Appendix 1

Groundwater Inflow Feasibility Report

AquaFirma Ltd.

Waikaka Gold Prospect;

Groundwater Inflow Feasibility Report.

L & M Mining Ltd

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Executive Summary.

This investigation report assesses the groundwater related aspects of feasibility for an alluvial mine proposal. The proposed mine is located on valley floor utilised as farmland between the Maitland and Waikaka localities in Southland. The proposed method of mining is opencast travelling excavation using tracked excavators and a floating processing plant.

The overburden is composed of Recent and Quaternary age alluvium mixed with dredge tailings from historic dredging of the valley floor. Dredging consumed most of the valley floor with only fragments of virgin ground remaining. Underlying these surficial deposits are sequences of clayey silt, sand, and sandy gravel, composed of quartzose and greywacke derived detritus. These alluvial sediments are thought to be of Tertiary age and host the remaining placer gold deposits. A particularly gold

rich horizon named the 'wash' tends to be associated with the coarser of the sandy quartz gravel horizons found in drilling investigation undertaken since 1995. The recognised stratigraphy is observed to dip gently to the north under structural and sedimentary controls.

Aquifer testing and hydraulic property estimation of the sandy gravel lithology within the Tertiary sediments is summarised in the table below:

	Pumping rate (m^3/d)	Pumping Test Site	Transmissivity (m^2/d)	Hydraulic conductivity (m/d)	Storage coefficient
Minimum	108	1st (SE)	3.7	1.5	$2.5\ 10^{-4}$
Maximum	285	3rd (Mid)	17.2	8.6	$1.1\ 10^{-4}$
Mean			9.1	4.2	$3.6\ 10^{-4}$

Transmissivity of this magnitude is at the lower end of the expected range for the lithology and is considerably lower than reported Quaternary gravel values for Southland. The aquifer type is classified from pumping test response as semi-confined. Interclastic clayey silt and clay horizons were found to have horizontal hydraulic conductivities of about 3×10^{-4} metres per day. The clay – gravel – clay sequence was found less pronounced in the southeast of the proposed mine with mixed very silty sandy gravel sequences predominating.

A conservatively high transmissivity of 50 m^2/d has been selected for calculations and modelling of mine excavation dewatering. The table below summarises the results of pit inflow calculations considering the Tertiary sediments.

	Peak Inflow (m^3/d)	Mean Inflow (m^3/d)
McWorter Analytical Equation	2,570	1,700
TWODAN Steady state simulation	4,790	2,770

The proposed mine is preliminarily planned to extend up to 40 metres below the existing ground and piezometric elevation. The mine is planned to progress in a northwest direction into increasing overburden and groundwater pressure.

Mine excavation dewatering may employ basal sumps, near-surface interception trenches, intermediate interception trenches and interception wells. The use of in-excavation pumping and peripheral interception wells is modelled. Modelling of the effectiveness of interception wells indicates that, providing suitable interception wells can be developed, peripheral interception groundwater is an effective strategy for relieving piezometric head and reducing the required rate of dewatering in the excavation.

A zone of drawdown in the piezometric surface will extend beyond the boundaries of the mine and potentially affect the ability to draw groundwater from the Tertiary sediments. Very little local information on the utilisation of groundwater from the Tertiary sediments, although there are indications of preferable alternative water supplies. A survey for any water bores in the potentially affected are is recommended.

1. Introduction.

L & M Mining Ltd is presently assessing the feasibility of extracting the gold resource lying beneath the Waikaka Stream valley floor between the Maitland and Waikaka settlements, Southland. Part of this process involves assessing the quantity of groundwater inflow to any opencast pit that may be used in the extraction process.

L & M Mining Ltd have engaged AquaFirma Ltd to make this assessment in parallel with other assessments of factors impinging on mine feasibility. Fieldwork for this hydrological assessment has been undertaken during allied gold resource and geotechnical investigation drilling. The hydrological assessment employs interpretation of aquifer testing, lithological modelling and computer modelling of groundwater flow.

2. Hydrogeological Setting.

The Waikaka deposit lies in the valley floor to either side of the Waikaka Stream. The surficial deposits have already been dredged earlier this century down to a depth up to 15 metres along distinct gold-rich horizons (Paul Woperis, *pers. comm.*, March 1997). A more general dredging depth of 6 – 7 metres was practised across the valley floor. Occasional intact areas of Quaternary flood-plain sediments are found along the margin of the valley.

Drilling of the deposit has delineated deeper zones of gold concentration than was reached by historic dredging. A horizon known by the mining term 'wash' has been recognised in gold resource definition drilling. The 'wash' sub-crops beneath the dredge tailings and deepens to the north. The positional and depth control on the 'wash' is inferred to be partly sedimentary and partly structural. The dominant lithology of the 'wash' is silty quartz gravel.

2.1 Tertiary Deposits.

Extensive alluvial deposits inferred to be of Tertiary age are found underlying Quaternary and Recent terrestrial deposits. Past workers has proposed these as "Waikaka Gravels" of Pliocene age. More recently, a revision of the lignite and associated sediments has assigned late Miocene age to the Upper Lignite Measures (Isaac & Lindqvist, 1990[i]).

Recent drilling has encountered fresh, non-coalified wood fragments that belie the Miocene – Pliocene age inferences. However, for consistency these sediments will be referred to as being of Tertiary origin. The deposit comprises a range of lithologies. The southern parts of the deposit proposed for mining maintains a reasonably homogeneous sequence of silty, sandy greywacke and quartz gravel. There is a gradational change to the north towards more segregated, heterogeneous sequences of clayey silts, carbonaceous clayey silts, sands and silty sandy greywacke / quartz gravel.

The base of the Tertiary sediments was not encountered in drilling to depths of up to 65 metres below ground. Lignite resource drilling in 1978 established that the Tertiary sediments extended more than 160 metres in depth without encountering basement rock. The Tertiary sediments are known to be laterally extensive for distances of 10 kilometres from the mine site. The closest boundary to the mine site is the Waikaka extension of the Hedgehope / Dunsdale fault system. The tertiary sediments are structurally deformed by what appears to be a fault-drag fold against this fault zone. The sediment in the proposed mine area appear to dip about 6° to the north-northwest.

2.2 Quaternary / Recent Deposits.

The oldest stratigraphically correlated Quaternary deposit is the early Quaternary alluvial deposit sometimes termed the Gore Piedmont Gravels. These deposits are heavily dissected by modern creek and stream drainages forming a pattern of rolling hills and terraces.

Lain between terraces of the Gore Piedmont Gravels are late Quaternary alluvial surfaces and flood-plain sediments. These comprise the ubiquitous sandy greywacke / quartz gravel lithologies found associated with large streams and the Mataura River.

Recent deposits of the Waikaka Stream are associated with present and past stream alignments. Significant micaeous silt horizons and sandy, poorly sorted gravel deposits are typical of the Recent deposits.

Modern tailings deposits associated with dredge mining activity earlier this century mantle most of the Waikaka valley floor. The typical tailing lithology is an under-consolidated, silty, cobble gravel.

2.3 Hydrogeologic Properties.

Hydrogeologic properties of the sediment types associated with the area to be mined have been derived and estimated by a variety of means as detailed below.

2.3.1 Pumping Tests.

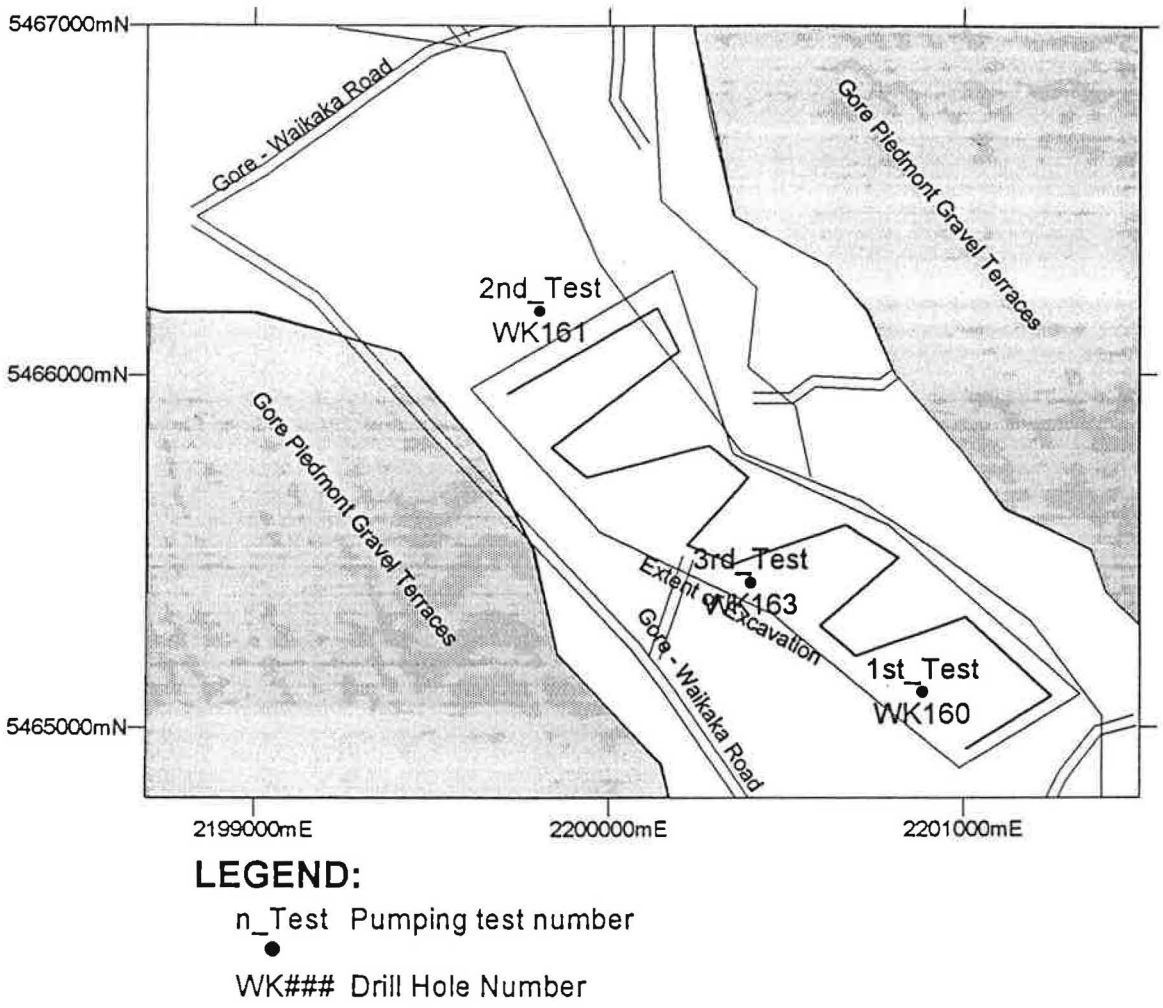
The most accurate means of determining hydraulic properties has been a series of pumping tests in the most permeable parts (e.g.; silty, sandy gravel) of the deposit being drilled. These pumping tests utilised 250-millimetre diameter bore holes placed as part of gold resource delineation investigations. Observation wells were drilled around the bore to be pumped and screened in the same horizon. In each case, a completed cable tool drill hole was used to install a temporary well screen. The 6-inch screen was placed over an interval up to 2 metres in the most permeable part of the formation penetrated in drilling. A 4-inch bore pump was then hung in the 10-inch diameter casing.

The table below summarises the results of the three pumping tests.

	Pumping rate (m^3/d)	**Radius (m)**	**Transmissivity (m^2/d)**	**Hydraulic conductivity (m/d)**	**Storage coefficient**
1st Test, P2	108	20	5.3	2.1	$7.5\ 10^{-4}$
1st Test, P2	108	40	3.7	1.5	$2.5\ 10^{-4}$
2nd Test, Q2	52	19.3	4.3	1.6	$3.9\ 10^{-5}$
2nd Test, Q3	52	60.5	3.9	1.5	$1.0\ 10^{-5}$
3rd Test, R1	285	10.2	17.2	8.6	$1.1\ 10^{-4}$
3rd Test, Combined	285	10.2, 19.4, & 39.75	20.1	10.1	$1.0\ 10^{-3}$
Mean			9.1	4.2	$3.6\ 10^{-4}$

The position of pumping tests is shown on the figure below.

Position of Pumping Tests in 1998.



Position of pumping test sites for determination of hydraulic propoerties of the Tertiary sediments.

Appendices contain detail on each test and interpretation used in deriving the parameters. Interpretation of each pumping test confirmed the inferences drawn from lithology that the deposit contains a number of semi-confined aquifers. Perhaps surprisingly, the pumping tests experienced very low groundwater yield and the derived permeability parameters lie at the low end of values for a gravel lithology.

The r/B ratios determined in the pumping tests give some indication of the hydraulic conductivity of the overlying confining layer.

$K' = \quad Tb' (r/B)^2 / r^2$

Where:

K' = Hydraulic conductivity of the confining layer (m/d)

T = Transmissivity of the aquifer (m^2/d)

b' = Thickness of the confining layer (m)

r = Radius of observation well from pumped well (m)

so, in the second pumping test the hydraulic conductivity of the confining layer composed of carbonaceous clay of 1.2 metres thickness is estimated by the following equation.

$K' = 3.9 \times 1.2 (0.5)^2 / (60.4)^2$

$= 0.00032$ m/d or 3.7×10^{-9} m/s

Most other pumping test interpretation proved to have a similar magnitude of confining layer permeability.

2.3.2 Grain Size Correlation.

Bulk sampling of the deposit using a bucket auger drilling rig (Caldweld rig) allowed the taking of undisturbed to semi-disturbed samples of groundwater hosting lithologies. These samples were sieve-analysed for their grain size distribution. The plot of the resulting grain size analysis is shown in the appendices.

For grain size distribution correction to an estimate of hydraulic conductivity, the Beyer Method is used on the coarsest sample in the profile having the lowest uniformity coefficient (i.e.; the most uniform). This sample was taken from a depth range of 13 to 15.5 metres below ground at a level and lithology consistent with the horizon tested in the third pumping test. The Beyer Method estimated the hydraulic conductivity of this sample to be about 20 metres per day. This estimate is approximately twice that determined in the nearby pumping test, but reasonably close considering the usually low resolution normally attributed to the grain size correction method.

Of most significance in this correlation is that it allows a qualitative comparison of permeability within a complete profile of groundwater hosting lithologies. The silty sandy gravel of 13 – 15.5 metres depth is the most permeable of all of the samples analysed. The "grey, silty, clay-bound gravels" of 16.9 to 25 metres depth are the least permeable. The Tailings from 0 – 3 metres below ground are also of lower permeability than 20 metres per day.

2.3.3 Literature Values.

The clayey silts encountered commonly in drilling are not feasible for any type of field permeability testing. Pumping test data may be used in estimating confining layer permeability as has been done above. However, the accuracy of this sort of approximation is of low resolution. Literature values for clayey silt range between

1×10^{-3} and 1×10^{-5} metres per day[1]. These values are consistent with the 3.2×10^{-4} estimated for carbonaceous clay in the second pumping test.

2.4 Surface Water.

Waikaka Stream mainstem skirts the eastern margin of the proposed mine area. At Craig Road, Willowbank the hydrological statistics for Waikaka Stream have been collected since 1984. These are detailed in the table below.

	Hydrological Statistic (l/s)
Mean Flow @ Willowbank (1984 - 1996)	3,589
Median Flow	1,897
Highest Daily Flow (1984 - 1996)	105,509
Lowest Daily Flow (1984 - 1996)	783
Q_{10}7d Low Flow (Hutchinson, 1990[ii])	281

The large difference between mean and median streamflow is indicative of the 'flashy', flood-prone nature of the Stream. Hydrological analysis of the 318 square kilometre upstream catchment has provided the following approximation of catchment water balance (Rekker, 1997[iii]).

	Area (km^2)	**Mean Precipitation**	**Evapotrans-piration**	**Mean Annual Streamflow**	
				Measured*	**Baseflow**
Waikaka	318	1,070 mm	626 mm	444 mm	226 mm

* Measured streamflow at Craig Road recorder, Willowbank, source Southland Regional Council.

A number of dredge ponds are found occupying the floor of the Waikaka valley near the proposed mine. These are frequently connect to each other by farm drains and ditches channelling runoff from the valley sides. The pond water levels generally coincide with the phreatic water level in tailings and Quaternary alluvium.

2.5 Groundwater Recharge Processes.

Groundwater in the Tertiary age, semi-confined aquifers in the proposed mine area has groundwater gradient for discharge. There is likely to be no recharge of groundwater in the semi-confined aquifers in the mine area because of this. Recharge will occur at point(s) distant from the mine site.

Profiling of the piezometric surface (by contouring of measured pressure head in the semi-confined aquifers under the mine site) indicates that groundwater flow is from northwest to southeast, along the alignment of the Waikaka valley. This supports the theory that the semi-confined aquifers are recharged at the zone where the bedding outcrops or sub-crops in a sub-vertical orientation against the Waikaka fault zone.

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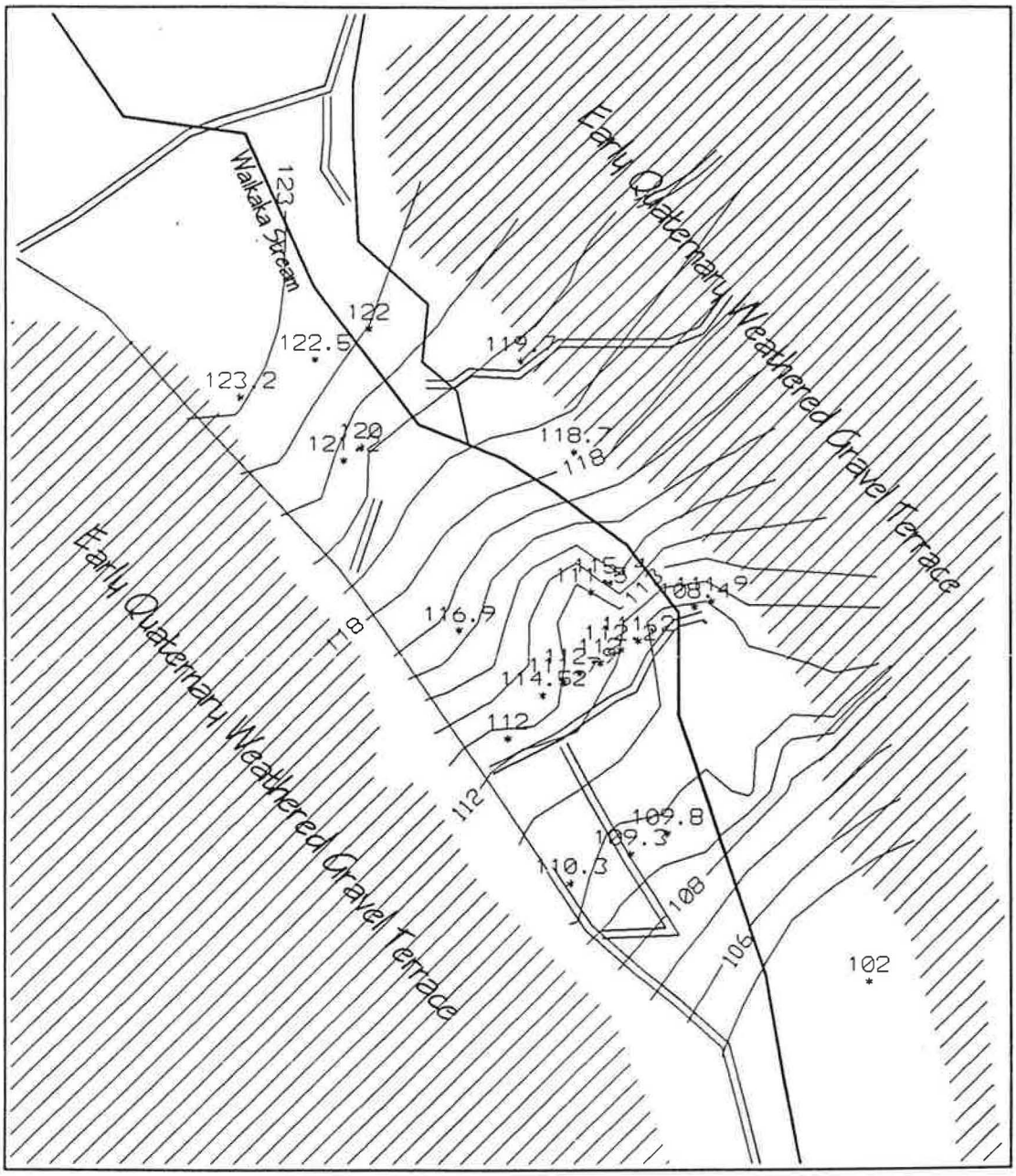
[1] From: *Ground Water Manual*, 1985, US Department of Interior, Bureau of Reclamation, Government Printing Office, Denver, 480 p.

The unconfined aquifers hosted with the tailings and undisturbed alluvium will be recharged from direct soil drainage, stream recharge and infiltration of creeks running off the valley flanks. Some parts of the Waikaka Stream will gain significant groundwater inflow from the unconfined aquifer. A limited quantity of streamflow will accrue from seepage of groundwater from the semi-confined aquifer.

2.6 Groundwater Flow Direction.

In 1995 a series of 105 air-core drill-holes were drilled by DLM Mining Ltd. Twenty-six corrected measurements of groundwater elevation were made at this time. These measurements were corrected and contoured. The figure below shows the results of the 1995 water level contouring.

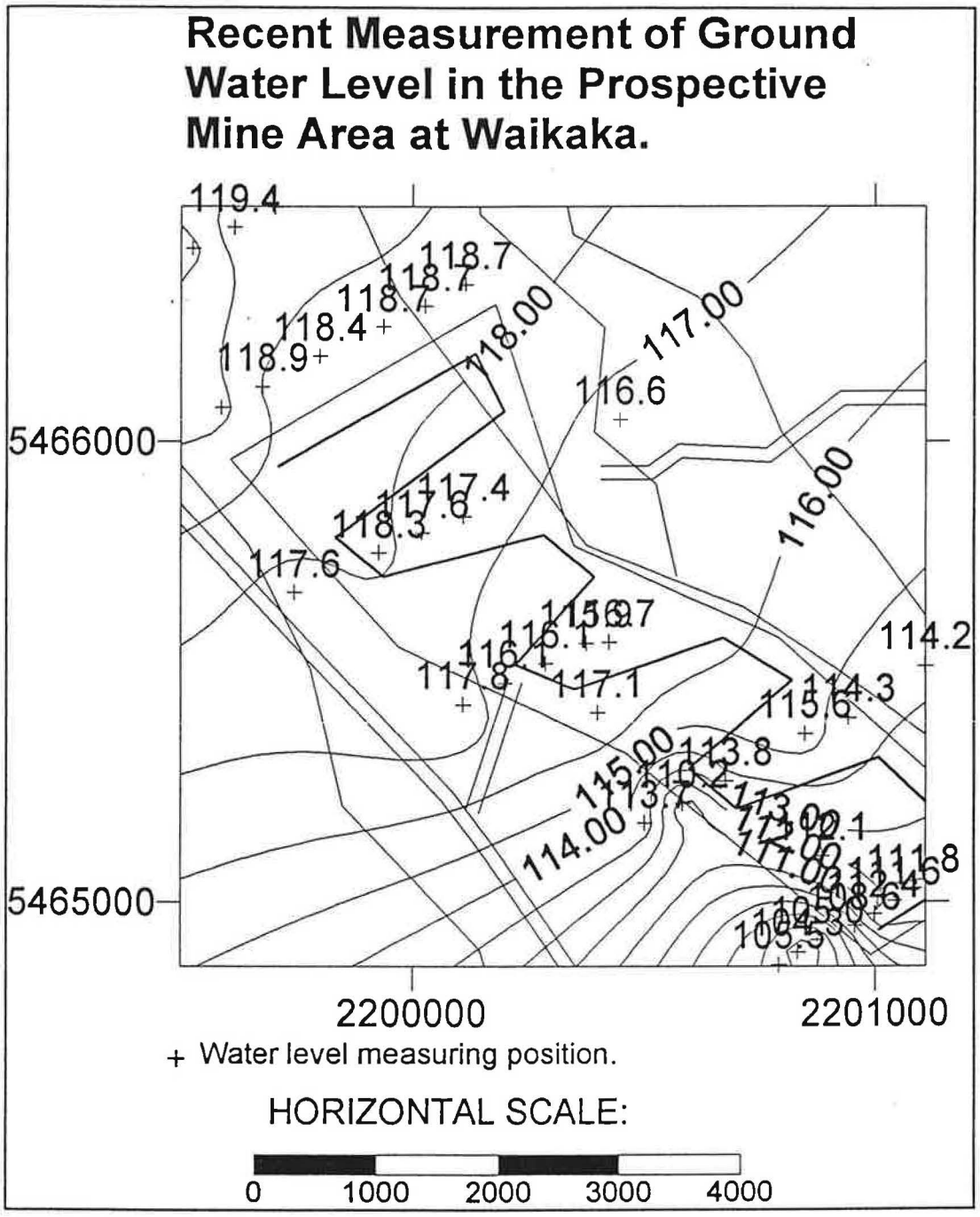


Contour plot of groundwater level measured in exploration air-core drill-holes placed in 1995 by L&M Mining Ltd.

The general groundwater direction inferred from the figure above is that of northwest to southeast.

In 1998, a renewed drilling programme involving 43 air-core holes, five cable tool holes and two auger bucket bulk sampling holes. Measurements of depth to groundwater have been made during air-core and cable tool drilling. These

measurements were corrected to mean sea level have been contoured across the area of drilling and are shown in the figure below.



Contouring of corrected water level elevations from more recent drilling in 1998.

The measurements made during drilling were generally made through drill pipes, on different dates and at different depths in the deposit. Consequently, the measurements were often not representative of the general piezometric height for the position, nor consistent with neighbouring drill-holes. However, an apparent groundwater flow direction of northwest to southeast can be once more inferred.

Another failing of all water level measurements made above was the inability to measure artesian water pressures that were encountered in the northwest of the deposit. The fact of aboveground water level was noted, but not measured. In many cases, several hours would have been required for static water level to establish after drilling disturbance. Artesian pressures of 1.6 metres above ground level were measured using piezometer pipe extensions during the second pumping test in the northwest of the deposit.

2.7 Groundwater Quality.

A knowledge of groundwater quality is necessary for the two reasons:

1. If groundwater inflows to the mine excavation are to be discharged to surface water, the water quality factors that might be detrimental to surface water quality should be known.
2. The concentrations of certain constituents in groundwater provide information on groundwater residence time and geo-chemical conditions in the deposit.

Two samples of groundwater were taken in conjunction with pumping tests in 1998. Grab samples were taken and dispatched to the Chemsearch laboratory in Dunedin within cooler bins. In 1997, two sets of samples were taken for the Gore District Council for analysis as to water quality parameters. These analyses are summarised in the table below.

Units: g/m^3, except: conductivity, pH & coliform counts	**Pumping test #2 WK161 19 Feb. 1998**	**Pumping test #1 WK160 2 March 1998**	**Flowing well WK100 (Pipe) 22 Jan. 1997**	**Drilling return WK70 12 March 1997**
Conductivity	208	200	219	
pH	_	_	6.63	
Calcium	11.1	6.2	10.4	
Magnesium	6.68	13.4	5.6	
Sodium	21.7	20.3	24.7	
Potassium	1.28	1.43	1.3	
Bicarbonate	79	87	101	
Chloride	20.6	20.6	20.2	
Sulphate	17.8	6.5	1.6	
Ammonia-N	0.04	0.07	_	
Nitrate-N	_	_	0.41	
Total phosphorous	0.17	Insufficient sample	_	
Ion balance	-3.8%	+4.2%	-4.1	
Dissolved iron	Insufficient sample	Insufficient sample	9.9	0.2
Coliforms	35	<1	Nil	
Faecal coliforms	<1	<1	Nil	
Arsenic	<0.2	_	_	

The water quality found in three separate sampling sites is reasonably uniform. The concentration of cations and anions are very similar to those found widely within Quaternary alluvial aquifer throughout Southland. The presence of nitrate, sulphate and low iron in samples indicates generally oxic geochemical conditions and little tendency for reducing conditions often found in groundwaters of semi-confined aquifers. The groundwater quality is not suggestive of long residence time (i.e.; residence time is < 50 years).

The quality of the groundwater has few detrimental factors for discharge to surface water. The most significant dissolved constituent in the groundwater is total phosphorous with a concentration of 170 mg/m^3. At this concentration, there are potential significant nuisance algal growths in Waikaka Stream near the discharge unless sunlight and dilution capacity is available.

3. Mine Setting.

A preliminary mine plan has been formulated on the basis of a number of constraints; namely, gold concentration, geo-technical, land availability and maintenance of environmental values. This mine plan is employed in assessing the hydrogeological impacts of the mine.

3.1 Mine Plan Options.

Consideration of mine plan options does not form part of this assessment. However, this assessment assumes that dewatering of deposit to the base of the wash will be necessary.

3.2 Groundwater Inflow implications.

Any mine plan option that entails de-pressurisation and dewatering of the semi-confined aquifers will involve diversion of groundwater flow into the collection point (either the pit sump or dewatering well-points). These groundwater inflows will need to be pumped to maintain an artificial water level in the excavation.

3.3 Potential Methods of Water Management.

3.3.1 Interception Methods.

The main method of water management in such situations is pumped removal of inflowing groundwater from a sump at the base of the mine excavation. Alternative or auxiliary methods of dewatering involve the installation of interception wells to dewater the formation beyond the perimeter of the excavation.

3.3.2 Impoundment Methods.

In some cases of problematic groundwater inflow conditions, means of containing groundwater are used, such as sheet-piling, slurry walls or formation freezing.

3.3.3 Potentially Suitable Methods for Waikaka.

The principal means thought potentially suitable for the Waikaka deposit are as follows:

1. Pit sump pumping; simple dewatering of groundwater as it enters the excavation and collects in a sump at its base,
2. Perimeter wells; wells installed outside the perimeter of the excavation screened to dewater the coarse sediments hosting groundwater,
3. Bench trenches; trenches set in benches in the excavation slope which intercept seepage at a higher level than the sump,
4. Near-surface collector trenches; trenches of up to 4 metres depth, designed to intercept unconfined groundwater and any surface runoff.

A schematic representation of dewatering options is shown in the figure below:

4. Groundwater Inflow Analysis.

Having defined the hydrogeology and the form and dimensions of the excavation, it is possible to define the steps in making estimates of the inflow of groundwater.

1. Quantify the amount of permeable and low permeability materials hosting the groundwater system (i.e. aquifer – aquitard differentiation) based on lithological data,
2. Resolve the hydro-lithological data into a scheme of water-bearing layers,
3. Develop a conceptual model of the deposit's hydrogeological characteristics, including aquifer properties,
4. Devise a system of analytical equations to simulate the effects of mine pit dewatering,
5. Devise a quasi-three-dimensional groundwater model to simulate the effects of mine pit dewatering.

Information on steps 1 – 3 is contained in appendices.

4.1 Analytical Equation.

The McWorter (1981[iv]) analytical equation for calculating confined aquifer inflow to a box-cut excavation is used to assess time-variant magnitude of inflow. The equation by McWorter (1981[iv]) is phrased as follows:

4.1.1 Initialisation.

$$Q = 2R(S_yTb^2/12 + STH_o^2/4 + STH_ob/4)^{0.5}\, t^{0.5} \quad \text{for } t > L/R$$

Where:

- R = rate of headwall advance (in metres)
- Q = groundwater inflow (in cubic metres per day, m^3/d)
- T = transmissivity (m^2/d)
  = K . b
- K = hydraulic conductivity (m/d)
- S_y = specific yield (as a decimal)
- S = storativity
- t = time point (d)
- L = length of pit at point in time (m)
- b = saturated thickness (m)
- H_o = pressure head over the aquifer (m)

The equation takes into account semi-confined pressure conditions. Saturated thickness of the wash is assumed to be 10 metres through the mine path. Time (t) and pressure head (H_o) will increase along mine path. The mean rate of head wall advance is 20 metres per day. Only inflows up to the completion of mining are considered (i.e.; $t > L/R$).

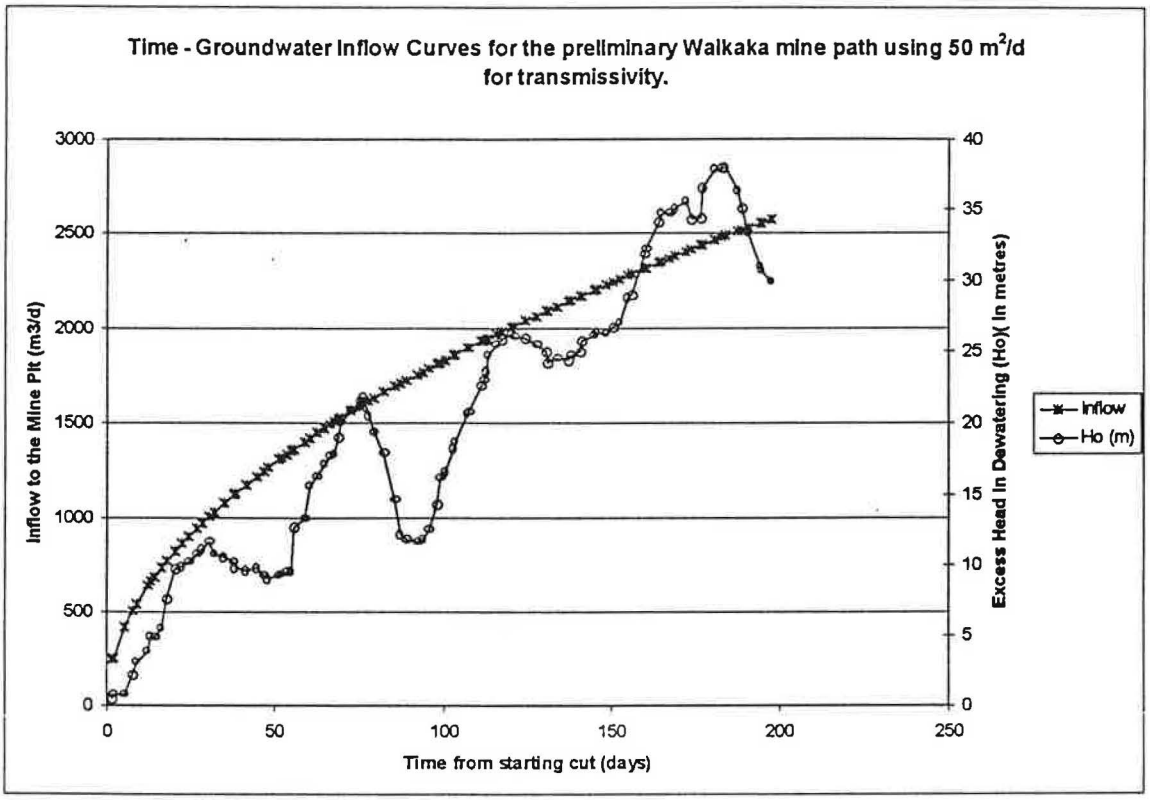
Primary initialisation of the calculation makes the following assumptions as to equation parameters:

R = 20 (metres per day)
Q = groundwater inflow is the primary variable in the calculation (in cubic metres per day, m^3/d)
T = 50 m^2/d
= 5 m/d × 10 m
K = 5 m/d
S_y = 0.20 (as a decimal)
S = 1×10^{-5} dimensionless
t = time point is the secondary variable (d)
L = 3,950 (m)
b = 10 m
H_o = pressure head over the aquifer is determined from the contoured difference between the base of the wash and the piezometric elevation (m)

The equation was imbedded in a computer spreadsheet and calculated for 100 equidistant points along the 3,950 metre mine path. The resulting list of groundwater inflow values provides a time series of seepage inflow as the mine pit progresses from the south-east to the north-west.

4.1.2 Results.

The difference between the base of the wash and the piezometric surface steadily increases as the mine path progresses north-west. This results in greater inflows as the pressure differential (H_o) increases. The figure below illustrates this increase in pressure differential and calculated groundwater inflow.



Time series of calculated groundwater inflow and pressure differential using the McWorter analytical equation.

A total of 336,670 cubic metres are pumped from the pit over a 198 day period. The mean pressure differential is 19.7 metres, implying that a mean and maximum delivery head of 25 and 45 metres, respectively, is required during the dewatering operation.

4.2 Groundwater Model.

A two-dimensional groundwater model allows significantly more variability and flexibility of analysis than a one-dimensional analytical equation. The analytical element method model code known as TWODAN is employed to simulate the effect of dewatering in the proposed Waikaka excavation.

4.2.1 Initialisation.

Using the same values for initialisation as the McWorter equation, a transmissivity of 50 m^2/d and the same piezometric elevation profile, the TWODAN model is initialised as one confined aquifer. Three principal models are developed:

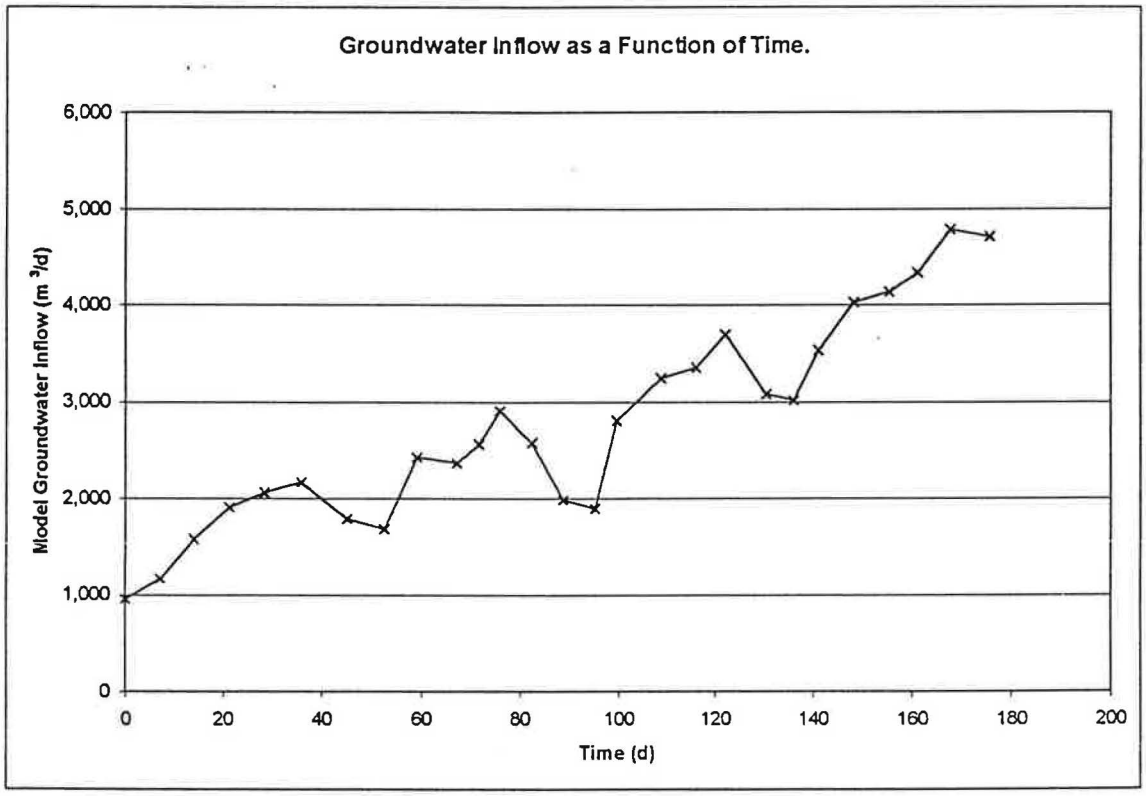
1. Steady-state, multi-point simulation,
2. Quasi-transient, multi-point simulation,
3. Interception wells simulation.

The TWODAN model code is quasi-transient, meaning that boundary conditions are steady state, but that extraction or injection of groundwater may be time-dependent in terms of head. In transient simulations, the change in groundwater pressure as a function of time can be assessed.

4.2.2 Steady State, Multi-point Simulation.

A series of 27 mock mine pits are arranged along the mine pit alignment over a distance of 3,510 metres. Dewatering in turn at these points as the mine pit progresses is simulated by groundwater extraction to satisfy dewatering to the base of the 'wash' to an average radius of 130 metres from the pit centre (approximately a 5.3 hectare area). The groundwater inflow results of each successive simulation are assigned to the corresponding time point in mine progression.

The graph below shows the change in groundwater inflow necessary to maintain a dry excavation as a function of time.



Time profile of groundwater inflow as modelled with TWODAN at 27 points.

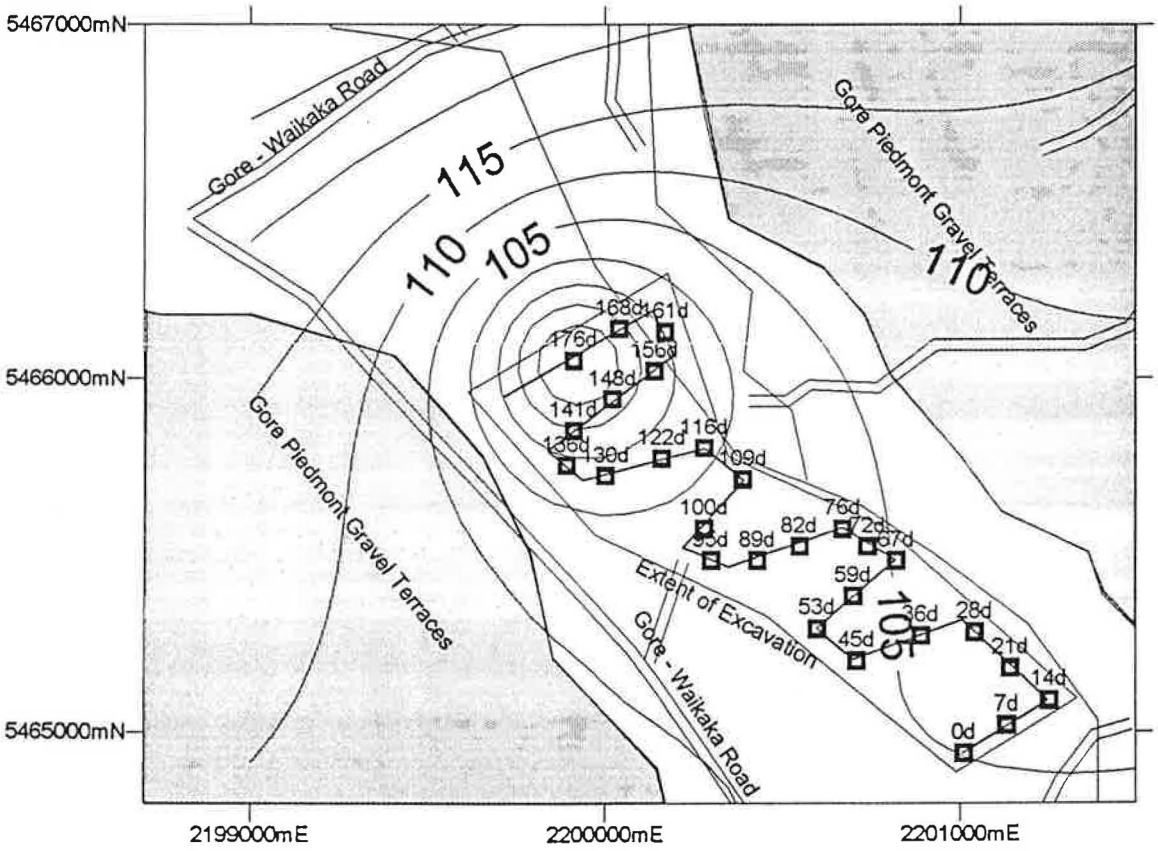
Peak inflow of 4,790 cubic metres per day is experienced at the 130 day mark. A total of 486,290 cubic metres are pumped from the pit over a 175 day period.

4.2.3 Transient Simulation.

The groundwater inflows determined in steady state modelling above for each of the 27 time-steps are used to set the pumping rate of the mine pits. The mine pit positions are activated in the model simulation in sequence and at times outlined for the steady state simulation. This transient simulation is mainly directed towards determining the effect on surrounding piezometeric elevations.

An example of the transient simulation shows the cone of depression in the piezometric surface around the last active pit position at the 175 day mark of mine progression. The figure below shows the pit position dewatered to 85 metre elevation, the base of the wash at this point.

Modelled Piezometric Pressure following 175 days of Mine Progress.



Contours of modelled piezometric pressure during dewatering of the 27th mock mine pit position. Pressure is released to the extent of dewatering the immediate vicinity of the excavation. Each mine position is marked with the number of days in the mine progression.

Broad aquifer depressurisation is experienced up to 1.5 metres from the active mine position as a result of dewatering activities.

4.2.4 Interception Well Simulation.

Interception wells are capable of depressurising the formation in advance of groundwater entering the mine excavation. This has the following advantages:

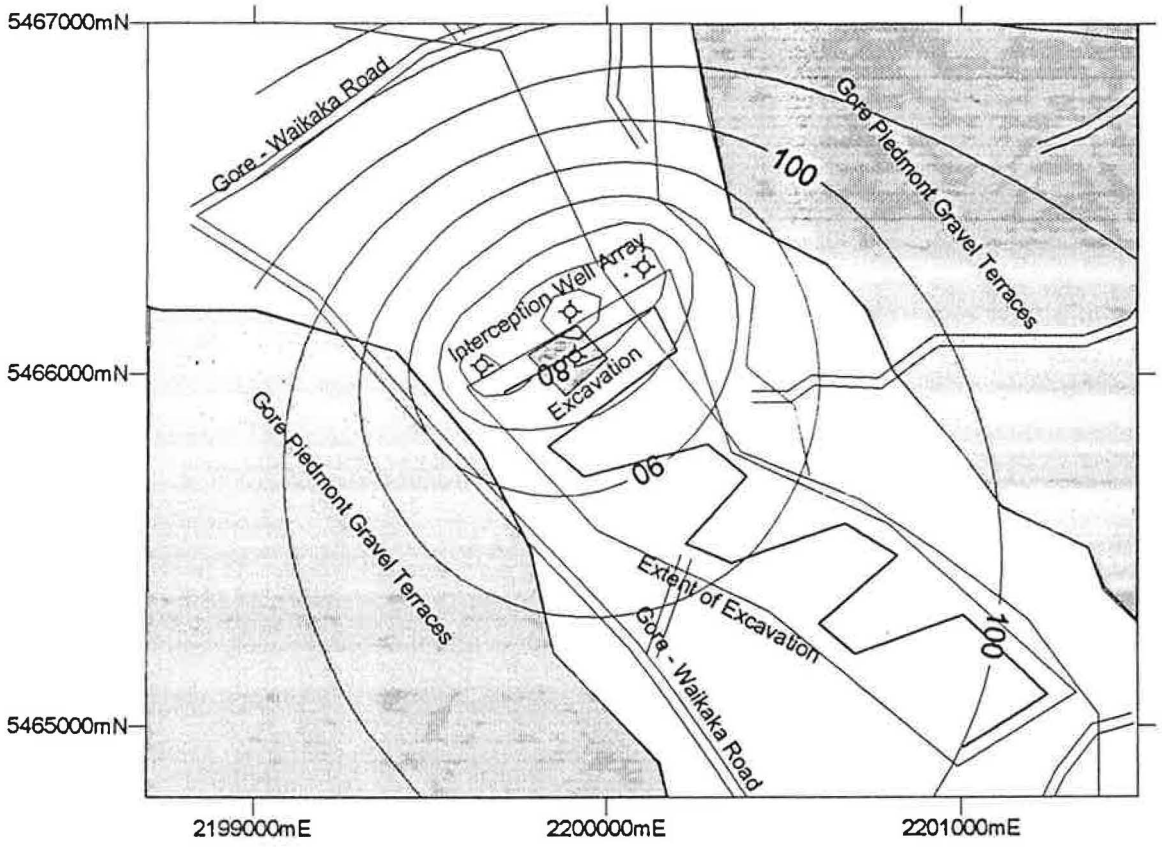
1. The sides of the excavation are less likely to be wet or moist from seepage faces. There is likely to be less cascading of perched groundwater in discrete water bearing horizons. Slope stability is likely to be less problematic than would otherwise be the case.
2. The excavation is more likely to be trafficable through having a drier base.
3. Since the groundwater extracted from the excavation is more likely to be turbid than water from interception wells, the problems associated with treatment prior to discharge to surface water are lessened by the ability to depressurise the aquifer with clean water discharge.

Interception wells are typically arranged in perimeter or radial arrays. In view of the lower aquifer transmissivity, established groundwater flow direction, inferred mode of recharge and direction of mine progression, the arrangement of interception wells would optimally be on the upstream side of excavation.

In this simulation three interception wells are arranged along the north-western margin edge of the excavation. It is assumed in this simulation that the interception wells can be operated so as to minimise inflow to the excavation by creating a cone of depression deeper than the base of the mine pit. This optimisation is achieved by adjusting the well extraction to permit near-zero inflow to the excavation. This results in a uniform necessary extraction of approximately 1,700 m^3/d from each interception wells adding to a pumpage of 5,100 m^3/d, or 59 litres per second. The simulation is carried out in steady state mode.

The figure below illustrates the distribution of piezometric head as a result of the interception array at the 175 day mark as the excavation approaches the well point array. This point in time approximates the worse case position for groundwater inflow.

