REPORT

Blue Triton Brands Aberfoyle Site

2022 Annual Monitoring Report

Submitted to:

Blue Triton Brands

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Submitted by:

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Key Facts for 2022 Operations at Aberfoyle

Key facts for the 2022 operations at Aberfoyle are summarized below.

1) Blue Triton Brands (Blue Triton) continued to operate under the terms of Permit to Take Water (PTTW) 3133-C5BUH9 for well TW3-80.

2) Blue Triton has complied with all the conditions in the PTTW for the Aberfoyle well TW3-80 in 2022.

3) Comprehensive annual monitoring reports are prepared for the Aberfoyle well (TW3-80) under the conditions of the PTTW.

4) No complaints arising from the taking of water authorized under the PTTW were received in 2022.

5) The Grand River Low Water Response Team declared a Level 1 Low Water Condition for the entire Grand River Watershed, including Mill Creek, on June 29, 2022 and increased to a Level 2 Low Water Condition on July 21, 2022. The Level 2 Low Water Condition was in effect for the remainder of 2022. Blue Triton committed to limit water takings to 90% of their monthly maximum permitted volume during the Level 1 Condition and 80% of their monthly maximum permitted volume during the Level 2 Condition.

6) TW3-80 pumps water from the Lower Bedrock Aquifer which is overlain by a Middle Bedrock Aquitard, an Upper Bedrock Aquifer and an overburden aquifer/aquitard.

7) The total volume of water taken in 2022 from TW3-80 was 672,615,929 L, approximately 51% of the permitted annual volume assuming continuous well operation.

8) The daily water takings at TW3-80 ranged from 0 L to 3,111,753 L. The average daily water taking was 1,842,783 L. The maximum daily taking corresponded to approximately 86% of the permitted maximum daily taking and, on most days, was substantially less than the maximum permitted daily taking. Any daily water takings greater than 80% of the daily permitted amount occurred prior to the Level 2 Low Water Condition.

9) The variations in water levels in TW3-80 continue to be due mainly to short-term changes in the pumping rate and during 2022 were within the historical range of observed water levels. Ongoing pumping from TW3-80 has not led to a long-term water level decline in the well.

10) Water levels in the Lower Bedrock Aquifer around the property over both the short-term and long-term, continue to be influenced mainly by pumping of TW3-80. The effects of long-term variability in pumping are observed more in the wells closer to TW3-80 where mean annual water levels correlate with total annual water takings (i.e., increased water takings result in lower water levels). The influence of pumping decreases with distance from the pumping well. Water levels recover when pumping rates are reduced, an indication that the water taking is sustainable. There is also some influence on the water levels from recharge and external influences, to varying degrees. Water levels measured within this aquifer in 2022 are generally similar to the water levels measured in 2018 when the annual pumping was similar. The second half of 2022 was marked by drought conditions and the low amount of recharge to the Lower Bedrock Aquifer is evident in the data from wells further away from TW3-80, where some water levels were observed below their historical ranges.

11) Water levels in the Upper Bedrock Aquifer around the property are partly influenced by pumping from TW3-80 (i.e., there is hydraulic connection between the Upper Bedrock and Lower Bedrock Aquifers); however, the connection is limited (i.e., there is less response than in the Lower Bedrock Aquifer). The magnitude of influence varies based on distance from TW3-80 and existing hydrogeologic conditions, reflecting complexity in the subsurface. While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there are also seasonal and long-term trends in the Upper Bedrock water levels that are reflective of recharge trends (i.e., lower water levels during years of below-average precipitation and higher water levels during years of above-average precipitation). This is reflected in 2022 by some of the lowest water levels measured in the monitoring wells during an extended period of below-average precipitation.

12) Water levels in the overburden are affected both by natural factors (recharge) and to a much lesser degree from pumping at TW3-80. The response to pumping in the overburden is muted compared to the responses in the Upper and Lower Bedrock Aquifers and only observed in the immediate vicinity of the pumping well. Some of the lowest water levels were recorded in the overburden wells during the second half of 2022 due to the below average precipitation but were within the range of water levels observed at the wells.

13) The water levels in the mini-piezometers generally increase in the spring, decline through the summer, and then increase in the fall. In addition to the seasonal trend, short-term changes (“spikes”) in water level in the shallow groundwater are influenced by individual precipitation events. Overall, the water levels are influenced primarily by precipitation events, which overwhelm any changes due to pumping from TW3-80. Some of the lowest water levels over the past five years were measured in the mini-piezometers in the summer of 2022, reflecting a period of sustained below average precipitation.

14) Surface water levels in Aberfoyle Creek and Mill Creek fluctuate in response to natural processes (i.e., precipitation, snow melt and evapotranspiration) with no measurable effects from changes in pumping from TW3-80. In general, surface water levels are higher in the winter/spring and lower in the summer and then increase slightly into the fall. “Spikes” in the water levels are related to precipitation events or spring melt. Summer stream flows at SW1 and SW2 were the lowest observed over the past five years, reflecting a period of sustained below average precipitation. The effects of pumping TW3-80 could not be detected in the surface water flows observed at SW1 and SW2 in 2022.

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1.0 INTRODUCTION

Blue Triton Brands (Blue Triton), formerly Nestlé Waters Canada (Nestlé), has retained WSP Canada Inc. (WSP) to conduct the annual monitoring program and report preparation for the Blue Triton Aberfoyle Site as required by Permit To Take Water (PTTW) Number 3133-C5BUH9 issued by the Ministry of the Environment, Conservation and Parks (MECP). The PTTW is provided in Appendix A. The PTTW was issued on November 15, 2021 and replaces the previous PTTW 1381-95ATPY.

The location of the Aberfoyle Spring/Plant (Site) is shown on Figure 1.1. The PTTW authorizes water taking from one on-Site bedrock well located on Lot 23, Concession 7, Geographic Township of Puslinch, Wellington County, Ontario. Water from TW3-80 is taken for the purpose of bottling water.

The Aberfoyle bottling facility is located on a 46.75 hectare parcel owned by Blue Triton, approximately 5 km southeast of Guelph and 12 km northeast of Cambridge (Figure 1.1). The Aberfoyle facility consists of a bottling plant, warehouse, paved parking and access drives, ponds, and open fields, and is bordered by wooded areas, wetlands and aggregate operations.

A summary of the PTTW Conditions and where the information can be found in this report are outlined in Table 1:

Table 1: Permit To Take Water Conditions

Condition Number	Condition Description	Report Section
3.2	Identifies use, rates, time and total takings allowed.	3.1.1, 4.1, Appendix C
3.3	Low Water Response Plan	4.1
4.1	Maintain a daily record of all water takings including date, volume of water taken and rate at which it was taken.	Appendix C
4.2, 4.3, 4.5	Establish the specified groundwater and surface water monitoring programs including monitoring requirements and monitoring timing.	3.1.2, 3.1.3
4.4	Undertake wetland monitoring and redd surveys and submit results to Director.	Appendix H
4.6	Notify the Director of monitoring locations that become inaccessible or abandoned and provide a recommendation for replacement.	3.1.2.1, 3.1.3.1, 3.1.4
4.7	Prepare and submit an annual monitoring report to the Director, which presents and interprets the data collected under the conditions of the PTTW.	This report
4.8	Submit details of the bottling operations to the Director.	4.1
4.9.1, 4.9.2, 4.9.3	Establish a publicly accessible website and have select technical data available for download. [https://bluetriton.ca/long-term-monitoring]	Not reported on; updated annually prior to March 31
4.10	Host an annual stakeholder meeting.	Not reported on; completed annually prior to September 30
5.1	Notify the local District Office of any complaint arising from the taking of water and proposed action to rectify the complaint.	4.1

Condition Number	Condition Description	Report Section
5.2	Supply water to anyone with a water supply (in effect prior to this taking) that has been negatively impacted.	Not applicable

Golder Associates Ltd. (now WSP) began monitoring at the Site in May 2014 on behalf of Nestlé and continues to monitor the site on behalf of Blue Triton. Prior to 2014, monitoring was performed by Conestoga Rovers and Associates (CRA) and Nestlé. The MECP has requested that the reporting follow the same outline and format as previous reports. The reporting of the geologic characterization has been updated to be consistent with the updated interpretation developed by the Ontario Geological Survey (Brunton, 2008, 2009; Brunton and Brintnell, 2011) rather than the previous geologic nomenclature. At some well locations there were insufficient data (i.e., core log, geophysical logs, detailed stratigraphic logging) to update to the new nomenclature. The bedrock has been divided into three units based on both the old and new nomenclature: Upper Bedrock Aquifer, Middle Bedrock Aquitard and Lower Bedrock Aquifer (as described in detail below).

The report is structured as follows:

- **Section 1.0**: Introduction including site location, history, and construction details for supply well TW3-80;
- **Section 2.0**: Regional setting including a description of topography, drainage, ecology, physiography, geology and hydrogeology;
- **Section 3.0**: Summary of 2022 field program including a description of field activities conducted in 2022;
- **Section 4.0**: Monitoring program results including a summary and analysis of the data collected in 2022;
- **Section 5.0**: Conclusions from the 2022 monitoring program; and
- **Section 6.0**: Recommendations from the 2022 monitoring program.

1.1 Historical Summary

TW3-80 was constructed in April 1980 for an aquaculture (fish farming) operation. In December 2000, the Perrier Group of America, a Nestlé Company, purchased the property. Nestlé has now been purchased by Blue Triton. Including the current PTTW, seven consecutive PTTWs have been issued for TW3-80 since Nestlé acquired the property, allowing for water takings for bottling water purposes. Additional investigations have been conducted over the years to determine if there have been any negative impacts on the natural environment and ensure that the water taking by Blue Triton is sustainable. These additional investigations have been requirements of previous permits and have been completed to the satisfaction of the MECP. Other than the on-going conditions of the PTTW, no additional studies were required in 2022.

1.2 Construction Details for Supply Well TW3-80

The borehole log for TW3-80 is provided in Appendix B. The glacial overburden at the well is 14.6 m thick and consists of a silt till to a depth of 12.2 m below grade, and 2.4 m of fine-to-medium sand overlying bedrock. Any coarse-grain sediments at surface may have been removed in the past.

The well was originally completed to a depth of 42.4 m below grade, 27.8 m into the bedrock. Conestoga Rovers and Associates (CRA, 2014) interpreted the bedrock through which TW3-80 was drilled as consisting of the Guelph Formation dolostone (14.6 to 16.8 m) and the Amabel Formation (Eramosa Member and underlying Unsubdivided Member) (16.8 to 42.4 m). Changes to the bedrock nomenclature have been made by the Ontario Geological Survey (OGS) (i.e., Brunton, 2008, 2009: Brunton and Brintnell, 2011). Based on the revised nomenclature, TW3-80 is interpreted to have been drilled through the Guelph, Eramosa, and Goat Island Formations and possibly into the Gasport Formation. The stratigraphy at TW3-80 is consistent with that of other wells in the area.

When TW3-80 was initially constructed in 1980; a 305 mm diameter steel casing was installed through the overburden and approximately 0.6 m into the top of rock, to a depth of 15.2 m, and cemented in place (CRA, 2014). The remainder of the well was completed as a 305 mm diameter open hole.

In 1999, the bottom 11.3 m of TW3-80 was sealed with gravel, bentonite grout, and a cement cap so that the well would pump water with more favourable natural water quality from within the Guelph to Goat Island/Gasport Formations. The revised finished depth is 31.1 m below grade.

To comply with Nestlé (now Blue Triton) water well construction standards, a liner was installed in the well in 2002. A 250 mm diameter stainless steel liner was installed inside the 305 mm steel casing and grouted in place, to a depth of 28.4 m. The revised open interval of TW3-80 is now 28.4 m to 31.1 m below grade and only allows pumping from the Goat Island/Gasport Formations. A schematic of the well construction is included on Figure 1.2.

2.0 REGIONAL SETTING

The following sections provide a summary of the regional and local topography, drainage, physiography, and overburden and bedrock geology/hydrogeology for the Site.

2.1 Topography and Drainage

Regional topography is characterized by northeast-southwest trending bands of hummocky terrain (Chapman and Putnam, 1984). Locally, the Blue Triton property is located in a relatively flat area between the Paris and Galt Moraines. Surface topography is shown on Figure 2.1. Within a 1 km radius of the Blue Triton property, ground surface elevations typically range from 310 to 330 masl (metres above sea level) with the lows occurring along Aberfoyle Creek and Mill Creek. The streambed elevation of the portion of Aberfoyle Creek that traverses Blue Triton's property is approximately 310.5 masl (+/- 1 m).

The Site is located within the Mill Creek Subwatershed (Figure 2.1) which forms part of the larger Grand River Watershed. Part of Mill Creek is located north of the Blue Triton property and generally flows in a southwesterly direction within the study area. A tributary of Mill Creek, referred to as Aberfoyle Creek, flows through the Site, also in a southwesterly direction, and confluences with Mill Creek west of the Blue Triton property. Aberfoyle Creek is located approximately 150 m to the northwest of TW3-80 at its nearest point. Mill Creek and Aberfoyle Creek are shown on Figure 2.1 along with other surface water and wetland features, which are described below.

As shown on Figure 2.1 several ponds exist, both natural and man-made, within a 1 km radius of the Blue Triton property. One such pond, referred to as the Aberfoyle Mill Pond, located east of and upstream from the Site, is created by a dam across Aberfoyle Creek. Most of the other ponds in the area appear to be man-made and are off-line ponds (i.e., not connected to streams). Some of the ponds are the result of aggregate extraction below the water table. Some small on-Site ponds exist on the Blue Triton property.

In addition to the ponds, several wetland areas are also present within a 1 km radius of the Blue Triton property (Figure 2.1). Most of these wetlands are part of the Mill Creek Puslinch Wetland Complex and are considered provincially significant. Wetlands are present within the northwest part of the Blue Triton property.

2.2 Ecological Setting

The northwestern half of the Blue Triton property is in a natural condition and supports a diversity of forest and wetland habitats as well as a watercourse and fish habitat. Most of these habitats are relatively undisturbed and support a diverse range of flora and fauna, including some that are locally significant.

The wetland habitats along Aberfoyle Creek form part of the provincially significant Mill Creek Puslinch Wetland Complex.

Collectively, these natural features comprise part of an extensive natural heritage system of the headwaters of the Mill Creek watershed. This natural heritage system is recognized for its provincial, regional and local significance.

Aberfoyle Creek is a branch of Mill Creek that traverses the Blue Triton property. Its confluence with Mill Creek is immediately downstream from the Blue Triton property. Upstream of the Blue Triton property, Aberfoyle Creek flows through a 10 hectare pond, created by a dam constructed in the 1860’s to power a grist mill. Outflows from the pond are controlled by a series of weirs. Upstream of mill pond, Aberfoyle Creek is a cold-water stream that contains both Brook Trout (*Salvelinus fontinalis*) and Brown Trout (*Salmo trutta*). However, during the summer the water is warmed in the Mill Pond so that downstream from the pond, through the Blue Triton property, the water temperature frequently exceeds the lethal temperature for these trout species. The most abundant fish species through the Blue Triton property are common cool-water species for which the water temperatures are suitable. Like the upper reaches of Aberfoyle Creek, Mill Creek is a cold-water stream that supports Brook Trout and Brown Trout.

2.3 Physiography

Chapman and Putnam (1984) define the physiographic region within which the Blue Triton property lies as the eastern limb of the Horseshoe Moraines. The existing landforms and most of the surficial soils in the area were created/deposited during the most recent glacial period, specifically the recession of the Lake Ontario ice lobe. During the recession of the Lake Ontario ice lobe, three distinct end moraines were formed in the area: the Paris Moraine, the Galt Moraine, and the Moffat Moraine (Karrow, 1987). The Paris Moraine is situated to the north of the property and the Galt Moraine is situated to the south of the property. These moraines are primarily composed of silty to sandy till and form the major drainage divides for the Mill Creek subwatershed. The Blue Triton property is situated mainly within an outwash gravel plain situated between the two moraines (Figure 2.2). The outwash gravel plain was likely formed by glacial meltwater associated with a halt in the ice retreat during the formation of the Galt Moraine.

2.4 Geology and Hydrogeology

The following sections provide a summary of the regional and local geology and hydrogeology. The regional interpretation is based on published mapping and information contained in the Mill Creek Subwatershed Study (CH2M Gore & Storrie, 1996). Detailed geologic information has also been obtained from logging of the stratigraphy by CRA at locations where monitoring wells were installed as part of previous field investigations.

The bedrock interpretation has been updated to follow the revised nomenclature of the OGS (Brunton, 2008 and 2009, Brunton and Brintnell, 2011).

2.4.1 Overburden Geology

The overburden ranges in thickness from 15 m in low-lying areas of the subwatershed near Mill Creek and Aberfoyle Creek to 35 m along the crests of the Paris and Galt Moraines (Drift Thickness Map P.535, M.A., Vos, 1968; CH2M Gore & Storrie, 1996).

The surficial overburden geology, as mapped by the OGS is shown on Figure 2.2. The surficial overburden of the area is characterized by the following units:

- Outwash gravel;
- Ice-contact gravel: kames and eskers; and
- Stoney, sandy silt till (Wentworth Till).

Regionally, the Paris and Galt Moraines, located north and south of the property, respectively, consist of Wentworth Till. Karrow (1987) describes the till as a buff-coloured, stony, sandy silt till. Located between the moraines are younger outwash gravel deposits and ice-contact gravel deposits. Deposits along parts of Aberfoyle Creek and Mill Creek are mapped as peat and muck (organic deposits). There are no bedrock outcrops within the study area.

The coarse-grained deposits between the moraines generally overlie the Wentworth Till. In some areas, particularly the central part of the Mill Creek subwatershed, the till is not present, and the coarse-grained deposits are continuous to bedrock. The surficial coarse-grained deposits are thinner and separated from the bedrock by the underlying till in the upper and lower reaches of the Mill Creek subwatershed. The site is located within the upper half of the watershed. Occasional coarse-grained deposits exist at various depths as lenses or discontinuous layers within or between till units (CH2M Gore & Storrie, 1996). A gravel layer is also present immediately above the bedrock in some locations, including at TW3-80.

Locally, within a 1 km radius of the property, the overburden is typically 10 m to 30 m thick and consists mainly of outwash gravel or ice-contact gravel deposits. As previously discussed, these coarse-grained deposits are situated between the moraines and are elongated in a southwest to northeast direction. The Wentworth Till is mapped as the surficial deposit along the moraines to the southeast (approximately 500 m) and northwest (approximately 2 to 2.5 km) of TW3-80.

2.4.2 Bedrock Geology

The bedrock surface is somewhat irregular, but generally dips to the southwest. The bedrock elevation in the vicinity of the Blue Triton property declines from approximately 306 masl northeast of the property (MW10-09) to 293 masl south of the property (MW16-12).

The regional bedrock geology is shown on Figure 2.3. As noted above, the bedrock nomenclature shown on Figure 2.3 has since been revised based on work by the OGS (Brunton, 2008 and 2009, Brunton and Brintnell, 2011). In summary, the previous Guelph Formation is now divided into the Guelph Formation and the Eramosa Formation (Stone Road Member and Reformatory Quarry Member); the previous Eramosa Member of the Amabel Formation is now the Vinemount Member of the Eramosa Formation; and the previous Unsubdivided Member of the Amabel Formation is now divided into the Goat Island, Gasport and Irondequoit Formations. The bedrock hydrogeologic units underlying the property, which are relevant to the Blue Triton water taking, are composed of limestone, dolostone and shale sequences and are described as follows (from oldest to youngest).

- Cabot Head Formation: The Cabot Head Formation, readily distinguished by its grey-green colour, is a non-calcareous shale with thin interbeds of sandstone and limestone. Due to its low hydraulic conductivity, the top of the Cabot Head Formation is interpreted to be the base of the active groundwater flow system;
- Merritton Formation: The Merritton Formation consists of a pinkish-brown, finely crystalline dolostone unit with dark shaley partings. This unit is relatively thin where present in the area;
- Rockway Formation: The Rockway Formation is a greenish-grey fine crystalline argillaceous dolostone with shaley partings (Brunton, 2008). The thickness of the Formation is fairly consistent and typically less than 2 m.;
- Irondequoit Formation: This Formation is a thickly to medium-bedded crinoidal grainstone (Brunton, 2008). The unit has a fairly consistent thickness of approximately 3 m throughout the area; and
- Gasport Formation: The Gasport Formation is a cross-bedded crinoidal grainstone-packstone with sequences of reef mound and coquina (shell bed) lithofacies. This unit has commonly been referred to as the Amabel Formation (Unsubdivided Member) in previous studies in the area (Turner, 1978). Wells in the vicinity of the Blue Triton property are generally not drilled through the entire sequence. In and around the City of Guelph, the Formation varies in thickness from about 25 to over 70 m, and the upper sections of the reef mounds, the crinoidal grainstones and the coquina shell beds make this formation highly transmissive, where they are present (Golder, 2011).
- Goat Island Formation: The Goat Island Formation consists of two members; the lower Niagara Falls Member and the upper Ancaster Member. Based on the boreholes completed in the area, the Goat Island Formation is estimated to range in thickness from approximately 2 m to 15 m.:
  - Goat Island Formation – Niagara Falls Member: The Niagara Falls Member is a finely crystalline and cross laminated crinoidal grainstone with small reef mounds; and
  - Goat Island Formation – Ancaster Member: The Ancaster Member is a chert-rich, finely crystalline dolostone that is medium to ash grey in colour.
- Eramosa Formation: The Eramosa Formation consists of three members including, from oldest to youngest, the Vinemount Member, the Reformatory Quarry Member and the Stone Road Member:
  - Eramosa Formation – Vinemount Member: The Vinemount Member consists of thinly bedded, fine crystalline dolostone with shaley beds that give off a distinctive petroliferous odour when broken (Brunton, 2008). This dark grey to black dolostone unit was commonly identified in water well records as ‘black shale’ and mapped in previous studies in the City of Guelph as the Eramosa Member of the Amabel Formation. The shaley beds of this Formation significantly reduce the vertical permeability across this unit relative to the other Formations. The Vinemount Member ranges in thickness from approximately 4 m to 12 m in the area of the property;
  - Eramosa Formation – Reformatory Quarry Member: The Reformatory Quarry Member, is described by Brunton (2008) as light brown to cream coloured, pseudonodular, thickly bedded and coarsely crystalline dolostone. This unit is susceptible to karstification due to its uniform fine dolomite crystallinity (Brunton,

2008). This unit also often contains mud-rich and microbial mat-bearing lithofacies that may act as aquitard materials, reducing the vertical permeability across this unit; and

  - Eramosa Formation – Stone Road Member: This cream coloured coarsely crystalline Upper Eramosa unit is not present in most of the area and can be difficult to distinguish from the Guelph Formation.

- Guelph Formation: The Guelph Formation is the upper bedrock unit in the study area and consists of medium to thickly bedded crinoidal grainstones and wackestones and reefal complexes (Brunton, 2008). The Guelph Formation is cream coloured and fossiliferous. The upper 0.3 m to 0.6 m is noted to be highly fractured and weathered. Based on data from borehole drilling, the Guelph Formation is typically less than 5 m thick in the vicinity of the property, which is thin relative to the regional scale thickness.

2.4.3 Hydrogeology

The interpretation and nomenclature for the bedrock formations has been revised (as indicated above); however, the interpretation of the hydrostratigraphy at the property and surrounding area has remained consistent. The hydrostratigraphy consists of the following from surface down:

- Overburden Aquifer/Aquitard;
- Upper Bedrock Aquifer (Guelph Formation, Reformatory Quarry Member of the Eramosa Formation);
- Middle Bedrock Aquitard (Vinemount Member of the Eramosa Formation and sometimes parts of the Reformatory Quarry Member of the Eramosa Formation and the Goat Island Formation); and
- Lower Bedrock Aquifer (Goat Island Formation and Gasport Formation).

The designations of aquifers and aquitards is a simplification of the hydrostratigraphy for conceptual purposes. In reality, the hydraulic properties of the bedrock are variable and at some locations of the hydraulic conductivity may be sufficiently small that locally a bedrock stratum act as an aquitard.

Two hydrostratigraphic cross-sections (A-A' and B-B') through the property are included on Figures 2.4 and 2.5 with the locations shown on Figure 2.2. Cross-section A-A' is oriented southwest to northeast roughly along Aberfoyle Creek and cross-section B-B' is oriented north to south through the property, crossing Aberfoyle Creek and including supply well TW3-80.

Based on the hydrostratigraphic interpretation around the property, the thickness of the hydrostratigraphic units is as follows: Overburden Aquifer/Aquitard – 7 to 35 m; Upper Bedrock Aquifer – 2 to 14 m; Middle Bedrock Aquitard – 4 to 12 m; and Lower Bedrock Aquifer – 46 to 58 m. As shown in cross-section A-A', TW3-80 is completed in the upper part of the Lower Bedrock Aquifer.

2.4.4 Groundwater Flow Under Non-Pumping Conditions

Non-pumping conditions have been observed prior to the start of pumping tests. In addition to the pumping tests, there are sometimes brief shutdowns during which water levels in the aquifers evolve towards non-pumping conditions. One such shutdown occurred in October 2010 for 3.4 days. CRA (2014) provided an interpretation of the non-pumping conditions in the overburden and bedrock groundwater levels measured on October 12, 2010, as discussed below and also compared to shutdowns that occurred in October 2004 and November 2006.

- The overburden water table interpretation is presented on Figure 2.6, which indicates that the direction of groundwater flow in the overburden is generally to the southwest, with local components of flow to the west and south toward Aberfoyle Creek. CRA (2014) indicates that this flow configuration was similar to the pattern observed for October 2004 and November 2006 shutdowns;

- The Upper Bedrock Aquifer interpretation is shown on Figure 2.7 with the groundwater flow direction identified in a southwest, south, and southeast direction, which is reported to be similar to the pattern observed for October 2004 and November 2006 shutdowns; and
- The Lower Bedrock Aquifer interpretation is shown on Figure 2.8 with the groundwater flow direction to the southwest in the vicinity of supply well TW3-80, which is reported to be similar to the pattern observed for October 2004 and November 2006 shutdowns.

Groundwater in the Lower Bedrock Aquifer flows generally south in the direction of TW3-80. The Aberfoyle aquifer is interpreted to be recharged primarily within the northern portion of the Mill Creek subwatershed and the capture zone for TW3-80 is inferred to extend to the north-northeast of the well. The Lower Bedrock Aquifer extends beyond Aberfoyle to the southwest, and groundwater is inferred to discharge to the Grand River in the vicinity of Cambridge.

2.5 Source Water Protection

Since the passing of the Clean Water Act (2006), municipalities in Ontario have been required to develop source protection plans to protect their municipal sources of drinking water. These plans identify both water quality and water quantity risks to local drinking water sources and develop strategies to reduce or eliminate these risks. Potential and existing risks for a municipal source are identified within wellhead protection areas (WHPA). A WHPA is an area projected to ground surface that delineates the zone in an aquifer where groundwater is flowing to a municipal drinking water source (pumping well). These areas are defined to protect water quality. The Blue Triton Aberfoyle property and well TW3-80 are located more than 2.6 km from the closest WHPAs, which include the City of Guelph WHPA to the northwest and the Freelton WHPA to the southeast and east in the Lake Ontario Basin. The closest City of Guelph wells are the Burke Well, which is located approximately 7 km away from TW3-80, and the Downey Well, which is more than 8 km away from TW3-80. The Freelton Wells are more than 10 km from TW3-80.

In addition to protecting water quality, water quantity is also a concern and is considered under Water Quantity Protection Plans. A Water Quantity Risk Assessment is completed to ensure that future water needs of a community can be met. It identifies existing and potential water quantity threats and future activities that may limit municipal water supplies. This is important because when more water is taken from an area than can be naturally replenished, water supplies are threatened, and water shortages are possible. The Aberfoyle property falls within a Water Quantity Protection Zone (WHPA-Q) for the City of Guelph municipal wells. The WHPA-Q zone for the City of Guelph has been assigned a significant risk level (Matrix Solutions, 2017). The Tier 3 Assessment scenarios predicted that the City's municipal wells can meet current needs. However, the assessment predicted that the City's Queensdale municipal well would be unable to meet projected increased future demands under normal climate conditions and during prolonged drought (Matrix Solutions, 2017). The Queensdale municipal well is located approximately 12 km northwest of TW3-80. The Tier 3 Assessment also assigned a high level of uncertainty to the results of the analyses for the City's Arkell Well 1, which is located approximately 10 km north of TW3-80. It is for these reasons that the City's WHPA-Q has been assigned a significant risk level with respect to water quantity. The Source Protection Committee reviewed all existing water takings within the WHPA-Q to evaluate their contribution to water quantity stress in the area. The study showed that municipal wells have the greatest impact on themselves (i.e., pumping at a municipal well influences the water levels in other municipal wells). TW3-80 was not found to interfere with the municipal wells' ability to supply water (Matrix Solutions, 2018). TW3-80 is estimated to be responsible for 1% of the drawdown at the closest municipal well (Burke Well located approximately 7 km north-northeast of TW3-80) (Matrix Solutions, 2018). With a drawdown in the order of approximately 10.8 m at the Burke Well, pumping from TW3-80 is estimated to be responsible for approximately 0.1 m of the drawdown observed at the Burke Well.

An assessment of the potential cumulative impacts that could be caused by the bottled water takings at the Blue Triton facilities at Aberfoyle was also conducted as part to the Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements (Ontario Ministry of the Environment and Climate Change Operations Division, April 2017). Matrix Solutions (2019) ran modelling scenarios to estimate the potential additional drawdown caused by an increase in the TW3-80 pumping from the current average to the maximum permitted rate. The additional drawdown at the City of Guelph Burke Well was predicted to be less than 0.02 m, well below the 2 m threshold to account for the natural seasonal variability beyond the effects of municipal pumping. As such, the groundwater withdrawal from TW3-80 has been assessed to not significantly interfere with existing municipal uses in the City of Guelph.

Matrix Solutions (2019) also analyzed how water levels would change if Blue Triton increased its pumping and there was a reoccurrence of the period of sustained below-average precipitation that was observed in the early to mid-1960s. The analysis showed that the effects of the increased pumping are predicted to be negligible.

3.0 SUMMARY OF 2022 FIELD PROGRAM

This section describes the field activities performed in 2022 associated with PTTW 3133-C5BUH9 for TW3-80.

3.1 Groundwater and Surface Water Monitoring Program

Groundwater and surface water monitoring was initiated in 2000 and has evolved over the years with the objectives to 1) characterize the existing hydrogeologic setting, and 2) document potential long-term changes to the groundwater and surface water resources in the area. The monitoring program includes measurement and record-keeping of water takings, groundwater levels, mini-piezometer levels, surface water levels, surface water flows and surface water temperatures. The monitoring program for PTTW 3133-C5BUH9 includes the following instrumentation, with the locations shown on Figures 3.1 through 3.3:

- Groundwater levels and pumping volumes in 1 production well;
- Groundwater levels in 43 monitoring wells at 18 sites (17 consisting of multiple monitoring intervals) with monitors in the Lower Bedrock Aquifer, Upper Bedrock Aquifer, and overburden;
- Groundwater levels in 2 private wells;
- Shallow groundwater levels in 8 mini-piezometers with a total of 16 monitors;
- Surface water levels at 5 stations;
- Stream flow at 2 locations; and
- Stream temperature at 6 locations.

3.1.1 Water Taking

Water taking from TW3-80 in 2022 was measured using a Krohne magnetic flow meter wired to an Allen Bradley industrial Programmable Logic Controller. The instantaneous flow and cumulative volume pumped are recorded every minute. The flow meter was calibrated on October 26, 2022 by Endress+Hauser.

The daily volumes taken from supply well TW3-80 in 2022 are provided in Appendix C.

3.1.2 Groundwater Monitoring Program

Groundwater levels have been measured at various locations for varying periods of time on-Site and off-Site since December 1980. Following the purchase of the Site by the Perrier Group of America, a monitoring program was initiated in December 2000. Modifications to the monitoring program have been made over time as a result of PTTW requirements, well abandonments, physical inaccessibility to wells, and changes in property ownership. During the 2022 monitoring period, none of the wells required as part of the monitoring program became inaccessible. All the existing monitoring locations and the decommissioned or unused wells are shown on Figure 3.4.

The monitoring locations for the 2022 groundwater monitoring program are shown on Figures 3.1 and 3.2 and are summarized below.

Overburden Monitors

- MW2D-07, MW2E-07, MW4C-07, MW10A-09, TW1-93, MW-S, PCC-S, PCC-I.

Bedrock Monitors

Upper Bedrock Aquifer Monitors

- MW2C-07, MW4B-07, MW6B-08, MW7B-08, MW8B-08, MW10B-09, MW14B-11, MW14C-11, MW15B-12, MW16B-12, MW17B-12, MW18B-12, MW19-18-7, MW20-19-7, MW21-18-4, MW-D, MW-I, PCC-D, Private Well “Y”.

Lower Bedrock Aquifer Monitors

- TW3-80 (Production Well), TW2-11, MW2A-07, MW2B-07, MW4A-07, MW6A-08, MW7A-08, MW8A-08, MW10C-09, MW10D-09, MW14A-11, MW15A-12, MW16A-12, MW17A-12, MW18A-12, MW19-18-4, MW20-19-5, MW21-18-3, PW5.

Some private wells are open across multiple bedrock units (for example private wells with a finished depth in the Lower Bedrock Aquifer are typically open across the Upper and Lower Bedrock Aquifers). Wells constructed in this manner have been grouped with the lowermost unit in which they are installed. It should be noted that water levels measured in wells open to multiple aquifer units represent average water levels that are not representative of the levels in any of the individual aquifer units. In addition, these wells may represent a potential pathway for contaminants in the shallow groundwater system to move into the deeper strata. Monitoring of these private wells is no longer required under PTTW3133-C5BUH9. None of the wells that Blue Triton owns are open across multiple aquifer units.

Water levels were measured at all locations quarterly under PTTW 3133-C5BUH9. Where required by the PTTW, dataloggers are used to record water levels at 60-minute intervals and downloaded quarterly. The groundwater levels measured in 2022 are presented in Appendix D.

3.1.2.1 Missing Data

There were no missing data from the 2022 groundwater monitoring.

3.1.3 Surface Water Monitoring Program

The monitoring locations for the 2022 surface water monitoring program are shown on Figure 3.3 and are summarized below.

Surface Water Levels

Measurement of surface water levels was initiated in December 2001 as part of the Nestlé (now Blue Triton) monthly monitoring program. In 2022, surface water levels were measured at the following locations:

- Aberfoyle Creek:
  - SW1 - located within the upstream part of the Blue Triton property;
  - SW2 - located within the downstream part of the Blue Triton property; and
  - SW3 - located at Gilmour Road, upstream of the Blue Triton property.
- Mill Creek:
  - SW4 - located on Mill Creek at Maple Leaf Lane, upstream of the confluence with Aberfoyle Creek; and
  - SW5 - located on Mill Creek at McLean Road, downstream of the Blue Triton property.

Water levels are measured at all locations during the third week of each month using a water level meter. At SW1 and SW2, dataloggers are used to record water levels at 60-minute intervals, which are also downloaded once a month. The surface water levels for 2022 are presented in Appendix E.

Stream Flow

Measurement of stream flow was initiated in December 2001 as part of the Nestlé (now Blue Triton) monthly monitoring program. Stream flow is measured at SW1 (upstream part of Blue Triton property) and SW2 (downstream part of Blue Triton property) in Aberfoyle Creek during the third week of each month. Despite the proximity of these onsite stations to one another, and the small difference in contributing drainage area between them, stream flows are measured at SW1 and SW2 to monitor for changes that could potentially be attributed to pumping at TW3-80. In 2022, stream flow velocities were measured using a Hach electromagnetic flow meter and the stream flows were calculated using the cross-sectional area-velocity method. The stream flow calculations for 2022 are presented in Appendix F.

In addition to the monthly stream flow measurements, water levels at SW1 and SW2 are logged continuously (hourly). The monthly surface water elevations ("stage") and stream flow measurements ("discharge") collected in 2022 are used to update and/or re-establish the stage-discharge relationships (rating curves) at SW1 and SW2. The rating curves are then used to infer continuous records of stream flow from the continuous water level measurements at SW1 and SW2. It should be noted that since the conditions of the stream channels at SW1 and SW2 change through time, updated rating curves are generally required for each year.

Mini-Piezometers

Mini-piezometers were initially installed in 2004 with additional mini-piezometers being installed since that time. In 2022, water levels were measured in mini-piezometers at eight locations, each containing a shallow and a deep monitor (see locations on Figure 3.3). The mini-piezometer nests are located along Aberfoyle Creek upstream of the Blue Triton property to Mill Creek downstream of the confluence of the two creeks as follows.

- MP1-16S/D;
- MP16S/D-08;
- MP6S-08/D-04;
- MP12S/D-04;
- MP14S/D-07;
- MP8S/D-04;
- MP17S/D-11; and
- MP18S/D-11.

Water levels were measured at all locations quarterly under PTTW 3133-C5BUH9. Where required by the PTTW, dataloggers are used to record water levels at 60-minute intervals and downloaded quarterly. The water levels measured in 2022 are presented in Appendix E.

Temperature

Measurement of surface water temperature began in 2005. In 2022, surface water temperature was measured at six locations along Aberfoyle Creek. The most upstream location is situated at Brock Road with the remainder of the sites located on the Blue Triton property downstream of Brock Road. Beginning upstream and moving downstream, the stream temperature sites are as follows (see locations on Figure 3.3).

- ST6-08;
- ST1-05;
- ST2-05;
- ST3-05;
- ST4-05; and
- ST5-05.

The dataloggers are located at the sediment-water interface with temperature data measured and logged at 30-minute intervals using Stowaway Tidbit® dataloggers or HOBO Tidbit MX dataloggers. Two dataloggers are installed at each site. Air temperature is also measured in a shaded area at ST1-05 at 30-minute intervals.

C. Portt and Associates Ltd. (2011) conducted a review of the appropriateness of the methodology for the temperature monitoring program. The report was approved by the MECP in October 2011 and recommendations from the report were implemented by CRA at that time and continued by Golder Associates Ltd. (now WSP) since May 2014. The temperature data are analyzed by C. Portt and Associates using ThermoStat software. A report on the surface water temperature is included as Appendix G.

3.1.3.1 Missing Data

The following table provides a list and description of missing data from the 2022 surface water monitoring. The missing data are technically not missing but rather were affected by winter conditions. The water levels in the mini-piezometers are close to surface and can become frozen in the winter. Slow moving water in the creeks can also become frozen in the winter. The water level is not necessarily representative of the actual water level under these frozen winter conditions. The issues were temporary and have been resolved.

Table 2: Missing Surface Water Data from the 2022 Monitoring

Monitoring Location	Missing Data	Comments
SW2	Frozen	Frozen in January
SW3	Not missing	New culvert installed in August
SW4	Frozen	Frozen in January
MP1-16D	Frozen	Frozen in December
MP14D-07	Frozen	Frozen in December

3.1.4 Notification Regarding Locations Which Become Inaccessible

None of the monitoring locations required in PTTW 3133-C5BUH9 have become inaccessible or removed from the monitoring program.

