**BEFORE INDEPENDENT HEARING COMMISSIONERS**

**AT NAPIER AND WAIPAWA**

**I MUA NGĀ KAIKŌMIHANA WHAKAWĀ MOTUHAKE**

**KI AHURIRI A WAIPAWA**

| | |
|---|---|
| **IN THE MATTER** | **of the Resource Management Act 1991** |
| **AND** | |
| **IN THE MATTER** | **of the hearing of submissions on applications for Tranche 2 Groundwater** |

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**STATEMENT OF PRIMARY EVIDENCE OF SUSAN RABBITTE ON BEHALF OF T2 COLLABORATIVE GROUP**

**(HYDROGEOLOGY)**

**31 OCTOBER 2022**

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## 1. EXECUTIVE SUMMARY

1.1 A new groundwater irrigation consent application is in process for an allocation of water identified in the Hawke's Bay Regional Council (**HBRC**) Tukituki Plan Change 6 (**PC6**) as Tranche 2 (**Tranche 2** or **T2**). The T2 groundwater allocation limit for the Ruataniwha Basin (**Basin**) is 15M $m^3$, but to access it there is a requirement to augment river flows to offset the impacts on low flows from the taking.

1.2 The concept is to use water stored in the aquifer as a buffer and to support river flows during times of low flow. However, this will still result in greater volumes of water being abstracted from the basin, and over the longer term the water table will reach a new lower dynamic equilibrium. This new lower equilibrium groundwater level may affect existing wells within the Basin. The application includes consideration of this potential effect in the form of a well interference (**WI**) assessment.

1.3 For this WI assessment all the wells recorded within the Ruataniwha Basin, a total of 724 wells, were considered. 9 wells were less than 3m in total depth, 2 were greater than 1km deep (old oil exploration wells), and 47 with no depth related information, were removed from detailed consideration, leaving 666 wells that are individually assessed. These wells were divided into 3 groups based on their recorded or assigned top screen heights. These categories were based on our understanding of the Basin's physical geology (shallow gravels [<20m top screen] Young Gravels [20-50m top screen] and Salisbury Gravels [>50m top screen]). This allowed separate consideration of variations in static water levels (**SWLs**) with depths and differing temporal responses.

1.4 A methodology for assessment was developed. The magnitude of interference was predicted by the numerical model, for each of the 666 individual well locations based on their positions and top screen heights. 4 different abstraction use scenarios were modelled. The background water levels and temporal fluctuations of them were assessed using available historical static water level (**SWL**) information from the State of the Environment (**SOE**) monitoring well network.

1.5 Specific well details such as total depth, screen height and location were also used in the assessment along with an appropriate pump length allowance.

1.6 An average value of the lowest 10% of SWL measurements from the SOE wells provided a weighted average. This was then adjusted for observed water level declines and a top casing reference point. This data was used to create contour plots of the SWL surface, from which values for the 666 assessed wells were interpolated.

1.7 This SWL estimate along with the top screen elevation allowed calculation of available head (**AH**), or the height of water column in each well available for use by the well owner, at all the assessed well locations. The magnitude of the drawdown prediction at each location, as made by the numerical model, was then compared as a percentage against the AH.

1.8 In some cases, the difference between SWL and top screen is negative meaning the well is potentially "inefficient". A total of 44 wells were identified in this category and almost all are very shallow, with <6m top screens.

1.9 Uncertainty analysis was undertaken by using a range of values generated from the modelling to represent the 5%ile and 95%ile outputs for the T2 drawdown predictions. Comparisons were made of the SWL contours against water level difference plots generated by the model. Direct comparison was also made of measured SWL and modelled values at well locations against those interpolated from the contour plots.

1.10 Where the drawdown prediction, as a percent of available head (AH), has a value of 20% or more this highlighted or flagged those wells for further specific consideration. It is noted that this value still retains 80% of the available water column for the well owners to access their water requirements.

1.11 The worst-case abstraction scenario and most conservative end of the drawdown prediction (5%ile) range of values identified 67 wells for further consideration. I would expect that the predicted interferences will not be problematic in all these flagged wells. Factors such as an existing use for example groundwater monitoring would mean a reduction in AH is of little consequence or the 2m pump length may not be realistic because the well diameter is simply too small to accommodate such a big pump. Therefore, further specific assessment is required, and that information will be presented at the hearing.

## 2. INTRODUCTION

**2.1** My name is Susan Claire Rabbitte. I hold a BA (Hons) in Natural Science (Geology) from Trinity College Dublin and a MSc and Diploma in Petroleum Geology from Imperial College London.

**2.2** I have worked specifically in the Hawke's Bay Region and also the wider North Island providing groundwater consultancy services to consent applicants for the last 16years. I have been involved in numerous water permit consent applications, including preparing submissions and hearing evidence for the Tukituki Plan Change. Prior to moving to NZ I spent 5 years in the UK as a groundwater and contaminated land consultant.

2.3 I have provided technical groundwater consultancy services to the applicants. I prepared from 2016 the original individual T2 water permit applications for Plantation Road, Buchanan's and Purunui. Following the formation of the Collaborative Group, in 2019, I was instructed to prepare the groups' Well Interference (WI) Assessment that was part of the AEE. More recently I also provided the Addendum Well Interference Report and Summary of WI Methodology (15 October 22).

2.4 Following further peer review and technical conferencing (20 October 22) it was determined that some additional modifications to the method, and further information, would improve confidence in the outcome of the Well Interference assessment. An Updated Summary of WI Methodology (29 October 22) was prepared and is attached to this evidence as **Appendix A**.

**Code of Conduct**

2.5 Although this is a Council hearing, I have read the Environment Court's Code of Conduct and agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this statement of evidence are within my area of expertise.

**Scope of Evidence**

2.6 My evidence will address the following matters:

(a) Consent Application Summary

(b) Numerical Modelling

(c) Review Aquifer Parameters

(d) Well Interference Methodology

(e) Well Interference Results

2.7 Where appropriate and relevant, my evidence will reference and rely on the evidence of Julian Weir (Numerical Modelling) and Alexandra Johansen (Review of Aquifer Parameters / Field Assessment Shallow Wells), whose opinions I agree with.

## 3. CONSENT APPLICATION SUMMARY

3.1 This water permit application is for irrigation water identified under the T2 allocation within the HBRC Tukituki PC6. However, there are restrictions on the take and use of it. To access the water there is a requirement to augment river flows to off-set the impacts on them of the T2 taking. The concept is to use aquifer storage as a buffer and to support river flows during times of low flow. However, this will still result in greater volumes of water being abstracted from the basin and over the longer term the water table will reach a new lower dynamic equilibrium.

3.2 The consent application comprises a collaborative group of applicants that have come together for this application to effectively address and manage the potential effects of the proposed taking on the surrounding environment and other nearby water users. The eight applicants are: Te Awahohonu Forest Trust (**TAFT**), Papawai Partnership, Tukituki Awa, Plantation Road Dairies, Springhill Dairies, I & P Farming, Buchanan Trust No. 2 and Purunui Trust. The locations of the applicants' properties, the proposed augmentation points, and the model area boundary are shown on the map in Figure 1.

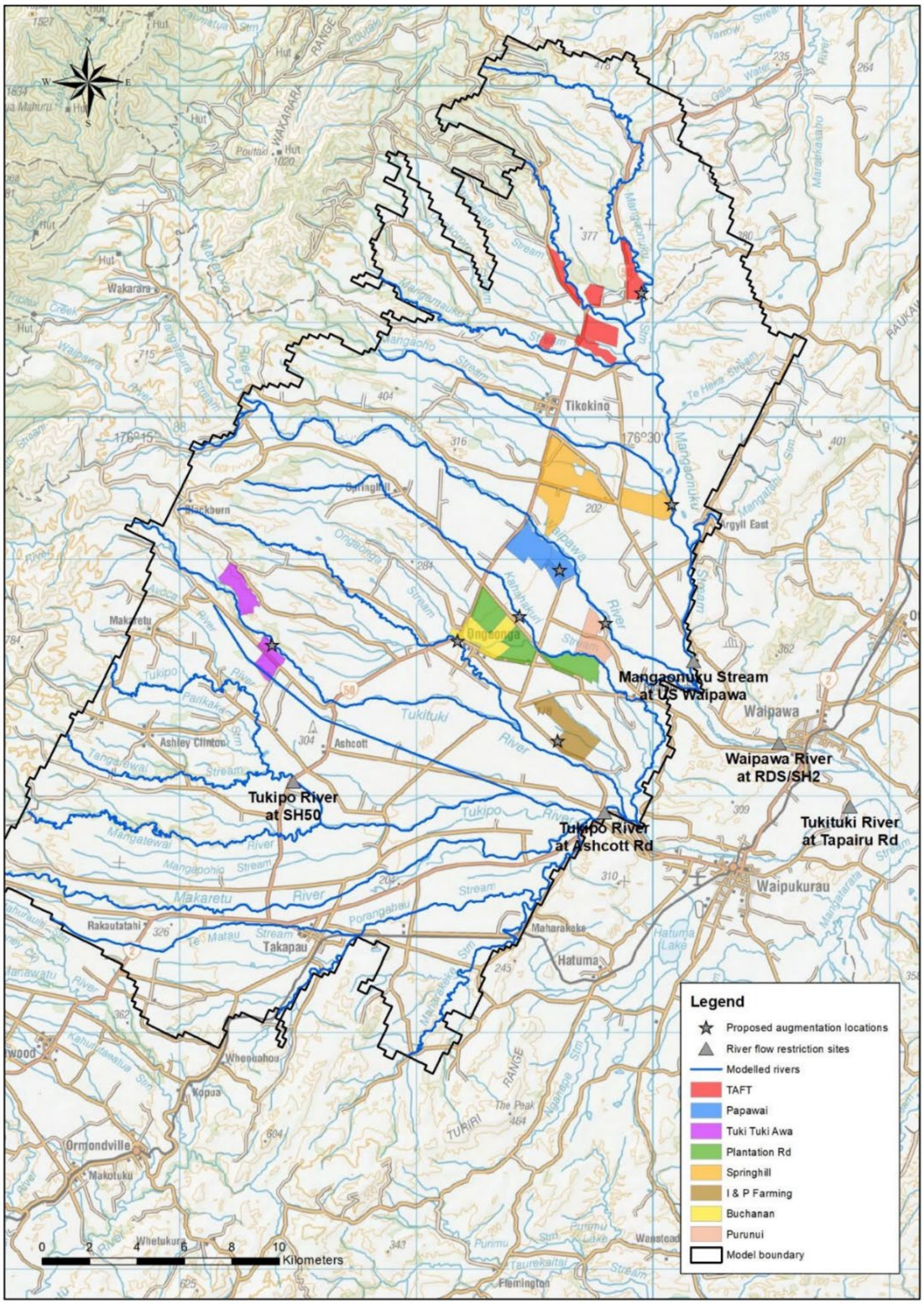
## 4. NUMERICAL MODELLING

4.1 A 3D numerical groundwater model was developed in 2013 by Julian Weir (Aqualinc Ltd), during the PC6 process. This model was recently updated and used to test the hydraulic response of the Basin's groundwater and surface water system, from multiple proposed T2 groundwater take applications. This revised model then informed the augmentation requirements and was used to identify an optimised scenario that provides for mitigation of the adverse impacts on river flows whilst maximising irrigation use. The effects of the T2 taking were shown to be basin wide and mitigation requires a distributed approach to augmentation locations.

4.2 Greater volumes of water will be abstracted from the Basin and over the longer term the water table will reach a new lower dynamic equilibrium. This lower water level has the potential to adversely impact existing well users within the Basin causing a reduction in their supply security.

4.3 The numerical model was used to assess several scenarios for the combined effects of all applicants together with augmentation. An optimised scenario (Scenario 4), that has the most water taken for irrigation versus that taken for augmentation, was identified and compared against a Status Quo scenario. Scenario 4 includes for Tuki Tuki Awa to abstract T2 water only to fill gaps in their existing surface water taking. Overall, augmentation scenario 4 is having a positive effect on the 7-day MALF exiting the Basin, and also fully or nearly mitigates the effects on low flows in both the Mangaonuku and Tukipo rivers.

Figure 1: Locations of Applicants' Properties

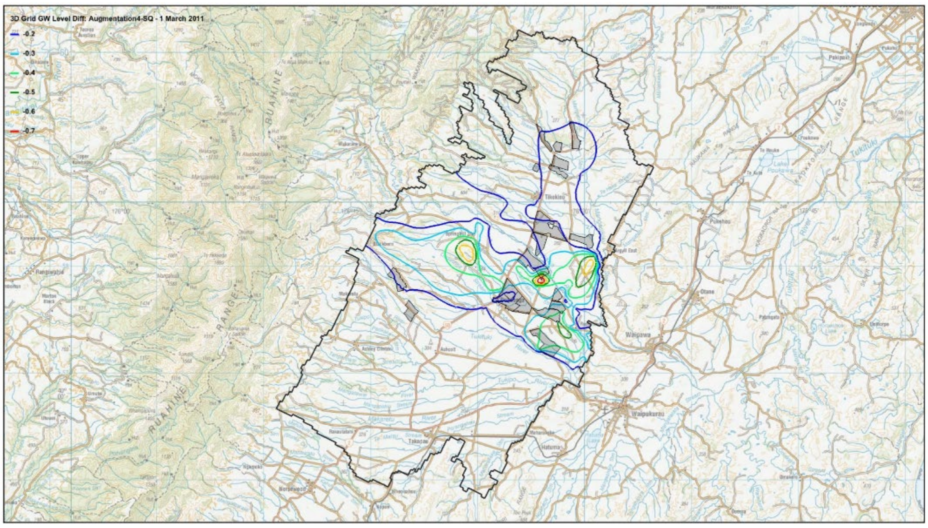



4.4 A map of groundwater level difference between the Status Quo and Augmentation Scenario 4 (March 2011) was presented, it is shown here in Figure 2. It shows how groundwater levels are predicted to change spatially during dry periods. The shallow (Layer 1) groundwater levels are predicted to lower up to a maximum of 0.7m, focussed in areas of greatest abstraction i.e. near the bulk of the applicants' properties. Elsewhere, shallow groundwater levels are predicted to change less than 0.2m.

4.5 Groundwater will not be mined. While groundwater levels will lower further with the additional Tranche 2 takes (made available under PC6), they will not continue to lower; they will simply reach a new (lower) dynamic equilibrium (Weir, 2022).

4.6 The time for the new groundwater level equilibrium to be reached varies depending on location and depth. The full effects of the proposed Tranche 2 activities are predicted to take between zero and 40+ years to be fully realised. On average, the full effects are predicted to be reached within approximately 10 years and 90% within approximately 7 years (Weir, 2022).

Figure 2: Difference in Shallow (Layer 1) Groundwater Level




## 5. REVIEW AQUIFER PARAMETERS

5.1 Locally derived aquifer parameters, calculated from aquifer pump testing, were reviewed by Alexandra Johansen (Bay Geological Services Limited) to aid understanding of the expected basin response to the proposed T2 abstraction. Focus was on aquifer parameters for wells >50m in depth as it is expected that all T2 abstraction wells will be screened at depths >50m.

5.2 The Ruataniwha Basin comprises a series of spatially distributed and discontinuous alluvial aquifer deposits with variable properties. There are no discrete gravel aquifers present. High transmissivity (T) values >1,500m$^2$/d occur at depths of 40m to 60m below ground level (bgl). Four deep wells (>75m) with high T values, are located between the Kahahakuri Stream and Waipawa River. Their aquifers are a result of adjacent well-developed, clean gravel paleo-channel deposits. Significantly lower T values are reported south of the Tukituki River, a less active depositional setting. This lower activity resulted in a meandering river with a channel off-set by tectonic activity and subsequently less well-developed gravel rich paleo-channels.

5.3 Storativity (S) values reduce with increasing depth and confinement. S values of 0.001 to 0.002 are common in the basin centre at 40m to 75m bgl, lowering to 0.0001 to 0.00001 in the north and west. At depths of >75m the S value is generally between 0.0005 to 0.00001. This is consistent with expectations in this geological setting where tectonic basin development results in alluvial in-filling. The bulk of the historically successful wells (and proposed T2 abstraction) are focused in the basin centre, more marginal performances are reported toward the boundaries. Centrally the T and S values are higher and the aquifers can better sustain abstraction with lower surrounding impacts. This is because the transmission of effect is more rapidly and widely distributed within the Basin at this level, more is gained from the higher storage component, and recharge is rapid.

5.4 Therefore, despite the greater proportion of T2 abstraction occurring in the central area of the Basin the water level difference is minimal. As the effects propagate northwards and combined with the abstractions at the northern end of the basin, the lower aquifer parameters are less able to distribute effects and maintain recharge. A greater decline occurs. South of the Tukituki River there is no T2 abstraction and subsequently less water level difference effects at deeper levels in this area. However, over time the effects continue to spread and propagate to the surface. The more basin wide and smaller magnitude impact is apparent, and this is reflected in the water level difference contour map provided by the numerical model and shown in Figure 2.

## 6. WELL INTERFERENCE METHODOLOGY

6.1 A well interference methodology was developed for assessment of the potential impact on surrounding well users. This was based on previous experience with this type of assessment and other consent applications within the consent area. Guidance was also sought from the HBRC's RRMP and from other Regional Councils within NZ. The methodology needed to filter through large amounts of data, some of which had significant data gaps.

6.2 Well interference occurs when water abstraction from a well causes a lowering of water levels in another nearby well or wells. This lowering caused by the nearby pumping can have adverse effects that reduce security of supply for the well user.

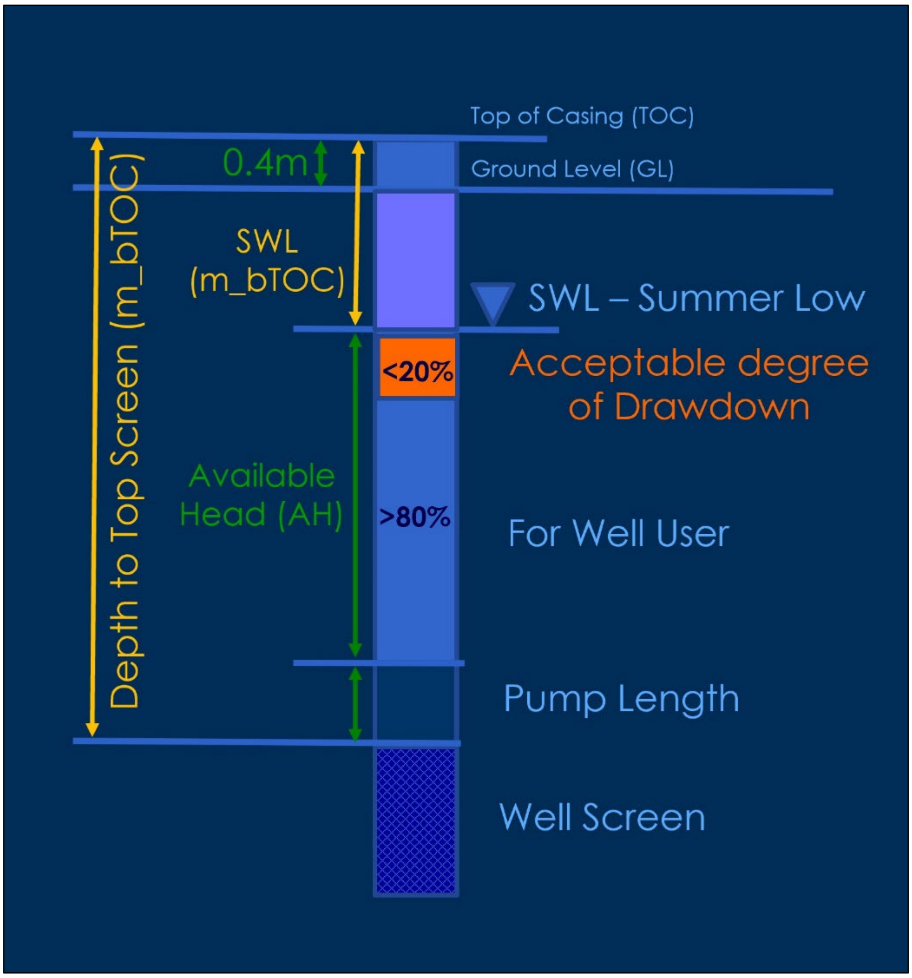
6.3 SWL varies throughout the year and from year to year because of natural changes in weather patterns which affect rainfall, river flows and their consequential aquifer recharge. Pumping for irrigation or other uses also causes declines in SWLs. The lowest measured water levels are a record of the maximum observed impacts from both natural variability and pumping related declines.

