PITEAU ASSOCIATES
Geotechnical and Water Management Consultants
A TETRA TECH COMPANY

SURFACE AND GROUNDWATER MONITORING PROGRAM

EAST KAWKAWA LAKE AREA, HOPE, BC

2023 ANNUAL REPORT

Prepared for

BLUETRITON BRANDS INC.

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Piteau Associates Engineering Ltd.
Suite 300 – 788 Copping Street
North Vancouver, B.C. Canada V7M 3G6
Tel. (604) 986-8551

EXECUTIVE SUMMARY

This report provides the 2023 annual summary for a surface and groundwater monitoring program underway in the vicinity of the BlueTriton water bottling facility near Hope, BC that includes a bottling facility (the Plant), a spring source (Hope Spring), and three spring-water production boreholes identified as BH-1, BH-2, and BH-3. All of these features are located within the BlueTriton Property (the Site).

The Site is located on the south side of an east - west trending valley (the Valley) that terminates at Kawkawa Lake. The source for Hope Spring and the production boreholes is an aquifer (the Aquifer) hosted within a thick succession of glaciofluvial sands and gravels with a saturated thickness of between 50 and 200 ft. The Coquihalla River, located near the Valley's eastern terminus, is interpreted to be the largest source of recharge to the Aquifer. Other sources of recharge include infiltration of surface runoff from the side walls of the Valley and infiltrating rain and snowmelt on the Valley floor.

The monitoring program, ongoing since 2005, utilizes a combination of manual measurements and automated equipment to monitor ground and surface water levels, water temperature, and spring discharge rates at the Site. Groundwater withdrawal rates from the production boreholes are also recorded. Data from monitoring systems operated by others include daily precipitation, Coquihalla River discharge, snow pillow water equivalent, and municipal well water levels and withdrawal rates. Biological surveys in watercourses at and near the Site are completed at scheduled intervals.

Year-over-year rising and falling trends in groundwater levels and spring flows coincide with wetter-than-normal and drier-than-normal periods in the precipitation record with some time lag. Seasonal fluctuations are superimposed on the annual trends. Based on Piteau's evaluation and interpretation of hydrologic monitoring data collected since 2005, BlueTriton's use of the groundwater resource does not affect the sustainability of the source Aquifer. The bottling facility can be operated indefinitely without valid negative impact on the aquifer.

RECORD OF AMENDMENTS

This report has been issued and amended as follows:

Issue	Description	Date	Prepared by	Reviewed by
1	Draft	February 27, 2024	J. Mancer, P.Eng. Sr. Hydrogeologist	D. Tiplady, P.Eng. Principal Hydrogeologist Vice President, Hydrogeology
2	Second Draft	March 22, 2024	J. Mancer, P.Eng. Sr. Hydrogeologist	D. Tiplady, P.Eng. Principal Hydrogeologist Vice President, Hydrogeology
3	Final	April 4, 2024	J. Mancer, P.Eng. Sr. Hydrogeologist	D. Tiplady, P.Eng. Principal Hydrogeologist Vice President, Hydrogeology

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1. BACKGROUND

1.1 INTRODUCTION AND OBJECTIVES

This report provides the 2023 annual summary for a surface and groundwater monitoring program underway in the vicinity of the BlueTriton water bottling facility near Hope, BC. This monitoring program was initiated by Piteau Associates Engineering Ltd. (Piteau) in December 2005.

The water monitoring program is augmented by biological monitoring of surface watercourses crossing the BlueTriton property. Biological monitoring has been conducted annually by Scott Resources Services (now Pinchin Ltd.) from 2008 to 2017, and in 2019 and 2022.

The objectives of the surface water, groundwater, and biological monitoring programs are to:

- Assess the groundwater and surface water flow regimes and their sensitivity to climate and groundwater extraction;
- Ensure that BlueTriton's use of the resource can be maintained indefinitely without valid negative impact on the aquifer; and
- Monitor aquatic habitat in the small drainage channels on the BlueTriton property.

1.2 PREVIOUS STUDIES

Hydrogeology assessments pertaining to the Site include the following studies by Piteau:

- An assessment of the Hope Spring and the Aquifer (Piteau, 2000);
- An assessment of the hydraulic connection between BH-1 and Hope Spring (Piteau, 2005);
- A capture zone analysis for BH-1 (Piteau, 2008);
- A report documenting the construction and testing of BH-2 (Piteau, 2011);
- A water budget assessment for the Aquifer (Piteau, 2014); and
- A report documenting construction, testing, and FDA SOI assessment for BH-2 and BH-3 (Piteau, 2015).

Additionally, reports summarizing the monitoring program have been prepared at least once per year since 2005.

2. PHYSICAL SETTING

2.1 PHYSIOGRAPHIC SETTING

BlueTriton's Hope facility (the Site) is located 2.5 miles east of the town center of Hope, BC. Situated in the Fraser River Valley at the mouth of the Coquihalla River, Hope lies about 70 miles east of the City of Vancouver (Figure 1). The operation includes a bottling facility (the Plant), a spring source (Hope Spring), and three spring-water production boreholes (BH-1, BH-2, and BH-3).

The Site is located on the south side of an east-west trending valley (the Valley) that terminates at Kawkawa Lake (the Lake). The Valley bottom is filled with a thick succession of glaciofluvial sands and gravels deposited during the last period of deglaciation. These sediments were never eroded down to the Fraser River level since the Coquihalla River follows a canyon in the adjacent valley to the south.

The valley-fill sediments host an extensive aquifer (the Kawkawa Lake Aquifer, hereafter referred to as the Aquifer) with a saturated thickness of between 50 and 200 ft. It is the source of spring water bottled by the Plant.

2.2 CLIMATE

The nearest climate station operated by Environment Canada is located at the Hope airport, approximately five miles west of the Site at an elevation of 128 ft-asl (feet above sea level). Hope A Station was replaced by Hope (Aut) Station at a nearby location in 2004. This, in turn, was replaced by a new Hope A Station in 2011, which remains operational today. The 10-year mean of annual precipitation measured at the Hope A station between 2014 and 2023 (calculated by Piteau) was 64.3 inches. Mean monthly precipitation varied from 1.2 inches in July to 11.5 inches in November (Environment Canada, 2024a).

Mean annual precipitation recorded at a Kawkawa Lake station between 1941 and 1971 was 61 inches. This is within ten percent of that recorded at the Hope airport over the same interval. The two stations are understood to reasonably represent precipitation at the Site.

Because the Valley floor and the Valley walls are at higher elevations than the Hope A Station (Section 2.3), precipitation on the Valley floor and on the south wall are assumed to be 10% greater than that received at the Hope airport. Precipitation on the north wall is assumed to be 20% greater than that received on the Valley floor (Piteau, 2014).

A portion of the south wall and north wall precipitation is stored as snowpack over the winter and spring (November to May) and is released as snowmelt over the summer (June to August). Snowpack measurements are available for three stations in the vicinity of Hope. These include stations in Hope (elevation = 230 ft-asl), Wahleach Lake (14 miles to the southwest of the Plant at an elevation of 4,600 ft-asl), and Spuzzum Creek (19 miles north of the Plant at 3,872 ft-asl). Based on data from these stations, up to three inches of water (expressed as snow water equivalent) is expected to fall as snow each year at the Site, and up to 27 inches of water is expected to accumulate at the top of Mt. Ogilvie (north wall). Current snowpack accumulation data are obtained from the Spuzzum Creek station.

2.3 TOPOGRAPHY, SURFACE HYDROLOGY, AND LAND USE

The Valley is approximately 3.9 miles long and 0.5 miles wide, narrowing to the east where it is crossed by the Coquihalla River. The valley bottom rises to the east and is marked by numerous kettles ranging in relief from about 15 ft to over 100 ft. The kettles resemble conical depressions, interpreted to have formed around melting ice blocks at the end of continental glaciation. The north wall of the Valley rises to elevations of 5,400 ft (Mt. Ogilvie) at an average slope of about 60%. The south wall of the valley rises less steeply (40% slope) to a ridge at an elevation of about 1,500 ft-asl.

The Coquihalla River originates in the Coquihalla Lakes area, 25 miles northeast of the Site, and collects water from a 280 square-mile watershed before discharging to the Fraser River at Hope. It crosses over the east end of the Kawkawa Lake Aquifer over a length of about 2.1 miles (Figure 1).

Several creeks drain the north wall of the Valley, including Camilos Creek and Corbett Creek (Figure 1). Most are active only after significant precipitation or snowmelt events. Surface runoff carried by these creeks readily infiltrates the talus and fan deposits below 1,200 ft-asl, and the glaciofluvial deposits on the Valley floor. Water that does not infiltrate reports to Sucker Creek, which conveys runoff westward towards the Lake during the wettest times of the year (November through January). Stanley Associates (1987) estimated that Corbett Creek loses water to the ground at a rate of 0.1 USgpm per square foot of wetted area.

Menz Creek and another unnamed creek are the only mapped watercourses draining the south wall of the Valley (Figure 1). Hence, a large proportion of precipitation falling on this side is interpreted to flow as unchanneled surface runoff and interflow through overburden sediments. Glacial kettles with no standing water indicate pervious sediments.

Several spring-fed channels originate where the regional water table intercepts the land surface at the Site. As shown on Figure 1, these include Chilaka, Kereluk and Kopp creeks, and three unnamed creeks. Sucker Creek is also likely to gain flows from groundwater discharge in this area.

Two of these springs are referred to as the Upper and Lower orifices of the Hope Spring (Figure 2). Discharge occurs year-round at rates ranging from 0.1 to 160 USgpm at the Upper Orifice and 20 to 400 USgpm at the Lower Orifice. Ranging from 44.0° to 48.5°F, the water temperature remains nearly constant. Water from the orifices reports to a tributary of Sucker Creek, which flows into Kawkawa Lake. The upper reaches of the Sucker and Kopp Creeks may have some connectivity during high flow conditions (Pinchin, 2020).

The Site lies within the Kopp Community Watershed. Land use in the vicinity of the Site includes a mix of woodland, residential, parks, a gravel pit, and natural gas and oil transmission. Groundwater seepage toward the Plant traverses an undeveloped area designated residential, Coquihalla Canyon Provincial Park, a gravel pit, and woodland before entering the Site. Three transmission pipelines conveying oil and gas cross the capture zone (Figure 3). The third pipeline was completed in 2023 and will be commissioned for oil transmission in 2024.

2.4 ECOLOGICAL SETTING

According to habitat mapping by the Province of BC, the Site is within the Coast and Mountains Ecoprovince, Pacific Ranges Ecoregion, Eastern Pacific Ranges Ecosection, and Coastal Western Hemlock - Dry Submaritime (Southern) Biogeoclimatic Subzone (iMapBC, 2016).

2.5 GEOLOGY

Geology mapping for the Hope area is shown on Figure 4. The mountain block bounding both sides of the Valley consists of granodiorite intrusive rock belonging to the Coast Plutonic Complex. The upper elevations of Mt. Ogilvie host older, undifferentiated sedimentary and mafic volcanic rock (chert, pelite, minor limestone, gabbro, and ultramafic). A thin veneer of talus and colluvial soil covers the north wall of the Valley and steeper sections are exposed as bare cliffs. Most of this area is forested, but bare patches are visible in unstable areas. Several alluvial fans and bouldery talus deposits flanking the lower slopes of the north wall result from rockfalls and debris flows along drainage channels. The south wall is blanketed by glacial till and is more densely forested.

Distributions of unconsolidated Quaternary alluvial sediment deposits are mapped on Figure 4, and their vertical extent is depicted in the hydrogeologic section on Figure 5. The valley-fill sediments range to over 300 ft thick. Bedrock was encountered in two boreholes on the section (test borehole BH07-2 at the Site and Well 103129 closer to the Coquihalla River). Depth to bedrock elsewhere along the section is not known owing to the relatively shallow depths of the wells. In most places, the Aquifer is capped by an upper layer of silty sand or till (up to about 50 ft thick).

Having been deposited by a glacier and rapidly flowing glacial meltwater rivers, the sediments are stratified with compositional variations ranging from silty sand to sandy gravel. The sediments can be grouped into four major strata or units in order of depth below ground:

- An upper till layer made up of dense, poorly sorted sand and gravel packed with silt. This unit is largely unsaturated and is expected to limit the downward movement of water from ground surface owing to its dense fine-grained matrix. It is about 60 ft thick at the northeast portion of the Site and thins out in the westward direction to eventually pinch out near the Springs in the southwest corner.
- A saturated sand and gravel horizon underlying the till layer. This unit hosts water-bearing strata (the Aquifer) that feed the Springs, BlueTriton boreholes, and a supply well operated by the District of Hope (Hope Well No. 8). The Aquifer is encountered at an elevation of about 370 ft-asl and extends to 155 ft-asl with a thickness of about 200 ft.

- A 50 ft thick stratum of silt and sand topped by a 6 ft layer of clay. Owing to its fine-grained composition, this unit acts as an aquitard separating the Aquifer from an underlying aquifer (the “lower aquifer”).
- A “lower aquifer”, encountered below 100 ft-asl elevation. It is composed of medium to coarse-grained gravelly sand. The unit was observed to be about 12 ft thick at test borehole BH07-2 and is directly underlain by bedrock.

Except for the upper till layer, these units likely display complex compositional bedding with the finer and coarser beds taking the form of the curvilinear channels into which they were deposited. However, on an aquifer scale, the bulk of each unit can be treated as a mass having relatively consistent overall hydraulic parameters.

2.6 HYDROGEOLOGY

The Aquifer is hosted within an extensive accumulation of valley-fill sediments with a saturated thickness of between 50 and 200 ft. Up to 250 ft of unsaturated materials overlie the water table in some places (Figure 5).