3.2 Biological Monitoring

Biological monitoring undertaken on the Blue Triton Aberfoyle property in 2022 was completed in accordance with the requirements of the PTTW for the site and under the guidance of recommendations provided in the 2021 Biological Monitoring Report (Beacon Environmental, 2022). Monitoring of terrestrial resources (vegetation and wildlife) was completed by Beacon Environmental and monitoring of aquatic resources (salmonid redd survey reaches of Aberfoyle Creek) was completed by C. Portt and Associates. The findings of the 2022 Biological Monitoring Program are presented in the 2022 Biological Monitoring Program Report (Beacon Environmental, 2023) which is included in Appendix H.

3.3 Surveying

SW2 was re-surveyed in 2022 due to heaving of the monitor. SW3 was also re-surveyed in 2022 following the construction of a new culvert at the road crossing.

3.4 Precipitation

Prior to 2021, precipitation data were obtained from Environment Canada from the Kitchener/Waterloo (KW) Station or the Waterloo Wellington Station (not recorded since April 2017), both of which reported total daily precipitation over the entire year. Based on reviews of the data it has been concluded that the KW Station may have underestimated the total precipitation since 2017. Environment Canada has been notified of this discrepancy and the data are under review. As such precipitation data were obtained from the Grand River Conservation Authority for the Shades Mill Station and are used in this report. The same data were used for the analysis of the potential recharge presented in Appendix I.

The following table provides a summary of the annual precipitation. The annual 20-year average (2001-2020) precipitation from the Shades Mill Station is 943.7 mm. For comparison, the annual 30-year average (1981-2010) precipitation from the Waterloo Wellington Station 916.5 mm. The total precipitation measured in 2022 was 682.3 mm, which is almost 28% below the average. This is the lowest annual precipitation over the past 22 years. Annual precipitation is also shown graphically on Figure 3.5 along with the 20-year average.

Table 3: Annual Precipitation

Year	Precipitation (mm)	% Difference from Average
2001	829.5	-12.1
2002	727.3	-22.9
2003	911.9	-3.4
2004	840.5	-10.9
2005	854.8	-9.4
2006	1180.5	25.1
2007	726.3	-23.0
2008	1200.8	27.2
2009	1011.0	7.1
2010	921.5	-2.4
2011	1023.9	8.5
2012	807.1	-14.5
2013	1108.1	17.4
2014	898.7	-4.8
2015	839.4	-11.1
2016	937.8	-0.6
2017	1091.8	15.7
2018	1048.6	11.1
2019	1058.9	12.2
2020	856.45	-9.2
2021	1022.8	8.4
2022	682.3	-27.7
Average (2001-2020)	943.7	

The monthly precipitation for 2022 is included in Table 5. Below average precipitation was recorded during nine months year. Above average precipitation was recorded in February, August and December with most of the precipitation coming in February. With the exception of August, below average precipitation was recorded from March through November.

Table 4: Monthly Precipitation 2022

Month	Precipitation (mm)	Average from 2001-2020 (mm)	% Difference from Average
January	36.6	71.4	-48.7
February	109.7	63.3	73.2
March	64.4	64.6	-0.3
April	36.6	81.0	-54.8
May	55.1	81.4	-32.3
June	57.2	82.2	-30.5
July	33.0	95.3	-65.4
August	87.0	77.4	12.3
September	28.4	81.6	-65.2
October	48.9	93.2	-47.5
November	34.6	75.8	-54.3
December	90.8	76.5	18.7

It is noted that in 2017, Nestlé (now Blue Triton) benefited from an exchange with the consulting hydrogeologist for Puslinch Township regarding the assessment of precipitation data from stations in the general area of the Aberfoyle facilities (memorandum prepared by Harden Environmental Services Inc. for Puslinch Township, May 12, 2017). It is recognized that there are differences between the amounts of precipitation recorded at the different stations. It is impossible to obtain a perfectly representative estimate of the annual precipitation over the full extent of the area of contribution for the Blue Triton Aberfoyle well. What is most important is that adopting a consistent approach from year to year allows an assessment of the differences with respect to long-term average conditions (30-year climate normals). An analysis of precipitation trends was conducted to see if there is a correlation with water level trends. We note that the actual influence on water levels (groundwater) would be due to recharge and not total precipitation, and that recharge is controlled by more than just precipitation. However, in the absence of detailed recharge data in the area, the use of precipitation totals allows for some comparison of long-term trends in water levels, particularly in the shallow monitors (overburden and mini piezometers).

An independent soil water balance analysis was conducted by S.S. Papadopulos & Associates to estimate annual average rates of potential recharge over the region surrounding TW3-80. The SWB code of the United States Geological Survey was applied (Westenbroek et al., 2010) with the records of precipitation data compiled since 2008. The results of the analysis suggested that the annual average potential recharge is about 17% of the annual precipitation. The estimated annual potential recharge for 2022 is 85 mm with an annual precipitation of 682 mm. The potential recharge for 2022 is the lowest estimated over the 15-year period of analysis. The estimated annual potential recharge is consistent with the trends inferred from the previous analyses. The updated analyses are documented in a technical memorandum included in Appendix I.

4.0 MONITORING PROGRAM RESULTS

4.1 Water Taking for TW3-80

Water taking at the Blue Triton Aberfoyle Site in 2022 continues to be governed by PTTW 3133-C5BUH9, which permits water to be taken from one well as outlined in Table 6.

Table 5: Permitted Water Takings at Aberfoyle

Source	Maximum Rate	Maximum Number of Hours of Water Taking per Day	Maximum Daily Water Taking	Maximum Number of Days of Water Taking per Year
TW3-80	2,500 L/min	24	3,600,000 L	365

The daily water takings for 2022 are tabulated in Table C1 in Appendix C. The daily water taking at TW3-80 ranged from 0 L to 3,111,753 L; the latter is 86% of the permitted taking. The average daily taking was 1,842,783 L. During 2022, the instantaneous flow rates and the daily takings were always below the limits of the PTTW (i.e., less than 2,500 L/min and 3,600,000 L, respectively).

The total volume of water taken each year from 2001 to 2022 is presented on Figure 4.1. The total volume of water taken in 2022 from TW3-80 was 672,615,929 L. In 2022, the total volume taken was approximately 51% of the permitted volume. The total pumping from TW3-80 in 2022 was similar to the total annual water taking in 2018 and has increased over the past four years (since 2019). Since 2002, the groundwater taking has ranged from approximately 43% to 67% of the permitted taking.

The monthly water takings for the past 5 years are presented on Figure 4.2. The monthly water takings in 2022 from TW3-80 ranged from 43,624,837 L in January to 69,800,641 L in July. In 2022, the monthly water takings generally increased during the first half of the year (with the exception of the high water takings in March), with the peak water taking in July, and then varied during the last four months of the year. In general, the monthly water taking amounts and trends over the year were higher in the summer and November and December 2022 compared to the previous year.

The Grand River Low Water Response Team declared a Level 1 Low Water Condition for the entire Grand River Watershed, including Mill Creek, on June 29, 2022 and increased to a Level 2 Low Water Condition on July 21, 2022. The Level 2 Low Water Condition was in effect for the remainder of 2022. Blue Triton committed to limit water takings to 90% of their monthly maximum permitted volume during the Level 1 Condition and 80% of their monthly maximum permitted volume during the Level 2 Condition. Blue Triton’s monthly water takings were below 65% of the permitted monthly amount from June to the end of the year. The daily water takings were below 87% of the permitted daily amount during the Level 1 Water Condition and below 74% during the Level 2 Water Condition. In addition, as per Condition 3.3, Blue Triton’s Low Water Response Program was implemented, which included an increase in monitoring and review of data from MW2-07 from quarterly to monthly. As per council resolution (April 13, 2022), Blue Triton also notified the Township of Puslinch and the Township Hydrogeologist (Harden Environmental) that a Level 1 and Level 2 Low Water Condition was declared for the entire Grand River Watershed.

Condition 4.8 of the PTTW requires details of the bottling operations such as location and name of facilities where water is delivered in bulk containers, if bulk water is containerized at the receiving location, the size of the containers into which the water is transferred, and total volume of water transported in bulk to each remote facility. Blue Triton has indicated that no water was shipped in bulk (container greater than 20 litres) in 2022.

As per Condition 5.1, Blue Triton has indicated that no complaints arising from the taking of water authorized under this PTTW were received in 2022.

4.2 Groundwater Monitoring Program

The groundwater levels measured manually in 2022 at the monitoring wells are tabulated in Table D1 in Appendix D. Hydrographs with the manual or transducer water level data are also included in Appendix D. In addition to the water levels, the hydrographs include the daily pumping volumes at TW3-80 and daily precipitation as recorded at the Shades Mill meteorological station.

4.2.1 TW3-80

Water levels and average daily pumping rates for TW3-80, along with daily precipitation, from 2018 through 2022 are shown on Figure D1a (Appendix D).

Water levels measured in 2022 at TW3-80 range from approximately 297.5 to 312.4 masl (or approximately 18.9 to 4.0 m below ground surface) under pumping and non-pumping conditions, respectively. These variations in water levels are mainly due to changes in the pumping rate and are within the historical range of water levels observed at TW3-80. An analysis of monthly average water levels at TW3-80 versus average pumping at TW3-80 was undertaken to assess how pumping water levels are related to pumping rates. A linear regression of the data indicates that pumping rate accounts for approximately 89% of the variation in water levels in TW3-80. A technical memorandum on the analysis is included in Appendix I.

Operation records of TW3-80 indicate that the well is seldom shut-down for significant periods of time and, consequently, there are few fully recovered non-pumping water levels available. Based on previous shutdowns, CRA (2014) indicates that the non-pumping water levels are approximately 311 to 313 masl or 5.4 to 3.4 m below ground surface. The estimated non-pumping water levels (partially recovered conditions following shutdown of the pump) measured in 2022 range from approximately 307 to 312 masl. The non-pumping water levels have been similar over the past five years (2018 through 2022) and higher than the previous three years (2015 through 2017) when the water takings were higher. The non-pumping water levels in 2022 are most similar to the non-pumping water levels in 2018 when the annual water takings were similar. It should be noted that non-pumping water levels do not represent “true” conditions that would be observed if there was no pumping at TW3-80 for an extended period. Instead, they represent partially recovered conditions, with the amount of recovery dependent on the average pumping rate before the pumping stopped, how much time has elapsed before pumping resumes and whether there is a background (seasonal) trend in the water levels. The results of the analysis presented in Appendix I suggest that the fully recovered non-pumping level in TW3-80 is about 313 m.

The pumping water levels in 2022 range from approximately 298 to 307 masl. Based on a static water level of 313 masl, the estimated drawdown at the well in 2022 ranged from approximately 6 to 15 m. The total available drawdown to the top of the pump intake is about 20.7 m (based on a static water elevation of 313 masl and a top of pump intake elevation of 292.3 masl). Referring to Figure 1.2, the top of the Lower Bedrock Aquifer is at an elevation of approximately 292.3 masl. The pumping levels in 2022 ranged from about 5 to 15 m above the top of the aquifer; confirming that the aquifer remained under confined conditions throughout 2022.

The records of average monthly water levels, monthly withdrawals and monthly precipitation between 2006 and 2022 are shown on the hydrograph for TW3-80 (Figure D1b). The hydrograph extends back to 2006 to include the period of increased pumping up to 2008. The data provide important insights into the performance of the well and the long-term sustainability of pumping. The water levels and pumping volumes can be categorized into four periods with a year of transition between each period as follows: 2006 through 2007 when pumping rates were higher and water levels were lower; 2009 through 2013 when pumping rates were lower and water levels were higher; 2015 through 2017, when pumping rates were higher and water levels were lower; and 2019 to 2021, when pumping rates have been lower and water levels higher. In 2022, the pumping and trends are similar to the transition years (e.g., 2014 and 2018). In general, the water level changes in TW3-80 correspond to the changes in the overall water taking from the well (i.e., lower water levels during periods of higher water takings (e.g., 2007) and higher water levels during periods of lower water takings (e.g., 2011)). Overall, the water levels respond to pumping as expected and the on-going groundwater taking at TW3-80 has not led to a long-term declining trend in the TW3-80 water levels. The capacity of the well has not changed through time.

4.2.2 Lower Bedrock Aquifer

The regional groundwater potentiometric surface in the Lower Bedrock Aquifer is shown on Figure 4.3. The potentiometric surface was prepared based on the water levels measured on July 24, 2022. This represents a time when the highest pumping volumes were recorded at TW3-80 and monthly precipitation was below average for the month of July. A review of the potentiometric surface on July 24, 2022, indicates groundwater flow toward TW3-80 from the northeast, north and northwest. The greater hydraulic connection with the area toward MW7-08 is evident in the potentiometric surface under pumping conditions. It is estimated that the water elevation contours return to the regional mean southerly flow pattern approximately 1.5 km south of the Site.

Hydrographs for wells completed in the Lower Bedrock Aquifer are included on Figures D2 through D17 in Appendix D.

The findings from a review of the hydrographs of wells completed in the Lower Bedrock Aquifer are summarized below.

- Water levels measured within this aquifer in 2022 are generally similar to the water levels measured in 2018 when the annual pumping was similar. Most of the water levels in the wells were within the range measured over the past years with the following exceptions. Water levels in the wells with a strong hydraulic connection to TW3-80 (MW2A-07, MW4A-07) had a brief decline in water levels at the end of June when pumping at TW3-80 increased. Following the decrease in water levels, the pumping was reduced and water levels returned to levels within the historical range. Water levels in some of the distant downgradient wells (MW15A-12, MW16A-12, MW17A-12) and a distant well to the northeast (MW10-D-09) were below the historical range of water levels during the second half of the year. A similar trend of low water levels during the second half of the year, although within the historical range of water levels, was observed at the other monitoring wells completed in the Lower Bedrock Aquifer. Water levels in these wells are partially influenced by the pumping at TW3-80 and also by the lack of recharge during most of 2022. Water levels in MW8A-08 (considered to provide some indication of background conditions) have been similar over the past five years;
- Water levels in portions of the Lower Bedrock Aquifer near TW3-80 are influenced by short-term fluctuations in TW3-80 pumping. The short-term pumping effects are evident with the water levels fluctuating in response to daily changes in pumping rates and are observed in monitoring wells closest to TW3-80 (e.g., MW2A-07 and MW4A-07). In comparison, wells located further away (upgradient – MW6A-08, MW8A-08, MW10C-09 and MW10D-09; downgradient – MW15A-12, MW16A-12 and MW17A-12) show only minor differences between the daily high and low water levels;

- Water levels in the Lower Bedrock Aquifer are also influenced by longer term trends in the TW3-80 pumping. The long-term pumping effects are evident in the wells closer to TW3-80 where water level changes from year to year correlate with overall annual water takings (i.e., increased annual water takings result in lower average water levels). During periods of reduced pumping, the water levels recover with no long-term increasing or decreasing trends. These effects of variations in total annual pumping decrease with distance from TW3-80, as can be seen by comparing the hydrographs for MW2A-07 against hydrographs for wells further from TW3-80 (e.g., MW8A-08). This is evident with the observed rise in water levels since September 2018 at MW2A-07, which correlates with an overall decrease in pumping at TW3-80 followed by the decrease in water levels in May 2022, which correlates with an overall increase in pumping at TW3-80. The start of a decreasing water level trend in the monitoring wells further away from TW3-80 is not related to pumping at TW3-80;
- As in previous years there appears to be a stronger hydraulic connection with TW3-80 at MW7A-08 (located approximately 1,050 m north of TW3-80) compared to the connection between TW3-80 and MW14A-11 (located approximately 750 m northwest of TW3-80) and TW3-80 and MW18A-12 (located approximately 750 m southwest of TW3-80). The response at MW7A-08 suggests that the zone of influence extends further upgradient toward MW7-08, as opposed to downgradient toward MW18-12. This interpreted hydraulic connection is consistent with previous years; and
- Another difference to these trends is at MW10C/D-09 (located approximately 1,230 m north east of TW3-80) and at MW16A-12 (located approximately 1,650 m south of TW3-80), where less seasonal change is evident. This is consistent with previous years. These wells are located further away from TW3-80 and may be influenced by external sources.

In summary, the water levels in the onsite monitoring wells in the Lower Bedrock Aquifer are influenced primarily by pumping at TW3-80. The effects of pumping at TW3-80 diminish with distance from the well, and beyond about a kilometre water levels are predominantly affected by other influences. In addition, water levels recover when pumping rates are reduced, as has been observed since September 2018 and decrease when pumping rates are increased, as has been observed since June 2022. In 2022, the low amount of recharge to the Lower Bedrock Aquifer is evident during the second half of the year in the wells further away from TW3-80. No long-term trends in the water levels due to pumping TW3-80 have been observed over the last five years.

4.2.3 Middle Bedrock Aquitard

Hydrographs for wells completed in the Middle Bedrock Aquitard are included on Figure D18 in Appendix D. One well is monitored within this unit (MW2B-07), which is sealed within the Middle Bedrock Aquitard but close to the top of the Lower Bedrock Aquifer.

The results of a review of the hydrograph of MW2B-07 completed in the Middle Bedrock Aquitard are summarized below:

- Water levels measured within this aquitard in 2022 are similar to the water levels measured in 2018 and lower that the water levels observed during the previous three years (2019 through 2021). The water levels are within the historical range measured at this well; and
- The water levels in MW2B-07 follow a similar trend as the water levels in the Lower Bedrock Aquifer from year to year and respond to pumping at TW3-80. However, the response to pumping is less compared to the response in the lower bedrock aquifer. This is consistent with the interpretation that the bottom of the screen is only 2 m above the contact between the Middle Bedrock Aquitard and the Lower Bedrock Aquifer.

4.2.4 Upper Bedrock Aquifer

The regional groundwater potentiometric surface in the Upper Bedrock Aquifer is shown on Figure 4.4. The potentiometric surface was prepared based on the water levels measured on July 24, 2022. This represents a time in 2022 when the highest pumping volumes were recorded at TW3-80 and monthly precipitation was below normal for the month of July. A review of the potentiometric surface on July 24, 2022, indicates groundwater flow toward TW3-80 from the northeast, north and northwest. The greater hydraulic connection with the area toward MW7-08 is evident in the potentiometric surface under pumping conditions.

Hydrographs for wells completed in the Upper Bedrock Aquifer are included on Figures D19 through D31 in Appendix D.

The findings from a review of the hydrographs of wells completed in the Upper Bedrock Aquifer are summarized below:

- With the exception of MW7B-08 and MW15B-12, water levels measured in the Upper Bedrock Aquifer in the summer and early fall of 2022 are lower than those measured over the past five years due to the below-average precipitation that occurred for most of the year. The lowest water levels since monitoring began were measured at MW16B-12, MW17B-12 and MW18B-12, all downgradient of TW3-80. Water levels generally began to rise in February and then declined from April through July. The water levels in the monitoring wells during the remainder of the year varied from increasing to stable to decreasing as some areas were influenced by the significant precipitation event in August;
- Water levels in the Upper Bedrock Aquifer around the Site show some effects of pumping at TW3-80 (i.e., there is hydraulic connection between the Lower Bedrock and Upper Bedrock Aquifers); however, the connection is limited (i.e., less response than in the Lower Bedrock Aquifer). The extent of influence varies based on distance from TW3-80 and existing hydrogeologic conditions (i.e., complexity in the subsurface geologic structure and properties);
- The relationship between the long-term average pumping rates and water levels (i.e., higher water levels during periods of decreased pumping since September 2018 and lower water levels during periods of increased pumping since June 2022) is only observed in the monitoring wells on the property (e.g., MW2C-07 and MWI/D) and MW7B-08 (upgradient);
- Typically, wells further away from TW3-80 show less effect from pumping, although this is not always the case. The greatest influence from pumping is observed at MW2C-07 and MW7B-08. There appears to be a stronger hydraulic connection between TW3-80 and MW7B-08 (located approximately 1,050 m north of TW3-80) compared to the connection between TW3-80 and MW4B-07 (located approximately 330 m northwest of TW3-80). This is also consistent with previous years and points to complexity in the subsurface;
- While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there are also long-term water level fluctuations that are reflective of variations in recharge (i.e., lower water levels during years of below-average precipitation (such as 2022) and higher water levels during years of above-average precipitation); and
- There are also seasonal influences observed in the water levels in the Upper Bedrock Aquifer. For example, melt events and significant precipitation events influence the water levels in the Upper Bedrock Aquifer. Recharge to the aquifer has more of an effect than pumping during these events (i.e., the changes in water level are more reflective of the wet spring/dry summer and fall compared to the total pumping).

In summary, the water levels in the onsite monitoring wells in the Upper Bedrock Aquifer are influenced by pumping at TW3-80 but to a lesser degree than water levels in the Lower Bedrock Aquifer due to a lower permeability bedrock layer that exists between the two aquifers. There is also an influence on water levels reflective of trends in recharge. This is reflected in 2022 by some of the lowest water levels measured in the monitoring wells during a time of below normal precipitation for an extended period. The long-term monitoring data, which show that water levels recover when pumping rates are reduced, are consistent with the interpretation that the water taking is sustainable.

4.2.5 Overburden

The potentiometric surface of the overburden plotted in Figure 4.5 is also based on water levels measured on July 24, 2022, during the month of highest pumping and lowest precipitation. A review of the potentiometric surface on July 24, 2022, indicates that groundwater flow is generally in a southerly direction with potentially some flow towards Aberfoyle Creek. We note that there is both lateral and vertical flow in the overburden. An interpretation of the lateral flow in the overburden is shown in Figure 4.5, while vertical gradients in the shallow overburden along the creek are discussed below. Shallow groundwater flow directions are more variable locally than the deeper bedrock flow systems as they are more influenced by topography and interactions with surface features.

Hydrographs for wells completed in the overburden are included on Figures D32 through D36 in Appendix D. The intermediate and deep overburden wells are installed in the till, in sand and gravel within or below the till, or deep within the surficial sand and gravel aquifer. Shallow overburden wells are typically installed in the upper portion of the surficial sand gravel.

Findings from a review of the hydrographs of wells completed in the overburden are summarized below:

- Similar to the water levels in the Upper Bedrock Aquifer, the water levels in the overburden generally began to rise in February and then declined from April through July. The water levels in the monitoring wells during the remainder of the year varied from increasing to stable to decreasing;
- Some of the lowest water levels were recorded in the overburden wells during the second half of 2022 due to the below average precipitation but were within the range of water levels observed at the wells. There is no significant overall increasing or decreasing trend; and
- Water levels in the overburden are affected by natural factors (recharge), and to a lesser degree by pumping at TW3-80. The response to pumping in the overburden is muted compared to the response in Upper and Lower Bedrock Aquifers but for monitoring wells immediately adjacent to TW3-80 there is a correlation with long-term variations in pumping.

In summary, the water levels in the overburden are influenced by weather events and to a lesser degree, pumping at TW3-80. The influence of pumping on water levels in the overburden is less than the influence of pumping on water levels in both the Upper and Lower Bedrock Aquifers. There are no long-term declining trends in the overburden water levels. The fact that water levels recover when pumping rates are reduced and there are no long-term declining trends is a line of evidence that the water taking is sustainable.

4.2.6 Vertical Gradients

Vertical gradients between the Lower Bedrock Aquifer and the Upper Bedrock Aquifer are plotted on Figures D37 through D50 in Appendix D; the gradients are inferred from multi-level monitoring wells completed in both units.

Note that a positive gradient is calculated when the water level in the upper aquifer exceeds the level in the lower aquifer. Under these conditions, the mean direction of vertical groundwater flow is downwards.

In general, based on a review of the graphs for the multi-level monitoring well locations, a dampened response in the Upper Bedrock Aquifer relative to the response in the Lower Bedrock Aquifer is evident. At locations where the positive gradient increases when pumping increases, this is due to the fact that water levels in the Lower Bedrock Aquifer respond more to pumping than do the water levels in the Upper Bedrock Aquifer.

A description of the gradients at the Site is as follows:

- MW2A/C-07 – positive gradient (potential downward flow) that increases with increased pumping. There are brief periods in 2022 and other years when the gradient is reversed, coinciding with reduced pumping. The long-term gradient trend correlates with the long-term pumping trend (i.e., the increased pumping during the second half of 2022 compared to the previous three years has resulted in an increase in the positive gradient). Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping (i.e., higher pumping during the summer months). Daily changes in the vertical gradient are greater than at wells further away from TW3-80;
- MW4A/C-07 – positive gradient (potential downward flow) that increases with increased pumping. The long-term gradient trends and seasonal changes in vertical gradient are also evident and similar to those observed at MW2-07. The daily changes in the vertical gradient are less than at MW2-07;
- MW6A/B-08 – positive gradient (potential downward flow) that has been relatively consistent over the past five years with a slight decrease since September 2018 correlating to the decrease in pumping over the same time period and a slight increase during the second half of 2022 correlating to the increase in pumping over the same time period;
- MW7A/B-08 – positive gradient (potential downward flow) that increases with increased pumping. There is a daily fluctuation in the positive gradient that relates to the daily pumping at TW3-80. There is some correlation between the long-term change in the gradient and the long-term changes in pumping of TW3-80 (i.e., the increased pumping during the second half of 2022 compared to the previous three years has resulted in an increase in the positive gradient);
- MW8A/B-08 – negative gradient (potential upward flow) that occasionally reverses to a positive gradient (potential downward flow) mainly during the summer. Since September 2018 the gradient has been negative with the exception of some positive gradients during the summer of 2020, 2021 and 2022 when pumping from TW3-80 was higher. Similar to MW6-08 the gradient has been relatively consistent over the past five years with a slight decrease since September 2018 correlating to the decrease in pumping over the same time period and a slight increase during the second half of 2022 correlating to the increase in pumping over the same time period;
- MW10B/C-09 – positive gradient (potential downward flow) that does not change with seasonal pumping fluctuations. The gradient has been consistent over the past five years and the change in total pumping in 2022 was not observed in the gradient;
- MW14A/C-11 – positive gradient (potential downward flow) that increases with increased pumping and correlates with the long-term pumping trend. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping;

- MW15A/B-12 – negative gradient (potential upward flow) that does not change with increased pumping. There has been a slight decrease in the vertical gradient since the second half of 2021 that does not correlate with pumping at TW3-80;
- MW16A/B-12 – positive gradient (potential downward flow) with minor changes related to seasonal changes in pumping;
- MW17A/B-12 – positive gradient (potential downward flow) that reverses to a negative gradient (potential upward flow) during times of decreased pumping. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping;
- MW18A/B-12 – negative gradient (potential upward flow) that reverses to a positive gradient (potential downward flow) during times of increased pumping. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping;
- MW19-18-4/7 – positive gradient (potential downward flow) with minor change related to seasonal changes in pumping;
- MW20-19-5/7 – positive gradient (potential downward flow) that increases with increased pumping. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping; and
- MW21-18-3/4 – positive gradient (potential downward flow) that increases with increased pumping. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping.

Most of the area around TW3-80 is characterized by positive gradients (downward flow) in the bedrock. A negative gradient (upward flow) is present at wells further away from TW3-80 (i.e., at MW15-12 to the west and MW8-08 to the north). Over the past five years, a negative gradient (upward flow) is also present at MW2-07 (close to TW3-80), and MW17-12 and MW18-12 (to the south) when pumping at TW3-80 has been lower.

4.3 Surface Water Monitoring Program

The surface water monitoring program includes measurement of mini-piezometer and surface water levels, surface water flows and surface water temperatures. The surface water levels measured in 2022 are presented in Appendix E along with hydrographs of the water levels. Surface water flows are tabulated and graphed in Appendix F. The hydrographs also include the daily pumping volumes at TW3-80 and daily precipitation as recorded at the Shades Mill meteorological stations. Surface water temperatures are discussed in Section 4.3.4 and Appendix G.

4.3.1 Mini-Piezometer Water Levels

Hydrographs for the mini-piezometer locations are presented on Figures E1 through E8 in Appendix E with the “a” figures including data for the last 5 years (2018 through 2022) and the “b” figures including data for 2022 only.

The findings from a review of the hydrographs for the mini-piezometers are summarized below.

- A new mini-piezometer nest (MP1-16) was installed in Aberfoyle Creek at the Blue Triton Gilmour Road property in April 2016 to monitor background conditions upstream of the Site. In 2018, the casing at MP1-16 was extended so that the mini-piezometer doesn’t flow (when not frozen). For the 2022 analysis, MP1-16 is considered to represent background conditions;

- The variation in water levels at MP1-16 over 2022 was approximately 0.5 m in both the deep piezometer and the shallow piezometer with spikes related to precipitation and/or snowmelt events. Water levels in MP1-16D were the lowest observed in the past five years but within the historical range. In 2022 the water levels rose in February to a peak in late March, followed by a decline into June and July, stable through to the beginning of October and then rising to the end of the year. These changes in water level are influenced by natural seasonal patterns. Lower water levels were observed during the second half of the year due to the below average precipitation recorded through most of the year. The potential for vertical flow at the MP1-16 nest is consistently upwards in 2022, similar to previous years (i.e., as shown in Figure E1a/b, water levels in MP1-16D exceed those in MP1-16S);
- There are five mini-piezometer nests situated on the Blue Triton Aberfoyle property (MP16, MP6, MP12, MP14, MP8) and two located downstream of the confluence of Aberfoyle Creek and Mill Creek (MP17, MP18). These mini-piezometer nests, located upgradient and downgradient of TW3-80, showed fluctuations of approximately 0.4 m to 0.9 m during 2022. The trends in water levels at the mini-piezometers were similar to those observed at MP1-16. The similarity in water level fluctuations indicates that changes in water levels correspond more with natural events rather than changes in pumping in TW3-80 and are mainly due to precipitation, snow melt and evaporation;
- Some of the lowest water levels were measured in the mini-piezometers in the summer of 2022 compared to the past five years, however, with the exception of MP14-07 and MP18D-11 these water levels are within the historical ranges. The low water levels are attributed to the below average precipitation recorded during most of the year;
- The water levels have generally increased in the spring, declined through the summer, and then increased in the fall (although there was less of an increase in the fall of 2022); and
- In addition to the seasonal trends, short-term changes (“spikes”) in water level in the shallow groundwater reflect the influence of precipitation. There were less spikes in the water levels in 2022 compared to previous years due to the lack of precipitation events in 2022.

Shallow gradients observed in the mini-piezometers are shown on Figures E9 through E11 in Appendix E with the “a” figures including data for the last 5 years (2018 through 2022) and the “b” figures including data for 2022 only. Beginning upstream and moving downstream, the vertical gradients are as follows:

- MP1-16 – strong negative gradient (potential upward flow) in 2022 and over the past five years. In the past there have been several short-term decreases in the negative gradient caused by rapidly rising surface water elevations following precipitation events, however these were less evident in 2022 due to the lack of precipitation events;
- MP16 – no gradient measured in 2022. Over the past five years, the gradient has varied from a weak negative gradient (potential upward flow) to a weak positive gradient (potential downward flow) that has remained close to no gradient. There is less “noise” in the data following the spring of 2019;
- MP6 – weak negative gradient (potential upward flow) that declined during the year and reversed to a weak positive gradient (potential downward flow) in the summer. The gradient has been similar over the past five years;

- MP12 – weak negative gradient (potential upward flow) that increased during the spring and then decreased and changed to a weak positive gradient (potential downward flow) in July. Over the previous three years the gradient was mostly negative. The change to positive during the second half of 2022 is due to the below average precipitation in 2022;
- MP14 – strong negative gradient (potential upward flow) in 2022. Historically the gradient is reduced during the summer but generally remains negative, which is what was also reflected in 2022;
- MP8 – weak negative gradient (potential upward flow) after mid-January that became stronger in the fall. Historically there has been a weak negative gradient (potential upward flow) at this location. There is less "noise" in the data following the spring of 2019; and
- MP17 and MP18 – weak positive gradient (potential downward flow) that reversed to a weak negative gradient (potential upward flow) in the spring of 2022. Over the past five years, with the exception of 2021, there has generally been a weak negative gradient (potential upward flow) during the first half of the year and then a weak positive gradient (potential downward flow) during the second half of the year.

The water levels in the mini-piezometers on July 20, 2022 are plotted on Figure 4.6 which is during the month of highest pumping and lowest precipitation. Review of the water levels on July 20, 2022 indicates that there is a strong negative gradient (potential upward flow) at MP1-16 located upstream of Aberfoyle Mill Pond. There is essentially no gradient at the three piezometers (MP16, MP6, MP12) upgradient of TW3-80 and then a strong negative gradient at MP14 near the middle of the property. Further downstream before the confluence with Mill Creek, there is a weak negative gradient at MP8 and then after the confluence, the gradient changes to weak positive gradient at MP17 and MP18. These gradients are similar to those observed in the past.

4.3.2 Surface Water Levels

Hydrographs for the surface water level monitoring locations are included on Figures E12 through E16 in Appendix E with the "a" figures including data for the last 5 years (2018 through 2022) and the "b" figures including data only for 2022.

A review of the hydrographs for the surface water level monitoring locations indicates the following:

- Surface water levels in the creeks fluctuate in response to precipitation, snow melt and evapotranspiration with no measurable effects from pumping at the current rates;
- In general, surface water levels have been higher in the winter/spring and lower in the summer and then have increased slightly into the fall. The trends were similar in 2022. In general, surface water levels at the on-Site stations (SW1 and SW2) and off-Site stations (SW3, SW4 and SW5) were similar throughout the year, with a rise in water levels observed in February and March followed by a decline in water levels into the summer and higher water levels again in the fall. Higher water levels were observed at all four of the five stations (possible erroneous water level at SW4 in October) in October which corresponded to a major precipitation event;
- The summer water levels were low, similar to past five years but within the historical range with the exception of the SW4 water level in October and the SW3 water level in November. Looking at the overall trend in the water levels, it is possible that these water levels may be erroneous; and
- It should be noted that the measuring point at SW2 was resurveyed in February 2022. Following the correction, the water levels at SW2 appear to be higher than the previous five years. It appears that the

change in the measuring point elevation may have occurred as far back as 2018 and may have been a slow change possibly due to slight heaving of the monitor each year.

The water levels at the surface water stations on July 20, 2022 are included on Figure 4.6, during the month of highest pumping and lowest precipitation. Review of the water levels on July 20, 2022 indicates that surface water features varied in elevation from approximately 317.32 masl at SW3 to 307.21 masl at SW5 with surface water levels across the Site ranging from 311.34 masl (SW1) to 310.37 masl (SW2).

It is important to note that the stream flow provides a more reliable data set for investigating the potential impacts of pumping compared to an analysis of stream water levels, which can be affected by channel geometry. An analysis of stream flow is presented in the following section.

4.3.3 Surface Water Flow

The monthly stream flow data collected in 2022 are summarized in Appendix F. Stream flow has been measured at SW1 and SW2 since December 2001. SW1 is located along Aberfoyle Creek near the upstream part of the property while SW2 is located along Aberfoyle Creek near the downstream part of the property.

Stage-discharge curves are developed for SW1 and SW2 which show the relationship between surface water elevation (stage) and stream flow (discharge). The stage-discharge relationship was used to convert the continuous measurements of stream stages to stream flows. Due to changing stream conditions, individual stage-discharge curves sometimes need to be created for individual years or a series of years. This is done because a review of the discrete flow and water level measurement results indicates that the hydraulic controls at the gauging stations have changed subtly. In 2022, the stage-discharge curves were updated at both stations. The stream geometry appears to have changed slightly at SW1 resulting in the need for a new stage-discharge curve. A new stage-discharge curve was also developed for SW2 based on the revised surveyed elevation at the monitor. These new stage-discharge curves were developed to represent continuous flows in 2022 at SW1 and SW2 to provide a better fit to the data. Stage-discharge curves were developed by estimating the level at which zero flow would occur (i.e., y0) at each station. This was estimated using the available low-flow measurements collected over the monitoring period. Historical data were included for comparison and to include measured data over a larger range of stream discharge conditions. Power functions were used to develop a best fit curve for the measured data at each station. Data outliers were evaluated with a lower confidence due to suspected winter conditions or measurement error. The updated stage-discharge curves for SW1 and SW2 are presented on Figures F1 and F2, respectively. Flow data from previous years were estimated using historic stage-discharge curves that best fit the monitoring data collected during those years (as presented in previous reports).

Graphs of estimated stream flow at SW1 and SW2, along with pumping rates and precipitation, are presented on Figure F3 in Appendix F with the “a” figure including data for the last 5 years (2018 through 2022) and the “b” figure including data for 2022. The updated stage-discharge relationship was used to estimate stream flow from the continuous water level elevation data in 2022. It should be noted that historically there are a few occasions when flow was estimated at SW1 and SW2 for stream elevations outside of the observed stage-discharge curve relationship (typically flows exceeding approximately 1,200 L/s), including some in February 2022.

Review of the flow data indicates the following:

- In 2022, stream flow measured in the field (during monthly monitoring) at SW1 ranged from 20.5 L/s (August) to 604.5 L/s (March) and at SW2 stream flow ranged from 19.5 L/s (August) to 648.5 L/s (March);

- The trends in surface water flow at SW1 and SW2 over the year are similar. This is consistent with previous years and as expected over the ~900 m reach of creek;
- In 2022, stream flow was higher in the late winter and spring following precipitation and melt events and then was lower through the summer with less variability in flow. The stream flow rose in October and then was relatively constant to the end of the year;
- The 2022 summer stream flows at SW1 and SW2 were some of the lowest observed over the past five years. The summer low flows were similar to those observed in 2018 but lasted for a longer period in 2022;
- The calculated flows, using the rating curves, indicate that flow at SW2 is typically greater than the flow at SW1 during the spring and similar during the summer (i.e., flow at SW1 and SW2 are essentially equal at low flows, when overland runoff is not present, and flow at SW2 is marginally higher than SW1 at moderate to high flows). It should be noted that the contributing drainage area between SW1 and SW2 is small in comparison to the total drainage area upstream of the site. This means that the expected increase in flow based on increase in drainage area will also be small and that stream flows at SW1 and SW2 will be similar and differences are likely to be within the margin of error for flow measurements in natural open channels; and
- Apparent flow is sometimes slightly lower at SW2 compared to SW1. This can sometimes be due to manual flow measurement accuracy or changed hydraulic controls. With respect to stream conditions, the channel cross section at SW1 is relatively stable from year to year and has a silty bed composition. This type of channel is less prone to underestimating flow due to irregularities. In contrast, the channel cross section at SW2 is wide, very shallow during low flow, has a cobbly substrate and the bed is mobile, often changing from year to year. The presence of large cobbles in the bed at SW2 introduces flow irregularities that cause additional error to flow measurements, especially at low flow conditions. In addition, flow through the coarse substrate, known as gauge underflow, is likely occurring at SW2. The magnitude of gauge underflow and the error it introduces cannot be measured using standard stream flow measurement techniques, but the relative error is larger for shallow depths of flow (when the flow above the bed is small) and less significant for deeper flows (when the flow above the bed is large). For this reason, discrete measurements can significantly underestimate the flow at SW2 during low water conditions.

There have been no significant effects observed on Aberfoyle Creek adjacent to the site since 2008 (when continuous monitoring began), which included nine Low Water Advisories over that time.

