Shotover WWTP

Surface Water and Groundwater Assessment

Queenstown Lakes District Council

30 April 2025

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1. Introduction

Queenstown Lakes District Council (QLDC – the applicant) is responsible for the conveyance, treatment, and disposal of wastewater generated by the district. The Shotover Wastewater Treatment Plant (WWTP) services the communities within the Whakatipu Basin of Queenstown, Arthurs Point, Frankton, Kelvin Heights/Willow Place, Quail Rise, Shotover Country, Lake Hayes Estate, Lake Hayes and Arrowtown.

The currently consented disposal system for treated effluent is disposal through a dose and drain (DAD) field. Due to significant issues and failures with the DAD disposal field, emergency works were undertaken on 31 March 2025 to commence the discharge of treated effluent through the historical discharge channel under section 330 of the Resource Management Act 1991 (RMA).

These emergency works are understood to have been needed to address unacceptable risks to aircraft as a result of increased waterfowl presence from ponded water within and outside of the existing disposal field. Diversion of treated wastewater to the historical discharge channel and subsequently to the Shotover River that was last used in 2019, was implemented to mitigate risks resulting from operation of the DAD.

GHD Limited (GHD) has been engaged by QLDC to undertake investigations and an assessment of effects to groundwater, surface water and water quality associated with the discharge of treated wastewater to the Shotover River. This technical assessment has been prepared to support the resource consent application and Assessment of Environmental Effects (AEE) prepared by LandPro (LandPro, 2025).

1.1 Purpose of this report

The purpose of this report is to provide:

– A description of the environment in and around the Shotover Delta
– Technical assessment of the effects of the discharge of treated wastewater through the historical discharge channel on surface water, groundwater and water quality.

1.2 Scope and limitations

This report: has been prepared by GHD for Queenstown Lakes District Council and may only be used and relied on by Queenstown Lakes District Council for the purpose agreed between GHD and Queenstown Lakes District Council as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Queenstown Lakes District Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

GHD has prepared this report on the basis of information provided by Queenstown Lakes District Council and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

GHD has relied on information from a number of other reports (referenced throughout this report) and data various public sources, including but not limited to:

– ORC records on groundwater and surface water
– River flow records supplied by NIWA
– Climate information from StatsNZ

We have assumed that information is correct and have not independently validated the information.

2. Proposed activity

2.1 Background

The Shotover Wastewater Treatment Plant (WWTP) was originally constructed in 1974, to treat wastewater for the wider Queenstown area with a basic inlet works channel and three oxidation ponds. The plant has evolved significantly over time to both improve plant infrastructure, treatment and allow for the plant to cater for population growth in the Wakatipu Basin. Previous upgrades include:

– In 1987, an aeration septage lagoon and new inlet works were built.
– New inlet works were built in 2014 to replace the previous inlet works.
– Stage 1 upgrades were commissioned in 2017, including a grit removal system, a septage receiving facility, a MLE reactor with secondary clarifier, and UV disinfection. The oxidation ponds were retained to treat a portion of the incoming wastewater, and the effluent streams are combined upstream of the UV for disinfection.
– Stage 2 upgrades were undertaken in 2019, which involved the implementation of a “disposal to land” scheme via rapid infiltration into the Shotover Delta gravels. Prior to this treated wastewater was discharged directed to the Shotover River via one of two open channels.
– Stage 3 upgrades are currently underway to accommodate growth in the Queenstown area. The upgrades will increase the treatment capacity significantly and the decommissioning of the oxidation ponds. The expected commissioning date of the Stage 3 upgrade works is late 2025.

Discharge of treated wastewater from the WWTP up to 2019 was via open channels to the Shotover River. Discharge of wastewater to ground, rather than direct discharge to river, commenced in 2019 with the commissioning of the Dose and Drain (DAD) field as part of the Stage 2 upgrades. The DAD field was constructed as a series of buried, gravel filled linear basket structures containing perforated pipes. The DAD field was excavated into the natural alluvial gravels and built up (1-2 m) above the river delta. Operation of the DAD constituted flooding (dosing) of the gravels and allowing the treated wastewater to soak (drain) into the underlying gravels and into the shallow groundwater system. Groundwater flow from the area influenced by the DAD flows predominantly towards the Kawarau River.

2.2 Wastewater treatment

Details of the wastewater treatment plant process, analysis of wastewater flows and quality, and projections for these over the duration of the short-term consent are outlined in the resource consent application (LandPro, 2025). The indicated treated wastewater discharge rates and quality have been adopted in consideration of the assessment of effects to surface water, groundwater and water quality.

2.3 Emergency works

The disposal field has experienced a number of problems since commissioning, with overflows and ponding occurring. Due to ongoing issues, the DAD baskets were dug out and the field operated as a Rapid Infiltration Basin (RIB), with a series of open ponds along the length of the disposal field.

The presence of ponded water presented an unacceptable bird strike risk to aircraft due to the presence of waterfowl directly below the flight path for landing at Queenstown airport. Due to the risk, QLDC decided to redirect the treated wastewater down an existing channel (last used in 2019) to the Shotover River under emergency works provisions. A summary of the activities associated with the emergency works is provided below:

– As the channel had not been used for a number of years, the channel was very overgrown. Vegetation clearance was undertaken using two excavators on 27-28 March 2025. These works were confined to the land parcels owned by QLDC and did not include the final 100 m of the channel on the land parcel owned by the Department of Conservation (DoC).
– Discharge down the channel commenced at approximately 7:45 am on the 31 March 2025.

– Approximately two days of dual discharge to the disposal field and discharge channel occurred. The discharge to the disposal field was turned off at approximately 5:30 pm 1 April 2025.
– There was a noticeable colour change in the water in discharge channel once the wastewater from the oxidation ponds was directed to the channel.
– The current discharge is to a pool adjacent to the true right bank of the Shotover River, therefore mixing is currently limited. A consent application has been submitted on the 10th April (LandPro, 2025) to allow for works in the river bed to form a channel to the main river braid to improve mixing of treated waste water and Shotover river flow at the point of discharge.

2.4 Discharge activity

This report includes a technical assessment of the discharge of treated wastewater to ground and surface water as described below.

2.4.1 Discharge of wastewater to ground and groundwater

As the treated wastewater flows along the discharge channel some may infiltrate the ground along the base and sides of the channel. This has the potential to result in:

– Changes in groundwater levels, including mounding effects, adjacent to and down gradient of the channel.
– Effects to groundwater quality due to wastewater seepage into ground.

2.4.2 Discharge to surface water

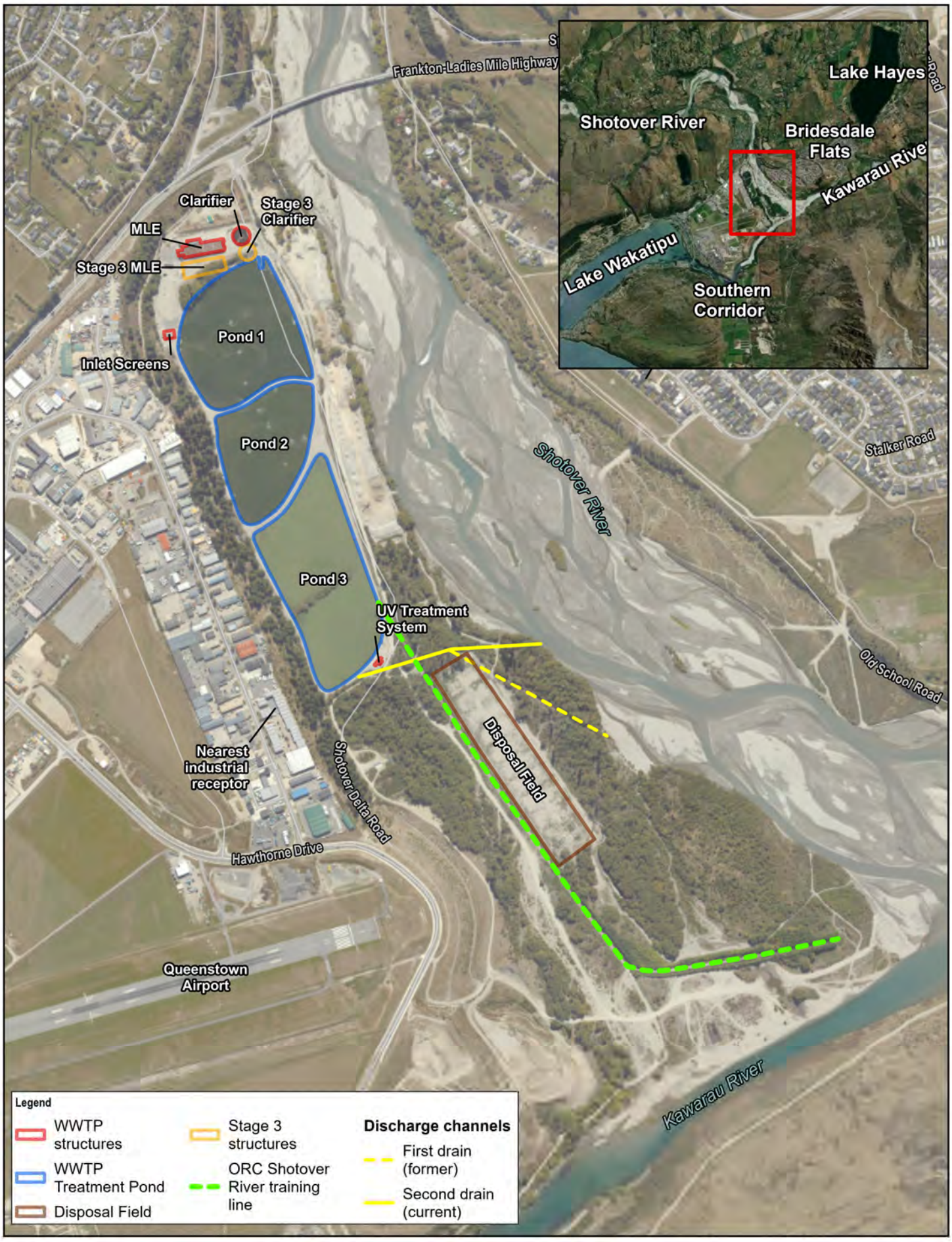
The discharge of treated wastewater to the river has the potential to impact water quality in the river. Currently the wastewater is discharging to a pool with limited mixing in the river. It is expected that mixing will be improved once a channel is excavated within the river bed to connect the discharge with the main braid.

3. Description of the environment

3.1 Site setting

The Shotover wastewater treatment plant (WWTP) is located on the Shotover River delta, on the true right bank of the Shotover River, near the State Highway 6 bridge. The river delta sits approximately 40 m below the Frankton terrace (also known as Frankton Flats), and fans from an upper, narrow section of approximately 300 m width, where the WWTP and oxidation ponds are located, to a broad exposed gravel bed of approximately 700 m width where it terminates at the Kawarau River. The site layout is shown in Figure 3.1, key features include:

- WWTP
- MLE and Clarifier
- Inlet screens
- UV treatment system
- Treatment Ponds
- Discharge channels to Shotover River
- Disposal field
- River Training Line



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Kilometers
Map Projection: Transverse Mercator
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Grid: NZGD 2000 New Zealand Transverse Mercator

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GHD

Queenstown Lakes District Council
Short term discharge assessment

Project No. **12645246**
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Date **29/04/2025**

Site Layout

FIGURE 3.1

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The historical discharge channel, recommissioned for these emergency works, was constructed in 2010. This replaced an older channel orientated oblique to the river flow direction. A typical cross section of the current discharge channel is shown below in Figure 3.2 (QLDC 2013).

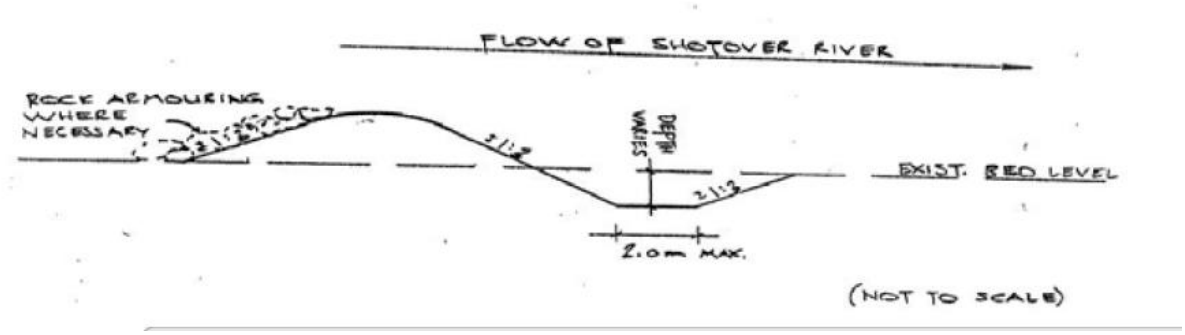

Figure 3.2 Cross section of the current discharge channel (QLDC 2013

3.2 Previous investigations

A number of investigations have been conducted in around the delta to support wastewater management, with most of these investigations related to the land disposal field. Previous investigations conducted over the past 10 years in the area include:

– LEI (2016) – 15 test pits in and around the disposal field area. Bulk samples were collected for particle size distribution (PSD) analysis and used to infer hydraulic conductivity of the alluvium.
– WSP (2019) – Test pitting and trace element analysis around the WWTP.
– Geosolve (2021) – Drilling and monitoring well installation around the disposal field. The majority of the wells (MP1-8) are located around the edge of the disposal field and screen to a shallow depth (<3 m). Three deeper bore holes were drilled (IH1A and IH2 to 40 m and IH3 to 30 m) although only shallow monitoring wells were installed (<3 m). Both IH1A and IH2 have been covered by the disposal field. A shallow monitoring well (BP1) was also installed adjacent to the Shotover River.
– McMillan (2021) completed cone penetration tests in the area between the disposal field and the river training line.

Water quality monitoring has been undertaken in accordance with consent requirements, this includes:

– Water quality monitoring in the Shotover River upstream and downstream of the discharge channel (2019 and earlier).
– Water quality monitoring in shallow monitoring wells surrounding the disposal field.

3.3 Site investigations (GHD)

Site investigations were undertaken to characterise the geological, hydrogeological and surface water environment in the vicinity of the site and assess the influence of wastewater discharges on the receiving environment. The investigations covered the broader delta, Shotover and Kawarau Rivers, and considered the influence of wastewater discharges associated with operation of the DAD and recommencement of discharges to the Shotover River. This report focusses on those findings of the investigation that are relevant to assessment of environmental effects associated with the discharge of wastewater to the Shotover River via the discharge channel, with information from the wider investigation included where it aids in the understanding of the potential effects. The site investigations included:

– Installation of 21 groundwater monitoring wells
– Groundwater level monitoring in the new monitoring wells and two existing monitoring wells (IH3 and BP01)
– Groundwater quality sampling
– Hydraulic testing of aquifer hydraulic conductivity
– Test pitting (19 pits) across the delta to confirm the geology

– Surface water sampling in the Shotover and Kawarau Rivers. Surface water sampling was undertaken on the following dates:
  - 10-11 March 2025 – prior to the surface water discharge
  - 1 April 2025 – one day after commencement of the surface water discharge
  - 3 April 2025
  - 8 April 2025
  - 10 April 2025.

3.4 Climate

The average annual rainfall from 1990 – 2020 is shown below in Figure 3.3.

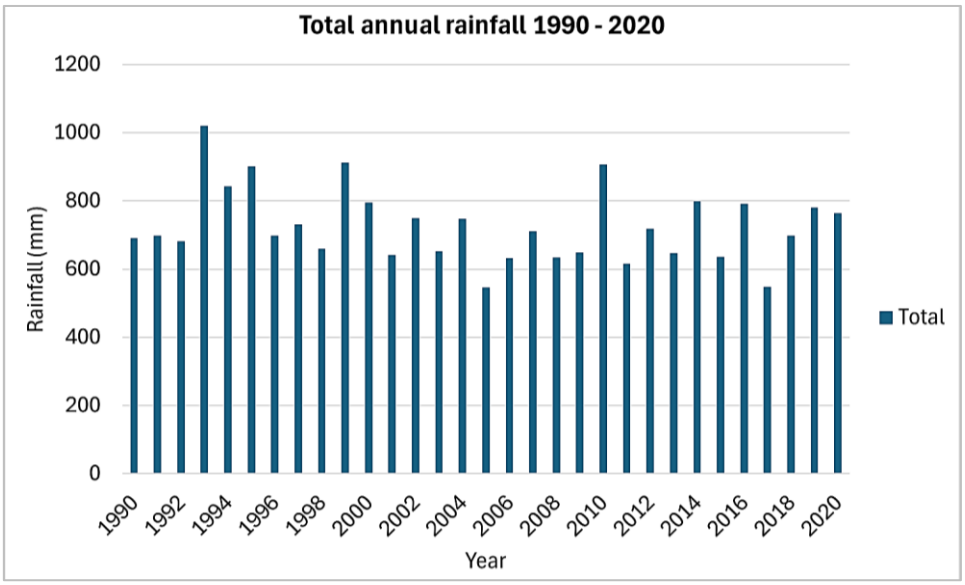

Figure 3.3 Annual rainfall in Queenstown from 1990 – 2020. Data source: NIWA climate database (StatsNZ 2023).

From 2020 – 2024 the average annual sunshine hours was 2,338 and the mean temperature was 10.5°C (NIWA 2025). The overall climate in Queenstown consists of warm summers, typically 20 – 30°C during the day, and cold winters with occasional low elevation snowfall. Table 3.1 provides a summary of seasonal rainfall from 1990 to 2020, sourced from NIWA's climate database (link to data from StatsNZ, 2023).

Queenstown is situated on the eastern side of the Southern Alps. The prevailing westerly winds bring moist air from the Tasman Sea, which rises over the mountains, cools, and condenses, leading to precipitation (NIWA 2015). Greater variability in rainfall occurs in spring and summer, where prolonged dry periods or high intensity rain events result from the influence of these westerly winds and annually variable occurrence of frontal systems.

Table 3.1 Seasonal rainfall summary from 1990 – 2020. Data sourced from NIWA Climate Database (StatsNZ 2023)

Season	Min (mm)	Max (mm)	Average (mm)
Autumn	103.4	271.6	179.3
Spring	70.3	333.2	181.0
Summer	83.6	454.8	190.5
Winter	100.4	273.1	175.0

3.5 Hydrology

3.5.1 Setting

The site is located on the Shotover River delta approximately 1 km upstream of the Kawarau River confluence. The lower Shotover River in the vicinity of the Shotover WWTP discharge is characterised by braided river channels, with frequent flood flows resulting in a moving gravel riverbed and changing channel locations. The lower Shotover River with currently active flows and channels (true left bank) is approximately 650 m in width. A further 700 m (width) of the delta on the true right bank is covered with established vegetation and infrastructure. Construction of the flood training wall on the true right of the river delta, has permanently altered the hydrology of the river during flood conditions. Where historically Shotover River waters entered the Kawarau River across the full extent of the confluence (approximately 1300 m width), flow is now constrained to approximately half of the delta.

The Kawarau River is a large river fed by Lake Wakatipu and is the principal tributary of the Clutha River. Large inflows to the Kawarau from the Shotover River can back up the Kawarau River causing a negative difference in lake level in Lake Wakatipu between Frankton and Queenstown resulting in a flood risk to Queenstown. For this reason, the ORC constructed a river training line on the Shotover delta to direct flows away from Queenstown. Aerial imagery of the Shotover River collected from 2004 to 2025 and provided in Appendix A, illustrate the significant change in the braided channel locations (as discussed in Section 3.5.2), the influence of flooding on the delta and the influence of the flood training wall constructed in 2011. It is considered unlikely that the full effect of the training wall on the delta landform and both the Shotover and Kawarau River channels has been realised in the current setting.

River flows in the Kawarau River are disturbed by floods to a lesser extent than the Shotover due to the buffering effect of Lake Wakatipu. The Shotover River responds rapidly to rainfall, with flood flows characterised by high sediment load and turbid waters due to the geology and topography of the headwaters.

Summary flow statistics for the Kawarau and Shotover Rivers upstream of the confluence are included in Table 3.2.

Table 3.2 Summary flow statistics (NIWA)[1]

River	Mean flow (m^3/s)	Median flow (m^3/s)	Mean annual low flow (MALF) (m^3/s)
Kawarau River	232.8	179.1	71.2
Shotover River	56.5	43.4	18.1

Flow monitoring for the Shotover River is shown in Figure 3.4. The Shotover River monitoring station at Bowens Peak is approximately 7 km upstream of the site. During the monitoring investigation period flood events occurred on 18 March, 4 April and a smaller flood event on the 8 April. Prior to 18 March, the river flows were decreasing slightly.

Flow monitoring for the Kawarau River is shown in Figure 3.5. The Kawarau River monitoring station at Chards Road is approximately 10 km downstream of the site. Like the Shotover, three flood events occurred on 18 March, 4 April and 8 April. A flood event was also recorded on 15 April in the Kawarau River, while the Shotover River flow record does not extend to this date it is assumed that high flows were also recorded in Shotover River on or around 15 April.

[1] https://shiny.niwa.co.nz/nzrivermaps/

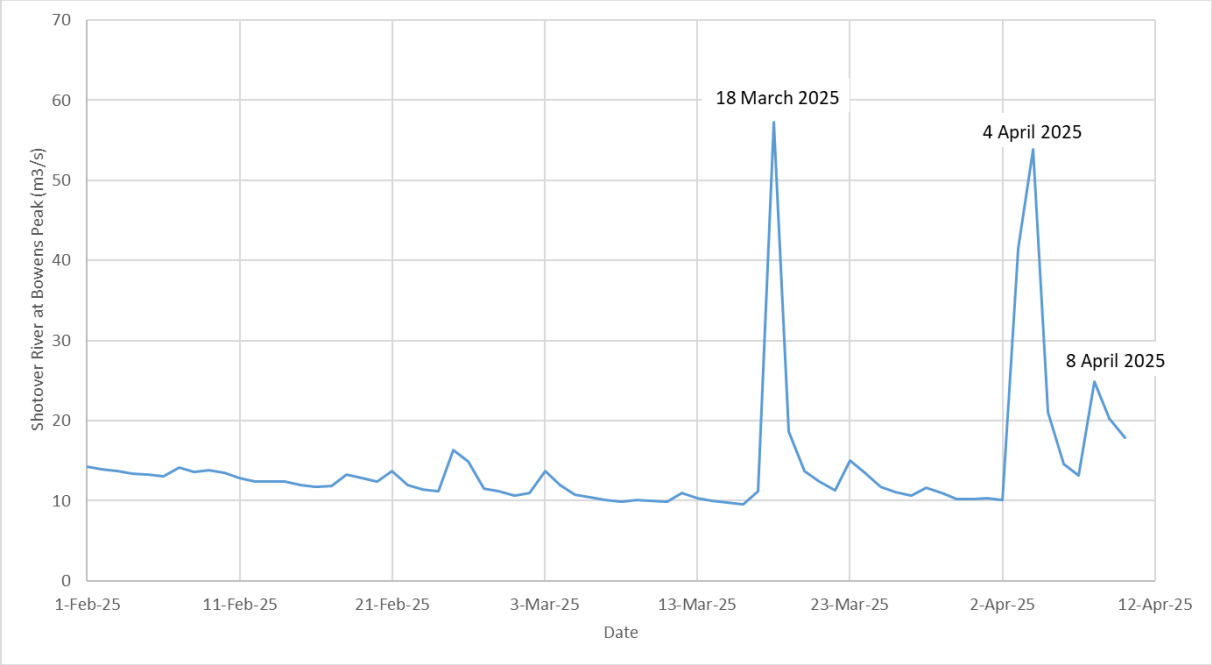

Figure 3.4 Shotover River (at Bowens Peak) – daily mean flow

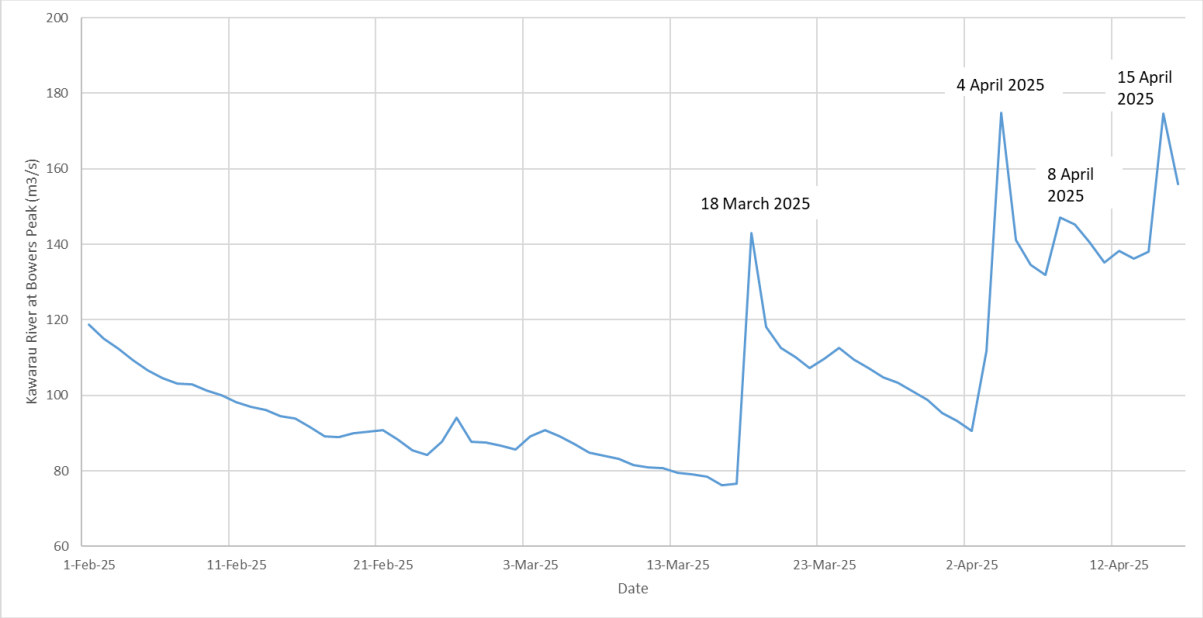

Figure 3.5 Kawarau River (at Chards Road) - daily mean flow

3.5.2 Historical channels/ river morphology

The former disposal field is located on the Shotover delta, in this area the Shotover River takes on a braided form. Braided rivers are characterised by multiple channels, high levels of sediment supply, and constant channel movements. The development of the WWTP and oxidations ponds, and other more recent activities on the true right bank has constrained the active river bed to approximately half of the former width.

The influence of the river and presence of historical channels are likely to influence groundwater flow through the delta gravels. A review of historical aerial photographs (Appendix A) was undertaken to identify former channel features and where they may influence groundwater flow within the delta gravels. Figure 3.6 shows the Shotover River delta in 2006 and 2023. In 2011, the river training line was constructed with aim of reducing the risk of flooding to Queenstown. During the 1999 floods significant flood flows down Shotover River resulted in Kawarau River backing up and raising Lake Wakatipu levels.

Figure 3.6 Shotover River Comparison 2006 and 2023

The river training line crosses the former main river channel (as seen in the 2006 photo (left)). As a result, this area became a low-flow area with fine sediment accumulating within the former channel and deposition of gravel across the former channel mouth. Vegetation has established within the former channels and behind the training line structure. The comparison also shows that the disposal field is situated on a former river channel, that was historically referred to as the 'high flow' channel.

3.6 Geology

3.6.1 Setting

The Queenstown area is underlain by schist and semi-schist of the Torlesse and Caples supergroup. The schist forms the mountain ranges and high points (e.g. Morven Hill) in and around the Wakatipu Basin. The basin geology is influenced by multiple glacial advances, carving out the basin and leaving behind glacial sediments (till and outwash gravels) as the glaciers retreated.

Frankton flats and the Shotover Delta are underlain by recent (Holocene) alluvial and fan deposits, comprising unconsolidated gravel sand and silt. The depth of the alluvium is unknown, with a 90 m deep bore hole drilled on the terrace (near 5 Mile development) not encountering basement schist (ORC, 2014).

3.6.2 Shotover delta

Several investigations have been undertaken to understand the geology of the Shotover delta. These investigations were primarily undertaken to inform the design of the former disposal field. Recent investigations (test pitting and drilling) have been undertaken by GHD to provide a wider understanding of the geological variability across the delta. Investigation locations are shown in Figure 3.7.

The geology underlying the delta is predominantly a sandy fine to coarse gravel with some cobbles. The gravel is made up of subrounded to subangular schist fragments. The gravel underlies a thin sandy topsoil. Notable exceptions include:

– Gravelly fine to coarse sand to approximately to 2 m depth in TP12.
– A layer of fine to coarse sand (to 1.5-2.5 m depth) in TP18 and TP19
– A layer of fill material placed at the base of the terrace around TP01, TP02 and BH14

Deeper boreholes drilled during the investigation indicate that the sandy gravel is underlain by a layer of fine sand, at least at the Kawarau River end of the delta. The sand was encountered at a depth of approximately 4 m in

BH18 and 7 m depth in BH20. In BH13 the sandy gravel was underlain by a gravelly sand layer from 3.8 m to the drilled depth at 9 m.

Previously drilled deep boreholes in the vicinity of the disposal field (IH1A, IH2 and IH3, Geosolve, 2021) showed alternating layers of sandy gravel and sand (fine to coarse), refer to Appendix B for the bore logs. Monitoring well IH3, located to the south east of the disposal field, was drilled to a depth of 30 m, although the piezometer casing only extends to 5 m bgl. Basement (schist) was not encountered during drilling.

Table 3.3 provides a summary of the geology in and around the discharge channel (BH02, 03, and 04)

Table 3.3 Geological summary

Bore ID	Bore Depth (m)	Geology Encountered (Depth range, m below ground level)
BH02	3	(0.0 – 0.5 m) Gravelly fine to coarse SAND (0.5 – 1.6 m) Medium to coarse SAND with minor cobbles (1.6 – 3.0 m) Sandy fine to coarse GRAVEL with minor cobbles
BH03	4.5	(0.0 – 0.45 m) TOPSOIL: Silty fine SAND with minor organic (0.45 – 1.4 m) Fine to medium SAND with trace gravel (1.4 – 4.5 m) Sandy fine to coarse GRAVEL
BH04	4.5	(0.0 – 0.45 m) Fine to medium SAND with minor gravel (0.45 – 4.5 m) Sandy fine to coarse GRAVEL

Particle size distribution (PSD) plots for samples collected in previous investigations (LEI (2016)) are included in Appendix C. These samples were collected by in and around the former disposal field.

Inspection of the historical disposal channel prior to recommencement of wastewater discharge indicated that fine sediment and debris had accumulated in the channel base, to thickness ranging from 0.1 m to 0.2 m. Exposed soils in the channel walls and base were comprised fine to medium sand, with fine to coarse gravel.

Paper Size ISO A4
Scale: 1:5,000

0 0.1 0.2

Kilometers
Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

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Queenstown Lakes District Council
Short term discharge assessment

Project No. 12645246
Revision No. 0
Date 28/04/2025

Investigation Plan - Groundwater and Test pits

FIGURE 3.7

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Data source: NZ - Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors. Created by: nrama

3.7 Hydrogeology

3.7.1 Setting

The glacial geology within the Wakatipu basin has resulted in a series of small, disconnected aquifer zones. These aquifers comprise glacial outwash gravels, lake fans and alluvium containing sand, silt and gravel. The presence of bedrock and/or low permeability lake silt or glacial till separates the permeable aquifer zones from other areas. These aquifer zones have been collectively mapped as the Wakatipu Basin aquifer by ORC[2].

The Wakatipu Basin Aquifer encompasses the Shotover Riverbed from approximately 2 km downstream of Arthurs Point to Shotover Downs, approximately 1 km upstream of the SH6 Bridge. From Shotover Downs, the Wakatipu Basin Aquifer is mapped only to cover a portion of the riverbed on the true left bank of the Shotover River. The WWTP site and location of the discharge channel are outside of the mapped aquifer zone.

QLDC abstract groundwater from a series of groundwater bores on the true left bank of the Shotover River (opposite riverbank to the discharge), approximately 500 m upstream of the discharge channel. The bores are screened at approximately 30 - 45 m depth. Bore logs for the production bores show a thick sequence of sandy gravels from near surface to the base of the bores.

3.7.2 Shotover delta hydrogeological properties

Hydraulic testing, comprising rising and falling head tests, of groundwater monitoring wells were carried out to provide an estimate of aquifer saturated hydraulic conductivity. Test results are summarised in Table 3.4 with analysis plots included in Appendix D. Testing of monitoring well BH18 was also carried out as this well is screened within the fine sand unit found to underlie the coarse sandy deposits in places. Depending on how extensive these fine grained materials are, they may have a significant influence on the potential depth of mixing in the aquifer of any infiltrating waters. Hydraulic testing indicated a very high hydraulic conductivity for deposits screened in wells BH02, BH03 and BH04 consistent with the sandy gravel lithology. This is considered to reflect the potential horizontal hydraulic conductivity, rather than the potential infiltration rate. In contrast, testing of the fine sand deposits indicates a significantly lower permeability more consistent with a silty sand. The difference in permeability between materials is significant and layers or infilled zones of such fine grained materials may influence groundwater flow direction.

Previous investigations undertaken by LEI (2016) inferred a hydraulic conductivity of soils around the disposal field based on a grain size analysis of bulk samples from test pits (Figure 3.8). An average hydraulic conductivity of 30 m/day was estimated by LEI, equivalent to 3 x 10^{-4} m/s.

Table 3.4 Results of hydraulic conductivity testing (geomean)

Bore ID	Hydraulic Conductivity (m/s)	Geology
BH02	>1 x 10^{-3}	Sandy gravel
BH03	>1 x 10^{-3}	
BH04	>1 x 10^{-3}	
BH18	4.7 x 10^{-7}	Fine sand

[2] ORC Aquifer Map C4, **c-map-series-c4.pdf**

Table 2.1: Disposal Area Hydraulic Conductivity

Soil Type	K (m/day)	Comment
Sandy GRAVEL (with minor traces of silt)	Range: 4.5 – 64 Average: 30	
GRAVEL (with minor traces of sand)	58	Only one sample collected
SAND (with minor traces of silt)	Range: 0.3 – 31.1 Average: 4.6	
Silty SAND	Range: 0.09 – 0.1 Average: 30	
Silty GRAVEL	n/a	No PSA testing due to only being a thin compacted top soil layer
Sandy SILT	0.09	Only one sample collected

Figure 3.8 Exert from LEI (2016) – inferred hydraulic conductivity based on bulk sample composition

3.7.3 Shotover delta groundwater levels and flow direction

The Shotover River forms a braid plain and a floodplain, both of which define the alluvial unconfined aquifer. Groundwater occurs at shallow depths (0.9 – 4.8 m bgl) across the delta area (Table 3.5) and has a strong hydraulic connection to the river (ORC, 2014).

A groundwater contour map was constructed based on the relative groundwater levels measured in April 2025 and is shown in Figure 3.9. The contour map incorporates surface water levels at several points along the Shotover and Kawarau Rivers (surveyed by LandPro 2025). Surveying of well casing elevation for well BH03 could not be achieved due to dense vegetation, and instead the relative levels provided for BH03 have been estimated from LiDAR measured surface elevation (in Table 3.5). Due to this uncertainty, groundwater level measurements for BH03 have not been incorporated into the groundwater contour map.

The direction of groundwater flow across the delta is considered to be generally to the southeast, towards the Kawarau River. Generally aligned with the direction of Shotover River flow, groundwater flow is expected to be influenced by the significant heterogeneity and anisotropy introduced by the alluvial depositional environment. Due to the variability of the sand and gravel deposits and historical channel features, former gravel beds commonly provide preferential groundwater flow paths, while fine sands (accumulated from flooding or in slack channels) create relative barriers to groundwater flow. In particular, vertical hydraulic conductivity can be significantly less than horizontal hydraulic conductivity.

Groundwater monitoring in newly installed wells upgradient (BH02) and downgradient (BH03) of the discharge channel determined groundwater levels to be approximately 2 m below the base of the channel. The hydraulic gradient between these wells is to the southeast and generally consistent with that seen elsewhere across the delta. Monitoring of groundwater levels over a period of 7 – 12 days using pressure transducers (Figure 3.10), and comparison to Shotover River level measurements reported by Otago Regional Council, demonstrate the relatively rapid response in groundwater levels BH02 and BH03 to changes in river level. This further supports the understanding of significant groundwater and river connectivity.

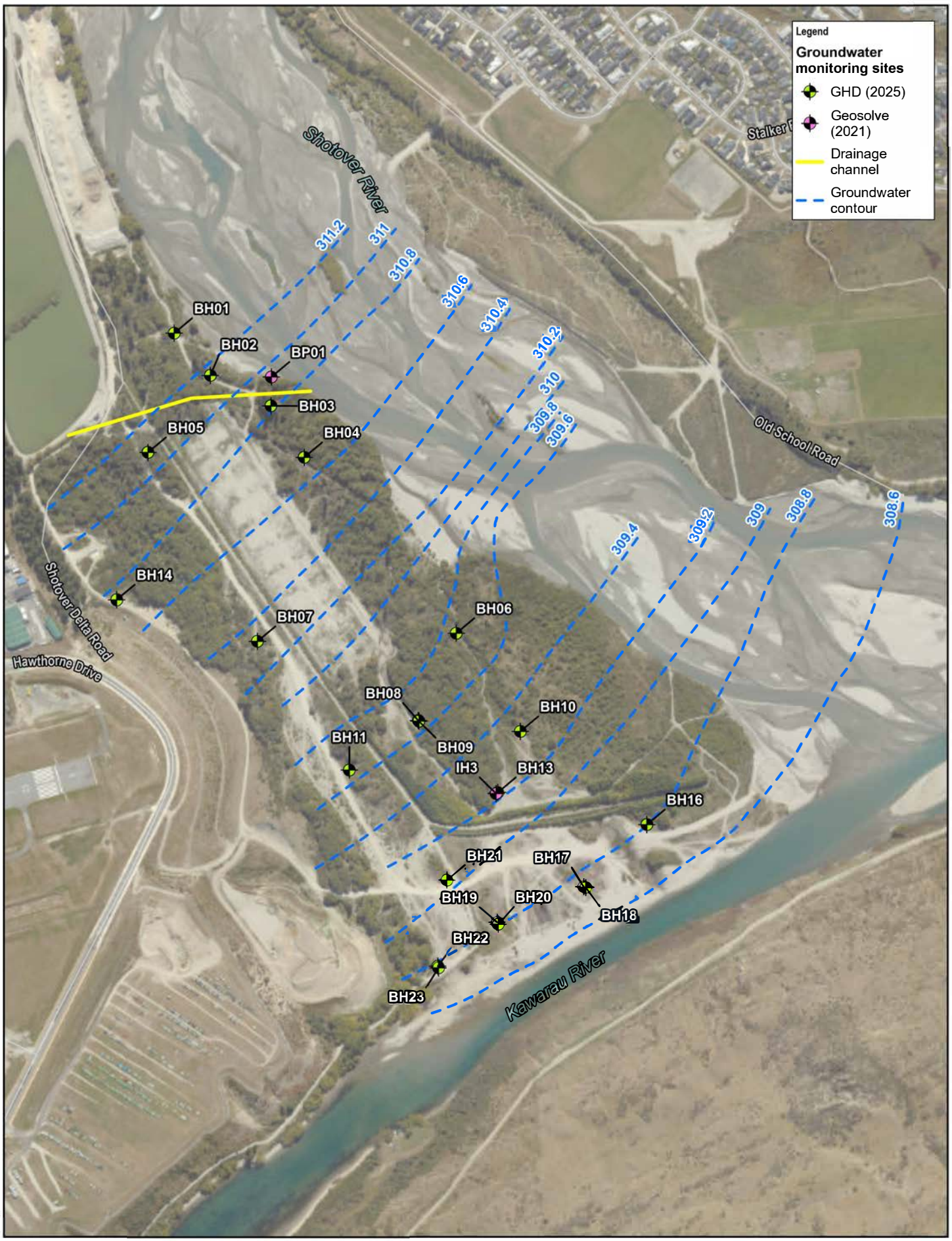
Groundwater monitoring records are included in Appendix E and summarised in Table 3.5.

Soakage from the discharge channel and changes in wastewater discharge rates to the channel do not appear to be notably influencing groundwater levels in monitoring wells BH02 and BH03. This is expected as a function of the modest potential for vertical infiltration from the channel base, relative to the high horizontal hydraulic conductivity that rapidly dissipates infiltrating treated wastewater. Similar conditions were evidenced in and around the DAD, where high water levels in the DAD and infiltration, did not result in corresponding significant increases in water levels downgradient of the DAD.

Table 3.5 Groundwater monitoring locations

Bore ID	Easting (NZTM)	Northing (NZTM)	Top of casing RL[1]	Ground RL[1]	Screened Interval (m bgl)	GWL (m bgl)	GWL (m RL)	
BH01	1265913.72	5007121.8	313.38	312.86	1 - 3	1.98	310.88	
BH02	1265968.29	5007058.06	313.19	312.82	1 - 3	2.07	310.75	
BH03	1266059.7	5007012.24	*313.11* *	*313.07* *	2.5 - 4.5	2.86	*310.21*	Well not surveyed due to vegetation, estimated from LiDAR
BH04	1266109.87	5006934.47	313.32	312.73	2.5 - 4.5	2.68	310.05	
BH05	1265874.15	5006942	313.34	312.81	1 - 3	2.26	310.55	
BH06	1266339.36	5006669.72	311.07	310.67	2.5 - 4.5	1.33	309.34	
BH07	1266039.33	5006657.48	312.3	311.85	1 - 3	1.98	309.87	
BH08	1266282.03	5006538.17	311.45	311.05	1 - 3	1.78	309.27	
BH09	1266283.06	5006537.07	311.49	310.97	6 - 8	1.86	309.11	
BH10	1266436	5006521.69	311.01	310.48	1 - 3	1.68	308.8	
BH11	1266178.04	5006463.39	312.31	311.93	2.5 - 4.5	2.66	309.27	
BH13	1266402.01	5006429.6	311.14	310.6	6 - 8	1.87	308.73	
BH14	1265826.97	5006719.89	315.55	315.04	4.5 - 6.5	4.79	310.25	
BH16	1266626.94	5006381.18	310.28	309.74	1 - 3	1.48	308.26	
BH17	1266532.92	5006287.44	309.62	309.24	1 - 3	0.89	308.35	
BH18	1266535.82	5006286.32	309.84	309.36	6 - 8	1.11	308.25	
BH19	1266401.85	5006233.66	310.9	310.34	1 - 3	1.97	308.37	
BH20	1266403.73	5006230.86	310.74	310.25	5.5 - 6.5	1.96	308.29	
BH21	1266326.33	5006297.09	310.87	310.42	1 - 3	1.83	308.59	
BH22	1266311.49	5006167.57	310.76	310.24	1.5 - 4.5	1.99	308.25	
BH23	1266312.54	5006165.17	310.51	310.06	4.5 - 6	1.48	308.58	
BP01	1266060.35	5007055.72	311.69	311.24	0.2 - 3	0.83	310.41	
IH3	1266399.55	5006427.99	311.36	310.77	3 - 5	-	-	Well dry/blocked

[1]Vertical datum DVD 1958



Paper Size ISO A4
Scale: 1:7,500

0 0.1 0.2

Kilometers
Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Queenstown Lakes District Council
Short term discharge assessment

Project No. 12645246
Revision No. 0
Date 28/04/2025

Groundwater contour map

FIGURE 3.9

\\ghdnet.internal\ghd\NZ\Christchurch\Projects\51\12645246\GIS\Maps\Working\12645246_WORKING\12645246_WORKING.aprx - 12645246_STDA_Fig3.10_GWContours_Rev0
Print date: 28 Apr 2025 - 13:28

Data source: NZ - Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors. Created by: nrama

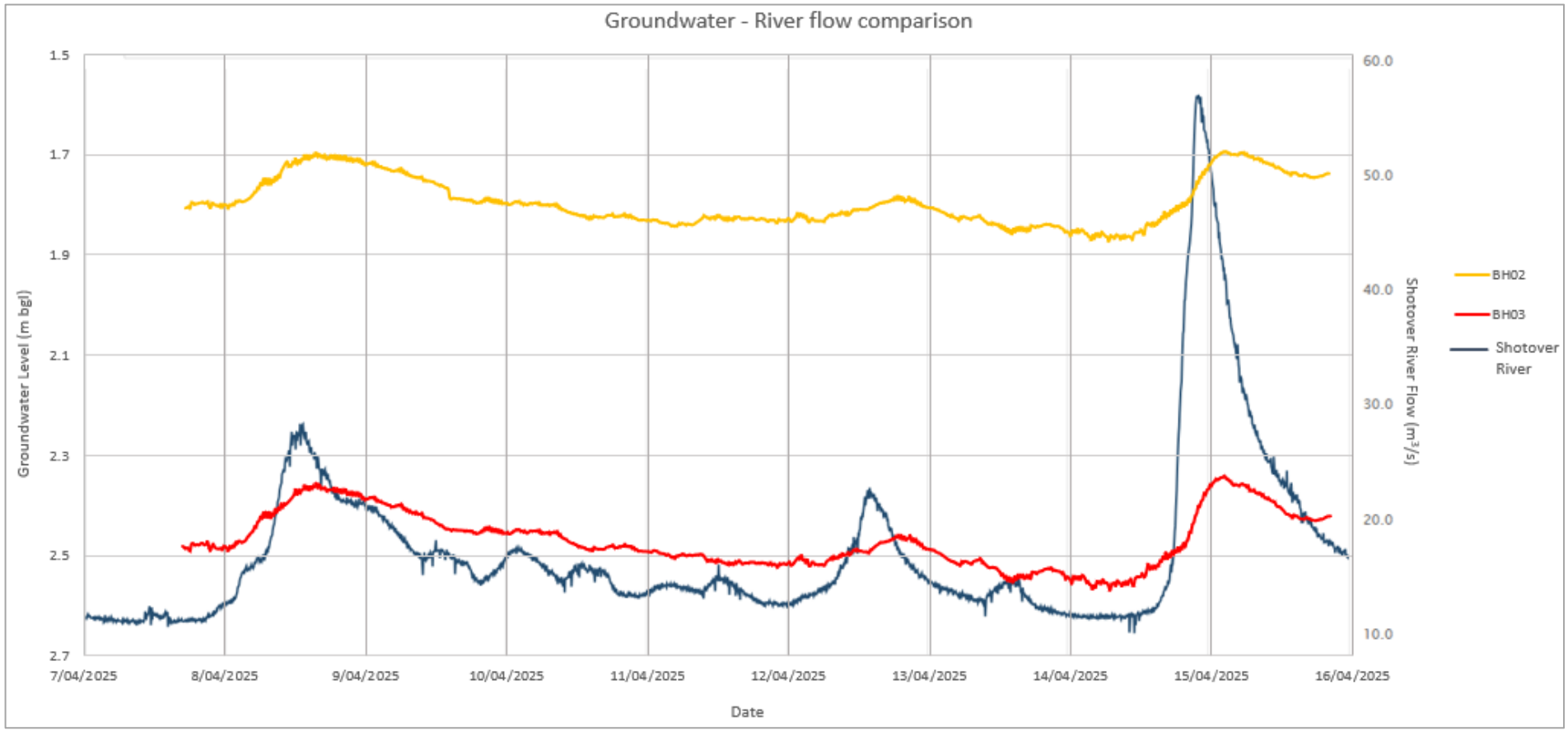


Figure 3.10 Groundwater level and Shotover River flow

3.8 Water quality

3.8.1 Groundwater

Groundwater wells up gradient and down gradient of the discharge channel were sampled using low flow sampling techniques. During sampling, field parameters were monitored until stabilisation and the samples were collected in laboratory supplied bottles. Groundwater results are included in Table 3.6. Laboratory reports are included in Appendix F. The groundwater samples were collected on the 8 April 2025, approximately one week after the discharge channel became operational. BH01 and BH02 are up gradient of the discharge channel. BH03 is located directly down gradient of the channel. BH04 is located adjacent to a historical discharge channel (disused since 2010), and relatively close to the DAD.

The influence of wastewater becomes increasingly evident in groundwater moving to the southeast, from BH01 to BH04, with notable change in conditions between BH02 and BH03, i.e. significant change in conditions downgradient of the discharge channel.

In summary, the following suggests influence of wastewater:

– Increasing relative proportion of sodium, potassium and chloride in groundwater, and increase electrical conductivity, with this demonstrating a transition away from the natural minerology of the area, towards an influence with greater dissolved solids.
– Increasing nitrogen concentrations, with a notable increase in BH03 and BH04 relative to the up-gradient wells (BH01 and BH02).
– A shift to low dissolved oxygen and reducing conditions moving towards BH03 and BH04, reflecting notable presence or influence of organic material/compounds and microbiological activity. The lower sulphate concentrations, and higher iron concentrations, in BH04 relative to BH03 suggests stronger reducing conditions in proximity of BH04.
– The presence of nitrogen as ammoniacal-N, supported by reducing conditions in groundwater, also reflects a source with high ammoniacal-N rather than a nitrate-N dominated source.
– Total Coliforms and *E. coli* are elevated in BH03 and BH04, however these microbiological contaminants were also detected in BH01 upgradient of the discharge channel.

Concentrations of ammoniacal-N in groundwater measured at BH03 and BH04, sampled on 8 April 2025, were greater than those measured in treated wastewater being initially discharged. The initial results showed the influence of nitrification with nitrogen predominantly in the nitrate-N form. Instead, the concentrations measured in groundwater are more consistent with ammoniacal-N concentrations subsequently measured in treated wastewater in the discharge channel.

With sampling approximately one week after the commencement of discharge to the historical channel, the potential influence of soakage from the channel on downgradient groundwater cannot be precluded. However, given the distance from the discharge channel to BH04, the increasing influence of wastewater from BH03 to BH04, and the proximity of BH04 to the DAD and an earlier discharge channel, it is considered likely that the influence of wastewater on groundwater identified in BH04 relates to longer term discharges to ground from the oxidation ponds and/or the DAD.

Table 3.6 Groundwater quality data

Parameters		Units	BH01	BH02	BH03	BH04	RS15 (Discharge Channel)	
							Min.	Max.
	Date		8 Apr 2025	8 Apr 2025	8 Apr 2025	8 Apr 2025	1, 3 & 7 Apr 2025	
	Lab Report Number		25-10522	25-10522	25-10522	25-10522	25-09648, 25-09967 & 25-10293	
	Time		8:59:00	10:04:00	11:17:00	13:51:00	-	-
Field	pH (Field)	pH units	7.73	7.34	7.1	7.02	7.16	8
	Electrical conductivity (field)	µS/cm	176.6	249	446.7	470.6	127.1	420.1
	DO (%S) (Field)	%S	6.79	1.11	0.57	0.53	98	182.1
	Redox (Field)	mV	115.5	98.5	-67.1	-130.9	127.1	195.9
	Temperature (Field)	°C	13.1	13.6	14.8	17.7	12.8	20.1
	TDS (Field)	mg/L	114.4	101.85	290.55	306.15	-	-
Lab	pH (Lab)	pH units	7.8	7.8	7.6	7.5	7.8	7.8
	Electrical conductivity (lab)	µS/cm	184	262	473	486	470	470
Biological	Total Coliforms (Colilert)	MPN/100 mL	>2,420	1,299.7	648.8	488.4	>2,420	>2,420
	E. coli	MPN/100 mL	4.1	<1	14.6	10.9	28.5	435.2
Major Ions	Calcium	mg/L	33.9	51.2	30.8	25.8	25.1	25.1
	Magnesium	mg/L	1.30	1.15	2.68	3.69	3.46	3.46
	Potassium	mg/L	0.94	0.53	17.1	16.1	16.6	16.6
	Sodium	mg/L	1.44	2.49	45.7	44.8	43.8	43.8
	Chloride	mg/L	0.51	1.23	36.5	35.6	38.4	38.4
	Sulphate	mg/L	8.27	6.61	35.8	7.15	32.2	32.2
	Total Alkalinity (CaCO3)	g CaCO3/m^3	77.0	117	119	161	106	106
	Cations Total	meq/L	1.88	2.77	4.60	4.91	4.37	4.37
	Anions Total	meq/L	1.74	2.54	4.18	4.40	4.20	4.20

Parameters		Units	BH01	BH02	BH03	BH04	RS15 (Discharge Channel)	
							Min.	Max.
Nutrients	Nitrate-N	mg/L	0.0229	0.138	<0.0020	0.0116	3.95	6.85
	Nitrogen (Total)	mg/L	<0.10	0.14	5.0	9.7	8.3	16
	Kjeldahl Nitrogen Total	mg/L	<0.10	<0.10	5.01	9.64	1.43	11.2
	Nitrite-N	mg/L	<0.0010	<0.0010	0.0035	0.0035	0.0195	0.0342
	Ammoniacal Nitrogen	mg/L	<0.005	<0.005	4.70	9.81	0.15	8.62
	Dissolved Reactive Phosphorus (DRP)	mg/L	<0.002	<0.002	0.430	1.318	1.707	1.867
	Phosphorus (Total)	mg/L	<0.0050	<0.0050	0.97	3.44	2.27	3.59
Metals	Iron (dissolved)	mg/L	<0.0050	<0.0050	1.60	6.21	0.11	0.11
	Manganese (dissolved)	mg/L	<0.00050	0.0017	0.724	0.897	0.0521	0.0521
	Zinc (dissolved)	mg/L	<0.0010	0.0014	0.0063	0.0050	0.061	0.061

3.8.2 Surface water

3.8.2.1 Routine monitoring – wider catchment

Water quality monitoring is undertaken by ORC on a routine basis for state of the environment monitoring in Shotover River upstream of the site (at Bowens Peak) and in the Kawarau River (at Chard Road). The State of the Environment classification from LAWA is summarised below in Table 3.7. The Shotover River is characterised by a high sediment load due to the geology and topography of its upper catchment. Therefore, it has a naturally low clarity classification.

Table 3.7 LAWA state of the environment

Station	Parameter	State
Shotover at Bowens Peak	*E. coli*	Not assessed
	Clarity	D
	Ammoniacal Nitrogen	A
	Nitrate Nitrogen	A
	Dissolved Reactive Phosphorus	A
Kawarau at Chards Road	*E. coli*	A
	Clarity	D
	Ammoniacal Nitrogen	A
	Nitrate Nitrogen	A
	Dissolved Reactive Phosphorus	A

3.8.2.2 Compliance monitoring (2017-2019)

Water quality monitoring was undertaken upstream and downstream of the Shotover River discharge, as a requirement of the previous surface water discharge consent. Water quality data for the period 2017 to 2019 has been considered as most representative of the current conditions, as it incorporates the Stage 2 upgrades to the treatment plant.

There were two monitoring points: one 50 m upstream (u/s) from the discharge point and one 50 m downstream (d/s). Samples collected at the time were analysed for nutrients, *E. coli* and $cBOD_5$, with results for monitoring presented in Figure 3.11, Figure 3.12 and Figure 3.13.

The d/s water quality at the sampling locations demonstrates the clear influence the historical discharge had on downstream water quality from December 2017 to April 2018. From April 2018, the downstream water quality improves significantly and remains improved even over the equivalent summer low-flow period.

Minor differences in river level under low flow conditions can significantly influence the occurrence and extent of temporary channels at the riverbank and where mixing of the discharge occurs within the river, with this evidenced in observations made following recommencement of the discharge in April 2025. Water levels in the Shotover River were very low from December 2017 through to February 2018, with elevated nitrogen and phosphorous concentrations at this time particularly high and demonstrating that wastewater was likely ponding in a small channel that extended past the routine d/s monitoring location. From that period, river levels while remaining low with intermittent high flow events, remained within a relatively consistent range through to October 2018, at which point higher flow conditions were apparent with the occurrence of snowmelt.

The significantly reduced influence of the historical discharge on water quality following April 2018 and into 2019 is considered to be primarily attributed to changes to the river level and how that influences discharge mixing in the Shotover River. Improvements in wastewater quality, in particular the level of disinfection, resulting from the plant upgrades is also expected to be influential in the apparent improvement in effects to water quality.

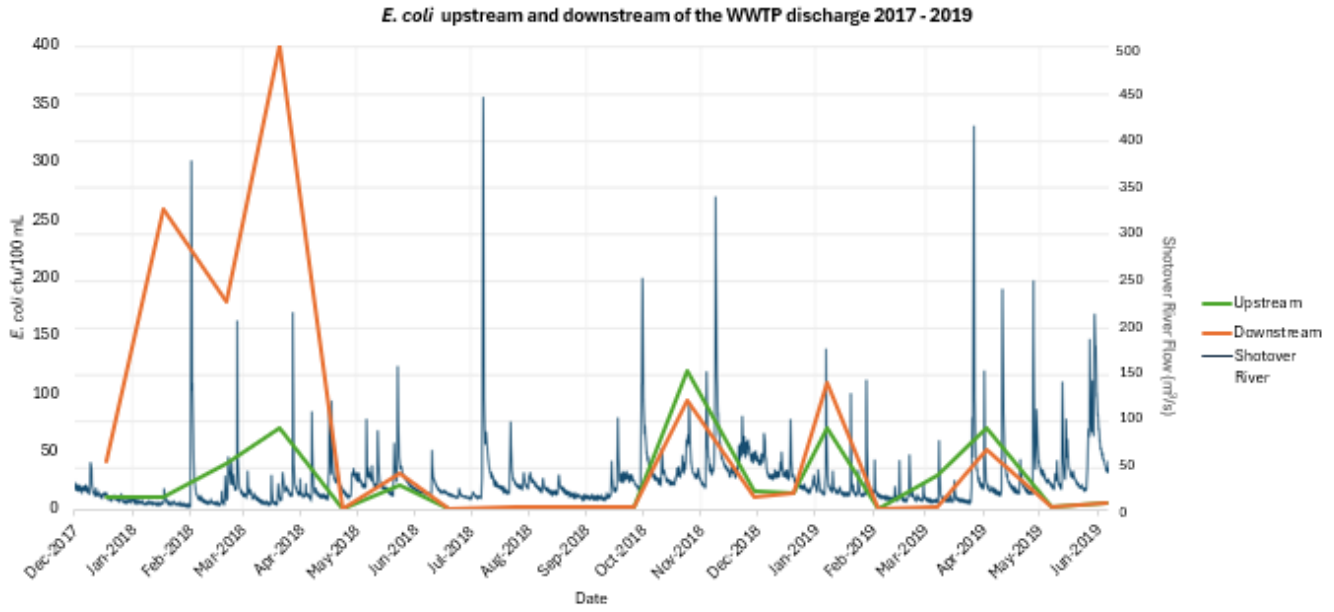


Figure 3.11 E. coli results from 50 m upstream and 50 m downstream of the WWTP discharge 2017 – 2019

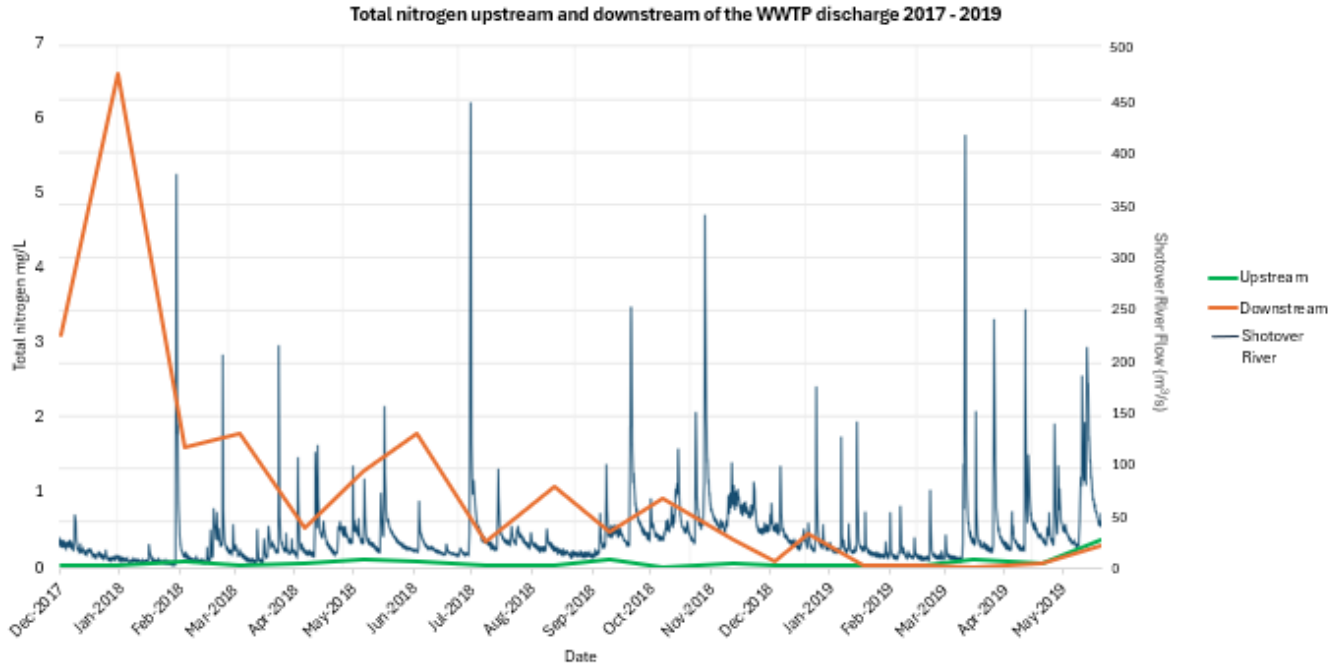


Figure 3.12 Total nitrogen results from 50m upstream and 50m downstream of the WWTP discharge 2017 – 2019

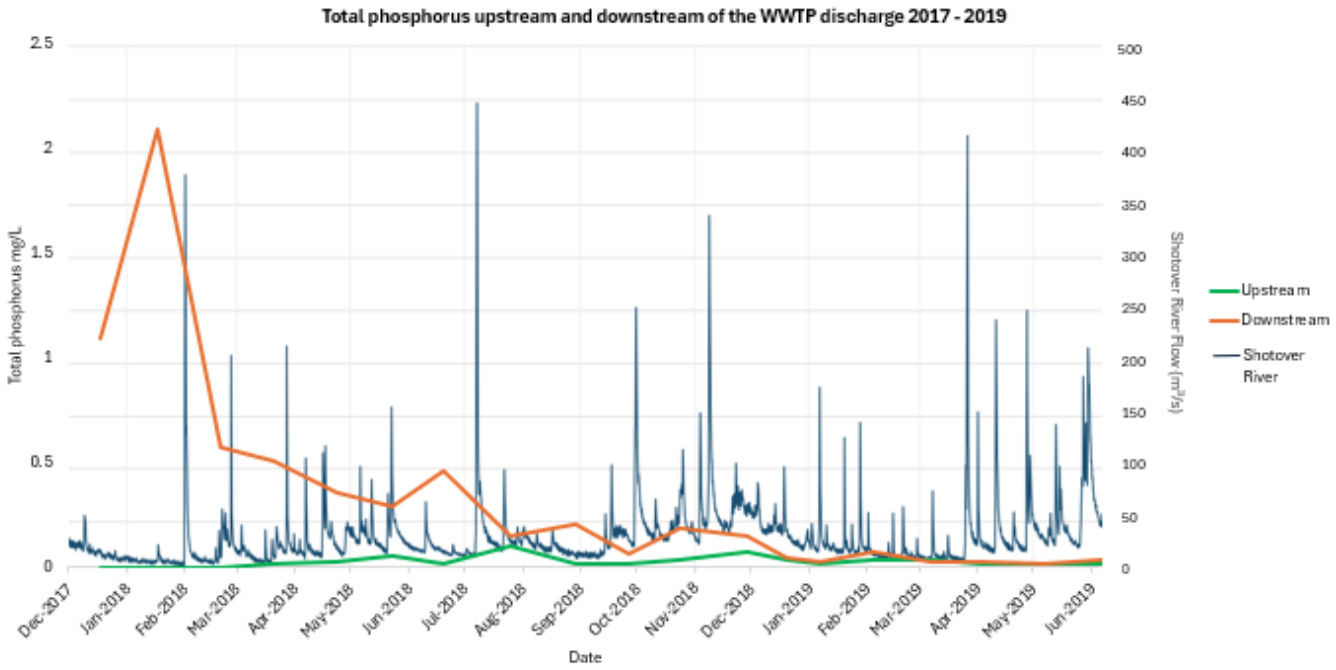


Figure 3.13 Total phosphorus results from 50m upstream and 50m downstream of the WWTP discharge 2017 – 2019

3.8.2.3 Baseline water quality sampling – August 2024

LandPro completed water quality sampling in August 2024 from six locations: S1 – S3 in the Shotover River, and S4 – S6 in the Kawarau River, shown in Figure 3.14 (reproduced from LandPro, 2024). In addition to water quality parameters, two eDNA samples were collected from S3 and S5.