Three production boreholes have been drilled at the Site since 2004. Borehole BH-1 was drilled in September 2004, Borehole BH-2 was drilled in May 2010 and Borehole BH-3 (not yet in service) was drilled in July 2012. Varying proportions of sand and gravel were encountered during advancement of the boreholes to depths of 120, 96, and 190 ft, respectively.

Depths to the water table across the Site range from 0 to 75 ft below ground level (ft-bgl). The relatively large range is the result of changes in ground elevation. Several springs where groundwater discharges to surface have been identified on the Site at elevations ranging from 320 to 360 ft-asl.

Hydraulic conductivities of aquifer sediments have been estimated from aquifer pumping tests and grain size distribution analyses. Geometrically averaged values calculated using these two methods are 497 and 391 ft/day respectively and are indicative of highly permeable sediments.

Total groundwater flows through the Aquifer under the Site were estimated using the Darcy equation:

$$Q = K \times i \times a$$

where:

Q is the groundwater flow;
K is the hydraulic conductivity of the Aquifer sediments;
i is the hydraulic gradient along the Valley axis; and
a is the average cross-sectional area perpendicular to groundwater flow.

The hydraulic gradient along the Valley axis (east of Site) is approximately 0.026 (Figure 5). The average saturated thickness of Aquifer sediments is about 200 ft, and the average saturated width is 2,300 ft, giving an estimated cross-sectional area of about 460,000 ft^2.

Multiplying this area by estimated values for hydraulic gradient (0.026) and hydraulic conductivity indicated above (497 ft/day) yields a groundwater flow rate of 30,900 USgpm. This is comparable to the flow rate estimated previously by Piteau in 2000 (28,200 USgpm).

Linear groundwater flow velocity (v^*) within the Aquifer upgradient of the Site can be estimated using the equation:

$$v^* = \frac{K \times i}{\eta}$$

Where η is the bulk porosity of the Aquifer sediments.

Assuming a porosity of 0.3 and a hydraulic conductivity of 497 ft/day, v^* is estimated at 43 ft/day. The estimated travel time between the Coquihalla River and the Plant (1.2 miles or 6,120 ft) is 142 days or 4.7 months.

2.7 EXISTING WELLS

Locations of existing production boreholes and wells in the vicinity of the Site are depicted on Figure 2. Two production boreholes, identified as BH-1 and BH-2, are utilized to supply spring water to the Plant. These boreholes are currently permitted as approved spring water sources by the California Department of Health – Food and Drug Branch (CDPH-FDB), in accordance with the USFDA Standard of Identity for a spring water source. A third production borehole, BH-3, has been constructed but has not yet been put into service. In addition, the District of Hope operates a well (Hope Well No. 8) in the northeast portion of the Site. Hope Well No. 8 and the BlueTriton boreholes (BH-1, BH-2, and BH-3) are completed in the Aquifer and all have screens at similar elevations. The South Monitoring Well is situated between Hope Spring and the BlueTriton production boreholes; its screen is positioned in the Aquifer at an elevation similar to the screens in the BlueTriton boreholes and Well 8.

Locations of other known water wells in the vicinity of the Site are shown on Figure 1. These supply water for domestic and municipal uses and have reported yield estimates ranging from 1 to 400 USgpm. Information from selected wells, including two of the District of Hope's municipal supply wells (Well Tag Numbers 13874 and 29695), was included on the hydrostratigraphic cross section on Figure 5. Lithologies and water levels for these wells were obtained from the provincial water well database.

Regulation of groundwater use in British Columbia has been overhauled by the *BC Water Sustainability Act (WSA)* that came into force in 2016, replacing the former *BC Water Act* (*WA*). Whereas groundwater use and well construction were previously unlicensed, the *WSA* requires licensing of all non-domestic water wells. BlueTriton submitted a water license application for BH-1, BH-2, and BH-3 in January 2018 and water use is authorized while the application is under review. Pursuant to the Groundwater Protection Regulation (GPR) (referenced by both the *WA* and the *WSA*), registration of all new wells is now mandatory.

Well construction methods are regulated by the Groundwater Protection Regulation (GPR), which specifies minimum standards for sanitary borehole completion, well closure and drillers' competence. In particular, the GPR specifies that every water supply well must include the following components:

- a surface seal;
- a vermin-proof cap;
- a means for preventing flood water from entering the well; and
- a Well ID Plate with unique number, issued by the Province of BC.

All BlueTriton boreholes discussed in this report have been constructed in compliance with the requirements of the GPR. Additionally, BH-1 and BH-2 are protected within a fenced compound and alarmed structures.

2.8 CONCEPTUAL GROUNDWATER FLOW MODEL

2.8.1 Description

The Site is located in the black hatched area on Figure 1, about half a mile east of Kawkawa Lake, in a 0.5-mile-wide valley (the Valley). The Valley bottom is filled with a thick succession of glaciofluvial sands and gravels deposited during the last period of glaciation. Extensive gravel deposits are exposed along Othello Road east of the Site.The saturated portion of these sand and gravel deposits (the Aquifer) is highly permeable and conducts groundwater flow at a rate on the order of tens of thousands of gallons per minute westward towards the Lake (Piteau, 2014).

The Coquihalla River, located near the Valley's eastern terminus, is interpreted to be the largest source of recharge to the Aquifer. It is estimated to contribute between 63 and 94% of the recharge in winter and summer, respectively. Recharge from the river is estimated to be a near-constant flow of about 21,900 USgpm. This is equivalent to about 4.5% of the annual flowrate in the river where it crosses over the east end of the Aquifer.

Other sources of recharge include infiltration of surface runoff from the side walls of the Valley, infiltrating rain and snowmelt on the Valley floor, and mountain block recharge moving through fractured bedrock underlying the Aquifer. Topography in the vicinity of the Site is shown on Figure 2. The BlueTriton production boreholes, the South Monitoring Well, and Hope Well No. 8 are all completed at similar elevations in the Aquifer.

2.8.2 Water Balance

A water balance for flow through the Aquifer is included in Appendix A. Most of the inputs to the water balance calculations are from Piteau's (2014) water balance study. Inputs include recharge from the Coquihalla River and other streams, precipitation, and mountain block recharge. Discharges from the modeled aquifer include seepage out of the model area, springs, and groundwater withdrawals.

Rates of groundwater recharge to the Aquifer are estimated to range from 23,400 USgpm in August to 36,500 USgpm in January, averaging 30,100 USgpm annually. The seasonal variation is largely attributable to changes in water inputs from incident rainfall and snowmelt and from seepage from creeks draining the north and south walls of the Valley.

Groundwater discharge to springs and surface watercourses downgradient of the Site (5,000 to 8,000 USgpm) constitutes less than a quarter of the total groundwater flow through the Aquifer. Most of the remaining groundwater flow in the Aquifer is interpreted to enter Kawkawa Lake. A small proportion of the flow will remain in the subsurface and move downgradient towards the Fraser River. At less than 200 USgpm, total mean groundwater withdrawals by Plant production boreholes, Hope Well No. 8, and private water wells upgradient from the Site (totalling less than 200 USgpm) represent less than 1% of groundwater flowing through the Aquifer past the Site (Piteau, 2014).

3. MONITORING PROGRAM, DATA, AND ANALYSIS

3.1 MONITORING PROGRAM METHODOLOGY

The monitoring program utilizes automated equipment to measure and record ground and surface water levels and water temperature at regular intervals. Data from monitoring systems operated by others include Coquihalla River discharge (Water Survey of Canada (WSC)) and snow pillow water equivalent (British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD)). Periodic manual measurements are made by BlueTriton staff to validate the water level data collected by the installed instrumentation at the Site. Piteau visits the Site quarterly to inspect the condition of the monitoring stations, perform manual measurements, and download instrument data.

3.1.1 On-Site Monitoring

Groundwater levels and temperatures have been monitored using Solinst Leveloggers. The recorded water levels are validated by periodic manual measurements by BlueTriton and Piteau.

The Levelogger measures total pressure in an unvented unit. A Solinst Barologger has also been deployed at the Site to measure and record barometric pressure to facilitate correction of Levelogger readings for variations in atmospheric pressure. This datalogger also records ambient air temperature. It was equipped with telemetry in November 2023. The monitoring interval for all equipment is four hours, except in production wells, where data are recorded hourly. All dataloggers were replaced with new equipment in July 2022.

Water levels and temperatures are monitored at the following stations (Figure 2):

- Production Borehole BH-1: From November 2005 to August 2006, groundwater levels were monitored manually using a graduated electric tape. Since August 2006, the water level has been measured by either a Levelogger or a permanently installed transducer that reports to the bottling facility's SCADA system.
- Production Borehole BH-2: Since October 2011, groundwater levels have been monitored using a combination of a Levelogger and a permanently installed pressure transducer linked to the SCADA system.
- Production Borehole BH-3: Since January 2013, groundwater levels have been monitored using a Levelogger.
- The South Monitoring Well: Since December 2005, groundwater levels have been monitored using a Levelogger. This unit was equipped with telemetry in November 2023.
- The Upper and Lower orifices of the Hope Spring: Parshall flumes straddling watercourses sourced from both orifices are used to monitor discharge rates from Hope Spring. Leveloggers have been operating at these locations since December 2005.
- Upstream and Downstream ponds: Water levels in the Upstream and Downstream ponds have been monitored using Leveloggers since December 2005 and April 2007, respectively.

3.1.2 Supplemental Data Sources

Other monitoring data utilized in this program include:

- Groundwater withdrawals for Borehole BH-1 (and BH-2 when in production) were recorded by BlueTriton daily.
- Groundwater withdrawal and water levels for Well No. 8 (East Kawkawa Lake) recorded by the District of Hope: meters measuring cumulative volume and hours pumped are recorded manually about three times per week.
- Flow in the Coquihalla River at Alexander Creek (WSC Station No. BC08MF068): the WSC monitors this station (Figure 1) continuously and releases data on a preliminary basis until it is verified (Environment Canada, 2023b). Whereas the flow data until 2022 are verified, 2023 data are still preliminary and subject to change.
- Mountain snowpack accumulation at Snow Pillow Station 1D19P – Spuzzum Creek (FLNRORD, 2023). The station is situated at an elevation of 3,927 ft-asl, in the Cascade Range 19 miles north of the Hope facility. Although runoff from this site reports to a different catchment (the Fraser River), this snow pillow is considered a reasonable surrogate for snow conditions within the Coquihalla River catchment.

3.2 RESULTS

Monitoring data for the 2023 calendar year are presented graphically on Figures 6 through 15 and discussed in the remainder of Section 3.

3.2.1 Precipitation

Monthly precipitation at the Hope A Station for 2023 is summarized in Table 1 below, and compared to the mean monthly precipitation between 2014 and 2023.

Table 1- Monthly Precipitation

Month	2023 Monthly Precipitation (inches)	Mean Monthly Precipitation (inches) (2014-2023)	% of 10-year Mean
January	4.28	7.39	58%
February	8.27	7.56	109%
March	2.86	6.08	47%
April	4.38	5.08	86%
May	1.62	2.65	61%
June	1.05	2.38	44%
July	0.83	1.19	70%
August	0.45	1.30	35%
September	2.69	3.52	76%
October	3.50	7.44	47%
November	10.42	11.50	91%
December	7.40	8.27	89%
Year	47.75	64.34	74%

The upper plot on Figure 6 shows monthly precipitation between 2014 and 2023. The dashed green line shows each month's mean (normal) precipitation.

The cusum plot in the centre of Figure 6 presents the cumulative deviation from the ten-year mean of mean monthly precipitation between January 2014 and December 2023. A rising trend on the cusum line indicates a wetter-than-normal period and a decreasing trend indicates a drier-than-normal period. The drying trend noted during 2022 continued through 2023, with lower-than-normal precipitation measured for all months except February (Table 1).

3.2.2 Coquihalla River Flows

Monthly mean Coquihalla River flows at WSC Station BC08MF068 above Alexander Creek (1.3 miles south of the Plant, Figure 1) for the interval 2014 to 2023 range from 234 cubic feet per second [cfs] (104,981 USgpm) in August to 2,495 cfs (1,119,668 USgpm) in May. Over the same interval, the lowest mean monthly flow (123 cfs or 55,378 USgpm) occurred in August 2023, and the highest mean monthly flow (3,697 cfs or 1,659,425 USgpm) occurred in May 2014 (Figure 6). Overall, mean Coquihalla River flows were approximately 68% of 10-year mean flows in 2023 (Table 2).

Table 2- Monthly Coquihalla River Flows above Alexander Creek

Month	2023 Mean Flow (cfs)	Mean Flow for 2014-2023 (cfs)	% of 10-year Mean
January	682	962	71%
February	658	922	71%
March	425	816	52%
April	877	1325	66%
May	2880	2495	115%
June	708	1746	41%
July	263	647	41%
August	123	234	53%
September	123	284	43%
October	200	696	29%
November	739	1408	53%
December	792	1002	79%
Year	706	1045	68%

3.2.3 Groundwater Withdrawals

Daily withdrawal rates from BH-1 in 2023 ranged from 1,515 to 340,979 US gallons per day (USgpd). Weekly withdrawals for 2023 were generally within the historically reported range, and annual withdrawals have been relatively consistent since 2019 (Table 3 and Figure 7). The mean annual withdrawal rate in 2023 was 169,491 USgpd or 117.7 USgpm, about 2% (1.9 USgpm) lower than the amount for 2022 (119.6 USgpm).

Use of BH-2 for production was discontinued when product lines were reorganized in 2017, and except for occasional pumping to circulate water, the well has not operated since 2019. In 2023, a total of 1,702,944 US gallons were withdrawn from BH-2 for a mean annual rate of 3.2 USgpm.

Hope Well No. 8 produced a mean of 42,149 USgpd in 2023 (29 USgpm). The well was operated on mean for about 1.7 hours per day at a mean pumping rate of 416 USgpm. Flow rates reported in 2023 are slightly lower than in 2022, but similar to those measured in previous years (Figure 8).