It was noted in CRA (2014) that pumping tests conducted in 2004, 2007, and 2010 indicated that surface water flow at SW1 and SW2 was not measurably affected by pumping. The on-going monitoring confirms this conclusion and shows that the stream flows are influenced primarily by precipitation events and fluctuate seasonally.

4.3.4 Surface Water Temperature

Surface water temperature was monitored at six stations across the Blue Triton property.

The average daily water and air temperature data for 2018 through 2022 are shown on Figure G1a and for 2022 on Figure G1b. Review of the data indicates the following:

- The seasonal trend in stream temperature levels in 2022 is similar to previous years;

- Average daily ambient air temperature ranged from -17.6ºC (2.2 ºC colder than 2021) to 25.2 ºC (0.7ºC warmer than 2021) in 2022;
- Average daily surface water temperature ranged from 0.2ºC to 27.0ºC at the upstream end of the property (ST6-08) and from -0.2ºC to 25.4ºC at the downstream end of the property (ST5-05). Surface water temperatures generally decrease, across the Site, moving downstream; and
- Air temperature significantly influences stream temperature as seen by the strong correlation between the two. The correlation is not evident during the winter months when air temperature typically drops below 0ºC and surface water temperature remains relatively constant around 0ºC.

The surface water temperature data were provided to C. Portt and Associates, and the results were incorporated in their report, which is also included in Appendix G.

The mill pond on Aberfoyle Creek has a major influence on the temperature of the creek and its fish community. During the summer, the water in the mill pond, upstream from Brock Road, becomes warm and, as a consequence, the creek is warm through the Blue Triton property. In the C. Portt and Associates report it is concluded that:

> In 2022, mean summer (June – August) air temperature was intermediate among those observed during the period 2007 – 2022. The overall pattern of water temperature suitability for the fish species found in the Aberfoyle Branch of Mill Creek from Brock Road downstream through the Blue Triton property in 2022 are consistent with previous years. Water temperatures during the June 1 – August 31 period are usually too warm for coldwater species such as brook trout and brown trout and too cold for warmwater species such as largemouth bass. The water temperatures during this period are most favourable for species such as common shiner which have intermediate thermal requirements. During the summer, the water in the mill pond upstream from Brock Road becomes warm and, although the creek temperature decreases with distance downstream, it frequently exceeds the ultimate upper incipient lethal temperature for brook trout and brown trout at the furthest downstream temperature monitoring site.
>
> The relationships between air temperature and water temperature were consistent with those observed in previous years at the three upstream sites but the 2022 stream temperatures were lower than predicted from the mean water temperature versus mean air temperature relationship at the three downstream sites. Stream flow in 2022 was the lowest during the period for which temperature data are available but the data do not demonstrate a relationship between flow and residuals of the water temperature versus air temperature relationship.

4.4 Biological Monitoring Program

In the 2022 Biological Monitoring Program Report for the Aberfoyle property (Beacon Environmental, 2023) it is concluded that:

> In summary, the findings suggest that there have not been any significant changes to the various terrestrial and aquatic parameters being monitored on the Aberfoyle property. Species richness, abundance, and distribution are generally within the range expected and attributable to natural variation and succession. The subject property continues to support high quality terrestrial and

wetland habitats that support a diverse range of native wildlife. The aquatic environment is strongly influenced by the thermal loading from the Aberfoyle Mill Pond.

The report also includes recommendations for continued biological monitoring in 2023. Details are included in the report which can be found in Appendix H.

5.0 CONCLUSIONS

The following conclusions are provided based on the results of the 2022 monitoring program.

1) Blue Triton has complied with all the conditions in the existing permit for the Aberfoyle well TW3-80.

2) TW3-80 has been operated in accordance with the pumping limits outlined in the PTTW. The daily water taking at TW3-80 in 2022 ranged from 0 L to 3,111,753 L. The average daily taking in 2022 was 1,842,783 L. The total volume of water taken in 2022 from TW3-80 was 672,615,929 L or 51% of the permitted volume.

3) The interpreted non-pumping water levels in TW3-80, which obtains water from the Lower Bedrock Aquifer, ranged from approximately 307 to 312 masl in 2022 and the interpreted water levels under variable pumping conditions ranged from approximately 298 to 307 masl. The drawdown at the well ranged from approximately 15 m to 6 m in 2022. Historical and current records indicate that long-term water levels generally correlate with the monthly pumping volumes (i.e., higher water levels during months of lower pumping and lower water levels during months of higher pumping). At all times the water level in TW3-80 remained above the top of the Lower Bedrock Aquifer.

4) The trends of water level variations within the Lower Bedrock Aquifer are stable with nearby monitoring wells in the Lower Bedrock Aquifer fluctuating in response to variations in pumping at TW3-80. Some of the lowest water levels were observed in the Lower Bedrock Aquifer in 2022. Water levels in these wells are partially influenced by the pumping at TW3-80 and also by the lack of recharge during most of 2022. The groundwater taking from TW3-80 has not led to a long-term declining trend in the aquifer water levels.

5) The muted responses at monitoring wells in the Upper Bedrock Aquifer relative to the Lower Bedrock Aquifer confirm that the Middle Bedrock Aquitard limits the effect of pumping on overlying units. The water levels in the Upper Bedrock Aquifer and overburden aquifer show seasonal trends that are reflective of spring melt and precipitation. Some of the lowest water levels were observed in these aquifers in 2022 due to the below average precipitation measured during most of 2022. Unacceptable impacts (i.e., long-term declining trends) to the Upper Bedrock Aquifer and overburden aquifer have not been observed.

6) Surface water levels fluctuate in response to precipitation, snow melt and evapotranspiration.

7) The water taking does not hinder the ability of the water resource to support existing natural functions of the ecosystem. The groundwater withdrawals do not result in physical and ecological impacts to the adjacent Aberfoyle Creek and wetlands.

8) The water taking does not prevent other water users from continuing their established pattern of use. The groundwater withdrawals from TW3-80 do not interfere with existing municipal uses or private uses. There have been no well interference complaints at Aberfoyle due to the water taking from TW3-80.

9) No irreversible impacts have been observed due to pumping of the aquifer or deterioration of groundwater quantity or quality on neighbouring properties.

10) Based on the monitoring data collected, the 2022 water takings from TW3-80 are sustainable.

6.0 RECOMMENDATIONS

No changes to the existing monitoring program are recommended.

Signature Page

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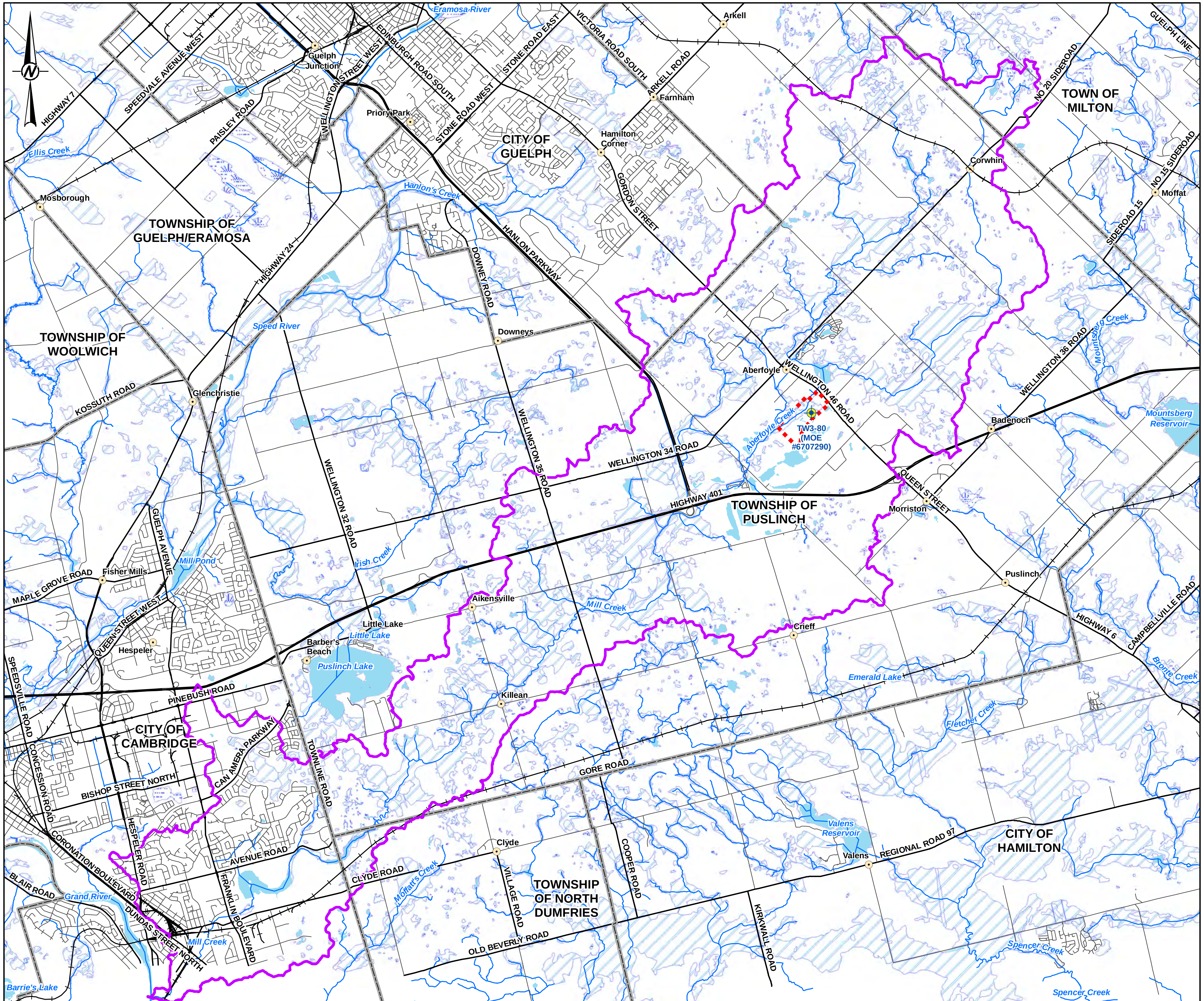
FIGURES

Figures 1.1 to 4.6



LEGEND

- Production Well
- City / Town
- Main Road /Highway
- Local Road
- Railway
- Watercourse
- Waterbody
- Wetland
- Provincially Significant Wetland
- Municipal Boundary
- Property Boundary
- Mill Creek Sub-Watershed

0 2 4 6

SCALE: 1:80,000 KILOMETERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
SITE LOCATION

CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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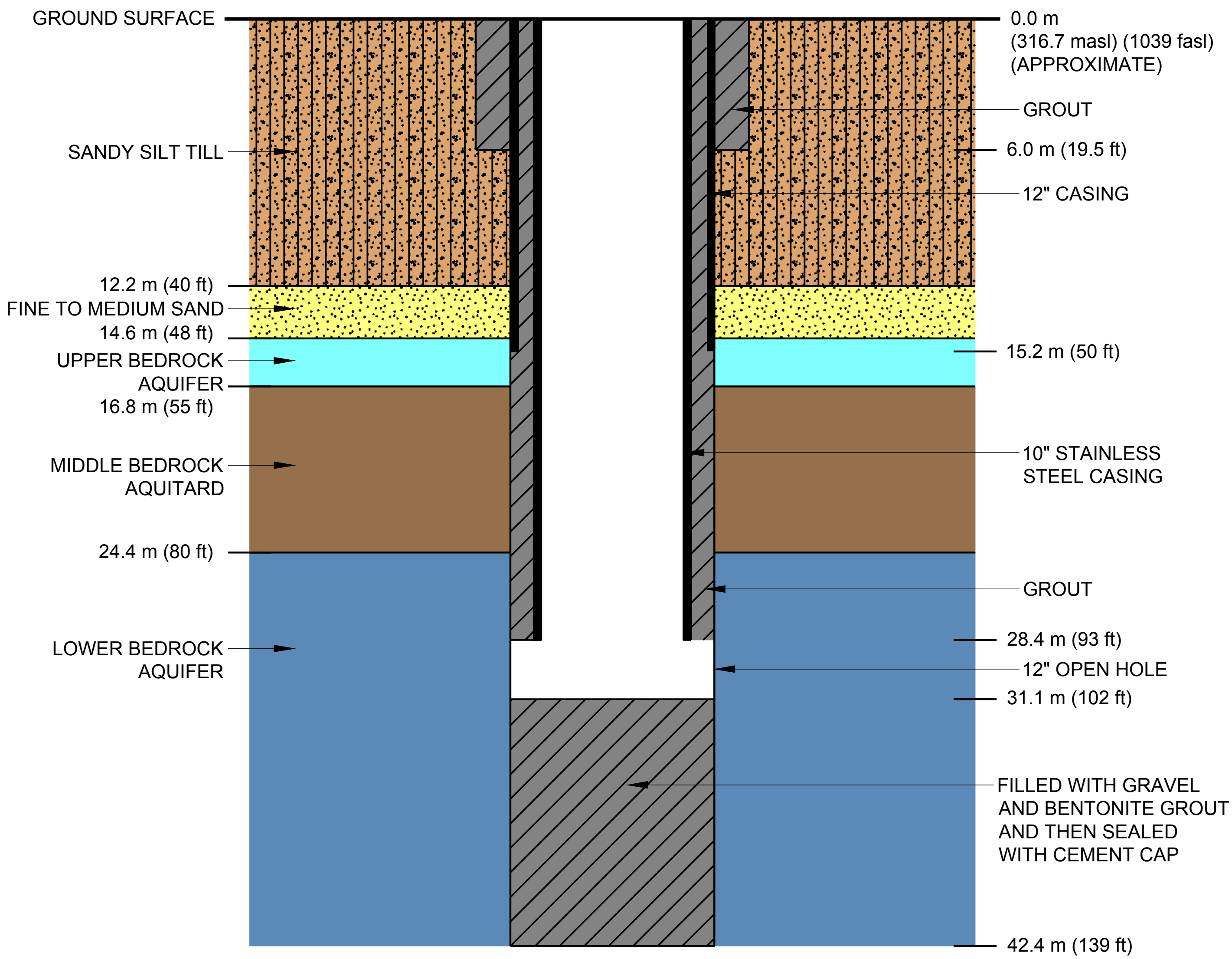


CLIENT
BLUE TRITON BRANDS

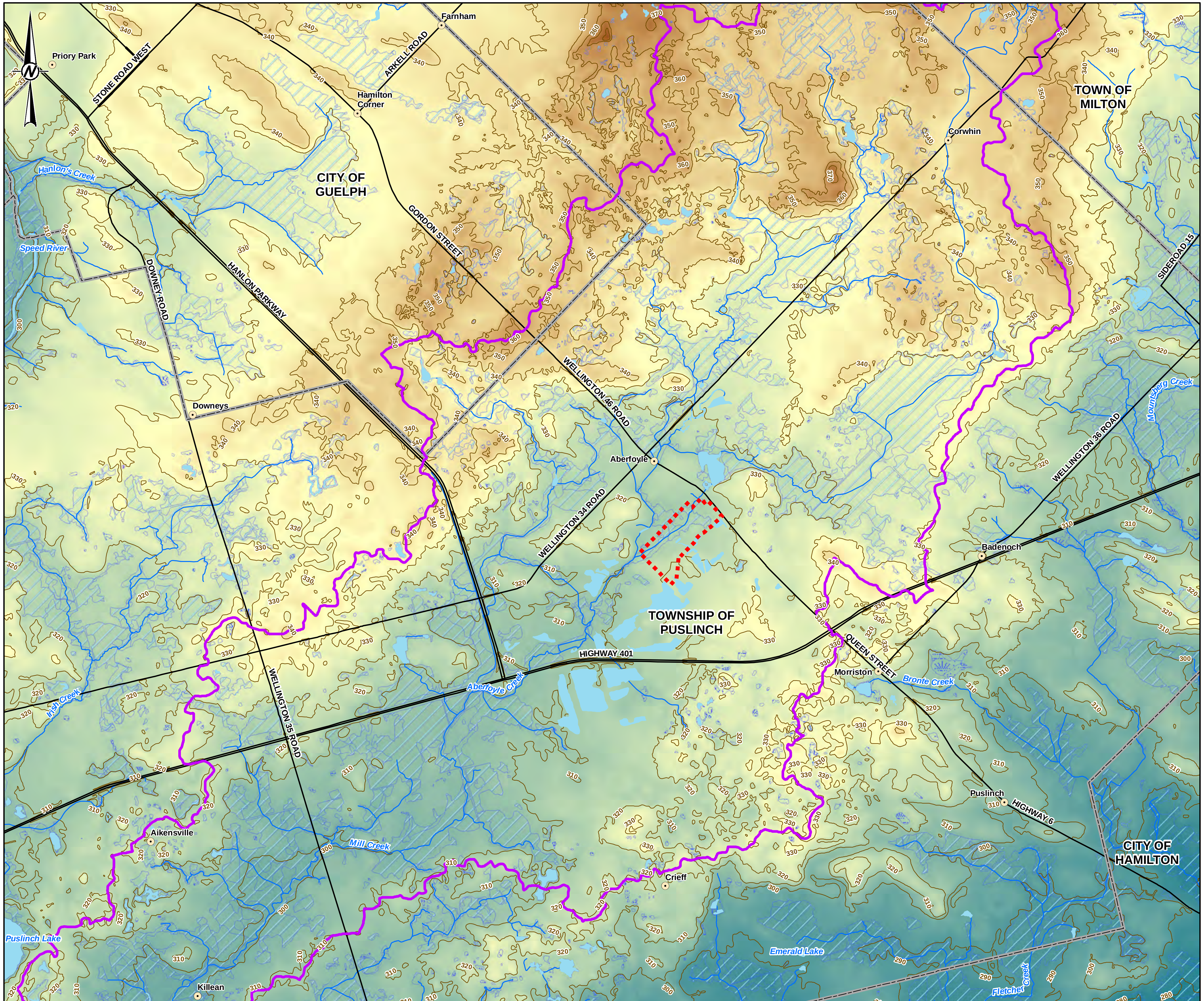
PROJECT
2022 ANNUAL REPORT

CONSULTANT

YYYY-MM-DD	2023-01-30
PREPARED	
DESIGN	
REVIEW	
APPROVED	

TITLE
CROSS SECTION A-A'

PROJECT No.	CONTROL	Rev.	FIGURE
20449101	(1100)	A	1.2



LEGEND

- City / Town
- Topographic Elevation Contour (masl)
- Main Road /Highway
- Watercourse
- Waterbody
- Wetland
- Provincially Significant Wetland
- Mill Creek Sub-Watershed
- Municipal Boundary
- Property Boundary

Value

High : 385.707

Low : 278.55

0 1 2 3 4

SCALE: 1:50,000 KILOMETERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
TOPOGRAPHY AND DRAINAGE

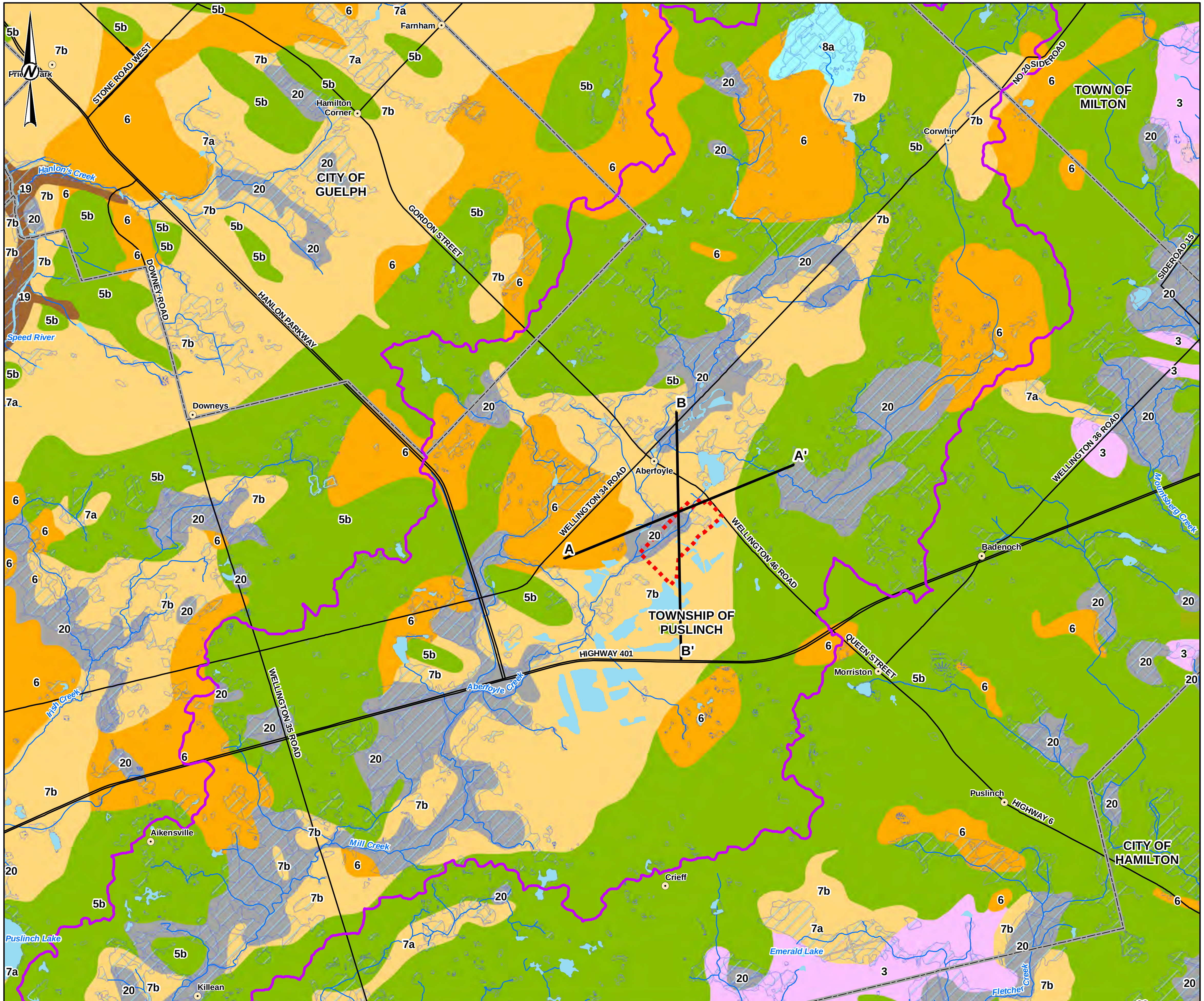
CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	2.1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- City / Town
- Cross-Section Location
- Main Road /Highway
- Watercourse
- Waterbody
- Wetland
- Provincially Significant Wetland
- Mill Creek Sub-Watershed
- Municipal Boundary
- Property Boundary
- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 7a: Sandy deposits
- 7b: Gravelly deposits
- 8a: Massive-well laminated
- 19: Modern alluvial deposits
- 20: Organic deposits

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

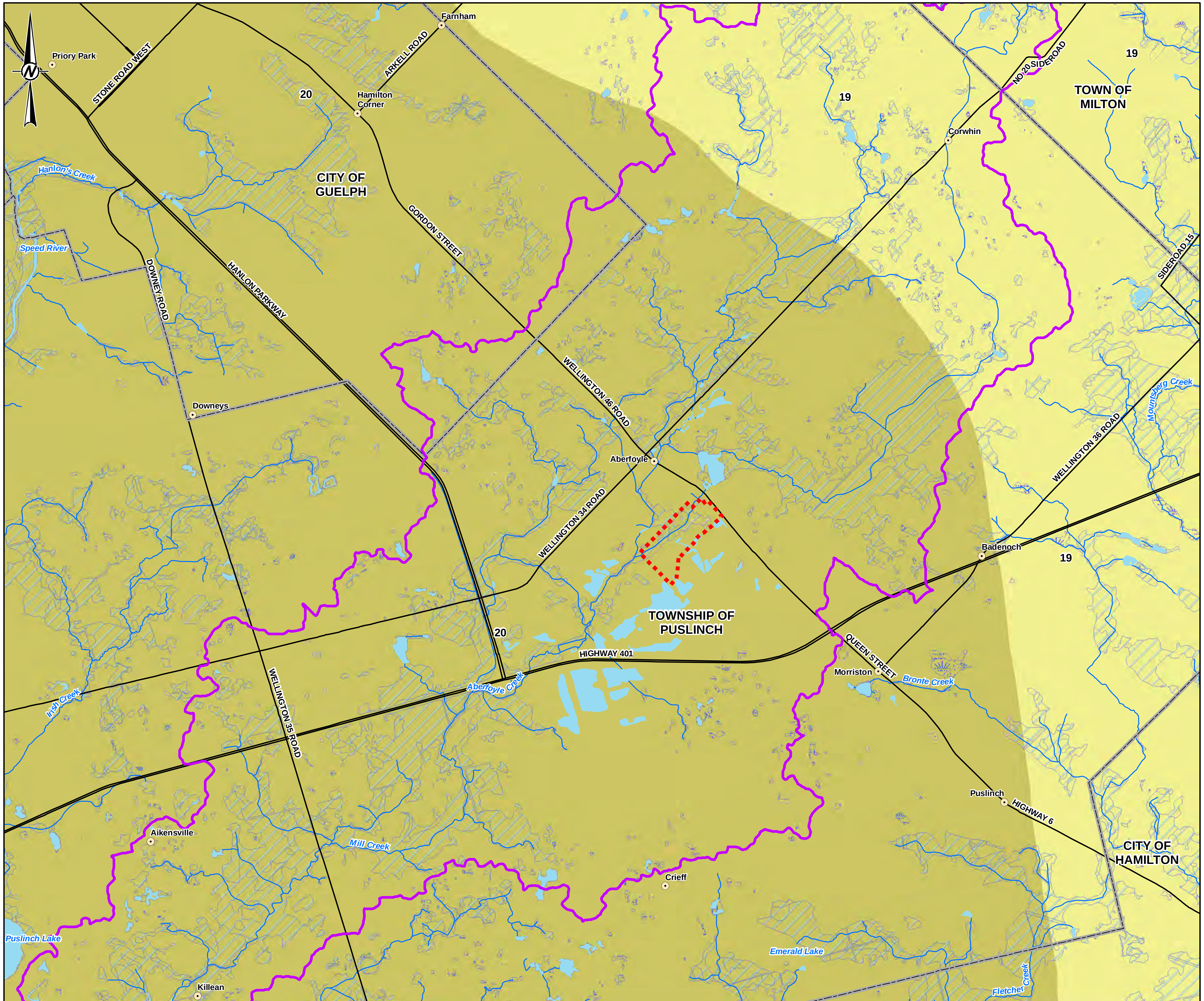
TITLE
REGIONAL QUATERNARY GEOLOGY

CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	**2.2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- City / Town
- Main Road /Highway
- Watercourse
- Waterbody
- Wetland
- Provincially Significant Wetland
- Mill Creek Sub-Watershed
- Municipal Boundary
- Property Boundary
- 20: Guelph - dolostone; thick-bedded, crinoidal, locally biohermal; locally bituminous (Eramosa Mb)
- 19: Amabel - dolostone, limestone, argillaceous dolostone; locally cherty; locally bituminous (Eramosa Mb)

0 1 2 3 4

SCALE: 1:50,000 KILOMETERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

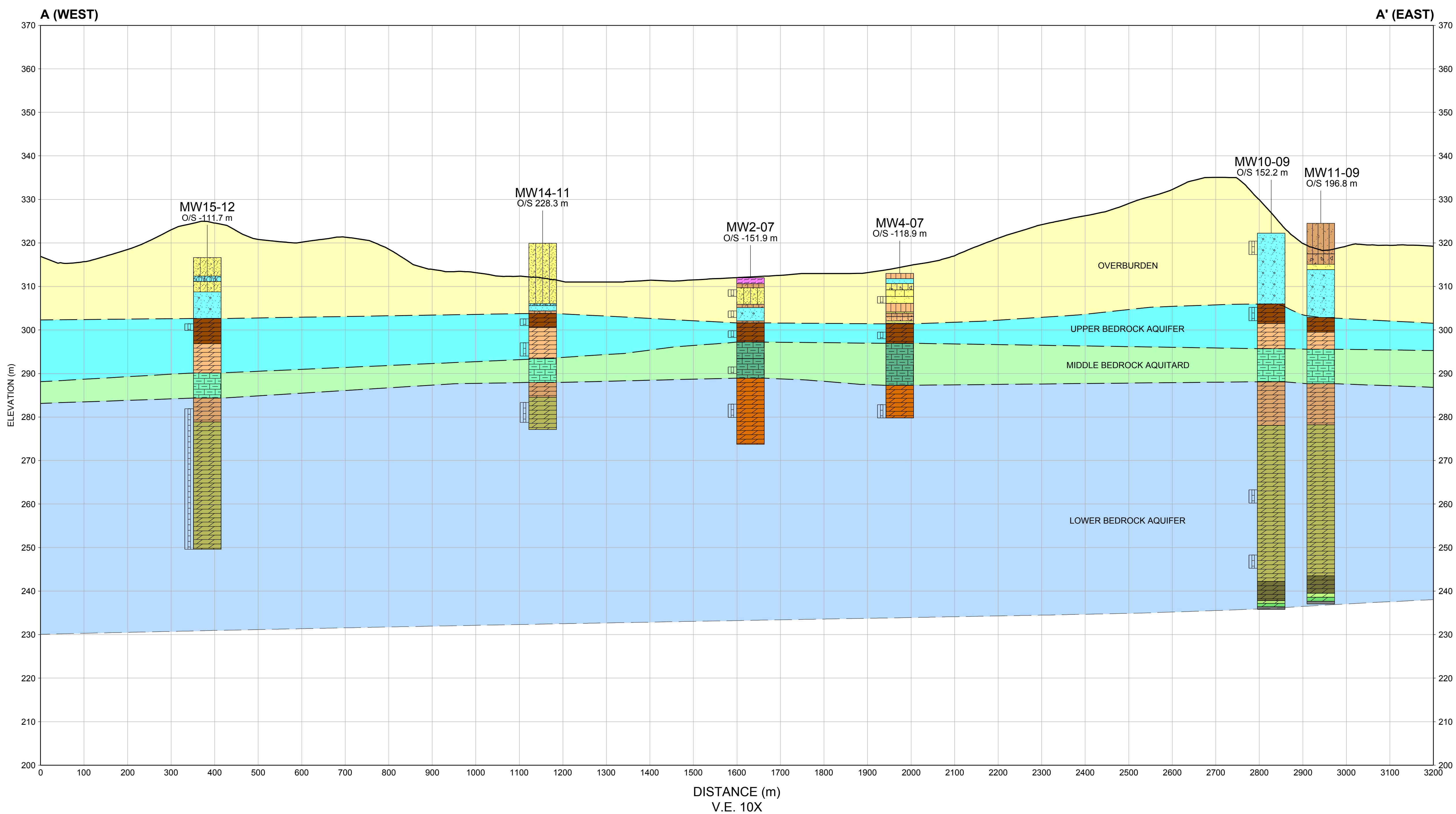
TITLE
REGIONAL BEDROCK GEOLOGY

CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	2.3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

OVERBURDEN	BEDROCK (OLD)	BEDROCK (NEW)
SAND	GUELPH	GUELPH
SILTY SAND	ERAMOSA	REFORMATORY QUARRY
SILTY SAND TILL	AMABEL	VINEMOUNT
SANDY SILT	BEDROCK	GOAT ISLAND
SANDY SILT TILL		GASPORT
SILT		IRONDEQUOIT
SILT TILL		ROCKWAY
TOPSOIL		MERRITTON
SAND AND GRAVEL		CABOT HEAD
GRAVEL AND SILT		

0 25 50
1:1,000 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
BLUE TRITON BRANDS

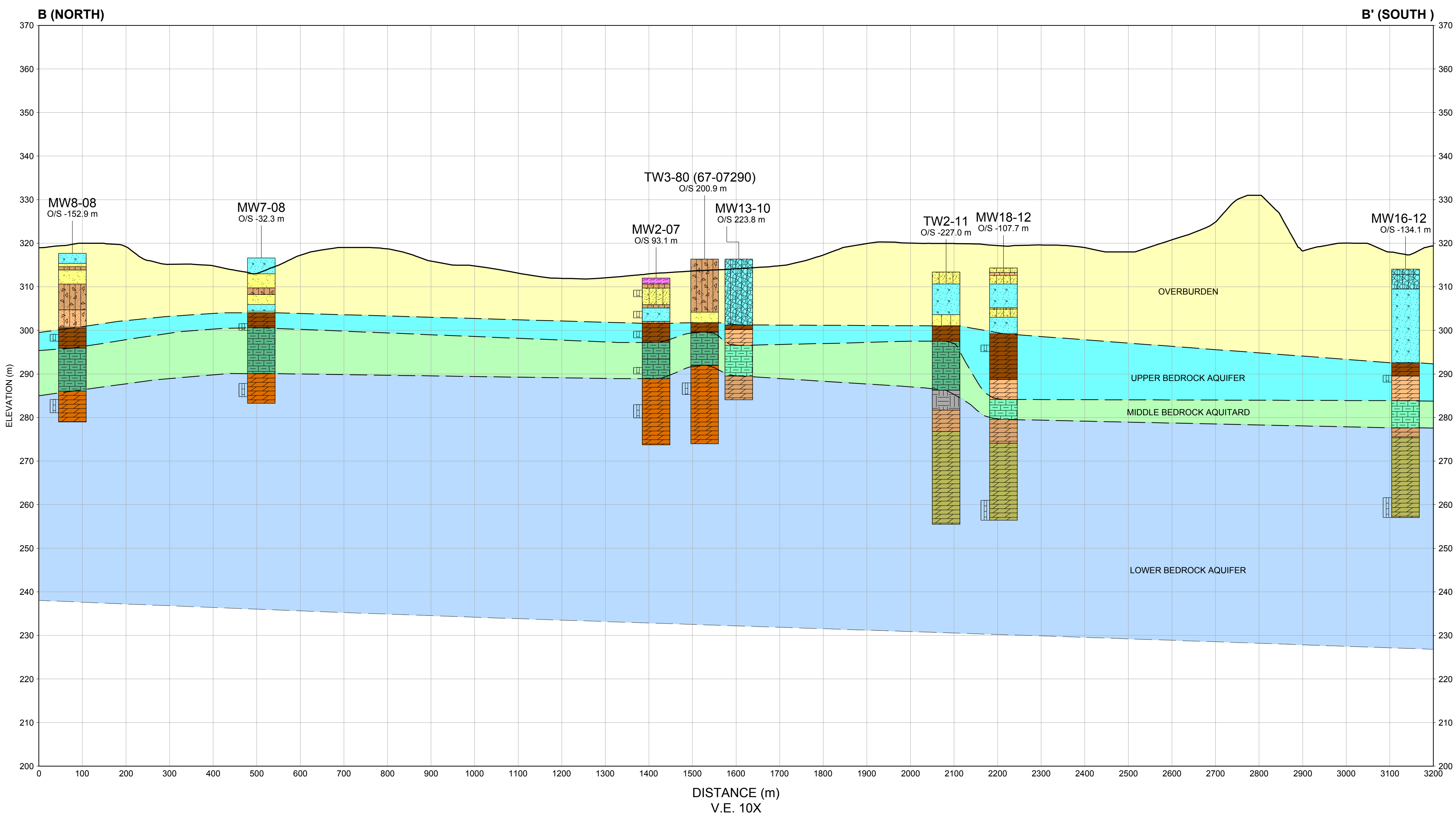
PROJECT
2022 ANNUAL REPORT

TITLE
CROSS SECTION A-A'

CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	GP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	(1100)	A	2.4



LEGEND

OVERBURDEN	BEDROCK (OLD)	BEDROCK (NEW)
SAND	GUELPH	GUELPH
SILTY SAND	ERAMOSA	REFORMATORY QUARRY
SILTY SAND TILL	AMABEL	VINEMOUNT
SANDY SILT	BEDROCK	GOAT ISLAND
SANDY SILT TILL		GASPORT
SILT		IRONDEQUOIT
SILT TILL		ROCKWAY
TOPSOIL		MERRITTON
SAND AND GRAVEL		CABOT HEAD
GRAVEL AND SILT		

0 25 50
1:1,000 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
NESTLE WATERS CANADA

PROJECT
2022 ANNUAL REPORT

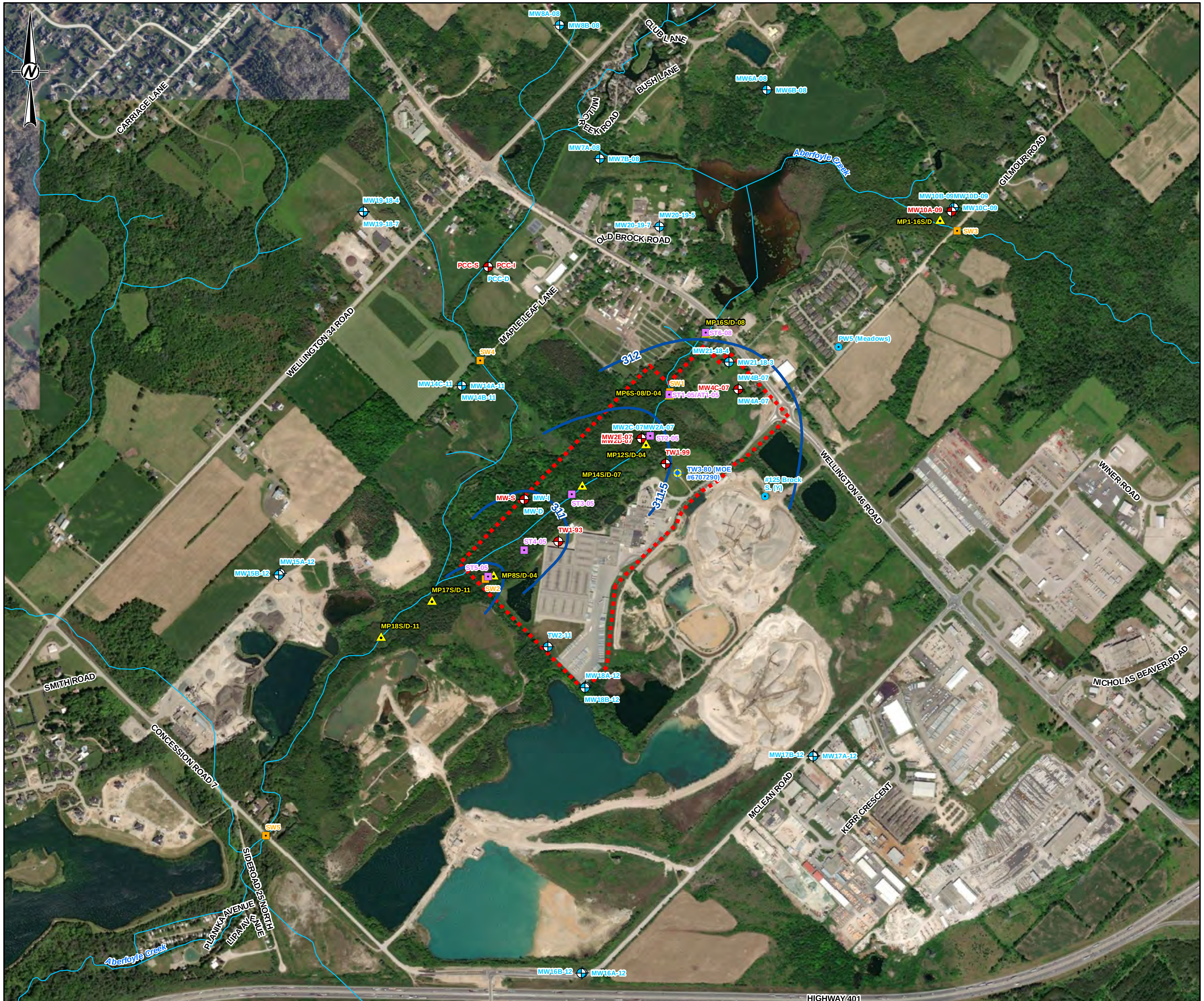
TITLE
CROSS SECTION A-A'

