western water
ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

August 5, 2022 WWAL Project: 22-072-01PG

Cariboo Regional District
Suite D, 180 North Third Ave.
Williams Lake, B.C.
V2G 2A4

Attn: Charles Boulet, P.Eng.,

Re: Groundwater Feasibility Assessment for the Tatla Lake Community, Tatla Lake, BC

Western Water Associates Ltd. (WWAL) is pleased to provide this hydrogeological assessment of the feasibility of developing a groundwater supply for the Tatla Lake Community. Most of the Tatla Lake Community is supplied with water from a well-based water system owned and operated by West Chilcotin Trading. Locations serviced by the West Chilcotin Trading water system include several businesses, community buildings and four residences. The West Chilcotin Trading water system has been under an Interior Health mandated do not consume order since April 2017 due to high arsenic levels. As a result of the order, potable water to businesses and residences connected to the water system is bottled and hauled from Williams Lake while non-potable water continues to be provided by the existing well.

The Tatla Lake Area Community Association wishes to develop its own groundwater supply to provide a supply of potable water to the community and has asked the Cariboo Regional District (CRD) for assistance in conducting a feasibility study. The required water demand is not well understood; for the purposes of this feasibility study we will assume the water system demand is on the order of 54 m^3/day (10 US gpm equivalent). It is our understanding that prior to the do not consume order, the existing well provided adequate water supply to the community. The existing well is believed to be on the order of 250 ft deep, flowing artesian, and has an estimated yield of 5-15 USgpm which would not typically be a sufficient yield for a small community. Based on discussion with the residents during a June 2020 site visit, the community appears conservative in their water use and likely utilizes far less water than would be expected.

1.0 SITE PHYSIOGRAPHY, HYDROLOGY AND GEOLOGY

The community of Tatla Lake is located in the West Chilcotin approximately 170 km west of Williams Lake, BC (Figure 1). The community is located within the Tatla Creek Valley, near the west end of Tatla Lake. To the north the community and creek valley are bordered by a hillside sloping steeply towards a plateau. The community is located at an elevation ranging from 920 m above sea level (asl) in lower areas near Tatla Creek to 930 m asl. The plateau to the north attains elevations of 970 - 980 m asl. Land in the community generally slopes north to south from areas of higher elevation in the north towards the creek, with steeper slopes in northern areas and sloping more gradually in the creek valley.

Clague et al (1992) mapped surficial geology in the Tatla Lake area, which indicates that lower lying areas of the community within the Tatla Creek Valley are underlain by lacustrine deposits comprised of silt, clay and sand. Areas of higher elevation in the north of the community and to the north of the community are

mapped as underlain by sandy till generally gravelly, cobbly or bouldery, with thickness up to 10 m on valley floors and lower slopes, and 1-3 m thick in most other areas.

A review of aerial imagery (Google Earth Pro, 2022) shows visible esker formations west of the Community indicating a historical depositional environment capable of depositing the overlying gravels and scouring the till units observed in drill logs near the Community (discussed further below).

Bedrock geology in the Tatla Lake area is mapped as metamorphic rocks of the Tatla Lake Complex comprised of hornblende-biotite granoblastic gneiss and fine grained granoblastic gneiss with origins in the Early to Late Cretaceous (146.6 to 65 million years ago) (ENV, 2022a). WWAL contacted local water well driller Doug Unrau of Aqua Drilling to discuss drilling conditions in the area and the potential to source water from a deeper bedrock aquifer. According to the driller, he is not aware of bedrock aquifers being sourced in the area for water supply (Unrau, 2022).

2.0 HYDROGEOLOGIC SETTING

WWAL searched the BC Ministry of Environment and Climate Change Strategy (ENV) GWELLS application to identify aquifers underlying the Tatla Lake area. Provincial mapping shows no mapped aquifers as underlying the project area.

We also searched the GWELLS application for wells drilled within Tatla Lake and surrounding areas and we have organized the wells into two groups: east community area and west elementary school area. In the east community area, we identified three registered wells, two of which are located in the community and one along the south valley wall. Two more wells are known to exist in the east community area including the well currently supplying non-potable water to the community; however, the well construction details are speculative and relatively unknown. Reported well yields in the Community area are moderate ranging from 3-40 US gpm and well depths range from 15 to 54 m (49 to 177 ft). Flowing artesian conditions or high static water levels are common in wells in this area.

There are four reported wells located to the west in proximity to the Tatla Lake Elementary school. The area is approximately 25 m (80 ft) higher in elevation and well depths range from 17.5 -184 ft. Only one of the wells (WTN52467) reported a yield (20 USgpm) and no wells are reported to be flowing artesian with static water levels noted between 80-95 ft below grade. Table 1 below provides a summary of select well details and well locations are depicted in Figure 2 following the report.

Table 1: Select well construction details for wells located near Tatla Lake.

WTN or Common Name	Well Use	Finished Well Depth (ft)	Diameter (in)	Depth to Bedrock (ft)	Depth to Water (ft)	Reported Well Yield (US gpm)
East Community Area						
26492	Unknown Well Use	78	6	-	flowing	40
72622	Not Applicable	60	6	-	14	40
72623* "Janet"	Not Applicable	80	6	-	flowing	10

90358	Decommissioned	49	6	-	-	-
117942	Private Domestic	177	6	-	flowing	3
Trading Co. Well	Community water supply	250 (estimate)	6	-	Flowing	unknown
Lars	Private Domestic	Unknown	Unknown	-	Near surface	unknown
West Elementary School Area						
52467	Commercial Industrial	176	-	-	95	20
121805	Commercial Industrial	120	6	-	80	-
75736	Elementary School	184	6	-	93	50
120982	Unknown Well Use	17.5	6	-	-	-

*-WTN72623 is mapped in the same location as what was described as the "Janet well" during the June 2022 site visit. Construction details may not be accurate.