Table 3 Annual Groundwater Withdrawals

Year	BH-1 Withdrawals (USgpm)	BH-2 Withdrawals (USgpm)	Hope Well No. 8 Withdrawals (USgpm)	Total Withdrawals (USgpm)
2014	119	18.5*	41	179
2015	120	1.3	34	155
2016	120	1.6	32	154
2017	140	4.6	30	175
2018	141	0.6	33*	175
2019	124	0.7*	31	156
2020	115	1.0*	29*	145
2021	116	1.1*	35*	152
2022	120	2.6*	29	152
2023	118	3.2	32	153
Mean	123	4	33	159

* indicates one to six months of data missing. Annual flow rate calculated over portion of year for which data are available.

3.2.4 Groundwater Levels

Static water levels in BH-1 in 2023 rose by 5 ft between January and mid-May, and then declined about 5 ft between May and September. Static water levels were relatively constant from September to December (Figure 9). The water level in BH-1 was at the low end of the 10-year range in May and June.

Static water levels in BH-2 in 2023 rose by about 3 ft between February and April and fell 5 ft between May and December (Figure 9). Similar to BH-1, the water level in BH-2 was on the low end of the 10-year range from April to June.

Measured water levels in Hope Well No. 8 in 2023 rose above 5 ft between February and May and fell 10 ft between May and November (Figure 9). The water level in Hope Well No. 8 was lower than the 10-year range in April.

Borehole water levels draw down by about 3 ft in BH-1 and by about 2 ft in BH-2 when the pump in BH-1 is operated. They recover within a few minutes upon cessation of pumping.

Groundwater levels in the South Monitoring Well and BH-3 were also lower than the 10-year range in April 2023 (Figure 10). Levels at the South Monitoring Well rose by 2 ft from February to May, and declined by 4 ft from mid-May to November, and did not rise above the level of the casing as they had in 2021 and 2022. Water levels at BH-3 rose by about 6 feet from February to May 2023 and declined by about 8 ft by early December.

3.2.5 Surface Water Levels

Water levels in the Upstream and Downstream ponds varied by less than 0.5 ft during 2023 (Figure 11), and were generally within the 10-year range.

3.2.6 Spring and River Discharge Rates

In 2023, discharge from the Upper Orifice typically varied from 5 USgpm to 30 USgpm and averaged about 14 USgpm (Figure 12). Discharge was on the low end of the 10-year observed range. For about a week in March, the datalogger readings were lower than the observed range.

The discharge rate from the Lower Orifice was between 50 and 150 USgpm and averaged about 95 USgpm during 2023. Flows were on the low end or slightly lower than the 10-year range from January to October (Figure 12).

3.2.7 Groundwater Temperature

Groundwater temperature trends in the South Monitoring Well ranged from 46.2 to 47.2 ºF during 2023 and were within the previously observed range, except for September through November when they were slightly above historical levels (Figure 13).

3.2.8 Surface Water Temperature

Temperatures in the Upstream and Downstream ponds varied between about 40 and 52 °F during 2023 (Figure 13). As in previous years, these trends continued to follow a similar pattern as air temperature, with some dampening.

3.3 INTERPRETATION AND DISCUSSION

3.3.1 Groundwater Level Trends

The seasonal rise and fall of groundwater levels in each year follows the same general pattern as total precipitation. Aquifer recharge response occurs immediately following rainfall events[1], but is more gradual when a portion of the precipitation is stored in the snowpack (Figure 14). Although the peak annual water levels in May 2023 were lower than typically observed, water levels for the remainder of the year were within the 10-year range.

Long-term groundwater levels generally rise and fall in concert with the precipitation cusum trend (Figure 14). The drier-than-normal trend starting in mid-2022 continued throughout 2023 when monthly precipitation was significantly lower than the 10-year mean and total annual precipitation was only 74% of the 10-year mean.

[1] such as in November 2023

Over the last ten years, groundwater withdrawal rates have fluctuated by less than 15%. The highest rates occurred in 2017 and 2018. Aquifer water levels and spring flow rates during this interval were higher than average amounts for 2014 through 2016 and 2019 (Figure 14). The lowest withdrawal rate occurred in 2020, when aquifer water levels and spring flow rates were higher than in 2019. These trends show that the groundwater levels and spring flows do not decline with increased groundwater withdrawal from Borehole BH-1, Borehole BH-2, and/or Hope Well No. 8.

3.3.2 Surface Water

Water levels in the Upstream and Downstream ponds (Figure 11) vary within one foot. Minor variations are attributed to changes to the configuration of the pond outlet or extreme precipitation events.

3.3.3 Groundwater Resource Sustainability

The monitoring program has been ongoing since 2005 and has included years with unusually high and low precipitation, snow pack, and stream discharges. As the monitoring record continues to augment, the interpretation of the interplay among the various factors continually improves.

Year-over-year rising and falling trends in groundwater levels and spring flows coincide with wetter-than-normal and drier-than-normal periods in the precipitation record with some time lag. Seasonal fluctuations are superimposed on annual trends.

Based on Piteau's evaluation and interpretation of hydrologic monitoring data collected since 2005, it is concluded that spring flows are strongly influenced by precipitation trends, and display no discernable effect of varying groundwater withdrawal rates from Borehole BH-1, Borehole BH-2, and/or Hope Well No. 8. Accordingly, the use of the groundwater resource can be maintained indefinitely without valid negative environmental impact.

4. AQUATIC AND RIPARIAN HABITAT ASSESSMENT

4.1 HABITAT ASSESSMENT

Scott Resources Services (now Pinchin Ltd.) has completed assessments of aquatic and riparian habitats at the BlueTriton Site since 2008 to characterize habitat quality and monitor for potential signs of environmental stress or habitat degradation. The assessments were completed annually from 2008 to 2017, and then reduced to a biennial schedule based on the consistent Site conditions. The last aquatic assessment was completed in 2022 (Pinchin, 2023) and the next assessment is anticipated in 2024.

4.2 FISH SAMPLING

Fish sampling has been conducted every 5 years and was last completed in 2020. The 2020 event confirmed the presence of cutthroat trout at all sampled sites and confirmed the presence of a barrier to upstream migration of fish in one of the small streams crossing the Site. However, the cutthroat trout population upstream of the barrier is not considered to be isolated because fish passage between the streams may be possible during high flow conditions (Pinchin, 2020). The next assessment is anticipated in 2025.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 AQUIFER LEVEL TRENDS AND RESOURCE SUSTAINABILITY

Year-over-year rising and falling trends in groundwater levels and spring flows coincide with wetter-than-normal and drier-than-normal periods in the precipitation record with some time lag. Seasonal fluctuations are superimposed on the annual trends.

Based on Piteau's evaluation and interpretation of hydrologic monitoring data collected since 2005, it is concluded that spring flows are strongly influenced by precipitation trends, and display no discernable linkage to groundwater withdrawal rates from Boreholes BH-1 and BH-2, and/or Hope Well No. 8. Accordingly, it follows that BlueTriton's use of the groundwater resource does not affect the sustainability of the source aquifer (Kawkawa Lake Aquifer) and can be maintained indefinitely without negative environmental impact.

5.2 AQUATIC AND RIPARIAN ASSESSMENTS

The aquatic and riparian habitat at the site has been assessed twelve times between 2008 and 2022. Results have consistently demonstrated that the aquatic habitat in small streams at the Site is stable and suitable for aquatic life.

5.3 RECOMMENDATIONS

Piteau recommends the continuation of the monitoring program to facilitate responsible stewardship of the groundwater resource and nearby aquatic habitats. Results of the surface and groundwater monitoring program should be reported annually. The aquatic and riparian assessment should be completed every two years, and the fish and fish habitat assessment every five years.

6. LIMITATIONS

Piteau Associates has exercised reasonable skill, care, and diligence in obtaining, reviewing, analyzing, and interpreting the information acquired during this study, but makes no guarantees or warranties, expressed or implied, as to the completeness of the information contained in this report. Conclusions and recommendations provided in this report are based on the information available at the time of this assessment.

Piteau has relied in good faith on information provided by the persons and organizations noted in this report. No responsibility is accepted for inaccuracies, deficiencies, or misstatements in the information obtained from these sources, whether or not specifically noted by Piteau.

This report is comprised of text, tables, figures, and appendices, and all components must be read and interpreted in the context of the whole report. The report has been prepared for the sole use of BlueTriton, and no representation of any kind is made to any other party.

Respectfully submitted,

PITEAU ASSOCIATES ENGINEERING LTD.

PROFESSIONAL
PROVINCE OF
J. S. MANCER
37153
BRITISH COLUMBIA
ENGINEER

2024-04-04

Jennifer Mancer, P.Eng.
Sr. Hydrogeologist

Reviewed by:

David J. Tiplady, P.Eng.
Principal Hydrogeologist
Vice President, Hydrogeology

PERMIT TO PRACTICE
PITEAU ASSOCIATES ENGINEERING LTD.
PERMIT NUMBER: 1001592
ENGINEERS AND GEOSCIENTISTS
BRITISH COLUMBIA

JM/DJT/ld
Att.

7. REFERENCES

BC MFLRORD, 2024. Manual Snow Survey and Automated Snow Pillow (ASP) data accessed online at [http://bcrfc.env.gov.bc.ca/data/], Accessed January 2024.

BC Water Wells Database, 2014. Water well construction and lithological records. [https://a100.gov.bc.ca/pub/wells/public/indexreports.jsp]. Accessed January 2014.

Environment Canada, 2024a. Historical Climate Data. [http://climate.weather.gc.ca/index_e.html]. Accessed February 2024.

Environment Canada, 2024b. Archived and Real Time Hydrometric Data. [http://www.wateroffice.ec.gc.ca/index_e.html]. Accessed February 2024.

iMapBC, 2016. [http://maps.gov.bc.ca/ess/sv/imapbc/]. Accessed 15 February 2016.

Pinchin, 2020. Revised 2020 Fish Habitat and Fish Sampling Report, Third Fish Report, Nestlé Waters Facility, 66700 Othello Road, Hope, British Columbia. Report prepared for Nestlé Waters North America, July 20.

Pinchin, 2023. 2022 Biological Monitoring Report, Twelfth Annual Report, Nestlé Waters Facility, 66700 Othello Road, Hope, British Columbia. Report prepared for Nestlé Waters North America, January 9.

Piteau, 2000. Hydrogeologic Assessment of Proposed Source for Bottled Water, Hope, B.C. Letter report to Aberfoyle Springs Ltd., January 4.

Piteau, 2005. Hydrogeologic Assessment of Borehole and Spring Connection, Hope, B.C. Facility. Letter report to Nestlé Waters North America Inc., March 31.

Piteau, 2008. Capture Zone Analysis for Groundwater Extraction – East Kawkawa Lake Area, Hope, B.C. Letter report to Nestlé Waters North America Inc., July 25.

Piteau, 2011. Construction and Testing of Borehole BH-2 – Hope, BC. Facility. Letter report to Nestlé Waters North America Inc., February 8.

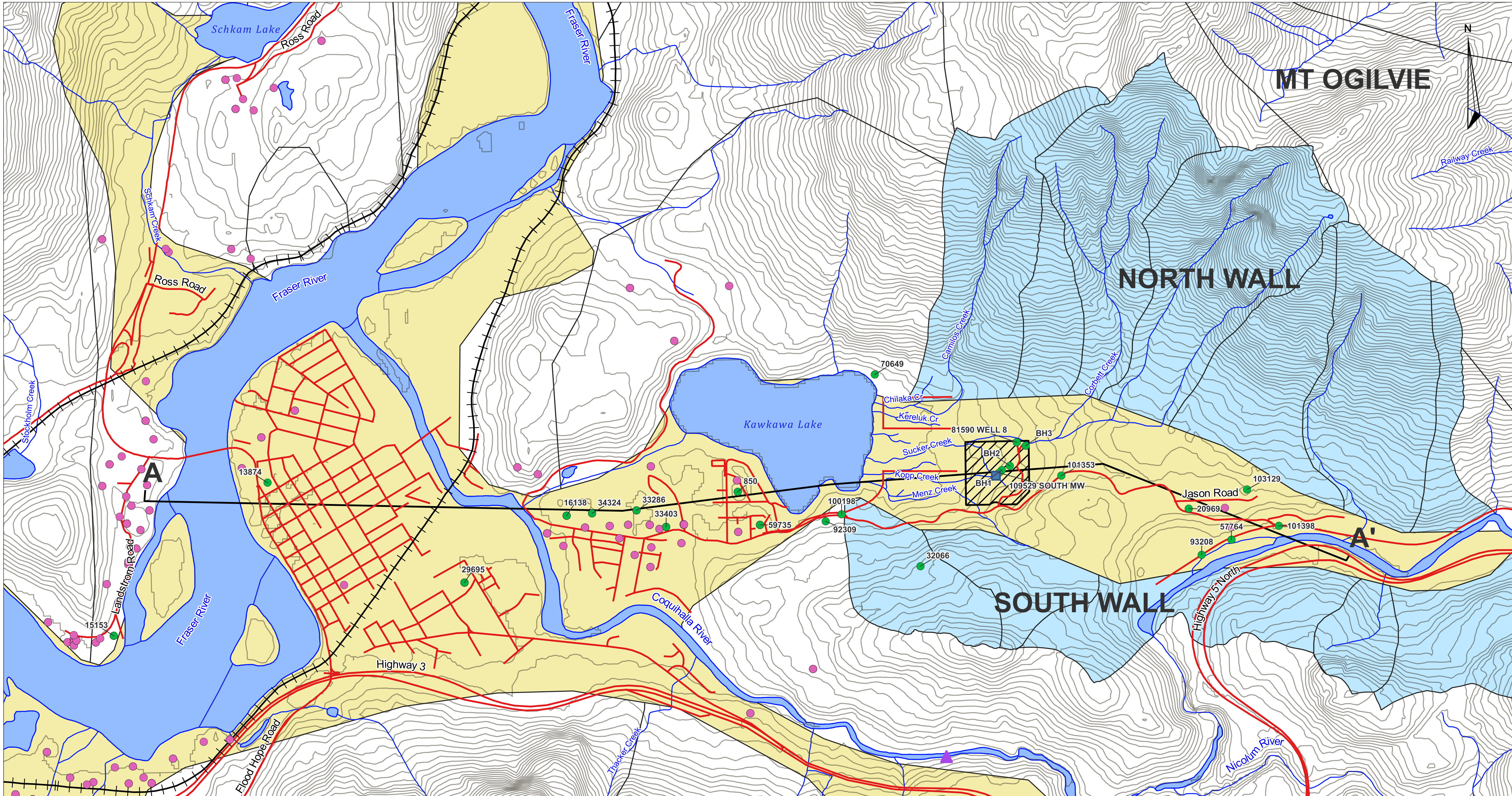
Piteau, 2014. Water Budget Assessment for Kawkawa Lake Aquifer – Hope, B.C. Letter report to Nestlé Waters North America Inc., May 8.