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	GP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	(1100)	A	2.5



LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Water Level Elevation Contour (Oct. 12, 2010)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
OVERBURDEN AND SURFACE WATER ELEVATIONS (NON-PUMPING CONDITION OCTOBER 2010)

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	2.6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

S:\Clients\Nestle\Aberfoyle\99_PROJ\1311520250_Monitoring\40_PROD\0019_2018_Annual_Report\1311520250-0019-CH-0008.mxd

LEGEND

- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Production Well
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Water Level Elevation Contour (Oct. 12, 2010)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF UPPER BEDROCK AQUIFER (NON-PUMPING CONDITION OCTOBER 2010)

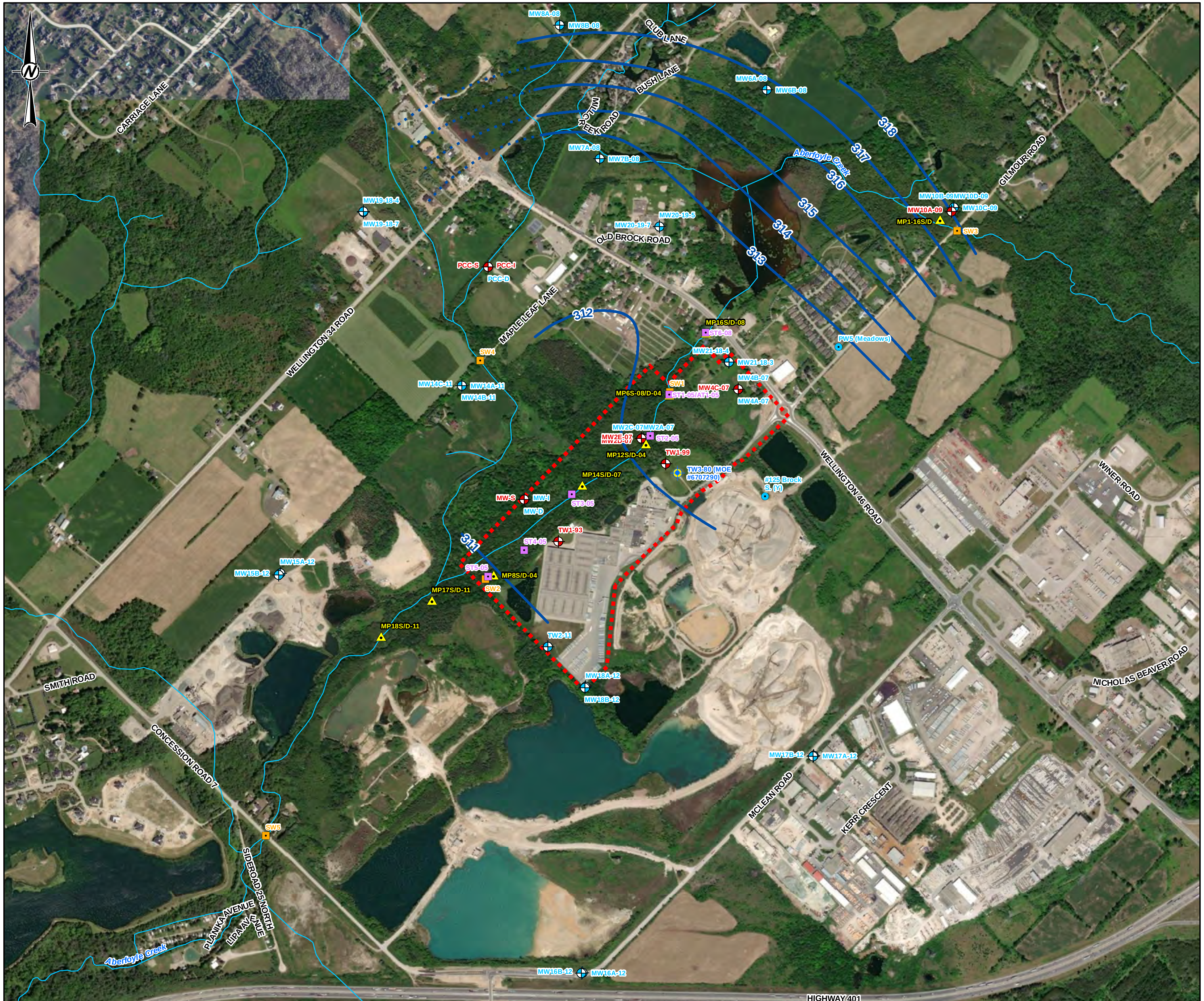
CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	2.7

S:\Clients\Nestle\Aberfoyle\99_PROJ\1311520250_Monitoring\40_PROD\0019_2018_Annual_Report\1311520250-0019-CH-0009.mxd

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:



LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Water Level Elevation Contour (Oct. 12, 2010)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF LOWER BEDROCK AQUIFER (NON-PUMPING CONDITION OCTOBER 2010)

CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	**2.8**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
2022 BEDROCK MONITORING LOCATIONS

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	3.1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

LEGEND

- Production Well
- Monitoring Well (Overburden)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

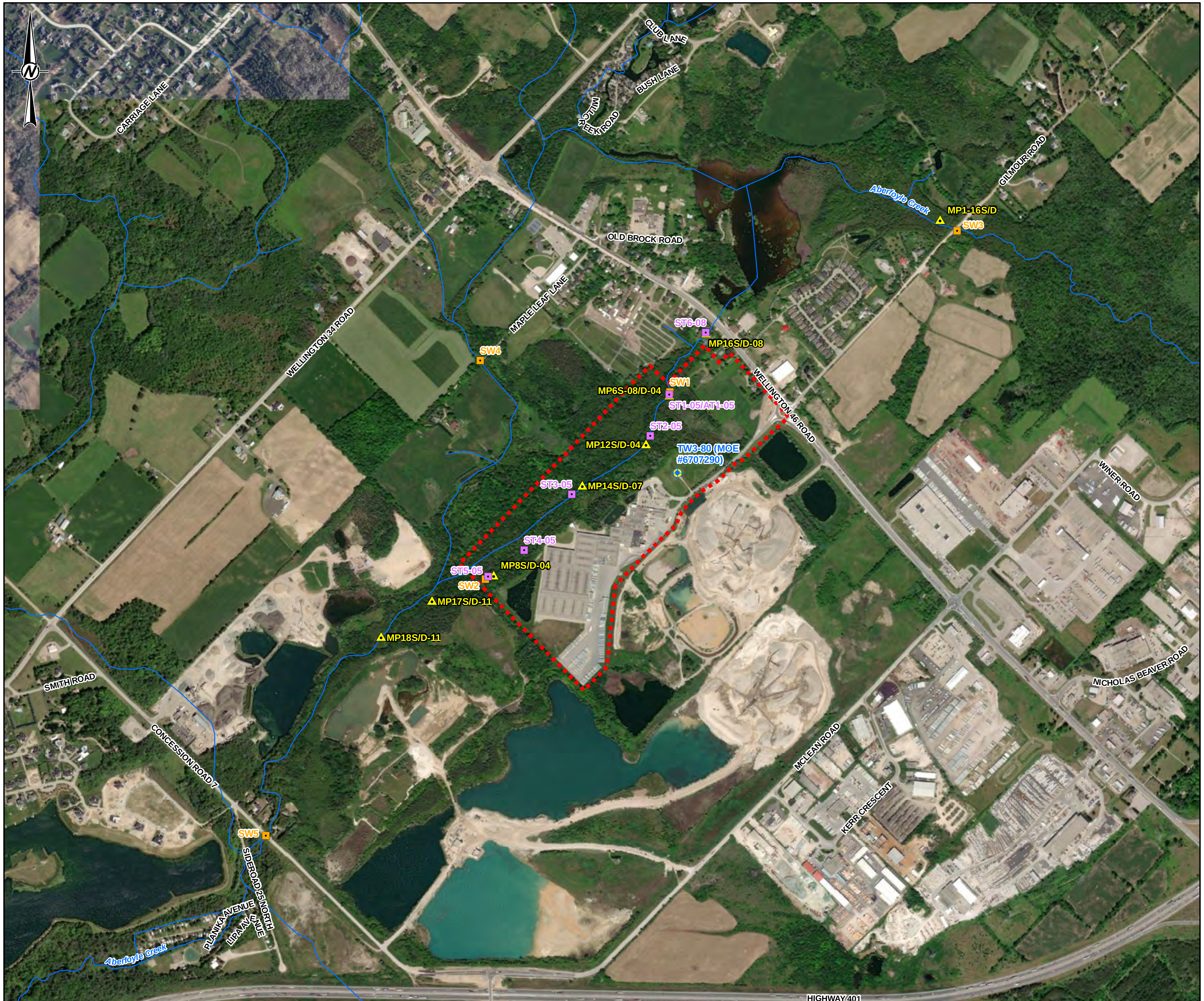
TITLE
2022 OVERBURDEN MONITORING LOCATIONS

CONSULTANT

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	3.2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- Production Well
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

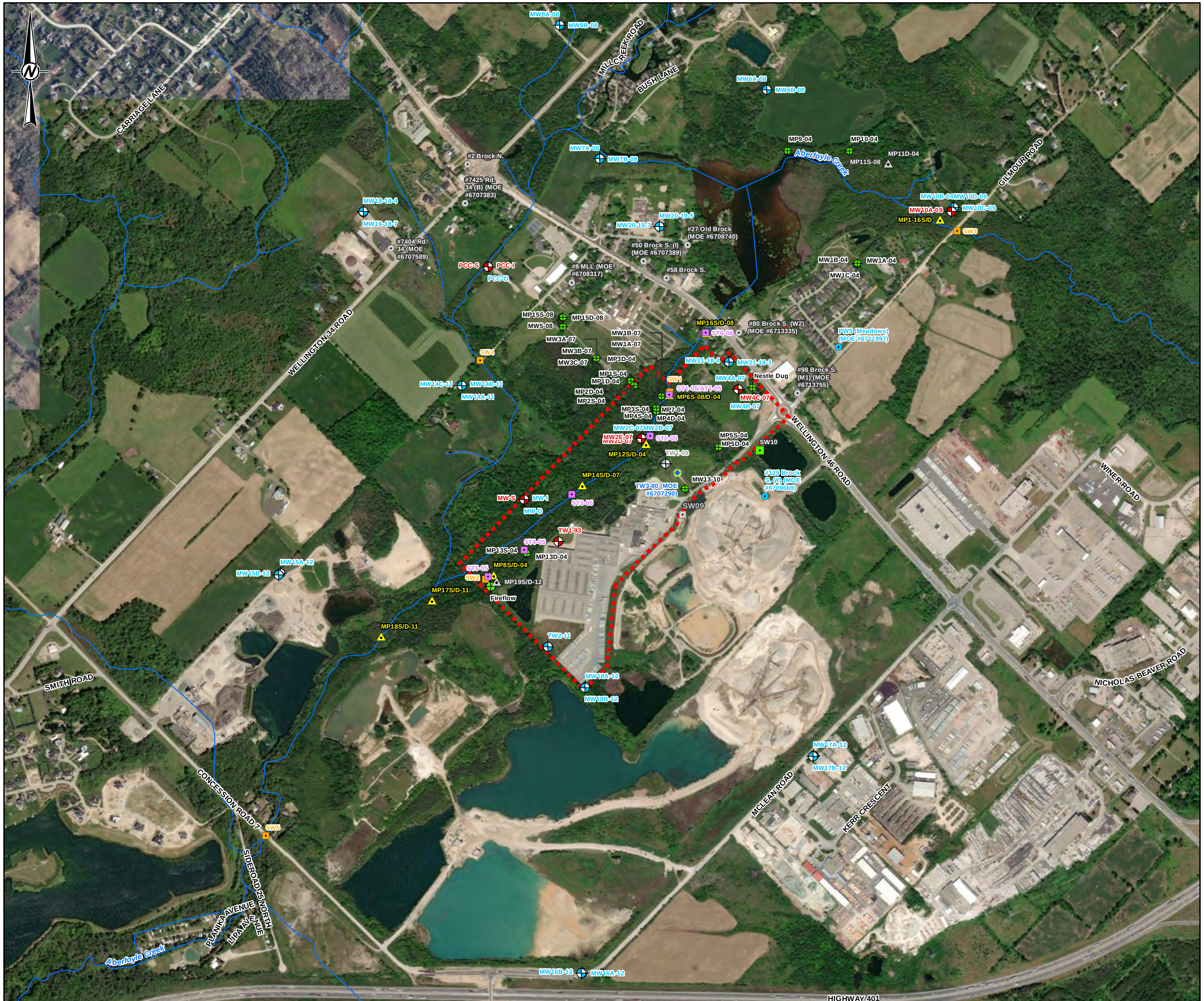
TITLE
2022 SURFACE WATER MONITORING LOCATIONS

CONSULTANT: WSP

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	3.3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Decommissioned
- Surface Water Station (not monitored)
- Monitoring Well (Overburden - not monitored)
- Piezometer (not monitored)
- Private Well (Bedrock - not monitored)
- Surface Water Station (Destroyed)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
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CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

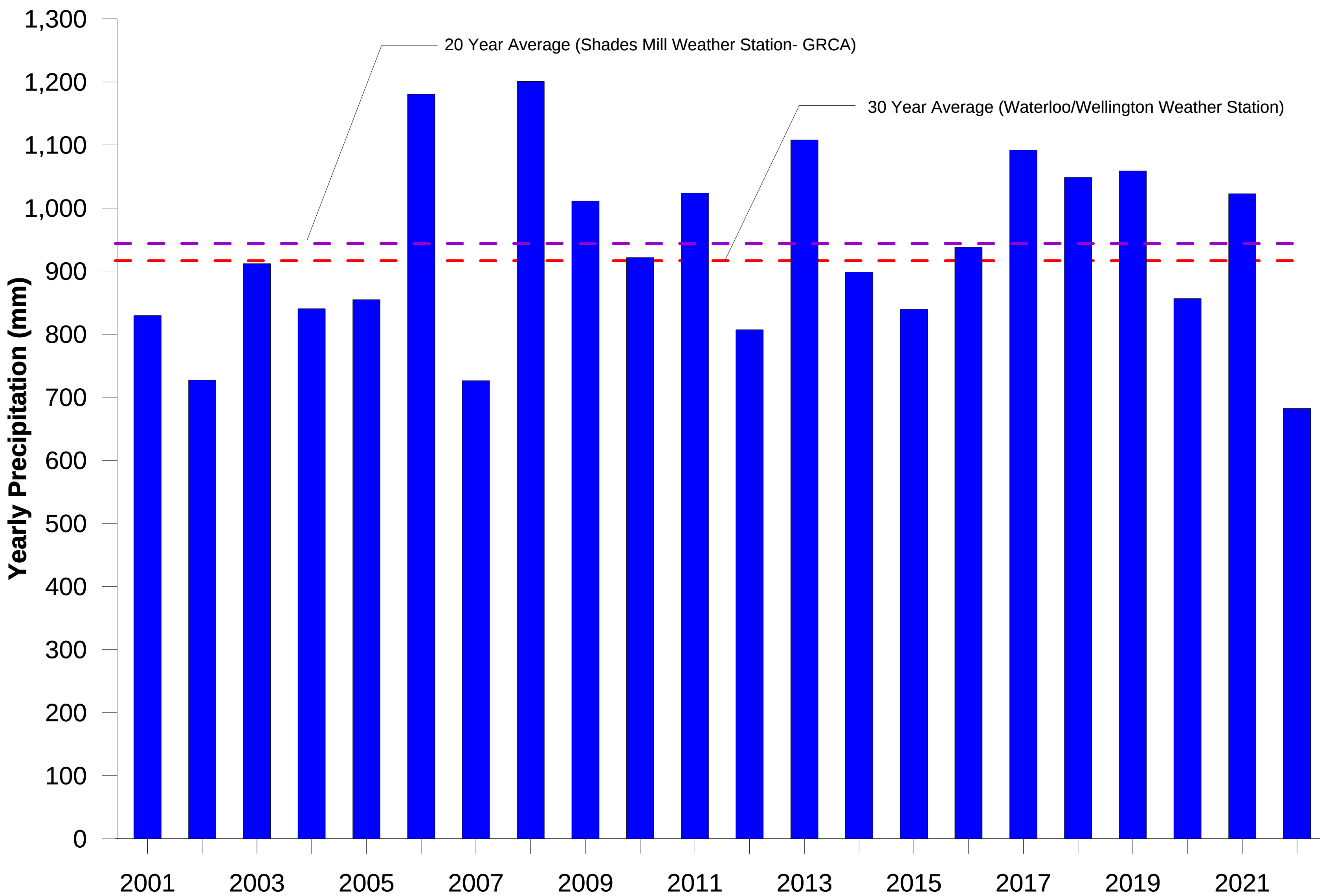
TITLE
WELL LOCATIONS

CONSULTANT

wsp

YYYY-MM-DD	2021-01-25
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449109	0019	1.0	3.4

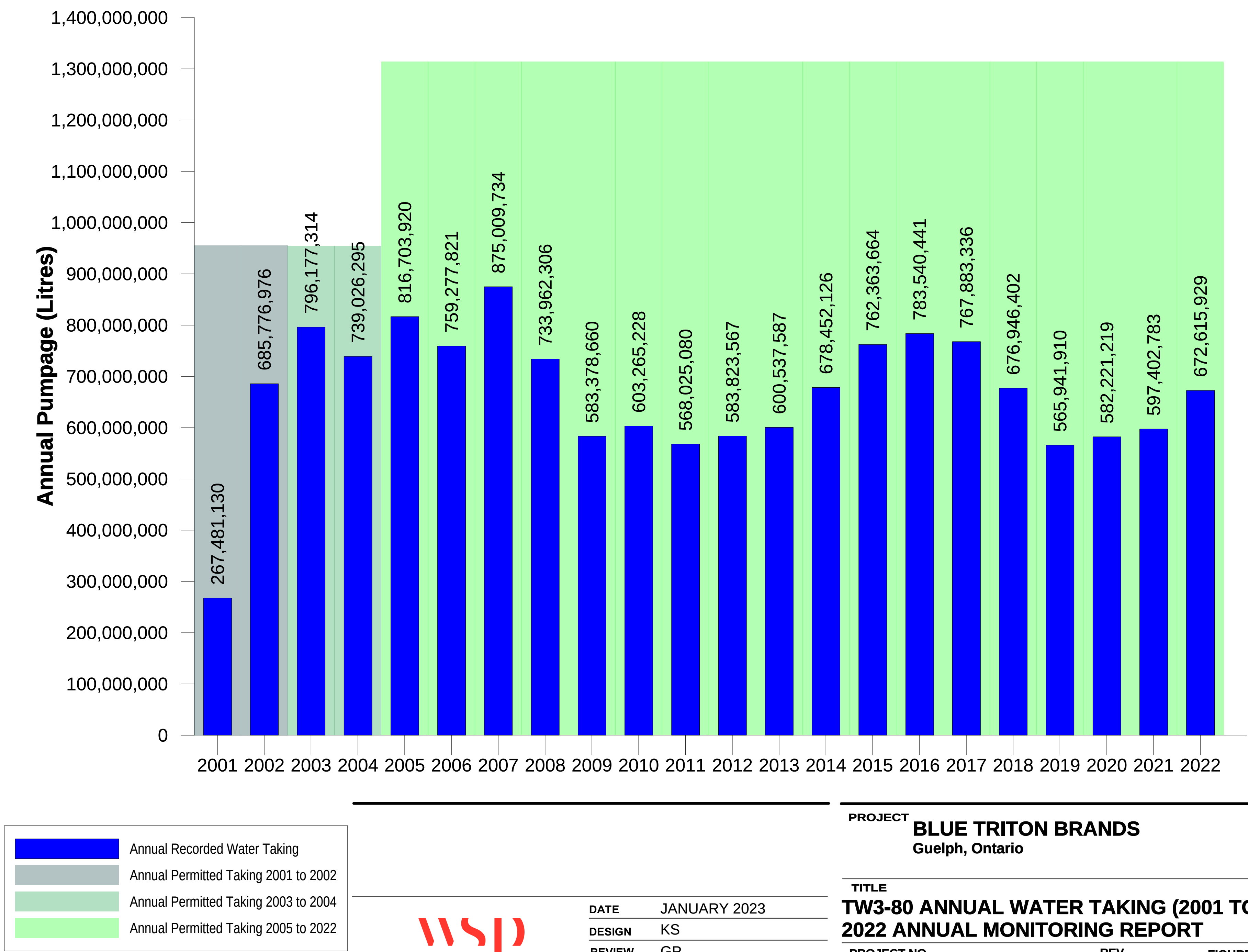


DATE	JANUARY 2023
DESIGN	SK
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Guelph, Ontario

TITLE
HISTORICAL YEARLY PRECIPITATION (2001 TO 2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1000)	A	3.5

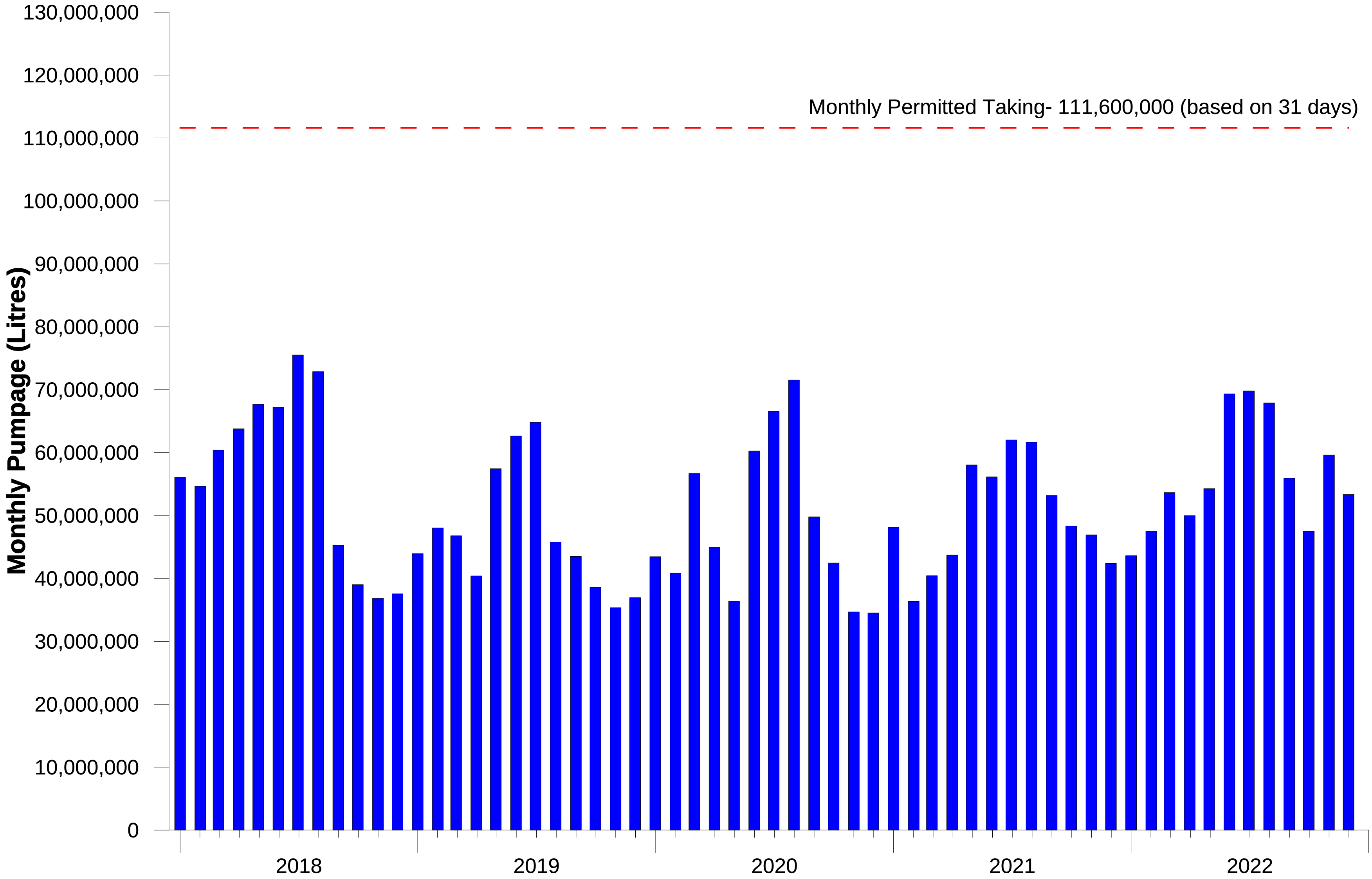


DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Guelph, Ontario

TITLE
TW3-80 ANNUAL WATER TAKING (2001 TO 2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	4.1



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

BLUE TRITON BRANDS
Guelph, Ontario

TITLE

TW3-80 MONTHLY WATER TAKING (2018 TO 2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	4.2

LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- 311.5 Water Level ELevation (July 24, 2022)
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF LOWER BEDROCK AQUIFER (JULY 2022)

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	4.3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- Water Elevation Contour (masl)
- 311.5 Water Level Elevation (July 24, 2022)
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF UPPER BEDROCK AQUIFER (JULY 2022)

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	ST
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	**4.4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

LEGEND

- Production Well
- Monitoring Well (Overburden)
- Watercourse
- Water Elevation Contour (masl)
- 311.4 Water Level Elevation (July 24, 2022)
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF OVERBURDEN (JULY 2022)

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	JMC
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	4.5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

LEGEND

- Piezometer
- Surface Water Station
- Watercourse
- 311.5 Water Level Elevation (July 20, 2022)
- Property Boundary

0 200 400 600 800 1,000

SCALE: 1:12,500 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
BLUE TRITON BRANDS

PROJECT
2022 ANNUAL REPORT

TITLE
SURFACE WATER ELEVATIONS (JULY 2022)

CONSULTANT

wsp

YYYY-MM-DD	2023-01-30
DESIGNED	JMC
PREPARED	SA
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
20449101	0019	1.0	4.6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

APPENDIX A

Permit to Take Water Number 3133-C5BUH9

Ministry of the Environment, Conservation and Parks
Environmental Assessment and Permissions Division
Brownfields and Permit to Take Water
Permit To Take Water Unit
Floor 1, 135 St Clair Ave W
Toronto, ON
M4V 1P5
Tel: (289) 830-5867

Ministère de l'Environnement, de la Protection de la nature et des Parcs
Division des évaluations et des permissions environnementales
Réaménagement des friches contaminées et réglementation des prélèvements d'eau
Unité de la réglementation des prélèvements d'eau
1er étage, 135 av St. Clair O
Toronto, ON
M4V 1P5
Tél:(289) 830-5867

Ontario

November 15, 2021

Triton Water Canada Holdings, Inc.
101 Brock Rd S
Puslinch, Ontario, N0B 2J0
Canada

Dear Andreanne Simard:

RE: Permit To Take Water No. 3133-C5BUH9
101 Brock Rd S, Puslinch, County of Wellington
Reference Number 3572-A8XGCE

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water, dated April 1, 2016 and signed by Andreanne Simard.

This Permit expires on November 15, 2026. Authorized rates and amounts are indicated on Table A. This Permit cancels and replaces Permit Number 1381-95ATPY, issued on December 19, 2013

Section 9(3) of Ontario Regulation 387/04 (Water Taking and Transfer) requires all holders of a permit to report daily water taking amounts annually, in a manner and form approved by the Director (https://www.lrcsde.lrc.gov.on.ca/wtrs/). For the purpose of s. 9(3), such reports shall be submitted electronically to the Water Taking Reporting System (WTRS) electronic database or via hard copy, as described in the Technical Bulletin entitled "Permit to Take Water Program Monitoring and Reporting of Water Takings", dated November 2010, PIBs 6003e (https://archive.org/details/std01079790.ome/mode/2up).

If you have questions about reporting requirements, please call the WTRS Help Desk at 416-235-6322 (toll free: 1-877-344-2011) or by email, WTRSHelpdesk@ontario.ca. It is preferred that you submit your data directly and electronically to the WTRS. Where this is impracticable, please contact the WTRS Help Desk to arrange for written submission of your data.

Condition 1.4 specifically indicates that this Permit is not transferable to another party. Any queries regarding a change in owner/operator should be made to the Permit to Take Water Evaluator at the above address.

Take notice that in issuing this Permit, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

Gregory Meek
Supervisor (Acting), Permit To Take Water
Director, Section 34.1, Ontario Water Resources Act, R.S.O. 1990
Environmental Permissions Branch

File Storage Number: -

PERMIT TO TAKE WATER
Ground Water
NUMBER 3133-C5BUH9

Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

Triton Water Canada Holdings, Inc.
101 Brock Rd S
Puslinch, Ontario
N0B 2J0

For the water taking from: One Drilled Well (TW3-80)

Located at: 101 Brock Rd S
Puslinch, County of Wellington

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.

(d) "District Office" means the Guelph District Office.

(e) "Permit" means this Permit to Take Water No. 3133-C5BUH9 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means Triton Water Canada Holdings, Inc..

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated April 1, 2016 and signed by Andreanne Simard , and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act* , R.S.O. 1990, the *Pesticides Act* , R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals
The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 **Expiry**

This Permit expires on **November 15, 2026**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	TW3-80	Well Drilled	Bottled Water	Commercial	2,500	24	3,600,000	365	17 569053 4812797
						Total Taking:	3,600,000		

3.3 It is the responsibility of the Permit Holder to keep advised of any Low Water Advisory within the jurisdiction of the Grand River Conservation Authority. For the purpose of this condition, Low Water Advisory means a Level 1, Level 2, or Level 3 low water condition as defined by the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) in their Low Water Response Program, as may be amended from time to time by the MNDMNRF.

When a Low Water Advisory exists within the Grand River Conservation Authority watershed, the Permit Holder shall undertake measures outlined in the Low Water Response Plan, as described in **Item 6** of **Schedule A**.

4. Monitoring

4.1 Under section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the *Ontario Water Resources Act* , the Permit Holder shall, on each day water is taken under the authorization of this Permit, record the date, the volume of water taken on that date and the rate at which it was taken. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director. The Permit Holder shall keep all records required by this condition current and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31st in every year, the records required by this condition to the ministry's Water Taking Reporting System.

4.2 The Permit Holder shall establish the following groundwater monitoring program for the duration of the Permit:

Bedrock Wells
(i) Continuous monitoring of groundwater levels in the following bedrock and overburden monitoring wells:

Upper Bedrock
- MW2C-07
- MW4B-07

- MW-D
- PCC-D
- MW6B-08
- MW7B-08
- MW8B-08
- MW10B-09
- MW14B-11
- MW14C-11
- MW15B-12
- MW16B-12
- MW17B-12
- MW18B-12
- MW19-18-7
- MW20-19-7
- MW21-18-4
- Private well "Y" MOE WWR #67-09669 (continuous monitoring is subject to owner's concurrence)
- MW-I

Lower bedrock

- TW3-80 (67-07290)
- TW2-11
- MW2A-07
- MW2B-07
- MW4A-07
- MW6A-07
- MW7A-08
- MW8A-08
- MW10C-09
- MW-10D-09
- MW14A-11
- MW15A-12
- MW16A-12
- MW17A-12
- MW18A-12
- MW19-18-4
- MW20-19-5
- MW21-18-3
- PW5 (continuous monitoring is subject to owner's concurrence)

Overburden Wells

- TW1-93
- MW-S
- PCC-S
- PCC-I

- MW2D-07
- MW2E-07
- MW4C-07
- MW10A-09

4.3 The Permit Holder shall establish the following surface water monitoring program for the duration of the Permit:

Surface Water Levels

(i) Continuous monitoring of water levels at the following locations:

- SW1
- SW2

(ii) Monthly monitoring of water levels at the following locations:

- SW3
- SW4
- SW5

Stream Flow

(iii) Monthly monitoring of flow, encompassing a range of flow conditions, and the development of a stage-discharge curve at the following surface water locations:

- SW1
- SW2

Multi-level Piezometers

(iv) Continuous monitoring of multi-level piezometers at the following locations:

- MP16S/D-08
- MP6S-08/D -04
- MP12S/D-04
- MP14S/D-07
- MP8S/D-04
- MP1-16S/D
- MP17S/D-11
- MP18S/D-11

Temperature

(v) Continuous monitoring of temperature at the sediment-water interface at the following locations:

- ST6-08
- ST1-05/AT-01
- ST2-05
- ST3-05
- ST4-05
- ST5-05

4.4 The Permit Holder shall undertake wetland monitoring and redd surveys as recommended in "2010 Biological Monitoring Program Final Report" by C. Portt and Associates dated January 28, 2011. Results from the wetland and redd surveys shall be submitted to the Director as a part of the annual monitoring report required under Condition 4.7.

4.5 Continuous monitoring shall be datalogged at 60 minute intervals and downloaded quarterly, however, the daily minimum water levels can be used to evaluate the water level variation with respect to pumping to improve the data handling and presentation.

Where monthly monitoring data is datalogged, this data shall also be downloaded on a quarterly basis.

4.6 The Permit Holder shall identify to the Director in writing, within 15 days of any monthly monitoring event, any monitoring locations identified in Conditions 4.2 and 4.3 which become permantly inaccessible and/or abandoned along with a recommendation for replacement monitoring locations. This shall exclude wells that become temporarily inaccessible, i.e., due to frozen conditions. Upon approval of the Director the monitoring program shall be appropriately modified.

4.7 The Permit Holder shall submit to the Director, an annual monitoring report which present and interprets the monitoring data to be collected under the Terms and Conditions of this Permit. This report shall be prepared, signed and stamped by a licensed professional geoscientist or a licensed professional engineer specializing in hydrogeology who shall take responsibility for its accuracy. Surface water impact assessment shall be conducted by a qualified surface water scientist who shall co-sign the report as responsibility for the accuracy of the surface water portion. The report shall be submitted to the Director by March 31 of each calendar year and include monitoring data for the 12 month period ending December 31 of the previous year.

4.8 The Permit Holder shall submit to the Director as part of the annual monitoring report, details of the bottling operations involved with water taking under this Permit to Take Water to indicate compliance with OWRA Section 34.3. These details shall include:

- Location and name of the facilities to which water is delivered in bulk containers greater than 20 L from this source,
- If the bulk water is containerized at the receiving location,
- The size of container(s) into which the water is transferred at the receiving location, and
- Total volume of the water transported in bulk in each calendar year to each remote facility.

4.9.1 Prior to December 31, 2021, the Permit Holder shall establish a publicly accessible internet Website, with no user, access or registration fees, and shall maintain the website for the duration of this permit. Following the establishment of the Website, the Permit Holder shall notify the Director in writing, of the Website URL address.

4.9.2 By December 31, 2021, the Permit Holder shall upload and make available for download the following information:

- all technical documentation submitted to support the Permit To Take Water application, items listed in Schedule A of this Permit;
- a plain language executive summary of the water taking activity; and,
- the well interference protocol.

4.9.3 By March 31 of each calendar year (until March 31, 2027) the Permit Holder shall upload and make available for download the following information to the Website:

- the monitoring report required by Condition 4.7 for the 12-month period ending December 31 of the previous year.
- The daily water taking records collected as required by Condition 4.1, uploaded in a suitable electronic format (e.g. Microsoft Excel) for the 12-month period ending December 31 of the previous year.

4.10 By September 30 of each calendar year (until September 30, 2027), the Permit Holder shall host an annual stakeholder meeting. The meeting will provide an opportunity for the Permit Holder to inform stakeholders of the Permit and the results of the annual monitoring report (for the 12-month period ending December 31 of the previous year), to receive submissions from stakeholders and the public, and to answer questions concerning the water taking.

The Permit Holder shall also directly notify the following stakeholders:

- The Director
- The City of Guelph
- The Grand River Conservation Authority
- Credit Valley Conservation Authority
- The Township of Puslinch
- The Six Nations of the Grand River
- The Mississaugas of the New Credit First Nation
- The Haudenosaunee Confederacy Chiefs Council (via the Haudenosaunee Development Institute)
- The Wellington Water Watchers
- Council of Canadians

The meeting may be held virtually and/or at suitable accessible and public venue within the County of Wellington.

A copy of the meeting invitations, agenda and minutes shall be submitted to the Director within 30 days of the meeting.

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Groundwater Takings

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

6.1 Subsection 4 (4) in the Water Taking and Transfer Regulation (Ontario Regulation 387/04) ("Regulation") sets out priorities of water use that the Director will take into account as a last resort to avoid or resolve conflict among water users in the event of a shortage of water resources in an area. The four priority of use categories set out in subsection 4 (2) of the regulation, are as follows:

- Priority 1 – Environment, drinking water, and Farm animal production;
- Priority 2 – Agricultural;
- Priority 3 – Industrial and commercial and other (including water bottling); and
- Priority 4 – Aesthetic

In the event of an urgent shortage of water resources in the Puslinch area, the Director may amend this Permit prioritize water takings in Priority categories 1 and 2.

The Director may also require the Permit Holder to investigate and resolve interferences that occur between existing water takings, working with the affected water users to identify potential solutions.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Minister of the Environment, Conservation and Parks, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Minister of the Environment, Conservation and Parks will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

a. The name of the appellant;
b. The address of the appellant;
c. The Permit to Take Water number;
d. The date of the Permit to Take Water;
e. The name of the Director;
f. The municipality within which the works are located;

This notice must be served upon:

The Secretary Environmental Review Tribunal 655 Bay Street, 15th Floor Toronto ON M5G 1E5 Fax: (416) 326-5370 Email: ERTTribunalsecretary@ontario.ca	*AND*	*The Minister of the Environment, Conservation and Parks 777 Bay Street, 5th Floor Toronto, Ontario M7J 2J3*	*AND*	*The Director, Section 34.1, Ministry of the Environment, Conservation and Parks Floor 1, 135 St Clair Ave W Toronto, ON M4V 1P5*

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

by Telephone at (416) 212-6349 Toll Free 1(866) 448-2248	by Fax at (416) 326-5370 Toll Free 1(844) 213-3474	by e-mail at www.ert.gov.on.ca

This instrument is subject to Section 38 of the ***Environmental Bill of Rights*** *that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

This Permit cancels and replaces Permit Number 1381-95ATPY, issued on 2013/12/19.