The results of this sampling, displayed in Figure 3.15 (reproduced from LandPro, 2024), and is considered representative of Shotover River winter conditions, prior to recommencement of the discharge to the river.

The following is noted regarding these baseline results:

– Increases in inorganic nitrogen concentrations (both nitrate-N and ammoniacal-N) between the upstream location S2 and downstream location S3, suggest a likely influence of wastewater management on the Shotover River downstream of the discharge area.
– The detectable dissolved phosphorous concentration in S3 further suggests an ongoing influence from the area of wastewater management, approximately 5 years following cessation of wastewater discharge to the Shotover River.
– Visual clarity of the Shotover River is often low, and lower than that evident in the Kawarau River.

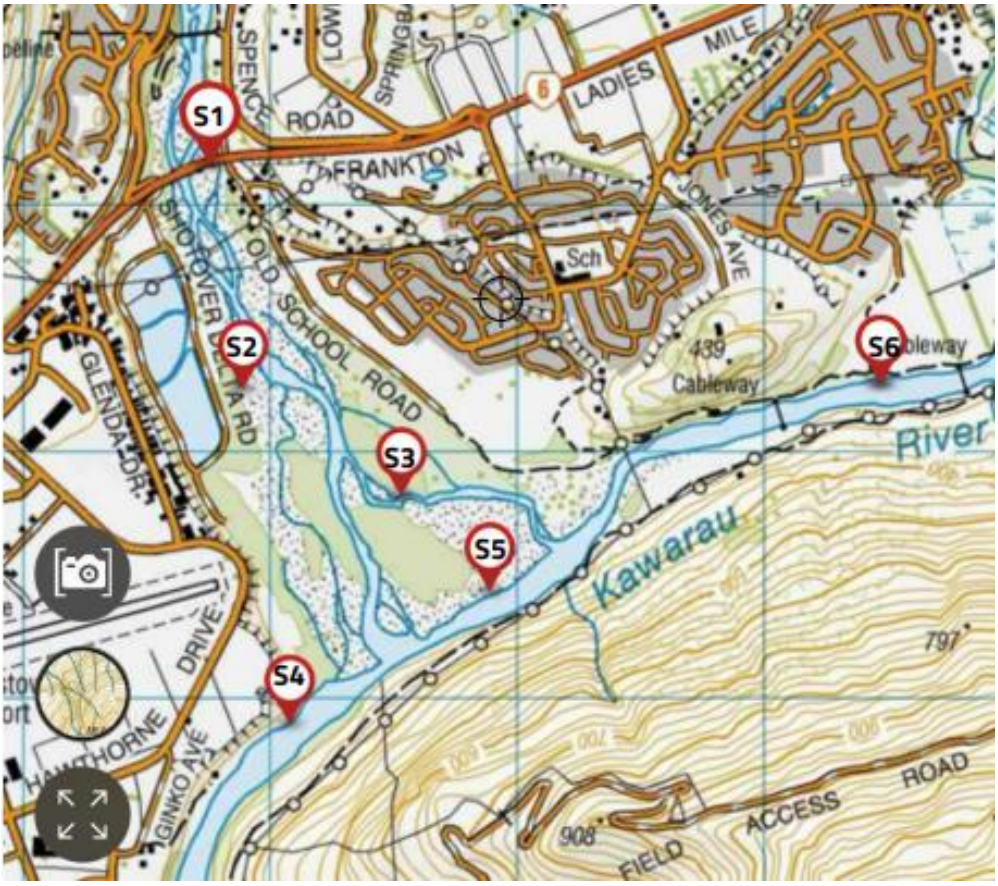


Figure 3.14 Landpro sampling locations August 2024 (Landpro 2024)

Water Quality Parameter	S1 Shotover	S2 Shotover	S3 Shotover	S4 Kawarau	S5 Kawarau	S6 Kawarau
Visual Clarity (m)	0.79	0.85	0.82	0.92	>1.0	0.86
Temp (Celsius)	2.8	2.9	3.3	7.8	7.8	6.9
pH (pH units)	8.19	8.19	8.31	8.13	7.95	8.09
Field DO (% sat.)	76.5	92.2	97.8	83.1	91.9	91
Field DO (mg/L)	10.34	12.43	13.04	9.89	10.94	11.07
Electrical Conductivity (EC) (mS/m)	185.4	184.5	188.7	123.2	133.2	136.3
Turbidity (NTU)	1.33	1.82	1.9	0.97	0.59	1.63
Total Suspended Solids (g/m³)	<3	<3	<3	<3	<3	7
Dissolved Inorganic Nitrogen (g/m³)	0.018	0.019	0.163	0.031	0.131	0.04
Total Nitrogen (g/m³)	<0.11	<0.11	0.17	0.1	0.14	<0.11
Total Ammoniacal-N (g/m³)	<0.010	<0.010	0.14	<0.01	0.074	0.015
Nitrite-N (g/m³)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nitrate-N (g/m³)	0.016	0.015	0.022	0.026	0.056	0.024
Nitrate-N + Nitrite-N (g/m³)	0.016	0.016	0.023	0.026	0.057	0.024
Total Phosphorus (g/m³)	<0.002	<0.002	0.006	<0.002	<0.002	<0.002
Dissolved Reactive Phosphorus (g/m³)	<0.004	<0.004	0.007	<0.004	<0.004	<0.004
Total Coliforms (MPN/100 mL)	50	21	25	96	74	42
Escherichia coli (MPN/100 mL)	11	7	10	5	3	3

Figure 3.15 Water quality results 8th August 2024 sampling event (LandPro 2024)

3.8.2.4 Shotover delta water quality sampling - 2025

GHD collected water quality samples from both the Shotover and Kawarau Rivers from March 2025. Sample locations are described in Table 3.8. Results are included Appendix G.

The surface water quality monitoring included the following:

– Monitoring of surface water and ponded water several locations in and around the delta in March 2025. The samples were collected to provide a broad understanding of the water quality in this area and included a wider suite of parameters (such as major ions and metals) than typical wastewater indicators. The samples were collected during very low flow conditions in the rivers and before the surface water discharge was implemented. The results from this monitoring are considered to reflect the baseline, low-flow water quality conditions in the Shotover River.
– Monitoring of surface water following the recommencement of discharge to the Shotover River. The sampling initially included an extensive suite of water quality parameters and large number of locations to allow for comparison to the March 2025 baseline sampling, and identification of appropriate monitoring locations to best monitor the influence of wastewater on the river. Approximately one week following commencement of discharge, a refined analytical suite and number of sampling locations were adopted, to focus on the influence of the discharge and understanding of water quality changes over time.
– Monitoring of the discharging water was carried out concurrently with surface water monitoring to provide an endmember for analysis of mixing and effects to water quality.

Table 3.9 includes the concentration of ammoniacal-N as measured by the lab which includes both free ammonia (toxic to aquatic life) and the ammonium ion. To allow for comparison to guidelines and assessment of effects, the table also includes the calculated concentration of ammoniacal-N normalised to pH8 and 20ºC, to allow for comparison to NPSFM 2020 guidelines (MfE, October 2024).

Monitoring results for the March 2025 event are interpreted to demonstrate the follow regarding the baseline, low-flow, Shotover River conditions:

– Nutrient concentrations are generally low in the Shotover River, with most samples from the main braid (RS01-04 and RS09) close to or below laboratory detection limits.
    - Nutrient concentrations were elevated in samples such as RS06, RS08 and RS09B, including the detection of high concentrations of ammoniacal-N (9.99 mg/L) at location RS06 and elevated electrical conductivity at both RS06 and RS08. These samples were from isolated pools or channels adjacent to the riverbank. Elevated levels within these waters are considered most likely the be the influence of organic material decomposition in near stagnant waters, wildlife influence on water quality biological activity and/or groundwater discharges influenced by the upgradient wastewater management.
– RS06 in particular differs from others in that:
    - While the measured redox conditions suggest relatively oxic conditions, the presence of nitrogen predominantly in the ammoniacal-N form suggests a source proximal to the location. i.e. unlikely to be sourced from upstream river flow and more likely to be a local discharge influence.
    - The small, isolated channel (where RS06 was collected from) is the remnant of the historical main braid of the Shotover River (pre 2010), which has been progressively closing and shifting over more than a decade. Gravel accumulation between location RS06 and RS08 necessitated change in discharge location from the first discharge channel (immediately south of RS06) in 2010, to the now recommissioned discharge channel, to allow discharge to the main braid of the river. Flow in the channel is mostly limited by whether it is open of closed downstream (near RS08), with it predominantly having very low flow relative to the adjacent main braid.
    - The small channel is frequently closed downstream of the RS06 due to movement of the riverbed, but remains a feature in this area, suggesting water interactions at the riverbank promote higher velocity flow immediately adjacent to the riverbank, promoting ongoing re-establishment of the channel.
– Nutrients in the Kawarau River are elevated in RS12 and RS13 compared to the upgradient RS14 location. These locations are located hydraulic down gradient of the DAD/disposal field and expected to be influenced by groundwater discharges to the Kawarau River under the low flow conditions at the time of monitoring.

  Location RS10, located downstream of the Shotover/Kawarau River confluence is considered to be representative of the fully mixed Shotover River water quality, with aerial imagery demonstrating the limited

extent of mixing of Shotover and Kawarau River waters that has occurred at this location. As such, water samples from this monitoring location are expected to be influenced by activities within the Shotover River and the diffuse groundwater discharges through the Shotover Delta gravels. While nutrient concentrations are low at this location, there is an order of magnitude increase in Nitrate-N concentration compared to RS14 (upstream Kawarau).

– Coliforms and *E. coli* are present within the Shotover River, and are not solely attributable to wastewater management on the delta, as demonstrated by detections at the upstream monitoring location RS01 (total coliforms of 547 and *E. coli* of 3 count/100 ml). Concentrations do increase downstream, including in areas distant from the riverbank and more centrally within the main braid, such as location RS09. The periodic increase in microbiological content due to catchment run-off is common and similarly, on braided rivers, local variation in microbiological concentrations can result from wildlife, and localised influence of features such as gravel islands with established vegetation and habitat. Whilst the source of measured microbes at location RS09 prior to and subsequent to the discharge occurring is unclear, it is considered likely that localised upstream sources in this area may be influential during periods of low flow. The pre-discharge sampling of RS09 also demonstrated elevated organic nitrogen, suggesting organic material and/or ecological source.

Table 3.8 Summary sampling location features

Sample number	River	Detail	Reasoning	Location comment
RS01	Shotover	Main channel beside SH6 road bridge	Upstream of WWTP and ponds	Fast river flows, channel width approximately 200 m.
RS02	Shotover	Main channel approximately 300 m upstream of discharge channel	Shotover River water quality upstream of discharge	Fast river flows, channel width approximately 100 m.
RS03	Shotover	Side channel approximately 250 m upstream of discharge channel	Shotover River water quality upstream of discharge	Fast river flows, channel width approximately 30 m. Flow follows riverbank with backflow creating a whirlpool effect.
RS04	Shotover	Side channel approximately 100 m upstream of discharge channel	Shotover River water quality upstream of discharge	Small side channel with low flows. Width approximately 5 m with a depth of <0.3 m.
RS04B	Shotover	Main channel approximately 100 m upstream of discharge channel	Shotover River water quality upstream of discharge	Dry river channel, signs that this location observes flow during heavy rainfall events.
RS06	Shotover	Side channel approximately 200 m downstream of discharge channel, not in immediate connection to the main channel.	Shotover River water quality downstream of discharge	Very low flow or stagnant water, signs of algae buildup on the gravels, channel width approximately 3 m with <0.3 m depth.
RS06B	Shotover	Main channel approximately 150 m downstream of the discharge channel	Shotover River water quality downstream of discharge	Fast flows in a main channel, width approximately 100 m with 1-2 m depth.
RS08	Shotover	Side channel approximately 350 m downstream of discharge channel, not in immediate connection to the main channel.	Shotover River water quality downstream of discharge	Dry river channel, signs that this location observes flow during heavy rainfall events.

Sample number	River	Detail	Reasoning	Location comment
RS09	Shotover	Main channel approximately 400 m downstream of the discharge channel	Shotover River water quality downstream of discharge	Fast river flows, channel width approximately 200 m with 2-3 m depth.
RS09B	Shotover	Side channel approximately 700 m downstream of discharge channel, not in immediate connection to the main channel.	Shotover River water quality downstream of discharge	Dry river channel, signs that this location observes flow during heavy rainfall events.
RS10	Kawarau	River downstream of Shotover confluence	Kawarau River downstream of Shotover confluence, provides indication of fully mixed water quality.	Fast river flows, channel width approximately 200 m with 3+ m depth.
RS11	Kawarau	River upstream of the Shotover confluence	Kawarau River down gradient of disposal field, potential to be influenced by overflows.	Sampled near bank of the fast-flowing river. Width approximately 100 m, depth 2 m.
RS12	Kawarau	River downgradient of DAD/disposal field	Kawarau River down gradient of disposal field, potential to be influenced by overflows.	Sampled near bank of the fast-flowing river. Width approximately 100 m, depth 2 m.
RS13	Kawarau	River downgradient of DAD/disposal field	Kawarau River down gradient of disposal field, potential to be influenced by overflows.	Sampled near bank of the fast-flowing river. Width approximately 100 m, depth 2 m.
RS14	Kawarau	River upstream of activities on Shotover Delta	Kawarau River upstream of potential influence of wastewater discharges.	Sampled in a low-to-high flow pool at the bank of the river. Width approximately 100 m, depth 2 m.
RS15	Discharge channel	Sample from treated wastewater discharge channel before flowing into river	Water discharging to Shotover River via historical discharge channel	Pooling area immediately downstream of the discharge. Slow mixing with the main downstream channel. Channel width approximately 20 m, depth 1-2 m.
RS16	Shotover	River location where treated wastewater is discharging into	Shotover River in immediate vicinity of discharge at historical channel	Silt embankment has been eroded away, which has expanded do approximately 20 m with a depth of 1-2 m. Fast flowing water, with visible bubbles and noticeable odour.

3.8.2.5 Water quality monitoring following recommencing discharge (April 2025)

Water quality monitoring was carried out on twice weekly following commencement of discharge to the Shotover River, on 1,3,7, 8 and 10 April 2025, and is ongoing on a weekly basis. A summary of the results is provided in Table 3.9. A complete table of all surface water results are provided in Appendix G.

The monitoring results are considered to reflect a seasonal low flow condition, approximating a worst-case scenario where mixing with river water does not occur adjacent to the point of discharge, and wastewater pools within a discrete channel, mixing with the river water proper some distance downstream of the discharge (in the proximity of RS06B).

The monitoring following discharge has shown the following:

- Monitoring locations RS01, RS02, RS03 and RS04B are considered to represent background Shotover River water quality, for concurrent monitoring of the downstream effects of discharge. The variability in *E. coli*, nitrogen and phosphorous that is apparent in results from these locations is considered to reflect variability in the upstream catchment influence on river water near the true right bank of the river. Concentrations of these indicator parameters are typically low in upstream monitoring locations, but rain events such as occurred on 8 April 2025, can result in periodic increases such as was measured at RS03. During this rainfall event, total phosphorous increased from below detection to 0.24 mg/l and *E. coli* increased from <20 count/100 ml to >200 count /100 ml.
- The initial discharge water (RS15) included elevated *E. coli* concentrations, in the order of 450 – 650 count/100 ml, these were greater than measured following UV treatment (and prior to entering the discharge channel). The disturbance of accumulated sediments and debris within the disused channel is considered to be the source of the elevated concentrations, which rapidly decreased after the initial flushing of the channel. Concentrations measured at RS15 have been reducing since 3 April and ongoing monitoring has shown the discharging water to have progressively more equivalent to *E. coli* concentrations to that of treated wastewater leaving the UV.
- Concentrations of total nitrogen at monitoring location RS16 located immediately downstream of the discharge location, initially showed limited dilution due to the very low flow occurring adjacent to the riverbank at that time. Increases in river flow that occurred in response to rain events demonstrated that greater dilution could be achieved at the location, with small increases in river water level. The location is considered to be within the immediate mixing zone of the discharge.
- Under the low river flow conditions apparent at the time of initial discharge, the mixing of discharged water occurred further downstream of the discharge point, where the riverbank channel joined a larger river braid. Monitoring location RS06B is immediately downstream of this confluence and is considered to provide an indication of the near field effects of discharging wastewater to the river. Total nitrogen concentrations in samples collected from RS06B ranged from 0.56 to 0.94 mg/L, reflecting an approximate 15-to-25-fold dilution of discharging water.
- Concentrations of *E. coli* at RS06B were found to be initially elevated (410 count/100 mL measured on 4 April 2025) but have subsequently decreased in line with the discharge water quality to below the 95th percentile criteria of 130 count/100 ml of the Excellent attribute band water (NPSFM). No concentrations of *E. coli* measured at sample location RS06B exceed the national bottom-line for human water contact.
- Nitrate-N concentrations at RS06B have been measured in the range of 0.15 to 0.17 mg/L. While elevated relative to background, the concentrations remain low and significantly less than the upper bound for water meeting Attribute band A of the NPSFM.
- Ammoniacal-N concentrations at RS06B, following the initial discharge period, have been in the order of 0.17 to 0.27 mg/l (standardised to pH8 and 20°C for comparison to ammonia toxicity criteria). Were these results taken as representative of the annual flow condition; it would reflect a localised change in NPSFM attribute band from A (upstream) to B (following nearfield mixing at location RS06B). Considering the limited dilution under the low-flow conditions at the time of monitoring, the average annual concentrations are expected to be significantly lower than measured. Likewise, where mitigation measures allow for additional dilution prior to this downstream monitoring location it is likely that ammoniacal-N concentrations will be significantly lower than has been measured.
- Dissolved reactive phosphorous, in the order of 0.05 to 0.1 mg/l were measured at RS06B following recommencement of discharge, with total phosphorous in the range 0.075 to 0.18 mg/l measured.
- The concentrations of *E. coli*, nitrogen and phosphorous measured at location RS06B are generally consistent with the water quality measured at the d/s monitoring location during 2019, following implementation of the plant upgrades.
- At location RS09 (in the main braid of the river) total nitrogen and *E. coli* concentrations remained below the levels measured pre-discharge (March 2025). Ammoniacal-N was, however, elevated in monitoring for 8 and 10 April 2025, where previously organic nitrogen was dominant. Concentrations of ammoniacal-N (standardised to pH8 and 20°C for comparison to ammonia toxicity criteria) at RS09 for 8-10 April were 0.17 and 0.16 respectively and similar in concentration to that measured at RS06B.

- Following complete mixing with the Shotover River main flow and the immediate confluence with the Kawarau River, at location RS10, concentrations of total nitrogen remained below detection levels (<0.1) over the period of monitoring. Ammoniacal-N was detected at a very low level (0.02 mg/l) in the sample collected on 10 April, but was not above detection levels in sampling on the 8 April. Notably, concentrations of ammoniacal-N at RS10 were lower than the upstream Kawarau River monitoring location RS11, where concentrations in the order of 0.08 to 0.09 mg/L were detected in concurrent monitoring and were measured at up to 0.63 mg/L in baseline (March 2025) pre-discharge to the Shotover River.
- Concentration of *E. coli* measured at RS10 is consistent with the local background, being generally lower than the upstream RS11, RS09 and RS06B. An elevated *E. coli* concentration measured on 8 April 2025 (517 count/100 mL) was consistent with temporary increases in concentration measured in other wells sampled that day (RS09, RS03 and RS02) and considered to be the result of catchment inflows during the rain event that day.

Table 3.9 Surface water results: minimum / maximum from sampling on 1,3,7, 8 and 10 April 2025

Location		pH (field)	EC	DO	Redox (field)	$CBOD_5$	*E. coli*	DRP	Nitrate N	TN	TKN	Nitrite N	Ammoniacal N	Ammoniacal N - @pH8 and 20°C	Phosphorus (Total)
	Units	pH	µS/cm	%S	mV	g/m^3	MPN/100ml	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3
RS01		7.94	111.7	104.2	104.9	<1.00	129.6	<0.002	0.018	0.17	0.15	<0.0010	<0.005	<0.005	0.13
RS02		7.88	113.1	103.2	105.9	<1.00	62.4	<0.002	0.016	<0.10	<0.10	<0.0010	<0.005	<0.005	0.021
RS03		7.88	111.5	102.8	106.7	<1.00	214.2	<0.002	0.021	<0.10	<0.10	<0.0010	<0.005	<0.005	0.24
RS04	Min.	7.81	110.7	100.5	118.1	-	14.8	-	0.004	-	-	-	<0.005	<0.005	0.006
	Max.	7.97	134.6	108.5	132.1	<1.00	130.1	<0.002	0.024	<0.1	<0.1	<0.001	0.03	0.017	0.011
RS04B	Min.	-	-	-	-	-	19.9	-	0.016	-	-	-	<0.005	-	0.015
	Max.	7.92	123.1	183.8	137.3	<1.00	20.1	<0.002	0.028	<0.1	<0.1	<0.001	0.008	<0.005	0.018
RS06	Min.	7.36	86.2	30	124.6	-	218.7	0.140	0.058	6.0	5.61	0.0111	5.58	0.907	0.23
	Max.	8.03	497.9	180.5	194.7	<1.00	435.2	0.172	0.414	10	10	0.0363	10.8	7.285	0.34
RS06B	Min.	7.61	104.7	97.3	115.8	-	18.7	0.014	0.075	0.5	0.33	0.0016	0.04	0.024	0.032
	Max.	7.93	144.8	115.8	137.8	<1.00	410.6	0.098	0.168	0.94	0.79	0.0027	0.55	0.267	0.18
RS09	Min.	7.77	103.5	103	119.6	-	20.3	0.073	0.007	0.56	0.38	0.0018	0.005	<0.005	0.006
	Max.	7.94	134.6	122.8	126.4	<1.00	435.2	0.078	0.179	0.69	0.54	0.0021	0.39	0.170	0.12
RS10	Min.	7.80	105.5	104.7	106.0	-	39.90	-	0.03	0.00	0.00	0.00	0.02	<0.005	0.01
	Max.	7.87	105.9	104.7	108.8	<1.00	517.20	<0.002	0.03	<0.10	<0.10	<0.0010	0.02	0.010	0.07
RS11	Min.	7.41	71.40	101.1	100.1	-	36.40	-	0.07	0.46	0.33	0.00	0.08	0.025	0.06
	Max.	7.67	78.10	111.5	149.1	<1.00	57.30	<0.002	0.35	0.58	0.39	0.01	0.30	0.055	0.06
RS12	Min.	7.60	64.00	101.1	99.1	-	42.20	0.01	0.07	0.28	0.17	0.00	0.12	0.036	0.01
	Max.	7.63	70.10	108.2	119.9	<1.00	115.30	0.05	0.18	0.74	0.56	0.01	0.59	0.166	0.06
RS13	Min.	7.38	41.60	90.80	118.0	-	52.00	-	0.17	0.28	0.26	0.00	0.20	0.034	-
	Max.	7.49	184.5	150.3	155.9	<1.00	222.40	<0.002	0.42	1.10	0.71	0.00	0.74	0.162	<0.005
RS14	Min.	7.55	54.20	102.8	91.00	-	52.00	-	0.02	-	-	-	-	<0.005	-
	Max.	7.78	62.00	141.2	155.3	<1.00	117.80	<0.002	0.03	<0.10	<0.10	<0.0010	0.01	0.002	<0.005
RS15	Min.	7.16	127.1	35.20	127.1	2.19	17.10	1.42	2.03	8.30	1.43	0.02	0.15	0.015	1.86
	Max.	8.00	420.1	182.1	195.90	16.50	435.20	1.87	6.85	16.00	11.50	0.04	8.62	4.831	3.59
RS16	Min.	7.28	170.1	86.7	145.6	1.99	16	0.015	0.07	0.17	0.11	0.004	0.07	0.009	0.031
	Max.	7.67	458.9	158.7	197	3.06	648.8	1.473	5.6	7.1	2.02	0.0203	2.32	0.765	1.74

3.9 Ecology

The Shotover River is a braided river system made up of loose gravels, cobbles and sand, with frequent high flow conditions. This poses an ever-changing environment resulting in locally and temporally variability in habitat and ecological communities. Braided rivers often have higher ecosystem sensitivity due to this, but also less potential for long term degradation than many lowland rivers.

3.9.1 During historical wastewater discharge

A survey completed in 2015 when the historical wastewater discharge to the Shotover River was occurring found that water and/or habitat quality at each site surveyed was “good” or “excellent” according to MCI and QMCI scores (Golder 2015). Periphyton, at low abundance was identified at one of the monitoring sites. Macroinvertebrates collected downstream and upstream of the WWTP discharge were similar, suggesting minimal impact, and dominated by *Deleatidium* mayflies (pollution-sensitive). The 2015 survey concluded that there was no evidence of increased periphyton growth due to the WWTP discharge (Golder 2015).

A biological survey in 2016 showed similar results and stated that the macroinvertebrate fauna is typical of physically disturbed, alpine gravel bed rivers, where frequently high flows and high sediment loads result in an invertebrate community dominated by *Deleatidium* mayflies (Ryder 2016).

Both reports reach the conclusion that the geomorphology of the river, with a highly mobile gravel substrate, and generally low nutrient levels, limits the potential for periphyton and macrophytes to establish in significant density.

3.9.2 Recent ecological monitoring

Environmental DNA sampling by LandPro in August 2024 identified several species of caddisfly, midges, mayflies, stonefly and flies in the Shotover River. Didymo was present in all Kawarau River sites (Landpro 2024).

E3Scientific (2024) reported sparse patches of phytoplankton (in low flow channels adjacent to the historical WWTP point) and periphyton cover in the Shotover River. Desktop review suggested that *Didymosphenia geminata* (didymo) may be more prevalent in the Shotover River upstream of the WWTP.

E3 Scientific (2024), in a report prepared for Otago Regional Council indicated that the macroinvertebrate taxonomic diversity and abundance of the river has been generally low from 2010 – 2022. Downstream of the historical WWTP discharge, macroinvertebrates were more abundant than upstream with a higher diversity of Chironomids (midge larvae), and dipteran and caddisfly larvae.

The Kawarau River and the Shotover River have been found to provide habitat for native and endemic fish species such as longfin eels (*Anguilla dieffenbachii*, At Risk-Declining), bullies (Common bully, *Gobiomorphus cotidianus*, and upland bully, *G. breviceps*, both not Threatened), kōaro (*Galaxias brevipinnis*, At Risk-Declining), and trout (brown and rainbow *Oncorhynchus mykiss,* both Introduced and Naturalised) (Wildlands 2024) (E3Scientific 2024). In 2024, the ecological value of the freshwater fish species likely present near the WWTP site was assessed as high (E3Scientific 2024), due to the occurrence of these at-risk species.

4. Assessment of effects on water

4.1 Commencement of the discharge

The discharge commenced at approximately 7:45 am on 31 March 2025. Prior to discharge excavators had been used to clear vegetation in the channel on the QLDC parcels of land. The final 100 m of the channel crosses Department of Conservation land and was not cleared of vegetation. When the discharge commenced there was significant amount of organic material, sediment, debris and vegetation within the channel. Soil disturbance caused by the excavator work is also likely to have increased the amount of loose sediment present within the discharge channel.

For the first approximately 2 days the discharge comprised predominantly MLE flow and represented only partial diversion of wastewater away from the DAD. Discharge of the complete flow, including flow sourced from the oxidation ponds, subsequently commenced at 5:30 pm on the 1 April 2025. This resulted in a notable colour change in the treated wastewater from the initially clear, light green water to a more pronounced green, low in clarity.

The discharge commenced during very low-flow conditions in the Shotover River. As there was an approximate 0.5 m drop from the discharge channel to the riverbed, the wastewater eroded a channel in the alluvium that had accumulated adjacent to the discharge point. The discharge occurred into a small river braid adjacent to the riverbank. Due to the minimal flow in this river channel, treated wastewater formed a pool at the riverbank with limited mixing from upstream river water. The discharge induced flow in this minor river channel, created downstream flow to a point approximately 50 m downstream, where it joined a larger river braid and mixed with the Shotover River water proper. From this mixing point onwards, visible influence of the treated wastewater was no longer apparent. Photos showing the discharge channel and flow into the river are included in Appendix H.

Completion of plant upgrades which will see all wastewater being treated by MLE and cessation of routine flow from the oxidation ponds is expected to provide significant improvements in the apparent colour and clarity of the discharge water.

Groundwater and surface water monitoring locations have been established and monitoring implemented in locations considered appropriate to monitor the influence of the discharge on water quality. The low-flow river conditions at the time of commencing discharge are considered to approximate a worst case for potential effects, owing to the limited mixing that occurs adjacent to the discharge area and pooling of treated wastewater adjacent to the riverbank that can occur where no immediate river mixing is available. The findings of the monitoring have been used to understand these low-flow effects and determine appropriate mitigations to manage effects in the future.

4.2 Mitigation measures

4.2.1 Improved mixing

While completion of the plant upgrade is expected to significantly reduce the visible influence of the discharge on water proximal to the discharge point, the potential for pooling of treated wastewater adjacent to the riverbank under very low flow conditions is proposed to be reduced by direction of minor volumes of river water past the general discharge area. Proposed riverbed works, to direct up to 2 m^3/s of water past the discharge location (consent submitted to ORC), are expected to significantly limit the apparent mixing zone and limit the potential contaminant concentrations in the river.

The need for such mitigation will be considered based on the outcomes of completing plant upgrades and the river conditions during the regular low-flow periods.

4.2.2 Erosion protection

Recommissioning of the engineered discharge channel has resulted in some limited erosion of the riverbank that formed at the discharge location since 2019. While the potential for retreat of the riverbank in this area is limited, to manage this potential and limit public access to the immediate area of discharge, the riverbank and riverbed will be armoured with riprap. This will comprise a riverbank width of approximately 6 m, and height of up to 2 m, using locally sourced boulders. The specific dimension and details of construction will be determined during detailed design.

4.3 Hydrology

The discharge volumes are small relative to the flow in the Shotover River, being in the order of 1% of flows under the mean annual low flow (MALF) conditions. The contribution to river flow over approximately 95% of the river flow conditions is notably less than this. The wastewater discharge is not predicted to have a measurable influence on river flow, river level or the extent of the braided river channel. As such, potential effects to the river hydrology are expected to be negligible.

In the context of the broader Kawarau catchment, the diversion of treated wastewater to the Shotover River, instead of discharge to the DAD, is expected to have no meaningful impact on the river water balance.

4.4 Flooding, erosion and sediment

Given the low volume of treated wastewater being discharged, the potential for the discharge to contribute to flooding is considered to be negligible. Similarly, the sediment contributions from the treated wastewater are considered to be negligible in the context of the Shotover River sediment load. Small amounts of organic sediment, sourced predominantly from the oxidation pond contribution to flow, will continue to be present in the discharge waters until completion of the current upgrades, however due to river water velocity and frequent high flow events, the potential for accumulation of such organic sediment on the riverbed is considered to be minimal.

The discharge channel is situated within a flood plain, and during very significant events, such as 100 ARI events, stormwater and flood flows entering the channel may cause treated wastewater to overtop the discharge channel and flow downstream with the flood waters. At such times, flood waters are considered to be part of the Shotover River, that flows towards and joins the Kawarau River. The potential influence of the wastewater mixing with flood waters at such time is considered to be negligible, given the broader impacts of flooding on the delta and the significant dilution that would occur during such an event.

4.5 Groundwater level and flows

With groundwater levels during low flow conditions estimated to be approximately 2 m below the base of the channel, there is potential for loss of treated wastewater to ground via soakage along the channel length. This has the potential to influence groundwater levels and flows. Groundwater investigations undertaken as part of this assessment indicate that the sandy gravels underlying the channel are highly permeable and allow relatively high rates of horizontal flow. Therefore, any wastewater that infiltrates the ground (noting that any silt in the base of the channel may limit infiltration) is expected to move laterally away with groundwater mounding effects expected to be localised and/or negligible. This inference is supported by water level monitoring to date, which indicates that changes in wastewater discharge volumes that occur daily, do not appear to be influencing groundwater levels, with no meaningful mounding identified.

4.6 Groundwater quality

Groundwater monitoring has identified that groundwater down gradient the discharge channel is influenced by wastewater management. Given the high potential for nutrients and other wastewater indicators to migrate in the shallow alluvium aquifer, discharges that reach groundwater are expected be freely transported downgradient within the groundwater system. Influence of wastewater discharges on groundwater is therefore expected where hydraulic gradients promote transport. Such means of dispersing wastewater have been relied upon for wastewater disposal (i.e. the DAD).

The wastewater influence on downgradient wells (BH03 and BH04) is not expected to be related to the commencement of discharge from the discharge channel, given the short timeframes for the effect to occur. In addition, there is an apparent increasing wastewater influence on groundwater with downgradient distance i.e. BH04 demonstrates notably greater wastewater influence than BH03. The volume of wastewater that will be lost ground from the discharge channel is relatively unknown, given the variability of the alluvium and the historical use of the channel for wastewater discharge which can impact upon infiltration capacity. Any volume discharged to ground reduces the direct discharge to the Shotover River and allows for further dissipation with groundwater flow.

The net effect of soakage of treated wastewater from the discharge channel on groundwater quality is expected to be significantly less than has resulted from operation of the DAD, due to the reduced volume of the discharge to ground. This shift in means and location of disposing of treated wastewater is also expected to result in improvements in groundwater quality across the broader delta, with reduction in the localised effect on water quality in the Kawarau River caused by groundwater discharges at the end of the delta (from the DAD discharge).

Overall, the potential effects on groundwater quality of the discharge, including cessation of discharge to the DAD, are considered to be positive in the context of the current setting, with any localised adverse effect expected to be relatively limited.

The potential for adverse effects on groundwater quality on upgradient water supply wells and groundwater as a resource is considered to be negligible, with the hydrogeological regime effectively limiting potential effects to the Shotover delta and immediate river environments surrounding it.

Ongoing monitoring of groundwater conditions in the vicinity of the discharge channel is proposed to provide ongoing understanding of effects and validation of assessment.

4.7 Surface water quality

Discharge to the Shotover River under low flow conditions, resulted in limited mixing in the immediate vicinity of the discharge, with mixing with river water proper occurring downstream of the discharge area. Approximately 15-to-25-fold dilution of treated wastewater occurred under the low-flow conditions within the first river braid where flow was occurring (a minor braid). Water quality subsequent to this initial mixing demonstrated increases in wastewater indicators and nutrients, such as nitrogen, phosphorous and *E. coli*. Of these, only the increase in ammoniacal-N constituted a potential localised change in attribute state, from A to B, as characterised by the NPSFM 20020. No visible change in colour or clarity was apparent after mixing.

Reported MALF for the Shotover River of 18.1 m^3/s is expected to provide a cumulative dilution of the discharge in the order of at least 100-fold dilution, with this mixing evident in downstream waters following the confluence with the Kawarau River (location RS10). While very small changes in water quality at that location were intermittently detected, the changes are not considered to be meaningful in terms of potential toxicity or eutrophication related effects. Additionally, the changes in microbiological contaminants, as measured by *E. coli*, were significantly smaller than increases induced by rain and run-off events i.e. considered to be within the background range.

The measured outcomes of the discharge are considered to provide an understanding of the approximate upper end of effects that occur for an unmitigated discharge. In the context of the changes in river water quality as a result of the discharge, the effects within mixing zone of the Shotover River i.e. mixing with the minor river braid, are considered to be minor in nature. After complete mixing, as demonstrated by downstream water quality (RS10) the minimal change in contaminant concentrations is considered to constitute a less than minor effect on surface water quality, with no changes in attribute bands as characterised by NPFSM 2020 expected to occur.

Notably, these effects are temporary in nature, with high flow events, seasonal changes in water levels and completion of plant upgrade works expected to further minimise the influence of the discharge on both the extent of the mixing zone and the mixed water quality. Under the majority of flow conditions, it is considered likely that there would be no discernible change in concentration of wastewater indicators beyond the near mixing zone.

The specific issue of ponding of treated wastewater in channels near the riverbank when river levels are low has been identified, with this resulting in limited to no mixing occurring at the point of discharge and increased potential for the visibility of the discharge and influence of wastewater on receptors in this area. While the risks associated

with this ponding are considered to be low given its limited extent, mitigation to reduce the risk and the maximum ammoniacal-N concentrations in the near mixing zone are proposed as detailed above in Section 4.2.

Together with plant upgrade (completion by 2026) and mitigation measures to manage low-flow conditions, the overall effects to water quality associated with the short-term discharge of wastewater to the Shotover River are considered to be less than minor in nature.

Ongoing monitoring of surface water and discharge water is proposed to validate the assessment and provide direction for need to implement mitigation measures.

4.8 Ecology

The potential effects to freshwater ecology and ecosystem predominantly relate to the following:

– Direct toxicity effects, resulting from elevated concentrations of potential toxicants, such as ammonia.
– Direct changes in physical conditions as a consequence of limited dilution of discharge waters, such as temperature or clarity changes.
– Indirect changes in water quality related to trophic state, such as dissolved oxygen, resulting from high organic loads, or excessive microphyte and macrophyte growth promoted by high nutrient concentrations.

Ecological monitoring carried out during the historical discharge of treated wastewater to the Shotover River, is considered to provide a reliable indication of the effects to ecology of the current short-term discharge, albeit that the current and future discharge quality is expected to better, with lower $cBOD_5$ and nutrient concentrations than wastewater being historically discharged. Cessation of oxidation pond discharges following completion of the Stage 3 upgrades is expected to make the most significant difference, with this expected to significantly reduce the potential for colour and clarity impacts during warmer months when algae and cyanobacteria can proliferate in the oxidation ponds.

The effects to ecology of the historical discharge were to a great extent limited, due to:

– The typically high dilution available in the river, reducing the potential for elevated nutrient and contaminant concentrations.
– The frequently high velocity of river water, reducing the potential for algae to proliferate to the extent that downstream clarity and colour is affected.
– The frequently high sediment load of the river, which provides habitat for primarily sediment tolerant species.
– The moving gravel bed of the river that precludes establishment of macrophyte and algae on the riverbed.

During periods when river flow at the point of discharge is relatively high, such as typically occurs between May – December, the potential for adverse influence on ecology is considered to be minimal. Rapid mixing near the point of discharge limits the potential for prolonged toxicity effects to the immediate vicinity of the discharge, with concentrations dissipating to near unmeasurable levels within a short distance (<50 m downstream). This, together with the naturally high mineral sediment concentrations in the Shotover River and a moving gravel bed during the higher flow periods, are expected to inhibit proliferation of periphyton or other algal growth such as invasive didymo. Potential for adverse influence on native and endemic fish species that may be present in the Shotover River are not expected to be adversely influenced due to this localised effect on water quality.

During lower flow periods, (such as occurring between January – April this year), the riverbed may be more exposed and the main channel of the Shotover River may retreat from the discharge area. As a result, the discharge is currently occurring into a discrete, low-flow channel, with reduced potential for mixing immediately following discharge. Observations immediately following commencement of the discharge, and records of the historical discharge, have shown that this results in a localised area of relatively unmixed treated wastewater. Mixing with the river water proper, then occurs when river channels merge further downstream. Toxicity effects may be expected for less mobile and more sensitive species during such events, such as macroinvertebrate species of mayflies, stoneflies and caddisflies. Macroinvertebrate communities may shift during times of low flow/higher toxicity to inhabiting by more pollutant-tolerant worm, snail and hydroptilid caddisfly species. Algal growth can also occur over these low flow periods. However, such events are limited in extent and duration, with associated effects being relatively temporary in nature, such that the influence on the river ecosystem is expected to be less than minor. To reduce the potential for these localised effects, diversion of river water is proposed during such low flow periods, to promote greater flow and water velocity in the immediate discharge area. Where

this occurs, the potential for meaningful species toxicity effects and algal growth are expected to be limited further, such that the overall effects to freshwater ecology are considered to be negligible.

The short-term discharge to the Shotover River is also expected to result in some reduction in effects associated with overflowing of wastewater from the DAD, including algal and macrophyte growth that has intermittently occurred on the Kawarau Riverbank.

4.9 Public health risk

The risk of infection with recreational use and food gathering from the Shotover and Kawarau Rivers (public health risk) is considered through use of water quality criteria developed by Ministry for the Environment (MfE, 2003), with these criteria adopted across New Zealand by public health authorities to manage access to water for such activities. The criteria make use of *E. coli* as a faecal indicator bacterium (FIB), as representative of the risk of infection by the range of pathogens sourced from human and catchment sources. The *E. coli* reference concentration has been developed on a model of infection by *Campylobacter*, a pathogen commonly associated with outbreaks of illness when people are exposed to water contaminated faecal sources.

Wastewater disinfection, as monitored by analysis of *E. coli* following UV treatment, indicates that a high level of pathogen reduction is being achieved, with concentrations in treated wastewater being in the order of 10-15 count/100 ml.

The quality of the treated wastewater discharging to the Shotover River, following commencement of the short-term discharge, demonstrated elevated levels of *E. coli* and faecal coliforms. Over a period of approximately 10 days, the microbiological concentrations decreased from initially high levels (monitoring location RS15 *E. coli* >400 count/ 100 ml on 1 April 2025) to levels more consistent with that measured in the treated wastewater prior to discharging into the engineered channel (monitoring location RS15 *E. coli* 17 count/ 100 ml on 1 April 2025). The disuse of the engineered channel between 2019 and 2025 allowed for accumulation of sediment, leaflitter and other organic material within the channel. Wildlife excrement and soil accumulated pathogens, a common microbiological contributor to stream and river water quality during rain events, is expected to have likewise accumulated within the engineered channel and be the source for the flush of FIB with recommencement of wastewater discharge.

Concentrations of *E. coli* in the Shotover River and Kawarau River increase following notable rainfall events, demonstrating the influence of catchment sourced microbiological contaminants. This is typical of all New Zealand rivers, and particularly in areas that receive urban stormwater and agricultural run-off. Monitoring of river water in both rivers demonstrates that *E.Coli* levels are typically low (<130 count/100 ml which is indicative of the no-calculated risk level for *Campylobacter*) during periods without catchment run-off, indicating a low risk of infection (<0.1% occurrence, MfE 2003) from primary exposure (direct ingestion), such as occurs during swimming. Such primary exposure in the Shotover and Kawarau Rivers is understood to be uncommon, with recreational activities understood to predominantly include wading, kayaking, boating, etc., which can result in potential secondary exposure (exposure indirectly, such as from contacting contaminated surface). The potential risk of infection from secondary exposure is markedly lower than from primary exposure, and as such, the actual risk to users of the rivers is expected to be lower than indicated through application of bathing water quality criteria.

Following notable rain events, monitoring suggests that there is a short period of elevated *E. coli* (>260 E. coli count/100 ml), resulting from catchment influence. This indicates a period of elevated risk of infection (estimated <5% risk of *Campylobacter* infection occurrence) for people swimming in the rivers. Such concentrations are not considered to represent a significant risk to the more prevalent secondary contact activities. The risk to public health is further limited by the tendency of people to avoid swimming during higher flow and higher sediment conditions that occur following notable rainfall events.

The influence of wastewater derived microbiological contaminants on the Shotover River water quality is best demonstrated by the difference in upstream (RS04B) and downstream (RS06B) monitoring locations and also comparing the pre-discharge sampling results (11 March 2025) to those collected since commencement of discharge. Both comparisons are considered to represent potential influence of treated wastewater under low-flow conditions. Following the initial flush of microbial contaminants from the engineered channel, the *E. coli* concentrations at RS06B downstream of the discharge are approximately consistent with those measured under flow conditions in March 2025, prior to commencing discharge of treated wastewater. The difference in concentration between the immediately upstream and downstream location is limited, with *E. coli* concentrations

changing by approximately 20 count/100 ml. The change in concentration of *E. coli* is notably less than the natural range of evident from monitoring over rain events and less than is apparent spatially. Given this limited influence on water quality, the greater dilution that will occur within the Shotover and Kawarau Rivers, and the use of the river for activities that provide predominantly secondary exposure opportunity, the influence of treated wastewater discharge on public health risk is considered to be negligible.

Water quality as a result of the short-term discharge, after mixing and except when influenced by other contaminant sources, is assessed as meeting the contact recreation standards outlined in the Kawarau Water Conservation Order, defined as:

1. The visual clarity of the water shall not be so low as to be unsuitable for bathing.
2. The water shall not be rendered unsuitable for bathing by the presence of contaminants.
3. There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

It is noted that catchment sourced sediment and pathogens that impact the Shotover River water quality during run-off events are considered to be significantly more influential on the achievement of the contact recreation standards. However, as is pragmatic for all wastewater discharges, exposure to water through recreational activities and food gathering within the immediate vicinity of the discharge location (in the immediate mixing zone) is not advised due to increased risk to health, and management is recommended to discourage this.

5. Summary and conclusion

Emergency discharge of wastewater to the Shotover River, via the previously decommissioned discharge channel commenced on 31 March 2025. The discharge occurred at a time of very low flow in the river, with the main river braid some distance from the riverbank. Monitoring undertaken characterised the effects on water quality of the discharge, with this providing an understanding of the likely upper-bound or worst-case effects. The findings of monitoring, together with historical records of previous discharges to the river, have been used to inform assessment of effects of the short-term discharge under the range of expected river conditions and to understand the merits of particular mitigation measures in minimising adverse effects.

The below summarises the findings of the assessment:

- Recommencement of discharges from the discharge channel resulted in an initial flushing of sediment, debris and accumulated microbiological contaminants that had accumulated in the channel since 2019. The influence of these was evident in early monitoring as elevated microbiological concentrations, including *E.coli*, in both discharging waters and downstream waters.
- The absence of meaningful flow in the river braid adjacent to the riverbank resulted in discharged waters pooling near the riverbank, with mixing within a flowing river braid not occurring within approximately 50 m of the discharge. The influence of wastewater from the oxidation pond on colour and clarity of the discharging water was evident at that time, however downstream of the first mixing area, there was no discernible influence on colour and clarity of river water.
- Discharge waters progressively mix with river flow moving towards the confluence with the Kawarau River. Following initial mixing with a minor braid, approximately 15 to 25-fold dilution occurred, with meaningful effects to water quality predominantly related to an increase an ammoniacal-N. On complete mixing downstream of the confluence, the influence on water quality is less than minor and may not be discernible from the background variation in water quality. After mixing, no change in NPSFM water quality attribute bands are expected to occur as a result of the discharge.
- No additional contaminant load to the Kawarau River catchment, beyond that currently consented, is considered to result from the discharge to the Shotover River.
- Mitigation measures, including diverting river water towards the discharge area to provide immediate mixing with river water is proposed during low-flow conditions, if needed, to promote greater mixing in the vicinity of the discharge and mitigate the ponding of treated wastewater in riverbank channels.
- Completion of Stage 3 upgrade works by end of 2025 will result in an improved level of wastewater treatment. This, together with the more typical flow rates that occur in the river, and the proposed mitigation measures to improve mixing of the treated wastewater during low flow periods is expected to limit potential effects to water quality, such that they are less than minor.
- The resulting risk to public health associated with the discharge is considered to be low, with downstream water remaining in an Excellent category for contact recreation (NPSFM 2020) and consistent with the contact recreation standards outlined in the Kawarau Water Conservation Order.
- Potential effects to ecology of the Shotover River during the short-term discharge period are also considered to be negligible, with mitigation measures proposed to limit the potential localised and short-term influence of increased ammoniacal-N during low flow periods.
- Soakage of treated wastewater from the discharge channel, may have a measurable influence on downgradient groundwater quality. This is expected to be notably less than has resulted from operation of the DAD and is likely to assist in more broadly dissipating the treated wastewater when considered in the context of the direct discharge to surface water.
- Ongoing monitoring is proposed to assist in identifying the need for mitigation measures and to validate the assessment findings.

6. References

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Appendix A

River morphology – aerial imagery 2004 – 2025

Table 1 Aerial imagery of the Shotover river, in the area of the WWTP, from 2004 – 2025 (Google Earth Pro, 2025)

Photo	Year
	2025

Photo	Year
	2024

Photo	Year
	2023

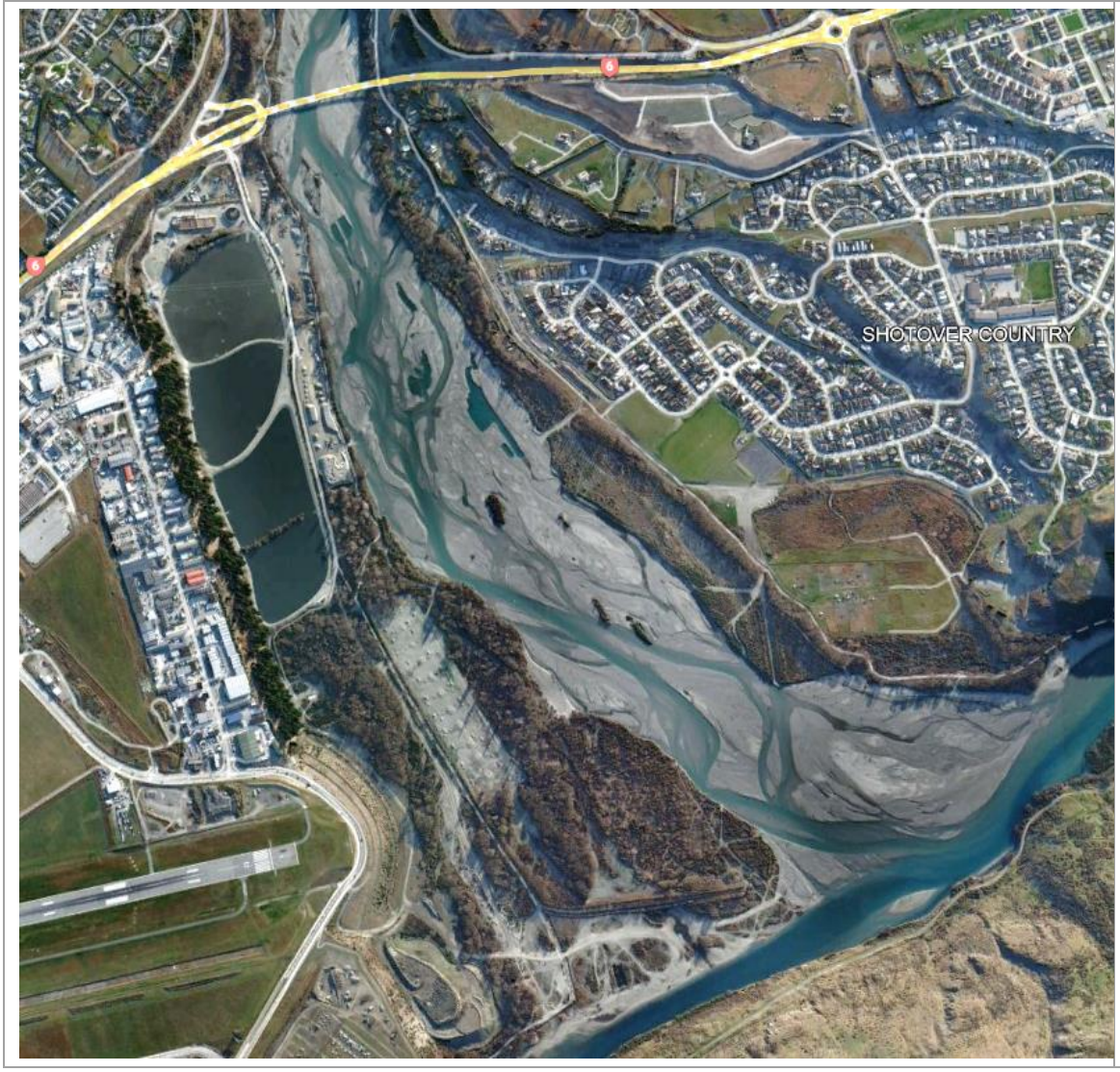
Photo	Year
	2022

Photo	Year
	2021

Photo	Year
	2020

Photo	Year
	Nov 2019

Photo	Year
	2018

Photo	Year
	2016

Photo	Year
	2015

Photo	Year
	2013

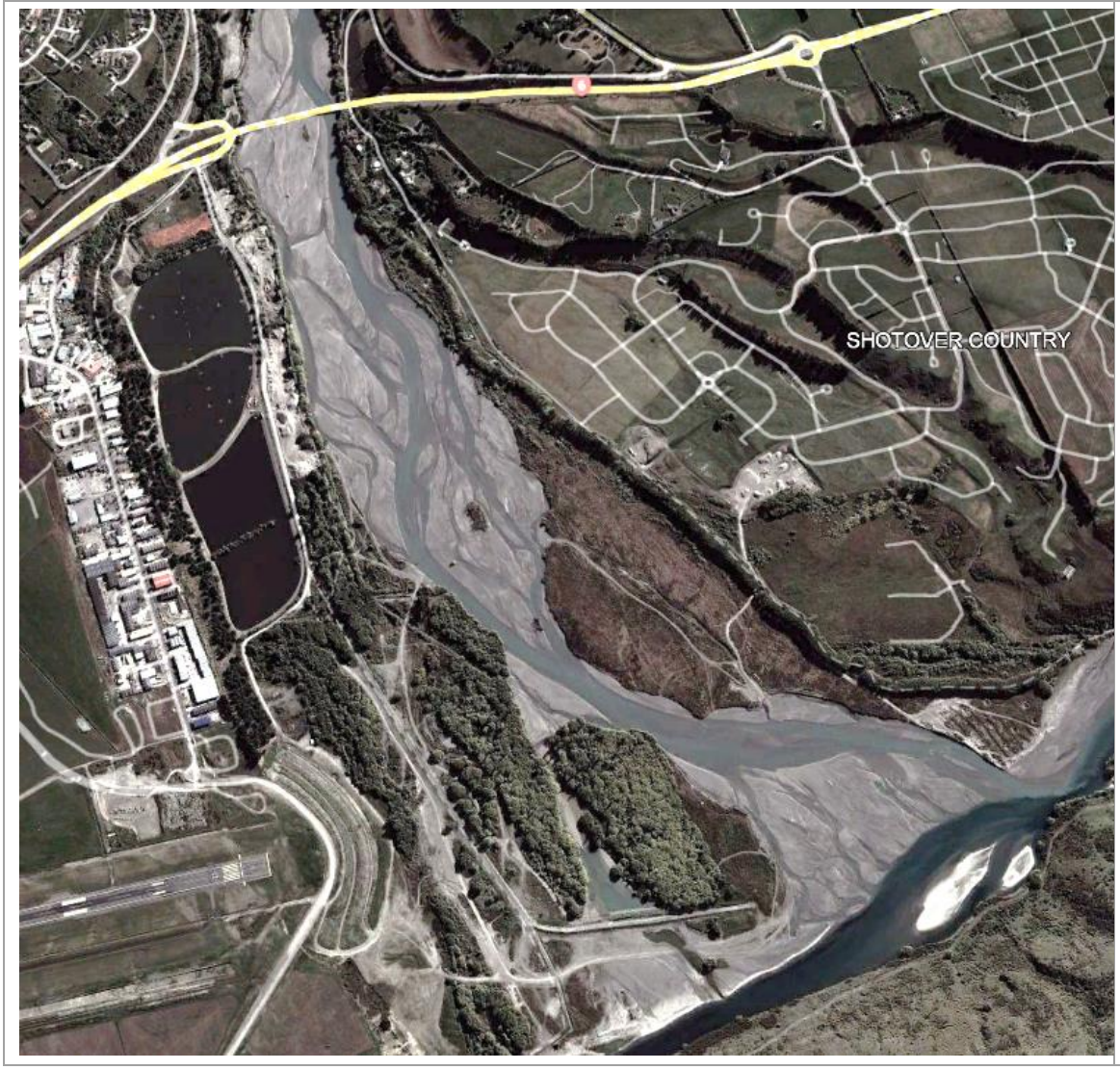
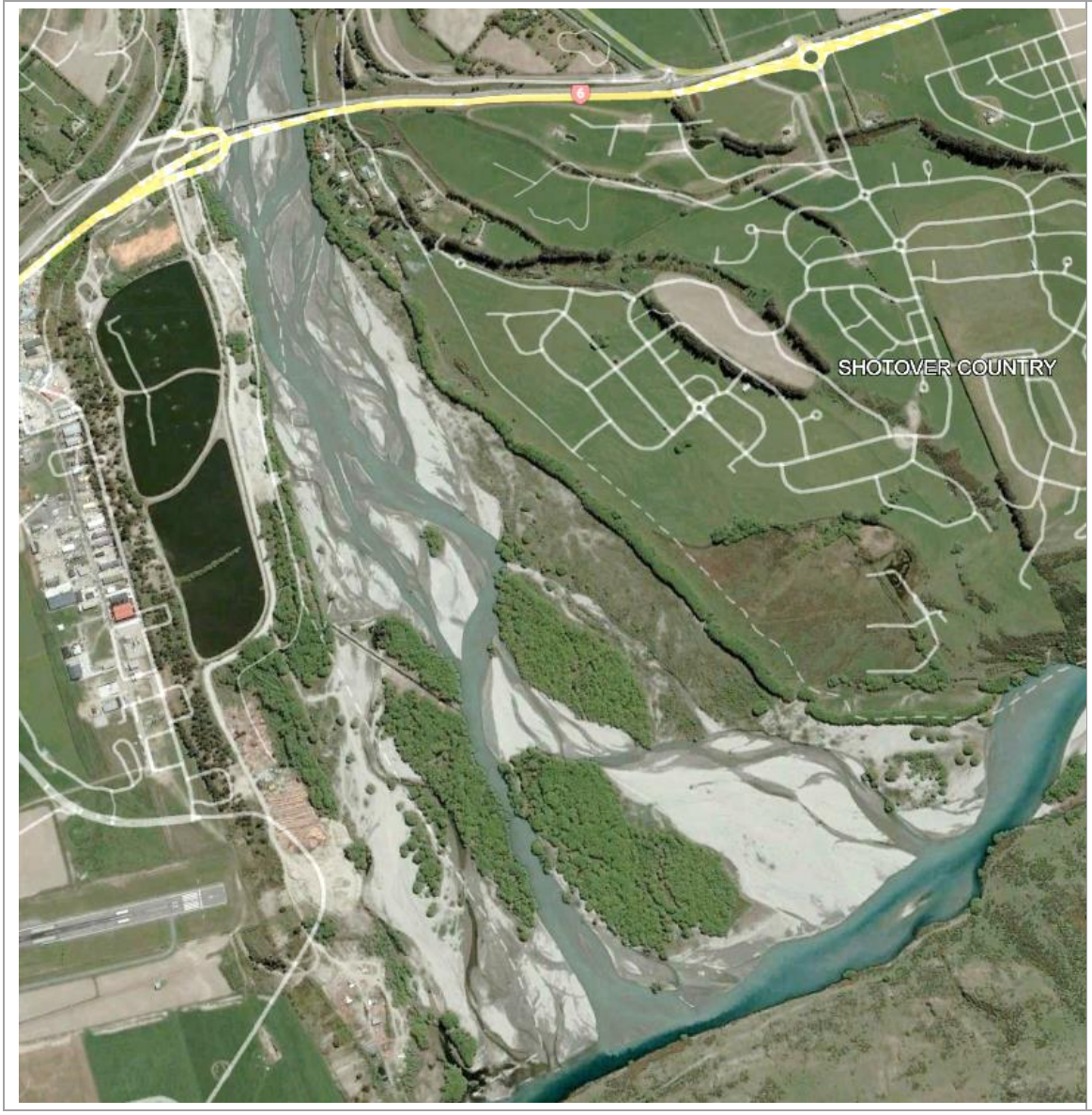
Photo	Year
	2012

