



Technical Memorandum

Water Supply Plan Feasibility Study Long-Term Ground Water Supply Sources (RFP 2337004)

Project Summary and Results

Test Well TW-5(25) at the Sechelt | shíshálh Hospital Site





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TECHNICAL MEMORANDUM

Date: April 02, 2025, *Revision June 30, 2025*

To: SUNSHINE COAST REGIONAL DISTRICT

Attn: Jesse Waldorf, Manager of Capital Projects
Pria Giri, Capital Projects Coordinator

RE: **Water Supply Plan Feasibility Study Long-Term Ground Water Supply Sources (RFP 2337004) | Project Summary and Results of Test Well TW-5(25) at the Sechelt | shishálh Hospital Site. *Final Version (Rev3)*.**

1 Introduction

1.1 Background

The Sunshine Coast Regional District (SCRD) issued a request for proposal (RFP 2337004) from qualified professional hydrogeologist to conduct **Water Supply Plan Feasibility Study Long-Term Ground Water Supply Sources** (*Groundwater Investigation Phase 5 – ‘the Project’*). This study has been initiated to assess the feasibility of supplying water to a larger population of the regional water service area, especially during the peak summer use periods when system demand is at its highest use and the available storage from Chapman Lake is at its lowest level; about 70 percent (%) of the water supply comes from the Chapman Water System which has Chapman Lake and Edwards Lake as supply sources. Furthermore, the project is to explore the possibility of securing additional groundwater supply to address the projected future water supply deficit and create regional water system resiliency. Kalwij Water Dynamics Inc. (KWD) was awarded the project to conduct the groundwater investigation (project management, consulting and contracting services).

1.2 Project Overview

1.2.1 Scope of Work

The work scope was formulated as follows (RFP 2337004):

1. Desktop review in support of identifying five (5) test well drilling site locations along the Sunshine Coast.
 2. Drilling and construction of up to 5 test wells that can be converted into production wells.
 3. Completion of 72-hour duration constant rate pumping tests and water quality analysis.
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4. Determining long-term yield for each test well and its suitability for a long-term municipal water source.
5. Determining the potential impact on neighbouring water users and the environment.

KWD's qualified professional (QP) Ineke Kalwij, Ph.D., P.Eng. is the project manager and lead hydrogeological engineer for this project. Thierry Carriou, MSc., P.Eng. (BC Groundwater Consulting Services Ltd.), reviewed selected aspects of this document (technical memorandum).

1.2.2 Project Implementation

The kick-off meeting was held at the SCRD office on August 2, 2023, and, following completion of the desktop review, KWD presented preliminary test well drilling locations during a meeting held on October 4, 2023. This was followed by several iterations between KWD and SCRD staff to finalize the test well drilling locations, with a primary focus on the Sechelt area. The results of the desktop review and proposed test well drilling locations were presented to the SCRD Committee of the Whole on January 25, 2024. The selected test well drilling sites are, *in sequence of completion*:

1. **TW-1(24)** - RC Fire Hall, 1302 Roberts Creek, Robert Creek, SCRD.
2. **TW-2(24)** - Airport at Hilltop Road, 4484 Hilltop Road, Wilson Creek, Sechelt.
3. **TW-3(24)** - Kinnikinnick Park, 6082 Ripple Way, Sechelt.
4. **TW-4(24)** - Whitaker Park, ROW Simpkins Road, Davis Bay, Sechelt.
5. **TW-5(25)** - Sechelt | shíshálh Hospital, 5544 Sunshine Coast Highway, Sechelt.

Figure 1 shows the test well drilling locations. Following approval from the District of Sechelt (Sites 2 - 5) and archaeological approval from shíshálh Nation, the test well drilling commenced on September 3, 2024. Sechelt | shíshálh Hospital site replaces initially selected Proctor Park Bike site due to site constraints for the latter. After receiving approval to proceed from shíshálh Nation and Vancouver Coastal Health (VCH), drilling at the Sechelt | shíshálh Hospital site commenced on January 23, 2025.

On February 28, 2025, KWD presented the test well drilling results to SCRD staff, with a focus on the results of the test well drilled at the Sechelt | shíshálh Hospital site, **TW-5(25)**. In the afternoon, the results were shared with members from shíshálh Nation and VCH. The results of Groundwater Investigation Phase 5 will be presented by KWD to the Committee of the Whole on April 10, 2025.

1.2.3 Summary of the Test Well Drilling Program

Table 1 (Attachment 1) summarizes results of the test well drilling testing program. Fyfe Well & Water Services (FYFE) was directly retained by KWD to undertake the test well drilling and construction. FYFE uses the dual rotary drilling technology (Foremost DR 24 drill rig). FYFE was also retained to complete the pumping tests for **TW-2(24)** and **TW-5(25)**. FYFE employs qualified well drillers and pump technicians. Field work oversight was provided by KWD's QP.

The results indicate that the estimated well yield for the test well at the Sechelt | shíshálh Hospital site is significantly higher than that of the other test wells. Therefore, the focus of next steps in the Project is exclusively on the Sechelt | shíshálh Hospital site¹ (shown in **Figure 2** and **Figure 3**) in **Attachment 1**).

¹ The original scope of work included a multiple criteria assessment for the five test well sites; this was not further pursued.

This technical memorandum summarizes the results for **TW-5(25)**; results for the other test well drilling sites will be summarized in separate memoranda. **Table 2 (Attachment 1)** summarizes test well information; **Drawing 1 (Attachment 1)** presents the well schematic and borehole lithology.

1.3 Regulatory Framework

The Water Sustainability Act² (WSA) and Water Sustainability Regulation³ (WSR) set out rules and requirements regarding the allocation and use of groundwater. Section 3(1) (Applications for licences and use approvals) outlines application requirements. The WSA and Groundwater Protection Regulation⁴ (GWPR) regulate the minimum standards for well construction, well maintenance, and well deactivation and decommissioning. The WSA and GWPR also set rules regarding, among others, the types of qualified people certified to drill wells, install pumping systems, and perform related services. The Health Hazard Regulation⁵ under the Public Health Act⁶ stipulates the minimum horizontal separation distance between a well and probable source of contamination.

1.4 Document Overview

In this Technical Memorandum we summarize the results of the drilling, construction and testing of **TW-5(25)**, and related tasks:

Section 2 – Hydrogeological Findings.

Section 3 – Pumping Test Results.

Section 4 – Water Quality Review.

Section 5 – Discussion: *Saltwater Intrusion, Groundwater Users, Impact Pumping of TW-5(25) on Nearby Streams, and Wellfield Infrastructural Requirements.*

Section 6 – Conclusions and recommendations.

General description of the geological / hydrogeological setting is based on information accessed through:

- McCammon, J.W. 1977. Surficial Geology and Sand and Gravel Deposits of Sunshine Coast, Powell River, and Campbell River Areas. Bulletin 65 Ministry of Energy, Mines, and Petroleum Resources.
- Government of BC online mapping (iMapBC): <https://maps.gov.bc.ca/ess/hm/imap4m/>.
- Government of BC online wells and aquifer data base: <https://apps.nrs.gov.bc.ca/gwells/>, <https://apps.nrs.gov.bc.ca/gwells/aquifers>.

Water samples were analyzed by Element (Surrey), an accredited water testing laboratory.

Attachment 1 includes *Tables, Figures and Drawing*, **Attachment 2** includes illustrations for TW-5(25) field work (drilling and pumping test). **Attachment 3** includes the water quality reports (Element).

² <https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015>.

³ https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/36_2016.

⁴ https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/39_2016.

⁵ https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/216_2011.

⁶ https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/08028_01.

2 Hydrogeological Findings

2.1 General Geological / Hydrogeological Setting⁷

McCammon (1977) characterizes the unconsolidated deposits⁸ (surficial geology) in the area as *fluvial deltaic, fan, and channel deposits: cobbles, gravel, sand and silt*, and is correlated to the Capilano lithostratigraphic unit comprising sediments of glacial retreat and well-out deposits. The sediments were deposited during the glacial retreat following the last glaciation⁹. McCammon (1977) described a pit located in the area east of the Sechelt | shíshálh Hospital, north of the Highway what is believed to be now Heidelberg Construction Ltd (aggregate mining) as consisting of sand and sandy gravel. McCammon (1977) described the unconsolidated deposits in the area, west of (approximately) Xenichen Avenue as *marine and glacio-marine deposit: varied gravelly, sandy, stoney, clay, and clay (normally over till)*. **Figure 4** shows the approximate delineation of quaternary deposits¹⁰ in addition to the (rock) geological setting.

The test well drilling site is located in an area where the sand and gravel water-bearing sediments are correlated to **Aquifer No. 566** (Government of BC¹¹), shown in **Figure 1**. The area of the aquifer is, reportedly, 9.7 square kilometres (km²). The aquifer material is described as consisting of *sands and gravels inferred as deltaic or glaciofluvial deposits; unconfined conditions are inferred based on overlying materials that are predominantly fine sand* (Hammond and Hinnell, 2018). The aquifer is classified as vulnerable to surface contamination based on the characterization of being unconfined and having a typically moderately shallow water table depth¹².

2.2 Site-Specific Borehole Lithology

The lithology of the borehole was assessed through the visual interpretation of drill cuttings retrieved at typically 1.5-metre (m) intervals during the drilling and casing of the 150-millimetre (mm) diameter test well. **Drawing 1** presents the borehole lithology.

Key observations are:

1. **Overburden** – 87.5 m in thickness, comprising layers of sand and gravel, varying in sand to gravel ratio; some layers comprising mostly sand (varying in fineness / grain sizes).
2. **Aquifer** – sand and gravel material, encountered from about 24.4 to 57 m below ground surface (bgs) and from about 63.7 to 87.5 m-bgs; significant production was observed.
3. **Lower permeable zone** – from about 57 to 63.7 m-bgs, comprising sand (very fine sand & medium to coarse sand); no significant production was observed.

⁷ The intent is to provide a high-level overview; a more in-depth review of information is beyond the scope of the project. We understand that the Province of BC has commissioned a water allocation desktop study for Aquifer No. 566 (Hatfield, 2023).

⁸ Unconsolidated refers to loose sediments such as sand, gravel, silt and clay.

⁹ This refers to the glacial retreat following the last glaciation, referred to as the Fraser Glaciation in British Columbia, which occurred between 25,000 and 10,000 years BP (before present).

¹⁰ The Quaternary Period is from 1.6 Million years ago till present day and includes post glacial (most recent) and multiple glaciation and non-glaciation periods.

¹¹ <https://apps.nrs.gov.bc.ca/gwells/aquifers/566>.

¹² With moderate shallow defined as 15 to 30 m, based on the median value of existing water depths (Hammond and Hinnell, 2018).

4. **Bedrock** – inferred to be granite type rock (grey and white rock fragments, with some black and pink rock fragments); based on Cui et al. (2017) the area of the test well is correlated *granodioritic intrusive rock* of the Late Jurassic stratigraphic age (**Figure 4**).

The 6.1 m long well screen was installed in the lower aquifer zone (i.e., below the lower permeable zone), targeting 77 - 83 m-bgs.

3 Pumping Test Results

3.1 Pumping Test Design

Aquifer testing was completed for **TW-5(25)** between February 13 and February 21, 2025, entailing: (i) a step-drawdown pumping test; 130 minutes (min) in duration, with as main purpose to determine the discharge rate for the constant rate pumping test; (ii) a constant rate pumping test of 72 hours (hrs); and recovery monitoring (0.5 hrs) following cessation of pumping.