Piteau, 2015. Construction and Standard of Identity Testing, Boreholes BH-2 and BH-3, Hope, BC. Report to Nestlé Waters North America Inc., November.

Stanley Associates Engineering Ltd., 1987. East Kawkawa Lake Drainage Study. Report prepared for the Regional District of Fraser-Cheam, November, 44 pp.

FIGURES

H:\Project\2572\ArcGIS\ArcMaps\2023\Figure 4 OB.qgz



Legend

- Water Well
- Water Well on Section (Identified by Well Tag Number)
- Coquihalla River Flow Monitoring Station (Active)
- Hope Springs
- Hydrogeological Cross-Section A-A'
- Road
- BlueTriton Property
- Surface Watersheds Reporting to Aquifer
- Quaternary Sediments (Aquifer Footprint)

0 1,000 2,000 3,000 4,000 ft

SCALE: 1:25,000

Contour Interval 20 ft

Note: Well locations are approximate, as given in BC MOE Water Wells database

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A TETRA TECH COMPANY

LOCATION MAP

BY:	DATE:
OB	APR 24
APPROVED:	FIG:
JM	1

LEGEND

- SOUTH MONITORING WELL
- WATER SUPPLY BOREHOLE
- SPRING ORIFICE
- PROPERTY BOUNDARY
- WATERCOURSE
- FLUME
- COQUIHALLA RIVER FLOW MONITORING STATION
- TRANSMOUNTAIN PIPLINE

NOTE:

1. TOPOGRAPHIC CONTOURS IN ft-asl, (6.5 ft INTERVAL).

0 100 200 300ft.

SCALE: 1" = 150 ft.

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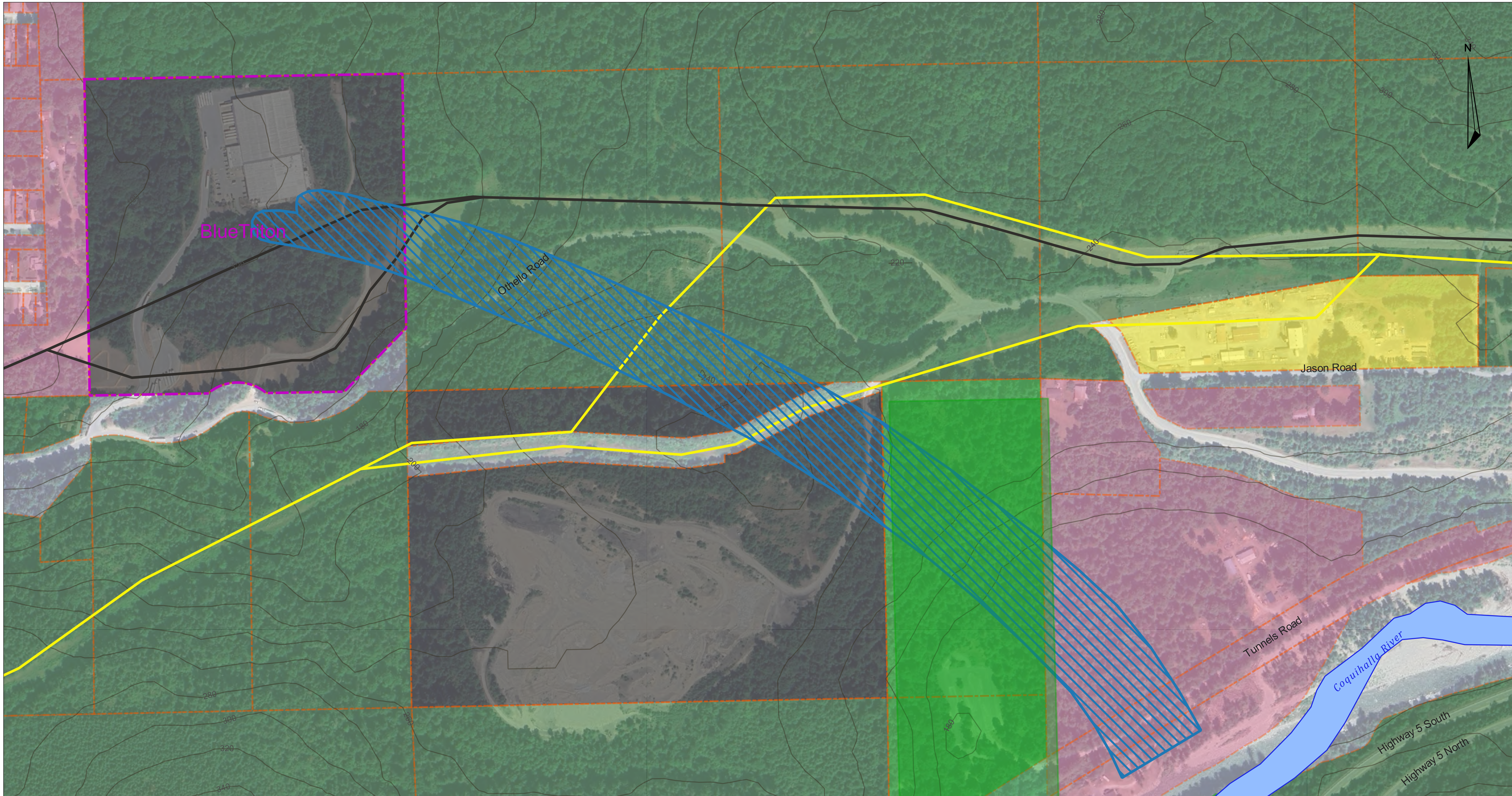
SITE PLAN

BY:	DATE:
JM/sl	APR 24
APPROVED:	FIG:
DJT	2

H:\Project\2572\ArcGIS\ArcMaps\2023\Fig 3 LandUse.mxd



Legend

- BlueTriton Property
- Combined BH1 and BH2 Capture Zone

Transmission
- Gas
- Oil

Land Use
- Industrial
- Natural Gas Transmission
- Park
- Residential
- Woodland

0 500 1,000 ft

SCALE: 1:5,000

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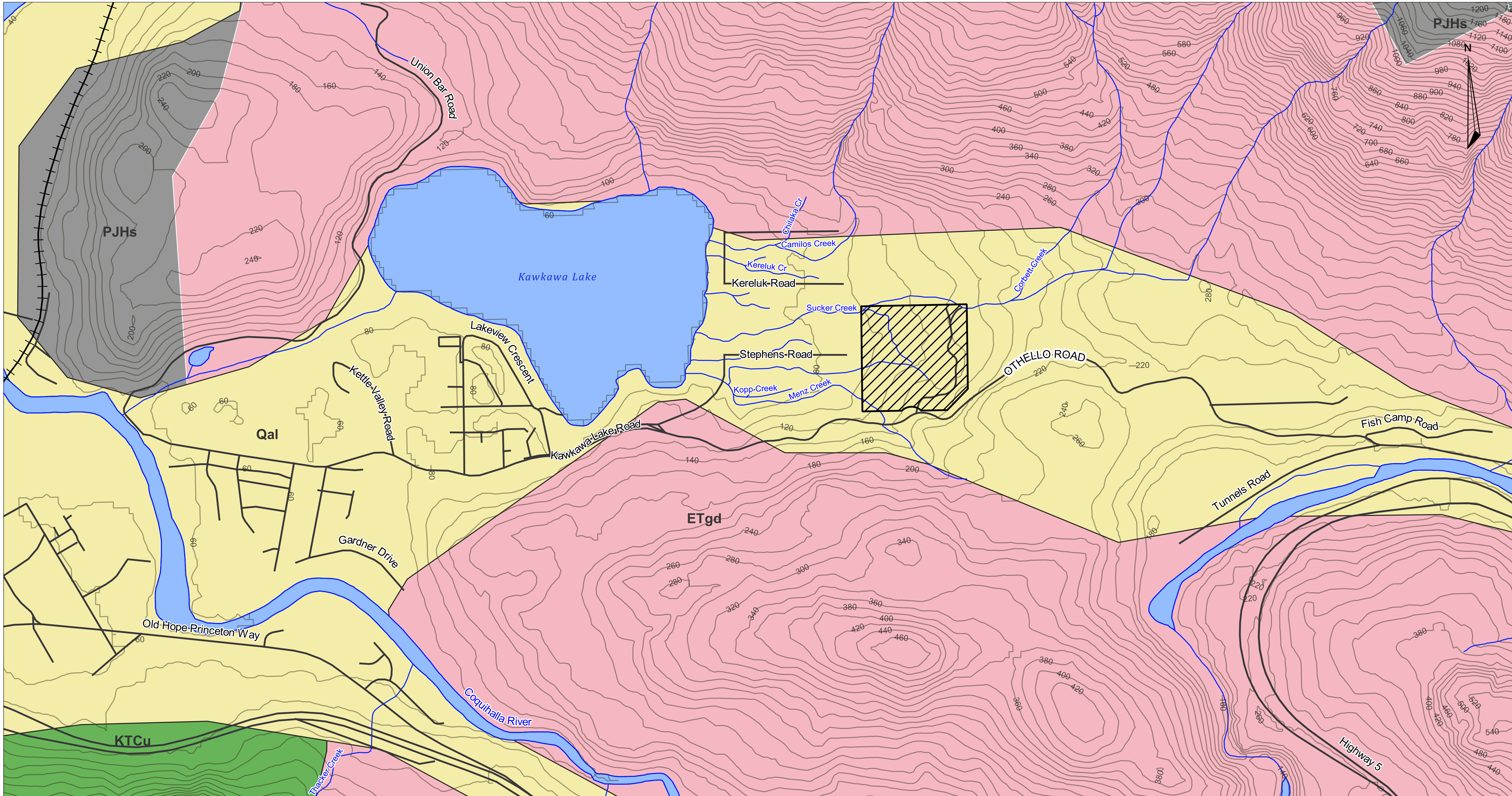
LAND USE

BY: JM	DATE: APR 24
APPROVED: JM	FIG: 3

H:\Project\2572\ArcGIS\ArcMaps\2023\Figure 4 OB.aqz



Legend

- BlueTriton Property
- Qal - Quaternary - Unconsolidated Alluvial Sediments

BEDROCK GEOLOGY

- ETgd - Cenozoic - Unnamed granodioritic intrusive rocks
- KTCu - Mesozoic to Cenozoic - Custer Gniess orthogniess metamorphic rocks
- PJHs - Paleozoic to Mesozoic - Hozameen Complex undivided sedimentary rocks

0 1,000 2,000 3,000 4,000 ft

SCALE: 1:15,000

Contour Interval 20 ft

Note: Mapping by BC Geological Survey

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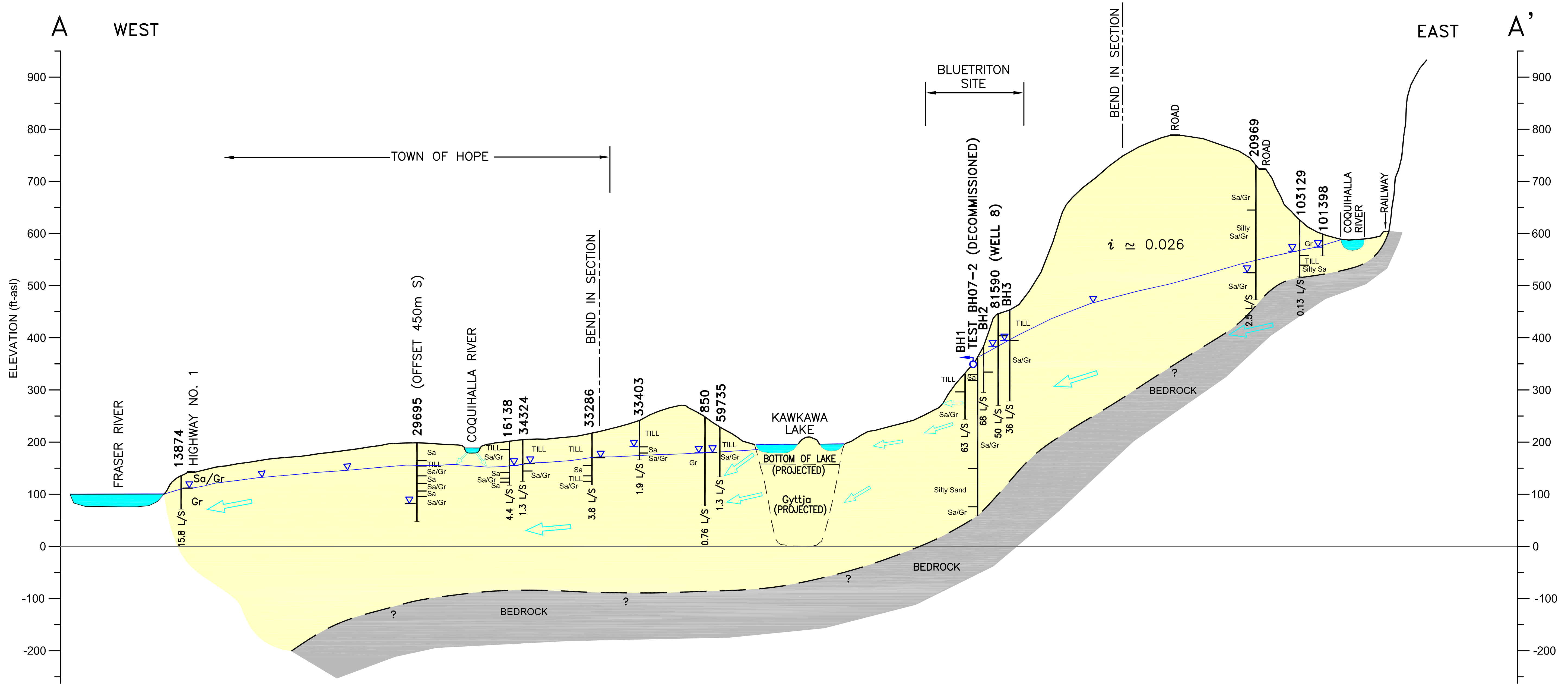
BEDROCK AND QUATERNARY GEOLOGY

BY:	DATE:
OB	APR 24
APPROVED:	FIG:
JM	4



LEGEND

Cl = CLAY
Sa/Gr = SAND AND GRAVEL
Sa = SAND
TILL = DENSE SILTY SAND AND GRAVEL
SPRING
PRODUCTION WELL
INTERPRETED GROUNDWATER FLOW DIRECTION

NOTES:

1. WELL TAG NUMBERS IN GROUNDWATER WELL DATABASE.
2. SEE FIGURE 1 FOR WELL LOCATIONS.
3. BEDROCK SURFACE INTERPRETED FROM WELL LOG LITHOLOGY.