3.0 CROSS-SECTION ANALYSIS

We developed two cross-sections based on lithology reported on the well driller's logs in the area including a north-south transect (Figure 4) perpendicular to the valley and an east-west transect encompassing wells with more favourable water quality located west of main community site (Figure 6). Based on our review of area well logs and cross-sections, sand and gravel is present at the surface, and underlain by a thick sequence of silty clay. The top of the aquifer occurs at elevations of 906 to 925 m asl, with the bottom of the aquifer noted at 895 m asl in WTN 26492. The clay confining unit observed in community well logs does not appear present in well logs west of the main community where gravel reportedly overlies the sand aquifer. Cross sectional analysis indicates the school wells likely source water from the same aquifer as the Community wells however the aquifer is unconfined in that area and the school wells are not flowing.

4.0 WATER CHEMISTRY

Water chemistry results for several water systems in the area were provided by the IHA and reviewed by WWAL to determine the prevalence of arsenic in the local aquifer. While WWAL was onsite in June 2022, two private wells were sampled for metals including the "Lars" well (east end of community) and "Janet" well (west end of Community). Both wells were in regular use and were purged for approximately 15 minutes prior to sampling. According to the owner of the "Janet" well, water is pumped from one well and blended from another adjacent flowing well and water quality information should be considered less reliable. A summary of the water quality results is included in Table 2 below and well locations are depicted on Figure 2. With the exception of the Tatla Elementary well, construction details for the wells are mostly unknown and the data was collected for preliminary screening purposes.

Table 2: Summary of water quality data for Tatla Lake area wells.

		Trading Co. Well	Lars Well	Janet Well	Tatla Elementary	
Date Samples Collected		Sept 22, 2021	June 24, 2022	June 24, 2022	Sept 22, 2022	
General Parameters and Nutrients						

Hardness	mg/L	125	139	95.8	137	N/A
Total Organic Carbon	mg/L	0.58	-	-	0.59	N/A
Selected Ions and Metals (Total)						
Aluminum	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	MAC 2.9
Antimony	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	MAC = 0.006
Arsenic	mg/L	0.0349	0.00946	0.00783	0.00616	MAC = 0.01
Barium	mg/L	0.0382	0.0239	0.0211	0.0221	MAC = 2
Boron	mg/L	0.129	0.0598	0.062	0.0542	MAC = 5
Cadmium	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	MAC = 0.005
Calcium	mg/L	35.9	43.5	31.8	41.8	N/A
Chromium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	MAC = 0.05
Copper	mg/L	0.00164	<0.00040	0.00997	0.00132	MAC = 2
Iron	mg/L	0.102	0.06	0.514	0.131	AO ≤ 0.30
Lead	mg/L	<0.00020	<0.00020	0.00034	<0.00020	MAC = 0.005
Manganese	mg/L	0.125	0.154	0.152	0.136	MAC = 0.12; AO ≤ 0.02
Selenium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	MAC = 0.05
Sodium	mg/L	44.2	84.8	86.2	30.8	AO ≤ 200
Strontium	mg/L	0.271	0.28	0.235	0.270	MAC = 7
Uranium	mg/L	0.000295	0.00107	0.0015	0.00162	MAC = 0.02
Zinc	mg/L	0.0301	<0.0040	0.0104	<0.0040	AO ≤ 5

Water quality from the four wells appears relatively consistent and is indicative of deeper mineralized aquifers of the BC interior. All wells exceeded the Maximum Allowable Concentration (MAC) for manganese. Arsenic in the "Trading Co." well was three times the MAC and although they did not exceed the MAC, the other wells in the community area near the guideline for Arsenic. Based on the one sample provided by the IHA, the Tatla Elementary well was almost half the MAC for arsenic. We note also that the Tata Elementary School system is currently under a water advisory which we assume to be due to the manganese exceedance (Interior Health Authority, 2022). In general, arsenic concentration appears higher in the east compared to the well at the elementary school.

5.0 SITE VISIT

WWAL hydrogeologist Warren Grafton, P.Geo. completed a site visit June 24, 2022 with CRD Director Gerald Kirby. Mr. Kirby arranged for access to the two sampled private wells and locations for potential well drilling were viewed. The "Trading Co." well was observed at a distance to have artesian flow discharging to ground north of the onsite building. The "Janet" well was observed to be located on the west side of the community (Photo 1, Figure 2) and was located in a soil mounded area and although not visible, the property owner described an older flowing well located adjacent the visible well which is allowed to flow into the new well (subsurface through a pipe) to add additional water volume for the property. The "Lars" well was located on the east end of the Community and appeared to be located in a well pit covered by a well shack containing a pressure tank.