Dated at Toronto this 15th day of November, 2021.

Gregory Meek
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule "A" forms part of Permit To Take Water 3133-C5BUH9, dated November 15, 2021.

1. Report titled "Nestle Waters Canada – Aberfoyle, Technical Study for Permit to Take Water Renewal Application", signed by Greg Padusenko, M.Sc., P.Eng., P.Geo. and John Piesol, M.Sc., P.Eng. of Golder Associates Ltd., Christopher J. Neville, M.Sc., P.Eng. of S.S. Papadopulos & Associates, Inc. and Ken Ursic, M.Sc. of Beacon Environmental, dated June 2019.

2. Report titled "Nestle Waters of Canada Aberfoyle Site, 2020 Annual Monitoring Report", signed by Greg Padusenko, M.Sc. P.Eng., P.Geo, and Kevin MacKenzie, P.Eng. and John Piersol, M.Sc. P.Geo. of Golder Associates Limited, dated March 2021.

3. Memo titled "Nestle Waters Canada Aberfoyle 2016 Annual Monitoring Report", prepared by Sarah Day, Surface Water Specialist, Technical Support Section, West Central Region, Ministry of the Environment and Climate Change, dated September 18, 2017.

4. Report titled "Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fish: 2006 to 2020:, signed by Cam Portt and Jim Reid of C. Portt & Associates, dated February 2021.

5. Report titled "2020 Biological Monitoring Program, Nestle Waters Canada, Aberfoyle Property", signed by Anna Cunningham, B. Sc, and Ken Ursic, M. Sc. of Beacon Environmental Limited, dated February 2021. Project No. 216114.

6. Technical Memorandum "Low Water Response Plan For Aberfoyle TW3-80" prepared by Greg Padusenko and John Piersol of Golder Associates Ltd., dated October 19, 2021, Project No. 20449101 (1000).

APPENDIX B

TW3-80 Borehole Log

Attachment 2

Project Name: ABERFOYLE FISHERIES
Job No. 979-653
Client: CUSTOM AGGREGATE
Borehole Type: 12" Ø Cable Tool
Location: Pit No. 1, Aberfoyle

Borehole No. TW3-80
Date Completed April 14/80
Geologist/Engineer A.V.N.
Elevation 1040.90, top of casing

Depth (Elev.)	Stratigraphy	Description & Remarks	Sample: Number	Sample: Type	Sample: Blows/Foot	Penetration Test Blows/Foot (20 40 60 80)	Piezometer or Standpipe Installation
0 (1039)		(316.7 m amsl) Brown clayey-silt till containing some sand and small gravel (304.5 m amsl)					12" Ø steel casing to rock grouted to 20' from surface
40							
45		fine - medium sand (303.0 m amsl)					
48		fine sand matrix w/sand and gravel (302.1 m amsl)					12" Ø Drive shoe seated into rock
		Eramosa member of the Guelph formation * Black dolomite slightly crystalline solid (292.3 m amsl)					
80 (959)		Saw Wiarton formation of the Amabel Group light - medium grey dolomite slightly crystalline fractured water bearing zone (274.3 m amsl)					12" Ø Open hole in rock
139 (900)		N.B. Static level, 11.42 ft. below top of casing on April 15/80 ELEV. = 1029.48					

FIGURE 2.3

* Based on driller's log, Guelph Fm. interpreted to occur from El. 302.1 to 299.9 m amsl. Eramosa from 299.9 to 292.3 m amsl.

Conestoga - Rovers & Associates

Ministry of the Environment

Ontario

The Ontario Water Resources Act

WATER WELL RECORD

TW #3/80

MOE # 67-07290

County or District	Township / Town / Village	Con.	Lot
Wellington	Puslinch	Con 7	23, 2

Owner	Address	Date Completed
Elliott, Mr. John	R.R. #3, Guelph, Ontario.	14 Apr. 8

LOG OF OVERBURDEN AND BEDROCK MATERIALS

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
Brown	Clay	Stones		0	20
Brown	" sand	Gravels		20	47
M. Br.		Rock		47	55
D. Br.		Rock		55	75
Black		Rock		75	85
M. Br.		Rock		85	95
Grey & Br.		Rock		95	135
D. Grey		Rock		135	139
	TW #3/80	Total Depth			139

12" shoe

WATER RECORD

Water Found at Feet	Kind of Water
55	Fresh
93	Fresh
130	Fresh

CASING & OPEN HOLE RECORD

Inside Diam. Inches	Material	Wall Thickness Inches	Depth From	Depth To
12"	Steel	.250	0	48
12	Open hole		48	139

PLUGGING & SEALING RECORD

Depth Set at – From	To	Material and Type
102	118	Cement
118	120	Bentonite Grout
120	139	Limestone Gravel

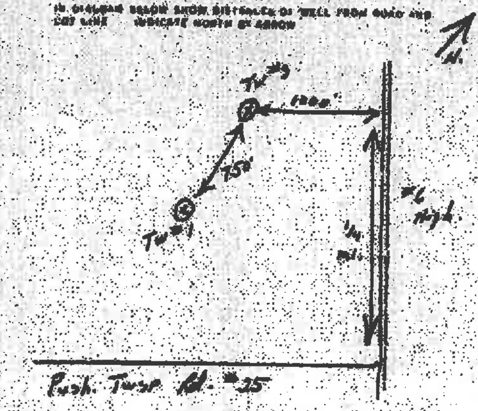
PUMPING TEST

Pump · Rate 1200 GPM · Duration 24 hours

Static level 11' 6" · Water level end of pumping 50 · 11' 6"

Recommended pumping rate 1200 · Recommended pump setting 100

LOCATION OF WELL



FINAL STATUS OF WELL: Water supply

WATER USE: Commercial

METHOD OF DRILLING: Cable tool

CONTRACTOR

Name of Well Contractor	Licence Number
Graham Well Drilling Ltd.	2936

Address: Guelph, Ont.

Name of Driller: J. Hawkins 22w

Submission date: 30 Apr. 80

CONTRACTOR'S COPY

APPENDIX C

TW3-80 Water Taking

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	**Volume** (US gpd)	**Average Flow Rate Over Time Taken** (US gpm)	**Volume** (L/day)	**Average Flow Rate Over Time Taken** (L/min)
01-Jan-22	56,828	39	215,118	149.4
02-Jan-22	69,990	49	264,941	184.0
03-Jan-22	384,561	267	1,455,722	1010.9
04-Jan-22	579,720	403	2,194,478	1523.9
05-Jan-22	518,380	360	1,962,281	1362.7
06-Jan-22	494,446	343	1,871,682	1299.8
07-Jan-22	480,624	334	1,819,359	1263.4
08-Jan-22	310,811	216	1,176,545	817.0
09-Jan-22	409,536	284	1,550,263	1076.6
10-Jan-22	438,713	305	1,660,709	1153.3
11-Jan-22	376,204	261	1,424,085	988.9
12-Jan-22	323,506	225	1,224,604	850.4
13-Jan-22	347,380	241	1,314,976	913.2
14-Jan-22	357,379	248	1,352,825	939.5
15-Jan-22	268,855	187	1,017,726	706.8
16-Jan-22	355,044	247	1,343,988	933.3
17-Jan-22	291,322	202	1,102,775	765.8
18-Jan-22	309,330	215	1,170,940	813.2
19-Jan-22	497,661	346	1,883,849	1308.2
20-Jan-22	399,089	277	1,510,717	1049.1
21-Jan-22	297,858	207	1,127,514	783.0
22-Jan-22	368,981	256	1,396,746	970.0
23-Jan-22	343,408	238	1,299,941	902.7
24-Jan-22	302,229	210	1,144,059	794.5
25-Jan-22	351,351	244	1,330,008	923.6
26-Jan-22	428,134	297	1,620,662	1125.5
27-Jan-22	455,583	316	1,724,570	1197.6
28-Jan-22	377,174	262	1,427,757	991.5
29-Jan-22	465,125	323	1,760,688	1222.7
30-Jan-22	435,747	303	1,649,479	1145.5
31-Jan-22	429,499	298	1,625,829	1129.0

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Feb-22	407,287	283	1,541,750	1070.7
02-Feb-22	376,240	261	1,424,222	989.0
03-Feb-22	535,192	372	2,025,921	1406.9
04-Feb-22	489,899	340	1,854,470	1287.8
05-Feb-22	589,738	410	2,232,398	1550.3
06-Feb-22	491,993	342	1,862,395	1293.3
07-Feb-22	429,769	298	1,626,851	1129.8
08-Feb-22	461,278	320	1,746,128	1212.6
09-Feb-22	415,561	289	1,573,070	1092.4
10-Feb-22	473,749	329	1,793,335	1245.4
11-Feb-22	457,882	318	1,733,269	1203.7
12-Feb-22	479,785	333	1,816,183	1261.2
13-Feb-22	505,387	351	1,913,097	1328.5
14-Feb-22	422,237	293	1,598,340	1110.0
15-Feb-22	399,760	278	1,513,257	1050.9
16-Feb-22	332,021	231	1,256,836	872.8
17-Feb-22	438,662	305	1,660,516	1153.1
18-Feb-22	378,385	263	1,432,342	994.7
19-Feb-22	408,245	284	1,545,373	1073.2
20-Feb-22	463,800	322	1,755,675	1219.2
21-Feb-22	481,529	334	1,822,785	1265.8
22-Feb-22	335,348	233	1,269,431	881.5
23-Feb-22	358,456	249	1,356,903	942.3
24-Feb-22	492,448	342	1,864,119	1294.5
25-Feb-22	457,036	317	1,730,067	1201.4
26-Feb-22	504,756	351	1,910,709	1326.9
27-Feb-22	461,363	320	1,746,449	1212.8
28-Feb-22	507,262	352	1,920,195	1333.5

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Mar-22	486,696	338	1,842,345	1279.4
02-Mar-22	500,292	347	1,893,810	1315.1
03-Mar-22	476,530	331	1,803,862	1252.7
04-Mar-22	499,481	347	1,890,739	1313.0
05-Mar-22	534,664	371	2,023,924	1405.5
06-Mar-22	507,512	352	1,921,143	1334.1
07-Mar-22	505,451	351	1,913,340	1328.7
08-Mar-22	513,573	357	1,944,083	1350.1
09-Mar-22	415,559	289	1,573,060	1092.4
10-Mar-22	385,250	268	1,458,331	1012.7
11-Mar-22	489,577	340	1,853,249	1287.0
12-Mar-22	477,598	332	1,807,905	1255.5
13-Mar-22	475,875	330	1,801,384	1251.0
14-Mar-22	426,345	296	1,613,891	1120.8
15-Mar-22	349,653	243	1,323,578	919.2
16-Mar-22	405,138	281	1,533,613	1065.0
17-Mar-22	559,393	388	2,117,531	1470.5
18-Mar-22	351,951	244	1,332,280	925.2
19-Mar-22	415,592	289	1,573,188	1092.5
20-Mar-22	345,219	240	1,306,795	907.5
21-Mar-22	388,927	270	1,472,247	1022.4
22-Mar-22	508,108	353	1,923,398	1335.7
23-Mar-22	447,459	311	1,693,815	1176.3
24-Mar-22	553,831	385	2,096,476	1455.9
25-Mar-22	455,558	316	1,724,475	1197.6
26-Mar-22	500,454	348	1,894,422	1315.6
27-Mar-22	492,942	342	1,865,989	1295.8
28-Mar-22	394,081	274	1,491,758	1035.9
29-Mar-22	396,121	275	1,499,482	1041.3
30-Mar-22	551,728	383	2,088,517	1450.4
31-Mar-22	364,772	253	1,380,812	958.9

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Apr-22	499,770	347	1,891,835	1313.8
02-Apr-22	489,418	340	1,852,649	1286.6
03-Apr-22	482,365	335	1,825,948	1268.0
04-Apr-22	487,454	339	1,845,212	1281.4
05-Apr-22	436,713	303	1,653,139	1148.0
06-Apr-22	446,579	310	1,690,485	1173.9
07-Apr-22	434,157	301	1,643,461	1141.3
08-Apr-22	516,699	359	1,955,918	1358.3
09-Apr-22	351,002	244	1,328,688	922.7
10-Apr-22	343,882	239	1,301,735	904.0
11-Apr-22	380,265	264	1,439,459	999.6
12-Apr-22	255,293	177	966,389	671.1
13-Apr-22	310,890	216	1,176,844	817.3
14-Apr-22	413,142	287	1,563,914	1086.1
15-Apr-22	381,526	265	1,444,231	1002.9
16-Apr-22	464,031	322	1,756,546	1219.8
17-Apr-22	508,957	353	1,926,610	1337.9
18-Apr-22	396,434	275	1,500,666	1042.1
19-Apr-22	439,994	306	1,665,556	1156.6
20-Apr-22	349,893	243	1,324,489	919.8
21-Apr-22	307,567	214	1,164,268	808.5
22-Apr-22	519,346	361	1,965,936	1365.2
23-Apr-22	490,348	341	1,856,170	1289.0
24-Apr-22	489,125	340	1,851,540	1285.8
25-Apr-22	445,490	309	1,686,361	1171.1
26-Apr-22	572,355	397	2,166,598	1504.6
27-Apr-22	537,933	374	2,036,297	1414.1
28-Apr-22	467,780	325	1,770,738	1229.7
29-Apr-22	426,127	296	1,613,064	1120.2
30-Apr-22	564,519	392	2,136,935	1484.0

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-May-22	566,627	393	2,144,915	1489.5
02-May-22	538,578	374	2,038,737	1415.8
03-May-22	506,560	352	1,917,536	1331.6
04-May-22	523,547	364	1,981,840	1376.3
05-May-22	359,142	249	1,359,500	944.1
06-May-22	418,723	291	1,585,038	1100.7
07-May-22	379,964	264	1,438,318	998.8
08-May-22	448,713	312	1,698,561	1179.6
09-May-22	300,233	208	1,136,505	789.2
10-May-22	359,418	250	1,360,544	944.8
11-May-22	389,524	271	1,474,506	1024.0
12-May-22	299,762	208	1,134,723	788.0
13-May-22	340,922	237	1,290,531	896.2
14-May-22	393,356	273	1,489,013	1034.0
15-May-22	376,330	261	1,424,565	989.3
16-May-22	323,716	225	1,225,397	851.0
17-May-22	443,035	308	1,677,067	1164.6
18-May-22	555,742	386	2,103,713	1460.9
19-May-22	422,380	293	1,598,880	1110.3
20-May-22	531,374	369	2,011,468	1396.9
21-May-22	585,206	406	2,215,245	1538.4
22-May-22	511,594	355	1,936,593	1344.9
23-May-22	464,023	322	1,756,516	1219.8
24-May-22	583,326	405	2,208,127	1533.4
25-May-22	639,830	444	2,422,020	1682.0
26-May-22	600,601	417	2,273,522	1578.8
27-May-22	519,595	361	1,966,881	1365.9
28-May-22	461,127	320	1,745,555	1212.2
29-May-22	489,025	340	1,851,161	1285.5
30-May-22	562,186	390	2,128,104	1477.8
31-May-22	448,174	311	1,696,522	1178.1

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Jun-22	442,642	307	1,675,580	1163.6
02-Jun-22	531,293	369	2,011,163	1396.6
03-Jun-22	719,125	499	2,722,184	1890.4
04-Jun-22	655,636	455	2,481,852	1723.5
05-Jun-22	574,225	399	2,173,675	1509.5
06-Jun-22	573,875	399	2,172,351	1508.6
07-Jun-22	452,923	315	1,714,499	1190.6
08-Jun-22	613,368	426	2,321,850	1612.4
09-Jun-22	542,905	377	2,055,117	1427.2
10-Jun-22	585,278	406	2,215,518	1538.6
11-Jun-22	575,320	400	2,177,824	1512.4
12-Jun-22	633,454	440	2,397,883	1665.2
13-Jun-22	645,992	449	2,445,346	1698.2
14-Jun-22	666,775	463	2,524,018	1752.8
15-Jun-22	493,192	342	1,866,936	1296.5
16-Jun-22	558,348	388	2,113,575	1467.8
17-Jun-22	665,203	462	2,518,064	1748.7
18-Jun-22	640,403	445	2,424,187	1683.5
19-Jun-22	661,923	460	2,505,650	1740.0
20-Jun-22	656,202	456	2,483,993	1725.0
21-Jun-22	532,902	370	2,017,253	1400.9
22-Jun-22	481,195	334	1,821,518	1264.9
23-Jun-22	465,142	323	1,760,753	1222.7
24-Jun-22	508,286	353	1,924,071	1336.2
25-Jun-22	686,831	477	2,599,937	1805.5
26-Jun-22	738,988	513	2,797,373	1942.6
27-Jun-22	634,304	440	2,401,099	1667.4
28-Jun-22	822,039	571	3,111,753	2160.9
29-Jun-22	741,163	515	2,805,606	1948.3
30-Jun-22	821,877	571	3,111,141	2160.5

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Jul-22	784,638	545	2,970,177	2062.6
02-Jul-22	720,347	500	2,726,809	1893.6
03-Jul-22	747,937	519	2,831,248	1966.1
04-Jul-22	783,416	544	2,965,551	2059.4
05-Jul-22	718,337	499	2,719,200	1888.3
06-Jul-22	676,959	470	2,562,567	1779.6
07-Jul-22	651,413	452	2,465,865	1712.4
08-Jul-22	652,587	453	2,470,309	1715.5
09-Jul-22	659,798	458	2,497,606	1734.4
10-Jul-22	584,651	406	2,213,144	1536.9
11-Jul-22	581,106	404	2,199,724	1527.6
12-Jul-22	473,414	329	1,792,066	1244.5
13-Jul-22	511,585	355	1,936,557	1344.8
14-Jul-22	449,609	312	1,701,954	1181.9
15-Jul-22	442,635	307	1,675,554	1163.6
16-Jul-22	527,863	367	1,998,176	1387.6
17-Jul-22	608,829	423	2,304,667	1600.5
18-Jul-22	528,439	367	2,000,359	1389.1
19-Jul-22	484,384	336	1,833,593	1273.3
20-Jul-22	660,270	459	2,499,392	1735.7
21-Jul-22	615,872	428	2,331,330	1619.0
22-Jul-22	638,793	444	2,418,092	1679.2
23-Jul-22	537,181	373	2,033,450	1412.1
24-Jul-22	581,047	404	2,199,503	1527.4
25-Jul-22	572,181	397	2,165,941	1504.1
26-Jul-22	568,175	395	2,150,777	1493.6
27-Jul-22	509,228	354	1,927,636	1338.6
28-Jul-22	518,032	360	1,960,965	1361.8
29-Jul-22	519,485	361	1,966,465	1365.6
30-Jul-22	582,758	405	2,205,977	1531.9
31-Jul-22	548,418	381	2,075,988	1441.7

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Aug-22	606,162	421	2,294,570	1593.5
02-Aug-22	608,741	423	2,304,334	1600.2
03-Aug-22	529,474	368	2,004,277	1391.9
04-Aug-22	558,618	388	2,114,596	1468.5
05-Aug-22	606,946	421	2,297,541	1595.5
06-Aug-22	487,356	338	1,844,841	1281.1
07-Aug-22	570,291	396	2,158,785	1499.2
08-Aug-22	495,078	344	1,874,073	1301.4
09-Aug-22	548,898	381	2,077,803	1442.9
10-Aug-22	532,599	370	2,016,104	1400.1
11-Aug-22	501,529	348	1,898,492	1318.4
12-Aug-22	450,784	313	1,706,401	1185.0
13-Aug-22	631,056	438	2,388,804	1658.9
14-Aug-22	584,204	406	2,211,451	1535.7
15-Aug-22	525,818	365	1,990,438	1382.2
16-Aug-22	626,310	435	2,370,840	1646.4
17-Aug-22	645,356	448	2,442,938	1696.5
18-Aug-22	595,779	414	2,255,268	1566.2
19-Aug-22	638,231	443	2,415,964	1677.8
20-Aug-22	695,434	483	2,632,502	1828.1
21-Aug-22	657,769	457	2,489,926	1729.1
22-Aug-22	631,315	438	2,389,787	1659.6
23-Aug-22	540,587	375	2,046,342	1421.1
24-Aug-22	543,185	377	2,056,176	1427.9
25-Aug-22	553,951	385	2,096,932	1456.2
26-Aug-22	580,938	403	2,199,089	1527.1
27-Aug-22	630,970	438	2,388,482	1658.7
28-Aug-22	670,206	465	2,537,005	1761.8
29-Aug-22	620,943	431	2,350,525	1632.3
30-Aug-22	570,688	396	2,160,286	1500.2
31-Aug-22	502,468	349	1,902,048	1320.9

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Sep-22	483,049	335	1,828,539	1269.8
02-Sep-22	563,260	391	2,132,170	1480.7
03-Sep-22	496,720	345	1,880,287	1305.8
04-Sep-22	400,577	278	1,516,349	1053.0
05-Sep-22	490,659	341	1,857,345	1289.8
06-Sep-22	594,746	413	2,251,357	1563.4
07-Sep-22	391,009	272	1,480,131	1027.9
08-Sep-22	600,334	417	2,272,512	1578.1
09-Sep-22	371,896	258	1,407,778	977.6
10-Sep-22	434,676	302	1,645,427	1142.7
11-Sep-22	459,107	319	1,737,910	1206.9
12-Sep-22	524,642	364	1,985,985	1379.2
13-Sep-22	543,780	378	2,058,431	1429.5
14-Sep-22	581,977	404	2,203,021	1529.9
15-Sep-22	482,474	335	1,826,362	1268.3
16-Sep-22	484,316	336	1,833,336	1273.1
17-Sep-22	463,059	322	1,752,867	1217.3
18-Sep-22	587,733	408	2,224,812	1545.0
19-Sep-22	585,594	407	2,216,713	1539.4
20-Sep-22	457,619	318	1,732,275	1203.0
21-Sep-22	312,379	217	1,182,481	821.2
22-Sep-22	570,457	396	2,159,415	1499.6
23-Sep-22	555,574	386	2,103,074	1460.5
24-Sep-22	574,446	399	2,174,512	1510.1
25-Sep-22	512,530	356	1,940,137	1347.3
26-Sep-22	396,534	275	1,501,043	1042.4
27-Sep-22	541,776	376	2,050,842	1424.2
28-Sep-22	426,246	296	1,613,514	1120.5
29-Sep-22	465,977	324	1,763,913	1224.9
30-Sep-22	424,665	295	1,607,531	1116.3

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	**Volume** (US gpd)	**Average Flow Rate Over Time Taken** (US gpm)	**Volume** (L/day)	**Average Flow Rate Over Time Taken** (L/min)
01-Oct-22	531,808	369	2,013,112	1398.0
02-Oct-22	556,290	386	2,105,785	1462.4
03-Oct-22	437,081	304	1,654,532	1149.0
04-Oct-22	326,593	227	1,236,289	858.5
05-Oct-22	458,720	319	1,736,443	1205.9
06-Oct-22	485,341	337	1,837,216	1275.8
07-Oct-22	554,651	385	2,099,580	1458.0
08-Oct-22	573,912	399	2,172,493	1508.7
09-Oct-22	485,951	337	1,839,522	1277.4
10-Oct-22	391,276	272	1,481,140	1028.6
11-Oct-22	385,166	267	1,458,011	1012.5
12-Oct-22	438,417	304	1,659,588	1152.5
13-Oct-22	363,784	253	1,377,073	956.3
14-Oct-22	261,214	181	988,801	686.7
15-Oct-22	508,158	353	1,923,588	1335.8
16-Oct-22	466,919	324	1,767,481	1227.4
17-Oct-22	436,435	303	1,652,085	1147.3
18-Oct-22	402,185	279	1,522,436	1057.2
19-Oct-22	410,271	285	1,553,043	1078.5
20-Oct-22	457,701	318	1,732,585	1203.2
21-Oct-22	452,902	315	1,714,419	1190.6
22-Oct-22	430,450	299	1,629,431	1131.5
23-Oct-22	137,624	96	520,962	361.8
24-Oct-22	0	0	0	0.0
25-Oct-22	184,091	128	696,859	483.9
26-Oct-22	285,094	198	1,079,199	749.4
27-Oct-22	296,739	206	1,123,279	780.1
28-Oct-22	446,600	310	1,690,565	1174.0
29-Oct-22	457,637	318	1,732,342	1203.0
30-Oct-22	447,559	311	1,694,196	1176.5
31-Oct-22	482,424	335	1,826,174	1268.2

TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Nov-22	563,328	391	2,132,429	1480.9
02-Nov-22	490,576	341	1,857,031	1289.6
03-Nov-22	544,947	378	2,062,847	1432.5
04-Nov-22	524,721	364	1,986,283	1379.4
05-Nov-22	488,044	339	1,847,446	1282.9
06-Nov-22	440,823	306	1,668,694	1158.8
07-Nov-22	486,554	338	1,841,807	1279.0
08-Nov-22	426,376	296	1,614,009	1120.8
09-Nov-22	519,526	361	1,966,617	1365.7
10-Nov-22	584,805	406	2,213,728	1537.3
11-Nov-22	597,131	415	2,260,387	1569.7
12-Nov-22	587,555	408	2,224,136	1544.5
13-Nov-22	603,043	419	2,282,764	1585.3
14-Nov-22	488,749	339	1,850,117	1284.8
15-Nov-22	474,188	329	1,794,995	1246.5
16-Nov-22	480,867	334	1,820,277	1264.1
17-Nov-22	546,656	380	2,069,318	1437.0
18-Nov-22	594,844	413	2,251,730	1563.7
19-Nov-22	590,748	410	2,236,224	1552.9
20-Nov-22	561,802	390	2,126,652	1476.8
21-Nov-22	461,715	321	1,747,779	1213.7
22-Nov-22	408,116	283	1,544,887	1072.8
23-Nov-22	415,607	289	1,573,244	1092.5
24-Nov-22	619,141	430	2,343,704	1627.6
25-Nov-22	589,387	409	2,231,071	1549.4
26-Nov-22	578,954	402	2,191,580	1521.9
27-Nov-22	523,432	363	1,981,403	1376.0
28-Nov-22	542,108	376	2,052,099	1425.1
29-Nov-22	488,501	339	1,849,176	1284.2
30-Nov-22	531,361	369	2,011,419	1396.8

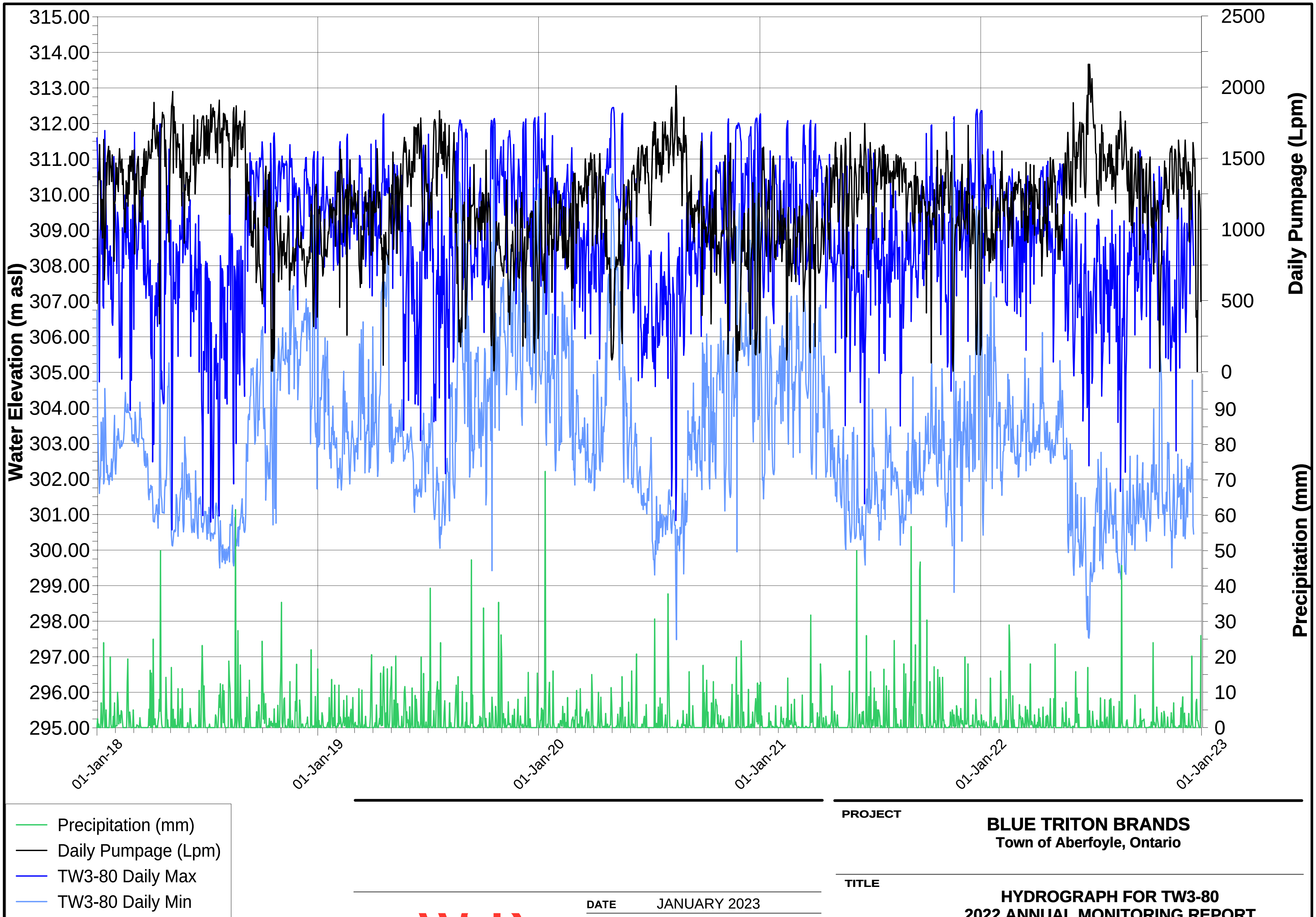
TABLE C1
TW3-80 DAILY WATER TAKING
BLUE TRITON BRANDS
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
01-Dec-22	502,030	349	1,900,388	1319.7
02-Dec-22	571,981	397	2,165,183	1503.6
03-Dec-22	461,780	321	1,748,026	1213.9
04-Dec-22	566,864	394	2,145,813	1490.1
05-Dec-22	619,211	430	2,343,968	1627.8
06-Dec-22	580,471	403	2,197,321	1525.9
07-Dec-22	541,458	376	2,049,640	1423.4
08-Dec-22	521,932	362	1,975,726	1372.0
09-Dec-22	487,306	338	1,844,654	1281.0
10-Dec-22	560,329	389	2,121,073	1473.0
11-Dec-22	542,646	377	2,054,136	1426.5
12-Dec-22	346,513	241	1,311,694	910.9
13-Dec-22	534,679	371	2,023,979	1405.5
14-Dec-22	527,801	367	1,997,943	1387.5
15-Dec-22	406,805	283	1,539,922	1069.4
16-Dec-22	495,401	344	1,875,297	1302.3
17-Dec-22	496,108	345	1,877,972	1304.1
18-Dec-22	612,643	425	2,319,103	1610.5
19-Dec-22	594,298	413	2,249,663	1562.3
20-Dec-22	549,258	381	2,079,166	1443.9
21-Dec-22	568,990	395	2,153,862	1495.7
22-Dec-22	457,444	318	1,731,614	1202.5
23-Dec-22	145,608	101	551,188	382.8
24-Dec-22	162,858	113	616,485	428.1
25-Dec-22	0	0	0	0.0
26-Dec-22	196,498	136	743,824	516.5
27-Dec-22	475,208	330	1,798,859	1249.2
28-Dec-22	484,474	336	1,833,934	1273.6
29-Dec-22	464,942	323	1,759,996	1222.2
30-Dec-22	430,682	299	1,630,306	1132.2
31-Dec-22	187,657	130	710,358	493.3

Notes:
1. All volumes measured with a flow meter and recorded on a datalogger.

APPENDIX D

Groundwater Level Monitoring



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

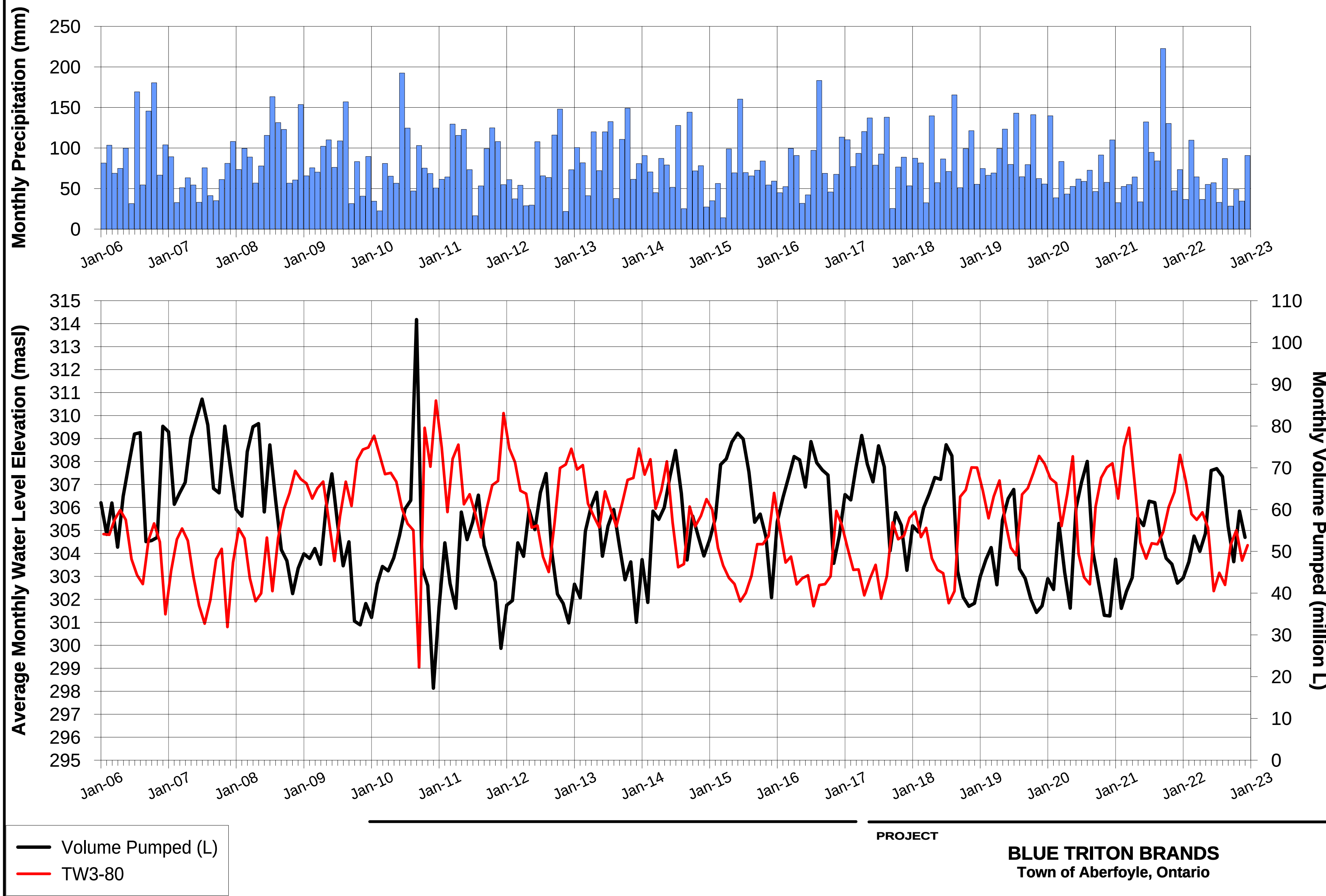
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

HYDROGRAPH FOR TW3-80
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D1a



PROJECT

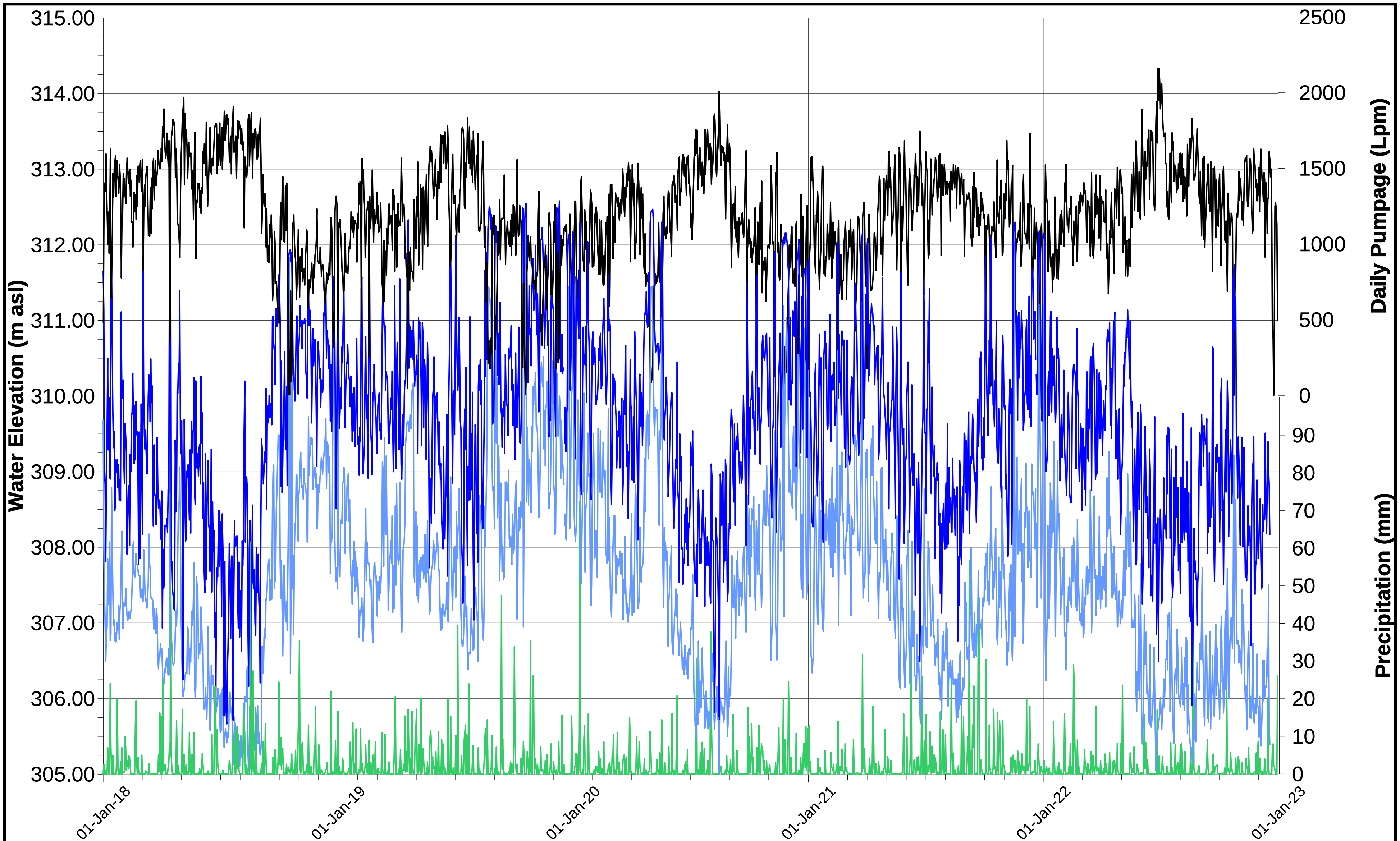
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVELS TW3-80
2022 ANNUAL MONITORING REPORT