0 1000 2000 3000 4000ft.

SCALE: 1" = 2000 ft.

10X VERTICAL EXAGGERATION

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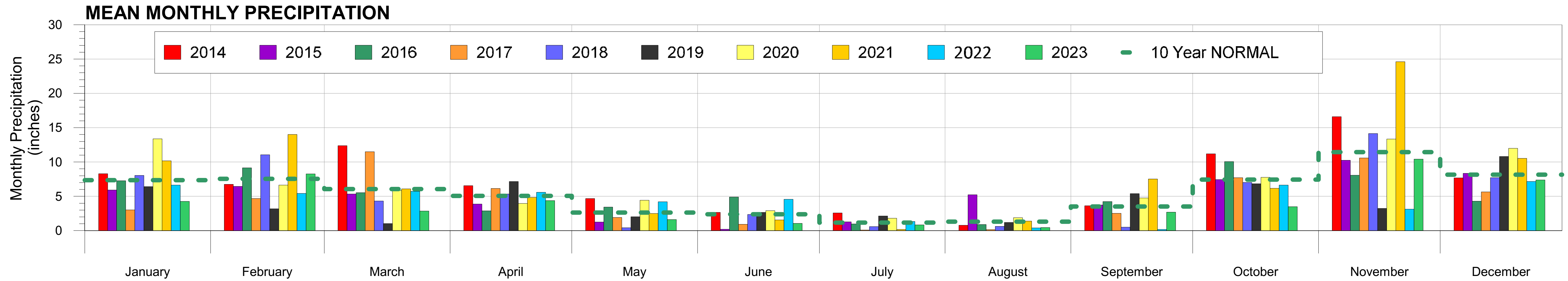
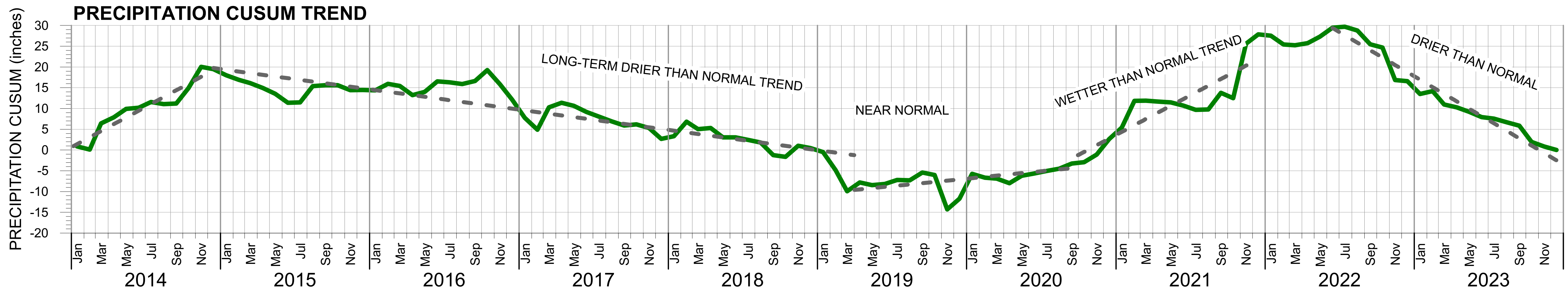
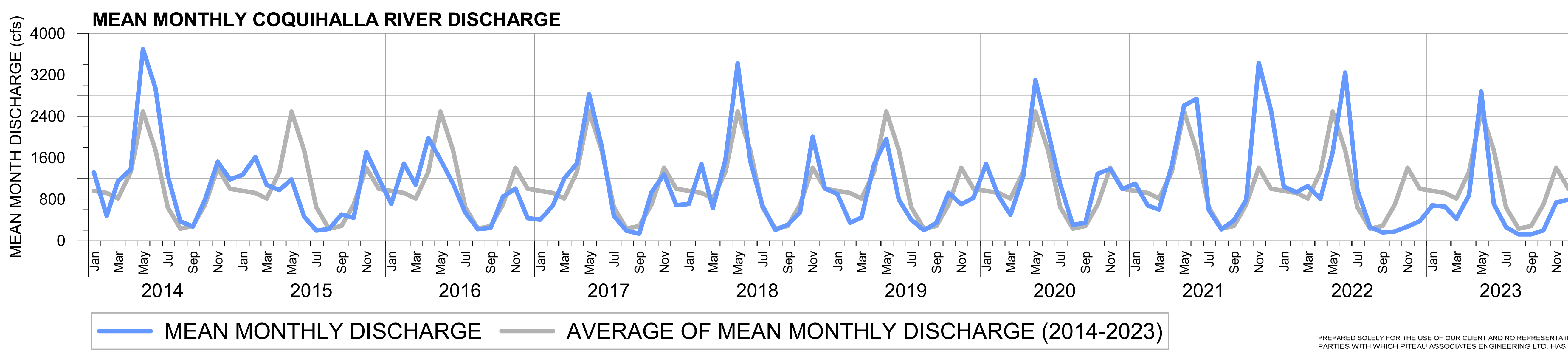
HYDROGEOLOGIC SECTION A-A'

BY:	DATE:
JM/sl	APR 24
APPROVED:	FIG:
DJT	5

H:\Project\2572\Water Monitoring\Trend Plots\6 Precip cusumrev.grf







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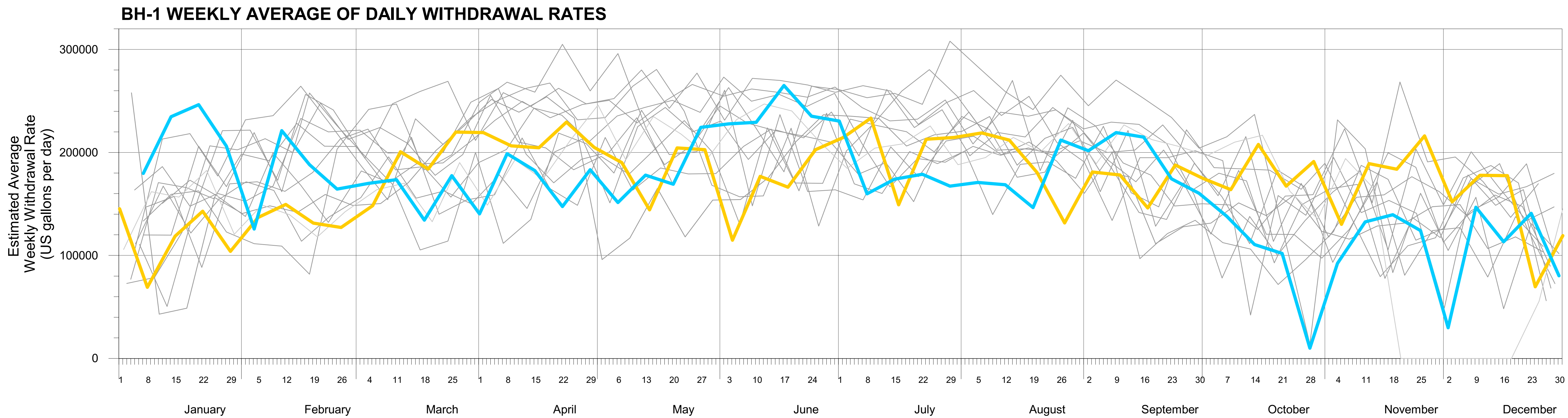
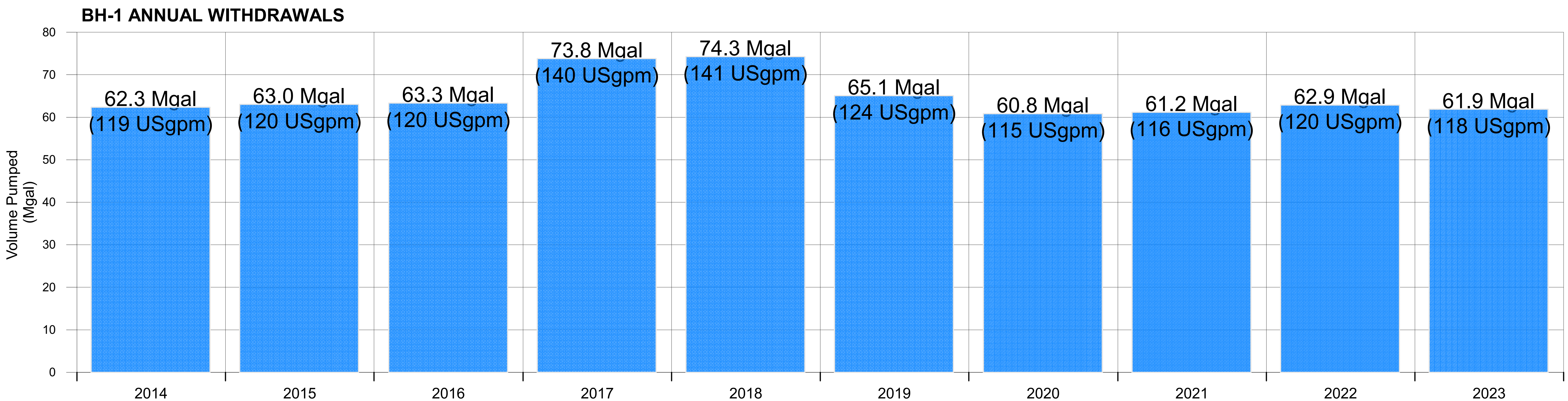
PRECIPITATION AND RIVER DISCHARGE TRENDS

BY:	DATE:
OB	APR 24
APPROVED:	FIG:
DJT	6

Notes:
1. Precipitation norms in the upper plot are calculated from Environment Canada's Hope A stations for the interval 2014 to 2023.
2. Hope A Station data are not available for intervals in 2020 through 2023. Monthly precipitation data for these months were estimated based on a correlation with daily precipitation at Agassiz RCS Station summed monthly.
3. Coquihalla River discharge data are from Water Survey of Canada Station 08MF068 (Coquihalla River at Alexander Creek).

H:\Project\2572\Water Monitoring\Trend Plots\7 Production BH1rev.grf





Legend
2023
2022
2014 - 2021

Notes:
1. Data prior to 2017 calculated based on flows from operating days only.
2. No withdrawals reported from November 13, 2021 to December 21, 2021 as the plant was closed for flooding.

