability of groundwater depths across the Site.

POTENTIAL HYDROLOGICAL EFFECTS OF THE REZONING REQUEST

25 The two key potential hydrological effects in relation to spring flows resulting from rezoning the land are:

25.1 A potential decrease in groundwater recharge contributing flow to springs due to an increase in impervious area;

25.2 The potential for re-directing/short-circuiting groundwater flow away from springs as a result of hardfill, drains, and service trenches.

26 I address the potential effects of these matters separately below.

Change in groundwater recharge as a result of the rezoning

27 Urban development has the potential to change (reduce) groundwater recharge due to the increase in impervious surfaces

(roofs and pavements) which has the potential to reduce land surface recharge (the source of the spring flow).

28 As detailed in paragraph 21 of my evidence the available information indicates a spatially large groundwater catchment for the springs that extends a substantial distance upgradient (i.e. north-west) from the Site. In addition, the soils on the Site are generally poorly drained (refer to paragraph 18 of my evidence) indicating that in the current (rural) state groundwater recharge from the development footprint area contributing to spring flow is likely to be small.

29 Based on these considerations I consider that the change in groundwater recharge contributing to spring flows as a result of the proposed development is relatively small and unlikely to be an issue.

Potential for re-directing/short-circuiting of groundwater flowpaths

30 One of the key potential effects of urban development on spring flows is the potential for drains, service trenches (for stormwater, sewer, telecommunication and electrical networks) and hardfill areas to intercept shallow groundwater and re-direct groundwater flow away from springs. Service trenches backfilled with gravels and hardfill areas can be much more permeable than the surrounding strata and if shallow groundwater (in water bearing seams or layers) is intercepted, they may act as preferential groundwater flow paths lowering the groundwater level and/or diverting water away from spring heads. This potentially results in reduced spring flows.

31 Based on these considerations, construction measures should be utilised to ensure that shallow groundwater is not diverted away from its natural flow path. I note that this approach is not new. For example, Christchurch City Council (*CCC*) require that any new stormwater pipe networks will be designed and constructed so that any diversion and discharge of shallow groundwater that might impact baseflow in streams and springs is avoided by implementing appropriate mitigation measures (as noted in section 5.10.8 of the Council's Infrastructure Design Standard[5]). These measures involve ensuring that any groundwater in the water-bearing seams and layers will not be diverted to a new discharge point through the backfill. More specifically, they require that backfill material with the same permeability as the surrounding ground will be used. In addition, CCC require low permeability backfill material to be used in trenches for underground services to provide a plug that avoids diversion of groundwater into a different catchment.

32 As detailed in the evidence of **Mr McLeod** hardfill may be required under roads and the excavation depth for roads is likely to be in the

[5] https://ccc.govt.nz/consents-and-licences/construction-requirements/infrastructure-design-standards/download-the-ids/

order of 0.6 m, much shallower than the anticipated excavated depth of service trenches (1.0-1.2 m deep). If required, engineered soils with low permeability or incorporation of geotextiles instead of granular hardfill can be used to avoid re-directing groundwater in areas of shallow groundwater.

33 As detailed in paragraph 22 to 24 of my evidence groundwater levels at monitoring bore M35/0596 vary from 0.12 – 1.4 m bgl which provides a good indication of the groundwater level range and maximum groundwater levels near the northern spring. Some groundwater level information is available for other areas of the Site (refer to **Appendix 5**). However, this groundwater level information is from one off groundwater level measurements and does not capture any potential seasonal groundwater level fluctuations nor does it capture maximum groundwater levels as these measurements were undertaken at a time that groundwater levels were relatively low (refer to **Appendix 4**).

34 To help inform the mitigation measures that may be required, I recommend that piezometers will be installed and monitored to determine the groundwater level range and maximum groundwater levels on the Site.

35 This groundwater level information can then be used to determine where excavations (for example for service trenches and roads) are likely to intercept shallow groundwater. For these areas the mitigation measures described above should be implemented to ensure spring flows on the Site are not adversely affected by the proposed urban development. Mitigation measures should focus on areas in the vicinity of the springs and groundwater seep (refer to **Appendix 3**).