Photo	Year
	2011

Photo	Year
	2010

Photo	Year
	2006

Photo	Year
	2004

Appendix B

Bore logs

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 1/04/2025 Completed: 1/04/2025

Easting: 1265913.72 Northing: 5007121.8 System: NZTM2000
RL: 312.86 m Datum: DVD1958 Method: SURVEY

Hole No. : BH01

Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
312	0		Gravelly fine to coarse SAND with trace rootlets; dark grey. Moist.		M					SNC				TCR: 100			
311	1.6		Gravelly medium to coarse SAND with minor cobbles; dark grey with some white, orange, and brown gravel. Wet. 1.62 m Ground Water Level		W					SNC				TCR: 100			1-04-2025
310	3		End of Hole @ 3m,														
309	4																
308	5																
307	6																
306	7																
305	8																
304	9																

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	00:00	1.62	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 1/04/2025 Completed: 1/04/2025

Easting: 1265968.29 Northing: 5007058.06 System: NZTM2000
RL: 312.82 m Datum: DVD1958 Method: SURVEY

Hole No. : BH02

Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
312	0		Gravelly fine to coarse SAND; dark grey. Moist.		M												
	1		0.50 - 1.60 Minor cobbles; grey; sand, medium to coarse.							SNC				TCR: 100			
			1.00 m Ground Water Level														1-04-2025
311	1.6		Sandy fine to coarse GRAVEL with minor cobbles; grey. Saturated.		S												
310	2									SNC				TCR: 100			
	3		End of Hole @ 3m,														
309	4																
308	5																
307	6																
306	7																
305	8																
304																	

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	16:30	1	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 3/04/2025 Completed: 3/04/2025

Hole No. : BH03
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

Easting: 1266059.7 Northing: 5007012.24 System: NZTM2000
RL: 313.11m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
313.11	0		TOPSOIL: Silty fine SAND with minor organic; grey. Moist; organics, rootlets.		M												
312.66	0.45		Fine to medium SAND with trace gravel; grey. Moist; gravel, fine to medium, subrounded to subangular, schist.							SNC				TCR: 100			
			1.20 Becomes gravelly														
311.71	1.4		Sandy fine to coarse GRAVEL; brownish grey. Moist; gravel, subrounded to subangular; schist; sand, fine to coarse.							SNC				TCR: 100			
			2.60 Becomes grey. Wet		W												3-04-2025
										SNC				TCR: 100			
308.61	4.5		End of Hole @ 4.5m,														

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
03/04/25	11:20	2.6	4.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 3/04/2025 Completed: 3/04/2025

Hole No. : BH04
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

Easting: 1266109.87 Northing: 5006934.47 System: NZTM2000
RL: 312.73 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
312	0		Fine to medium SAND with minor gravel; grey. Moist; gravel, subrounded to subangular, schist.		M												
	0.45		Sandy fine to coarse GRAVEL; brownish grey. Moist; gravel, subrounded to subangular.							SNC				TCR: 100			
311	1																
310	2		2.20 Becomes wet		W					SNC				TCR: 100			3-04-2025
309	3		3.00 Becomes grey							SNC				TCR: 100			
308	4		End of Hole @ 4.5m,														
307	5																
306	6																
305	7																
304	8																
	9																

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
03/04/25	13:15	2.2	4.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 1/04/2025 Completed: 1/04/2025

Hole No. : BH05
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1265874.15 Northing: 5006942 System: NZTM2000
RL: 312.81 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
312	0		Fine to medium SAND with trace gravel and rootlets; grey. Moist; gravel, fine.		M												
	0.5		Fine SAND; light grey. Dry.		D					SNC				TCR: 100			
311	1		Gravelly fine to medium SAND; brownish grey. Moist; gravel, fine.		M												
	1.4		Sandy fine to coarse GRAVEL with minor cobbles; light grey, with some white, brown and orange gravels. Saturated. 1.68 m Ground Water Level		S					SNC				TCR: 100			1-04-2025
310	2																
	1.6		End of Hole @ 3m,														
309	3																
308	4																
307	5																
306	6																
305	7																
304	8																
	9																

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	00:00	1.68	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 4/04/2025 Completed: 4/04/2025

Hole No. : BH06
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266339.36 Northing: 5006669.72 System: NZTM2000
RL: 310.67 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Gravelly fine to coarse SAND; grey. Moist.		M					SNC				TCR: 100			
309	1.5		Fine to coarse GRAVEL with minor cobbles; grey, with some white, brown and orange gravels. Wet.		W					SNC				TCR: 100			
308	2		2.10 m Ground Water Level														4-04-2025
307	3		Sandy fine to coarse GRAVEL; grey, with some white, brown and orange gravels. Moist.		M					SNC				TCR: 100			
306	3.2		Fine to coarse SAND with minor gravel; grey. Moist.														
305	4		End of Hole @ 4.5m,														
304	4.3																
303	5																
302	6																
	7																
	8																
	9																

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
04/04/25	00:00	2.1	4.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 27/03/1900 Completed: 27/03/2025

Hole No. : BH07
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266039.33 Northing: 5006657.48 System: NZTM2000
RL: 311.85 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
311	0		Gravelly SAND with minor cobbles; light grey. Moist.		M					SNC				TCR: 100			
	1		1.37 m Ground Water Level														28-02-2025
310	1.4		Sandy GRAVEL with minor cobbles; light grey with some white, orange and brown gravels. Saturated		S					SNC				TCR: 100			
309	2																
	3		End of Hole @ 3m,														
308	4																
307	5																
306	6																
305	7																
304	8																
303	9																

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/02/25	00:00	1.37	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 1/04/2025 Completed: 1/04/2025

Hole No. : BH08
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

Easting: 1266282.03 Northing: 5006538.17 System: NZTM2000
RL: 311.05 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	1		Sandy fine to coarse GRAVEL with trace silt; brown. Moist; gravel, subrounded to subangular, schist; sand, fine to coarse.		M					SNC				TCR: 100			
309	2		Sandy fine to coarse GRAVEL; grey. Wet; subrounded to subangular, schist; sand, fine to coarse.		W					SNC				TCR: 100			
308	3		End of Hole @ 3m,														
307	4																
306	5																
305	6																
304	7																
303	8																

Notes and Comments:
End of Hole @ 3m
Ground water was not observed
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge		Hole No.	: BH09
Client : Queenstown Lakes District Council		Sheet	: 1 of 1
Site : Shotover WWTP,		Hole Length	: 9
Job Number: 12645246		Scale @ A4	: 1:45
Commenced: 31/03/2025	Completed: 3/03/2025	Logged	: CS
Easting: 1266283.06	Northing: 5006537.07	Processed	: MG
RL: 310.97 m	Datum: DVD1958	Checked	: DB
	System: NZTM2000		
	Method: SURVEY		

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Gravelly SAND with some rootlets and trace bark; greyish brown. Moist. Slight organic smell.		M					SNC				TCR: 100			
	1.4		Coarse GRAVEL; dark grey, white, black. Moist. Slight organic smell.														
309	1.7		sandy fine to coarse GRAVEL; dark grey, black. Saturated.		S					SNC				TCR: 100			
308	2.6		Gravelly coarse SAND; dark grey. Wet. Slight organic smell.		W												
	3		Coreless							SNC				TCR: 73			
	3.4		Coarse GRAVEL; dark grey, with some white, orange and brown gravels. Wet. Slight organic odour.														
307	3.6		Gravelly medium to coarse SAND; dark grey. Wet. Slight organic odour.														
306			4.50 m no odour							SNC				TCR: 100			
305										SNC				TCR: 100			
304										SNC				TCR: 100			
303										SNC				TCR: 100			
302			End of Hole @ 9m,														

Notes and Comments:

End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 31/03/2025 Completed: 31/03/2025

Hole No. : BH10
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266436 Northing: 5006521.69 System: NZTM2000
RL: 310.48 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Silty SAND with some rootlets; dark grey. Moist.		M												
	0.2		Sandy fine to coarse GRAVEL with some cobbles; grey with some white, orange and brown gravels.. Saturated.		S					SNC				TCR: 100			
309	1																
	1.5		Coreless														
	1.8		Coarse GRAVEL; grey, orange, brown,white, greenish gray. Wet.		W												
308	2		Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels.. Saturated.		S					SNC				TCR: 100			
	3		End of Hole @ 3m,														
307	4																
306	5																
305	6																
304	7																
303	8																
302	9																

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 28/03/2025 Completed: 28/03/2025

Hole No. : BH11
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266178.04 Northing: 5006463.39 System: NZTM2000
RL: 311.93 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
311	0		Silty medium to coarse SAND; dark grey. Moist.		M												
	0.2		Fine to medium SAND with some gravel; light grey. Dry; gravel, fine to coarse.		D					SNC				TCR: 100			
310	1.4		Sandy fine to coarse GRAVEL; dark grey with some white, orange and brown gravels.. Saturated; sand, fine to coarse.		S					SNC				TCR: 100			28-03-2025
309	3.5		Coreless							SNC				TCR: 67			
308	4		Sandy fine to coarse GRAVEL; dark grey with some white, orange and brown gravels.. Saturated; sand, fine to coarse.														
307	4.5		End of Hole @ 4.5m,														
306																	
305																	
304																	
303																	

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/03/25	00:00	2.3	4.5

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Hole No. : BH13
Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45

Commenced: 31/03/2025 Completed: 31/03/2025

Logged : CS
Processed : MG
Checked : DB

Easting: 1266402.01 Northing: 5006429.6 System: NZTM2000
RL: 310.6 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type / Result	Sample	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0.10		Silty SAND with some rootlets; dark grey. Moist.		M												
	0.4		Fine to medium SAND; dark grey. Moist.														
			Gravelly medium to coarse SAND; light grey. Dry.		D					SNC				TCR: 100			
309	1.5		Sandy fine to coarse GRAVEL; dark grey with some white, orange and brown gravels. Dry.		S												31-03-2025
			1.50 m Ground Water Level							SNC				TCR: 100			
308																	
307	3.8		Gravelly medium to coarse SAND; dark grey. Moist.		M					SNC				TCR: 100			
306																	
305										SNC				TCR: 100			
304																	
303										SNC				TCR: 100			
302																	
			End of Hole @ 9m,							SNC				TCR: 100			

Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	00:00	1.5	9

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 2/04/2025 Completed: 2/04/2025

Hole No. : BH14
Sheet : 1 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

Easting: 1265826.97 Northing: 5006719.89 System: NZTM2000
RL: 315.04 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type / Sample / Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
314	1		FILL: Silty, sandy fine to coarse GRAVEL; brown. Moist; subangular; schist; sand, fine to coarse.		M				SNC				TCR: 100			
313	2								SNC				TCR: 100			
312	3		Fine SAND with minor silt; grey. Moist; mica and roots in top 250 mm.						SNC				TCR: 100			
311	4		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; subrounded to subangular; schist and quartz; sand, fine to coarse.		W				SNC				TCR: 100			2-04-2025
310	5								SNC				TCR: 100			
309	6								SNC				TCR: 100			
308	7								SNC				TCR: 100			
307	8								SNC				TCR: 100			

Notes and Comments:
End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	00:00	4.1	10.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 2/04/2025 Completed: 2/04/2025

Easting: 1265826.97 Northing: 5006719.89 System: NZTM2000
RL: 315.04 m Datum: DVD1958 Method: SURVEY

Hole No. : BH14
Sheet : 2 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
305	10		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; subrounded to subangular; schist and quartz; sand, fine to coarse. *(continued from layer starting at 4.1m)*							SNC				TCR: 100			
304	11		End of Hole @ 10.5m,														
303	12																
302	13																
301	14																
300	15																
299	16																
298	17																

Notes and Comments:
End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	00:00	4.1	10.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 28/03/2025 Completed: 28/03/2025

Hole No. : BH16
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266626.94 Northing: 5006381.18 System: NZTM2000
RL: 309.74 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
309	0		Silty SAND with some rootlets; dark grey. Wet.		W												
	0.10		Sandy fine to coarse GRAVEL with some cobbles; grey with some white, orange and brown gravels. Moist.		M					SNC				TCR: 100			
308	1		1.26 m Ground Water Level														28-03-2002
307	2									SNC				TCR: 100			
306	3		End of Hole @ 3m,														
305	4																
304	5																
303	6																
302	7																
301	8																
	9																

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/03/02	00:00	1.26	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 27/03/2025 Completed: 27/03/2025

Easting: 1266532.92 Northing: 5006287.44 System: NZTM2000
RL: 309.24 m Datum: DVD1958 Method: SURVEY

Hole No. : BH17
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
309	0		Sandy fine to coarse GRAVEL with minor silt and rootlets; dark grey. Moist.		M												
	0.2		Sandy fine to coarse GRAVEL with some cobbles; dark grey. Moist.							SNC				TCR: 100			
308	1		0.85 m Ground Water Level														27-03-2025
307	2									SNC				TCR: 100			
	3		End of Hole @ 3m,														
306	4																
305	5																
304	6																
303	7																
302	8																
301																	

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	0.85	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 27/03/2025 Completed: 27/03/2025

Easting: 1266535.82 Northing: 5006286.32 System: NZTM2000
RL: 309.36 m Datum: DVD1958 Method: SURVEY

Hole No. : BH18
Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
309	0		Fine to medium SAND; light grey. Wet.		W					SNC				TCR: 100			
	0.10		Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Wet		W												
308	1		0.95 m Ground Water Level														27-03-2025
	1.5		Fine to coarse GRAVEL with some sand; grey with some white, orange and brown gravels. Saturated.		S					SNC				TCR: 100			
307	2																
306	3									SNC				TCR: 100			
305	4																
	4.2		Fine SAND; dark grey. Moist. 4.20 - 9.00 (Low Permeability)		M					SNC				TCR: 100			
304	5		5.00 m becomes Wet		W												
303	6									SNC				TCR: 100			
302	7																
301	8									SNC				TCR: 100			
	9		End of Hole @ 9m,														

Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	0.95	9

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 27/03/2025 Completed: 27/03/2025

Hole No. : BH19
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266401.85 Northing: 5006233.66 System: NZTM2000
RL: 310.34 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample / In Situ Test Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Silty fine to coarse SAND with trace roots; dark grey. Moist.		M												
	0.2		Medium SAND; light grey. Dry.		D												
	0.6		Gravelly coarse SAND; light grey. Dry; gravel, fine to coarse.		D					SNC				TCR: 100			
309	1																
	1.4		Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Saturated.		S												
308	2		1.82 m Ground Water Level							SNC				TCR: 100			27-03-2025
307	3		End of Hole @ 3m,														
306	4																
305	5																
304	6																
303	7																
302	8																

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	1.82	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 27/03/2025 Completed: 27/03/2025

Easting: 1266403.73 Northing: 5006230.86 System: NZTM2000
RL: 310.25 m Datum: DVD1958 Method: SURVEY

Hole No. : BH20

Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Medium to coarse SAND; dark grey. Moist.		M												
	0.5		Gravelly fine to coarse SAND; light grey. Dry; gravel, fine to coarse.		D					SNC				TCR: 100			
309	1																
	1.5		Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Saturated. 1.72 m Ground Water Level		S					SNC				TCR: 100			27-03-2025
308	2																
307	3																
	3.3		Coarse SAND with minor gravel; grey. Wet		W												
	3.5		Coreless							SNC				TCR: 67			
306	4		Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Saturated.		S												
	4.5		Coreless							SNC				TCR: 67			
305	5		Fine to coarse GRAVEL with some sand; grey with some white, orange and brown gravels. Wet.		W												
304	6									SNC				TCR: 100			
	6.8		Fine SAND; light grey. Moist.		M												
303	7									SNC				TCR: 100			
302	8																
			End of Hole @ 9m,														

Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	1.72	9

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 28/03/2025 Completed: 28/03/2025

Hole No. : BH21
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266326.33 Northing: 5006297.09 System: NZTM2000
RL: 310.42 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Silty medium SAND with trace rootlets and minor gravel and trace rootlets; dark grey. Wet; gravel, fine.		W												
	0.5		Gravelly fine to coarse SAND; light grey. Dry.		D					SNC				TCR: 100			
309	1																
	1.4		Sandy fine to coarse GRAVEl with minor Cobble; grey with some white, orange and brown gravels. Saturated.		S												
308	2		2.00 m Ground Water Level							SNC				TCR: 100			28-03-2025
	3		End of Hole @ 3m,														
307	4																
306	5																
305	6																
304	7																
303	8																
302																	

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/03/25	00:00	2	3

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 26/03/2025 Completed: 26/03/2025

Hole No. : BH22
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266311.49 Northing: 5006167.57 System: NZTM2000
RL: 310.24 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Sandy SILT; dark grey. Moist.		M												
	0.2		Silty fine to coarse SAND with some gravel; dark grey		D	"											
	0.6		Gravelly fine to coarse SAND; light grey. Dry.							SNC				TCR: 93			
309	1																
	1.4		Coreless														
	1.6		Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels.. Wet. 1.68 m Ground Water Level		W												28-03-2025
308	2									SNC				TCR: 93			
	3		Coreless														
307										SNC				TCR: 67			
	4		Fine to coarse GRAVEl; grey with some white, orange and brown gravels.. Wet.		W												
306			End of Hole @ 4.5m,														
305	5																
304	6																
303	7																
302	8																
	9																

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	00:00	1.68	4.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246

Commenced: 26/03/2025 Completed: 26/03/2025

Easting: 1266312.54 Northing: 5006165.17 System: NZTM2000
RL: 310.06 m Datum: DVD1958 Method: SURVEY

Hole No. : BH23
Sheet : 1 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0		Sandy SILT: dark grey. Moist.		M					SNC				TCR: 100			
	0.2		Silty fine to coarse SAND with some gravel; dark grey. Moist; gravel, fine.														
	0.6		Gravelly fine to coarse SAND; light grey. Dry.		D												
309	1																
	1.4		Sandy fine to coarse GRAVEL; grey, brown, orange, white, greenish grey. Wet. 1.62 m Ground Water Level		W					SNC				TCR: 100			26-03-2025
308	2																
307	3		Coreless														
	3.2		Sandy fine to coarse GRAVEL with minor cobbles; grey with some white, orange and brown gravels. Wet.		W					SNC				TCR: 87			
306	4																
305	5									SNC				TCR: 100			
304	6																
	6.2		Fine SAND; dark grey. Moist.		M					SNC				TCR: 100			
303	7																
302	8									SNC				TCR: 100			
	9																

Notes and Comments:
End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	00:00	1.62	10.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 26/03/2025 Completed: 26/03/2025

Hole No. : BH23
Sheet : 2 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266312.54 Northing: 5006165.17 System: NZTM2000
RL: 310.06 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
300	10		Fine SAND; dark grey. Moist. *(continued from layer starting at 6.2m)*							SNC				TCR: 100			
299	11		End of Hole @ 10.5m,														
298	12																
297	13																
296	14																
295	15																
294	16																
293	17																

Notes and Comments:
End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	00:00	1.62	10.5

Report ID: GENERAL_LOG || Project: 12645246_ALL_LOGS.GPJ || Library: GHD - NZGD - TP ONLY.GLB || Date: 16 April 2025

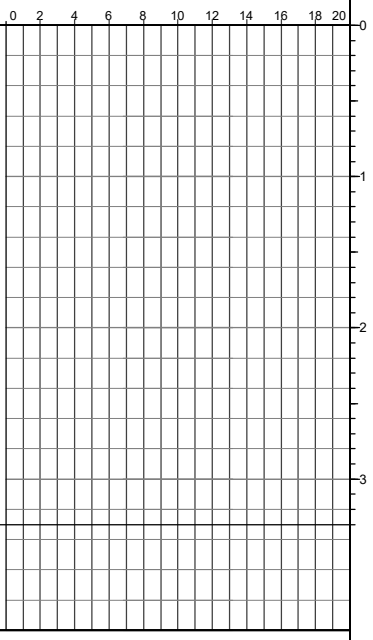
Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP01
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 3.3
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 2/04/2025	Completed: 2/04/2025	Logged	: VM
Easting: 1265814	Northing: 5006820	System: NZTM2000	Processed : MG
RL: 314.1 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT308 | Contractor: Speight Drilling | Operator: Duncan

Length: 3m | Width: 1.5m | Orientation: 320° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
314	0		FILL: Sandy fine to coarse GRAVEL with some cobbles and refuse; grey. Dry; sand, fine to coarse, refuse consists of concrete.	D				
313	1							
	1.65		Fine SAND; light grey. Dry.			B- 1.65		
312	2		Sandy fine to coarse GRAVEL; light grey. Dry; sand, fine to coarse.			2.10		
			2.60 Becomes moist.	M				
311	3		2.80 Becomes wet.	W				2/04/2025
			End of Hole @ 3.3m, C					

Dynamic Cone Penetrometer
Blows per 100mm intervals



Notes and Comments:

End of Hole @ 3.3m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT308

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	03:50	3.2	3.3

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP02
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 3.2
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 2/04/2025	Completed: 2/04/2025	Logged	: VM
Easting: 1265921	Northing: 5006650	System: NZTM2000	Processed : MG
RL: 313.6 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT308 Contractor: Speight Drilling Operator: Duncan

Length: 3.2m Width: 1.5m Orientation: 107° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
313	0		FILL: Silty fine to coarse GRAVEL with some sand, with minor cobbles and trace boulders and refuse; brown. Dry; refuse consists of tree roots, concrete, and obsolete piping.	D				
			0.30 Becomes moist.	M				
312	1							
	2		BURIED TOPSOIL: SILT with tree rootlets; brown. Moist					
311	2.2		Fine SAND with trace silt and organic; grey. Moist.					
	2.6		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; sand fine to coarse.	W		B- 2 bags 2.60		2/04/2025
310	3		End of Hole @ 3.2m, C			3.20		

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 3.2m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT308

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	14:30	3.1	3.2

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP03
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.7
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 1/04/2025	Completed: 1/04/2025	Logged	: VM
Easting: 1265988	Northing: 5006734	System: NZTM2000	Processed : MG
RL: 312.1 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator: Alistair

Length: 3m | Width: 1.3m | Orientation: | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
312	0.2		TOPSOIL: Fine to coarse SAND with minor gravel; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist.	M					
311	1		Sandy fine to coarse GRAVEL with minor cobbles; grey. Moist; subrounded to subangular; schist; sand, medium to coarse. 1.10 - 1.20 Brown band, 100mm thick 1.50 Becomes saturated	S		B- 0.50 0.80		1-04-2025	
310	2		End of Hole @ 1.7m, C						
309	3								

0 2 4 6 8 10 12 14 16 18 20

0 1

Notes and Comments:

End of Hole @ 1.7m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	14:00	1.6	1.7

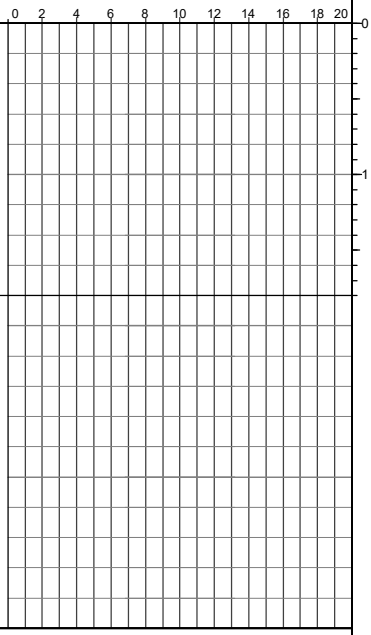
Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP04
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.8
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 1/04/2025	Completed: 1/04/2025	Logged	: VM
Easting: 1266034	Northing: 5006666	Processed	: MG
System: NZTM2000		Checked	: DB
RL: 311.7 m	Datum: NZVD2016	Method: GPSH	

Equipment: CAT 310 Contractor: Speight Drilling Operator: Alistair

Length: 4.5m Width: 1.8m Orientation: Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
311	0.2		TOPSOIL: Silty fine to medium SAND with some organic; brown. Moist.	D				
			Sandy fine to coarse GRAVEL with trace cobbles; grey. Dry; subrounded to subangular, schist; sand, fine to coarse.					
310	1		1.10 Becomes moist. 1.10 - 1.80 Brown banding.	M				
			1.60 Becomes saturated	S				1/04/2025
309	2		End of Hole @ 1.8m, C					
308	3							

Dynamic Cone Penetrometer
Blows per 100mm intervals



Notes and Comments:

End of Hole @ 1.8m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	14:45	1.7	1.8

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP05
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.4
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 1/04/2025	Completed: 1/04/2025	Logged	: VM
Easting: 1266063	Northing: 5006589	System: NZTM2000	Processed : MG
RL: 311.2 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator: Alistair

Length: 3m | Width: 1.3m | Orientation: 212° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Water level
311	0.10		TOPSOIL: Silty fine to medium SAND with some organic; brown. Moist.	M				
			Sandy fine to coarse GRAVEL with some cobbles; grey. Moist; subrounded to subangular; schist; sand, medium to coarse. 0.60 - 0.80 Brown banding, 50mm thick. 0.80 - 1.00 Brown banding, 200mm thick.			B- 0.60 1.00		
310	1		Medium to coarse SAND with some gravel and trace cobbles; grey. Wet; gravel and cobbles, fine to coarse, subrounded to subangular; schist.	W				1-04-2025
	1.2		Sandy fine to coarse GRAVEL with some cobbles; grey. Saturated; subrounded to subangular; schist; sand, medium to coarse.	S				
309	2		End of Hole @ 1.4m, C					
308	3							

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	12:45	1.2	1.4

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP06
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 2
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 1/04/2025	Completed: 1/04/2025	Logged	: VM
Easting: 1266119	Northing: 5006479	System: NZTM2000	Processed : MG
RL: 311.5 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 Contractor: Speight Drilling Operator:

Length: 3m Width: 1.2m Orientation: 240° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
311	0		Fine to coarse SAND with minor gravel; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist.	D		BLK- 1 Bag 0.00		
	0.5		Sandy fine to coarse GRAVEL with minor cobbles; light grey. Dry; gravel, subrounded to subangular, schist; sand, fine to coarse.	D		0.50		
	0.8		Gravelly fine to coarse SAND with trace cobbles; light grey. Dry; gravel, subrounded to subangular, schist.	D				
310	1		1.20 m becomes moist	M				
			1.80 m Becomes wet	W				1-04-2025
	2		1.90 Becomes saturated End of Hole @ 2m, C	S				
309								
	3							
308								

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 2m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	11:30	1.9	2

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP07
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.8
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 1/04/2025	Completed: 1/04/2025	Logged	: VM
Easting: 1266157	Northing: 5006393	System: NZTM2000	Processed : MG
RL: 310.5 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3m | Width: 1.4m | Orientation: 260° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
310	0.2 0		TOPSOIL: Organics fine to medium SAND; light grey. Dry; organics, fibrous, roots.	D				
			Sandy fine to coarse GRAVEL with minor cobbles; grey. Dry; gravel, subrounded to subangular, schist gravel; sand, fine to coarse.	D				
309	1		0.60 Becomes moist 0.60 - 0.90 Brown banding	M				
			1.60 becomes saturated	S				1-04-2025
308	2		End of Hole @ 1.8m, C					
307	3							

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.8m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	00:00	1.6	1.8

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP08
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.5
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged	: VM
Easting: 1266219	Northing: 5006289	System: NZTM2000	Processed : MG
RL: 310.2 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3m | Width: 1.2m | Orientation: 264° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
310	0		Sandy fine to coarse GRAVEL; light grey. Dry; gravel, subrounded to subangular, schist gravel; sand, fine to coarse.	D				
	0.4		Sandy fine to coarse GRAVEL with trace of cobbles; grey with orange banding. Moist; gravel, subrounded to subangular, schist gravel; sand, coarse.	M		BLK- 2 bags 0.50 1.00		
309	1		1.00 No orange banding					
			1.30 Becomes saturated	S				31-03-2025
			End of Hole @ 1.5m, C					
308	2							
307	3							

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.5m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	16:10	1.3	1.5

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP09
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.4
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged	: VM
Easting: 1266274	Northing: 5006311	System: NZTM2000	Processed : MG
RL: 309.8 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3m | Width: 1.2m | Orientation: 135° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
309	0		Fine to coarse SAND with some gravel; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist gravel.	D				
	0.3		Sandy fine to coarse GRAVEL with trace cobbles; light grey. Moist; gravel, subangular, schist; sand, fine.	M		0.00 BLK- No sample recovered		
1	1.1		Fine to coarse GRAVEL with some sand; grey. Wet; gravel, subrounded to subangular, schist; sand, medium to coarse.	W				31-03-2025
308			End of Hole @ 1.4m, C			1.40		
2								
307								
3								
306								

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	15:50	1.2	1.4

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 26/03/2025 Completed: 26/03/2025

Hole No. : TP10
Sheet : 1 of 1
Hole Length : 2.2
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266293 Northing: 5006224 System: NZTM2000
RL: 310.9 m Datum: NZVD2016 Method: GPSH

Equipment: CAT 310 Contractor: Operator:
Length: 3.5m Width: 1.1m Orientation: 355° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
310	0		Fine to medium SAND with trace roots; light grey. Dry.	D				
	0.7		Sandy fine to coarse GRAVEL; grey. Moist; gravel, subrounded to subangular, schist gravel; sand, medium to coarse.	M				
309	1							
	2		1.90 Becomes saturated	S		BLK - 2 bags 2.00		26-03-2025
308	2.20		End of Hole @ 2.2m, C					
307	3							

Dynamic Cone Penetrometer
Blows per 100mm intervals

Notes and Comments:
End of Hole @ 2.2m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	12:25	1.9	2.2

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP11
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.4
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 26/03/2025	Completed: 26/03/2025	Logged	: VM
Easting: 1266389	Northing: 5006224	System: NZTM2000	Processed : MG
RL: 309.6 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3.5m | Width: 1.1m | Orientation: 155° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
309	0.150		TOPSOIL: SAND with some organics; light grey. Dry; organics, roots.	D					
	1		Sandy fine to coarse GRAVEL with trace cobbles: light grey. Dry; gravel and cobbles, subrounded to subangular, schist gravel; sand, fine to coarse. Lenses of gravelly sand.						
			1.10 m becomes wet	W					
308			1.35 Becomes saturated	S		BLK- 2 bags 1.30		26-03-2025	
	2		End of Hole @ 1.4m, C			BLK- 1.40			
307									
	3								
306									

Dynamic Cone Penetrometer Blows per 100mm intervals: 0 2 4 6 8 10 12 14 16 18 20 (0 to 1)

Notes and Comments:

End of Hole @ 1.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	13:30	1.35	1.4

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP12
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 2.4
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged	: VM
Easting: 1266357	Northing: 5006463	System: NZTM2000	Processed : MG
RL: 311.4 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 2.5m | Width: 1.2m | Orientation: 184° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Water level
311	0		Fine to coarse SAND with trace organic and gravel; light grey. Dry; gravel, subrounded to subangular, schist; organics, roots.	D				
	1		Gravelly fine to coarse SAND; grey. Moist; gravel, fine to coarse.	M		BLK- 2 bags 1.20 1.60		
310			1.80 Brown banding					
309	2		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; gravel, subrounded to subangular, schist gravel; sand, fine to coarse.	W				31-03-2025
308	3		End of Hole @ 2.4m, C					

Dynamic Cone Penetrometer
Blows per 100mm intervals

Notes and Comments:

End of Hole @ 2.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	11:05	2.4	2.4

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP13
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged	: VM
Easting: 1266454	Northing: 5006422	System: NZTM2000	Processed : MG
RL: 309.7 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT310 Contractor: Speight Drilling Operator:

Length: 3.2m Width: 1.4m Orientation: 243° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
309	0.2		Silty fine SAND; light grey. Dry.	D					
			Sandy fine to coarse GRAVEL with trace cobbles; grey. Moist. 0.50 Dark brown banding	M					
	0.80					BLK-		31-03-2025	
308	1		0.90 Becomes saturated	S		1.00			
			End of Hole @ 1m, C						
307	2								
306	3								

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	10:10	0.8	1

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP14
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.5
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 27/03/2025	Completed: 27/03/2025	Logged	: VM
Easting: 1266409	Northing: 5006338	Processed	: MG
System: NZTM2000		Checked	: DB
RL: 309.9 m	Datum: NZVD2016	Method: GPSH	

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3.2m | Width: 1.1m | Orientation: 120° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Water level
309	0		Sandy fine to coarse GRAVEL with trace cobbles: light grey. Dry; gravel, subrounded to subangular, schist; sand, fine to coarse, micaceous.	D				
	1		1.00 Brown banding.					
			1.40 Becomes saturated	S				27-03-2025
308			End of Hole @ 1.5m, C					
	2							
307								
	3							
306								

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.5m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	09:15	1.4	

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP15
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1.3
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 26/03/2025	Completed: 26/03/2025	Logged	: VM
Easting: 1266525	Northing: 5006359	System: NZTM2000	Processed : MG
RL: 309.5 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3.5m | Width: 1.1m | Orientation: 272° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
309	0		Sandy fine to coarse GRAVEL; light grey. Dry; subrounded to subangular, schist; sand, medium to coarse.	D					
	1		0.60 Moist 0.60 - 1.15 Becomes mottled orange	M					
	1.15		Medium to coarse SAND with trace gravel; grey. Wet; gravel, subrounded to subangular, schist; sand, micaceous.	W		BLK- 1 bag-SAND 1.15 1.30		26-03-2025	
308			Observed at the base of pit: Sandy fine to coarse GRAVEL; light grey. Saturated; gravel, subrounded to subangular, schist gravel; sand, medium to coarse.	S					
	2		End of Hole @ 1.3m, C						
307									
	3								
306									

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.3m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	15:15	1.2	1.3

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP16
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 0.6
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 26/03/2025	Completed: 26/03/2025	Logged	: VM
Easting: 1266459	Northing: 5006252	Processed	: MG
RL: 308.6 m	Datum: NZVD2016	Checked	: DB
	System: NZTM2000		
	Method: GPSH		

Equipment: CAT 310 Contractor: Speight Drilling Operator:

Length: 3.5m Width: 1.1m Orientation: 150° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
308	0		Sandy fine to coarse GRAVEL; light grey. Dry; subrounded to subangular, schist gravel; sand, fine to coarse.	D				26-03-2025	
			0.40 Becomes saturated	S					
307	1		End of Hole @ 0.6m, C						
306	2								
305	3								

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 0.6m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	02:30	0.4	0.6

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP17
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged	: VM
Easting: 1266360	Northing: 5006653	System: NZTM2000	Processed : MG
RL: 310.1 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3m | Width: 1.2m | Orientation: 70° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
310	0.150		TOPSOIL: Fine to medium SAND with minor organic; grey. Moist; organics, roots.	M					
	0.7		Fine to medium SAND with some gravel; grey. Moist; gravel, fine to medium, subrounded to subangular, schist gravel.			B- 2 bags 0.30			
309	1		Fine to coarse GRAVEL with minor sand; grey. Wet; subrounded to subangular, schist gravel, sand, medium to coarse.	W		0.70		31-03-2025	
			End of Hole @ 1m, C						
308	2								
307	3								

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	12:40	0.8	1

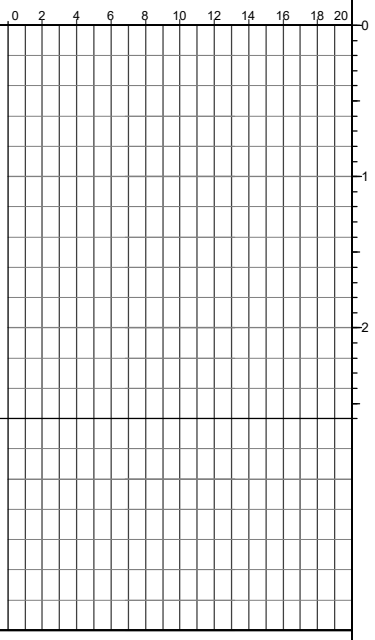
Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP18
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 2.6
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 27/03/2025	Completed: 27/03/2025	Logged	: VM
Easting: 1266650	Northing: 5006530	System: NZTM2000	Processed : MG
RL: 311.3 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3m | Width: 3.1m | Orientation: 285° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
311	0		Fine to medium SAND with some gravel; light grey. Dry.	D		BLK- 1 bag 0.30		
310	1							
309	1.55		Sandy fine to medium GRAVEL with trace cobbles; light grey. moist.	M		1.55		
	2		2.40 Becomes Wet	W				27-03-2025
308	3		End of Hole @ 2.6m, C					

Dynamic Cone Penetrometer
Blows per 100mm intervals



Notes and Comments:

End of Hole @ 2.6m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	2.55	2.6

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP19
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 2.8
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 27/03/2025	Completed: 27/03/2025	Logged	: VM
Easting: 1266620	Northing: 5006468	System: NZTM2000	Processed : MG
RL: 311.3 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 | Contractor: Speight Drilling | Operator:

Length: 3.5m | Width: 1.1m | Orientation: 286° | Shear Vane Id: | Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
311	0.10		TOPSOIL: Fine to coarse SAND with some gravel and trace organic; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist gravel; organic, roots.	D		BLK-0.00		
			Gravelly fine to coarse SAND; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist.	D				
310	1		0.70 Becomes moist	M				
309	2							
	2.5		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; subrounded to subangular, schist; sand, medium to coarse.	W				27-03-2025
308	3		2.60 Becomes saturated	S				
			End of Hole @ 2.8m, C					

Dynamic Cone Penetrometer
Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 2.8m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical | Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	2.7	2.8

DRILLHOLE LOG

DRILLHOLE No: BP1

SHEET 1 OF 1

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5007053 mN, 1266055 mE

DIRECTION: Vertical

ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic

DATUM: Ground Level

R.L. GROUND: m

R.L. COLLAR: m

HOLE STARTED: 21/04/21

HOLE FINISHED: 21/04/21

DRILLED BY: Speight Drilling

LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) / Depth (m)	Graphic Log	Drillers Notes	TESTING (Hammer Efficiency: Borehole Diameter: Liner:)	Water Loss (%)	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Sandy, fine to coarse GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular. - a trace of cobbles @ 0.8 m.	Sonic	40 / 40	To be confirmed	Inferred Medium Dense	1 / 2					See drillers logs for water level	0.2 m - 3.0 m Slotted; 0.2 m - 3.0 m Walton Park Sand; 0.0-0.2 m Bentonite + Cement		1
	End of Bore Hole @ 3.0 m.					3								

COMMENTS:

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH1A

DRILLHOLE LOG

SHEET 1 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006956 mN, 1265996 mE
DIRECTION: Vertical
ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) / Depth (m)	Graphic Log	Drillers Notes	TESTING (Hammer Efficiency: Borehole Diameter: Liner:)	Water Loss (%)	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly medium to coarse SAND with a trace of silt; brown/grey. Gravel, fine to medium, subrounded to subangular.	Sonic	100	To be confirmed	Inferred Loose	0				25 50 75	See drillers logs for water level	0.0-0.2 m Cement Seal		
	Fine to coarse SAND with minor gravel and a trace of rootlets; grey. Gravel, fine to coarse, subrounded to subangular.													
	Gravelly fine to coarse SAND with a trace of silt and cobbles; grey. Gravel, fine to coarse, subrounded to subangular.					1								
	Sandy fine to coarse GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.		90		Inferred Medium Dense	2						0.2 m - 2.8 m Bentonite Cement Seal		
						3			- Falling Head Test 1 @ 3.0 m depth.					
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to medium, subrounded to subangular.		90			4						2.8 m - 5.0 m Walton Park Sand		
	- gravel, fine to coarse from 5.2 m.		100			5						Screen 3.0 - 5.0 m		3
			100			6								
	Core Loss 7.5 m - 9.0 m. Drillers notes: gravelly SAND.		0			7								4
						8								
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.		95		Inferred Medium Dense	9								

COMMENTS:

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH1A

DRILLHOLE LOG

SHEET 2 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006956 mN
1265996 mE

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

DIRECTION: Vertical
ANGLE FROM HORIZ.: 90 °

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: Borehole Diameter: Liner:	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.	Sonic	95	To be confirmed	Inferred Medium Dense	11					See drillers logs for water level			4
	Sandy, fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.		95			12								5
			85			13								
			100			14								6
	Core Loss 15.0 m - 16.5 m. Drillers notes: gravelly SAND		0			15								
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.		95		Inferred Medium Dense	16								7
	Sandy, fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.		90			17								
			95			18								8
						19								

COMMENTS:

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH1A

DRILLHOLE LOG

SHEET 3 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006956 mN, 1265996 mE
DIRECTION: Vertical
ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: Borehole Diameter: Liner:	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly fine to medium SAND with a trace of silt; grey. Gravel, medium to coarse, subrounded to subangular.	Sonic	95	To be confirmed	Inferred Medium Dense	21					See drillers logs for water level			7
	- Sand, fine to coarse from 21.3 m.		100			22								8
	- Gravel, fine to medium from 22.5 m.		70			23								
			100			24								9
	- a trace of cobbles from 25.8 m.					25								
	Sandy fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse, gravel, subrounded to subangular.		100			26								10
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.		100			27								
	Sandy fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.		100			28								11
						29								

COMMENTS:

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH1A

DRILLHOLE LOG

SHEET 4 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006956 mN, 1265996 mE
DIRECTION: Vertical
ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING (Hammer Efficiency: Borehole Diameter: Liner:)	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.	Sonic	100	To be confirmed	Inferred Medium Dense	31						See drillers logs for water level		11
						32								12
			100			33								
						34								13
			100			35								
	Sandy, fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.		85			36								
						37								14
	Fine to coarse SAND with a trace of silt and gravel; grey. Gravel, fine, subrounded to subangular.		90											
	Sandy, fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.					38								
			100											
						39								15
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to medium, subrounded to subangular.		65											

COMMENTS: End of Bore Hole @ 40.0 m.

Survey Method:

Log Scale 1:50

DRILLHOLE LOG

DRILLHOLE No: IH2

SHEET 1 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006650 mN, 1226199 mE

DIRECTION: Vertical

ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic

DATUM: Ground Level

R.L. GROUND: m

R.L. COLLAR: m

HOLE STARTED: 22/04/21

HOLE FINISHED: 22/04/21

DRILLED BY: Speight Drilling

LOGGED BY: JN | CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)	Depth (m)
UNCONTR-OLLED FILL	Sandy fine to medium GRAVEL with minor silt; dark grey. Sand, fine to medium.	0.0
	Sandy SILT with minor rootlets and a trace of organic silt; dark brown. Sand, fine.	0.4
SHOTOVER ALLUVIUM	SAND with some silt and a trace of gravel and rootlets; grey. Sand, fine to medium; gravel, fine, subrounded to subangular.	1.0
	Sandy, fine to medium GRAVEL with a trace of silt and rootlets; grey. Sand, fine to coarse; gravel, subrounded to subangular.	2.0
	Gravelly fine to medium SAND with a trace of silt; grey. Gravel, fine to medium, subrounded to subangular.	3.0
	Sandy, fine to corase GRAVEL with a trace of silt; grey. Sand, fine to coarse; gravel, subrounded to subangular.	3.2
	- gravel, fine to medium from 3.8 m.	
	Gravelly fine to coarse SAND with minor silt; brown grey. Gravel, fine to coarse, subrounded to subangular.	6.0
	- a trace of silt from 7.5 m.	
		10.0

Sampling Method: Sonic

Core Recovery (%): 95, 70, 100, 60, 45, 100, 60

Moisture Condition: To be confirmed

Strength/Density Classification: Inf. Loose; Inferred Firm; Inferred Loose; Inferred Medium Dense

TESTING: Hammer Efficiency: Borehole Diameter: Liner:

Water Loss (%): 25, 50, 75

Water Level: See drillers logs for water level

Casing / Installation: 0.0-0.2 m Cement Seal; 0.2 m - 2.8 m Bentonite Cement Seal; 2.8 m - 5.0 m Walton Park Sand; Screen 3.0 - 5.0 m

Core Box: 1, 2, 3, 4

COMMENTS:

Survey Method:

Log Scale 1:50

DRILLHOLE LOG

DRILLHOLE No: IH2

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006650 mN
1226199 mE

DIRECTION: Vertical

ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic

DATUM: Ground Level

R.L. GROUND: m

R.L. COLLAR: m

HOLE STARTED: 22/04/21

HOLE FINISHED: 22/04/21

DRILLED BY: Speight Drilling

LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: Borehole Diameter: Liner:	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly fine to coarse SAND with a trace of silt; brownish grey. Gravel, fine to coarse, subrounded to subangular.	Sonic	100 100 100 100 60 100 100 100	To be confirmed	Inferred Medium Dense	11 12 13 14 15 16 17 18 19					See drillers logs for water level			4 5 6 7 8
	Sandy, fine to corase GRAVEL with a trace of silt; grey brown. Sand, fine to coarse; gravel, subrounded to subangular.													

COMMENTS:

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH2

DRILLHOLE LOG

SHEET 3 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006650 mN, 1226199 mE
DRILL TYPE: Sonic
HOLE STARTED: 22/04/21
DATUM: Ground Level
HOLE FINISHED: 22/04/21
DIRECTION: Vertical
R.L. GROUND: m
DRILLED BY: Speight Drilling
ANGLE FROM HORIZ.: 90°
R.L. COLLAR: m
LOGGED BY: JN
CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: Borehole Diameter: Liner:	Water Loss (%)	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Sandy, fine to corase GRAVEL with a trace of silt; grey brown. Sand, fine to coarse; gravel, subrounded to subangular.	Sonic	100	To be confirmed	Inferred Medium Dense	21					See drillers logs for water level			8
	Gravelly fine to coarse SAND with a trace of silt; grey brown. gravel, fine to coarse, subrounded to subangular.		85			22								9
			100			23								
			100			24								10
			100			25								
			100			26								11
			100			27								
			100			28								12
						29								

COMMENTS:

Survey Method:

Log Scale 1:50

DRILLHOLE LOG

DRILLHOLE No: IH2

SHEET 4 OF 4

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006650 mN
1226199 mE

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

DIRECTION: Vertical
ANGLE FROM HORIZ.: 90 °

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: Borehole Diameter: Liner:	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly fine to coarse SAND with a trace of silt; grey brown. Gravel, fine to coarse, subrounded to subangular.	Sonic	95		Inferred Medium Dense	31					See drillers logs for water level			12
														13
			100			32								
						33								14
	Sandy, fine to corase GRAVEL with a trace of silt; brownish grey. Sand, fine to coarse; gravel, subrounded to subangular.		85											
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.					34								
			95			35								15
			100			36								
						37								
			100			38								16
						39								
			100											

COMMENTS: End of Bore Hole @ 40 m depth.

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH3

DRILLHOLE LOG

SHEET 1 OF 3

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006416 mN, 1266399 mE
DIRECTION: Vertical
ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)
UNCONTR-OLLED FILL	SILT with some gravel, minor rootlets and a trace of sand; dark grey.
SHOTOVER ALLUVIUM	Sandy, fine to coarse GRAVEL with a trace of silt; brown. Sand, fine to coarse; gravel, subrounded to subangular.
	- a trace of cobbles from 1.6 m
	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to medium, subrounded to subangular.
	Core Loss 3.0 m - 4.5 m. Drillers notes: gravelly SAND + SILT
	Gravelly fine to medium SAND with minor silt; brown grey. Gravel, fine to coarse, subrounded to subangular.
	- Sand, fine to coarse from 6.0 m.

Sampling Method: Sonic
Core Recovery (%): 90, 30, 0, 100, 100, 95, 85
Moisture Condition: To be confirmed
Strength/Density Classification: Inferred Firm; Inferred Medium Dense; Inferred Medium Dense
RL (m) / Depth (m): 1 2 3 4 5 6 7 8 9
Graphic Log
Drillers Notes

TESTING
Hammer Efficiency:
Borehole Diameter:
Liner:

Water Loss (%): 25 50 75
Water Level: See drillers logs for water level
Casing / Installation: 0.0-0.2 m Cement Seal; 0.2 m - 2.8 m Bentonite Cement Seal; 2.8 m - 5.0 m Walton Park Sand; Screen 3.0 - 5.0 m
Core Box: 1 2 3

COMMENTS:

Survey Method:

Log Scale 1 :50

GEOSOLVE

DRILLHOLE No: IH3

DRILLHOLE LOG

SHEET 2 OF 3

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006416 mN
1266399 mE

DIRECTION: Vertical
ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: Borehole Diameter: Liner:	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
SHOTOVER ALLUVIUM	Gravelly fine to coarse SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.	Sonic	85		Inferred Medium Dense	11					See drillers logs for water level			3
			100											4
			100			12								
			100			13								5
	- gravel, fine to medium from 15.0 m.		100			14								
			100			15								6
			100			16								
	Fine to coarse SAND with some gravel; grey. Gravel, fine to coarse, subrounded to subangular.		100			17								7
			100			18								
	- minor gravel from 19.8 m.		85			19								8

COMMENTS:

Survey Method:

Log Scale 1:50

GEOSOLVE

DRILLHOLE No: IH3

DRILLHOLE LOG

SHEET 3 OF 3

PROJECT: Frankton WWTP Logging | JOB No: 210320 | LOCATION: Shotover WWTP | HOLE LOCATION: See drillers logs

CORDINATES: 5006416 mN, 1266399 mE
DIRECTION: Vertical
ANGLE FROM HORIZ.: 90°

DRILL TYPE: Sonic
DATUM: Ground Level
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 22/04/21
HOLE FINISHED: 22/04/21
DRILLED BY: Speight Drilling
LOGGED BY: JN CHECKED: MBS

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)
SHOTOVER ALLUVIUM	Fine to coarse SAND with a trace of silt; brownish grey.
	Fine to coarse SAND with some gravel and a trace of silt; brownish grey. Gravel, fine to coarse, subrounded to subangular.
	Gravelly fine to coarse SAND; grey. Gravel, fine to coarse, subrounded to subangular.
	Fine to coarse SAND with some gravel and a trace of silt; brownish grey. Gravel, fine to coarse, subrounded to subangular.
	Fine to coarse SAND with a trace of gravel and silt; brownish grey.
	Gravelly fine to coarse SAND; grey. Gravel, fine to coarse, subrounded to subangular.
	Fine to coarse SAND; grey.
	Fine to coarse GRAVEL with minor sand; grey. Sand, fine to medium; gravel, subrounded to subangular.
	Gravelly fine to medium SAND with a trace of silt; grey. Gravel, fine to coarse, subrounded to subangular.
	Fine to coarse SAND; grey.
	Sandy fine to medium GRAVEL. Sand, fine to coarse; gravel, subrounded to subangular.
	Medium to coarse GRAVEL with minor sand; grey. Sand, fine to medium; gravel, subrounded to subangular.
	Fine to coarse SAND with a trace of gravel; grey. Gravel, fine to coarse, subrounded to subangular.
	Coarse GRAVEL with a trace of sand; grey. Sand, fine to coarse; gravel, subrounded to subangular.
	Gravelly fine to coarse SAND with a trace of silt; grey brown. Gravel, fine to coarse, subrounded to subangular.

Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) / Depth (m)	Graphic Log	Drillers Notes
Sonic	85, 80, 90, 95, 65, 55, 50		Inferred Medium Dense	21, 22, 23, 24, 25, 26, 27, 28, 29		

TESTING
Hammer Efficiency:
Borehole Diameter:
Liner:

Water Loss (%)	Water Level	Casing	Installation	Core Box
25 50 75	See drillers logs for water level			8, 9, 10, 11

COMMENTS: End of Bore Hole @ 30.0 m.

Survey Method:

Log Scale 1:50

Appendix C

LEI PSD reports and location plan

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Consulting Group
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Ph: (03) 374 6515, Fax: (03) 374 6516
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SHOTOVER DELTA TEST PIT AND INFILTRATION TEST LOCATION PLAN

Scale: 1:3500 @ A3
Date: January 2008

Drawing No: 9017-02C

Sheet 1 of 1 Sheets

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	1
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.20

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2175885E, 5568636N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 34 50 100 150
grey silty sand massive structure, firm soil strength, poorly graded with fine schist gravel	SM					
bluish grey silty sand, massive structure, firm soil strength, tightly	SM					
grey fine to coarse schist gravels loosely packed well graded	SG		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	2
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.30

Project:	Shotover Oxidation Ponds				
Client:	Queenstown Lakes District Council				
Hole location:	2175885E, 5568636N				
Driller:		Contractor:	Jones Contracting	Equipment: Digger	R.L:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 34 50 100 150
grey silty sand massive structure, firm soil strength, loosely packed,well graded with fine schist gravel	SM					
bluish grey silty sand, massive structure, firm soil strength, tightly	SM					
grey fine to coarse schist gravels, tightly packed, well graded	SG		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	3
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.20

Project:	Shotover Oxidation Ponds				
Client:	Queenstown Lakes District Council				
Hole location:	2175966E, 5568472N				
Driller:		Contractor:	Jones Contracting	Equipment: Digger	R.L:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 34 50 100 150
grey silt loam, massive structure, firm soil strength, tightly packed, well graded	ML					
bluish grey silt loam, massive structure, firm soil strength, tightly	ML					
grey fine to coarse schist gravels, tightly packed, well graded	SG					
grey silty sand, massive structure, firm soil strength, loosely	ML					
grey fine to coarse schist gravels, tightly packed, well graded	SG		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	4
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	0.70

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176012E, 5568387N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silty sand , massive soil structure, soft soil strength, well	SM					
grey fine to coarse schist gravels, massive structure, firm soil	SG					
grey silty sand , massive soil structure, firm soil strength, well	SM					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

S.P.T N uncorrected: 0, 50, 100

SCALA PENETROMETER (mm/blow): 0, 34, 50, 100, 150

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	5
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	0.80

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176054E, 5568293N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silty sand , massive soil structure, soft soil strength, well	SM				50 100	0 34 50 100 150
grey fine to coarse schist gravels, massive structure, firm soil	SG					
grey silty sand , massive soil structure, firm soil strength, well	SM					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	6
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	0.80

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176099 E, 5568201 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silty sand , massive soil structure, soft soil strength, well graded, tightly packed, fine, medium and coarse schist gravels	SM					
brownish grey sand with fine to coarse schist gravels, massive	SW					
grey silt , massive soil structure, firm soil strength, well graded, tightly packed	ML		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

S.P.T N uncorrected: 0 50 100

SCALA PENETROMETER (mm/blow): 0 34 50 100 150

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	7
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	0.90

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176157 E, 5568098 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0, 50, 100)	SCALA PENETROMETER (mm/blow) (0, 34, 50, 100, 150)
grey silty sand , massive soil structure, soft soil strength, well graded, tightly packed, fine, medium and coarse schist gravels	SM					
grey sand , massive soil structure, firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SW		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	8
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.60

Project:	Shotover Oxidation Ponds				
Client:	Queenstown Lakes District Council				
Hole location:	2176221 E, 5568028 N				
Driller:	Contractor:	Jones Contracting	Equipment:	Digger	R.L:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silty sand , massive soil structure, soft soil strength, well graded, tightly packed	SM					
grey sandy gravel , massive soil structure, firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SM					
grey sandy gravel , massive soil structure, firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SG					

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	9
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	0.60

Project:	Shotover Oxidation Ponds					
Client:	Queenstown Lakes District Council					
Hole location:	2176268 E, 5567981 N					
Driller:	Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:						

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed	ML					
bluish grey silt loam, massive structure, firm soil strength, tightly ~~grey sandy gravel , massive soil structure, firm soil strength, well~~	ML					
graded, tightly packed, with fine, medium and coarse schist gravels	SW					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	10
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.00

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176324 E, 5568096 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed	ML					
grey sandy gravel , massive soil structure, firm soil strength, well graded, tightly packed, with fine, medium and coarse schist gravels	SW		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

S.P.T N uncorrected: 0 50 100

SCALA PENETROMETER (mm/blow): 0 34 50 100 150

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	11
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	0.90

Project:	Shotover Oxidation Ponds				
Client:	Queenstown Lakes District Council				
Hole location:	2176345 E, 5568207 N				
Driller:		Contractor:	Jones Contracting	Equipment: Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 34 50 100 150
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed, with fine schist gravel	ML					
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed	ML					
grey sandy gravel , massive soil structure, firm soil strength, well graded, tightly packed, with fine, medium and coarse schist gravels	SW		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	12
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.10

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176283 E, 5568235 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 0 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
grey sandy loam , massive soil structure, firm soil strength, well graded, tightly packed, with fine to medium schist gravel	SW					
grey sandy gravel , massive soil structure, firm soil strength, well graded, tightly packed, with fine, medium and coarse schist gravels	SG					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	13
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176295 E, 5568348 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0, 50, 100)	SCALA PENETROMETER (mm/blow) (0, 34, 50, 100, 150)
grey silty sandy loam , massive soil structure, firm soil strength, well graded, tightly packed, with fine to medium schist gravel	SM					
Grey sandy loam , massive structure, firm soil strength, well graded	SW					
grey sandy gravel , massive soil structure, firm soil strength, well graded, tightly packed	SG					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	14
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176265 E, 5568429 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 34 50 100 150
grey silty sandy loam , massive soil structure, firm soil strength, well graded, tightly packed	SM					
grey silt loam , massive structure, firm soil strength, well graded and tightly packed	ML					
~~grey silty sand, massive soil structure, firm soil strength, well graded~~	SM					
grey sand , well graded , tightly packed, soft soil strength with fine, medium and coarse schist gravels	SW					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	15
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Shotover Oxidation Ponds					
Client:	Queenstown Lakes District Council					
Hole location:	217 6225 E, 5563527 N					
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:
Notes:						

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 0 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
grey sandy loam , massive soil structure, firm soil strength, well graded, tightly packed and 60% organic matter	SW					
grey silt loam , massive structure, firm soil strength, well graded and tightly packed	ML					
grey sand , well graded , tightly packed, soft soil strength with fine, medium and coarse schist gravels	SW					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	16
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.30

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176172 E, 556841 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0, 50, 100)	SCALA PENETROMETER (mm/blow) (0, 34, 50, 100, 150)
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed	ML					
brownish grey silt loam , massive structure, firm soil strength, well graded and tightly packed with 35% iron staining	ML					
grey sand , well graded , tightly packed, soft soil strength with fine, medium and coarse schist gravels	SW		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	17
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.10

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176009 E, 5568531 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey sandy loam , massive soil structure, firm soil strength, well graded, tightly packed with fine and medium schist gravels	SW					
grey sandy gravel with fine, medium and coarse schist gravels	SG					
grey sand , well graded , tightly packed, soft soil strength with fine and medium schist gravels	SW					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

S.P.T N uncorrected: 0, 50, 100

SCALA PENETROMETER (mm/blow): 0, 34, 50, 100, 150

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	18
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176131 E, 5568319 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed	ML
grey silt loam , massive soil structure, soft soil strength, well graded, tightly packed with fine and medium schist gravels	ML
grey silt loam , massive soil structure, firm soil strength, well graded	ML
grey sand , well graded , tightly packed, soft soil strength with fine and medium schist gravels	SW

Graphic Log | Water Table | Samples | S.P.T N uncorrected (0, 50, 100) | SCALA PENETROMETER (mm/blow) (0, 34, 50, 100, 150)

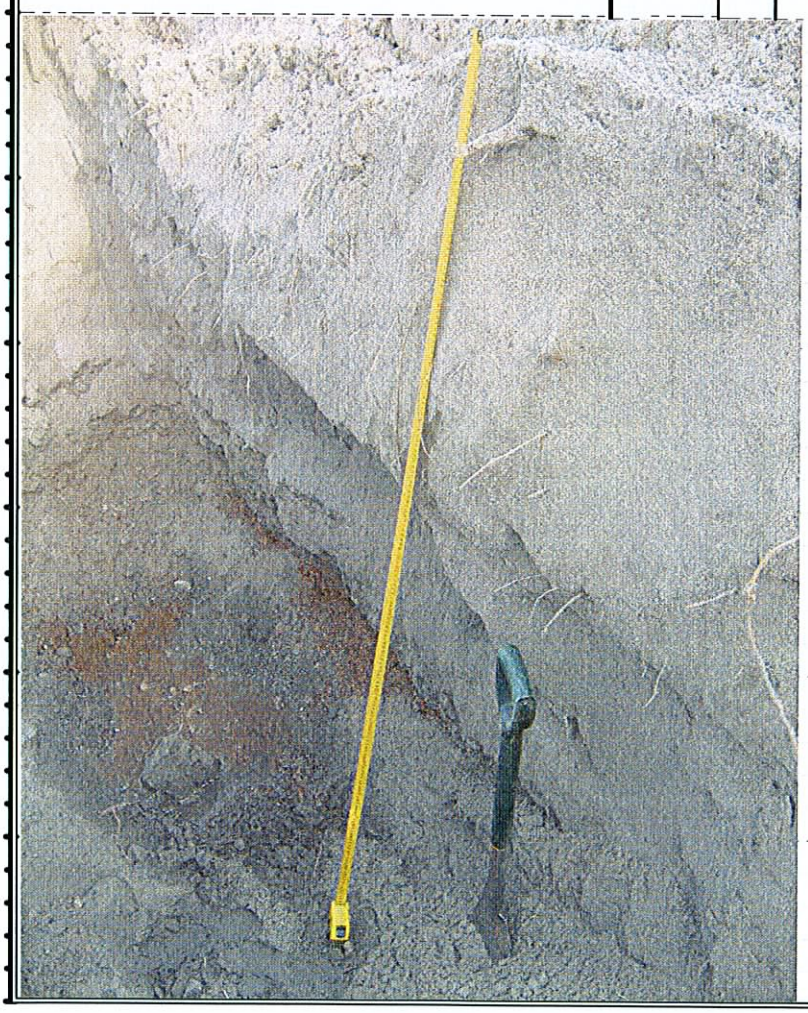
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	19
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.80

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176172 E, 5568224 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 0 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed with layering	ML					
grey sand , well graded , tightly packed, soft soil strength with fine and medium schist gravels	SW		Δ			