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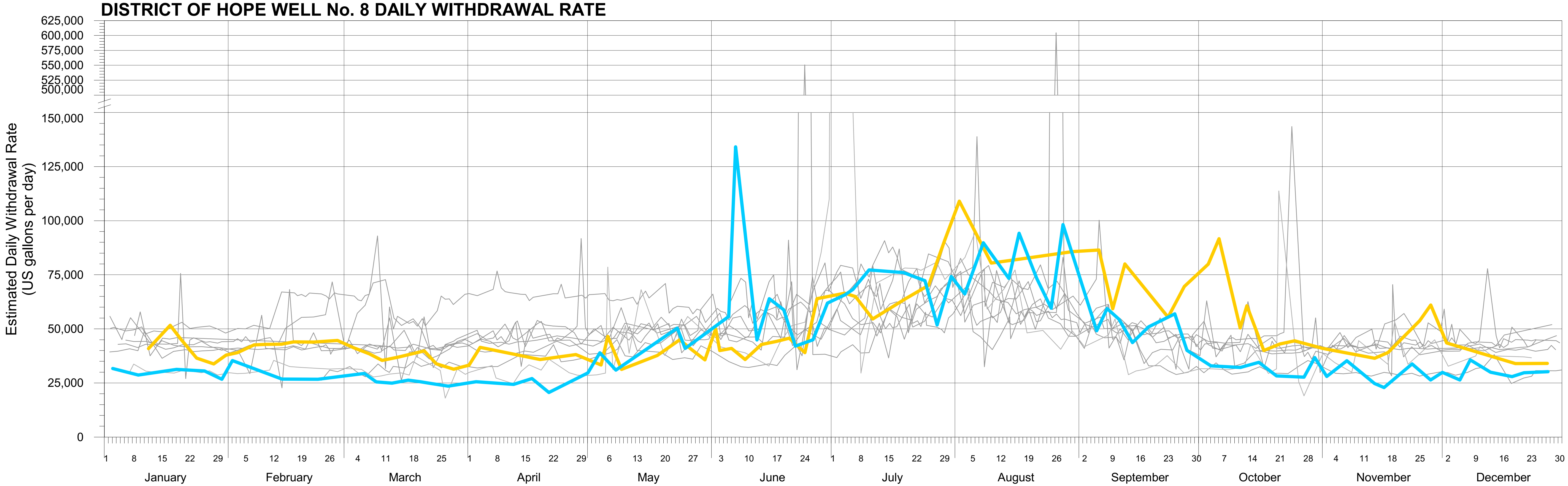
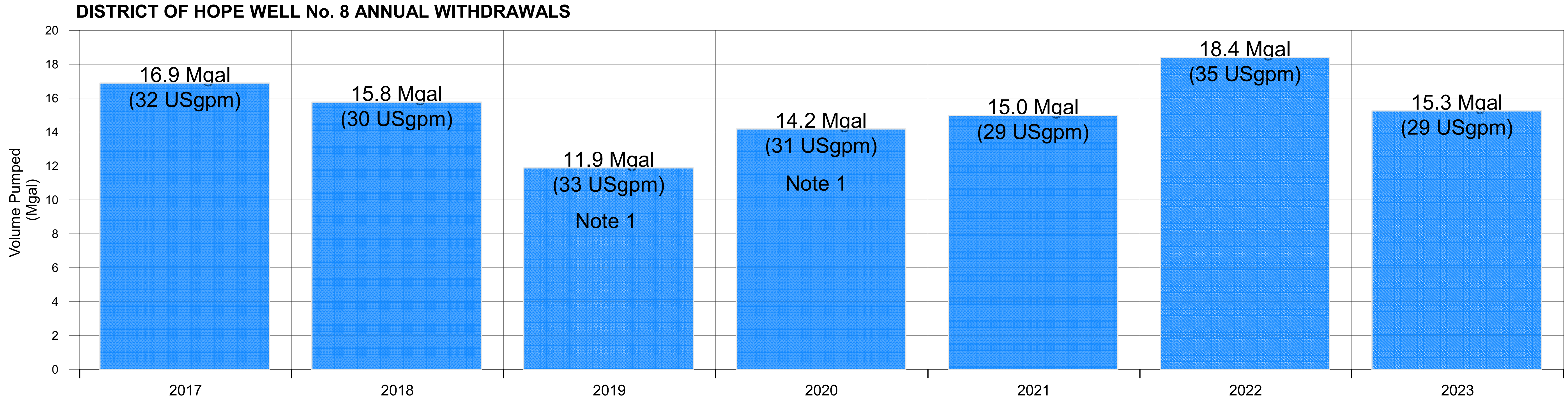
BOREHOLE BH-1
GROUNDWATER WITHDRAWALS

BY:	DATE:
OB	APR 24
APPROVED: JM	FIG: 7

H:\Project\2572\Water Monitoring\Trend Plots\8 Production Hope 8.grf





Legend
- 2023
- 2022
- 2014 - 2021

NOTES:
1) Well No. 8 flow meter failed on September 9, 2019 and was replaced on February 21, 2020. Total volumes for 2019 and 2020 as measured by flow meter. Average flow rates calculated over period of record only.
2) Large daily flows on June 24 and August 26, 2020 and July 1, 2020 are a result of longer than normal pumping periods.

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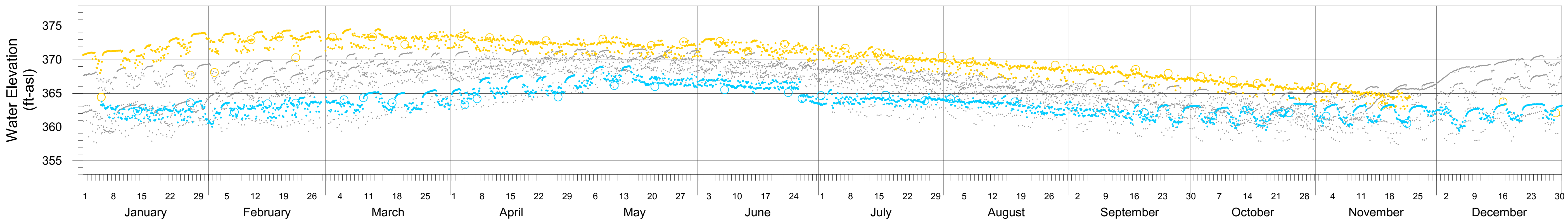
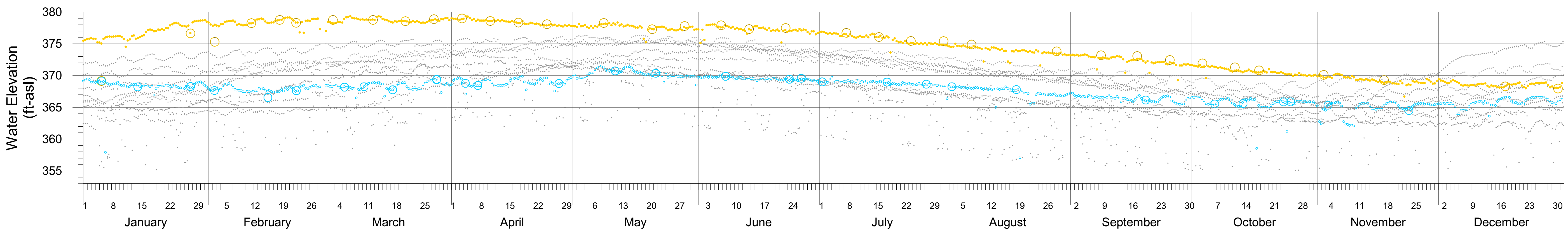
HOPE WELL No. 8
GROUNDWATER WITHDRAWALS

BY:	DATE:
OB	APR 24
APPROVED: JM	FIG: 8

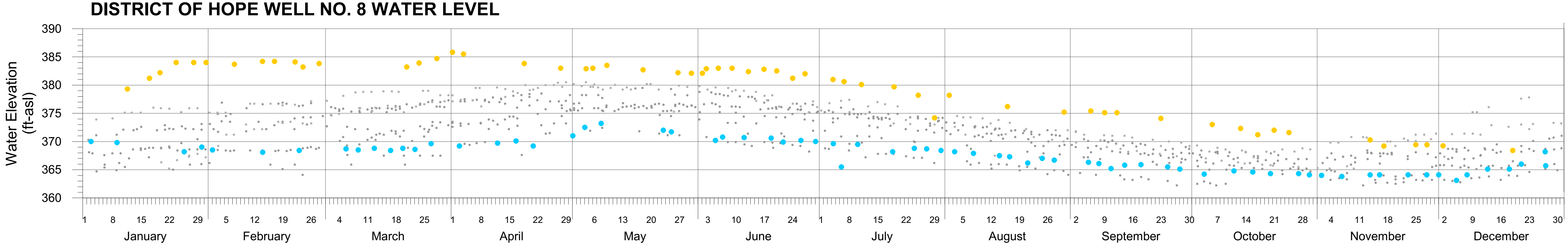
BH-1 WATER LEVEL



BH-2 WATER LEVEL



DISTRICT OF HOPE WELL NO. 8 WATER LEVEL



Legend
- 2023
- 2022
- 2014 - 2021

H:\Project\2572\Water Monitoring\Trend Plots\9 PW WL.grf

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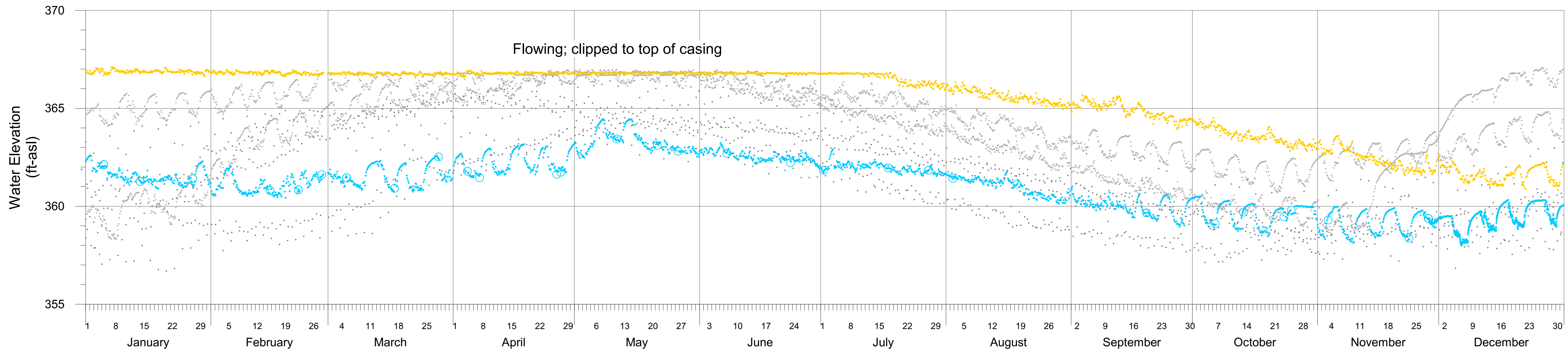
PRODUCTION BOREHOLE WATER LEVELS

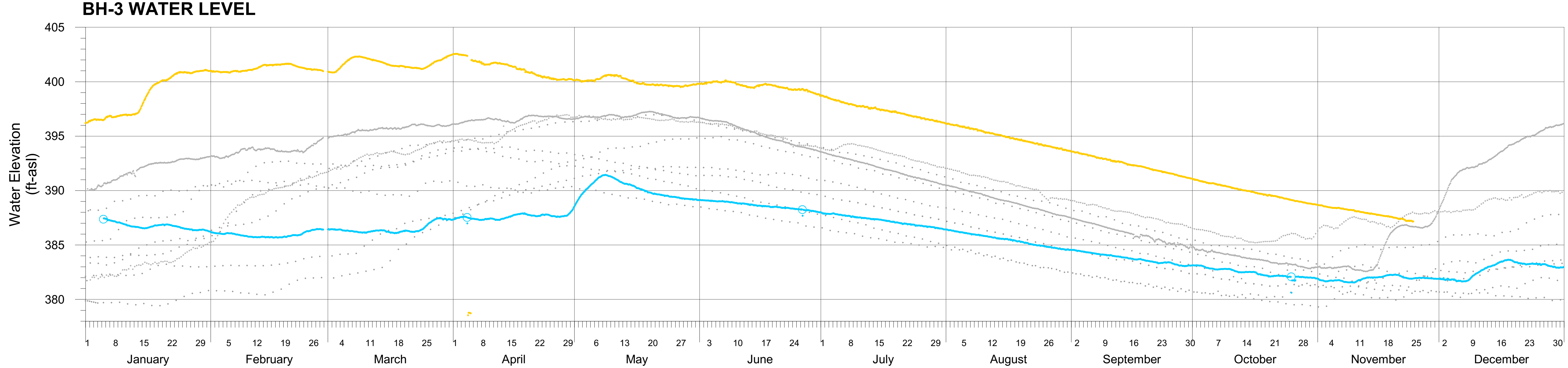
BY:	DATE:
OB	APR 24
APPROVED:	FIG:
JM	9

Notes:
1. Circle or cross symbol denotes manual measurement. For clarity, BH-1 and BH-2 manual measurements are shown only for the current year.
2. BH-1 LevelLogger malfunction between November 24, 2022 and January 5, 2023.

SOUTH MONITORING WELL WATER LEVEL



BH-3 WATER LEVEL



- 2023
- 2022
- 2014-2021

Notes:
1. Circle symbol denotes manual measurement. For clarity, manual measurements are only shown for the current year.
2. For BH-3, the interval of record begins in 2013.
BH-3 LevelLogger malfunction between November 24, 2022 to January 5, 2023.