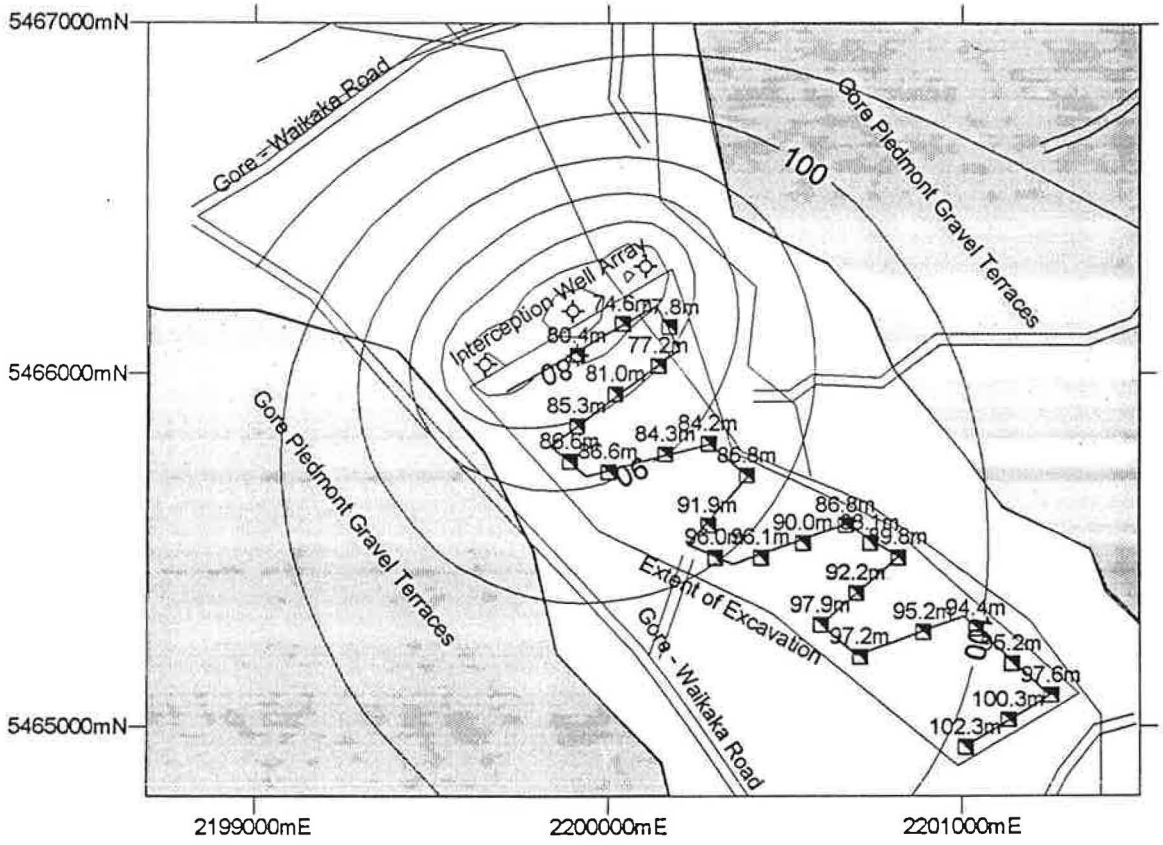
Use of Interception Wells for Aquifer Depressurisation.



Piezometric pressure as a result of pumping of three interception wells at a rate of 1,700 m^3/d. At this rate there is no gradient for inflow into the nearby excavation with a base of 80.3 metres above sea level.

The above simulation is undertaken in steady state mode, meaning that time dependence of depressurisation is not considered. A further transient simulation is undertaken with interception wells only. The interception wells are run for 1 year in the simulation. At the close of the year period, the state of aquifer pressure is assessed and is illustrated in the figure below.

Piezometric Pressure following 1 year of Extraction at 5,100 m3/d from Three Interception Wells.



Aquifer piezometric pressure following operation of three interception wells at a discharge of 1,700 m³/d over a 365 day period. Contours indicate the aquifer pressure in metres above sea level, while the values above the crossed boxes indicate the elevation of the base of the excavation.

Results of the transient simulation with interception wells indicate that the array would be effective in depressurising the aquifer if the interception array was set pumping 6 months in advance of the start of mining at the south-east end of the mine path. The figure above illustrates that depressurisation by the interception wells brings piezometric head within a few metres of the base of the excavation. This allows excavation to proceed with lower rates of pit dewatering than would be the case without intercept wells.

It should be noted that this modelling does not indicate that establishing interception wells is a feasible enterprise. Pumping tests of the most permeable drilled horizon of the deposit experienced difficulties in well development and low yield.

4.3 Section Summary; Analysis.

- The McWorter analytical equation allows transient calculation of the box-cut excavation at Waikaka. Calculations using an aquifer transmissivity of 50 m^2/d indicate a peak groundwater inflow of 2,570 m^3/d, with an average of 1,700 m^3/d.
- The TWODAN groundwater model is used to allow two-dimensional simulation of the required groundwater dewatering of the excavation. Using a transmissivity of 50 m^2/d, the peak inflow to the mine is 4,790 m^3/d, with an average of 2,770 m^3/d.
- In both cases the analyses indicate that groundwater inflows will increase as the excavation progresses in the north-west direction.
- Transient modelling with TWODAN, again using 50 m^2/d for transmissivity, indicates broadly exerted depressurisation of the aquifer over a kilometre width of the Waikaka Valley.
- The use of interception wells placed at the terminal, north-west end of the excavation provide an effective curtain against groundwater inflow which would occur under existing groundwater gradients.

5. Impact Assessment.

The implications to groundwater of the characterisation and analyses outlined in the above two sections are presented in this section on groundwater impacts.

5.1 Sensitivity of the Waikaka Area.

The Waikaka area is partially served by the Otama rural water supply scheme operated by Gore District Council. The source of raw water for the Otama RWS is a gallery well adjacent to the Mataura River at Pyramid Bridge, more than 20 kilometres distant. Other parts of the Waikaka valley have access to water supply from the Glenkinnock rural water scheme operated by Clutha District Council and drawn from the Pomahaka River in nearby Otago. This scheme covers Waikaka township and the east side of the Waikaka Valley as far west as Turnbull Road. On-site water supply is drawn from streams, springs and water bores on properties not connected to either rural water scheme. Commercial properties in Waikaka township usually have a shallow water bores drawing on Quaternary gravel aquifers.

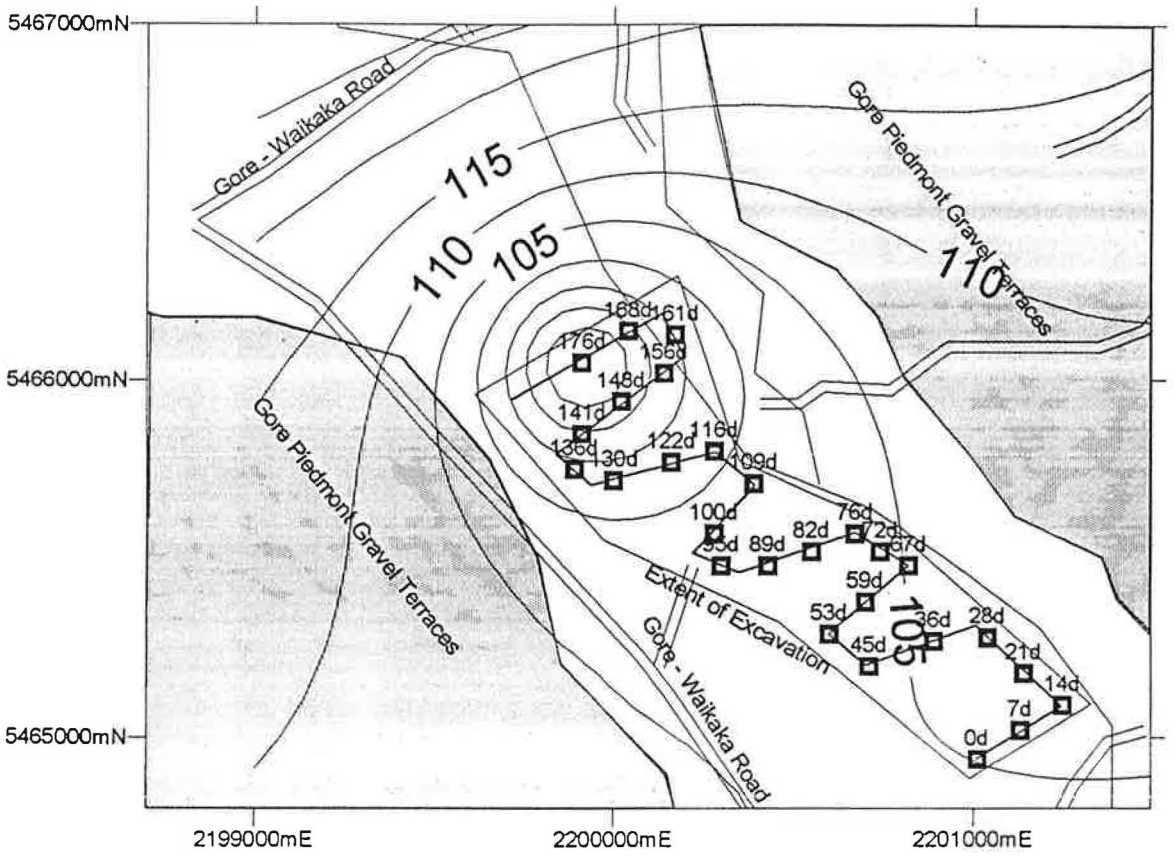
There has been no consistent collection of drilling information, nor are drilling consents required in Southland. Only one confirmed record of bore drilling can be located for the Waikaka area from drilling records made available to AquaFirma Ltd. A drilling record from Middlemiss Drilling refers to a 100 feet deep bore on Turnbull Road. The approximate elevation of the bore collar is 150 metres. Being 30 metres deep, the bore intake lies at the same elevation of the Waikaka valley floor. The bore *probably* taps groundwater in the base of the Gore piedmont gravel deposits forming the terraces to either side of the valley. It is also *possible* that the bore is in hydraulic communication with the Tertiary sediments forming the gold deposit.

Overall, there are few indications of groundwater use in the Waikaka area, and fewer of exploitation of the deeper, Tertiary sediment hosted groundwater. Water use in the Waikaka Valley is largely restricted to domestic and stock water requirements. The quantity of exploitation is therefore limited to much less than the permitted 10 litres per second for such uses of water under Southland's transitional regional plan. Bores, where they are installed, are frequently placed to draw water from just under the lowest ambient water level for reasons of cost. This practice makes the bores more vulnerable to the effects of localised drawdown in the groundwater level.

5.2 Groundwater Drawdown.

Drawdown is the process of decline in groundwater head as a result in extraction of water from a well or excavation. The TWODAN modelling has assessed the extent and magnitude of drawdown as a result of mine dewatering operation. A map of the lateral extent and elevation of the drawdown cone is shown in the figure below.

Modelled Piezometric Pressure following 175 days of Mine Progress.



Modelled piezometric head elevation in the Tertiary sediment hosted aquifers in the Waikaka Valley. The drawdown resulting from mine pit dewatering is evident in the encircled contours.

The direction of mine travel results in an elongated area of drawdown trailing in the wake of the progressing mine pit. The drawdown will be temporary, in that one gold extraction is completed, pit rehabilitation begun and dewatering shut down, the area of drawdown will fill back in again. The rate of recovery from drawdown is related to the groundwater transmissivity and storage coefficients, but will be no longer than the period involved in producing the drawdown.

5.3 Groundwater Inflow.

Groundwater inflow is principal groundwater-related effect having a bearing on mine feasibility. The magnitude of groundwater inflow also has a bearing on the potential environmental effects of clean and treated water discharge. Groundwater inflow analysis has been principally directed towards estimating groundwater inflow.

The sense of mine travel into the higher piezometric pressures and deeper parts of the excavation generally dictates the groundwater inflow increases with mine progression in a manner which could be likened to a thickening wedge. The peak groundwater inflows are modelled to occur towards the terminus of the mine path. Two estimates of peak inflow from the semi-confined Tertiary sediment aquifers have been made:

	Peak Inflow (m^3/d)	Mean Inflow (m^3/d)
McWorter Analytical Equation	2,570	1,700
TWODAN Steady state simulation	4,790	2,770

These inflows may be significantly reduced through the use of interception wells on the upgradient side of the ultimate mine extent. Providing that the construction of interception wells and extraction at the necessary discharge are feasible, dewatering by this means has the advantage of significantly lowering piezometric head and reducing the dewatering discharge from the mine pit itself.

Modelling in steady state mode using the TWODAN model indicates that interception well dewatering at a combined discharge of 5,100 m^3/d for about one year is sufficient to effectively dewater the proposed mine area to near the base of the 'wash'. This groundwater is a clean water discharge, which will be more likely to meet norms for discharge to surface water.

5.4 Mitigation & Monitoring.

5.4.1 Mitigation.

The dewatering activities will have an affect beyond the boundaries of the proposed mine as drawdown and a groundwater discharge to surface water. Mitigation of adverse effects may be necessary to avoid compromise of environmental, resource utilisation and amenity values.

Drawdown of groundwater piezometric elevation in Tertiary sediments will extend to a distance up to 2 kilometres from the mine centre-line. Rural water schemes serve the majority of properties existing in the area. It is probable that very few water bores are utilised within the area. However, little information could be secured with which to confirm this inference. Mitigation of the drawdown effect would include a farm-visit survey of any existing bores which records the following:

- The depth and interval of aquifer tapping,
- The utilisation of the bore (i.e.; frequency of use, rate of extraction and purpose),
- The standing and pumping water levels in the bore,
- The depth / elevation of the pump intake in the bore.

Once this survey is complete an assessment of the degree of effect on groundwater users can be assessed.

Should allied assessments of the sensitivity of the receiving waters suggest adverse effects from discharge of groundwater, then discharge minimisation strategies or alternative sites for discharge may merit assessment. These can be foreshadowed as interception programming, mining methods less affected by seepage and land application of discharge water.

5.4.2 Monitoring.

Monitoring of drawdown can be achieved by measuring the elevation of the piezometric surface through time. Observation wells have been installed during drilling investigations to provide for monitoring before, during and after mining of the deposit.

6. References Cited.

[i] Issac, M.J.; and Lindquist, J.K. 1990. Geology and resources of the Eastern Southland Group, New Zealand. New Zealand Geological Survey Bulletin 101. DSIR, Wellington.

[ii] Hutchinson, P.D. 1990. Recession Estimation of Low Flow in New Zealand. Publication No. 22 of the Hydrology Centre, DSIR Marine & Freshwater, Christchurch.

[iii] Rekker, J.H. 1997. Baseflow hydrology of Southland. Prepared for Southland Regional Council by AquaFirma Ltd, Invercargill.

[iv] McWorter, D. B. 1981. Predicting groundwater response to disturbance by mining-selected problems. *Proceedings* 1981 Symposium on Surface Mining Hydrology, Sedimentology and Reclamation. University of Kentucky. UKY BU126. pp.89-95.

Bore Construction Report

OFFICE USE ONLY		
Date received	Accession number	Signed
Bore number	Entered IRIS date	Invoice date

GENERAL DETAILS											
Client/Consent holders name	**Waikaka Gold – Main Bore Lake**						**Consent number**				
Location/Address											
Grid reference	E		N		GPS ■		Other ☐		Cell #		
Sketch plan attached	Yes ☐	No ■	**Photos**		Yes ■		No ☐		Home #		

DRILLING DETAILS			
Drilling company	**SouthDrill LTD**	**Driller**	Russell Davy
Machine/Rig	**Schramm**	**Fleet**	2101
Drill method	Air Rotary		

BORE CONSTRUCTION DETAILS					
Start date	**27-10-21**		**Finish date**	05-11-21	
Bore diameter	**300**	mm	**Casing material**	Steel	
Screen material	Stainless Steel				
Screen diameter	Inside 265	mm		Outside 270	mm
Screen slots	2.5	mm		Sump diameter	mm
Overdrilled	Yes ☐	No ■			

PUMPING/WATER DETAILS									
Dry bore	Yes ☐	No ■	**If dry, was casing retrieved?**	Yes ☐	No ☐	**Bore filled in**	Yes ☐	No ☐	
Development period	**9**	hours	**Development method**		Air				
Yield/Test pumping	Airlifted ☐		Pumped ■		**Test pump period**		24 hours		
Test pump rate	1.3	litres/second	**Method of measuring rate**		Volumetric Test				
Comments	SWL 1.13								
Pumped water level		metres							

WATER QUALITY ETC						
Bacterial water test	Yes ☐	No ☐	**Chemical water Test**	Yes ☐	No ☐	
Casing top sealed	Yes ☐	No ☐	**Impervious seal at ground**	Yes ■	No ☐	

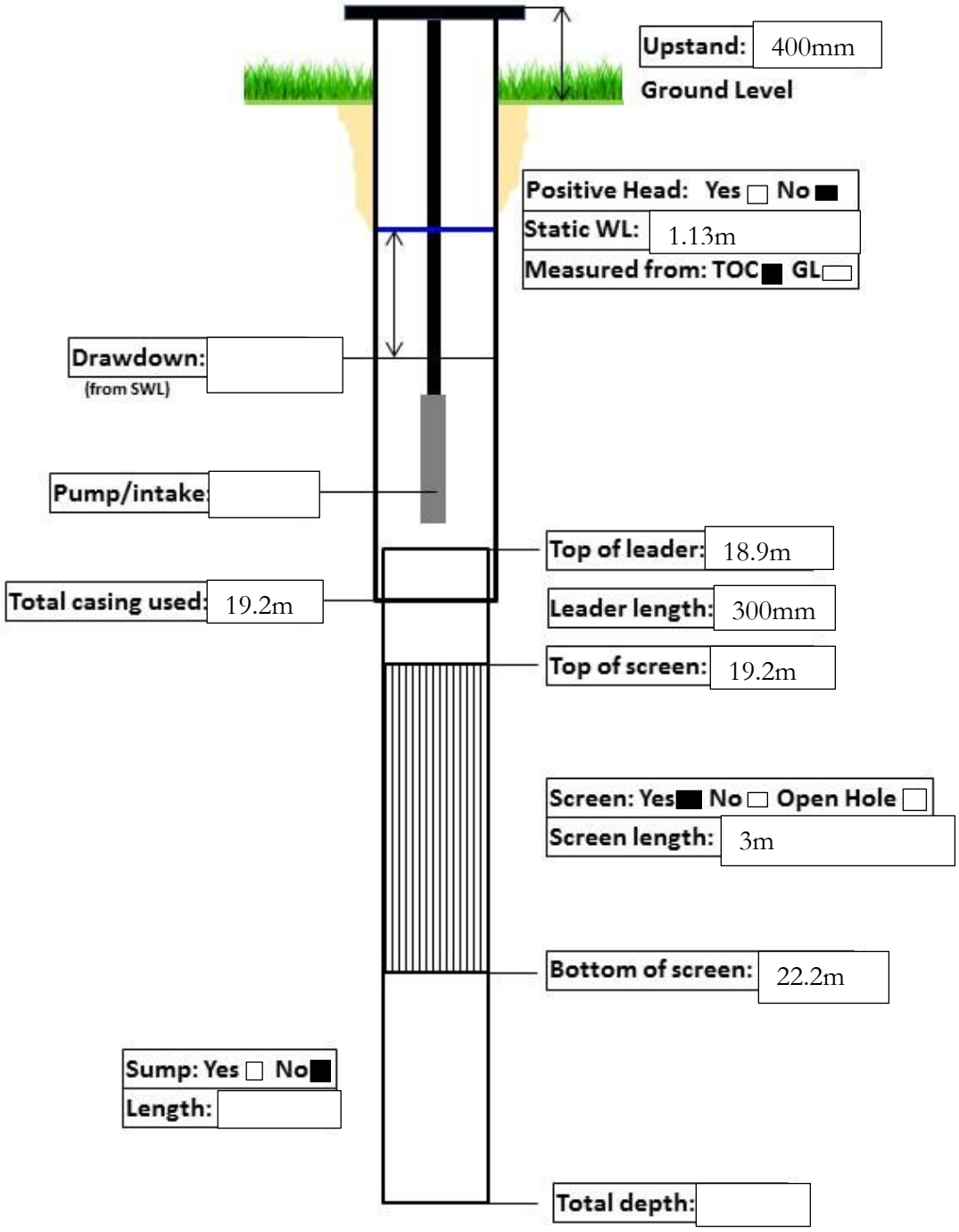
Comments

BORE LOG (METRES BELOW REFERENCE POINT)
0.0m-3.0m top gravels
3.0m-6.0m Grey pug silts
6.0m-7.0m Grey pug some gravels
7.0m-12m Clay pug
12m-18m Clay bound gravels
18m-22.2m Clay bound gravels

Do you intend to drill more bores under this Land Use Consent number? Yes ☐ No ☐

If yes, number of bores drilled ..... ***of*** _____ ***Bores drilled*** ***Number bore logs provided*** .....

PTO for bore diagram


Upstand: 400mm
Ground Level
Positive Head: Yes ☐ No ■
Static WL: 1.13m
Measured from: TOC ■ GL ☐
Drawdown:
(from SWL)
Pump/intake:
Top of leader: 18.9m
Total casing used: 19.2m
Leader length: 300mm
Top of screen: 19.2m
Screen: Yes ■ No ☐ Open Hole ☐
Screen length: 3m
Bottom of screen: 22.2m
Sump: Yes ☐ No ■
Length:
Total depth:

Bore Construction Report

OFFICE USE ONLY		
Date received	Accession number	Signed
Bore number	Entered IRIS date	Invoice date

GENERAL DETAILS											
Client/Consent holders name	**Waikaka Gold – Piezo two north**						**Consent number**				
Location/Address											
Grid reference	E		N		GPS ■		Other ☐		Cell #		
Sketch plan attached	Yes ☐	No ■	**Photos**		Yes ■		No ☐		Home #		

DRILLING DETAILS			
Drilling company	**SouthDrill LTD**	**Driller**	Russell Davy
Machine/Rig	**Schramm**	**Fleet**	2101
Drill method	Air Rotary		

BORE CONSTRUCTION DETAILS							
Start date	**9-11-21**			**Finish date**	9-11-21		
Bore diameter	**50mm**	mm		**Casing material**	PVC		
Screen material	PVC						
Screen diameter	Inside 50	mm			Outside 50	mm	
Screen slots	1.5	mm			Sump diameter	mm	
Overdrilled	Yes ☐	No ■					

PUMPING/WATER DETAILS										
Dry bore	Yes ■	No ☐	**If dry, was casing retrieved?**	Yes ■	No ☐	**Bore filled in**	Yes ■	No ☐		
Development period		hours	**Development method**		Air					
Yield/Test pumping	Airlifted ☐		Pumped ■		**Test pump period**	hours				
Test pump rate		litres/second	**Method of measuring rate**							
Comments										
Pumped water level		metres								

WATER QUALITY ETC						
Bacterial water test	Yes ☐	No ☐	**Chemical water Test**	Yes ☐	No ☐	
Casing top sealed	Yes ☐	No ☐	**Impervious seal at ground**	Yes ■	No ☐	

Comments

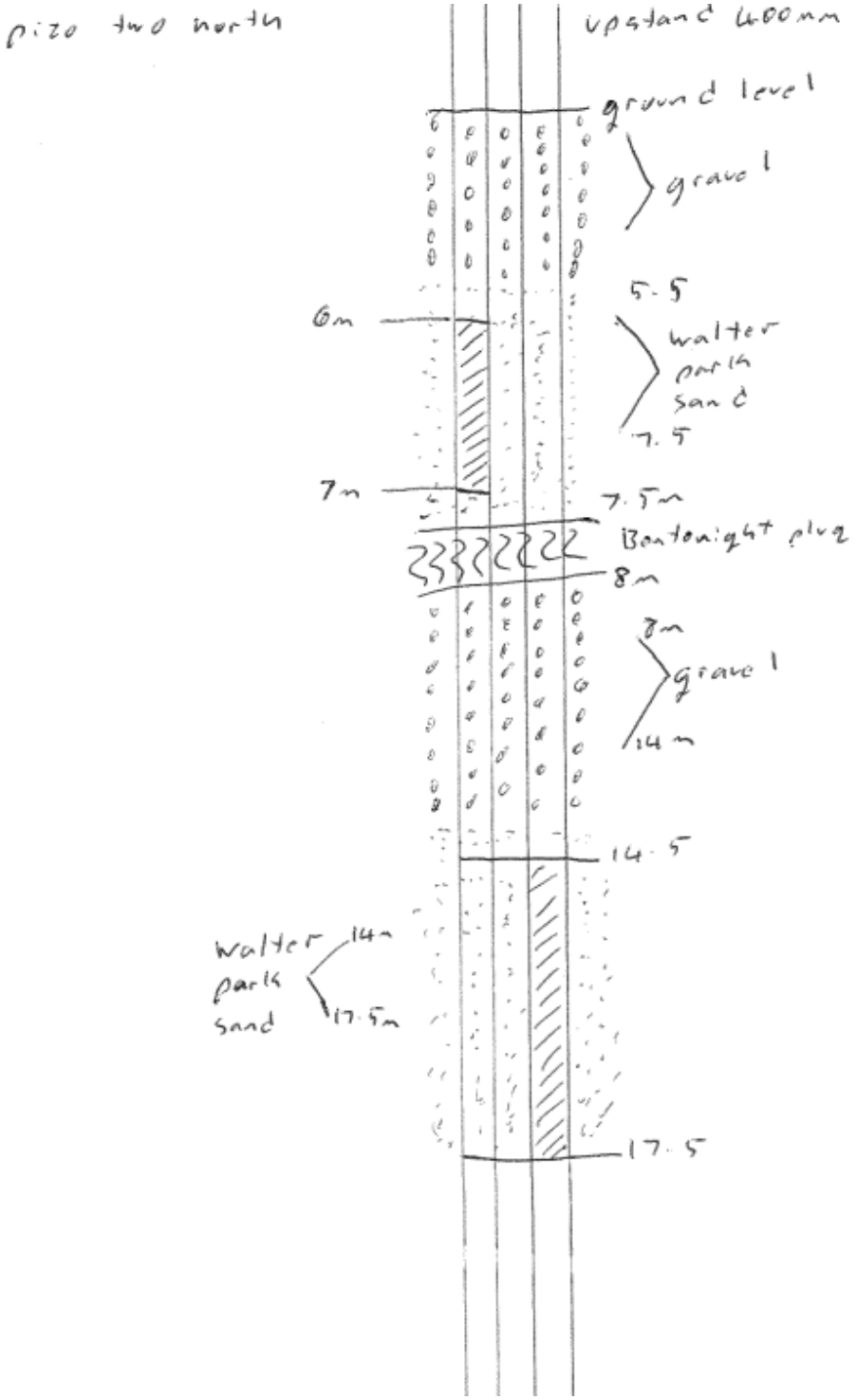
Two Piezos in hole
Shallow SWL 1.9
Deep 1.74

BORE LOG (METRES BELOW REFERENCE POINT)
0.0m-3.0m Top Gravels
3.0m-6.0m Grey pug
6.0m-7.0m Grey pug damp
7.0m-12m Clay pug
12m-17.5m Gravels

Do you intend to drill more bores under this Land Use Consent number? Yes ☐ No ☐

If yes, number of bores drilled ..... ***of*** _____ ***Bores drilled*** ***Number bore logs provided*** .....

PTO for bore diagram


piezo two north
upstand 400mm
ground level
gravel
5.5
6m
walter
park
sand
7.5
7m
7.5m
Bentonight plug
8m
7m
gravel
14m
14.5
walter
park
sand
14m
17.5m
17.5

Bore Construction Report

OFFICE USE ONLY		
Date received	Accession number	Signed
Bore number	Entered IRIS date	Invoice date

GENERAL DETAILS											
Client/Consent holders name	**Waikaka Gold – Piezo two lake in paddock**						**Consent number**				
Location/Address											
Grid reference	E		N		GPS ■		Other ☐		Cell #		
Sketch plan attached	Yes ☐	No ■	**Photos**		Yes ■		No ☐		Home #		

DRILLING DETAILS			
Drilling company	**SouthDrill LTD**	**Driller**	Russell Davy
Machine/Rig	**Schramm**	**Fleet**	2101
Drill method	Air Rotary		

BORE CONSTRUCTION DETAILS							
Start date	**27-10-21**			**Finish date**	27-10-21		
Bore diameter	**50mm**	mm		**Casing material**	PVC		
Screen material	PVC						
Screen diameter	Inside 50	mm			Outside 50	mm	
Screen slots	1.5	mm			Sump diameter	mm	
Overdrilled	Yes ☐	No ■					

PUMPING/WATER DETAILS										
Dry bore	Yes ■	No ☐	**If dry, was casing retrieved?**	Yes ■	No ☐	**Bore filled in**	Yes ■	No ☐		
Development period		hours	**Development method**							
Yield/Test pumping	Airlifted ☐		Pumped ■		**Test pump period**	hours				
Test pump rate		litres/second	**Method of measuring rate**							
Comments										
Pumped water level		metres								

WATER QUALITY ETC						
Bacterial water test	Yes ☐	No ☐	**Chemical water Test**	Yes ☐	No ☐	
Casing top sealed	Yes ☐	No ☐	**Impervious seal at ground**	Yes ■	No ☐	

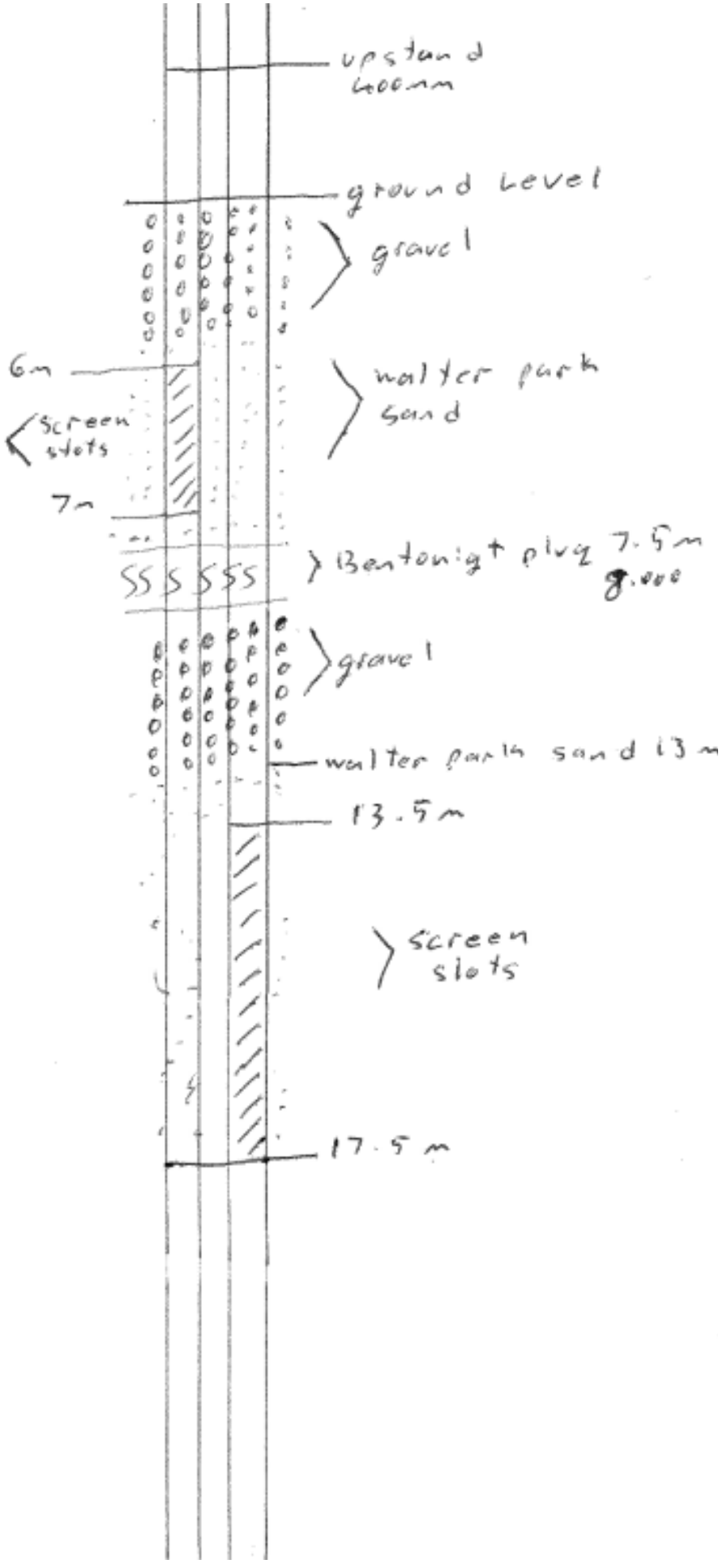
Comments

BORE LOG (METRES BELOW REFERENCE POINT)
0.0m-3.0m Top gravels
3.0m-6.0m Grey silty pug
6.0m-7.0m Gravels
7.0m-12m Clay pug
12m-17.5m Gravels

Do you intend to drill more bores under this Land Use Consent number? Yes ☐ No ☐

If yes, number of bores drilled ..... ***of*** _____ ***Bores drilled*** ***Number bore logs provided*** .....

PTO for bore diagram


upstand 600mm
ground level
gravel
6m
walter park sand
screen slots
7m
Bentonight plug 7.5m
9.000
gravel
walter park sand 13m
13.5m
screen slots
17.5m

Bore Construction Report

OFFICE USE ONLY		
Date received	Accession number	Signed
Bore number	Entered IRIS date	Invoice date

GENERAL DETAILS											
Client/Consent holders name	**Waikaka Gold**						**Consent number**				
Location/Address											
Grid reference	E		N		GPS ■		Other ☐		Cell #		
Sketch plan attached	Yes ☐	No ■	**Photos**		Yes ■		No ☐		Home #		

DRILLING DETAILS			
Drilling company	**SouthDrill LTD**	**Driller**	Russell Davy
Machine/Rig	**Schramm**	**Fleet**	2101
Drill method	Air Rotary		

BORE CONSTRUCTION DETAILS							
Start date	**10-11-21**			**Finish date**	17-11-21		
Bore diameter	**300**	mm		**Casing material**	Steel		
Screen material	Stainless Steel						
Screen diameter	Inside 265	mm			Outside 270	mm	
Screen slots	2.5	mm			Sump diameter 270	mm	
Overdrilled	Yes ☐	No ■					

PUMPING/WATER DETAILS										
Dry bore	Yes ■	No ☐	**If dry, was casing retrieved?**	Yes ■	No ☐	**Bore filled in**	Yes ■	No ☐		
Development period	**6**	hours	**Development method**	Air						
Yield/Test pumping	Airlifted ☐		Pumped ■		**Test pump period**	24 hours				
Test pump rate	2.8	litres/second	**Method of measuring rate**	Volumetric Test						
Comments										
Pumped water level		metres								

WATER QUALITY ETC						
Bacterial water test	Yes ☐	No ☐	**Chemical water Test**	Yes ☐	No ☐	
Casing top sealed	Yes ☐	No ☐	**Impervious seal at ground**	Yes ■	No ☐	

Comments

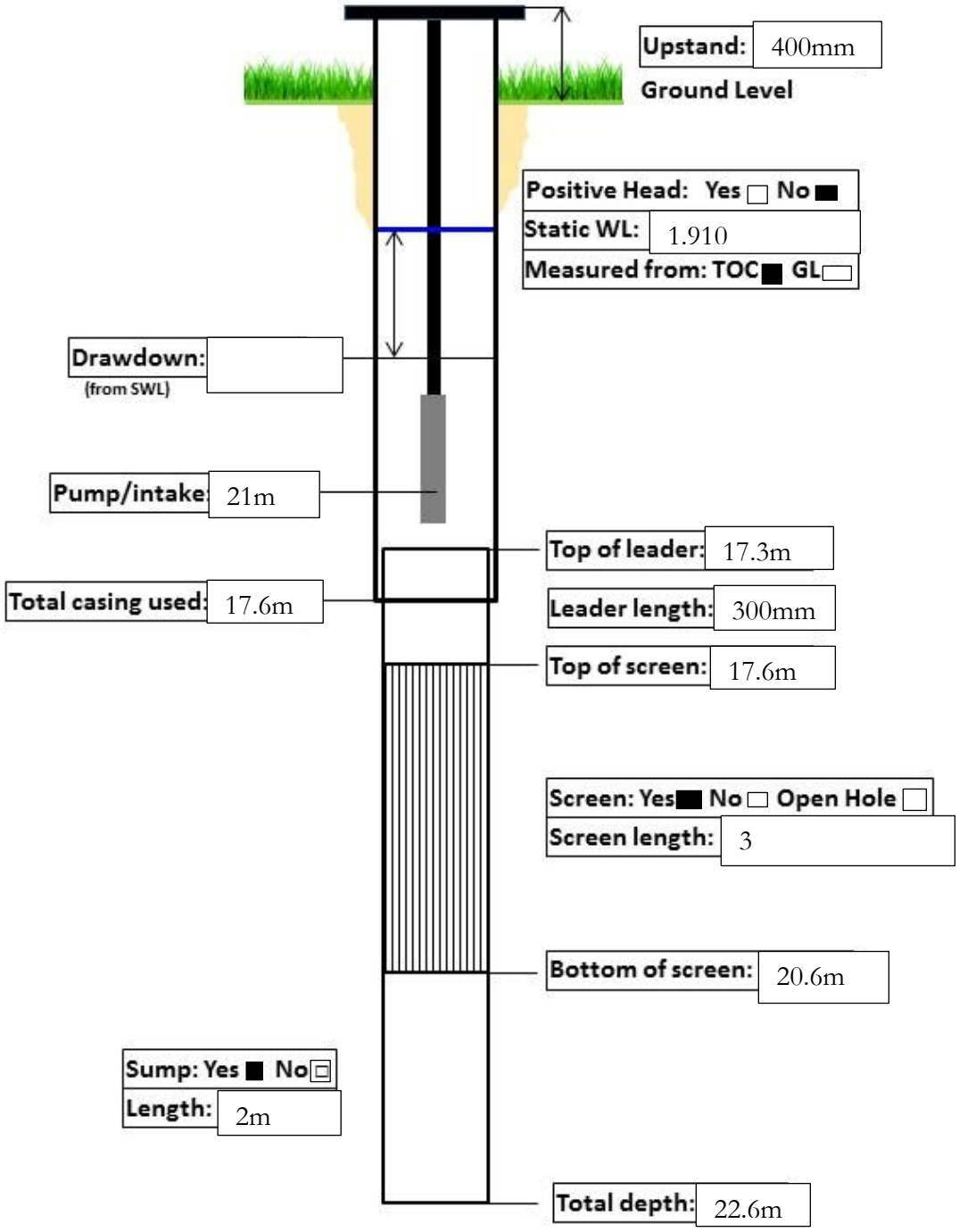
All casing removed at the end of test as test drilling for a gold mine.

BORE LOG (METRES BELOW REFERENCE POINT)
0.0m-3.0m Top soil Gravels
3.0m-5.5m Grey pug, wet gravels
5.5m-7.5m Brown gravels wet
7.5m-12m Clay pug
12m-22.6m Gravels clay

Do you intend to drill more bores under this Land Use Consent number? Yes ☐ No ☐

If yes, number of bores drilled ..... ***of*** _____ ***Bores drilled*** ***Number bore logs provided*** .....

PTO for bore diagram


Upstand: 400mm
Ground Level
Positive Head: Yes ☐ No ■
Static WL: 1.910
Measured from: TOC ■ GL ☐
Drawdown:
(from SWL)
Pump/intake: 21m
Top of leader: 17.3m
Total casing used: 17.6m
Leader length: 300mm
Top of screen: 17.6m
Screen: Yes ■ No ☐ Open Hole ☐
Screen length: 3
Bottom of screen: 20.6m
Sump: Yes ■ No ☐
Length: 2m
Total depth: 22.6m

Bore Construction Report

SOUTHDRILL EXPLORATION & PILING

OFFICE USE ONLY		
Date received	Accession number	Signed
Bore number	Entered IRIS date	Invoice date

GENERAL DETAILS											
Client/Consent holders name	**Waikaka Gold – Piezo one south**							**Consent number**			
Location/Address											
Grid reference	E		N		GPS ■		Other ☐		Cell #		
Sketch plan attached	Yes ☐	No ■	**Photos**		Yes ■		No ☐		Home #		

DRILLING DETAILS			
Drilling company	**SouthDrill LTD**	**Driller**	Russell Davy
Machine/Rig	**Schramm**	**Fleet**	2101
Drill method	Air Rotary		

BORE CONSTRUCTION DETAILS					
Start date	**08-11-21**		**Finish date**	09-11-21	
Bore diameter	**50mm**	mm	**Casing material**	PVC	
Screen material	PVC				
Screen diameter	Inside 50	mm		Outside 50	mm
Screen slots	1.5	mm		Sump diameter	mm
Overdrilled	Yes ☐	No ■			

PUMPING/WATER DETAILS									
Dry bore	Yes ■	No ☐	**If dry, was casing retrieved?**	Yes ■	No ☐	**Bore filled in**	Yes ■	No ☐	
Development period		hours	**Development method**						
Yield/Test pumping	Airlifted ☐		Pumped ■		**Test pump period**		hours		
Test pump rate		litres/second	**Method of measuring rate**						
Comments									
Pumped water level		metres							

WATER QUALITY ETC						
Bacterial water test	Yes ☐	No ☐	**Chemical water Test**	Yes ☐	No ☐	
Casing top sealed	Yes ☐	No ☐	**Impervious seal at ground**	Yes ■	No ☐	

Comments

Two piezos in same hole
SWL shallow 1.96
SWL Deep 1.76

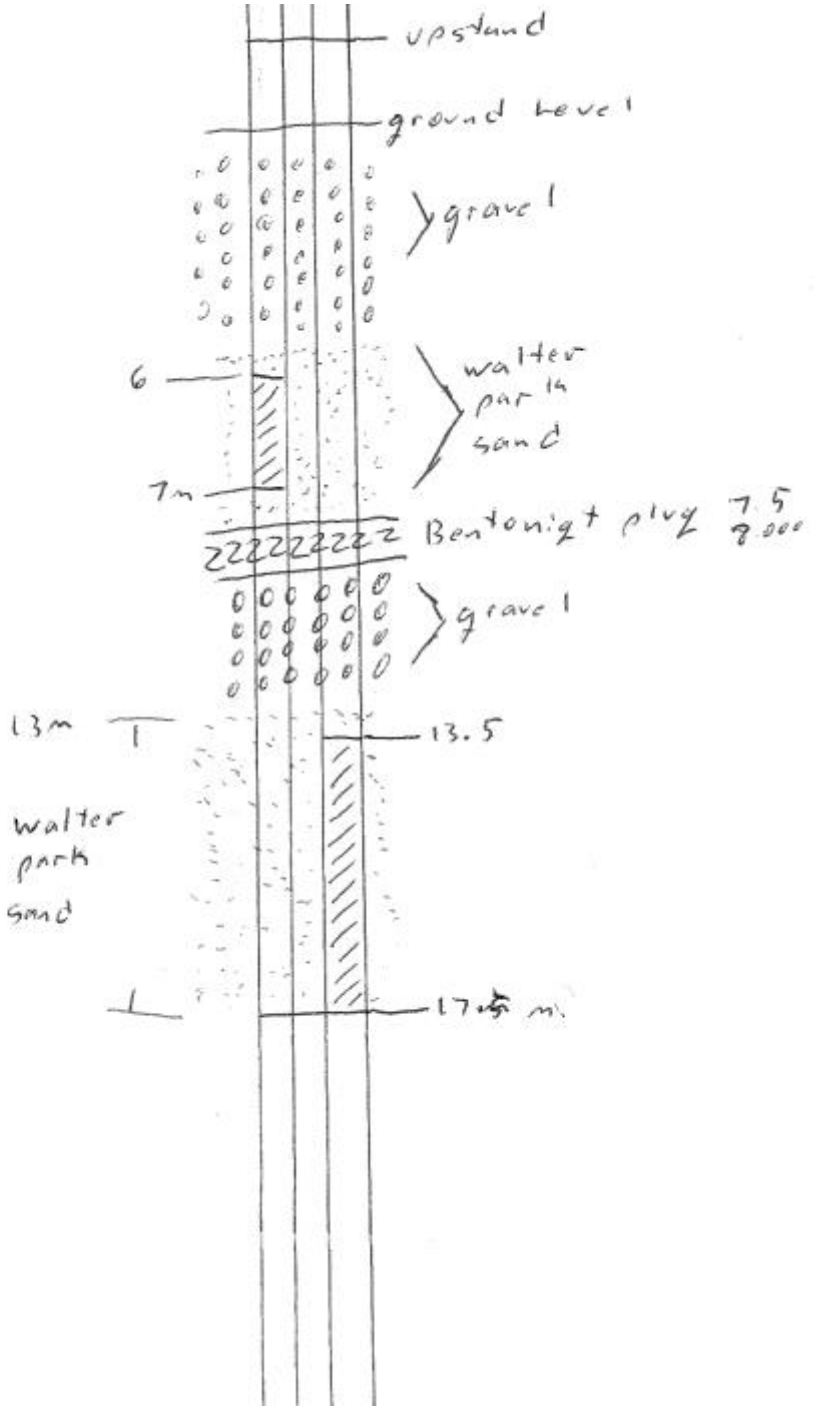
BORE LOG (METRES BELOW REFERENCE POINT)
0.0m-3.0m Top gravels
3.0m-7.0m Grey pug with gravels
7.0m-12m Clay pug
12m-17.5m Clay with gravels

Do you intend to drill more bores under this Land Use Consent number? Yes ☐ No ☐

If yes, number of bores drilled ..... ***of*** _____ ***Bores drilled*** ***Number bore logs provided*** .....

PTO for bore diagram

1:20 one ~~scale~~
South



Bore Construction Report

OFFICE USE ONLY		
Date received	Accession number	Signed
Bore number	Entered IRIS date	Invoice date

GENERAL DETAILS											
Client/Consent holders name	**Waikaka Gold – Piezo one lake**						**Consent number**				
Location/Address											
Grid reference	E		N		GPS ■		Other ☐		Cell #		
Sketch plan attached	Yes ☐	No ■	**Photos**		Yes ■		No ☐		Home #		
DRILLING DETAILS											
Drilling company	**SouthDrill LTD**					**Driller**	Russell Davy				
Machine/Rig	**Schramm**					**Fleet**	2101				
Drill method	Air Rotary										
BORE CONSTRUCTION DETAILS											
Start date	**22-10-21**					**Finish date**	26-10-21				
Bore diameter	**50mm**	mm				**Casing material**	PVC				
Screen material	PVC										
Screen diameter	Inside 50	mm					Outside 50	mm			
Screen slots	1.5	mm					Sump diameter	mm			
Overdrilled	Yes ☐	No ■									
PUMPING/WATER DETAILS											
Dry bore	Yes ■	No ☐	**If dry, was casing retrieved?**	Yes ■	No ☐	**Bore filled in**	Yes ■	No ☐			
Development period		hours	**Development method**	Air							
Yield/Test pumping	Airlifted ☐		Pumped ■		**Test pump period**	hours					
Test pump rate		litres/second	**Method of measuring rate**								
Comments											
Pumped water level		metres									
WATER QUALITY ETC											
Bacterial water test	Yes ☐	No ☐			**Chemical water Test**	Yes ☐	No ☐				
Casing top sealed	Yes ☐	No ☐			**Impervious seal at ground**	Yes ■	No ☐				

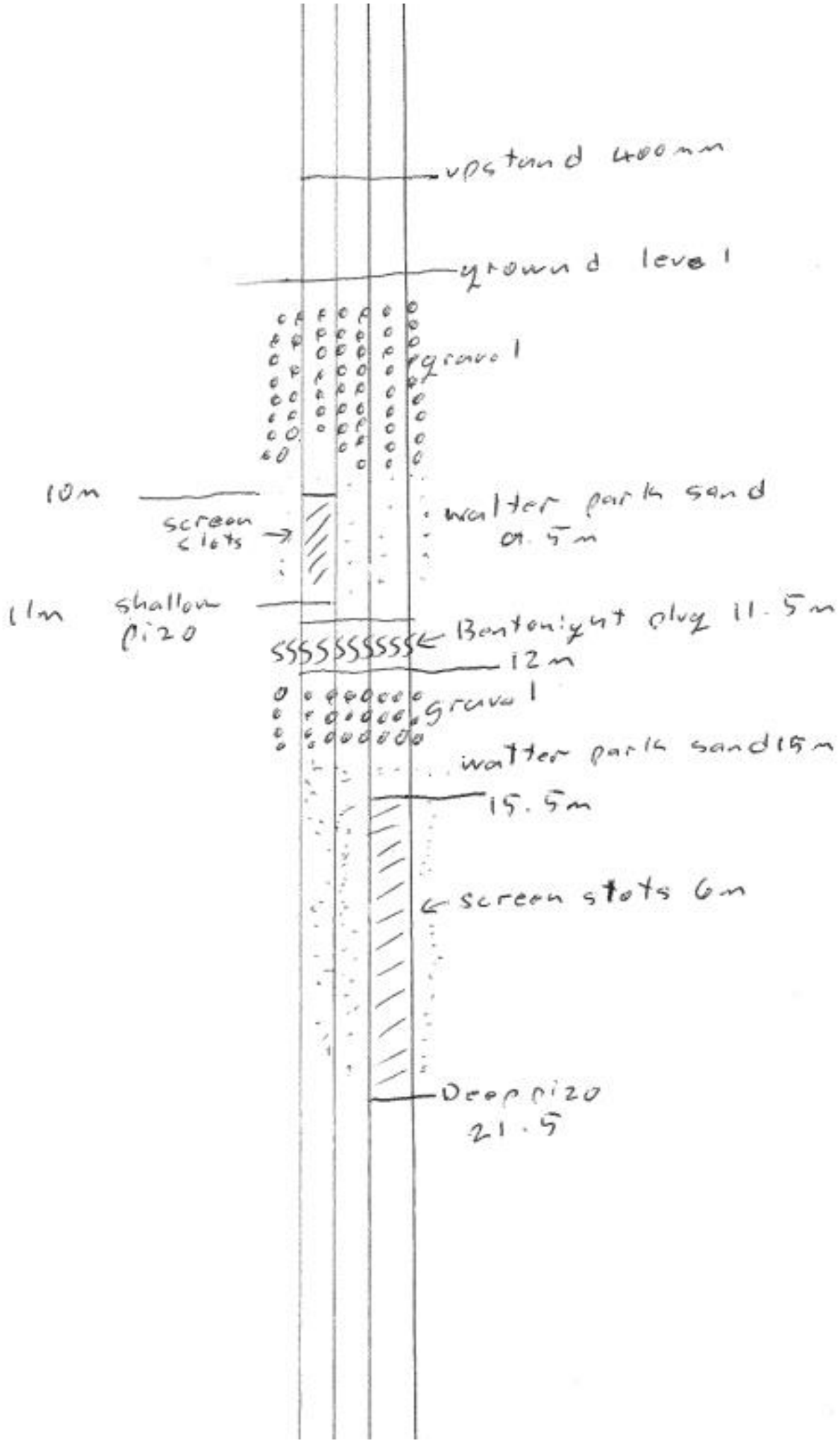
Comments

BORE LOG (METRES BELOW REFERENCE POINT)
0.0m-6.0m Grey pug
6.0m-10m Grey pug
10m-11m Gravels
11m-14.6m Clay fine silts
14.6m-21.5m Gravels

Do you intend to drill more bores under this Land Use Consent number? Yes ☐ No ☐

If yes, number of bores drilled _____ ***of*** _____ ***Bores drilled*** ***Number bore logs provided*** _____

PTO for bore diagram


upstand 400mm
ground level
gravel
10m
screen slots
water park sand
0.5m
11m
shallow pi20
Bentonight clay 11.5m
12m
gravel
water park sand 15m
15.5m
screen slots 6m
Deep pi20
21.5

Pump Site #1 (adjacent L&M pond)				
		Easting	Northing	RL
South	Piezo #1 - Collar	1,290,709.69	4,903,619.79	115.08
	Piezo #1 - Ground	1,290,709.67	4,903,620.07	114.42
North	Piezo #2 - Collar	1,290,719.23	4,903,661.23	115.71
	Piezo #2 - Ground	1,290,719.19	4,903,661.26	115.11
Pump Location	Collar	1,290,711.68	4,903,640.40	115.57
	Ground	1,290,711.68	4,903,640.40	114.97

Pump Site #2 (paddock, closer to river)			
		Easting	Northing
South	Piezo #1 - Collar	1,290,247.42	4,903,936.62
	Piezo #1 - Ground	1,290,247.27	4,903,936.66
North	Piezo #2 - Collar	1,290,275.79	4,903,965.01
	Piezo #2 - Ground	1,290,275.97	4,903,964.86
Pump Location	Collar	1,290,261.38	4,903,950.53
	Ground	1,290,261.38	4,903,950.53

Calculation of the distance of the Piezos from the pump bore by geometry

Piezo #1		squared	hypotenuse
delta x	- 1.99	3.97	20.71
delta y	- 20.62	425.02	
Piezo #2			
delta x	7.55	56.96	22.18
delta y	20.86	435.14	

Piezo #1		squared	hypotenuse
delta x	- 13.96	194.97	19.71
delta y	- 13.91	193.40	
Piezo #2			
delta x	14.41	207.53	20.32
delta y	14.33	205.29	

RL
118.84
118.47
118.84
118.34
119.03
118.43

1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P2 @ 10m radius.