6.4 Firstly, it is necessary to estimate the current availability of water within a well based on the total water column or AH, i.e. the difference between the SWL or top surface and the TS height or bottom surface. The key features for assessing WI are illustrated in Figure 3 and different aspects of this are further discussed in this evidence.

6.5 There is a network of HBRC monitoring wells with good spatial and vertical coverage within the Ruataniwha Basin. Often with a long record of data and others with shorter records that still capture dry (low water) periods. They are deemed the best available dataset for quantification of a summer or low SWL. An average of the lowest 10% of all readings at each monitoring well location was generated, to reduce the influence of local scale extreme lows and provide a weighted average.

6.6 Monitor well data was split into three depth groups to better represent SWL surfaces in wells of similar depths when interpolating to locations of other wells. Shallow wells show little water level variability because levels are maintained by surface water interactions and high aquifer storage. Greater variation is seen in intermediate and deeper wells. To provide better control for SWL contouring at shallow depths 24 river points, extending along gaining reaches of 4 rivers, were used as controls.

Figure 3: Key Features for Assessing Well Interference

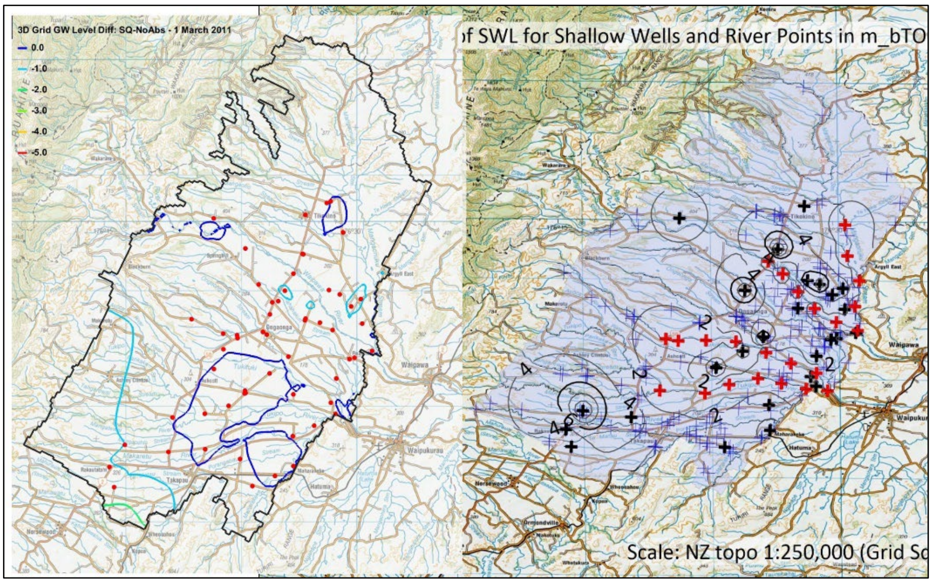



6.7 For optimal use a submersible pump should be placed above the level of the top screen and the intake should remain submerged. In the WI assessment very, shallow wells were assigned a 0m pump length as shallow wells generally use surface pumps, all other wells were assigned a 2m pump length. In some instances where the diameter of the well is small and used for domestic or stockwater (or small irrigation rates) the submersible pump length is likely to be shorter (such as 1m).

6.8 Water levels in some monitor wells were observed to show a temporal decline. This may be reflective of increasing use of T1 allocations or other climatic factors. A declining trend was calculated for 20 wells and the magnitude was estimated for the next 5 years. Water levels in affected wells were adjusted for the observed declines. A further adjustment of 0.4m was made to account for the difference between ground level (GL) and top of casing (TOC) at monitor well locations. TOC elevations are not recorded for these wells, but this is the reference point for top screen heights.

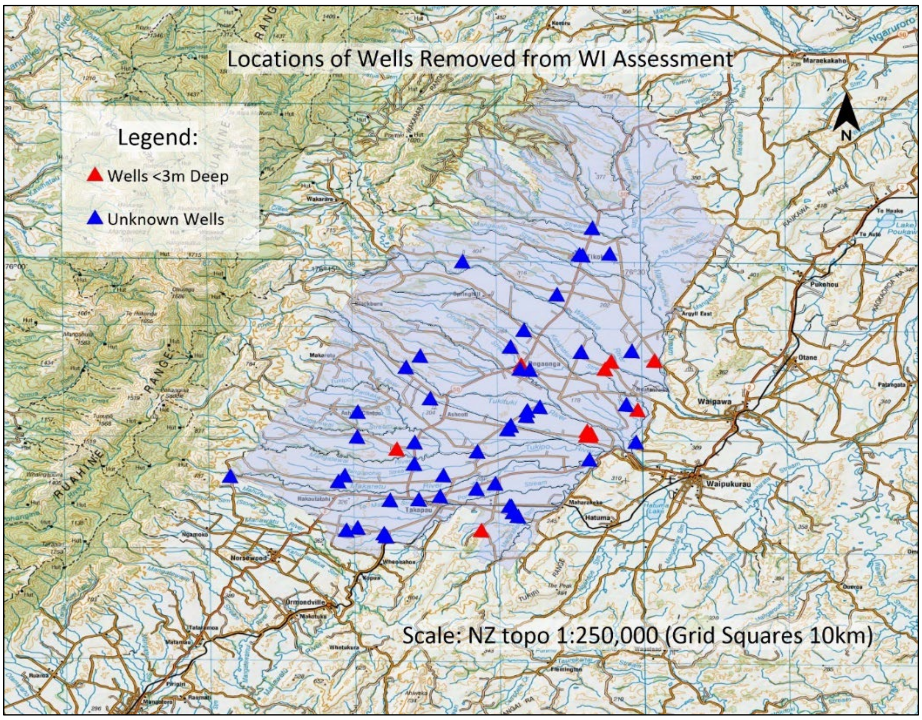
6.9 The adjusted 10% summer low SWL values were used to create three SWL contours. When compared against 4 numerical model layer water use outputs, they show similar patterns of differences, an example is shown in Figure 4. The monitoring bores are considered to adequately represent the basin-scale response and are suitable for interpolation of existing low SWL levels. Values were interpolated from these contour grids to estimate SWLs in 666 bores identified for inclusion in the WI assessment.

Figure 4: Comparison Model Layer 1 and Shallow SWL Contours



6.10 There is a total of 724 wells recorded for the Basin. An assessment of the information available for the bores showed that it is not possible, or necessary in some instances, to consider every bore location. Based on the information available a total of 666 bores were identified for inclusion in the WI assessment. Wells <3m deep and greater than 1km deep were excluded, as were 47 wells with insufficient data. The locations of all the bores, removed from the assessment are shown on the map in Figure 5. It is not possible to quantify the effects of T2 takes on these wells because of a lack of data. The wells deeper than 1km are two old oil exploration wells and these are fully decommissioned (red triangles in the basin centre farthest to the west). The very shallow wells are adjacent to rivers with SWLs supported by high levels of surface water interaction. The unknown wells are less certain but given the absence of information they are most likely unused or very low water users.

Figure 5: Locations of Wells Removed from the WI Assessment




6.11 A comparison was made of the interpolated SWL values against available existing measured well data and numerical model output data to assess reliability. The least reliable predictions were those compared with measured shallow well SWL data. There are numerous reasons why this could be so, including locations in areas of contouring with less well control or that they represent extreme value low SWLs. Comparison with measured intermediate and deep well data was reasonable and with modelled output was good.

6.12 Predictions of interference drawdown were made using the numerical model for a range of scenarios. There is some uncertainty associated with the values produced so a range, the same as that applied to the numerical model, was used for the generated outputs to apply upper (5%ile) and lower (95%ile) bounds.

## 7. WELL INTERFERENCE RESULTS

7.1 The AH was calculated for each well for each scenario, and then the proportion of the available drawdown (including the proposed T2 activities) as a percent of the AH. An arbitrary value of 20% was chosen to highlight wells for more specific consideration. Specific effects on wells used as registered drinking water supply are addressed in the evidence of Alexandra Johansen.

7.2 Essentially, when only the SWL and pump length are included, 44 wells show a negative AH and may be considered "inefficient" in terms of RRMP Pol 77; the locations of these wells are shown in Figure 6. It is noted that of these 44 wells only 6 have TS heights greater than 6m, i.e. as a group they represent very shallow wells.

7.3 For the remaining 622 wells the full T2 abstraction scenario has 3 potential outcomes: the most conservative (5%ile) identifies 67 wells with values greater than 20%, the mid-range (AVE) shows 51 and the best-case (95%ile) has 30 wells greater than 20%, the locations of these wells are shown in Figure 7. The 13Mm$^3$/yr take scenario (representing the effects of the T2 Applicants' proposed use has a worst case scenario effect on 36 wells. A summary table of all the assessed WI outcomes is shown in Table 1. Further consideration is required of these flagged wells. It is noted that some are only just over the 20% threshold. Factors such as an existing use for example groundwater monitoring would mean a reduction in AH is of little consequence or the 2m pump length may not be realistic because the well diameter is simply too small to accommodate such a big pump. Therefore, further specific assessment is required, and that information will be presented at the hearing.

Figure 6: Locations of Well with Negative Available Head

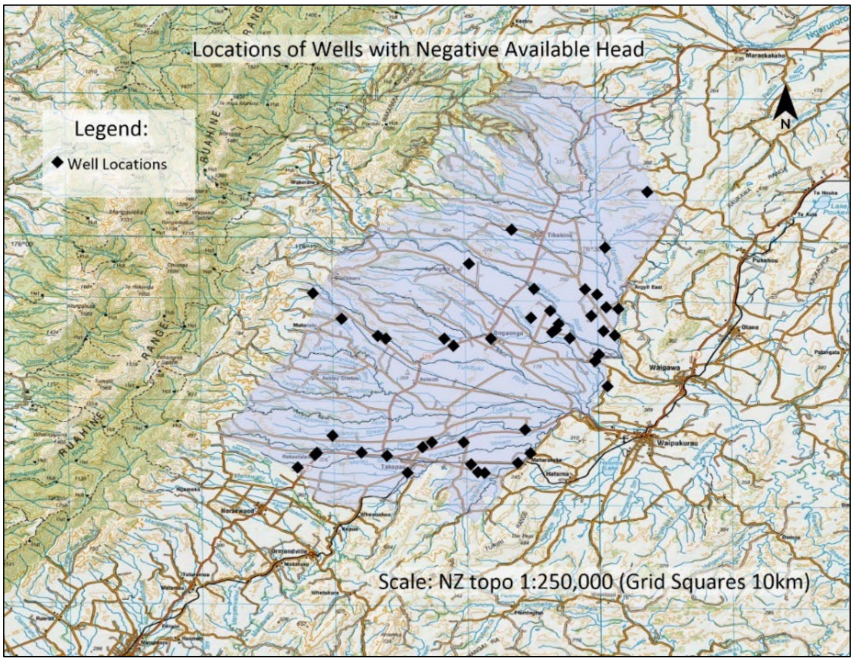



Figure 7: Locations of Worst Case Scenario Flagged Wells

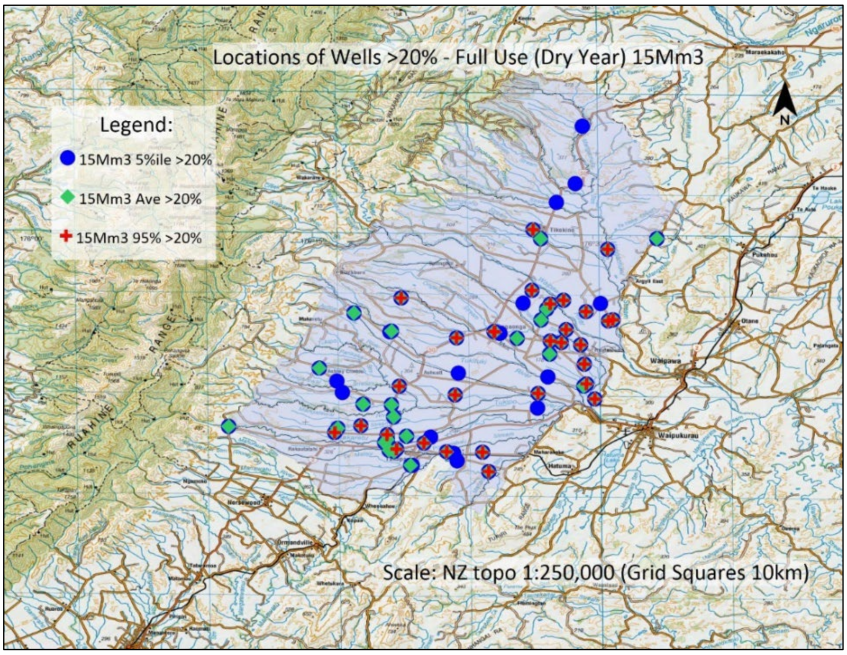


Table 1: Summary of WI Outcomes

| | **Well Categories** | | | |
|---|---|---|---|---|
| | <20m TS | 20-50m TS | >50m TS | Totals |
| Total No. Wells | 233 | 252 | 181 | 666 |
| No. -ve AH | 42 | 2 | 0 | **44** |
| No. +ve AH | 191 | 250 | 181 | 622 |
| Of those with +ve AH | | | | |
| **Full Use - 15Mm3 (AVE)** | | | | |
| No. >20% | 37 | 14 | 0 | **51** |
| No. <20% | 154 | 236 | 181 | 571 |
| Totals | 191 | 250 | 181 | 622 |
| **Full Use - 15Mm3 (5%)** | | | | |
| No. >20% | 51 | 16 | 0 | **67** |
| No. <20% | 140 | 234 | 181 | 555 |
| Totals | 191 | 250 | 181 | 622 |
| **Full Use - 15Mm3 (95%)** | | | | |
| No. >20% | 27 | 3 | 0 | **30** |
| No. <20% | 164 | 247 | 181 | 592 |
| Totals | 191 | 250 | 181 | 622 |
| **Ave Use - 15Mm3** | | | | |
| No. >20% | 22 | 1 | 0 | 23 |
| No. <20% | 169 | 249 | 181 | 599 |
| Totals | 191 | 250 | 181 | 622 |
| **Full Use - 13Mm3** | | | | |
| No. >20% | 30 | 6 | 0 | 36 |
| No. <20% | 161 | 244 | 181 | 586 |
| Totals | 191 | 250 | 181 | 622 |
| **Ave Use - 13Mm3** | | | | |
| No. >20% | 23 | 1 | 0 | 24 |
| No. <20% | 168 | 249 | 181 | 598 |
| Totals | 191 | 250 | 181 | 622 |

SRabbitte

**Susan Rabbitte**

**31 October 2022**

## APPENDIX A – UPDATED WELL INTERFERENCE REPORT, 29 OCTOBER 2022

**Executive Summary**
**Revised Well Interference Assessment**
**29 October 2022**
**Prepared by Susan Rabbitte**

Following peer review and technical conferencing it was determined that some modifications to the method, and further information, would improve confidence in the outcome of the Well Interference (WI) assessment. This updated report identifies those modifications, provides further information and an update of the WI outcomes.

Well interference occurs when water abstraction from a well causes a lowering of water levels in another nearby well or wells. This lowering caused by the nearby pumping can have adverse effects that reduce security of supply.

Static Water Level (SWL) varies throughout the year and from year to year because of natural changes in weather patterns which affect rainfall, river flows and their aquifer recharge. Pumping for irrigation or other uses also causes declines in SWLs. The lowest measured water levels are a record of the maximum observed impacts from both natural variability and pumping related declines.

The SWL for the WI assessment provides a representative top surface from which the available head (AH) is calculated, and the top well screen height is the bottom surface.

There is a network of council monitoring wells with good spatial and vertical coverage within the Ruataniwha Basin. Often with a long record of data and others with shorter records that still capture dry (low water) periods. They are deemed the best available dataset for quantification of a summer or low SWL. An average of the lowest 10% of all readings at each monitoring well location was generated, to reduce the influence of local scale extreme lows and provide a weighted average.

Monitor well data was split into three depth groups to better represent SWL surfaces in wells of similar depths when interpolating to locations of other wells. Shallow wells show little water level variability because levels are maintained by surface water interactions and high aquifer storage. Greater variation is seen in intermediate and deeper wells. To provide better control for SWL contouring at shallow depths 24 river points, extending along gaining reaches of 4 river, were used as controls.

For optimal use a submersible pump should be placed above the level of the top screen and the intake should remain submerged. In the WI assessment very, shallow wells were assigned a 0m pump length, all other wells were 2m.

Water levels in some monitor wells show temporal decline. This may be reflective of increasing use of T1 allocations or other climatic factors. A declining trend was calculated and estimated for the next 5 years. Water levels in affected wells were adjusted for the observed declines. A further adjustment of 0.4m was made to account for the difference between ground level (GL) and top of casing (TOC) at monitor well locations. The adjusted 10% summer low SWL values were used to create three SWL contours. When compared against 4 numerical model layer outputs, they show similar patterns of differences. The monitoring bores are considered to adequately represent the basin-scale response and are suitable for interpolation of existing low SWL levels. Values were interpolated from these contour grids to estimate SWLs in 666 bores identified for inclusion in the WI assessment, 58 wells were excluded.

A comparison was made of the interpolated values against available existing measured well data and numerical model output data to assess reliability. The least reliable predictions were those compared with measured shallow well SWL data, there are numerous reasons why this could be so. Comparison with measured intermediate and deep well data was reasonable and with modelled output was good.

Predictions of interference drawdown were made using the numerical model for a range of scenarios. There is some uncertainty associated with the values produced so a range, the same as that applied to the numerical model, was used for the generated outputs to apply upper (5%ile) and lower (95%ile) bounds.

The AH was calculated for each well for each scenario, and then the proportion of the available drawdown (including the proposed T2 activities) as a percent of the AH. An arbitrary value of 20% was chosen to highlight wells for more specific consideration. Specific effects on wells used as registered drinking water supply are addressed in the evidence of Alexandra Johansen.

Essentially, when only the SWL and pump length are included 44 wells show a negative AH and may be considered "inefficient" in terms of RRMP Pol 77. It is noted that of these 44 wells only 6 have TS heights greater than 6m i.e. they represent very shallow wells.

For the remaining 622 wells the worst-case abstraction scenario has 3 potential outcomes, the most conservative (5%ile) identifies 67 wells with values greater than 20%, the mid-range (AVE) shows 51 and the best-case (95%ile) has 30 wells greater than 20%. Further consideration is required of these flagged wells. It is noted that some are only just over the 20% threshold. Factors such as an existing use for example groundwater monitoring would mean a reduction in AH is of little consequence or the 2m pump length may not be realistic because the well diameter is simply too small to accommodate such a big pump. Therefore, further specific assessment is required, and that information will be presented at the hearing.

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**Updated Report**
**Revised Well Interference Methodology**
**29 October 2022**

**Prepared by: Susan Rabbitte**

## 1.0 INTRODUCTION

The original well interference assessment was reviewed by Pattle Delamore Partners (PDP) and the reviewers' identified concerns regarding the methodology. Some key issues were raised during peer reviews and within the Evidence in Chief (EIC) of Neil Thomas. A Revised Well Interference Methodology (15 October 2022) was prepared by Susan Rabbitte and submitted for review. Joint technical conferencing was then held on 20 October 2022, attended by Susan Rabbitte, Julian Weir, Alexandra Johansen, Hilary Lough and Neil Thomas. Following the conferencing a Joint Witness Statement (JWS) was issued. A number of items were agreed, and some were not. Some modifications to the method and further information were requested to provide greater confidence to reach agreement This updated report provides that further information and an update of the impacts of some changes to the methodology on the Well Interference (WI) assessment. A summary of the WI outcomes is provided with a number of wells identified for further consideration.

### 1.1 Well Interference

Well interference occurs when water abstraction from a well causes a lowering of water levels in another nearby well or wells. This lowering caused by the nearby pumping can have adverse effects if the magnitude of affect is sufficiently large that nearby well users have a reduce security of supply i.e. there is at times not enough head of water left in the well for the affected user to pump at their usual rate and volume. To assess the impact of new takes the existing conditions must be understood as water levels are also influenced by changing climatic conditions and other existing well users and consents.