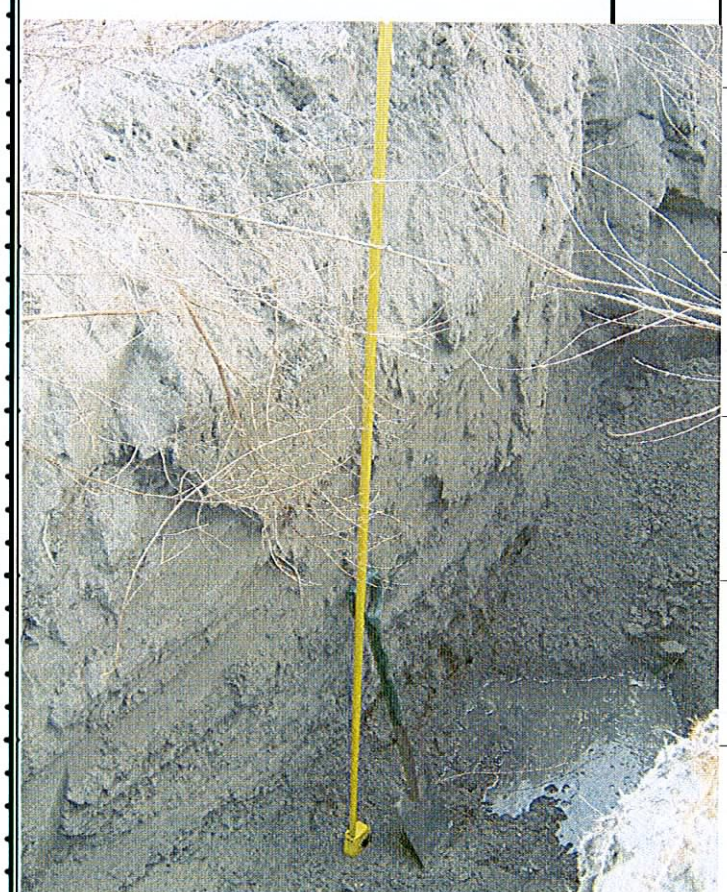
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	20
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	2.10

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176223 E, 5568144 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0 50 100)	SCALA PENETROMETER (mm/blow) (0 34 50 100 150)
grey silty sand , massive soil structure, firm soil strength, well graded, tightly packed	SM					
grey sand , well graded , tightly packed, soft soil strength with fine and medium schist gravels	SM					
grey coarse sand , well graded , tightly packed, soft soil strength with fine and medium and coarse schist gravels	SG					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	21
Job No:	9017QLD
Logged by:	HW
Date drilled:	
Checked by:	MR
Date checked:	
Max depth:	1.00

Project:	Shotover Oxidation Ponds						
Client:	Queenstown Lakes District Council						
Hole location:	2176264 E, 5568318 N						
Driller:		Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silty sand , massive soil structure, firm soil strength, well graded, tightly packed	SM				0 50 100	0 34 50 100 150
grey sand , well graded , tightly packed, soft soil strength with fine and medium and coarse schist gravels	SW		Δ			

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

						Hole No:	22
						Job No:	9017QLD
						Logged by:	HW
	Project:	Shotover Oxidation Ponds				Date drilled:	
	Client:	Queenstown Lakes District Council				Checked by:	MR
	Hole location:	2176097 E, 5568225 N				Date checked:	
Driller:	Contractor:	Jones Contracting	Equipment:	Digger	R.L.:	Max depth:	1.10
Notes:							

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed	ML					
grey silt loam , massive soil structure, firm soil strength, well graded, tightly packed with fine, medium and coarse gravels	ML					
grey sand gravel, well graded , tightly packed, soft soil strength with fine and medium and coarse schist gravels	SG					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

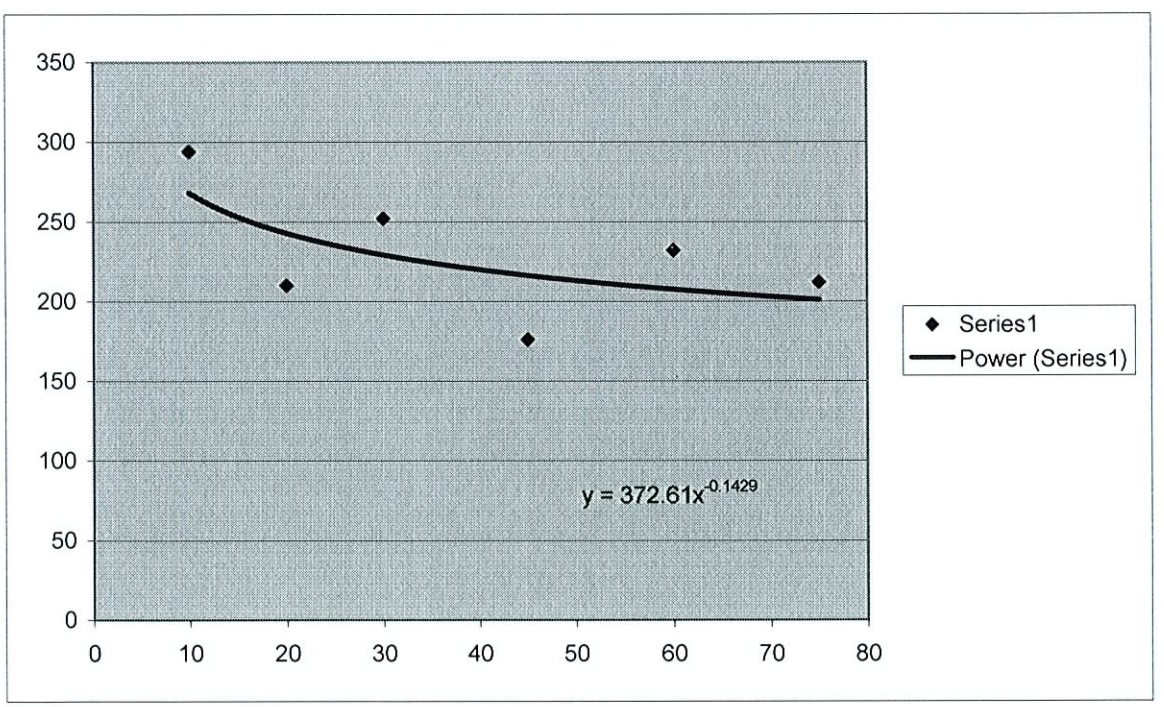
S.P.T N uncorrected: 0, 50, 100

SCALA PENETROMETER (mm/blow): 0, 34, 50, 100, 150

Infiltration/Percolation Test Results

Job Number: 9017
Site: 1
Date: 3/09/2007
Method: Double Ring Infiltration Test
Convert: n

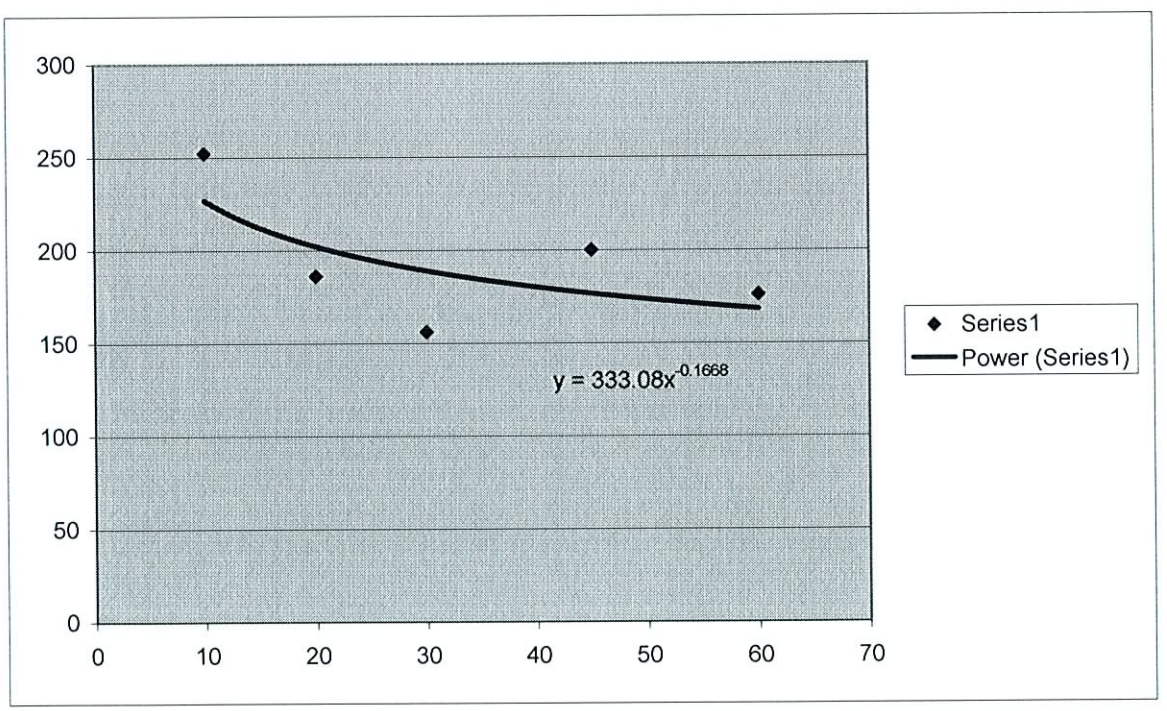
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	300	-300		0			
9:10	251	-251	10	10	49	294	
9:20	216	-216	10	20	35	210	
9:30	174	-174	10	30	42	252	
9:45	130	-130	15	45	44	176	
10:00	72	-72	15	60	58	232	
10:15	19	-19	15	75	53	212	
10:30							**Ksat** 201



Infiltration/Percolation Test Results

Job Number: 9017
Site: 2
Date: 3/09/2007
Method: Double Ring Infiltration Test
Convert: n

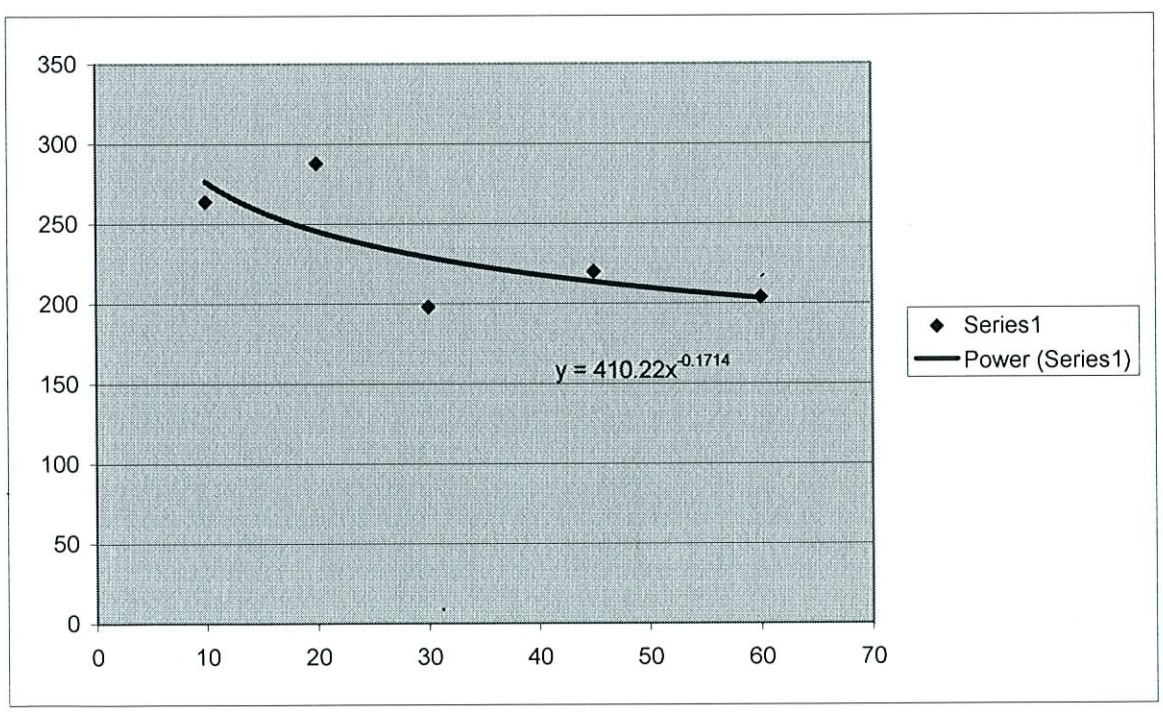
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	200	-200		0			
9:10	158	-158	10	10	42	252	
9:20	127	-127	10	20	31	186	
9:30	101	-101	10	30	26	156	
9:45	51	-51	15	45	50	200	
10:00	7	-7	15	60	44	176	
10:15							
10:30							**Ksat** 168



Infiltration/Percolation Test Results

Job Number: 9017
Site: 3
Date: 3/09/2007
Method: Double Ring Infiltration Test
Convert: n

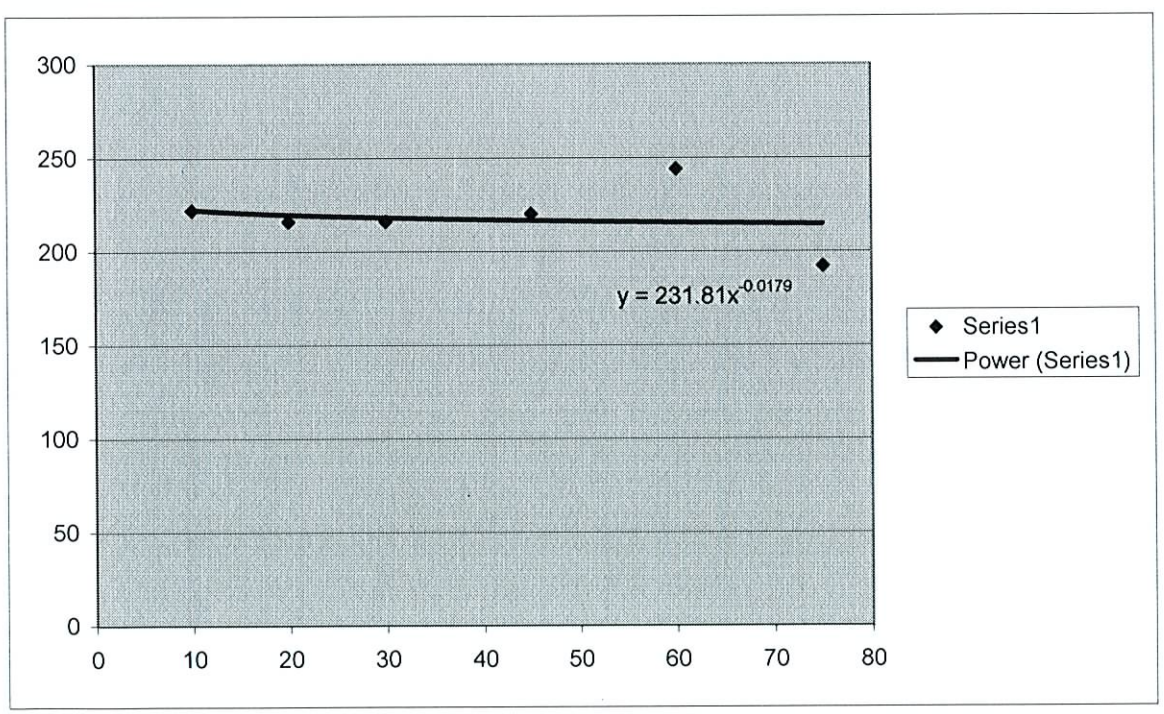
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	250	-250		0			
9:10	206	-206	10	10	44	264	
9:20	158	-158	10	20	48	288	
9:30	125	-125	10	30	33	198	
9:45	70	-70	15	45	55	220	
10:00	19	-19	15	60	51	204	
10:15							
10:30							**Ksat** 203



Infiltration/Percolation Test Results

Job Number: 9017
Site: 4
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

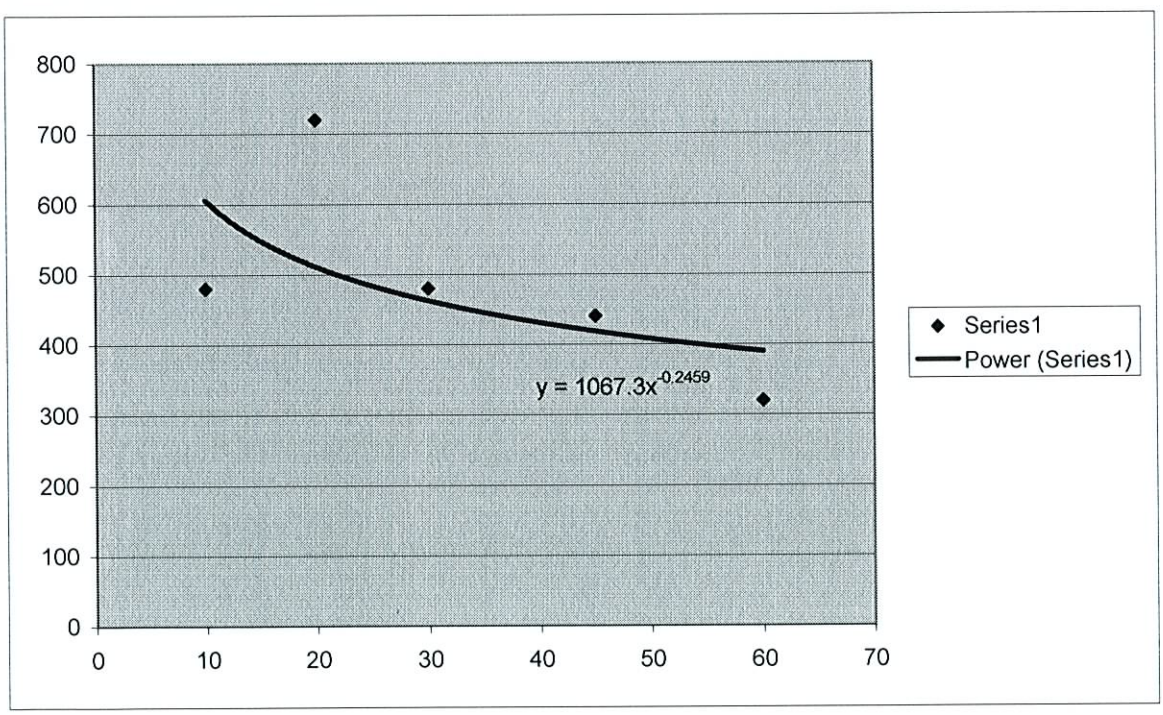
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	300	-300		0			
9:10	263	-263	10	10	37	222	
9:20	227	-227	10	20	36	216	
9:30	191	-191	10	30	36	216	
9:45	136	-136	15	45	55	220	
10:00	75	-75	15	60	61	244	
10:15	27	-27	15	75	48	192	
10:30							**Ksat**
							215



Infiltration/Percolation Test Results

Job Number: 9017
Site: 5
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

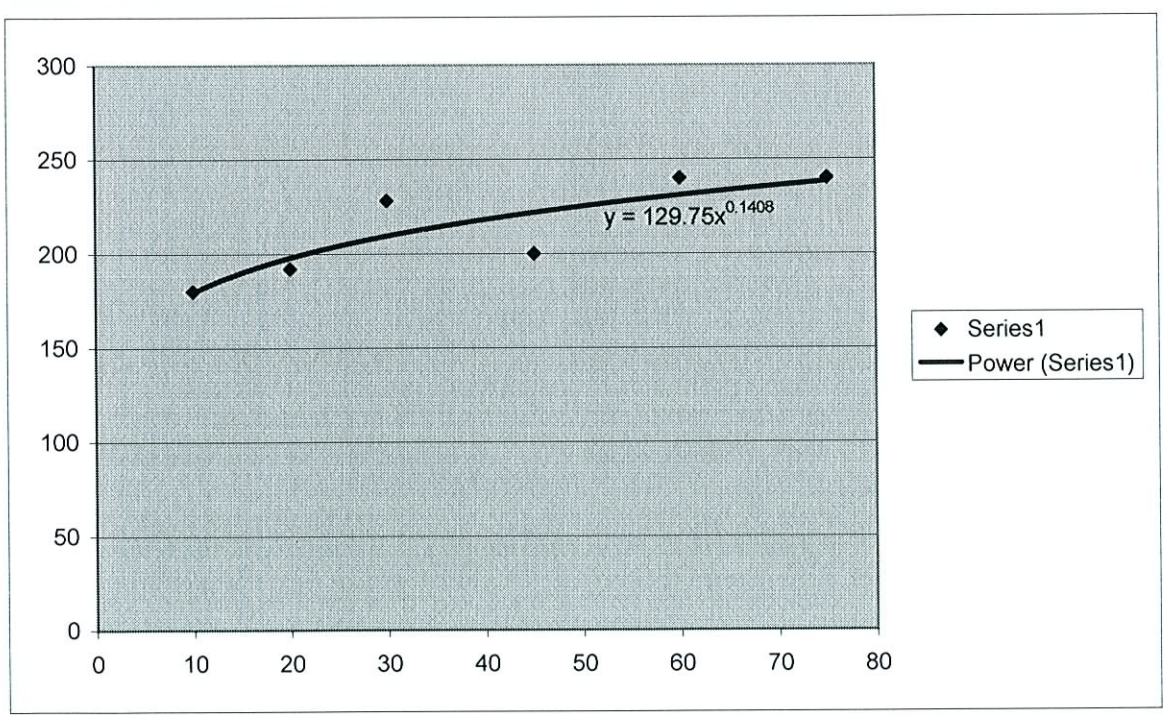
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	500	-500		0			
9:10	420	-420	10	10	80	480	
9:20	300	-300	10	20	120	720	
9:30	220	-220	10	30	80	480	
9:45	110	-110	15	45	110	440	
10:00	30	-30	15	60	80	320	
10:15							
10:30							**Ksat** 390



Infiltration/Percolation Test Results

Job Number: 9017
Site: 6
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

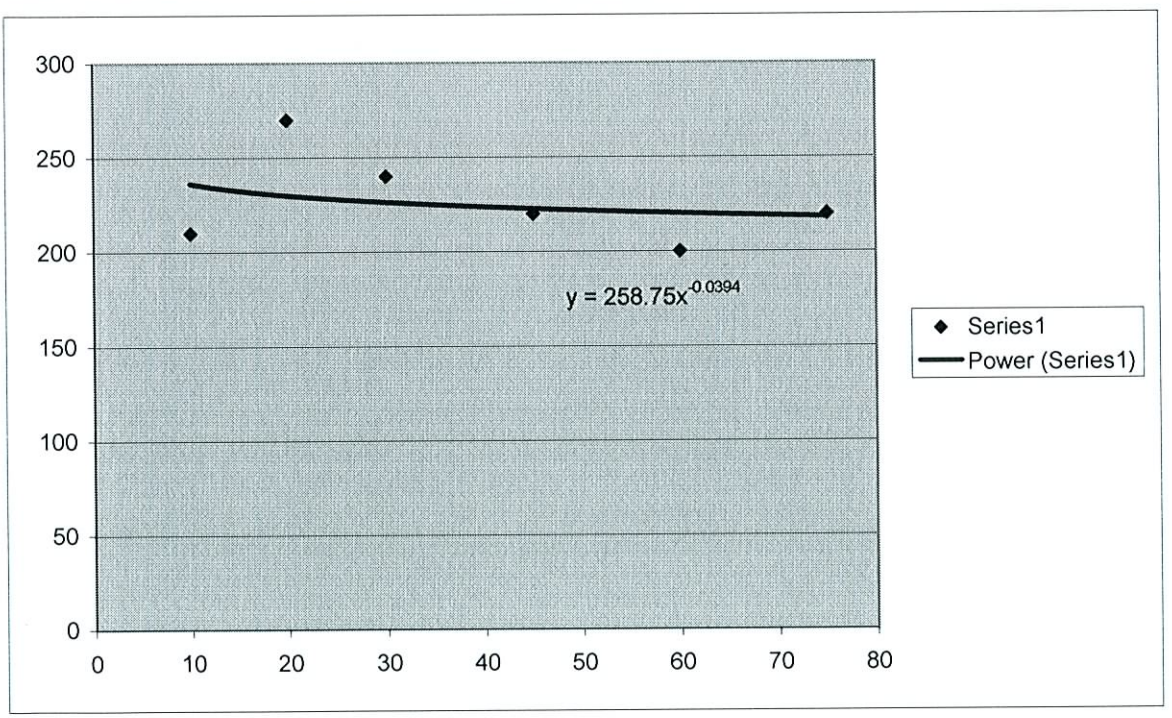
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	300	-300		0			
9:10	270	-270	10	10	30	180	
9:20	238	-238	10	20	32	192	
9:30	200	-200	10	30	38	228	
9:45	150	-150	15	45	50	200	
10:00	90	-90	15	60	60	240	
10:15	30	-30	15	75	60	240	
10:30							**Ksat**
							238



Infiltration/Percolation Test Results

Job Number: 9017
Site: 7
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

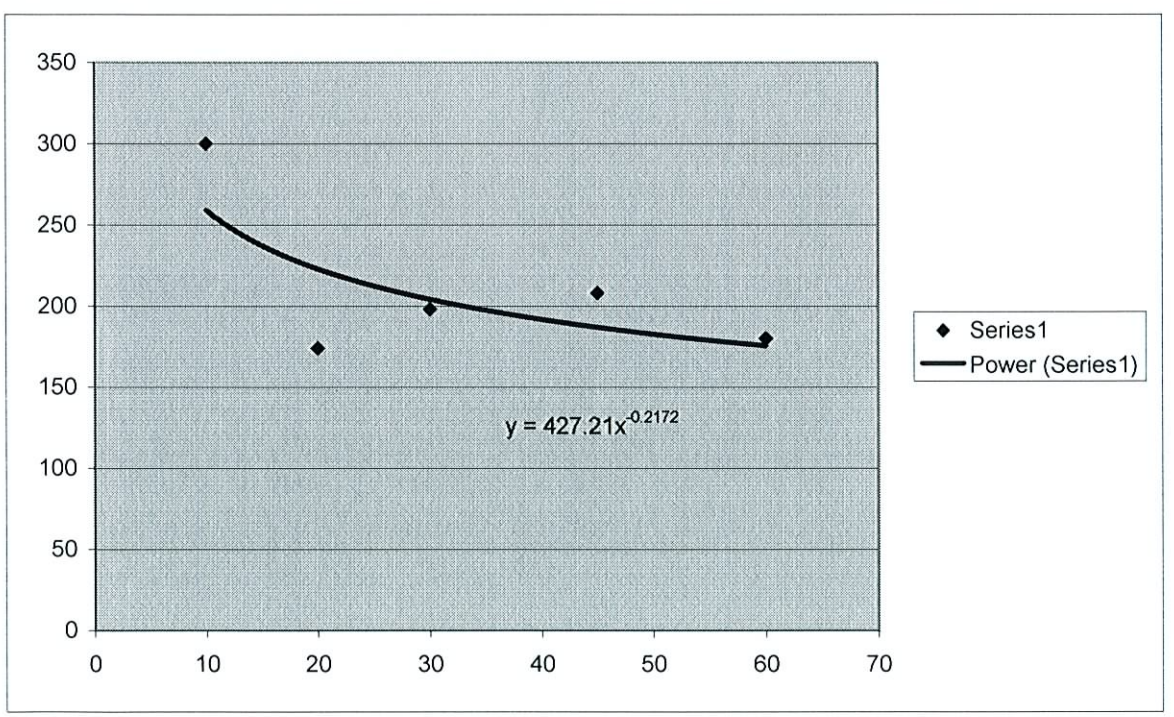
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	300	-300		0			
9:10	265	-265	10	10	35	210	
9:20	220	-220	10	20	45	270	
9:30	180	-180	10	30	40	240	
9:45	125	-125	15	45	55	220	
10:00	75	-75	15	60	50	200	
10:15	20	-20	15	75	55	220	
10:30							**Ksat** 218



Infiltration/Percolation Test Results

Job Number: 9017
Site: 8
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

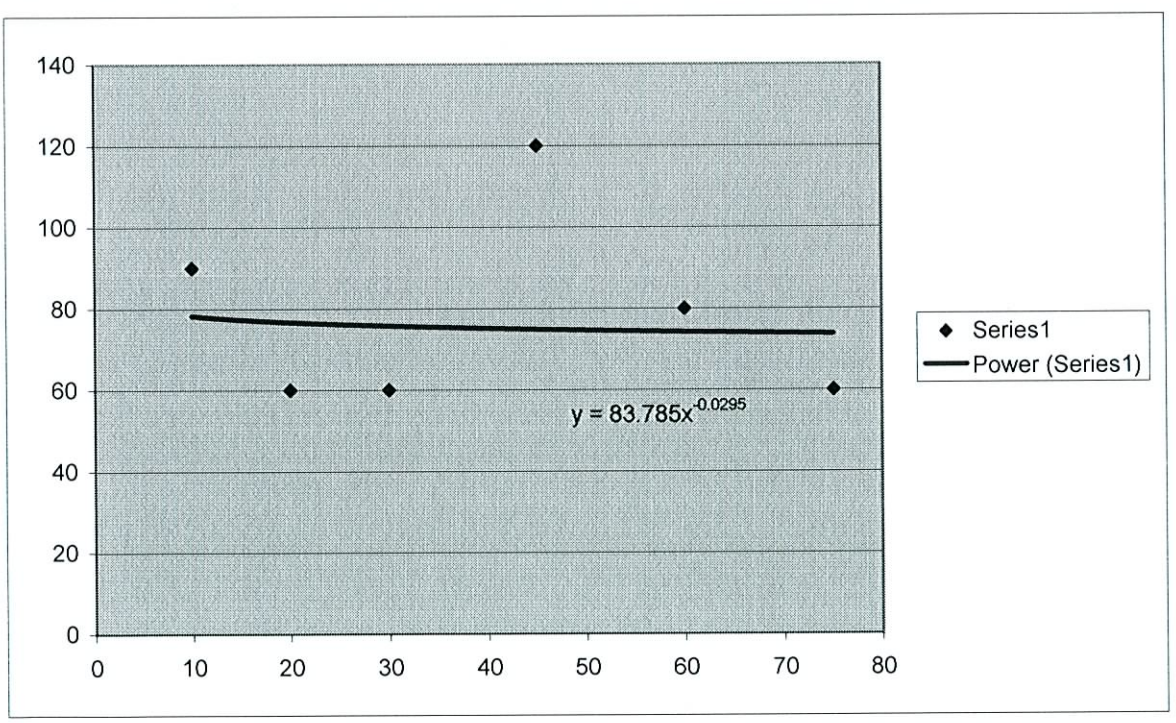
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	250	-250		0			
9:10	200	-200	10	10	50	300	
9:20	171	-171	10	20	29	174	
9:30	138	-138	10	30	33	198	
9:45	86	-86	15	45	52	208	
10:00	41	-41	15	60	45	180	
10:15							
10:30							**Ksat**
							176



Infiltration/Percolation Test Results

Job Number: 9017
Site: 9
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

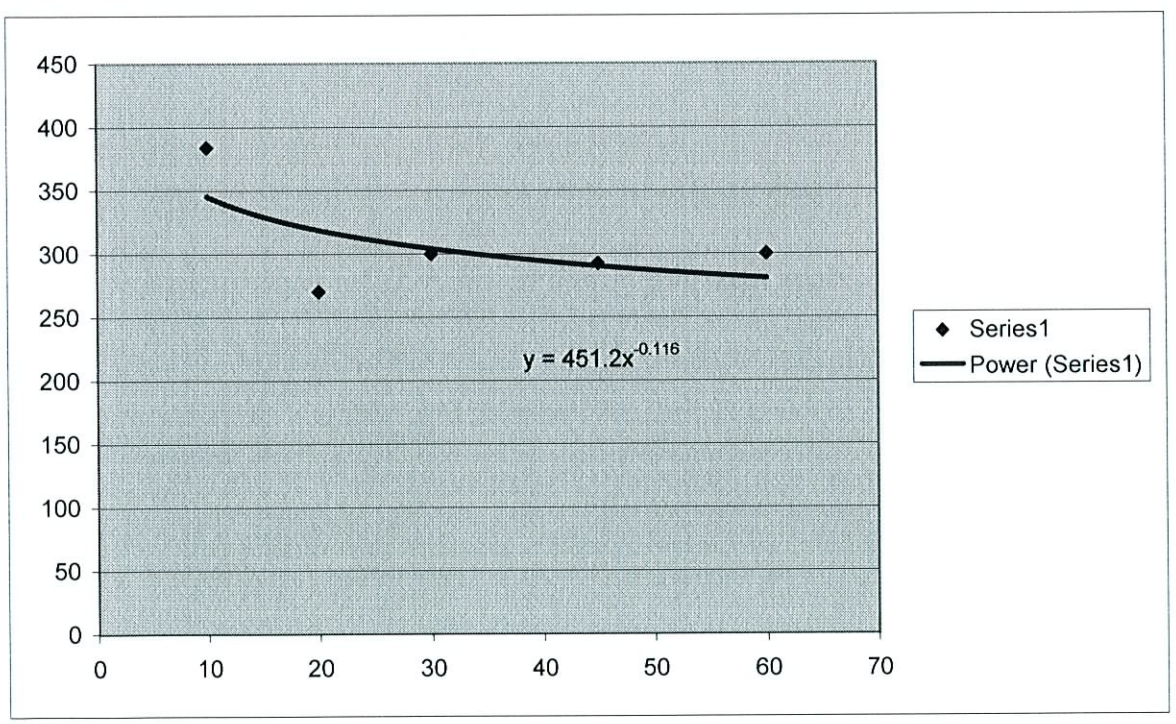
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	100	-100		0			
9:10	85	-85	10	10	15	90	
9:20	75	-75	10	20	10	60	
9:30	65	-65	10	30	10	60	
9:45	35	-35	15	45	30	120	
10:00	15	-15	15	60	20	80	
10:15	0	0	15	75	15	60	
10:30							**Ksat**
							74



Infiltration/Percolation Test Results

Job Number: 9017
Site: 10
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

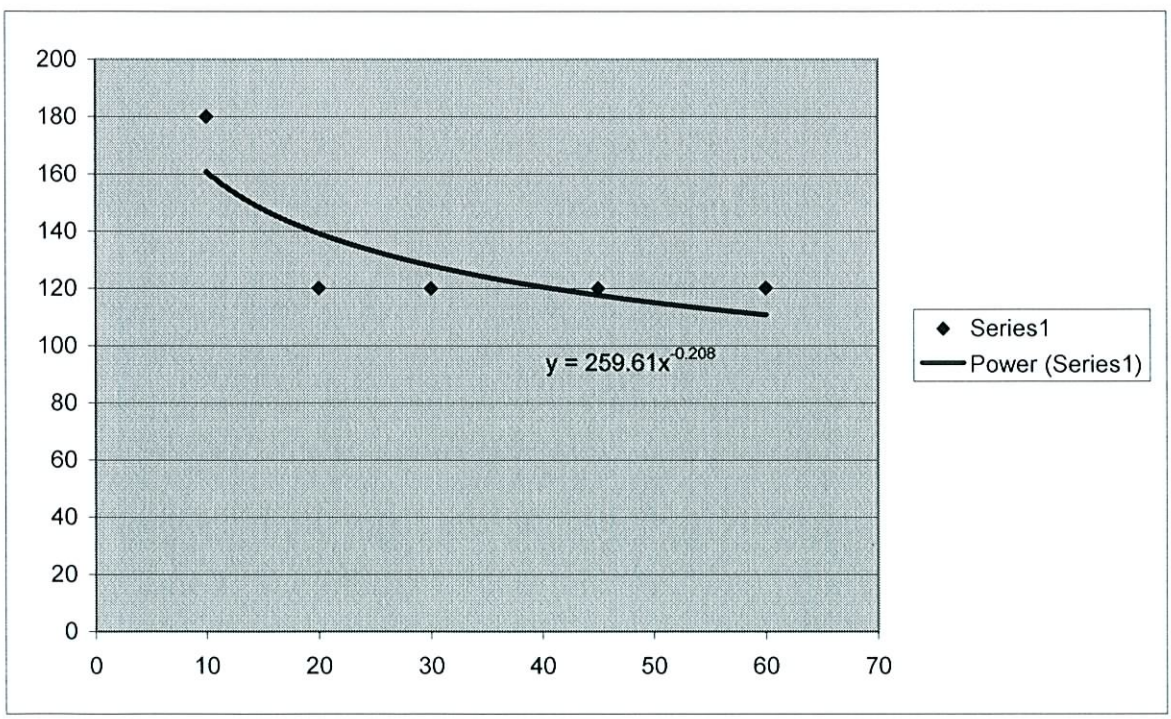
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	350	-350		0			
9:10	286	-286	10	10	64	384	
9:20	241	-241	10	20	45	270	
9:30	191	-191	10	30	50	300	
9:45	118	-118	15	45	73	292	
10:00	43	-43	15	60	75	300	
10:15							
10:30							Ksat
							281



Infiltration/Percolation Test Results

Job Number: 9017
Site: 11
Date: 4/09/2007
Method: Double Ring Infiltration Test
Convert: n

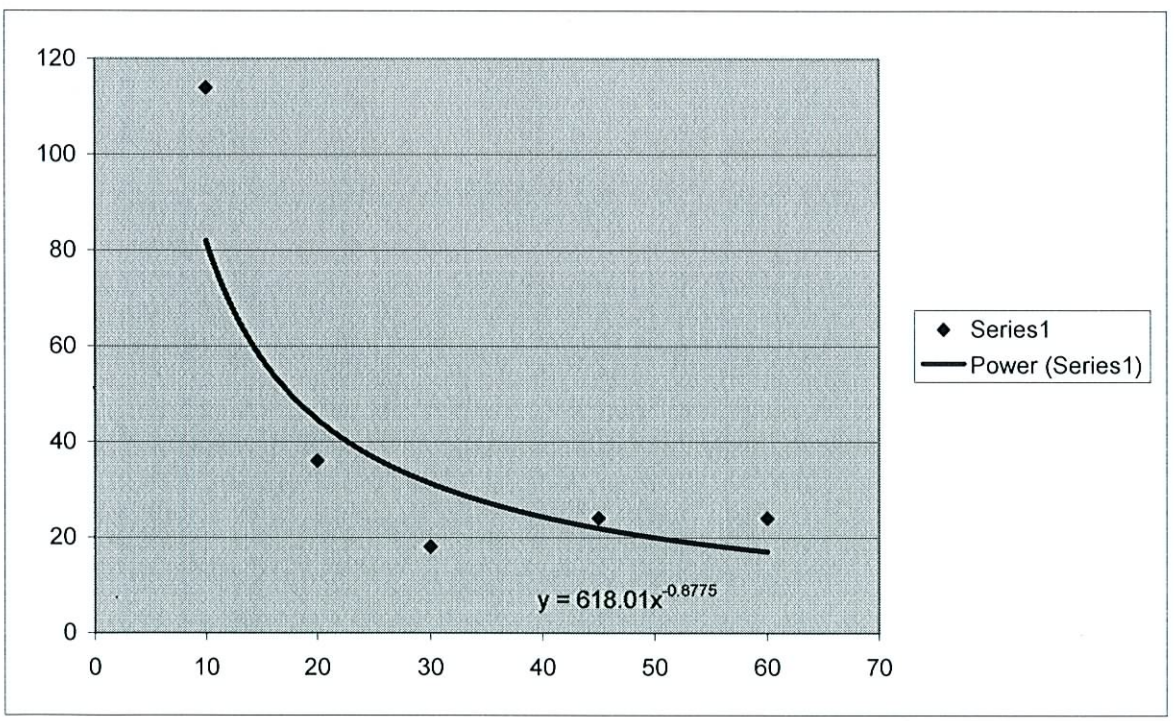
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	200	-200		0			
9:10	170	-170	10	10	30	180	
9:20	150	-150	10	20	20	120	
9:30	130	-130	10	30	20	120	
9:45	100	-100	15	45	30	120	
10:00	70	-70	15	60	30	120	
10:15							
10:30							**Ksat** 111



Infiltration/Percolation Test Results

Job Number: 9017
Site: 12
Date: 5/09/2007
Method: Double Ring Infiltration Test
Convert: n

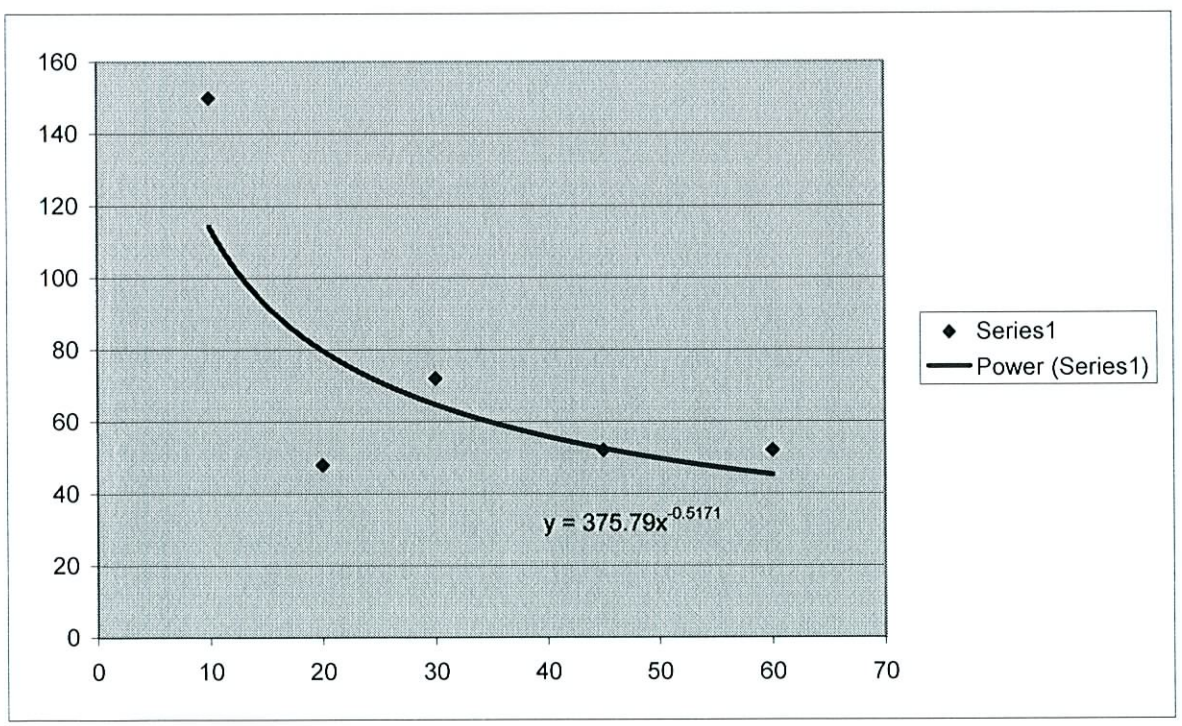
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	115	-115		0			
9:10	96	-96	10	10	19	114	
9:20	90	-90	10	20	6	36	
9:30	87	-87	10	30	3	18	
9:45	81	-81	15	45	6	24	
10:00	75	-75	15	60	6	24	
10:15							
10:30							**Ksat** 17



Infiltration/Percolation Test Results

Job Number: 9017
Site: 13
Date: 5/09/2007
Method: Double Ring Infiltration Test
Convert: n

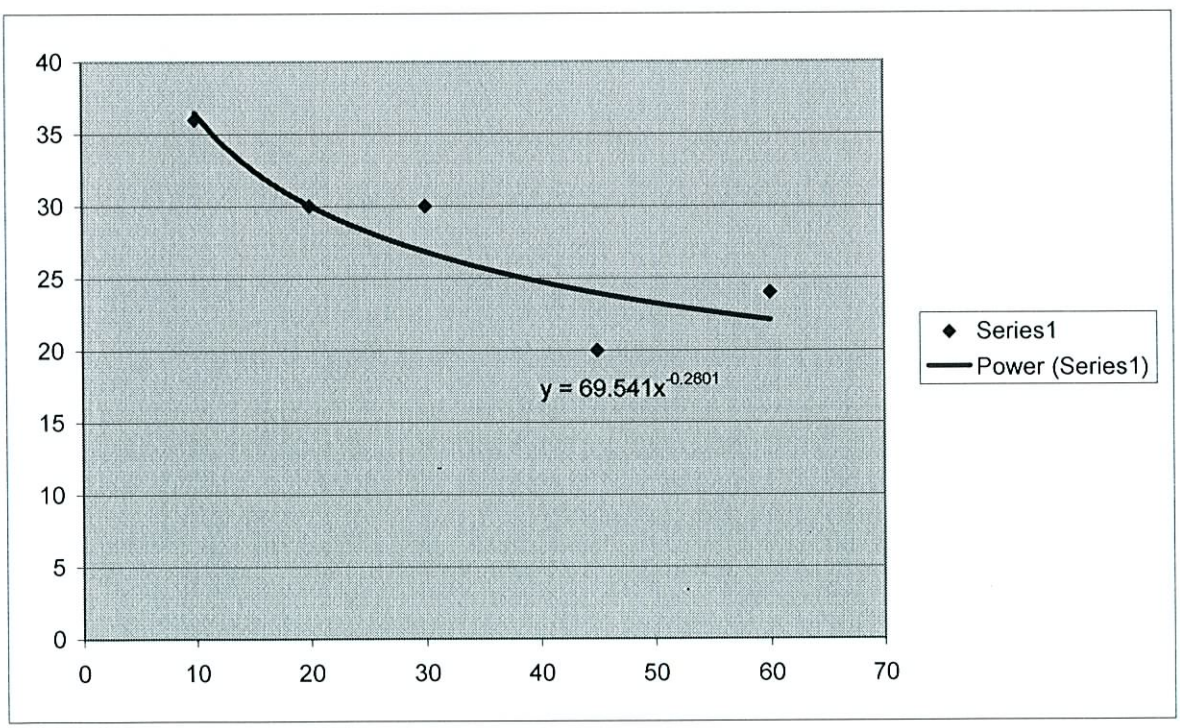
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	100	-100		0			
9:10	75	-75	10	10	25	150	
9:20	67	-67	10	20	8	48	
9:30	55	-55	10	30	12	72	
9:45	42	-42	15	45	13	52	
10:00	29	-29	15	60	13	52	
10:15							
10:30							Ksat 45



Infiltration/Percolation Test Results

Job Number: 9017
Site: 14
Date: 5/09/2007
Method: Double Ring Infiltration Test
Convert: n

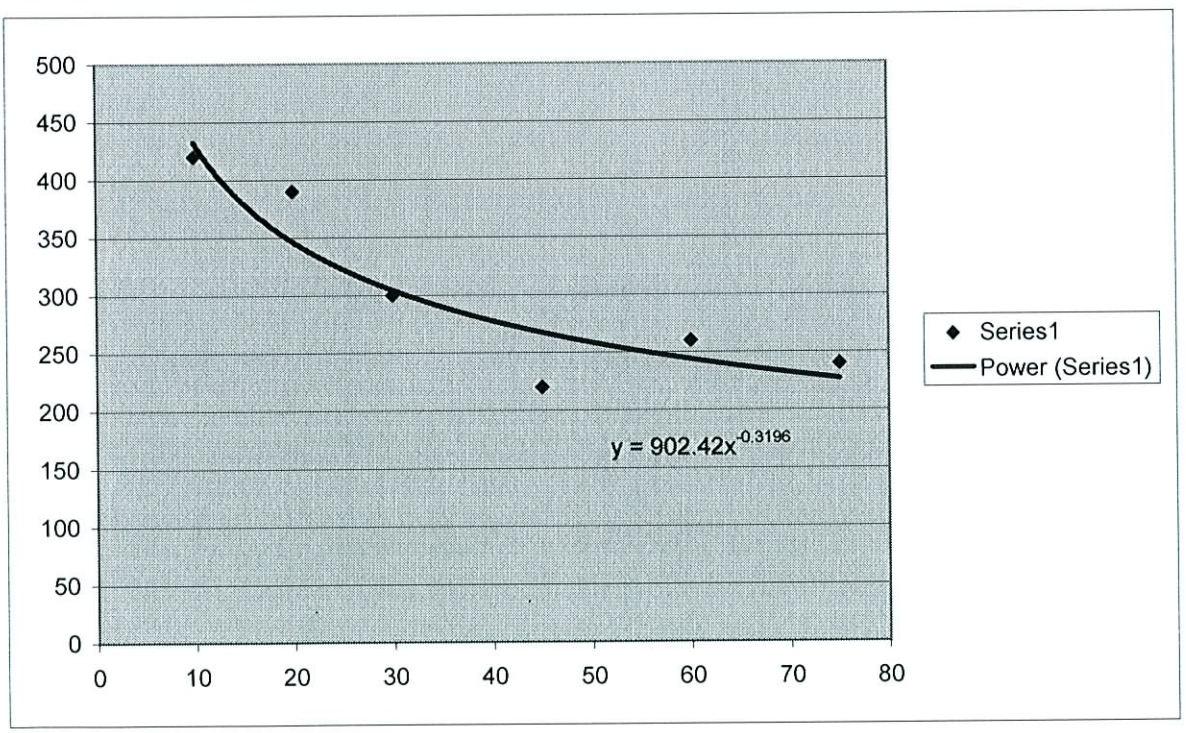
Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	115	-115		0			
9:10	109	-109	10	10	6	36	
9:20	104	-104	10	20	5	30	
9:30	99	-99	10	30	5	30	
9:45	94	-94	15	45	5	20	
10:00	88	-88	15	60	6	24	
10:15							
10:30							Ksat 22



Infiltration/Percolation Test Results

Job Number: 9017
Site: 15
Date: 5/09/2007
Method: Double Ring Infiltration Test
Convert: n

Time (24 hr)	Depth (mm)	Rise/fall conversion	t change (mins)	Accum t (mins)	d change (mm)	d/m (mm/hr)	Notes
9:00	400	-400		0			
9:10	330	-330	10	10	70	420	
9:20	265	-265	10	20	65	390	
9:30	215	-215	10	30	50	300	
9:45	160	-160	15	45	55	220	
10:00	95	-95	15	60	65	260	
10:15	35	-35	15	75	60	240	
10:30							**Ksat** 227



Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 16/1311

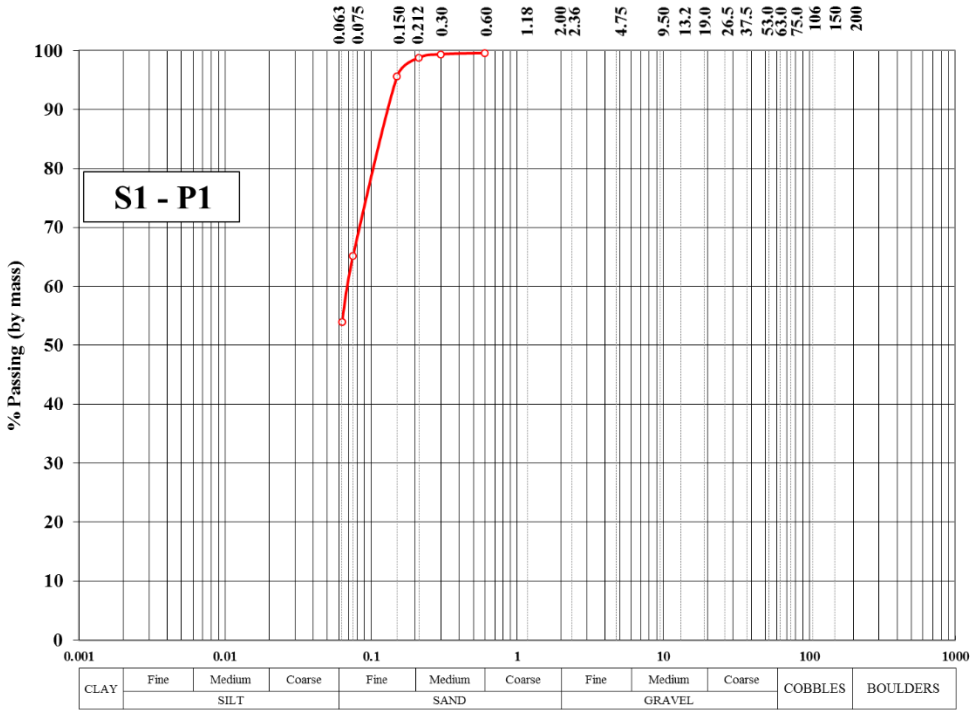
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy SILT**	**Client Order No:**	**N/A**
Sample Source:	**S1 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	100
0.30	99
0.212	99
0.150	96
0.075	65
0.063	54



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

- ***Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005 and sampling.***
- ***This report may not be reproduced except in full.***

Tested By: **C. Julius** **Date:** **30-May-16 to 2-Jun-16**

Checked By:

Tests indicated as Not Accredited are outside the laboratory's scope of accreditation

IANZ ACCREDITED LABORATORY
Accreditation No: 434

Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 16/1311

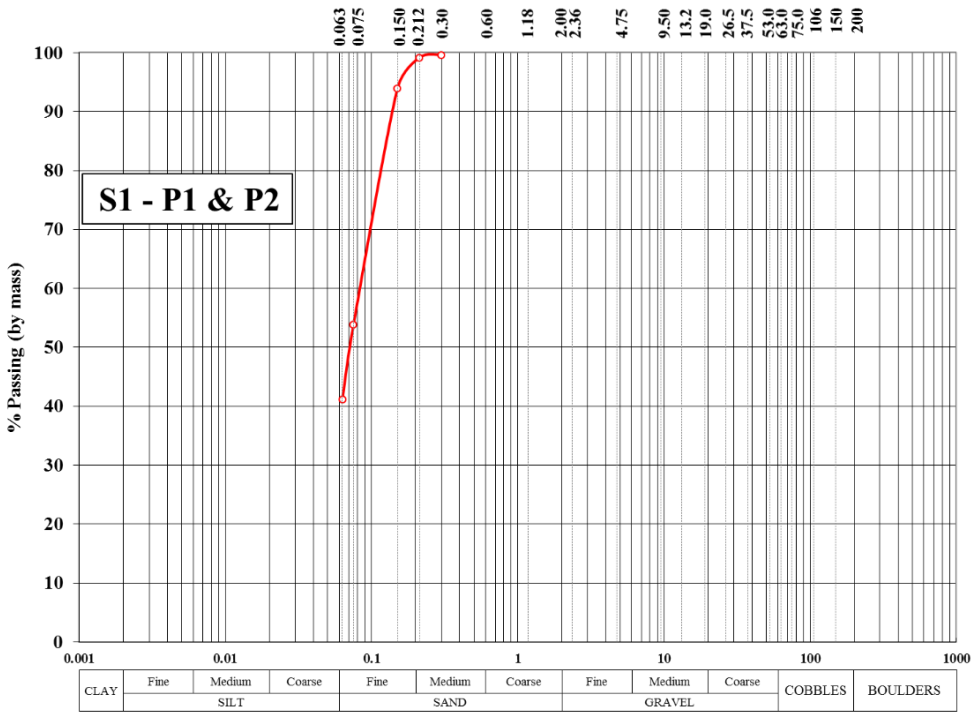
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Silty SAND**	**Client Order No:**	**N/A**
Sample Source:	**S1 - P1 & P2**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	
0.30	100
0.212	99
0.150	94
0.075	54
0.063	41



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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Tested By: **C. Julius** **Date:** **30-May-16 to 2-Jun-16**

Checked By:

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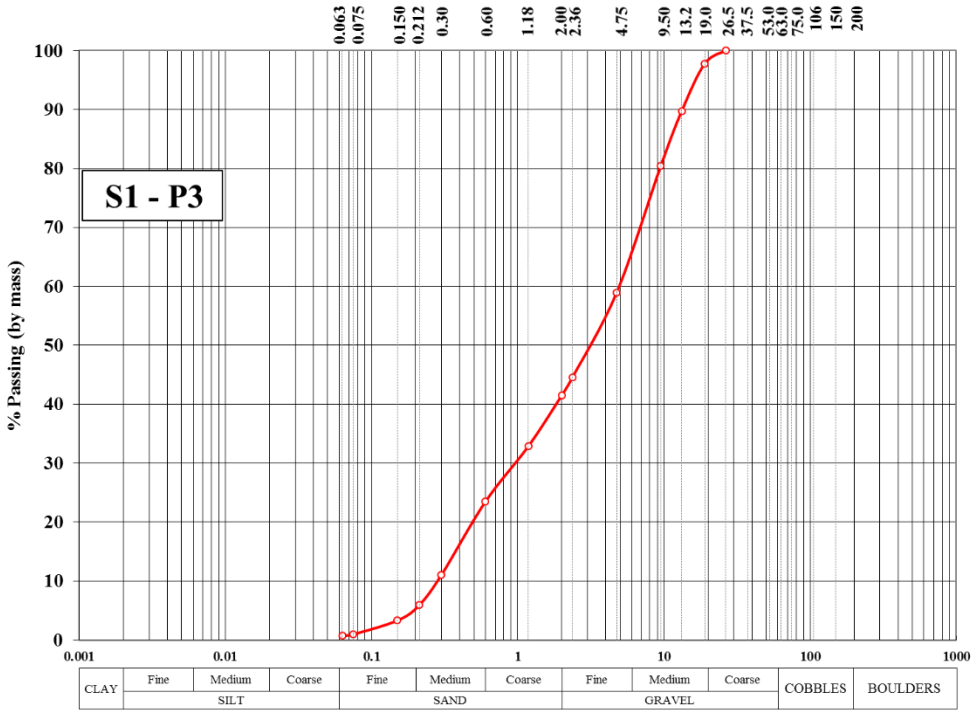
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S1 - P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	100
19.0	98
13.2	90
9.50	80
4.75	59
2.36	45
2.00	42
1.18	33
0.60	23
0.30	11
0.212	6
0.150	3
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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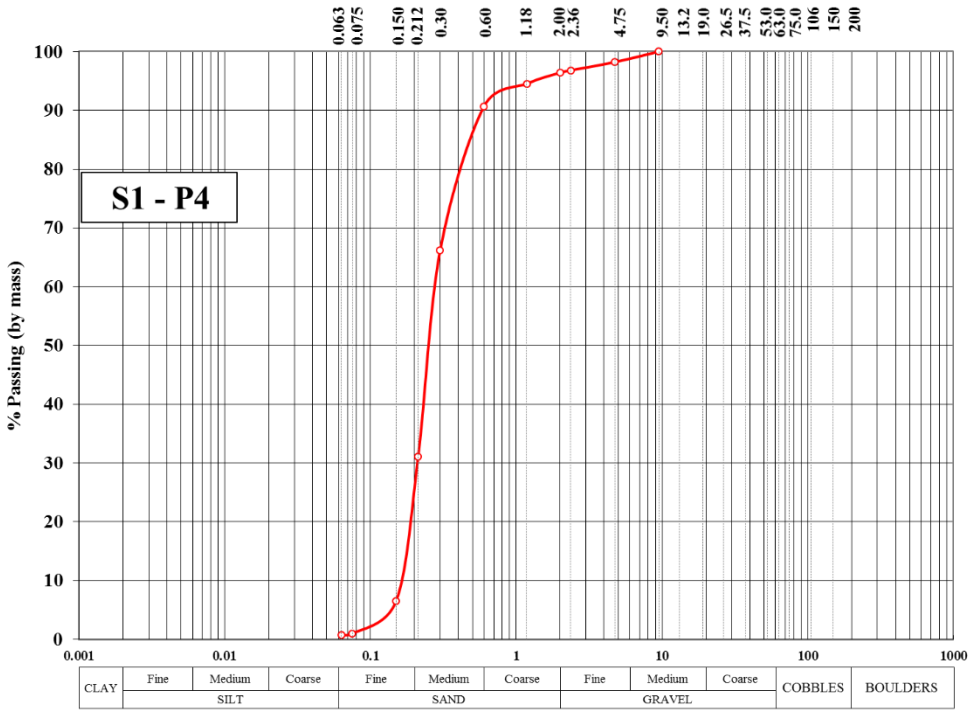
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**SAND with trace of gravel and trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S1 - P4**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	
9.50	100
4.75	98
2.36	97
2.00	96
1.18	95
0.60	91
0.30	66
0.212	31
0.150	7
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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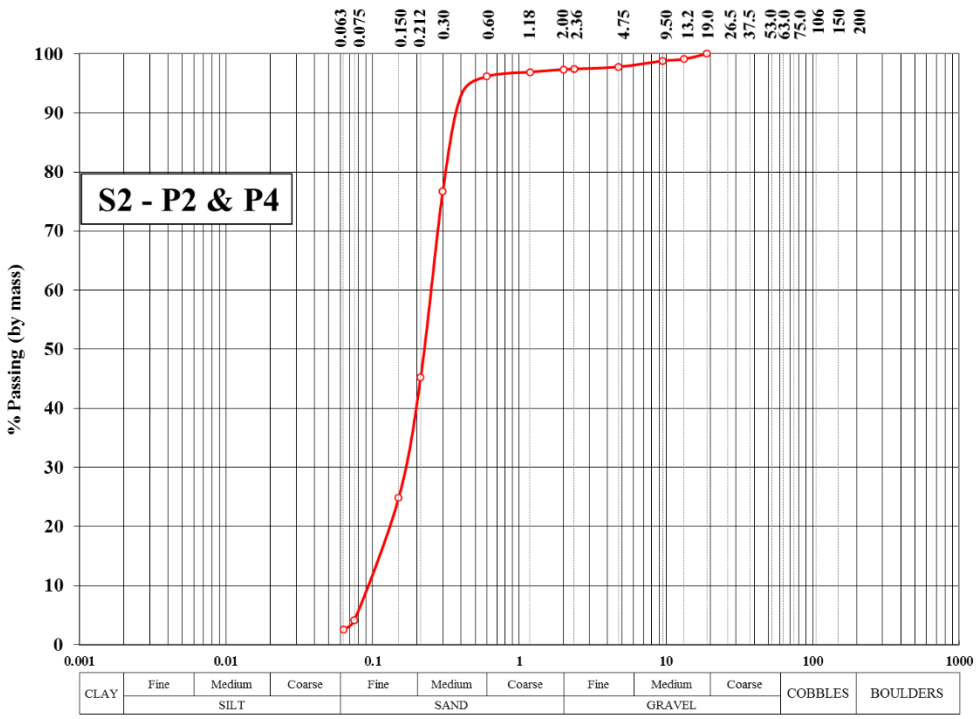
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**SAND with trace of gravel & trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S2 - P2 & P4**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	100
13.2	99
9.50	99
4.75	98
2.36	97
2.00	97
1.18	97
0.60	96
0.30	77
0.212	45
0.150	25
0.075	4
0.063	3