KWD's QP was responsible for designing the pumping test and the overall supervision of the pumping test implementation. FYFE was responsible for the pumping test implementation. Staff was at the site to collect the various data, based on the instructions provided by KWD's QP. KWD and FYFE maintained frequent communications throughout the pumping test field program implementation, with KWD's QP at the site on the day of the step drawdown pumping test and towards the end of the constant rate pumping test. **Table 3** summarises additional pumping test information. **Attachment 2** includes pumping test illustrations.

3.2 Well Production

TW-5(25) has been successfully tested at a sustained average discharge rate of 22.2 litres per second (L/s) or 351 US gallons per minute (US gpm) for 72 hrs¹³. The well produced a total of 5744 cubic metres (m³) or 1,517,404 US gallons (USG). Well storage accounts for an estimated 0.02 % of the total withdrawal volume and is considered insignificant.

3.3 Drawdown & Recovery Trends

Figure 5 shows the drawdown and recovery trends observed during the constant rate pumping test for **TW-5(25)**. The drawdown trend shows an almost instantaneous drop in water level after the pumping test started, i.e., 3.74 m drawdown at time $t = 1$ min, after which further increase in drawdown is small, resulting in a drawdown at the end of the pumping test of 3.91 m ($t = 4320$ min). There is no clear evidence of tidal influence (*the tidal prediction graph is shown in the figure*). The observed drawdown is 8% of the available drawdown of 50 m¹⁴. Following cessation of pumping, the water level in the well was recovered (99%) within 1 minute, suggesting an instantaneous recovery (**Figure 5**).

¹³ 22.2 L/s is close to the maximum pumping rate possible due to physical limitations of the pump-motor assembly that fits in a 150 mm well (a small buffer in the discharge rate was maintained).

¹⁴ KWD assessed the available drawdown as the difference between the static water level and the start of the lower aquifer unit.

3.4 Well Yield Potential

Based on the pumping test results the potential well yield was computed for **TW-5(25)** (**Table 4**). The **long-term yield** based on the industry-accepted 100-day method (MOE, 2007).

The results suggest that the estimated theoretical long-term yield is 187 L/s, which suggests a potentially productive aquifer (at this location). KWD's QP certified 22.2 L/s, set equal to the pumping test average discharge rate. *Higher capacity pumping tests need to be completed to better define future wellfield potential and long-term yield.*

3.5 Well Interference

Based on recorded water levels in the designated monitoring wells during the 72-hr constant rate pumping test, there was no measurable impact observed in the monitoring wells (due to pumping at **TW-5(25)** at an average discharge rate of 22.2 L/s). **Figure 6** and **Figure 7** show the water level trends for **MW-1** (*well owned by Heidelberg Construction, along Ti'Ta Way*) and **MW-2** (WP2, owned by Heidelberg Construction, located at Salish Soils). WP2 shows interference from WP3 (Heidelberg Construction), located about 40 m from WP2, located on the same property (Salish Soils); the wells are shown in **Figure 2**. *Any determination regarding possible well interference of the proposed wellfield on third party wells can only be determined with a satisfactory level of certainty once production-sized test wells are constructed and adequately tested, and the necessary analysis, based on field data, is completed.*

3.6 Aquifer Parameters (Preliminary Analysis)

Preliminary aquifer parameter estimation was completed for the aquifer **hydraulic conductivity** (K) with unit metres per day (m/d) and **transmissivity** (T) with unit square metre per day (m²/d). T is computed through applying the analytical equation presented by Cooper - Jacob (1946)¹⁵. Results are presented in **Table 6**.

T is estimated at 5841 m²/d which suggests a high transmitting capacity; K is 314 m/d, based on: $K = T/d$, with d the aquifer thickness of the lower aquifer unit (18.6 m).

The computed values (K and T) are reasonable for productive coarse-grained aquifers. Results suggest that the K value falls within the range of coarse sand to gravel (Dominico and Schwartz, 1990; Freeze and Cherry, 1979).

¹⁵ A drawdown correction (for dewatering) was applied.

4 Water Quality Review

4.1. Water Sampling Procedure

Towards the end of the constant rate pumping test, KWD's QP collected the water samples in sample containers. The sample containers and necessary preservatives were supplied in a cooler by Element. KWD hand-delivered the cooled sample containers to Element in Surrey the following day. Raw water was analyzed for various physical, mechanical, and microbiological parameters in addition to volatile organic compounds (VOC).

4.2. Water Quality Results

4.2.1 General Water Quality

The results of the analysis are included in **Attachment 3**. The results of the water quality analysis suggest that for the analyzed constituents (Element Report No. 3109081), the raw water quality meets Canadian Drinking Water Guidelines (Health, 2024) for maximum acceptable concentration (MAC) and aesthetic objectives (AO). Results of the VOC analysis suggests all analyzed parameters are below nominal detection limits (NDL) (Element **Report No. 3109082**). Selected results are:

- ✓ The reported **pH** values of 6.67 indicate that the water is in the acidic range (< 7.0).
- ✓ The reported **hardness** of 60 milligrams per litre (mg/L) classifies the water as soft.
- ✓ The **Langelier Index** (LI) of -1.65 suggests that the water is under-saturated with calcium carbonate and has a tendency towards corrosion in the distribution system.
- ✓ The **electrical conductivity** (EC) was found to be 158 micro-siemens per centimetre ($\mu\text{S}/\text{cm}$) which confirms fresh groundwater.
- ✓ **Total Dissolved Solids** refer to minerals, salts, metals, cations, and anions dissolved in water, and was found to be 79 mg/L, well below the AO of 500 mg/L.
- ✓ The **UV Transmittance** value was found to be 99.6 percent per centimetre ($\%/ \text{cm}$) which suggests clear source water.
- ✓ **Organic Carbon** (*total nonpurgeable*) of the tested water was found to be 0.8 mg/L, which is a value typical for groundwater.
- ✓ **Iron** concentration (*total*) was found to be 0.014 mg/L, which is below the AO of 0.3 mg/L.
- ✓ **Manganese** concentration (*total*) was found to be below of NDL of 0.005 mg/L.
- ✓ **Arsenic** concentration (*total*) was found to be below the nominal detection limit (NDL) of 0.001 mg/L.

4.2.2 Water Chemistry

Based on the **Piper Analysis**¹⁶ (**Figure 8**), the results suggest that the water chemistry for the raw water samples collected from **TW-5(25)** is of **calcium-bicarbonate** (Ca-HCO_3) type. Generally, flow paths that are short and well flushed have bicarbonate as the dominant anion and usually calcium as the dominant cation (Poeter et al, 2020). Ca-HCO_3 type groundwater is typically associated with local groundwater systems (low solubility).

¹⁶ Piper (1944); used software: AQ.QA Program by Rockware®.

5 Discussion

5.1 Saltwater Intrusion

TW-5(25) is located at approximately 600 m and 560 m from Porpoise Bay (to the north) and Trail Bay (to the south), respectively (both saltwater bodies). The static water level in the well is estimated at an elevation of 2.5 m-above mean sea level (amsl) (February 18, 2025), based on an inferred ground elevation of 18 m-amsl. Based on collected information to date, no immediate and measurable concerns were identified pertaining to possible risk of saltwater intrusion¹⁷:

- ✓ Water quality results for parameters such as calcium, sodium, chloride, potassium, hardness, EC, pH, and total dissolved solids (**Attachment 3**) were all (well) below the AO guideline limits (where applicable), i.e., no signs of elevated concentrations for any of the constituents that would suggest saltwater intrusion.
- ✓ Groundwater geochemistry (Piper Diagram – **Figure 8**) suggests a calcium bicarbonate type water (brackish / saline water has a chemistry of type sodium chloride).
- ✓ EC trends (**Figure 9**) monitored during the 72-hr pumping tests do not show any indication of saltwater intrusion for the well (i.e., no significant increasing trend in EC was observed).

KWD acknowledges that 72 hrs of pumping may not be long enough (and the discharge rate not high enough) to observe any signs of saltwater intrusion. *Any determination regarding saltwater intrusion potential for the proposed wellfield can only be made once production-sized pumping rates have been established and tested. Future wellfield operation requires long-term groundwater monitoring to ensure that saltwater intrusion is not occurring.*

5.2 Groundwater Users

Figure 2 shows groundwater users within a 1-kilometre (km) radius of **TW-5(25)**. **Table 5** includes information about each well, retrieved from the Provincial well database. It suggests that there are 8 wells within a 1 km radius. KWD confirmed that there are two active production wells, WP2 and WP3, at Salish Soils property, at a distance of approximately 676 m and 640 m, respectively, from **TW-5(25)**. KWD confirmed the location of the well with well tag number (WTN) 117951, located about 400 m west of **TW-5(25)** along inlet road. Well with WTN 93261 is an inactive well.

5.3 Impact Pumping of TW-5(25) on Nearby Streams

TW-5(25) is located about 1.8 km west of Chapman Creek and about 1.9 km south of Irgens Creek. Based on the results of **MW-1**, located about 300 m northeast of **TW-5(25)**, the zone of influence¹⁸ of the test well did not reach **MW-1** (i.e., no well interference was observed). *Any determination regarding possible impacts of a proposed wellfield on the identified streams can only be determined with a satisfactory level of certainty once production-sized test wells are constructed and adequately tested, and the necessary analysis, based on field data, is completed.*

¹⁷ The focus of the monitoring was on immediate and short-term risk.

¹⁸ The zone of influence (ZOI) is the lateral area where due to pumping at a specific discharge rate and for a specific duration drawdown is observed in the aquifer; ZOI is typically determined analytically and/or by means of direct measurements (monitoring wells) and/or through numerical groundwater flow modeling.

5.4 Wellfield Infrastructural Requirements¹⁹

We anticipate that developing a wellfield at the Sechelt | shíshálh Hospital site would entail:

1. At least two production wells – with that having a mechanical backup when a well is offline.
 - a. Anticipated well diameter: 400 mm.
 - b. Anticipated well depth: 85 m.
2. Pump station for pump controls, communications, and disinfection station (separate room).
3. Backup generator (genset).

A **Class C** cost estimate for developing a groundwater source is summarized in **Table 7**. Costs include the development of a wellfield with two production wells. The cost estimate includes:

- Production well drilling and construction.
- Well testing.
- Hydrogeological and engineering services (field program, analysis, well design).
- Permitting (groundwater licence application and technical assessment reporting).
- Technical support, project management, site preparation, sediment removal, etc.
- Contingencies.

¹⁹ In consultation with the SCRD we focus our high-level discussion primarily on the wellfield. Tie-in considerations to Chapman Water System and other works will be part of a future project phase. Drilling of production wells is necessary to complete high-capacity testing and related analysis to confirm wellfield capacity and possible environmental impacts in addition to impacts on other groundwater users.

6 Conclusions and Recommendations

6.1 Conclusions

1	The results of the constant rate pumping test confirm that test well TW-5(25) is capable of producing 5744 m ³ of water at a sustained average discharge rate of 22.2 L/s (351 US gpm) over a period of 72 hrs.
2	The estimated theoretical long-term yield is 187 L/s suggesting a potentially productive aquifer, supported by the preliminary estimated transmissivity of 5841 m ² /d and hydraulic conductivity of 314 m/d.
3	The certified yield for TW-5(25) is 22.2 L/s, set equal to the pumping test discharge rate.
4	The results of the water quality analysis suggest that for the analyzed constituents, the raw water quality meets Canadian Drinking Water Guidelines.
5	The analyzed water chemistry suggests calcium bicarbonate (Ca-HCO ₃) type groundwater which is typically associated with local groundwater systems (low solubility).
6	No immediate and measurable concerns were identified pertaining to possible risk of saltwater intrusion, based on the water quality results.
7	No measurable well interference was observed at the designated monitoring during the constant rate pumping test of TW-5(25) .
8	The Sechelt shíshálh Hospital site is suitable for the development of a wellfield, potentially capable of producing 74 L/s.