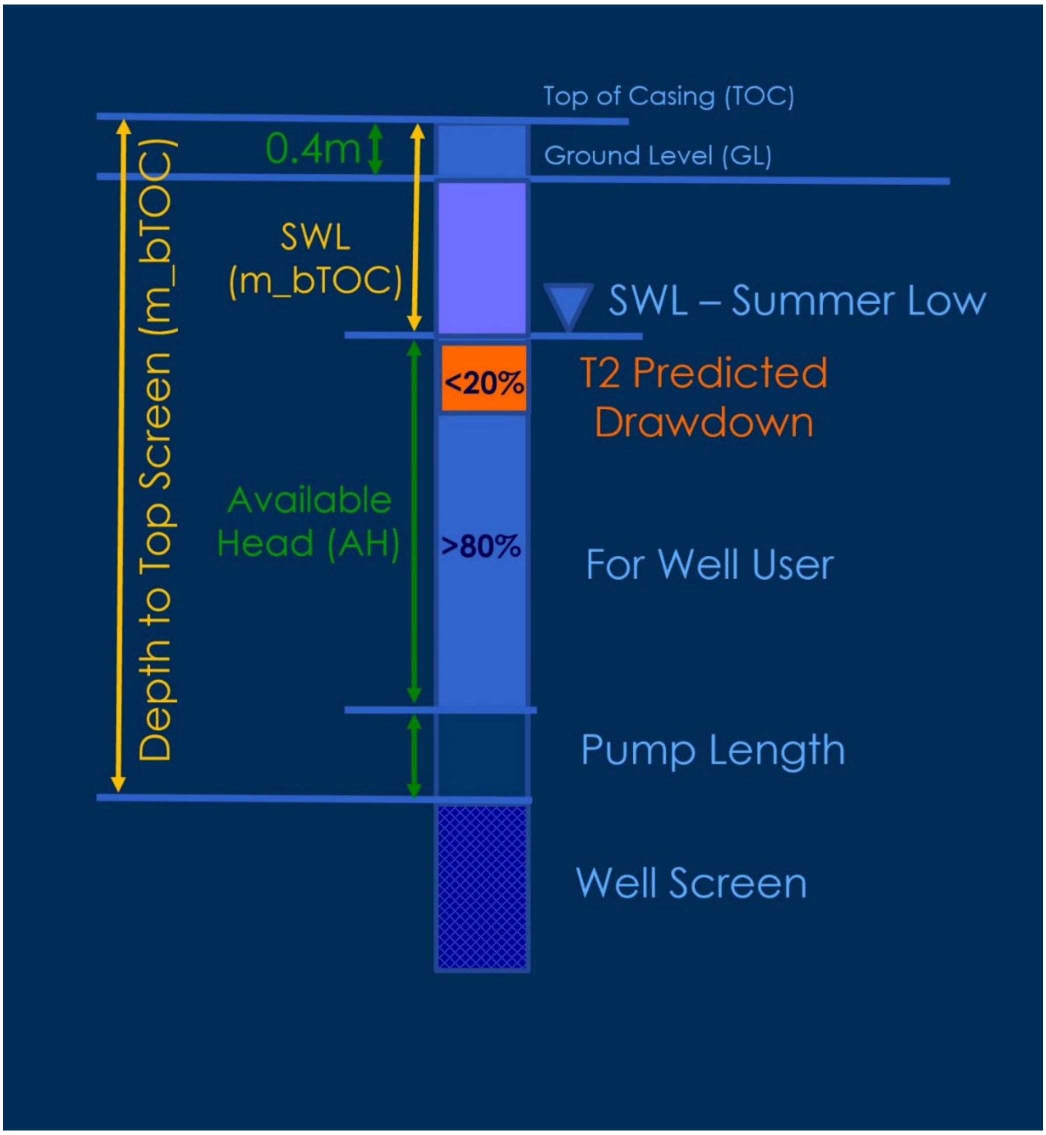
Static Water Level (SWL) varies throughout the year and from year to year. This variation is caused by natural changes in weather patterns which subsequently affects rainfall, river flows and consequential aquifer recharge.

Pumping for irrigation or other uses causes declines in SWLs. The effects of this can be large local to the pumped well, or modest at further distances away, and takes time to propagate and stabilise. The impact varies in relation to aquifer parameters, well position within the aquifer (relative to the assessed bore) and subsequent pressure variations and recharge capacities (e.g. shallow wells near rivers have modest variations as their SWLs are maintained by nearby rivers or water table storage; by comparison a deep well with low storage and confinement restricting recharge may have a large variation).

The lowest measured water levels are a record of the maximum observed impacts from both natural variability and pumping related declines. The purpose of defining the SWL for the assessment is to provide a representative surface from which the available head (AH) within wells is calculated. AH is the term for the water column portion within a well that is available for use by the well user and may accommodate interference associated with new takes. The SWL represents the top surface and the top well screen height the bottom surface. The well screen height is important because this represents the optimal depth at which water is drawn into the pump intake during abstraction. An image to illustrate these terms in relation to a well is provided as Figure 1. There are other features illustrated in this image which impact the calculations and they will be discussed further throughout this report.

For this revised assessment it was deemed that the most suitable SWL to use is one that represents a period (or periods) of low water levels throughout the basin. The range in SWLs used also needs to reflect the potential for depth-based variability (shallow versus deep). It needs to allow for declining trends (in places) as increased up-take of existing allocation occurs as infrastructure development matures, even where no new allocations are issued or climate varies. The specifics of how the revised SWLs were determined are detailed in the following sections.

**Figure 1: Well Interference Terms**




## 2.0 ESTIMATION OF STATIC WATER LEVEL

The summer low water level within the Ruataniwha Basin is critical for making allowance of the seasonal variation within the basin. Seasonal variations include declining water levels in response to both natural factors (e.g. reduced summer rainfall and river flows) and the impacts of irrigation pumping within the basin.

Real data collected by HBRC over an extended period of time was used to determine an appropriate set of values to represent a Summer or low water level. This dataset is the HBRC Monitoring well (or SOE) network encompassing 74 monitoring wells. The wells range in depth with top screen heights reported between 2.3m and 142.5m deep. The period of record for each well varies in length and the wells encompass a variety of depths and locations across the basin. This network was used to calibrate the numerical model (Weir, 2022), though two wells have subsequently been added 17183 and 17178. The locations of all these wells are shown on the map in Figure 2. They are split into three categories based on their top screen (TS) elevations, the reason for this is discussed in Section 2.2.

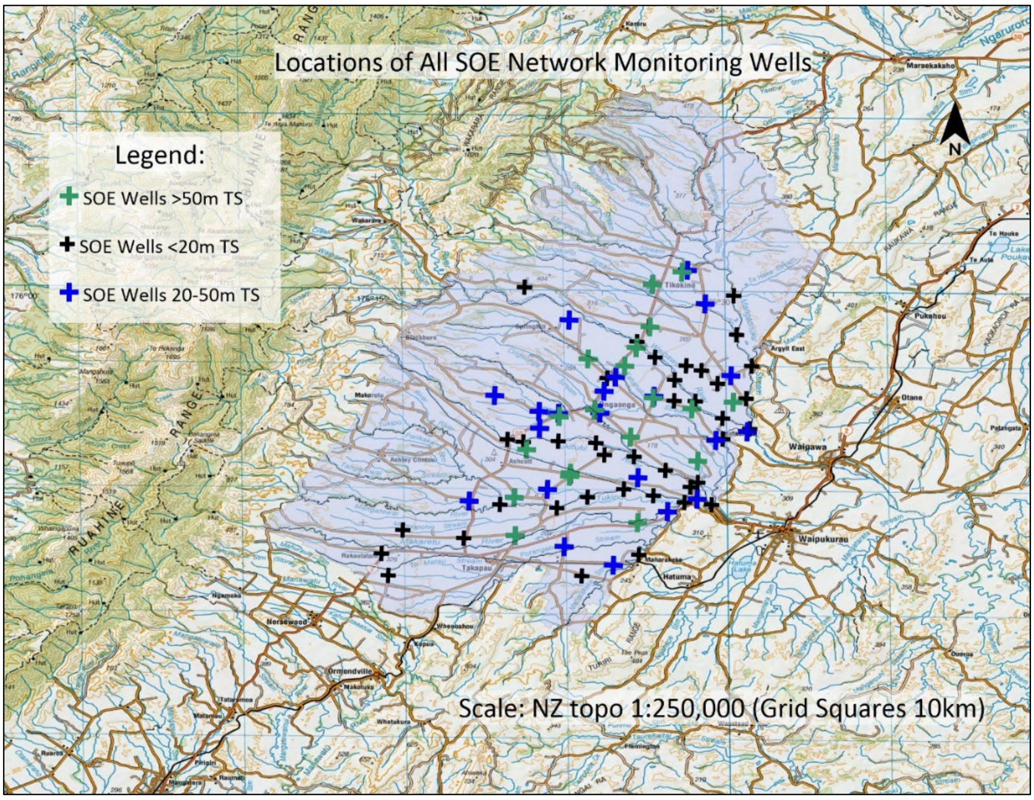
The earliest SOE monitoring data was collected in 1992 spanning 19 wells. Two more wells were added in 1997, followed by a further 10 by 2003 and then 4 more up to 2009, making a total of 35 monitoring wells. Nine of these wells had ceased monitoring by 2005. This period is of interest because it was in 2009/10 that HBRC issued the last new water take consents ahead of Tukituki Plan Change 6 (which became operative in October 2015). All consents issued prior to 2010 are include in the Tranche 1 (T1) allocation. Their development and use from this point may have increased which is likely to have contributed to declining water levels in some areas. From 2014 to the present day a further 39 wells were added to the network, the greatest number in 2017 with 20 new wells added.

A piezometric survey was undertaken in 2008 spanning 50 wells within the basin. However, this survey represents one point in time (14-16 October 2008). So, while this is a useful resource, it is does not represent a SWL surface of a present-day summer low period. It is not expected to include declines in water level that have occurred as a result of increased uptake of T1 allocation between 2009 and the present. Furthermore, the survey occurred near the start of the irrigation season. Therefore, it is not truly reflective of the current seasonal low water levels within the basin.

Assessment of the SOE monitoring well data shows that the lowest water level measurements recorded at each well location tend to have occurred in the last few years. Of the 74 wells 46 have recorded their lowest WL value since 2019, with 30 of these occurring in 2020. This means that despite their relatively short durations, the 39 wells added in 2017 will provide a good representation of a SWL low for the basin. Annual Rainfall and PET graphs are shown in the Evidence of Julian Weir paragraph A10, and confirm 2019 and 2020 as low rainfall years with above average PET.

To assess the SOE monitor well network coverage in relation to existing wells and well use the locations of all wells and all T1 consented wells are shown on the map in Figure 3. The consented wells (red triangles) and generally the largest users are primarily within central and eastern edge of the basin, the same area as the SOE wells, shown in Figure 1. The bulk of other wells are also in these areas, but some do extend out to the west and south with a few in the north. Contouring and interpolation for wells outside this central and eastern area of good SOE well coverage will have a lower reliability than those inside the main area. It is also noted that the locations of the consented wells (red triangles) also generally correspond with lower areas in the SWL contour plots, suggesting that the contours do reflect T1 water use in the basin.

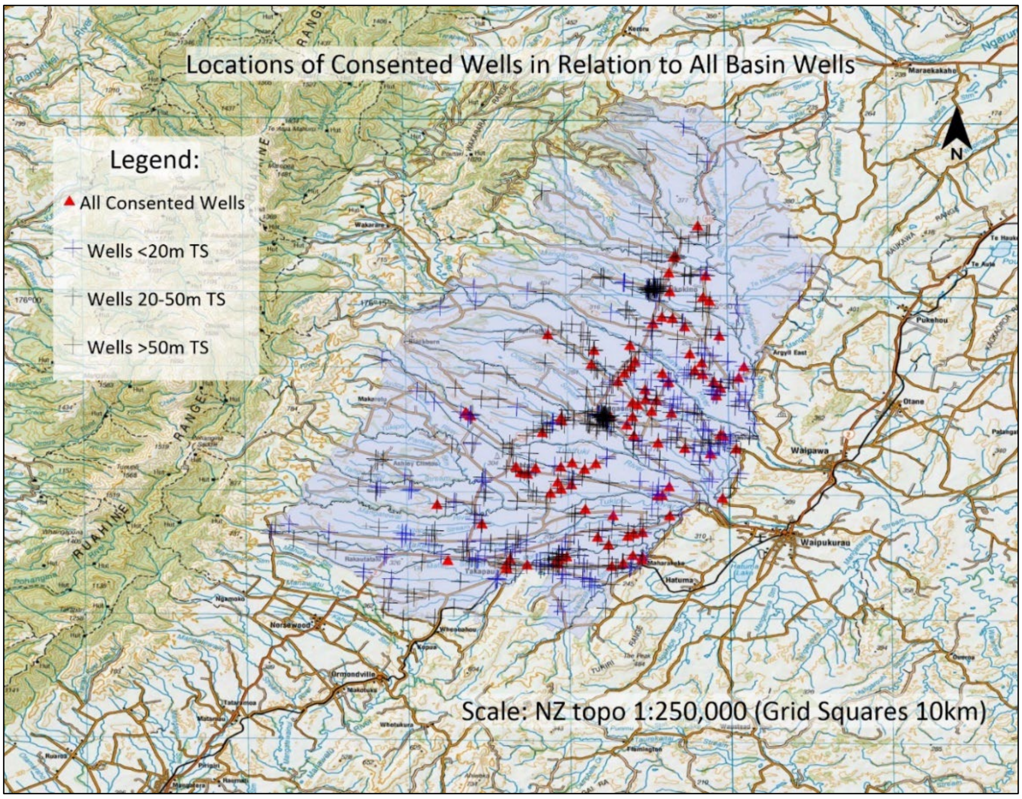
**Figure 2: All SOE Well Locations**




The large number of SOE wells their spatial and vertical coverage along with an often long record of data, means that this data set is deemed the best available for quantification of a summer or low water level to represent the seasonal variation, including T1 water use. This includes a combination of successive dry years with increased uptake of existing pumping allocation and is expected to provide an adequate representation of existing water use and seasonal effects.

To determine a value for each SOE location that represents a summer low (and hence the potential seasonal variation within the basin) an average of the lowest 10% of all readings at each monitoring well location was generated. The use of an average value of the lowest 10% of the records reduces the influence of local scale extreme lows due to short term pumping (or other causes), and it provides a weighted average over dry periods of the assessment.

**Figure 3: Locations of Consented Wells and Other Basin Wells**




## 2.1 Ground Levels

A value for GL was provided as part of the original dataset for most of the SOE wells. However, there were some values missing. These missing ground level (GL) datapoints were previously interpolated from the existing data. Following JWS conferencing this was changed, and the missing data points are now updated using elevation data provided by Hawke's Bay Regional Council (HBRC) from their LiDAR dataset [*heights interpolated from the Regional LiDAR dataset digital elevation model (so in terms of NZVD2016)]*. For the SOE well locations with missing data the new values used are shown in Table 1, with comparison of the original data used and a DEM interpolation. It is interesting to note the level of difference with these different techniques.

**Table 1: Ground Level Data Used for Points with Missing Elevations**

| Well no | GrndElev Interpolated (masl) | DEM (masl) | LiDAR (masl) |
|---|---|---|---|
| 1900 | **164.00** | 173.98 | 165.9037 |
| 3702 | **215.13** | 231.45 | 237.5769 |
| 4693 | **157.00** | 152.06 | 153.9055 |
| 4694 | **172.38** | 152.06 | 153.9109 |
| 4695 | **148.00** | 151.52 | 145.2839 |
| 4696 | **164.04** | 151.52 | 145.2839 |
| 4697 | **199.33** | 195.17 | 201.2122 |
| 4702 | | 180.09 | 178.955 |
| 15014 | **185.00** | 175.77 | 180.5888 |
| 15015 | **190.74** | 185.5 | 187.9073 |

## 2.2 Well Depth Categories

There is a relationship between well depth, water level and magnitude of variability. There is direct evidence for this within the SOE monitoring well data. Some shallow and deep wells positioned at the same locations, have different SWLs (when measured at the same time). Bores 4693 (6.2 m deep) and 4694 (44 m deep), both on Stockade Road, are an example. Groundwater levels were measured at 154.7 m_asl and 143.4 m_asl (respectively) on 2/8/22. There are several other examples, so it is not considered reasonable to use data from multiple wells of different depths and locations to create one piezometric surface to represent a SWL in the basin.

Well data from the SOE wells was split into three groups based on top screen (TS) depth. This allows better representation of SWL surfaces when interpolating to locations of other wells of similar depths. Three categories were identified to allow sufficient and similar levels of data across the basin in each group. The categories were based on our understanding of basin's physical geology (shallow gravels [<20m top screen] Young Gravels [20-50m top screen] and Salisbury Gravels [>50m top screen]).

The three categories have 26, 25 and 23 wells each respectively. The locations are shown on the map in Figure 2 with the category split illustrated. Despite this split each category is still considered to represent an adequate spread over the basin, because they now also consider vertical variations. However, again there is limited data in the west and north in all three cases. Shallow wells are more well represented in the south than the deeper wells.

Graphs showing water level and ground level (GL) information are provided in Figures 4, 5 and 6. It is evident from this that there is little variability in shallow wells. This is expected because water levels are likely to be maintained by surface water interactions and high aquifer storage. There are a few exceptions 16249, 16247, 16484 and 1944. There is also generally little difference between GL and SWL. Greater variation is seen in intermediate and deeper wells. The use of the lowest 10% is seen to smooth out the extremes of the minimum levels in the data sets.