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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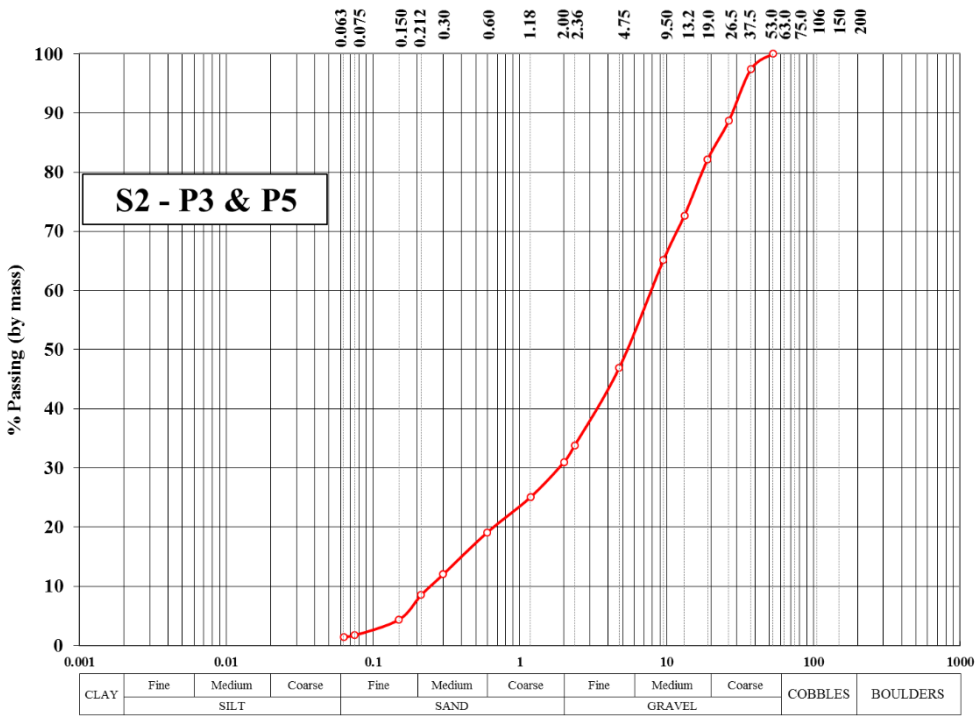
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S2 - P3 & P5**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	100
37.5	97
26.5	89
19.0	82
13.2	73
9.50	65
4.75	47
2.36	34
2.00	31
1.18	25
0.60	19
0.30	12
0.212	9
0.150	4
0.075	2
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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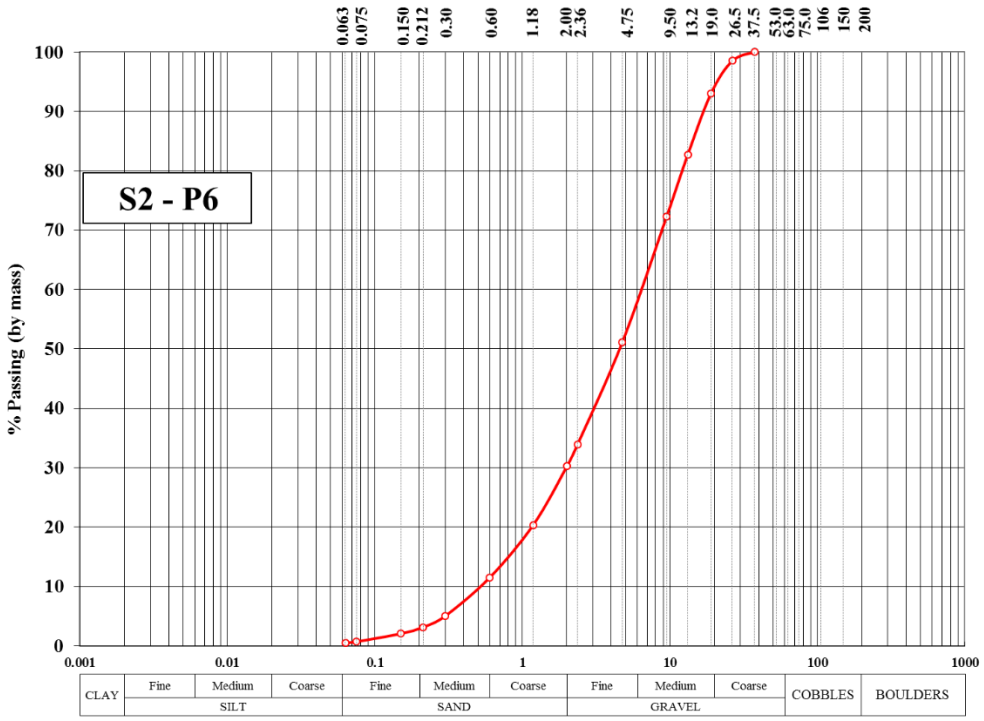
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S2 - P6**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	99
19.0	93
13.2	83
9.50	72
4.75	51
2.36	34
2.00	30
1.18	20
0.60	12
0.30	5
0.212	3
0.150	2
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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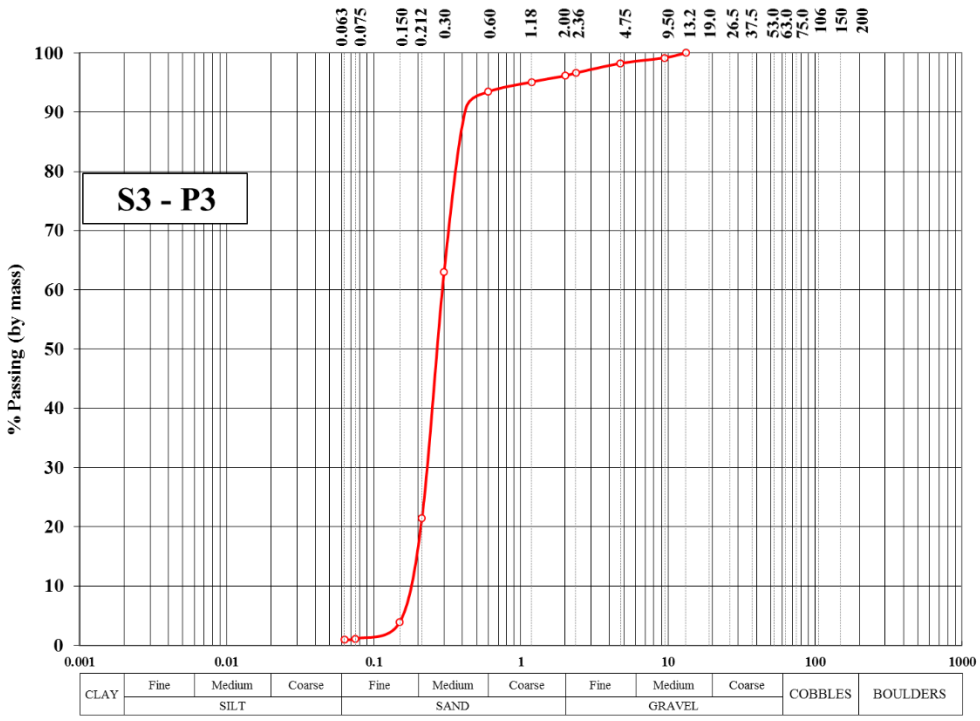
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**SAND with trace of gravel and trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S3 - P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	100
9.50	99
4.75	98
2.36	97
2.00	96
1.18	95
0.60	93
0.30	63
0.212	21
0.150	4
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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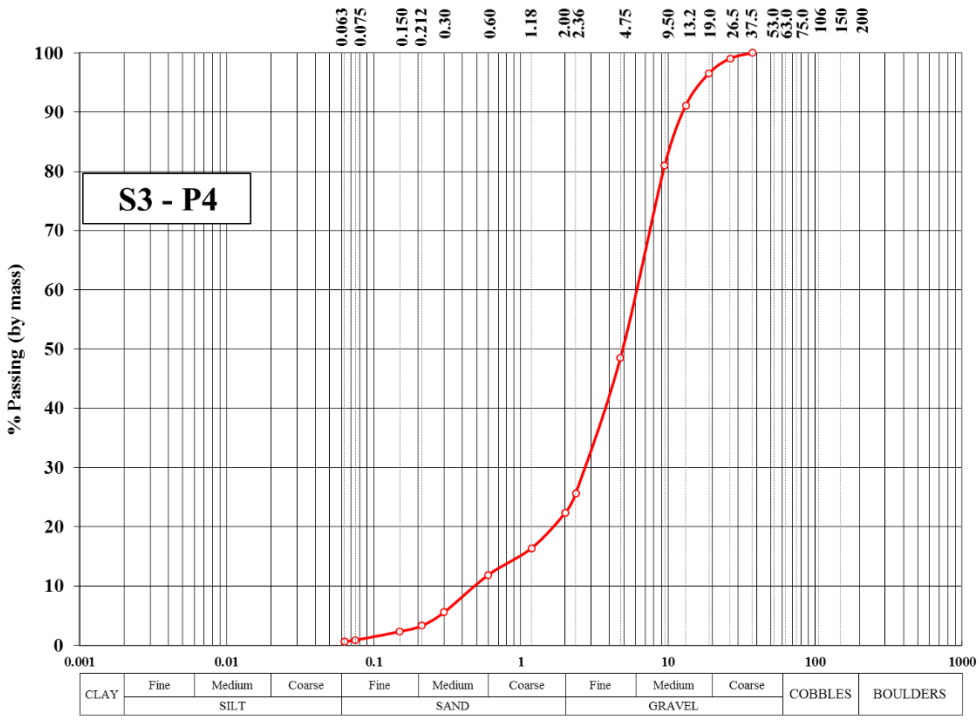
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S3 - P4**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	99
19.0	97
13.2	91
9.50	81
4.75	49
2.36	26
2.00	22
1.18	16
0.60	12
0.30	6
0.212	3
0.150	2
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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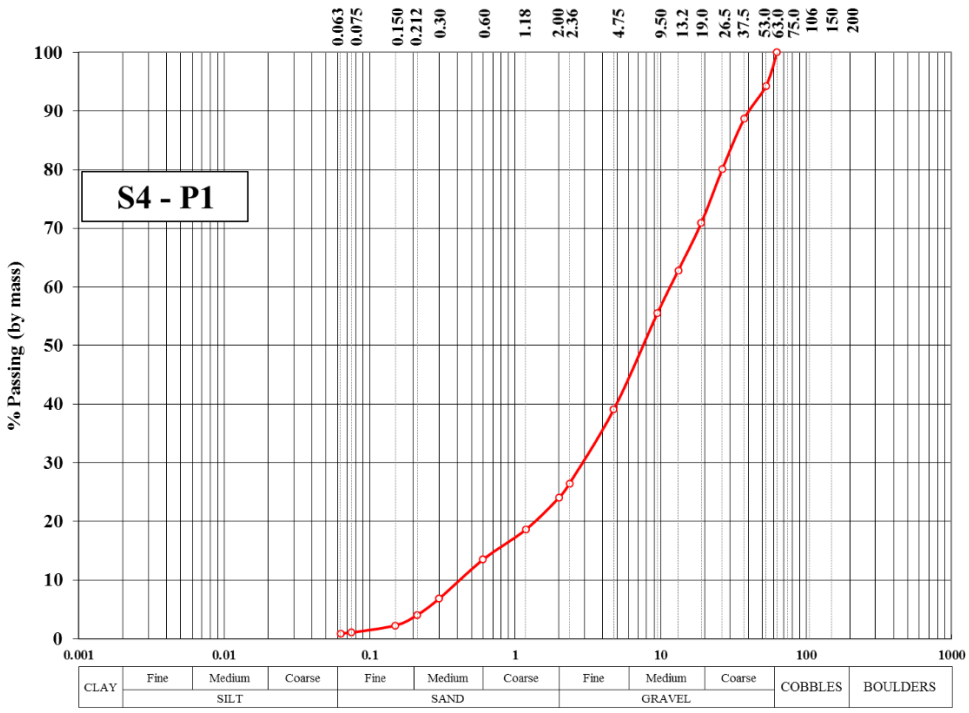
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S4 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
63.0	100
53.0	94
37.5	89
26.5	80
19.0	71
13.2	63
9.50	56
4.75	39
2.36	26
2.00	24
1.18	19
0.60	13
0.30	7
0.212	4
0.150	2
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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Tested By: C. Julius **Date:** 30-May-16 to 2-Jun-16

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Reference No: 16/1311

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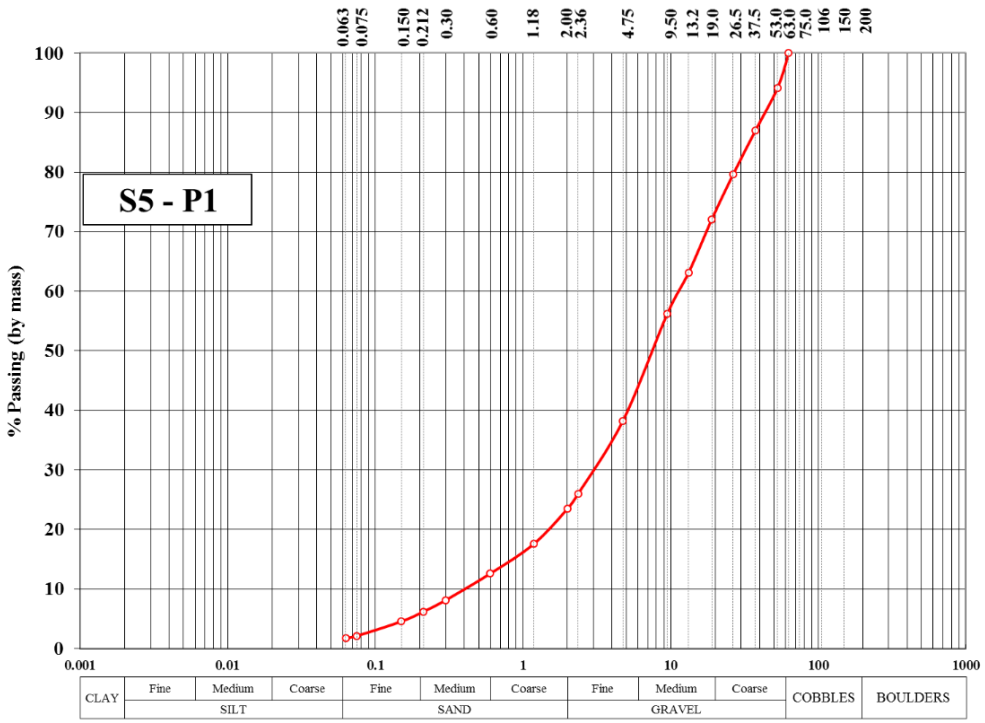
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S5 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
63.0	100
53.0	94
37.5	87
26.5	80
19.0	72
13.2	63
9.50	56
4.75	38
2.36	26
2.00	23
1.18	18
0.60	13
0.30	8
0.212	6
0.150	5
0.075	2
0.063	2



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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Tested By: C. Julius **Date:** 30-May-16 to 2-Jun-16

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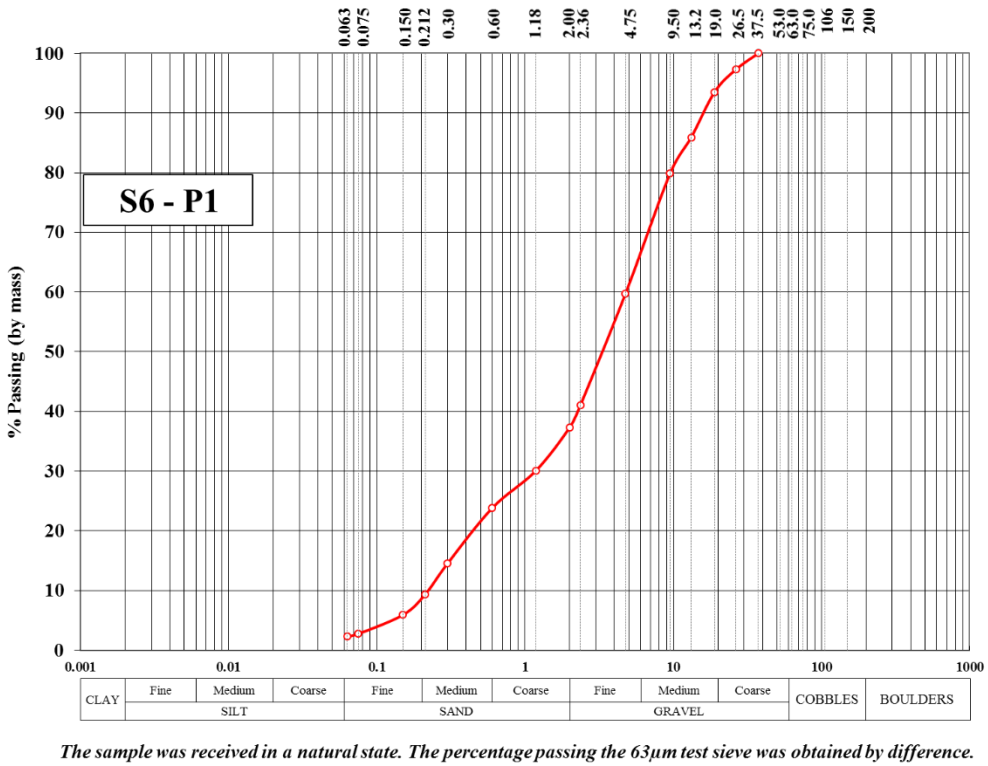
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S6 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	97
19.0	94
13.2	86
9.50	80
4.75	60
2.36	41
2.00	37
1.18	30
0.60	24
0.30	15
0.212	9
0.150	6
0.075	3
0.063	2



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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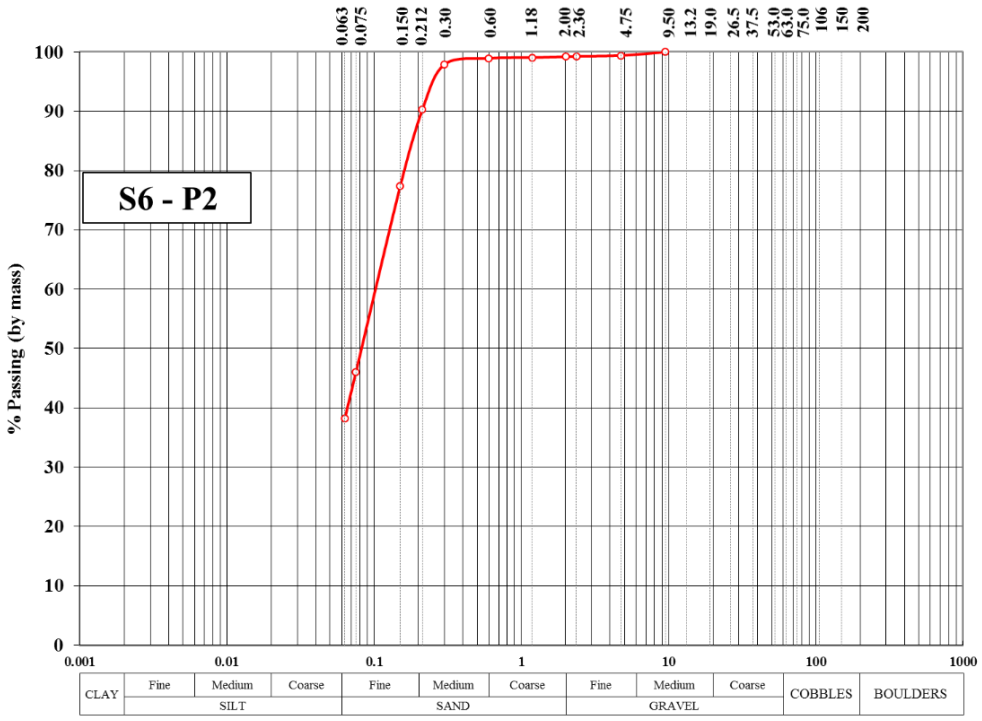
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Silty SAND with trace of gravel**	**Client Order No:**	**N/A**
Sample Source:	**S6 - P2**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	
9.50	100
4.75	99
2.36	99
2.00	99
1.18	99
0.60	99
0.30	98
0.212	90
0.150	77
0.075	46
0.063	38



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Reference No: 16/1311

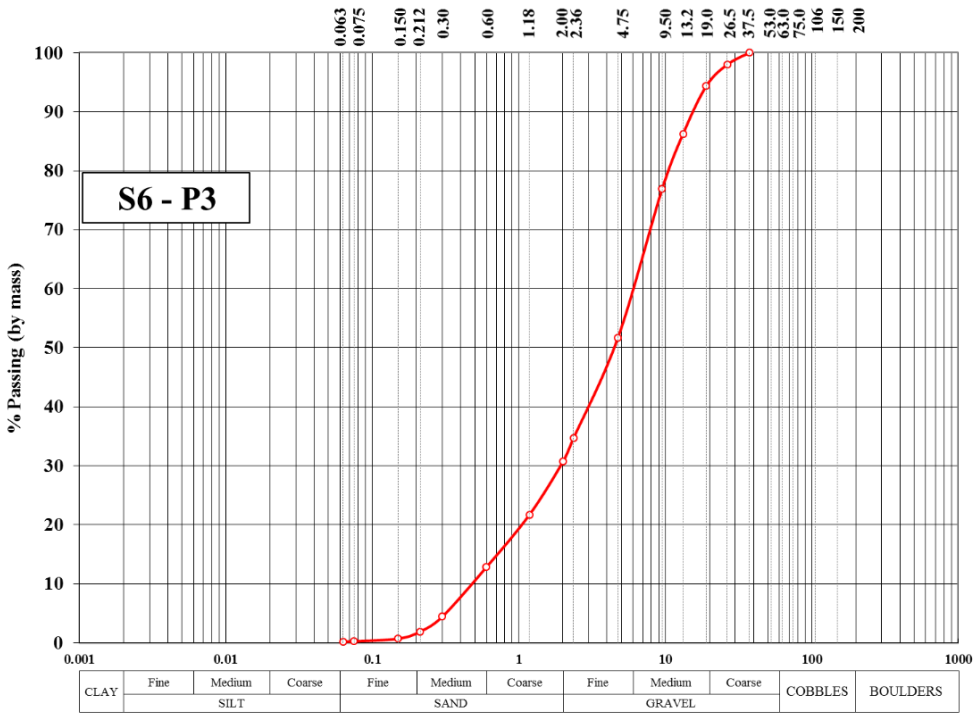
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL**	**Client Order No:**	**N/A**
Sample Source:	**S6 - P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	98
19.0	94
13.2	86
9.50	77
4.75	52
2.36	35
2.00	31
1.18	22
0.60	13
0.30	4
0.212	2
0.150	1
0.075	0
0.063	0



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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Tested By: C. Julius **Date:** 30-May-16 to 2-Jun-16

Checked By:

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P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 16/1311

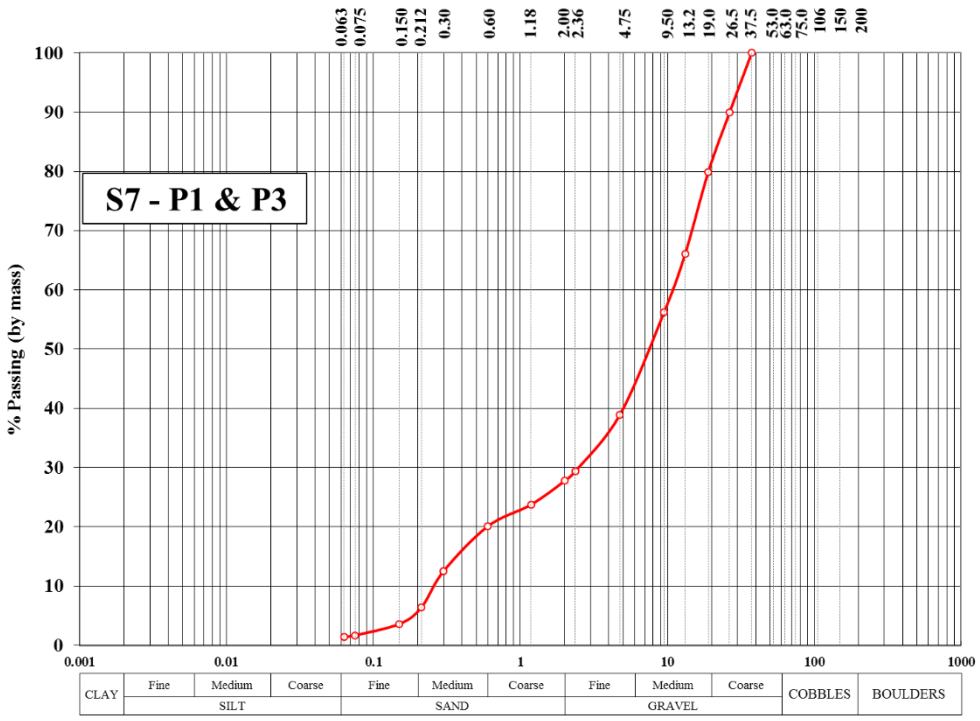
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S7 - P1 & P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	90
19.0	80
13.2	66
9.50	56
4.75	39
2.36	29
2.00	28
1.18	24
0.60	20
0.30	13
0.212	6
0.150	4
0.075	2
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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Reference No: 16/1311

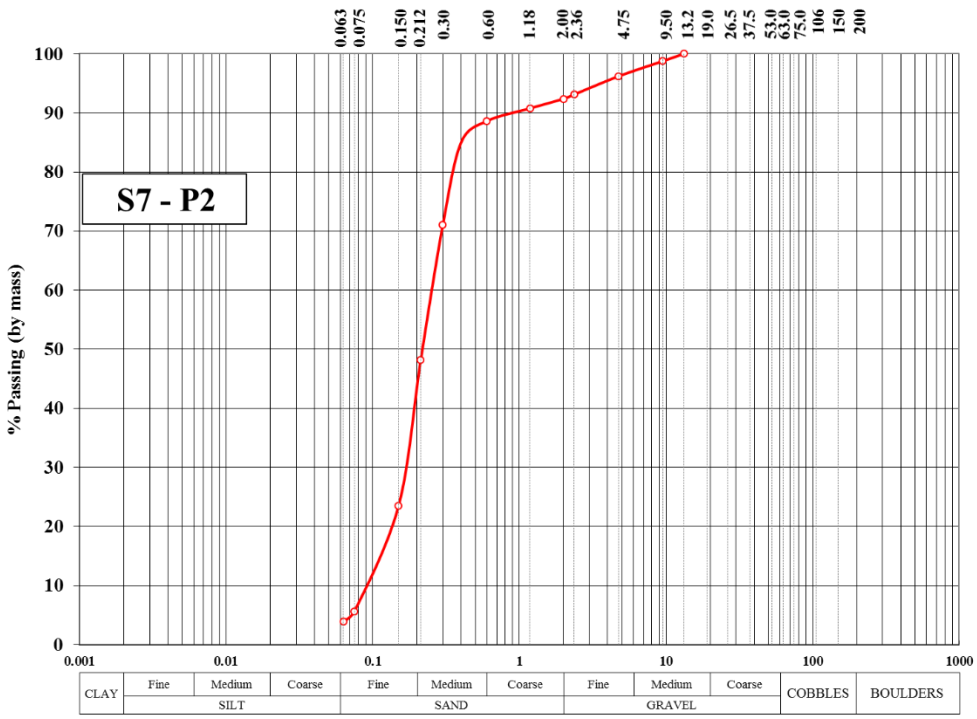
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**SAND with minor gravel and trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S7 - P2**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	100
9.50	99
4.75	96
2.36	93
2.00	92
1.18	91
0.60	89
0.30	71
0.212	48
0.150	24
0.075	6
0.063	4



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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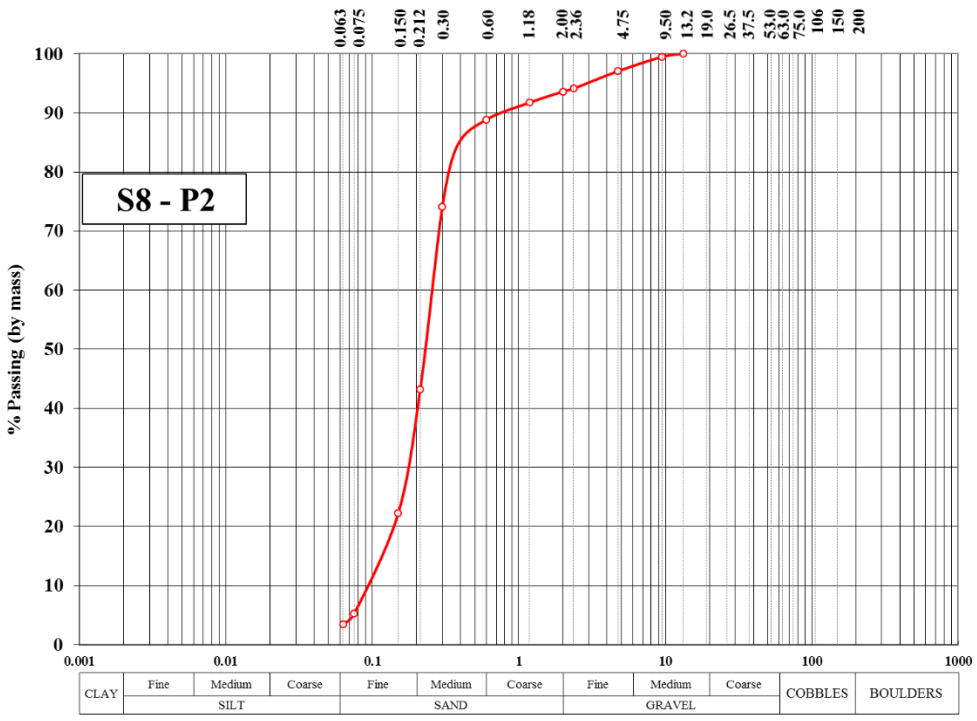
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**SAND with minor gravel and trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S8 - P2**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	100
9.50	99
4.75	97
2.36	94
2.00	94
1.18	92
0.60	89
0.30	74
0.212	43
0.150	22
0.075	5
0.063	3



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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Reference No: 16/1311

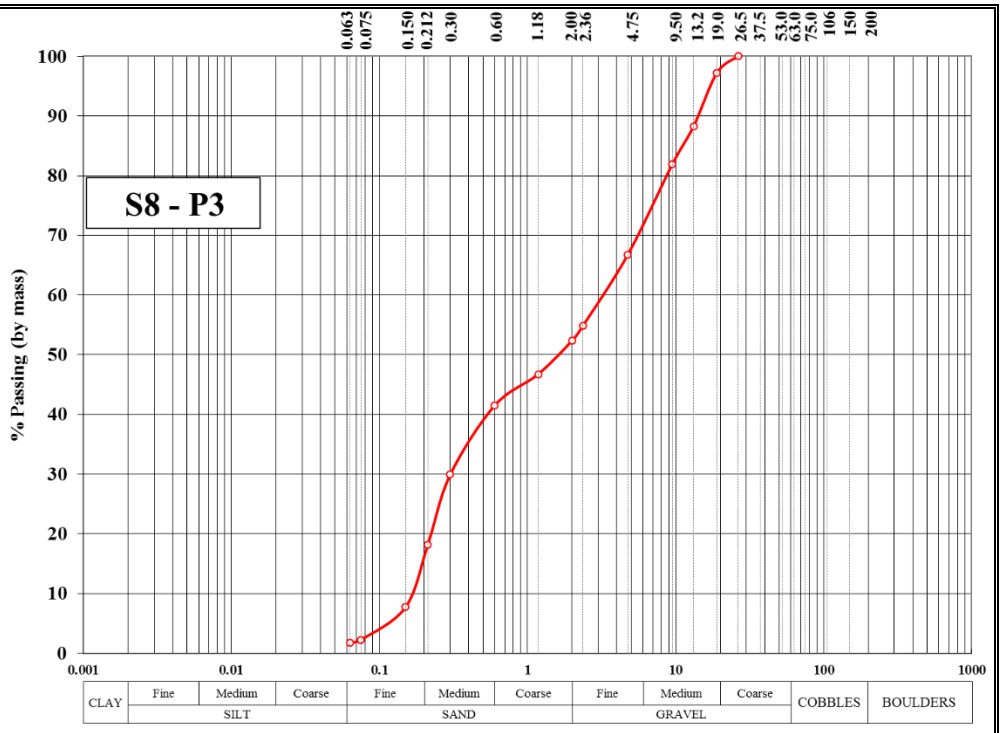
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Gravelly SAND with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S8 - P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	100
19.0	97
13.2	88
9.50	82
4.75	67
2.36	55
2.00	52
1.18	47
0.60	42
0.30	30
0.212	18
0.150	8
0.075	2
0.063	2



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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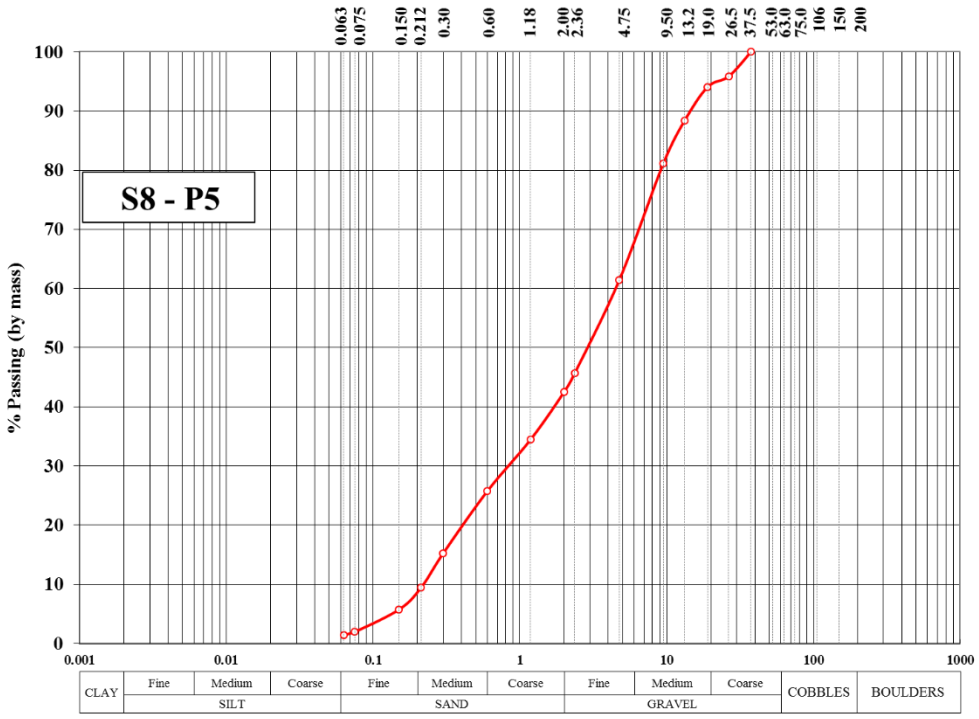
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S8 - P5**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	96
19.0	94
13.2	88
9.50	81
4.75	61
2.36	46
2.00	43
1.18	34
0.60	26
0.30	15
0.212	9
0.150	6
0.075	2
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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Tested By: C. Julius **Date:** 30-May-16 to 2-Jun-16

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Reference No: 16/1311

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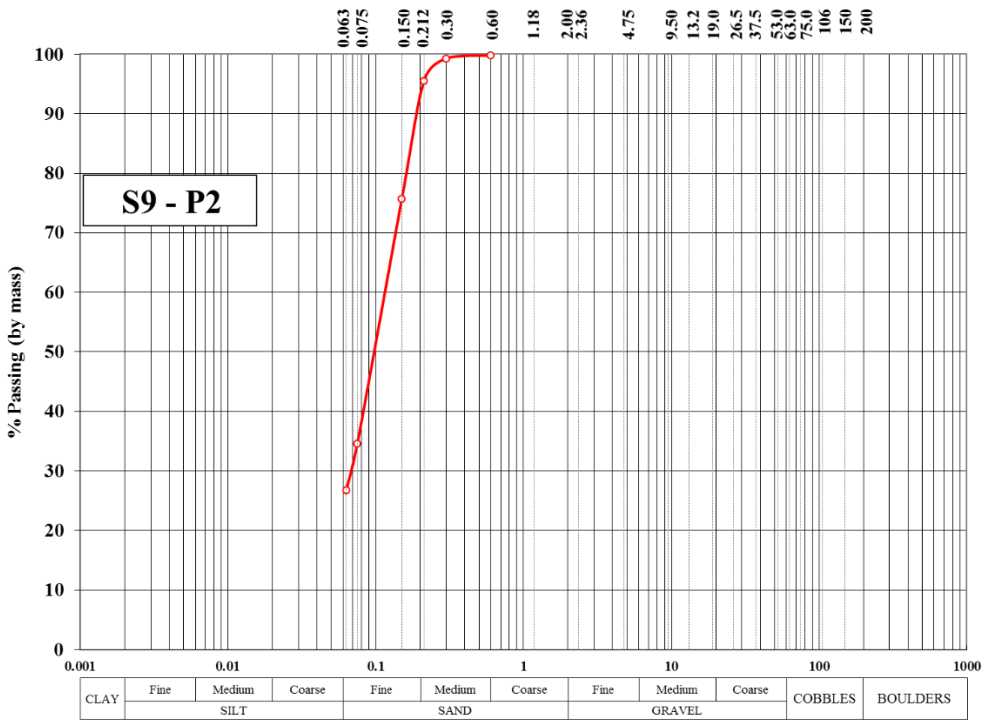
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Silty SAND**	**Client Order No:**	**N/A**
Sample Source:	**S9 - P2**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	100
0.30	99
0.212	96
0.150	76
0.075	35
0.063	27



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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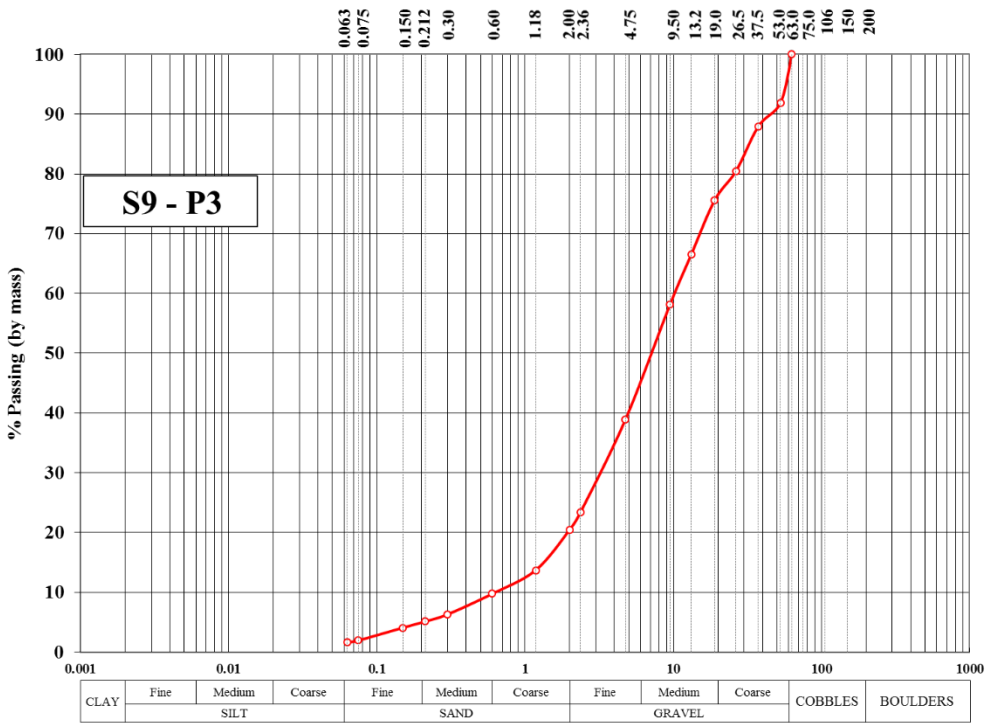
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**GRAVEL with some sand and trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S9 - P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
63.0	100
53.0	92
37.5	88
26.5	80
19.0	76
13.2	67
9.50	58
4.75	39
2.36	23
2.00	20
1.18	14
0.60	10
0.30	6
0.212	5
0.150	4
0.075	2
0.063	2



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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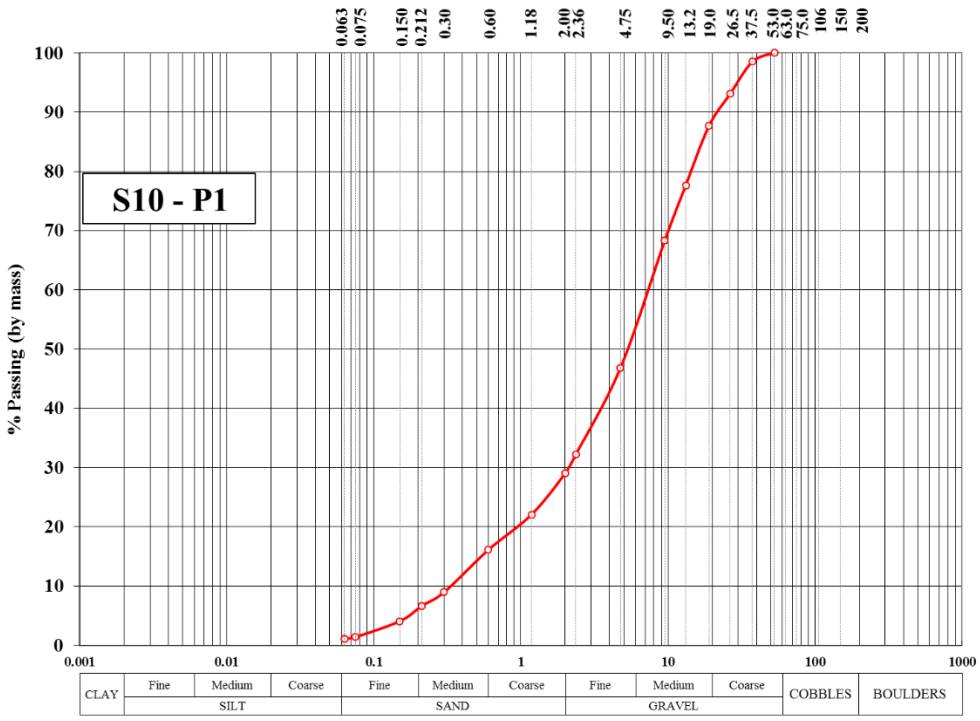
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S10 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	100
37.5	99
26.5	93
19.0	88
13.2	78
9.50	68
4.75	47
2.36	32
2.00	29
1.18	22
0.60	16
0.30	9
0.212	7
0.150	4
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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Tested By: **C. Julius** **Date:** **30-May-16 to 2-Jun-16**

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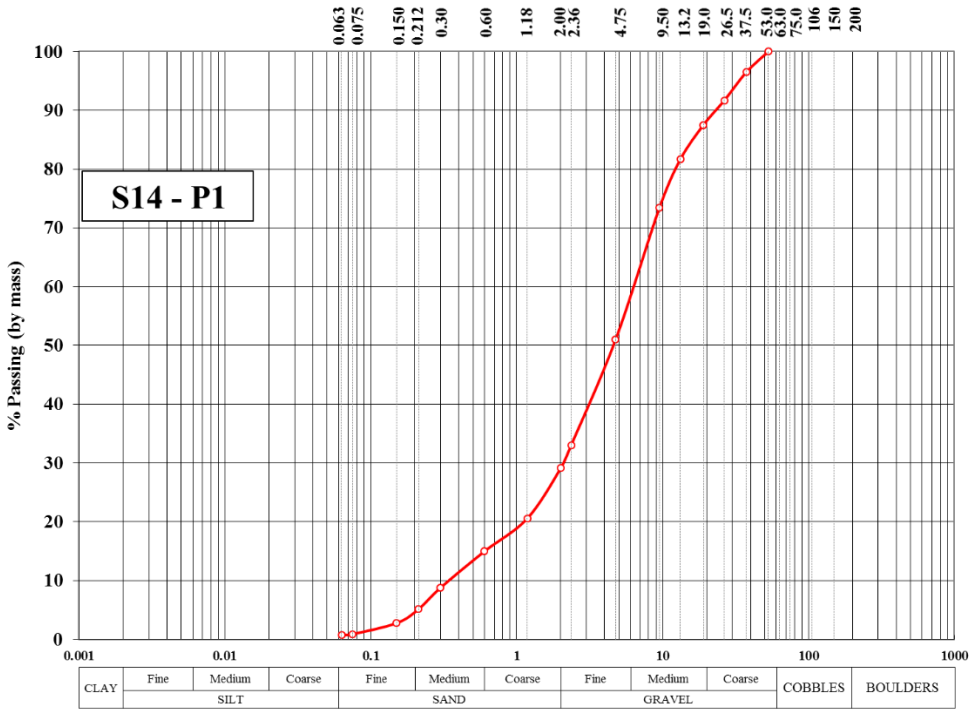
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S14 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	100
37.5	97
26.5	92
19.0	88
13.2	82
9.50	73
4.75	51
2.36	33
2.00	29
1.18	21
0.60	15
0.30	9
0.212	5
0.150	3
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63μm test sieve was obtained by difference.

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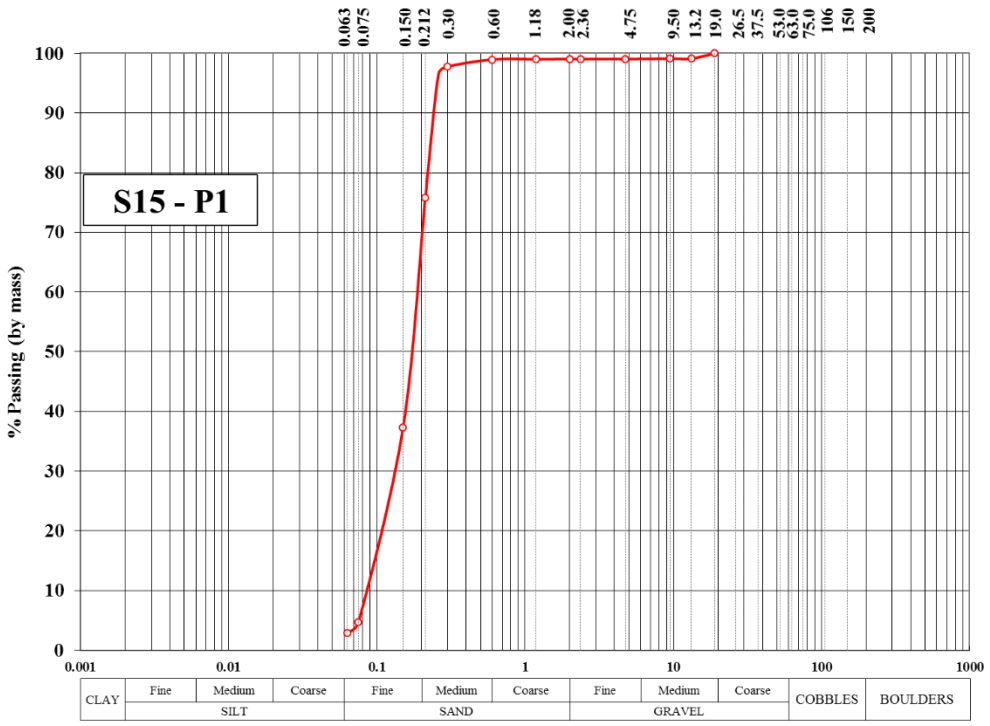
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**SAND with trace of gravel and trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S15 - P1**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	100
13.2	99
9.50	99
4.75	99
2.36	99
2.00	99
1.18	99
0.60	99
0.30	98
0.212	76
0.150	37
0.075	5
0.063	3



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

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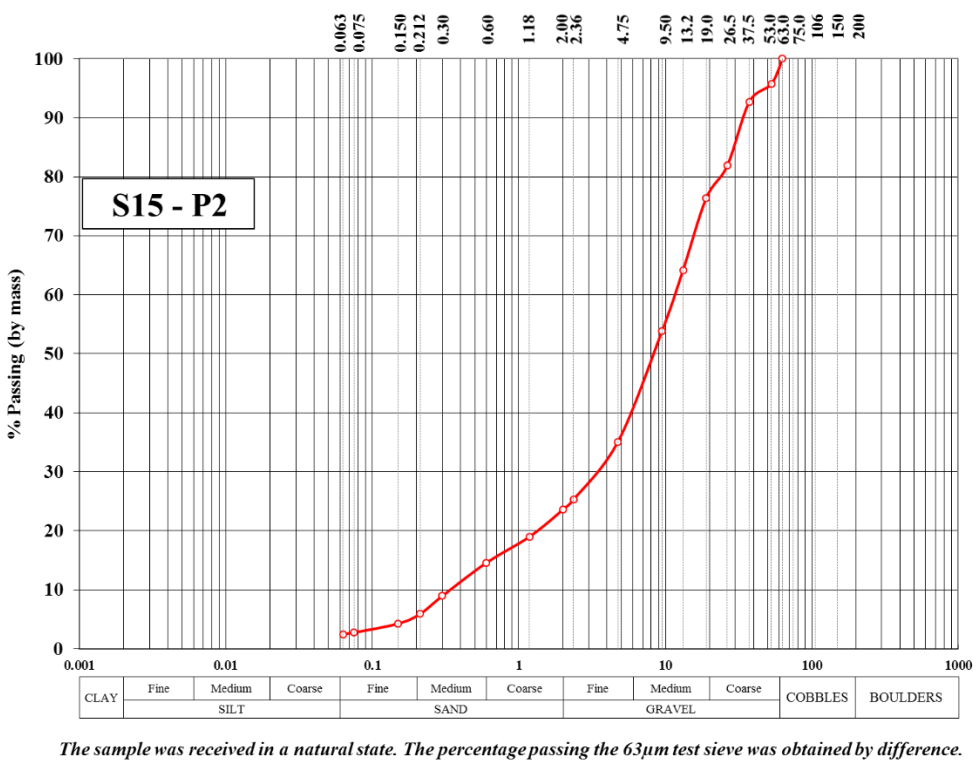
Date: 2 June 2016

TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S15 - P2**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
63.0	100
53.0	96
37.5	93
26.5	82
19.0	76
13.2	64
9.50	54
4.75	35
2.36	25
2.00	24
1.18	19
0.60	15
0.30	9
0.212	6
0.150	4
0.075	3
0.063	2



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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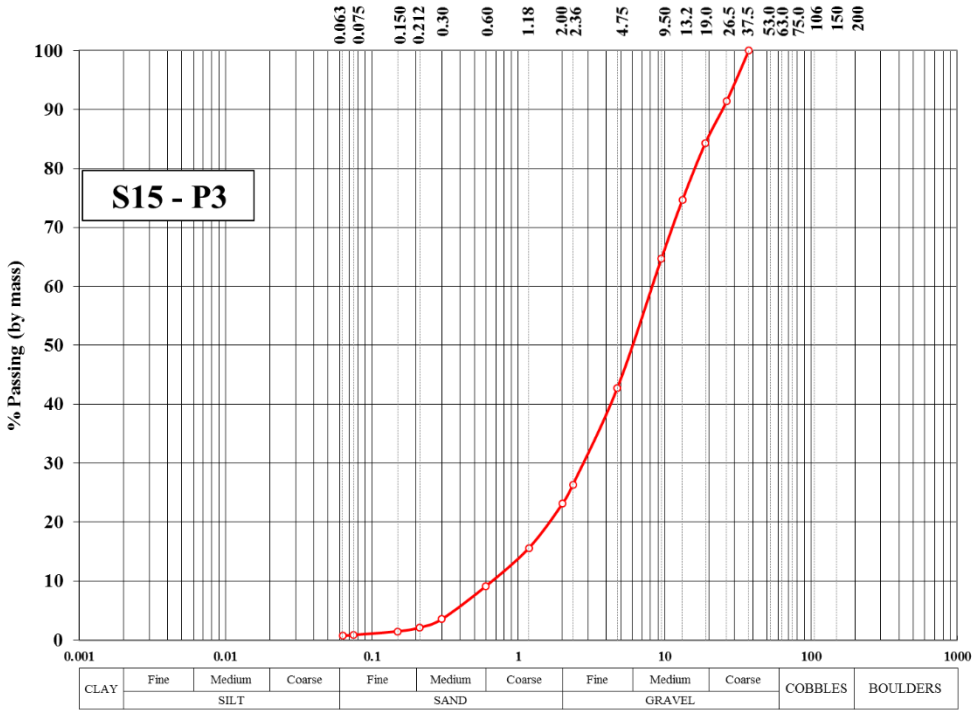
TEST REPORT – PROJECT SHOTOVER INVESTIGATIONS

Client Details:	**Lowe Environmental Impact, P.O. Box 29288, Christchurch**	**Attention:**	**C. Mars**
Job Description:	**Project Shotover Investigations**		
Sample Description:	**Sandy GRAVEL with trace of silt**	**Client Order No:**	**N/A**
Sample Source:	**S15 - P3**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**25 & 26-May-16**	**Sampled By:**	**C. Mars**
Sample Method:	**Unknown**	**Date Received:**	**28-May-16**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	100
26.5	91
19.0	84
13.2	75
9.50	65
4.75	43
2.36	26
2.00	23
1.18	16
0.60	9
0.30	4
0.212	2
0.150	1
0.075	1
0.063	1



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

Note:

- ***Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005 and sampling.***
- ***This report may not be reproduced except in full.***

Tested By: **C. Julius** **Date:** **30-May-16 to 2-Jun-16**

Checked By:

Approved Signatory

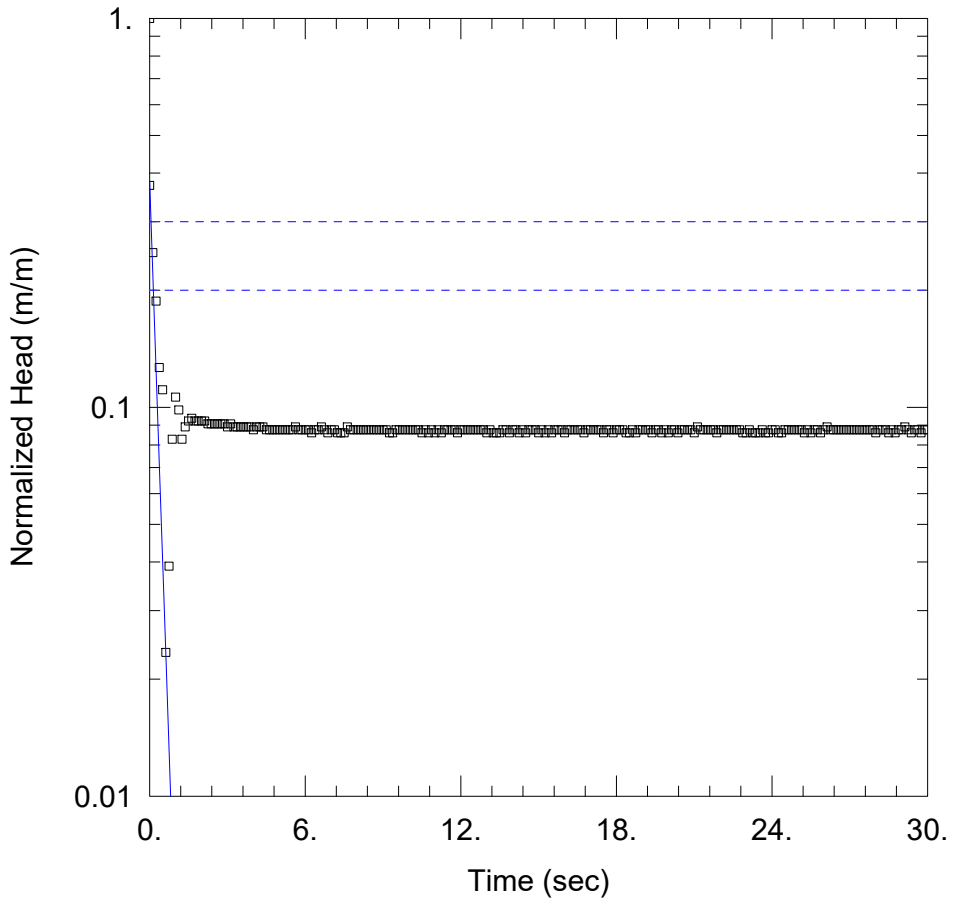
A.P. Julius
Laboratory Manager

Tests indicated as Not Accredited are outside the laboratory's scope of accreditation

IANZ ACCREDITED LABORATORY
Accreditation No: 434

Appendix D

Aquifer hydraulic testing



BH02_FHT1

Data Set: \...\12645246_BH02_FHT1_BR.aqt
Date: 04/16/25 Time: 09:25:10

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

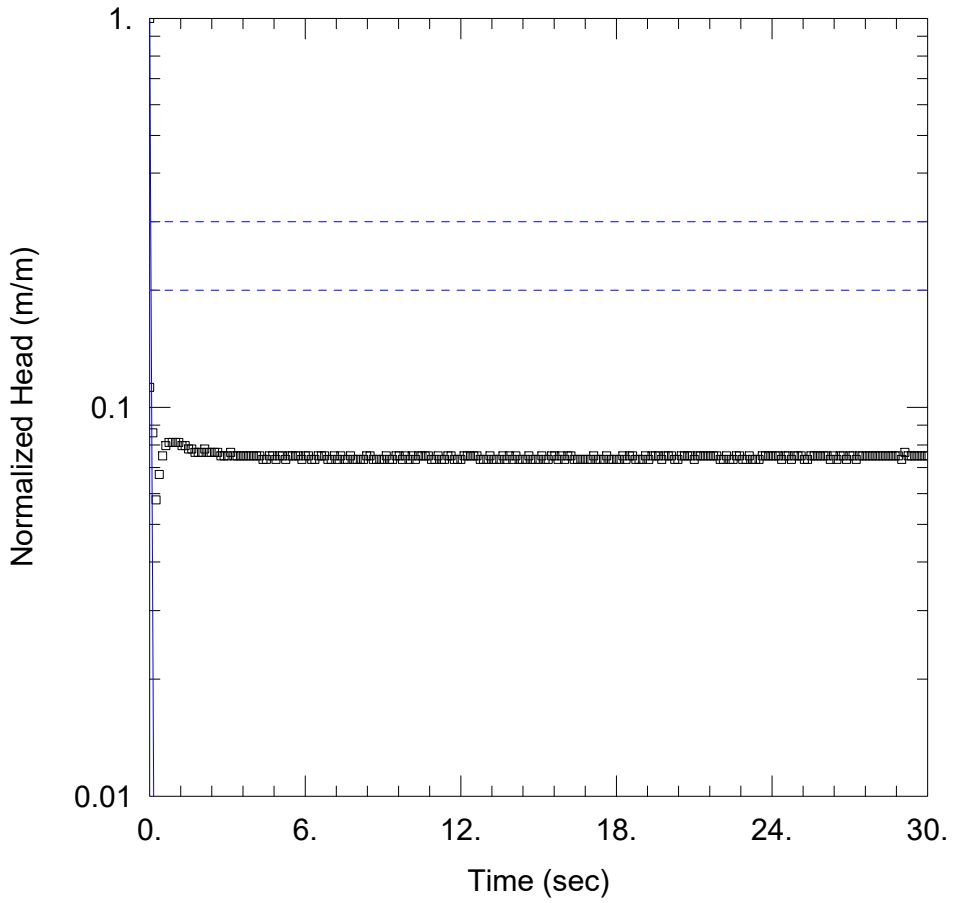
WELL DATA (BH02)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.025 m
Static Water Column Height: 1.41 m
Screen Length: 1.41 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.004571 m/sec y0 = 0.244 m



BH02_FHT2

Data Set: \...\12645246_BH02_FHT2_BR.aqt
Date: 04/16/25 Time: 09:54:04

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

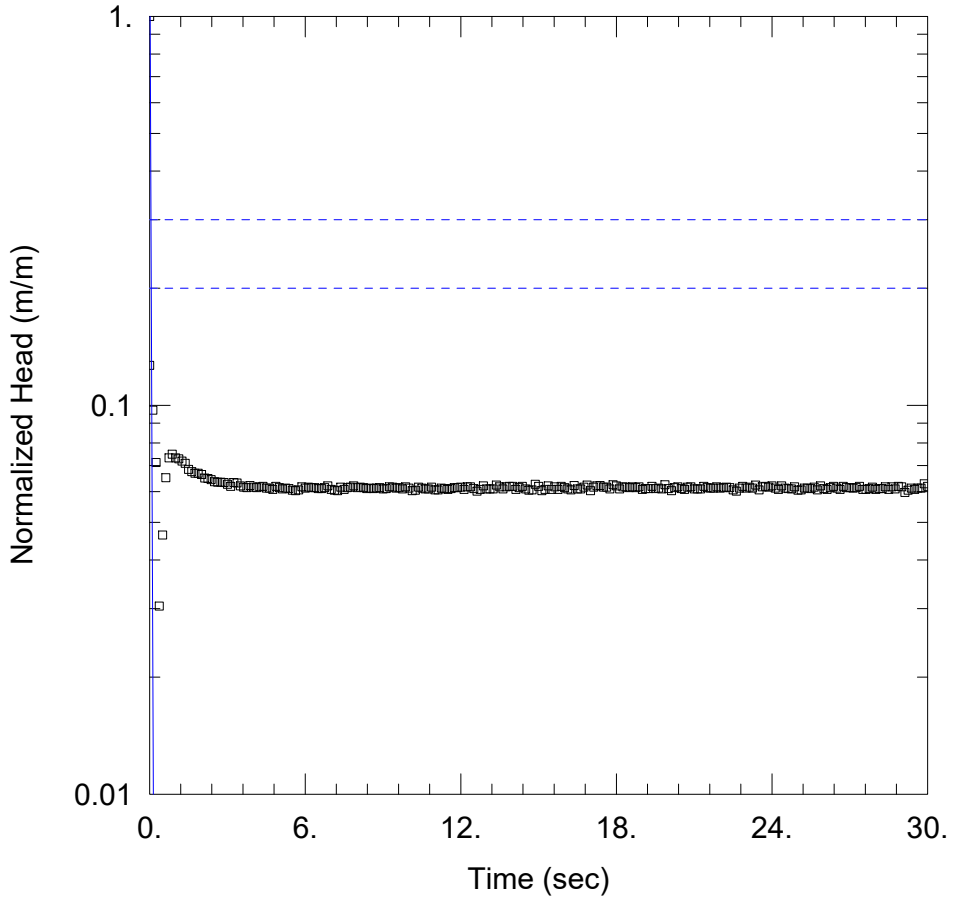
WELL DATA (BH02)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.025 m
Static Water Column Height: 1.41 m
Screen Length: 1.41 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0297 m/sec y0 = 0.6355 m