6.2 Recommendations

1	<p>Advance to the next phase by drilling two production-sized test wells to facilitate high-capacity pumping tests:</p> <ul style="list-style-type: none"> ✓ to confirm wellfield capacity, long-term yield, and other considerations (<i>possible well interference, risk of saltwater intrusion and impact on streams</i>). ✓ to inform future decisions and provide data for continued engagement with members of shíshálh Nation and Vancouver Coastal Health, and other stakeholders.
2	Submit a groundwater licence application for 74 L/s to the Ministry of Water, Land and Resource Stewardship.
3	Design and implement a groundwater monitoring program for TW-5(25) including water quality and groundwater levels.
4	Conduct a Groundwater at Risk of Containing Pathogens (GARP) assessment in support of disinfection requirements.
5	Continue engagement with members of shíshálh Nation and Vancouver Coastal Health.

7 Closure

Thank you for giving Kalwij Water Dynamics Inc. the opportunity to prepare this technical memorandum, *Water Supply Plan Feasibility Study Long-Term Ground Water Supply Sources (RFP 2337004) | Project Summary and Results of Test Well TW-5(25) at the Sechelt | shíshálh Hospital Site*.

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Yours Truly,

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Attachments

Attachment 1: Tables and Figures.

Tables

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Figure 6	Water Level Trend – MW-1 (Ti'Ta Way, Heidelberg Construction).
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Figure 8	Water Chemistry (Piper Diagram) – TW-5(25).
Figure 9	Electrical Conductivity Trends – TW-5(25), Observed during the Constant Rate Pumping Test.

Drawing

Drawing 1 – TW-5(25) Borehole Lithology and Well Schematic.

Attachment 2: Project Illustrations Sechelt | shíshálh Hospital Test Well Drilling Site.

Attachment 3: Water Quality Reports TW-5(25).

- Water Quality Reports No. 3109081 (Element).
- Water Quality Reports No. 3109082 (Element).

Attachment 1

Tables, Figures, Drawing.

Tables

Table 1 Test Well Drilling Results.

Location	Well Reference	Well ID (Tag)	Aquifer	Drilling	Pumping test	Well Depth	Depth to bedrock	Yield Estimate
						m	m	L/s
1. RC Fire Hall	TW-1 (24)	69701	fractured rock	Sep. 2024	-	274	0	0.95
2. Airport - Hilltop Rd.	TW-2 (24)	69704	fractured rock	Sep. 2024	Nov. 2024	186	34	*4.6
3. Kinnikinnick Park	TW-3 (24)	69709	fractured rock	Oct. 2024	-	247	73	1.2
4. Whitaker Park	TW-4 (24)	69708	sand and gravel / fractured rock	Nov. 2024	-	195	89	**2.2
5. Sechelt shíshálh Hospital	TW-5 (25)	69710	sand and gravel	Jan. 2025	Feb. 2025	83	87	*22+

m = metre | L/s = litre per second.

All test wells have a nominal diameter of 150 millimetres (mm).

* Yield estimate based on pumping test results (other yield estimates based on airlift during drilling).

** Yield estimate for the water-bearing unit in the overburden; yield estimate fractured rock: 0.95 L/s.

The test wells have been constructed in accordance with the Groundwater Protection Regulation.

Table 2 Summary of Information – TW-5(25).

Description	Units	TW-05(25)	
		SecheIt shíshálh Hospital Site	
General			
Well ID No.		69710	Well tag
Civic Address		5544 Sunshine Coast Highway SecheIt	
Legal Description		Plan EPP4330	
Parcel Identifier		028-052-579	
Geographic location (GPS)		49°28'33.38"N	
		123°45'1.44"W	
Ground elevation	m-geod.	18.0	SCRD WebMap.
Drilling date		Jan 23 - 31, 2025	
Pumping test date		Feb. 13 - 21, 2025	
Drilling depth	m-bgs	91.4	
Borehole diameter	mm	150	
Well development technology		Air	
Well development duration	hrs	20	
Aquifer System			
Aquifer Type		Unconsolidated	
Material Type		Sand and Gravel	
Water-bearing zone	m-bgs	24.4 - 57.0	
Lower permeable zone	m-bgs	57.0 - 63.7	
Water-bearing zone	m-bgs	63.7 - 87.5	
Well Specifications			
Well depth	m-bgs	82.8	
Casing diameter (nominal diameter)	mm	150	ASTM A53 - 5.563 mm wall thickness
Total casing installed	m	77.6	
Well stickup	m	0.6	
Well screen assembly length	m	6.6	K-packer, screen, plug.
Screen length	m	6.1	
Style of screen bottom		plug	
Surface seal length	m	5.0	Thickness: 5 cm.
Surface material	-	Bentonite	3/8" coarse grade.
Well Hydraulics			
Static Water Level	m-bgs	15.50	Feb. 18, 2025 @ 12:55 PM.
Pumping test discharge rate (avg)	L/s	22.16	
Pumping Water Level	m-bgs	19.46	
Drawdown	m	3.96	
Specific capacity	L/s/m	5.59	

Table 3 Pumping Test Information – TW-5(25).

Description	Units	TW-05(25)
		Sechelt shíshálh Hospital Site
Pumping Test Information		
Date Step-Drawdown Pumping Test		13-Feb-23
Duration ⁽¹⁾	min	130
Discharge rates	L/s	19.1 L/s, 22.1 L/s
Date Constant Rate Pumping Test		Feb. 18 - 21, 2025 (2 PM)
Duration	min	72
Target Discharge Rate	L/s	22.1
Duration recovery monitoring	min	0.5
Water level measurement methods		Level sounder (manual recording at user-defined intervals ⁽²⁾) & leveloggers (programmed at 1-min intervals)
Discharge to ground provision		Via lay-flat, discharge into stormwater drain
Observation well location		MW-1 (Ta'Ta Way), MW-2 (WP2 at Salish Soils), both owned by Heidelberg Construction
Creek monitoring		.-
Pumping System & Controls		
Submersible Pump		S.E.I. 30 hp, 385 USG (24.3 L/s)
Submersible Motor		S.E.I. 60 Hz, 460 Volt, 3 Phase
Pump intake depth (approx.)	m-bgs	58.5
Flow Meter		Siemens Electromagnetic Flow Meter and Totalizer
Power supply		Generator

hp = horsepower; USG = US gallons.

The pumping test was completed in accordance with the Government of B.C. [Guide for Conducting Pumping Tests](#).

Table 4 - Well Yield Estimation – TW-5(25).

Description	Units	Value	Remark
Well Name		TW-05(25)	Sechelt shísháhlh Hospital site
Well ID		69710	Well tag
Static water level (SWL)	m-bgs	15.5	Feb. 18, 2025 @ 12:55 pm.
SWL - incl seasonal variation		-	Included in the safety factor
Well depth	m-bgs	82.8	
Depth to lower aquifer	m-bgs	65.5	
Available water column	m	50.0	
Average tested pumping rate	L/s	22.2	351 US gpm
Drawdown (end of test)	m	3.96	
Specific capacity (SC)	L/s/m	5.59	
Safety factor	-	0.70	Equals 15 m of water column
Safe available drawdown	m	35.0	
100-day projected drawdown	m	4.15	
Projected SC (theoretical)	L/s/m	5.34	
Computed long-term yield (THEORETICAL)	L/s	187	
Certified yield*	L/s	22.2	Set equal to the 72-hr pumping test average discharge rate.
	m ³ /d	1915	

*Certified By KWD's QP.

Table 5 – Wells Located within 1 km Radius from TW-5(25).

Well Tag Number	Well ID Plate	Construction Start Date	Well Class	Intended Water Use	Finished Well Depth	Well Diameter	Static Water Level	Well Yield		Aquifer ID
								L/s	US gpm	
117951	53548	2019-07-04	Water Supply	Commercial and Industrial	22.56	150	5.79	1.89	30	
88780		2006-06-11	Water Supply	Commercial and Industrial	33.53	150		3.15	50	566
88753		2006-06-11	Water Supply	Private Domestic	33.53	150		3.15	50	566
93261		2002-03-25	Water Supply	Private Domestic	60.96	200	29.87	0.63	10	566
123528			Dewatering/ drainage	Not Applicable						
128745	50678	1985-01-01	Water Supply	Water Supply System						566
93084	possibly WP2	2003-08-27	Water Supply	Industrial	49.68	300	29.87			566
93094	possibly WP3	2003-08-27	Water Supply	Industrial	49.68	300	29.87	25.24	400	566

No depth to bedrock information.

No artesian wells.

Intended water use not confirmed except for the wells owned by Heidelberg Construction (on Salish Soils).

Data as recorded in the Provincial wells database; KWD converted values to metric; KWD corrections / additions shown in blue.

Table 6 - Preliminary Results Aquifer Parameter Estimation.

Scenario	Q	D _{avg}	Δs*	T	K
t = 10-100 log Cycle	m ³ /day	m	m	m ² /day	m/d
TW-5(25)	1915	18.6	0.06	5841	314

* Based on drawdown data corrected for dewatering.

The assumption is made that Cooper – Jacob (1946) analytical solution can be applied by including the drawdown correction (Jacob (1963), needed for applying the solution to hydraulically unconfined aquifer conditions.

Definitions:

T is the capacity of an aquifer to transmit water of the prevailing kinematic viscosity (Heath, 1983).

K is volume of water that will move in a unit of time under a unit hydraulic gradient through a unit area (Heath,1983).

Cooper-Jacob

$$T = \frac{2.3Q}{2\pi\Delta s}$$

T = transmissivity (m²/d), Q = well discharge rate (m³/d), and Δs = drawdown across one log cycle (m).

$$K = T/D_{avg}$$

K = hydraulic conductivity (m/d), D_{avg} = aquifer thickness (m).

D_{avg} is based on the lower permeable zone; in KWD's opinion this suffices for the presented preliminary estimation of K.

Aquifer parameters (T, K) should be further refined and storativity computed by having a monitoring well sufficiently close enough to the pumping well that meaningful drawdown is observed in the monitoring well.

Table 7 - Class C Cost Estimate – Groundwater Development.

Item	Cost	Remark
Two production wells, pumping tests	\$1 M	Including 25% contingency.
Consulting and permitting	\$0.1 M	
Contingency (30%)	\$0.33 M	For budgeting purposes.
Total	\$1.43 M	Proposed budget.

Figures



[566] Aquifer number, provincial aquifer database; delineations are shape files retrieved from iMapBC (Prov. of BC).



Sunshine Coast Regional District

Groundwater Investigation Phase 5
TW-5(25) | Sechelt / shíshálh Hospital Site

REV0	IMK	23/03/2025

Test Well Drilling Locations and
 Aquifer Delineations.

Figure 1



- TW-5(25).
- 1 km radius.
- Documented wells (BC Provincial database).
- Added: WP2 (top) and WP3 (bottom) owned by Heidelberg Construction, located on Salish Soils property.
- # No wells located here.
- Elevation contour lines.
- Parcel boundaries.

Sources: NRCan, Esri Canada, and Canadian Community Maps contributors., Sources: Esri, Maxar, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatasysteisen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap, and the GIS user community, Sunshine Coast Regional District, Esri, Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, US Census Bureau, USDA, NRCan, Parks Canada

WP2 was a designated monitoring well (MW-2) for TW-5(25) pumping test.