**Figure 4: Graph of Shallow Well SWL and GL Elevations**

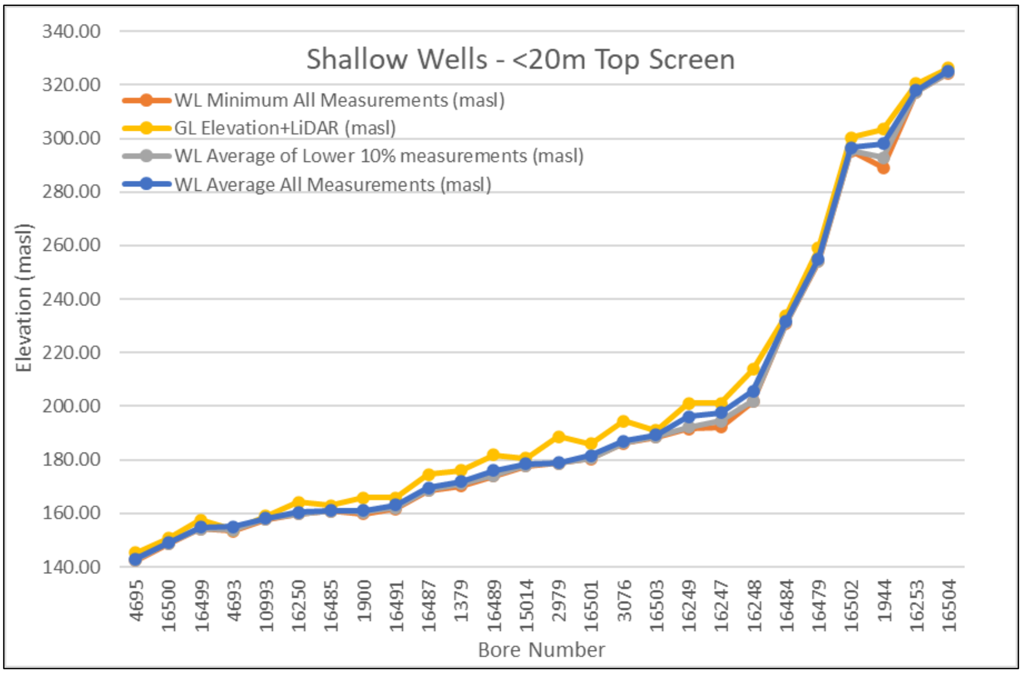


**Figure 5: Graph of Intermediate Well SWL and GL Elevations**

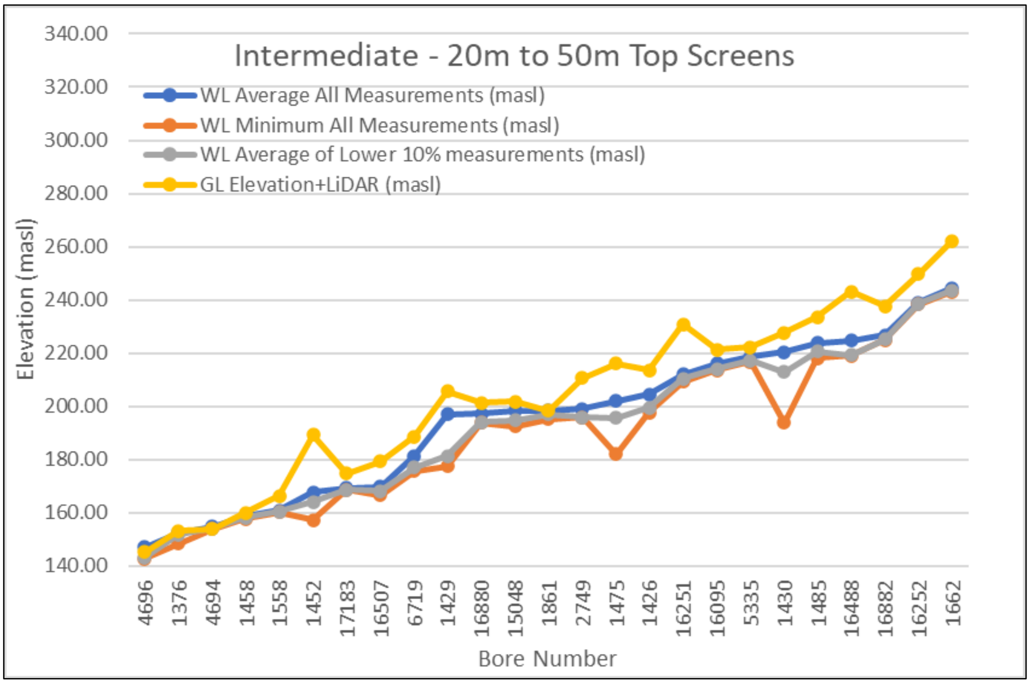
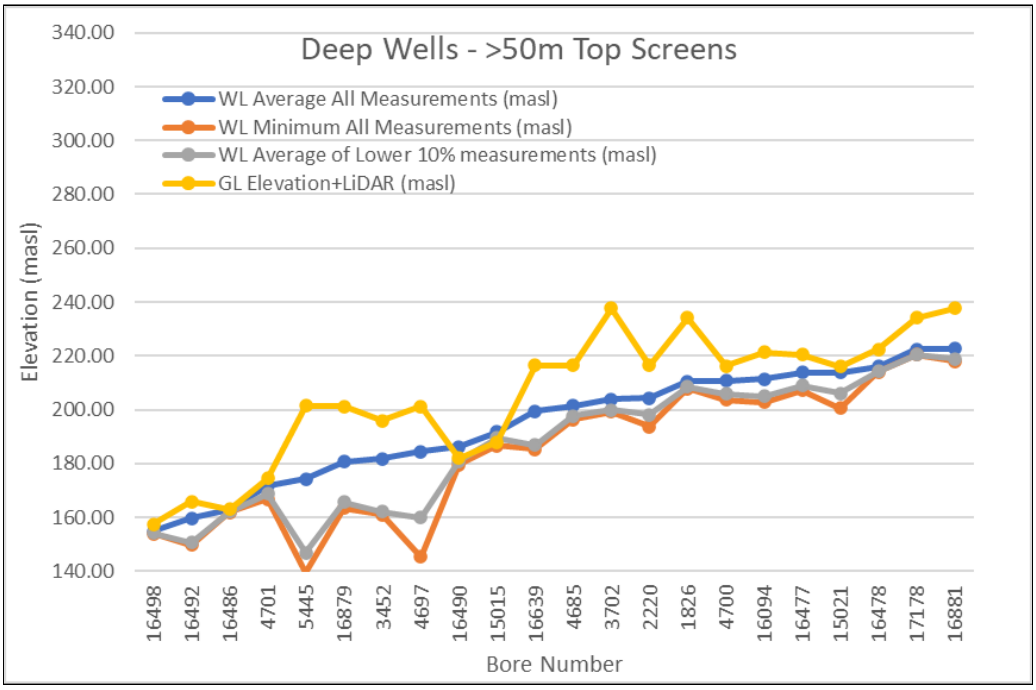


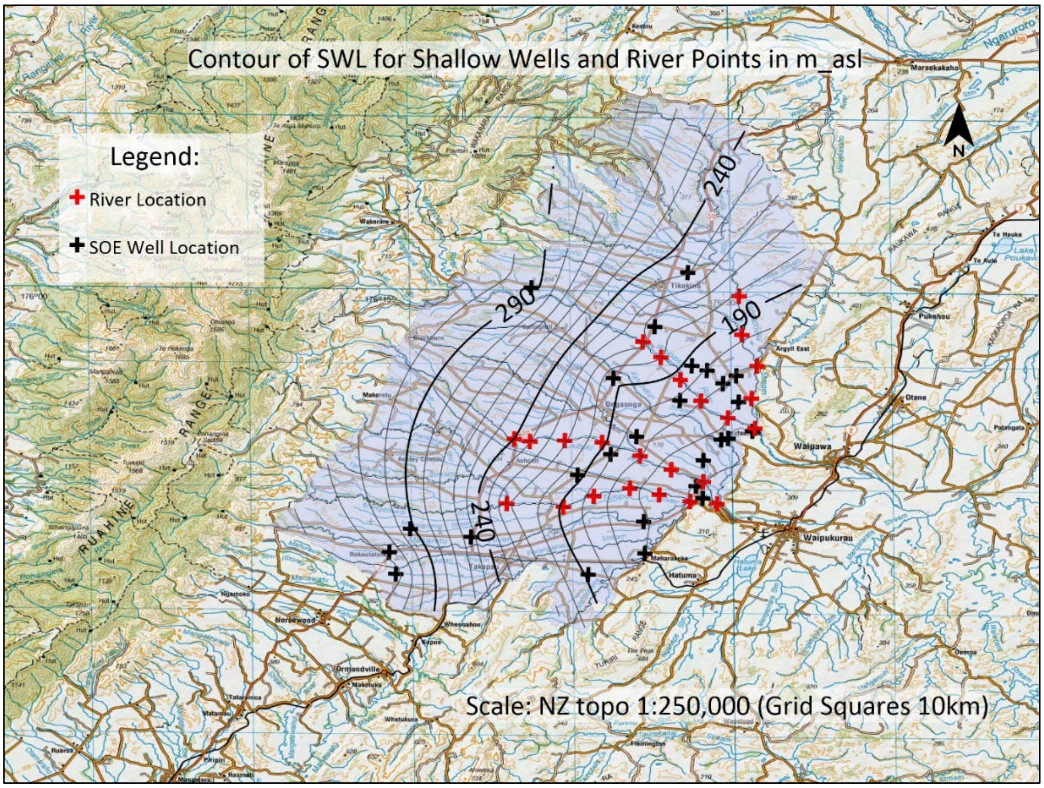

**Figure 6: Graph of Deep Well SWL and GL Elevations**




## 2.3 River Point Levels

As noted previously the low magnitude of SWL variation observed in the shallow SOE wells is expected because the water levels are likely to be maintained by surface water interactions and high aquifer storage. Shallow wells are expected to be sensitive to water level variation because of their lack of depth and subsequently low values of AH. To provide better control for SWL contouring it was recommended as part of the JWS to used river points as controls on the shallow SWL. These additional datapoints are expected to improved interpolation from the contours. A total of 24 river level data points, extending along four rivers, were selected from gaining reaches. The elevations were provided from a DEM map and they range from 140m_asl to 240m_asl, this is well within the range of the shallow groundwater level SOE well data values. A contour plot of the shallow SWL elevations in m_asl is shown in Figure 7.

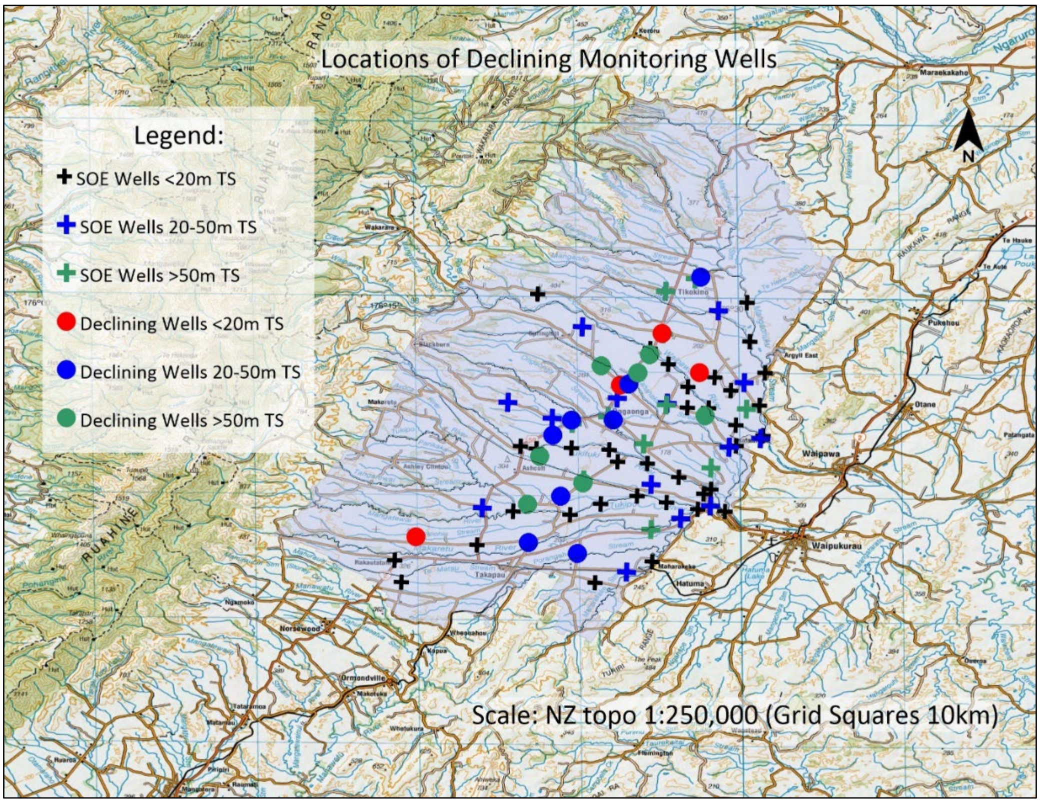
**Figure 7: Contour Shallow Water level in m_asl**




2.4 Declining Well Data

The water levels in some SOE wells are appearing to show some temporal decline. This may be reflective of increasing use of T1 allocations or other climatic factors. The groundwater level graphs provided in Appendix A of Weir (2022) were reviewed and where an ongoing decline is noted then each of the individual wells was plotted, and a declining summer low water level trend was calculated. These declining wells were split into the previously described depth categories: Shallow (4), Intermediate (8) and Deep (8). 20 wells out of the 74 wells were assessed on this basis. There are 31 wells that were deemed to have insufficient data for reliable determination of a declining SWL trend. Another well (well 4702) was removed as this is a deep Limestone well in the south of the basin, hydraulicly quite separate from main gravel aquifer. The locations of the declining wells and their respective depth categories are shown in the plot in Figure 8 and the values calculated are summarised in Appendix 2. The locations of these wells is similar to those noted by Julian Weir in his Evidence A13.

**Figure 8: Locations of the Identified Declining Wells**




The amount of decline, based on the calculated trend, was estimated for the next 5 years. Over time the T1 use is expected to stabilise as the maximum allocation limits provide a cap in dry years. These declining trends were then subtracted from the summer low 10% values calculated. This summer low value, adjusted for the declining wells, can then be subtracted from the GL elevation to provide a SWL estimate in m_bgl.

## 2.5 Top of Casing (TOC) Adjustment

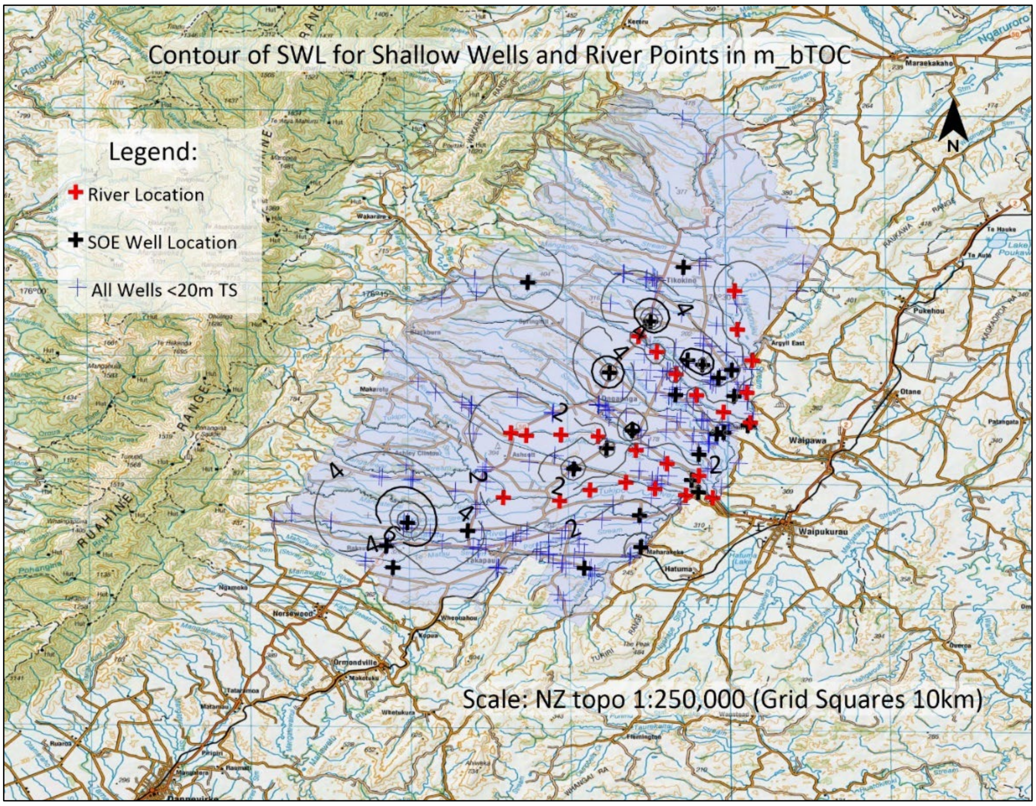
To calculate an estimate of AH for a well the SWL must be referenced to the same reference datum as the top screen (TS) height, see Figure 1. This TS value is discussed further in Section 3.0 of this report, but the reference height for TS is usually top of casing (TOC). This is because it is recorded at the time of drilling by the well drillers along with well depth and a GL reference is not. The main well information database (Welstor) held by HBRC does not record GL elevations for all the wells in the basin. The values shown in Table 1, illustrate the potential differences in elevation reference points when interpolating from different data sources. TOC is considered a more reliable reference point for the large number of wells included in the assessment, but there is still some uncertainty associated with its use. The height above GL of a TOC reference point varies from well to well. Though they are usually in the range 0.3m to 0.5m above ground level (0.4m is used as an average). The SWL in m_bgl was therefore adjusted by 0.4m to account for the difference between GL and TOC, as illustrated in Figure 1.

## 2.6 SOE Monitor Well - SWL Contouring

The 10% summer low SWL values calculated from the SOE wells, with adjustments for declining trends and TOC reference level, and now expressed as m_bTOC were used to create three SWL contour grids. The contouring software used is Surfer

(Version 24.1.181) the gridding method is Inverse Distance to a power. The river point locations were included with shallow water level SOE data points with a surface water level reference value of 0m. These grids created for the three depth categories extend to the boundaries of the basin, they are shown as Figures 9, 10 and 11. Locations on these grids can then be interpolated to provide SWL values for wells included in the Well Interference (WI) assessment that require this data. The locations of the other basin wells that require interpolation in the respective depth categories are also shown on the contour plots. Those located greater distances from the control points will be less reliable.

**Figure 9: Contour Plot of the Shallow Wells SWL Data**




The contour plots all show the greatest dips in SWL in the central to east and southern areas of the basin, where the majority of the wells and existing consents are located. The shallow SWL contours in Figure 9 are supported by the locations of the rivers, with the greatest declines in areas away from the river points in the centre-west and south. The biggest declines in the deeper wells are seen to the south and east. This is not surprising given the more challenging water conditions in this area with lower transmissivity, storage and fault lines than further north.

The contour maps were compared against 4 model layer outputs (of increasing depth) from the numerical model that show the differences in groundwater levels between No Abstraction and Status Quo (SQ) scenarios and they show similar patterns of differences. There are no obvious 'holes' or 'humps' over the basin that are outside of the monitoring bores coverage. This is likely due to most abstraction (volumetric-wise) occurring within (or near) the bounds of monitoring bore coverage. The current monitoring bores are considered to adequately represent the basin-scale response and can be used for the interpolation of existing low SWL levels. The bores to the south of the model (where the change is greatest in layer 3) capture the spatial variability well.

**Figure 10: Contour Plot of the Intermediate Wells SWL Data**

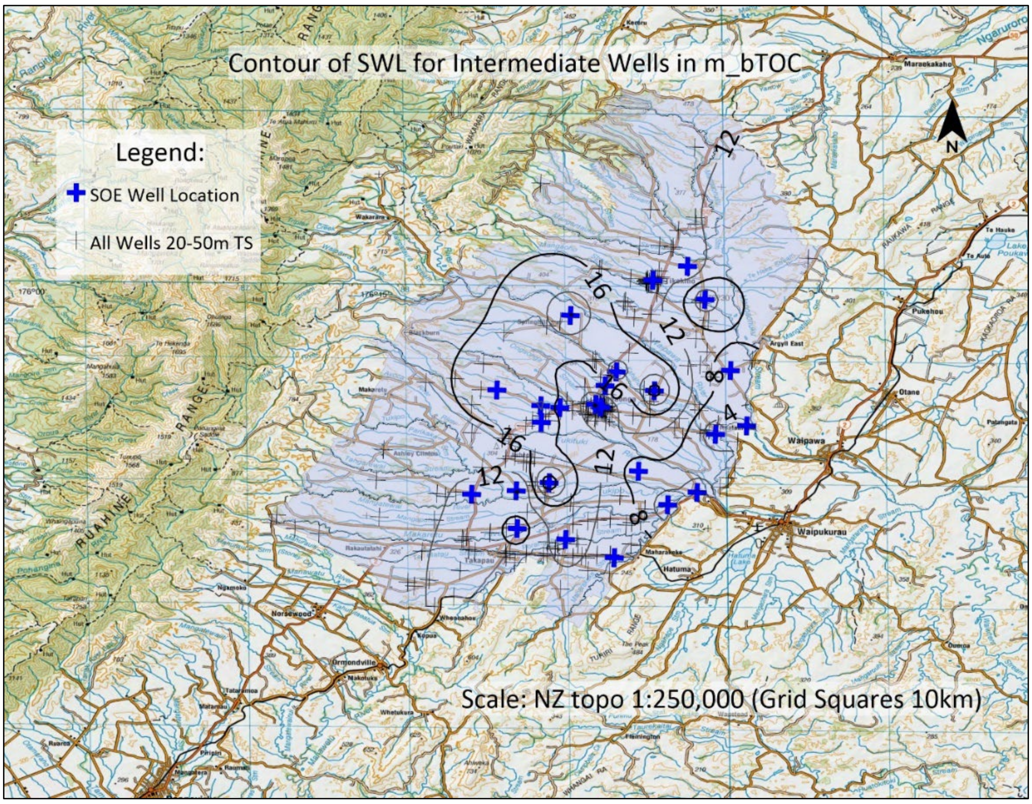
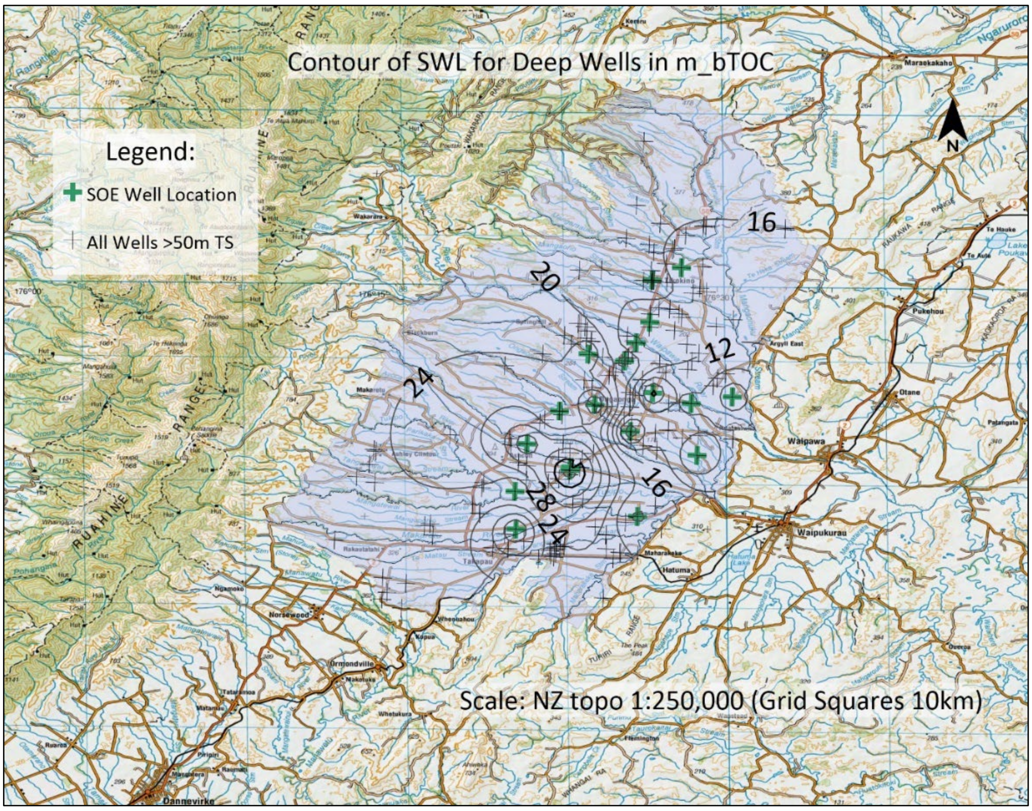


**Figure 11: Contour Plot of the Deep Wells SWL Data**




## 3.0 ALL WELLS DATA – RUATANIWHA BASIN

There are 74 SOE monitoring wells that were used to estimate basin scale SWL contour grids. However, within the Ruataniwha Basin there are a total of 724 bore locations registered with HBRC. The WI assessment needs to consider the potential impact of the proposed T2 abstraction on all these existing bores. However, an assessment of the information available for these bores showed that it is not possible, or necessary in some instances, to consider every bore location. Based on the information available a total of 666 bores were identified for inclusion in the WI assessment. Wells <3m deep and greater than 1km deep were excluded, as were 47 wells with insufficient data. The locations of all the bores, and those with consents, are shown on the map in Figure 3.