BH02_FHT3

Data Set: \...\12645246_BH02_FHT3_BR.aqt
Date: 04/16/25 Time: 10:03:53

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

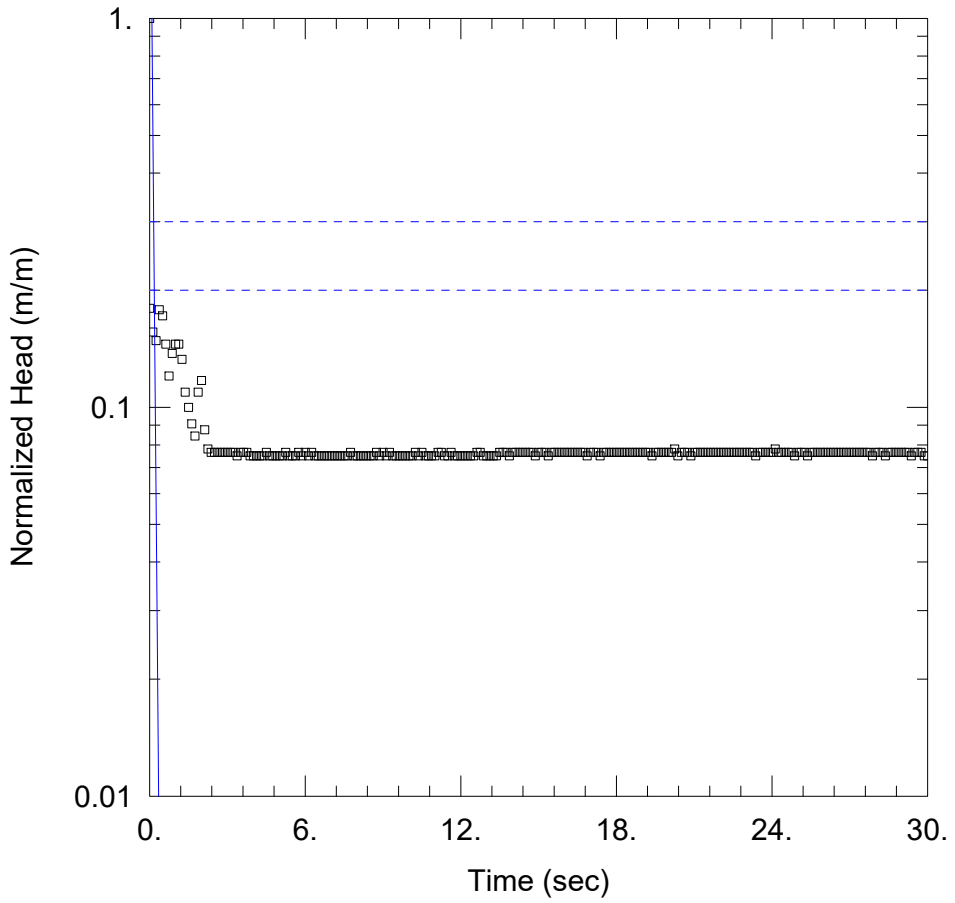
Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH02)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.025 m
Static Water Column Height: 1.41 m
Screen Length: 1.41 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.03859 m/sec
y0 = 1.512 m



BH02_RHT1

Data Set: \...\12645246_BH02_RHT1_BR.aqt
Date: 04/16/25 Time: 10:08:21

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

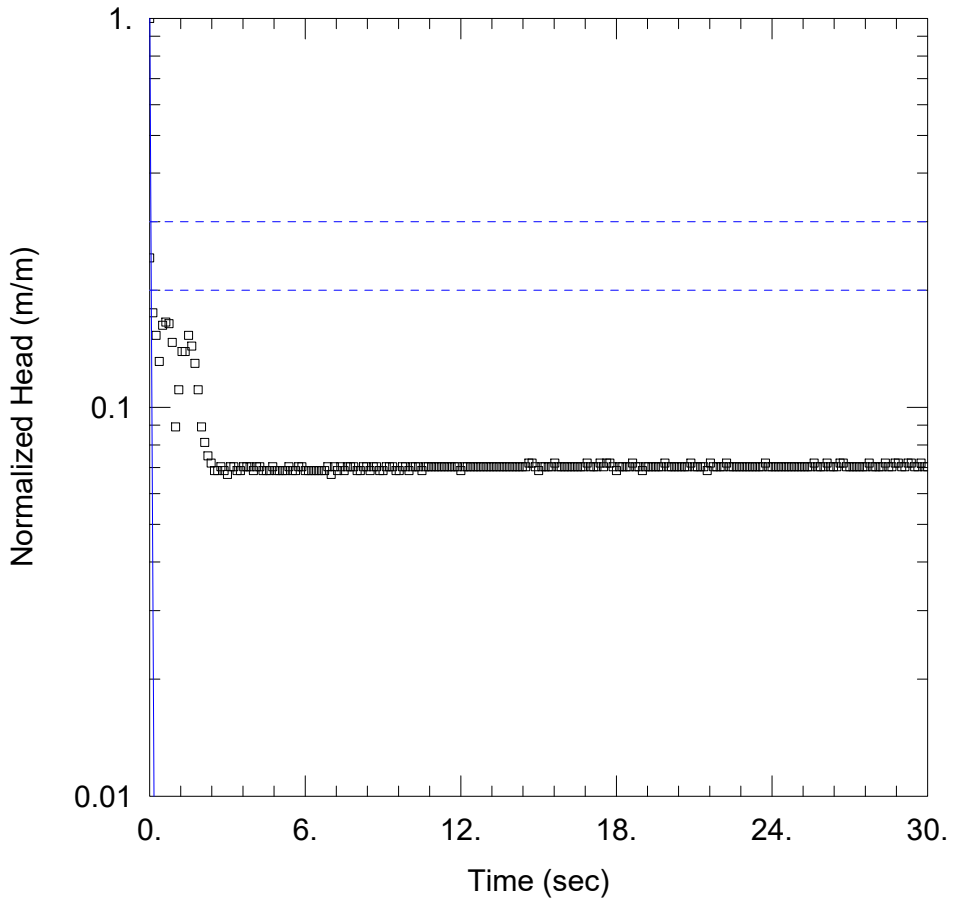
WELL DATA (BH02)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.025 m
Static Water Column Height: 1.41 m
Screen Length: 1.41 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01825 m/sec y0 = 3.344 m



BH02_RHT2

Data Set: \...\12645246_BH02_RHT2_BR.aqt
Date: 04/16/25 Time: 10:11:17

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

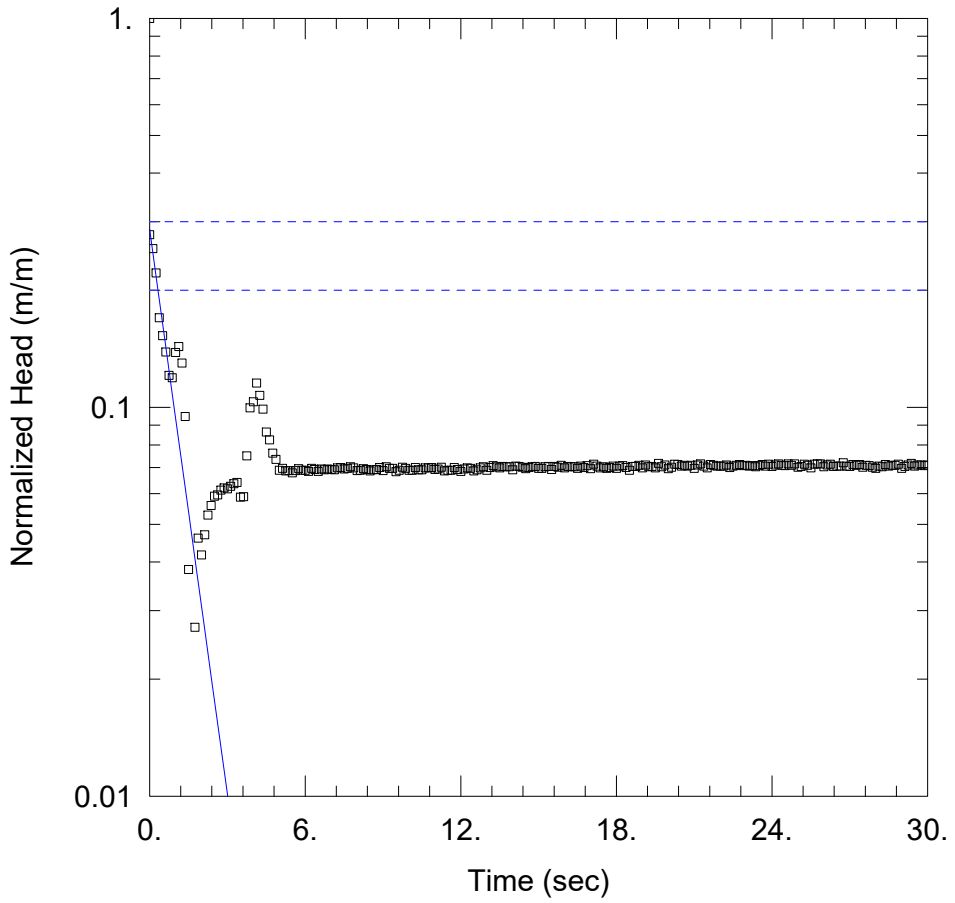
WELL DATA (BH02)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.025 m
Static Water Column Height: 1.41 m
Screen Length: 1.41 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02927 m/sec y0 = 0.7926 m



BH02_RHT3

Data Set: \...\12645246_BH02_RHT3_BR.aqt
Date: 04/16/25 Time: 10:28:14

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

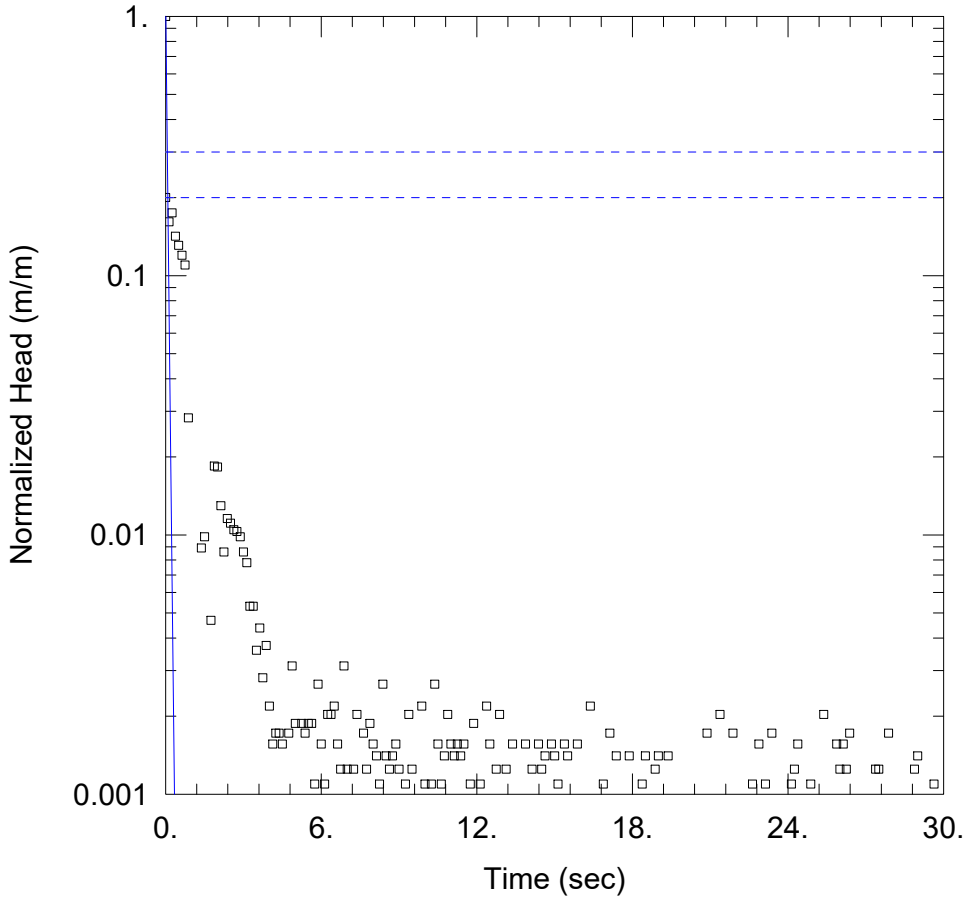
WELL DATA (BH02)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.025 m
Static Water Column Height: 1.41 m
Screen Length: 1.41 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001139 m/sec y0 = 0.1837 m



BH03_FHT1

Data Set: \...\12645246_BH03_FHT1_BR.aqt
Date: 04/16/25 Time: 10:32:23

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH03
Test Well: BH03
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.12 m Anisotropy Ratio (Kz/Kr): 1.

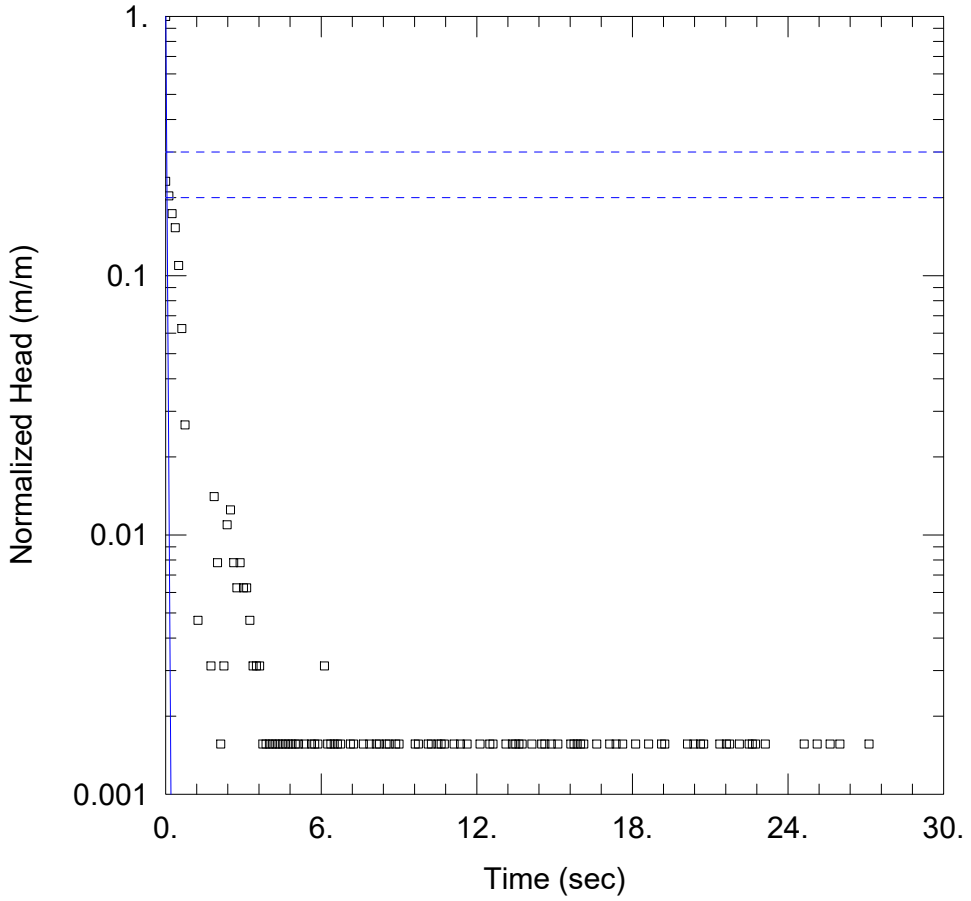
WELL DATA (BH03)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 4. m
Casing Radius: 0.025 m
Static Water Column Height: 2.12 m
Screen Length: 2. m
Well Radius: 0.05 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01988 m/sec
y0 = 0.7531 m



BH03_FHT2

Data Set: \...\12645246_BH03_FHT2_BR.aqt
Date: 04/16/25 Time: 10:35:58

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH02
Test Well: BH02
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.12 m Anisotropy Ratio (Kz/Kr): 1.

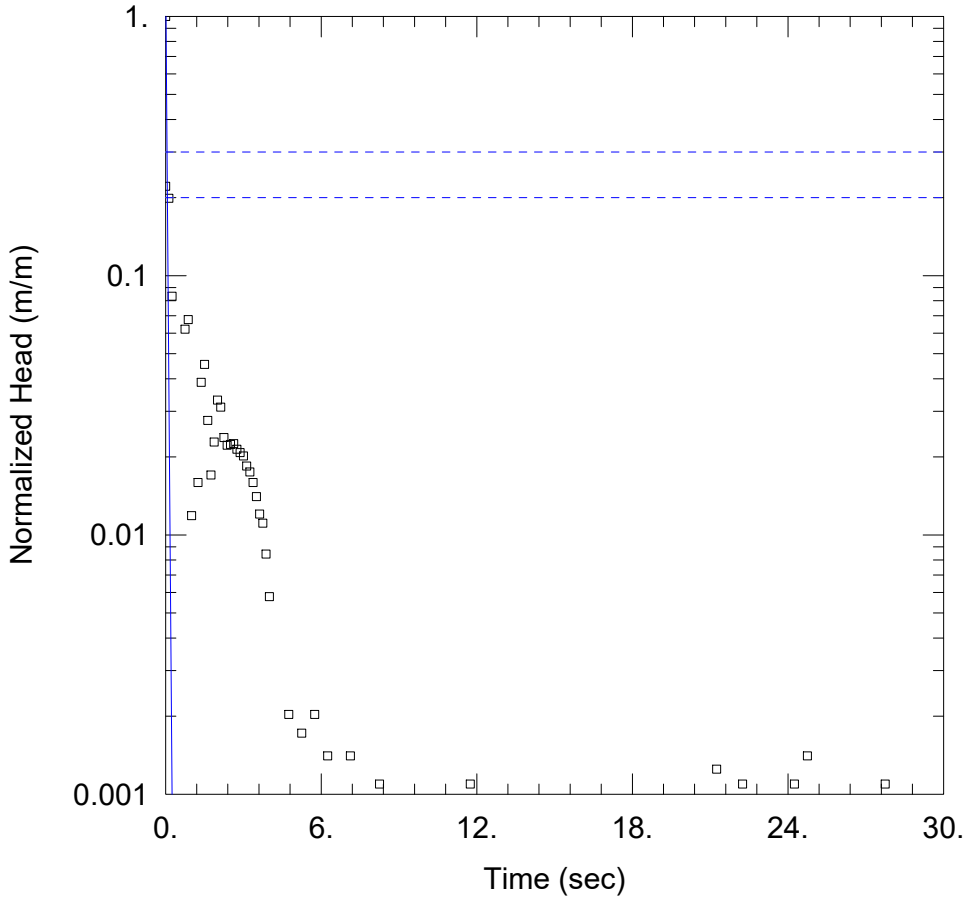
WELL DATA (BH03)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 4. m
Casing Radius: 0.025 m
Static Water Column Height: 2.12 m
Screen Length: 2. m
Well Radius: 0.05 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0335 m/sec y0 = 0.8708 m



BH03_FHT3

Data Set: \...\12645246_BH03_FHT3_BR.aqt
Date: 04/16/25 Time: 10:38:08

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH03
Test Well: BH03
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.12 m Anisotropy Ratio (Kz/Kr): 1.

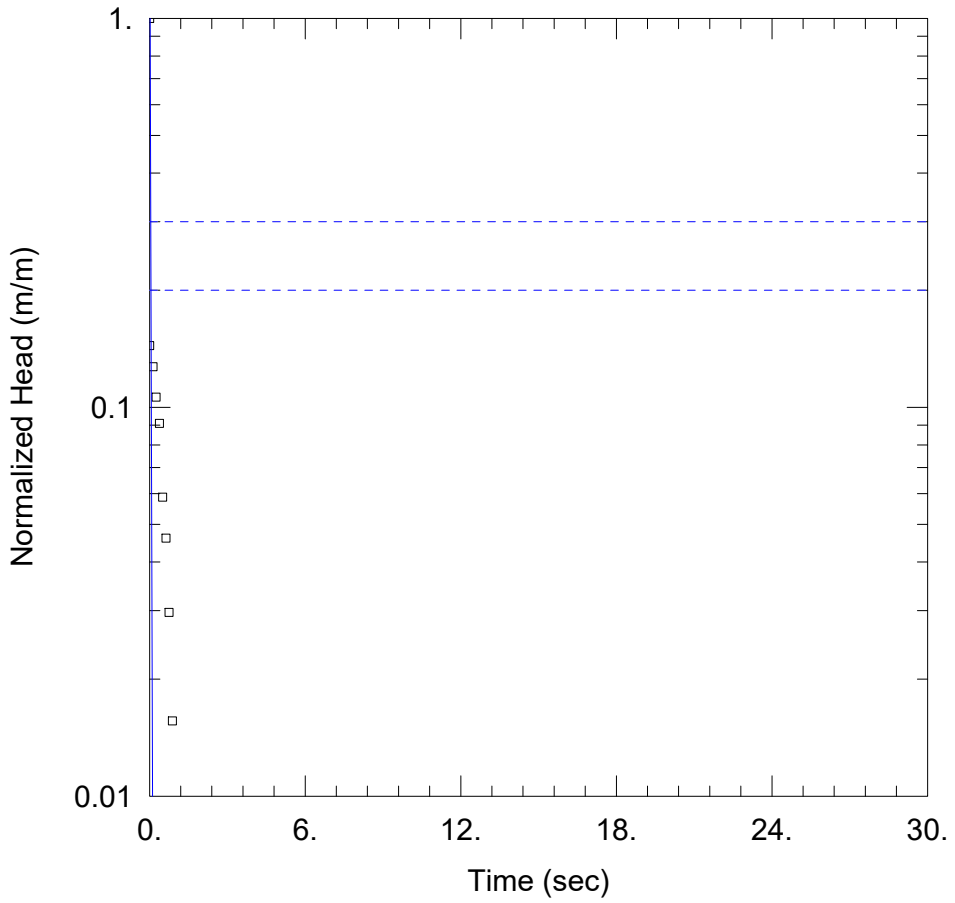
WELL DATA (BH03)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 4. m
Casing Radius: 0.025 m
Static Water Column Height: 2.12 m
Screen Length: 2. m
Well Radius: 0.05 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02903 m/sec y0 = 1.111 m



BH03_RHT1

Data Set: \...\12645246_BH03_RHT1_BR.aqt
Date: 04/16/25 Time: 10:40:13

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH03
Test Well: BH03
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.12 m Anisotropy Ratio (Kz/Kr): 1.

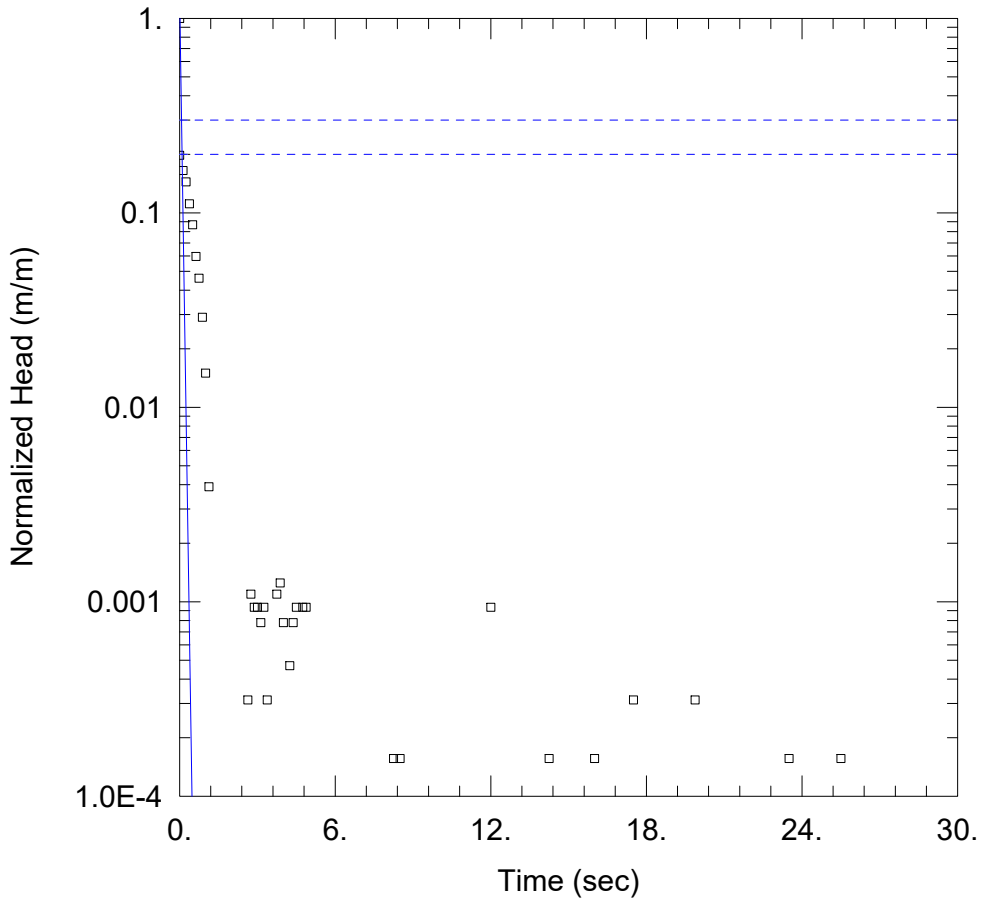
WELL DATA (BH03)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 4. m
Casing Radius: 0.025 m
Static Water Column Height: 2.12 m
Screen Length: 2. m
Well Radius: 0.05 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.04788 m/sec y0 = 1.981 m



BH03_RHT2

Data Set: \...\12645246_BH03_RHT2_BR.aqt
Date: 04/16/25 Time: 10:45:55

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH03
Test Well: BH03
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.12 m Anisotropy Ratio (Kz/Kr): 1.

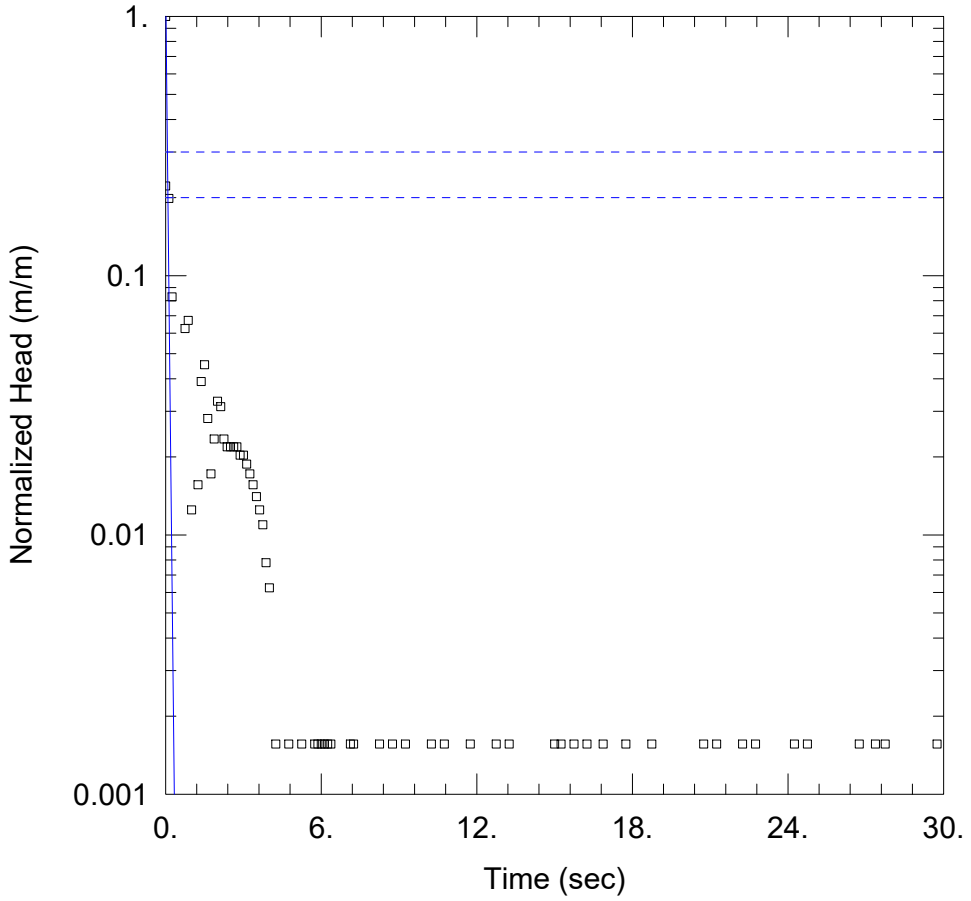
WELL DATA (BH03)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 4. m
Casing Radius: 0.025 m
Static Water Column Height: 2.12 m
Screen Length: 2. m
Well Radius: 0.05 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01919 m/sec y0 = 0.8644 m



BH03_RHT3

Data Set: \...\12645246_BH03_RHT3_BR.aqt
Date: 04/16/25 Time: 10:47:29

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH03
Test Well: BH03
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.12 m Anisotropy Ratio (Kz/Kr): 1.

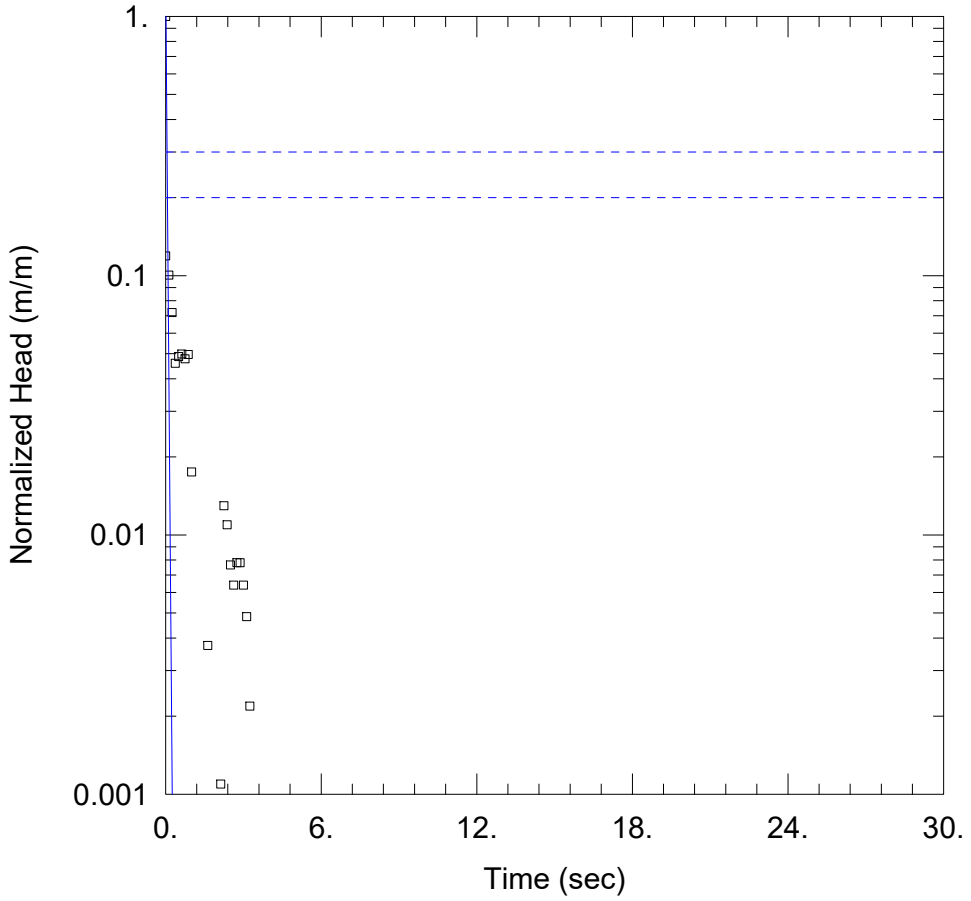
WELL DATA (BH03)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 4. m
Casing Radius: 0.025 m
Static Water Column Height: 2.12 m
Screen Length: 2. m
Well Radius: 0.05 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0206 m/sec y0 = 0.8716 m



BH04_FHT1

Data Set: \...\12645246_BH04_FHT1_BR.aqt
Date: 04/16/25 Time: 10:50:22

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH04
Test Well: BH04
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.49 m Anisotropy Ratio (Kz/Kr): 1.

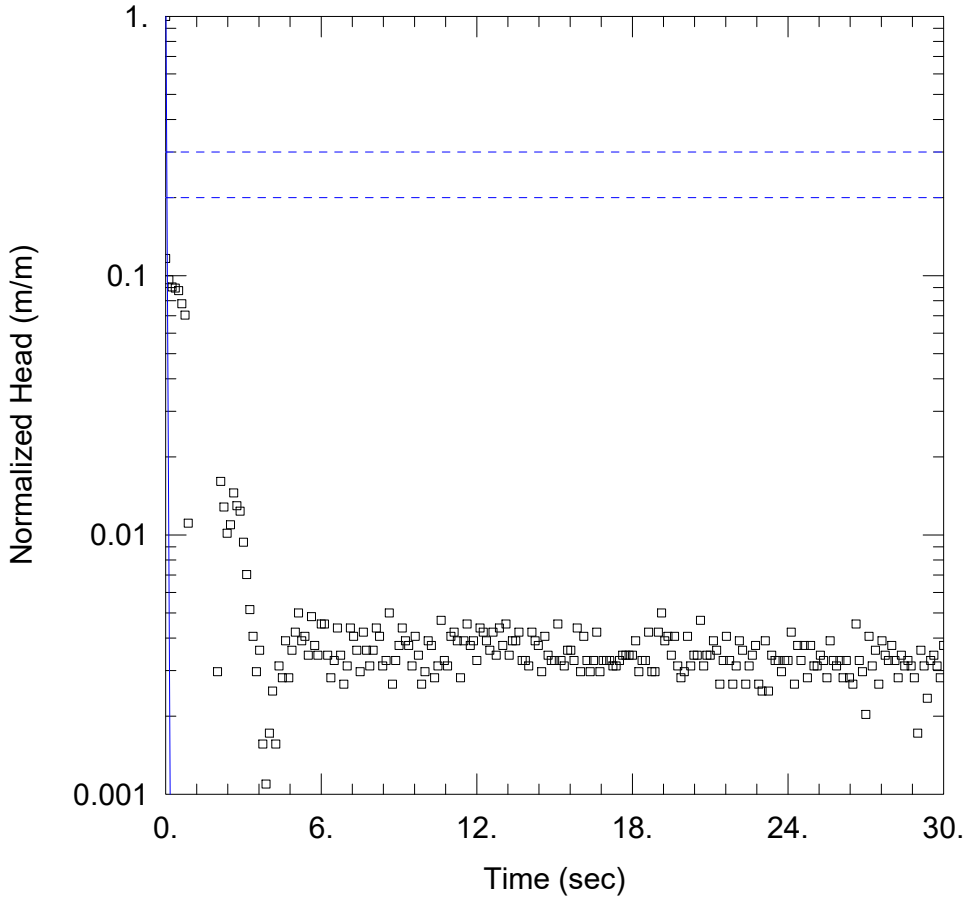
WELL DATA (BH04)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.025 m
Static Water Column Height: 2.49 m
Screen Length: 2. m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.02108 m/sec
y0 = 0.9797 m



BH04_FHT2

Data Set: \...\12645246_BH04_FHT2_BR.aqt
Date: 04/16/25 Time: 10:53:48

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH04
Test Well: BH04
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.49 m Anisotropy Ratio (Kz/Kr): 1.

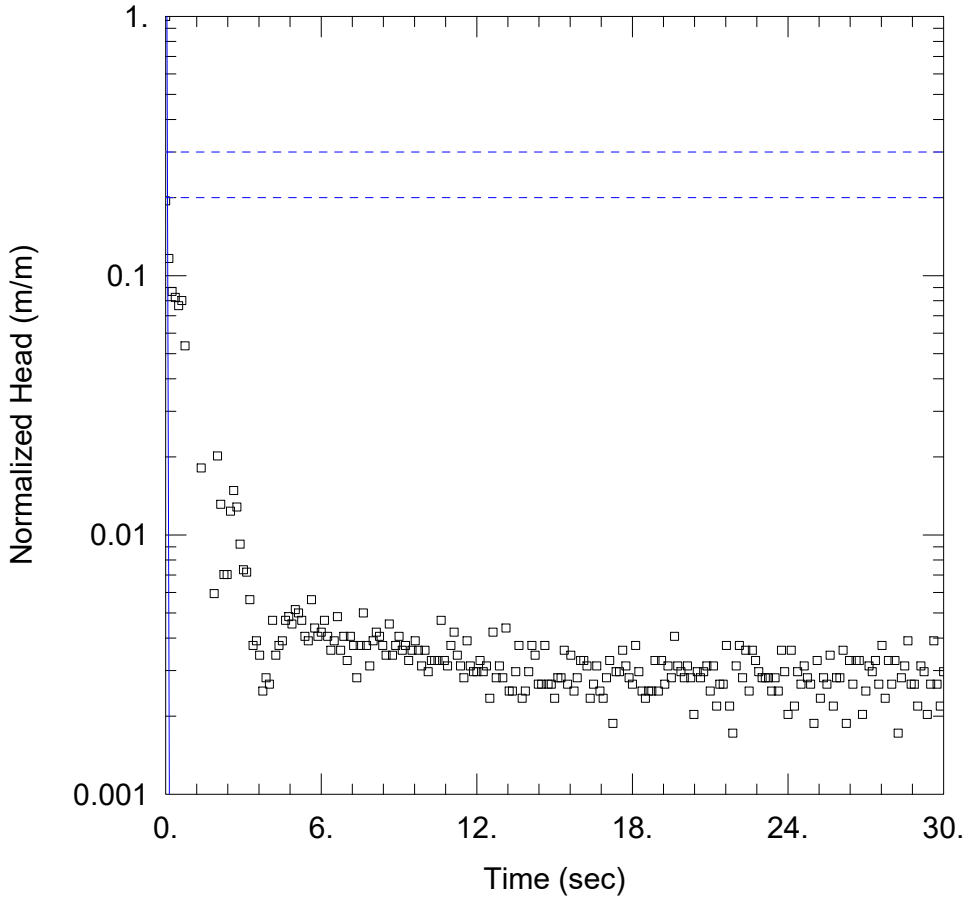
WELL DATA (BH04)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.025 m
Static Water Column Height: 2.49 m
Screen Length: 2. m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.03144 m/sec y0 = 1.414 m



BH04_FHT3

Data Set: \...\12645246_BH04_FHT3_BR.aqt
Date: 04/16/25 Time: 10:55:12

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH04
Test Well: BH04
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.49 m Anisotropy Ratio (Kz/Kr): 1.

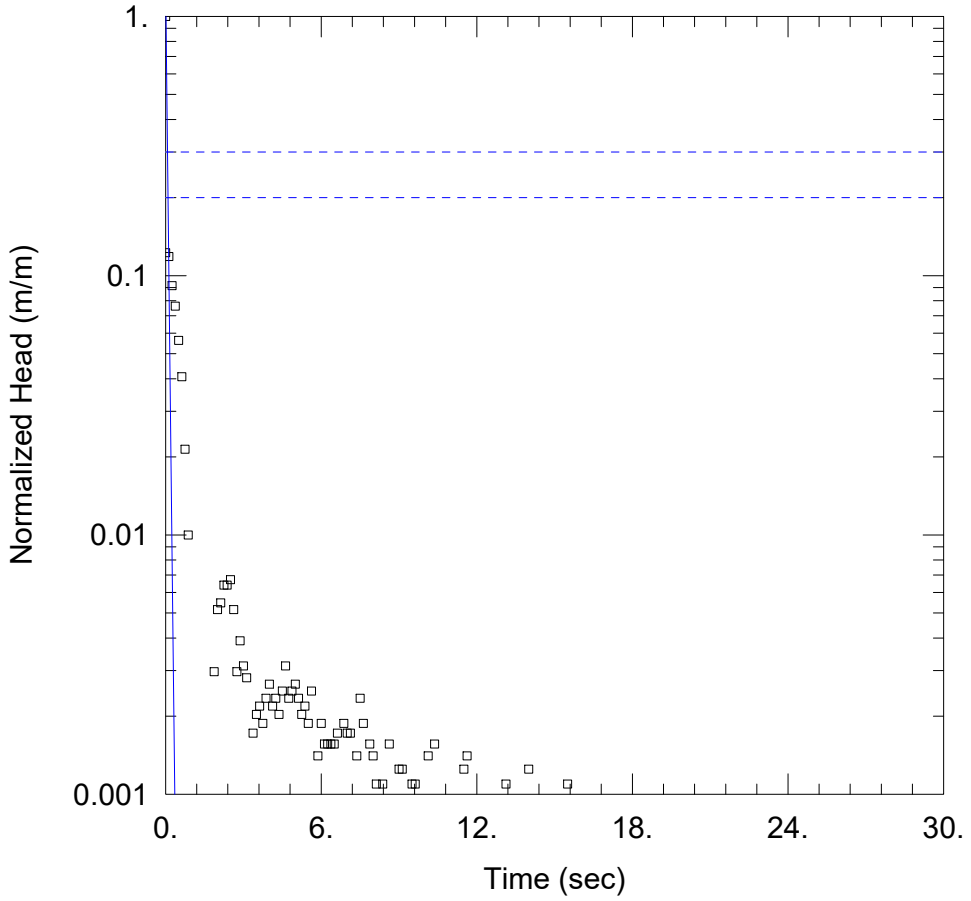
WELL DATA (BH04)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.025 m
Static Water Column Height: 2.49 m
Screen Length: 2. m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.05394 m/sec y0 = 34.57 m



BH04_RHT1

Data Set: \...\12645246_BH04_RHT1_BR.aqt
Date: 04/16/25 Time: 10:56:40

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH04
Test Well: BH04
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.49 m Anisotropy Ratio (Kz/Kr): 1.

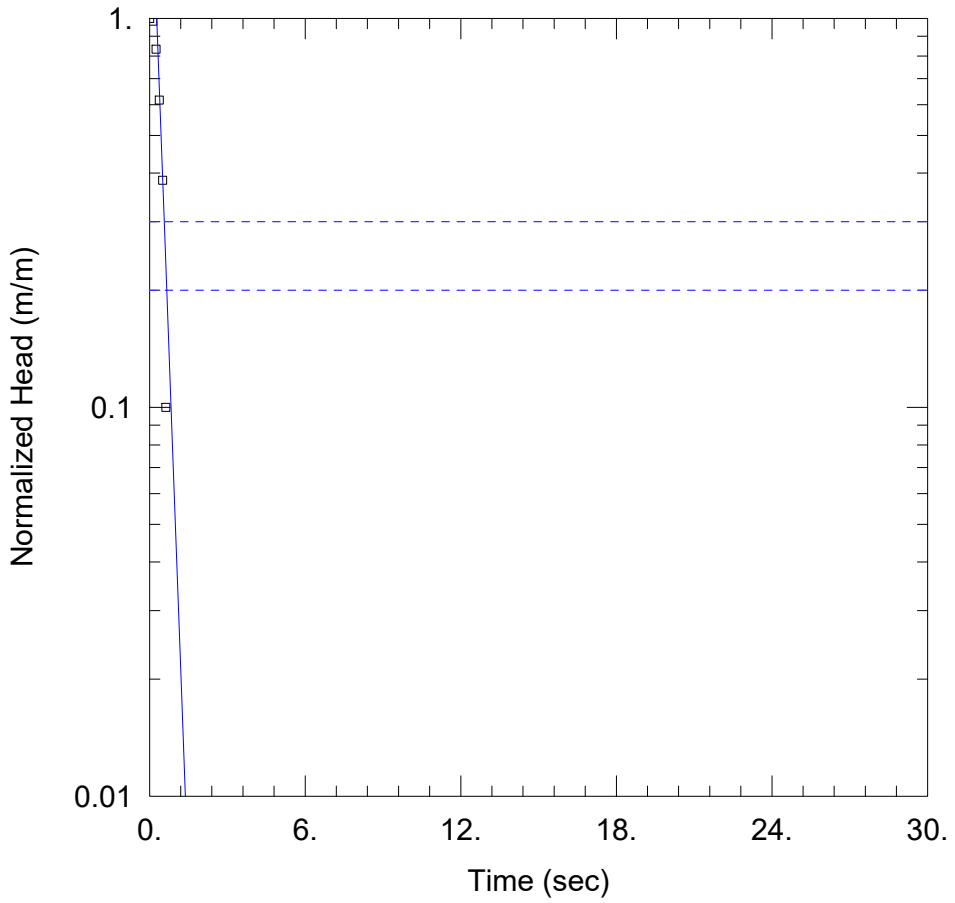
WELL DATA (BH04)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.025 m
Static Water Column Height: 2.49 m
Screen Length: 2. m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01473 m/sec y0 = 0.8358 m



BH04_RHT2

Data Set: \...\12645246_BH04_RHT2_BR.aqt
Date: 04/16/25 Time: 11:02:47

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH04
Test Well: BH04
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.49 m Anisotropy Ratio (Kz/Kr): 1.

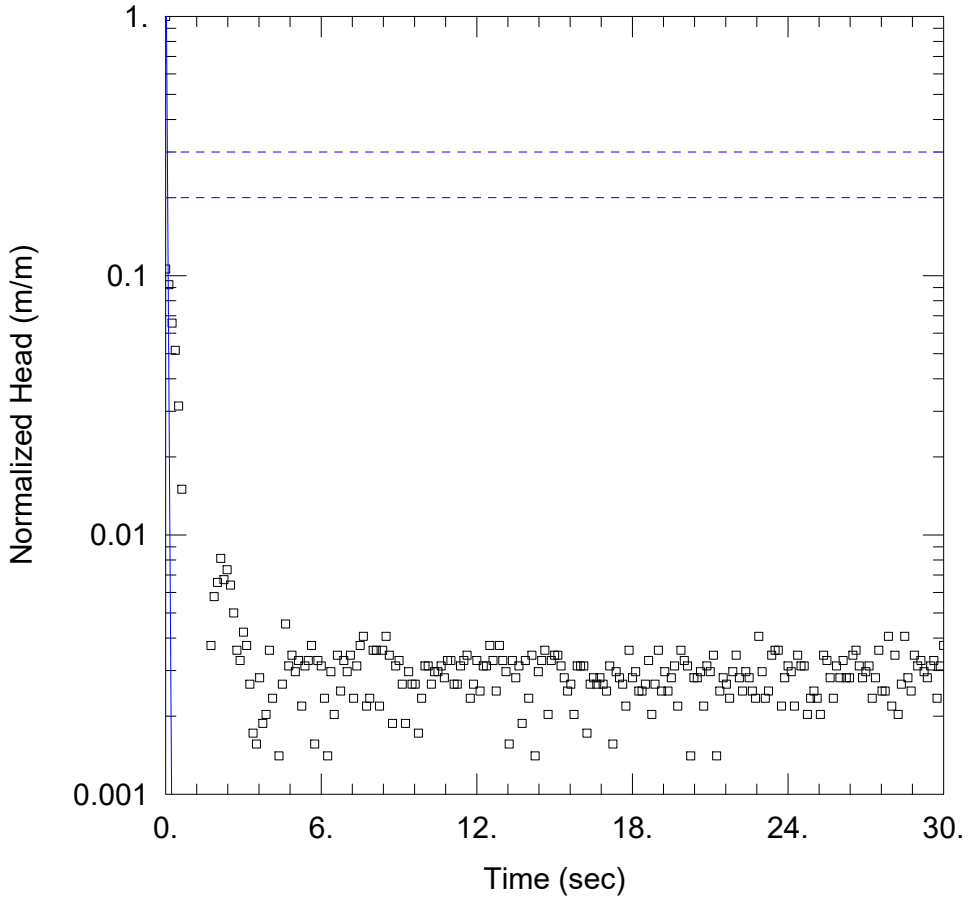
WELL DATA (BH04)

Initial Displacement: 0.06 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.025 m
Static Water Column Height: 2.49 m
Screen Length: 2. m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.003032 m/sec y0 = 0.1895 m



BH04_RHT3

Data Set: \...\12645246_BH04_RHT3_BR.aqt
Date: 04/16/25 Time: 11:05:13

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH04
Test Well: BH04
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 2.49 m Anisotropy Ratio (Kz/Kr): 1.

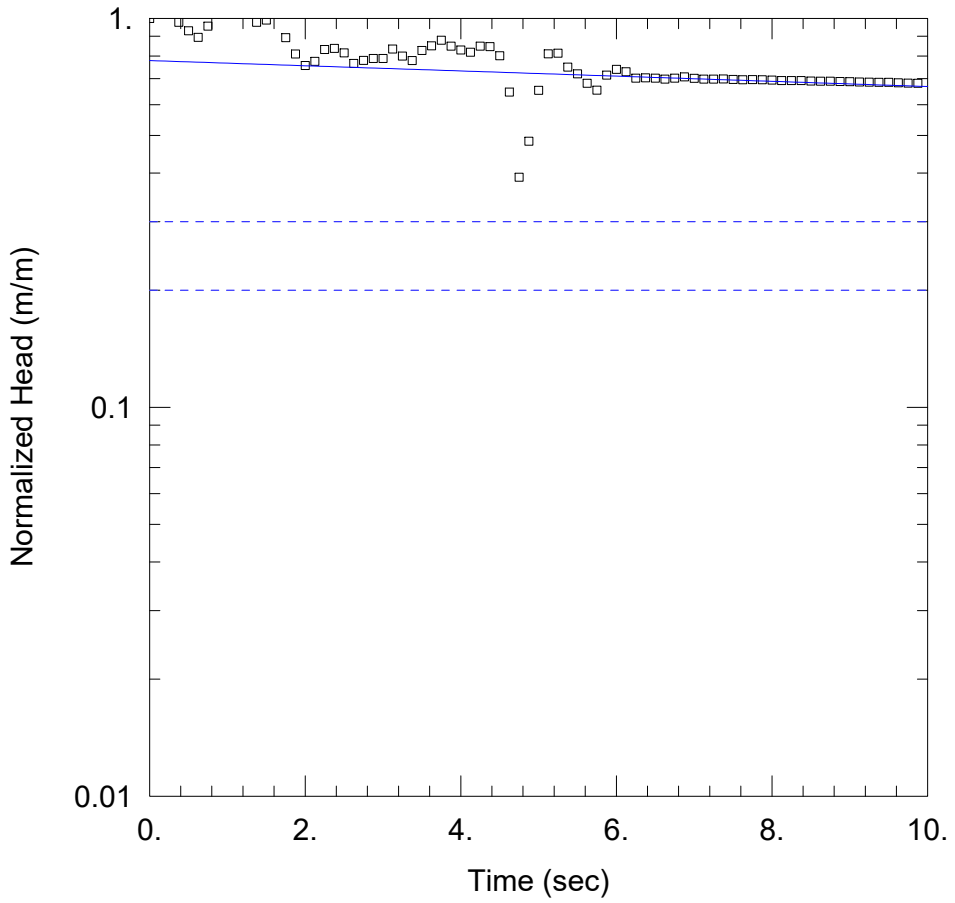
WELL DATA (BH04)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.025 m
Static Water Column Height: 2.49 m
Screen Length: 2. m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02561 m/sec y0 = 2.002 m



BH18_FHT1

Data Set: \...\12645246_BH18_FHT1_BR.aqt
Date: 04/16/25 Time: 11:07:48

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH18
Test Well: BH18
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 7.81 m Anisotropy Ratio (Kz/Kr): 1.

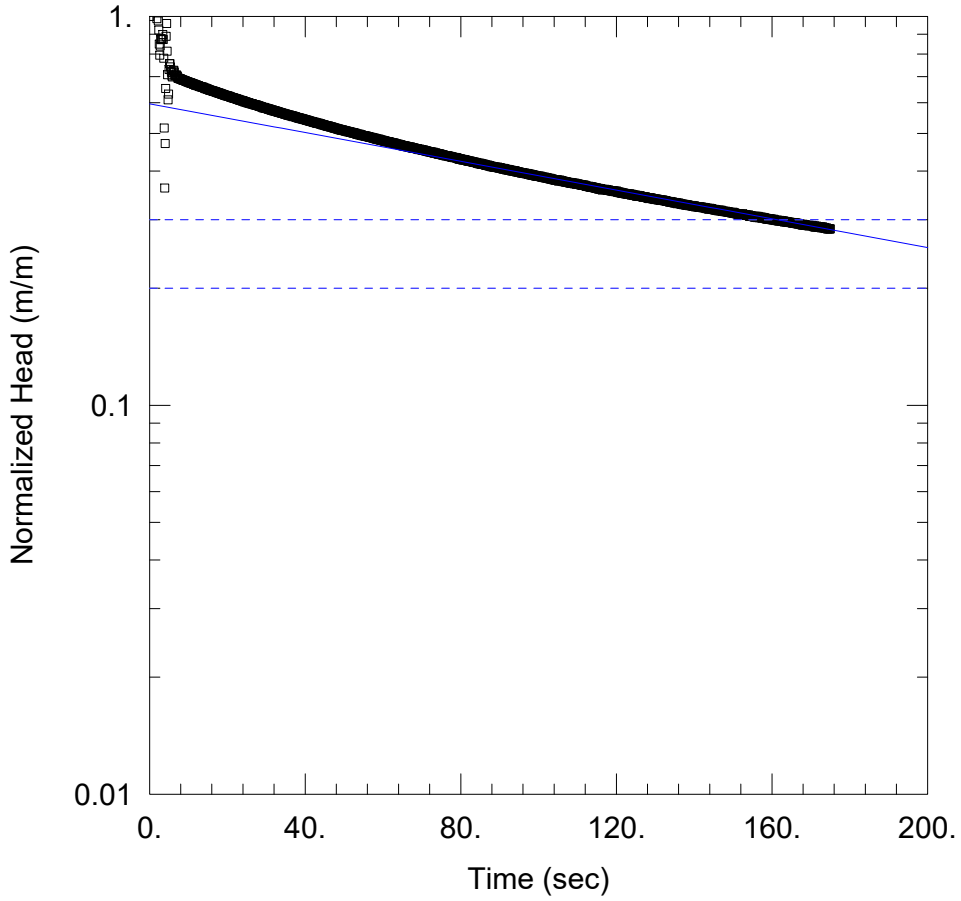
WELL DATA (BH18)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 6.81 m
Casing Radius: 0.025 m
Static Water Column Height: 7.81 m
Screen Length: 2. m
Well Radius: 0.05 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 7.359E-6 m/sec
y0 = 0.4986 m



BH18_FHT2

Data Set: \...\12645246_BH18_FHT2_BR.aqt
Date: 04/16/25 Time: 11:10:48

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH18
Test Well: BH18
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 7.81 m Anisotropy Ratio (Kz/Kr): 1.

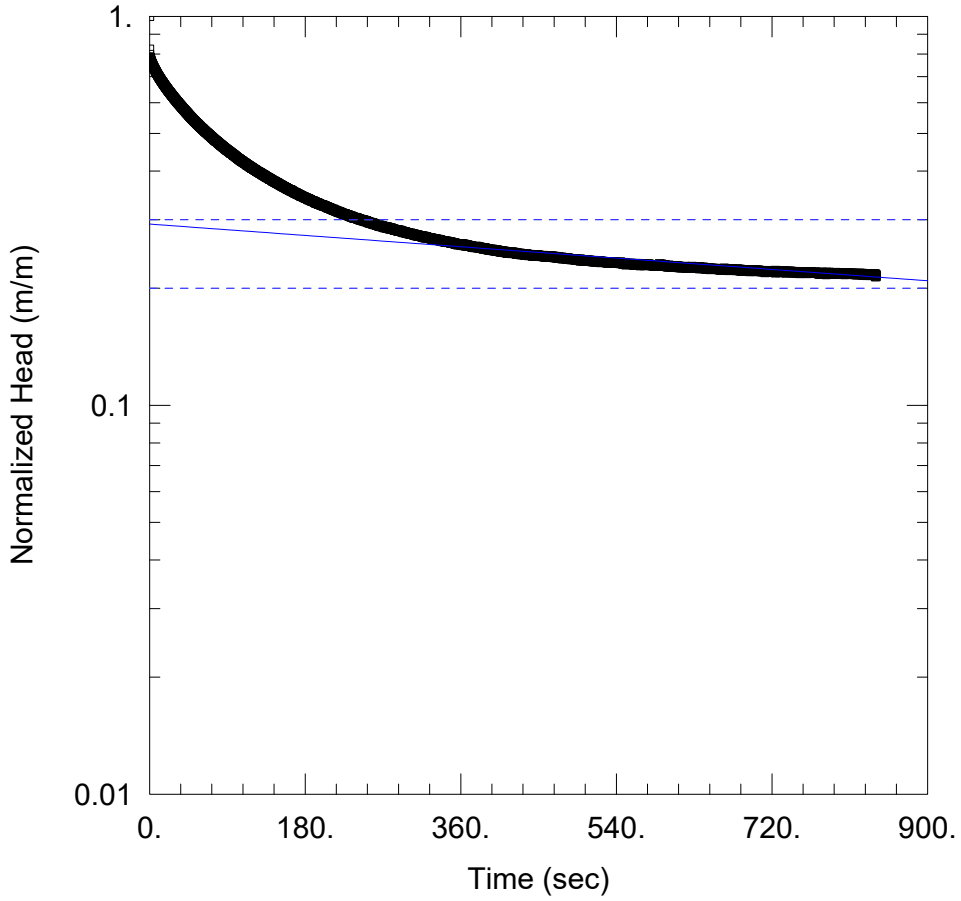
WELL DATA (BH18)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 6.81 m
Casing Radius: 0.025 m
Static Water Column Height: 7.81 m
Screen Length: 2. m
Well Radius: 0.05 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.037E-6 m/sec
y0 = 0.3814 m



BH18_FHT3

Data Set: \...\12645246_BH18_FHT3_BR.aqt
Date: 04/16/25 Time: 11:10:11

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH18
Test Well: BH18
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 7.81 m Anisotropy Ratio (Kz/Kr): 1.

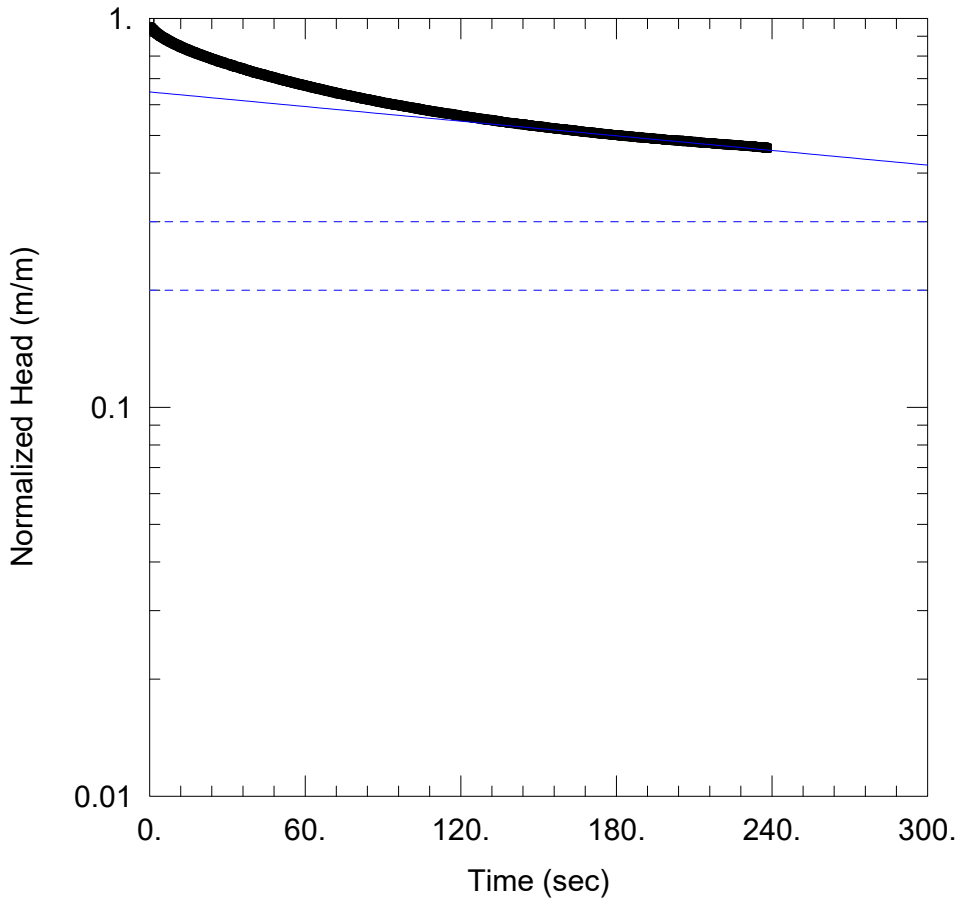
WELL DATA (BH18)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 6.81 m
Casing Radius: 0.025 m
Static Water Column Height: 7.81 m
Screen Length: 2. m
Well Radius: 0.05 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.784E-7 m/sec
y0 = 0.1871 m



BH18_RHT1

Data Set: \...\12645246_BH18_RHT1_BR.aqt
Date: 04/16/25 Time: 11:12:16

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH18
Test Well: BH18
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 7.81 m Anisotropy Ratio (Kz/Kr): 1.