36 In addition to groundwater level monitoring, I also recommend spring water levels and spring flow monitoring prior to, during and following construction to provide more certainty on the potential lowering of groundwater levels and subsequent potential adverse effects on spring flow.

37 The ODP text now includes a requirement to undertake groundwater level, spring water level and spring flow monitoring across the Site. The monitoring will enable the collection of data which can be used to identify the most appropriate management measures to avoid adverse hydrological effects as a result of the rezoning and development of the land.

38 In addition, the ODP text now also includes a requirement to specify construction measures (in the vicinity of the springs and groundwater seep) to ensure that shallow groundwater (in water bearing seams and layers) is not diverted away from its natural flow path for those areas where the shallow groundwater is likely to be intercepted by service trenches and hardfill areas.

39 With the proposed monitoring and mitigation measures in place, I consider that the potential adverse effects of the proposed rezoning request on spring flows can be adequately mitigated. I note that the ODP and ODP text also specifies a buffer distance of 30 meters between the developed areas and springs. A 10 meter buffer distance is also proposed between the developed areas and the groundwater seep shown in **Appendix 3**. Based on my understanding of the hydrogeologic characteristics of the Site, the proposed separation distances should be more than sufficient to avoid any adverse hydrological effects on the springs and groundwater seep. Further details on the proposed (ecological) rationale for the proposed buffer distances is provided in the evidence of **Ms Drummond**.

CONCLUSION

40 In my evidence I have considered the key potential hydrological effects in relation to spring flows and spring water levels as a result of the rezoning request.

41 In summary I consider that:

41.1 The potential for re-directing shallow groundwater flow away from springs can be adequately mitigated through the appropriate design and construction of underground service trenches and roads in areas where they are likely to intercept shallow groundwater. In these areas, appropriate mitigation measures are available to ensure spring flows and water levels are not adversely affected.

41.2 The buffer distance of 10 - 30 meters between the developed areas and the springs and groundwater seep as outlined in the ODP and ODP text, further reduces the risk of any potential adverse hydrological effects on spring flows.

41.3 The potential decrease in groundwater recharge contributing flow to springs due to an increase in impervious area is unlikely to be an issue.