Sunshine Coast Regional District

Groundwater Investigation Phase 5
TW-5(25) | Sechelt / shíshálh Hospital Site

REV1	IMK	28/03/2025
REV0	IMK	23/03/2025

Area locale and locations of existing wells.

Figure 2



-  Location test well, TW-5(25).
-  Parcel boundaries.

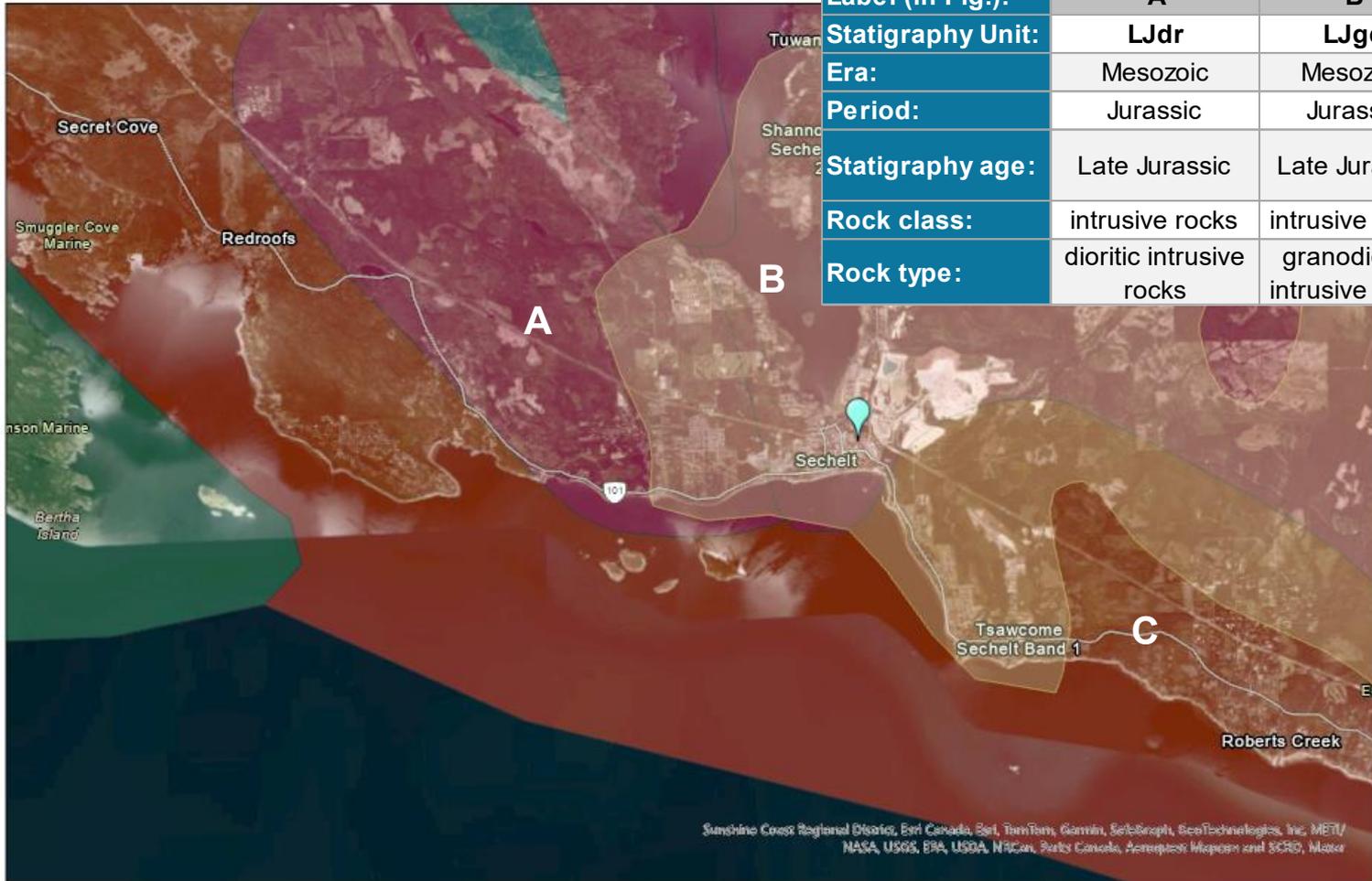
Proposed wellfield development at the location of the test well (grassy area).



REV1	IMK	28/03/2025
REV0	IMK	23/03/2025

Test Well Drilling Location -
Sechelt / shíshálh Hospital Site.

Figure 3



Label (in Fig.):	A	B	C
Statigraphy Unit:	LJdr	LJgd	Ekgd
Era:	Mesozoic	Mesozoic	Mesozoic
Period:	Jurassic	Jurassic	Creaceous
Statigraphy age:	Late Jurassic	Late Jurassic	Early Cretaceous
Rock class:	intrusive rocks	intrusive rocks	intrusive rocks
Rock type:	dioritic intrusive rocks	granodioritic intrusive rocks	granodioritic intrusive rocks

-  Delineation Quaternary Deposits.
-  TW-5(25).

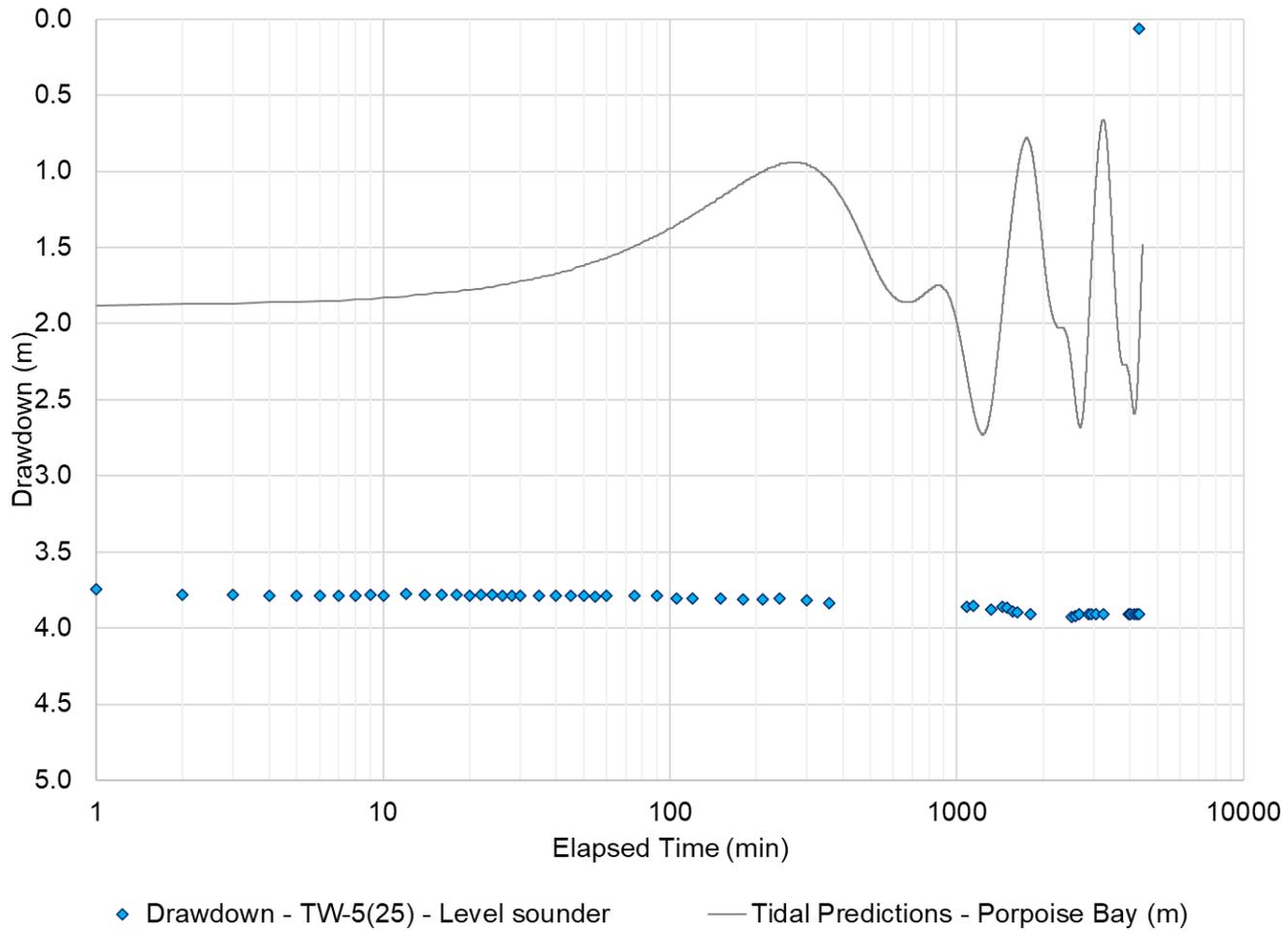
Source geology basemap and information: Cui, Y. et al. (2017); Quaternary Deposit shapefile retrieved from iMapBC (Prov. of BC).



Sunshine Coast Regional District		
Groundwater Investigation Phase 5		
TW-5(25) Sechelt / shíshálh Hospital Site		
REV1	IMK	30/06/2025
REV0	IMK	23/03/2025

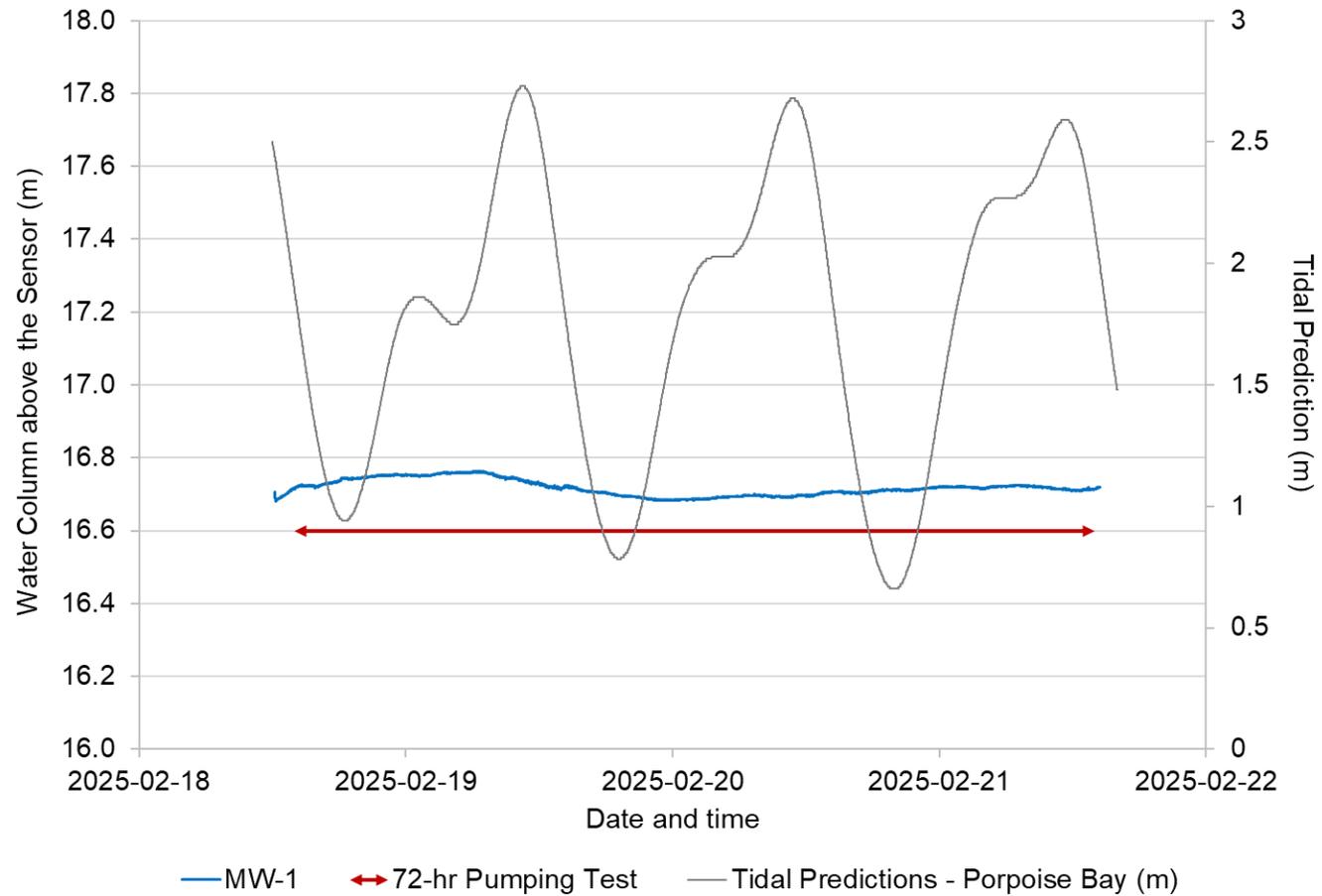
Area Geology and Quaternary Deposits.