	Water Level	Time Elapsed (min)	Drawdown (m)	WL_i
9:00:00	2.83	0.0	0.00	2.83
9:03:38	2.84	3.6	0.01	
9:04:16	2.85	4.3	0.02	
9:04:45	2.86	4.8	0.03	
9:05:10	2.87	5.2	0.04	
9:05:29	2.88	5.5	0.05	
9:06:04	2.90	6.1	0.07	
9:06:43	2.92	6.7	0.09	
9:07:08	2.94	7.1	0.11	
9:07:33	2.96	7.5	0.13	
9:07:57	2.98	8.0	0.15	
9:08:23	3.00	8.4	0.17	
9:08:41	3.02	8.7	0.19	
9:09:03	3.04	9.0	0.21	
9:09:21	3.06	9.4	0.23	
9:09:39	3.08	9.6	0.25	
9:09:57	3.10	10.0	0.27	
9:10:04	3.15	10.1	0.32	
9:11:18	3.20	11.3	0.37	
9:11:55	3.25	11.9	0.42	
9:12:30	3.30	12.5	0.47	
9:13:05	3.35	13.1	0.52	
9:13:39	3.40	13.7	0.57	
9:14:11	3.45	14.2	0.62	
9:14:43	3.50	14.7	0.67	
9:15:14	3.55	15.2	0.72	
9:15:46	3.60	15.8	0.77	
9:16:16	3.65	16.3	0.82	
9:16:48	3.70	16.8	0.87	
9:17:19	3.75	17.3	0.92	
9:17:51	3.80	17.9	0.97	
9:18:23	3.85	18.4	1.02	
9:18:51	3.90	18.9	1.07	
9:19:22	3.95	19.4	1.12	
9:19:58	4.00	20.0	1.17	
9:20:29	4.05	20.5	1.22	
9:21:00	4.10	21.0	1.27	
9:21:34	4.15	21.6	1.32	
9:22:09	4.20	22.2	1.37	
9:22:42	4.25	22.7	1.42	
9:23:20	4.30	23.3	1.47	
9:23:56	4.35	23.9	1.52	
9:24:31	4.40	24.5	1.57	
9:25:10	4.45	25.2	1.62	
9:25:50	4.50	25.8	1.67	
9:26:30	4.55	26.5	1.72	
9:27:11	4.60	27.2	1.77	
9:27:52	4.65	27.9	1.82	
9:28:34	4.70	28.6	1.87	
9:29:19	4.75	29.3	1.92	
9:30:02	4.80	30.0	1.97	
9:30:48	4.85	30.8	2.02	

1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P2 @ 10m radius.

	Water Level	Time Elapsed (min)	Drawdown (m)	WL_i
9:31:35	4.90	31.6	2.07	
9:32:26	4.95	32.4	2.12	
9:33:18	5.00	33.3	2.17	
9:34:04	5.05	34.1	2.22	
9:34:56	5.10	34.9	2.27	
9:36:41	5.20	36.7	2.37	
9:37:31	5.30	37.5	2.47	
9:40:47	5.40	40.8	2.57	
9:42:51	5.50	42.9	2.67	
9:45:04	5.60	45.1	2.77	
9:48:45	5.75	48.8	2.92	
9:50:54	5.80	50.9	2.97	
9:52:32	5.90	52.5	3.07	
9:56:25	6.00	56.4	3.17	
9:58:15	6.10	58.3	3.27	
10:01:27	6.20	61.4	3.37	
10:04:43	6.30	64.7	3.47	
10:08:21	6.40	68.4	3.57	
10:12:56	6.50	72.9	3.67	
10:16:15	6.60	76.3	3.77	
10:20:55	6.70	80.9	3.87	
10:25:40	6.80	85.7	3.97	
10:31:00	6.90	91.0	4.07	
10:36:48	7.00	96.8	4.17	
10:42:48	7.10	102.8	4.27	
10:49:40	7.20	109.7	4.37	
10:56:26	7.30	116.4	4.47	
11:04:48	7.40	124.8	4.57	
11:13:36	7.50	133.6	4.67	
11:18:30	7.55	138.5	4.72	
11:19:20	7.56	139.3	4.73	
11:20:26	7.57	140.4	4.74	
11:21:33	7.58	141.6	4.75	
11:23:19	7.60	143.3	4.77	
11:24:32	7.61	144.5	4.78	
11:25:46	7.62	145.8	4.79	
11:26:53	7.63	146.9	4.80	
11:27:47	7.64	147.8	4.81	
11:28:45	7.65	148.8	4.82	
11:30:52	7.67	150.9	4.84	
11:32:06	7.68	152.1	4.85	
11:33:09	7.69	153.2	4.86	
11:34:15	7.70	154.3	4.87	
11:35:21	7.71	155.4	4.88	
11:38:41	7.74	158.7	4.91	
11:39:44	7.75	159.7	4.92	
11:40:49	7.76	160.8	4.93	
11:43:58	7.78	164.0	4.95	
11:45:08	7.80	165.1	4.97	
11:47:14	7.82	167.2	4.99	
11:48:30	7.84	168.5	5.01	
11:51:42	7.86	171.7	5.03	

1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P2 @ 10m radius.

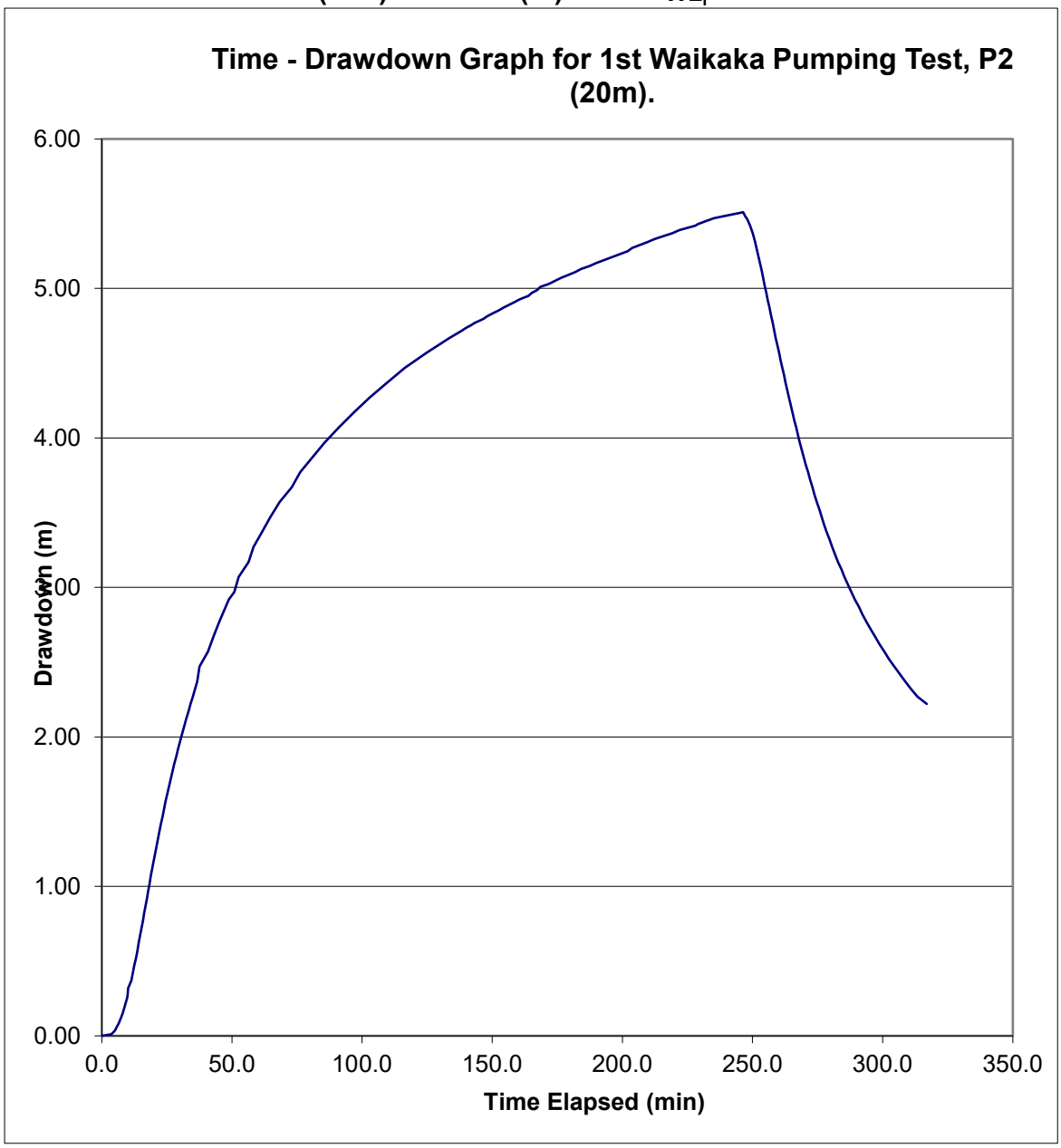
	Water Level	Time Elapsed (min)	Drawdown (m)	WL_i
11:53:58	7.88	174.0	5.05	
11:56:22	7.90	176.4	5.07	
11:59:11	7.92	179.2	5.09	
12:01:50	7.94	181.8	5.11	
12:04:12	7.96	184.2	5.13	
12:07:24	7.98	187.4	5.15	
12:09:50	8.00	189.8	5.17	
12:21:59	8.08	202.0	5.25	
12:23:44	8.10	203.7	5.27	
12:26:38	8.12	206.6	5.29	
12:29:27	8.14	209.5	5.31	
12:32:24	8.16	212.4	5.33	
12:35:43	8.18	215.7	5.35	
12:39:09	8.20	219.2	5.37	
12:41:58	8.22	222.0	5.39	
12:47:57	8.25	228.0	5.42	
12:48:52	8.26	228.9	5.43	
12:52:05	8.28	232.1	5.45	
12:55:14	8.30	235.2	5.47	
13:06:20	8.34	246.3	5.51	
13:07:18	8.31	247.3	5.48	
13:07:40	8.30	247.7	5.47	
13:08:16	8.28	248.3	5.45	
13:09:03	8.25	249.1	5.42	
13:10:04	8.20	250.1	5.37	
13:10:53	8.15	250.9	5.32	
13:11:33	8.10	251.6	5.27	
13:12:14	8.05	252.2	5.22	
13:12:49	8.00	252.8	5.17	
13:13:28	7.95	253.5	5.12	
13:14:05	7.90	254.1	5.07	
13:14:41	7.85	254.7	5.02	
13:15:19	7.80	255.3	4.97	
13:15:54	7.75	255.9	4.92	
13:16:29	7.70	256.5	4.87	
13:17:05	7.65	257.1	4.82	
13:17:42	7.60	257.7	4.77	
13:18:18	7.55	258.3	4.72	
13:18:55	7.50	258.9	4.67	
13:19:33	7.45	259.6	4.62	
13:20:09	7.40	260.2	4.57	
13:20:46	7.35	260.8	4.52	
13:21:25	7.30	261.4	4.47	
13:22:03	7.25	262.1	4.42	
13:22:42	7.20	262.7	4.37	
13:23:21	7.15	263.4	4.32	
13:24:00	7.10	264.0	4.27	
13:24:38	7.05	264.6	4.22	
13:25:18	7.00	265.3	4.17	
13:26:02	6.95	266.0	4.12	
13:26:44	6.90	266.7	4.07	
13:27:26	6.85	267.4	4.02	

1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P2 @ 10m radius.

	Water Level	Time Elapsed (min)	Drawdown (m)	WL_i
13:28:10	6.80	268.2	3.97	
13:28:55	6.75	268.9	3.92	
13:29:41	6.70	269.7	3.87	
13:30:30	6.65	270.5	3.82	
13:31:18	6.60	271.3	3.77	
13:32:10	6.55	272.2	3.72	
13:33:00	6.50	273.0	3.67	
13:33:51	6.45	273.9	3.62	
13:34:44	6.40	274.7	3.57	
13:35:39	6.35	275.7	3.52	
13:36:35	6.30	276.6	3.47	
13:37:31	6.25	277.5	3.42	
13:38:32	6.20	278.5	3.37	
13:39:35	6.15	279.6	3.32	
13:40:37	6.10	280.6	3.27	
13:41:45	6.05	281.8	3.22	
13:42:52	6.00	282.9	3.17	
13:44:07	5.95	284.1	3.12	
13:45:19	5.90	285.3	3.07	
13:46:38	5.85	286.6	3.02	
13:47:59	5.80	288.0	2.97	
13:49:19	5.75	289.3	2.92	
13:50:49	5.70	290.8	2.87	
13:52:12	5.65	292.2	2.82	
13:53:45	5.60	293.8	2.77	
13:55:27	5.55	295.5	2.72	
13:57:04	5.50	297.1	2.67	
13:58:46	5.45	298.8	2.62	
14:00:40	5.40	300.7	2.57	
14:02:29	5.35	302.5	2.52	
14:04:28	5.30	304.5	2.47	
14:06:32	5.25	306.5	2.42	
14:08:43	5.20	308.7	2.37	
14:10:57	5.15	311.0	2.32	
14:13:24	5.10	313.4	2.27	
14:16:55	5.05	316.9	2.22	

1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P2 @ 10m radius.

Water Level	Time Elapsed (min)	Drawdown (m)
WL_i		



1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P3 @ 40m radius.

	Water Level (m BGL)	Time Elapsed (min)	Drawdown (m)	WL_i
9:00:00	3.86	0.0	0.02	3.84 m BGL
9:07:20	3.84	7.3	0.00	
9:10:30	3.86	10.5	0.02	
9:11:30	3.88	11.5	0.04	
9:12:20	3.90	12.3	0.06	
9:12:57	3.92	12.9	0.08	
9:13:39	3.94	13.7	0.10	
9:14:18	3.96	14.3	0.12	
9:14:51	3.98	14.9	0.14	
9:15:31	4.00	15.5	0.16	
9:16:00	4.02	16.0	0.18	
9:16:30	4.04	16.5	0.20	
9:17:08	4.06	17.1	0.22	
9:17:35	4.08	17.6	0.24	
9:18:04	4.10	18.1	0.26	
9:18:33	4.12	18.5	0.28	
9:19:00	4.14	19.0	0.30	
9:19:32	4.16	19.5	0.32	
9:20:03	4.18	20.1	0.34	
9:20:30	4.20	20.5	0.36	
9:20:58	4.22	21.0	0.38	
9:21:28	4.24	21.5	0.40	
9:21:56	4.26	21.9	0.42	
9:22:28	4.28	22.5	0.44	
9:23:00	4.30	23.0	0.46	
9:23:30	4.32	23.5	0.48	
9:24:02	4.34	24.0	0.50	
9:24:35	4.36	24.6	0.52	
9:25:09	4.38	25.2	0.54	
9:25:39	4.40	25.7	0.56	
9:26:11	4.42	26.2	0.58	
9:26:45	4.44	26.7	0.60	
9:27:20	4.46	27.3	0.62	
9:27:52	4.48	27.9	0.64	
9:28:31	4.50	28.5	0.66	
9:29:05	4.52	29.1	0.68	
9:29:41	4.54	29.7	0.70	
9:30:19	4.56	30.3	0.72	
9:30:55	4.58	30.9	0.74	
9:31:30	4.60	31.5	0.76	
9:32:15	4.62	32.3	0.78	
9:33:50	4.64	33.8	0.80	
9:33:30	4.66	33.5	0.82	
9:34:11	4.68	34.2	0.84	
9:34:52	4.70	34.9	0.86	
9:35:32	4.72	35.5	0.88	
9:36:15	4.74	36.3	0.90	
9:36:56	4.76	36.9	0.92	
9:37:40	4.78	37.7	0.94	
9:38:22	4.80	38.4	0.96	
9:39:09	4.82	39.2	0.98	
9:39:51	4.84	39.9	1.00	

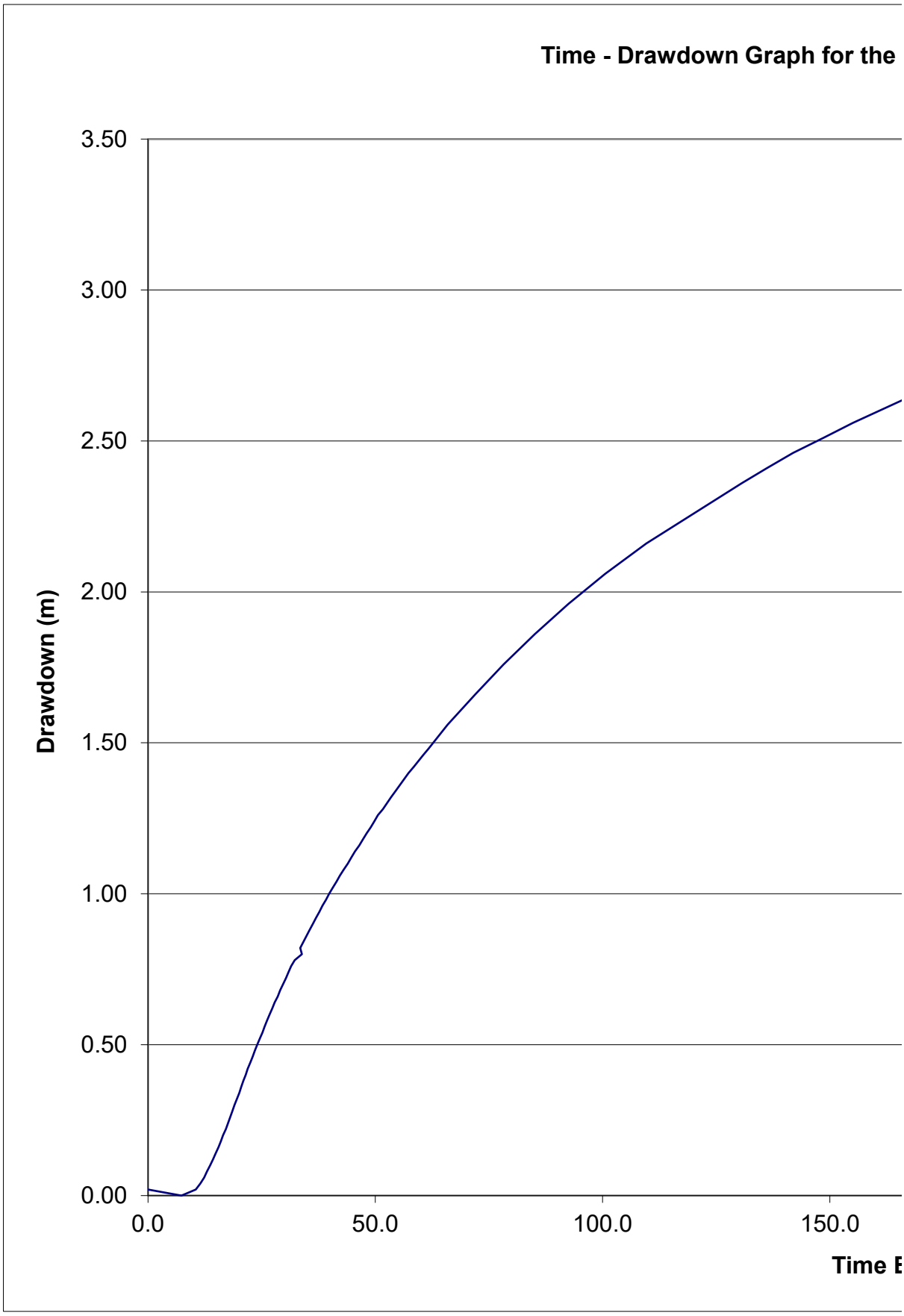
1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P3 @ 40m radius.

9:40:39	4.86	40.7	1.02
9:41:29	4.88	41.5	1.04
9:42:12	4.90	42.2	1.06
9:43:03	4.92	43.0	1.08
9:43:55	4.94	43.9	1.10
9:44:43	4.96	44.7	1.12
9:45:31	4.98	45.5	1.14
9:46:28	5.00	46.5	1.16
9:47:14	5.02	47.2	1.18
9:48:05	5.04	48.1	1.20
9:49:00	5.06	49.0	1.22
9:49:48	5.08	49.8	1.24
9:50:35	5.10	50.6	1.26
9:51:40	5.12	51.7	1.28
9:52:33	5.14	52.6	1.30
9:53:28	5.16	53.5	1.32
9:54:26	5.18	54.4	1.34
9:55:23	5.20	55.4	1.36
9:56:22	5.22	56.4	1.38
9:57:19	5.24	57.3	1.40
9:58:26	5.26	58.4	1.42
9:59:29	5.28	59.5	1.44
10:00:33	5.30	60.6	1.46
10:01:39	5.32	61.7	1.48
10:05:56	5.40	65.9	1.56
10:11:57	5.50	72.0	1.66
10:18:12	5.60	78.2	1.76
10:25:05	5.70	85.1	1.86
10:32:27	5.80	92.5	1.96
10:40:35	5.90	100.6	2.06
10:49:35	6.00	109.6	2.16
11:10:36	6.20	130.6	2.36
11:16:05	6.25	136.1	2.41
11:21:54	6.30	141.9	2.46
11:28:35	6.35	148.6	2.51
11:35:05	6.40	155.1	2.56
11:42:17	6.45	162.3	2.61
11:49:30	6.50	169.5	2.66
11:57:40	6.55	177.7	2.71
12:04:55	6.60	184.9	2.76
12:13:20	6.65	193.3	2.81
12:22:10	6.70	202.2	2.86
12:31:12	6.75	211.2	2.91
12:40:17	6.80	220.3	2.96
12:50:26	6.85	230.4	3.01
13:00:10	6.90	240.2	3.06
13:10:00	6.92	250.0	3.08
13:11:45	6.90	251.8	3.06
13:12:50	6.88	252.8	3.04
13:13:49	6.86	253.8	3.02
13:14:48	6.84	254.8	3.00
13:15:37	6.82	255.6	2.98
13:16:27	6.80	256.5	2.96
13:17:20	6.78	257.3	2.94
13:18:09	6.76	258.2	2.92
13:18:56	6.74	258.9	2.90

1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P3 @ 40m radius.

13:19:37	6.72	259.6	2.88
13:20:25	6.70	260.4	2.86
13:21:07	6.68	261.1	2.84
13:21:49	6.66	261.8	2.82
13:22:32	6.64	262.5	2.80
13:23:17	6.62	263.3	2.78
13:24:00	6.60	264.0	2.76
13:24:51	6.58	264.9	2.74
13:25:30	6.56	265.5	2.72
13:26:13	6.54	266.2	2.70
13:27:02	6.52	267.0	2.68
13:27:48	6.50	267.8	2.66
13:28:32	6.48	268.5	2.64
13:29:18	6.46	269.3	2.62
13:30:05	6.44	270.1	2.60
13:30:50	6.42	270.8	2.58
13:31:37	6.40	271.6	2.56
13:32:22	6.38	272.4	2.54
13:33:05	6.36	273.1	2.52
13:34:00	6.34	274.0	2.50
13:34:45	6.32	274.8	2.48
13:39:55	6.20	279.9	2.36
13:44:40	6.10	284.7	2.26
13:49:43	6.00	289.7	2.16
13:55:26	5.90	295.4	2.06
14:01:34	5.80	301.6	1.96
14:16:28	5.60	316.5	1.76

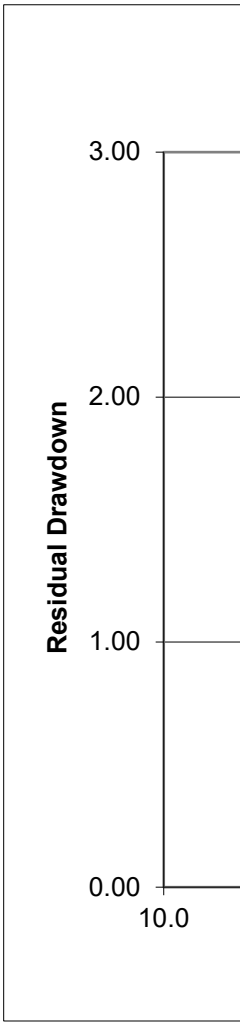
1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P3 @ 40m radius.



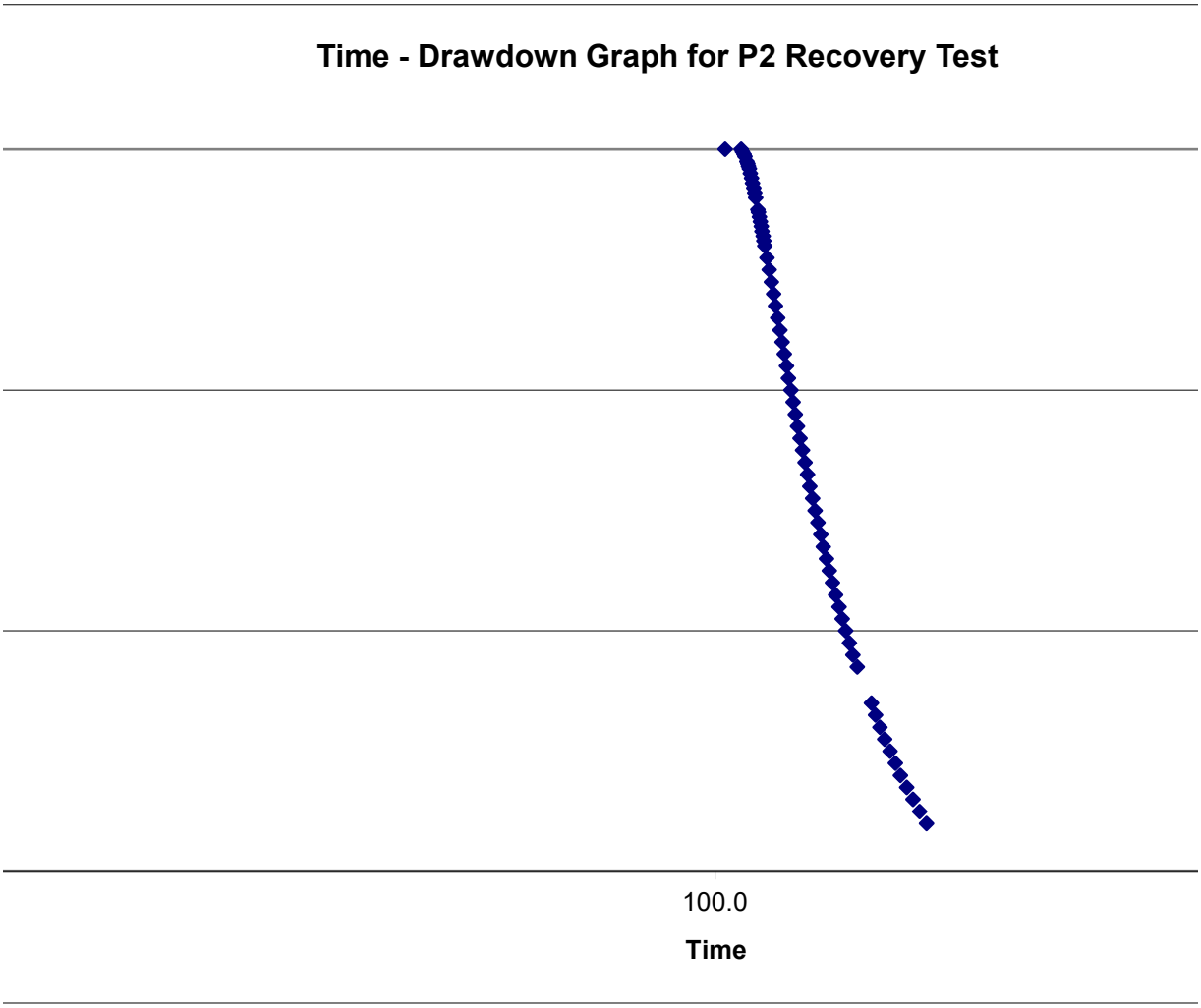
1st Pumping Test at Waikaka, drill hole WK160.
Piezometer P3 @ 40m radius.

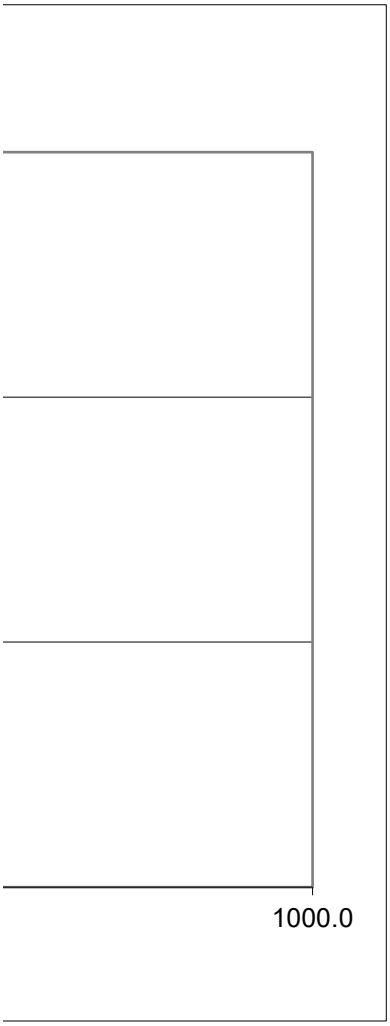

1st Test at Waikaka, P3 (40m)
200.0
250.0
300.0
350.0
Elapsed (min)

0:00:00	Depth-water	tr (min)	t		t + t_r		Drawdown
0:03:00	7.2		3.0	100		103.0	3.00
0:04:00	7.22		4.0	WL_i		104.0	3.02
0:05:00	7.225		5.0	4.2		105.0	3.03
0:06:12	7.22		6.2			106.2	3.02
0:07:13	7.21		7.2			107.2	3.01
0:07:59	7.2		8.0			108.0	3.00
0:08:25	7.19		8.4			108.4	2.99
0:08:52	7.18		8.9			108.9	2.98
0:09:11	7.17		9.2			109.2	2.97
0:09:45	7.15		9.8			109.8	2.95
0:10:04	7.14		10.1			110.1	2.94
0:10:18	7.13		10.3			110.3	2.93
0:10:34	7.12		10.6			110.6	2.92
0:10:56	7.1		10.9			110.9	2.90
0:11:17	7.08		11.3			111.3	2.88
0:11:41	7.06		11.7			111.7	2.86
0:12:00	7.04		12.0			112.0	2.84
0:12:21	7.02		12.4			112.4	2.82
0:12:39	7		12.7			112.7	2.80
0:13:21	6.95		13.4			113.4	2.75
0:13:37	6.94		13.6			113.6	2.74
0:13:55	6.92		13.9			113.9	2.72
0:14:12	6.9		14.2			114.2	2.70
0:14:32	6.88		14.5			114.5	2.68
0:14:49	6.86		14.8			114.8	2.66
0:15:09	6.84		15.2			115.2	2.64
0:15:27	6.82		15.5			115.5	2.62
0:15:45	6.8		15.8			115.8	2.60
0:16:32	6.75		16.5			116.5	2.55
0:17:12	6.7		17.2			117.2	2.50
0:18:00	6.65		18.0			118.0	2.45
0:18:44	6.6		18.7			118.7	2.40
0:19:27	6.55		19.5			119.5	2.35
0:20:12	6.5		20.2			120.2	2.30
0:21:00	6.45		21.0			121.0	2.25
0:21:45	6.4		21.8			121.8	2.20
0:22:32	6.35		22.5			122.5	2.15
0:23:20	6.3		23.3			123.3	2.10
0:24:04	6.25		24.1			124.1	2.05
0:24:56	6.2		24.9			124.9	2.00
0:25:48	6.15		25.8			125.8	1.95
0:26:36	6.1		26.6			126.6	1.90
0:27:27	6.05		27.5			127.5	1.85
0:28:18	6		28.3			128.3	1.80
0:29:15	5.95		29.3			129.3	1.75
0:30:12	5.9		30.2			130.2	1.70
0:31:10	5.85		31.2			131.2	1.65
0:32:07	5.8		32.1			132.1	1.60
0:33:10	5.75		33.2			133.2	1.55
0:34:09	5.7		34.2			134.2	1.50
0:35:14	5.65		35.2			135.2	1.45
0:36:21	5.6		36.4			136.4	1.40
0:37:28	5.55		37.5			137.5	1.35
0:38:38	5.5		38.6			138.6	1.30



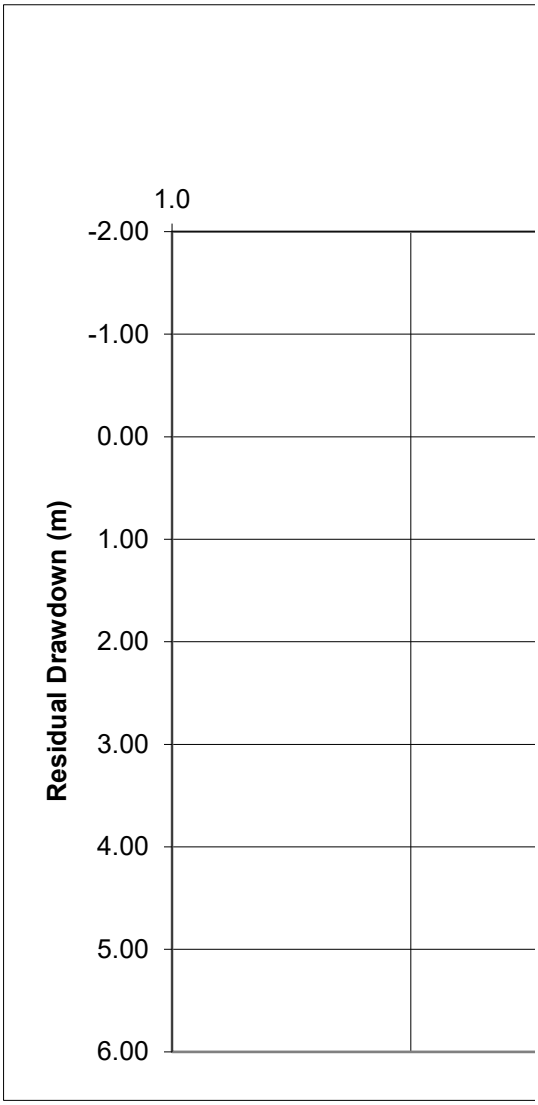
0:39:54	5.45	39.9	139.9	1.25
0:41:10	5.4	41.2	141.2	1.20
0:42:30	5.35	42.5	142.5	1.15
0:43:51	5.3	43.9	143.9	1.10
0:45:18	5.25	45.3	145.3	1.05
0:46:46	5.2	46.8	146.8	1.00
0:48:25	5.15	48.4	148.4	0.95
0:49:55	5.1	49.9	149.9	0.90
0:51:51	5.05	51.9	151.9	0.85
0:58:18	4.9	58.3	158.3	0.70
1:00:13	4.85	60.2	160.2	0.65
1:02:18	4.8	62.3	162.3	0.60
1:04:35	4.75	64.6	164.6	0.55
1:07:05	4.7	67.1	167.1	0.50
1:09:43	4.65	69.7	169.7	0.45
1:12:23	4.6	72.4	172.4	0.40
1:15:30	4.55	75.5	175.5	0.35
1:18:44	4.5	78.7	178.7	0.30
1:22:16	4.45	82.3	182.3	0.25
1:25:58	4.4	86.0	186.0	0.20


Time - Drawdown Graph for P2 Recovery Test
100.0
Time


1000.0

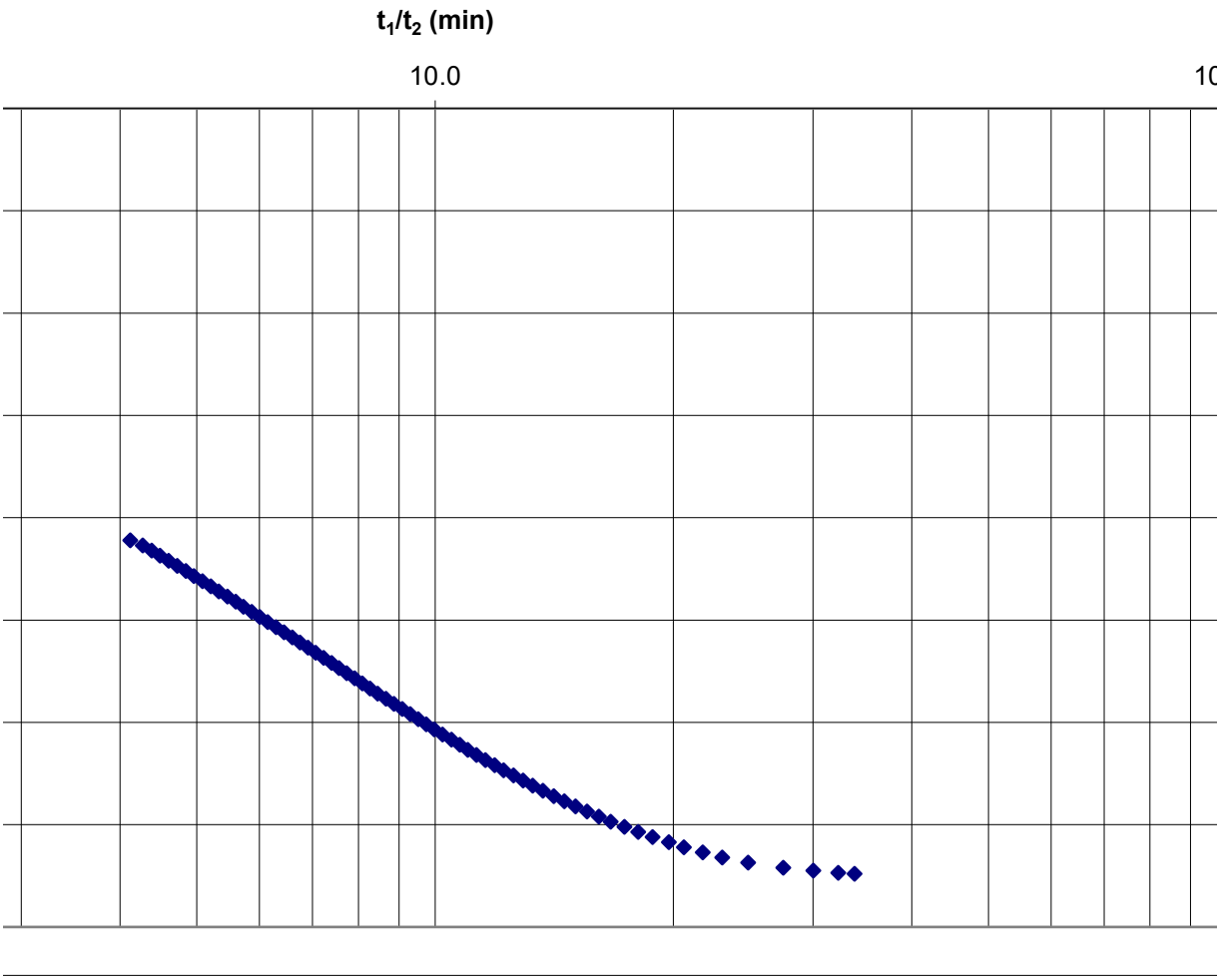
0:03:00
0:04:00
0:05:00

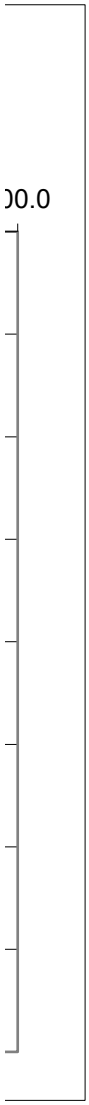
t_1	t_2	t_1/t_2 (min)	Residual Drawdown
240	0.00		5.51
247.3	7.30	33.9	5.48
247.7	7.67	32.3	5.47
248.3	8.27	30.0	5.45
249.1	9.05	27.5	5.42
250.1	10.07	24.8	5.37
250.9	10.88	23.1	5.32
251.6	11.55	21.8	5.27
252.2	12.23	20.6	5.22
252.8	12.82	19.7	5.17
253.5	13.47	18.8	5.12
254.1	14.08	18.0	5.07
254.7	14.68	17.3	5.02
255.3	15.32	16.7	4.97
255.9	15.90	16.1	4.92
256.5	16.48	15.6	4.87
257.1	17.08	15.0	4.82
257.7	17.70	14.6	4.77
258.3	18.30	14.1	4.72
258.9	18.92	13.7	4.67
259.6	19.55	13.3	4.62
260.2	20.15	12.9	4.57
260.8	20.77	12.6	4.52
261.4	21.42	12.2	4.47
262.1	22.05	11.9	4.42
262.7	22.70	11.6	4.37
263.4	23.35	11.3	4.32
264.0	24.00	11.0	4.27
264.6	24.63	10.7	4.22
265.3	25.30	10.5	4.17
266.0	26.03	10.2	4.12
266.7	26.73	10.0	4.07
267.4	27.43	9.7	4.02
268.2	28.17	9.5	3.97
268.9	28.92	9.3	3.92
269.7	29.68	9.1	3.87
270.5	30.50	8.9	3.82
271.3	31.30	8.7	3.77
272.2	32.17	8.5	3.72
273.0	33.00	8.3	3.67
273.9	33.85	8.1	3.62
274.7	34.73	7.9	3.57
275.7	35.65	7.7	3.52
276.6	36.58	7.6	3.47
277.5	37.52	7.4	3.42
278.5	38.53	7.2	3.37
279.6	39.58	7.1	3.32
280.6	40.62	6.9	3.27
281.8	41.75	6.7	3.22
282.9	42.87	6.6	3.17
284.1	44.12	6.4	3.12
285.3	45.32	6.3	3.07
286.6	46.63	6.1	3.02
288.0	47.98	6.0	2.97
289.3	49.32	5.9	2.92



290.8	50.82	5.7	2.87
292.2	52.20	5.6	2.82
293.8	53.75	5.5	2.77
295.5	55.45	5.3	2.72
297.1	57.07	5.2	2.67
298.8	58.77	5.1	2.62
300.7	60.67	5.0	2.57
302.5	62.48	4.8	2.52
304.5	64.47	4.7	2.47
306.5	66.53	4.6	2.42
308.7	68.72	4.5	2.37
311.0	70.95	4.4	2.32
313.4	73.40	4.3	2.27
316.9	76.92	4.1	2.22

Graph of Residual (Recovery) Drawdown.

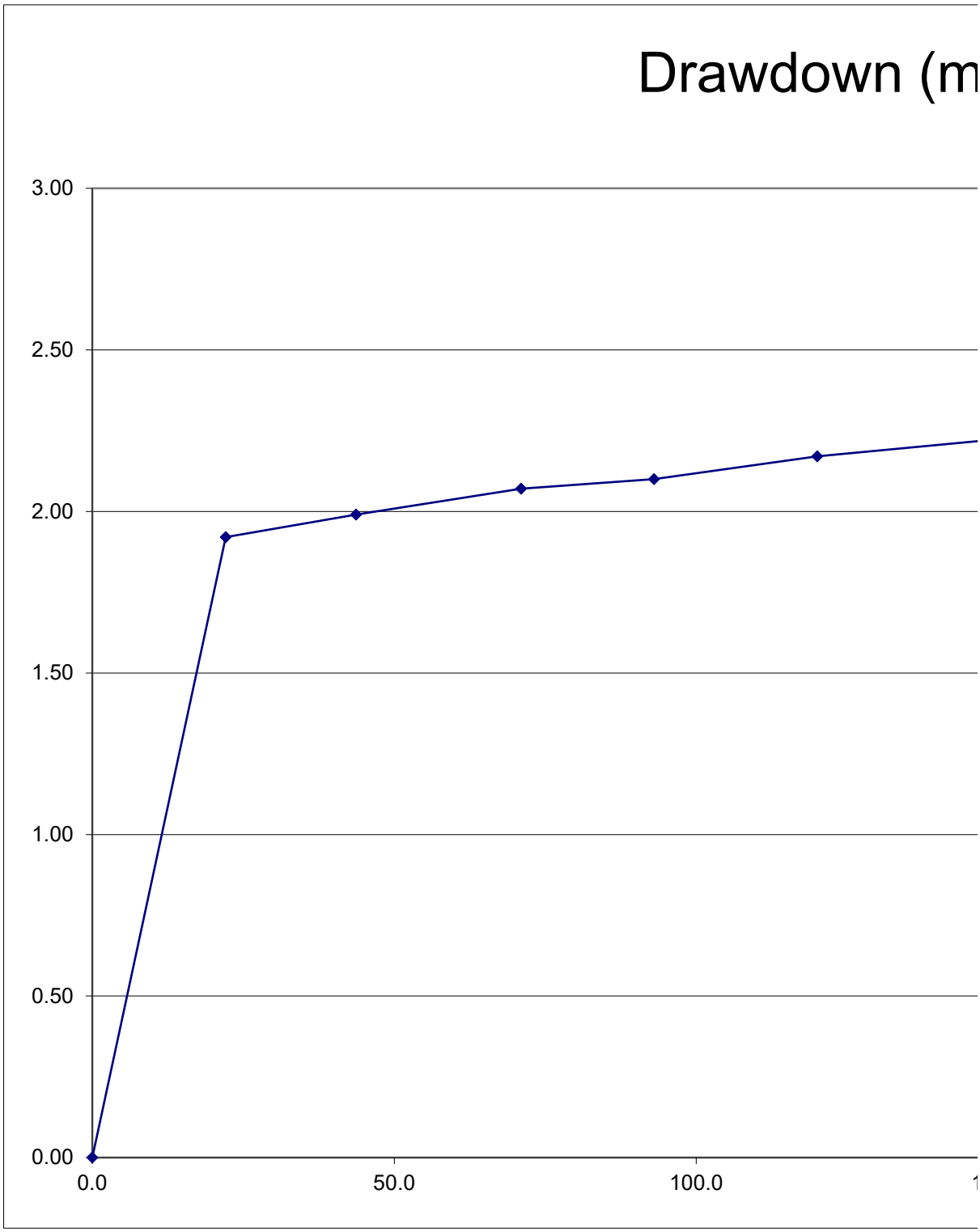



00.0

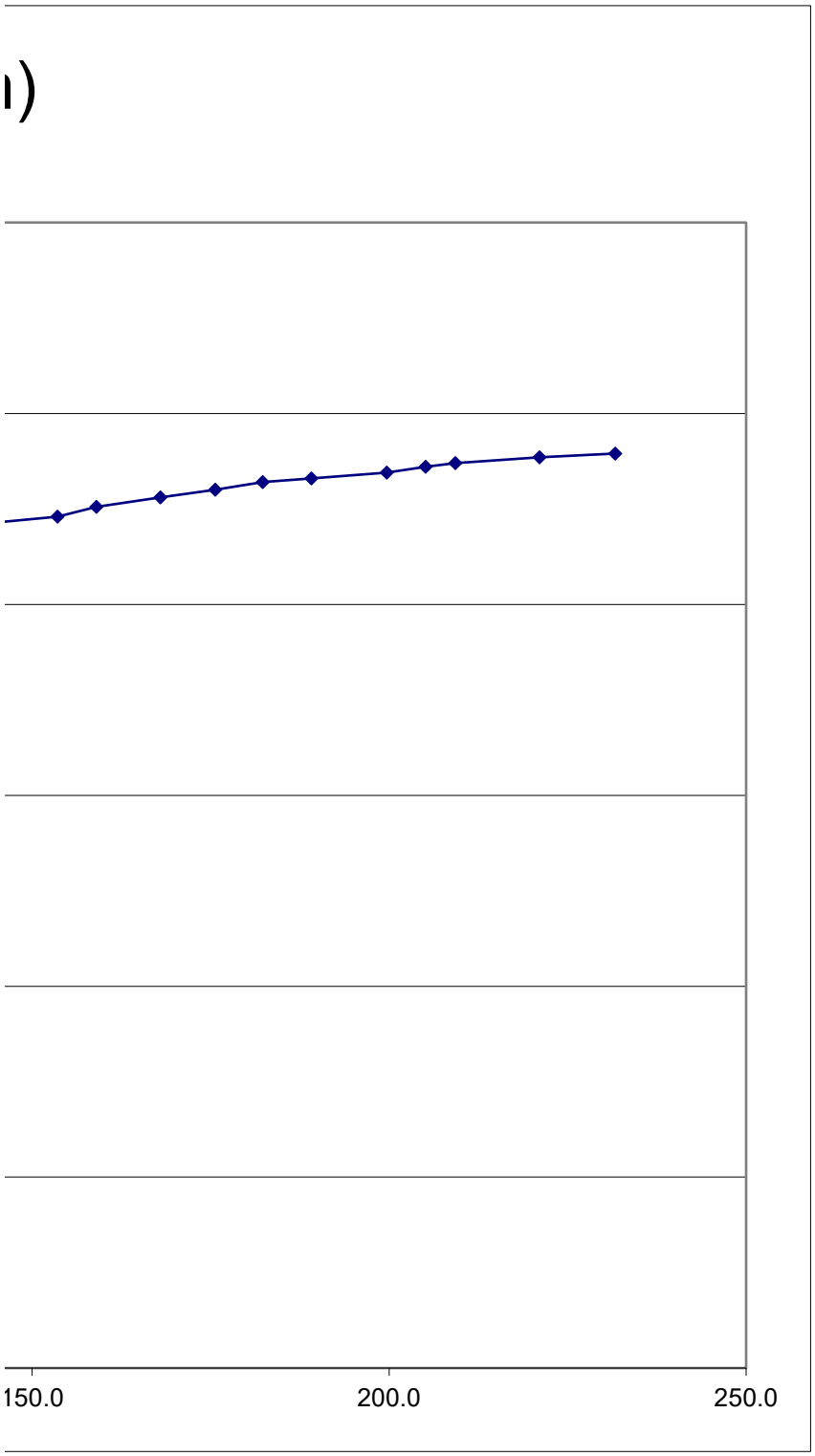
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q1 @ 10 m radius.