Dated: 1 March 2024

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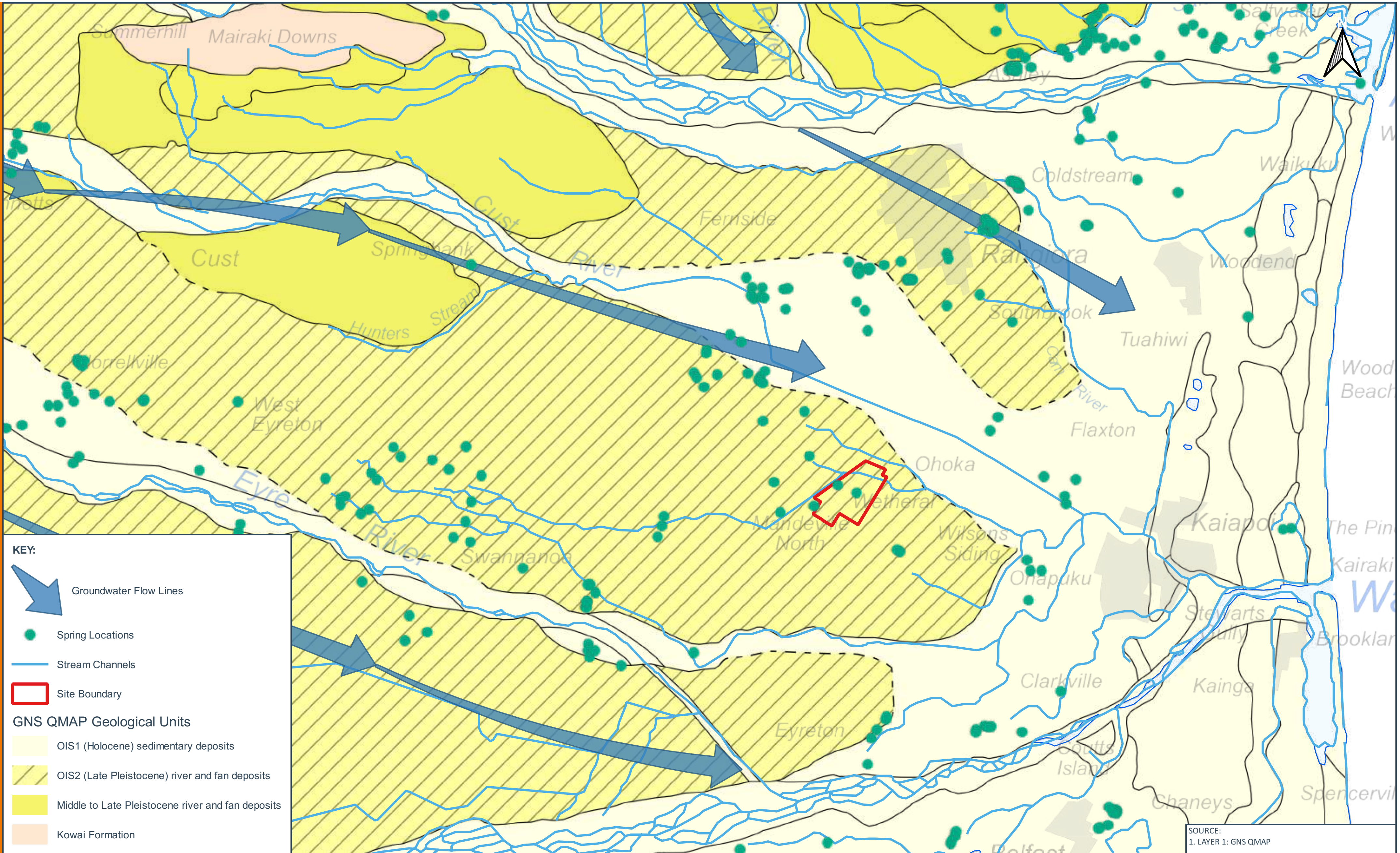
Bas Veendrick

APPENDIX 1 - GROUNDWATER FLOW PATHS AND HYDROGEOLOGICAL SETTING



pdp

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KILOMETRES

SCALE : 1:120,000 (A4)