The minimum data requirement for the inclusion of the bores in the WI assessment is their location, depth and/or top screen (TS) height. During previous assessments, it was noted that TS height is absent in more than a quarter of the wells. From the original WI assessment (that included 703 wells) only 498 (71%) had recorded top screen data, 11 were recorded as 0 m and 194 (28%) had no data. It was also noted that, 654 (93%) of wells had total depth data, 3 wells were recorded as 0 m deep and only 46 (7%) had no data.

So, where data was absent for top screens, a value for this was estimated based on wells with data. Wells were grouped into categories based on their total depth. Averages of the available data points within each group were calculated for depth, top screen height, bottom screen height and screen length. Then for wells with top screen values missing, these were calculated by subtracting the average screen length, as per Table 2, from the recorded total well depth for the respective depth categories.

**Table 2: Determination of Values for Missing Top Screen Data**

| Depth (m) | Average Depth (m) | Top Screen Height (m) | Bottom Screen Height (m) | Screen Length (m) |
|---|---|---|---|---|
| 0-9.99m | 5.91 | 4.15 | 6.22 | 2.07 |
| 10-19.99 | 14.58 | 11.06 | 13.73 | 2.68 |
| 20-29.99 | 25.88 | 21.03 | 23.90 | 2.87 |
| 30-39.99 | 34.74 | 27.54 | 31.12 | 3.58 |
| 40-49.99 | 44.71 | 37.19 | 39.90 | 2.71 |
| 50-59.99 | 54.82 | 41.67 | 48.21 | 6.54 |
| 60-69.99 | 64.22 | 48.83 | 58.11 | 9.28 |
| 70-79.99 | 74.89 | 60.04 | 69.80 | 9.76 |
| 80-89.99 | 84.55 | 71.96 | 80.48 | 8.52 |
| 90-99.99 | 95.40 | 76.25 | 92.32 | 16.07 |
| 100-109.99 | 105.36 | 81.28 | 89.28 | 8.00 |
| 110-119.99 | 115.67 | 122.28 | 130.45 | 8.17 |
| 120-129.99 | 123.57 | 100.25 | 112.90 | 12.66 |
| 130-139.99 | 133.13 | 118.31 | 128.33 | 10.02 |
| 140-199.99 | 155.10 | 114.15 | 120.33 | 6.18 |
| >200 | 270.67 | 48.40 | 72.00 | 23.60 |

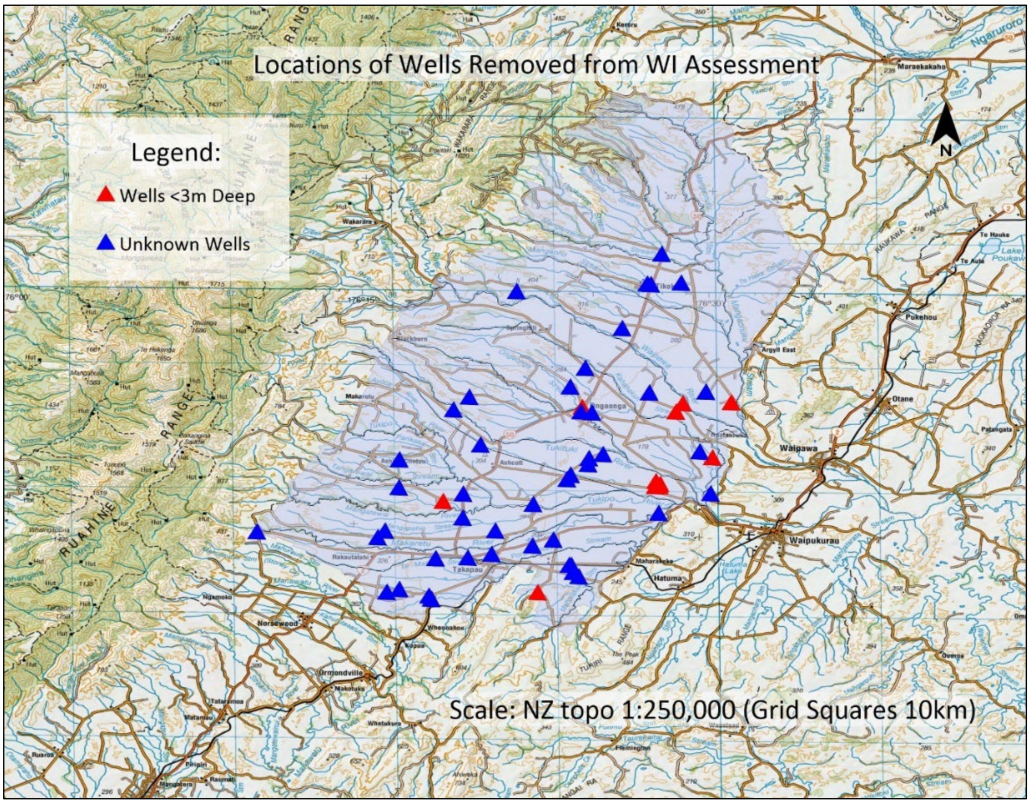
This amended well dataset was provided to Julian Weir (Aqualinc). He used the well location and top screen elevation data to extract specific drawdown predictions at each well from the numerical model that is estimated from the proposed T2 activities under four different scenarios. These predictions were then used in the WI assessment. The suitability of this method of estimation of drawdown prediction for the T2 abstraction is agreed in the JWS.

### 3.1 Unknown Well Location

A map showing the locations of the wells less than 3m deep and greater than 1km along with the Unknown wells is provided as Figure 12. They are quite widely spread across the basin, but more to the south than the north.

It is not possible to quantify the effects of T2 takes on these wells because of a lack of data. The wells deeper than 1km are two old oil exploration wells and these are fully decommissioned. The very shallow wells maybe adjacent to rivers with WLs supported by high levels of surface water interaction. The unknown wells are less certain but given the absence of information they are most likely unused or very low water users.

**Figure 12: Locations of Unknown and Removed Wells**




3.2 Pump Length

As part of the well interference assessment an allowance is required for pump length. For optimal use a submersible pump should be placed above the level of the top screen and the intake should remain submerged. For the WI assessment it is considered that wells with top screens less than 6m deep will likely use a surface pump with a suction tube that extends to the top screen. Therefore, no submersible pump length allowance is needed, and the value assigned is 0m. For all other wells the pump length allowance is 2m. In some instances where the diameter of the well is small and used for domestic or stockwater (or small irrigation rates) the submersible pump length is likely to be shorter (such as 1m).

## 4.0 INTERPOLATION OF SWL VALUES

To provide a value for SWL for each of the 666 basin wells included in the WI assessment to represent a summer low (and hence the potential seasonal variation within the basin), the basin wells were separated into three categories to match the SOE well contour plots. The locations of the wells in each category were overlaid on the contours and a point value for well location was interpolated. These values were then used within the WI assessment spreadsheet. However, before this assessment was completed, as recommended in the JWS, a comparison was made of the interpolated values against available existing measured well data and numerical model output data to assess their reliability.

## 4.1 Comparison with Measured Data

Measured SWL data from the HBRC Welstor database was compared against the interpolated SWLs generated using the SOE well data contours. This measured data is available for 319 out of the total of 666 assessed wells or 48%. These SWLs represent data that was most likely collected at the time of drilling. So, spans a variety years and times of year and may represent either high or low water periods. The interpolated values are an average of the lowest 10% of measured values in the SOE wells, some have declining trends added, but they do not represent a minimum value outlier. The three contoured surfaces; shallow, intermediate and deep were each compared. The results are summarised in Table 3. The SWLs tend to under predict in about 25% of the intermediate and deep wells and 42% in the shallow wells with an average of 31%.

## 4.2 Comparison with Modelled T1 Drawdown Data

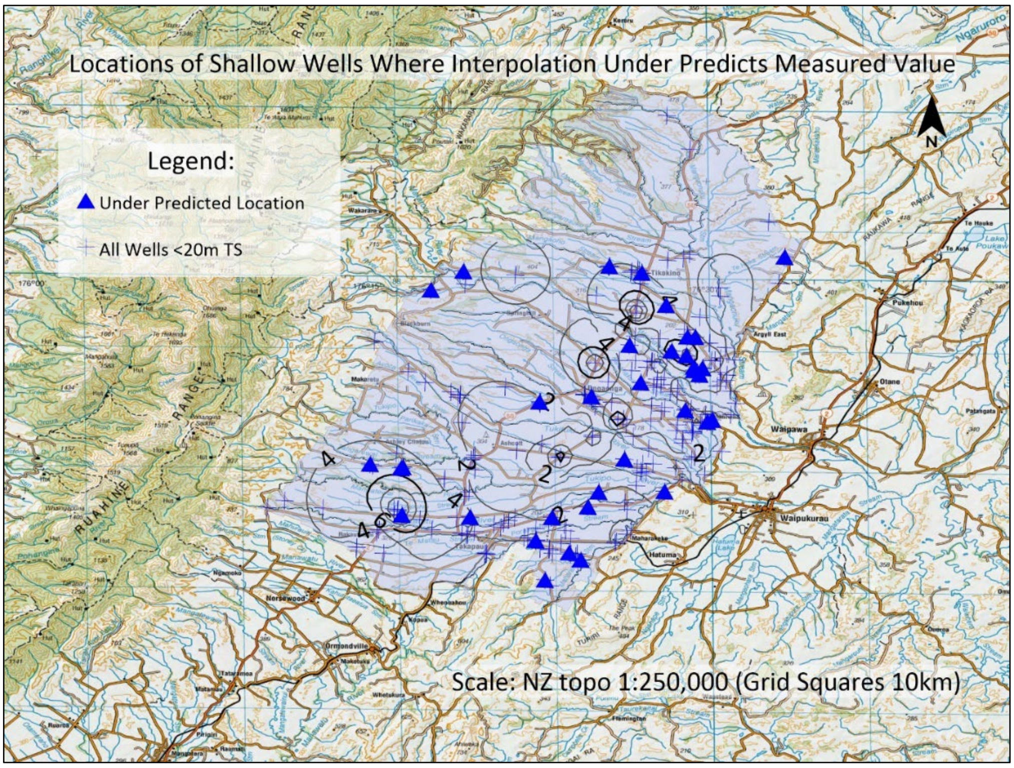
The interpolated SWLs were also compared against the drawdown predictions made by the model of the non-pumped (no abstraction) to status quo (existing T1 use) from the March 2011 dry season to represent a high level of use. This comparison is not really like for like as the modelled data does not include for background variation or an initial depth to water. But it does indicate whether the interpolated SWL has room to accommodate the drawdowns predicted for the T1 use. In the vast majority of case the indication is that it does have room.

**Table 3: Summary of Interpolation Data Comparison**

| | | Measured Data Comparison | | | Modelled Data Comparison | | |
|---|---|---|---|---|---|---|---|
| Contour Layer | Total No. Wells | Total No. Welstor Recorded SWLs | No. Interpolated Values less than recorded | % Under Predicted | Total No. Modelled T1 drawdowns | No. Interpolated Values less than modelled | % Under Predicted |
| Shallow | 233 | 107 | 45 | 42% | 233 | 33 | 14% |
| Intermediate | 252 | 146 | 36 | 25% | 252 | 47 | 19% |
| Deep | 181 | 66 | 17 | 26% | 181 | 10 | 6% |
| Totals | 666 | 319 | 98 | 31% | 666 | 90 | 14% |

A closer review of the worst-case result in Table 3, the shallow measured versus interpolated wells, shows that of the 45 wells identified, 10 have differences that are small (<0.5m). The locations of the remaining 35 wells were plotted, Figure 13. It is noted that some of these are located at the periphery of the basin area where there is less SOE well control and reduced reliability is anticipated. Four of the bores, 2926, 3664, 3140 and 10895 have TS <20m, but bottom screens >25m and maybe influenced to some degree by the deeper layers. Eight of the 35 wells have SWL values greater than 10m_bTOC, of these 4744 has a recorded SWL greater than its total depth, suggesting an error in the database. For bores 2926 and 4228 measured levels are greater that their screen tops so they could be inefficient. Some might represent extreme low points and as noted previously the 10% average low value used to generate the SWL does not represent extreme low measurements. This indicates there are mitigating factors with some of the datapoint interpolations.

**Figure 13: Under Predicted Measured Shallow Well Location**




## 5.0 WELL INTERFERENCE ASSESSMENT

All the data discussed in this report was entered into a series of spreadsheets. They represent 4 scenarios of pumping: [FULL] use (near worst-case dry year) and average [AVE] (more typical) use of 15Mm³ of T2 water and the equivalent for 13Mm³.

The T2 drawdown prediction under this range of water use scenarios were extracted from the numerical model, based on each individual well location and a mid-well screen depth. This was agreed upon in the JWS as the best method for determining the drawdown predictions. However, it was noted that there may be some uncertainty associated with the values produced. The same uncertainty ranges applied to the groundwater modelling were therefore applied to the outputs for the WI assessment. For the most conservative highest water use [FULL] scenario abstraction, three data values were generated to represent the 5%ile, 95%ile and an intermediate or more average use. Each of these three outputs were considered in the WI assessment to provide an upper and lower range.

The WI spreadsheets calculate the available head (AH) for each well for each scenario, and then the proportion of the available drawdown (including the proposed T2 activities) as a percent of the AH. An arbitrary value of 20% was chosen to highlight wells requiring further, more specific consideration. The remaining 80% AH is considered sufficient to accommodate self-induced drawdown within a well. Specific effects on wells used as registered drinking water supply are addressed in the evidence of Alexandra Johansen.

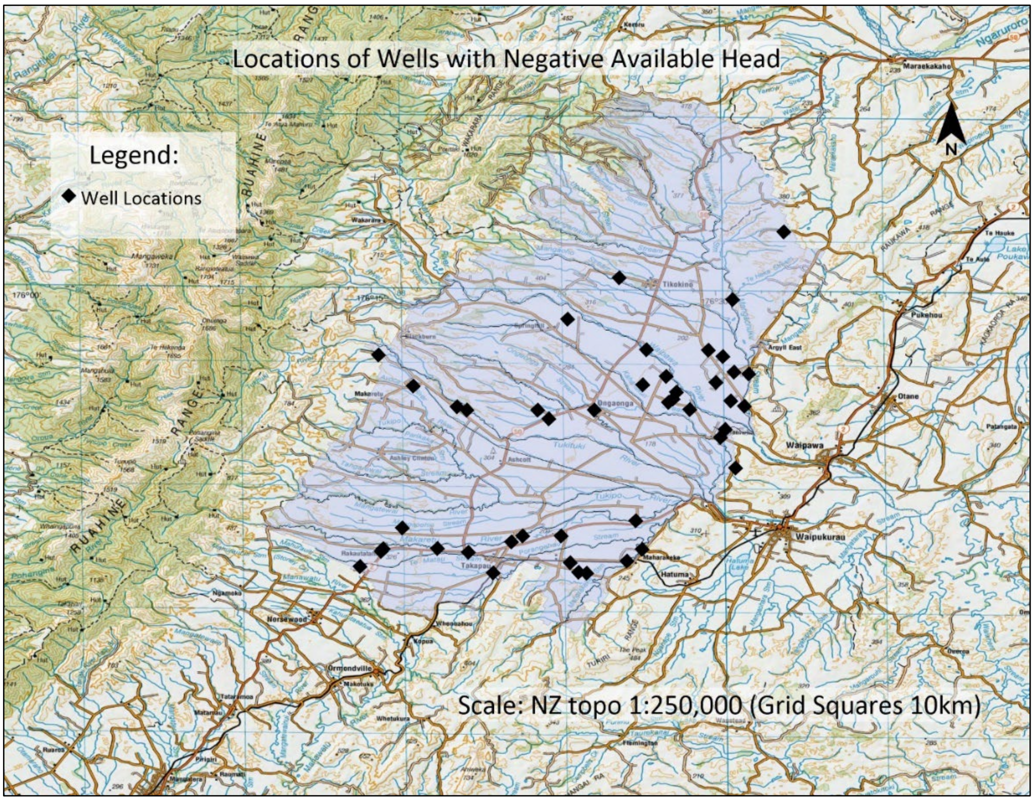
The findings of the WI assessments are summarised in Table 4. Essentially, when only the SWL and pump length are included 42 wells with top screens (TS) less 20m and

2 with TS 20-50m show a negative available head (AH). The locations of these wells (44) are shown in Figure 14. These wells are located towards the south and east of the basin with some in a line towards the west. They seem to follow the river lines. It is noted that of these 44 wells only 6 have TS heights greater than 6m i.e. they generally represent very shallow wells.