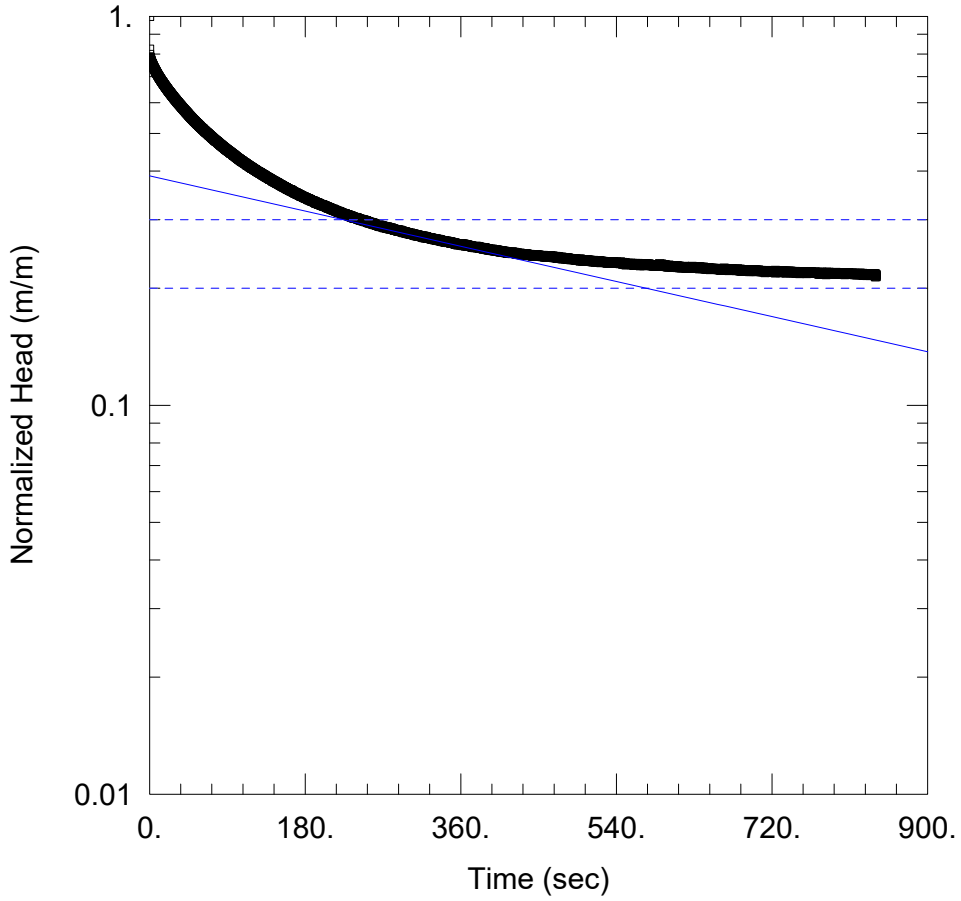
WELL DATA (BH18)

Initial Displacement: 0.547 m
Total Well Penetration Depth: 6.81 m
Casing Radius: 0.025 m
Static Water Column Height: 7.81 m
Screen Length: 2. m
Well Radius: 0.05 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 6.912E-7 m/sec
y0 = 0.3539 m



BH18_RHT2

Data Set: \...\12645246_BH18_RHT2_BR.aqt
Date: 04/16/25 Time: 11:15:17

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH18
Test Well: BH18
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 7.81 m Anisotropy Ratio (Kz/Kr): 1.

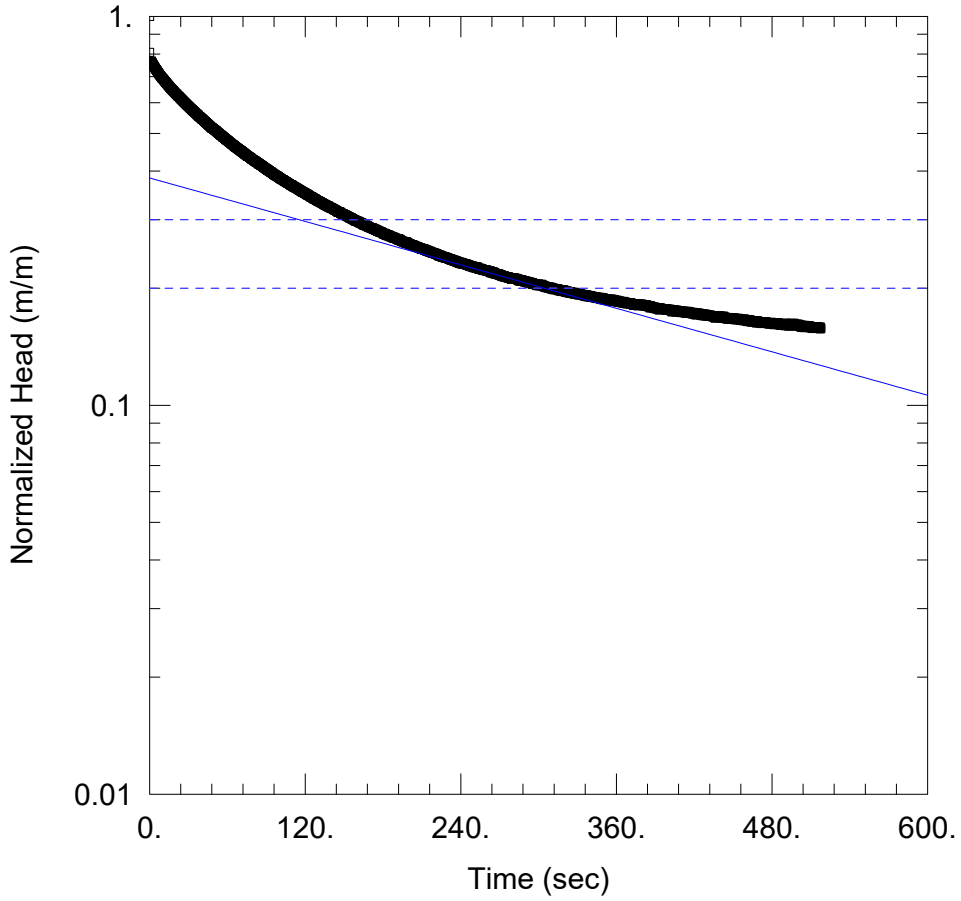
WELL DATA (BH18)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 6.81 m
Casing Radius: 0.025 m
Static Water Column Height: 7.81 m
Screen Length: 2. m
Well Radius: 0.05 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 5.538E-7 m/sec
y0 = 0.2488 m



BH18_RHT3

Data Set: \...\12645246_BH18_RHT3_BR.aqt
Date: 04/16/25 Time: 11:14:21

PROJECT INFORMATION

Company: GHD
Client: QLDC
Project: 12645246
Location: BH18
Test Well: BH18
Test Date: 11/04/2025

AQUIFER DATA

Saturated Thickness: 7.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH18)

Initial Displacement: 0.64 m
Total Well Penetration Depth: 6.81 m
Casing Radius: 0.025 m
Static Water Column Height: 7.81 m
Screen Length: 2. m
Well Radius: 0.05 m

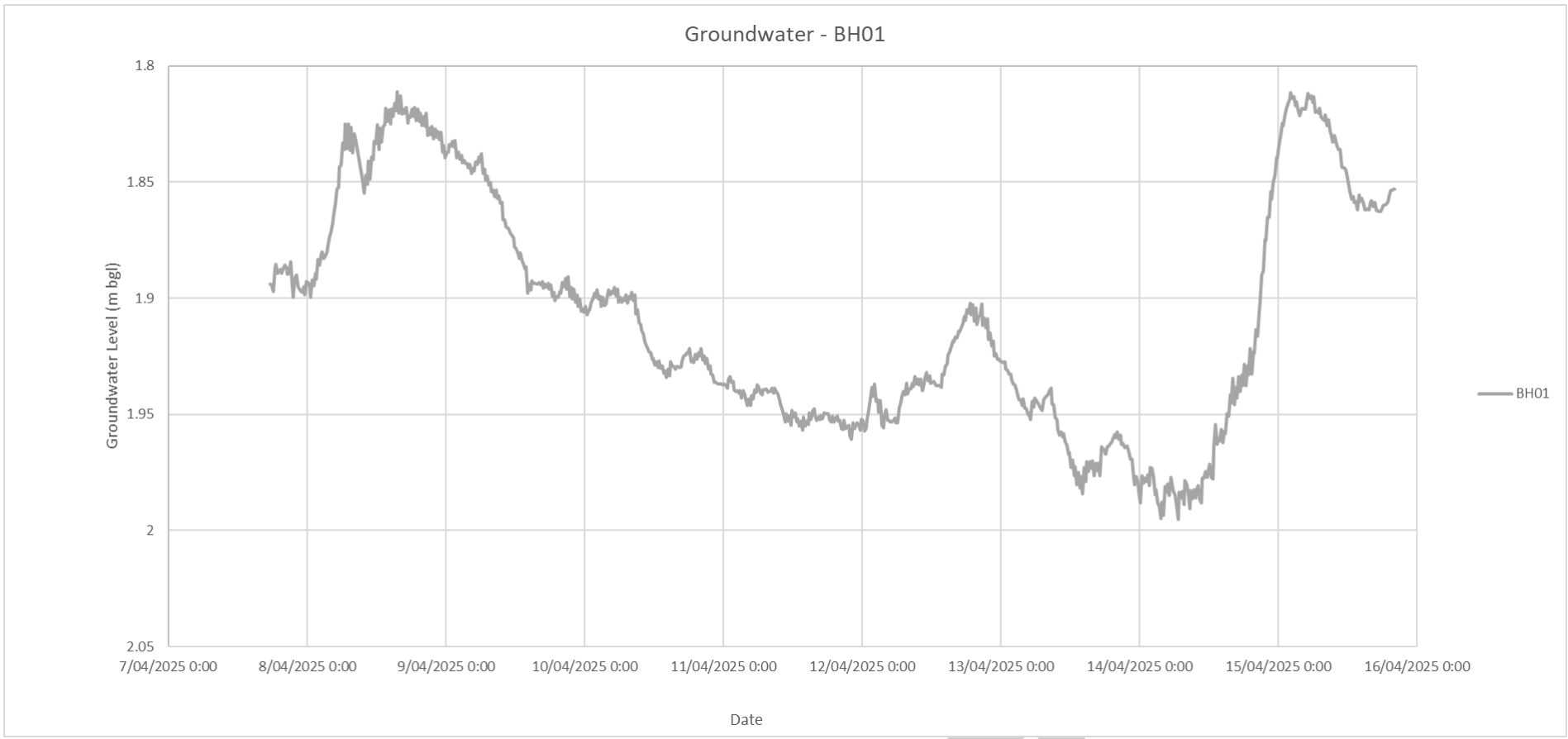
SOLUTION

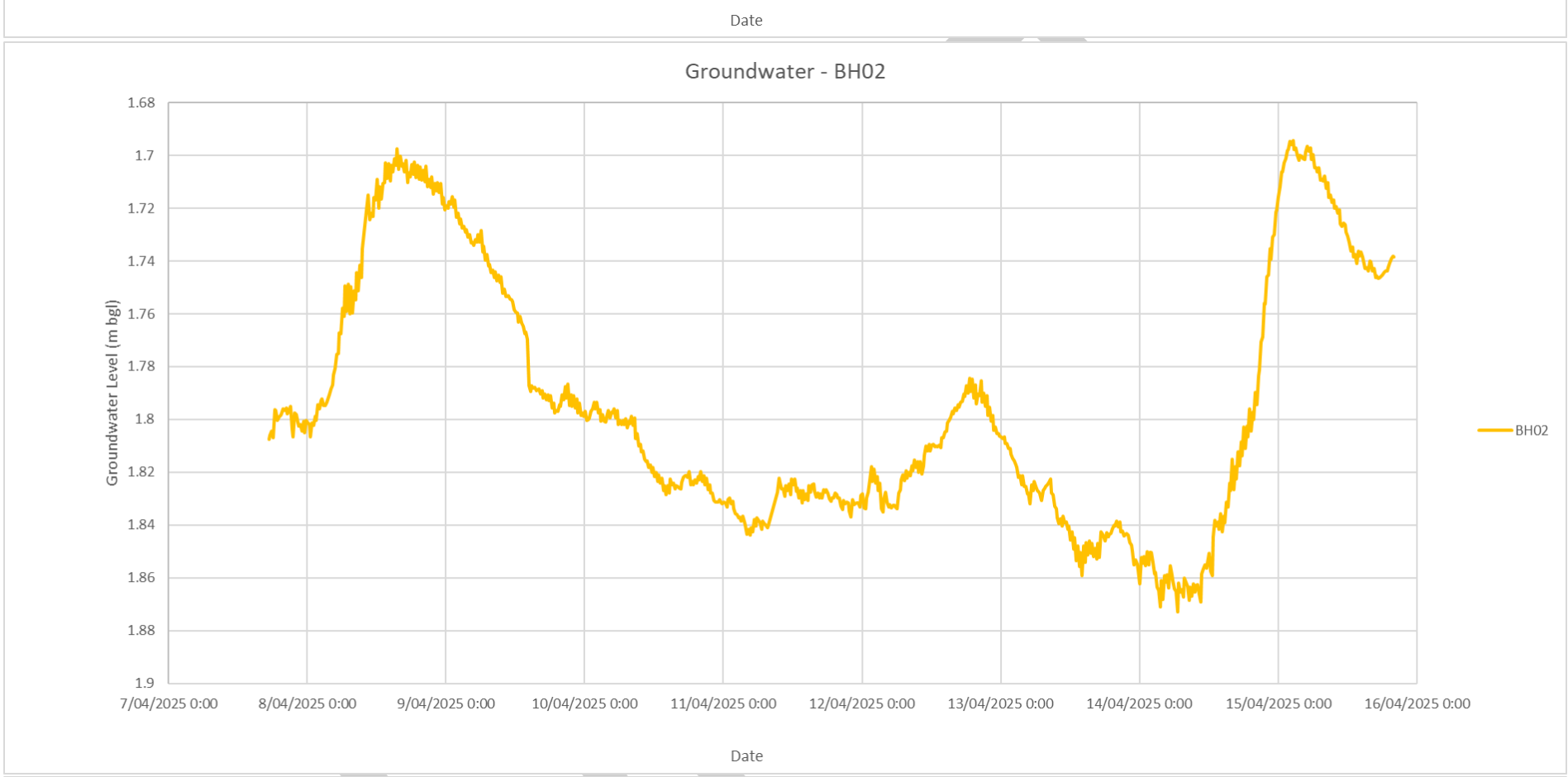
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

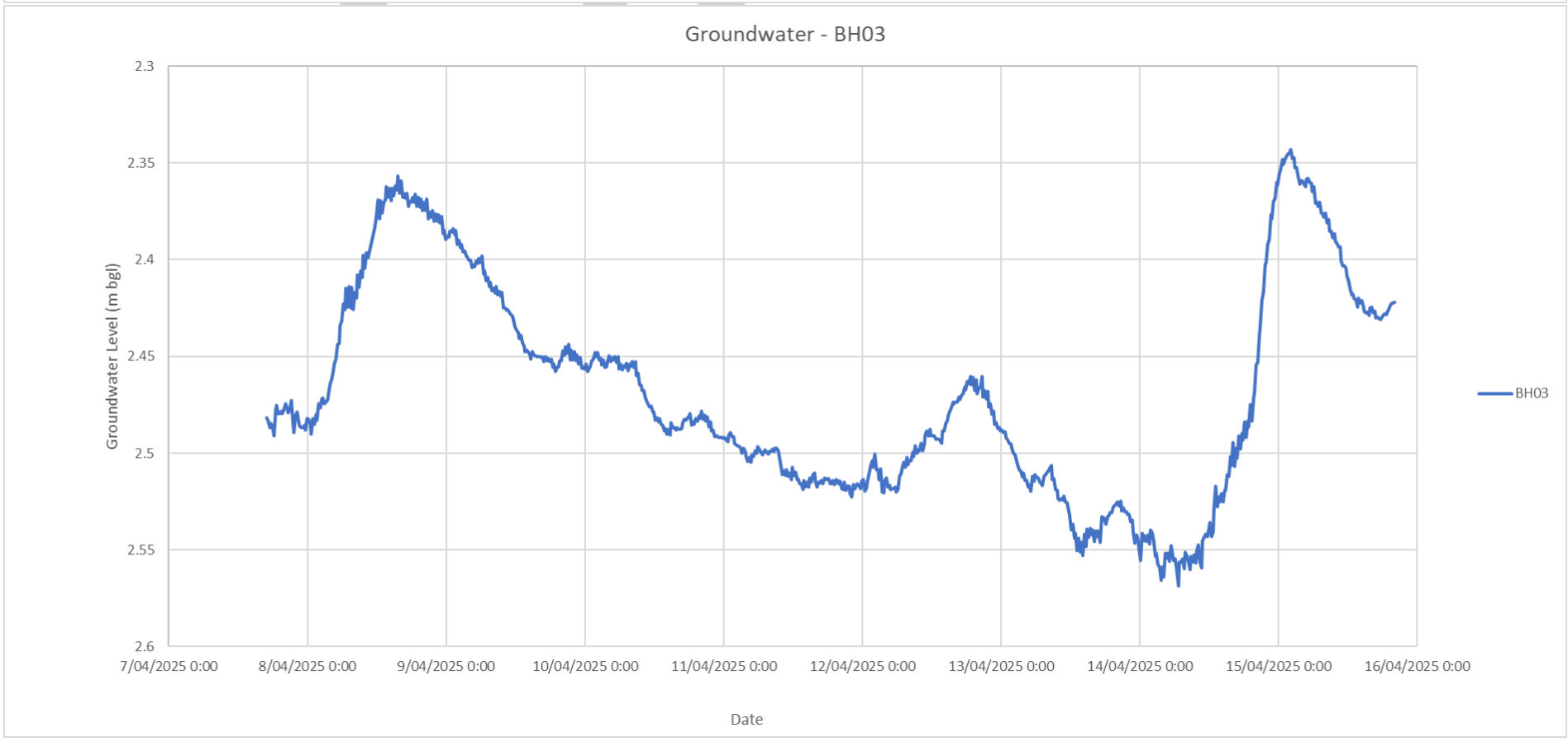
K = 1.027E-6 m/sec
y0 = 0.2459 m

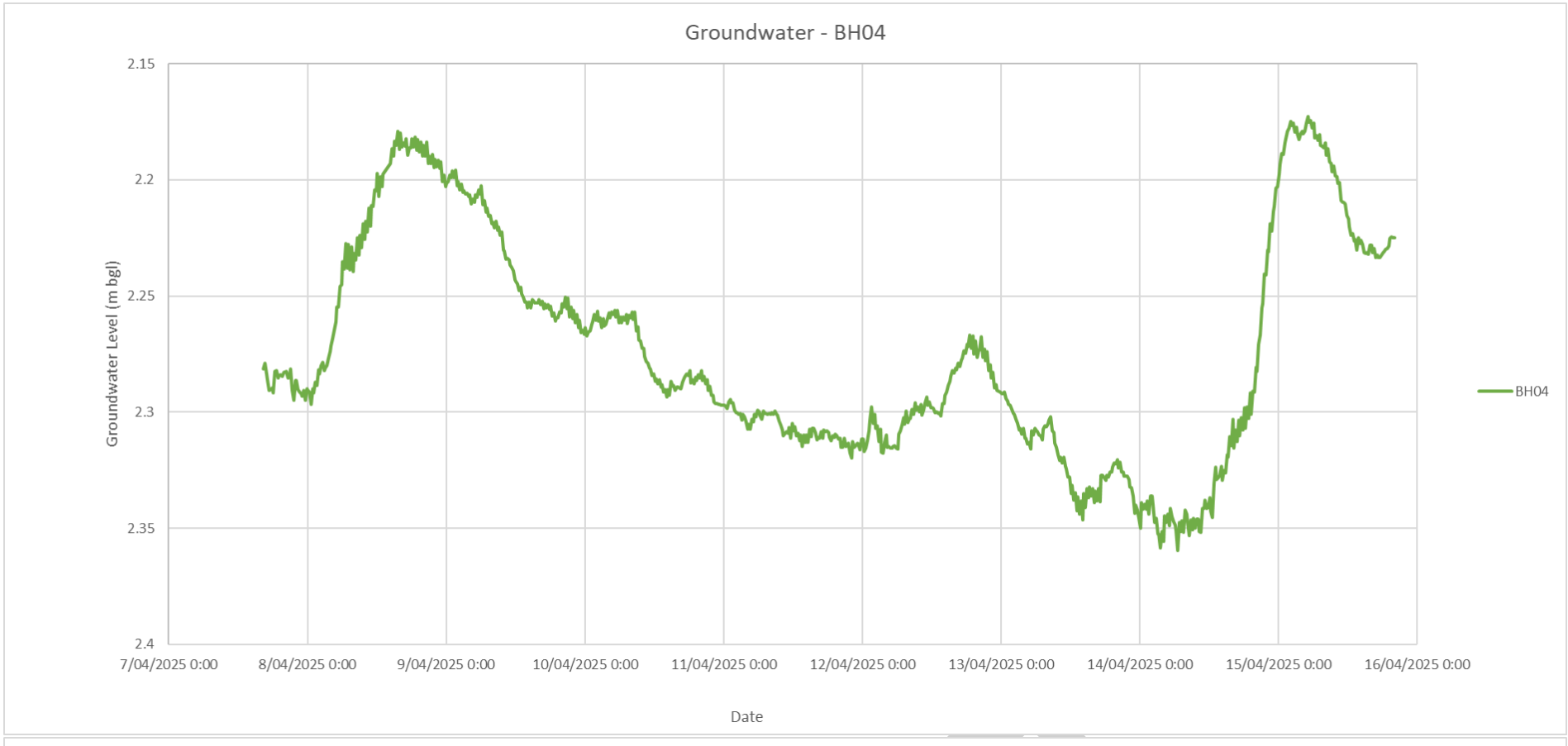
Appendix E

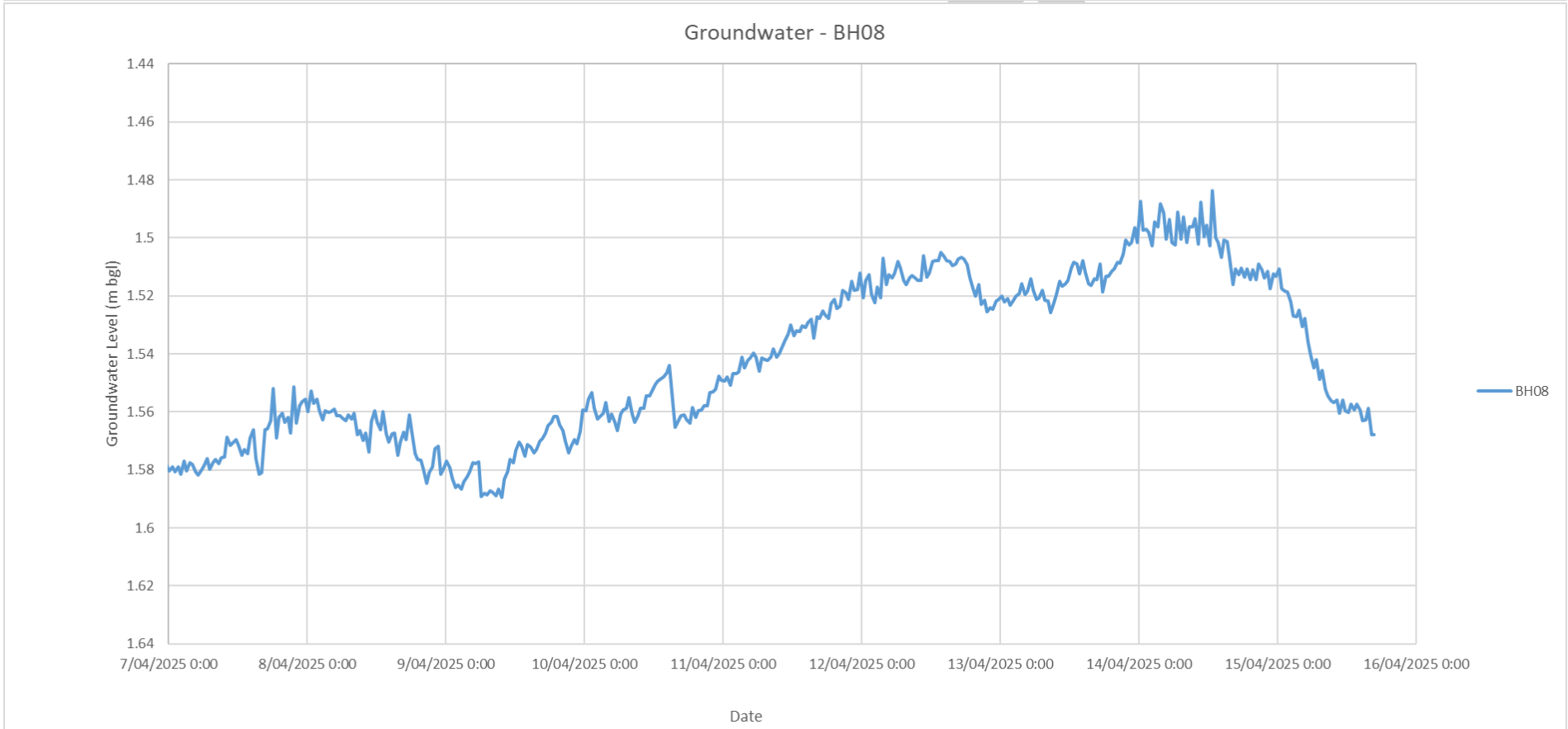
Groundwater monitoring

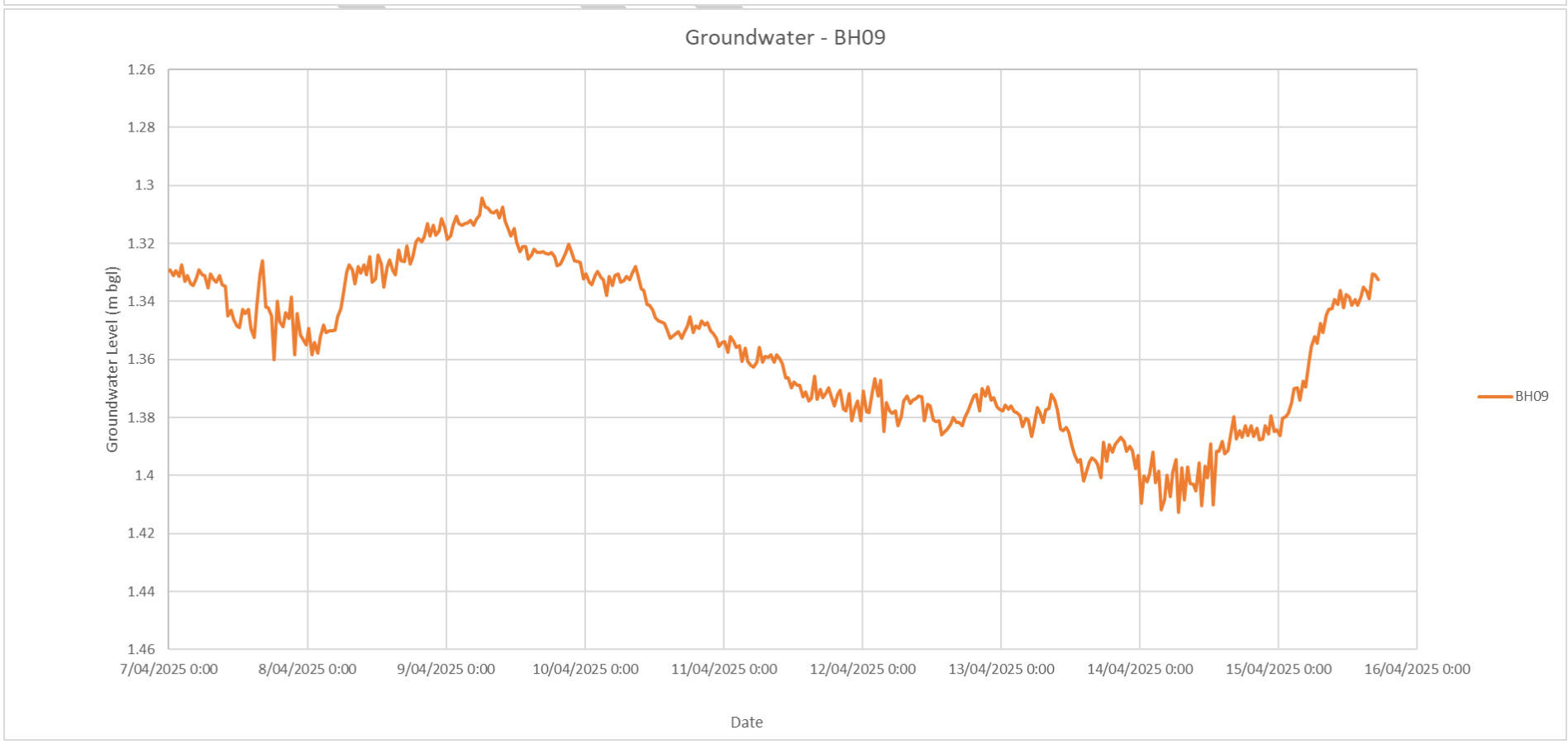

Groundwater - BH01
Groundwater Level (m bgl)
1.8
1.85
1.9
1.95
2
2.05
7/04/2025 0:00
8/04/2025 0:00
9/04/2025 0:00
10/04/2025 0:00
11/04/2025 0:00
12/04/2025 0:00
13/04/2025 0:00
14/04/2025 0:00
15/04/2025 0:00
16/04/2025 0:00
Date
BH01


Groundwater - BH02
Groundwater Level (m bgl)
1.68
1.7
1.72
1.74
1.76
1.78
1.8
1.82
1.84
1.86
1.88
1.9
7/04/2025 0:00
8/04/2025 0:00
9/04/2025 0:00
10/04/2025 0:00
11/04/2025 0:00
12/04/2025 0:00
13/04/2025 0:00
14/04/2025 0:00
15/04/2025 0:00
16/04/2025 0:00
Date
BH02


Groundwater - BH03
Groundwater Level (m bgl)
2.3
2.35
2.4
2.45
2.5
2.55
2.6
7/04/2025 0:00
8/04/2025 0:00
9/04/2025 0:00
10/04/2025 0:00
11/04/2025 0:00
12/04/2025 0:00
13/04/2025 0:00
14/04/2025 0:00
15/04/2025 0:00
16/04/2025 0:00
Date
BH03


Groundwater - BH04
Groundwater Level (m bgl)
2.15
2.2
2.25
2.3
2.35
2.4
7/04/2025 0:00
8/04/2025 0:00
9/04/2025 0:00
10/04/2025 0:00
11/04/2025 0:00
12/04/2025 0:00
13/04/2025 0:00
14/04/2025 0:00
15/04/2025 0:00
16/04/2025 0:00
Date
BH04


Groundwater - BH08
Groundwater Level (m bgl)
1.44
1.46
1.48
1.5
1.52
1.54
1.56
1.58
1.6
1.62
1.64
7/04/2025 0:00
8/04/2025 0:00
9/04/2025 0:00
10/04/2025 0:00
11/04/2025 0:00
12/04/2025 0:00
13/04/2025 0:00
14/04/2025 0:00
15/04/2025 0:00
16/04/2025 0:00
Date
BH08


Groundwater - BH09
Groundwater Level (m bgl)
1.26
1.28
1.3
1.32
1.34
1.36
1.38
1.4
1.42
1.44
1.46
7/04/2025 0:00
8/04/2025 0:00
9/04/2025 0:00
10/04/2025 0:00
11/04/2025 0:00
12/04/2025 0:00
13/04/2025 0:00
14/04/2025 0:00
15/04/2025 0:00
16/04/2025 0:00
Date
BH09

Appendix F

Laboratory results

ALS Food & Environmental NZ
Ruakura Research Centre
10 Bisley Road, Hamilton 3214, New Zealand
T: +64 7 974 4740
E: ALSEnviro.Hamilton@alsglobal.com

CERTIFICATE OF ANALYSIS

GHD Ltd

Queenstown

Attention: Dusk Mains
Phone: 0220487922
Email: dusk.mains@ghd.com

Sampling Site: Shotover

Lab Reference: 25-07104
Submitted by: Dusk Mains
Date Received: 11/03/2025
Testing Initiated: 11/03/2025
Date Completed: 17/03/2025
Order Number:
Reference:

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Anion/Cation Suite

	Client Sample ID		DS02	RS01	RS02	RS03	RS04
	Date Sampled		10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-1	25-07104-2	25-07104-3	25-07104-4	25-07104-5
pH	pH	*1*	7.8	7.8	7.8	7.8	7.8
Electrical Conductivity	µS/cm	*0.2*	481	138	139	134	138
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	112	57.5	56.6	58.7	58.7
Chloride	g/m^3	*0.5*	33.1	<0.50	<0.50	0.52	0.52
Sulfate	g/m^3	*0.15*	24.3	7.13	7.25	7.46	7.48
Nitrate-N	g/m^3	*0.002*	2.11	0.0146	0.0142	0.0141	0.0130
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	2.539	<0.002	<0.002	<0.002	<0.002
Ammoniacal-N	g/m^3	*0.005*	7.99	<0.005	<0.005	<0.005	<0.005
Sodium	g/m^3	*0.01*	57.2	1.58	1.55	1.58	1.59
Potassium	g/m^3	*0.05*	20.3	0.83	0.85	0.82	0.83
Calcium	g/m^3	*0.05*	35.8	24.6	24.2	24.8	24.5
Magnesium	g/m^3	*0.01*	6.71	1.49	1.46	1.49	1.48
Iron	g/m^3	*0.005*	0.29	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	g/m^3	*0.001*	0.070	<0.0010	<0.0010	<0.0010	<0.0010
Manganese	g/m^3	*0.0005*	0.034	0.00087	0.0010	0.0010	0.0010
Sum of Anions*	meq/L	*0.01*	3.88	1.31	1.29	1.36	1.36
Sum of Cations*	meq/L	*0.01*	5.93	1.44	1.42	1.45	1.44
EC/10*	(mS/m)/10	*0.002*	4.81	1.38	1.39	1.34	1.38

Anion/Cation Suite

Client Sample ID			RS05A	RS05B	RS06	RS07	RS08
Date Sampled			10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-6	25-07104-7	25-07104-8	25-07104-9	25-07104-10
pH	pH	*1*	7.8	7.9	7.8	7.9	7.7
Electrical Conductivity	µS/cm	*0.2*	138	138	464	335	438
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	58.0	56.2	171	127	155
Chloride	g/m^3	*0.5*	<0.50	0.57	28.9	17.3	30.4
Sulfate	g/m^3	*0.15*	7.43	7.43	4.38	7.02	4.50
Nitrate-N	g/m^3	*0.002*	0.0121	0.0089	0.0845	0.321	0.246
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	0.148	0.117	0.211
Ammoniacal-N	g/m^3	*0.005*	<0.005	<0.005	9.99	2.51	1.56
Sodium	g/m^3	*0.01*	1.57	1.53	33.8	20.8	36.0
Potassium	g/m^3	*0.05*	0.83	0.83	13.4	7.31	8.11
Calcium	g/m^3	*0.05*	24.4	24.4	32.8	37.1	47.5
Magnesium	g/m^3	*0.01*	1.45	1.46	3.36	2.81	2.88
Iron	g/m^3	*0.005*	<0.0050	<0.0050	0.022	0.0050	0.010
Zinc	g/m^3	*0.001*	<0.0010	<0.0010	<0.0010	<0.0010	0.0058
Manganese	g/m^3	*0.0005*	0.0011	0.0011	2.85	1.80	0.908
Sum of Anions*	meq/L	*0.01*	1.33	1.31	4.36	3.22	4.10
Sum of Cations*	meq/L	*0.01*	1.43	1.43	4.55	3.42	4.53
EC/10*	(mS/m)/10	*0.002*	1.38	1.38	4.64	3.35	4.38

Total Nitrogen / Kjeldahl Nitrogen in Water

Client Sample ID			DS02	RS01	RS02	RS03	RS04
Date Sampled			10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-1	25-07104-2	25-07104-3	25-07104-4	25-07104-5
Total Kjeldahl Nitrogen	g/m^3	*0.1*	9.91	0.10	<0.10	<0.10	<0.10
Total Nitrogen	g/m^3	*0.1*	12	0.12	<0.10	<0.10	<0.10

Total Nitrogen / Kjeldahl Nitrogen in Water

Client Sample ID			RS05A	RS05B	RS06	RS07	RS08
Date Sampled			10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-6	25-07104-7	25-07104-8	25-07104-9	25-07104-10
Total Kjeldahl Nitrogen	g/m^3	*0.1*	<0.10	0.11	9.74	2.80	1.92
Total Nitrogen	g/m^3	*0.1*	<0.10	0.12	9.9	3.2	2.2

Inorganic Nutrients and Nutrient Species in Water

Client Sample ID			DS02	RS01	RS02	RS03	RS04
Date Sampled			10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-1	25-07104-2	25-07104-3	25-07104-4	25-07104-5
Nitrite-N	g/m^3	*0.001*	0.335	<0.0010	<0.0010	<0.0010	<0.0010

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS05A	RS05B	RS06	RS07	RS08
	Date Sampled		10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-6	25-07104-7	25-07104-8	25-07104-9	25-07104-10
Nitrite-N	g/m^3	*0.001*	<0.0010	<0.0010	0.0413	0.113	0.0337

Total Phosphorus in Water

	Client Sample ID		DS02	RS01	RS02	RS03	RS04
	Date Sampled		10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-1	25-07104-2	25-07104-3	25-07104-4	25-07104-5
Total Phosphorus	g/m^3	*0.005*	2.61	<0.0050	<0.0050	<0.0050	<0.0050

Total Phosphorus in Water

	Client Sample ID		RS05A	RS05B	RS06	RS07	RS08
	Date Sampled		10/03/2025	10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analyte	Unit	*Reporting Limit*	25-07104-6	25-07104-7	25-07104-8	25-07104-9	25-07104-10
Total Phosphorus	g/m^3	*0.005*	<0.0050	<0.0050	0.26	0.12	0.21

Method Summary

pH	Samples measured as received using a conventional pH electrode. (APHA 4500 H^+ B. Online edition).
Electrical Conductivity	Samples analysed as received using a conventional conductivity electrode. (APHA 2510 B - Modified - Auto-titrator - Online edition).
Total Alkalinity ($CaCO_3$)	Samples analysed as received by potentiometric titration. (APHA 2320 B Online edition).
Chloride	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110 B - Online edition).
Sulfate	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110B - Online edition).
NO3-N	Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). In house procedure based on US EPA 200.8.
Sum of Anions	Sum of milliequivalents/Litre of measured Anions.
Sum of Cations	Sum of milliequivalents/Litre of measured Cations.
TKN	Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).
TN	Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).
NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).

Method Summary

Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)

Matthew Counsell, B.Sc.
Environmental Lab Manager

Rowin Angkico, B.Sc.
Laboratory Technician

Deanna Rhind
Technician

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-006939-01** REPORT DATE **11/03/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com

Copy to: QLDC Lab Results (lab.results@qldc.govt.nz), Lado (celeste.lado@veolia.com), Soria (francisco.soria@veolia.com), Spooner

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 10/03/2025 3:54:06pm
Submission Reference: GHD samples
Order code: EUNZCH-00210374
Reception temperature: 17.4 °C
Purchase Order Number: GHD/Veolia

SAMPLE CODE:			**817-2025-00024950**	**817-2025-00024951**	**817-2025-00024952**	**817-2025-00024953**
Sample Name:			DS02	RS01	RS02	RS03
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analysis Ending Date:			11/03/2025	11/03/2025	11/03/2025	11/03/2025
Product Type			raw water	raw water	raw water	raw water
Sampled Date & Time			10/03/2025 11:00	10/03/2025 12:30	10/03/2025 13:45	10/03/2025 13:30
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	107.6	3.1	12.2	15.8
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	> 2420	547.5	461.1	547.5

SAMPLE CODE:			**817-2025-00024954**	**817-2025-00024955**	**817-2025-00024956**	**817-2025-00024957**
Sample Name:			RS04	RS05A	RS05B	RS06
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			10/03/2025	10/03/2025	10/03/2025	10/03/2025
Analysis Ending Date:			11/03/2025	11/03/2025	11/03/2025	11/03/2025
Product Type			raw water	raw water	raw water	raw water
Sampled Date & Time			10/03/2025 13:45	10/03/2025 14:30	10/03/2025 14:00	10/03/2025 14:30
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	11.9	13.4	7.5	275.5
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	435.2	313	275.5	> 2420

SAMPLE CODE:			**817-2025-00024958**	**817-2025-00024959**		
Sample Name:			RS07	RS08		
Product Type:			Surface water, raw water	Surface water, raw water		
Analysis Started on:			10/03/2025	10/03/2025		
Analysis Ending Date:			11/03/2025	11/03/2025		
Product Type			raw water	raw water		
Sampled Date & Time			10/03/2025 15:00	10/03/2025 15:00		
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	579.4	231		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	> 2420	> 2420		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

Tomas Hais Key Technical Person K.T.P

EXPLANATORY NOTE

①Test is not accredited
②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
⑥Test result is provided by the customer and is not accredited
⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

The Customer acknowledges and accepts that: (a) where Eurofins is not responsible for sampling, the test result(s) in this report apply only to the sample as received. Customer is solely responsible for the sampling process and warrants that the sample provided to Eurofins is representative of the lot / batch from which the samples were drawn; and (b) Eurofins expresses no opinion and accepts no liability in respect of the Customer's production process or homogeneity of the product.
This document can only be reproduced in full.
The tests are identified by a five-digit code, their description is available on request.
Accreditation does not apply to comments or graphical representations.
Unless otherwise stated, all tests in this analytical report (except for subcontracted tests) are performed at 43 Detroit Drive, Rolleston, Christchurch, NEW ZEALAND.
The laboratory is not responsible for the information provided by the customer which can affect the validity of the results, for example: sampling information such as date/time, field data etc.
Eurofins may subcontract the performance of part or all of the Services to a third party and the Customer authorises the release of all information necessary to the third party for the provision of the Services.
All samples become the property of Eurofins to the extent necessary for the performance of the Services.
Eurofins will not be required to store samples and may destroy or otherwise dispose of the samples or return the samples to the Customer (at the Customer's cost in all respects) immediately following analysis of the samples.
If the Customer pays for storage of the samples Eurofins will take commercially reasonable steps to store the samples for the agreed period in terms of industry practice.
The Eurofins water sampling service follows methodology based on AS/NZS 5667 and / or best practice to collect and transport samples that are fit for the purpose of analytical testing. The laboratory is not responsible for sampling activities unless explicitly indicated by the statement "Sampled by Eurofins" on the report for water samples.
The Customer acknowledges that the Services are provided using the current state of technology and methods developed and generally applied by Eurofins and involve analysis, interpretations, consulting work and conclusions. Eurofins shall use commercially reasonable degree of care in providing the Services.
This report is produced and issued on the basis of information, documents and/or samples provided by, or on behalf of, the Customer and solely for the benefit of the Customer who is responsible for acting as it sees fit on the basis of this report. Neither Eurofins nor any of its officers, employees, agents or subcontractors shall be liable to the Customer nor any third party for any actions taken or not taken on the basis of this report nor for any incorrect results arising from unclear, erroneous, incomplete, misleading or false information provided to Eurofins.
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END OF REPORT

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CERTIFICATE OF ANALYSIS

GHD Ltd

Queenstown

Attention: Dusk Mains
Phone: 027 739 3037
Email: dusk.mains@ghd.com

Sampling Site: Shotover

Lab Reference: 25-07376
Submitted by: D. Mains
Date Received: 13/03/2025
Testing Initiated: 13/03/2025
Date Completed: 19/03/2025
Order Number:
Reference: 12645246

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Anion/Cation Suite

	Client Sample ID		RS06B	RS09	RS09B	DS04	RS11
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-1	25-07376-3	25-07376-4	25-07376-5	25-07376-6
pH	pH	*1*	7.8	7.8	7.7	7.6	7.5
Electrical Conductivity	µS/cm	*0.2*	140	140	216	486	106
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	57.6	56.5	85.5	121	37.8
Chloride	g/m^3	*0.5*	0.53	0.55	4.17	37.1	2.91
Sulfate	g/m^3	*0.15*	7.09	7.35	9.44	20.4	4.13
Nitrate-N	g/m^3	*0.002*	0.0212	0.0177	0.359	0.355	0.278
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	0.002	5.696	<0.002
Ammoniacal-N	g/m^3	*0.005*	0.03	0.03	0.01	7.08	0.63
Sodium	g/m^3	*0.01*	1.88	1.76	6.07	52.2	4.61
Potassium	g/m^3	*0.05*	0.89	0.89	2.2	20.7	1.7
Calcium	g/m^3	*0.05*	24.1	24.1	34.4	21.1	14.6
Magnesium	g/m^3	*0.01*	1.55	1.49	1.80	4.54	0.96
Iron	g/m^3	*0.005*	0.011	0.052	<0.0050	0.589	0.029
Zinc	g/m^3	*0.001*	<0.0010	0.0013	<0.0010	0.016	0.0012
Manganese	g/m^3	*0.0005*	0.0068	0.010	0.0099	0.050	0.136
Sum of Anions*	meq/L	*0.01*	1.33	1.31	2.06	4.00	0.95
Sum of Cations*	meq/L	*0.01*	1.44	1.43	2.19	4.76	1.10
EC/10*	(mS/m)/10	*0.002*	1.40	1.40	2.16	4.86	1.06

Anion/Cation Suite

Client Sample ID			RS14	RS13	RS12	RS10
Date Sampled			11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-11	25-07376-12	25-07376-13	25-07376-14
pH	pH	*1*	7.3	7.6	7.3	7.8
Electrical Conductivity	µS/cm	*0.2*	60.4	230	137	157
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	23.2	103	46.9	64.8
Chloride	g/m^3	*0.5*	<0.50	2.01	6.59	0.59
Sulfate	g/m^3	*0.15*	3.69	5.49	4.69	7.98
Nitrate-N	g/m^3	*0.002*	0.0064	0.113	0.258	0.0571
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	0.063	<0.002
Ammoniacal-N	g/m^3	*0.005*	<0.005	0.44	1.06	<0.005
Sodium	g/m^3	*0.01*	1.25	3.30	10.3	1.99
Potassium	g/m^3	*0.05*	0.42	1.3	3.5	0.91
Calcium	g/m^3	*0.05*	9.93	34.3	15.4	28.3
Magnesium	g/m^3	*0.01*	0.61	1.77	1.25	1.76
Iron	g/m^3	*0.005*	0.0098	0.0070	0.016	0.0085
Zinc	g/m^3	*0.001*	<0.0010	0.0014	<0.0010	<0.0010
Manganese	g/m^3	*0.0005*	0.0024	0.031	0.582	0.0096
Sum of Anions*	meq/L	*0.01*	0.54	2.26	1.24	1.49
Sum of Cations*	meq/L	*0.01*	0.61	2.07	1.51	1.67
EC/10*	(mS/m)/10	*0.002*	0.60	2.30	1.37	1.57

Inorganic Nutrients and Nutrient Species in Water

Client Sample ID			RS06B	BS03	RS09	RS09B	DS04
Date Sampled			11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-1	25-07376-2	25-07376-3	25-07376-4	25-07376-5
Nitrate-N	g/m^3	*0.002*		8.04			
Nitrite-N	g/m^3	*0.001*	<0.0010	0.263	<0.0010	0.0020	0.0415
Ammoniacal-N	g/m^3	*0.005*		3.38			
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*		<0.002			

Inorganic Nutrients and Nutrient Species in Water

Client Sample ID			RS11	BS01	BS05	BS04	BS02
Date Sampled			11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-6	25-07376-7	25-07376-8	25-07376-9	25-07376-10
Nitrate-N	g/m^3	*0.002*		12.0	4.28	3.11	3.64
Nitrite-N	g/m^3	*0.001*	0.0046	0.122	0.200	0.0345	0.0127
Ammoniacal-N	g/m^3	*0.005*		0.24	4.48	4.35	0.03
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*		<0.002	<0.002	0.394	0.006

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS14	RS13	RS12	RS10
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-11	25-07376-12	25-07376-13	25-07376-14
Nitrite-N	g/m^3	*0.001*	<0.0010	0.0033	0.0027	<0.0010

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS06B	BS03	RS09	RS09B	DS04
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-1	25-07376-2	25-07376-3	25-07376-4	25-07376-5
Total Kjeldahl Nitrogen	g/m^3	*0.1*	<0.10	8.81	1.10	<0.10	13.2
Total Nitrogen	g/m^3	*0.1*	<0.10	17	1.1	0.36	14

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS11	BS01	BS05	BS04	BS02
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-6	25-07376-7	25-07376-8	25-07376-9	25-07376-10
Total Kjeldahl Nitrogen	g/m^3	*0.1*	0.72	1.98	5.99	8.67	1.95
Total Nitrogen	g/m^3	*0.1*	1.0	14	10	12	5.6

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS14	RS13	RS12	RS10
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-11	25-07376-12	25-07376-13	25-07376-14
Total Kjeldahl Nitrogen	g/m^3	*0.1*	<0.10	0.40	2.78	<0.10
Total Nitrogen	g/m^3	*0.1*	<0.10	0.52	3.0	<0.10

Total Phosphorus in Water

	Client Sample ID		RS06B	BS03	RS09	RS09B	DS04
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-1	25-07376-2	25-07376-3	25-07376-4	25-07376-5
Total Phosphorus	g/m^3	*0.005*	<0.0050	17.5	0.0051	<0.0050	6.81

Total Phosphorus in Water

	Client Sample ID		RS11	BS01	BS05	BS04	BS02
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-6	25-07376-7	25-07376-8	25-07376-9	25-07376-10
Total Phosphorus	g/m^3	*0.005*	<0.0050	3.88	0.26	1.63	31.4

Total Phosphorus in Water

	Client Sample ID		RS14	RS13	RS12	RS10
	Date Sampled		11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analyte	Unit	*Reporting Limit*	25-07376-11	25-07376-12	25-07376-13	25-07376-14
Total Phosphorus	g/m^3	*0.005*	<0.0050	<0.0050	0.064	<0.0050

Method Summary

pH	Samples measured as received using a conventional pH electrode. (APHA 4500 H^+ B. Online edition).
Electrical Conductivity	Samples analysed as received using a conventional conductivity electrode. (APHA 2510 B - Modified - Auto-titrator - Online edition).
Total Alkalinity ($CaCO_3$)	Samples analysed as received by potentiometric titration. (APHA 2320 B Online edition).
Chloride	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110 B - Online edition).
Sulfate	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110B - Online edition).
NO3-N	Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). In house procedure based on US EPA 200.8.
Sum of Anions	Sum of milliequivalents/Litre of measured Anions.
Sum of Cations	Sum of milliequivalents/Litre of measured Cations.
NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).
TKN	Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).
TN	Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).
Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)

Matthew Counsell, B.Sc.
Environmental Lab Manager

Rowin Angkico, B.Sc.
Laboratory Technician

L. Coombridge
Louise Coombridge, B.Sc.
Chemist

Deanna Rhind
Technician

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-007055-01** REPORT DATE **12/03/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 11/03/2025 2:24:13pm
Submission Reference: GHD/Veolia Samples shotover
Order code: EUNZCH-00210559
Purchase Order Number: 455236

SAMPLE CODE:			**817-2025-00025874**	**817-2025-00025875**	**817-2025-00025876**	**817-2025-00025877**
Sample Name:			RS09	DS04	RS6B	RS11
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analysis Ending Date:			12/03/2025	12/03/2025	12/03/2025	12/03/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			Dusk Mains	Dusk Mains	Dusk Mains	Dusk Mains
Sampled Date & Time			11/03/2025 12:00	11/03/2025 12:30	11/03/2025 12:00	11/03/2025 11:30
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	> 2420	> 2420	40.5	17.3
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	> 2420	> 2420	579.4	217.8

SAMPLE CODE:			**817-2025-00025878**	**817-2025-00025879**	**817-2025-00025880**	**817-2025-00025881**
Sample Name:			RS09B	RS12	RS13	RS14
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			11/03/2025	11/03/2025	11/03/2025	11/03/2025
Analysis Ending Date:			12/03/2025	12/03/2025	12/03/2025	12/03/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			Dusk Mains	Dusk Mains	Dusk Mains	Dusk Mains
Sampled Date & Time			11/03/2025 12:00	11/03/2025 12:00	11/03/2025 12:00	11/03/2025 12:00
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	47.3	39.9	82	33.6
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	547.5	387.3	313	410.6

SAMPLE CODE:			**817-2025-00025882**		
Sample Name:			RS10		
Product Type:			Surface water, raw water		
Analysis Started on:			11/03/2025		
Analysis Ending Date:			12/03/2025		
Product Type			Surface water, raw water		
Sampler(s)			Dusk Mains		
Sampled Date & Time			11/03/2025 12:00		
	LOQ	**Unit**			
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	16.1		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	313		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

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②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
⑥Test result is provided by the customer and is not accredited
⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited
***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

The Customer acknowledges and accepts that: (a) where Eurofins is not responsible for sampling, the test result(s) in this report apply only to the sample as received. Customer is solely responsible for the sampling process and warrants that the sample provided to Eurofins is representative of the lot / batch from which the samples were drawn; and (b) Eurofins expresses no opinion and accepts no liability in respect of the Customer's production process or homogeneity of the product.
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The tests are identified by a five-digit code, their description is available on request.
Accreditation does not apply to comments or graphical representations.
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Eurofins may subcontract the performance of part or all of the Services to a third party and the Customer authorises the release of all information necessary to the third party for the provision of the Services.
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Eurofins will not be required to store samples and may destroy or otherwise dispose of the samples or return the samples to the Customer (at the Customer's cost in all respects) immediately following analysis of the samples.
If the Customer pays for storage of the samples Eurofins will take commercially reasonable steps to store the samples for the agreed period in terms of industry practice.
The Eurofins water sampling service follows methodology based on AS/NZS 5667 and / or best practice to collect and transport samples that are fit for the purpose of analytical testing. The laboratory is not responsible for sampling activities unless explicitly indicated by the statement "Sampled by Eurofins" on the report for water samples.
The Customer acknowledges that the Services are provided using the current state of technology and methods developed and generally applied by Eurofins and involve analysis, interpretations, consulting work and conclusions. Eurofins shall use commercially reasonable degree of care in providing the Services.
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END OF REPORT

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CERTIFICATE OF ANALYSIS

GHD Ltd
138 Victoria Street
Christchurch

Attention: Dusk Mains
Phone: 022 329 1597
Email: dusk.mains@ghd.com

Sampling Site: Shotover

Lab Reference: 25-09648
Submitted by: Chad Selbert
Date Received: 2/04/2025
Testing Initiated: 2/04/2025
Date Completed: 8/04/2025
Order Number:
Reference: 12645246

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS04	RS09	RS16	RS06	RS06B
	Date Sampled		1/04/2025	1/04/2025	1/04/2025	1/04/2025	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-1	25-09648-2	25-09648-3	25-09648-4	25-09648-5
Total Kjeldahl Nitrogen	g/m³	*0.1*	<0.10	<0.10	1.43	10.0	<0.10
Total Nitrogen	g/m³	*0.1*	<0.10	<0.10	7.1	10	<0.10

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS15
	Date Sampled		1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-6
Total Kjeldahl Nitrogen	g/m³	*0.1*	1.43
Total Nitrogen	g/m³	*0.1*	8.3

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS04	RS09	RS16	RS06	RS06B
	Date Sampled		1/04/2025	1/04/2025	1/04/2025	1/04/2025	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-1	25-09648-2	25-09648-3	25-09648-4	25-09648-5
Nitrate-N	g/m³	*0.002*	0.0211	0.0224	5.60	0.0578	0.0747
Nitrite-N	g/m³	*0.001*	<0.0010	<0.0010	0.0203	0.0122	<0.0010
Ammoniacal-N	g/m³	*0.005*	<0.005	<0.005	0.14	10.8	0.04
Dissolved Reactive Phosphorus (FIA)	g/m³	*0.002*	<0.002	<0.002	1.473	0.172	0.014

Inorganic Nutrients and Nutrient Species in Water

		Client Sample ID	RS15
		Date Sampled	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-6
Nitrate-N	g/m^3	*0.002*	6.85
Nitrite-N	g/m^3	*0.001*	0.0195
Ammoniacal-N	g/m^3	*0.005*	0.15
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	1.867

Biochemical Oxygen Demand

		Client Sample ID	RS04	RS09	RS16	RS06	RS06B
		Date Sampled	1/04/2025	1/04/2025	1/04/2025	1/04/2025	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-1	25-09648-2	25-09648-3	25-09648-4	25-09648-5
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	<1.00	<1.00	<1.00	<1.00

Biochemical Oxygen Demand

		Client Sample ID	RS15
		Date Sampled	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-6
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	2.19

Total Phosphorus in Water

		Client Sample ID	RS04	RS09	RS16	RS06	RS06B
		Date Sampled	1/04/2025	1/04/2025	1/04/2025	1/04/2025	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-1	25-09648-2	25-09648-3	25-09648-4	25-09648-5
Total Phosphorus	g/m^3	*0.005*	<0.0050	<0.0050	1.74	0.34	0.032

Total Phosphorus in Water

		Client Sample ID	RS15
		Date Sampled	1/04/2025
Analyte	Unit	*Reporting Limit*	25-09648-6
Total Phosphorus	g/m^3	*0.005*	3.59

Method Summary

TKN	Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).
TN	Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).
NO3-N	Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)

Method Summary

NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
cBOD	Dissolved oxygen measured using a dissolved oxygen electrode after addition of the nitrification inhibitior ATU and a 5 day incubation period. (APHA 5210 B - Online edition).
Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)

L. Coombridge
Louise Coombridge, B.Sc.
Chemist

Rowin Angkico, B.Sc.
Laboratory Technician

Matthew Counsell, B.Sc.
Environmental Lab Manager

Deanna Rhind
Technician

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-009388-01** REPORT DATE **02/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 01/04/2025 1:50:56pm
Submission Reference: GHD/Veolia Samples
Order code: EUNZCH-00213007
Reception temperature: 2.5 °C
Purchase Order Number: GHD - David Reine

SAMPLE CODE:			817-2025-00033842	817-2025-00033843	817-2025-00033844	817-2025-00033845
Sample Name:			RS04	RS09	RS16	RS15
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			01/04/2025	01/04/2025	01/04/2025	01/04/2025
Analysis Ending Date:			02/04/2025	02/04/2025	02/04/2025	02/04/2025
Product Type			raw water	raw water	raw water	raw water
Sampler(s)			Customer Sampled - Chad	Customer Sampled - Chad	Customer Sampled - Chad	Customer Sampled - Chad
Sampled Date & Time			01/04/2025 09:00	01/04/2025 09:30	01/04/2025 10:15	01/04/2025 10:45
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	35.5	435.2	648.8	435.2
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	95.8	727	> 2420	> 2420

Food & Water Testing

SAMPLE CODE:			**817-2025-00033846**	**817-2025-00033847**	
Sample Name:			RS06	RS06B	
Product Type:			Surface water, raw water	Surface water, raw water	
Analysis Started on:			01/04/2025	01/04/2025	
Analysis Ending Date:			02/04/2025	02/04/2025	
Product Type			raw water	raw water	
Sampler(s)			Customer Sampled - Chad	Customer Sampled - Chad	
Sampled Date & Time			01/04/2025 11:20	01/04/2025 11:30	
	LOQ	**Unit**			
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	238.2	46.4	
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	1986.3	290.9	

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

①Test is not accredited
②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
⑥Test result is provided by the customer and is not accredited
⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

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END OF REPORT

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-009624-01** REPORT DATE **04/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 03/04/2025 3:11:32pm
Submission Reference: GHD/Veolia
Order code: EUNZCH-00213341
Reception temperature: 4 °C
Purchase Order Number: 455236

SAMPLE CODE:	LOQ	Unit	817-2025-00035128	817-2025-00035129	817-2025-00035130	817-2025-00035131
Sample Name:			RS04	RS15	RS16	RS06B #2
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			03/04/2025	03/04/2025	03/04/2025	03/04/2025
Analysis Ending Date:			04/04/2025	04/04/2025	04/04/2025	04/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			GHD - Chad	GHD - Chad	GHD - Chad	GHD - Chad
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	130.1	32.3	120.1	> 2420
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	866.4	> 2420	> 2420	> 2420

SAMPLE CODE:			**817-2025-00035132**	**817-2025-00035133**	**817-2025-00035134**	**817-2025-00035135**
Sample Name:			RS09	RS14	RS13	RS12
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			03/04/2025	03/04/2025	03/04/2025	03/04/2025
Analysis Ending Date:			04/04/2025	04/04/2025	04/04/2025	04/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			GHD - Chad	GHD - Chad	GHD - Chad	GHD - Chad
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	128.1	117.8	222.4	42.2
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	613.1	240	435.2	272.3

SAMPLE CODE:			**817-2025-00035136**	**817-2025-00035137**		
Sample Name:			RS11	RS06B #1		
Product Type:			Surface water, raw water	Surface water, raw water		
Analysis Started on:			03/04/2025	03/04/2025		
Analysis Ending Date:			04/04/2025	04/04/2025		
Product Type			Surface water, raw water	Surface water, raw water		
Sampler(s)			GHD - Chad	GHD - Chad		
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	36.4	261.3		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	1299.7	2419.6		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

Tonia Bulling Head of Southern Laboratory (K.T.P)

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

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LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

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END OF REPORT

ALS Food & Environmental NZ
Ruakura Research Centre
10 Bisley Road, Hamilton 3214, New Zealand
T: +64 7 974 4740
E: ALSEnviro.Hamilton@alsglobal.com

CERTIFICATE OF ANALYSIS

GHD Ltd
138 Victoria Street
Christchurch

Attention: Dusk Mains
Phone: 022 329 1597
Email: dusk.mains@ghd.com

Sampling Site:

Lab Reference: 25-09967
Submitted by: Chad Selbert
Date Received: 4/04/2025
Testing Initiated: 4/04/2025
Date Completed: 14/04/2025
Order Number:
Reference: 12645246

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS04	RS15	RS16	RS06	RS09
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-1	25-09967-2	25-09967-3	25-09967-4	25-09967-5
Total Kjeldahl Nitrogen	g/m³	*0.1*	<0.10	11.2	1.32	9.34	<0.10
Total Nitrogen	g/m³	*0.1*	<0.10	16	1.9	9.5	<0.10

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS14	RS13	RS12	RS11	RS06B
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-6	25-09967-7	25-09967-8	25-09967-9	25-09967-10
Total Kjeldahl Nitrogen	g/m³	*0.1*	<0.10	0.26	0.56	0.33	0.40
Total Nitrogen	g/m³	*0.1*	<0.10	0.43	0.74	0.69	0.56

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS04	RS15	RS16	RS06	RS09
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-1	25-09967-2	25-09967-3	25-09967-4	25-09967-5
Nitrate-N	g/m³	*0.002*	0.0041	4.56	0.526	0.120	0.0071
Nitrite-N	g/m³	*0.001*	<0.0010	0.0301	0.0040	0.0363	<0.0010
Ammoniacal-N	g/m³	*0.005*	<0.005	8.62	0.84	9.80	0.005
Dissolved Reactive Phosphorus (FIA)	g/m³	*0.002*	<0.002	1.774	0.184	0.140	<0.002

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS14	RS13	RS12	RS11	RS06B
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-6	25-09967-7	25-09967-8	25-09967-9	25-09967-10
Nitrate-N	g/m^3	*0.002*	0.0282	0.166	0.179	0.349	0.160
Nitrite-N	g/m^3	*0.001*	<0.0010	0.0041	0.00711	0.00511	0.0016
Ammoniacal-N	g/m^3	*0.005*	<0.005	0.20	0.59	0.30	0.33
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	0.048	<0.002	0.059

Biochemical Oxygen Demand

	Client Sample ID		RS04	RS15	RS16	RS06	RS09
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-1	25-09967-2	25-09967-3	25-09967-4	25-09967-5
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	12.3	1.99	<1.00	<1.00

Biochemical Oxygen Demand

	Client Sample ID		RS14	RS13	RS12	RS11	RS06B
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-6	25-09967-7	25-09967-8	25-09967-9	25-09967-10
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	<1.00	<1.00	<1.00	<1.00

Total Phosphorus in Water

	Client Sample ID		RS04	RS15	RS16	RS06	RS09
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-1	25-09967-2	25-09967-3	25-09967-4	25-09967-5
Total Phosphorus	g/m^3	*0.005*	<0.0050	2.41	0.28	0.31	0.0056

Total Phosphorus in Water

	Client Sample ID		RS14	RS13	RS12	RS11	RS06B
	Date Sampled		3/04/2025	3/04/2025	3/04/2025	3/04/2025	3/04/2025
Analyte	Unit	*Reporting Limit*	25-09967-6	25-09967-7	25-09967-8	25-09967-9	25-09967-10
Total Phosphorus	g/m^3	*0.005*	<0.0050	<0.0050	0.056	0.059	0.097

Method Summary

TKN Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).