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CLIENT

ROLLESTON INDUSTRIAL DEVELOPMENTS LTD

FIGURE

FIGURE 1: GROUNDWATER FLOW PATHS AND HYDROGEOLOGICAL SETTING

PROJECT

HYDROLOGICAL ASSESSMENT - OHOKA PLAN CHANGE

APPENDIX 2 – SOIL MAP

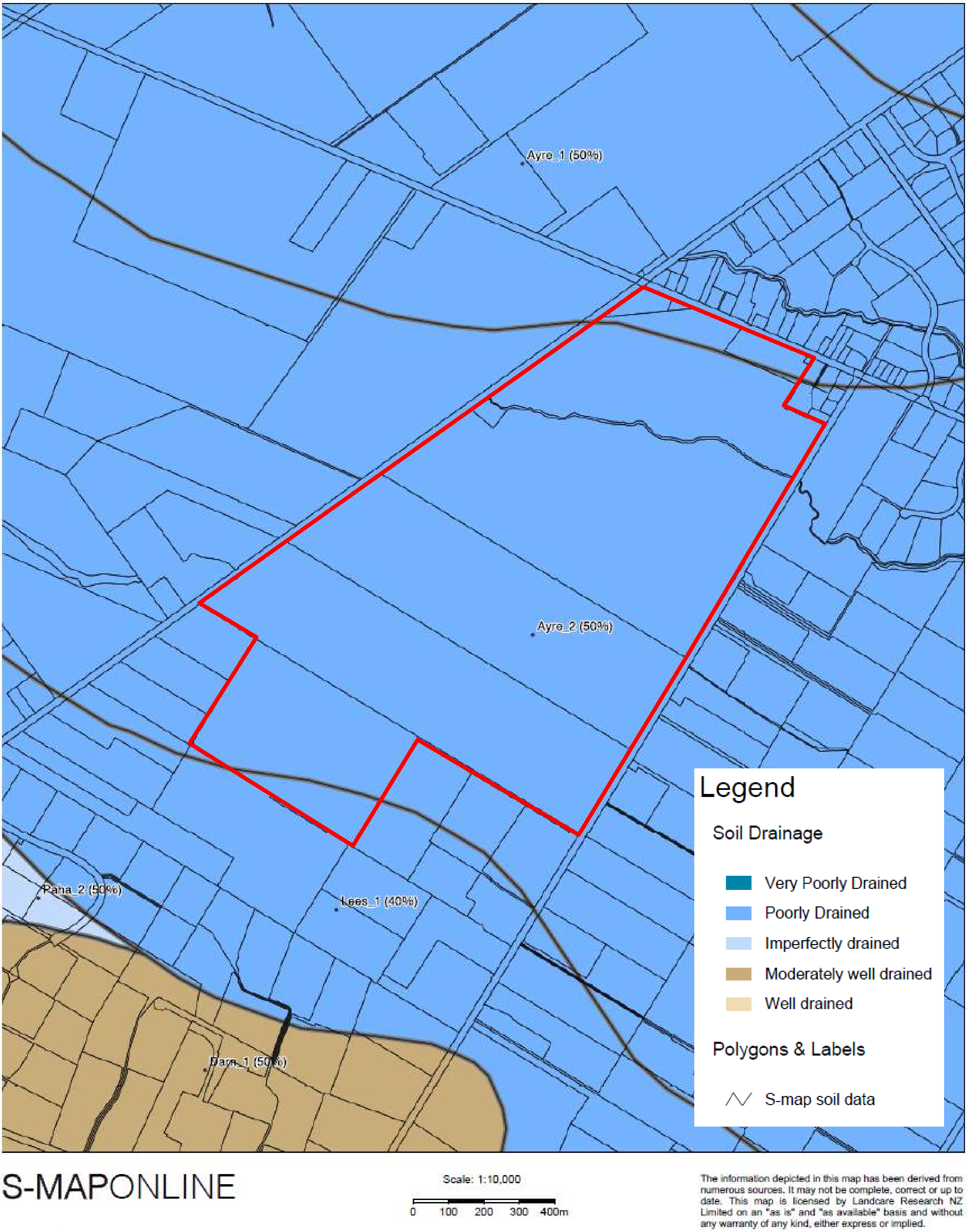

FIGURE 2: S-MAP SOIL TYPES AND SOIL DRAINAGE. SITE BOUNDARY SHOWN IN RED.

APPENDIX 3 – SITE DETAIL

pdp

0 100 200 m
METRES
SCALE : 1:10,000 (A4)

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SOURCE
1. LAYER 1: LINZ background maps
2. LAYER 2: Canterbury Maps

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FIGURE
FIGURE 3: SITE DETAIL