			Time Elapsed (min)	**Drawdown (m)**	WL_i	lengthpole
10:30:00						
10:30:00		0.08	0.0	0.00	0.08	1.35
10:52:05	0.65	2.00	22.1	1.92		
11:13:40	0.72	2.07	43.7	1.99		
11:41:00	0.80	2.15	71.0	2.07		
12:03:00	0.83	2.18	93.0	2.10		
12:30:00	0.90	2.25	120.0	2.17		
13:03:34	0.96	2.31	153.6	2.23		
13:09:00	0.99	2.34	159.0	2.26		
13:17:58	1.01	2.36	168.0	2.28		
13:25:38	1.03	2.38	175.6	2.30		
13:32:17	1.05	2.40	182.3	2.32		
13:39:06	1.06	2.41	189.1	2.33		
13:49:40	1.08	2.43	199.7	2.35		
13:55:06	1.09	2.44	205.1	2.36		
13:59:17	1.10	2.45	209.3	2.37		
14:11:03	1.12	2.47	221.1	2.39		
14:21:40	1.13	2.48	231.7	2.40	2.395	

2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q1 @ 10 m radius.



2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q1 @ 10 m radius.



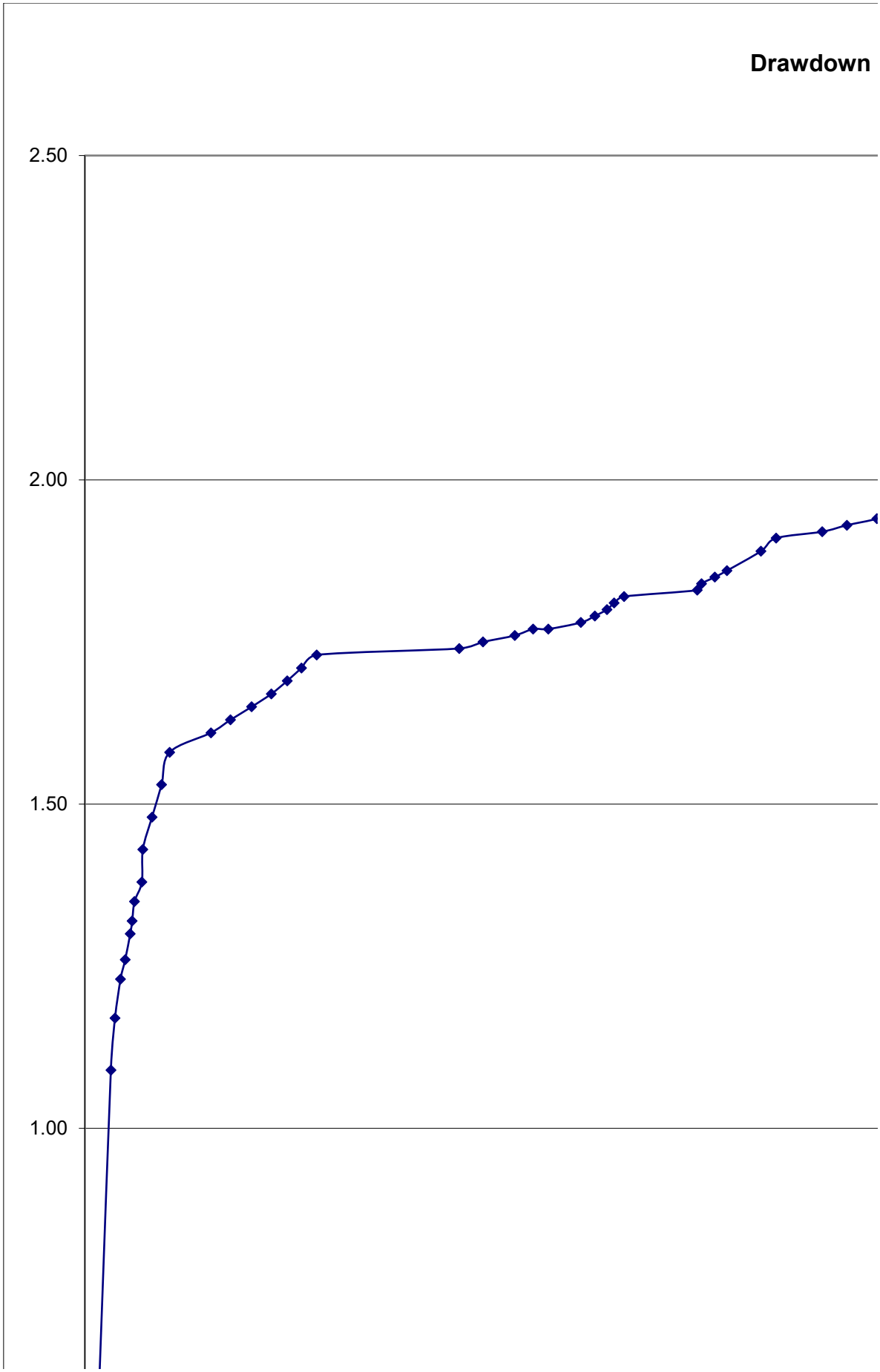
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q2 @ 20 m radius.

			Time Elapsed (min)	**Drawdown (m)**	WL_i	polelength
10:30:00	tookoutpole					
10:30:00		0.77	0.0	0.00	0.77	2.03
10:35:57		1.86	6.0	1.09		
10:36:54		1.94	6.9	1.17		
10:38:10		2.00	8.2	1.23		
10:39:13		2.03	9.2	1.26		
10:40:23		2.07	10.4	1.30		
10:40:50		2.09	10.8	1.32		
10:41:22		2.12	11.4	1.35		
10:43:03		2.15	13.1	1.38		
10:43:16		2.20	13.3	1.43		
10:45:22		2.25	15.4	1.48		
10:47:33		2.30	17.6	1.53		
10:49:23		2.35	19.4	1.58		
10:58:50		2.38	28.8	1.61		
11:03:20		2.40	33.3	1.63		
11:08:09		2.42	38.2	1.65		
11:12:40		2.44	42.7	1.67		
11:16:17		2.46	46.3	1.69		
11:19:35		2.48	49.6	1.71		
11:23:02		2.50	53.0	1.73		
11:55:40		2.51	85.7	1.74		
12:01:05		2.52	91.1	1.75		
12:08:21		2.53	98.4	1.76		
12:12:34		2.54	102.6	1.77		
12:16:00	0.51	2.54	106.0	1.77		
12:23:28	0.52	2.55	113.5	1.78		
12:26:40	0.53	2.56	116.7	1.79		
12:29:26	0.54	2.57	119.4	1.80		
12:31:03	0.55	2.58	121.1	1.81		
12:33:20	0.56	2.59	123.3	1.82		
12:50:06	0.57	2.60	140.1	1.83		
12:51:06	0.58	2.61	141.1	1.84		
12:54:07	0.59	2.62	144.1	1.85		
12:56:54	0.60	2.63	146.9	1.86		
13:04:40	0.63	2.66	154.7	1.89		
13:08:08	0.65	2.68	158.1	1.91		
13:18:40	0.66	2.69	168.7	1.92		
13:24:19	0.67	2.70	174.3	1.93		
13:31:12	0.68	2.71	181.2	1.94		
13:34:22	0.69	2.72	184.4	1.95		
13:38:10	0.70	2.73	188.2	1.96		
13:48:22	0.71	2.74	198.4	1.97		
13:54:03	0.72	2.75	204.1	1.98		
13:58:12	0.73	2.76	208.2	1.99		
14:01:50	0.74	2.77	211.8	2.00		
14:10:58	0.75	2.78	221.0	2.01		
14:30:00	0.76	2.79	240.0	2.02	2.02	
14:33:52		2.73	243.9	1.96		
14:34:50		2.71	244.8	1.94		
14:35:09		2.70	245.2	1.93		
14:37:40		2.68	247.7	1.91		
14:38:45		2.66	248.8	1.89		

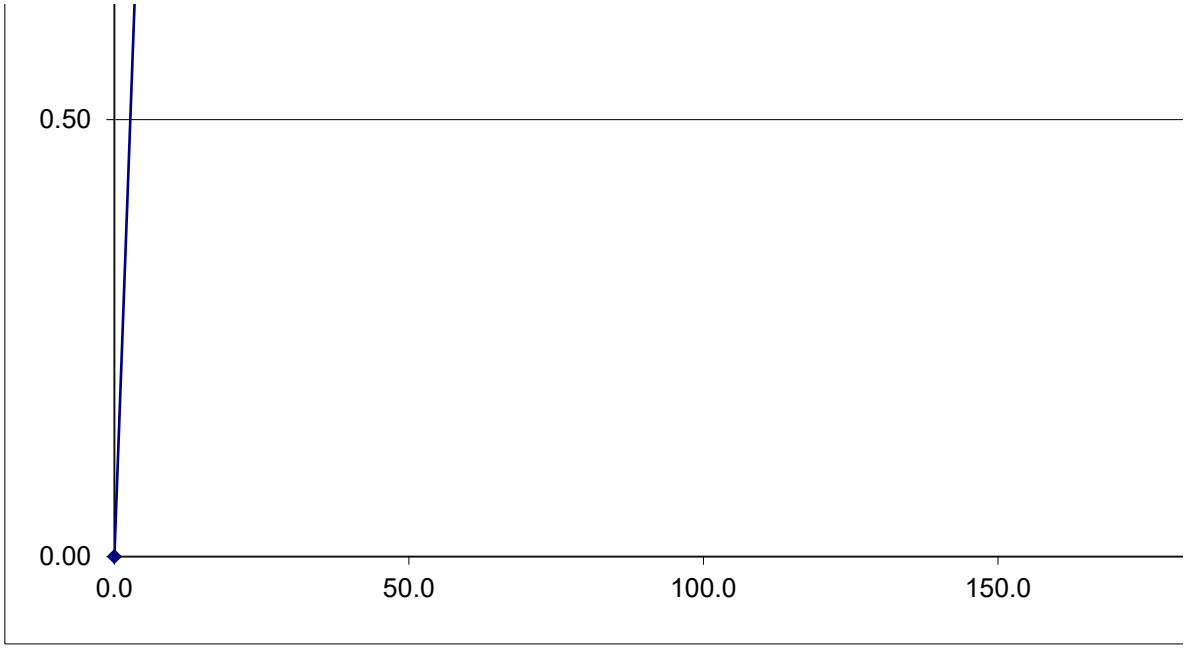
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q2 @ 20 m radius.

14:39:30	2.64	249.5	1.87
14:41:15	2.62	251.3	1.85
14:42:41	2.60	252.7	1.83
14:44:20	2.58	254.3	1.81
14:45:19	2.56	255.3	1.79
14:46:47	2.54	256.8	1.77
14:48:00	2.52	258.0	1.75
14:49:46	2.50	259.8	1.73
14:51:11	2.48	261.2	1.71
14:52:07	2.46	262.1	1.69
14:53:28	2.44	263.5	1.67
14:55:00	2.42	265.0	1.65
14:56:30	2.40	266.5	1.63
14:57:45	2.38	267.8	1.61
14:59:03	2.36	269.1	1.59
15:00:42	2.34	270.7	1.57
15:02:17	2.32	272.3	1.55
15:03:56	2.30	273.9	1.53
15:05:36	2.28	275.6	1.51
15:07:13	2.26	277.2	1.49
15:08:41	2.24	278.7	1.47
15:10:10	2.22	280.2	1.45
15:11:57	2.20	282.0	1.43
15:14:36	2.18	284.6	1.41
15:16:36	2.16	286.6	1.39
15:18:26	2.14	288.4	1.37
15:19:59	2.12	290.0	1.35
15:21:35	2.10	291.6	1.33
15:23:04	2.08	293.1	1.31
15:24:19	2.06	294.3	1.29
15:25:52	2.04	295.9	1.27
15:27:39	2.02	297.7	1.25
15:29:13	2.00	299.2	1.23
15:31:12	1.98	301.2	1.21
15:33:11	1.96	303.2	1.19
15:34:40	1.94	304.7	1.17

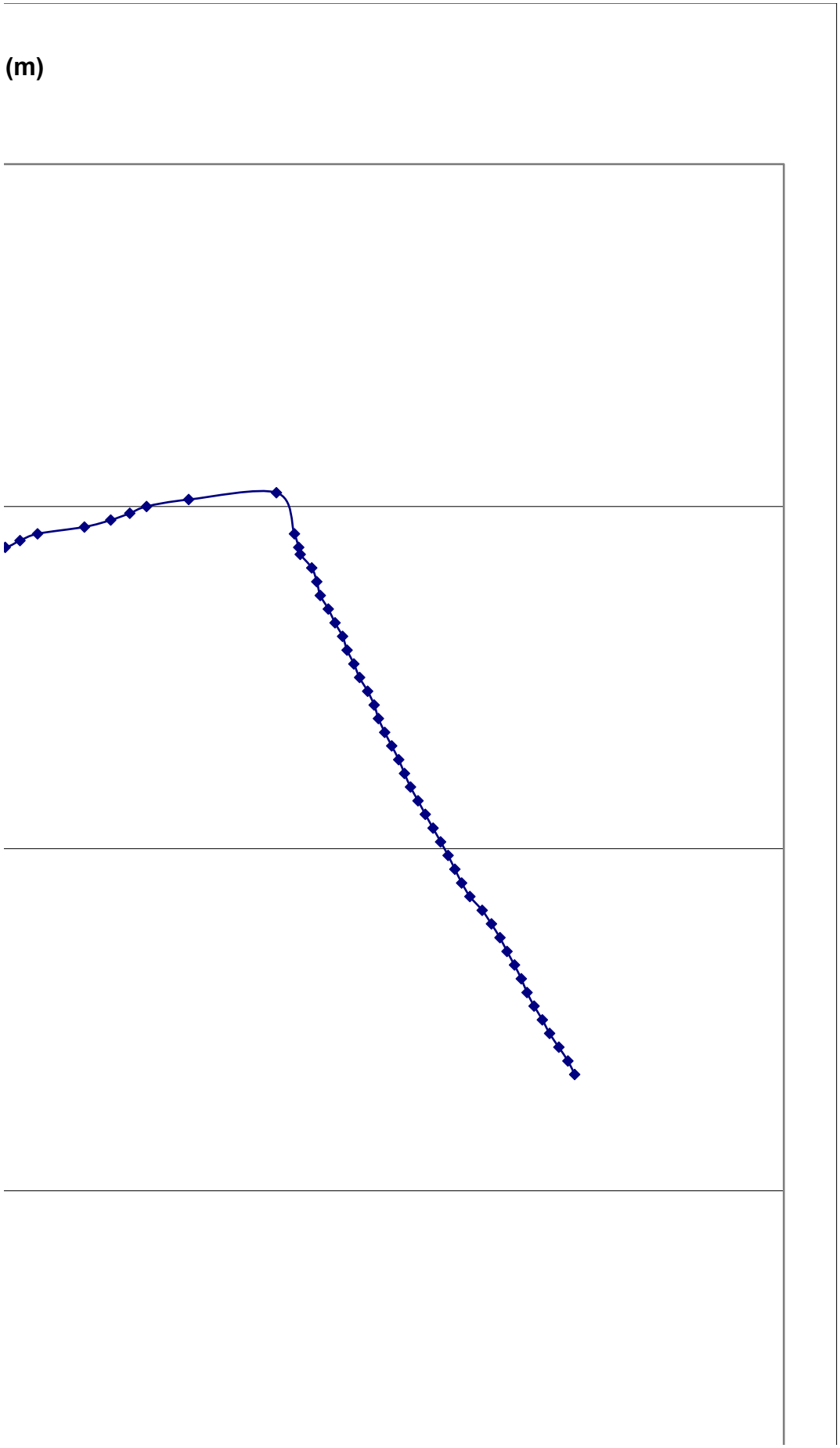
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q2 @ 20 m radius.



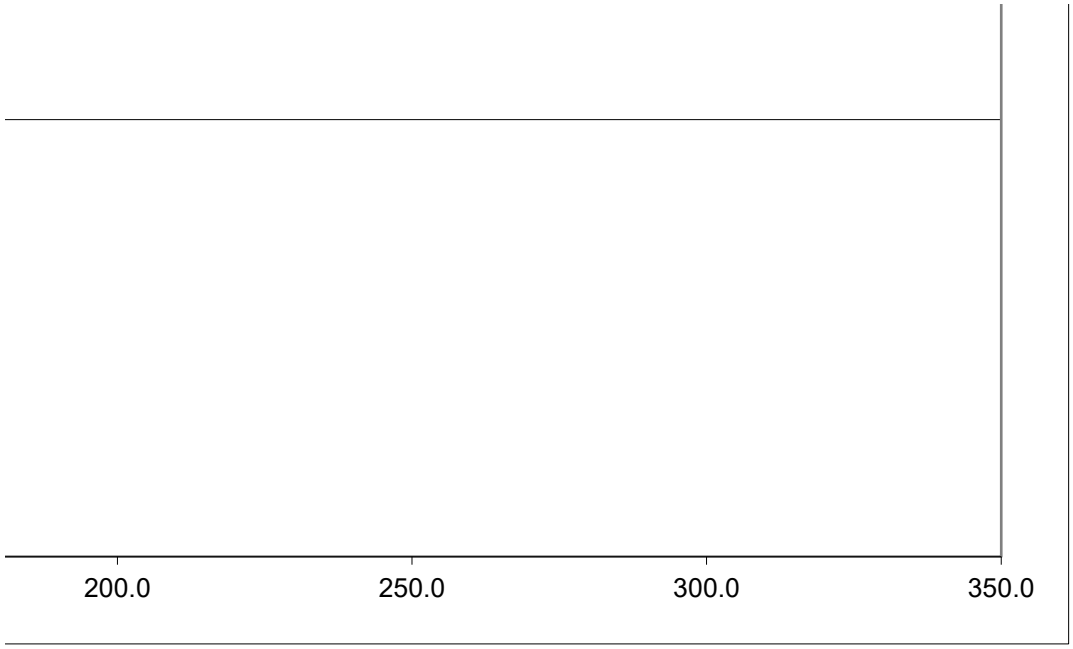
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q2 @ 20 m radius.



2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q2 @ 20 m radius.



2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q2 @ 20 m radius.



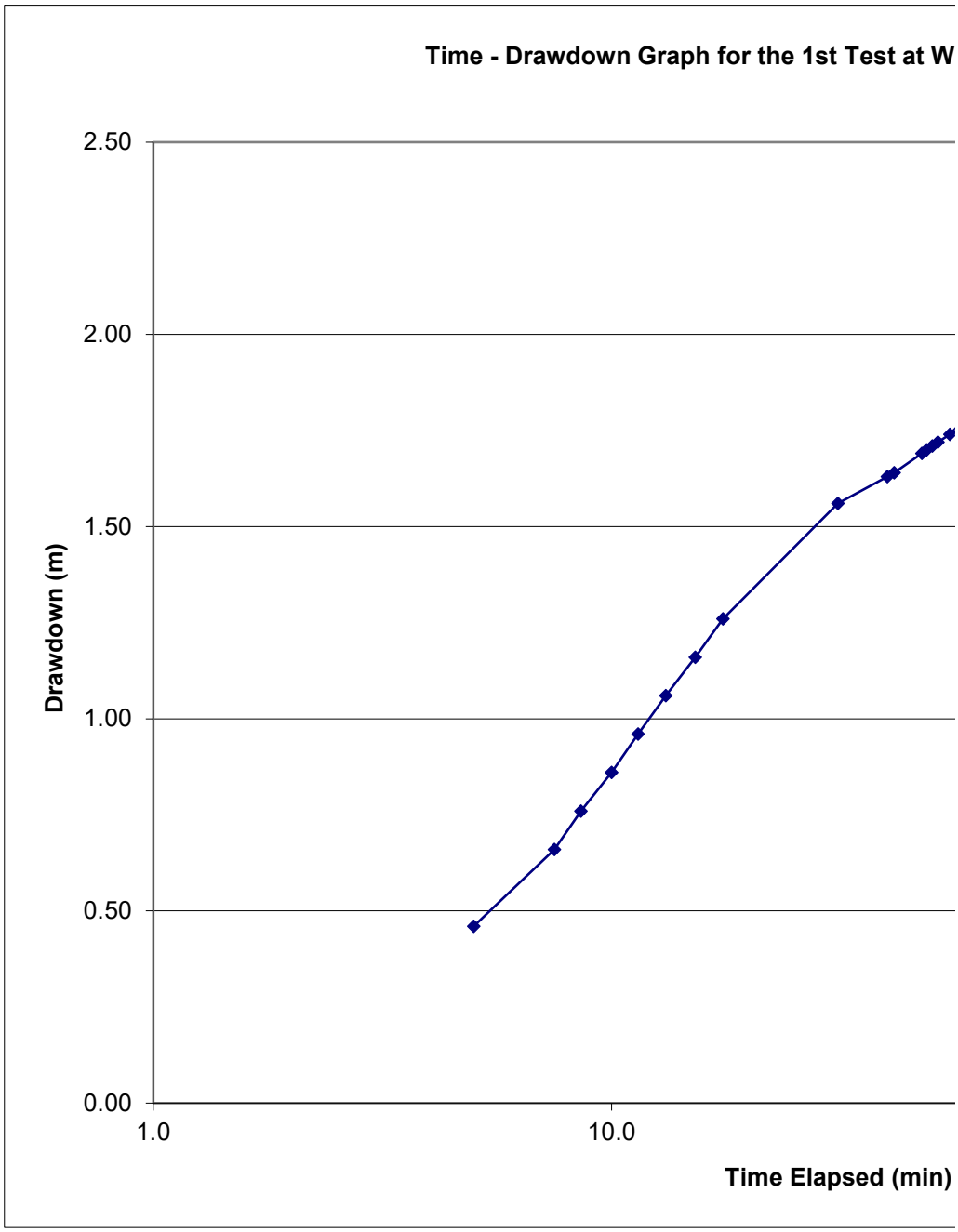
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q3 @ 60 m radius.

			Time Elapsed (min)	**Drawdown (m)**	WL_i	lengthpole
10:30:00						
10:35:00		0.90	5.0	0.46	0.44	1.62
10:37:30		1.10	7.5	0.66		
10:38:34		1.20	8.6	0.76		
10:40:00		1.30	10.0	0.86		
10:41:25		1.40	11.4	0.96		
10:43:08		1.50	13.1	1.06		
10:45:13		1.60	15.2	1.16		
10:47:30		1.70	17.5	1.26		
11:01:10		2.00	31.2	1.56		
11:09:55	0.45	2.07	39.9	1.63		
11:11:20	0.46	2.08	41.3	1.64		
11:17:30	0.51	2.13	47.5	1.69		
11:18:40	0.52	2.14	48.7	1.70		
11:20:05	0.53	2.15	50.1	1.71		
11:21:30	0.54	2.16	51.5	1.72		
11:24:40	0.56	2.18	54.7	1.74		
11:27:10	0.57	2.19	57.2	1.75		
11:31:40	0.58	2.20	61.7	1.76		
11:34:53	0.59	2.21	64.9	1.77		
11:37:55	0.60	2.22	67.9	1.78		
11:52:20	0.62	2.24	82.3	1.80		
11:56:41	0.63	2.25	86.7	1.81		
12:01:00	0.64	2.26	91.0	1.82		
12:09:48	0.66	2.28	99.8	1.84		
12:15:08	0.67	2.29	105.1	1.85		
12:24:08	0.69	2.31	114.1	1.87		
12:29:58	0.70	2.32	120.0	1.88		
12:34:40	0.73	2.35	124.7	1.91		
12:42:54	0.74	2.36	132.9	1.92		
12:50:05	0.75	2.37	140.1	1.93		
12:53:23	0.76	2.38	143.4	1.94		
12:56:06	0.77	2.39	146.1	1.95		
12:58:52	0.78	2.40	148.9	1.96		
13:03:32	0.79	2.41	153.5	1.97		
13:07:08	0.80	2.42	157.1	1.98		
13:19:08	0.84	2.46	169.1	2.02		
13:23:42	0.85	2.47	173.7	2.03		
13:26:52	0.86	2.48	176.9	2.04		
13:32:15	0.87	2.49	182.3	2.05		
13:36:20	0.88	2.50	186.3	2.06		
13:40:10	0.89	2.51	190.2	2.07		
13:45:29	0.90	2.52	195.5	2.08		
13:54:29	0.91	2.53	204.5	2.09		
13:58:28	0.92	2.54	208.5	2.10		
14:03:20	0.93	2.55	213.3	2.11		
14:08:50	0.94	2.56	218.8	2.12		
14:18:20	0.95	2.57	228.3	2.13		
14:30:00		2.59	240.0	2.15	2.15	
14:33:00		2.57	243.0	2.13		
14:34:20		2.56	244.3	2.12		
14:35:30		2.55	245.5	2.11		
14:37:39		2.53	247.7	2.09		

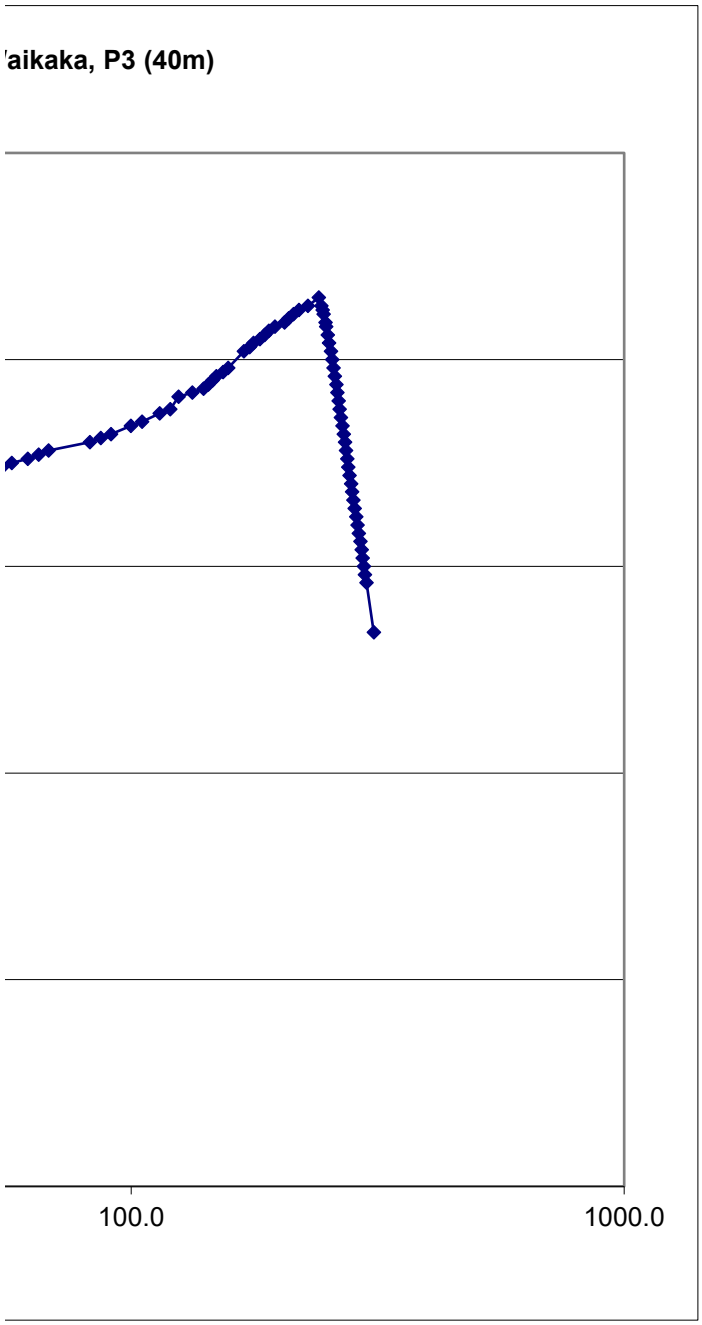
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q3 @ 60 m radius.

14:38:37	2.52	248.6	2.08
14:40:27	2.50	250.5	2.06
14:41:55	2.48	251.9	2.04
14:44:16	2.46	254.3	2.02
14:45:41	2.44	255.7	2.00
14:47:07	2.42	257.1	1.98
14:48:41	2.40	258.7	1.96
14:50:38	2.38	260.6	1.94
14:51:40	2.36	261.7	1.92
14:53:20	2.34	263.3	1.90
14:54:45	2.32	264.8	1.88
14:56:20	2.30	266.3	1.86
14:58:20	2.28	268.3	1.84
14:59:40	2.26	269.7	1.82
15:01:25	2.24	271.4	1.80
15:02:50	2.22	272.8	1.78
15:04:20	2.20	274.3	1.76
15:05:35	2.18	275.6	1.74
15:07:05	2.16	277.1	1.72
15:09:10	2.14	279.2	1.70
15:10:30	2.12	280.5	1.68
15:12:10	2.10	282.2	1.66
15:14:00	2.08	284.0	1.64
15:16:05	2.06	286.1	1.62
15:17:40	2.04	287.7	1.60
15:19:25	2.02	289.4	1.58
15:21:25	2.00	291.4	1.56
15:23:10	1.98	293.2	1.54
15:24:50	1.96	294.8	1.52
15:26:20	1.94	296.3	1.50
15:28:00	1.92	298.0	1.48
15:30:05	1.90	300.1	1.46
15:40:20	1.78	310.3	1.34

2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q3 @ 60 m radius.



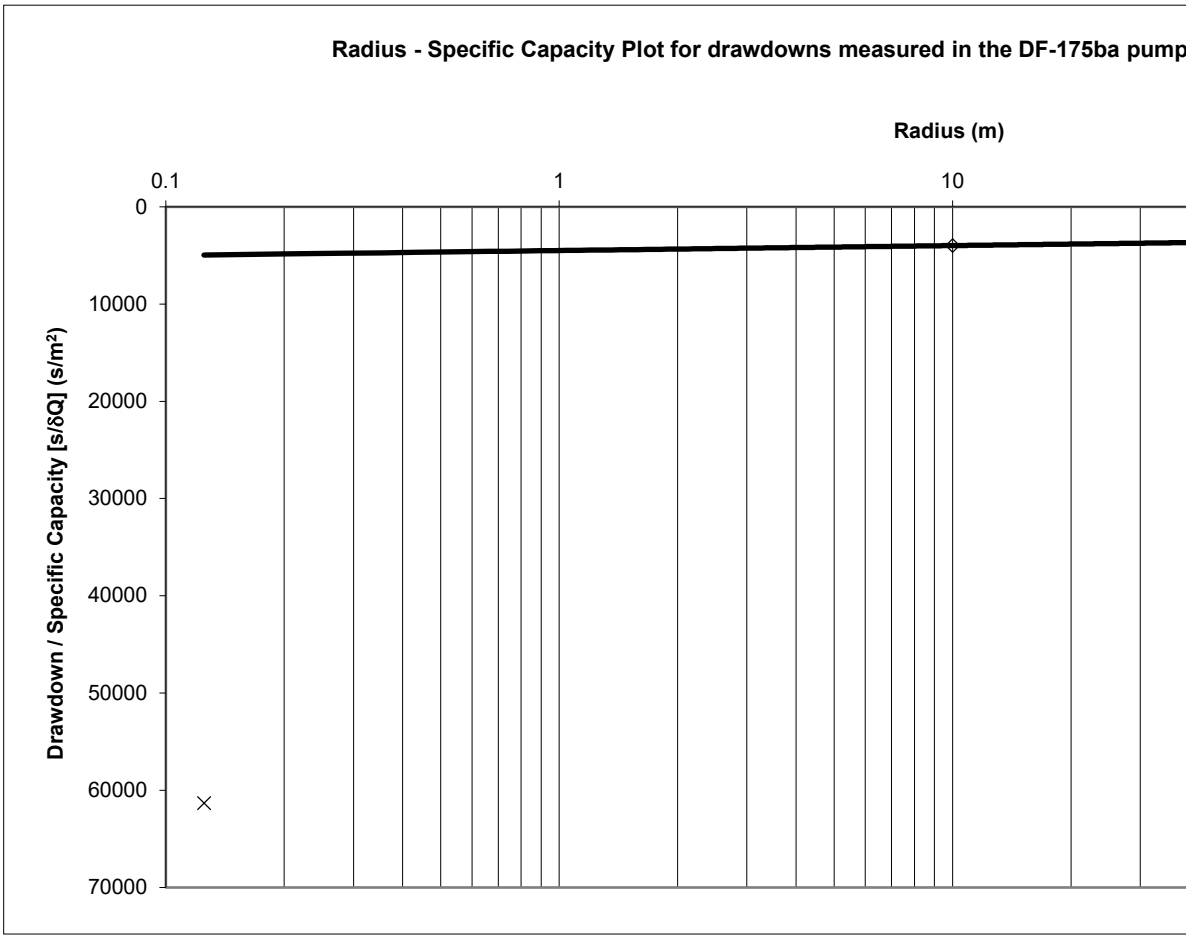
2nd Pumping Test at Waikaka, drill hole WK161.
Piezometer Q3 @ 60 m radius.



	FWL	Radius
Pumpwell	36.8	0.1
Q1	2.39	10.0
Q2	2.02	19.3
Q3	2.15	60.5

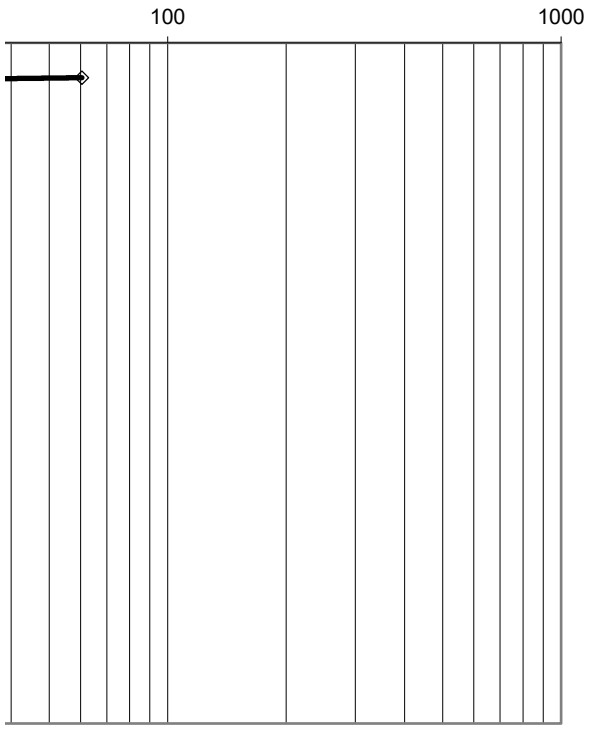
Q	r_o	r_1	r_2	R	r_o	r_1	r_2
	0.125	10	60.5		0.125	10	60.5
0.0006	36.8	2.39	2.15		61333.33	3983.333	3583.333

	S/δQ (piezo	S/δQ (PW)
0.125		61333.33
10	3983.33	
60.5	3583.33	

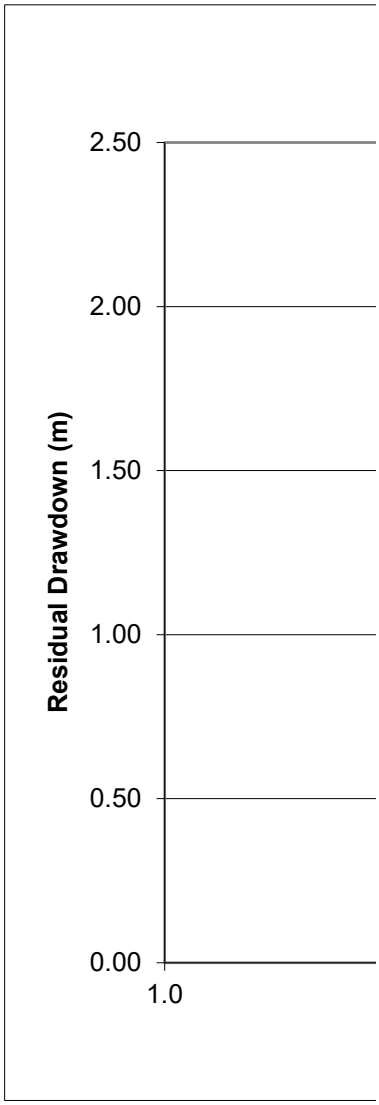


	s/Q
0.0245	106.73
0.022	26.04
0.0112	4.00

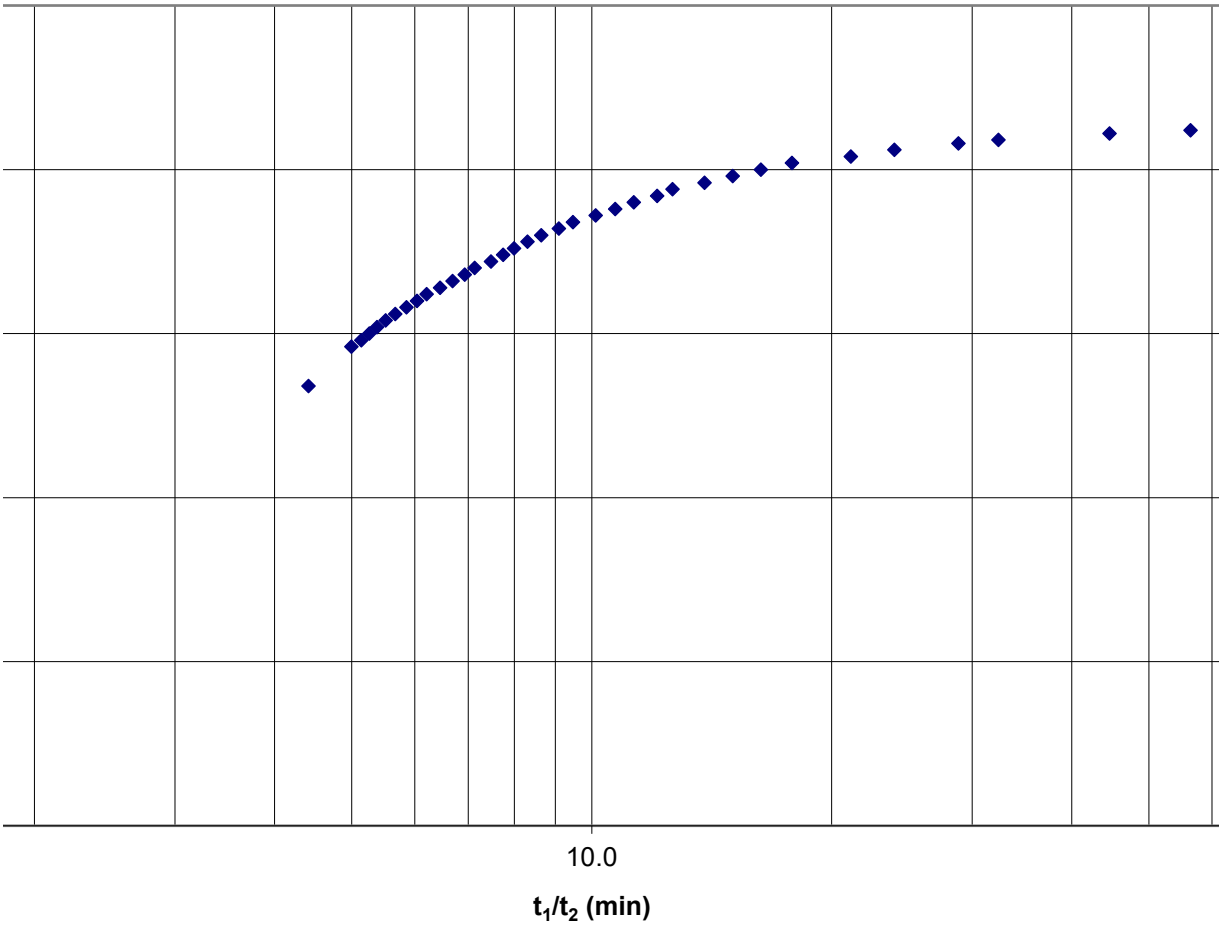
ping test, 2 June 1993.

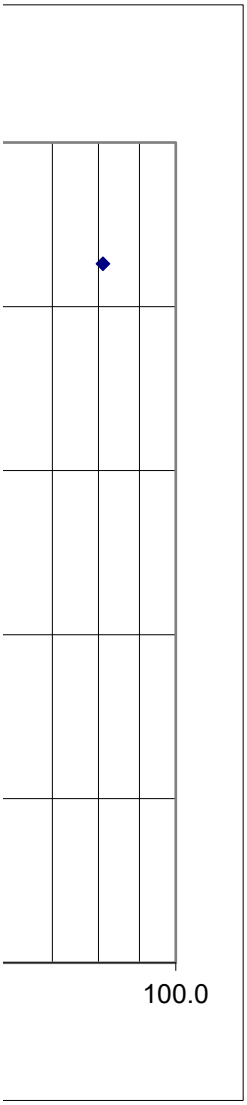


t_1	t_2	t_1/t_2 (min)	Residual Drawdown
240.0	0.00		2.15
243.0	3.00	81.0	2.13
244.3	4.33	56.4	2.12
245.5	5.50	44.6	2.11
247.7	7.65	32.4	2.09
248.6	8.62	28.9	2.08
250.5	10.45	24.0	2.06
251.9	11.92	21.1	2.04
254.3	14.27	17.8	2.02
255.7	15.68	16.3	2.00
257.1	17.12	15.0	1.98
258.7	18.68	13.8	1.96
260.6	20.63	12.6	1.94
261.7	21.67	12.1	1.92
263.3	23.33	11.3	1.90
264.8	24.75	10.7	1.88
266.3	26.33	10.1	1.86
268.3	28.33	9.5	1.84
269.7	29.67	9.1	1.82
271.4	31.42	8.6	1.80
272.8	32.83	8.3	1.78
274.3	34.33	8.0	1.76
275.6	35.58	7.7	1.74
277.1	37.08	7.5	1.72
279.2	39.17	7.1	1.70
280.5	40.50	6.9	1.68
282.2	42.17	6.7	1.66
284.0	44.00	6.5	1.64
286.1	46.08	6.2	1.62
287.7	47.67	6.0	1.60
289.4	49.42	5.9	1.58
291.4	51.42	5.7	1.56
293.2	53.17	5.5	1.54
294.8	54.83	5.4	1.52
296.3	56.33	5.3	1.50
298.0	58.00	5.1	1.48
300.1	60.08	5.0	1.46
310.3	70.33	4.4	1.34



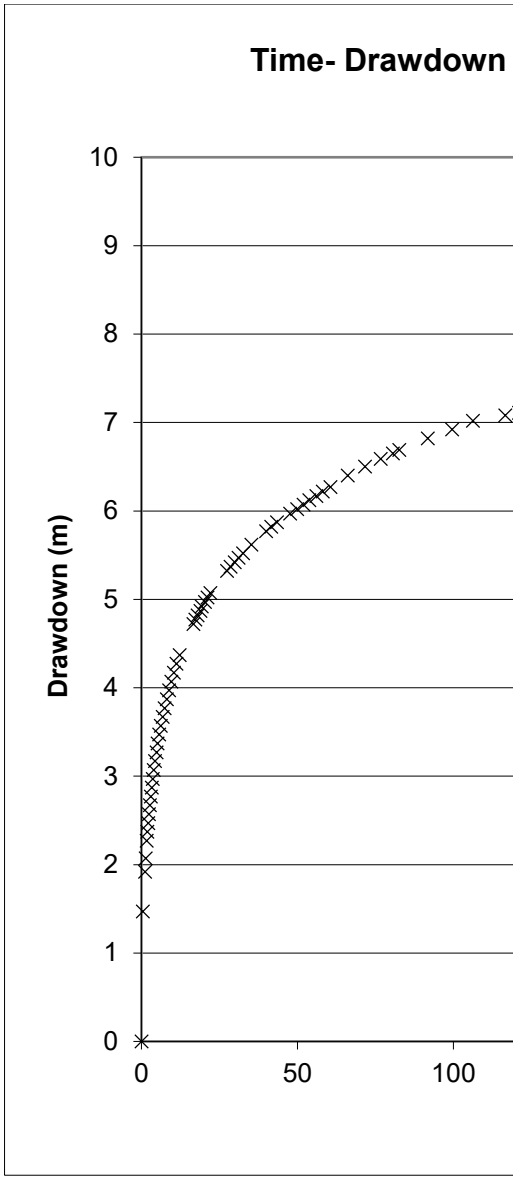
Graph of Residual (Recovery) Drawdown.




100.0

3rd Pumping Test at Waikaka, drill hole WK163.
Piezometer R1 @ 10 m radius.

		Time Elapsed (min)	Drawdown (m)
9:31:21	Depth - WL		
9:31:21	0.73	0.0	0.00
9:31:50	2.20	0.5	1.47
9:32:32	2.65	1.2	1.92
9:32:44	2.80	1.4	2.07
9:33:05	3.00	1.7	2.27
9:33:17	3.10	1.9	2.37
9:33:32	3.20	2.2	2.47
9:33:47	3.30	2.4	2.57
9:34:05	3.40	2.7	2.67
9:34:21	3.50	3.0	2.77
9:34:39	3.60	3.3	2.87
9:34:58	3.70	3.6	2.97
9:35:18	3.80	3.9	3.07
9:35:44	3.90	4.4	3.17
9:36:11	4.00	4.8	3.27
9:36:34	4.10	5.2	3.37
9:37:01	4.20	5.7	3.47
9:37:32	4.30	6.2	3.57
9:38:07	4.40	6.8	3.67
9:38:47	4.50	7.4	3.77
9:39:27	4.60	8.1	3.87
9:40:11	4.70	8.8	3.97
9:40:57	4.80	9.6	4.07
9:41:44	4.90	10.4	4.17
9:42:37	5.00	11.3	4.27
9:43:39	5.10	12.3	4.37
9:47:58	5.45	16.6	4.72
9:48:38	5.50	17.3	4.77
9:49:18	5.55	18.0	4.82
9:50:13	5.60	18.9	4.87
9:50:42	5.65	19.4	4.92
9:51:42	5.70	20.4	4.97
9:52:30	5.75	21.1	5.02
9:53:24	5.80	22.1	5.07
9:58:49	6.05	27.5	5.32
9:59:56	6.10	28.6	5.37
10:01:12	6.15	29.9	5.42
10:02:30	6.20	31.1	5.47
10:03:54	6.25	32.6	5.52
10:06:32	6.35	35.2	5.62
10:11:18	6.50	39.9	5.77
10:12:55	6.55	41.6	5.82
10:14:44	6.60	43.4	5.87
10:19:02	6.70	47.7	5.97
10:21:14	6.75	49.9	6.02
10:23:17	6.80	51.9	6.07
10:25:10	6.85	53.8	6.12
10:27:24	6.90	56.1	6.17
10:29:28	6.95	58.1	6.22
10:31:54	7.00	60.6	6.27
10:37:30	7.13	66.1	6.40
10:43:00	7.23	71.7	6.50



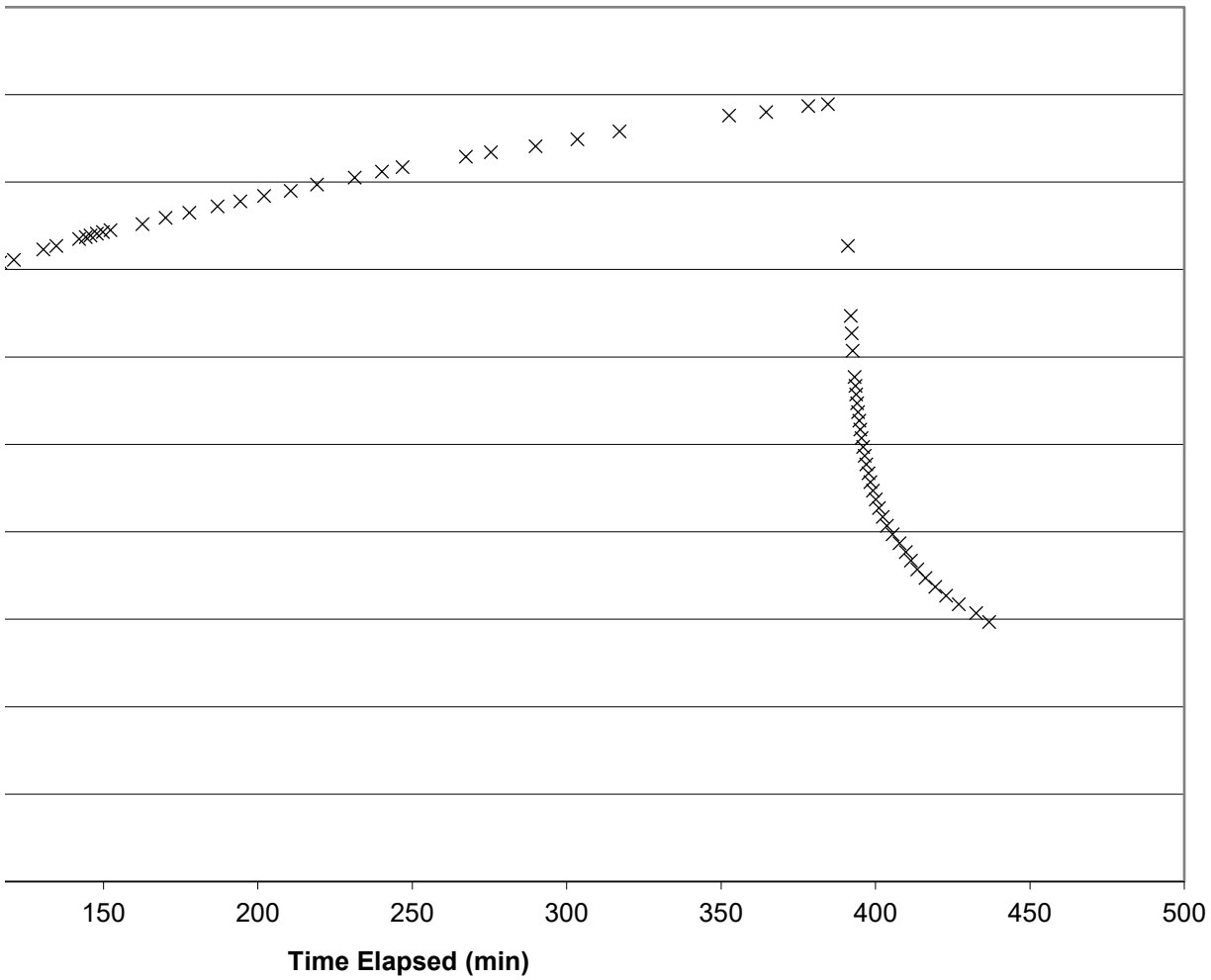
3rd Pumping Test at Waikaka, drill hole WK163.
Piezometer R1 @ 10 m radius.