**Table 4: Summary of WI Outcomes**

| | **Well Categories** | | | |
|---|---|---|---|---|
| | <20m TS | 20-50m TS | >50m TS | Totals |
| Total No. Wells | 233 | 252 | 181 | 666 |
| No. -ve AH | 42 | 2 | 0 | **44** |
| No. +ve AH | 191 | 250 | 181 | 622 |
| Of those with +ve AH | | | | |
| **Full Use - 15Mm3 (AVE)** | | | | |
| No. >20% | 37 | 14 | 0 | **51** |
| No. <20% | 154 | 236 | 181 | 571 |
| Totals | 191 | 250 | 181 | 622 |
| **Full Use - 15Mm3 (5%)** | | | | |
| No. >20% | 51 | 16 | 0 | **67** |
| No. <20% | 140 | 234 | 181 | 555 |
| Totals | 191 | 250 | 181 | 622 |
| **Full Use - 15Mm3 (95%)** | | | | |
| No. >20% | 27 | 3 | 0 | **30** |
| No. <20% | 164 | 247 | 181 | 592 |
| Totals | 191 | 250 | 181 | 622 |
| **Ave Use - 15Mm3** | | | | |
| No. >20% | 22 | 1 | 0 | 23 |
| No. <20% | 169 | 249 | 181 | 599 |
| Totals | 191 | 250 | 181 | 622 |
| **Full Use - 13Mm3** | | | | |
| No. >20% | 30 | 6 | 0 | 36 |
| No. <20% | 161 | 244 | 181 | 586 |
| Totals | 191 | 250 | 181 | 622 |
| **Ave Use - 13Mm3** | | | | |
| No. >20% | 23 | 1 | 0 | 24 |
| No. <20% | 168 | 249 | 181 | 598 |
| Totals | 191 | 250 | 181 | 622 |

**Figure 14: Locations of Wells with Negative Available Head**

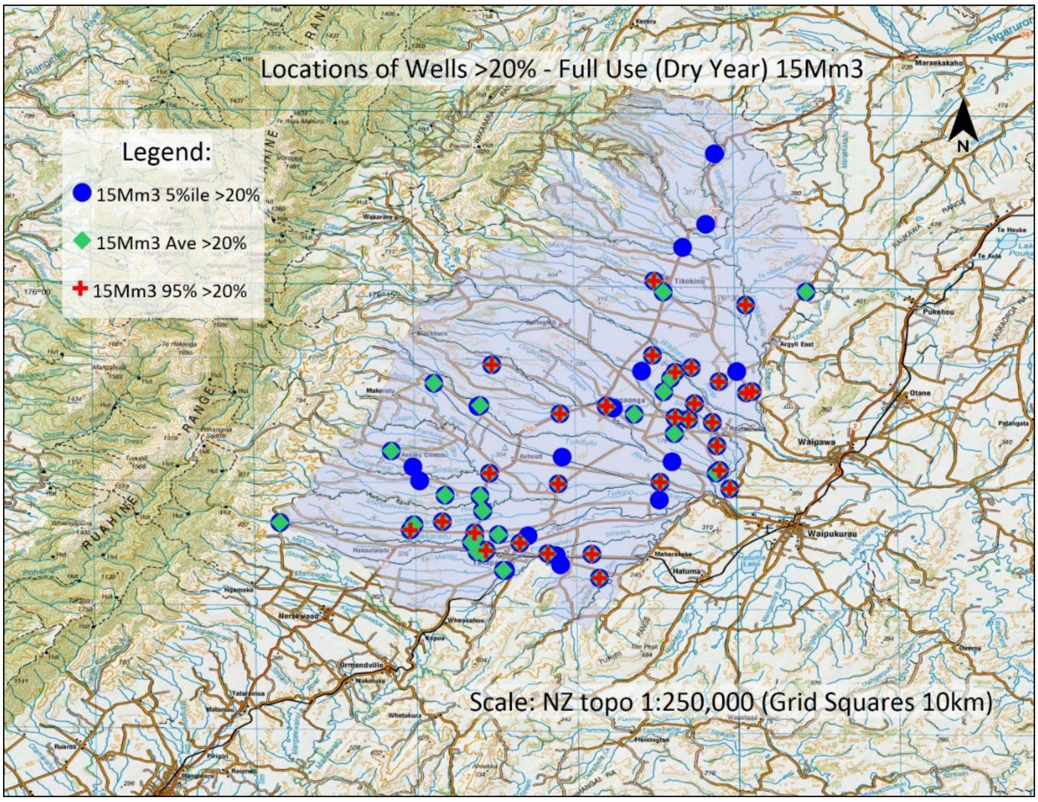



Wells that have negative available head values as part of this assessment could be considered as "inefficient". Policy 77(c) of the Regional Resource Management Plan (RRMP) seeks to manage new groundwater takes such that existing "efficient" groundwater takes are not disadvantaged. "Efficient taking" of groundwater is defined by the RRMP as being: "the abstraction by a bore which penetrates the aquifer from which water is being drawn at a depth sufficient to enable water to be drawn all year (i.e. the bore depth is below the range of seasonal fluctuations in groundwater level), with the bore being adequately maintained, of sufficient diameter and screened to minimise drawdown, with a pump capable of drawing water from the base of the bore to the land surface".

For the 622 wells that retain a positive AH for the worst-case (driest year) and largest abstraction volume (15Mm$^3$) three potential outcomes are presented to manage uncertainty in the numerical model predictions. The most conservative (5%ile) identifies 67 wells with values greater than 20%, the mid-range (AVE) shows 51 and the best-case (95%ile) has 30 wells greater than 20%. These outcomes and the well locations identified are shown on the map in Figure 15. The locations of the flagged wells is fairly widespread, and there are wells located in the main township areas and to the east of Ongaonga and south of the basin.

The other scenarios range between 23 and 36 wells flagged as greater than 20%. It is noted that there are no flagged wells in the deep category wells under any of the scenarios.

**Figure 15: Locations of Wells Flagged – Worst-Case T2 Abstraction Scenario**




Further consideration is required of the flagged wells that are greater than 20% of the AH. It is noted that some are only just over the 20% threshold. Factors such as an existing use for example groundwater monitoring would mean a reduction in AH is of little consequence or the 2m pump length may not be realistic because the well diameter is simply too small to accommodate such a big pump. Therefore, further specific assessment is required, and that information will be presented at the hearing.

# Appendix 1 – Summary of SWL Data

| Lat | Long | Well Number | Well Name | Depth - Top Screen (m) | WL L10%&DECL (masl) | GL Elevation (masl) | Depth to SWL (mbgl) | Estimated Correction to TOC | **SWL Summer Low (mbTOC)** |
|---|---|---|---|---|---|---|---|---|---|
| 176.472 | -39.9031 | 15014 | Hudson | 2.3 | 177.90 | **180.5888** | 2.7 | 0.4 | 3.1 |
| 176.5258 | -39.9234 | 4693 | Stockade Rd (shallow) | 4.1 | 153.74 | **153.9055** | 0.2 | 0.4 | 0.6 |
| 176.5147 | -39.9025 | 16485 | Linburn Rd 5m | 4.3 | 160.87 | 162.91 | 2.0 | 0.4 | 2.4 |
| 176.2701 | -40.0371 | 16504 | Dean Rd | 4.3 | 324.56 | 326.33 | 1.8 | 0.4 | 2.2 |
| 176.5083 | -39.9293 | 16250 | Stockade Rd | 4.3 | 159.82 | 164.17 | 4.3 | 0.4 | 4.7 |
| 176.449 | -39.9923 | 16491 | Speedy Rd 6m | 4.4 | 162.16 | 165.87 | 3.7 | 0.4 | 4.1 |
| 176.2646 | -40.0216 | 16253 | Snee Rd | 4.8 | 317.37 | 320.51 | 3.1 | 0.4 | 3.5 |
| 176.5033 | -39.9305 | 10993 | Punanui No.2 | 4.8 | 157.96 | 159 | 1.0 | 0.4 | 1.4 |
| 176.4914 | -39.9736 | 4695 | Ashcott Reserve (shallow) | 5.0 | 142.60 | **145.2839** | 2.7 | 0.4 | 3.1 |
| 176.4742 | -39.8097 | 16484 | Butler Rd | 5.0 | 231.26 | 233.99 | 2.7 | 0.4 | 3.1 |
| 176.2794 | -40.0039 | 1944 | Springfield | 7.1 | 291.66 | 303.42 | 11.8 | 0.4 | 12.2 |
| 176.4907 | -39.946 | 16499 | Hobin Rd 9m | 9.0 | 154.26 | 157.57 | 3.3 | 0.4 | 3.7 |
| 176.3607 | -39.8251 | 16502 | Makaroro Rd | 9.8 | 295.50 | 300.287 | 4.8 | 0.4 | 5.2 |
| 176.4798 | -39.8774 | 3076 | Feedlot | 10.0 | 186.29 | 194.49 | 8.2 | 0.4 | 8.6 |
| 176.4414 | -39.9305 | 16489 | Onga Onga Waipuk Rd 11m | 10.2 | 174.14 | 181.91 | 7.8 | 0.4 | 8.2 |
| 176.4861 | -39.965 | 16500 | Onga Onga Waipuk Rd | 10.3 | 148.85 | 150.72 | 1.9 | 0.4 | 2.3 |
| 176.5123 | -39.8835 | 16487 | Argyll Rd | 10.3 | 168.69 | 174.59 | 5.9 | 0.4 | 6.3 |
| 176.41 | -40.0323 | 16503 | Oruawhara Rd | 10.3 | 188.64 | 190.95 | 2.3 | 0.4 | 2.7 |
| 176.3237 | -40.0082 | 16479 | Paget Rd | 10.7 | 254.25 | 258.97 | 4.7 | 0.4 | 5.1 |
| 176.4909 | -39.8804 | 2979 | Eastern Equities | 11.0 | 178.81 | 188.64 | 9.8 | 0.4 | 10.2 |
| 176.3996 | -39.9601 | 16247 | Burnside Rd | 12.5 | 194.42 | 201.04 | 6.6 | 0.4 | 7.0 |
| 176.423 | -39.8886 | 16249 | Wakarara Rd | 13.1 | 191.40 | 201.04 | 9.6 | 0.4 | 10.0 |
| 176.4507 | -40.0155 | 1900 | Hatuma | 14.6 | 160.36 | **165.9037** | 5.5 | 0.4 | 5.9 |
| 176.4231 | -39.9441 | 16501 | Burnside Rd | 14.8 | 180.68 | 185.95 | 5.3 | 0.4 | 5.7 |
| 176.5029 | -39.8895 | 1379 | Glen Athol | 15.8 | 171.09 | 175.97 | 4.9 | 0.4 | 5.3 |
| 176.4516 | -39.8501 | 16248 | Makaroro Rd 20m | 18.7 | 201.19 | **213.7** | 12.5 | 0.4 | 12.9 |
| 176.4702 | -39.9834 | 1376 | Golf Club | 20.1 | 151.90 | 153.1 | 1.2 | 0.4 | 1.6 |
| 176.3746 | -39.9145 | 16251 | Blackburn Rd | 20.2 | 210.42 | 230.81 | 20.4 | 0.4 | 20.8 |
| 176.4479 | -39.9597 | 1558 | Livingstone | 20.5 | 160.52 | 166.29 | 5.8 | 0.4 | 6.2 |
| 176.3265 | -39.9812 | 16252 | Ashley Clinton Rd | 22.3 | 238.46 | 249.67 | 11.2 | 0.4 | 11.6 |
| 176.4914 | -39.9736 | 4696 | Ashcott Reserve (deep) | 22.8 | 143.20 | **145.2839** | 2.1 | 0.4 | 2.5 |
| 176.3938 | -39.8475 | 16488 | Caldwell Rd | 23.4 | 219.38 | 243.106 | 23.7 | 0.4 | 24.1 |
| 176.3591 | -39.9774 | 16095 | Balfour Rd 26m | 25.1 | 214.01 | 221.31 | 7.3 | 0.4 | 7.7 |
| 176.4147 | -39.912 | 16880 | Bridge St Ongaonga 30m | 25.2 | 194.09 | 201.24 | 7.2 | 0.4 | 7.6 |
| 176.4326 | -40.0236 | 16507 | Station Rd | 27.6 | 168.24 | 179.4 | 11.2 | 0.4 | 11.6 |
| 176.4531 | -39.8196 | 16882 | Murchison St Tikokino 30m | 28.5 | 225.20 | 237.73 | 12.5 | 0.4 | 12.9 |
| 176.3608 | -40.005 | 5335 | Takapau | 28.8 | 216.94 | 222.21 | 5.3 | 0.4 | 5.7 |
| 176.3965 | -40.0115 | 6719 | H.B.F.M Co. | 30.0 | 176.28 | 188.68 | 12.4 | 0.4 | 12.8 |
| 176.4187 | -39.914 | 15048 | Ongaonga | 30.1 | 193.48 | 201.75 | 8.3 | 0.4 | 8.7 |
| 176.5033 | -39.9305 | 1458 | Punanui No.1 | 33.4 | 158.07 | 159.93 | 1.9 | 0.4 | 2.3 |
| 176.3421 | -39.9042 | 1662 | Totaranui | 33.5 | 243.55 | 262.23 | 18.7 | 0.4 | 19.1 |
| 176.3886 | -39.9153 | 1426 | Forest Gate | 38.1 | 198.75 | 213.67 | 14.9 | 0.4 | 15.3 |
| 176.4918 | -39.8321 | 1861 | Riddell | 38.7 | 197.05 | 198.29 | 1.2 | 0.4 | 1.6 |
| 176.3755 | -39.9267 | 1430 | Kindar | 39.1 | 210.46 | 227.77 | 17.3 | 0.4 | 17.7 |
| 176.478 | -39.8083 | 1485 | Atherstone | 39.3 | 219.74 | 233.47 | 13.7 | 0.4 | 14.1 |
| 176.5123 | -39.8834 | 17183 | Argyll Rd 42m | 40.0 | 168.66 | 174.66 | 6.0 | 0.4 | 6.4 |
| 176.3829 | -39.9706 | 1429 | Lutz | 42.0 | 179.69 | 205.64 | 25.9 | 0.4 | 26.3 |
| 176.5258 | -39.9234 | 4694 | Stockade Rd (deep) | 42.9 | 154.11 | **153.9109** | -0.2 | 0.4 | 0.2 |
| 176.4211 | -39.8981 | 2749 | Meridith SH50 | 43.0 | 195.79 | 210.585 | 14.8 | 0.4 | 15.2 |
| 176.429 | -39.8875 | 1475 | Thompsen | 46.3 | 193.32 | 216.04 | 22.7 | 0.4 | 23.1 |
| 176.4573 | -39.9004 | 1452 | Grocorp Pacific | 47.9 | 164.15 | 189.23 | 25.1 | 0.4 | 25.5 |
| 176.4567 | -39.9017 | 15015 | Pacific Orchard | 51.2 | 189.46 | **187.9073** | -1.6 | 0.4 | -1.2 |
| 176.4741 | -39.8098 | 17178 | Butler Rd 58m | 56.2 | 220.47 | 234.05 | 13.6 | 0.4 | 14.0 |
| 176.4086 | -39.8752 | 1826 | Springhill | 56.7 | 207.72 | 234.11 | 26.4 | 0.4 | 26.8 |
| 176.3608 | -40.0049 | 16478 | Nelsons Rd 58m | 56.8 | 214.21 | 222.47 | 8.3 | 0.4 | 8.7 |
| 176.4907 | -39.946 | 16498 | Hobin Rd 69m | 67.8 | 154.19 | 157.572 | 3.4 | 0.4 | 3.8 |
| 176.3989 | -39.9582 | 3452 | MacGregor Burnside Rd | 71.1 | 162.07 | 195.89 | 33.8 | 0.4 | 34.2 |
| 176.449 | -39.9922 | 16492 | Speedy Rd 73m | 72.3 | 150.68 | 165.88 | 15.2 | 0.4 | 15.6 |
| 176.3893 | -39.9176 | 4685 | Forest Gate 78m | 76.0 | 197.69 | 216.54 | 18.8 | 0.4 | 19.2 |
| 176.4414 | -39.9305 | 16490 | Onga Onga Waipuk Rd 79m | 77.8 | 180.93 | 181.95 | 1.0 | 0.4 | 1.4 |
| 176.5147 | -39.9025 | 16486 | Linburn Rd 80m | 78.3 | 162.15 | 162.92 | 0.8 | 0.4 | 1.2 |
| 176.4525 | -39.8503 | 16477 | Makaroro Rd 81m | 80.2 | 208.85 | 220.48 | 11.6 | 0.4 | 12.0 |
| 176.4353 | -39.8793 | 2220 | Te Papa No.2 | 81.5 | 196.00 | 216.5 | 20.5 | 0.4 | 20.9 |
| 176.3591 | -39.9774 | 16094 | Balfour Rd 85m | 83.4 | 201.42 | 221.31 | 19.9 | 0.4 | 20.3 |
| 176.3985 | -39.9604 | 4697 | Burnside Rd | 84.5 | 159.97 | **201.2122** | 41.2 | 0.4 | 41.6 |
| 176.4148 | -39.912 | 16879 | Bridge St Ongaonga 90m | 85.8 | 165.64 | 201.24 | 35.6 | 0.4 | 36.0 |
| 176.4531 | -39.8196 | 16881 | Murchison St Tikokino 90m | 88.7 | 218.91 | 237.73 | 18.8 | 0.4 | 19.2 |
| 176.4433 | -39.8657 | 4700 | Waipawa River | 92.0 | 204.22 | 216.14 | 11.9 | 0.4 | 12.3 |
| 176.3893 | -39.9176 | 16639 | Forest Gate 108m | 107.0 | 186.92 | 216.54 | 29.6 | 0.4 | 30.0 |
| 176.485 | -39.9084 | 4701 | Swamp Rd | 108.0 | 167.78 | 174.57 | 6.8 | 0.4 | 7.2 |
| 176.3666 | -39.9423 | 3702 | Ashcott Park | 114.5 | 199.22 | **237.5769** | 38.4 | 0.4 | 38.8 |
| 176.3986 | -39.9604 | 5445 | Burnside Rd 2 | 129.3 | 146.45 | 201.38 | 54.9 | 0.4 | 55.3 |
| 176.4432 | -39.8657 | 15021 | Waipawa River | 142.5 | 202.57 | 215.96 | 13.4 | 0.4 | 13.8 |

## Appendix 2 – Summary Declining Wells Identified and Rates Calculated

| **Shallow Well no** | Declining Rate (m/yr) | Amount Over Next 5 Years | **Intermediate Well no** | Declining Rate (m/yr) | Amount Over Next 5 Years | **Deep Well no** | Declining Rate (m/yr) | Amount Over Next 5 Years |
|---|---|---|---|---|---|---|---|---|
| 1379 | X | | 1376 | X | | **1826** | **0.167** | **0.83** |
| 1900 | X | | **1426** | **0.143** | **0.71** | **2220** | **0.417** | **2.08** |
| **1944** | **0.220** | **1.1** | **1429** | **0.333** | **1.67** | 3452 | Insufficient data | |
| 2979 | Insufficient data | | **1430** | **0.500** | **2.5** | **3702** | **0.143** | **0.71** |
| **3076** | **0.027** | **0.14** | 1452 | X | | 4685 | Insufficient data | |
| 4693 | X | | 1458 | X | | 4697 | X | |
| 4695 | X | | **1475** | **0.450** | **2.25** | **4700** | **0.333** | **1.67** |
| 10993 | X | | **1485** | **0.182** | **0.91** | **4701** | **0.182** | **0.91** |
| 15014 | X | | 1558 | X | | **4702** | deep LMST | |
| 16247 | X | | 1662 | X | | **5445** | **0.063** | **0.31** |
| **16248** | **0.167** | **0.84** | 1861 | X | | 15015 | X | |
| **16249** | **0.180** | **0.9** | 2749 | Insufficient data | | **15021** | **0.714** | **3.57** |
| 16250 | Insufficient data | | 4694 | X | | **16094** | **0.714** | **3.57** |
| 16253 | Insufficient data | | 4696 | X | | 16477 | Insufficient data | |
| 16479 | Insufficient data | | **5335** | **0.056** | **0.28** | 16478 | Insufficient data | |
| 16484 | Insufficient data | | **6719** | **0.125** | **0.63** | 16486 | Insufficient data | |
| 16485 | Insufficient data | | **15048** | **0.250** | **1.25** | 16490 | Insufficient data | |
| 16487 | Insufficient data | | 16095 | X | | 16492 | Insufficient data | |
| 16489 | Insufficient data | | 16251 | X | | 16498 | Insufficient data | |
| 16491 | Insufficient data | | 16252 | Insufficient data | | 16639 | Insufficient data | |
| 16499 | Insufficient data | | 16488 | Insufficient data | | 16879 | Insufficient data | |
| 16500 | Insufficient data | | 16507 | Insufficient data | | 16881 | Insufficient data | |
| 16501 | Insufficient data | | 16880 | Insufficient data | | 17178 | Insufficient data | |
| 16502 | Insufficient data | | 16882 | Insufficient data | | | | |
| 16503 | Insufficient data | | 17183 | Insufficient data | | | | |
| 16504 | Insufficient data | | | | | | | |