PROJECT
HYDROLOGICAL ASSESSMENT - OHOKA PLAN CHANGE

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APPENDIX 4 - GROUNDWATER LEVEL RECORD FOR MONITORING BORE M35/0596

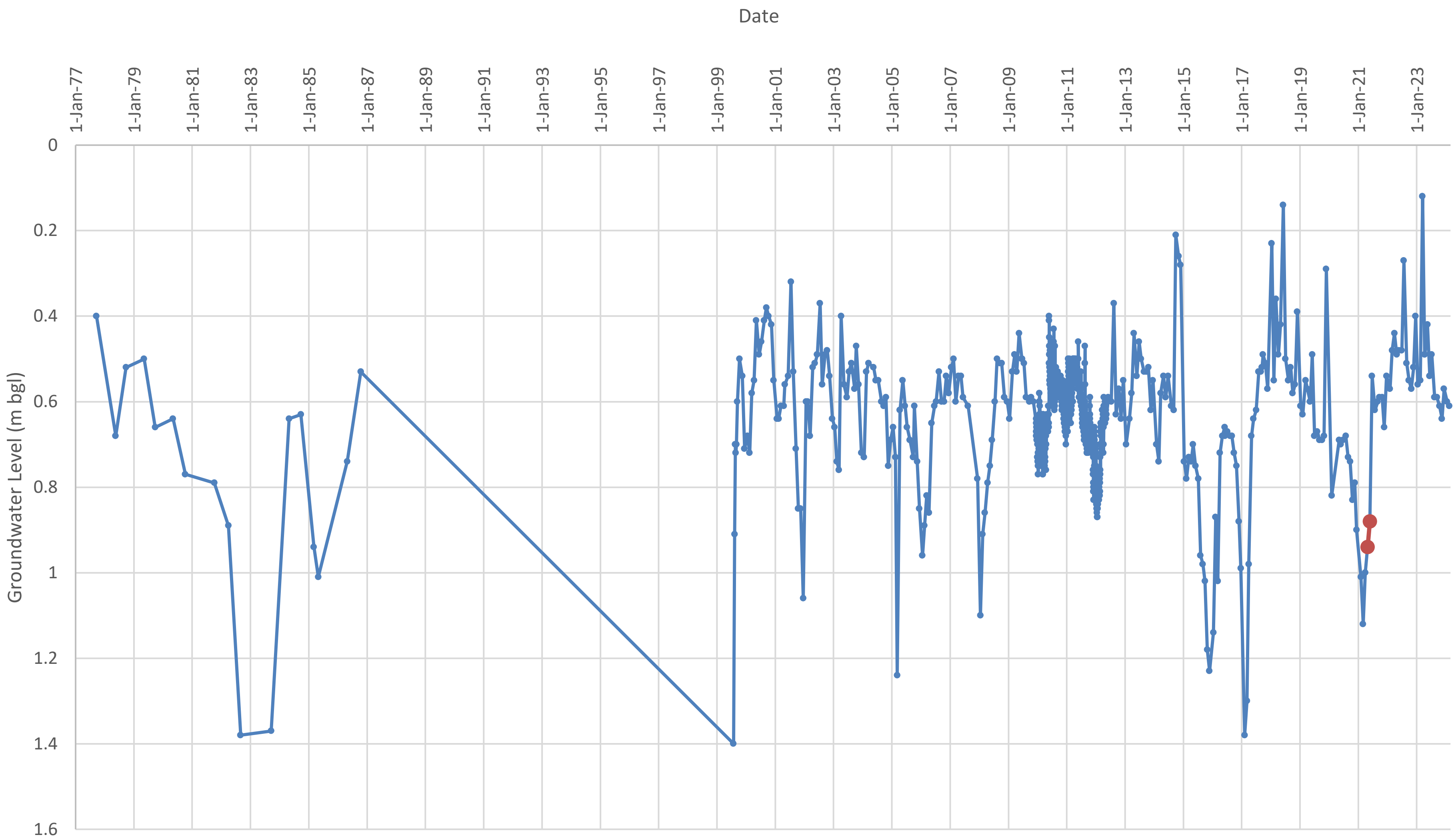

FIGURE 4: GROUNDWATER LEVEL RECORD FOR MONITORING BORE M35/0596. THE MEASUREMENTS RECORDED IN APRIL AND MAY 2021 (THE TIME PERIOD WHEN TEST PITTING OCCURRED ON SITE) ARE HIGHLIGHTED IN RED.