Figure 4



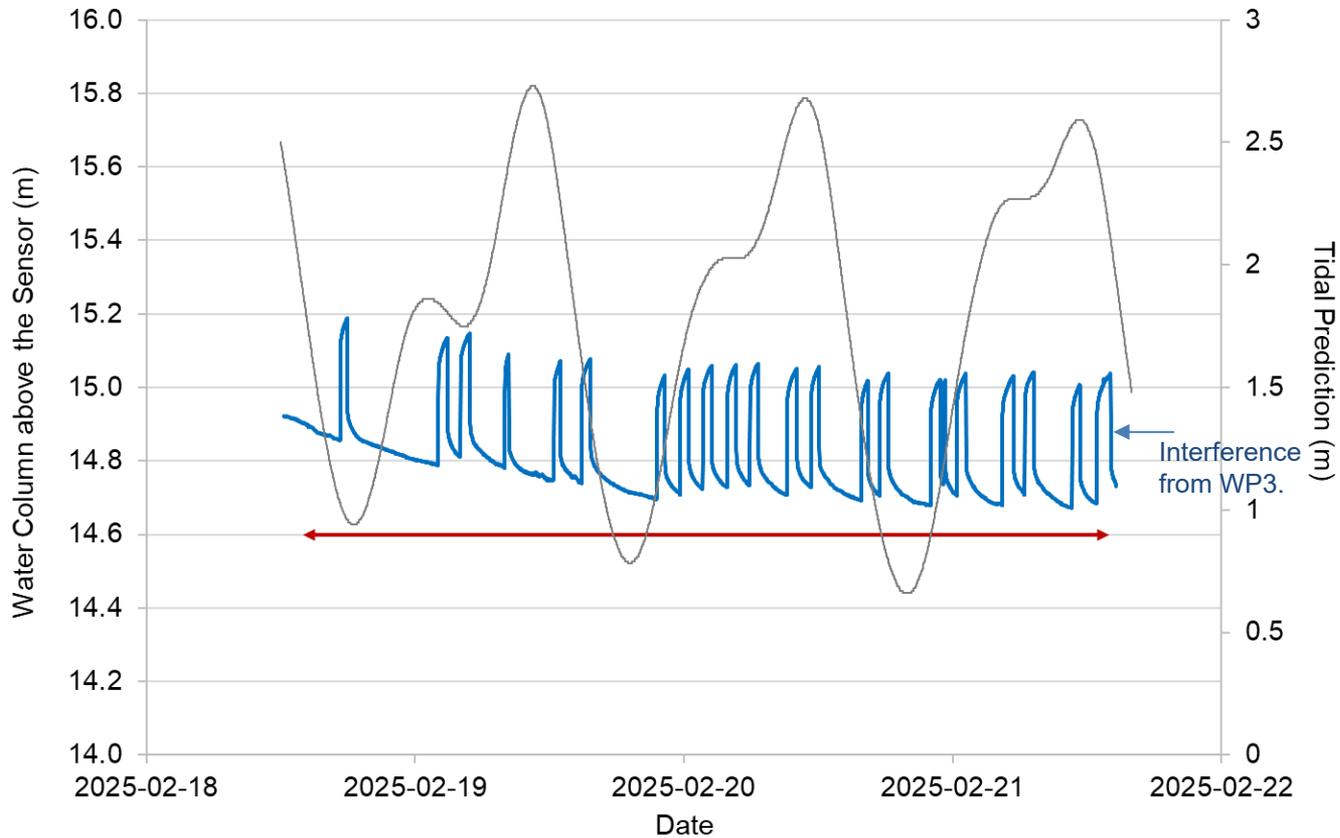
72-hr Constant Rate Pumping Test @ Q = 22.2 L/s (Feb. 18 – Feb. 21, 2025).

REV0	IMK	23/03/2025



72-hr Constant Rate Pumping Test @ Q = 22.2 L/s (Feb. 18 – Feb. 21, 2025).

REV0	IMK	23/03/2025



— MW-2 ↔ 72-hr Pumping Test — Tidal Predictions - Porpoise Bay (m)

72-hr Constant Rate Pumping Test @ Q = 22.2 L/s (Feb. 18 – Feb. 21, 2025).

MW-2 is WP2 of Heidelberg Construction; distance WP2 – WP3 ~ 40 m.



Kalwij Water Dynamics

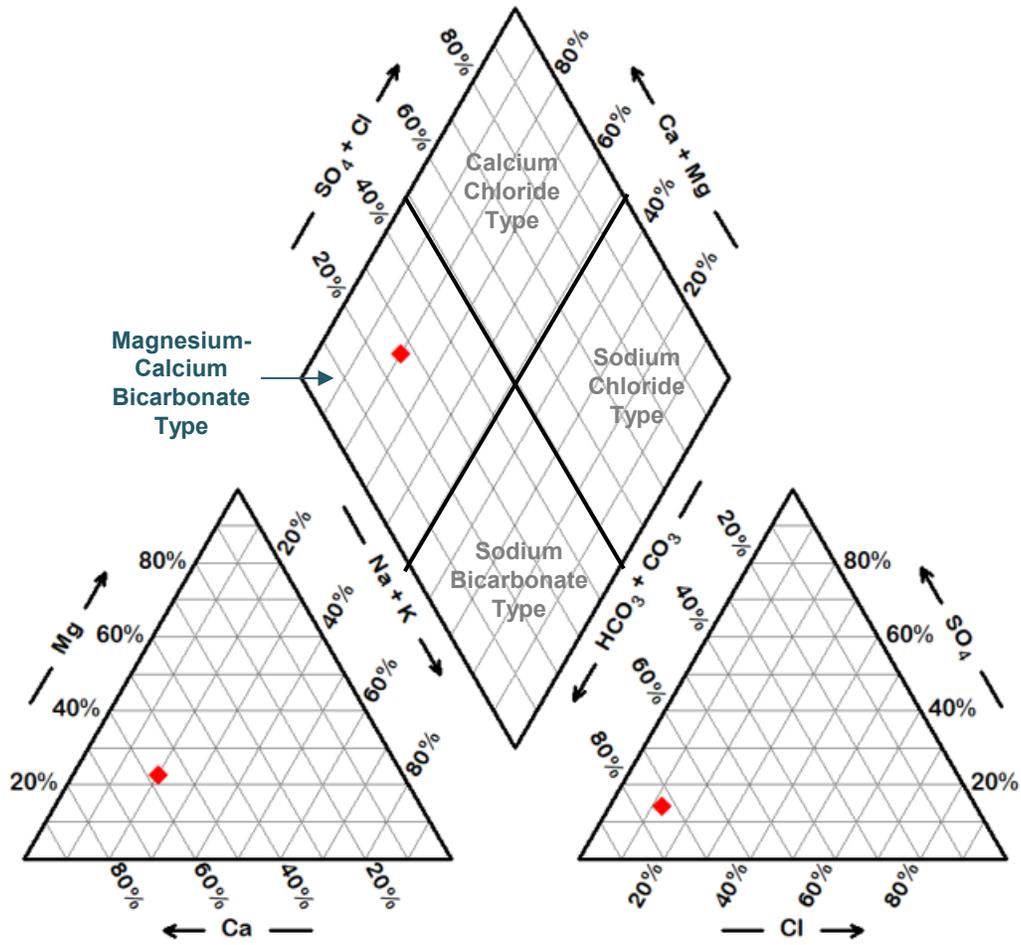
Sunshine Coast Regional District

Groundwater Investigation Phase 5
 TW-5(25) | Sechelt / shíshálh Hospital Site

REV0	IMK	23/03/2025

Water Level Trend – MW-2 (WP2, Heidelberg Construction).

Figure 7



Cations (+)

% meq/l

% meq/l

Anions (-)

◆ TW-5(25) – Sample date: 21 Feb. 2025 (raw water).

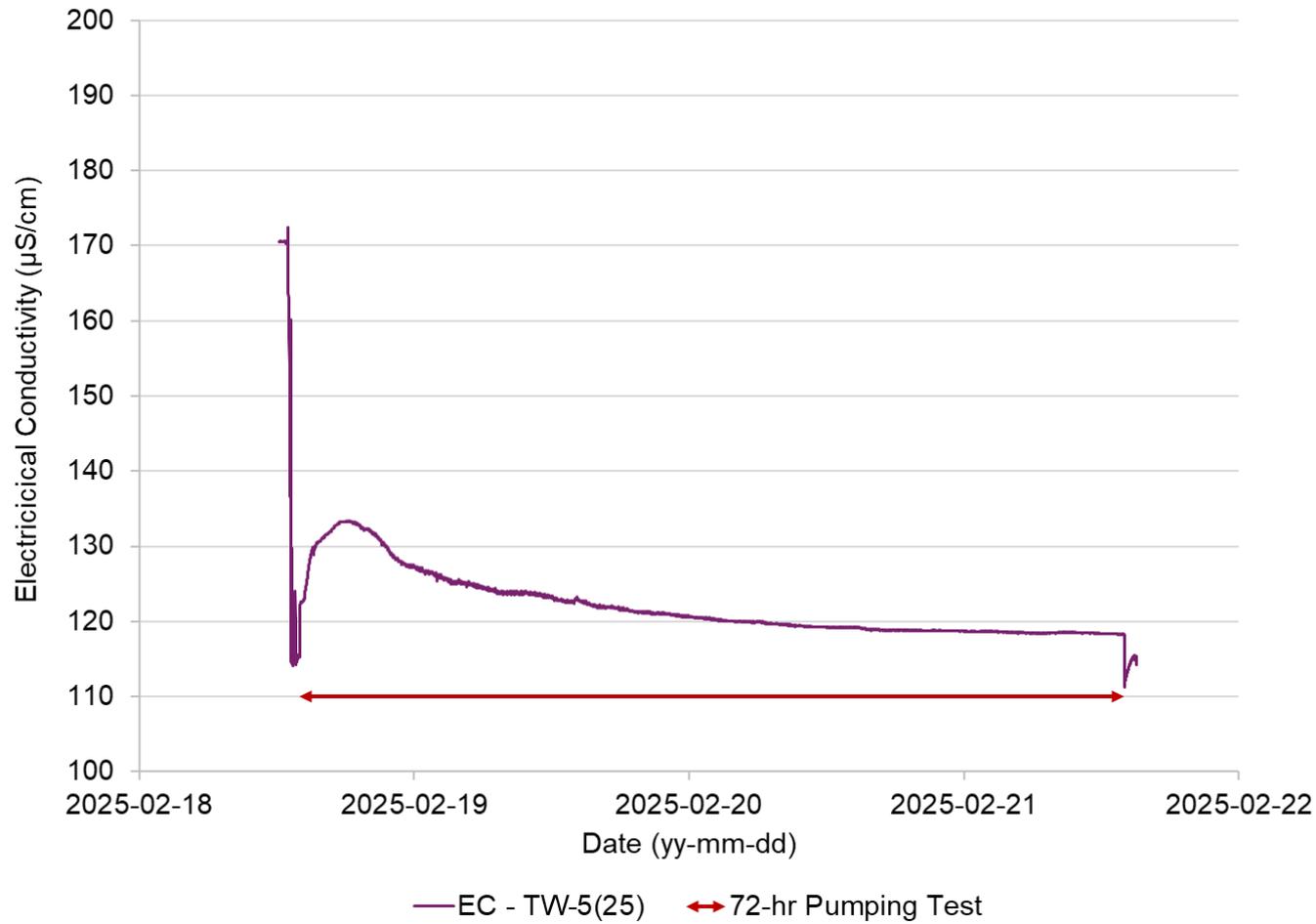
Sunshine Coast Regional District

Groundwater Investigation Phase 5
 TW-5(25) | Sechelt / shishálh
 Hospital Site.