10:48:00	7.32	76.7	6.59	
10:51:55	7.38	80.6	6.65	
10:54:00	7.42	82.7	6.69	
11:03:05	7.55	91.7	6.82	
11:10:56	7.65	99.6	6.92	
11:17:35	7.75	106.2	7.02	
11:27:58	7.81	116.6	7.08	
11:32:22	7.84	121.0	7.11	
11:41:54	7.96	130.6	7.23	
11:46:05	8.00	134.7	7.27	
11:53:30	8.08	142.2	7.35	
11:55:34	8.10	144.2	7.37	
11:57:10	8.12	145.8	7.39	
11:59:10	8.14	147.8	7.41	
12:01:10	8.16	149.8	7.43	
12:03:35	8.18	152.2	7.45	
12:14:00	8.25	162.7	7.52	
12:21:30	8.32	170.2	7.59	
12:29:10	8.38	177.8	7.65	
12:38:15	8.45	186.9	7.72	
12:45:40	8.51	194.3	7.78	
12:53:20	8.57	202.0	7.84	
13:01:58	8.63	210.6	7.90	
13:10:30	8.70	219.2	7.97	
13:22:40	8.78	231.3	8.05	
13:31:32	8.85	240.2	8.12	
13:38:11	8.90	246.8	8.17	
13:58:43	9.02	267.4	8.29	
14:06:50	9.07	275.5	8.34	
14:21:15	9.14	289.9	8.41	
14:34:50	9.22	303.5	8.49	
14:48:30	9.31	317.2	8.58	
15:24:00	9.49	352.7	8.76	
15:35:58	9.53	364.6	8.80	
15:49:35	9.60	378.2	8.87	
15:56:00	9.62	384.7	8.89	8.89
16:02:26	8.00	391.1	7.27	
16:03:21	7.20	392.0	6.47	
16:03:38	7.00	392.3	6.27	
16:04:00	6.80	392.7	6.07	
16:04:36	6.50	393.3	5.77	
16:04:50	6.40	393.5	5.67	
16:05:08	6.30	393.8	5.57	
16:05:24	6.20	394.1	5.47	
16:05:43	6.10	394.4	5.37	
16:06:04	6.00	394.7	5.27	
16:06:25	5.90	395.1	5.17	
16:06:52	5.80	395.5	5.07	
16:07:19	5.70	396.0	4.97	
16:07:50	5.60	396.5	4.87	
16:08:25	5.50	397.1	4.77	
16:09:02	5.40	397.7	4.67	
16:09:45	5.30	398.4	4.57	
16:10:34	5.20	399.2	4.47	
16:11:28	5.10	400.1	4.37	
16:12:28	5.00	401.1	4.27	

3rd Pumping Test at Waikaka, drill hole WK163.
Piezometer R1 @ 10 m radius.

16:13:40	4.90	402.3	4.17
16:15:05	4.80	403.7	4.07
16:16:52	4.70	405.5	3.97
16:19:08	4.60	407.8	3.87
16:21:10	4.50	409.8	3.77
16:22:48	4.40	411.5	3.67
16:24:55	4.30	413.6	3.57
16:27:35	4.20	416.2	3.47
16:30:45	4.10	419.4	3.37
16:34:15	4.00	422.9	3.27
16:38:20	3.90	427.0	3.17
16:43:55	3.80	432.6	3.07
16:48:10	3.70	436.8	2.97

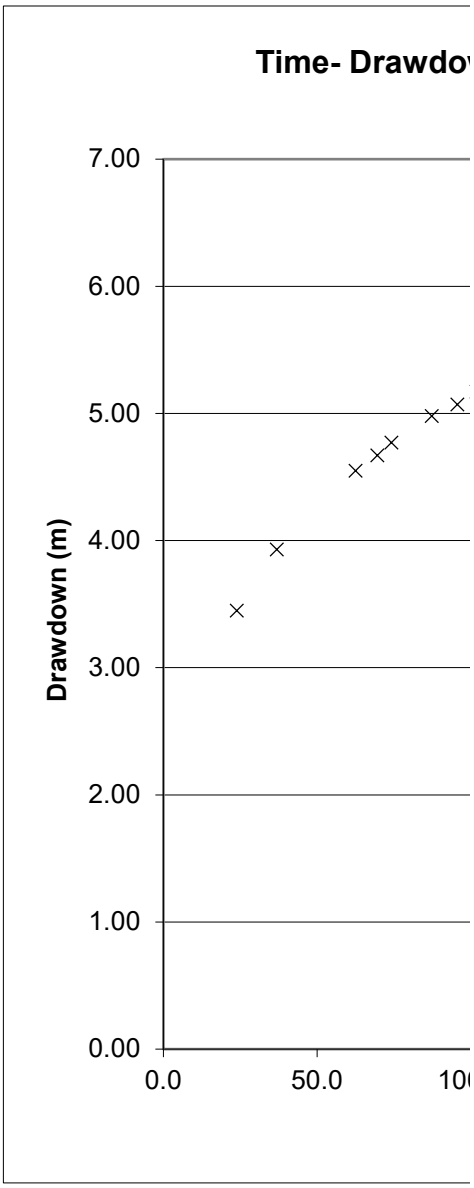
Curve of 3rd Waikaka Pumping Test at Piezometer R1 (10.2m).



3rd Pumping Test at Waikaka, drill hole WK163.
Piezometer R1 @ 10 m radius.

3rd Pumping Test at Waikaka, drill hole WK163.
Piezometer R2 @ 19.4 m radius.

		Time Elapsed (min)	Drawdown (m)
9:31:21	0.45	0.0	0.00
9:55:11	3.90	23.8	3.45
10:08:11	4.38	36.8	3.93
10:33:50	5.00	62.5	4.55
10:40:58	5.12	69.6	4.67
10:45:30	5.22	74.1	4.77
10:58:35	5.43	87.2	4.98
11:06:59	5.52	95.6	5.07
11:13:10	5.62	101.8	5.17
11:23:30	5.75	112.2	5.30
11:38:30	5.38	127.2	4.93
11:48:20	5.47	137.0	5.02
12:08:30	5.63	157.2	5.18
12:17:50	5.71	166.5	5.26
12:23:40	5.76	172.3	5.31
12:31:48	5.83	180.5	5.38
12:41:40	5.90	190.3	5.45
12:48:50	5.96	197.5	5.51
12:56:00	6.02	204.7	5.57
13:04:50	6.09	213.5	5.64
13:14:02	6.15	222.7	5.70
13:25:20	6.23	234.0	5.78
13:33:08	6.29	241.8	5.84
13:40:50	6.35	249.5	5.90
14:01:45	6.49	270.4	6.04
14:15:50	6.55	284.5	6.10
14:40:30	6.69	309.2	6.24
14:45:20	6.71	314.0	6.26
14:54:00	6.76	322.7	6.31
15:29:10	6.93	357.8	6.48
15:43:20	7.00	372.0	6.55
15:53:30	7.04	382.2	6.59
16:49:30	3.44	438.2	2.99

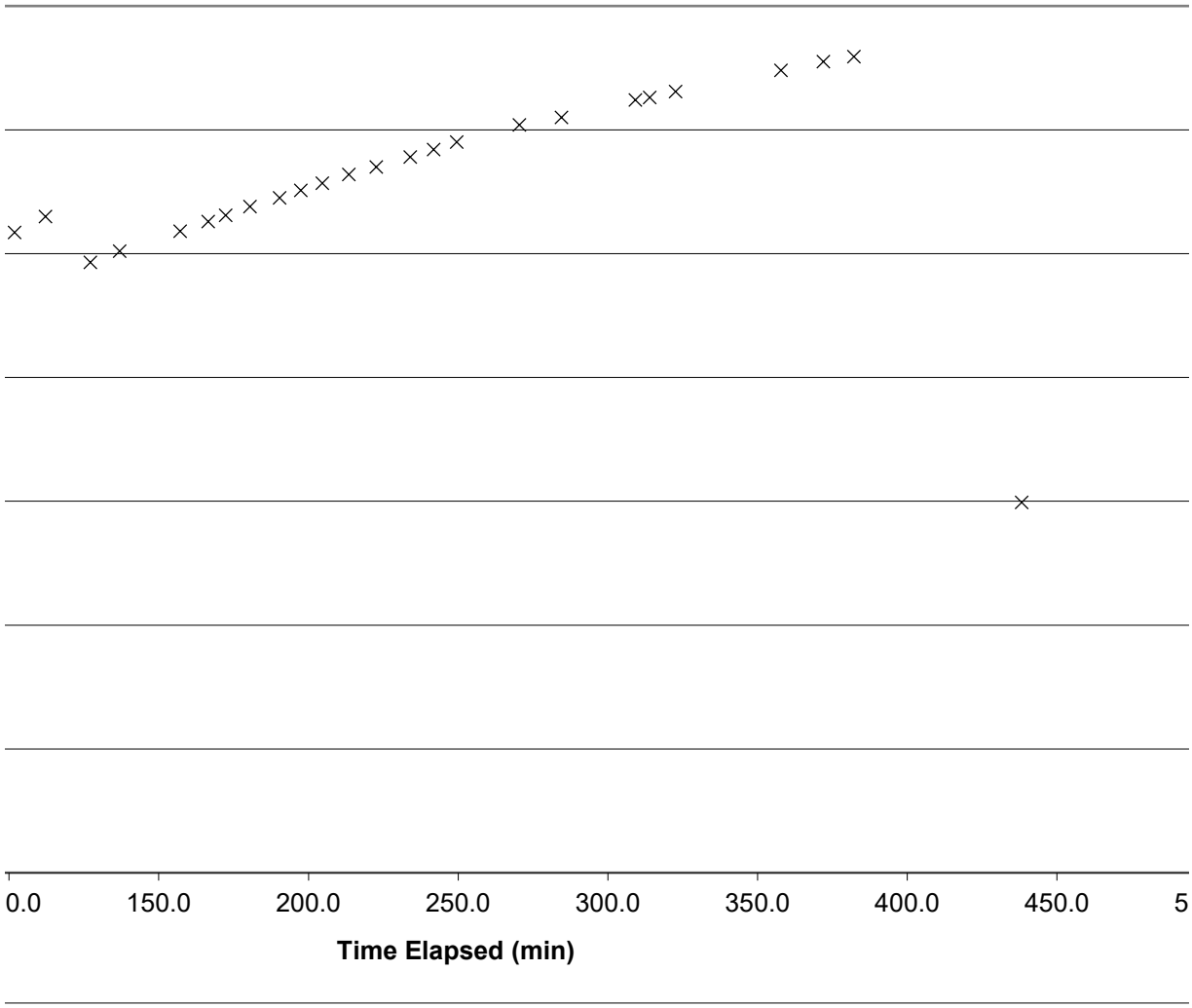


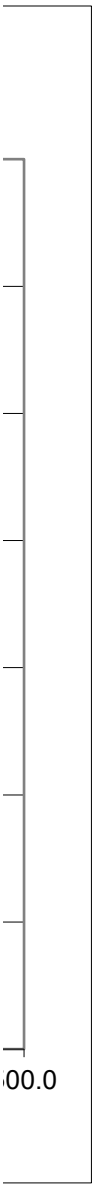
2.02

2.73	-571.4	2.73
2.71	-571.4	2.71
2.70	-571.4	2.70
2.68	-571.4	2.68

2.66	-571.4	2.66
2.64	-571.4	2.64
2.62	-571.4	2.62
2.60	-571.4	2.60
2.58	-571.4	2.58
2.56	-571.4	2.56
2.54	-571.4	2.54
2.52	-571.4	2.52
2.50	-571.4	2.50
2.48	-571.4	2.48
2.46	-571.4	2.46
2.44	-571.4	2.44
2.42	-571.4	2.42
2.40	-571.4	2.40
2.38	-571.4	2.38
2.36	-571.4	2.36
2.34	-571.4	2.34
2.32	-571.4	2.32
2.30	-571.4	2.30
2.28	-571.4	2.28
2.26	-571.4	2.26
2.24	-571.4	2.24
2.22	-571.4	2.22
2.20	-571.4	2.20
2.18	-571.4	2.18
2.16	-571.4	2.16
2.14	-571.4	2.14
2.12	-571.4	2.12
2.10	-571.4	2.10
2.08	-571.4	2.08
2.06	-571.4	2.06
2.04	-571.4	2.04
2.02	-571.4	2.02
2.00	-571.4	2.00
1.98	-571.4	1.98
1.96	-571.4	1.96
1.94	-571.4	1.94

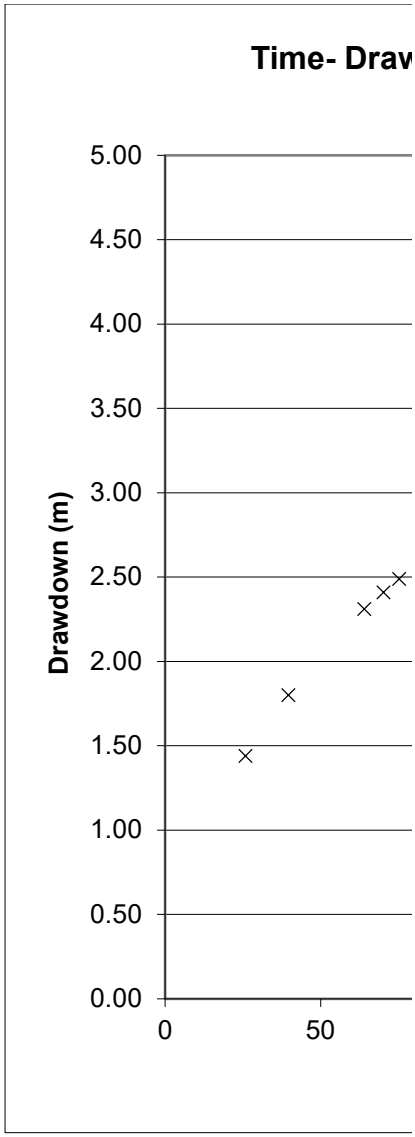
wn Curve of 3rd Waikaka Pumping Test at Piezometer R2 (19.4m).



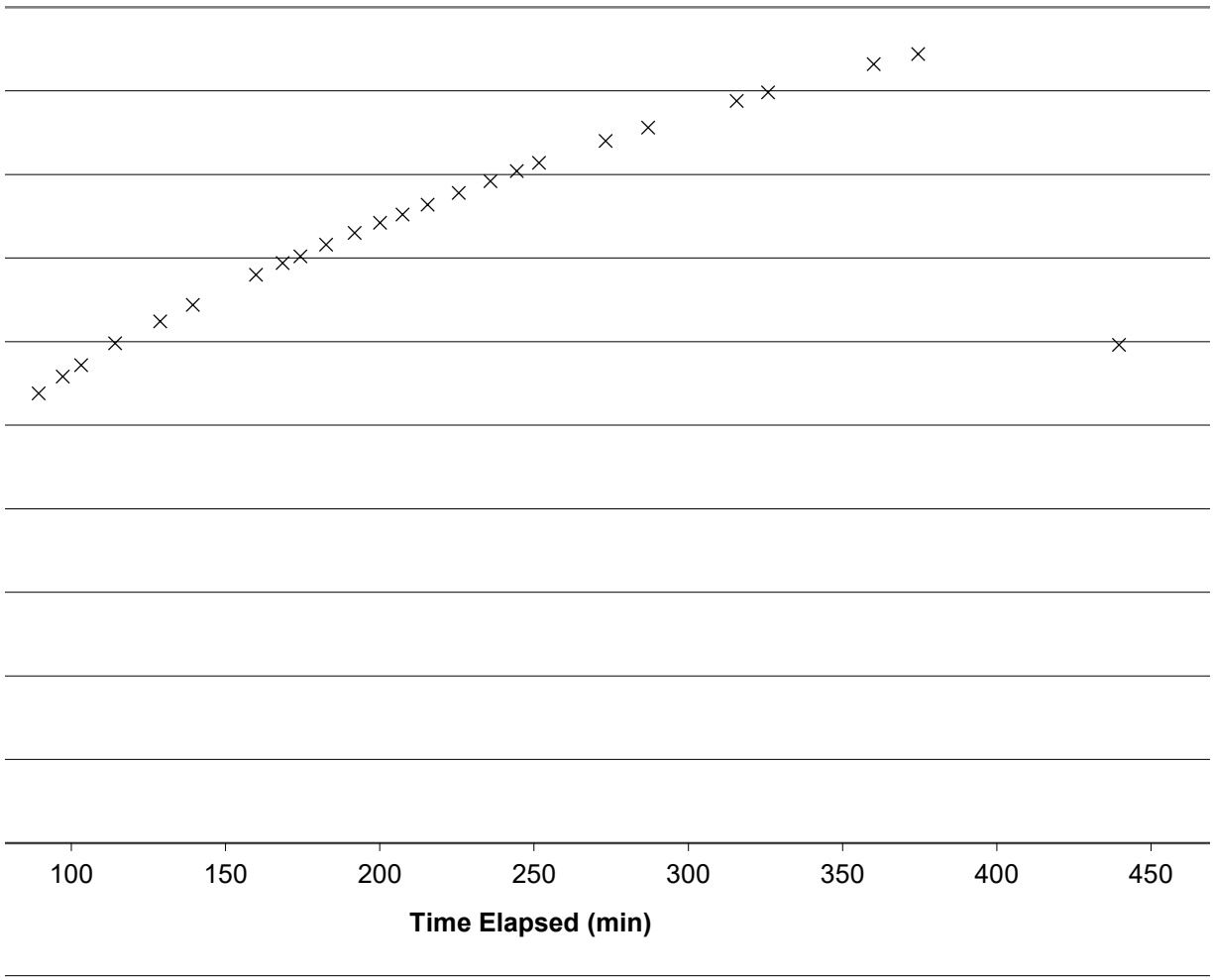

00.0

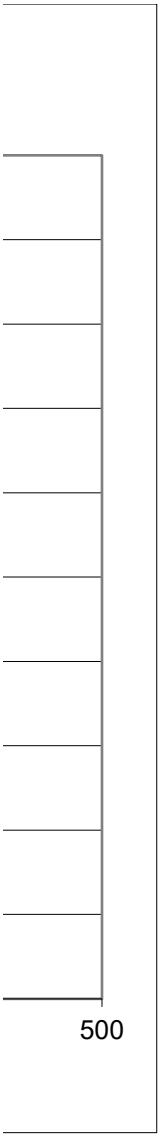
3rd Pumping Test at Waikaka, drill hole WK163.
Piezometer R3 @ 39.8 m radius.

		Time Elapsed (min)	Drawdown (m)
9:31:21	0.05	0.0	0.00
9:57:08	1.44	25.8	1.44
10:10:55	1.80	39.6	1.80
10:35:22	2.31	64.0	2.31
10:41:28	2.41	70.1	2.41
10:46:35	2.49	75.2	2.49
11:00:42	2.69	89.4	2.69
11:08:33	2.79	97.2	2.79
11:14:30	2.86	103.2	2.86
11:25:30	2.99	114.2	2.99
11:40:10	3.12	128.8	3.12
11:50:45	3.22	139.4	3.22
12:11:10	3.40	159.8	3.40
12:19:50	3.47	168.5	3.47
12:25:39	3.51	174.3	3.51
12:33:57	3.58	182.6	3.58
12:43:10	3.65	191.8	3.65
12:51:23	3.71	200.0	3.71
12:58:45	3.76	207.4	3.76
13:06:50	3.82	215.5	3.82
13:16:57	3.89	225.6	3.89
13:27:12	3.96	235.9	3.96
13:35:47	4.02	244.4	4.02
13:43:00	4.07	251.7	4.07
14:04:30	4.20	273.2	4.20
14:18:20	4.28	287.0	4.28
14:47:00	4.44	315.7	4.44
14:57:10	4.49	325.8	4.49
15:31:26	4.66	360.1	4.66
15:45:50	4.72	374.5	4.72
16:51:00	2.98	439.7	2.98



vdown Curve of 3rd Waikaka Pumping Test at Piezometer R3 (39.75m).

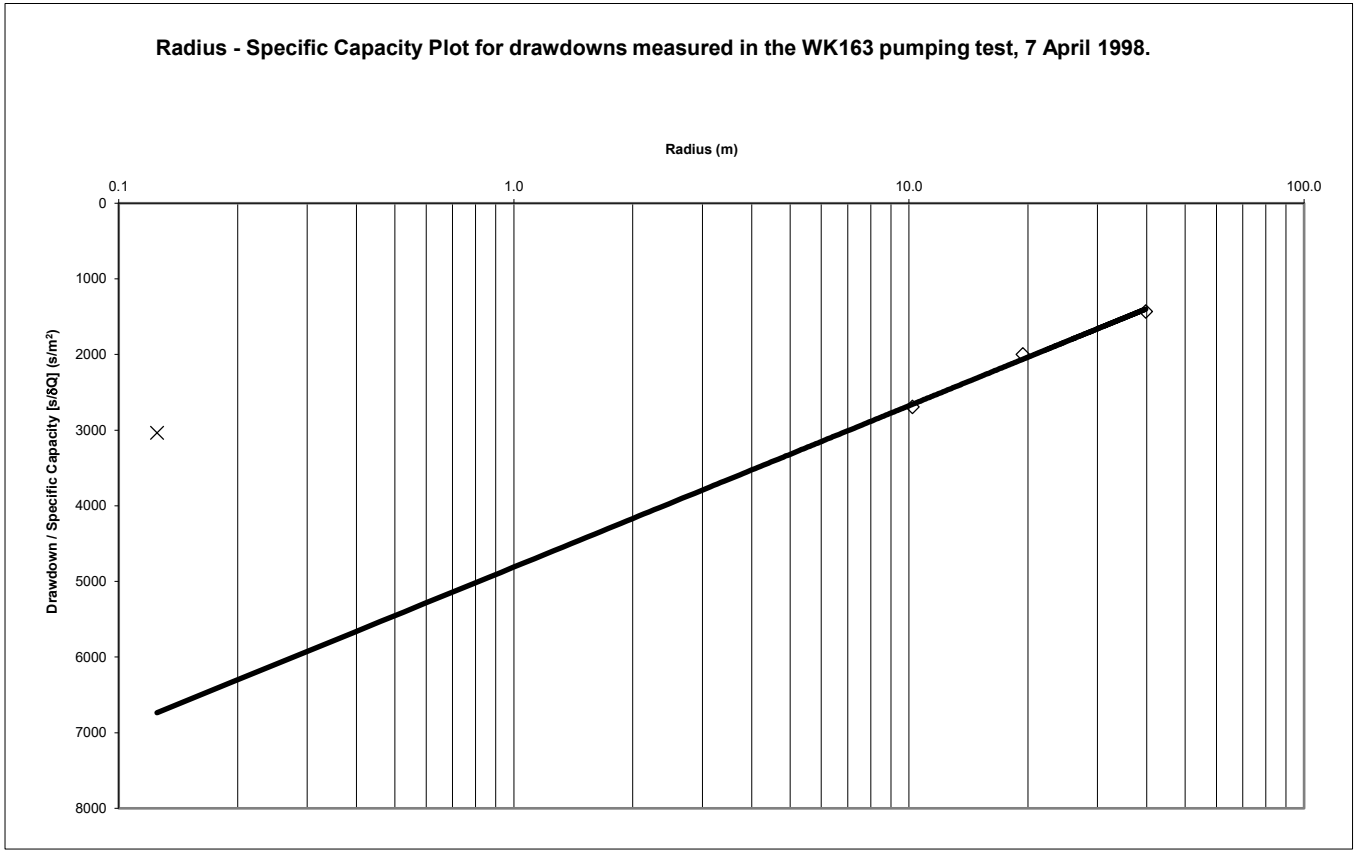



500

	FWL	Radius	Pump rate
RW	10.02	0.1	285
R1	8.89	10.2	
R2	6.59	19.4	
R3	4.72	39.8	

Pumped	r_o	r_1	r_2	r_3		r_o	r_1	r_2	r_3	
Discharge	0.125	10.2	19.4	39.75	m radius	0.125	10.2	19.4	39.75	
0.0033	10.02	8.89	6.59	4.72	l/s	3036.364	2693.939	1996.97	1430.303	l/s/m

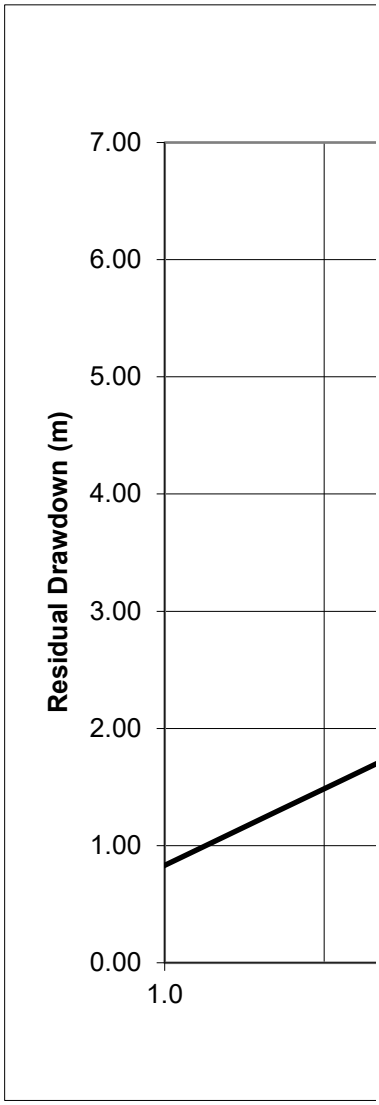
Radius (m)	$s/\delta Q_{piezo}$	$s/\delta Q_{PW}$	Symbol
0.1		3036.36	x
10.2	2693.94		o
19.4	1996.97		o
39.8	1430.303		o



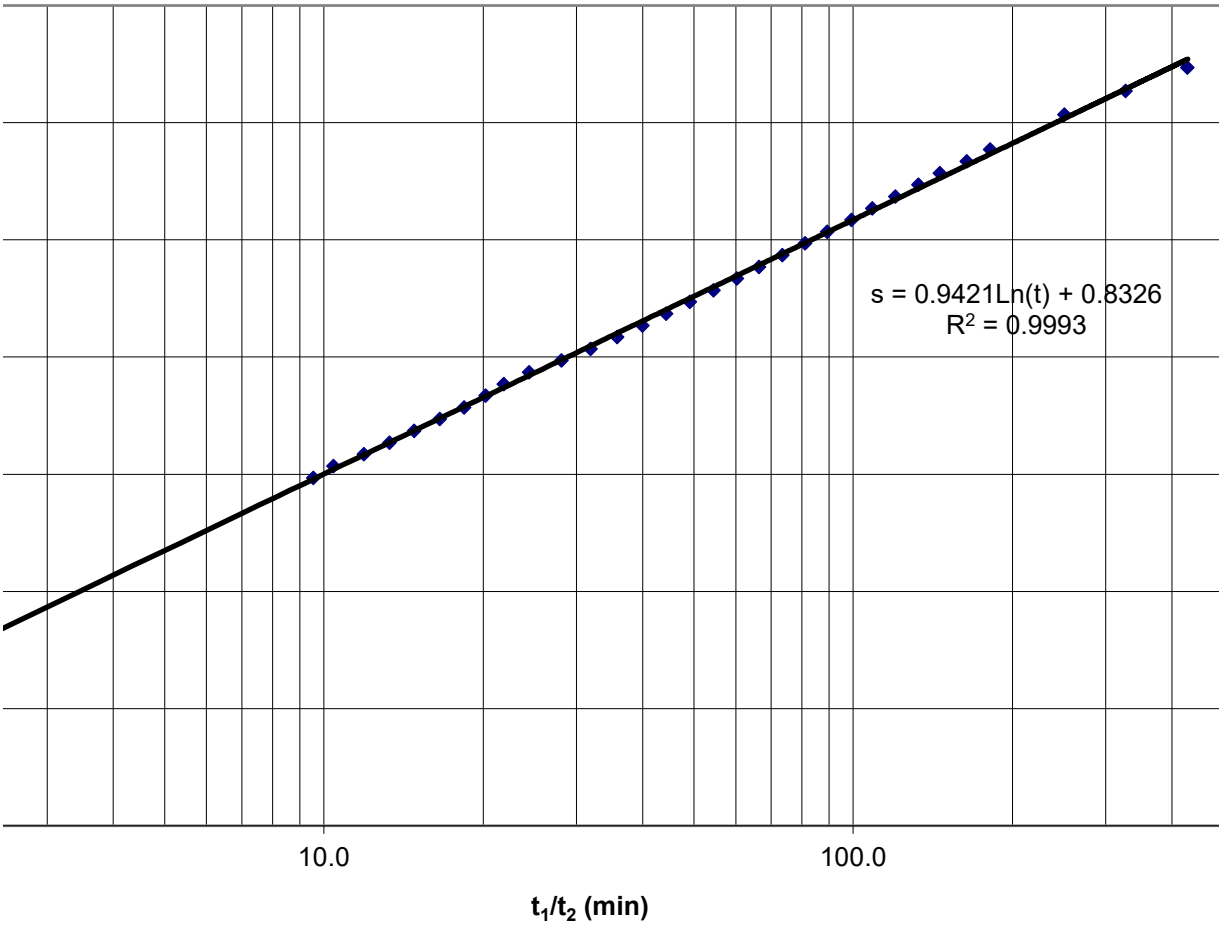
Permeability Calculations.

r_1 =	10
r_2 =	100
s/Q_{10m} =	2677.269
s/Q_{100m} =	544.3388
$\Delta s/Q$ =	2132.931
T =	0.366 / Δ(s/Q)
T =	0.000172 m^2/s
T =	14.8 m^2/d
b =	2.3 m
K_h =	6.4 m/d

t_1	t_2	t_1/t_2 (min)	Residual Drawdown	
391.1	0.00		7.27	Δs =
392.0	0.92	427.6	6.47	
392.3	1.20	326.9	6.27	
392.7	1.57	250.6	6.07	
393.3	2.17	181.5	5.77	
393.5	2.40	164.0	5.67	
393.8	2.70	145.8	5.57	
394.1	2.97	132.8	5.47	
394.4	3.28	120.1	5.37	
394.7	3.63	108.6	5.27	
395.1	3.98	99.2	5.17	
395.5	4.43	89.2	5.07	
396.0	4.88	81.1	4.97	
396.5	5.40	73.4	4.87	
397.1	5.98	66.4	4.77	
397.7	6.60	60.3	4.67	
398.4	7.32	54.5	4.57	
399.2	8.13	49.1	4.47	
400.1	9.03	44.3	4.37	
401.1	10.03	40.0	4.27	
402.3	11.23	35.8	4.17	
403.7	12.65	31.9	4.07	
405.5	14.43	28.1	3.97	
407.8	16.70	24.4	3.87	
409.8	18.73	21.9	3.77	
411.5	20.37	20.2	3.67	
413.6	22.48	18.4	3.57	
416.2	25.15	16.6	3.47	
419.4	28.32	14.8	3.37	
422.9	31.82	13.3	3.27	
427.0	35.90	11.9	3.17	
432.6	41.48	10.4	3.07	
436.8	45.73	9.6	2.97	



Graph of Residual (Recovery) Drawdown.

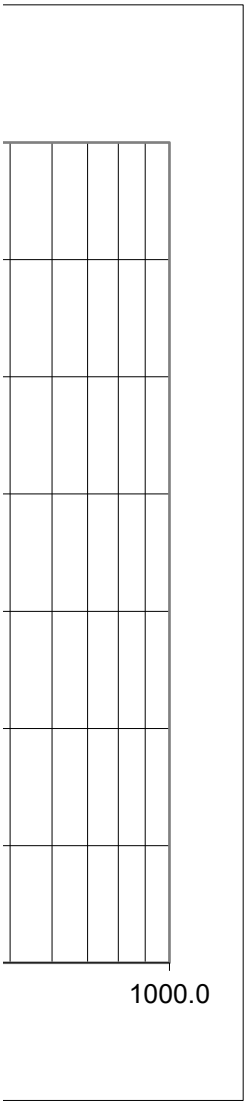


s = 0.9421Ln(t) + 0.8326

	t_1/t_2	s	
t_1/t_2 =	10	3.00	m
t_1/t_2 =	100	5.17	m
	Δs =	2.17	m
	Q =	285	m^3/d

$T = 2.3\ Q / 4\Pi\ \Delta s$

$= 24.05\ m^2/d$


1000.0

SOUTHDRILL
EXPLORATION & PILING

PUMPING TEST DATA SHEET
Constant Rate Test

Client : Waikaka Gold		
Production Bore	**Piezo 1**	**Piezo 2**
GPS Location:	GPS location	GPS location
Transducer #	SWL	SWL
Pump Details	Upstand casing	Upstand casing
SWL	Piezo dia	Piezo dia
Upstand casing	Piezo depth	Piezo depth
Casing Dia	Transducer #	Transducer #

Rainfall	**Notes**
GPS Discharge	Static production bore = 1m 8:35
Bore Sealed ?	
Bore Photo ?	

START DATE: ..... **4/11/2021** **Finish Date**

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	*L/S*	Remarks			
4/11/2021 8:35	0	0.00		0				
4/11/2021 8:36	1	-1.590		2.262				
4/11/2021 8:37	2	-3.520		2.242				
4/11/2021 8:38	3	-4.190		2.273				
4/11/2021 8:39	4	-5.180		2.256				
4/11/2021 8:40	5	-7.100		2.470				
4/11/2021 8:45	10	-8.120		2.261				
4/11/2021 8:50	15	-9.210		2.235				
4/11/2021 8:55	20	-9.870		2.219				
4/11/2021 9:00	25	-10.680		2.208				
4/11/2021 9:05	30	-12.020		2.201				
4/11/2021 9:15	40	-13.240		2.183				
4/11/2021 9:25	50	-14.810		2.149				
4/11/2021 9:35	60	-16.900		2.145				
4/11/2021 9:50	75	-19.180		2.134				
4/11/2021 10:05	90	-19.760		1.897	Had to cut back flow			
4/11/2021 10:20	105	-19.780		1.870				
4/11/2021 10:35	120	-19.780		1.777				
4/11/2021 11:05	150	-19.680		1.638				
4/11/2021 11:35	180	-18.780		1.531				
4/11/2021 12:05	210	-18.550		1.497				
4/11/2021 12:35	240	-16.040		1.499				
4/11/2021 13:05	270	-15.680		1.514				
4/11/2021 13:35	300	-16.270		1.503				
4/11/2021 14:05	330	-16.620		1.517				
4/11/2021 14:35	360	-16.360		1.487				
4/11/2021 15:35	7	-16.670		1.501				
4/11/2021 16:35	8	-13.030		1.402				
4/11/2021 17:35	9	-13.340		1.401				
4/11/2021 21:35	13	-14.370		1.399				
4/11/2021 22:35	14	-13.960		1.399				
5/11/2021 0:35	16	-14.200		1.399				
	18							
	20							
5/11/2021 6:35	22	-14.030		1.399				
5/11/2021 8:35	24	-13.220		1.408	Shut dows at 8.35am			

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	*L/S*	Remarks			
Recovery								
5/11/2021 8:36	1m	-11.80						
5/11/2021 8:37	2m	-10.85						
5/11/2021 8:38	3m	-9.93						
5/11/2021 8:39	4m	-9.11						
5/11/2021 8:40	5m	-8.40						
5/11/2021 8:45	10m	-5.67						
5/11/2021 8:50	15m	-4.50						
5/11/2021 8:55	20m	-4.12						
5/11/2021 9:00	25m	-3.90						
5/11/2021 9:05	30m	-3.77						
5/11/2021 9:15	40m	-3.56						
5/11/2021 9:25	50m	-3.41						
5/11/2021 9:35	1 hour	-3.28						
5/11/2021 9:50	1.15	-3.12						
5/11/2021 10:05	1.3	-2.99						

5/11/2021 10:20	1.45	-2.88						
5/11/2021 10:35	2 hour	-2.46						

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	*Q L/S*	Remarks	Pizo Bore #1	Pizo Bore #2	

SOUTHDRILL
EXPLORATION & PILING

PUMPING TEST DATA SHEET
Constant Rate Test

Client : Waikaka Gold		
Production Bore	**Piezo 1**	**Piezo 2**
GPS Location:	GPS location	GPS location
Transducer #	SWL	SWL
Pump Details	Upstand casing	Upstand casing
SWL	Piezo dia	Piezo dia
Upstand casing	Piezo depth	Piezo depth
Casing Dia	Transducer #	Transducer #

Rainfall	**Notes**
GPS Discharge	
Bore Sealed ?	
Bore Photo ?	

START DATE: ..... **4/11/2021** **Finish Date**

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	*L/S*	Remarks	Pizo Bore #1	Pizo Bore #2	Pizo Bore #3	Pizo Bore #4	
8.36	1m					0.75	3.05	0.99	1.62	
8.37	2m					0.88	3.11	1.05		
8.38	3m					1.01	3.11	1.10	1.62	
8.39	4m					1.18	3.11	1.18		
8.40	5m					1.27	3.10	1.24	1.63	
8.45	10m					1.67		1.51		
8.50	15m					1.90		1.89	1.63	
8.55	20m					2.20		2.15		
9.00	25m					2.40		2.35		
9.05	30m					2.55		2.48	1.63	
9.15	40m					2.70		2.70		
9.25	50m					2.90		2.92		
9.35	1 hour					3.04		3.07	1.63	
9.50	1.25					3.21		3.28		
10.05	1.5					3.39	3.08	3.41	1.63	
10.20	1.75					3.46		3.51		
10.35	2hours					3.55	3.08	3.61		
11.05	2.5					3.60	3.08	3.68	1.63	
11.35	3 hours					3.61		3.72		
12.05	3.5					3.70		3.80	1.62	
12.35 pm	4 hours					3.85		3.96		
1.05	4.5					3.85		3.96		
1.35	5 hours					3.90	3.08	4.00		
2.05	5.5					3.95		4.05		
2.35	6 hours					4.30		4.13		
3.35	7 hours					4.10	3.08	4.20	16.20	
4.35	8 hours					4.12	3.08	4.22		
5.35	9 hours					4.12		4.23		
9.35	13 hours					4.25		4.38		
10.35 pm	14 hours					4.29		4.40		
12.35 am	16 hours					4.32		4.44		
2.35	18 hours									
4.35	20 hours									
6.35	22 hours					4.45		4.56		
Finish 8.35am	24 hours					4.49	3.10	4.60	1.62	
Recovery	1					4.48		4.54		
8.36 an	2					4.46		4.57		
8.37	3					4.43		4.54		
8.38	4					4.39		4.52		
8.39	5					4.35		4.50		
8.40	10					4.11		4.29		
8.45	15					3.82		4.06		
8.50	20					3.58		3.66		
8.55	25					3.41		3.60		
9.00	30					3.29		3.49		
9.05	40					3.09		3.37		
9.15	50.0					2.94		3.21		
9.25	1 hour					2.82		3.09		
9.35	1.25					2.66		2.93		
	1.5					2.52		2.79		
	1.8					2.41		2.68		
	2 hour					2.31		2.58		

					Pizo Bore #1				
Actual time	**Elasped Time (min)**	**Water level below datum (m)**	**Change in water levels**	***Q L/S***	**Remarks**		**Pizo Bore #2**			

Actual time	Elasped Time (min)	Pizo Bore #1	Pizo Bore #2	Pizo Bore #3	Pizo Bore #4	
1 L/S						
2.3	1	0.720	3.110			
	2	0.000				
	3	0.840	3.110			
	4	0.870	3.120			
	5			1.100	1.630	
	6	1.190	3.120	1.170	1.630	
	10	1.290	3.120	1.290		
	15			1.440	1.630	
	20					
	25	1.440	3.120			
	30			1.620	1.630	
	40	1.700		1.760	1.630	
	50	1.760	3.130	1.890	1.630	
	60		3.130	1.910	1.630	
2.2 L/S						
3.3	1	1.970	3.120	1.940	1.630	
	2					
	3		3.120			
	4	2.100				
	5			2.200	1.630	
	6					
	10	2.500	3.120	2.360	1.630	
	15	2.660	3.120	2.640	1.630	
	20	2.880	3.120	2.770	1.630	
	25					
	30	3.050				
	40	3.300		3.210		
	50	3.410		3.390		
	60	3.530		3.470	1.630	
5pm		4.000		4.060		
	Recovery					
5.34	1					
	2	4.120		4.200		
	3					
	4	4.060				
	5	3.850		4.100		
	10	3.590		3.830		
	15	3.250		3.550		
	20	2.900		3.270		

25	2.700	3.050
30	2.540	2.900
40	2.320	2.650
50	2.150	2.480
60	2.010	2.330

SOUTHDRILL
EXPLORATION & PILING

PUMPING TEST DATA SHEET
Constant Rate Test

Client : Waikaka Gold	South 1.935	North 1.9605
Production Bore	**Piezo 1**	**Piezo 2**
GPS Location:	GPS location	GPS location
Transducer #	SWL 1.74	SWL 1.76
Pump Details	Upstand casing	Upstand casing
SWL 1.910 - Main Bore	Piezo dia	Piezo dia
Upstand casing	Piezo depth	Piezo depth
Casing Dia	Transducer #	Transducer #

Rainfall	**Notes** Heavy rain over weekend
GPS Discharge	
Bore Sealed ?	
Bore Photo ?	