# Appendix 3: Well Interference Assessment – Key Results

## Negative AH Well List

| Lat | Long | BoreNo | Diameter (mm) | Total Depth (mbTOC) | Top Screen (mbTOC) | Btm Screen (mbTOC) | SWL Summer (mTOC) | Pump Length (m) | Availble Head (AH) (m) | Full Use 15Mm3-Predicted T2 Drawdown (m) | T2 Drawdown as % AH | 5% - Full Use 15Mm3-Predicted T2 Drawdown (m) | T2 Drawdown as % AH | 95% - Full Use 15Mm3-Predicted T2 Drawdown (m) | T2 Drawdown as % AH | Well Use (1) | Well Use (2) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 176.5077 | -39.8704 | 2030 | 400 | 3.0 | 0.9 | 3.0 | 2.71168377 | 0.0 | -1.79 | 0.06 | | 0.06 | | 0.05 | | Domestic Water | Stock Watering | |
| 176.5115 | -39.9234 | 4222 | 50 | 4.0 | 1.0 | 4.0 | 3.14399537 | 0.0 | -2.17 | 0.06 | | 0.16 | | 0.05 | | Groundwater sampling/monitoring | | |
| 176.3467 | -40.0341 | 2732 | 100 | 3.2 | 1.1 | 3.2 | 4.30580822 | 0.0 | -3.18 | 0.00 | | 0.16 | | -0.01 | | Stock Watering | Unknown | |
| 176.4544 | -40.0129 | 15014 | 100 | 3.3 | 1.2 | 3.3 | 5.02468602 | 0.0 | -3.80 | 1.21 | | 1.39 | | 1.05 | | Unused | | |
| 176.4727 | -39.9027 | 15025 | 150 | 3.3 | 1.2 | 3.3 | 4.24887979 | 0.0 | -3.02 | 0.34 | | 0.46 | | 0.28 | | Unused | | |
| 176.475 | -39.8977 | 10899 | 250 | 37.5 | 1.4 | 3.7 | 11.8148068 | 0.0 | -10.44 | 0.02 | | 0.02 | | 0.01 | | | | |
| 176.5248 | -39.906 | 2926 | 300 | 30.0 | 1.5 | 28.0 | 3.41182702 | 0.0 | -1.88 | 0.78 | | 0.79 | | 0.54 | | Domestic Water | Stock Watering | |
| 176.4088 | -40.0313 | 5393 | 200 | 4.6 | 1.6 | 2.9 | 2.70035563 | 0.0 | -1.10 | 0.01 | | 0.01 | | 0.00 | | Domestic Water | Supply | |
| 176.5271 | -39.8824 | 4227 | 150 | 4.9 | 1.8 | 4.4 | 2.49092256 | 0.0 | -0.69 | 0.23 | | 0.27 | | 0.19 | | Groundwater sampling/monitoring | | |
| 176.4302 | -39.816 | 15028 | 1000 | 3.9 | 1.8 | 3.9 | 4.48289435 | 0.0 | -2.66 | 0.45 | | 0.66 | | 0.36 | | Groundwater sa | Unused | |
| 176.4671 | -39.8864 | 15866 | 50 | 4.0 | 1.9 | 4.0 | 2.42496913 | 0.0 | -0.50 | 0.15 | | 0.16 | | 0.11 | | | | |
| 176.2497 | -40.0332 | 5531 | 100 | 5.0 | 2.0 | 5.0 | 2.50403043 | 0.0 | -0.50 | 0.21 | | 0.26 | | 0.19 | | Exploratory Well | | |
| 176.5132 | -39.8288 | 2902 | 50 | 4.1 | 2.1 | 4.1 | 5.08342148 | 0.0 | -2.97 | 0.45 | | 0.46 | | 0.39 | | Domestic Water | Stock Watering | |
| 176.3231 | -39.9164 | 15023 | 100 | 4.5 | 2.4 | 4.5 | 3.77005455 | 0.0 | -1.34 | 0.48 | | 0.66 | | 0.39 | | Groundwater sa | Unused | |
| 176.4157 | -39.9129 | 15024 | 1000 | 4.6 | 2.5 | 4.6 | 9.1572094 | 0.0 | -6.63 | 0.48 | | 0.66 | | 0.39 | | Groundwater sa | Unused | |
| 176.3158 | -39.9144 | 2747 | 100 | 3.6 | 2.6 | 3.6 | 4.0899892 | 0.0 | -1.49 | 0.15 | | 0.16 | | 0.11 | | Irrigation | Unknown | |
| 176.4436 | -40.0218 | 3092 | 150 | 5.3 | 2.8 | 5.3 | 4.22368941 | 0.0 | -1.47 | 0.15 | | 0.16 | | 0.11 | | Domestic Water | Groundwater sampling/monitoring | |
| 176.3951 | -40.0054 | 5659 | 150 | 8.8 | 2.8 | 8.8 | 3.53149225 | 0.0 | -0.73 | 0.06 | | 0.16 | | 0.05 | | Exploratory Well | | |
| 176.3055 | -40.0179 | 5532 | 100 | 5.0 | 2.9 | 5.0 | 3.52590777 | 0.0 | -0.60 | 0.12 | | 0.23 | | 0.09 | | Unknown | | |
| 176.452 | -39.8676 | 15719 | 100 | 5.0 | 2.9 | 5.0 | 9.90376694 | 0.0 | -6.98 | 0.15 | | 0.16 | | 0.11 | | | | |
| 176.2573 | -39.8788 | 1468 | 100 | 7.0 | 3.0 | 7.0 | 4.01377248 | 0.0 | -1.01 | 0.15 | | 0.16 | | 0.11 | | Unknown | Unknown | |
| 176.3592 | -40.0111 | 17054 | 100 | 4.5 | 3.0 | 4.5 | 4.04485546 | 0.0 | -1.04 | 0.01 | | 0.16 | | 0.00 | | Groundwater sampling/monitoring | | |
| 176.3671 | -40.0064 | 17125 | 80 | 6.0 | 3.0 | 6.0 | 4.39159854 | 0.0 | -1.39 | 0.01 | | 0.16 | | 0.00 | | Groundwater sampling/monitoring | | |
| 176.266 | -40.0196 | 2135 | 50 | 5.5 | 3.4 | 5.5 | 4.95323904 | 0.0 | -1.53 | 0.21 | | 0.24 | | 0.18 | | Unknown | Unknown | |
| 176.2794 | -40.0039 | 10986 | 150 | 5.8 | 3.7 | 5.8 | 5.74340942 | 0.0 | -2.03 | 0.15 | | 0.16 | | 0.11 | | Agriculture (not irrigation) | | |
| 176.4694 | -39.9053 | 15027 | 100 | 6.0 | 3.9 | 6.0 | 4.02450558 | 0.0 | -0.10 | 0.29 | | 0.39 | | 0.24 | | Stock Watering | Unused | |
| 176.4852 | -39.9099 | 16346 | 100 | 6.0 | 3.9 | 6.0 | 11.7581314 | 0.0 | -7.83 | 0.40 | | 0.60 | | 0.33 | | | | |
| 176.5486 | -39.7781 | 10963 | 200 | 46.8 | 4.3 | 6.5 | 5.69967111 | 0.0 | -1.40 | 0.37 | | 0.37 | | 0.31 | | | | |
| 176.5201 | -39.9512 | 16485 | 100 | 5.5 | 4.3 | 5.5 | 4.94671148 | 0.0 | -0.65 | 0.34 | | 0.35 | | 0.28 | | Groundwater sampling/monitoring | | |
| 176.5147 | -39.9025 | 16504 | | 5.5 | 4.3 | 5.5 | 4.85825461 | 0.0 | -0.56 | 0.35 | | 0.37 | | 0.29 | | | | |
| 176.5083 | -39.9293 | 16491 | 150 | 5.6 | 4.4 | 5.6 | 5.22048124 | 0.0 | -0.82 | 0.48 | | 0.48 | | 0.37 | | | | |
| 176.449 | -39.9923 | 16777 | 100 | 7.5 | 4.5 | 7.5 | 11.1448603 | 0.0 | -6.64 | 0.25 | | 0.25 | | 0.21 | | | | |
| 176.5034 | -39.8895 | 16253 | 5000 | 6.0 | 4.8 | 6.0 | 10.6924671 | 0.0 | -5.91 | 0.29 | | 0.33 | | -0.37 | | Groundwater sampling/monitoring | | |
| 176.2646 | -40.0216 | 15936 | 110 | 6.5 | 4.8 | 6.5 | 4.95259285 | 0.0 | -0.15 | 0.02 | | 0.03 | | 0.02 | | | | |
| 176.4147 | -40.0318 | 10946 | 100 | 7.0 | 4.9 | 7.0 | 6.6801197 | 0.0 | -1.75 | 0.15 | | 0.23 | | 0.14 | | | | |
| 176.4024 | -40.0246 | 4743 | 75 | 7.1 | 5.1 | 7.1 | 5.50884463 | 0.0 | -0.41 | 0.32 | | 0.38 | | 0.27 | | Groundwater sampling/monitoring | | |
| 176.4503 | -39.8932 | 10950 | 100 | 7.2 | 5.1 | 7.2 | 7.75282023 | 0.0 | -2.63 | 0.22 | | 0.27 | | 0.18 | | Domestic Water | Supply | |
| 176.3281 | -40.0198 | 10973 | 100 | 7.6 | 5.3 | 6.2 | 7.32591729 | 0.0 | -2.05 | 0.34 | | 0.35 | | 0.28 | | | | |
| 176.3829 | -39.9206 | 16097 | 100 | 18.5 | 6.5 | 18.5 | 5.77517212 | 2.0 | -1.28 | 0.15 | | 0.16 | | 0.11 | | | | |
| 176.5163 | -39.8815 | 17155 | 150 | 12.0 | 9.1 | 12.0 | 10.2347576 | 2.0 | -3.13 | 0.40 | | 0.57 | | 0.33 | | Groundwater sampling/monitoring | | |
| 176.2834 | -39.9005 | 10968 | 150 | 13.1 | 10.4 | 11.6 | 10.6996135 | 2.0 | -2.34 | 0.25 | | 0.40 | | 0.21 | | | | |
| 176.497 | -39.8662 | 2773 | 100 | 18.0 | 12.0 | 18.0 | 11.8146567 | 2.0 | -1.81 | 0.24 | | 0.28 | | 0.22 | | Domestic Water | Stock Watering | |
| 176.3746 | -39.9145 | 16251 | 150 | 21.5 | 20.2 | 21.5 | 20.2522001 | 2.0 | -2.01 | 1.79 | | 2.34 | | 1.36 | | | | |
| 176.3938 | -39.8475 | 16488 | 300 | 26.0 | 23.4 | 24.4 | 23.9696693 | 2.0 | -2.57 | 0.69 | | 1.20 | | 0.60 | | Groundwater sampling/monitoring | | |

## Flagged Wells List with Average Model Outputs

| Lat | Long | BoreNo | Diameter (mm) | Total Depth (mbTOC) | Top Screen (mbTOC) | Btm Screen (mbTOC) | SWL Summer (mTOC) | Pump Length (m) | Availble Head (AH) (m) | Full Use 15Mm3-Predicted T2 Drawdown (m) | T2 Drawdown as % AH | Well Use (1) | Well Use (2) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 176.4163 | -39.9126 | 16778 | 100 | 6.0 | 2.0 | 5.0 | 1.01666928 | 0.0 | 0.98 | 0.25 | 25% | | | |
| 176.4649 | -39.8858 | 5137 | 1000 | 4.7 | 2.5 | 4.0 | 2.39356346 | 0.0 | 0.08 | 0.49 | 645% | Groundwater sampling/monitoring | | |
| 176.4974 | -39.9383 | 5529 | 150 | 5.0 | 2.5 | 5.0 | 1.91849326 | 0.0 | 0.58 | 0.21 | 36% | Exploratory Well | | |
| 176.4157 | -39.9124 | 5530 | 100 | 5.0 | 2.5 | 5.0 | 2.48375384 | 0.0 | 0.02 | 0.21 | 1293% | Exploratory Well | | |
| 176.4572 | -39.9662 | 10938 | 50 | 7.6 | 2.6 | 7.6 | 2.51143498 | 0.0 | 0.09 | 0.15 | 169% | | | |
| 176.4157 | -40.0376 | 2372 | 100 | 6.7 | 2.7 | 6.7 | 2.66362098 | 0.0 | 0.05 | 0.25 | 539% | Irrigation | Unknown | |
| 176.3457 | -40.0346 | 2368 | 150 | 5.0 | 2.9 | 5.0 | 2.37225096 | 0.0 | 0.55 | 0.15 | 27% | Stock Watering | Unknown | |
| 176.357 | -40.0143 | 1357 | 100 | 5.2 | 3.1 | 5.2 | 2.36835437 | 0.0 | 0.74 | 0.25 | 34% | Domestic Water | Unknown | |
| 176.558 | -39.8238 | 1512 | 100 | 7.1 | 3.1 | 5.1 | 1.60218811 | 0.0 | 1.53 | 0.36 | 24% | Stock Watering | Unknown | |
| 176.4935 | -39.9213 | 4398 | 100 | 4.6 | 3.2 | 4.2 | 3.17439417 | 0.0 | 0.03 | 0.25 | 976% | Domestic Water | Stock Watering | |
| 176.447 | -39.82 | 2309 | 50 | 5.5 | 3.4 | 5.5 | 3.05574798 | 0.0 | 0.37 | 0.21 | 56% | Domestic Water | Unknown | |
| 176.4766 | -39.8821 | 2775 | 150 | 51.8 | 4.0 | 50.6 | 3.64355221 | 0.0 | 0.32 | 0.21 | 66% | Domestic Water | Unknown | |
| 176.5143 | -39.8351 | 15030 | 100 | 6.7 | 4.6 | 6.7 | 4.17125811 | 0.0 | 0.45 | 0.30 | 66% | Stock Watering | | |
| 176.4662 | -39.9188 | 16774 | 50 | 5.7 | 4.7 | 5.7 | 3.60582207 | 0.0 | 1.10 | 0.38 | 34% | | | |
| 176.5215 | -39.8978 | 4620 | 50 | 6.8 | 4.7 | 6.8 | 4.1784955 | 0.0 | 0.55 | 0.75 | 137% | Groundwater sampling/monitoring | | |
| 176.4619 | -39.8905 | 15121 | 375 | 6.8 | 4.7 | 6.8 | 2.18141385 | 0.0 | 2.54 | 0.56 | 22% | Unused | | |
| 176.5174 | -39.899 | 4621 | 150 | 7.4 | 5.3 | 7.4 | 4.35622528 | 0.0 | 0.97 | 0.33 | 34% | Groundwater sampling/monitoring | | |
| 176.48 | -39.9082 | 3690 | 150 | 7.5 | 5.4 | 7.5 | 4.97586853 | 0.0 | 0.45 | 0.60 | 134% | Domestic Water | Supply | |
| 176.5079 | -39.9691 | 5356 | 150 | 11.8 | 5.8 | 11.8 | 1.3346917 | 0.0 | 4.47 | 1.70 | 38% | Groundwater sampling/monitoring | | |
| 176.329 | -39.992 | 5135 | 50 | 8.1 | 6.0 | 7.4 | 1.72198589 | 2.0 | 2.32 | 0.49 | 21% | Groundwater sampling/monitoring | | |
| 176.4977 | -39.958 | 4742 | 100 | 8.2 | 6.2 | 8.2 | 2.13970678 | 2.0 | 2.02 | 0.40 | 20% | Groundwater sampling/monitoring | | |
| 176.4481 | -39.8742 | 4477 | 150 | 10.2 | 6.2 | 10.2 | 3.39681458 | 2.0 | 0.80 | 0.19 | 24% | Groundwater sampling/monitoring | | |
| 176.3824 | -39.9193 | 5342 | 150 | 8.4 | 6.3 | 8.4 | 3.19909724 | 2.0 | 1.13 | 0.32 | 28% | Groundwater sampling/monitoring | | |
| 176.3329 | -39.9644 | 15029 | 150 | 8.7 | 6.6 | 8.7 | 4.59735298 | 2.0 | 0.03 | 0.41 | 1457% | Stock Watering | | |
| 176.4762 | -39.9199 | 15362 | 100 | 8.8 | 6.7 | 8.8 | 4.54459559 | 2.0 | 0.18 | 0.41 | 226% | | | |
| 176.4661 | -39.9306 | 16665 | 100 | 7.7 | 6.7 | 7.7 | 4.17581509 | 2.0 | 0.55 | 0.15 | 27% | | | |
| 176.2794 | -40.0039 | 16773 | 100 | 8.0 | 7.5 | 8.0 | 4.17324345 | 2.0 | 1.33 | 0.31 | 24% | | | |
| 176.5 | -39.956 | 1839 | 100 | 17.1 | 8.0 | 14.0 | 2.454393 | 2.0 | 3.57 | 1.57 | 44% | Unknown | Unknown | |
| 176.1819 | -40.0061 | 10931 | 100 | 20.1 | 10.1 | 20.1 | 1.87832021 | 2.0 | 6.24 | 1.42 | 23% | | | |
| 176.2769 | -40.0079 | 16489 | 100 | 10.2 | 10.2 | 11.5 | 2.65103253 | 2.0 | 5.55 | 3.75 | 68% | | | |
| 176.3237 | -40.0082 | 4188 | 150 | 60.4 | 10.8 | 60.4 | 2.32413068 | 2.0 | 6.51 | 2.26 | 35% | Domestic Water | Stock Watering | |
| 176.4364 | -39.9176 | 10934 | 100 | 13.4 | 12.1 | 13.4 | 6.36676821 | 2.0 | 3.75 | 0.82 | 22% | Stock Watering | | |
| 176.4971 | -39.8915 | 16247 | 100 | 13.9 | 12.4 | 13.9 | 4.89678386 | 2.0 | 5.55 | 1.63 | 29% | | | |
| 176.4096 | -40.0205 | 16249 | 100 | 14.3 | 13.1 | 14.3 | 3.76629894 | 2.0 | 7.32 | 2.96 | 40% | | | |
| 176.4541 | -39.8279 | 10955 | 100 | 16.2 | 13.5 | 16.2 | 4.45918266 | 2.0 | 7.07 | 1.88 | 27% | | | |
| 176.3775 | -40.0213 | 16501 | 100 | 16.0 | 14.8 | 16.0 | 3.80035841 | 2.0 | 9.03 | 2.33 | 26% | | | |
| 176.3326 | -40.0207 | 10924 | 150 | 34.1 | 19.4 | 34.1 | 11.5738026 | 2.0 | 5.83 | 2.56 | 44% | Public Water Supply | | |
| 176.3012 | -39.9817 | 16331 | 150 | 24.3 | 21.4 | 24.3 | 12.2971845 | 2.0 | 7.13 | 1.97 | 28% | | | |
| 176.3 | -40.0009 | 10943 | 100 | 31.5 | 21.5 | 23.0 | 12.0943587 | 2.0 | 7.41 | 3.42 | 46% | | | |
| 176.3265 | -39.9812 | 16252 | 100 | 23.5 | 22.3 | 23.5 | 11.6147117 | 2.0 | 8.66 | 1.98 | 23% | Groundwater sampling/monitoring | | |
| 176.3218 | -40.0152 | 3615 | 100 | 40.0 | 22.4 | 33.6 | 11.3534919 | 2.0 | 9.05 | 2.66 | 29% | Domestic Water | Stock Watering | |
| 176.3305 | -40.0228 | 3571 | 100 | 24.7 | 22.8 | 24.7 | 10.9493787 | 2.0 | 9.85 | 2.52 | 26% | Domestic Water | Stock Watering | |
| 176.3241 | -40.0123 | 15863 | 150 | 26.0 | 23.5 | 26.0 | 11.2609081 | 2.0 | 10.19 | 2.76 | 27% | | | |
| 176.3411 | -40.0088 | 5325 | 150 | 27.4 | 25.6 | 27.4 | 9.79983649 | 2.0 | 13.80 | 2.86 | 21% | Domestic Water | Supply | |
| 176.3261 | -40.022 | 10944 | 150 | 28.5 | 25.6 | 28.5 | 11.1690869 | 2.0 | 12.47 | 2.54 | 20% | | | |
| 176.2609 | -39.9509 | 3859 | 150 | 54.9 | 25.7 | 54.9 | 13.5385991 | 2.0 | 10.12 | 2.53 | 25% | | | |
| 176.3315 | -39.8855 | 16454 | 300 | 77.0 | 29.0 | 77.0 | 17.0839402 | 2.0 | 9.92 | 3.53 | 36% | | | |
| 176.3241 | -39.9154 | 3188 | 100 | 48.8 | 33.5 | 48.8 | 16.6934999 | 2.0 | 14.84 | 3.24 | 22% | Unknown | Unknown | |
| 176.2899 | -39.9005 | 2579 | 100 | 46.6 | 37.2 | 46.6 | 15.1198844 | 2.0 | 20.07 | 4.19 | 21% | Stock Watering | Unknown | |
| 176.3831 | -39.9703 | 1429 | 200 | 65.9 | 42.0 | 44.1 | 25.3150786 | 2.0 | 14.72 | 3.82 | 26% | Irrigation | Unknown | |
| 176.4573 | -39.9004 | 1452 | 200 | 55.2 | 47.8 | 55.2 | 24.7873613 | 2.0 | 21.06 | 4.25 | 20% | Irrigation | Groundwater sampling/monitoring | |