REVO	IMK	23/03/2025

Water Chemistry (Piper Diagram) – TW-5(25).

Figure 8



72-hr Constant Rate Pumping Test @ Q = 22.2 L/s (Feb. 18 – Feb. 21, 2025).

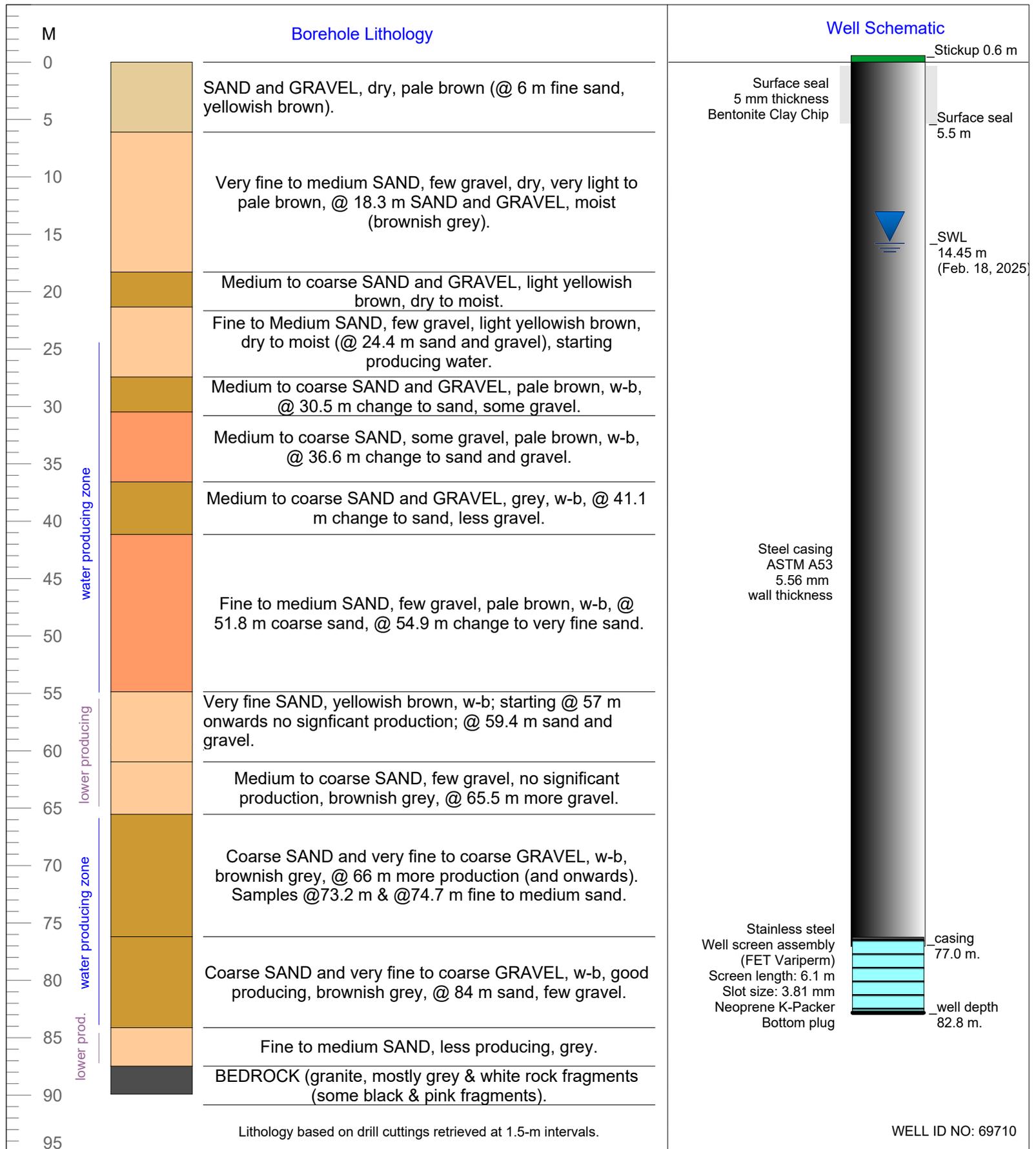


Sunshine Coast Regional District		
Groundwater Investigation Phase 5		
TW-5(25) Sechelt / shíshálh Hospital Site		
REV0	IMK	23/03/2025

Electrical Conductivity Trends – TW-5(25), Observed during the Constant Rate Pumping Test.

Figure 9

Drawing



 <p>Kalwij Water Dynamics Inc. www.waterdynamics.ca (604) 615-4932</p>	<p>The presented results are site-specific and should not be used to extrapolate beyond the test well drilling site. Additional boreholes are needed to confirm lithology laterally.</p>					
	Client	Sunshine Coast Regional District				
	Drawing	1				
	Title	Lithology and Well Design Schematic TW-5(25)				
	Location	Sechelt shísháłh Hospital site, Sechelt.				
	Version	R0	Design	IMK	Date	Mar. 24, 2025
	Version	R1	Review	IMK	Date	Mar. 28, 2025
Version	R2			Date		

Attachment 2

**Project Illustrations Sechelt | shíshálh
Hospital Test Well Drilling Site.**



1. Test well drilling site at Sechelt | shíshálh Hospital.



2. Test well drilling field setup.



4. Drilling in progress.



5. Discharge (airlift) from water-bearing formation.



5. Examples of drill cuttings retrieved during the test well drilling.



6. Well screen assembly (next to the drill rods).



7. Well screen assembly installation in progress.



8. Discharge during well development.



9. Completed Bentonite surface seal.



10. Pumping test field setup – discharge is via the layflat into the stormwater drain.



11. Manual recording of the water levels (levelsounder).



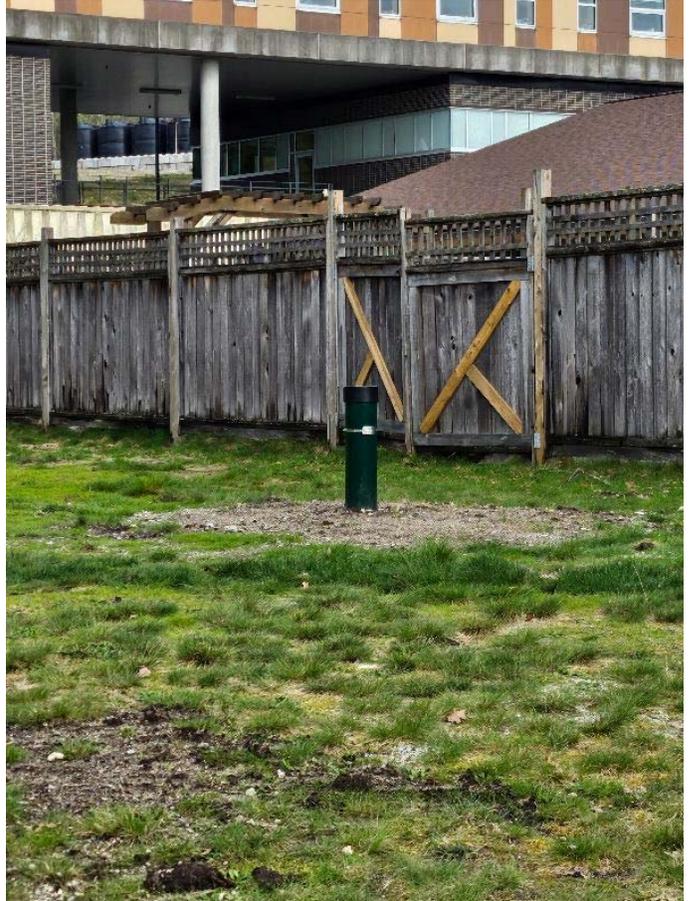
11. Designated monitoring well (MW-1) located along Ti'Ta Way, owned by Heidelberg Construction.



12. Designated monitoring well (MW-2), WP2 located on Salish Soils property, owned by Heidelberg Construction.



13. Location TW-5(25) – not yet painted.



14. TW-5(25), with well ID number 69710.

Attachment 3

Water Quality Reports TW-5(25).

Water Quality Reports No. 3109081 (Element)

Report Transmission Cover Page

Bill To: Kalwij Water Dynamics Inc	Project ID:	Lot ID: 1796335
P.O. Box 684 Station Main	Project Name: SCR D - Test Well Drilling	Control Number:
Port Coquitlam, BC, Canada	Project Location: Hospital Site Test Well	Date Received: Feb 22, 2025
V3B 6H9	LSD:	Date Reported: Mar 6, 2025
Attn: Ineke Kalwij	P.O.:	Report Number: 3109081
Sampled By:	Proj. Acct. code:	Report Type: Final Report
Company:		

Contact	Company	Address
Ineke Kalwij	Kalwij Water Dynamics Inc	P.O. Box 684 Station Main Port Coquitlam, BC V3B 6H9 Phone: (604) 615-4932 Fax: (604) 475-4062 Email: ineke@kalwijwaterdynamics.com

Delivery	Format	Deliverables
Email	PDF	COC / Test Report
Email	Standard Crosstab Without Tabs	Test Report
Email - Merge	PDF	COA
Email - Merge	PDF	COA / COC
Email - Merge	PDF	COC / Invoice