9am Start

START DATE: ..... **15/11/2021** **Finish Date** 17/11/2021

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	L/S	Remarks	Pizo Bore #1	Pizo Bore #2	
15/11/2021 9:00	0							
15/11/2021 9:01	1m	2.690		1.541				
15/11/2021 9:02	2m	2.940		1.526				
15/11/2021 9:03	3m	3.140		1.542				
15/11/2021 9:04	4m	3.270		1.535				
15/11/2021 9:05	5m	3.360		1.525				
15/11/2021 9:10	10m	3.630		1.522				
15/11/2021 9:15	15m	3.840		1.520				
15/11/2021 9:20	20m	4.010		1.513				
15/11/2021 9:30	30m	4.240		1.507				
15/11/2021 9:45	45m	4.530		1.511				
15/11/2021 10:00	1 hour	4.770		1.501				
15/11/2021 10:30	1.5 hours	5.110		1.498				
15/11/2021 11:00	2hours	5.410		1.500				
15/11/2021 11:30	2.5 hours	5.600		1.496				
15/11/2021 12:00	3 hours	2.820		1.499				
15/11/2021 13:00	4 hours	6.170		1.481				
15/11/2021 14:00	5 hours	6.380		1.500				
15/11/2021 16:00	7 hours	7.370		1.783				
15/11/2021 16:15	7.25 hours	7.450		1.776				
15/11/2021 16:30	7.5 hours	7.530		1.809				
15/11/2021 16:45	7.75 hours	7.600		1.790				
15/11/2021 17:00	8 hours	7.640		1.780				
15/11/2021 18:00	9 hours	7.870		1.751				
15/11/2021 22:00	13 hours	8.410		1.759				
15/11/2021 23:00	14 hours	8.500		1.769				
16/11/2021 0:00	15 hours	8.575		1.770				
16/11/2021 6:00	21 hours	9.000		1.760				
16/11/2021 8:00	23 hours	9.050		1.752				
16/11/2021 9:00	24 hours	9.060		1.762				

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	Q L/S	Remarks	Pizo Bore #1	Pizo Bore #2	
RECOVERY								
16/11/2021 9:01	1 MIN	8.21						
16/11/2021 9:02	2.0	7.83						
16/11/2021 9:03	3.0	7.67						
16/11/2021 9:04	4.0	7.54						
16/11/2021 9:05	5.0	7.44						
16/11/2021 9:10	10 MIN	7.18						
16/11/2021 9:15	15.0	6.94						
16/11/2021 9:20	20.0	6.77						
16/11/2021 9:30	30.0	6.45						
16/11/2021 9:45	45.0	6.08						
16/11/2021 10:00	1 HOUR	5.79						
16/11/2021 10:30	1.5	5.28						
16/11/2021 11:00	2 HOUR	4.79						
16/11/2021 11:30	2.5	4.67						
3 HOUR CONSTANT RATE TEST								
1230PM LARGE PUMP WL 4.29								
		2.801	SWL					
	1 MIN	2.823						
	2.0							
	3.0	2.792						
	4.0	2.782						
	5.0	2.770						
	10 MIN	2.765						
	15.0	2.771						
	20.0	2.781						
	30.0	2.784						
	45	2.762						
	1 HOUR	2.767						
	1.5	2.144						
	2 HOUR	2.735						
	2.5	2.855						
	3 HOUR	2.831						
	3.5	2.822						

	1.91		-1.91	
2.690	2.69	0.000	-2.69	
2.940	2.94	0.000	-2.94	
3.140	3.14	0.000	-3.14	
3.270	3.27	0.000	-3.27	
3.360	3.36	0.000	-3.36	
3.630	3.63	0.000	-3.63	
3.840	3.84	0.000	-3.84	
4.010	4.01	0.000	-4.01	
4.240	4.24	0.000	-4.24	
4.530	4.53	0.000	-4.53	
4.770	4.77	0.000	-4.77	
5.110	5.11	0.000	-5.11	
5.410	5.41	0.000	-5.41	
5.600	5.6	0.000	-5.6	
5.820	5.82	0.000	-5.82	
6.170	6.17	0.000	-6.17	
6.380	6.38	0.000	-6.38	
7.370	7.37	0.000	-7.37	
7.450	7.45	0.000	-7.45	
7.530	7.53	0.000	-7.53	
7.600	7.6	0.000	-7.6	
7.640	7.64	0.000	-7.64	
7.870	7.87	0.000	-7.87	
8.410	8.41	0.000	-8.41	
8.500	8.5	0.000	-8.5	
8.575	8.575	0.000	-8.575	
9.000	9	0.000	-9	
9.050	9.05	0.000	-9.05	
9.060	9.06	0.000	-9.06	
8.21	8.21	0.000	-8.21	recov
7.83	7.83	0.000	-7.83	
7.67	7.67	0.000	-7.67	
7.54	7.54	0.000	-7.54	
7.44	7.44	0.000	-7.44	
7.18	7.18	0.000	-7.18	
6.94	6.94	0.000	-6.94	
	6.77	0.000	-6.77	
6.45	6.45	0.000	-6.45	
6.08	6.08	0.000	-6.08	
5.79	5.79	0.000	-5.79	
5.28	5.28	0.000	-5.28	
4.79	4.79	0.000	-4.79	
4.67	4.67	0.000	-4.67	

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	*Q L/S*	Remarks	Pizo Bore #1	Pizo Bore #2	

Actual time	Elasped Time (min)	Water level below datum (m)	Change in water levels	*L/S*
15/11/2021 9:00	**SWL**	1.91		0
15/11/2021 9:01	1m	2.69		1.54
15/11/2021 9:02	2m	2.94		1.541
15/11/2021 9:03	3m	3.14		1.526
15/11/2021 9:04	4m	3.27		1.542
15/11/2021 9:05	5m	3.36		1.535
15/11/2021 9:10	10m	3.63		1.525
15/11/2021 9:15	15m	3.84		1.522
15/11/2021 9:20	20m	4.01		1.52
15/11/2021 9:30	30m	4.24		1.513
15/11/2021 9:45	45m	4.53		1.507
15/11/2021 10:00	1 hour	4.77		1.511
15/11/2021 10:30	1.5 hours	5.11		1.501
15/11/2021 11:00	2hours	5.41		1.498
15/11/2021 11:30	2.5 hours	5.6		1.5
15/11/2021 12:00	3 hours	5.82		1.496
15/11/2021 13:00	4 hours	6.17		1.499
15/11/2021 14:00	5 hours	6.38		1.481
15/11/2021 16:00	7 hours	7.37		1.5
15/11/2021 16:15	7.25	7.45		1.776
15/11/2021 16:30	7.5	7.53		1.809
15/11/2021 16:45	7.75	7.6		1.79
15/11/2021 17:00	8 hours	7.64		1.78
15/11/2021 18:00	9 hours	7.87		1.751
15/11/2021 22:00	13 hours	8.41		1.759
15/11/2021 23:00	14 hours	8.5		1.769
16/11/2021 0:00	15 hours	8.375		1.77
16/11/2021 6:00	21 hours	9		1.76
16/11/2021 8:00	23 hours	9.05		1.752
16/11/2021 9:00	24 hours	9.06		1.762
RECOVERY				
16/11/2021 9:01	1	8.21		0
16/11/2021 9:02	2	7.83		0
16/11/2021 9:03	3	7.67		0
16/11/2021 9:04	4	7.34		0
16/11/2021 9:05	5	7.44		0
16/11/2021 9:10	10 MIN	7.18		0
16/11/2021 9:15	15	6.94		0
16/11/2021 9:20	20	6.77		0
16/11/2021 9:30	30	6.45		0
16/11/2021 9:45	45	6.08		0

16/11/2021 10:00	1 HOUR	5.79	0
16/11/2021 10:30	1.5 HOUR	5.28	0
16/11/2021 11:00	2 HOUR	4.79	0
16/11/2021 11:30	2.5	4.67	0

3 HOUR CONSTANT RATE TEST

		2.801
1 MIN	5.82	2.823
2	6.07	2.792
3	6.35	2.782
4	6.67	
5	6.85	2.765
10 MIN	7.48	2.771
15	7.93	2.781
20	8.22	2.784
30	8.71	2.762
45	9.27	2.767
1 HOUR	9.96	2.144
1.5	10.38	2.735
2 HOUR	10.66	2.855
2.5	11.14	2.831
3 HOUR	11.45	2.822

Remarks	Pizo Bore #1 SOUTH p1	Shallow p2	Pizo Bore #2 NORTH p3	Shallow p4			
	1.74	1.93	1.76	1.96	-1.74	-1.93	-1.76
	1.8	1.92	1.78	1.96	-1.8	-1.92	-1.78
	1.89	1.92	1.82	1.96	-1.89	-1.92	-1.82
	1.975	1.92	1.87	1.96	-1.975	-1.92	-1.87
	2.04	1.92	1.92	1.96	-2.04	-1.92	-1.92
	2.1	1.92	1.98	1.96	-2.1	-1.92	-1.98
	2.342	1.92	2.2	1.96	-2.342	-1.92	-2.2
	2.518	1.92	2.36	1.96	-2.518	-1.92	-2.36
	2.665	1.92	2.5	1.96	-2.665	-1.92	-2.5
	2.93	1.92	2.75	1.96	-2.93	-1.92	-2.75
	3.23	1.92	3.05	1.96	-3.23	-1.92	-3.05
	3.48	1.92	3.39	1.96	-3.48	-1.92	-3.39
	3.88	1.92	3.7	1.96	-3.88	-1.92	-3.7
	4.19	1.92	4.02	1.96	-4.19	-1.92	-4.02
	4.47	1.92	4.28	1.96	-4.47	-1.92	-4.28
	4.66	1.92	4.49	1.96	-4.66	-1.92	-4.49
	4.99	1.92	4.83	1.96	-4.99	-1.92	-4.83
	5.28	1.92	5.11	1.94	-5.28	-1.92	-5.11
	2.97	1.92	5.77	1.94	-2.97	-1.92	-5.77
	6.08	1.92	5.85	1.94	-6.08	-1.92	-5.85
	6.14	1.92	5.94	1.94	-6.14	-1.92	-5.94
	6.22	1.92	6.01	1.94	-6.22	-1.92	-6.01
	6.29	1.92	6.07	1.94	-6.29	-1.92	-6.07
	6.49	1.92	6.285	1.94	-6.49	-1.92	-6.285
	7.02	1.92	6.815	1.94	-7.02	-1.92	-6.815
	7.105	1.92	6.89	1.96	-7.105	-1.92	-6.89
	7.185	1.92	6.965	1.96	-7.185	-1.92	-6.965
	7.585	1.92	7.38	1.96	-7.585	-1.92	-7.38
	7.64	1.92	7.415	1.96	-7.64	-1.92	-7.415
	7.64	1.92	7.43	1.96	-7.64	-1.92	-7.43
	7.585	1.92	7.4	1.98	-7.585	-1.92	-7.4
	7.500	1.92	7.37	1.98	-7.5	-1.92	-7.37
	7.425	1.92	7.33	1.98	-7.425	-1.92	-7.33
	7.350	1.92	7.28	1.98	-7.35	-1.92	-7.28
	7.285	1.92	7.23	1.98	-7.285	-1.92	-7.23
	7.000	1.92	6.98	1.98	-7	-1.92	-6.98
	6.790	1.92	6.79	1.98	-6.79	-1.92	-6.79
	6.610	1.92	6.61	1.98	-6.61	-1.92	-6.61
	6.298	1.92	6.3	1.98	-6.298	-1.92	-6.3
	5.920	1.92	5.94	1.98	-5.92	-1.92	-5.94

5.605	1.92	5.63	1.98	-5.605	-1.92	-5.63
4.860	1.92	5.15	1.98	-4.86	-1.92	-5.15
4.130	1.92	4.8	1.98	-4.13	-1.92	-4.8
3.400	1.92	4.51	1.98	-3.4	-1.92	-4.51

	4.13	1.98
	4.19	1.98
	4.27	1.98
	4.34	1.98
5.160	4.42	1.98
	4.77	1.98
5.700	5.08	1.98
6.012	5.32	1.98
6.570	5.72	1.98
6.970	6.2	1.98
7.540	6.58	1.98
8.040	7.09	1.98
8.480	7.56	1.98
	7.96	1.98

-1.96
-1.96
-1.96
-1.96
-1.96
-1.96
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-1.96
-1.96
-1.96
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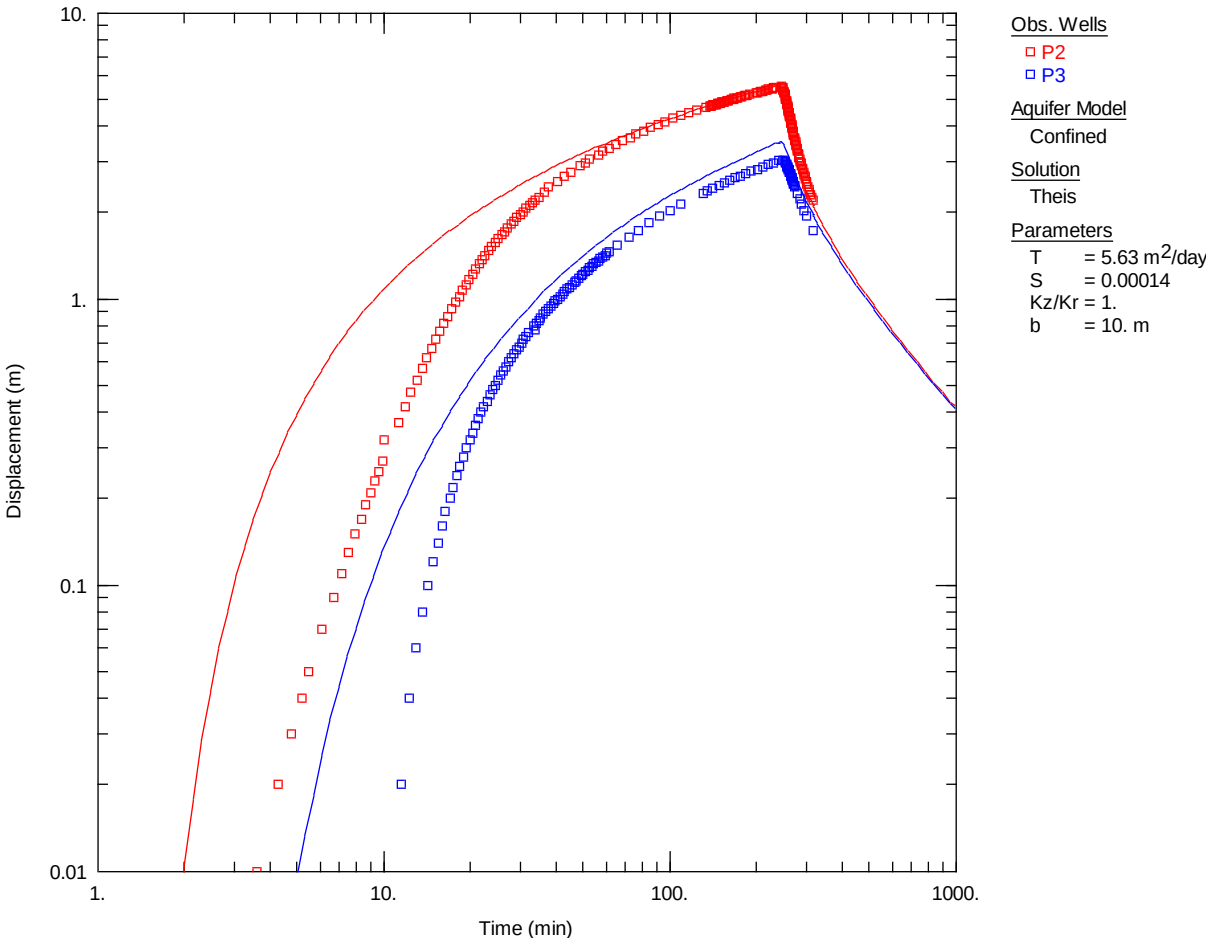
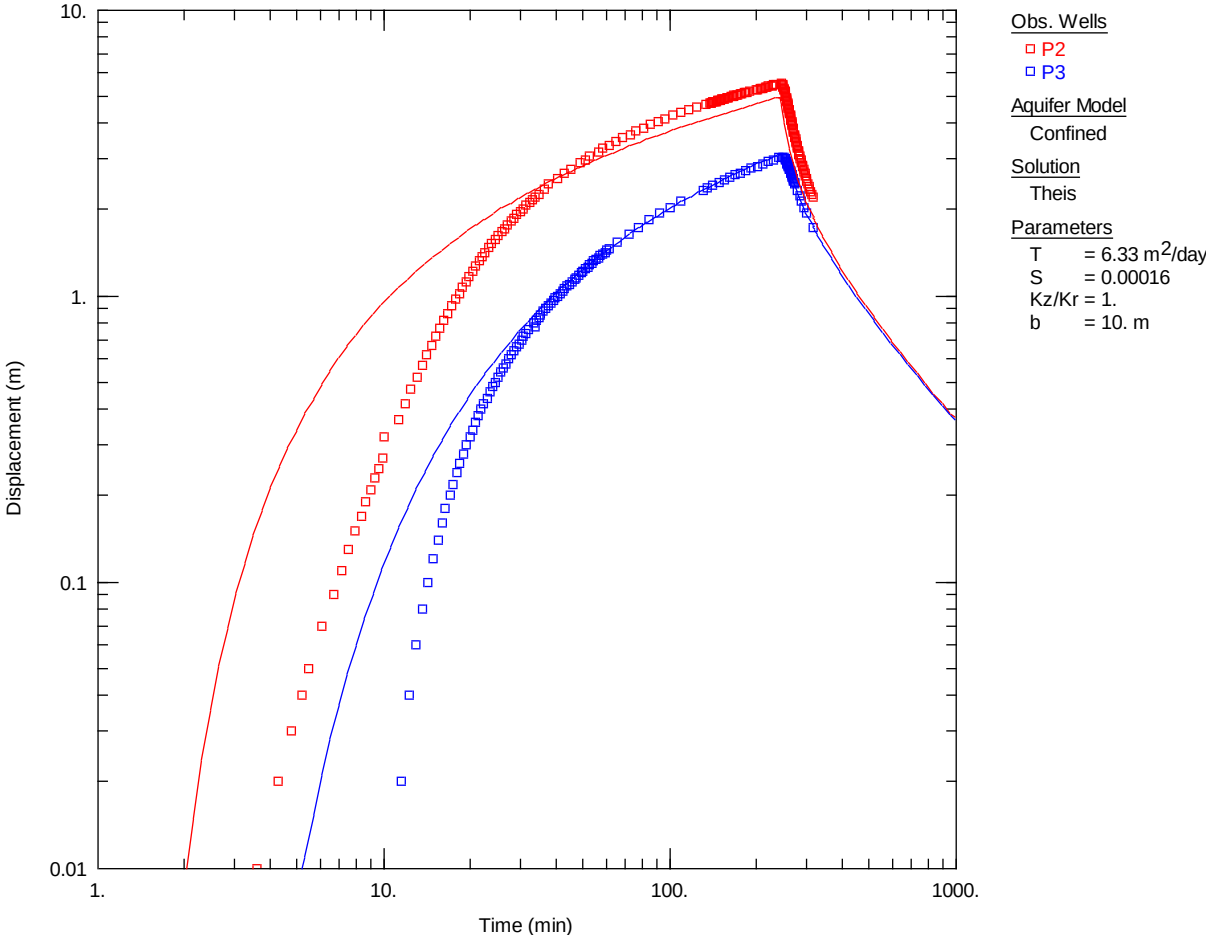
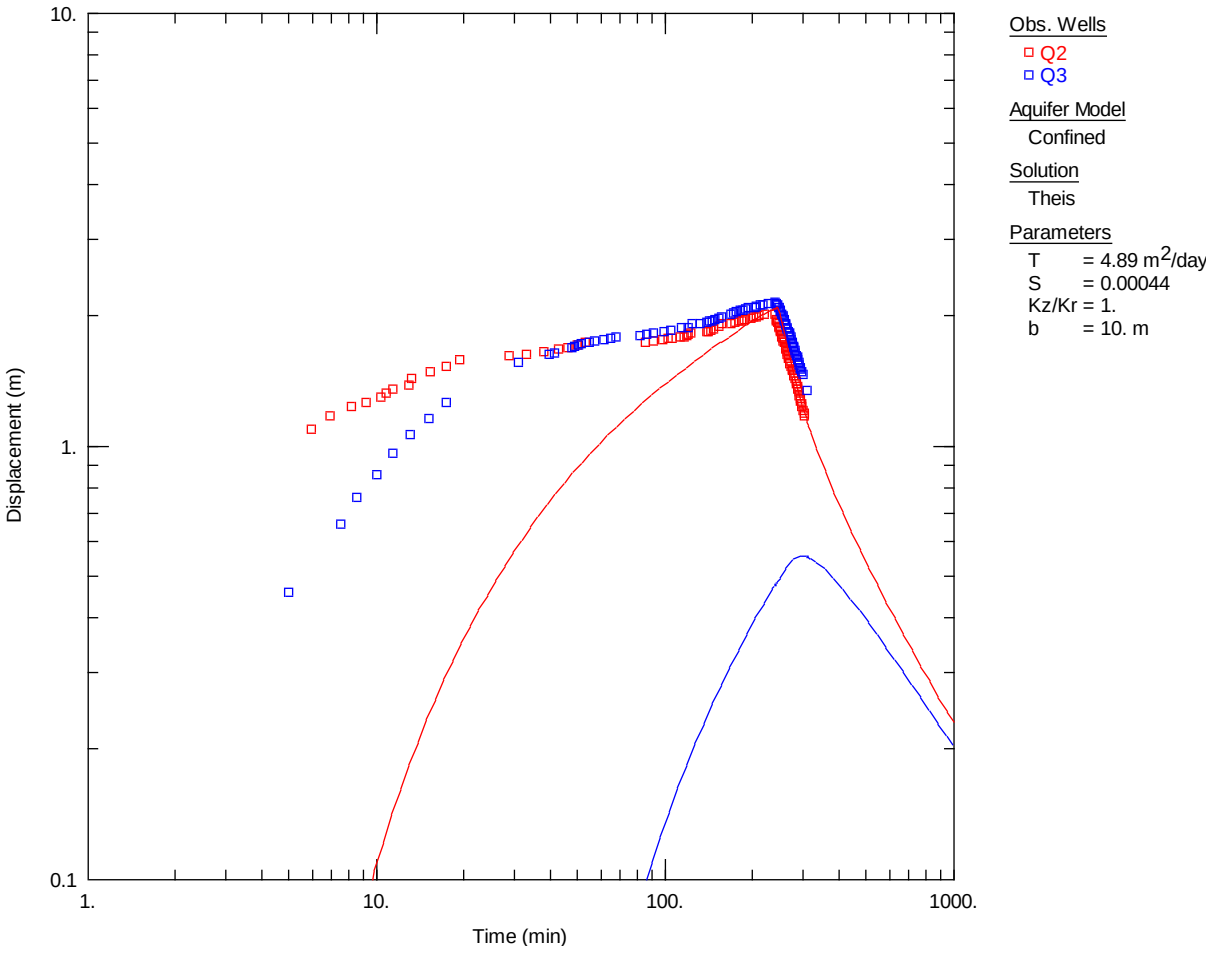
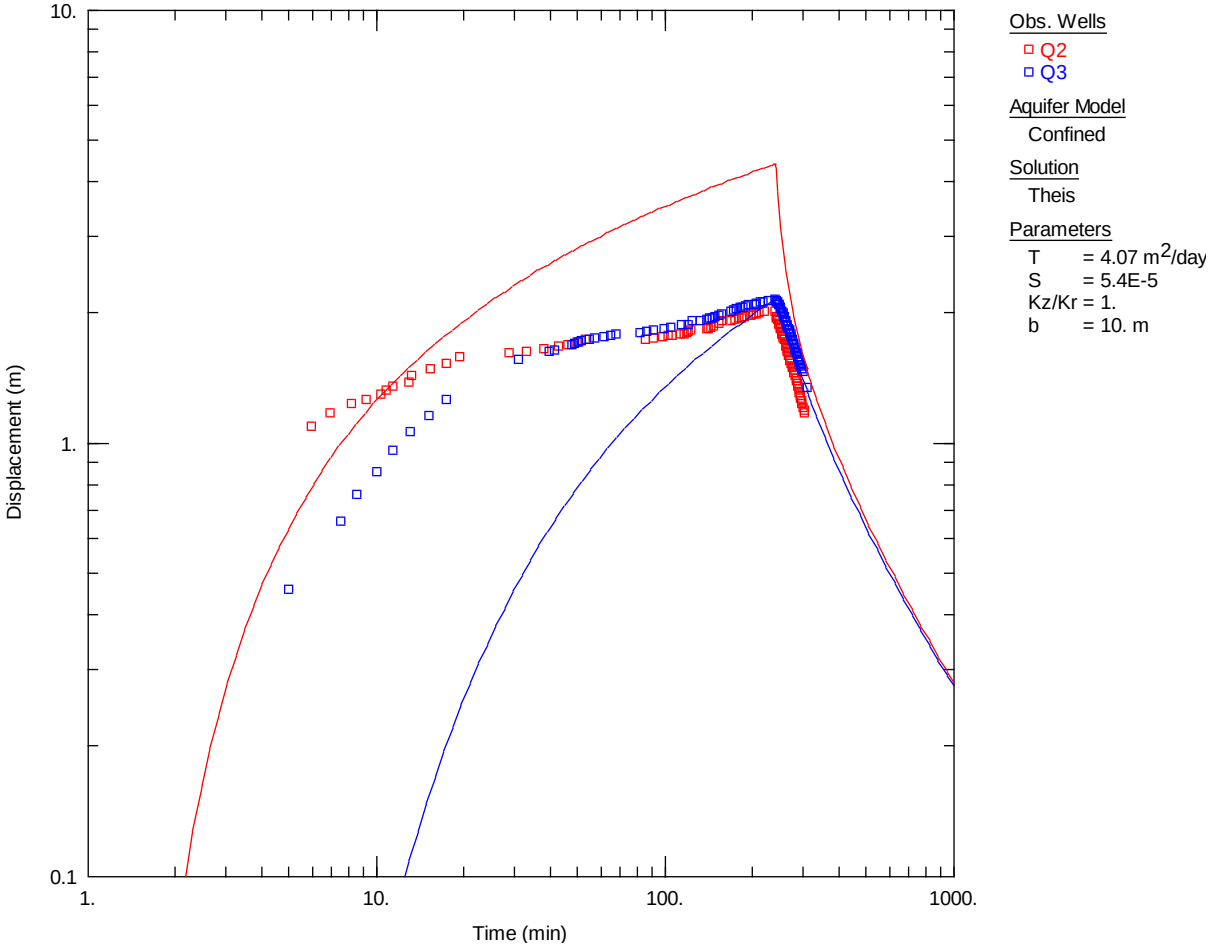
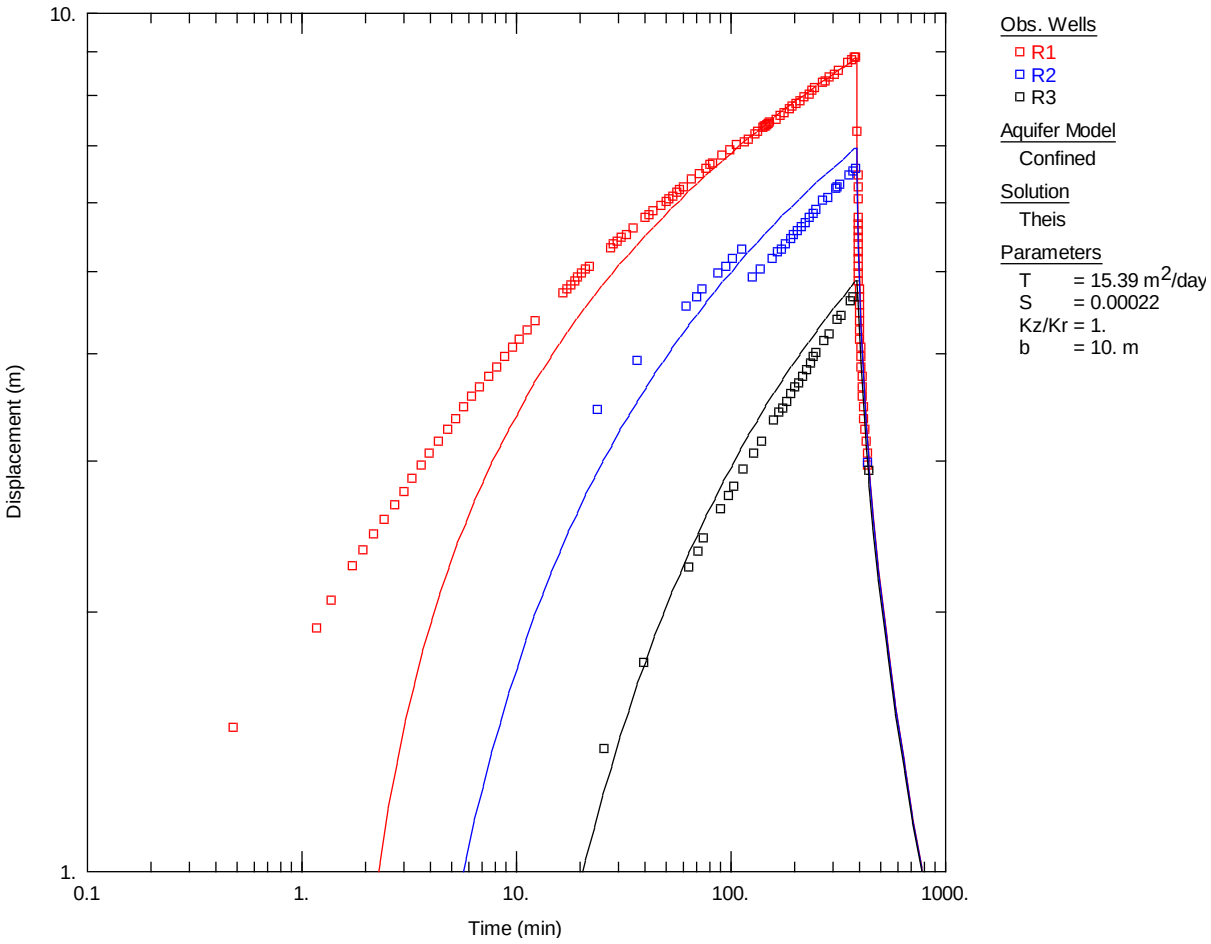
-1.98

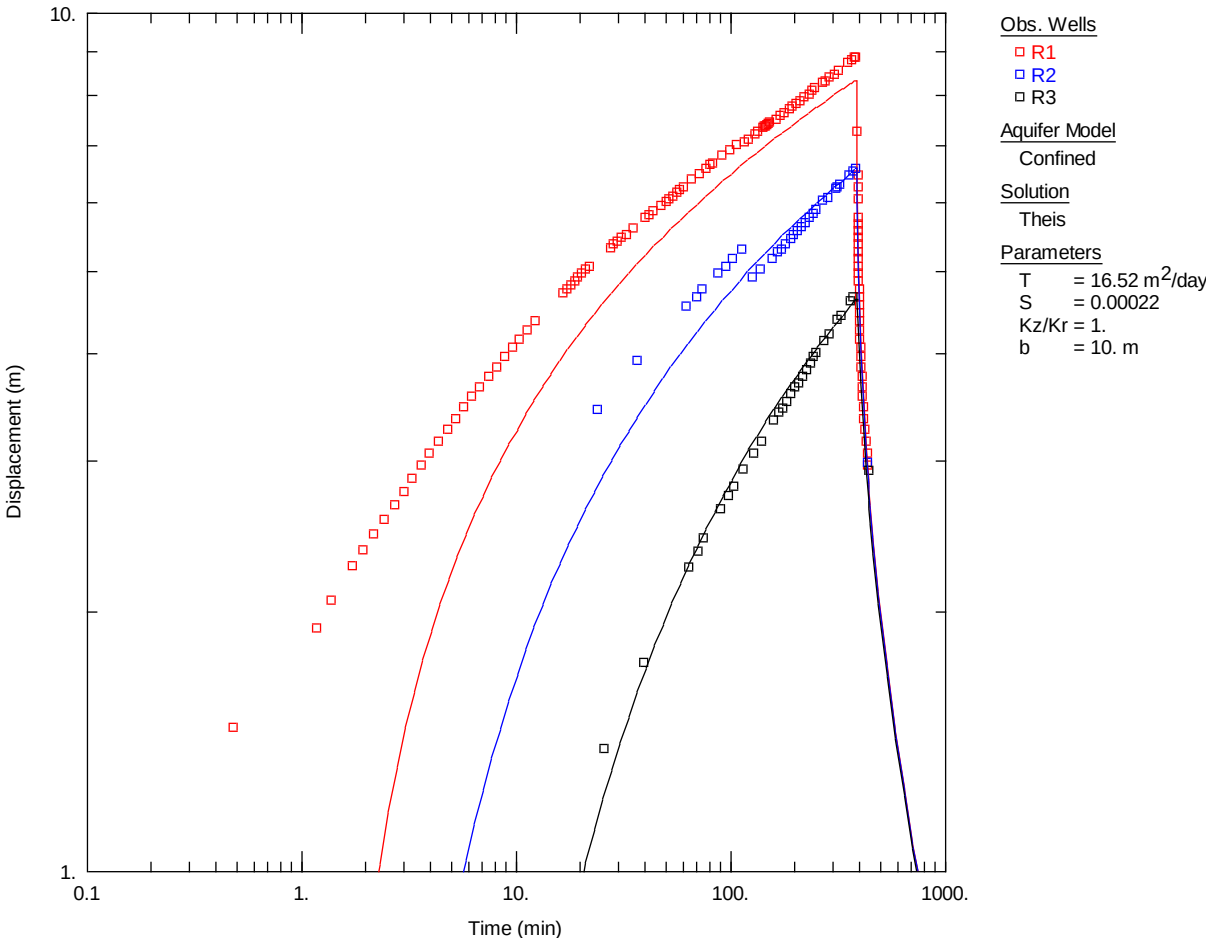

10.
1.
0.1
0.01
Displacement (m)
1.
10.
100.
1000.
Time (min)
Obs. Wells
P2
P3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 5.63 m2/day
S = 0.00014
Kz/Kr = 1.
b = 10. m

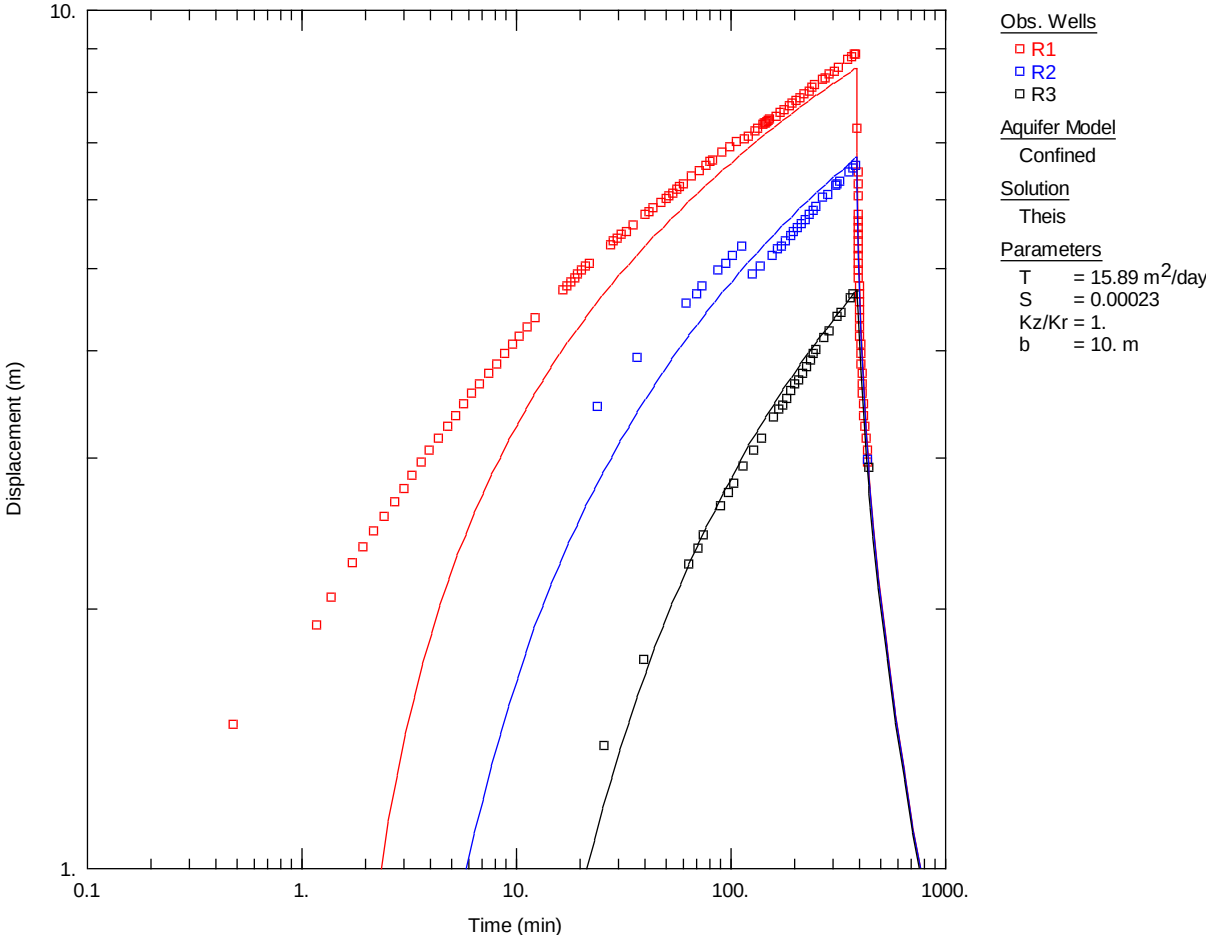

10.
1.
0.1
0.01
Displacement (m)
1.
10.
100.
1000.
Time (min)
Obs. Wells
P2
P3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 6.33 m2/day
S = 0.00016
Kz/Kr = 1.
b = 10. m

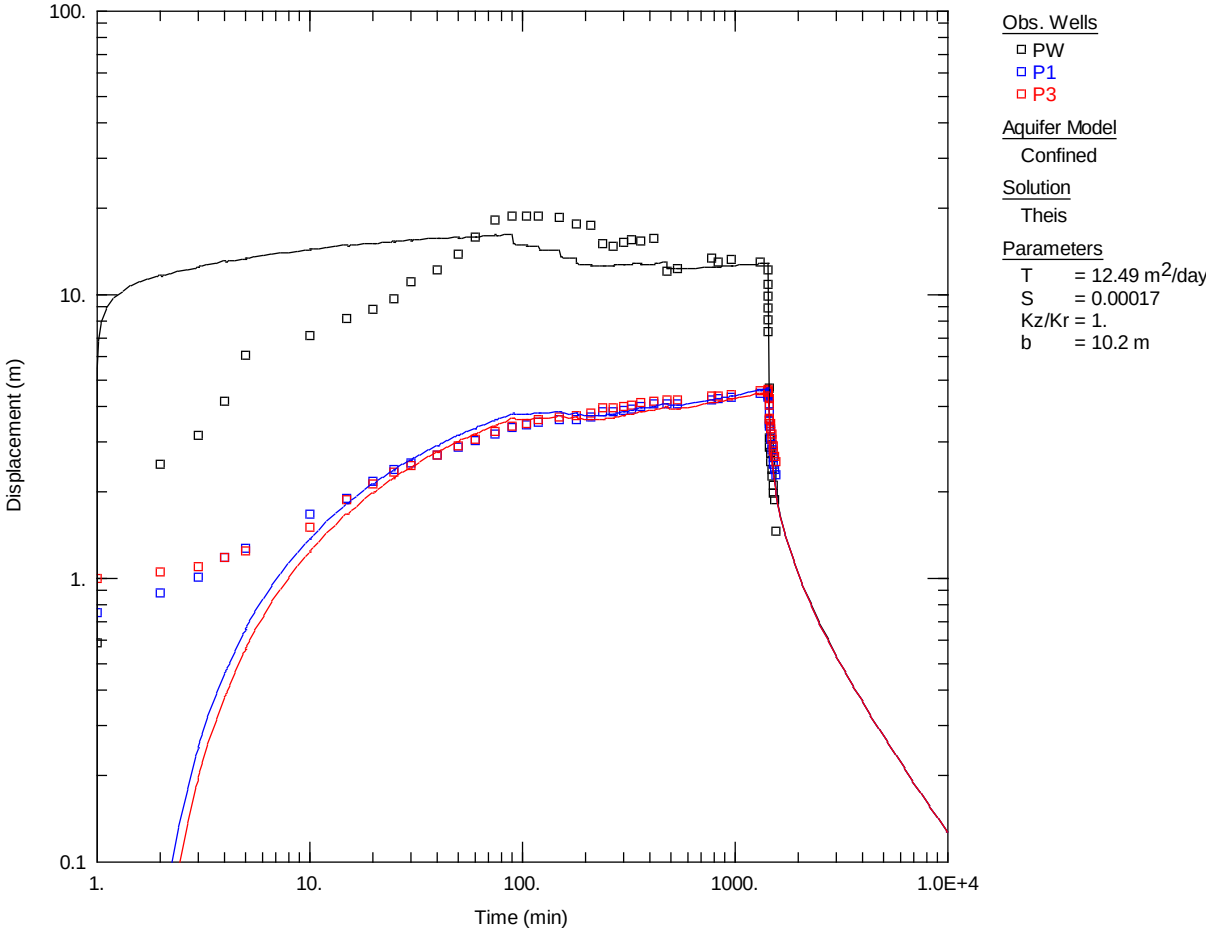

10.
1.
0.1
Displacement (m)
1.
10.
100.
1000.
Time (min)
Obs. Wells
Q2
Q3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 4.89 m2/day
S = 0.00044
Kz/Kr = 1.
b = 10. m

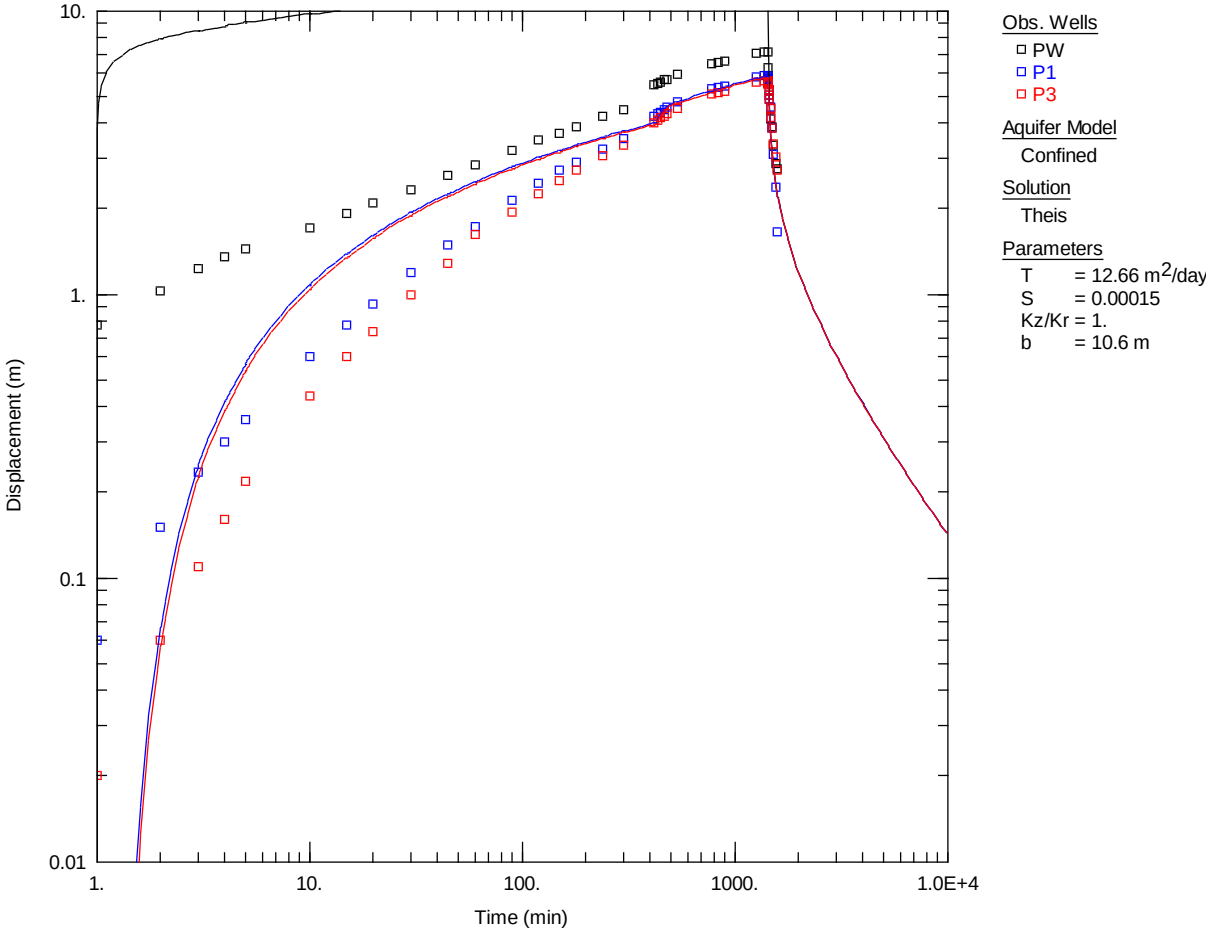

10.
1.
0.1
Displacement (m)
1.
10.
100.
1000.
Time (min)
Obs. Wells
Q2
Q3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 4.07 m2/day
S = 5.4E-5
Kz/Kr = 1.
b = 10. m


10.
1.
Displacement (m)
0.1
1.
10.
100.
1000.
Time (min)
Obs. Wells
R1
R2
R3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 15.39 m2/day
S = 0.00022
Kz/Kr = 1.
b = 10. m


10.
1.
Displacement (m)
0.1
1.
10.
100.
1000.
Time (min)
Obs. Wells
R1
R2
R3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 16.52 m2/day
S = 0.00022
Kz/Kr = 1.
b = 10. m


10.
1.
0.1
1.
10.
100.
1000.
Displacement (m)
Time (min)
Obs. Wells
R1
R2
R3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 15.89 m2/day
S = 0.00023
Kz/Kr = 1.
b = 10. m


100.
10.
1.
0.1
Displacement (m)
1.
10.
100.
1000.
1.0E+4
Time (min)
Obs. Wells
PW
P1
P3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 12.49 m2/day
S = 0.00017
Kz/Kr = 1.
b = 10.2 m


10.
1.
0.1
0.01
Displacement (m)
1.
10.
100.
1000.
1.0E+4
Time (min)
Obs. Wells
PW
P1
P3
Aquifer Model
Confined
Solution
Theis
Parameters
T = 12.66 m2/day
S = 0.00015
Kz/Kr = 1.
b = 10.6 m

Stream depletion analysis - Hunt (1999) solution

Pumped aquifer

Transmissivity (T)	20	(m^2/d)
Storage coefficient (S)	0.1	-

Streambed

Hydraulic conductivity (K")	1	(m/d)
Thickness (B")	1	(m)
Width (W)	100	(m)
Stream bed conductance (λ)	**100**	(m/d)

Well

Pumping rate (Q)	8.1	(L/s)
Separation distance (L)	90	(m)

Application efficiency

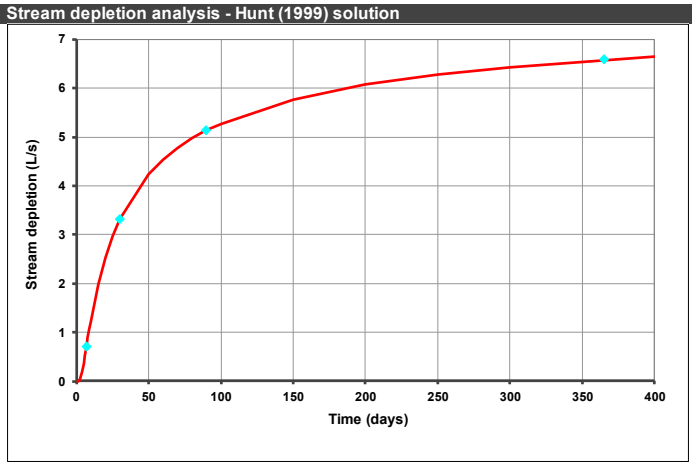
Irrigation efficiency	100%	
Separation distance (L2)	90	(m)

Stream depletion after

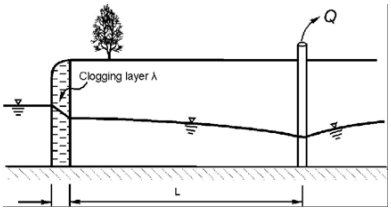
Time (days)	q (L/s)	%
7	1	**9%**
30	3	**41%**
90	5	**63%**
365	7	**81%**

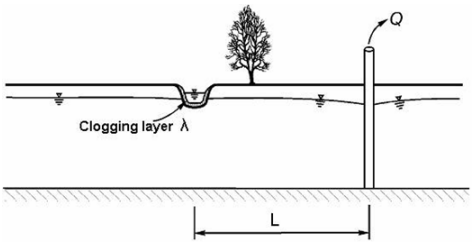
Only the values in shaded cells can be updated - all other cells are dependent on those input values.

Setting lambda to a very high value will give Theis solution



Time (days)	Depletion Rate @100% (L/s)	@100% (L/s)
1.0	0.0	0.0
2.0	0.0	0.0
3.0	0.1	0.1
4.0	0.2	0.2
5.0	0.4	0.4
6.0	0.5	0.5
7.0	0.7	0.7
8.0	0.9	0.9
9.0	1.1	1.1
10.0	1.2	1.2
15.0	2.0	2.0
20.0	2.5	2.5
25.0	3.0	3.0
30.0	3.3	3.3
50.0	4.2	4.2
60.0	4.5	4.5
70.0	4.8	4.8
80.0	5.0	5.0
90.0	5.1	5.1
100.0	5.3	5.3
150.0	5.8	5.8
200.0	6.1	6.1
250.0	6.3	6.3
300.0	6.4	6.4
400.0	6.7	6.7





Stream depletion analysis - Hunt (1999) solution

Pumped aquifer

Transmissivity (T)	20	(m^2/d)
Storage coefficient (S)	0.1	-

Streambed

Hydraulic conductivity (K")	1	(m/d)
Thickness (B")	1	(m)
Width (W)	100	(m)
Stream bed conductance (λ)	**100**	(m/d)

Well

Pumping rate (Q)	7.3	(L/s)
Separation distance (L)	90	(m)

Application efficiency

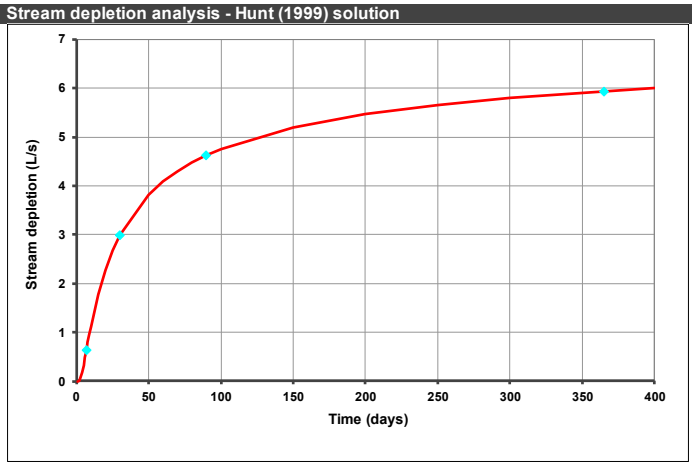
Irrigation efficiency	100%	
Separation distance (L2)	90	(m)

Stream depletion after

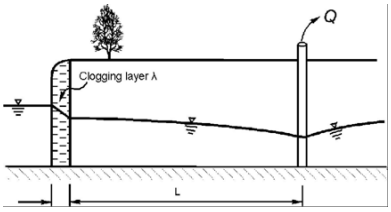
Time (days)	q (L/s)	%
7	1	**9%**
30	3	**41%**
90	5	**63%**
365	6	**81%**

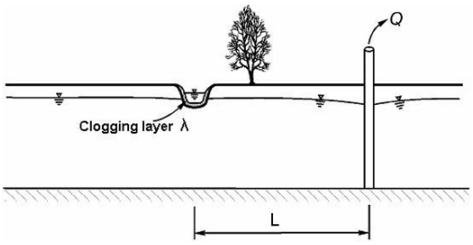
Only the values in shaded cells can be updated - all other cells are dependent on those input values.

Setting lambda to a very high value will give Theis solution



Time (days)	Depletion Rate @100% (L/s)	@100% (L/s)
1.0	0.0	0.0
2.0	0.0	0.0
3.0	0.1	0.1
4.0	0.2	0.2
5.0	0.3	0.3
6.0	0.5	0.5
7.0	0.6	0.6
8.0	0.8	0.8
9.0	1.0	1.0
10.0	1.1	1.1
15.0	1.8	1.8
20.0	2.3	2.3
25.0	2.7	2.7
30.0	3.0	3.0
50.0	3.8	3.8
60.0	4.1	4.1
70.0	4.3	4.3
80.0	4.5	4.5
90.0	4.6	4.6
100.0	4.8	4.8
150.0	5.2	5.2
200.0	5.5	5.5
250.0	5.7	5.7
300.0	5.8	5.8
400.0	6.0	6.0





Stream depletion analysis - Hunt (1999) solution

Pumped aquifer

Transmissivity (T)	20	(m^2/d)
Storage coefficient (S)	0.1	-

Streambed

Hydraulic conductivity (K")	1	(m/d)
Thickness (B")	1	(m)
Width (W)	100	(m)
Stream bed conductance (λ)	**100**	(m/d)

Well

Pumping rate (Q)	3.3	(L/s)
Separation distance (L)	90	(m)

Application efficiency

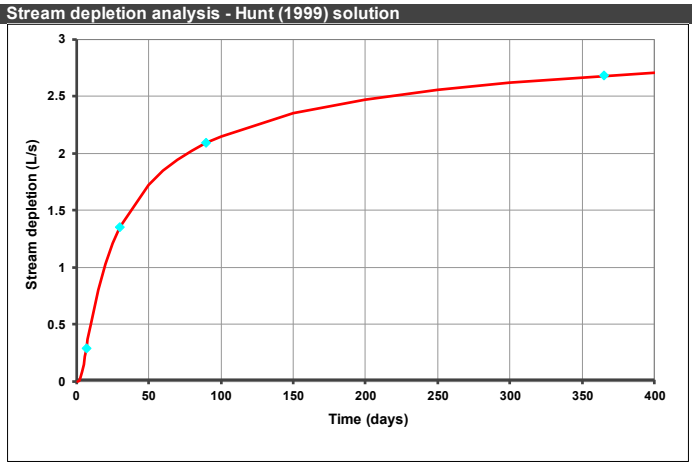
Irrigation efficiency	100%	
Separation distance (L2)	90	(m)

Stream depletion after

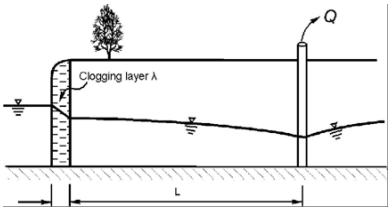
Time (days)	q (L/s)	%
7	0	**9%**
30	1	**41%**
90	2	**63%**
365	3	**81%**

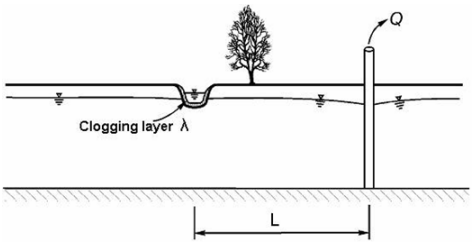
Only the values in shaded cells can be updated - all other cells are dependent on those input values.