# Flagged Wells List with 5%ile Model Outputs

| Lat | Long | BoreNo | Diameter (mm) | Total Depth (mbTOC | Top Screen (mbTOC | Btm Screen (mbTOC | SWL Summer (mTOC) | Pump Length (m | Availble Head (AH) (m) | 5% - Full Use 15Mm3- Predicted T2 Drawdown (m | T2 Drawdown as % AH | Well Use (1) | Well Use (2) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 176.4163 | -39.9126 | 16778 | 100 | 6.0 | 2.0 | 5.0 | 1.01666928 | 0.0 | 0.98 | 0.25 | 25% | | | |
| 176.4649 | -39.8858 | 5137 | 1000 | 4.7 | 2.5 | 4.0 | 2.39356346 | 0.0 | 0.08 | 0.50 | 658% | Groundwater sampling/monitoring | | |
| 176.4974 | -39.9383 | 5529 | 150 | 5.0 | 2.5 | 5.0 | 1.91849326 | 0.0 | 0.58 | 0.26 | 45% | Exploratory Well | | |
| 176.4157 | -39.9124 | 5530 | 100 | 5.0 | 2.5 | 5.0 | 2.48375384 | 0.0 | 0.02 | 0.26 | 1598% | Exploratory Well | | |
| 176.4572 | -39.9662 | 10938 | 50 | 7.6 | 2.6 | 7.6 | 2.51143498 | 0.0 | 0.09 | 0.16 | 178% | | | |
| 176.277 | -39.9619 | 2310 | 1000 | 4.7 | 2.6 | 4.7 | 2.14350179 | 0.0 | 0.48 | 0.16 | 33% | Domestic Water | Stock Watering | |
| 176.4157 | -40.0376 | 2372 | 100 | 6.7 | 2.7 | 6.7 | 2.66362098 | 0.0 | 0.05 | 0.25 | 540% | Irrigation | Unknown | |
| 176.4875 | -39.7259 | 1838 | 100 | 11.9 | 2.7 | 8.8 | 2.05941576 | 0.0 | 0.68 | 0.16 | 23% | Domestic Water | Stock Watering | |
| 176.3227 | -39.9161 | 4160 | 100 | 5.9 | 2.8 | 5.4 | 2.12121833 | 0.0 | 0.68 | 0.16 | 23% | Groundwater sampling/monitoring | | |
| 176.3457 | -40.0346 | 2368 | 150 | 5.0 | 2.9 | 5.0 | 2.37225096 | 0.0 | 0.55 | 0.16 | 29% | Stock Watering | Unknown | |
| 176.3626 | -40.0088 | 17053 | 1200 | 4.5 | 3.0 | 4.5 | 2.85643324 | 0.0 | 0.14 | 0.16 | 110% | Groundwater sampling/monitoring | | |
| 176.357 | -40.0143 | 1357 | 100 | 5.2 | 3.1 | 5.2 | 2.36835437 | 0.0 | 0.74 | 0.25 | 34% | Domestic Water | Unknown | |
| 176.558 | -39.8238 | 1512 | 100 | 7.1 | 3.1 | 5.1 | 1.60218811 | 0.0 | 1.53 | 0.37 | 24% | Stock Watering | Unknown | |
| 176.4935 | -39.9213 | 4398 | 100 | 4.6 | 3.2 | 4.2 | 3.17439417 | 0.0 | 0.03 | 0.25 | 978% | Domestic Water | Stock Watering | |
| 176.447 | -39.82 | 2309 | 50 | 5.5 | 3.4 | 5.5 | 3.05574798 | 0.0 | 0.37 | 0.24 | 66% | Domestic Water | Unknown | |
| 176.3472 | -40.0347 | 15026 | 100 | 6.0 | 3.9 | 6.0 | 2.15084291 | 0.0 | 1.77 | 0.41 | 23% | Stock Watering | Unused | |
| 176.4766 | -39.8821 | 2775 | 150 | 51.8 | 4.0 | 50.6 | 3.64355221 | 0.0 | 0.32 | 0.26 | 82% | Domestic Water | Unknown | |
| 176.2823 | -39.9719 | 2132 | 100 | 6.3 | 4.2 | 6.3 | 3.13762164 | 0.0 | 1.09 | 0.25 | 23% | Domestic Water | Unknown | |
| 176.5143 | -39.8351 | 15030 | 100 | 6.7 | 4.6 | 6.7 | 4.17125811 | 0.0 | 0.45 | 0.36 | 79% | Stock Watering | | |
| 176.4662 | -39.9188 | 16774 | 50 | 5.7 | 4.7 | 5.7 | 3.60582207 | 0.0 | 1.10 | 0.39 | 35% | | | |
| 176.5215 | -39.8978 | 4620 | 50 | 6.8 | 4.7 | 6.8 | 4.1784955 | 0.0 | 0.55 | 0.84 | 154% | Groundwater sampling/monitoring | | |
| 176.4619 | -39.8905 | 15121 | 375 | 6.8 | 4.7 | 6.8 | 2.18141385 | 0.0 | 2.54 | 0.57 | 22% | Unused | | |
| 176.3852 | -39.9507 | 16484 | 100 | 7.0 | 4.9 | 7.0 | 3.65910034 | 0.0 | 1.27 | 0.86 | 68% | Groundwater sampling/monitoring | | |
| 176.4653 | -39.951 | 15957 | 100 | 6.6 | 5.2 | 6.6 | 4.98130444 | 0.0 | 0.17 | 0.16 | 94% | | | |
| 176.5174 | -39.899 | 4621 | 150 | 7.4 | 5.3 | 7.4 | 4.35622528 | 0.0 | 0.97 | 0.44 | 46% | Groundwater sampling/monitoring | | |
| 176.48 | -39.9082 | 3690 | 150 | 7.5 | 5.4 | 7.5 | 4.97586853 | 0.0 | 0.45 | 0.61 | 136% | Domestic Water | Supply | |
| 176.5098 | -39.8837 | 10925 | 100 | 7.6 | 5.5 | 7.6 | 4.32992308 | 0.0 | 1.20 | 0.27 | 23% | Irrigation | | |
| 176.5079 | -39.9691 | 5356 | 150 | 11.8 | 5.8 | 11.8 | 1.3346917 | 0.0 | 4.47 | 1.71 | 38% | Groundwater sampling/monitoring | | |
| 176.329 | -39.992 | 5135 | 50 | 8.1 | 6.0 | 7.4 | 1.72198589 | 2.0 | 2.32 | 0.50 | 22% | Groundwater sampling/monitoring | | |
| 176.4977 | -39.958 | 4742 | 100 | 8.2 | 6.2 | 8.2 | 2.13970678 | 2.0 | 2.02 | 0.43 | 21% | Groundwater sampling/monitoring | | |
| 176.4406 | -39.886 | 4744 | 100 | 8.2 | 6.2 | 8.2 | 3.21051603 | 2.0 | 0.95 | 0.27 | 28% | Groundwater sampling/monitoring | | |
| 176.4481 | -39.8742 | 4477 | 150 | 10.2 | 6.2 | 10.2 | 3.39681458 | 2.0 | 0.80 | 0.23 | 29% | Groundwater sampling/monitoring | | |
| 176.3824 | -39.9193 | 5342 | 150 | 8.4 | 6.3 | 8.4 | 3.19909724 | 2.0 | 1.13 | 0.40 | 36% | Groundwater sampling/monitoring | | |
| 176.3329 | -39.9644 | 15029 | 150 | 8.7 | 6.6 | 8.7 | 4.59735298 | 2.0 | 0.03 | 0.48 | 1701% | Stock Watering | | |
| 176.4762 | -39.9199 | 15362 | 100 | 8.8 | 6.7 | 8.8 | 4.54459559 | 2.0 | 0.18 | 0.42 | 229% | | | |
| 176.4661 | -39.9306 | 16665 | 100 | 7.7 | 6.7 | 7.7 | 4.17581509 | 2.0 | 0.55 | 0.16 | 28% | | | |
| 176.421 | -39.9137 | 15032 | 150 | 9.0 | 6.9 | 9.0 | 2.60212372 | 2.0 | 2.32 | 0.49 | 21% | Domestic Water | Supply | |
| 176.3838 | -40.0225 | 1944 | 200 | 20.6 | 7.1 | 17.1 | 2.34185354 | 2.0 | 2.72 | 1.27 | 47% | Domestic Water | Groundwater sampling/monitoring | |
| 176.2794 | -40.0039 | 16773 | 100 | 8.0 | 7.5 | 8.0 | 4.17324345 | 2.0 | 1.33 | 0.32 | 24% | | | |
| 176.3871 | -40.0291 | 2744 | 100 | 8.0 | 7.6 | 8.0 | 4.08042232 | 2.0 | 1.51 | 0.38 | 25% | Domestic Water | Stock Watering | |
| 176.5 | -39.956 | 1839 | 100 | 17.1 | 8.0 | 14.0 | 2.454393 | 2.0 | 3.57 | 1.58 | 44% | Unknown | Unknown | |
| 176.4571 | -39.9792 | 3076 | 100 | 12.0 | 9.3 | 12.0 | 5.08823284 | 2.0 | 2.23 | 0.66 | 30% | Unknown | Groundwater sampling/monitoring | |
| 176.1819 | -40.0061 | 10931 | 100 | 20.1 | 10.1 | 20.1 | 1.87832021 | 2.0 | 6.24 | 1.43 | 23% | | | |
| 176.2769 | -40.0079 | 16489 | 100 | 10.2 | 10.2 | 11.5 | 2.65103253 | 2.0 | 5.55 | 3.80 | 68% | | | |
| 176.3237 | -40.0082 | 4188 | 150 | 60.4 | 10.8 | 60.4 | 2.32413068 | 2.0 | 6.51 | 2.27 | 35% | Domestic Water | Stock Watering | |
| 176.4364 | -39.9176 | 10934 | 100 | 13.4 | 12.1 | 13.4 | 6.36676821 | 2.0 | 3.75 | 0.83 | 22% | Stock Watering | | |
| 176.4971 | -39.8915 | 16247 | 100 | 13.9 | 12.4 | 13.9 | 4.89678386 | 2.0 | 5.55 | 1.97 | 35% | | | |
| 176.4096 | -40.0205 | 16249 | 100 | 14.3 | 13.1 | 14.3 | 3.76629894 | 2.0 | 7.32 | 3.15 | 43% | | | |
| 176.4541 | -39.8279 | 10955 | 100 | 16.2 | 13.5 | 16.2 | 4.45918266 | 2.0 | 7.07 | 1.89 | 27% | | | |
| 176.3775 | -40.0213 | 16501 | 100 | 16.0 | 14.8 | 16.0 | 3.80035841 | 2.0 | 9.03 | 2.38 | 26% | | | |
| 176.3326 | -40.0207 | 10924 | 150 | 34.1 | 19.4 | 34.1 | 11.5738026 | 2.0 | 5.83 | 2.57 | 44% | Public Water Supply | | |
| 176.3012 | -39.9817 | 16331 | 150 | 24.3 | 21.4 | 24.3 | 12.2971845 | 2.0 | 7.13 | 1.98 | 28% | | | |
| 176.3 | -40.0009 | 10943 | 100 | 31.5 | 21.5 | 23.0 | 12.0943587 | 2.0 | 7.41 | 3.43 | 46% | | | |
| 176.4831 | -39.7774 | 10959 | 200 | 49.7 | 21.9 | 23.1 | 12.1493489 | 2.0 | 7.73 | 1.65 | 21% | | | |
| 176.3265 | -39.9812 | 16252 | 100 | 23.5 | 22.3 | 23.5 | 11.6147117 | 2.0 | 8.66 | 2.77 | 32% | Groundwater sampling/monitoring | | |
| 176.3218 | -40.0152 | 3615 | 100 | 40.0 | 22.4 | 33.6 | 11.3534919 | 2.0 | 9.05 | 2.67 | 30% | Domestic Water | Stock Watering | |
| 176.467 | -39.7949 | 4271 | 150 | 39.4 | 22.4 | 39.4 | 12.8769633 | 2.0 | 7.52 | 1.64 | 22% | | | |
| 176.3305 | -40.0228 | 3571 | 100 | 24.7 | 22.8 | 24.7 | 10.9493787 | 2.0 | 9.85 | 2.53 | 26% | Domestic Water | Stock Watering | |
| 176.3241 | -40.0123 | 15863 | 150 | 26.0 | 23.5 | 26.0 | 11.2609081 | 2.0 | 10.19 | 2.77 | 27% | | | |
| 176.3411 | -40.0088 | 5325 | 150 | 27.4 | 25.6 | 27.4 | 9.79983649 | 2.0 | 13.80 | 2.87 | 21% | Domestic Water | Supply | |
| 176.3261 | -40.022 | 10944 | 150 | 28.5 | 25.6 | 28.5 | 11.1690869 | 2.0 | 12.47 | 2.55 | 20% | | | |
| 176.2609 | -39.9509 | 3859 | 150 | 54.9 | 25.7 | 54.9 | 13.5385991 | 2.0 | 10.12 | 2.54 | 25% | | | |
| 176.3315 | -39.8855 | 16454 | 300 | 77.0 | 29.0 | 77.0 | 17.0839402 | 2.0 | 9.92 | 3.54 | 36% | | | |
| 176.3241 | -39.9154 | 3188 | 100 | 48.8 | 33.5 | 48.8 | 16.6934999 | 2.0 | 14.84 | 3.25 | 22% | Unknown | Unknown | |
| 176.2899 | -39.9005 | 2579 | 100 | 46.6 | 37.2 | 46.6 | 15.1198844 | 2.0 | 20.07 | 4.20 | 21% | Stock Watering | Unknown | |
| 176.3831 | -39.9703 | 1429 | 200 | 65.9 | 42.0 | 44.1 | 25.3150786 | 2.0 | 14.72 | 3.83 | 26% | Irrigation | Unknown | |
| 176.4573 | -39.9004 | 1452 | 200 | 55.2 | 47.8 | 55.2 | 24.7873613 | 2.0 | 21.06 | 4.39 | 21% | Irrigation | Groundwater sampling/monitoring | |

# Flagged Wells List with 95%ile Model Outputs

| Lat | Long | BoreNo | Diameter (mm) | Total Depth (mbTOC) | Top Screen (mbTOC) | Btm Screen (mbTOC) | SWL Summer (mTOC) | Pump Length (m) | Availble Head (AH) (m) | 95% - Full Use 15Mm3- Predicted T2 Drawdown (m) | T2 Drawdown as % AH | Well Use (1) | Well Use (2) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 176.4163 | -39.9126 | 16778 | 100 | 6.0 | 2.0 | 5.0 | 1.01666928 | 0.0 | 0.98 | 0.21 | 21% | | | |
| 176.4649 | -39.8858 | 5137 | 1000 | 4.7 | 2.5 | 4.0 | 2.39356346 | 0.0 | 0.08 | 0.41 | 539% | Groundwater sampling/monitoring | | |
| 176.4974 | -39.9383 | 5529 | 150 | 5.0 | 2.5 | 5.0 | 1.91849326 | 0.0 | 0.58 | 0.19 | 33% | Exploratory Well | | |
| 176.4157 | -39.9124 | 5530 | 100 | 5.0 | 2.5 | 5.0 | 2.48375384 | 0.0 | 0.02 | 0.19 | 1188% | Exploratory Well | | |
| 176.4572 | -39.9662 | 10938 | 50 | 7.6 | 2.6 | 7.6 | 2.51143498 | 0.0 | 0.09 | 0.11 | 124% | | | |
| 176.4157 | -40.0376 | 2372 | 100 | 6.7 | 2.7 | 6.7 | 2.66362098 | 0.0 | 0.05 | 0.21 | 453% | Irrigation | Unknown | |
| 176.357 | -40.0143 | 1357 | 100 | 5.2 | **3.1** | **5.2** | 2.36835437 | 0.0 | 0.74 | 0.21 | 28% | Domestic Water | Unknown | |
| 176.4935 | -39.9213 | 4398 | 100 | 4.6 | 3.2 | 4.2 | 3.17439417 | 0.0 | 0.03 | 0.21 | 820% | Domestic Water | Stock Watering | |
| 176.447 | -39.82 | 2309 | 50 | 5.5 | **3.4** | **5.5** | 3.05574798 | 0.0 | 0.37 | 0.18 | 48% | Domestic Water | Unknown | |
| 176.4766 | -39.8821 | 2775 | 150 | 51.8 | 4.0 | 50.6 | 3.64355221 | 0.0 | 0.32 | 0.19 | 61% | Domestic Water | Unknown | |
| 176.5143 | -39.8351 | 15030 | 100 | 6.7 | **4.6** | **6.7** | 4.17125811 | 0.0 | 0.45 | 0.26 | 56% | Stock Watering | | |
| 176.4662 | -39.9188 | 16774 | 50 | 5.7 | 4.7 | 5.7 | 3.60582207 | 0.0 | 1.10 | 0.31 | 28% | | | |
| 176.5215 | -39.8978 | 4620 | 50 | 6.8 | **4.7** | **6.8** | 4.1784955 | 0.0 | 0.55 | 0.63 | 115% | Groundwater sampling/monitoring | | |
| 176.5174 | -39.899 | 4621 | 150 | 7.4 | **5.3** | **7.4** | 4.35622528 | 0.0 | 0.97 | 0.28 | 29% | Groundwater sampling/monitoring | | |
| 176.48 | -39.9082 | 3690 | 150 | 7.5 | **5.4** | **7.5** | 4.97586853 | 0.0 | 0.45 | 0.49 | 109% | Domestic Water Supply | | |
| 176.5079 | -39.9691 | 5356 | 150 | 11.8 | 5.8 | 11.8 | 1.3346917 | 0.0 | 4.47 | 1.31 | 29% | Groundwater sampling/monitoring | | |
| 176.4481 | -39.8742 | 4477 | 150 | 10.2 | 6.2 | 10.2 | 3.39681458 | 2.0 | 0.80 | 0.17 | 21% | Groundwater sampling/monitoring | | |
| 176.3824 | -39.9193 | 5342 | 150 | 8.4 | **6.3** | **8.4** | 3.19909724 | 2.0 | 1.13 | 0.25 | 22% | Groundwater sampling/monitoring | | |
| 176.3329 | -39.9644 | 15029 | 150 | 8.7 | **6.6** | **8.7** | 4.59735298 | 2.0 | 0.03 | 0.35 | 1221% | Stock Watering | | |
| 176.4762 | -39.9199 | 15362 | 100 | 8.8 | **6.7** | **8.8** | 4.54459559 | 2.0 | 0.18 | 0.34 | 187% | | | |
| 176.5 | -39.956 | 1839 | 100 | 17.1 | 8.0 | 14.0 | 2.454393 | 2.0 | 3.57 | 1.09 | 31% | Unknown | Unknown | |
| 176.2769 | -40.0079 | 16489 | 100 | 10.2 | 10.2 | 11.5 | 2.65103253 | 2.0 | 5.55 | 3.07 | 55% | | | |
| 176.3237 | -40.0082 | 4188 | 150 | 60.4 | 10.8 | 60.4 | 2.32413068 | 2.0 | 6.51 | 1.57 | 24% | Domestic Water | Stock Watering | |
| 176.4971 | -39.8915 | 16247 | 100 | 13.9 | 12.4 | 13.9 | 4.89678386 | 2.0 | 5.55 | 1.24 | 22% | | | |
| 176.4096 | -40.0205 | 16249 | 100 | 14.3 | 13.1 | 14.3 | 3.76629894 | 2.0 | 7.32 | 2.51 | 34% | | | |
| 176.3775 | -40.0213 | 16501 | 100 | 16.0 | 14.8 | 16.0 | 3.80035841 | 2.0 | 9.03 | 1.94 | 21% | | | |
| 176.3326 | -40.0207 | 10924 | 150 | 34.1 | 19.4 | 34.1 | 11.5738026 | 2.0 | 5.83 | 1.60 | 27% | Public Water Supply | | |
| 176.3 | -40.0009 | 10943 | 100 | 31.5 | 21.5 | 23.0 | 12.0943587 | 2.0 | 7.41 | 2.45 | 33% | | | |
| 176.3315 | -39.8855 | 16454 | 300 | 77.0 | 29.0 | 77.0 | 17.0839402 | 2.0 | 9.92 | 2.79 | 28% | | | |
| 176.3831 | -39.9703 | 1429 | 200 | 65.9 | 42.0 | 44.1 | 25.3150786 | 2.0 | 14.72 | 2.96 | 20% | Irrigation | Unknown | |