DATE	JANUARY 2023
DESIGN	KJ
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D1b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

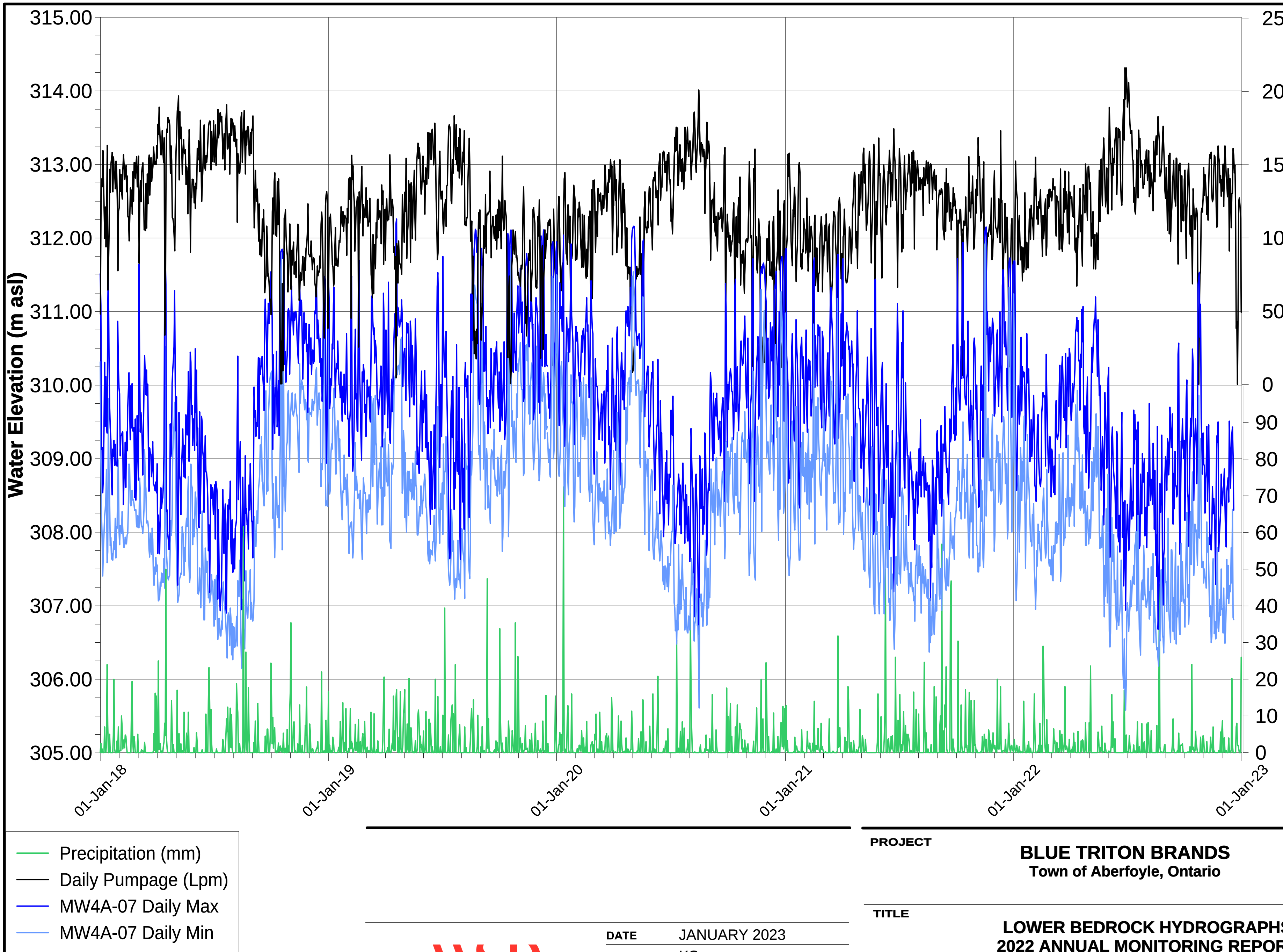
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D2



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

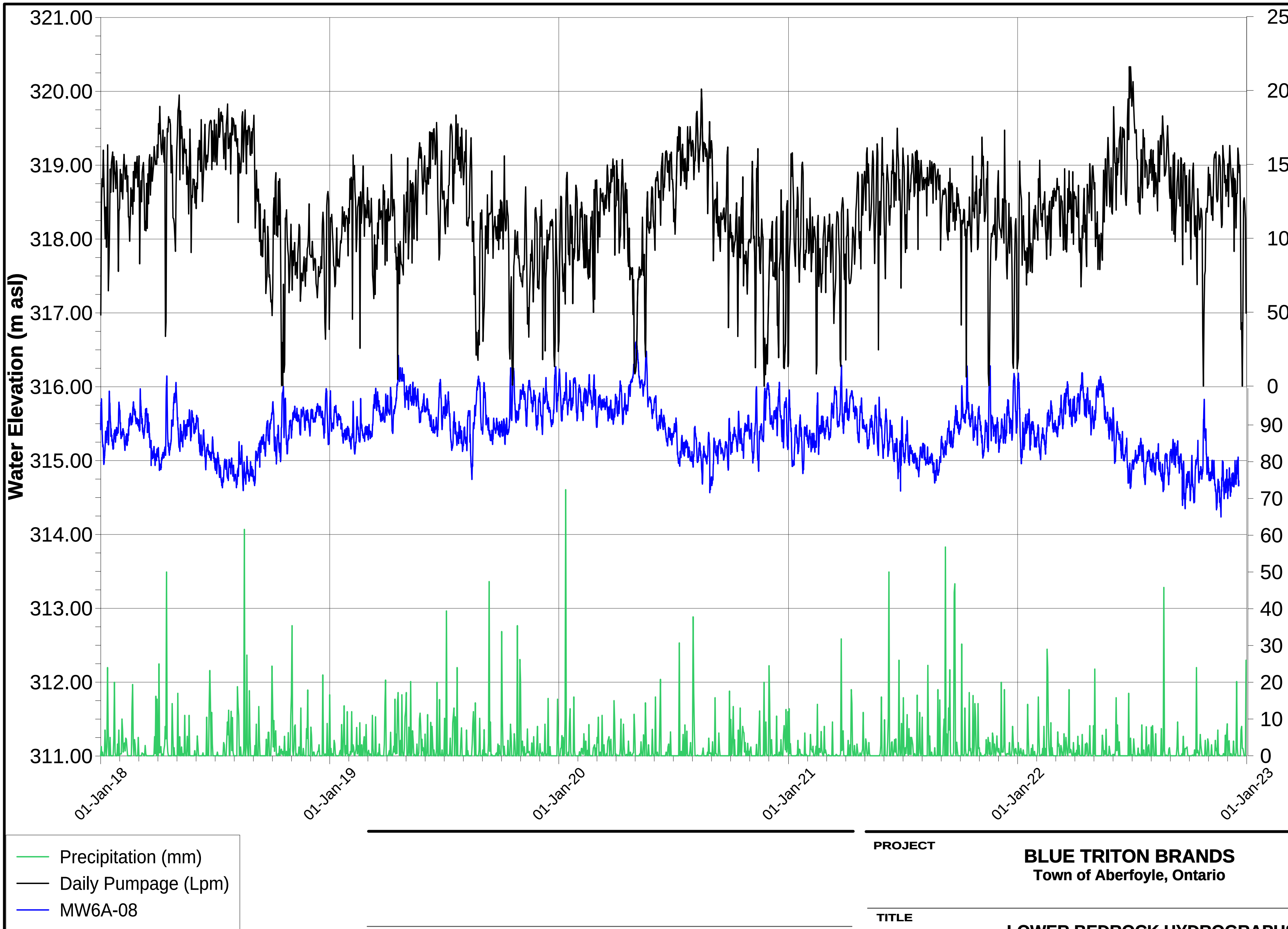
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D3



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

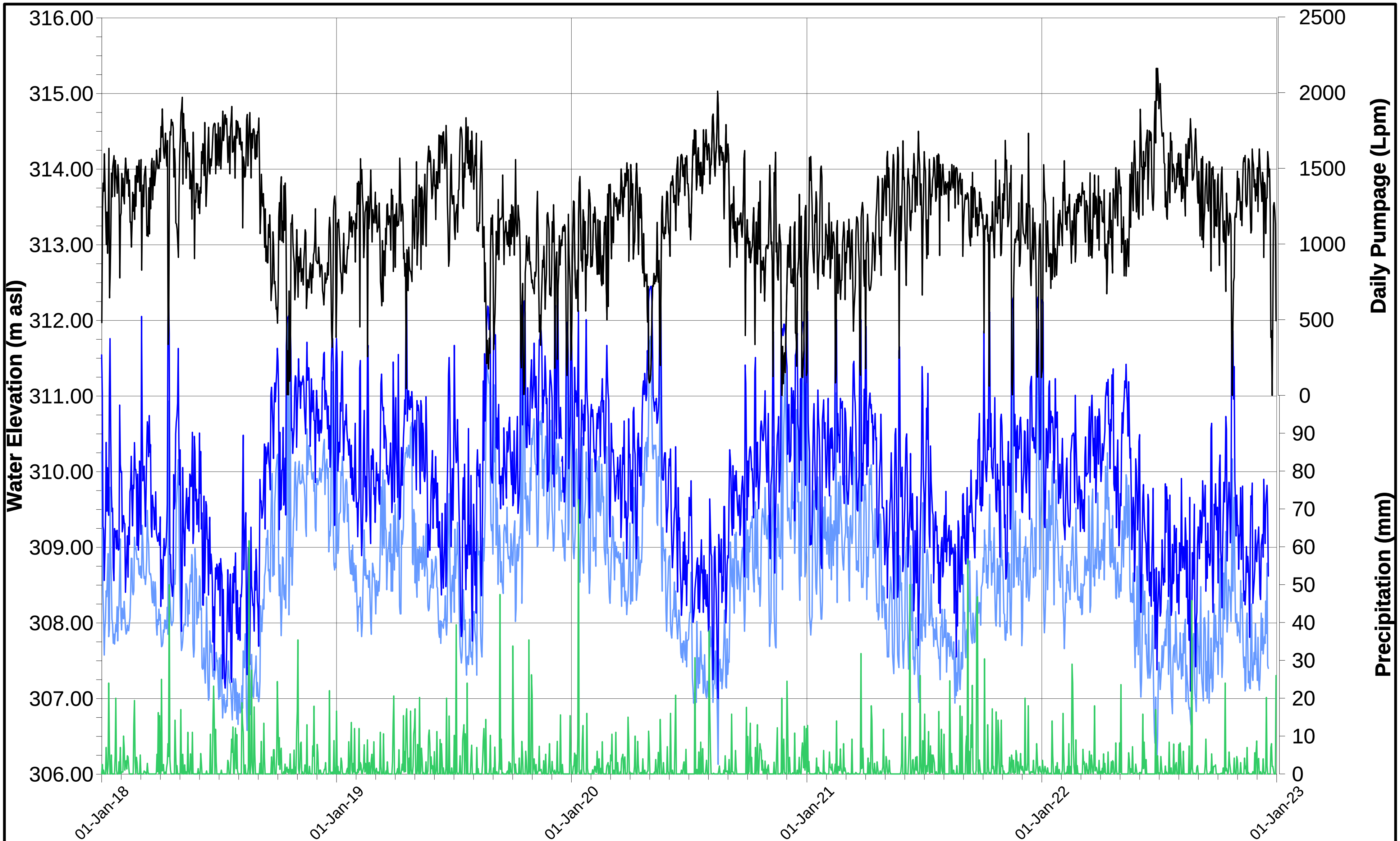
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D4



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

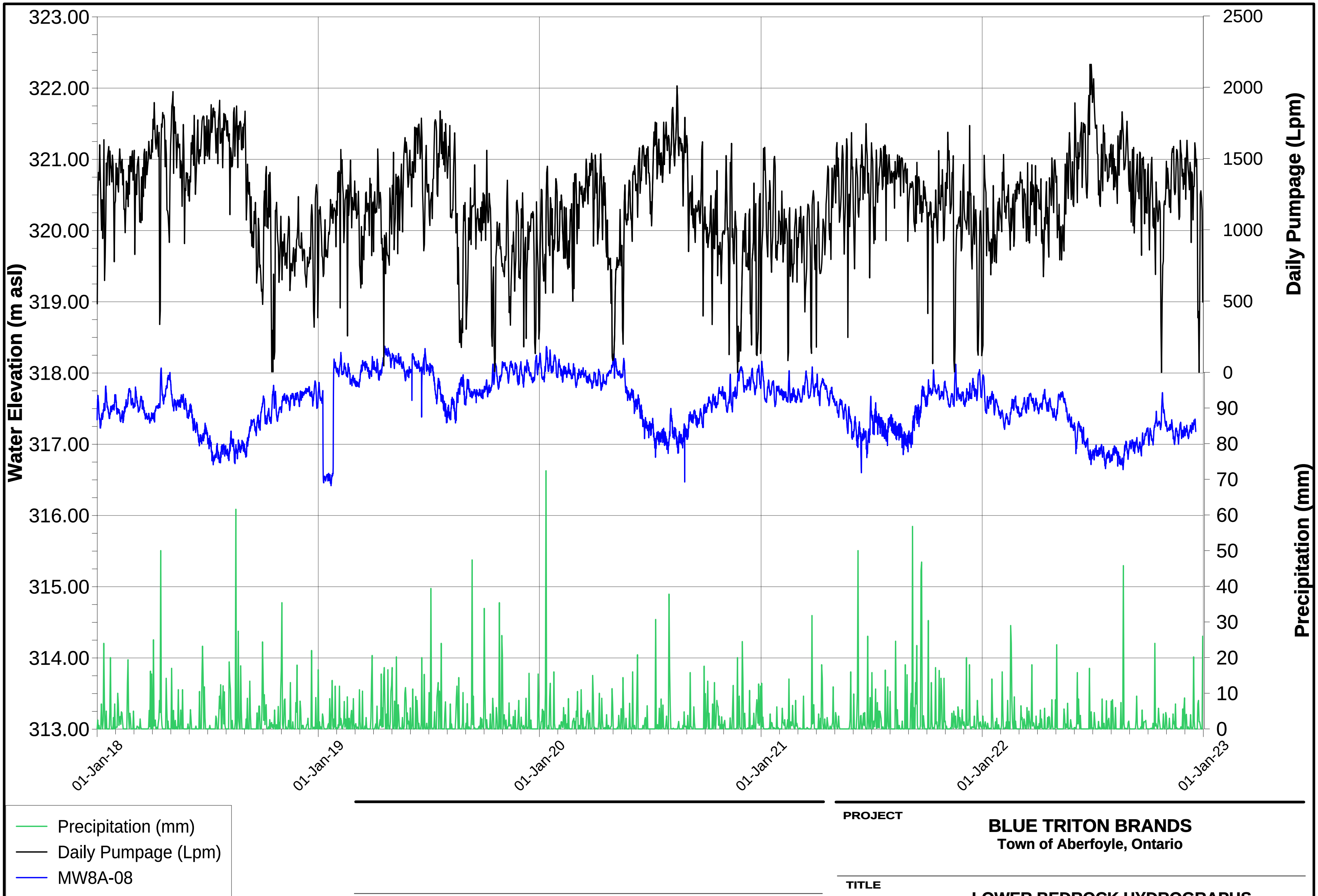
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D5



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

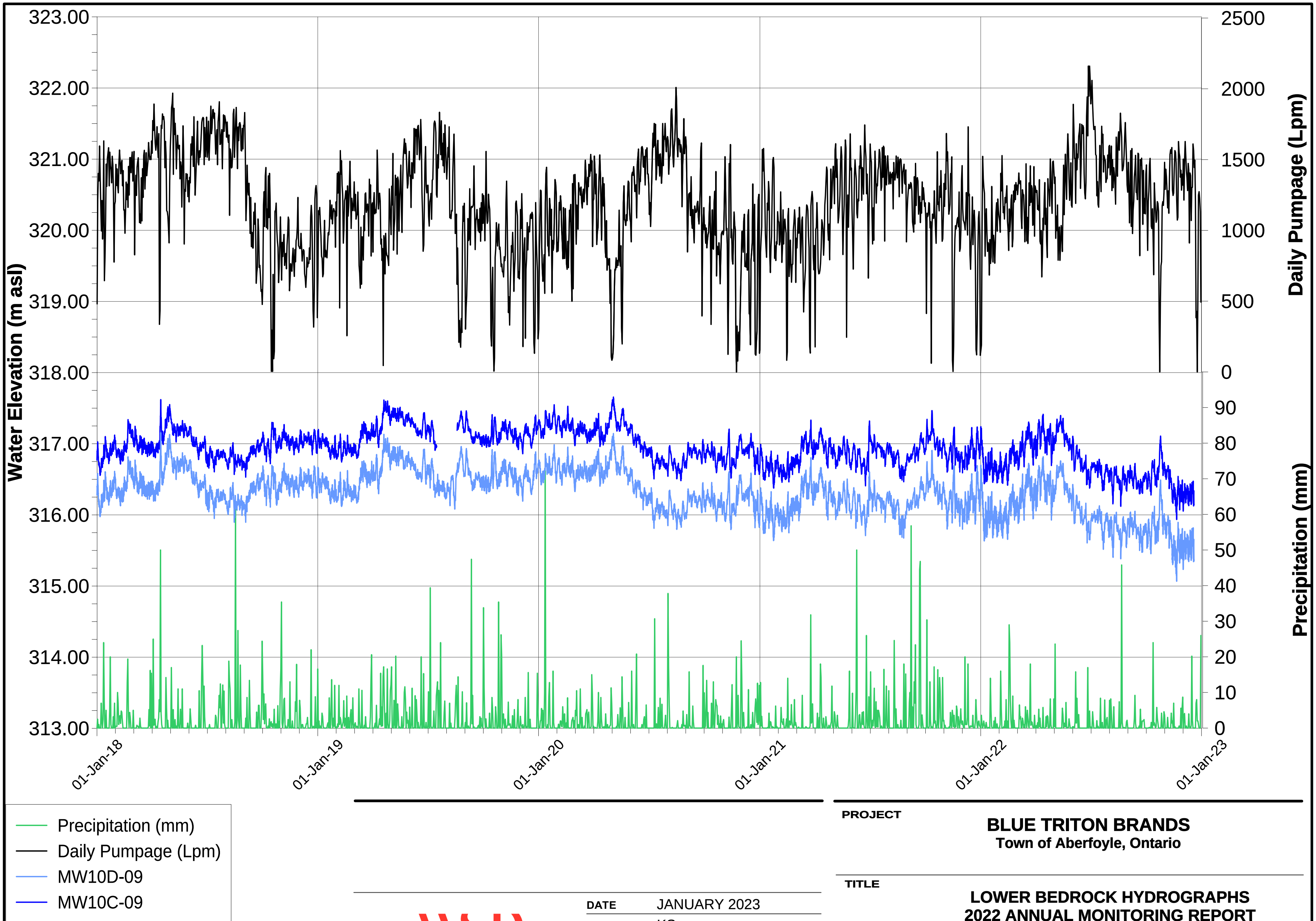
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D6



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

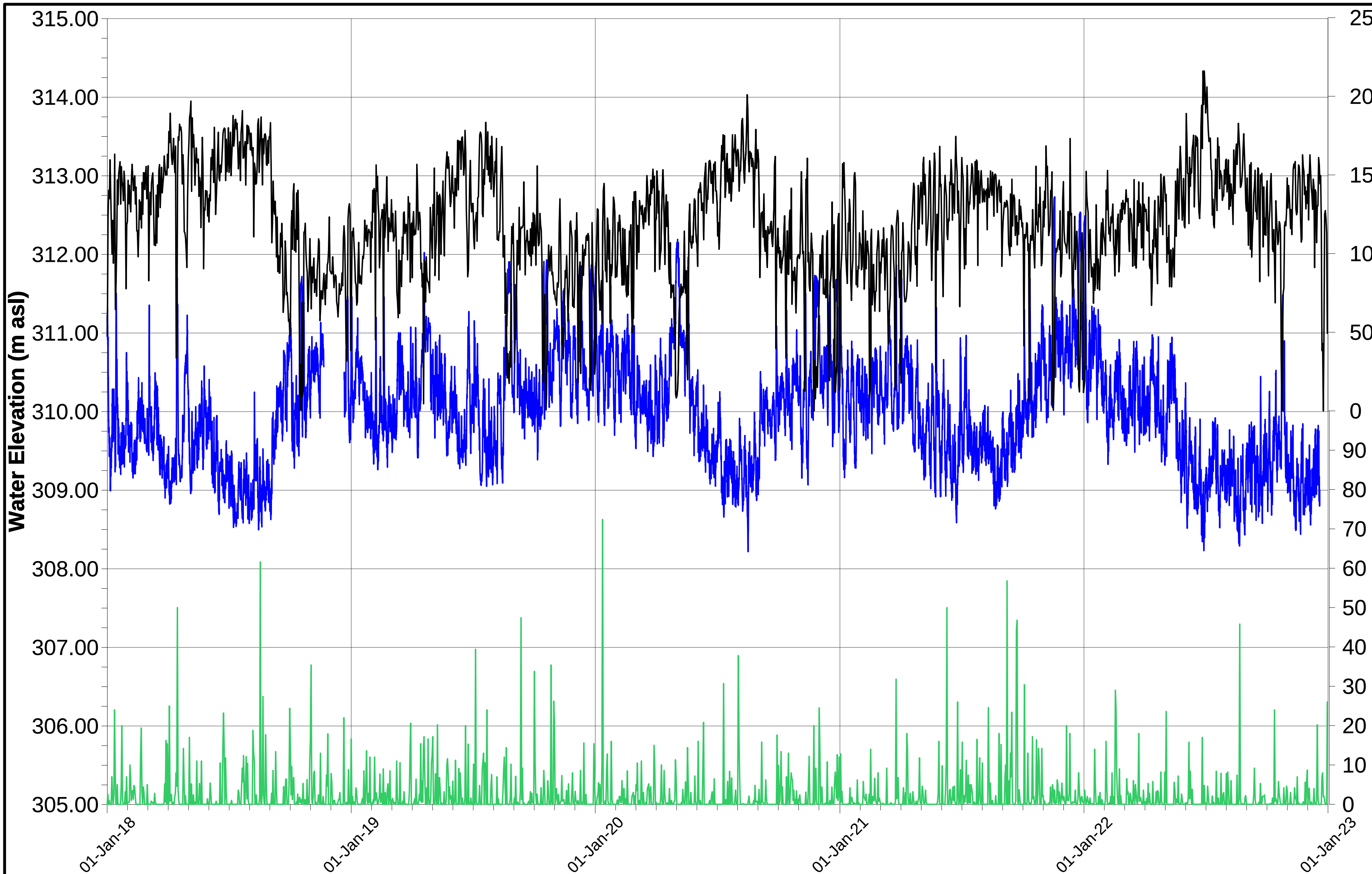
BLUE TRITON BRANDS

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D7



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

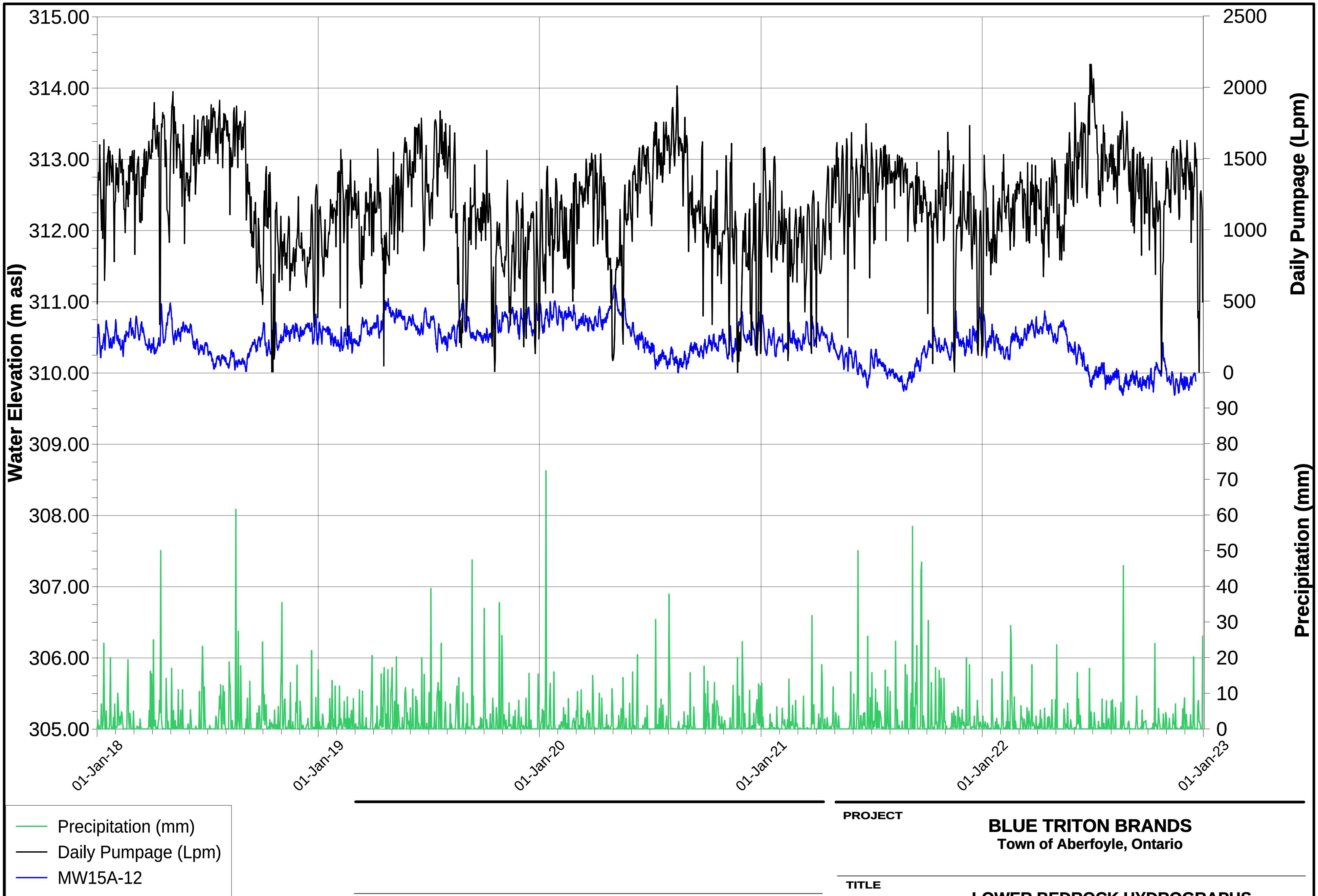
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D8



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

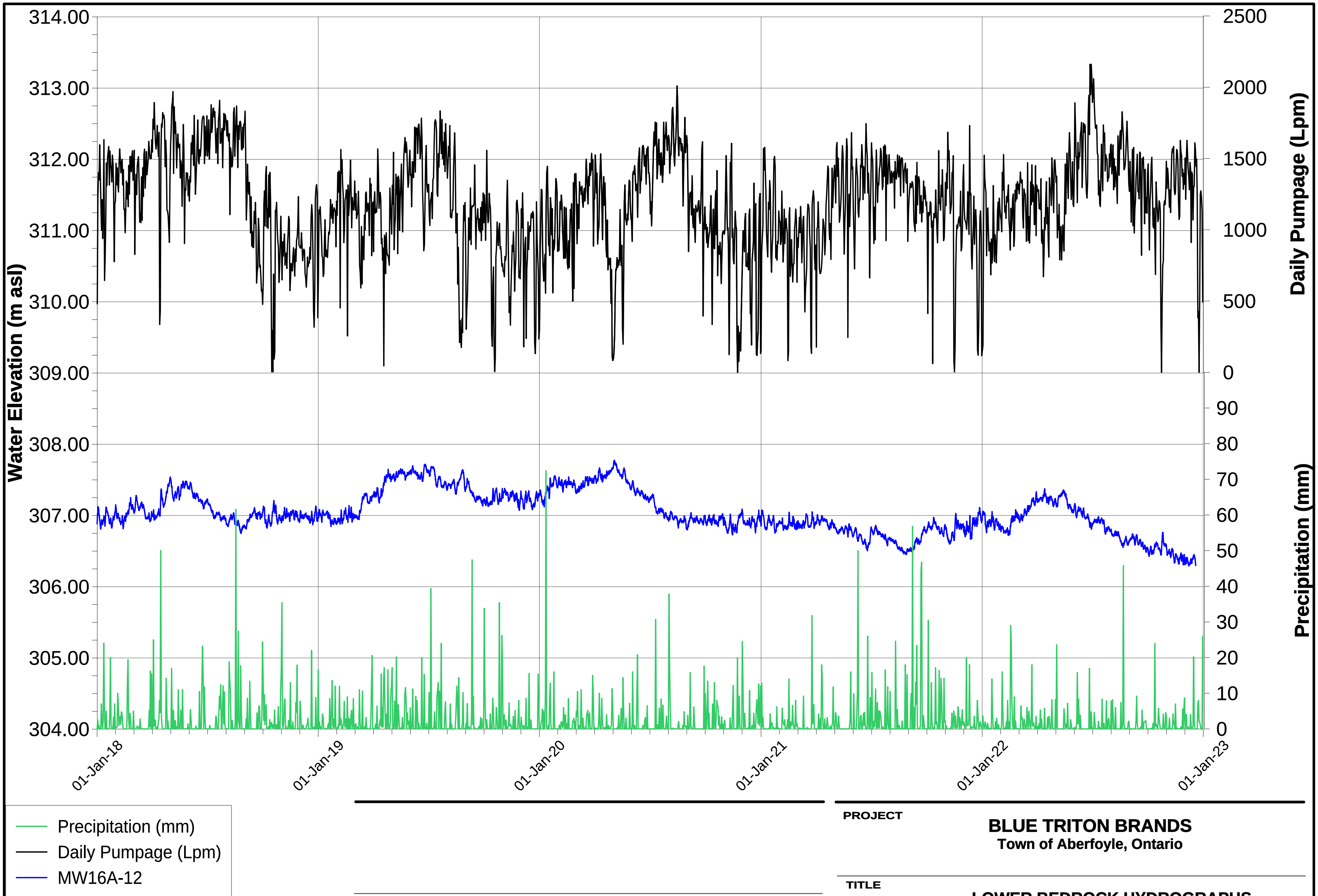
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D9



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

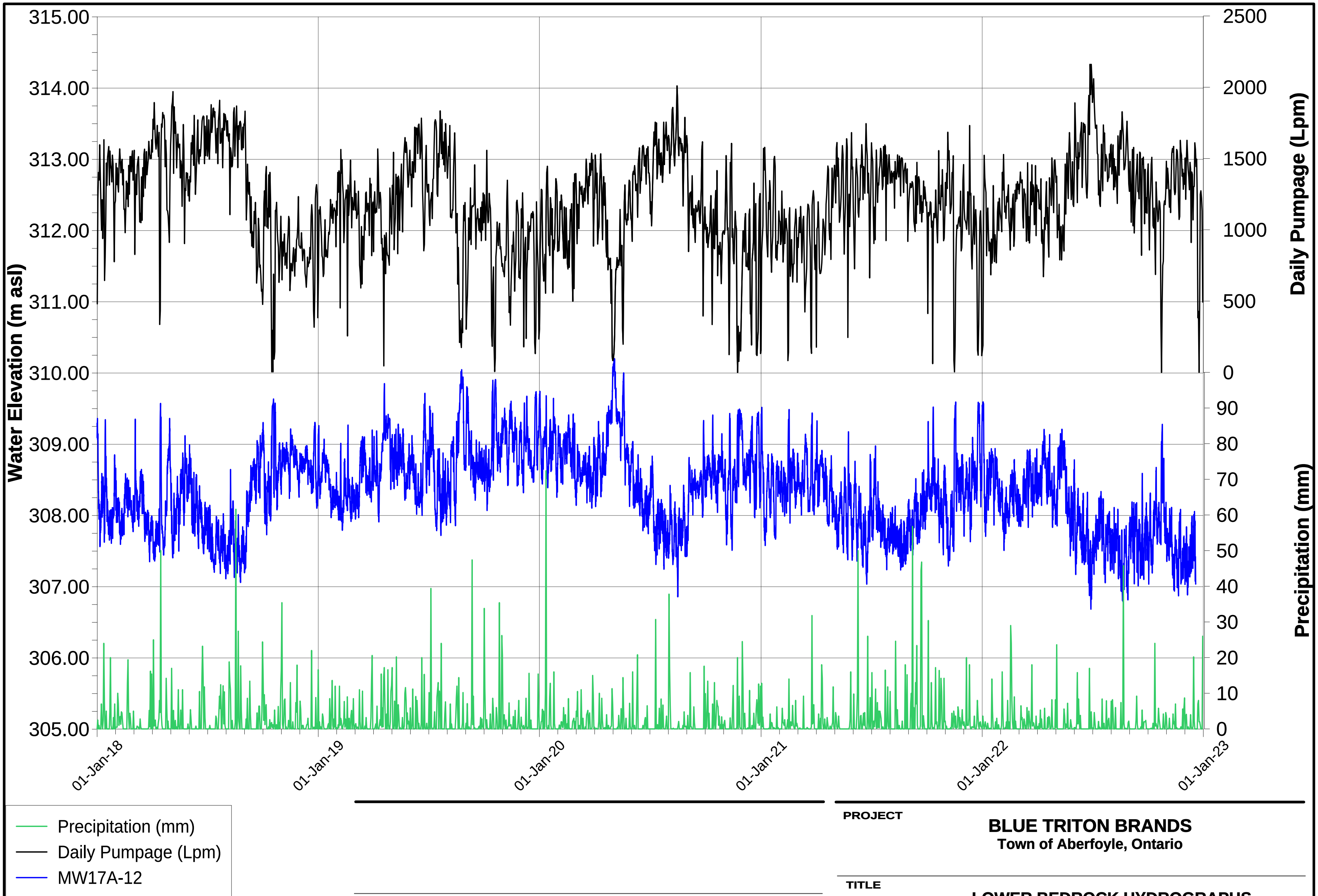
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D10



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

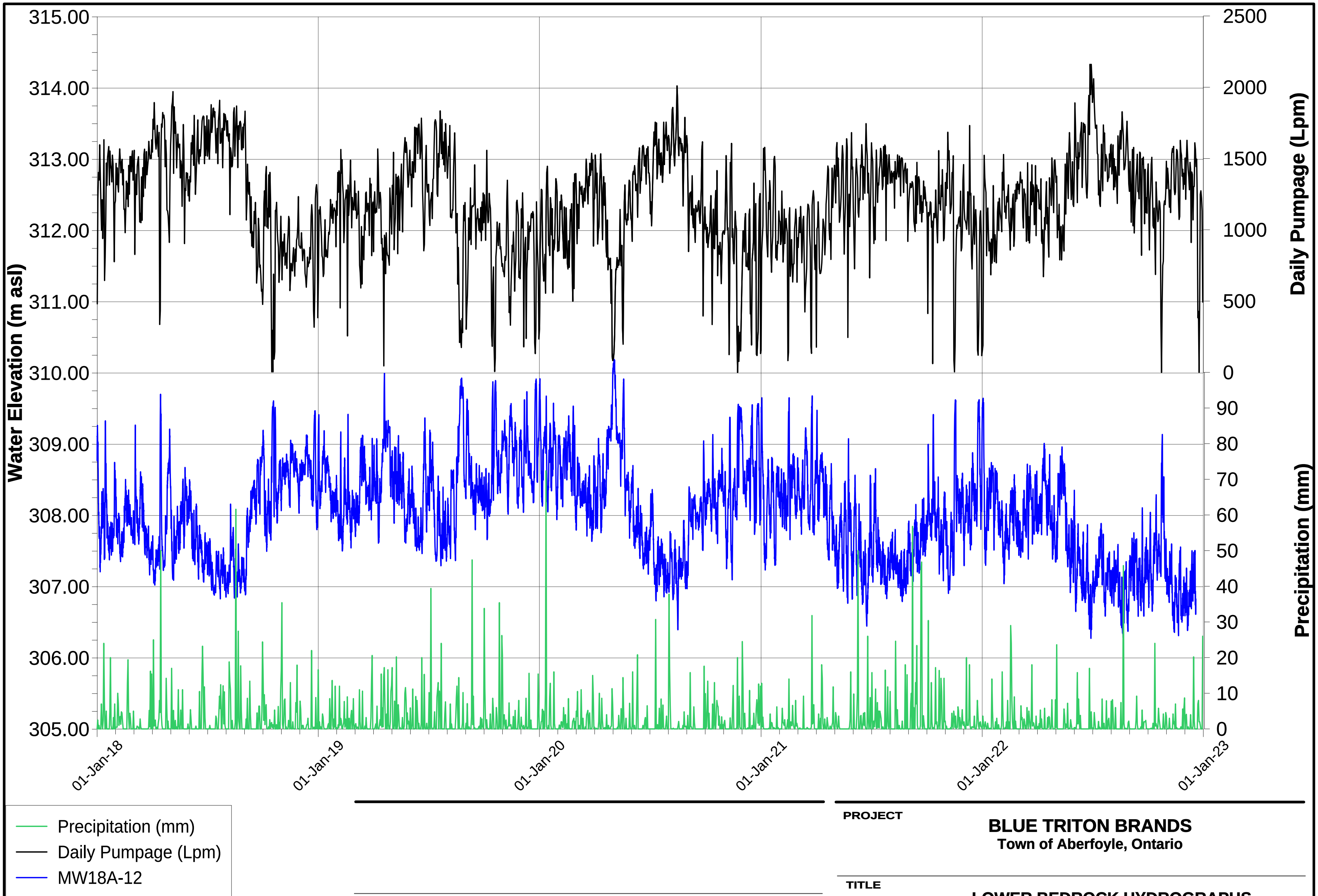
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D11