Setting lambda to a very high value will give Theis solution



Time (days)	Depletion Rate @100% (L/s)	@100% (L/s)
1.0	0.0	0.0
2.0	0.0	0.0
3.0	0.0	0.0
4.0	0.1	0.1
5.0	0.1	0.1
6.0	0.2	0.2
7.0	0.3	0.3
8.0	0.4	0.4
9.0	0.4	0.4
10.0	0.5	0.5
15.0	0.8	0.8
20.0	1.0	1.0
25.0	1.2	1.2
30.0	1.3	1.3
50.0	1.7	1.7
60.0	1.8	1.8
70.0	1.9	1.9
80.0	2.0	2.0
90.0	2.1	2.1
100.0	2.1	2.1
150.0	2.3	2.3
200.0	2.5	2.5
250.0	2.6	2.6
300.0	2.6	2.6
400.0	2.7	2.7





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Certificate of Analysis
Laboratory Reference:211209-159

Attention:		*Final Report:*	**439561-0**		
Client:	**WAIKAIA GOLD LTD**	*Report Issue Date:*	**20-Dec-2021**		
Address:	**1616 Riversdale, RD 7, Gore, 9777**	*Received Date:*	**09-Dec-2021**		
		Sampled By:	**Noel Becker**		
Client Reference:	**Stream & Bore Samples**	*Laboratory Activity Dates:*	**09-Dec-2021**	-	**17-Dec-2021**
Purchase Order:	**Not Supplied**	*Quote Reference :*	**5453**		

Please note: Waikaka Bore- insufficient sample received, not able to test for TOC and Bromide.

Sample Details		WATERS	WATERS
Lab Sample ID:		**211209-159-1**	**211209-159-2**
Client Sample ID:			
Sample Date/Time		09/12/2021 10:13	09/12/2021 10:14
Description:		Waikaka Pump Bore	Waikaka Stream
Chemistry Detailed			
Anions			
Bromide	mg/L	-	0.019
General Testing			
Conductivity (at 25 °C)	µS/cm	220	85
Nitrate Nitrogen (as N)	mg/L	<0.01	0.32
pH (at room temp c. 20 °C)	pH unit	6.56	7.18
Turbidity	NTU	23	6.4
Metals			
Total Metals by ICP-MS—Trace (Default Digest)			
Arsenic (Total)	mg/L	0.0068	0.00053
Boron (Total)	mg/L	<0.005	<0.005
Cadmium (Total)	mg/L	<0.00005	<0.00005
Calcium (Total)	mg/L	10	5.5
Chromium (Total)	mg/L	0.00065	0.00054
Cobalt (Total)	mg/L	0.00011	0.00021
Copper (Total)	mg/L	0.00055	0.00081
Iron (Total)	mg/L	4.4	0.79
Lead (Total)	mg/L	0.00071	0.00012
Magnesium (Total)	mg/L	5.5	2.1
Manganese (Total)	mg/L	0.2	0.024
Mercury (Total)	mg/L	<0.00005	<0.00005
Potassium (Total)	mg/L	1.2	0.72
Organics			
Total Organic Carbon by Non-dispersive infrared detection			
Total Organic Carbon	mg/L	-	2.7
Microbiology			
Escherichia coli by MPN(Colilert-18)			
Escherichia coli (Colilert-18)	MPN/100mL	<10	640

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Reference Methods

The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
Chemistry Detailed				
Anions				
Bromide	APHA (online edition) 4110 B	0.005 mg/L	2	Auckland
General Testing				
Conductivity (at 25 °C) by Electrode	APHA (online edition) 2510 B	2 µS/cm	All	Invercargill
Nitrate Nitrogen (as N) by Colorimetry/Discrete Analyser	Nitrate-N Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N	0.010 mg/L	All	Invercargill
pH (at room temp c. 20 °C) by Electrode	APHA (online edition) 4500-H B (Tested beyond 15 minute APHA holding time)	0.1 pH unit	All	Invercargill
Turbidity by Nephelometry	APHA (online edition) 2130 B (modified)	0.1 NTU	All	Invercargill
Metals				
Total Metals by ICP-MS—Trace (Default Digest)				
Arsenic (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	All	Auckland
Boron (Total)	APHA (online edition) 3125 B by ICPMS	0.005 mg/L	All	Auckland
Cadmium (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	All	Auckland
Calcium (Total)	APHA (online edition) 3125 B by ICPMS	0.010 mg/L	All	Auckland
Chromium (Total)	APHA (online edition) 3125 B by ICPMS	0.0005 mg/L	All	Auckland
Cobalt (Total)	APHA (online edition) 3125 B by ICPMS	0.00003 mg/L	All	Auckland
Copper (Total)	APHA (online edition) 3125 B by ICPMS	0.0002 mg/L	All	Auckland
Iron (Total)	APHA (online edition) 3125 B by ICPMS	0.002 mg/L	All	Auckland
Lead (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	All	Auckland
Magnesium (Total)	APHA (online edition) 3125 B by ICPMS	0.001 mg/L	All	Auckland
Manganese (Total)	APHA (online edition) 3125 B by ICPMS	0.0005 mg/L	All	Auckland
Mercury (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	All	Auckland
Potassium (Total)	APHA (online edition) 3125 B by ICPMS	0.05 mg/L	All	Auckland
Organics				
Total Organic Carbon by Non-dispersive infrared detection				
Total Organic Carbon	APHA (online edition) 5310 B	0.1 mg/L	2	Auckland
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli (Colilert-18)	APHA (online edition) 9223 B Colilert Quantitray	1 MPN/100mL	All	Invercargill
Preparations				
Digest for Total Metals in Liquids	APHA 3030E Modified (4:1 Nitric:Hydrochloric Acid: 95°C 2 hours)		All	Auckland
Membrane Filtration (0.45 µm)	APHA (online edition) 4500-P B (preliminary filtration)		2	Auckland

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher.

For more information please contact the Compliance and Projects Manager.

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Peter Boniface
KTP Signatory

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Certificate of Analysis
Laboratory Reference:220119-120

Attention:		*Final Report:*	**444293-0**
Client:	**WAIKAIA GOLD LTD**	*Report Issue Date:*	**27-Jan-2022**
Address:	**1616 Riversdale, RD 7, Gore, 9777**	*Received Date:*	**19-Jan-2022**
		Sampled By:	**Noel Becker**
Client Reference:	**Upper Aquifer**	*Laboratory Activity Dates:*	**19-Jan-2022 - 27-Jan-2022**
Purchase Order:	**Not Supplied**	*Quote Reference :*	**5453**

Sample Details		WATERS
Lab Sample ID:		**220119-120-2**
Client Sample ID:		
Sample Date/Time		18/01/2022
Description:		Waikaka Water Pump Test Bore
General Testing		
Chloride	mg/L	11
Conductivity (at 25 °C)	µS/cm	345
pH (at room temp c. 20 °C)	pH unit	6.41
Total Oxidised Nitrogen (as N)	mg/L	<0.01
Total Phosphorus (as P)	mg/L	0.75
Turbidity	NTU	2900
Metals		
Total Metals by ICP-MS—Trace (Default Digest)		
Arsenic (Total)	mg/L	0.071
Cadmium (Total)	mg/L	<0.00025
Chromium (Total)	mg/L	0.033
Cobalt (Total)	mg/L	0.012
Copper (Total)	mg/L	0.05
Iron (Total)	mg/L	63
Lead (Total)	mg/L	0.052
Manganese (Total)	mg/L	2.1
Mercury (Total)	mg/L	0.00026
Microbiology		
Escherichia coli by MPN(Colilert-18)		
Escherichia coli (Colilert-18)	MPN/100mL	<100

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Reference Methods
The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
General Testing				
Chloride by Colorimetry/Discrete Analyser	APHA (online edition) 4500-Cl E	5 mg/L	All	Invercargill
Conductivity (at 25 °C) by Electrode	APHA (online edition) 2510 B	2 µS/cm	All	Invercargill
pH (at room temp c. 20 °C) by Electrode	APHA (online edition) 4500-H B (Tested beyond 15 minute APHA holding time)	0.1 pH unit	All	Invercargill
Total Oxidised Nitrogen (as N) by Colorimetry/Discrete Analyser	APHA (online edition) 4500-NO3 H	0.010 mg/L	All	Invercargill
Total Phosphorus (as P) by Persulphate Digestion and Colorimetry/Discrete Analyser	APHA (online edition) 4500-P B, J (modified)	0.010 mg/L	All	Invercargill

General Testing				
Turbidity by Nephelometry	APHA (online edition) 2130 B (modified)	0.1 NTU	All	Invercargill
Metals				
Total Metals by ICP-MS—Trace (Default Digest)				
Arsenic (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	All	Auckland
Cadmium (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	All	Auckland
Chromium (Total)	APHA (online edition) 3125 B by ICPMS	0.0005 mg/L	All	Auckland
Cobalt (Total)	APHA (online edition) 3125 B by ICPMS	0.00003 mg/L	All	Auckland
Copper (Total)	APHA (online edition) 3125 B by ICPMS	0.0002 mg/L	All	Auckland
Iron (Total)	APHA (online edition) 3125 B by ICPMS	0.002 mg/L	All	Auckland
Lead (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	All	Auckland
Manganese (Total)	APHA (online edition) 3125 B by ICPMS	0.0005 mg/L	All	Auckland
Mercury (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	All	Auckland
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli (Colilert-18)	APHA (online edition) 9223 B Colilert Quantitray	1 MPN/100mL	All	Invercargill
Preparations				
Digest for Total Metals in Liquids	APHA 3030E Modified (4:1 Nitric:Hydrochloric Acid: 95°C 2 hours)		All	Auckland

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher.

For more information please contact the Compliance and Projects Manager.

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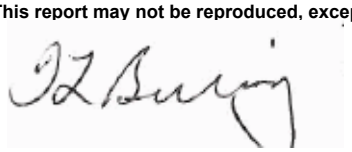

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Certificate of Analysis
Laboratory Reference:220525-096

Attention:	Noel Becker	*Final Report:*	**462272-0**		
Client:	**WAIKAIA GOLD LTD**	*Report Issue Date:*	**01-Jun-2022**		
Address:	**1616 Riversdale, RD 7, Gore, 9777**	*Received Date:*	**25-May-2022**		
		Sampled By:	**Noel Becker**		
Client Reference:	**Waikaia Gold Water Samples**	*Laboratory Activity Dates:*	**25-May-2022**	-	**31-May-2022**
Purchase Order:	**Not Provided**	*Quote Reference :*	**5453**		

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**220525-096-1**	**220525-096-2**	**220525-096-3**	**220525-096-4**
Client Sample ID:		3011	3012	3013	3014
Sample Date/Time		24/05/2022	24/05/2022	24/05/2022	24/05/2022
Description:		Piezo, basal aquifer, Non oxidised sample	Piezo, basal aquifer. Oxidised sample	Shepherds Creek, upstream of confluence	Shepherds Creek below landfill
Metals					
Total Metals by ICP-MS—Trace (Default Digest)					
Arsenic (Total)	mg/L	0.0021	0.002	0.00057	0.00052
Cadmium (Total)	mg/L	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (Total)	mg/L	11	11	18	18
Lead (Total)	mg/L	0.00066	0.00053	<0.0001	<0.0001
Magnesium (Total)	mg/L	5.4	5.4	3.7	3.8
Manganese (Total)	mg/L	0.19	0.19	0.022	0.013
Mercury (Total)	mg/L	<0.00005	<0.00005	<0.00005	<0.00005
Potassium (Total)	mg/L	1.2	1.1	2.0	2.1
Sodium (Total)	mg/L	21	21	10	10
Zinc (Total)	mg/L	<0.001	<0.001	0.0018	0.0031

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**220525-096-5**	**220525-096-6**	**220525-096-7**	**220525-096-8**
Client Sample ID:		3015	3016	3017	3019
Sample Date/Time		24/05/2022	24/05/2022	24/05/2022	24/05/2022
Description:		Waikaka Stream, downstream of Sepherds Creek	Waikaka Stream, between SC and L&M pond outfall	Waikaka Stream, downstream of L&M Pond	Piezo, basal aquifer. Non oxidised sample
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	-	-	-	0.04
Dissolved Reactive Phosphorus (as P)	mg/L	-	-	-	0.048
Nitrate Nitrogen (as N)	mg/L	-	-	-	0.06
Total Phosphorus (as P)	mg/L	-	-	-	0.12
Metals					
Total Metals by ICP-MS—Trace (Default Digest)					
Arsenic (Total)	mg/L	0.00035	0.00037	0.00042	-
Cadmium (Total)	mg/L	<0.00005	<0.00005	<0.00005	-
Calcium (Total)	mg/L	6.9	8.3	8.6	-
Lead (Total)	mg/L	<0.0001	0.00011	<0.0001	-
Magnesium (Total)	mg/L	2.0	2.3	2.3	-
Manganese (Total)	mg/L	0.018	0.02	0.023	-
Mercury (Total)	mg/L	<0.00005	<0.00005	<0.00005	-
Potassium (Total)	mg/L	1.2	1.3	1.3	-
Sodium (Total)	mg/L	7.1	7.7	7.8	-
Zinc (Total)	mg/L	<0.001	0.002	<0.001	-

Sample Details (continued)		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**220525-096-5**	**220525-096-6**	**220525-096-7**	**220525-096-8**
Client Sample ID:		3015	3016	3017	3019
Sample Date/Time:		24/05/2022	24/05/2022	24/05/2022	24/05/2022
Description:		Waikaka Stream, downstream of Sepherds Creek	Waikaka Stream, between SC and L&M pond outfall	Waikaka Stream, downstream of L&M Pond	Piezo, basal aquifer. Non oxidised sample
Microbiology					
Escherichia coli by MPN(Colilert-18)					
Escherichia coli (Colilert-18)	MPN/100mL	-	-	-	<10

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**220525-096-9**	**220525-096-10**	**220525-096-11**	**220525-096-12**
Client Sample ID:		3020	3021	3022	3023
Sample Date/Time		24/05/2022	24/05/2022	24/05/2022	24/05/2022
Description:		Piezo, basal aquifer. Oxidised sample	Shepherds Creek, upstream of confluence	Sheperds Creek, below landfill	Waikaka Stream, downstream of Sepherds Creek
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.01	0.14	0.08	0.01
Dissolved Reactive Phosphorus (as P)	mg/L	0.034	0.029	0.026	0.015
Nitrate Nitrogen (as N)	mg/L	0.02	3.1	3.1	1.0
Total Phosphorus (as P)	mg/L	0.13	0.08	0.07	0.05
Microbiology					
Escherichia coli by MPN(Colilert-18)					
Escherichia coli (Colilert-18)	MPN/100mL	<10	800	490	400

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**220525-096-13**	**220525-096-14**	**220525-096-15**	**220525-096-16**
Client Sample ID:		3024	3025	3027	3028
Sample Date/Time		24/05/2022	24/05/2022	24/05/2022	24/05/2022
Description:		Waikaka Stream, between SC and L&M pond outfall	Waikaka Stream, downstream of L&M Pond	L&M Pond at discharge	At discharge
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.02	0.02	-	0.06
Dissolved Reactive Phosphorus (as P)	mg/L	0.015	0.015	-	<0.005
Nitrate Nitrogen (as N)	mg/L	1.4	1.3	-	0.51
Total Phosphorus (as P)	mg/L	0.05	0.04	-	0.05
Metals					
Total Metals by ICP-MS—Trace (Default Digest)					
Arsenic (Total)	mg/L	-	-	0.0024	-
Cadmium (Total)	mg/L	-	-	<0.00005	-
Calcium (Total)	mg/L	-	-	23	-
Lead (Total)	mg/L	-	-	<0.0001	-
Magnesium (Total)	mg/L	-	-	6.0	-
Manganese (Total)	mg/L	-	-	0.093	-
Mercury (Total)	mg/L	-	-	<0.00005	-
Potassium (Total)	mg/L	-	-	2.7	-
Sodium (Total)	mg/L	-	-	11	-
Zinc (Total)	mg/L	-	-	0.0011	-
Microbiology					
Escherichia coli by MPN(Colilert-18)					
Escherichia coli (Colilert-18)	MPN/100mL	380	480	-	-

Sample Details		WATERS	WATERS
Lab Sample ID:		**220525-096-17**	**220525-096-18**
Client Sample ID:		3029	3030
Sample Date/Time		24/05/2022	24/05/2022
Description:		Waikaka Stream - Below bridge	Waikaka Stream - Below bridge
General Testing			
Ammoniacal Nitrogen (as N)	mg/L	-	0.01
Dissolved Reactive Phosphorus (as P)	mg/L	-	0.016
Nitrate Nitrogen (as N)	mg/L	-	0.99
Total Phosphorus (as P)	mg/L	-	0.04
Metals			
Total Metals by ICP-MS—Trace (Default Digest)			
Arsenic (Total)	mg/L	0.00033	-
Cadmium (Total)	mg/L	<0.00005	-
Calcium (Total)	mg/L	6.8	-
Lead (Total)	mg/L	<0.0001	-
Magnesium (Total)	mg/L	2.1	-
Manganese (Total)	mg/L	0.019	-
Mercury (Total)	mg/L	<0.00005	-
Potassium (Total)	mg/L	1.2	-
Sodium (Total)	mg/L	7.2	-
Zinc (Total)	mg/L	<0.001	-

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Reference Methods

The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
General Testing				
Ammoniacal Nitrogen (as N) by Colorimetry/Discrete Analyser	ISBN 0117516139 (modified)	0.010 mg/L	8, 9, 10, 11, 12, 13, 14, 16, 18	Invercargill
Dissolved Reactive Phosphorus (as P) by Colorimetry/Discrete Analyser	APHA (online edition) 4500-P E	0.005 mg/L	8, 9, 10, 11, 12, 13, 14, 16, 18	Invercargill
Nitrate Nitrogen (as N) by Colorimetry/Discrete Analyser	Nitrate-N Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N	0.010 mg/L	8, 9, 10, 11, 12, 13, 14, 16, 18	Invercargill
Total Phosphorus (as P) by Persulphate Digestion and Colorimetry/Discrete Analyser	APHA (online edition) 4500-P B, J (modified)	0.010 mg/L	8, 9, 10, 11, 12, 13, 14, 16, 18	Invercargill
Metals				
Total Metals by ICP-MS—Trace (Default Digest)				
Arsenic (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Cadmium (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Calcium (Total)	APHA (online edition) 3125 B by ICPMS	0.010 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Lead (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Magnesium (Total)	APHA (online edition) 3125 B by ICPMS	0.001 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Manganese (Total)	APHA (online edition) 3125 B by ICPMS	0.0005 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Mercury (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Potassium (Total)	APHA (online edition) 3125 B by ICPMS	0.05 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Sodium (Total)	APHA (online edition) 3125 B by ICPMS	0.1 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Zinc (Total)	APHA (online edition) 3125 B by ICPMS	0.001 mg/L	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli (Colilert-18)	APHA (online edition) 9223 B Colilert Quantitray	1 MPN/100mL	8, 9, 10, 11, 12, 13, 14	Invercargill

Preparations			
Digest for Total Metals in Liquids	APHA 3030E Modified (4:1 Nitric:Hydrochloric Acid: 95°C 2 hours)	1, 2, 3, 4, 5, 6, 7, 15, 17	Auckland
Membrane Filtration (0.45 µm)	APHA (online edition) 4500-P B (preliminary filtration)	8, 9, 10, 11, 12, 13, 14, 16, 18	Invercargill

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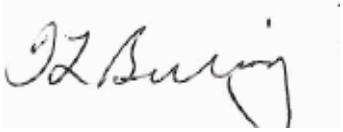

Tonia Bulling
KTP Signatory

Watercare Services Limited
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T: (09) 539 7600
clientsupport@water.co.nz
www.watercarelabs.co.nz

Certificate of Analysis
Laboratory Reference:220901-143

Attention:		*Final Report:*	**475480-0**
Client:	**WAIKAIA GOLD LTD**	*Report Issue Date:*	**14-Sep-2022**
Address:	**1616 Riversdale, RD 7, Gore, 9777**	*Received Date:*	**01-Sep-2022**
Client Reference:	**1051-1054**	*Laboratory Activity Dates:*	**01-Sep-2022 - 13-Sep-2022**
Purchase Order:	**Not Available**	*Quote Reference :*	**5453**

Due to insufficient Sample provided we are not able to test for E.coli, SO4, HCO3 and FL

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**220901-143-1**	**220901-143-2**	**220901-143-3**	**220901-143-4**
Client Sample ID:					
Sample Date/Time		30/08/2022	30/08/2022	30/08/2022	30/08/2022
Description:		UPS LM Pond	Pond	Seep Stock pile North	Seep Stock pile South
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.03	0.02	0.05	1.5
Dissolved Reactive Phosphorus (as P)	mg/L	0.01	0.008	0.015	0.042
Nitrate Nitrogen (as N)	mg/L	0.77	4.0	0.07	<0.01
pH (at room temp c. 20 °C)	pH unit	7.20	7.95	6.52	6.79
Total Nitrogen (as N)	mg/L	1.2	5.0	2.7	11
Total Phosphorus (as P)	mg/L	0.04	0.02	0.26	0.81
Metals					
Total Metals by ICP-MS—Trace (Default Digest)					
Arsenic (Total)	mg/L	0.00029	0.00091	0.0041	0.013
Cadmium (Total)	mg/L	<0.00005	<0.00005	<0.0001	<0.00025
Calcium (Total)	mg/L	7.1	26	41	77
Lead (Total)	mg/L	<0.0001	<0.0001	0.001	0.00061
Magnesium (Total)	mg/L	2.4	5.4	16	19
Manganese (Total)	mg/L	0.021	0.059	5.6	13
Mercury (Total)	mg/L	<0.00005	<0.00005	<0.0001	<0.00025
Potassium (Total)	mg/L	0.75	2.4	4.1	8.7
Sodium (Total)	mg/L	7.8	11	14	13
Zinc (Total)	mg/L	<0.001	0.0018	0.014	0.0082

*Results marked with * are not accredited to International Accreditation New Zealand. A dash indicates no test performed.*

Where samples have been supplied by the client, they are tested as received.

The results of analysis contained in this report relate only to the sample(s) tested. Where sample collection was performed by the laboratory, the results of analysis contained in this report relate only to the sample(s) collected.

Reference Methods
The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
General Testing				
Ammoniacal Nitrogen (as N) by Colorimetry/Discrete Analyser	ISBN 0117516139 (modified)	0.010 mg/L	All	Invercargill
Dissolved Reactive Phosphorus (as P) by Colorimetry/Discrete Analyser	APHA (online edition) 4500-P E	0.005 mg/L	All	Invercargill
Nitrate Nitrogen (as N) by Colorimetry/Discrete Analyser	Nitrate-N Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N	0.010 mg/L	All	Invercargill
pH (at room temp c. 20 °C) by Electrode	APHA (online edition) 4500-H B (Tested beyond 15 minute APHA holding time)	0.1 pH unit	All	Invercargill
Total Nitrogen (as N) by Persulphate Digestion and Colorimetry/Discrete Analyser	APHA (online edition) 4500-P J, 4500-NO3 H	0.010 mg/L	All	Invercargill

General Testing				
Total Phosphorus (as P) by Persulphate Digestion and Colorimetry/Discrete Analyser	APHA (online edition) 4500-P B, J (modified)	0.010 mg/L	All	Invercargill
Metals				
Total Metals by ICP-MS—Trace (Default Digest)				
Arsenic (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	All	Auckland
Cadmium (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	All	Auckland
Calcium (Total)	APHA (online edition) 3125 B by ICPMS	0.010 mg/L	All	Auckland
Lead (Total)	APHA (online edition) 3125 B by ICPMS	0.00010 mg/L	All	Auckland
Magnesium (Total)	APHA (online edition) 3125 B by ICPMS	0.001 mg/L	All	Auckland
Manganese (Total)	APHA (online edition) 3125 B by ICPMS	0.0005 mg/L	All	Auckland
Mercury (Total)	APHA (online edition) 3125 B by ICPMS	0.00005 mg/L	All	Auckland
Potassium (Total)	APHA (online edition) 3125 B by ICPMS	0.05 mg/L	All	Auckland
Sodium (Total)	APHA (online edition) 3125 B by ICPMS	0.1 mg/L	All	Auckland
Zinc (Total)	APHA (online edition) 3125 B by ICPMS	0.001 mg/L	All	Auckland
Preparations				
Digest for Total Metals in Liquids	APHA 3030E Modified (4:1 Nitric:Hydrochloric Acid: 95°C 2 hours)		All	Auckland
Membrane Filtration (0.45 µm)	APHA (online edition) 4500-P B (preliminary filtration)		All	Invercargill

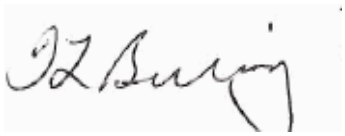
The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher. For more information please contact the Compliance and Projects Manager.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

Watercare Laboratory Services is a division of Watercare Services Limited .

Rhys Carter

KTP Signatory



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PO Box 747
Invercargill, 9840
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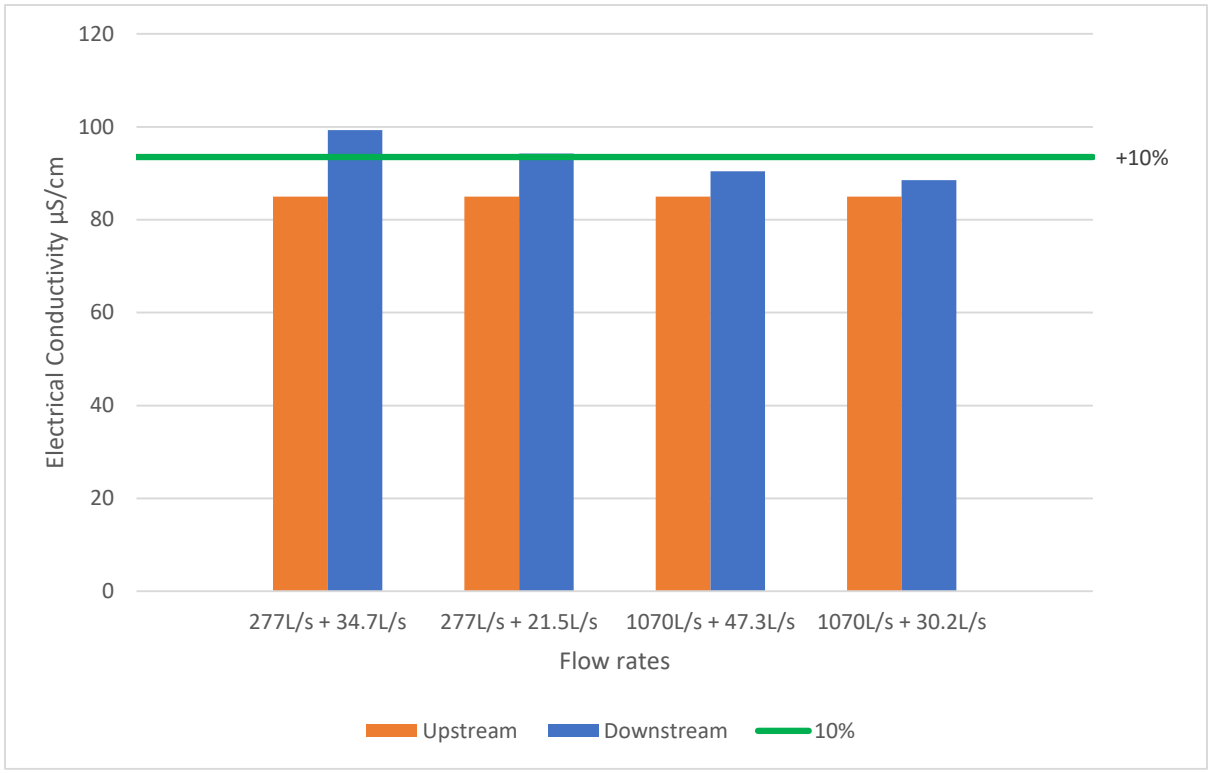
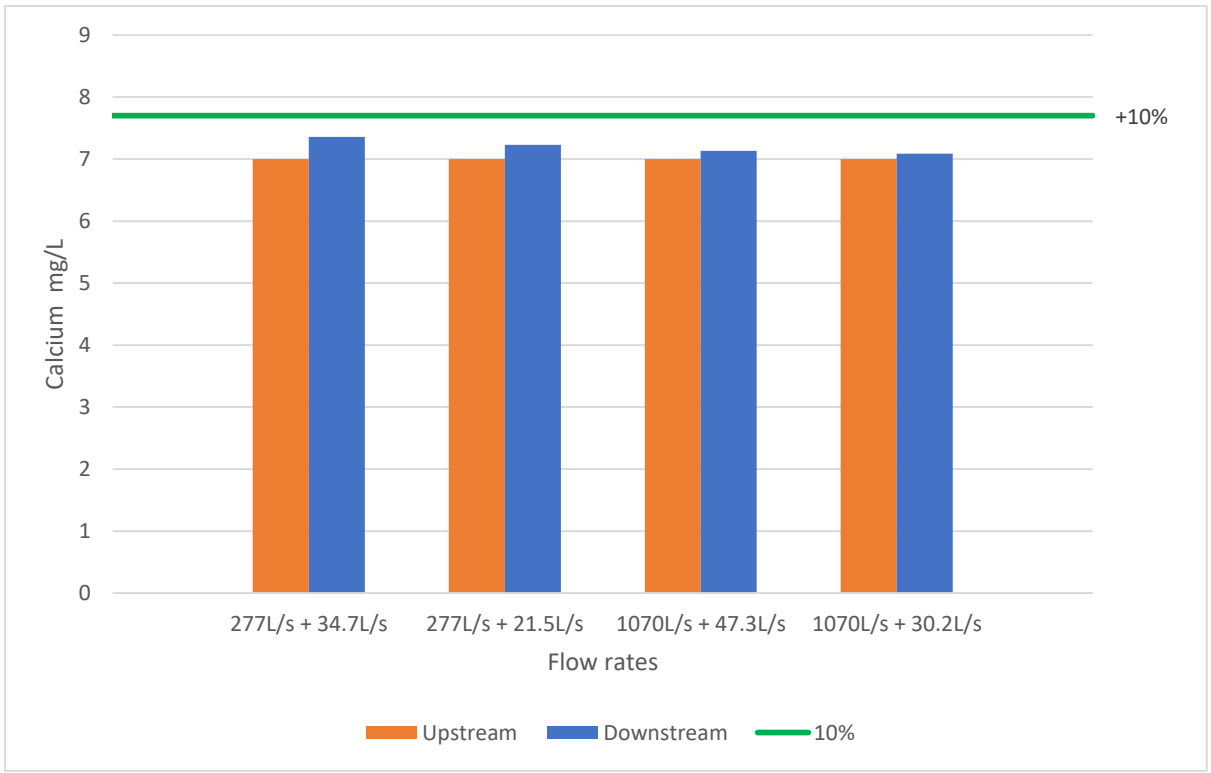
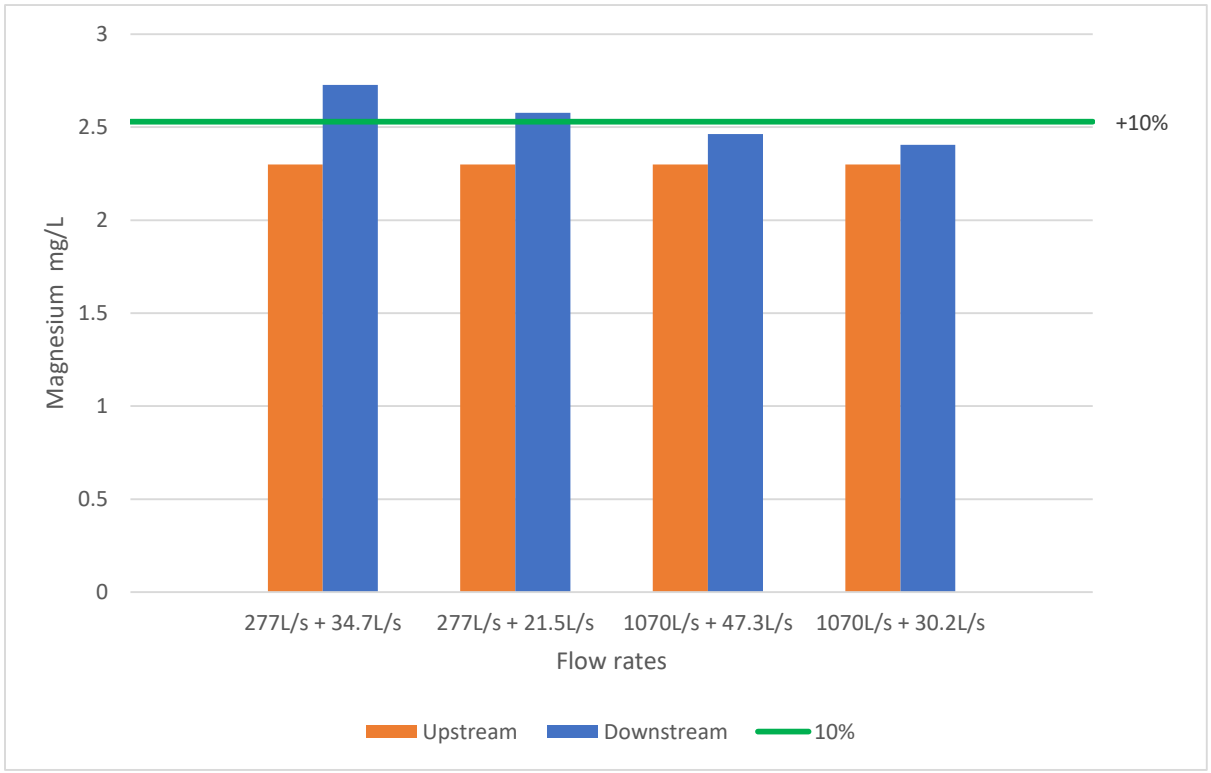
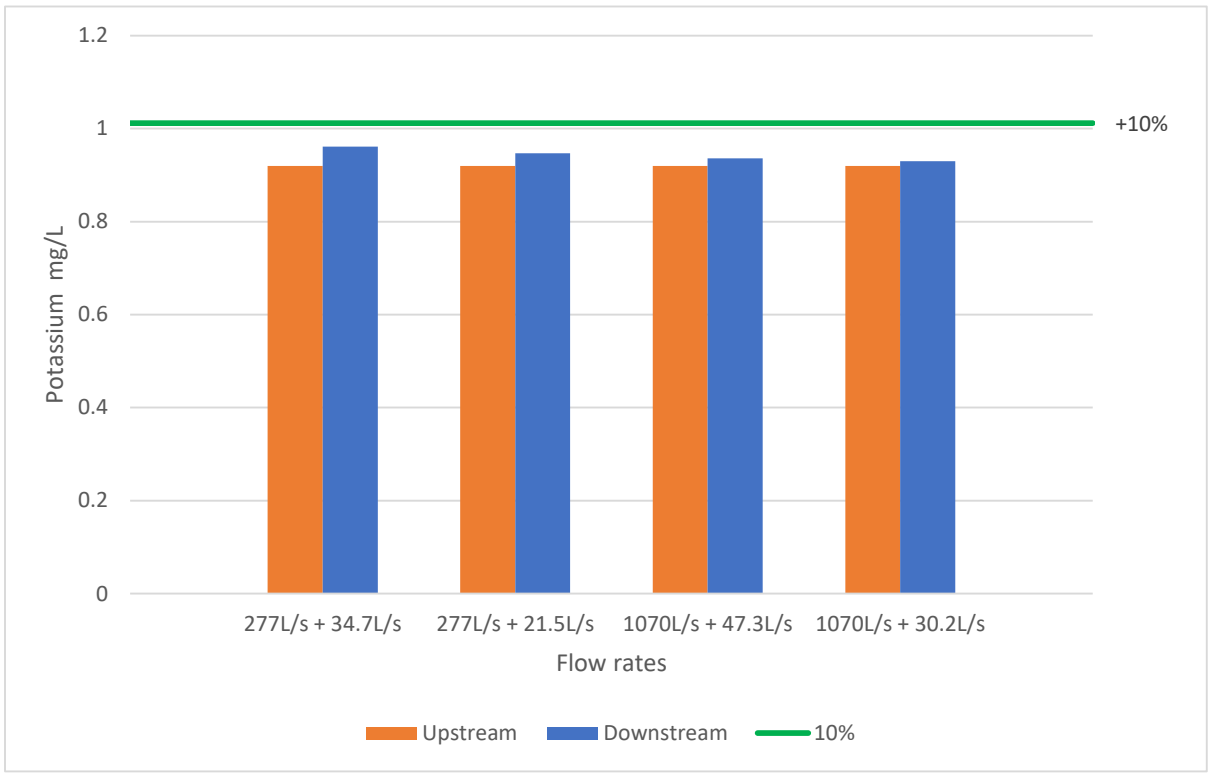
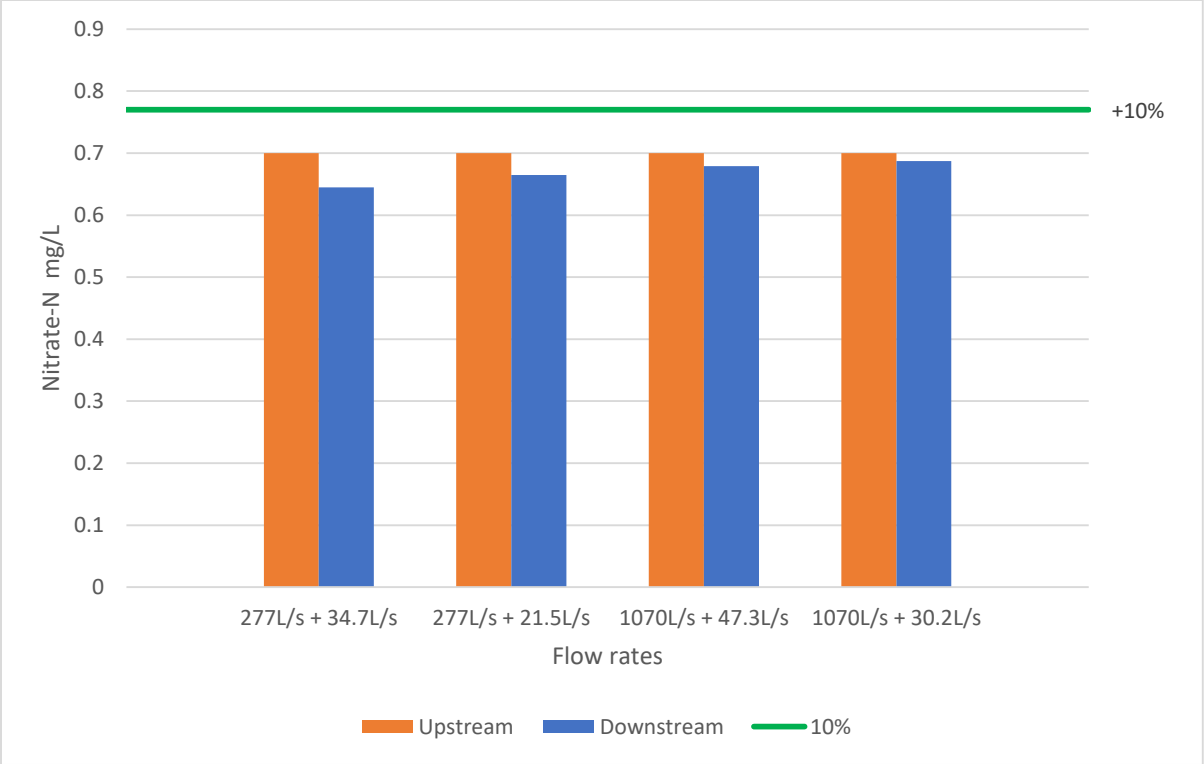
F: (03) 214 4041

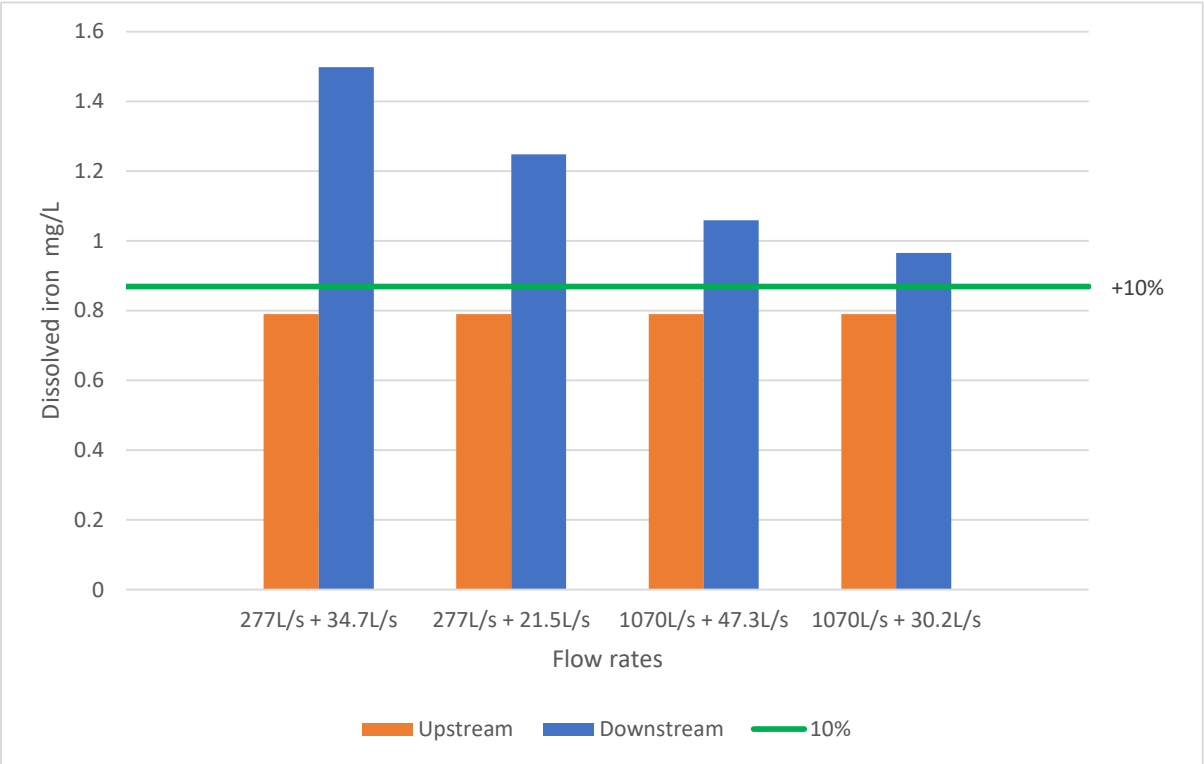

120
100
80
60
40
20
0
Electrical Conductivity µS/cm
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%

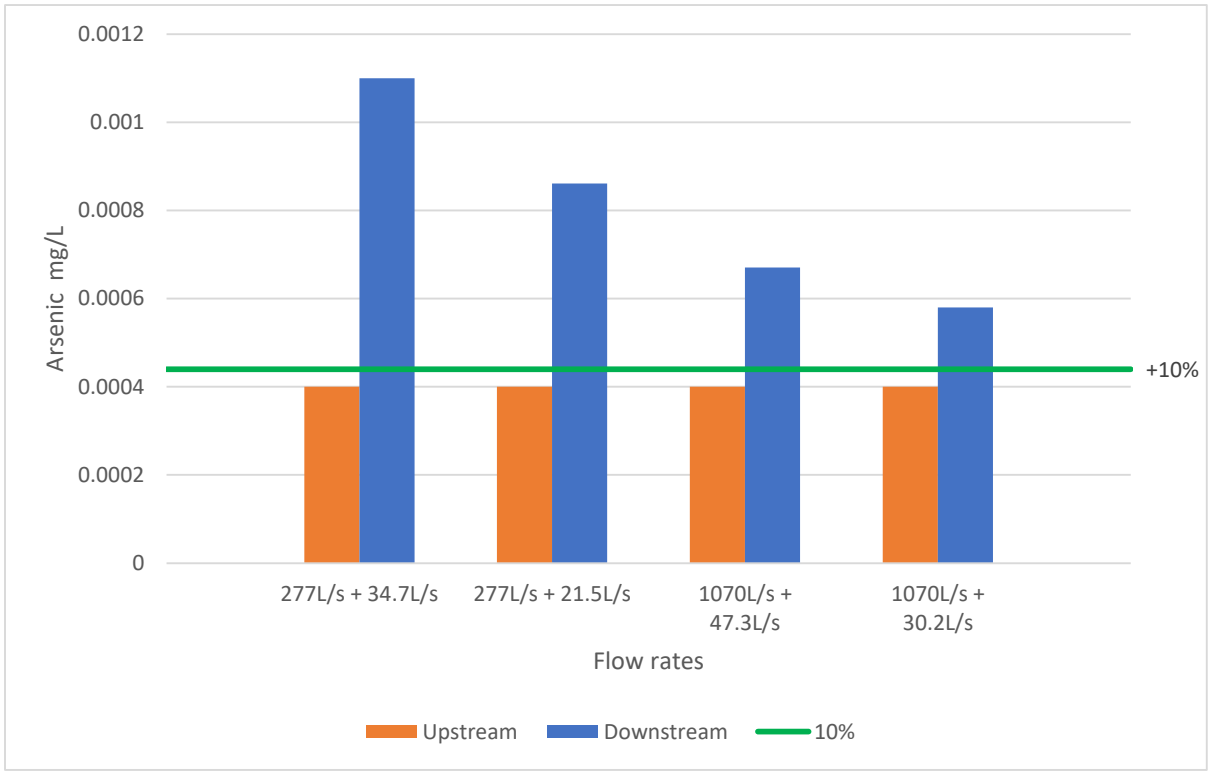

9
8
7
6
5
4
3
2
1
0
Calcium mg/L
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%

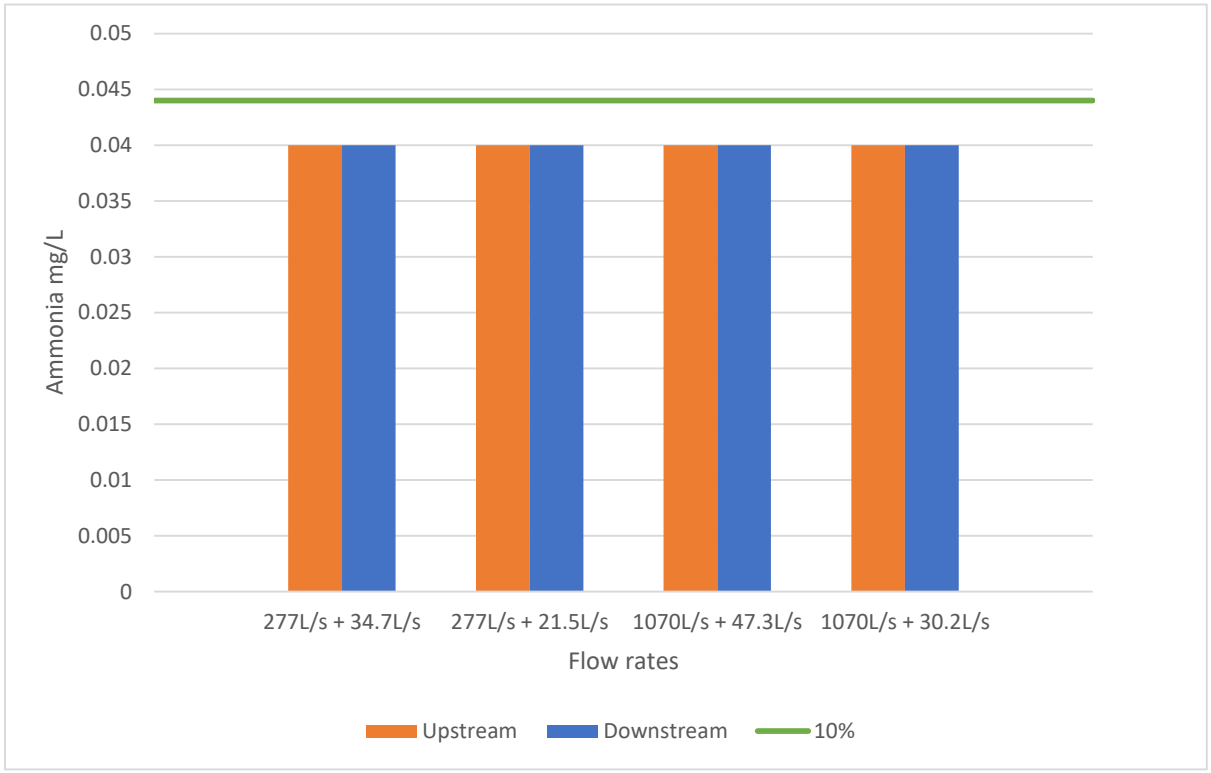

3
2.5
2
1.5
1
0.5
0
Magnesium mg/L
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%

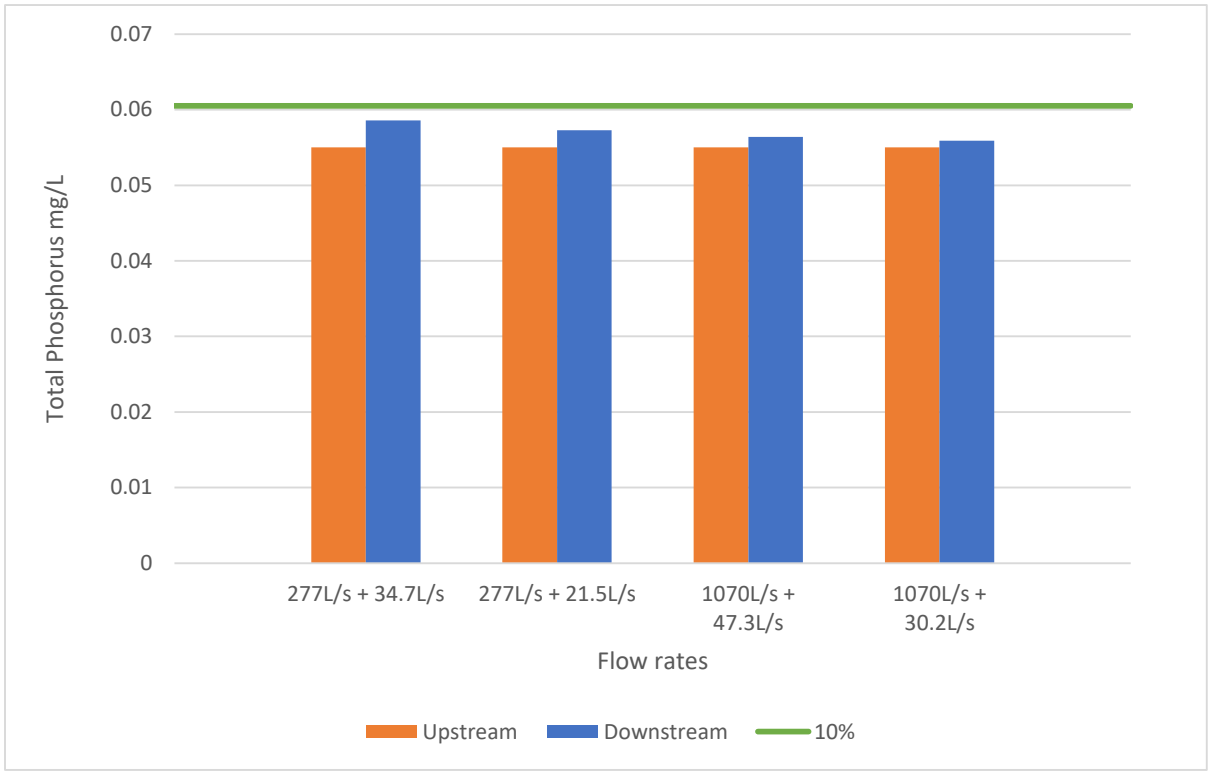

1.2
1
0.8
0.6
0.4
0.2
0
Potassium mg/L
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Nitrate-N mg/L
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%