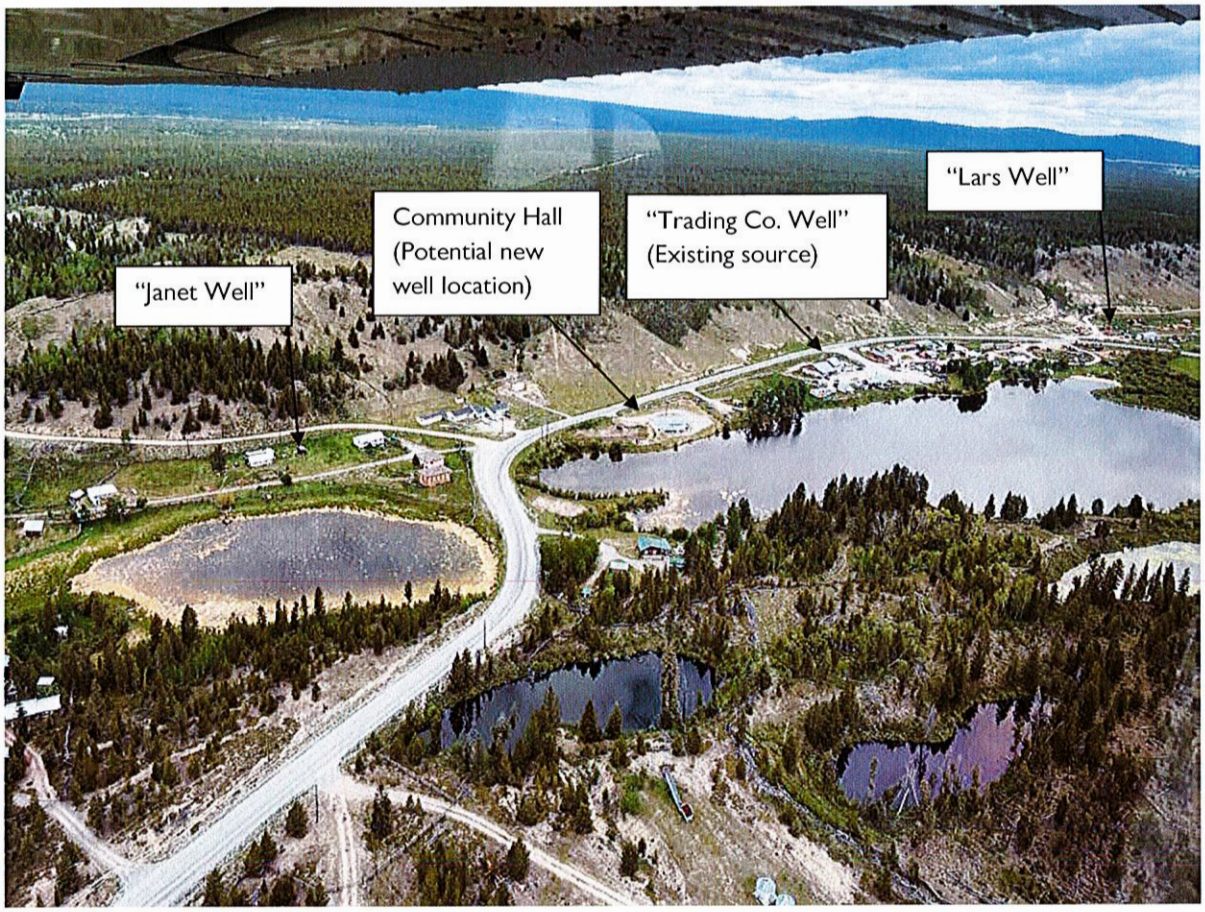

Photo 1: Areal image of the Tatla Lake Community area and well locations.

If a well is desired to be drilled within the community area, available space would be present at the community hall (Kirby, 2022). While onsite, the location of nearby septic systems and any other sources of contamination were discussed and a well location on the north side of the community hall property (near the existing sign) would meet all applicable setbacks (Photo 2).

WWAL also visited the Tatla Lake Elementary School location located approximately 2.3 km west of the Community where another IHA permitted water system was located. The school sources water from WTN 75736 (Figure 2) which was drilled in 1997 after the original well began producing sand as no screen was installed (open bottom completion) (Unrau, 2022). The school and well are located on a gravelly hilltop and the well was not observed to have artesian overflow.

Photo 2: North parking lot of Tatla Lake community hall with potential well location near existing sign.

6.0 B.C. SITE REGISTRY SEARCH

WWAL completed a search of the iMap B.C. Environmental Remediation Sites layer on April 28, 2022, which includes all sites recorded in the B.C. Site Registry Database. The database was searched to determine if there were any areas unsuitable for future well development due to contaminated soils or groundwater. We identified one registered site associated with Site ID 8769 within the community. WWAL requested a detailed report for Site ID 8769 through BC Online. Site ID 8769 is associated with the property that "West Chilcotin Trading" is located on. The detailed report indicates that vehicle repair, salvage and/or wrecking were historically conducted at Site ID 8769 and that a historical underground storage tank (UST) was located at this site. In 2003, at the time the information was entered for Site ID 8769 an above ground storage tank was present and land use included a petroleum dispensing facility. A Notice of Independent Remediation Initiation was submitted and approved for Site ID 8769 in December of 2003. Analytical lab results, a treatment cell, site plan, site sketches and a title search were submitted with the notification. The detailed report included no further information. It is our understanding that a spill had occurred at the property and that at least two excavations took place to remove impacted soils (Kirby, 2022). As a future water supply at the property is not planned and the underlying aquifer is protected by

a significant confining unit, we do not consider the site to be of major concern for future groundwater development in the community.

7.0 DISCUSSION

Based on our review, it appears that:

- A partially confined or confined aquifer is present underlying the community and extending to the west near the elementary school.
- The aquifer appears to be confined in the community area resulting in flowing artesian conditions with unknown shut-in pressures.
- Near the elementary school, west of the community, the clay confining unit does not appear present. Artesian conditions do not appear to exist in this area and the aquifer in this area may be charactered by better quality, less mineralized groundwater.
- All wells in the area have manganese concentrations exceeding the MAC requiring treatment to be potable.
- Arsenic concentration is highest (three times the MAC) in the existing "Trading Co." well. Water quality from two other wells in the Community are slightly under the MAC and the elementary school well west of the Community is nearly half the MAC.

8.0 GROUNDWATER DEVELOPMENT POTENTIAL

Based on our feasibility assessment, it is our opinion that two potential options exist to develop a water supply for the Community with more favourable water quality. Both options have advantages and disadvantages and relative risk levels with regards to a successful outcome. The two options include drilling a well west of the Community near the elementary school or drilling a well at the community hall for direct connection to the water system. The two options are discussed further below:

Elementary School Well Option

Water quality in the elementary school well is significantly better with respect to arsenic when compared to wells in the community area. A well near this location has the highest chance of producing water only requiring treatment for manganese which is common in similar sized water systems. The location also has a low risk of producing a flowing artesian well allowing for a less expensive well drilling program and completion. However, as the location is 2 km away from the Community, direct connection to the community network is likely not feasible due to cost. It may be possible to construct a fill station and for bottled water, which would greatly reduce trucking costs from Williams Lake. It is also unknown if property in the area is available for a well and fill station.