TN Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).

NO3-N Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)

Method Summary

NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
cBOD	Dissolved oxygen measured using a dissolved oxygen electrode after addition of the nitrification inhibitior ATU and a 5 day incubation period. (APHA 5210 B - Online edition).
Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)

L. Coombridge
Louise Coombridge, B.Sc.
Chemist

Rowin Angkico, B.Sc.
Laboratory Technician

N. Waldron
Neve Waldron
Laboratory Technician

Matthew Counsell, B.Sc.
Environmental Lab Manager

Deanna Rhind
Technician

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-009761-01** REPORT DATE **05/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 04/04/2025 1:09:13pm
Submission Reference: GHD/Veolia
Order code: EUNZCH-00213450
Reception temperature: 20.1 °C
Purchase Order Number: 455236

	LOQ	Unit	817-2025-00035462	817-2025-00035463		
SAMPLE CODE:						
Sample Name:			RS06	RS06B		
Product Type:			Surface water, raw water	Surface water, raw water		
Analysis Started on:			04/04/2025	04/04/2025		
Analysis Ending Date:			05/04/2025	05/04/2025		
Product Type			Surface water, raw water	Surface water, raw water		
Sampler(s)			GHD - Chad	GHD - Chad		
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	435.2	410.6		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	2419.6	2419.6		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

Tomas Hais Key Technical Person K.T.P

EXPLANATORY NOTE

①Test is not accredited
②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
⑥Test result is provided by the customer and is not accredited
⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

*Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

END OF REPORT

ALS Food & Environmental NZ
Ruakura Research Centre
10 Bisley Road, Hamilton 3214, New Zealand
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CERTIFICATE OF ANALYSIS

GHD Ltd
Level 3, 138 Victoria Street
Christchurch

Attention: Dusk Mains
Phone: 022 052 4929
Email: dusk.mains@ghd.com

Sampling Site: Queenstown Shotover

Lab Reference: 25-10293
Submitted by: O. Tate & C. Selbert
Date Received: 8/04/2025
Testing Initiated: 8/04/2025
Date Completed: 15/04/2025
Order Number: 12645246
Reference: Queenstown Shot

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Anion/Cation Suite

	Client Sample ID		RS14	RS13	RS12	RS11	RS06
	Date Sampled		7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-1	25-10293-2	25-10293-3	25-10293-4	25-10293-5
pH	pH	*1*	7.4	7.8	7.4	7.4	7.9
Electrical Conductivity	µS/cm	*0.2*	60.8	184	73.2	73.6	332
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	23.8	71.8	27.4	25.9	119
Chloride	g/m^3	*0.5*	0.55	5.72	1.28	1.12	16.8
Sulfate	g/m^3	*0.15*	4.17	4.02	4.40	4.28	7.04
Nitrate-N	g/m^3	*0.002*	0.0176	0.422	0.0655	0.0659	0.414
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	0.005	<0.002	0.156
Ammoniacal-N	g/m^3	*0.005*	<0.005	0.74	0.12	0.08	5.58
Sodium	g/m^3	*0.01*	1.19	7.90	2.89	1.80	21.0
Potassium	g/m^3	*0.05*	0.43	3.2	0.97	0.67	9.13
Calcium	g/m^3	*0.05*	9.55	28.7	11.5	11.4	28.0
Magnesium	g/m^3	*0.01*	0.58	1.58	0.73	0.67	2.58
Iron	g/m^3	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	0.011
Zinc	g/m^3	*0.001*	0.0020	0.0018	0.0011	<0.0010	<0.0010
Manganese	g/m^3	*0.0005*	<0.00050	0.050	0.029	0.018	1.92
Sum of Anions*	meq/L	*0.01*	0.58	1.72	0.68	0.64	3.07
Sum of Cations*	meq/L	*0.01*	0.59	2.04	0.79	0.72	3.23
EC/10*	(mS/m)/10	*0.002*	0.61	1.84	0.73	0.74	3.32

Anion/Cation Suite

Client Sample ID			RS06B	RS15	RS16	RS04	RS04B
Date Sampled			7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-6	25-10293-7	25-10293-8	25-10293-9	25-10293-10
pH	pH	*1*	7.8	7.8	7.8	7.8	7.8
Electrical Conductivity	µS/cm	*0.2*	140	470	129	125	125
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	53.5	106	52.6	48.5	51.0
Chloride	g/m^3	*0.5*	1.64	38.4	0.80	0.69	<0.50
Sulfate	g/m^3	*0.15*	8.22	32.2	7.71	7.88	7.46
Nitrate-N	g/m^3	*0.002*	0.168	3.95	0.0685	0.0239	0.0277
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	0.050	1.707	0.015	<0.002	<0.002
Ammoniacal-N	g/m^3	*0.005*	0.23	6.95	0.07	<0.005	<0.005
Sodium	g/m^3	*0.01*	2.92	43.8	1.67	1.33	1.30
Potassium	g/m^3	*0.05*	1.4	16.6	0.88	0.76	0.73
Calcium	g/m^3	*0.05*	21.8	25.1	21.7	22.1	21.5
Magnesium	g/m^3	*0.01*	1.33	3.46	1.24	1.26	1.24
Iron	g/m^3	*0.005*	<0.0050	0.11	<0.0050	<0.0050	<0.0050
Zinc	g/m^3	*0.001*	0.0021	0.061	<0.0010	0.0013	<0.0010
Manganese	g/m^3	*0.0005*	0.0094	0.0521	0.0090	0.0022	0.0021
Sum of Anions*	meq/L	*0.01*	1.31	4.20	1.25	1.16	1.19
Sum of Cations*	meq/L	*0.01*	1.38	4.37	1.28	1.28	1.25
EC/10*	(mS/m)/10	*0.002*	1.40	4.70	1.29	1.25	1.25

Inorganic Nutrients and Nutrient Species in Water

Client Sample ID			RS14	RS13	RS12	RS11	RS06
Date Sampled			7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-1	25-10293-2	25-10293-3	25-10293-4	25-10293-5
Nitrite-N	g/m^3	*0.001*	<0.0010	0.0047	<0.0010	0.0013	0.0111

Inorganic Nutrients and Nutrient Species in Water

Client Sample ID			RS06B	RS15	RS16	RS04	RS04B
Date Sampled			7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-6	25-10293-7	25-10293-8	25-10293-9	25-10293-10
Nitrite-N	g/m^3	*0.001*	0.0018	0.0342	<0.0010	<0.0010	<0.0010

Total Nitrogen / Kjeldahl Nitrogen in Water

Client Sample ID			RS14	RS13	RS12	RS11	RS06
Date Sampled			7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-1	25-10293-2	25-10293-3	25-10293-4	25-10293-5
Total Kjeldahl Nitrogen	g/m^3	*0.1*	<0.10	0.71	<0.10	<0.10	5.61
Total Nitrogen	g/m^3	*0.1*	<0.10	1.1	<0.10	<0.10	6.0

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS06B	RS15	RS16	RS04	RS04B
	Date Sampled		7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-6	25-10293-7	25-10293-8	25-10293-9	25-10293-10
Total Kjeldahl Nitrogen	g/m^3	*0.1*	0.33	9.34	0.11	<0.10	<0.10
Total Nitrogen	g/m^3	*0.1*	0.50	13	0.17	<0.10	<0.10

Total Phosphorus in Water

	Client Sample ID		RS14	RS13	RS12	RS11	RS06
	Date Sampled		7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-1	25-10293-2	25-10293-3	25-10293-4	25-10293-5
Total Phosphorus	g/m^3	*0.005*	<0.0050	<0.0050	0.0093	<0.0050	0.23

Total Phosphorus in Water

	Client Sample ID		RS06B	RS15	RS16	RS04	RS04B
	Date Sampled		7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-6	25-10293-7	25-10293-8	25-10293-9	25-10293-10
Total Phosphorus	g/m^3	*0.005*	0.075	2.27	0.031	0.0065	0.018

Biochemical Oxygen Demand

	Client Sample ID		RS14	RS13	RS12	RS11	RS06
	Date Sampled		7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-1	25-10293-2	25-10293-3	25-10293-4	25-10293-5
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	<1.00	<1.00	<1.00	<1.00

Biochemical Oxygen Demand

	Client Sample ID		RS06B	RS15	RS16	RS04	RS04B
	Date Sampled		7/04/2025	7/04/2025	7/04/2025	7/04/2025	7/04/2025
Analyte	Unit	*Reporting Limit*	25-10293-6	25-10293-7	25-10293-8	25-10293-9	25-10293-10
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	6.17	<1.00	<1.00	<1.00

Method Summary

pH	Samples measured as received using a conventional pH electrode. (APHA 4500 H^+ B. Online edition).
Electrical Conductivity	Samples analysed as received using a conventional conductivity electrode. (APHA 2510 B - Modified - Auto-titrator - Online edition).
Total Alkalinity ($CaCO_3$)	Samples analysed as received by potentiometric titration. (APHA 2320 B Online edition).
Chloride	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110 B - Online edition).

Method Summary

Sulfate	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110B - Online edition).
NO3-N	Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). In house procedure based on US EPA 200.8.
Sum of Anions	Sum of milliequivalents/Litre of measured Anions.
Sum of Cations	Sum of milliequivalents/Litre of measured Cations.
NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).
TKN	Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).
TN	Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).
Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)
cBOD	Dissolved oxygen measured using a dissolved oxygen electrode after addition of the nitrification inhibitior ATU and a 5 day incubation period. (APHA 5210 B - Online edition).

Matthew Counsell, B.Sc.
Environmental Lab Manager

Rowin Angkico, B.Sc.
Laboratory Technician

Neve Waldron
Laboratory Technician, B.Sc.

Deanna Rhind
Technician

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-010051-01** REPORT DATE **08/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND

Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com

Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 07/04/2025 3:39:56pm
Submission Reference: GHD/Veolia

Order code: EUNZCH-00213652
Reception temperature: 7.5 °C
Purchase Order Number: GHD

	LOQ	Unit	817-2025-00036162	817-2025-00036163	817-2025-00036164	817-2025-00036165
SAMPLE CODE:						
Sample Name:			RS14	RS13	RS12	RS11
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			07/04/2025	07/04/2025	07/04/2025	07/04/2025
Analysis Ending Date:			08/04/2025	08/04/2025	08/04/2025	08/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			O. Tate + C. Selbert	O. Tate + C. Selbert	O. Tate + C. Selbert	O. Tate + C. Selbert
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	96	107.6	115.3	50.4
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	435.2	488.4	290.9	547.5

SAMPLE CODE:			**817-2025-00036166**	**817-2025-00036167**	**817-2025-00036168**	**817-2025-00036169**
Sample Name:			RS04	RS04B	RS06B	RS06
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			07/04/2025	07/04/2025	07/04/2025	07/04/2025
Analysis Ending Date:			08/04/2025	08/04/2025	08/04/2025	08/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			O. Tate + C. Selbert	O. Tate + C. Selbert	O. Tate + C. Selbert	O. Tate + C. Selbert
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	24.3	19.9	36.8	218.7
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	98.5	290.9	461.1	> 2420

SAMPLE CODE:			**817-2025-00036170**	**817-2025-00036171**		
Sample Name:			RS16	RS15		
Product Type:			Surface water, raw water	Surface water, raw water		
Analysis Started on:			07/04/2025	07/04/2025		
Analysis Ending Date:			08/04/2025	08/04/2025		
Product Type			Surface water, raw water	Surface water, raw water		
Sampler(s)			O. Tate + C. Selbert	O. Tate + C. Selbert		
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	45.7	28.5		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	488.4	> 2420		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

①Test is not accredited
②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
⑥Test result is provided by the customer and is not accredited
⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

The Customer acknowledges and accepts that: (a) where Eurofins is not responsible for sampling, the test result(s) in this report apply only to the sample as received. Customer is solely responsible for the sampling process and warrants that the sample provided to Eurofins is representative of the lot / batch from which the samples were drawn; and (b) Eurofins expresses no opinion and accepts no liability in respect of the Customer's production process or homogeneity of the product.
The tests are identified by a five-digit code, their description is available on request.
Accreditation does not apply to comments or graphical representations.
Unless otherwise stated, all tests in this analytical report (except for subcontracted tests) are performed at 43 Detroit Drive, Rolleston, Christchurch, NEW ZEALAND.
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END OF REPORT

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CERTIFICATE OF ANALYSIS

GHD Ltd
Level3, 138 Victoria Street
Christchurch

Attention: Dusk Mains
Phone: 022 052 4929
Email: dusk.mains@ghd.com

Sampling Site: Queenstown Shotorer

Lab Reference: 25-10522
Submitted by: Oliver Tate
Date Received: 9/04/2025
Testing Initiated: 9/04/2025
Date Completed: 15/04/2025
Order Number: 12645246
Reference: 12645246

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Anion/Cation Suite

	Client Sample ID		BH01	BH02	BH03	BP01	BH04
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-1	25-10522-2	25-10522-3	25-10522-4	25-10522-5
pH	pH	*1*	7.8	7.8	7.6	7.7	7.5
Electrical Conductivity	µS/cm	*0.2*	184	262	473	146	486
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	77.0	117	119	59.3	161
Chloride	g/m^3	*0.5*	0.51	1.23	36.5	0.82	35.6
Sulfate	g/m^3	*0.15*	8.27	6.61	35.8	8.09	7.15
Nitrate-N	g/m^3	*0.002*	0.0229	0.138	<0.0020	0.126	0.0116
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	0.430	0.067	1.318
Ammoniacal-N	g/m^3	*0.005*	<0.005	<0.005	4.70	<0.005	9.81
Sodium	g/m^3	*0.01*	1.44	2.49	45.7	2.03	44.8
Potassium	g/m^3	*0.05*	0.94	0.53	17.1	1.1	16.1
Calcium	g/m^3	*0.05*	33.9	51.2	30.8	26.3	25.8
Magnesium	g/m^3	*0.01*	1.30	1.15	2.68	1.17	3.69
Iron	g/m^3	*0.005*	<0.0050	<0.0050	1.60	<0.0050	6.21
Zinc	g/m^3	*0.001*	<0.0010	0.0014	0.0063	0.0045	0.0050
Manganese	g/m^3	*0.0005*	<0.00050	0.0017	0.724	0.015	0.897
Sum of Anions*	meq/L	*0.01*	1.74	2.54	4.18	1.40	4.40
Sum of Cations*	meq/L	*0.01*	1.88	2.77	4.60	1.53	4.91
EC/10*	(mS/m)/10	*0.002*	1.84	2.62	4.73	1.46	4.86

Anion/Cation Suite

	Client Sample ID		BH05
	Date Sampled		8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-6
pH	pH	*1*	7.7
Electrical Conductivity	µS/cm	*0.2*	495
Total Alkalinity (CaCO3)	g $CaCO_3/m^3$	*1*	125
Chloride	g/m^3	*0.5*	32.1
Sulfate	g/m^3	*0.15*	28.7
Nitrate-N	g/m^3	*0.002*	6.95
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	0.037
Ammoniacal-N	g/m^3	*0.005*	2.34
Sodium	g/m^3	*0.01*	36.3
Potassium	g/m^3	*0.05*	4.5
Calcium	g/m^3	*0.05*	55.6
Magnesium	g/m^3	*0.01*	1.89
Iron	g/m^3	*0.005*	0.023
Zinc	g/m^3	*0.001*	0.0061
Manganese	g/m^3	*0.0005*	0.480
Sum of Anions*	meq/L	*0.01*	4.51
Sum of Cations*	meq/L	*0.01*	4.81
EC/10*	(mS/m)/10	*0.002*	4.95

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		BH01	BH02	BH03	BP01	BH04
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-1	25-10522-2	25-10522-3	25-10522-4	25-10522-5
Total Kjeldahl Nitrogen	g/m^3	*0.1*	<0.10	<0.10	5.01	<0.10	9.64
Total Nitrogen	g/m^3	*0.1*	<0.10	0.14	5.0	0.13	9.7

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		BH05	RS09	RS02	RS03	RS10
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-6	25-10522-7	25-10522-8	25-10522-9	25-10522-10
Total Kjeldahl Nitrogen	g/m^3	*0.1*	2.74	0.38	<0.10	<0.10	<0.10
Total Nitrogen	g/m^3	*0.1*	9.7	0.56	<0.10	<0.10	<0.10

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS01
	Date Sampled		8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-11
Total Kjeldahl Nitrogen	g/m^3	*0.1*	0.15
Total Nitrogen	g/m^3	*0.1*	0.17

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		BH01	BH02	BH03	BP01	BH04
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-1	25-10522-2	25-10522-3	25-10522-4	25-10522-5
Nitrite-N	g/m^3	*0.001*	<0.0010	<0.0010	0.0035	<0.0010	0.0035

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		BH05	RS09	RS02	RS03	RS10
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-6	25-10522-7	25-10522-8	25-10522-9	25-10522-10
Nitrate-N	g/m^3	*0.002*		0.179	0.0161	0.0211	0.0277
Nitrite-N	g/m^3	*0.001*	0.00782	0.0018	<0.0010	<0.0010	<0.0010
Ammoniacal-N	g/m^3	*0.005*		0.35	<0.005	<0.005	<0.005
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*		0.078	<0.002	<0.002	<0.002

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS01
	Date Sampled		8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-11
Nitrate-N	g/m^3	*0.002*	0.0184
Nitrite-N	g/m^3	*0.001*	<0.0010
Ammoniacal-N	g/m^3	*0.005*	<0.005
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002

Total Phosphorus in Water

	Client Sample ID		BH01	BH02	BH03	BP01	BH04
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-1	25-10522-2	25-10522-3	25-10522-4	25-10522-5
Total Phosphorus	g/m^3	*0.005*	<0.0050	<0.0050	0.97	0.067	3.44

Total Phosphorus in Water

	Client Sample ID		BH05	RS09	RS02	RS03	RS10
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-6	25-10522-7	25-10522-8	25-10522-9	25-10522-10
Total Phosphorus	g/m^3	*0.005*	0.060	0.11	0.021	0.24	0.074

Total Phosphorus in Water

	Client Sample ID		RS01
	Date Sampled		8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-11
Total Phosphorus	g/m^3	*0.005*	0.13

Biochemical Oxygen Demand

	Client Sample ID		RS09	RS02	RS03	RS10	RS01
	Date Sampled		8/04/2025	8/04/2025	8/04/2025	8/04/2025	8/04/2025
Analyte	Unit	*Reporting Limit*	25-10522-7	25-10522-8	25-10522-9	25-10522-10	25-10522-11
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	<1.00	<1.00	<1.00	<1.00

Method Summary

pH	Samples measured as received using a conventional pH electrode. (APHA 4500 H^+ B. Online edition).
Electrical Conductivity	Samples analysed as received using a conventional conductivity electrode. (APHA 2510 B - Modified - Auto-titrator - Online edition).
Total Alkalinity ($CaCO_3$)	Samples analysed as received by potentiometric titration. (APHA 2320 B Online edition).
Chloride	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110 B - Online edition).
Sulfate	Analysis by Ion exchange chromatography following sample filtration. (APHA 4110B - Online edition).
NO3-N	Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). In house procedure based on US EPA 200.8.
Sum of Anions	Sum of milliequivalents/Litre of measured Anions.
Sum of Cations	Sum of milliequivalents/Litre of measured Cations.
TKN	Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).
TN	Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).
NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).
Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)
cBOD	Dissolved oxygen measured using a dissolved oxygen electrode after addition of the nitrification inhibitior ATU and a 5 day incubation period. (APHA 5210 B - Online edition).

Matthew Counsell, B.Sc.
Environmental Lab Manager

Rowin Angkico, B.Sc.
Laboratory Technician

Neve Waldron
Laboratory Technician, B.Sc.

Deanna Rhind
Technician

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-010132-02 #** REPORT DATE **11/04/2025**

This amended report supersedes Analytical Report number AR-25-NC-010132-01, dated 09/04/2025.

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND

Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com

Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 08/04/2025 3:45:20PM
Submission Reference: GHD/Veolia
Comments: Times of all sample collection corrected as per submission form.

Order code: EUNZCH-00213823
Reception temperature: 4.7 °C
Purchase Order Number: 455236

SAMPLE CODE:			817-2025-00036739	817-2025-00036740	817-2025-00036741	817-2025-00036742
Sample Name:			BH01	BH02	BH03	BP01
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			08/04/2025	08/04/2025	08/04/2025	08/04/2025
Analysis Ending Date:			09/04/2025	09/04/2025	09/04/2025	09/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			Oliver Tate	Oliver Tate	Oliver Tate	Oliver Tate
Sampled Date & Time			08/04/2025 09:00	08/04/2025 10:04	08/04/2025 11:17	08/04/2025 12:26
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	4.1	< 1	14.6	< 1
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	> 2420	1299.7	648.8	< 1

SAMPLE CODE:			**817-2025-00036743**	**817-2025-00036744**	**817-2025-00036745**	**817-2025-00036746**
Sample Name:			BH04	BH05	RS09	RS02
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			08/04/2025	08/04/2025	08/04/2025	08/04/2025
Analysis Ending Date:			09/04/2025	09/04/2025	09/04/2025	09/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			Oliver Tate	Oliver Tate	Oliver Tate	Oliver Tate
Sampled Date & Time			08/04/2025 13:54	08/04/2025 14:45	08/04/2025 08:45	08/04/2025 10:05
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	10.9	< 1	435.2	62.4
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	488.4	387.3	1986.3	816.4

SAMPLE CODE:			**817-2025-00036747**	**817-2025-00036748**	**817-2025-00036749**
Sample Name:			RS03	RS10	RS01
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			08/04/2025	08/04/2025	08/04/2025
Analysis Ending Date:			09/04/2025	09/04/2025	09/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			Oliver Tate	Oliver Tate	Oliver Tate
Sampled Date & Time			08/04/2025 10:30	08/04/2025 14:00	08/04/2025 13:15
	LOQ	**Unit**			
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	214.2	517.2	129.6
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	1046.2	1203.3	770.1

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

①Test is not accredited
②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
⑥Test result is provided by the customer and is not accredited
⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

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The tests are identified by a five-digit code, their description is available on request.
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END OF REPORT

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-010291-01** REPORT DATE **10/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 09/04/2025 3:50:37pm
Submission Reference: Veolia/GHD
Order code: EUNZCH-00213977
Reception temperature: 6.8 °C
Purchase Order Number: 455236

	LOQ	Unit	817-2025-00037292	817-2025-00037293	817-2025-00037294	817-2025-00037295
SAMPLE CODE:						
Sample Name:			BH23	BH22	BH17	BH18
Product Type:			Surface water, raw water	Ground water, raw water	Ground water, raw water	Ground water, raw water
Analysis Started on:			09/04/2025	09/04/2025	09/04/2025	09/04/2025
Analysis Ending Date:			10/04/2025	10/04/2025	10/04/2025	10/04/2025
Sampler(s)			GHD	GHD	GHD	GHD
Sampled Date & Time			09/04/2025 08:56	09/04/2025 09:50	09/04/2025 10:58	09/04/2025 11:59
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	1	< 1	< 1	< 1
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	> 2420	17.3	410.6	378.4

SAMPLE CODE:			**817-2025-00037296**	**817-2025-00037297**	**817-2025-00037298**	**817-2025-00037299**
Sample Name:			BH16	BH13	BH19	BH21
Product Type:			Ground water, raw water	Ground water, raw water	Ground water, raw water	Ground water, raw water
Analysis Started on:			09/04/2025	09/04/2025	09/04/2025	09/04/2025
Analysis Ending Date:			10/04/2025	10/04/2025	10/04/2025	10/04/2025
Sampler(s)			GHD	GHD	GHD	GHD
Sampled Date & Time			09/04/2025 13:13	09/04/2025 14:27	09/04/2025 10:50	09/04/2025 12:05
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	< 1	9.4	< 1	< 1
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	42.6	261.3	178.5	1299.7

Food & Water Testing

SAMPLE CODE:			**817-2025-00037300**	**817-2025-00037301**		
Sample Name:			BH20	BH06		
Product Type:			Ground water, raw water	Ground water, raw water		
Analysis Started on:			09/04/2025	09/04/2025		
Analysis Ending Date:			10/04/2025	10/04/2025		
Sampler(s)			GHD	GHD		
Sampled Date & Time			09/04/2025 09:39	09/04/2025 14:35		
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	< 1	< 1		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	920.8	13.2		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

Tonia Bulling Head of Southern Laboratory (K.T.P)

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

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⑨Test is RLP accredited
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Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

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END OF REPORT

ALS Food & Environmental NZ
Ruakura Research Centre
10 Bisley Road, Hamilton 3214, New Zealand
T: +64 7 974 4740
E: ALSEnviro.Hamilton@alsglobal.com

CERTIFICATE OF ANALYSIS

GHD Ltd
Level 3, 138 Victoria Street
Christchurch

Attention: Dusk Mains
Phone: 022 329 1597
Email: dusk.mains@ghd.com

Sampling Site:

Lab Reference: 25-10838
Submitted by: Chad Selbert
Date Received: 11/04/2025
Testing Initiated: 11/04/2025
Date Completed: 22/04/2025
Order Number:
Reference: 12645246

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at ALS NZ (or at the subcontracted laboratories, when applicable). Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS04	RS04B	RS15	RS16	RS06B
	Date Sampled		10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-1	25-10838-2	25-10838-3	25-10838-4	25-10838-5
Total Kjeldahl Nitrogen	g/m³	*0.1*	<0.10	<0.10	11.5	2.02	0.79
Total Nitrogen	g/m³	*0.1*	<0.10	<0.10	14	2.5	0.94

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS9	RS14	RS13	RS12	RS11
	Date Sampled		10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-6	25-10838-7	25-10838-8	25-10838-9	25-10838-10
Total Kjeldahl Nitrogen	g/m³	*0.1*	0.54	<0.10	0.44	0.17	0.39
Total Nitrogen	g/m³	*0.1*	0.69	<0.10	0.63	0.28	0.46

Total Nitrogen / Kjeldahl Nitrogen in Water

	Client Sample ID		RS10
	Date Sampled		10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-11
Total Kjeldahl Nitrogen	g/m³	*0.1*	<0.10
Total Nitrogen	g/m³	*0.1*	<0.10

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS04	RS04B	RS15	RS16	RS06B
	Date Sampled		10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-1	25-10838-2	25-10838-3	25-10838-4	25-10838-5
Nitrate-N	g/m^3	*0.002*	0.0127	0.0159	2.03	0.477	0.148
Nitrite-N	g/m^3	*0.001*	<0.0010	<0.0010	0.0396	<0.01	0.0027
Ammoniacal-N	g/m^3	*0.005*	0.03	0.008	8.13	2.32	0.55
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002	<0.002	1.415	0.354	0.098

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS9	RS14	RS13	RS12	RS11
	Date Sampled		10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-6	25-10838-7	25-10838-8	25-10838-9	25-10838-10
Nitrate-N	g/m^3	*0.002*	0.144	0.0333	0.183	0.112	0.0677
Nitrite-N	g/m^3	*0.001*	0.0021	<0.0010	0.0023	0.0011	0.0011
Ammoniacal-N	g/m^3	*0.005*	0.39	0.005	0.42	0.16	0.09
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	0.073	<0.002	<0.002	0.007	<0.002

Inorganic Nutrients and Nutrient Species in Water

	Client Sample ID		RS10
	Date Sampled		10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-11
Nitrate-N	g/m^3	*0.002*	0.0347
Nitrite-N	g/m^3	*0.001*	<0.0010
Ammoniacal-N	g/m^3	*0.005*	0.02
Dissolved Reactive Phosphorus (FIA)	g/m^3	*0.002*	<0.002

Biochemical Oxygen Demand

	Client Sample ID		RS04	RS04B	RS15	RS16	RS06B
	Date Sampled		10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-1	25-10838-2	25-10838-3	25-10838-4	25-10838-5
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	<1.00	16.5	3.06	<1.00

Biochemical Oxygen Demand

	Client Sample ID		RS9	RS14	RS13	RS12	RS11
	Date Sampled		10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-6	25-10838-7	25-10838-8	25-10838-9	25-10838-10
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00	<1.00	<1.00	<1.00	<1.00

Biochemical Oxygen Demand

		Client Sample ID	RS10
		Date Sampled	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-11
Carbonaceous Biochemical Oxygen Demand	g/m^3	*1*	<1.00

Total Phosphorus in Water

		Client Sample ID	RS04	RS04B	RS15	RS16	RS06B
		Date Sampled	10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-1	25-10838-2	25-10838-3	25-10838-4	25-10838-5
Total Phosphorus	g/m^3	*0.005*	0.011	0.015	1.86	0.57	0.18

Total Phosphorus in Water

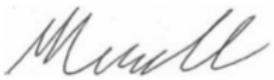
		Client Sample ID	RS9	RS14	RS13	RS12	RS11
		Date Sampled	10/04/2025	10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-6	25-10838-7	25-10838-8	25-10838-9	25-10838-10
Total Phosphorus	g/m^3	*0.005*	0.12	<0.0050	<0.0050	0.0088	<0.0050

Total Phosphorus in Water

		Client Sample ID	RS10
		Date Sampled	10/04/2025
Analyte	Unit	*Reporting Limit*	25-10838-11
Total Phosphorus	g/m^3	*0.005*	0.011

Method Summary

TKN	Samples analysed colourimetrically following an acid digestion. (APHA 4500-N_{Org} D - Modified - Discrete Analyser - Online edition).
TN	Sum of Total Kjeldahl Nitrogen (APHA 4500 N_{org} - Modified - Online edition), Nitrate-N and Nitrite-N (APHA 4500 NO_3 I - Online edition). (APHA 4500-N A - Online Edition).
NO3-N	Calculated from oxidised nitrogen and Nitrite-N, measured colourimetrically by flow injection analysis. (APHA NO_{3-} I. Online edition)
NO2-N	Samples analysed colourimetrically by flow injection analysis following filtration. (APHA 4500-NO_3 I. Online edition).
Ammoniacal-N	Samples are filtered and measured colourimetrically by flow injection analysis. Results represent total ammonical nitrogen (APHA 4500-NH_3 H - Modified - Online edition).
Dissolved Reactive Phosphorus	Samples filtered and measured colourimetrically by flow injection analysis. (APHA 4500-P G - Modified - Online edition)
cBOD	Dissolved oxygen measured using a dissolved oxygen electrode after addition of the nitrification inhibitior ATU and a 5 day incubation period. (APHA 5210 B - Online edition).
Total Phosphorus	Samples analysed colourimetrically following an acid digestion. (APHA 4500 P H - Modified - Discrete Analyser - Online edition)



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Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-010410-01** REPORT DATE **11/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 10/04/2025 9:20:01am
Submission Reference: GHD
Order code: EUNZCH-00214042
Reception temperature: 8.2 °C
Purchase Order Number: 455236

SAMPLE CODE:			817-2025-00037602	817-2025-00037603		
Sample Name:			BH10	BH11		
Product Type:			Surface water, raw water	Surface water, raw water		
Analysis Started on:			10/04/2025	10/04/2025		
Analysis Ending Date:			11/04/2025	11/04/2025		
Product Type			Surface water, raw water	Surface water, raw water		
Sampler(s)			O. Tate + C. Selbert	O. Tate + C. Selbert		
Sampled Date & Time			09/04/2025 15:22	09/04/2025 16:35		
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	1	< 1		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	313	< 1		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

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②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
④Test is subcontracted outside Eurofins group and is accredited
⑤Test is subcontracted outside Eurofins group and is not accredited
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⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
⑩Test is subcontracted within Eurofins group and is RLP accredited

N/A means Not Applicable
Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

*Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

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END OF REPORT

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-010412-01** REPORT DATE **11/04/2025**

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NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 10/04/2025 2:24:00pm
Submission Reference: GHD/Veolia
Order code: EUNZCH-00214096
Reception temperature: 11.4 °C
Purchase Order Number: 455236

SAMPLE CODE:			817-2025-00037752	817-2025-00037753	817-2025-00037754	817-2025-00037755
Sample Name:			RS04	RS04B	RS15	RS16
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analysis Ending Date:			11/04/2025	11/04/2025	11/04/2025	11/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			GHD - Chad	GHD - Chad	GHD - Chad	GHD - Chad
Sampled Date & Time			10/04/2025 11:48	10/04/2025 11:45	10/04/2025 11:30	10/04/2025 10:58
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	14.8	20.1	17.1	16
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	261.3	122.4	> 2420	1046.2

SAMPLE CODE:			**817-2025-00037756**	**817-2025-00037757**	**817-2025-00037758**	**817-2025-00037759**
Sample Name:			RS06B	RS09	RS14	RS13
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			10/04/2025	10/04/2025	10/04/2025	10/04/2025
Analysis Ending Date:			11/04/2025	11/04/2025	11/04/2025	11/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			GHD - Chad	GHD - Chad	GHD - Chad	GHD - Chad
Sampled Date & Time			10/04/2025 10:55	10/04/2025 10:55	10/04/2025 08:30	10/04/2025 08:55
	LOQ	**Unit**				
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	18.7	20.3	52	52
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	435.2	307.6	190.4	206.4

SAMPLE CODE:			**817-2025-00037760**	**817-2025-00037761**	**817-2025-00037762**
Sample Name:			RS12	RS11	RS10
Product Type:			Surface water, raw water	Surface water, raw water	Surface water, raw water
Analysis Started on:			10/04/2025	10/04/2025	10/04/2025
Analysis Ending Date:			11/04/2025	11/04/2025	11/04/2025
Product Type			Surface water, raw water	Surface water, raw water	Surface water, raw water
Sampler(s)			GHD - Chad	GHD - Chad	GHD - Chad
Sampled Date & Time			10/04/2025 09:15	10/04/2025 09:45	10/04/2025 10:04
	LOQ	**Unit**			
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	54.6	57.3	39.9
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	261.3	275.5	137.4

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

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②Test is subcontracted within Eurofins group and is accredited
③Test is subcontracted within Eurofins group and is not accredited
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⑦Tested at the sampling point by Eurofins and is not accredited
⑧Tested at the sampling point by Eurofins and is accredited
⑨Test is RLP accredited
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Symbol - in result column means not tested

***Test was performed at Eurofins ELS Limited, Unit 1/74 Glenda Drive, Frankton, Queenstown

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Food & Water Testing

ANALYTICAL REPORT

REPORT CODE **AR-25-NC-010415-01** REPORT DATE **11/04/2025**

Attention Veolia Water Services (ANZ) Pty Ltd
NZ Queenstown Lab Results
74 Glenda Drive
Frankton
9300 Queenstown
NEW ZEALAND
Phone 03 450 9240
Email nz.queenstown.lab-results.all.groups@veolia.com
Copy to: Lado (celeste.lado@veolia.com), Spooner (janie.spooner@veolia.com)

Contact for your orders: James Thornton
Contract: Waste Water - Additional
Reception Date & Time: 10/04/2025 2:24:00pm
Submission Reference: GHD/Veolia
Order code: EUNZCH-00214220
Reception temperature: 11.4 °C

	LOQ	Unit	817-2025-00037875	817-2025-00037876		
SAMPLE CODE:						
Sample Name:			BH08	BH09		
Product Type:			Surface water, raw water	Surface water, raw water		
Analysis Started on:			10/04/2025	10/04/2025		
Analysis Ending Date:			11/04/2025	11/04/2025		
Sampler(s)			GHD	GHD		
Sampled Date & Time			10/04/2025 14:15	10/04/2025 14:54		
* **ZM2LF Enumeration (MPN) of Escherichia coli using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	6.3	3.1		
* **ZM12D Enumeration (MPN) of Total Coliforms using Colilert-18 97-Well Quanti-Tray2000**	1	MPN/100 ml	727	290.9		

LIST OF METHODS

ZM12D **Total Coliforms E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

ZM2LF **Escherichia coli E (Water) [NZ] <1 >2 420 /100 ml (0)**
Colilert-18-Q: SMEWW 9223B; APHA 24th Edition

Signature

David Hoekendijk Team Lead KTP

EXPLANATORY NOTE

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Not Detected means not detected at or above the Limit of Quantification (LOQ)
LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit
Symbol - in result column means not tested

END OF REPORT

Appendix G

Surface water results

			Field Parameters									Biochemical	Inorganics		Biological		Nutrients								
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	Carbonaceous Biochemical Oxygen Demand (cBOD$_5$)	EC/10* (EC/10)	pH (Lab)	Total Coliforms (Colilert)	*E.coli*	Dissolved Reactive Phosphorus (FIA) (DRP) (filtered)	Nitrate-N (NO3-N) (filtered)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-) (filtered)	Ammoniacal Nitrogen	Ammonia	Ammoniacal N - @pH8 and 20°C	Phosphorus (Total)
			pH units	µS/cm	mg/L	%S	mV	°C	NTU	mg/L	cm	g/m^3	(mS/m)/10	pH units	MPN/100mL	MPN/100mL	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3
EQL												1	0.002	1			0.002	0.002	0.1	0.1	0.001	0.005			0.005
Location Code	**Date**	**Time**																							
RS01	10 Mar 2025	12:45:00	8.12	139	9.7	-	-	14.9	-	-	-	-	1.38	7.8	547.5	3.1	<0.002	0.0146	0.12	0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS01	08 Apr 2025	13:10:00	7.84	104.1	104.2	104.2	104.9	9.4	70.2	-	15	<1.00	-	-	770.1	129.6	<0.002	0.0184	0.17	0.15	<0.0010	<0.005	<0.005	<0.005	0.13
RS01	10 Apr 2025	9:08:00	7.94	111.7	13.3	-	91.4	7.4	-	72.8	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS02	10 Mar 2025	13:18:00	8.06	139	9.76	-	-	15.1	-	-	-	-	1.39	7.8	461.1	12.2	<0.002	0.0142	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS02	08 Apr 2025	10:10:00	7.88	113.1	103.2	103.2	105.9	9.6	19.03	-	40	<1.00	-	-	816.4	62.4	<0.002	0.0161	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	0.021
RS03	10 Mar 2025	13:30:00	8.07	138	10.57	-	-	15.3	-	-	-	-	1.34	7.8	547.5	15.8	<0.002	0.0141	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS03	08 Apr 2025	10:30:00	7.88	111.5	102.8	102.8	106.7	9.7	35.5	-	17	<1.00	-	-	1,046.2	214.2	<0.002	0.0211	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	0.24
RS04	10 Mar 2025	13:50:00	8.12	139	9.9	-	-	15.8	-	-	-	-	1.38	7.8	435.2	11.9	<0.002	0.0130	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS04	01 Apr 2025	9:00:00	7.81	134.6	100.5	100.5	121.9	12	-	-	-	<1.00	-	-	95.8	35.5	<0.002	0.0211	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS04	03 Apr 2025	14:30:00	7.97	131.5	-	104.5	118.1	14	-	-	-	<1.00	-	-	866.4	130.1	<0.002	0.0041	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS04	07 Apr 2025	14:55:00	7.97	121.7	108.5	108.5	132.1	12.4	-	-	96.7	<1.00	1.25	7.8	98.5	24.3	<0.002	0.0239	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	0.0065
RS04	10 Apr 2025	11:48:00	7.9	110.7	11.86	-	119.3	8.7	-	72.15	63	<1.00	-	-	261.3	14.8	<0.002	0.0127	<0.10	<0.10	<0.0010	0.03	0.001	0.017	0.011
RS04 B	07 Apr 2025	14:40:00	7.92	123.1	183.8	183.8	137.3	12.4	-	-	75	<1.00	1.25	7.8	290.9	19.9	<0.002	0.0277	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	0.018
RS04 B	10 Apr 2025	11:45:00	-	-	-	-	-	-	-	-	-	<1.00	-	-	122.4	20.1	<0.002	0.0159	<0.10	<0.10	<0.0010	0.008	-	-	0.015
RS05 A	10 Mar 2025	14:30:00	8.12	139	9.78	-	-	16.2	-	-	-	-	1.38	7.8	313	13.4	<0.002	0.0121	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS05 B	10 Mar 2025	14:18:00	8.27	139	9.1	-	-	17.8	-	-	-	-	1.38	7.9	275.5	7.5	<0.002	0.0089	0.12	0.11	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS06	10 Mar 2025	14:50:00	7.53	399.7	7.11	-	-	23.4	-	-	-	-	4.64	7.8	>2,420	275.5	0.148	0.0845	9.9	9.74	0.0413	9.99	0.091	2.395	0.26
RS06	01 Apr 2025	11:20:00	7.38	497.9	180.5	180.5	180.5	14.9	-	-	-	<1.00	-	-	1,986.3	238.2	0.172	0.0578	10	10.0	0.0122	10.8	0.070	1.838	0.34
RS06	03 Apr 2025	13:45:00	8.03	454	-	123.8	187.4	15.6	-	-	-	<1.00	-	-	-	-	0.140	0.120	9.5	9.34	0.0363	9.80	0.277	7.285	0.31
RS06	04 Apr 2025	12:15:00	7.71	86.2	103	103	124.6	12.9	142.5	-	-	-	-	-	2,419.6	435.2	-	-	-	-	-	-	-	-	-
RS06	07 Apr 2025	14:00:00	7.36	317.4	30	30	194.7	16.6	3.2	-	105	<1.00	3.32	7.9	>2,420	218.7	0.156	0.414	6.0	5.61	0.0111	5.58	0.034	0.907	0.23
RS06 A	10 Mar 2025	15:24:00	8.08	140	9.4	-	-	16.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS06 B	11 Mar 2025	12:00:00	8	140.5	10.02	-	-	14.5	-	-	-	-	1.40	7.8	>579.4	>40.5	<0.002	0.0212	<0.10	<0.10	<0.0010	0.03	0.001	0.021	<0.0050
RS06 B	01 Apr 2025	11:30:00	7.93	138.6	115.8	115.8	115.8	12.5	-	-	-	<1.00	-	-	290.9	46.4	0.014	0.0747	<0.10	<0.10	<0.0010	0.04	0.001	0.024	0.032
RS06 B	03 Apr 2025	13:50:00	7.88	144.8	-	105.4	136.3	13.3	-	-	-	<1.00	-	-	-	-	0.059	0.160	0.56	0.40	0.0016	0.33	0.007	0.175	0.097
RS06 B	04 Apr 2025	13:30:00	7.61	104.7	104.7	104.7	131.5	13.1	132.6	-	-	-	-	-	2,419.6	410.6	-	-	-	-	-	-	-	-	-
RS06 B	07 Apr 2025	13:45:00	7.89	135.6	97.3	97.3	132.3	13.3	-	-	97.3	<1.00	1.40	7.8	461.1	36.8	0.050	0.168	0.50	0.33	0.0018	0.23	0.005	0.125	0.075
RS06 B	10 Apr 2025	10:58:00	7.84	115.7	0.56	-	137.8	9	-	75.4	68	<1.00	-	-	435.2	18.7	0.098	0.148	0.94	0.79	0.0027	0.55	0.010	0.267	0.18
RS07	10 Mar 2025	14:55:00	7.7	333	1.97	-	-	23	-	-	-	-	3.35	7.9	>2,420	579.4	0.117	0.321	3.2	2.80	0.113	2.51	0.034	0.886	0.12
RS08	10 Mar 2025	15:00:00	7.17	439	4.17	-	-	17.9	-	-	-	-	4.38	7.7	>2,420	231	0.211	0.246	2.2	1.92	0.0337	1.56	0.006	0.164	0.21
RS09	11 Mar 2025	12:00:00	8.13	141	9.9	-	-	14.7	-	-	-	-	1.40	7.8	>2,420	>2,420	<0.002	0.0177	1.1	1.10	<0.0010	0.03	0.001	0.028	0.0051
RS09	01 Apr 2025	9:30:00	7.87	134.6	122.8	122.8	122.8	12.1	-	-	-	<1.00	-	-	727	435.2	<0.002	0.0224	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS09	03 Apr 2025	13:15:00	7.94	103.5	-	103.6	119.6	13.2	-	-	-	<1.00	-	-	613.1	128.1	<0.002	0.0071	<0.10	<0.10	<0.0010	0.005	0.000	0.003	0.0056
RS09	08 Apr 2025	8:45:00	7.84	131.5	105.5	105.5	126.4	9.5	12.1	-	45	<1.00	-	-	1,986.3	435.2	0.078	0.179	0.56	0.38	0.0018	0.35	0.006	0.170	0.11
RS09	10 Apr 2025	10:55:00	7.77	126.9	-	103	123.9	9.2	8.12	-	80	<1.00	-	-	307.6	20.3	0.073	0.144	0.69	0.54	0.0021	0.39	0.006	0.161	0.12
RS09 B	11 Mar 2025	12:15:00	7.25	210.5	2.84	-	-	17.4	-	-	-	-	2.16	7.7	547.5	47.3	0.002	0.359	0.36	<0.10	0.0020	0.01	0.000	0.001	<0.0050
RS10	11 Mar 2025	13:15:00	8	157	9.35	-	-	16.4	-	-	-	-	1.57	7.8	313	16.1	<0.002	0.0571	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS10	08 Apr 2025	14:00:00	7.8	105.5	104.7	104.7	108.8	10.2	57.2	-	19	<1.00	-	-	1,203.3	517.2	<0.002	0.0277	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	0.074
RS10	10 Apr 2025	10:09:00	7.87	105.9	12.06	-	106	9.9	-	68.9	52	<1.00	-	-	137.4	39.9	<0.002	0.0347	<0.10	<0.10	<0.0010	0.02	0.000	0.010	0.011
RS11	11 Mar 2025	11:30:00	7.51	112.4	8.55	-	-	16.5	-	-	-	-	1.06	7.5	>217.8	>17.3	<0.002	0.278	1.0	0.72	0.0046	0.63	0.005	0.144	<0.0050
RS11	03 Apr 2025	9:45:00	7.41	71.4	-	101.1	122.1	15.1	-	-	-	<1.00	-	-	1,299.7	36.4	<0.002	0.349	0.58	0.33	0.00511	0.30	0.002	0.055	0.059
RS11	07 Apr 2025	12:00:00	7.65	74.1	111.5	111.5	149.1	15.4	-	-	120	<1.00	0.74	7.4	547.5	50.4	<0.002	0.0659	<0.10	<0.10	0.0013	0.08	0.001	0.025	<0.0050
RS11	10 Apr 2025	9:45:00	7.67	78.1	-	101.6	100.1	14.2	1.61	-	120	<1.00	-	-	275.5	57.3	<0.002	0.0677	0.46	0.39	0.0011	0.09	0.001	0.030	<0.0050
RS12	11 Mar 2025	10:00:00	7.39	77.3	8.57	-	-	16.7	-	-	-	-	1.37	7.3	387.3	39.9	0.063	0.258	3.0	2.78	0.0027	1.06	0.007	0.185	0.064
RS12	03 Apr 2025	10:10:00	7.6	64	-	103	113.6	15.1	-	-	-	<1.00	-	-	272.3	42.2	0.048	0.179	0.74	0.56	0.00711	0.59	0.006	0.166	0.056
RS12	07 Apr 2025	11:48:00	7.63	70.1	108.2	108.2	119.9	15.3	-	-	120	<1.00	0.73	7.4	290.9	115.3	0.005	0.0655	<0.10	<0.10	<0.0010	0.12	0.001	0.036	0.0093
RS12	10 Apr 2025	9:15:00	7.62	65.3	-	101.1	99.1	14.5	1.31	-	120	<1.00	-	-	261.3	54.6	0.007	0.112	0.28	0.17	0.0011	0.16	0.002	0.047	0.0088
RS13	11 Mar 2025	8:30:00	7.22	210	5.18	-	-	13.4	-	-	-	-	2.30	7.6	313	82	<0.002	0.113	0.52	0.40	0.0033	0.44	0.002	0.052	<0.0050
RS13	03 Apr 2025	10:25:00	7.38	79.4	-	100	118.2	14.9	-	-	-	<1.00	-	-	435.2	222.4	<0.002	0.166	0.28	0.26	0.0041	0.20	0.001	0.034	<0.0050
RS13	07 Apr 2025	11:25:00	7.49	184.5	150.3	150.3	155.9	16.3	-	-	120	<1.00	1.84	7.8	488.4	107.6	<0.002	0.422	1.1	0.71	0.0047	0.74	0.006	0.162	<0.0050
RS13	10 Apr 2025	8:55:00	7.44	41.6	-	90.8	118	12.3	1.6	-	120	<1.00	-	-	206.4	52	<0.002	0.183	0.63	0.44	0.0023	0.42	0.003	0.082	<0.0050
RS14	11 Mar 2025	9:30:00	7.7	61.7	8.8	-	-	16.5	-	-	-	-	0.60	7.3	410.6	33.6	<0.002	0.0064	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS14	03 Apr 2025	10:50:00	7.55	54.2	-	102.8	105.9	15.1	-	-	-	<1.00	-	-	240	117.8	<0.002	0.0282	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS14	07 Apr 2025	11:00:00	7.78	62	141.2	141.2	155.3	15.3	-	-	120	<1.00	0.61	7.4	435.2	96	<0.002	0.0176	<0.10	<0.10	<0.0010	<0.005	<0.005	<0.005	<0.0050
RS14	10 Apr 2025	8:30:00	7.72	60.3	-	107.8	91	14.2	1.64	-	120	<1.00	-	-	190.4	52	<0.002	0.0333	<0.10	<0.10	<0.0010	0.005	0.000	0.002	<0.0050
RS15	01 Apr 2025	10:45:00	7.16	358.4	182.1	182.1	182.1	20.1	-	-	-	2.19	-	-	>2,420	435.2	1.867	6.85	8.3	1.43	0.0195	0.15	0.001	0.015	3.59
RS15	03 Apr 2025	14:00:00	7.38	420.1	-	98.9	195.9	19.2	-	-	-	12.3	-	-	>2,420	32.3	1.774	4.56	16	11.2	0.0301	8.62	0.056	1.467	2.41
RS15	07 Apr 2025	14:30:00	8	127.1	98	98	127.1	12.8	12.11	-	74	6.17	4.70	7.8	>2,420	28.5	1.707	3.95	13	9.34	0.0342	6.95	0.184	4.831	2.27
RS15	10 Apr 2025	11:45:00	7.34	324.5	-	35.2	172.8	17.5	134.6	-	27	16.5	-	-	>2,420	17.1	1.415	2.03	14	11.5	0.0396	8.13	0.048	1.262	1.86
RS16	01 Apr 2025	10:15:00	7.52	202.3	158.7	158.7	158.7	14.5	-	-	-	<1.00	-	-	>2,420	648.8	1.473	5.60	7.1	1.43	0.0203	0.14	0.001	0.033	1.74
RS16	03 Apr 2025	14:10:00	7.66	206	-	97.2	163.8	15.2	-	-	-	1.99	-	-	>2,420	120.1	0.184	0.526	1.9	1.32	0.0040	0.84	0.010	0.271	0.28
RS16	07 Apr 2025	14:45:00	7.28	458.9	86.7	86.7	197	19.1	8.1	-	45	<1.00	1.29	7.8	488.4	45.7	0.015	0.0685	0.17	0.11	<0.0010	0.07	0.000	0.009	0.031
RS16	10 Apr 2025	11:30:00	7.67	170.1	-	103.2	145.6	10.2	23.72	-	27	3.06	-	-	1,046.2	16	0.354	0.477	2.5	2.02	<0.0100	2.32	0.029	0.765	0.57

			Major Ions									Metals		
			Total Alkalinity ($CaCO_3$)	Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride (filtered)	Sulphate (filtered)	Cations Total	Anions Total	Iron (filtered)	Manganese (filtered)	Zinc (filtered)
			g $CaCO_3/m^3$	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	meq/L	meq/L	g/m^3	g/m^3	g/m^3
EQL			1	0.05	0.01	0.05	0.01	0.5	0.15	0.01	0.01	0.005	0.0005	0.001
Location Code	**Date**	**Time**												
RS01	10 Mar 2025	12:45:00	57.5	24.6	1.49	0.83	1.58	<0.50	7.13	1.44	1.31	<0.0050	0.00087	<0.0010
RS01	08 Apr 2025	13:10:00	-	-	-	-	-	-	-	-	-	-	-	-
RS01	10 Apr 2025	9:08:00	-	-	-	-	-	-	-	-	-	-	-	-
RS02	10 Mar 2025	13:18:00	56.6	24.2	1.46	0.85	1.55	<0.50	7.25	1.42	1.29	<0.0050	0.0010	<0.0010
RS02	08 Apr 2025	10:10:00	-	-	-	-	-	-	-	-	-	-	-	-
RS03	10 Mar 2025	13:30:00	58.7	24.8	1.49	0.82	1.58	0.52	7.46	1.45	1.36	<0.0050	0.0010	<0.0010
RS03	08 Apr 2025	10:30:00	-	-	-	-	-	-	-	-	-	-	-	-
RS04	10 Mar 2025	13:50:00	58.7	24.5	1.48	0.83	1.59	0.52	7.48	1.44	1.36	<0.0050	0.0010	<0.0010
RS04	01 Apr 2025	9:00:00	-	-	-	-	-	-	-	-	-	-	-	-
RS04	03 Apr 2025	14:30:00	-	-	-	-	-	-	-	-	-	-	-	-
RS04	07 Apr 2025	14:55:00	48.5	22.1	1.26	0.76	1.33	0.69	7.88	1.28	1.16	<0.0050	0.0022	0.0013
RS04	10 Apr 2025	11:48:00	-	-	-	-	-	-	-	-	-	-	-	-
RS04 B	07 Apr 2025	14:40:00	51.0	21.5	1.24	0.73	1.30	<0.50	7.46	1.25	1.19	<0.0050	0.0021	<0.0010
RS04 B	10 Apr 2025	11:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS05 A	10 Mar 2025	14:30:00	58.0	24.4	1.45	0.83	1.57	<0.50	7.43	1.43	1.33	<0.0050	0.0011	<0.0010
RS05 B	10 Mar 2025	14:18:00	56.2	24.4	1.46	0.83	1.53	0.57	7.43	1.43	1.31	<0.0050	0.0011	<0.0010
RS06	10 Mar 2025	14:50:00	171	32.8	3.36	13.4	33.8	28.9	4.38	4.55	4.36	0.022	2.85	<0.0010
RS06	01 Apr 2025	11:20:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06	03 Apr 2025	13:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06	04 Apr 2025	12:15:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06	07 Apr 2025	14:00:00	119	28.0	2.58	9.13	21.0	16.8	7.04	3.23	3.07	0.011	1.92	<0.0010
RS06 A	10 Mar 2025	15:24:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06 B	11 Mar 2025	12:00:00	57.6	24.1	1.55	0.89	1.88	0.53	7.09	1.44	1.33	0.011	0.0068	<0.0010
RS06 B	01 Apr 2025	11:30:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06 B	03 Apr 2025	13:50:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06 B	04 Apr 2025	13:30:00	-	-	-	-	-	-	-	-	-	-	-	-
RS06 B	07 Apr 2025	13:45:00	53.5	21.8	1.33	1.4	2.92	1.64	8.22	1.38	1.31	<0.0050	0.0094	0.0021
RS06 B	10 Apr 2025	10:58:00	-	-	-	-	-	-	-	-	-	-	-	-
RS07	10 Mar 2025	14:55:00	127	37.1	2.81	7.31	20.8	17.3	7.02	3.42	3.22	0.0050	1.80	<0.0010
RS08	10 Mar 2025	15:00:00	155	47.5	2.88	8.11	36.0	30.4	4.50	4.53	4.10	0.010	0.908	0.0058
RS09	11 Mar 2025	12:00:00	56.5	24.1	1.49	0.89	1.76	0.55	7.35	1.43	1.31	0.052	0.010	0.0013
RS09	01 Apr 2025	9:30:00	-	-	-	-	-	-	-	-	-	-	-	-
RS09	03 Apr 2025	13:15:00	-	-	-	-	-	-	-	-	-	-	-	-
RS09	08 Apr 2025	8:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS09	10 Apr 2025	10:55:00	-	-	-	-	-	-	-	-	-	-	-	-
RS09 B	11 Mar 2025	12:15:00	85.5	34.4	1.80	2.2	6.07	4.17	9.44	2.19	2.06	<0.0050	0.0099	<0.0010
RS10	11 Mar 2025	13:15:00	64.8	28.3	1.76	0.91	1.99	0.59	7.98	1.67	1.49	0.0085	0.0096	<0.0010
RS10	08 Apr 2025	14:00:00	-	-	-	-	-	-	-	-	-	-	-	-
RS10	10 Apr 2025	10:09:00	-	-	-	-	-	-	-	-	-	-	-	-
RS11	11 Mar 2025	11:30:00	37.8	14.6	0.96	1.7	4.61	2.91	4.13	1.10	0.95	0.029	0.136	0.0012
RS11	03 Apr 2025	9:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS11	07 Apr 2025	12:00:00	25.9	11.4	0.67	0.67	1.80	1.12	4.28	0.72	0.64	<0.0050	0.018	<0.0010
RS11	10 Apr 2025	9:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS12	11 Mar 2025	10:00:00	46.9	15.4	1.25	3.5	10.3	6.59	4.69	1.51	1.24	0.016	0.582	<0.0010
RS12	03 Apr 2025	10:10:00	-	-	-	-	-	-	-	-	-	-	-	-
RS12	07 Apr 2025	11:48:00	27.4	11.5	0.73	0.97	2.89	1.28	4.40	0.79	0.68	<0.0050	0.029	0.0011
RS12	10 Apr 2025	9:15:00	-	-	-	-	-	-	-	-	-	-	-	-
RS13	11 Mar 2025	8:30:00	103	34.3	1.77	1.3	3.30	2.01	5.49	2.07	2.26	0.0070	0.031	0.0014
RS13	03 Apr 2025	10:25:00	-	-	-	-	-	-	-	-	-	-	-	-
RS13	07 Apr 2025	11:25:00	71.8	28.7	1.58	3.2	7.90	5.72	4.02	2.04	1.72	<0.0050	0.050	0.0018
RS13	10 Apr 2025	8:55:00	-	-	-	-	-	-	-	-	-	-	-	-
RS14	11 Mar 2025	9:30:00	23.2	9.93	0.61	0.42	1.25	<0.50	3.69	0.61	0.54	0.0098	0.0024	<0.0010
RS14	03 Apr 2025	10:50:00	-	-	-	-	-	-	-	-	-	-	-	-
RS14	07 Apr 2025	11:00:00	23.8	9.55	0.58	0.43	1.19	0.55	4.17	0.59	0.58	<0.0050	<0.00050	0.0020
RS14	10 Apr 2025	8:30:00	-	-	-	-	-	-	-	-	-	-	-	-
RS15	01 Apr 2025	10:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS15	03 Apr 2025	14:00:00	-	-	-	-	-	-	-	-	-	-	-	-
RS15	07 Apr 2025	14:30:00	106	25.1	3.46	16.6	43.8	38.4	32.2	4.37	4.20	0.11	0.0521	0.061
RS15	10 Apr 2025	11:45:00	-	-	-	-	-	-	-	-	-	-	-	-
RS16	01 Apr 2025	10:15:00	-	-	-	-	-	-	-	-	-	-	-	-
RS16	03 Apr 2025	14:10:00	-	-	-	-	-	-	-	-	-	-	-	-
RS16	07 Apr 2025	14:45:00	52.6	21.7	1.24	0.88	1.67	0.80	7.71	1.28	1.25	<0.0050	0.0090	<0.0010
RS16	10 Apr 2025	11:30:00	-	-	-	-	-	-	-	-	-	-	-	-

Appendix H

Photos showing the discharge channel and flow into the river

Photos

Discharge channel prior to vegetation clearance (March 2025)	
Discharge channel 31 March 2025	

Discharge channel 31 March 2025. Vegetation being washed down channel	
Erosion at river edge. 31 March 2025.	

Discharge to River, 31 March 2025 Surface water sample location RS16	
Pool at end of discharge channel (RS16) looking upstream. 1 April 2025.	

Discharge channel downstream of last culvert. 2 April 2025	
Discharge channel downstream of last culvert. 3 April 2025	

Mixing of discharge with river water. Downstream of RS16. 7 April 2025.	
Pooled area at end of discharge channel (RS16). 7 April 2025	
Mixing of discharge with river water. Downstream of RS16. 10 April 2025.	

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