APPENDIX 5 - DEPTH TO GROUNDWATER ACROSS SITE AS RECORDED IN TEST PITS

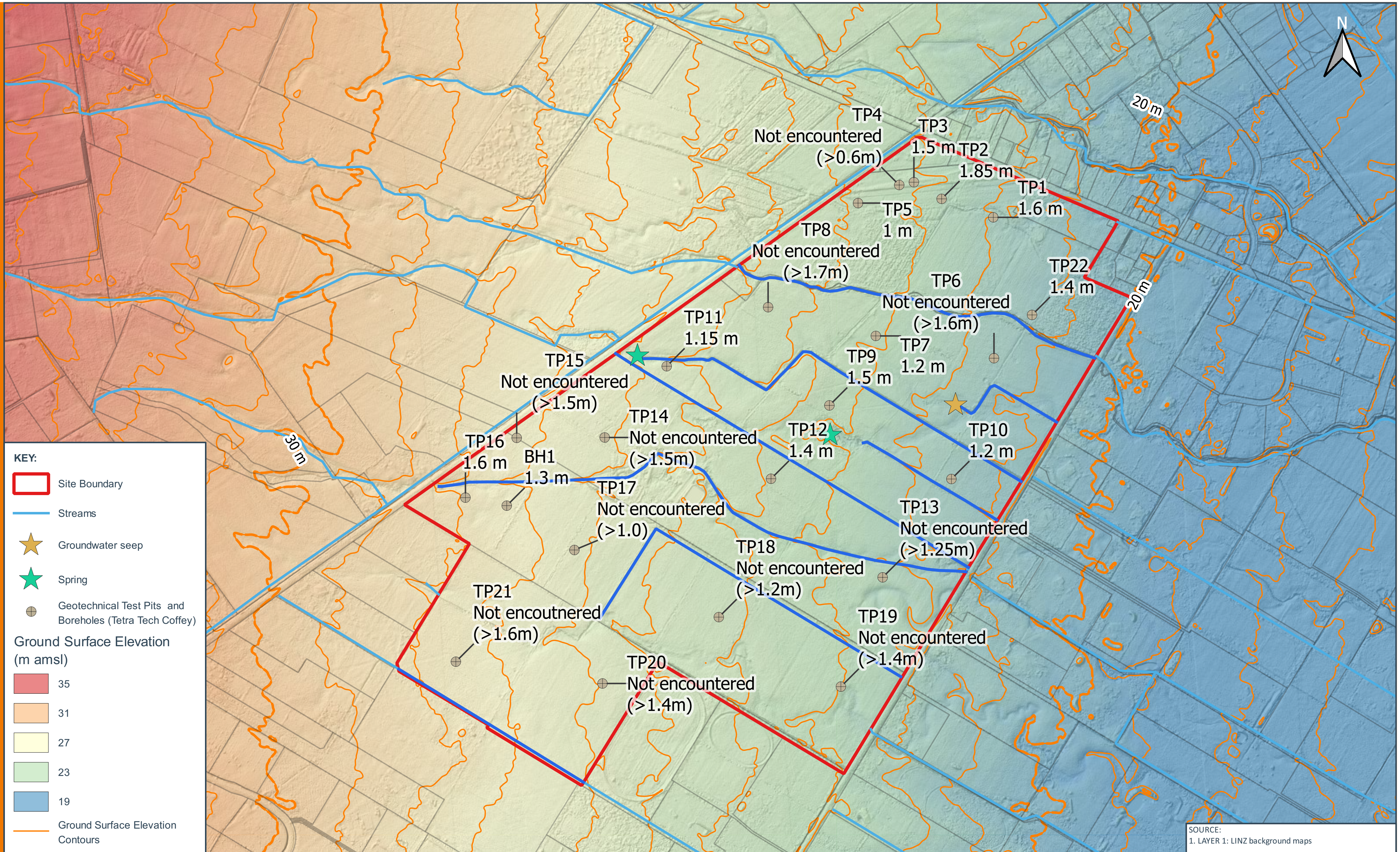

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FIGURE

FIGURE 5: DEPTH TO GROUNDWATER ACROSS SITE AS MEASURED IN TEST PITS

PROJECT

HYDROLOGICAL ASSESSMENT - OHOKA PLAN CHANGE