Community Hall Well Option

A well drilled at the community hall has the advantage of direct connection to the Community water system; however, the aquifer in this location has a higher risk of poorer water quality. With the exception of the Trading Co. well, all other wells in the Community appear to be just under the acceptable limit for

arsenic and a well drilled at the community hall may be similar only requiring treatment for manganese. We note that this conclusion is based on a small number of water quality samples. In our experience, arsenic concentrations can easily vary by 20% over multiple sampling events, which in this case could result in a guideline exceedance.

Note also that although there is technically a MAC for arsenic, health authorities stipulate that there is no "safe" arsenic concentration and all available effort should be made to source or treat water to lowest possible arsenic concentrations.

The Community Hall location has the advantage of available power supply and the property is reportedly available for use (Kirby, 2022). With respect to well construction, a cemented surface seal and other controls will be necessary to accommodate a flowing artesian well resulting in a more expensive drilling program.

9.0 GROUNDWATER LICENSING / COMMUNITY WELL APPROVAL PROCESS

Should the CRD proceed down the path of pursuing a groundwater source, the source would eventually require a new-use groundwater licence. Licensing of groundwater in B.C. began in 2016 with the introduction of the Water Sustainability Act. Since 2016, all new wells for purposes other than private domestic (one well servicing one home) require a groundwater licence.

The groundwater licence application process can be lengthy, and in our experience the processing time for new-use groundwater licence applications is one year or more. To support a groundwater licence application, a technical assessment of the well is typically required. The Province has produced a *Guidance Document for Technical Assessment Requirements in Support of Groundwater License Applications* which outlines the information requirements for technical assessments. Technical assessments are typically based on pumping test programs and include evaluating well interference effects, aquifer parameters, water quality and seasonal effects on well yields. In this case, it is possible the technical assessment would also have to address the potential of a new well affecting existing licensed users on springs and brooks in the area.

We do not expect there to be an issue obtaining a new source license as the water demand in the area is relatively low and there are no reported water allocation restrictions on aquifers in the area.

Should a viable community supply well be found, the well would then need to be permitted through the Interior Health Authority (IHA) for use as a potable well. This is a three-stage process including New Source Approval, Waterworks Construction Permit, and Operating Permit. The Waterworks Construction Permit process typically involves the services of a civil engineer who would prepare water system design drawings for the pumping, treatment and distribution system for approval by the IHA public health engineer.

10.0 RECOMMENDATIONS

Based on the above discussion, the following recommendations are made:

RI An engineering feasibility study should be conducted to confirm the design yield requirements (average and maximum day demands) from a groundwater source. The engineering study should

also include a high-level cost estimate for the two options discussed above (i.e. a supply well near the elementary school or at the community hall) or other water supply options identified. Cost associated with treatment for manganese should be included in the engineering study, as any groundwater source developed is likely to have manganese at concentrations that exceed the MAC guideline.

R2 The Tatla Lake Community Association and the CRD should investigate if land is available near the elementary school for potential construction of a well and filling station.

R3 If a well location near the community hall is desired, additional sampling of nearby wells is recommended to confirm the preliminary results from samples collected during the June 2020 site visit. To date, water quality data available is primarily for total metals. A more comprehensive suite of parameters should be sampled for to determine if there are other water quality issues requiring consideration.

R4 If a well location near the elementary school is desired, historical sampling results for the school well should be reviewed to confirm the water quality. If no historical results are available, we recommend additional sampling prior to committing to a drilling program.

R5 After review of water supply options and a decision with respect to a potential drilling location is made a drilling program should be developed with consideration for artesian conditions, drilling methodology and pump testing including regular water quality sampling for metals.

6.0 COST ESTIMATES

To aid with the overall feasibility study, we provide the following cost estimates for well drilling, pumping tests, and hydrogeological oversight/reporting for various tasks.

Table 4: Cost Estimates for Well Drilling, pumping Test and Hydrogeological Oversight

Task	Cost Estimate
Option 1 - Elementary School Location	
Hydrogeological Oversight, Data Analysis, Water Sample and Reporting.	$25,000
6-inch diameter test/production well. Assume Depth of 200 ft, 10 ft of well screen.	$35,000
48 Hour Pumping Test	$20,000
Total	**$80,000**
Option 2 -Community Hall Location	
Hydrogeological Oversight, Data Analysis, Water Sample and Reporting.	$25,000
6-inch diameter test well. Assume Depth of 200 ft, 10 ft of well screen and completion suitable for artesian conditions.	$55,000
48 Hour Pump Test	$20,000
Total	**$100,000**

CLOSURE

We trust that the professional opinions and advice presented in this document are sufficient for your current requirements. Should you have any questions, or if we can be of further assistance in this matter, please contact the undersigned.

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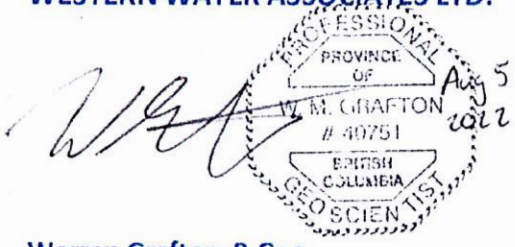

Warren Grafton, P.Geo.
Hydrogeologist

Reviewed by:

Ryan Rhodes, P.Geo
Hydrogeologist

Attachments: Figures 1 through 6

REFERENCES

BC Online: Site Registry. (2022, June). Area Search. Williams Lake, BC.