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Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Mar 6, 2025 Report Number: 3109081 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-1
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents					
UV Transmittance	%/cm	99.6	0.1		
Inorganic Nonmetallic Parameters					
Ammonium - N	mg/L	<0.025	0.025		
Sulfide	Total mg/L	<0.002	0.002	0.05	Below AO
Organic Carbon	Total Nonpurgeable mg/L	0.8	0.5		
Metals Extractable					
Silicon	Extractable mg/L	13.4	0.05		
Aluminum	Extractable mg/L	<0.002	0.002	0.1 OG; 2.9 MAC	Below OG
Antimony	Extractable mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Extractable mg/L	<0.0002	0.0002	0.01	Below MAC
Barium	Extractable mg/L	0.004	0.001	2.0	Below MAC
Boron	Extractable mg/L	0.005	0.002	5	Below MAC
Cadmium	Extractable mg/L	0.00002	0.00001	0.007	Below MAC
Chromium	Extractable mg/L	<0.0005	0.0005	0.05	Below MAC
Copper	Extractable mg/L	0.006	0.001	1 AO; 2 MAC	Below AO
Lead	Extractable mg/L	0.0005	0.0001	0.005	Below MAC
Molybdenum	Extractable mg/L	<0.001	0.001		
Nickel	Extractable mg/L	<0.0005	0.0005		
Selenium	Extractable mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Extractable mg/L	<0.00001	0.00001		
Uranium	Extractable mg/L	<0.0005	0.0005	0.02	Below MAC
Zinc	Extractable mg/L	0.043	0.001	5	Below AO
Trace Metals Dissolved					
Digestion	Dissolved	Field filtered and Pres Dissol			
Titanium	Dissolved mg/L	<0.002	0.002		
Aluminum	Dissolved mg/L	<0.001	0.001	0.1 OG; 2.9 MAC	Below OG
Antimony	Dissolved mg/L	<0.00002	0.00002	0.006	Below MAC
Arsenic	Dissolved mg/L	0.0002	0.0001	0.010	Below MAC
Barium	Dissolved mg/L	0.0042	0.0001	2.0	Below MAC
Beryllium	Dissolved mg/L	<0.00005	0.00005		
Bismuth	Dissolved mg/L	<0.0001	0.0001		
Boron	Dissolved mg/L	0.006	0.002	5	Below MAC
Cadmium	Dissolved mg/L	0.00001	0.00001	0.007	Below MAC
Chromium	Dissolved mg/L	<0.00005	0.00005	0.05	Below MAC
Cobalt	Dissolved mg/L	<0.00002	0.00002		
Copper	Dissolved mg/L	0.0043	0.0005	1 AO; 2 MAC	Below AO
Iron	Dissolved mg/L	0.004	0.002	0.3	Below AO
Lead	Dissolved mg/L	0.00025	0.00001	0.005	Below MAC

Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Mar 6, 2025 Report Number: 3109081 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-1
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Trace Metals Dissolved - Continued						
Lithium	Dissolved	mg/L	0.0013	0.0005		
Manganese	Dissolved	mg/L	<0.001	0.001	0.02 AO; 0.12 MAC	Below AO
Molybdenum	Dissolved	mg/L	0.00006	0.00002		
Nickel	Dissolved	mg/L	<0.0002	0.0002		
Selenium	Dissolved	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00001	0.00001		
Strontium	Dissolved	mg/L	0.071	0.0001	7.0	Below MAC
Tellurium	Dissolved	mg/L	<0.00005	0.00005		
Thallium	Dissolved	mg/L	<0.00001	0.00001		
Thorium	Dissolved	mg/L	<0.00005	0.00005		
Tin	Dissolved	mg/L	<0.0001	0.0001		
Uranium	Dissolved	mg/L	0.00022	0.00001	0.02	Below MAC
Vanadium	Dissolved	mg/L	0.00095	0.00005		
Zinc	Dissolved	mg/L	0.035	0.0005	5.0	Below AO
Zirconium	Dissolved	mg/L	<0.0001	0.0001		
Metals Total						
Mercury	Total	mg/L	<0.000005	0.000005	0.001	Below MAC
Calcium	Total	mg/L	19	0.01		
Magnesium	Total	mg/L	4.1	0.02		
Potassium	Total	mg/L	1.6	0.04		
Silicon	Total	mg/L	13	0.005		
Sulfur	Total	mg/L	2.5	0.02		
Sodium	Total	mg/L	6.6	0.1	200	Below AO
Titanium	Total	mg/L	0.002	0.002		
Microbiological Analysis						
Total Coliforms	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Thermotolerant (Fecal) Coliforms	Enzyme Substrate Test	MPN/100 mL	<1.0	1		
Escherichia coli	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Approximate Slime Forming Bacteria Population	BART Kit	CFU/mL	440000			
Heterotrophic Count - Aerobic	SimPlate	MPN/mL	28.0	2		
Approximate Iron Related Bacteria Population	BART Kit	CFU/mL	35000			
Approximate Sulfate Reducing Bacteria	BART Kit	CFU/mL	<1			

Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Mar 6, 2025 Report Number: 3109081 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-1
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

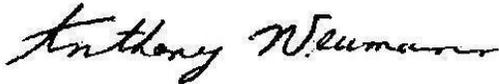
Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Microbiological Analysis - Continued					
Population					
Physical and Aggregate Properties					
Colour	Apparent, Potable	Colour units	<5	5	15 Below AO
Turbidity		NTU	0.1	0.1	0.1/0.3/1.0 OG
Routine Water					
pH			6.67	1	7.0-10.5 Below OG Range
Electrical Conductivity	at 25 °C	µS/cm	158	1	
Calcium	Extractable	mg/L	17.4	0.2	
Magnesium	Extractable	mg/L	4.1	0.2	
Sodium	Extractable	mg/L	6.3	0.4	200 Below AO
Potassium	Extractable	mg/L	1.5	0.4	
Iron	Extractable	mg/L	<0.01	0.01	0.3 Below AO
Manganese	Extractable	mg/L	<0.005	0.005	0.02 AO; 0.12 MAC Below AO
Chloride	Dissolved	mg/L	5.1	0.4	250 Below AO
Fluoride		mg/L	<0.05	0.05	1.5 Below MAC
Nitrate - N		mg/L	0.77	0.01	10 Below MAC
Nitrite - N		mg/L	<0.005	0.005	1 Below MAC
Sulfate (SO4)	Extractable	mg/L	7.4	0.9	500 Below AO
Carbonate		mg/L	<6		
Bicarbonate		mg/L	75		
T-Alkalinity	as CaCO3	mg/L	61	5	
Total Dissolved Solids		mg/L	79	1	500 Below AO
Hardness	as CaCO3	mg/L	60		
Langelier Index	Extractable		-1.65		
Saturation pH	Extractable	pH	8.32		
Calcium	Dissolved	mg/L	18	0.01	
Magnesium	Dissolved	mg/L	4.0	0.02	
Potassium	Dissolved	mg/L	1.5	0.04	
Silicon	Dissolved	mg/L	13	0.005	
Sodium	Dissolved	mg/L	6.4	0.1	200 Below AO
Sulfur	Dissolved	mg/L	2.6	0.02	
Hardness	as CaCO3 (dissolved)	mg/L	62	5	
Trace Metals Total					
Aluminum	Total	mg/L	<0.001	0.001	0.1 OG; 2.9 MAC Below OG
Antimony	Total	mg/L	<0.00002	0.00002	0.006 Below MAC
Arsenic	Total	mg/L	0.0002	0.0001	0.010 Below MAC
Barium	Total	mg/L	0.0046	0.0001	2.0 Below MAC

Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Mar 6, 2025 Report Number: 3109081 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-1
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Trace Metals Total - Continued						
Beryllium	Total	mg/L	<0.00005	0.00005		
Bismuth	Total	mg/L	<0.0001	0.0001		
Boron	Total	mg/L	0.004	0.002	5	Below MAC
Cadmium	Total	mg/L	0.00001	0.00001	0.007	Below MAC
Chromium	Total	mg/L	<0.00005	0.00005	0.05	Below MAC
Cobalt	Total	mg/L	<0.00002	0.00002		
Copper	Total	mg/L	0.0036	0.0002	1 AO; 2 MAC	Below AO
Iron	Total	mg/L	0.014	0.002	0.3	Below AO
Lead	Total	mg/L	0.00037	0.00001	0.005	Below MAC
Lithium	Total	mg/L	0.0015	0.0005		
Manganese	Total	mg/L	<0.001	0.001	0.02 AO; 0.12 MAC	Below AO
Molybdenum	Total	mg/L	0.00006	0.00002		
Nickel	Total	mg/L	<0.0002	0.0002		
Selenium	Total	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Total	mg/L	<0.00001	0.00001		
Strontium	Total	mg/L	0.079	0.0001	7.0	Below MAC
Tellurium	Total	mg/L	<0.00005	0.00005		
Thallium	Total	mg/L	<0.00001	0.00001		
Thorium	Total	mg/L	<0.00005	0.00005		
Tin	Total	mg/L	<0.0001	0.0001		
Uranium	Total	mg/L	0.00024	0.00001	0.02	Below MAC
Vanadium	Total	mg/L	0.00099	0.00005		
Zinc	Total	mg/L	0.035	0.0005	5.0	Below AO
Zirconium	Total	mg/L	<0.0001	0.0001		

Approved by: 
 Anthony Neumann, MSc
 General Manager

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).

Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

Methodology and Notes

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Mar 6, 2025 Report Number: 3109081 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	* Alkalinity - Titration Method, 2320 B	Feb 25, 2025	Element Edmonton - Roper Road
Alkalinity, pH, and EC in water	APHA	* Conductivity, 2510 B	Feb 25, 2025	Element Edmonton - Roper Road
Alkalinity, pH, and EC in water	APHA	* pH - Electrometric Method, 4500-H+ B	Feb 25, 2025	Element Edmonton - Roper Road
Ammonium-N in Water	APHA	* Automated Phenate Method, 4500-NH3 G	Feb 26, 2025	Element Edmonton - Roper Road
Anions (Routine) by Ion Chromatography	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Feb 26, 2025	Element Edmonton - Roper Road
Approval-Edmonton	APHA	Checking Correctness of Analyses, 1030 E	Feb 28, 2025	Element Edmonton - Roper Road
Carbon Organic (Total) in water (TOC)	APHA	High-Temperature Combustion Method, 5310 B	Feb 26, 2025	Element Edmonton - Roper Road
Chloride in Water	APHA	* Automated Ferricyanide Method, 4500-Cl- E	Feb 26, 2025	Element Edmonton - Roper Road
Colour (Apparent) in water	APHA	* Visual Comparison Method, 2120 B	Feb 25, 2025	Element Edmonton - Roper Road
Fecal Coliforms- Colilert (VAN)	APHA	Enzyme Substrate Test, APHA 9223 B	Feb 22, 2025	Element Vancouver
Heterotrophic (Standard) Plate Count (Aerobic SP) - VAN	APHA	Enzyme Substrate Method, 9215 E	Feb 22, 2025	Element Vancouver
Iron Reducing and Oxidizing Bacteria	IRB-BART	Iron Related Bacteria - BART Method, IRB-BART	Feb 22, 2025	Element Vancouver
Mercury (Total) in water	EPA	* Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, 245.7	Feb 26, 2025	Element Edmonton - Roper Road
Metals ICP-MS (Extractable) in water	APHA/USEPA	* Metals By Inductively Coupled Plasma/Mass Spectrometry, APHA 3125 B / USEPA 200.2, 200.8	Feb 26, 2025	Element Edmonton - Roper Road
Metals ICP-MS (Extractable) in water	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Feb 26, 2025	Element Edmonton - Roper Road
Metals SemiTrace (Dissolved) in water (VAN)	US EPA	* Metals & Trace Elements by ICP-AES, 6010C	Feb 24, 2025	Element Vancouver
Metals SemiTrace (Total) in Water (VAN)	US EPA	* Metals & Trace Elements by ICP-AES, 6010C	Feb 24, 2025	Element Vancouver
Metals Trace (Extractable) in water	APHA	Hardness by Calculation, 2340 B	Feb 26, 2025	Element Edmonton - Roper Road
Metals Trace (Extractable) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B	Feb 26, 2025	Element Edmonton - Roper Road
Slime Forming Bacteria - BART (VAN)	SLYM-BART	Slime Forming Bacteria - BART Method, SLYM-BART	Feb 22, 2025	Element Vancouver
Sulfate Reducing Bacteria - BART	SRB-BART	Sulfate Reducing Bacteria - BART Method, SRB-BART	Feb 22, 2025	Element Vancouver
Sulfide in water	APHA	* Gas Dialysis, Automated Methylene Blue Method, 4500-S2- E	Feb 25, 2025	Element Edmonton - Roper Road
Total and E-Coli - Colilert - DW (VAN)	APHA	Enzyme Substrate Test, APHA 9223 B	Feb 22, 2025	Element Vancouver
Trace Metals (dissolved) in Water	US EPA	* Determination of Trace Elements in	Feb 25, 2025	Element Vancouver