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

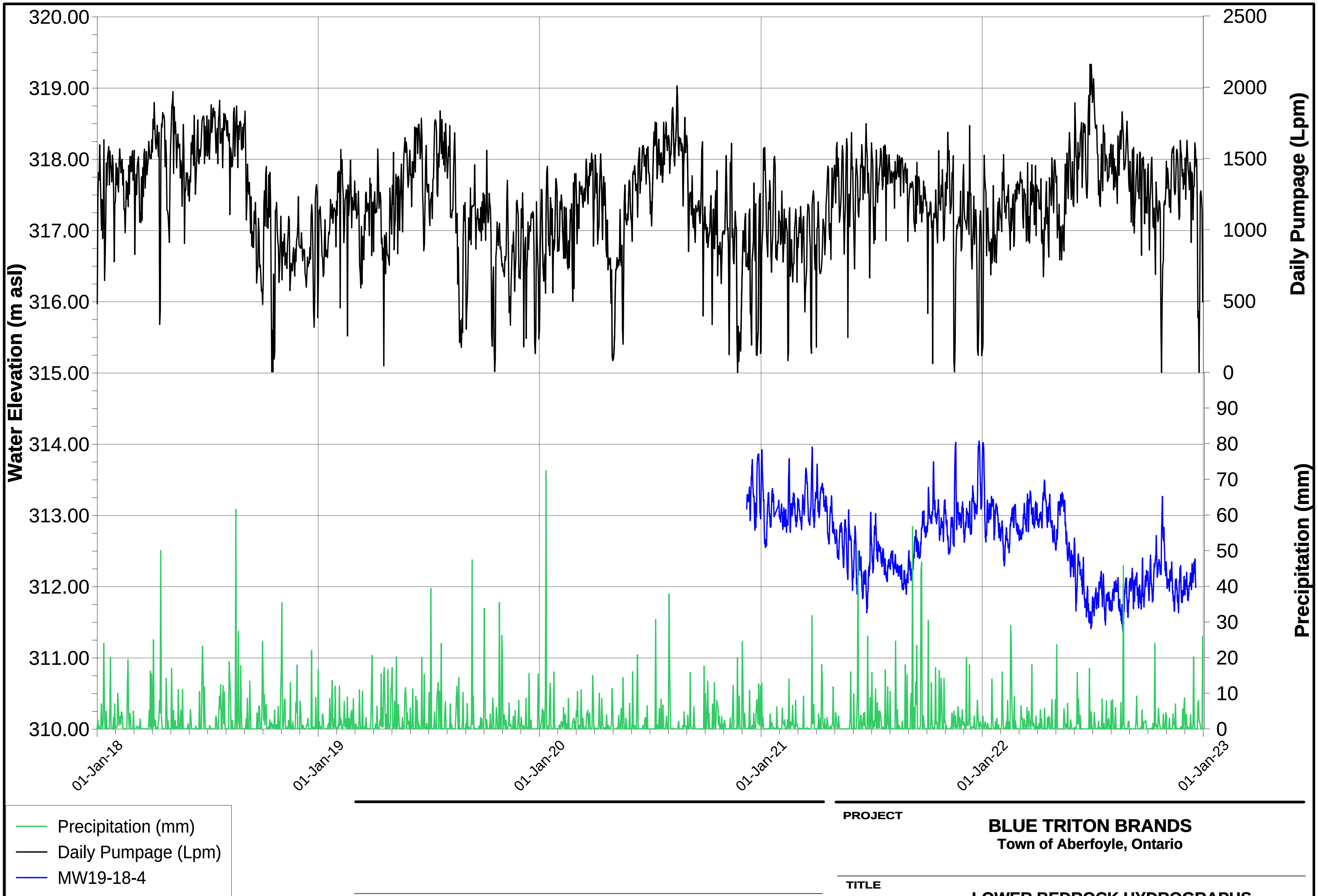
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D12



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

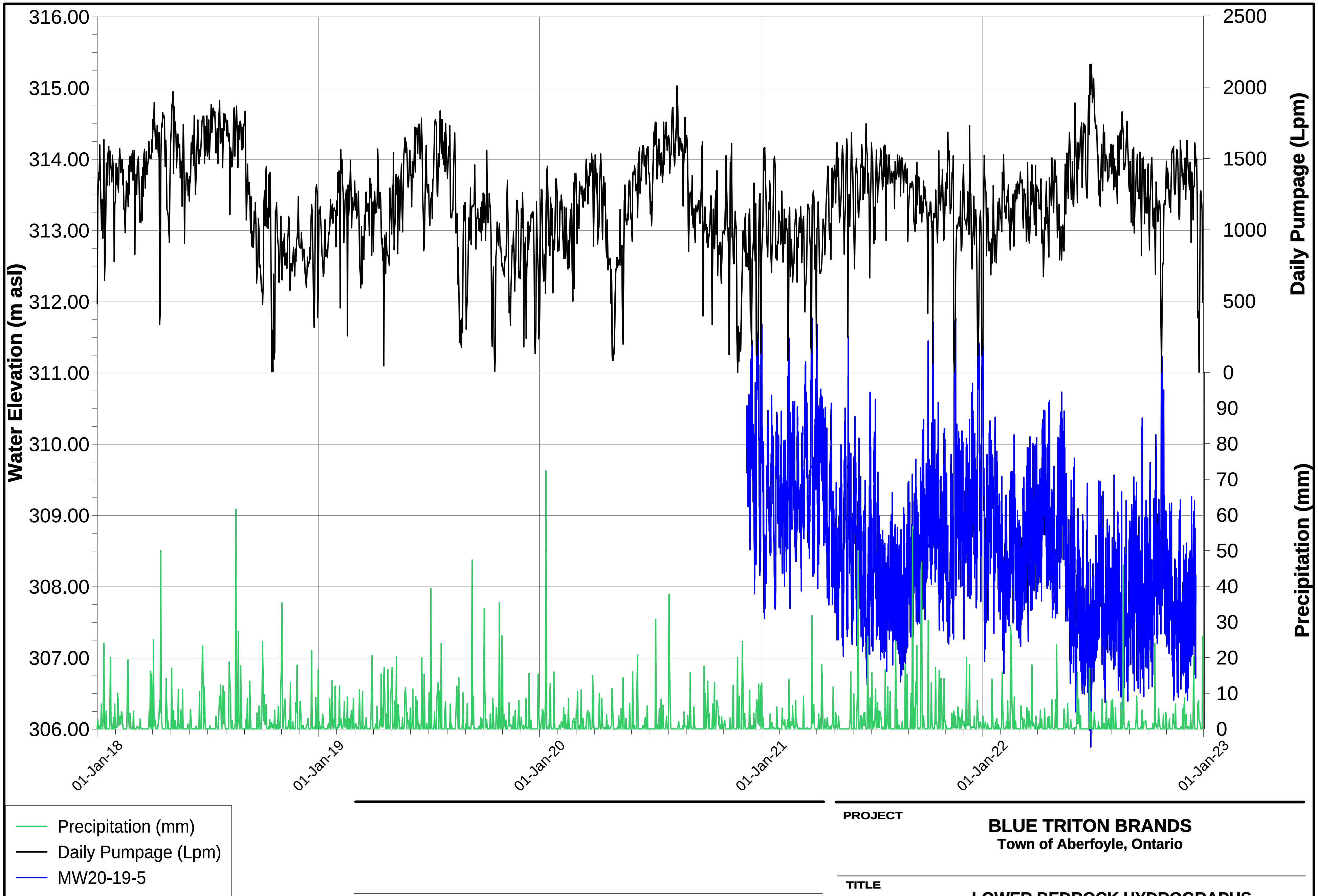
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D13



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

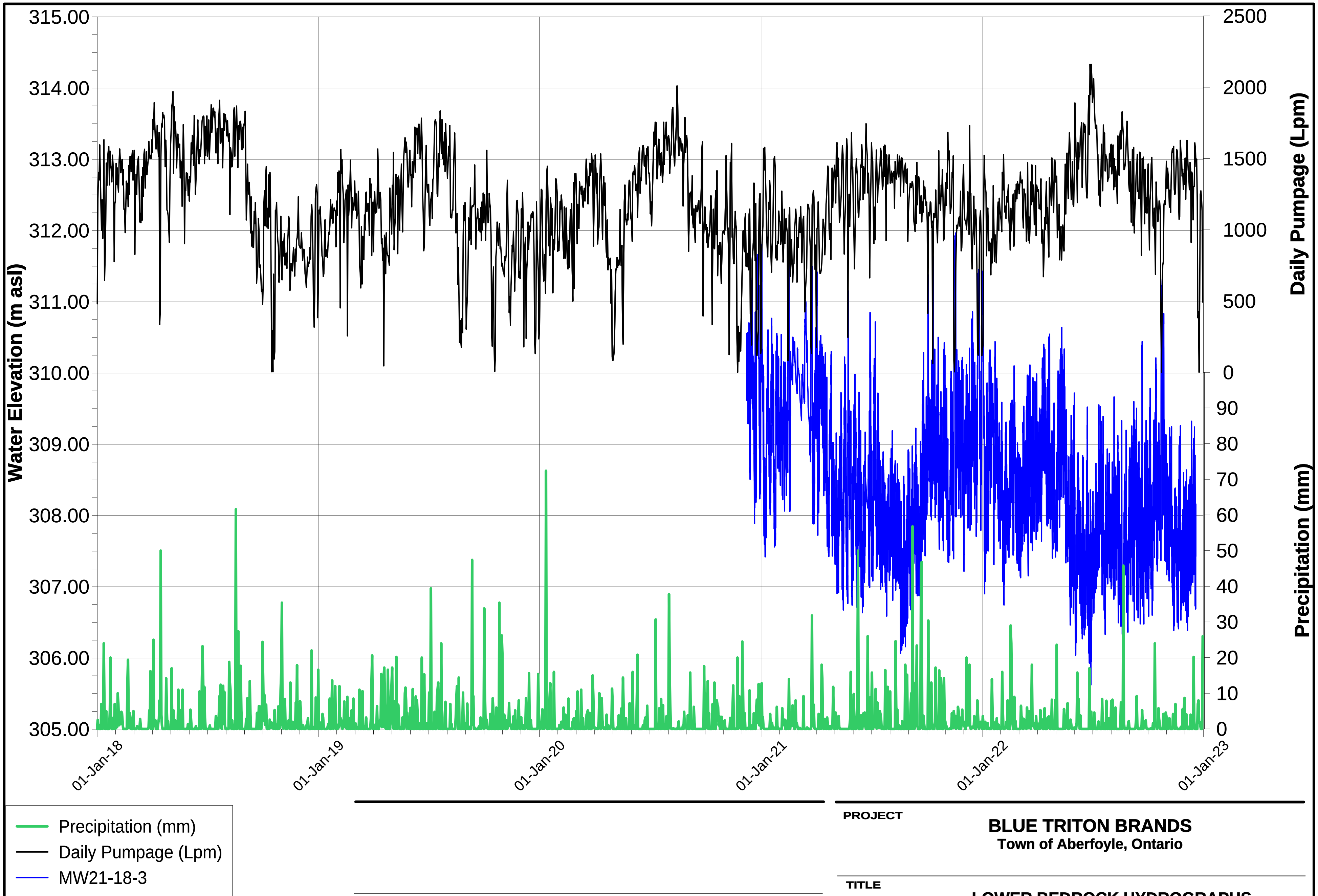
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D14



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

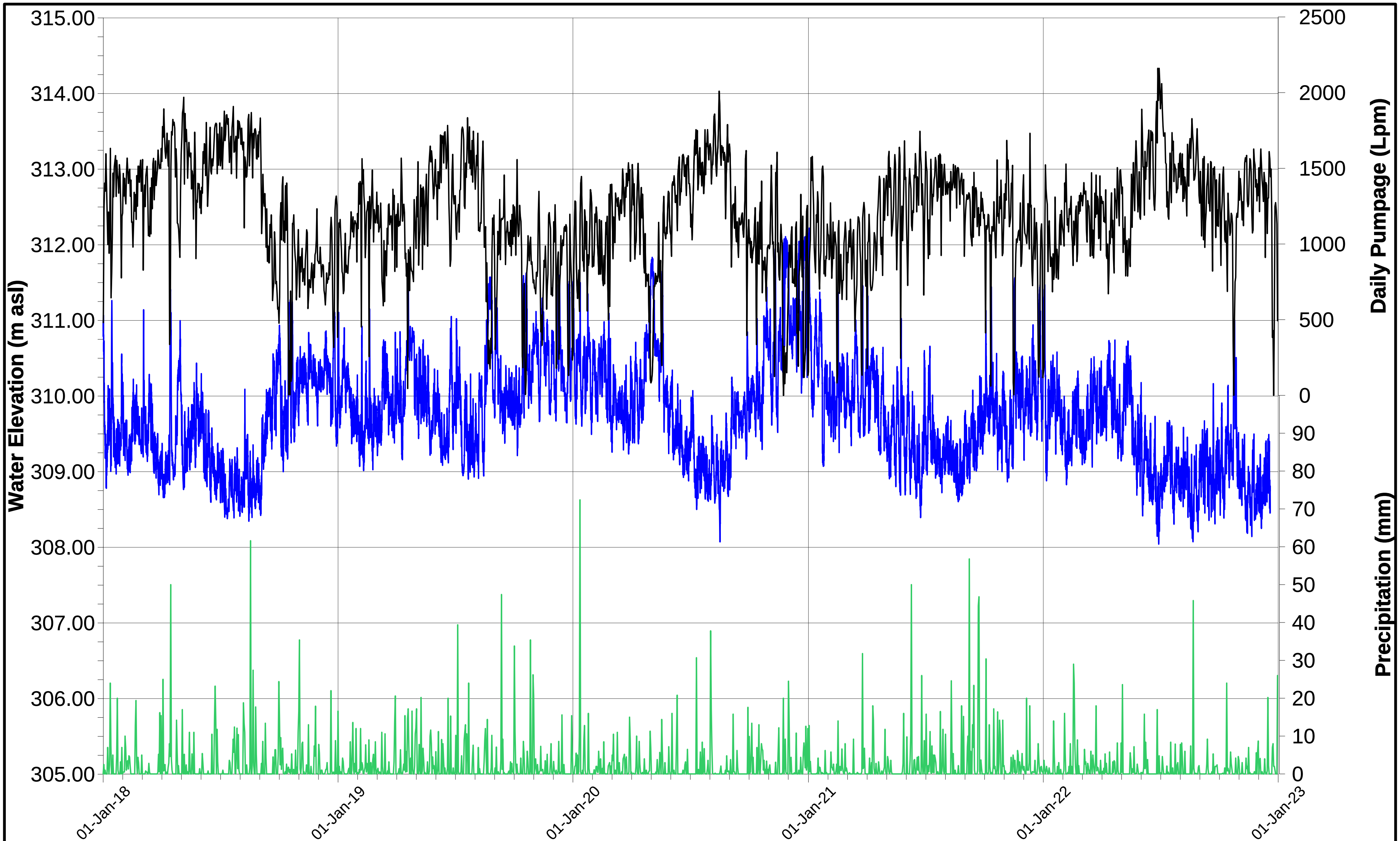
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D15



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

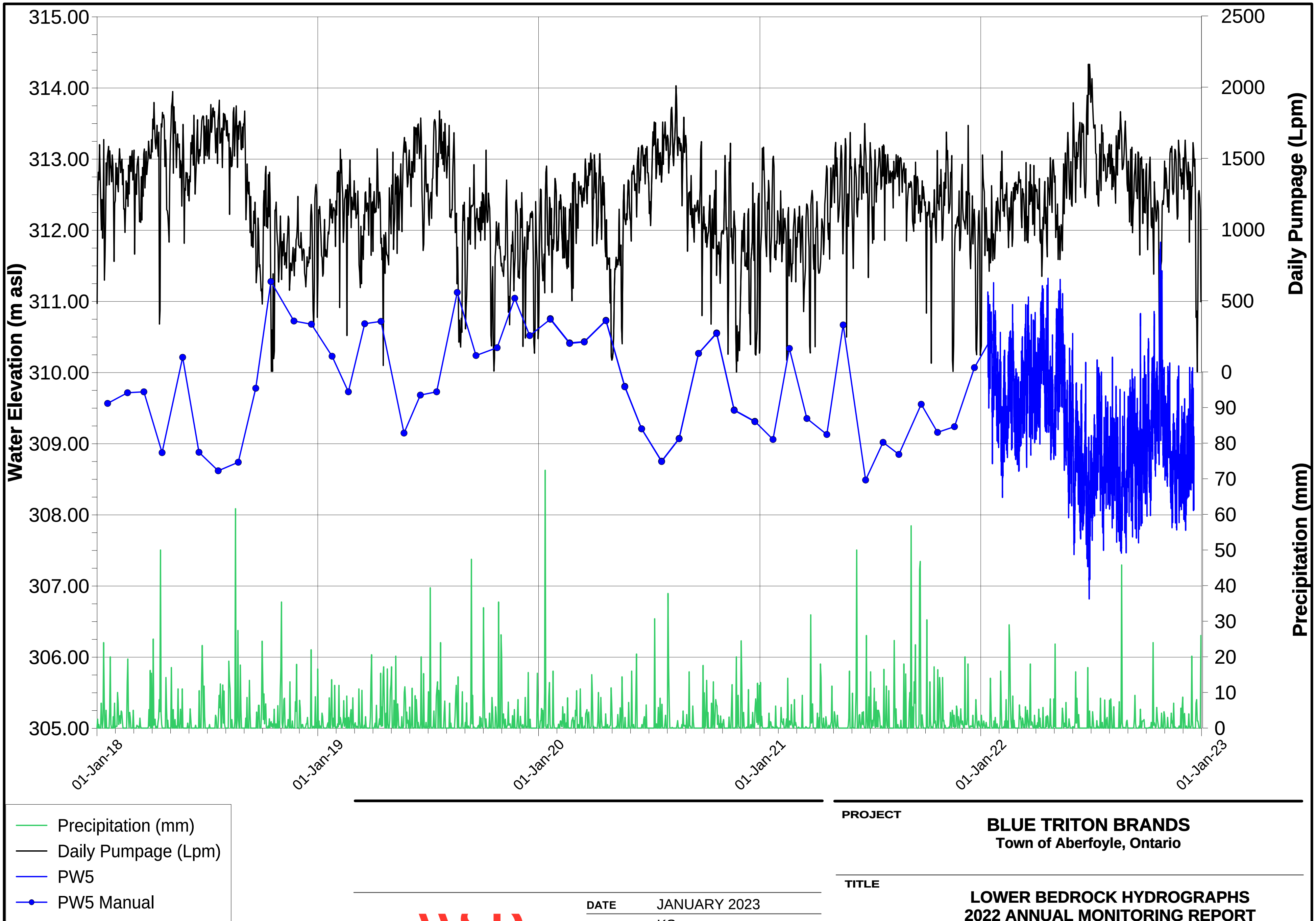
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D16



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

BLUE TRITON BRANDS

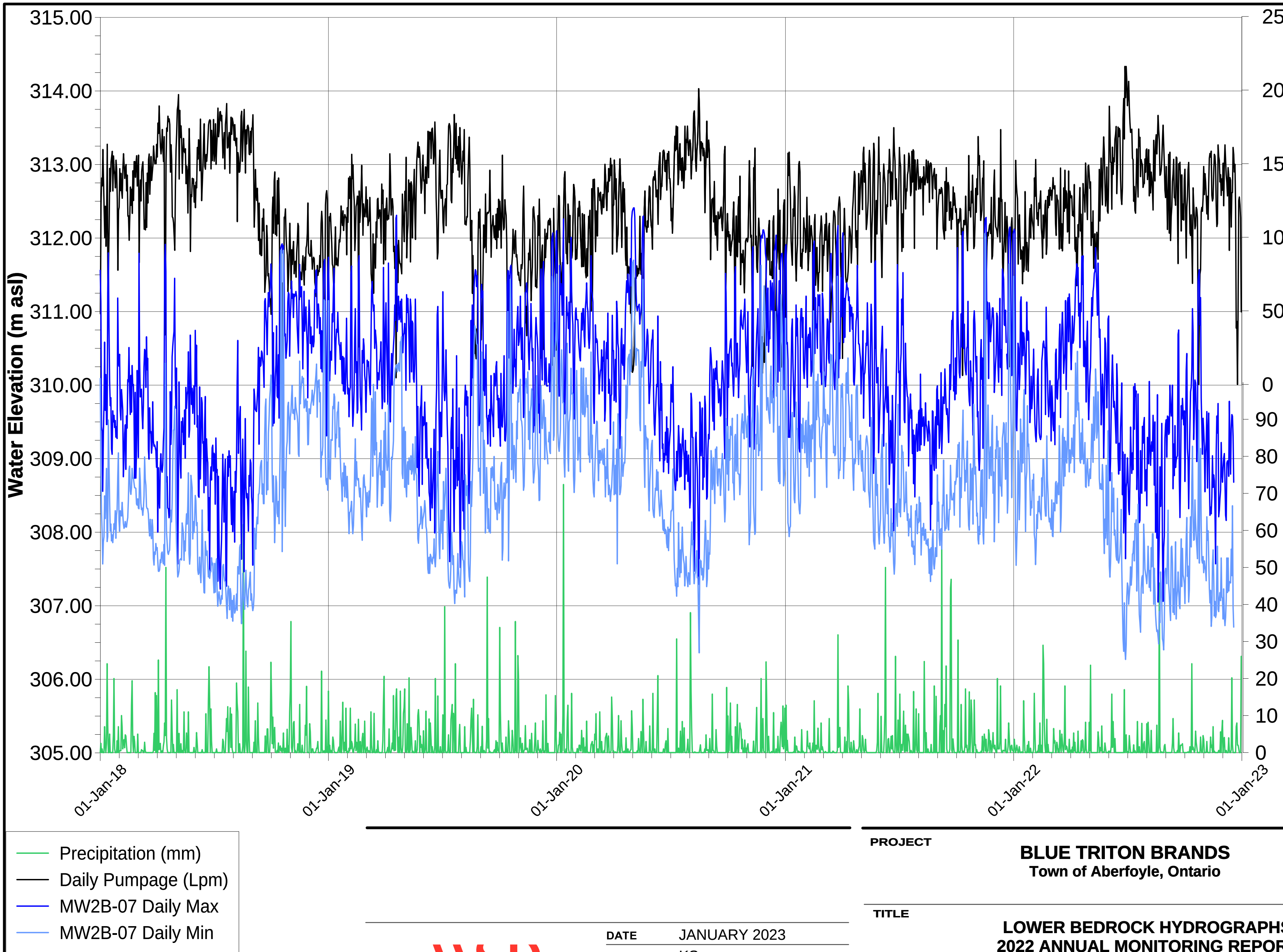
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D17



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

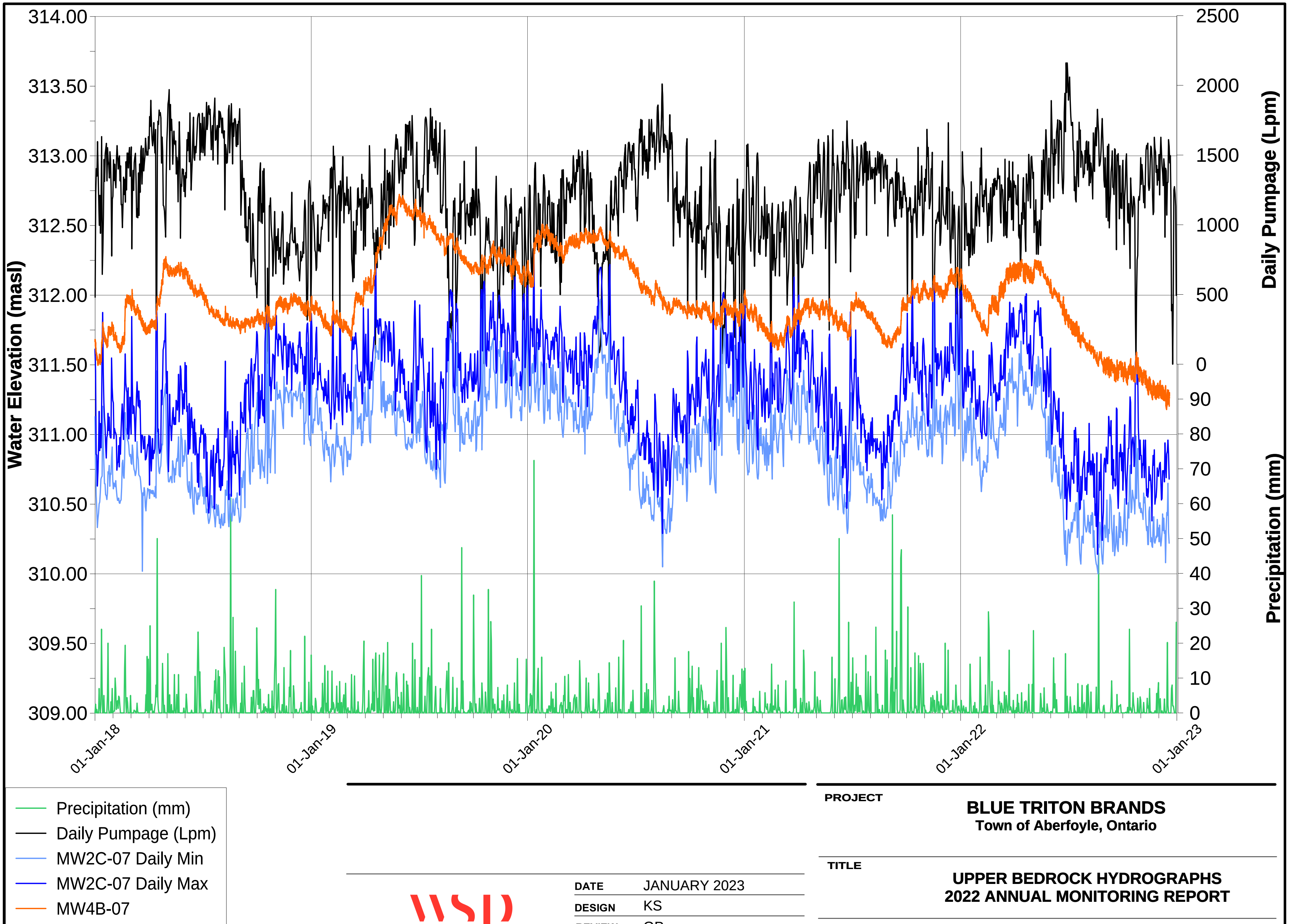
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D18



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

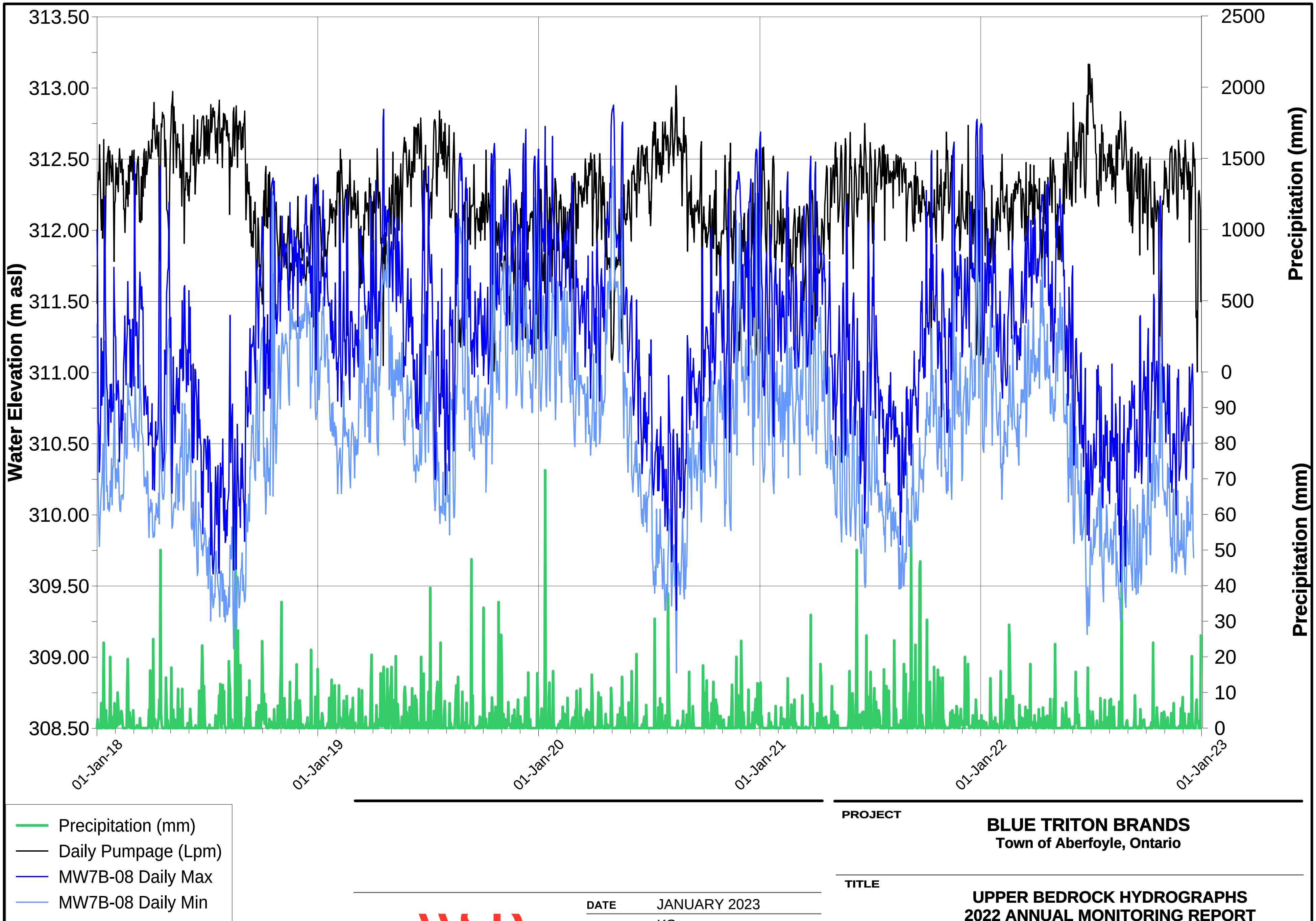
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D19



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

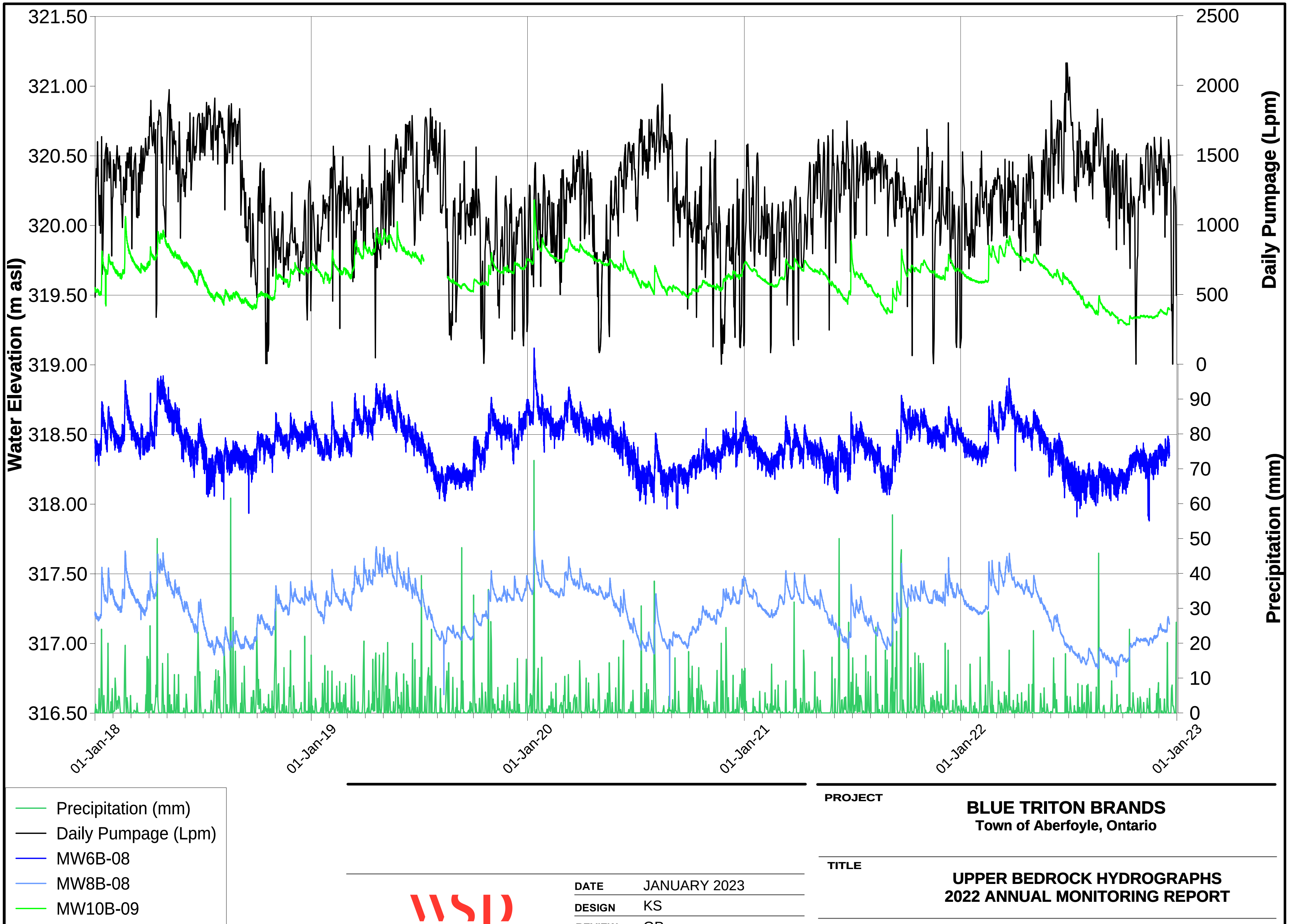
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D20



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

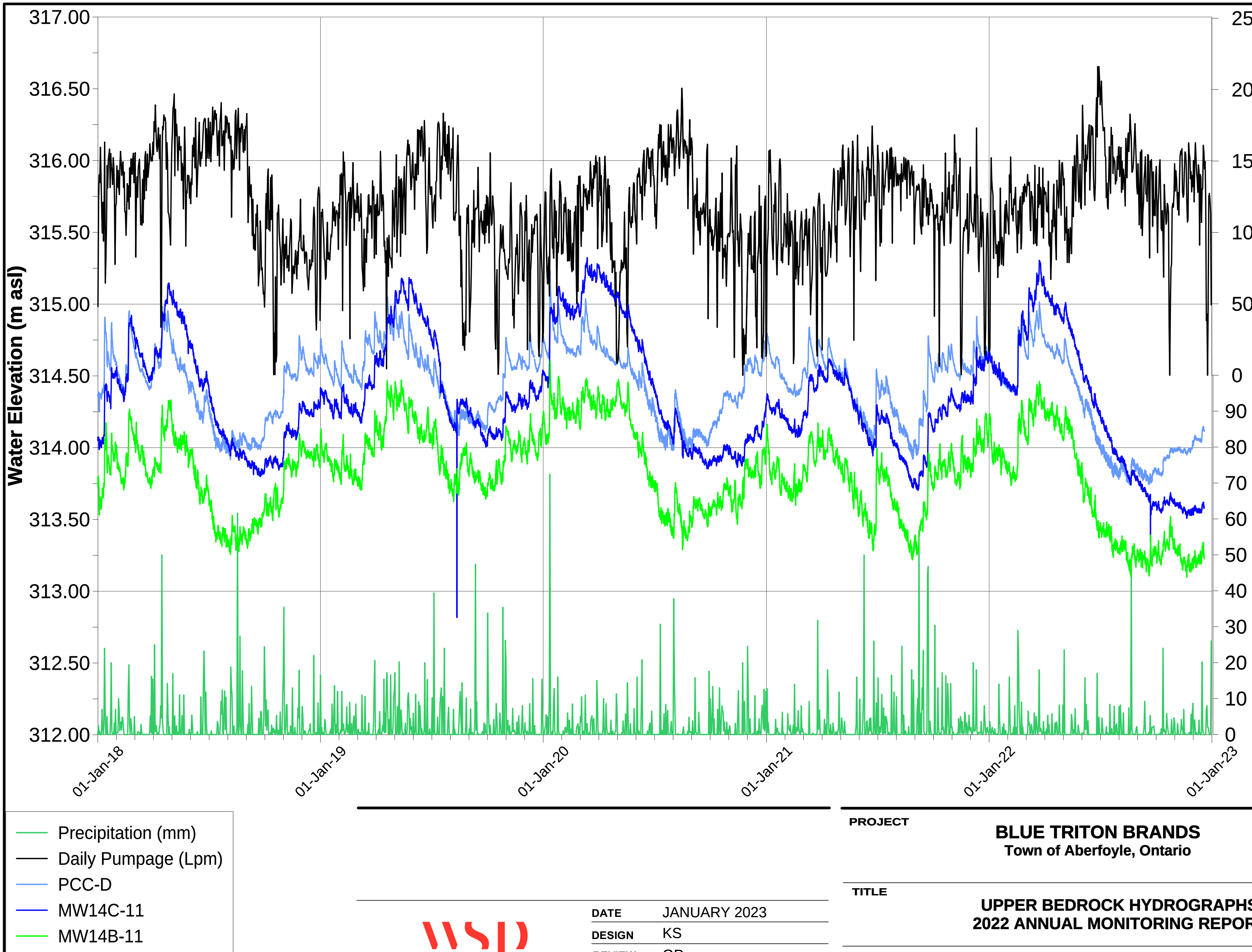
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D21



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

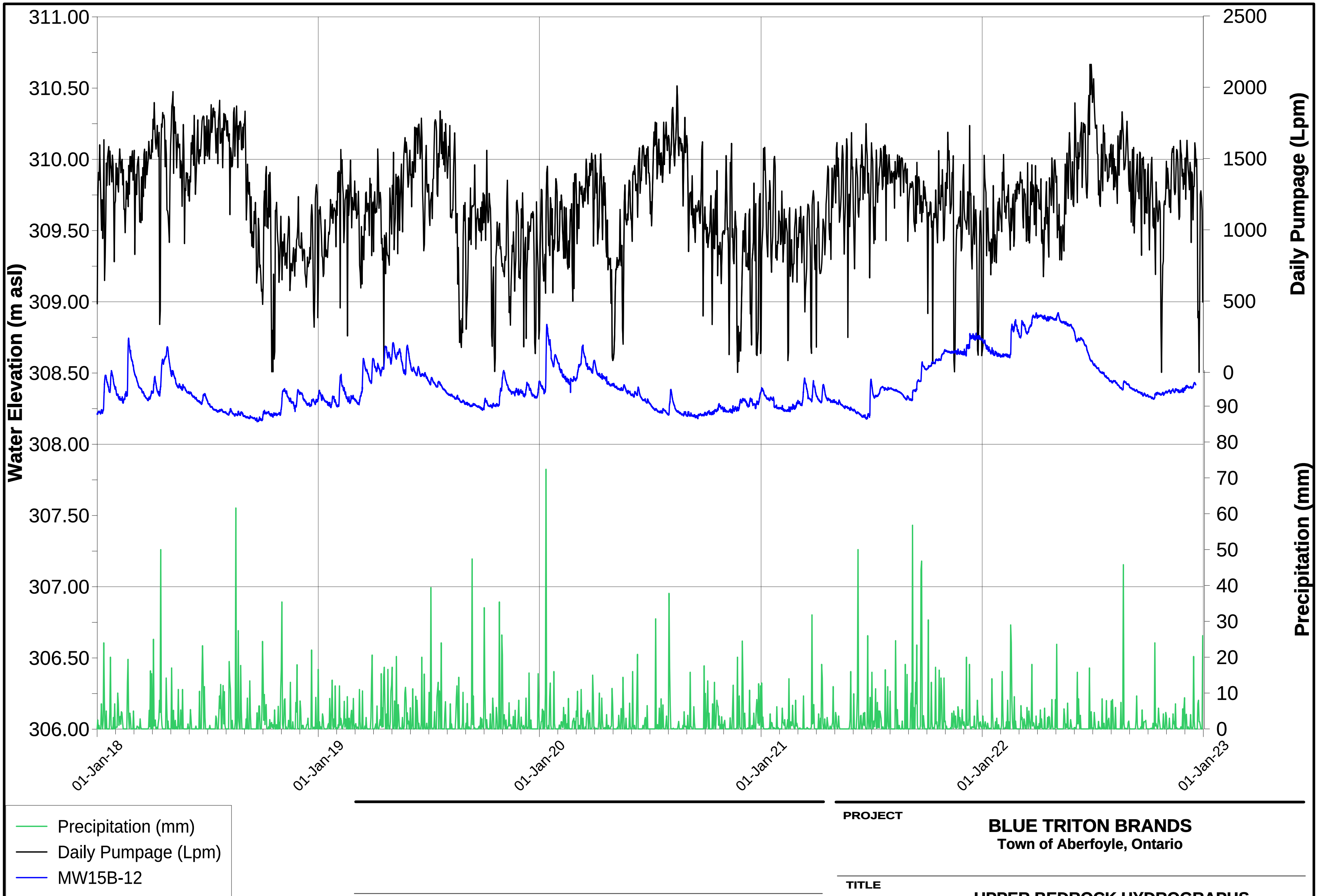
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D22