ENV. (2022a). *BC Water Resources Atlas*. Retrieved from https://maps.gov.bc.ca/ess/hm/wrbc/

Google Earth Pro. (2002, July 27). Tatla Lake imagery. *Maxar Technologies*.

Interior Health Authority. (2022, July 28). Water Quality Advisory Map. Tatla Lake, British Columbia, Canada.

Kirby, G. (2022, June 24). Personal communication regrding current Tatla Lake Water Supply and historical land use. (W. Grafton, Interviewer)

Unrau, D. (2022, July 28). Personal communication regrding Tatla Lake Elementary Well. (W. Grafton, Interviewer)

Western Water Associates Ltd.

Report Limitations

Subject to the following conditions and limitations, Western Water Associates Ltd. (WWAL) conducted the investigation described in this report in a manner consistent with a reasonable level of care and skill normally exercised by members of the hydrogeology profession currently practicing under similar conditions in British Columbia.

1. The Scope of Work for the investigation has been limited by the budget set for the investigation in the work program. The scope of work completed has been reasonable having regard to that budget constraint.
2. The investigation described in this report has relied upon information provided by third parties concerning climate, local and regional geology, borehole stratigraphy, presence of aquifers, and existence of nearby wells as indicated by a search of the provincial databases. Except as stated in this report, we have not made an independent verification of third-party information.
3. The investigation documented in this report has been made in the context of existing government regulations and guidelines in effect as of the date of this report. Except as specifically noted herein, the investigation did not take into account any government regulations not in effect or promulgated as of the date of this report.
4. The findings and conclusions in this report are valid only for the specific property or properties and well or wells identified in the report; and may be considered current for a period of up to one year from the date of this report. Water quality sample results, if contained herein, unless stated otherwise herein, represent a single sample collected during the investigation and may or may not represent the long-term water quality produced by the well or wells, unless specifically commented on.
5. For more information on the responsibilities of private well owners, please visit the B.C. Ministry of Environment website at http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html

In accepting delivery of this report, Fountain Capital Corp. hereby agrees that any and all claims which it may have against WWAL or any of its servants, agents, owners, or employees arising out of or in any way connected with the investigation described in this report or the preparation of this report, whether such claims are in contract or in tort, and whether such claims are based on negligence or otherwise, shall be limited to a total amount equal to the fees payable to WWAL under contract with the CRD.

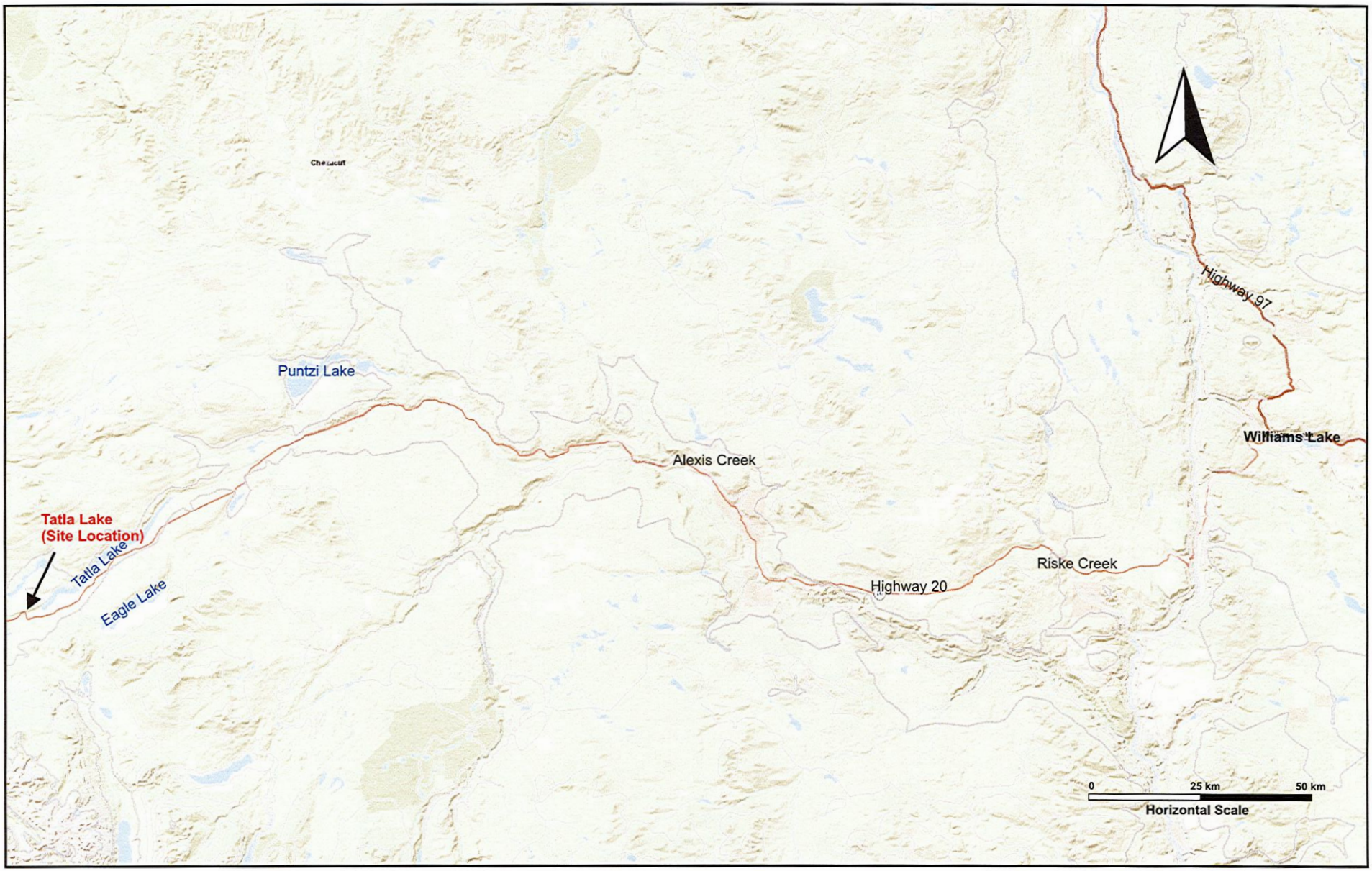

Figure 1: Site Location Map

Client: Cariboo Regional District	WWAL Project: 22-072-01PG	
Date: July 2022	Drawn by: LG	Checked by: WG