Methodology and Notes

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Mar 6, 2025 Report Number: 3109081 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Method Name	Reference	Method	Date Analysis Started	Location
(VAN)	US EPA	Waters and Wastes by ICP-MS, 200.8		
Trace Metals (Total) in Water (VAN)	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Feb 24, 2025	Element Vancouver
Turbidity in Water	APHA	* Turbidity - Nephelometric Method, 2130 B	Feb 25, 2025	Element Edmonton - Roper Road
Ultraviolet Transmittance in Water	APHA	* Ultraviolet Absorption Method, 5910 B	Feb 25, 2025	Element Vancouver

* Reference Method Modified

References

APHA	Standard Methods for the Examination of Water and Wastewater
APHA/USEPA	Standard Methods For Water/ Environmental Protection Agency
EPA	Environmental Protection Agency Test Methods - US
IRB-BART	IRB-BART. Std Methods for the App. of BART Testers, DBI
SLYM-BART	SLYM-BART. Std Methods for the App. of BART Testers, DBI
SRB-BART	SRB-BART. Std Methods for the App. of BART Testers, DBI
US EPA	US Environmental Protection Agency Test Methods

Guidelines

Guideline Description	Health Canada GCDWQ
Guideline Source	Guidelines for Canadian Drinking Water Quality, Health Canada, August 2024
Guideline Comments	MAC = Maximum Acceptable Concentration AO = Aesthetic Objective OG = Operational Guideline for Water Treatment Plants (does not apply to private groundwater wells). Refer to Health Canada for complete guidelines at www.hc-sc.gc.ca

The comparison of test results to guideline limits is provided for information purposes only. This is not to be taken as a statement of conformance / nonconformance to any guideline, regulation or limit. The data user is responsible for all conclusions drawn with respect to the data and is advised to consult official regulatory references when evaluating compliance.

Please direct any inquiries regarding this report to our Client Services group.
Results relate only to samples as submitted.

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Water Quality Reports No. 3109082 (Element)

Report Transmission Cover Page

Bill To: Kalwij Water Dynamics Inc	Project ID:	Lot ID: 1796335
P.O. Box 684 Station Main	Project Name: SCR D - Test Well Drilling	Control Number:
Port Coquitlam, BC, Canada	Project Location: Hospital Site Test Well	Date Received: Feb 22, 2025
V3B 6H9	LSD:	Date Reported: Feb 28, 2025
Attn: Ineke Kalwij	P.O.:	Report Number: 3109082
Sampled By:	Proj. Acct. code:	Report Type: Final Report
Company:		

Contact	Company	Address
Ineke Kalwij	Kalwij Water Dynamics Inc	P.O. Box 684 Station Main Port Coquitlam, BC V3B 6H9 Phone: (604) 615-4932 Fax: (604) 475-4062 Email: ineke@kalwijwaterdynamics.com

Delivery	Format	Deliverables
Email	PDF	COC / Test Report
Email	Standard Crosstab Without Tabs	Test Report
Email - Merge	PDF	COA
Email - Merge	PDF	COA / COC
Email - Merge	PDF	COC / Invoice

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Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Feb 28, 2025 Report Number: 3109082 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-2
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
VOC Screen - Water					
Acetone	µg/L	<10.0	10		
Acetonitrile	µg/L	<5.0	5		
Acrylonitrile	µg/L	<5.0	5		
Allyl Chloride	µg/L	<5.0	5.0		
Benzene	µg/L	<0.5	0.5		
Bromobenzene	µg/L	<0.5	0.5		
Bromochloromethane	µg/L	<1.0	1		
Bromodichloromethane	µg/L	<0.5	0.5		
Bromoform	µg/L	<0.5	0.5		
Bromomethane	µg/L	<1.0	1		
1,3-Butadiene	µg/L	<1.0	1.0		
n-Butylbenzene	µg/L	<0.5	0.5		
sec-Butylbenzene	µg/L	<0.5	0.5		
tert-Butylbenzene	µg/L	<0.5	0.5		
Carbon Disulfide	µg/L	<2.0	2		
Carbon Tetrachloride	µg/L	<0.5	0.50		
Chlorobenzene	µg/L	<1.0	0.5		
Chloroethane	µg/L	<10.0	10		
2-Chloroethyl Vinyl Ether	µg/L	<1.0	1		
Chloroform	µg/L	<0.5	0.5		
Chloromethane	µg/L	<10.0	10		
2-Chlorotoluene	µg/L	<0.5	0.5		
4-Chlorotoluene	µg/L	<0.5	0.5		
Dibromochloromethane	µg/L	<0.5	0.5		
1,2-Dibromo-3-Chloropropane	µg/L	<0.5	0.5		
1,2-Dibromoethane	µg/L	<0.5	0.5		
Dibromomethane	µg/L	<0.5	0.5		
1,4-Dichloro-2-Butene(cis)	µg/L	<25.0	25		
1,4-Dichloro-2-Butene(trans)	µg/L	<25.0	25		
1,2-Dichlorobenzene	µg/L	<0.5	0.5		
1,3-Dichlorobenzene	µg/L	<1.0	0.5		
1,4-Dichlorobenzene	µg/L	<0.5	0.5		
1,1-Dichloroethane	µg/L	<0.5	0.5		
1,2-Dichloroethane	µg/L	<0.5	0.5		
1,1-Dichloroethylene	µg/L	<0.5	0.5		
1,2-Dichloroethylene(cis)	µg/L	<0.5	0.5		
1,2-Dichloroethylene	µg/L	<0.5	0.5		

Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Feb 28, 2025 Report Number: 3109082 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-2
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
VOC Screen - Water - Continued					
(trans)					
Dichlorodifluoromethane	µg/L	<1.0	1		
Dichloromethane	µg/L	<5	2		
1,2-Dichloropropane	µg/L	<0.5	0.5		
1,3-Dichloropropane	µg/L	<0.5	0.5		
2,2-Dichloropropane	µg/L	<10.0	10		
1,1-Dichloropropene	µg/L	<1.0	1		
1,3-Dichloropropene(cis)	µg/L	<0.5	0.5		
1,3-Dichloropropene(trans)	µg/L	<0.5	0.5		
Ethylbenzene	µg/L	<0.5	0.5		
Ethyl Methacrylate	µg/L	<25.0	25		
Hexachlorobutadiene	µg/L	<2.0	2.0		
Hexachloroethane	µg/L	<2.0	2		
2-Hexanone	µg/L	<5.0	5		
Iodomethane	µg/L	<10.0	10		
p-Isopropyltoluene	µg/L	<5.0	5		
Methacrylonitrile	µg/L	<5.0	5		
Methyl t-Butyl Ether	µg/L	<1.0	1		
Methylcyclohexane	µg/L	<0.5	0.5		
Methyl Methacrylate	µg/L	<5.0	5.0		
4-Methyl-2-Pentanone (MIBK)	µg/L	<25.0	25		
Naphthalene	µg/L	<5.0	5		
Propionitrile	µg/L	<25.0	25		
iso-Propylbenzene	µg/L	<1.0	0.5		
1-Propylbenzene	µg/L	<0.5	0.5		
Styrene	µg/L	<1.0	1		
1,1,1,2-Tetrachloroethane	µg/L	<0.5	0.5		
1,1,1,2,2-Tetrachloroethane	µg/L	<0.5	0.5		
Tetrachloroethylene	µg/L	<0.5	0.5		
Toluene	µg/L	<0.5	0.5		
1,2,3-Trichlorobenzene	µg/L	<1.0	1		
1,2,4-Trichlorobenzene	µg/L	<1.0	1		
1,1,1-Trichloroethane	µg/L	<0.5	0.5		
1,1,2-Trichloroethane	µg/L	<0.5	0.5		
1,3,5-Trichlorobenzene	µg/L	<0.5	0.5		
Trichloroethylene	µg/L	<0.5	0.5		
Trichlorofluoromethane	µg/L	<1.0	1		
1,2,3-Trichloropropane	µg/L	<0.5	0.5		

Analytical Report

Bill To: Kalwij Water Dynamics Inc P.O. Box 684 Station Main Port Coquitlam, BC, Canada V3B 6H9	Project ID: Project Name: SCRD - Test Well Drilling Project Location: Hospital Site Test Well LSD: P.O.:	Lot ID: 1796335 Control Number: Date Received: Feb 22, 2025 Date Reported: Feb 28, 2025 Report Number: 3109082 Report Type: Final Report
Attn: Ineke Kalwij	Proj. Acct. code:	
Sampled By:		
Company:		

Reference Number	1796335-2
Sample Date	February 21, 2025
Sample Time	12:59
Sample Location	
Sample Description	ID 69710 / TW5 / 7.4 °C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
VOC Screen - Water - Continued					
1,2,4-Trimethylbenzene	µg/L	<1.0	1		
1,3,5-Trimethylbenzene	µg/L	<1.0	1		
Vinyl Acetate	µg/L	<1.0	1		
Vinyl Chloride	µg/L	<1.0	1.0		
Xylene-o	µg/L	<0.5	0.5		
Xylene-m&p	µg/L	<1.0	1		
Total Xylenes (m,p,o)	µg/L	<1.0	1		
Methyl Ethyl Ketone (MEK)	µg/L	<25.0	5		
VOC - Water - Surrogate Recovery					
Bromofluorobenzene	EPA Surrogate	%	103	50-140	
Dibromofluoromethane	EPA Surrogate	%	114	50-140	
Toluene-d8	EPA Surrogate	%	115	50-140	

Approved by: 
 Max Hewitt
 Operations Manager

Methodology and Notes

Bill To: Kalwij Water Dynamics Inc	Project ID:	Lot ID: 1796335
P.O. Box 684 Station Main	Project Name: SCRD - Test Well Drilling	Control Number:
Port Coquitlam, BC, Canada	Project Location: Hospital Site Test Well	Date Received: Feb 22, 2025
V3B 6H9	LSD:	Date Reported: Feb 28, 2025
Attn: Ineke Kalwij	P.O.:	Report Number: 3109082
Sampled By:	Proj. Acct. code:	Report Type: Final Report
Company:		

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
VOC - BC Water	US EPA	* Volatile Organic Compounds by GCMS / Purge and Trap for Aqueous Samples, 8260/5030 <i>* Reference Method Modified</i>	Feb 27, 2025	Element Vancouver

References

US EPA US Environmental Protection Agency Test Methods

Guidelines

Guideline Description Health Canada GCDWQ
 Guideline Source Guidelines for Canadian Drinking Water Quality, Health Canada, August 2024
 Guideline Comments MAC = Maximum Acceptable Concentration
 AO = Aesthetic Objective
 OG = Operational Guideline for Water Treatment Plants
 (does not apply to private groundwater wells).
 Refer to Health Canada for complete guidelines at www.hc-sc.gc.ca

The comparison of test results to guideline limits is provided for information purposes only. This is not to be taken as a statement of conformance / nonconformance to any guideline, regulation or limit. The data user is responsible for all conclusions drawn with respect to the data and is advised to consult official regulatory references when evaluating compliance.

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