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OBSERVATION BOREHOLE WATER LEVELS

BY:	DATE:
OB	APR 24
APPROVED: JM	FIG: 10

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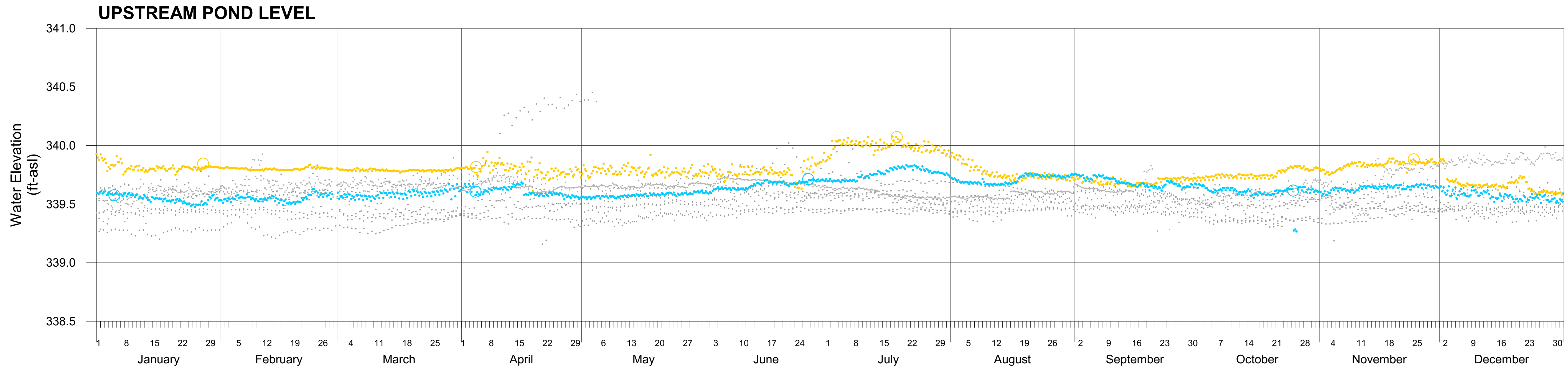

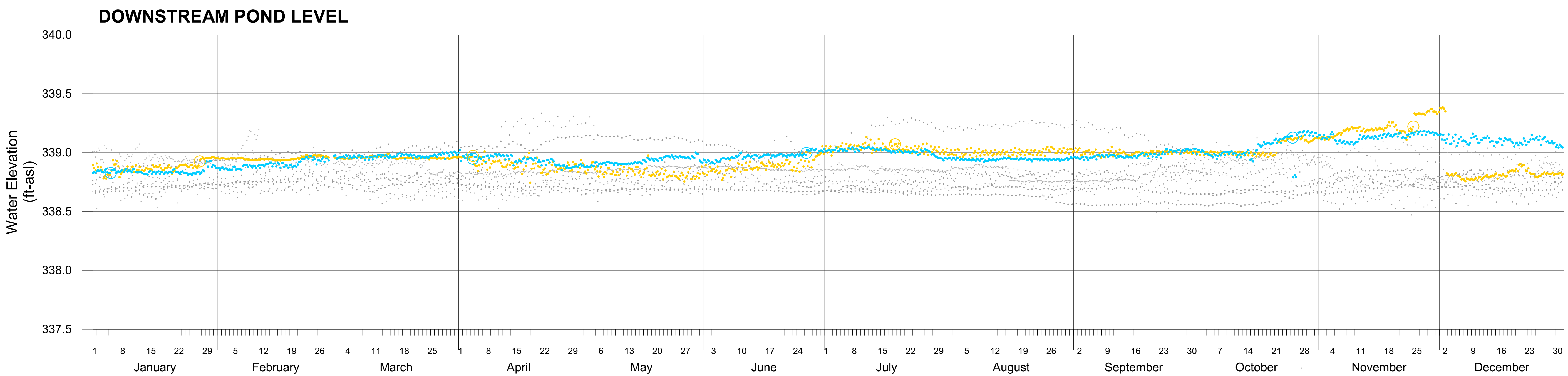

Legend
- 2023
- 2022
- 2014-2021

Note: Circle symbol denotes manual measurement. For clarity, manual measurements are only shown for the current year.

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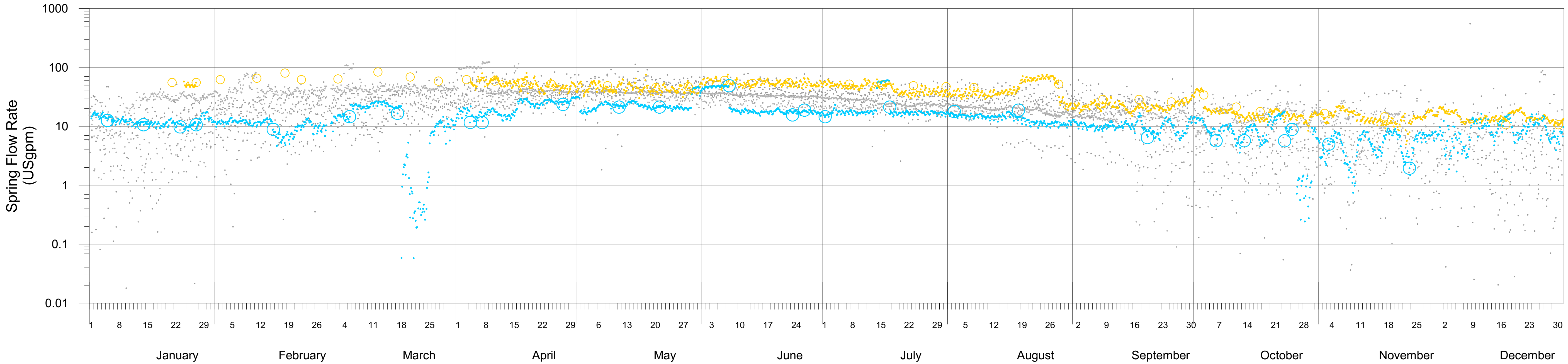
POND WATER LEVELS

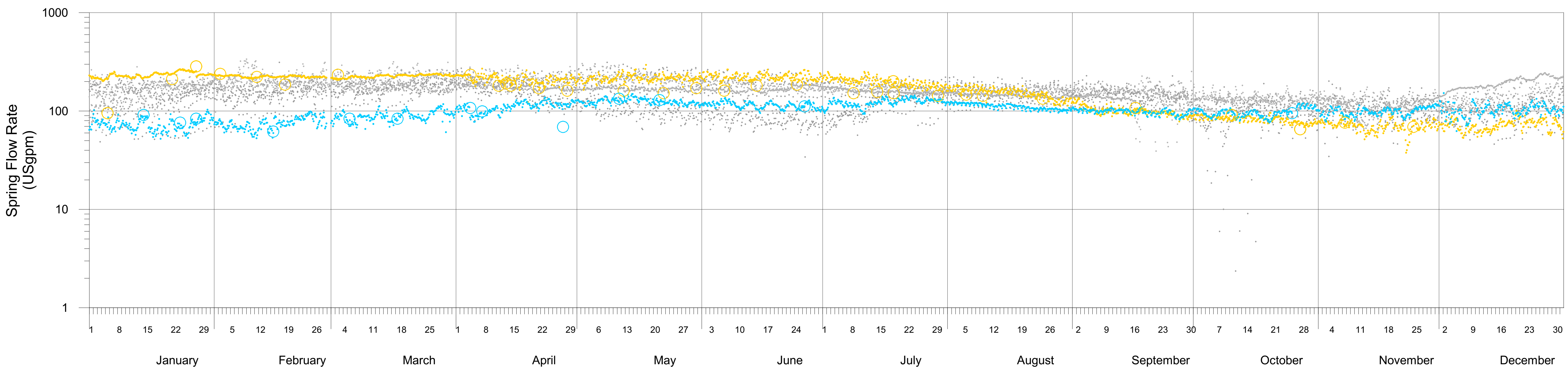
BY:	DATE:
OB	APR 24
APPROVED:	FIG:
JM	11

H:\Project\2572\Water Monitoring\Trend Plots\12 Spring.grf

UPPER ORIFICE FLOW RATE



LOWER ORIFICE FLOW RATE



Legend
- 2023
- 2022
- 2014 - 2021

NOTES:
1. Open circle denotes flow calculated from manual water level measurement. For clarity, manual measurements are shown only for the current year.
2. November, 2021 to April, 2022 logger data not available from Upper Orifice due to datalogger malfunction.

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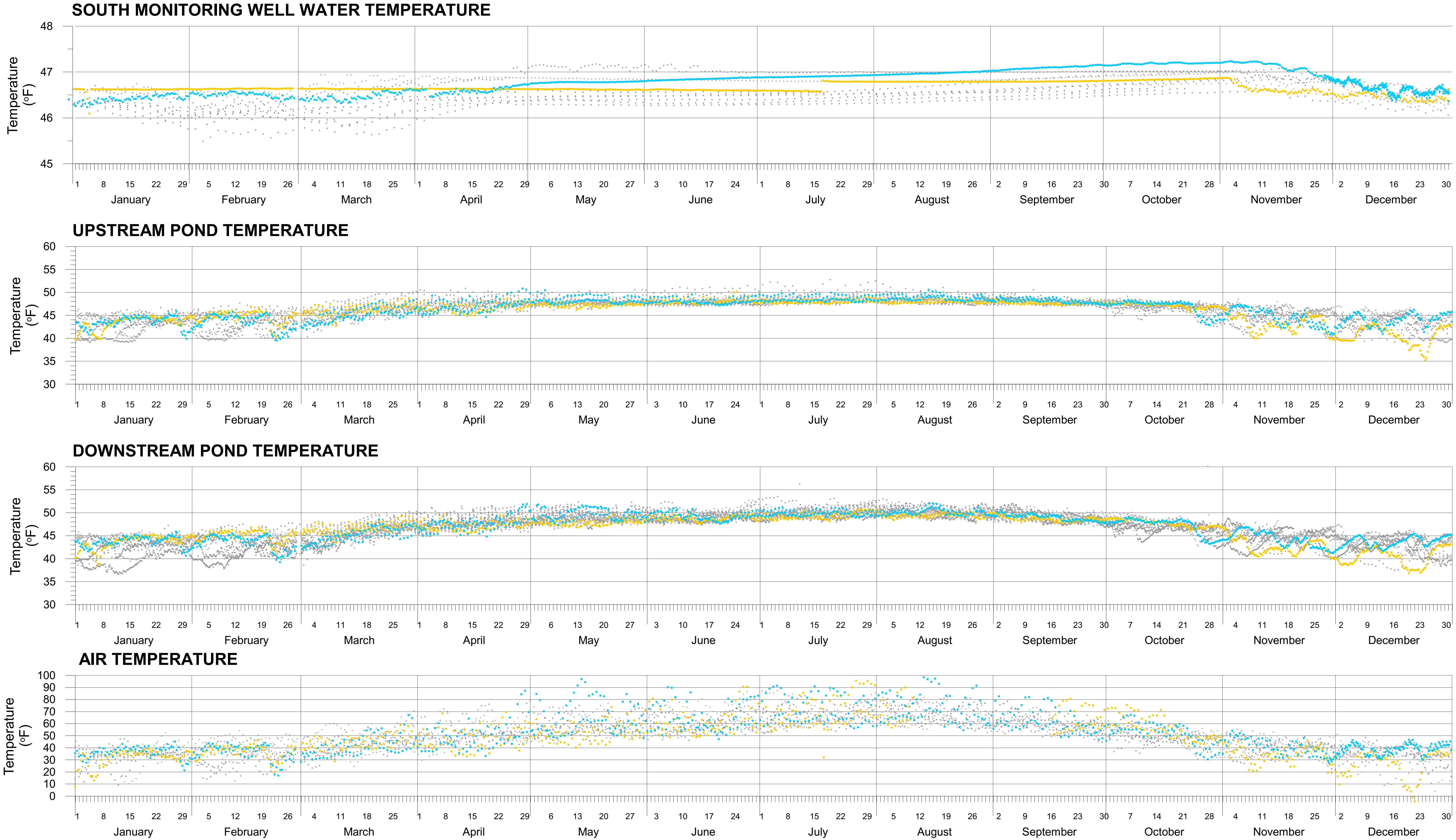
SPRING FLOW RATES

BY:	DATE:
OB	APR 24
APPROVED:	FIG:
JM	12

H:\Project\2572\Water Monitoring\Trend Plots\13 All Temperatures.grf



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Note: Air temperature plotted at 3pm each day.

Legend
- 2023
- 2022
- 2014 - 2021

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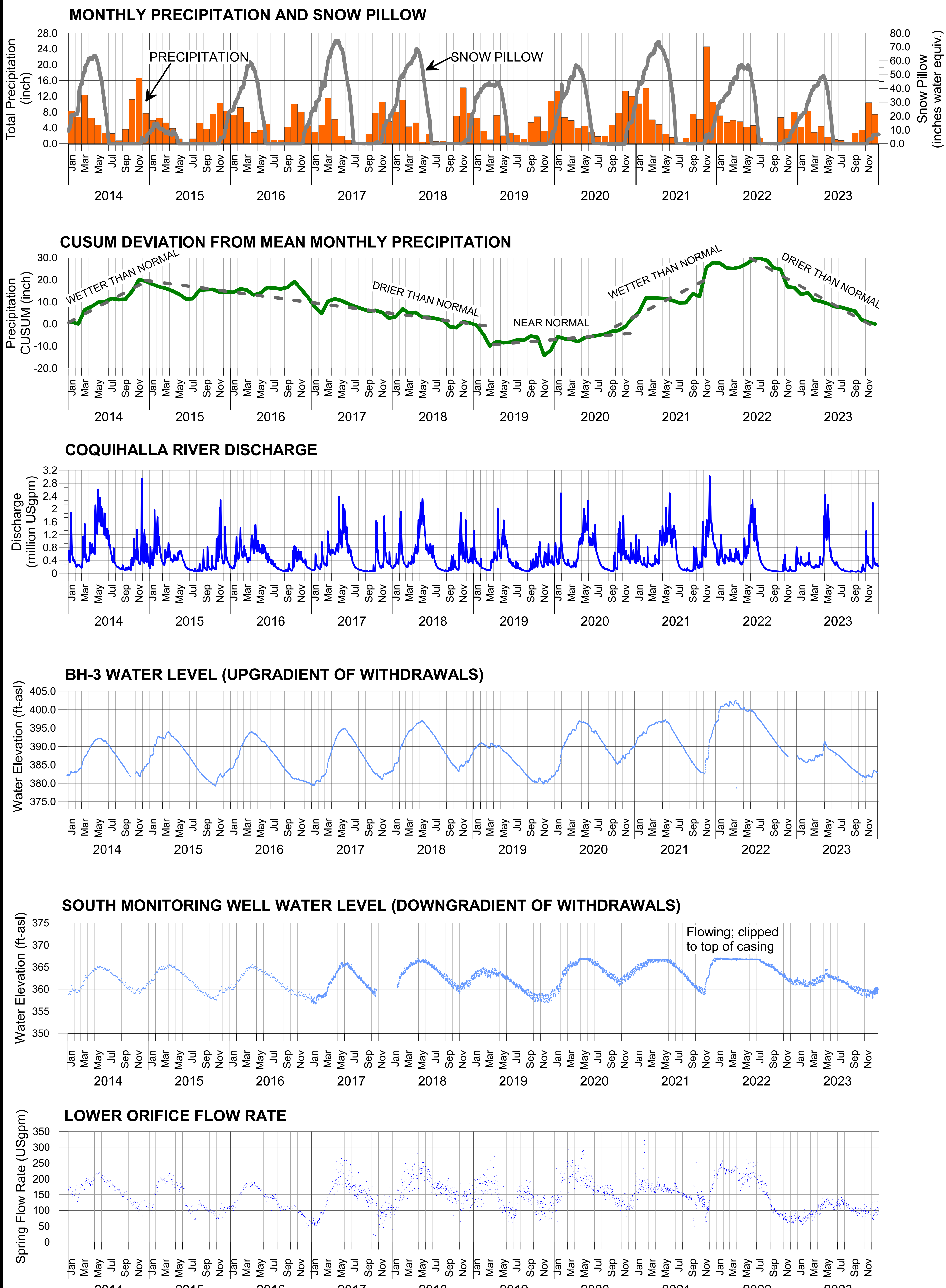
MONITORING WELL, POND WATER AND AIR TEMPERATURES

BY:	DATE:
OB	APR 24
APPROVED: JM	FIG: 13



Notes:
1. Precipitation data from Environment Canada's Hope A Climate Station.
2. Snow Pillow data are from BC Ministry of Forests, Lands, Natural Resource Operations and River Development.
3. Coquihalla River discharge data are from Water Survey of Canada (BC08MF068).