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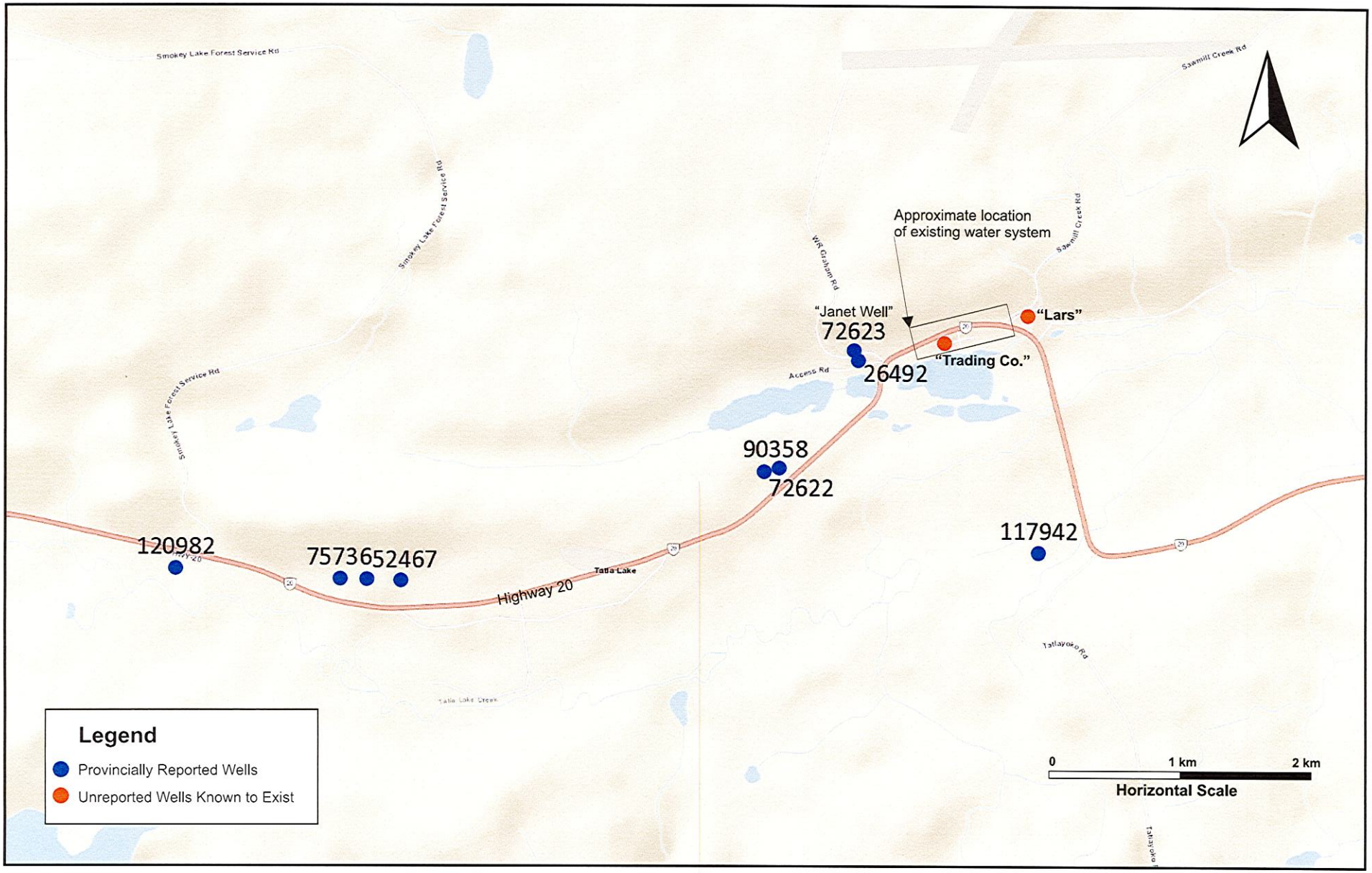

Figure 2: Well location Map

Client: Cariboo Regional District	WWAL Project: 22-072-01PG	
Date: July 2022	Drawn by: LG	Checked by: WG

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Figure 3: Cross-section A to A' Trace

Client: Cariboo Regional District	WWAL Project: 22-072-01PG	
Date: April 2022	Drawn by: LG	Checked by: WG