1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dissolved iron mg/L
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%


0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Arsenic mg/L
+10%
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%


0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Ammonia mg/L
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%


0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Total Phosphorus mg/L
277L/s + 34.7L/s
277L/s + 21.5L/s
1070L/s + 47.3L/s
1070L/s + 30.2L/s
Flow rates
Upstream
Downstream
10%

Piezometer data and readings

Well ID	**P2**	**Piezometer**		**deep**		**P3**		**deep**		
Diameter (mm)										
Depth (m)										
Screened interval (m)										
Type										
Meas point	TOC	RL				TOC	RL			
Top casing to GL (mm)										
Meas by										
Initial WL		**-2.83**					**-3.86**			

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Date time	WL (m)	Time (mins)	Drawdown (m)	Weight
9:00:00	-2.83	0	0.000	1.000	9:00:00	-3.86	0	0.000	1.000
9:03:38	-2.84	3.63	0.010	1.000	9:07:20	-3.86	7.33	0.000	1.000
9:04:16	-2.85	4.27	0.020	1.000	9:10:30	-3.86	10.50	0.000	1.000
9:04:45	-2.86	4.75	0.030	1.000	9:11:30	-3.88	11.50	0.020	1.000
9:05:10	-2.87	5.17	0.040	1.000	9:12:20	-3.9	12.33	0.040	1.000
9:05:29	-2.88	5.48	0.050	1.000	9:12:57	-3.92	12.95	0.060	1.000
9:06:04	-2.9	6.07	0.070	1.000	9:13:39	-3.94	13.65	0.080	1.000
9:06:43	-2.92	6.72	0.090	1.000	9:14:18	-3.96	14.30	0.100	1.000
9:07:08	-2.94	7.13	0.110	1.000	9:14:51	-3.98	14.85	0.120	1.000
9:07:33	-2.96	7.55	0.130	1.000	9:15:31	-4	15.52	0.140	1.000
9:07:57	-2.98	7.95	0.150	1.000	9:16:00	-4.02	16.00	0.160	1.000
9:08:23	-3	8.38	0.170	1.000	9:16:30	-4.04	16.50	0.180	1.000
9:08:41	-3.02	8.68	0.190	1.000	9:17:08	-4.06	17.13	0.200	1.000
9:09:03	-3.04	9.05	0.210	1.000	9:17:35	-4.08	17.58	0.220	1.000
9:09:21	-3.06	9.35	0.230	1.000	9:18:04	-4.1	18.07	0.240	1.000
9:09:39	-3.08	9.65	0.250	1.000	9:18:33	-4.12	18.55	0.260	1.000
9:09:57	-3.1	9.95	0.270	1.000	9:19:00	-4.14	19.00	0.280	1.000
9:10:04	-3.15	10.07	0.320	1.000	9:19:32	-4.16	19.53	0.300	1.000
9:11:18	-3.2	11.30	0.370	1.000	9:20:03	-4.18	20.05	0.320	1.000
9:11:55	-3.25	11.92	0.420	1.000	9:20:30	-4.2	20.50	0.340	1.000
9:12:30	-3.3	12.50	0.470	1.000	9:20:58	-4.22	20.97	0.360	1.000
9:13:05	-3.35	13.08	0.520	1.000	9:21:28	-4.24	21.47	0.380	1.000
9:13:39	-3.4	13.65	0.570	1.000	9:21:56	-4.26	21.93	0.400	1.000
9:14:11	-3.45	14.18	0.620	1.000	9:22:28	-4.28	22.47	0.420	1.000
9:14:43	-3.5	14.72	0.670	1.000	9:23:00	-4.3	23.00	0.440	1.000
9:15:14	-3.55	15.23	0.720	1.000	9:23:30	-4.32	23.50	0.460	1.000
9:15:46	-3.6	15.77	0.770	1.000	9:24:02	-4.34	24.03	0.480	1.000
9:16:16	-3.65	16.27	0.820	1.000	9:24:35	-4.36	24.58	0.500	1.000
9:16:48	-3.7	16.80	0.870	1.000	9:25:09	-4.38	25.15	0.520	1.000
9:17:19	-3.75	17.32	0.920	1.000	9:25:39	-4.4	25.65	0.540	1.000
9:17:51	-3.8	17.85	0.970	1.000	9:26:11	-4.42	26.18	0.560	1.000
9:18:23	-3.85	18.38	1.020	1.000	9:26:45	-4.44	26.75	0.580	1.000
9:18:51	-3.9	18.85	1.070	1.000	9:27:20	-4.46	27.33	0.600	1.000
9:19:22	-3.95	19.37	1.120	1.000	9:27:52	-4.48	27.87	0.620	1.000
9:19:58	-4	19.97	1.170	1.000	9:28:31	-4.5	28.52	0.640	1.000
9:20:29	-4.05	20.48	1.220	1.000	9:29:05	-4.52	29.08	0.660	1.000
9:21:00	-4.1	21.00	1.270	1.000	9:29:41	-4.54	29.68	0.680	1.000
9:21:34	-4.15	21.57	1.320	1.000	9:30:19	-4.56	30.32	0.700	1.000
9:22:09	-4.2	22.15	1.370	1.000	9:30:55	-4.58	30.92	0.720	1.000
9:22:42	-4.25	22.70	1.420	1.000	9:31:30	-4.6	31.50	0.740	1.000
9:23:20	-4.3	23.33	1.470	1.000	9:32:15	-4.62	32.25	0.760	1.000
9:23:56	-4.35	23.93	1.520	1.000	9:33:50	-4.64	33.83	0.780	1.000
9:24:31	-4.4	24.52	1.570	1.000	9:33:30	-4.66	33.50	0.800	1.000
9:25:10	-4.45	25.17	1.620	1.000	9:34:11	-4.68	34.18	0.820	1.000
9:25:50	-4.500	25.83	1.670	1.000	9:34:52	-4.700	34.87	0.840	1.000
9:26:30	-4.550	26.50	1.720	1.000	9:35:32	-4.720	35.53	0.860	1.000
9:27:11	-4.600	27.18	1.770	1.000	9:36:15	-4.740	36.25	0.880	1.000
9:27:52	-4.65	27.87	1.820	1.000	9:36:56	-4.760	36.93	0.900	1.000
9:28:34	-4.7	28.57	1.870	1.000	9:37:40	-4.780	37.67	0.920	1.000
9:29:19	-4.75	29.32	1.920	1.000	9:38:22	-4.800	38.37	0.940	1.000
9:30:02	-4.8	30.03	1.970	1.000	9:39:09	-4.820	39.15	0.960	1.000
9:30:48	-4.85	30.80	2.020	1.000	9:39:51	-4.840	39.85	0.980	1.000
9:31:35	-4.9	31.58	2.070	1.000	9:40:39	-4.860	40.65	1.000	1.000
9:32:26	-4.95	32.43	2.120	1.000	9:41:29	-4.880	41.48	1.020	1.000
9:33:18	-5	33.30	2.170	1.000	9:42:12	-4.900	42.20	1.040	1.000
9:34:04	-5.05	34.07	2.220	1.000	9:43:03	-4.920	43.05	1.060	1.000
9:34:56	-5.1	34.93	2.270	1.000	9:43:55	-4.940	43.92	1.080	1.000
9:36:41	-5.2	36.68	2.370	1.000	9:44:43	-4.960	44.72	1.100	1.000
9:37:31	-5.3	37.52	2.470	1.000	9:45:31	-4.980	45.52	1.120	1.000
9:40:47	-5.4	40.78	2.570	1.000	9:46:28	-5.000	46.47	1.140	1.000
9:42:51	-5.5	42.85	2.670	1.000	9:47:14	-5.020	47.23	1.160	1.000

Pump Well data and readings

Well ID	**Pump Well (AX layer)**		**AQF 1**	**deep**	**Test discharge away from site**
Diameter (mm)			Well number		Nil rain prior to and during test
Depth (m)					
Screened interval (m)					
Type	Steel cased				
Meas point	TOC	RL			
Top casing to GL (mm)					
Flow test by	Meter				
Meas by					
Initial WL					

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Flow (L/s)	Flow test
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		

Flows

Comment	Date time	Flow rate (L/s)	Time (mins)	Flow rate (m3/day)
	15/11/2021 9:00	0	0	0
	15/11/2021 9:01	1.25	1	108
	15/11/2021 13:00	1.25	240	108
	15/11/2021 13:01	0	241	0
	15/11/2021 14:17	0	317	0

P3

40

Pump well

20

P2

Pump well location 1st test wk160

Saturated thickness = 10 m estimated from well log

Piezometer data and readings

Well ID	**P1**	**Piezometer**	**deep**	**P2**	**mid**	
Diameter (mm)						
Depth (m)						
Screened interval (m)						
Type						
Meas point	TOC	RL		TOC	RL	
Top casing to GL (mm)						
Meas by						
Initial WL		**0**			**-3.11**	

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Date time	WL (m)	Time (mins)	Drawdown (m)	Weight
4/11/2021 8:35	0.000	0	0.000	1.000	4/11/2021 8:35	-3.110	0	0.000	1.000
4/11/2021 8:36	-0.750	1	0.750	1.000	4/11/2021 8:36	-3.110	1	0.000	1.000
4/11/2021 8:37	-0.880	2	0.880	1.000	4/11/2021 8:37	-3.110	2	0.000	1.000
4/11/2021 8:38	-1.010	3	1.010	1.000	4/11/2021 8:38	-3.110	3	0.000	1.000
4/11/2021 8:39	-1.180	4	1.180	1.000	4/11/2021 8:39	-3.110	4	0.000	1.000
4/11/2021 8:40	-1.270	5	1.270	1.000	4/11/2021 8:40	-3.100	5	-0.010	1.000
4/11/2021 8:45	-1.670	10	1.670	1.000	4/11/2021 8:45	-3.090	10	-0.020	1.000
4/11/2021 8:50	-1.900	15	1.900	1.000	4/11/2021 8:50	-3.090	15	-0.020	1.000
4/11/2021 8:55	-2.200	20	2.200	1.000	4/11/2021 8:55	-3.090	20	-0.020	1.000
4/11/2021 9:00	-2.400	25	2.400	1.000	4/11/2021 9:00	-3.090	25	-0.020	1.000
4/11/2021 9:05	-2.550	30	2.550	1.000	4/11/2021 9:05	-3.090	30	-0.020	1.000
4/11/2021 9:15	-2.700	40	2.700	1.000	4/11/2021 9:15	-3.090	40	-0.020	1.000
4/11/2021 9:25	-2.900	50	2.900	1.000	4/11/2021 9:25	-3.090	50	-0.020	1.000
4/11/2021 9:35	-3.040	60	3.040	1.000	4/11/2021 9:35	-3.090	60	-0.020	1.000
4/11/2021 9:50	-3.210	75	3.210	1.000	4/11/2021 9:50	-3.090	75	-0.020	1.000
4/11/2021 10:05	-3.390	90	3.390	1.000	4/11/2021 10:05	-3.080	90	-0.030	1.000
4/11/2021 10:20	-3.460	105	3.460	1.000	4/11/2021 10:20	-3.080	105	-0.030	1.000
4/11/2021 10:35	-3.550	120	3.550	1.000	4/11/2021 10:35	-3.080	120	-0.030	1.000
4/11/2021 11:05	-3.600	150	3.600	1.000	4/11/2021 11:05	-3.080	150	-0.030	1.000
4/11/2021 11:35	-3.610	180	3.610	1.000	4/11/2021 11:35	-3.080	180	-0.030	1.000
4/11/2021 12:05	-3.700	210	3.700	1.000	4/11/2021 12:05	-3.080	210	-0.030	1.000
4/11/2021 12:35	-3.850	240	3.850	1.000	4/11/2021 12:35	-3.080	240	-0.030	1.000
4/11/2021 13:05	-3.850	270	3.850	1.000	4/11/2021 13:05	-3.080	270	-0.030	1.000
4/11/2021 13:35	-3.900	300	3.900	1.000	4/11/2021 13:35	-3.080	300	-0.030	1.000
4/11/2021 14:05	-3.950	330	3.950	1.000	4/11/2021 14:05	-3.080	330	-0.030	1.000
4/11/2021 14:35	-4.030	360	4.030	1.000	4/11/2021 14:35	-3.080	360	-0.030	1.000
4/11/2021 15:35	-4.100	420	4.100	1.000	4/11/2021 15:35	-3.080	420	-0.030	1.000
4/11/2021 16:35	-4.120	480	4.120	1.000	4/11/2021 16:35	-3.080	480	-0.030	1.000
4/11/2021 17:35	-4.120	540	4.120	1.000	4/11/2021 17:35	-3.080	540	-0.030	1.000
4/11/2021 21:35	-4.250	780	4.250	1.000	4/11/2021 21:35	-3.080	780	-0.030	1.000
4/11/2021 22:35	-4.290	840	4.290	1.000	4/11/2021 22:35	-3.080	840	-0.030	1.000
5/11/2021 0:35	-4.320	960	4.320	1.000	5/11/2021 0:35	-3.080	960	-0.030	1.000
5/11/2021 6:35	-4.450	1320	4.450	1.000	5/11/2021 6:35	-3.090	1320	-0.020	1.000
5/11/2021 8:35	-4.490	1440	4.490	1.000	5/11/2021 8:35	-3.100	1440	-0.010	1.000
5/11/2021 8:36	-4.480	1441	4.480	1.000	5/11/2021 8:36	-3.100	1441	-0.010	1.000
5/11/2021 8:37	-4.460	1442	4.460	1.000	5/11/2021 8:37	-3.100	1442	-0.010	1.000
5/11/2021 8:38	-4.430	1443	4.430	1.000	5/11/2021 8:38	-3.100	1443	-0.010	1.000
5/11/2021 8:39	-4.390	1444	4.390	1.000	5/11/2021 8:39	-3.100	1444	-0.010	1.000
5/11/2021 8:40	-4.350	1445	4.350	1.000	5/11/2021 8:40	-3.100	1445	-0.010	1.000
5/11/2021 8:45	-4.110	1450	4.110	1.000	5/11/2021 8:45	-3.100	1450	-0.010	1.000
5/11/2021 8:50	-3.820	1455	3.820	1.000	5/11/2021 8:50	-3.100	1455	-0.010	1.000
5/11/2021 8:55	-3.580	1460	3.580	1.000	5/11/2021 8:55	-3.100	1460	-0.010	1.000
5/11/2021 9:00	-3.410	1465	3.410	1.000	5/11/2021 9:00	-3.100	1465	-0.010	1.000
5/11/2021 9:05	-3.290	1470	3.290	1.000	5/11/2021 9:05	-3.100	1470	-0.010	1.000
5/11/2021 9:15	-3.090	1480	3.090	1.000	5/11/2021 9:15	-3.100	1480	-0.010	1.000
5/11/2021 9:25	-2.940	1490	2.940	1.000	5/11/2021 9:25	-3.100	1490	-0.010	1.000
5/11/2021 9:35	-2.820	1500	2.820	1.000	5/11/2021 9:35	-3.100	1500	-0.010	1.000
5/11/2021 9:50	-2.66	1515	2.660	1.000	5/11/2021 9:50	-3.100	1515	-0.010	1.000
5/11/2021 10:05	-2.52	1530	2.520	1.000	5/11/2021 10:05	-3.100	1530	-0.010	1.000
5/11/2021 10:20	-2.41	1545	2.410	1.000	5/11/2021 10:20	-3.100	1545	-0.010	1.000
5/11/2021 10:35	-2.31	1560	2.310	1.000	5/11/2021 10:35	-3.100	1560	-0.010	1.000

Pump Well data and readings

Well ID	**Pump Well (AX layer)**	**WGL 1**	**deep**	**Test discharge away from site**
Diameter (mm)		Well number		Nil rain prior to and during test
Depth (m)				
Screened interval (m)				
Type	Steel cased			
Meas point	TOC	RL		
Top casing to GL (mm)				
Flow test by	Meter			
Meas by				
Initial WL		**-1**		

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Flow (L/s)	Flow test
4/11/2021 8:35	-1.00	0	0.000	1.000	0	
4/11/2021 8:36	-1.590	1	0.590	1.000	2.262	Meter
4/11/2021 8:37	-3.520	2	2.520	1.000	2.242	Meter
4/11/2021 8:38	-4.190	3	3.190	1.000	2.273	Meter
4/11/2021 8:39	-5.180	4	4.180	1.000	2.256	Meter
4/11/2021 8:40	-7.100	5	6.100	1.000	2.260	Meter
4/11/2021 8:45	-8.120	10	7.120	1.000	2.261	Meter
4/11/2021 8:50	-9.210	15	8.210	1.000	2.235	Meter
4/11/2021 8:55	-9.870	20	8.870	1.000	2.219	Meter
4/11/2021 9:00	-10.680	25	9.680	1.000	2.208	Meter
4/11/2021 9:05	-12.020	30	11.020	1.000	2.201	Meter
4/11/2021 9:15	-13.240	40	12.240	1.000	2.183	Meter
4/11/2021 9:25	-14.810	50	13.810	1.000	2.149	Meter
4/11/2021 9:35	-16.900	60	15.900	1.000	2.145	Meter
4/11/2021 9:50	-19.180	75	18.180	1.000	2.134	Meter
4/11/2021 10:05	-19.760	90	18.760	1.000	1.897	Meter
4/11/2021 10:20	-19.780	105	18.780	1.000	1.870	Meter
4/11/2021 10:35	-19.780	120	18.780	1.000	1.777	Meter
4/11/2021 11:05	-19.680	150	18.680	1.000	1.638	Meter
4/11/2021 11:35	-18.780	180	17.780	1.000	1.531	Meter
4/11/2021 12:05	-18.550	210	17.550	1.000	1.497	Meter
4/11/2021 12:35	-16.040	240	15.040	1.000	1.499	Meter
4/11/2021 13:05	-15.680	270	14.680	1.000	1.514	Meter
4/11/2021 13:35	-16.270	300	15.270	1.000	1.503	Meter
4/11/2021 14:05	-16.620	330	15.620	1.000	1.517	Meter
4/11/2021 14:35	-16.360	360	15.360	1.000	1.487	Meter
4/11/2021 15:35	-16.670	420	15.670	1.000	1.501	Meter
4/11/2021 16:35	-13.030	480	12.030	1.000	1.402	Meter
4/11/2021 17:35	-13.340	540	12.340	1.000	1.401	Meter
4/11/2021 21:35	-14.370	780	13.370	1.000	1.399	Meter
4/11/2021 22:35	-13.960	840	12.960	1.000	1.399	Meter
5/11/2021 0:35	-14.200	960	13.200	1.000	1.399	Meter
5/11/2021 6:35	-14.030	1320	13.030	1.000	1.399	Meter
5/11/2021 8:35	-13.220	1440	12.220	1.000	1.408	Meter
5/11/2021 8:36	-11.80	1441	10.800	1.000	0	
5/11/2021 8:37	-10.85	1442	9.850	1.000	0	
5/11/2021 8:38	-9.93	1443	8.930	1.000	0	
5/11/2021 8:39	-9.11	1444	8.110	1.000	0	
5/11/2021 8:40	-8.40	1445	7.400	1.000	0	
5/11/2021 8:45	-5.67	1450	4.670	1.000	0	
5/11/2021 8:50	-4.50	1455	3.500	1.000	0	
5/11/2021 8:55	-4.12	1460	3.120	1.000	0	
5/11/2021 9:00	-3.90	1465	2.900	1.000	0	
5/11/2021 9:05	-3.77	1470	2.770	1.000	0	
5/11/2021 9:15	-3.56	1480	2.560	1.000	0	
5/11/2021 9:25	-3.41	1490	2.410	1.000	0	
5/11/2021 9:35	-3.28	1500	2.280	1.000	0	
5/11/2021 9:50	-3.12	1515	2.120	1.000	0	
5/11/2021 10:05	-2.99	1530	1.990	1.000	0	
5/11/2021 10:20	-2.88	1545	1.880	1.000	0	
5/11/2021 10:35	-2.46	1560	1.460	1.000	0	

Flows

Comment	Date time	Flow rate (L/s)	Time (mins)	Flow rate (m3/day)
	4/11/2021 8:35	0	0	0
	4/11/2021 8:36	2.262	1	195.4368
	4/11/2021 8:37	2.242	2	193.7088
	4/11/2021 8:38	2.273	3	196.3872
	4/11/2021 8:39	2.256	4	194.9184
	4/11/2021 8:40	2.260	5	195.264
	4/11/2021 8:45	2.261	10	195.3504
	4/11/2021 8:50	2.235	15	193.104
	4/11/2021 8:55	2.219	20	191.7216
	4/11/2021 9:00	2.208	25	190.7712
	4/11/2021 9:05	2.201	30	190.1664
	4/11/2021 9:15	2.183	40	188.6112
	4/11/2021 9:25	2.149	50	185.6736
	4/11/2021 9:35	2.145	60	185.328
2.216	4/11/2021 9:50	2.134	75	184.3776
	4/11/2021 10:05	1.897	90	163.9008
	4/11/2021 10:20	1.870	105	161.568
	4/11/2021 10:35	1.777	120	153.5328
1.796	4/11/2021 11:05	1.638	150	141.5232
	4/11/2021 11:35	1.531	180	132.2784
	4/11/2021 12:05	1.497	210	129.3408
	4/11/2021 12:35	1.499	240	129.5136
	4/11/2021 13:05	1.514	270	130.8096
	4/11/2021 13:35	1.503	300	129.8592
	4/11/2021 14:05	1.517	330	131.0688
	4/11/2021 14:35	1.487	360	128.4768
1.506	4/11/2021 15:35	1.501	420	129.6864
	4/11/2021 16:35	1.402	480	121.1328
	4/11/2021 17:35	1.401	540	121.0464
	4/11/2021 21:35	1.399	780	120.8736
	4/11/2021 22:35	1.399	840	120.8736
	5/11/2021 0:35	1.399	960	120.8736
	5/11/2021 6:35	1.399	1320	120.8736
1.401	5/11/2021 8:35	1.408	1440	121.6512
	5/11/2021 8:36	0.000	1441	0
	5/11/2021 10:35	0.000	1560	0

P3 & P4

22.18

Pump well

20.71

40

P1 &P2

Lake

Pump well location E 1290712
N 4903640

Saturated thickness = 10.2 m estimated from well log

Pump well dist to:

Lake = 40 m

Piezometer data and readings

Well ID	**Q2**	**Piezometer**		**deep**		**Q3**		**deep**		
Diameter (mm)										
Depth (m)										
Screened interval (m)										
Type										
Meas point	TOC	RL				TOC	RL			
Top casing to GL (mm)										
Meas by										
Initial WL		**-0.77**					**-0.44**			

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Date time	WL (m)	Time (mins)	Drawdown (m)	Weight
10:30:00	-0.77	0	0.000	1.000	10:30:00	-0.44	0.00	0.000	1.000
10:35:57	-1.86	5.95	1.090	1.000	10:35:00	-0.9	5.00	0.460	1.000
10:36:54	-1.94	6.90	1.170	1.000	10:37:30	-1.1	7.50	0.660	1.000
10:38:10	-2	8.17	1.230	1.000	10:38:34	-1.2	8.57	0.760	1.000
10:39:13	-2.03	9.22	1.260	1.000	10:40:00	-1.3	10.00	0.860	1.000
10:40:23	-2.07	10.38	1.300	1.000	10:41:25	-1.4	11.42	0.960	1.000
10:40:50	-2.09	10.83	1.320	1.000	10:43:08	-1.5	13.13	1.060	1.000
10:41:22	-2.12	11.37	1.350	1.000	10:45:13	-1.6	15.22	1.160	1.000
10:43:03	-2.15	13.05	1.380	1.000	10:47:30	-1.7	17.50	1.260	1.000
10:43:16	-2.2	13.27	1.430	1.000	11:01:10	-2	31.17	1.560	1.000
10:45:22	-2.25	15.37	1.480	1.000	11:09:55	-2.07	39.92	1.630	1.000
10:47:33	-2.3	17.55	1.530	1.000	11:11:20	-2.08	41.33	1.640	1.000
10:49:23	-2.35	19.38	1.580	1.000	11:17:30	-2.13	47.50	1.690	1.000
10:58:50	-2.38	28.83	1.610	1.000	11:18:40	-2.14	48.67	1.700	1.000
11:03:20	-2.4	33.33	1.630	1.000	11:20:05	-2.15	50.08	1.710	1.000
11:08:09	-2.42	38.15	1.650	1.000	11:21:30	-2.16	51.50	1.720	1.000
11:12:40	-2.44	42.67	1.670	1.000	11:24:40	-2.18	54.67	1.740	1.000
11:16:17	-2.46	46.28	1.690	1.000	11:27:10	-2.19	57.17	1.750	1.000
11:19:35	-2.48	49.58	1.710	1.000	11:31:40	-2.2	61.67	1.760	1.000
11:23:02	-2.5	53.03	1.730	1.000	11:34:53	-2.21	64.88	1.770	1.000
11:55:40	-2.51	85.67	1.740	1.000	11:37:55	-2.22	67.92	1.780	1.000
12:01:05	-2.52	91.08	1.750	1.000	11:52:20	-2.24	82.33	1.800	1.000
12:08:21	-2.53	98.35	1.760	1.000	11:56:41	-2.25	86.68	1.810	1.000
12:12:34	-2.54	102.57	1.770	1.000	12:01:00	-2.26	91.00	1.820	1.000
12:16:00	-2.54	106.00	1.770	1.000	12:09:48	-2.28	99.80	1.840	1.000
12:23:28	-2.55	113.47	1.780	1.000	12:15:08	-2.29	105.13	1.850	1.000
12:26:40	-2.56	116.67	1.790	1.000	12:24:08	-2.31	114.13	1.870	1.000
12:29:26	-2.57	119.43	1.800	1.000	12:29:58	-2.32	119.97	1.880	1.000
12:31:03	-2.58	121.05	1.810	1.000	12:34:40	-2.35	124.67	1.910	1.000
12:33:20	-2.59	123.33	1.820	1.000	12:42:54	-2.36	132.90	1.920	1.000
12:50:06	-2.6	140.10	1.830	1.000	12:50:05	-2.37	140.08	1.930	1.000
12:51:06	-2.61	141.10	1.840	1.000	12:53:23	-2.38	143.38	1.940	1.000
12:54:07	-2.62	144.12	1.850	1.000	12:56:06	-2.39	146.10	1.950	1.000
12:56:54	-2.63	146.90	1.860	1.000	12:58:52	-2.4	148.87	1.960	1.000
13:04:40	-2.66	154.67	1.890	1.000	13:03:32	-2.41	153.53	1.970	1.000
13:08:08	-2.68	158.13	1.910	1.000	13:07:08	-2.42	157.13	1.980	1.000
13:18:40	-2.69	168.67	1.920	1.000	13:19:08	-2.46	169.13	2.020	1.000
13:24:19	-2.7	174.32	1.930	1.000	13:23:42	-2.47	173.70	2.030	1.000
13:31:12	-2.71	181.20	1.940	1.000	13:26:52	-2.48	176.87	2.040	1.000
13:34:22	-2.72	184.37	1.950	1.000	13:32:15	-2.49	182.25	2.050	1.000
13:38:10	-2.73	188.17	1.960	1.000	13:36:20	-2.5	186.33	2.060	1.000
13:48:22	-2.74	198.37	1.970	1.000	13:40:10	-2.51	190.17	2.070	1.000
13:54:03	-2.75	204.05	1.980	1.000	13:45:29	-2.52	195.48	2.080	1.000
13:58:12	-2.76	208.20	1.990	1.000	13:54:29	-2.53	204.48	2.090	1.000
14:01:50	-2.770	211.83	2.000	1.000	13:58:28	-2.54	208.47	2.100	1.000
14:10:58	-2.780	220.97	2.010	1.000	14:03:20	-2.550	213.33	2.110	1.000
14:30:00	-2.790	240.00	2.020	1.000	14:08:50	-2.560	218.83	2.120	1.000
14:33:52	-2.73	243.87	1.960	1.000	14:18:20	-2.570	228.33	2.130	1.000
14:34:50	-2.71	244.83	1.940	1.000	14:30:00	-2.590	240.00	2.150	1.000
14:35:09	-2.7	245.15	1.930	1.000	14:33:00	-2.570	243.00	2.130	1.000
14:37:40	-2.68	247.67	1.910	1.000	14:34:20	-2.560	244.33	2.120	1.000
14:38:45	-2.66	248.75	1.890	1.000	14:35:30	-2.550	245.50	2.110	1.000
14:39:30	-2.64	249.50	1.870	1.000	14:37:39	-2.530	247.65	2.090	1.000
14:41:15	-2.62	251.25	1.850	1.000	14:38:37	-2.520	248.62	2.080	1.000
14:42:41	-2.6	252.68	1.830	1.000	14:40:27	-2.500	250.45	2.060	1.000
14:44:20	-2.58	254.33	1.810	1.000	14:41:55	-2.480	251.92	2.040	1.000
14:45:19	-2.56	255.32	1.790	1.000	14:44:16	-2.460	254.27	2.020	1.000
14:46:47	-2.54	256.78	1.770	1.000	14:45:41	-2.440	255.68	2.000	1.000
14:48:00	-2.52	258.00	1.750	1.000	14:47:07	-2.420	257.12	1.980	1.000
14:49:46	-2.5	259.77	1.730	1.000	14:48:41	-2.400	258.68	1.960	1.000
14:51:11	-2.48	261.18	1.710	1.000	14:50:38	-2.380	260.63	1.940	1.000

<u>Pump Well data and readings</u>

Well ID	**Pump Well (AX layer)**		**AQF 2**	**deep**	**Test discharge away from site**
Diameter (mm)			Well number		Nil rain prior to and during test
Depth (m)					
Screened interval (m)					
Type	Steel cased				
Meas point	TOC	RL			
Top casing to GL (mm)					
Flow test by	Meter				
Meas by					
Initial WL					

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Flow (L/s)	Flow test
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		

Flows

Comment	Date time	Flow rate (L/s)	Time (mins)	Flow rate (m3/day)
	10:30:00	0	0	0
	10:31:00	0.6	1	51.84
	14:30:00	0.6	240	51.84
	14:31:00	0	241	0
	15:41:00	0	311	0

Q3

60.5

Pump well

19.3

Q2

Pump well location 2nd test wk161

Saturated thickness = 10 m estimated from well log

Piezometer data and readings

Well ID	**P1**	**Piezometer**	**deep**	**P2**	**mid**
Diameter (mm)					
Depth (m)					
Screened interval (m)					
Type					
Meas point	TOC	RL		TOC	RL
Top casing to GL (mm)					
Meas by					
Initial WL		**-1.74**			**-1.93**

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Date time	WL (m)	Time (mins)	Drawdown (m)	Weight
15/11/2021 9:00	-1.74	0	0.000	1.000	15/11/2021 9:00	-1.93	0	0.000	1.000
15/11/2021 9:01	-1.8	1	0.060	1.000	15/11/2021 9:01	-1.92	1	-0.010	1.000
15/11/2021 9:02	-1.89	2	0.150	1.000	15/11/2021 9:02	-1.92	2	-0.010	1.000
15/11/2021 9:03	-1.975	3	0.235	1.000	15/11/2021 9:03	-1.92	3	-0.010	1.000
15/11/2021 9:04	-2.04	4	0.300	1.000	15/11/2021 9:04	-1.92	4	-0.010	1.000
15/11/2021 9:05	-2.1	5	0.360	1.000	15/11/2021 9:05	-1.92	5	-0.010	1.000
15/11/2021 9:10	-2.342	10	0.602	1.000	15/11/2021 9:10	-1.92	10	-0.010	1.000
15/11/2021 9:15	-2.518	15	0.778	1.000	15/11/2021 9:15	-1.92	15	-0.010	1.000
15/11/2021 9:20	-2.665	20	0.925	1.000	15/11/2021 9:20	-1.92	20	-0.010	1.000
15/11/2021 9:30	-2.93	30	1.190	1.000	15/11/2021 9:30	-1.92	30	-0.010	1.000
15/11/2021 9:45	-3.23	45	1.490	1.000	15/11/2021 9:45	-1.92	45	-0.010	1.000
15/11/2021 10:00	-3.48	60	1.740	1.000	15/11/2021 10:00	-1.92	60	-0.010	1.000
15/11/2021 10:30	-3.88	90	2.140	1.000	15/11/2021 10:30	-1.92	90	-0.010	1.000
15/11/2021 11:00	-4.19	120	2.450	1.000	15/11/2021 11:00	-1.92	120	-0.010	1.000
15/11/2021 11:30	-4.47	150	2.730	1.000	15/11/2021 11:30	-1.92	150	-0.010	1.000
15/11/2021 12:00	-4.66	180	2.920	1.000	15/11/2021 12:00	-1.92	180	-0.010	1.000
15/11/2021 13:00	-4.99	240	3.250	1.000	15/11/2021 13:00	-1.92	240	-0.010	1.000
15/11/2021 14:00	-5.28	300	3.540	1.000	15/11/2021 14:00	-1.92	300	-0.010	1.000
15/11/2021 16:00	-5.97	420	4.230	1.000	15/11/2021 16:00	-1.92	420	-0.010	1.000
15/11/2021 16:15	-6.08	435	4.340	1.000	15/11/2021 16:15	-1.92	435	-0.010	1.000
15/11/2021 16:30	-6.14	450	4.400	1.000	15/11/2021 16:30	-1.92	450	-0.010	1.000
15/11/2021 16:45	-6.22	465	4.480	1.000	15/11/2021 16:45	-1.92	465	-0.010	1.000
15/11/2021 17:00	-6.29	480	4.550	1.000	15/11/2021 17:00	-1.92	480	-0.010	1.000
15/11/2021 18:00	-6.49	540	4.750	1.000	15/11/2021 18:00	-1.92	540	-0.010	1.000
15/11/2021 22:00	-7.02	780	5.280	1.000	15/11/2021 22:00	-1.92	780	-0.010	1.000
15/11/2021 23:00	-7.105	840	5.365	1.000	15/11/2021 23:00	-1.92	840	-0.010	1.000
16/11/2021 0:00	-7.185	900	5.445	1.000	16/11/2021 0:00	-1.92	900	-0.010	1.000
16/11/2021 6:00	-7.585	1260	5.845	1.000	16/11/2021 6:00	-1.92	1260	-0.010	1.000
16/11/2021 8:00	-7.64	1380	5.900	1.000	16/11/2021 8:00	-1.92	1380	-0.010	1.000
16/11/2021 9:00	-7.64	1440	5.900	1.000	16/11/2021 9:00	-1.92	1440	-0.010	1.000
16/11/2021 9:01	-7.585	1441	5.845	1.000	16/11/2021 9:01	-1.92	1441	-0.010	1.000
16/11/2021 9:02	-7.5	1442	5.760	1.000	16/11/2021 9:02	-1.92	1442	-0.010	1.000
16/11/2021 9:03	-7.425	1443	5.685	1.000	16/11/2021 9:03	-1.92	1443	-0.010	1.000
16/11/2021 9:04	-7.35	1444	5.610	1.000	16/11/2021 9:04	-1.92	1444	-0.010	1.000
16/11/2021 9:05	-7.285	1445	5.545	1.000	16/11/2021 9:05	-1.92	1445	-0.010	1.000
16/11/2021 9:10	-7	1450	5.260	1.000	16/11/2021 9:10	-1.92	1450	-0.010	1.000
16/11/2021 9:15	-6.79	1455	5.050	1.000	16/11/2021 9:15	-1.92	1455	-0.010	1.000
16/11/2021 9:20	-6.61	1460	4.870	1.000	16/11/2021 9:20	-1.92	1460	-0.010	1.000
16/11/2021 9:30	-6.298	1470	4.558	1.000	16/11/2021 9:30	-1.92	1470	-0.010	1.000
16/11/2021 9:45	-5.92	1485	4.180	1.000	16/11/2021 9:45	-1.92	1485	-0.010	1.000
16/11/2021 10:00	-5.605	1500	3.865	1.000	16/11/2021 10:00	-1.92	1500	-0.010	1.000
16/11/2021 10:30	-4.86	1530	3.120	1.000	16/11/2021 10:30	-1.92	1530	-0.010	1.000
16/11/2021 11:00	-4.13	1560	2.390	1.000	16/11/2021 11:00	-1.92	1560	-0.010	1.000
16/11/2021 11:30	-3.4	1590	1.660	1.000	16/11/2021 11:30	-1.92	1590	-0.010	1.000

Pump Well data and readings

Well ID	**Pump Well (AX layer)**	**WGL 2**	**deep**	**Test discharge away from site**
Diameter (mm)		Well number		Nil rain prior to and during test
Depth (m)				
Screened interval (m)				
Type	Steel cased			
Meas point	TOC	RL		
Top casing to GL (mm)				
Flow test by	Meter			
Meas by				
Initial WL		**-1.91**		

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Flow (L/s)	Flow test
15/11/2021 9:00	-1.91	0	0.000	1.000	0	
15/11/2021 9:01	-2.69	1	0.780	1.000	1.54	Meter
15/11/2021 9:02	-2.94	2	1.030	1.000	1.541	Meter
15/11/2021 9:03	-3.14	3	1.230	1.000	1.526	Meter
15/11/2021 9:04	-3.27	4	1.360	1.000	1.542	Meter
15/11/2021 9:05	-3.36	5	1.450	1.000	1.535	Meter
15/11/2021 9:10	-3.63	10	1.720	1.000	1.525	Meter
15/11/2021 9:15	-3.84	15	1.930	1.000	1.522	Meter
15/11/2021 9:20	-4.01	20	2.100	1.000	1.52	Meter
15/11/2021 9:30	-4.24	30	2.330	1.000	1.513	Meter
15/11/2021 9:45	-4.53	45	2.620	1.000	1.507	Meter
15/11/2021 10:00	-4.77	60	2.860	1.000	1.511	Meter
15/11/2021 10:30	-5.11	90	3.200	1.000	1.501	Meter
15/11/2021 11:00	-5.41	120	3.500	1.000	1.498	Meter
15/11/2021 11:30	-5.6	150	3.690	1.000	1.5	Meter
15/11/2021 12:00	-5.82	180	3.910	1.000	1.496	Meter
15/11/2021 13:00	-6.17	240	4.260	1.000	1.499	Meter
15/11/2021 14:00	-6.38	300	4.470	1.000	1.481	Meter
15/11/2021 16:00	-7.37	420	5.460	1.000	1.5	Meter
15/11/2021 16:15	-7.45	435	5.540	1.000	1.776	Meter
15/11/2021 16:30	-7.53	450	5.620	1.000	1.809	Meter
15/11/2021 16:45	-7.6	465	5.690	1.000	1.79	Meter
15/11/2021 17:00	-7.64	480	5.730	1.000	1.78	Meter
15/11/2021 18:00	-7.87	540	5.960	1.000	1.751	Meter
15/11/2021 22:00	-8.41	780	6.500	1.000	1.759	Meter
15/11/2021 23:00	-8.5	840	6.590	1.000	1.769	Meter
16/11/2021 0:00	-8.575	900	6.665	1.000	1.77	Meter
16/11/2021 6:00	-9	1260	7.090	1.000	1.76	Meter
16/11/2021 8:00	-9.05	1380	7.140	1.000	1.752	Meter
16/11/2021 9:00	-9.06	1440	7.150	1.000	1.762	Meter
16/11/2021 9:01	-8.21	1441	6.300	1.000	0	
16/11/2021 9:02	-7.83	1442	5.920	1.000	0	
16/11/2021 9:03	-7.67	1443	5.760	1.000	0	
16/11/2021 9:04	-7.54	1444	5.630	1.000	0	
16/11/2021 9:05	-7.44	1445	5.530	1.000	0	
16/11/2021 9:10	-7.18	1450	5.270	1.000	0	
16/11/2021 9:15	-6.94	1455	5.030	1.000	0	
16/11/2021 9:20	-6.77	1460	4.860	1.000	0	
16/11/2021 9:30	-6.45	1470	4.540	1.000	0	
16/11/2021 9:45	-6.08	1485	4.170	1.000	0	
16/11/2021 10:00	-5.79	1500	3.880	1.000	0	
16/11/2021 10:30	-5.28	1530	3.370	1.000	0	
16/11/2021 11:00	-4.79	1560	2.880	1.000	0	
16/11/2021 11:30	-4.67	1590	2.760	1.000	0	

Flows

Comment	Date time	Flow rate (L/s)	Time (mins)	Flow rate (m3/day)
	15/11/2021 9:00	0	0	0
	15/11/2021 9:01	1.54	1	133.056
	15/11/2021 9:02	1.541	2	133.1424
	15/11/2021 9:03	1.526	3	131.8464
	15/11/2021 9:04	1.542	4	133.2288
	15/11/2021 9:05	1.535	5	132.624
	15/11/2021 9:10	1.525	10	131.76
	15/11/2021 9:15	1.522	15	131.5008
	15/11/2021 9:20	1.52	20	131.328
	15/11/2021 9:30	1.513	30	130.7232
	15/11/2021 9:45	1.507	45	130.2048
	15/11/2021 10:00	1.511	60	130.5504
	15/11/2021 10:30	1.501	90	129.6864
	15/11/2021 11:00	1.498	120	129.4272
	15/11/2021 11:30	1.5	150	129.6
	15/11/2021 12:00	1.496	180	129.2544
	15/11/2021 13:00	1.499	240	129.5136
	15/11/2021 14:00	1.481	300	127.9584
	15/11/2021 16:00	1.5	420	129.6
	15/11/2021 16:15	1.776	435	153.4464
	15/11/2021 16:30	1.809	450	156.2976
	15/11/2021 16:45	1.79	465	154.656
	15/11/2021 17:00	1.78	480	153.792
	15/11/2021 18:00	1.751	540	151.2864
	15/11/2021 22:00	1.759	780	151.9776
	15/11/2021 23:00	1.769	840	152.8416
	16/11/2021 0:00	1.77	900	152.928
	16/11/2021 6:00	1.76	1260	152.064
	16/11/2021 8:00	1.752	1380	151.3728
	16/11/2021 9:00	1.762	1440	152.2368
	16/11/2021 9:01	0	1441	0
	16/11/2021 11:30	0	1590	0

P3 & P4

20.32

Pump well

19.71

P1 &P2

Pump well location E 1290261
N 4903951

Saturated thickness = 10.6 m estimated from well log

Piezometer data and readings

Well ID	**R1**	**Piezometer**	**deep**	**R2**	**deep**	
Diameter (mm)						
Depth (m)						
Screened interval (m)						
Type						
Meas point	TOC	RL		TOC	RL	
Top casing to GL (mm)						
Meas by						
Initial WL		**-0.73**			**-0.45**	

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Date time	WL (m)	Time (mins)	Drawdown (m)	Weight
9:31:21	-0.73	0	0.000	1.000	9:31:21	-0.45	0.00	0.000	1.000
9:31:50	-2.2	0.48	1.470	1.000	9:55:11	-3.9	23.83	3.450	1.000
9:32:32	-2.65	1.18	1.920	1.000	10:08:11	-4.38	36.83	3.930	1.000
9:32:44	-2.8	1.38	2.070	1.000	10:33:50	-5	62.48	4.550	1.000
9:33:05	-3	1.73	2.270	1.000	10:40:58	-5.12	69.62	4.670	1.000
9:33:17	-3.1	1.93	2.370	1.000	10:45:30	-5.22	74.15	4.770	1.000
9:33:32	-3.2	2.18	2.470	1.000	10:58:35	-5.43	87.23	4.980	1.000
9:33:47	-3.3	2.43	2.570	1.000	11:06:59	-5.52	95.63	5.070	1.000
9:34:05	-3.4	2.73	2.670	1.000	11:13:10	-5.62	101.82	5.170	1.000
9:34:21	-3.5	3.00	2.770	1.000	11:23:30	-5.75	112.15	5.300	1.000
9:34:39	-3.6	3.30	2.870	1.000	11:38:30	-5.38	127.15	4.930	1.000
9:34:58	-3.7	3.62	2.970	1.000	11:48:20	-5.47	136.98	5.020	1.000
9:35:18	-3.8	3.95	3.070	1.000	12:08:30	-5.63	157.15	5.180	1.000
9:35:44	-3.9	4.38	3.170	1.000	12:17:50	-5.71	166.48	5.260	1.000
9:36:11	-4	4.83	3.270	1.000	12:23:40	-5.76	172.32	5.310	1.000
9:36:34	-4.1	5.22	3.370	1.000	12:31:48	-5.83	180.45	5.380	1.000
9:37:01	-4.2	5.67	3.470	1.000	12:41:40	-5.9	190.32	5.450	1.000
9:37:32	-4.3	6.18	3.570	1.000	12:48:50	-5.96	197.48	5.510	1.000
9:38:07	-4.4	6.77	3.670	1.000	12:56:00	-6.02	204.65	5.570	1.000
9:38:47	-4.5	7.43	3.770	1.000	13:04:50	-6.09	213.48	5.640	1.000
9:39:27	-4.6	8.10	3.870	1.000	13:14:02	-6.15	222.68	5.700	1.000
9:40:11	-4.7	8.83	3.970	1.000	13:25:20	-6.23	233.98	5.780	1.000
9:40:57	-4.8	9.60	4.070	1.000	13:33:08	-6.29	241.78	5.840	1.000
9:41:44	-4.9	10.38	4.170	1.000	13:40:50	-6.35	249.48	5.900	1.000
9:42:37	-5	11.27	4.270	1.000	14:01:45	-6.49	270.40	6.040	1.000
9:43:39	-5.1	12.30	4.370	1.000	14:15:50	-6.55	284.48	6.100	1.000
9:47:58	-5.45	16.62	4.720	1.000	14:40:30	-6.69	309.15	6.240	1.000
9:48:38	-5.5	17.28	4.770	1.000	14:45:20	-6.71	313.98	6.260	1.000
9:49:18	-5.55	17.95	4.820	1.000	14:54:00	-6.76	322.65	6.310	1.000
9:50:13	-5.6	18.87	4.870	1.000	15:29:10	-6.93	357.82	6.480	1.000
9:50:42	-5.65	19.35	4.920	1.000	15:43:20	-7	371.98	6.550	1.000
9:51:42	-5.7	20.35	4.970	1.000	15:53:30	-7.04	382.15	6.590	1.000
9:52:30	-5.75	21.15	5.020	1.000	16:49:30	-3.44	438.15	2.990	1.000
9:53:24	-5.8	22.05	5.070	1.000					
9:58:49	-6.05	27.47	5.320	1.000					
9:59:56	-6.1	28.58	5.370	1.000					
10:01:12	-6.15	29.85	5.420	1.000					
10:02:30	-6.2	31.15	5.470	1.000					
10:03:54	-6.25	32.55	5.520	1.000					
10:06:32	-6.35	35.18	5.620	1.000					
10:11:18	-6.5	39.95	5.770	1.000					
10:12:55	-6.55	41.57	5.820	1.000					
10:14:44	-6.6	43.38	5.870	1.000					
10:19:02	-6.7	47.68	5.970	1.000					
10:21:14	-6.750	49.88	6.020	1.000					
10:23:17	-6.800	51.93	6.070	1.000					
10:25:10	-6.850	53.82	6.120	1.000					
10:27:24	-6.9	56.05	6.170	1.000					
10:29:28	-6.95	58.12	6.220	1.000					
10:31:54	-7	60.55	6.270	1.000					
10:37:30	-7.13	66.15	6.400	1.000					
10:43:00	-7.23	71.65	6.500	1.000					
10:48:00	-7.32	76.65	6.590	1.000					
10:51:55	-7.38	80.57	6.650	1.000					
10:54:00	-7.42	82.65	6.690	1.000					
11:03:05	-7.55	91.73	6.820	1.000					
11:10:56	-7.65	99.58	6.920	1.000					
11:17:35	-7.75	106.23	7.020	1.000					
11:27:58	-7.81	116.62	7.080	1.000					
11:32:22	-7.84	121.02	7.110	1.000					
11:41:54	-7.96	130.55	7.230	1.000					

Pump Well data and readings

Well ID	**Pump Well (AX layer)**		**AQF 3**	**deep**	**Test discharge away from site**
Diameter (mm)			Well number		Nil rain prior to and during test
Depth (m)					
Screened interval (m)					
Type	Steel cased				
Meas point	TOC	RL			
Top casing to GL (mm)					
Flow test by	Meter				
Meas by					
Initial WL					

Date time	WL (m)	Time (mins)	Drawdown (m)	Weight	Flow (L/s)	Flow test
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		
		0	0.000	1.000		

Flows

Comment	Date time	Flow rate (L/s)	Time (mins)	Flow rate (m3/day)
	9:31:00	0	0	0
	9:32:00	3.3	1	285.12
	15:56:00	3.3	385	285.12
	15:57:00	0	386	0
	16:52:00	0	441	0

R2 **R3**

19.4 **39.75**

Pump well

10.2

R1

Pump well location 3rd test wk163

Saturated thickness = 10 m estimated from well log