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CONSOLIDATED PRECIPITATION, RIVER DISCHARGE, WATER LEVEL, AND SPRING FLOW TRENDS

BY: OB	DATE: APR 24
APPROVED: JM	FIG: 14

APPENDIX A
WATER BALANCE

APPENDIX A

WATER BALANCE- PART I - INPUTS

Site Name:	Hope, BC Facility			
Date:	February 26, 2024			
Prepared by:	J. Mancer Piteau Associates Engineering Ltd.	Description of watershed	From Coquihalla River at Othello to Kawkawa Lake	
Variable	Description		Units	Comments/Source
Area (A)	The area of the watershed (surface water drainage basin) of interest for the water balance. This could be the watershed of a Compliance Point that is a downstream surface water monitoring location you have reliable flow data from and that is close enough to the withdrawal to be able to observe a flow decrease caused by our water use. It could also be a larger watershed you wish to compare your withdraw to. If the springs occur along a stream/river rather than forming the headwaters, then the area should be the acres of watershed that contribute water the stream segment between the upstream and downstream monitoring locations. In this case, these monitoring locations are the source of the SWin and SWout inputs below. Please note that all the remaining inputs should be valid for the watershed you are defining in this input.	3,030	ac	See map
Precipitation (P)	The annual precipitation that falls on the defined watershed. If you use an average for a particular set years, use data from the same set of years to calculate all the inputs below. If using data from one year, use only data from that year for the inputs below. P= R + runoff + ET.	73	ipy	Average of Hope A precipitation for 2019 to 2023 over 1.1 square mile aquifer footprint (64 ipy), and prorated by 120% for 2.5 square mile North Wall catchment area (77 ipy) and by 10% for 1.1 square mile South Wall (71 ipy)
Recharge from Precipitation (R)	The estimated recharge rate in the defined watershed. The estimate of recharge used in the site numeric model, if one exists, or in your site conceptual model. Adjust this to the timeframe you are using for all your inputs. If adequate stream flow data exists, an analysis of the base flow can be used to generate the recharge rate. R=P-ET-runoff	28	ipy	= Precipitation - Runoff - Actual Evapotranspiration
Other recharge to the Aquifer	This could be surface water infiltration, or infiltration from excess irrigation derived from out of the WS or other out of WS sources of additional water. Within this file "other recharge" will be added to recharge from precipitation and GWin to obtain the total amount of groundwater into the water budget.	-	afy	None
Evapotran- spiration (ET)	The average evapotranspiration rate in the watershed (not including ET induced by irrigation). Use best estimate from site numeric model, if one exists, or your site conceptual model. If the precipitation input above is derived from a different set of years than the ET value in your model (numeric or conceptual), then adjust the ET value to correspond to the time period used for your precip input. Alternately, ET may be based on published estimates for the area (based on local climate, soil type, slope, and vegetation type/density). ET=P-R-runoff.	23	ipy	Thornthwaite method, average of Potential ET for Plant Site and North Wall from Piteau (2014), reduced to 98% to obtain Actual ET reflecting the high soil moisture at all times of the year
Direct Surface Runoff (Roffws)	The component of precipitation that flows over land directly to surface water within the watershed. The magnitude of stream flow responses to rain events should shed light on how much precip becomes runoff. Use the value from the site numeric model, if one exists, or your site conceptual model. If the precipitation input above is derived from a different set of years than the runoff value in your model (numeric or conceptual) then adjust the runoff value to correspond to the same time period as precip input. Alternately, you may use Precip minus ET and Recharge to get a runoff estimate. If you have uncertainty regarding ET or recharge, then make a best estimate based on your site conceptual model, which should consider soil type, slope, vegetation, etc.	22	ipy	Approximately 30% of precipitation. Estimated using a runoff coefficient multiplied by net precipitation plus snowmelt (Piteau, 2014). Runoff coefficient for the Aquifer Footprint is used since North and South wall creek drainages mostly report to Aquifer Footprint.
GWin	Best estimate of volume of water that flows into the defined watershed as groundwater. This occurs when the shallow groundwater divide for the groundwater basin that feeds the springs is outside of the watershed (the surface water divide). There is no way to directly measure this. You may know that there is GWin based on the size of spring/creek flows relative to the size of the watershed. If you have a site numeric model, use the value from the model. Otherwise, use your conceptual model to estimate GWin based on known aquifer characteristics and any available evidence regarding the location of the groundwater divide.	35,325	afy	From Coquihalla River aquifer. Estimated in Piteau, 2014 by two methods: 1) seepage through aquifer based on Darcy's Law, and 2) balancing the 2014 water balance
GWout	Volume of water flowing out of the defined watershed as groundwater (still in the ground but flowing out of the defined watershed). If you believe this occurs, estimate the magnitude of the flow based on the site numeric model, if one exists, or on your site conceptual model.	34,063	afy	Estimated by balancing water budget
SWin	Base flow of any streams that flow into the defined watershed. You will have SWin when the water budget is for a watershed contributing to a stream segment (as opposed to a headwaters watershed). See explanation in the "Area" description above. Base flow may be obtained through hydrograph separation, frequency analysis, or recession analysis.	-	afy	Small streams entirely in watershed are accounted for in precipitation/ runoff calcs; Coquihalla River flow excluded from model
SWout	Base flow of the surface water body that drains the watershed at the point where the stream leaves the defined watershed. By definition, a watershed has one discharge location. Base flow may be obtained through hydrograph separation, frequency analysis, or recession analysis.	8,150	afy	Estimated based on Piteau, 2014 and adjusted based on 2019 to 2023 precipitation: range is 8,065 to 12,904 afy
GWW	Ground water withdrawn from the watershed by users other than BlueTriton, such as large scale irrigation. Use actual data if reported, or estimate based on what is known about the well or the use. Do not include water withdrawn from a deeper aquifer that is hydraulically disconnected from the water budget being assessed.	51	afy	District of Hope Well No. 8 (municipal supply) average annual usage 2019 to 2023
ne	Effective Porosity. This may be known or estimated.	30%	%	estimated
Wldelta	Average change in the water table level per year over the time period used for the inputs above (outside the area of influence of the production wells). Positive represents an increase in the water table, negative represents a decline in the water table.	-	ft.	There are no long term groundwater level changes observed in the basin (see hydrographs in main body of report)
BlueTriton permit capacity (BlueTritonp)	Maximum BlueTriton can take in accordance with the Permit (License application).	233	gpm	Licensing in progress persuant to new BC WSA.
BlueTriton actual use (BlueTritonu)	The actual average rate of water captured by BlueTriton for a specific year(s) identified below.	120	gpm	Average flow 2019 to 2023.
Year(s) of BlueTriton actual use	The year(s) corresponding with the BlueTriton usage rate reported above. If possible, use the same set of years as used for the other inputs.	2019 to 2023	year	

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afy = acre feet per year
ipy = inches per year
gpm = gallons per minute
ac = acres
1USgpm = 1.61afy   1 afy = 0.62 USgpm

References:

Piteau, 2014. Water Budget Assessment for Kawkawa Lake Aquifer - Hope, BC. Report to Nestlé Waters North America.   May 8.

APPENDIX A

WATER BALANCE - PART II - CALCULATIONS

Basin/Recharge Area Size:		Value:	Units:
Area (A)	The area of the watershed (surface water drainage basin) of interest for the water balance. This could be the watershed of a Compliance Point that is a downstream surface water monitoring location you have reliable flow data from and that is close enough to the withdrawal to be able to observe a flow decrease caused by our water use. It could also be a larger watershed you wish to compare your withdraw to. If the springs occur along a stream/river rather than forming the headwaters, then the area should be the acres of watershed that contribute water the stream segment between the upstream and downstream monitoring locations. In this case, these monitoring locations are the source of the SWin and SWout inputs below. Please note that all the remaining inputs should be valid for the watershed you are defining in this input.	**3,030**	**ac**
Precipitation (P)	The annual precipitation that falls on the defined watershed. If you use an average for a particular set years, use data from the same set of years to calculate all the inputs below. If using data from one year, use only data from that year for the inputs below. P= R + runoff + ET.	**73**	**ipy**
Recharge from Precipitation (R)	The estimated recharge rate in the defined watershed. The estimate of recharge used in the site numeric model, if one exists, or in your site conceptual model. Adjust this to the timeframe you are using for all your inputs. If adequate stream flow data exists, an analysis of the base flow can be used to generate the recharge rate. R=P-ET-runoff	**28**	**ipy**
Other recharge to the Aquifer	This could be surface water infiltration, or infiltration from excess irrigation derived from out of the WS or other out of WS sources of additional water. Within this file "other recharge" will be added to recharge from precipitation and GWin to obtain the total amount of groundwater into the water budget.	**-**	**afy**
Direct Surface Runoff (Roff)	The component of precipitation that flows over land directly to surface water within the watershed. The magnitude of stream flow responses to rain events should shed light on how much precip becomes runoff. Use the value from the site numeric model, if one exists, or your site conceptual model. If the precipitation input above is derived from a different set of years than the runoff value in your model (numeric or conceptual) then adjust the runoff value to correspond to the same time period as precip input. Alternately, you may use Precip minus ET and Recharge to get a runoff estimate. If you have uncertainty regarding ET or recharge, then make a best estimate based on your site conceptual model, which should consider soil type, slope, vegetation, etc.	**5,497**	**afy**
GW in	Best estimate of volume of water that flows into the defined watershed as groundwater. This occurs when the shallow groundwater divide for the groundwater basin that feeds the springs is outside of the watershed (the surface water divide). There is no way to directly measure this. You may know that there is GWin based on the size of spring/creek flows relative to the size of the watershed. If you have a site numeric model, use the value from the model. Otherwise, use your conceptual model to estimate GWin based on known aquifer characteristics and any available evidence regarding the location of the groundwater divide.	**35,325**	**afy**
SW in	Base flow of any streams that flow into the defined watershed. You will have SWin when the water budget is for a watershed contributing to a stream segment (as opposed to a headwaters watershed). See explanation in the "Area" description above. Base flow may be obtained through hydrograph separation, frequency analysis, or recession analysis.	**-**	**afy**
(P*A)+Gwin+Swin+Other Recharge	Total water into the System.	**53,649**	
BlueTriton actual use (BlueTritonu)	The actual average rate of water captured by BlueTriton for a specific year(s) identified below.	**208**	**afy**
GWW	Ground water withdrawn from the watershed by users other than BlueTriton, such as large scale irrigation. Use actual data if reported, or estimate based on what is known about the well or the use. Do not include water withdrawn from a deeper aquifer that is hydraulically disconnected from the water budget being assessed.	**51**	**afy**
GW out	Volume of water flowing out of the defined watershed as groundwater (still in the ground but flowing out of the defined watershed). If you believe this occurs, estimate the magnitude of the flow based on the site numeric model, if one exists, or on your site conceptual model.	**34,063**	**afy**
Sdelta	the average change in Storage per year for the years evaluated	**-**	**afy**
Direct Surface Runoff for the watershed (Roffws)	The component of precipitation that flows over land directly to surface water within the watershed. The magnitude of stream flow responses to rain events should shed light on how much precip becomes runoff. Use the value from the site numeric model, if one exists, or your site conceptual model. If the precipitation input above is derived from a different set of years than the runoff value in your model (numeric or conceptual) then adjust the runoff value to correspond to the same time period as precip input. Alternately, you may use Precip minus ET and Recharge to get a runoff estimate. If you have uncertainty regarding ET or recharge, then make a best estimate based on your site conceptual model, which should consider soil type, slope, vegetation, etc.	**5,478**	**afy**
SW out	Base flow of the surface water body that drains the watershed at the point where the stream leaves the defined watershed. By definition, a watershed has one discharge location. Base flow may be obtained through hydrograph separation, frequency analysis, or recession analysis.	**8,150**	**afy**
Evapotranspiration (ET ws)	The average evapotranspiration rate in the watershed (not including ET induced by irrigation). Use best estimate from site numeric model, if one exists, or your site conceptual model. If the precipitation input above is derived from a different set of years than the ET value in your model (numeric or conceptual), then adjust the ET value to correspond to the time period used for your precip input. Alternately, ET may be based on published estimates for the area (based on local climate, soil type, slope, and vegetation type/density). ET=P-R-runoff.	**5,680**	**afy**
ET+BlueTritonu+GWW+Gwout+Swout+Sdelta+Roff	Total water out of the system	**53,649**	**afy**

afy = acre feet per year
1 USgpm = 1.61 afy
1 afy = 0.62 USgpm
ipy - inches per year
gpm = gallons per minute
ac = acres

	Value	Units
Total In	**53,649**	**afy**
Total Out	**53,649**	**afy**
Difference	**(0.0)**	**afy**

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