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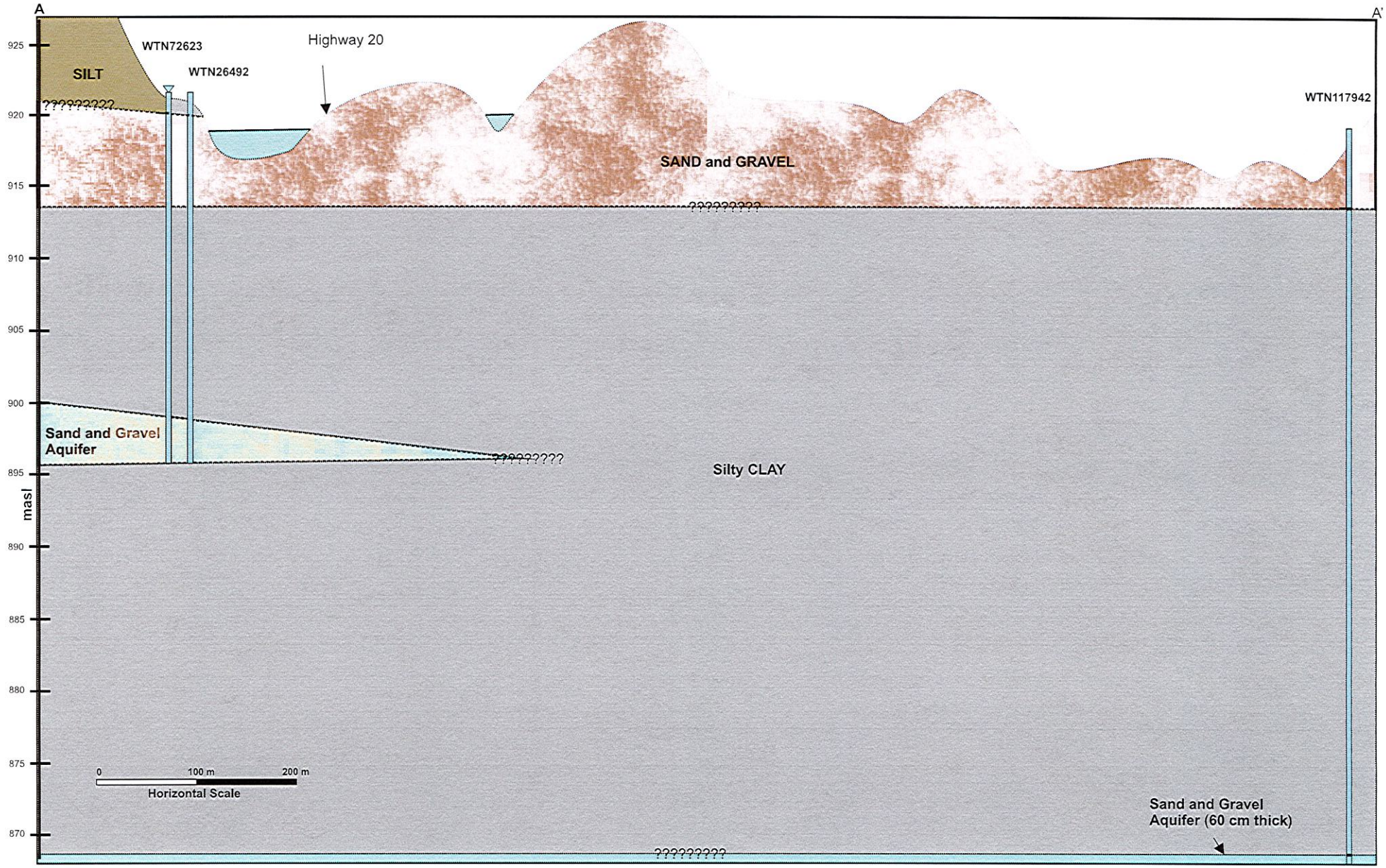

Figure 6: Cross-section A to A'

Client: Cariboo Regional District	WWAL Project: 22-072-01PG	
Date: April 2022	Drawn by: LG	Checked by: WG

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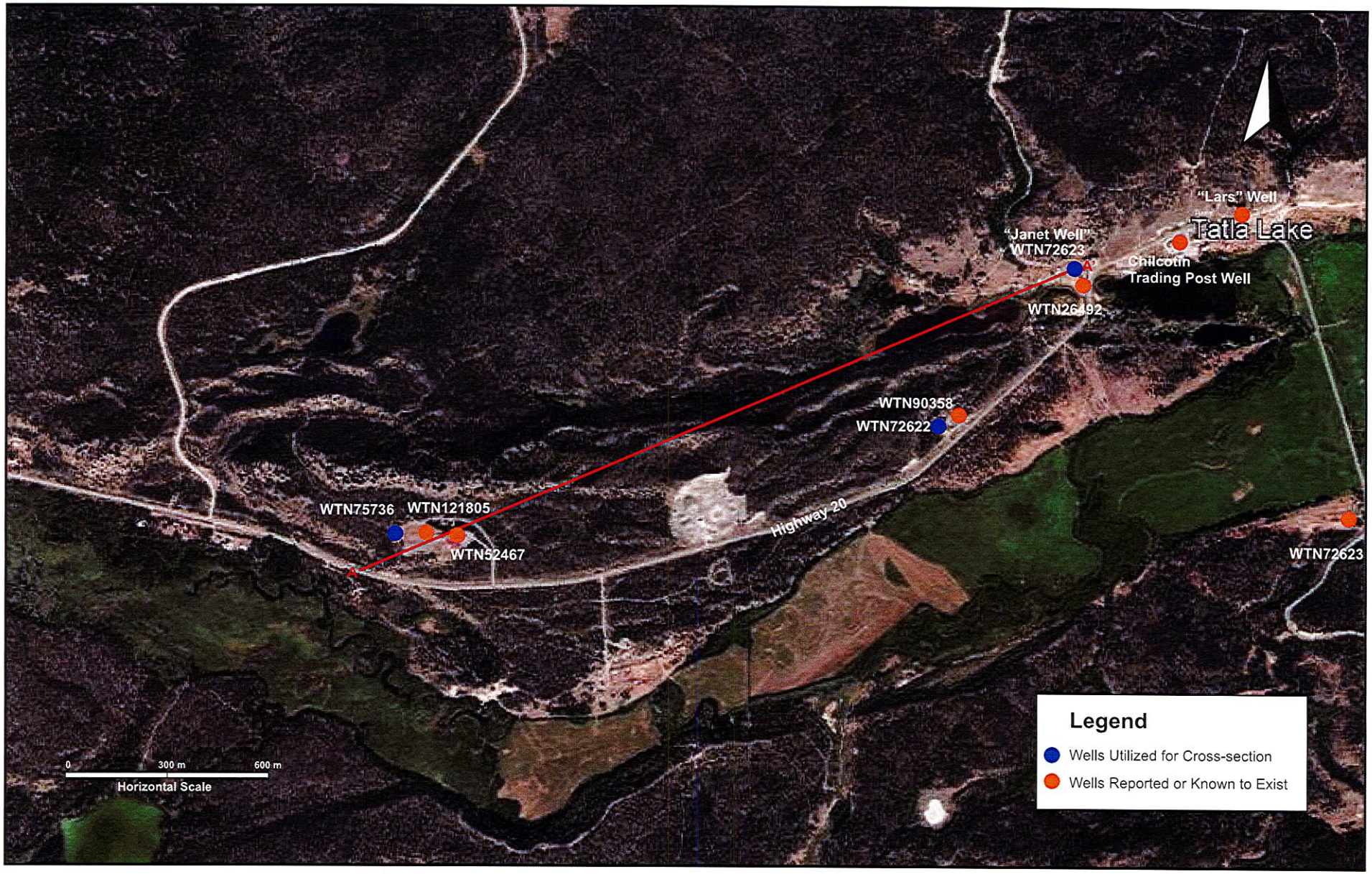

Figure 5: Cross-section B to B' Trace

Client: Cariboo Regional District	WWAL Project: 22-072-01PG	
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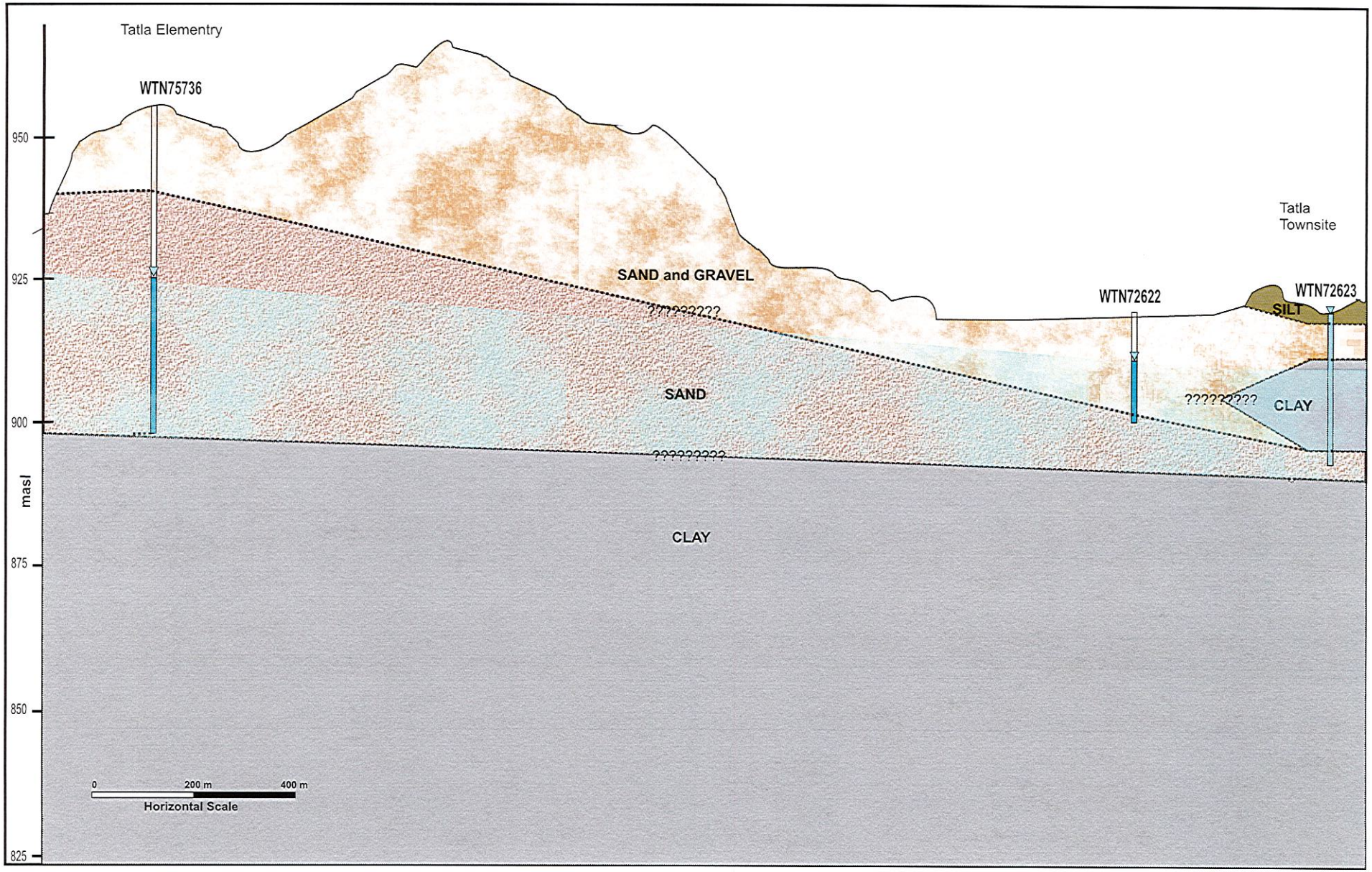

Figure 6: Cross-section B to B'

Client: Cariboo Regional District	WWAL Project: 22-072-01PG	
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Groundwater Supply Development and Management
Source Water Assessment and Protection
Well Monitoring & Maintenance
Environmental & Water Quality Monitoring
Storm & Wastewater Disposal to Ground
Groundwater Modeling
Aquifer Test Design and Analysis
Geothermal / Geoexchange Systems
Policy and Guideline Development
Applied Research
Rural Subdivision Services
Environmental Assessment & Permitting
Contaminated Sites