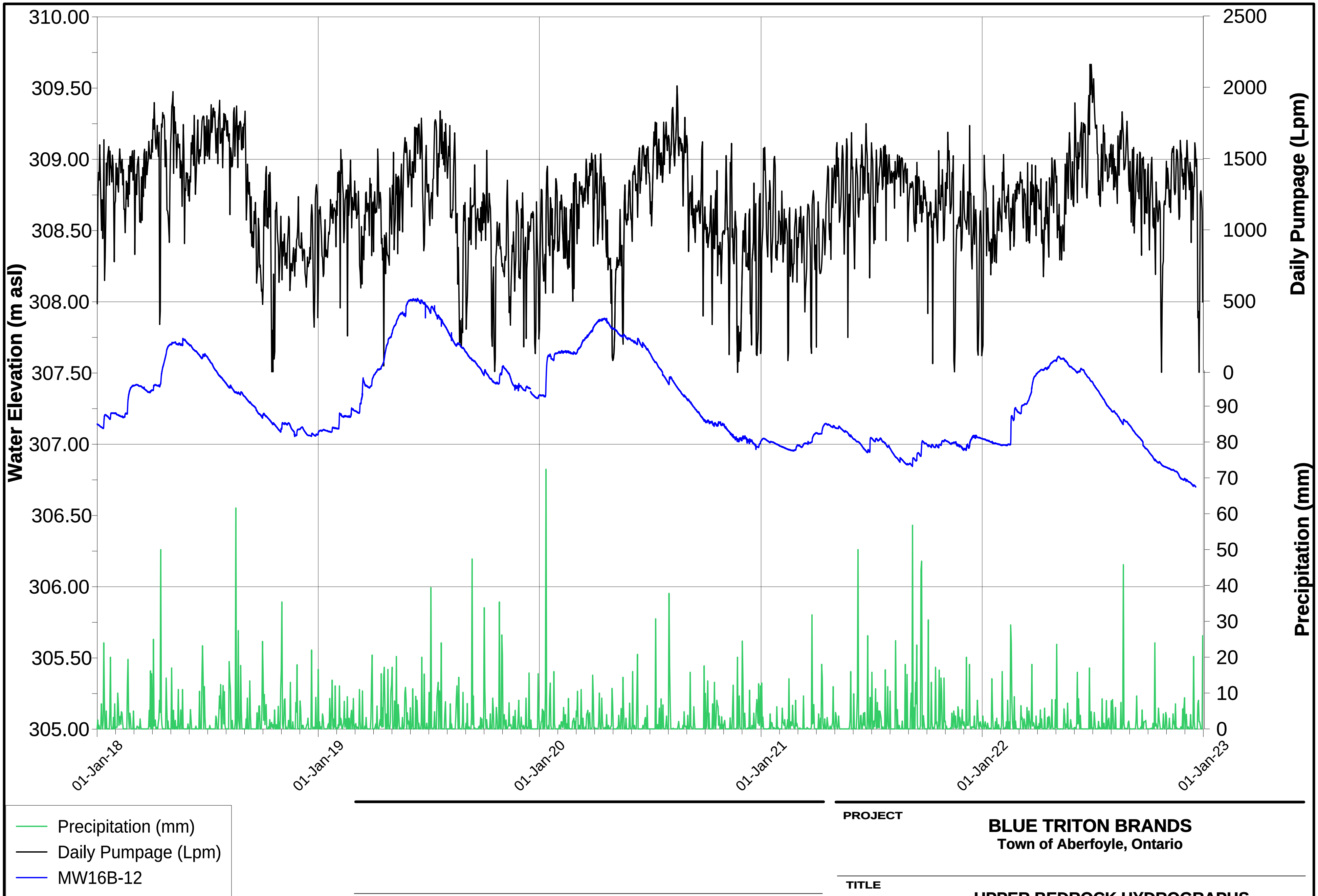
wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D23



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

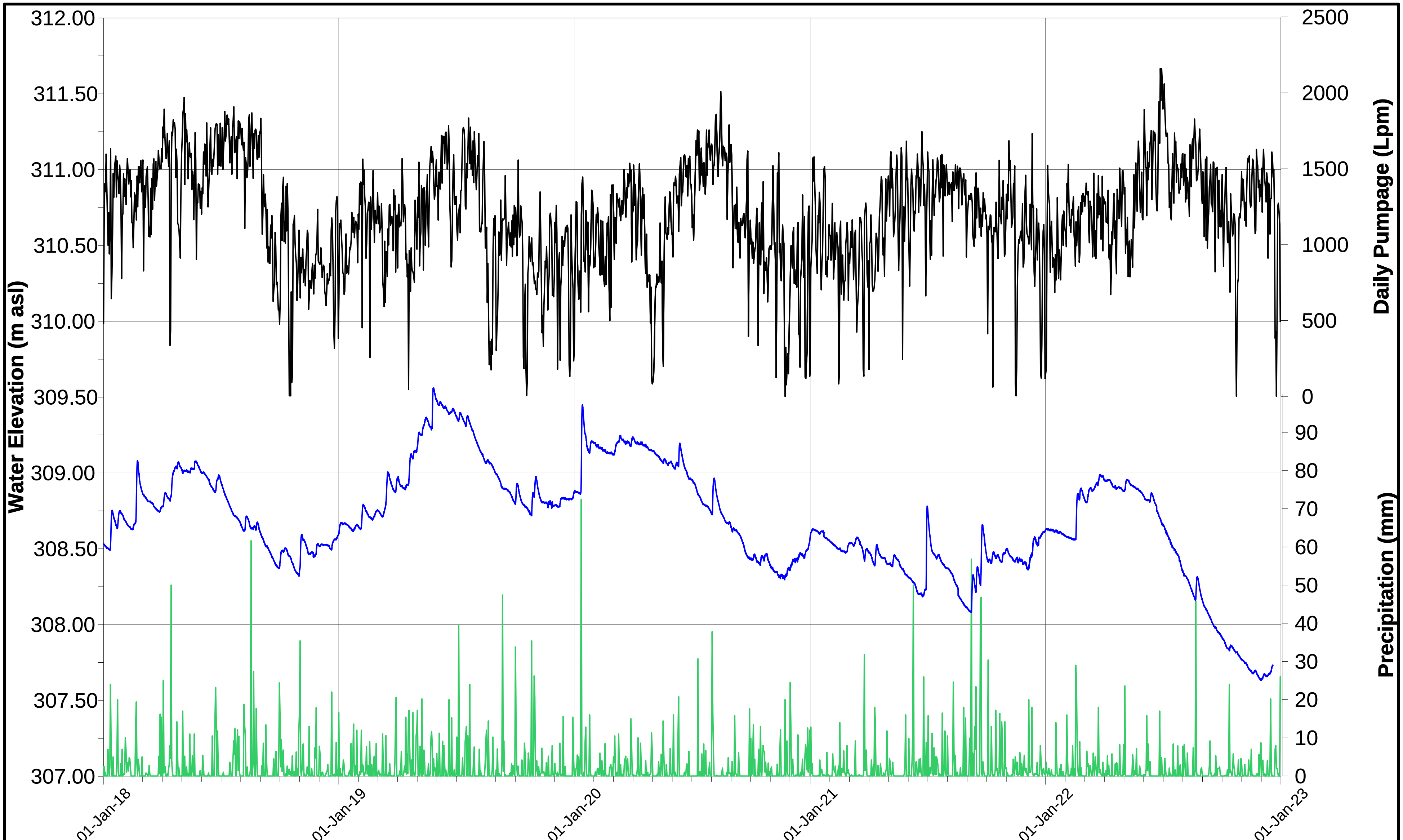
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D24

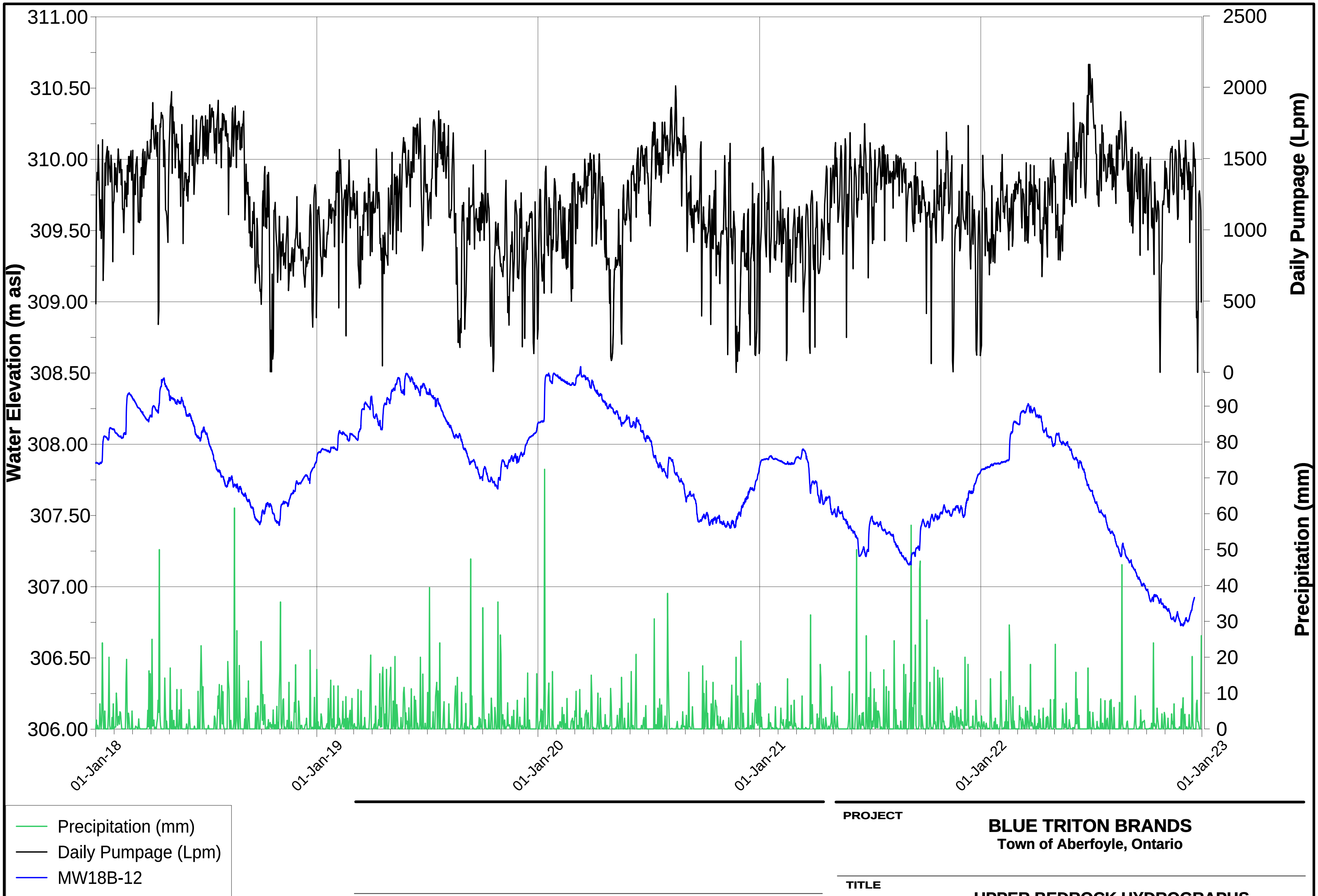


DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D25



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

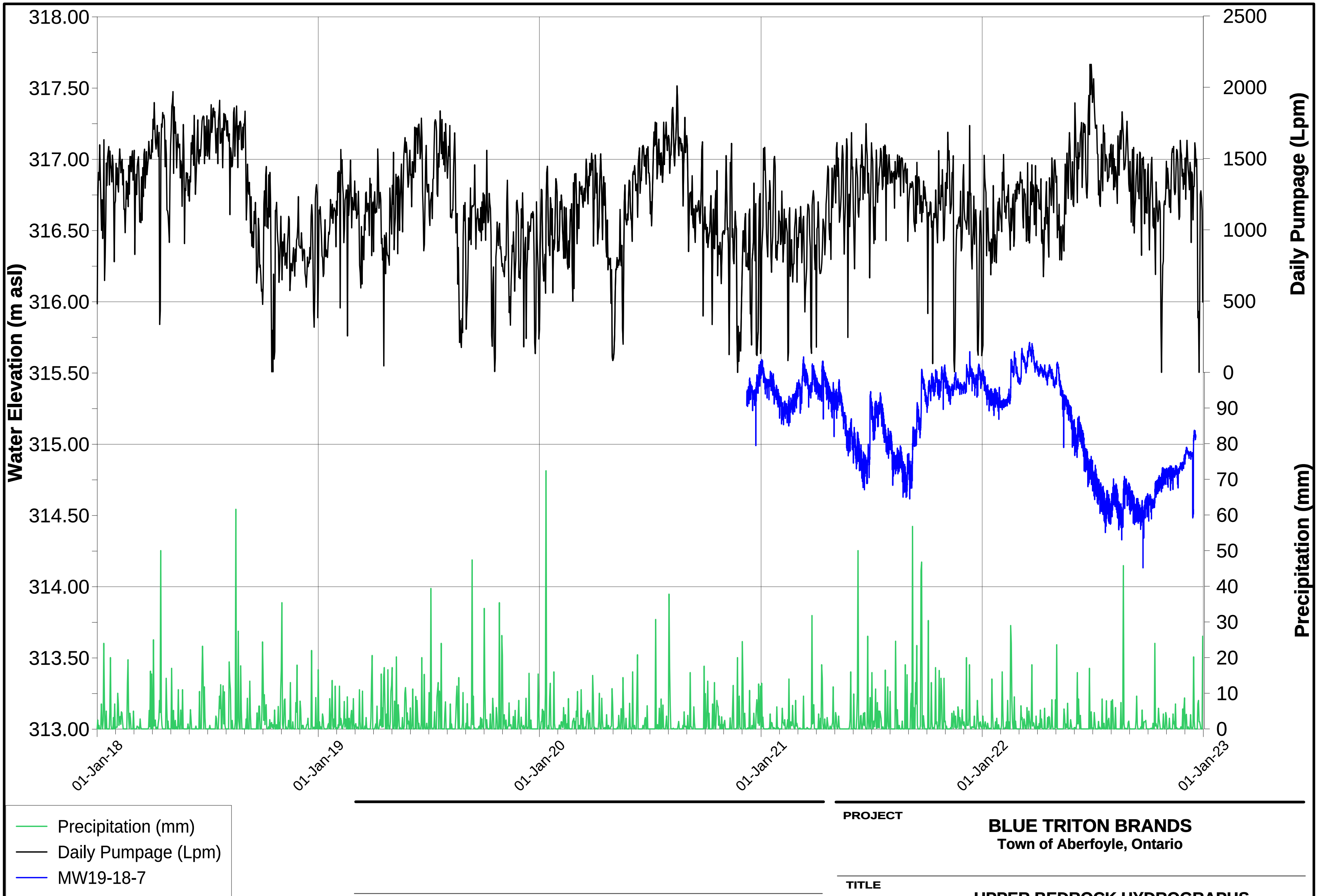
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D26



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

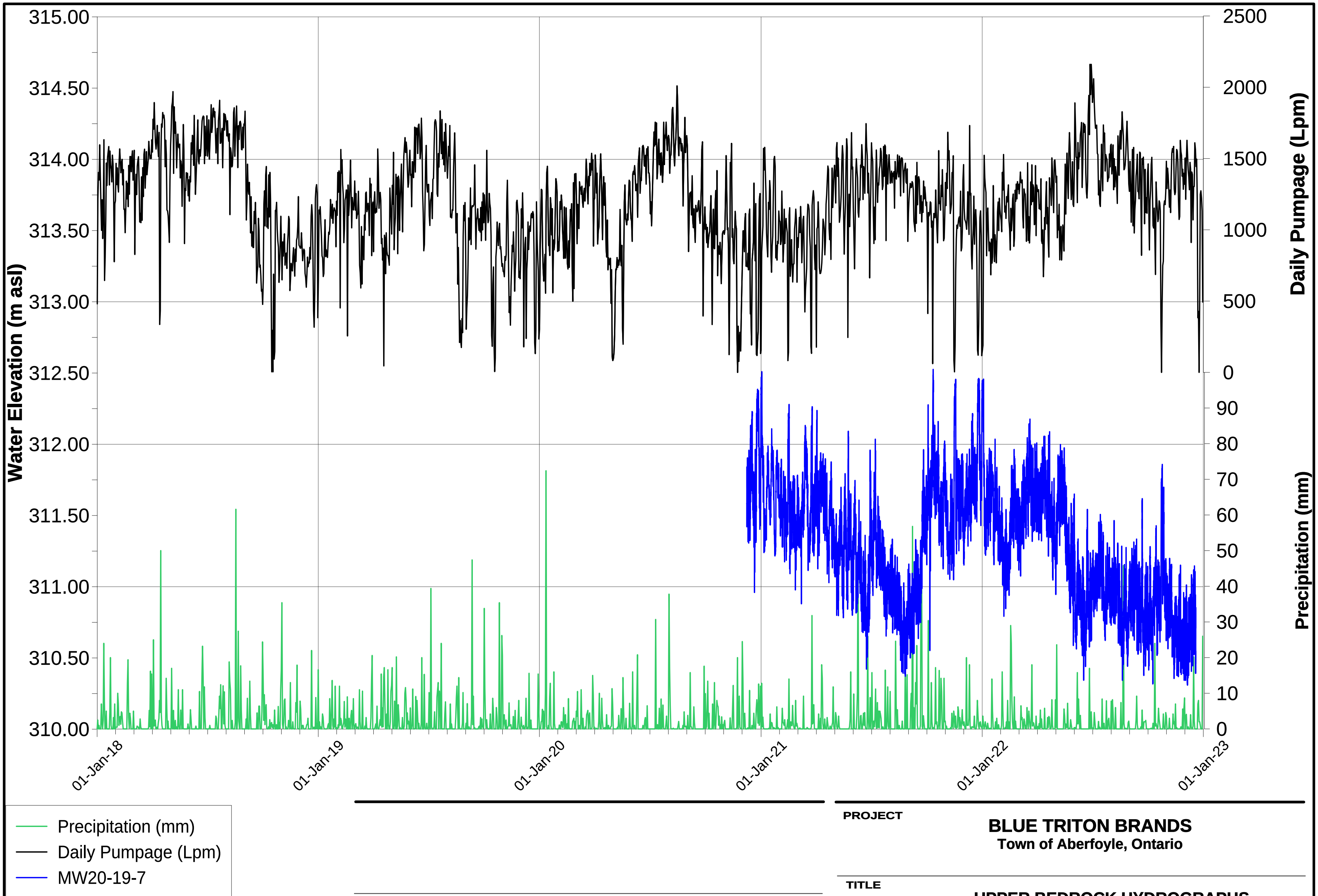
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D27



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

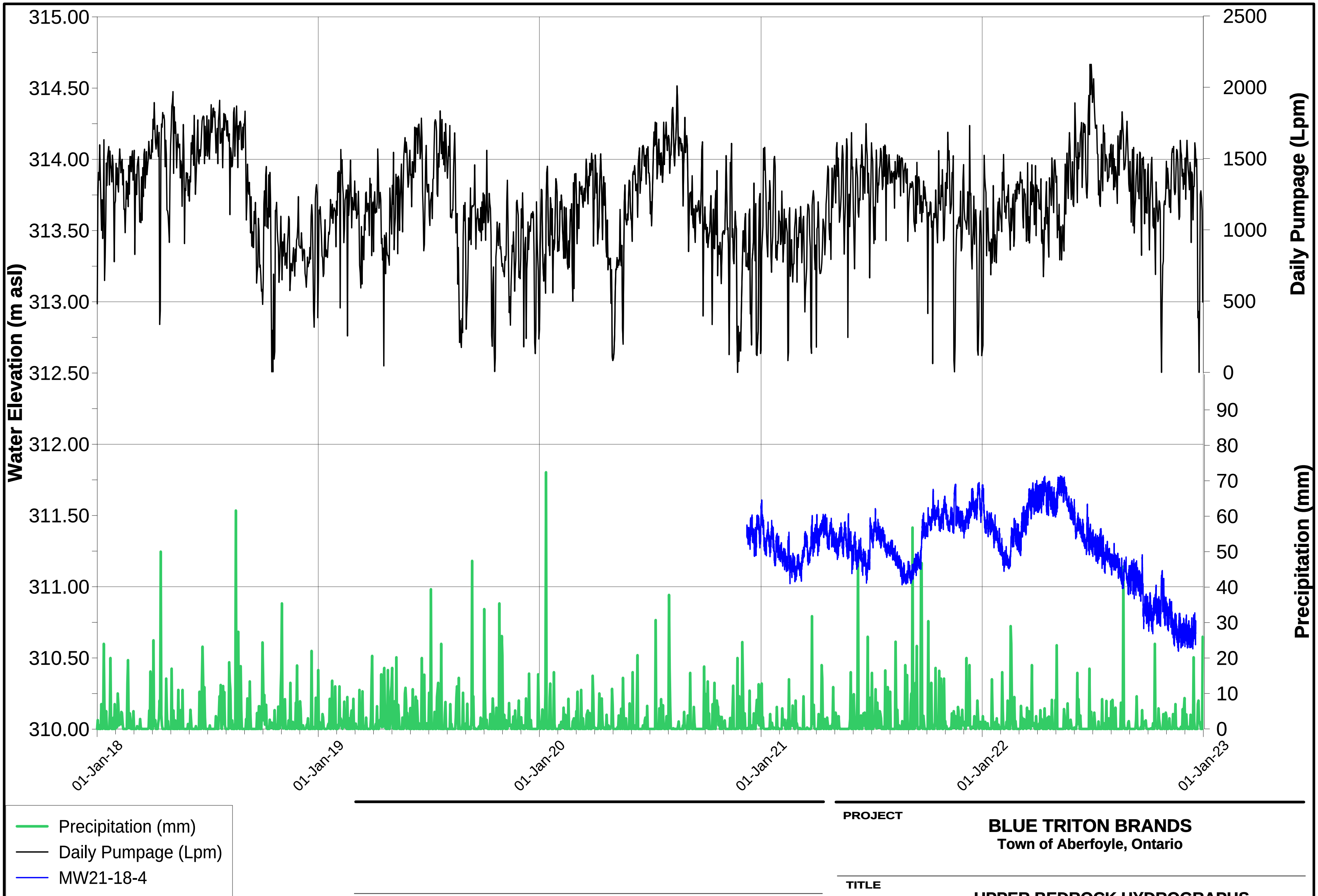
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D28



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

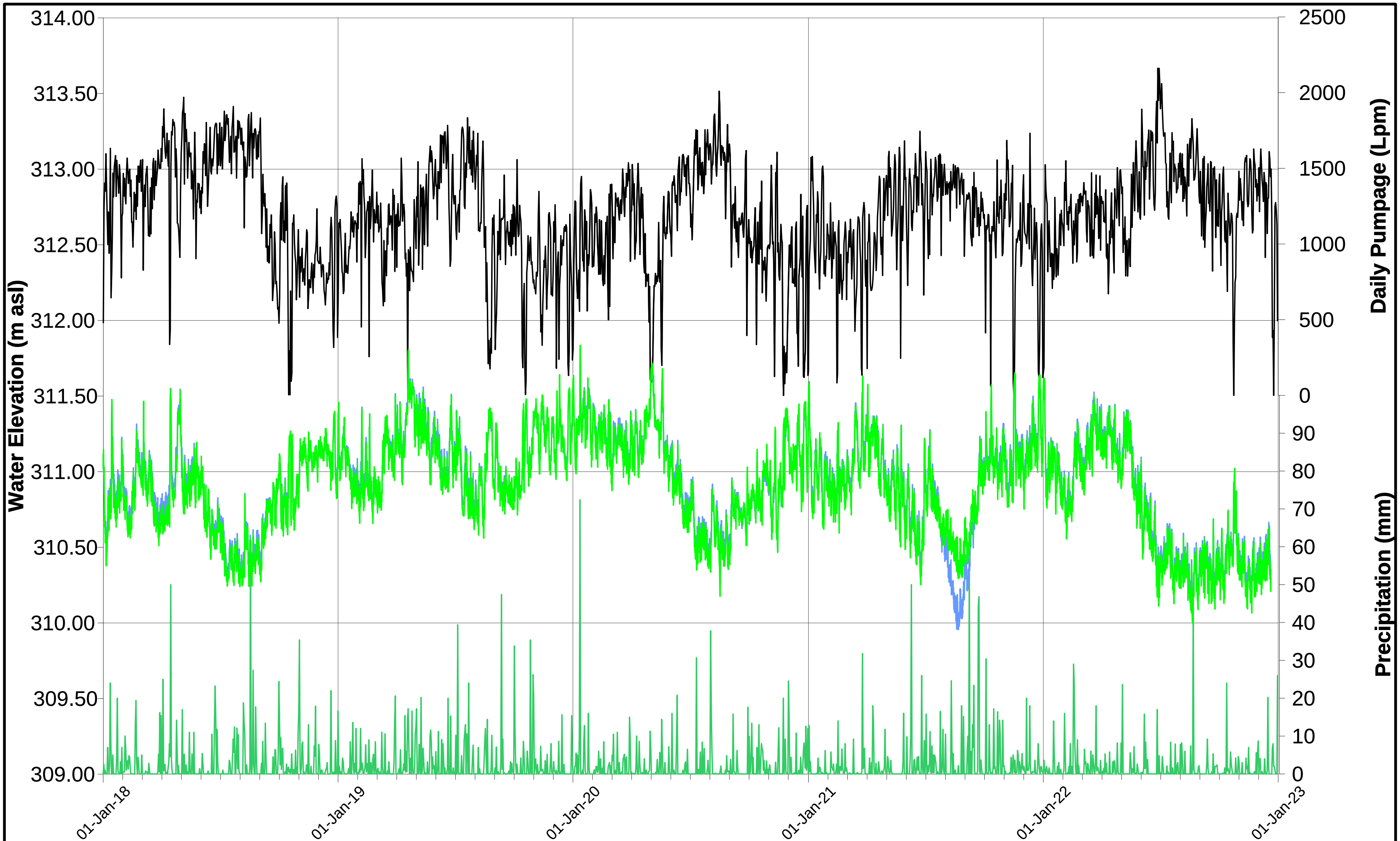
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D29



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

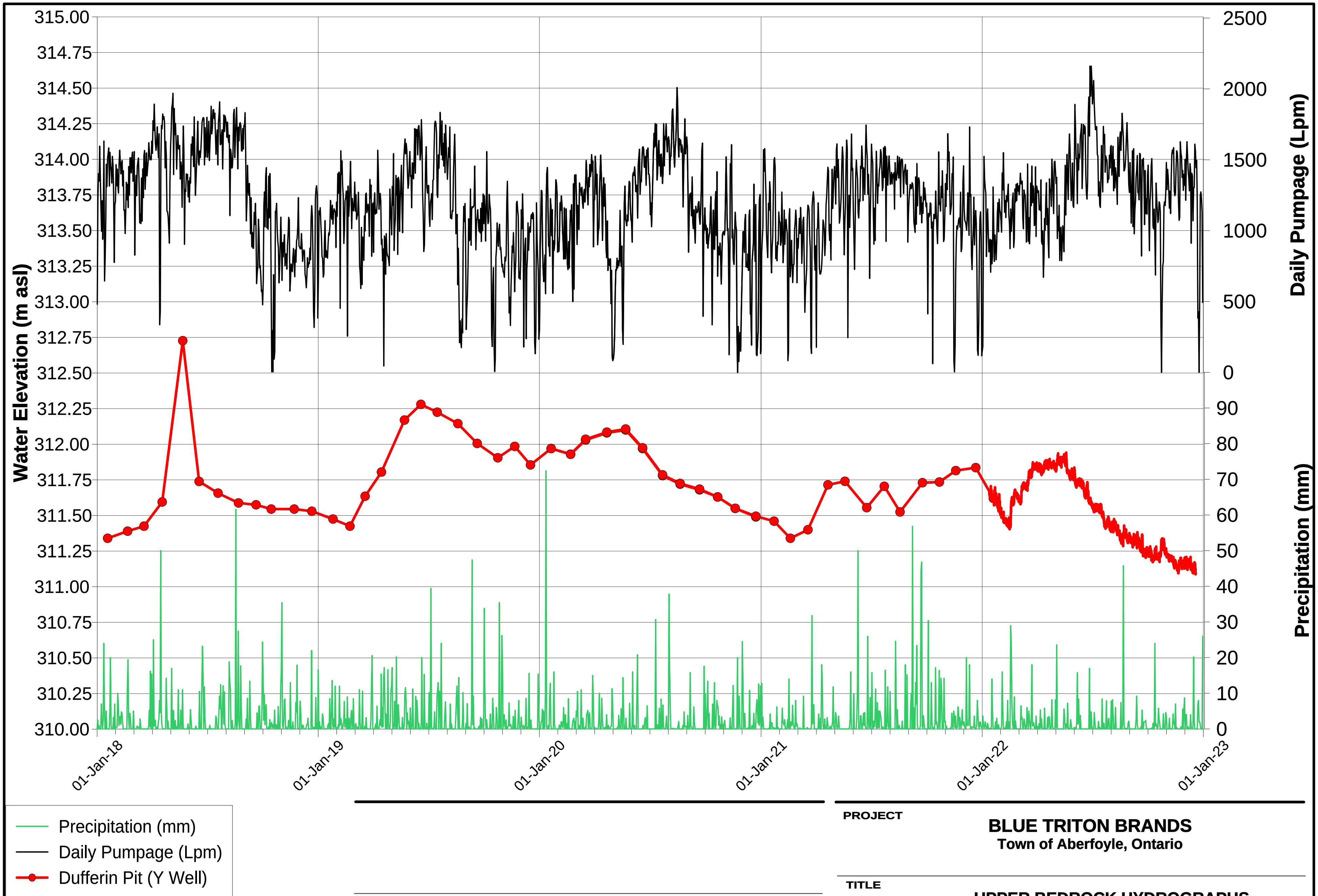
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D30



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

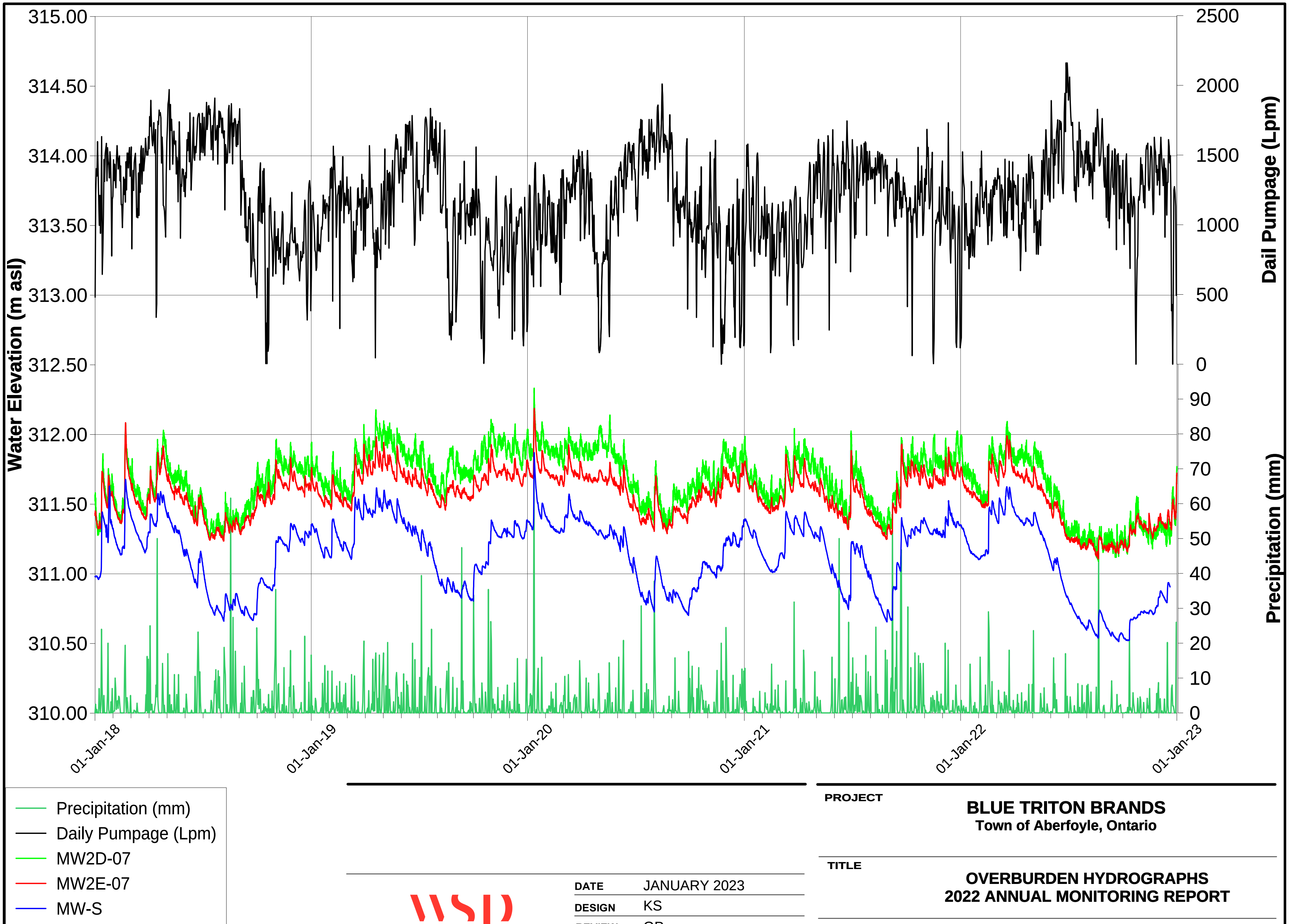
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D31



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

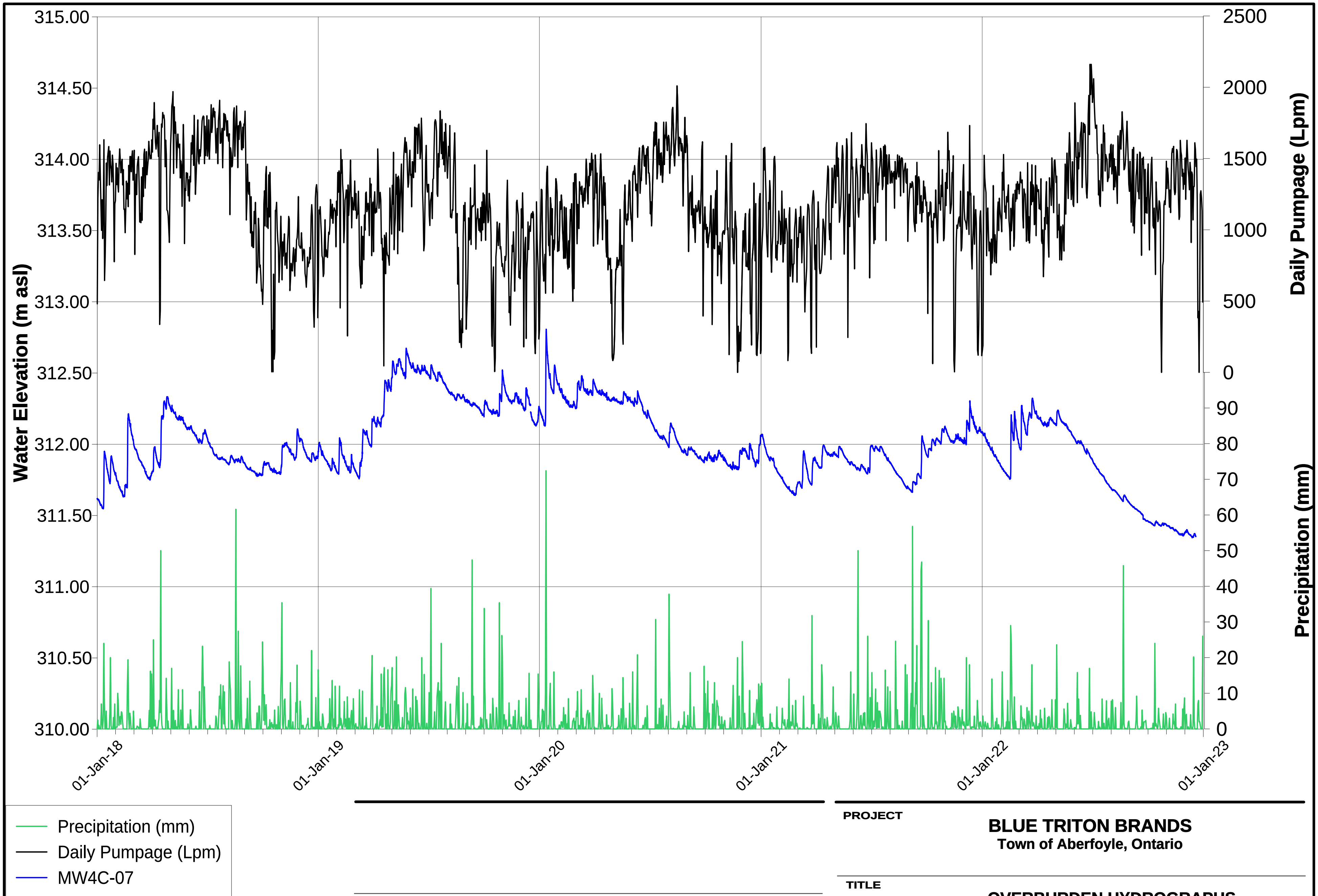
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D32



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

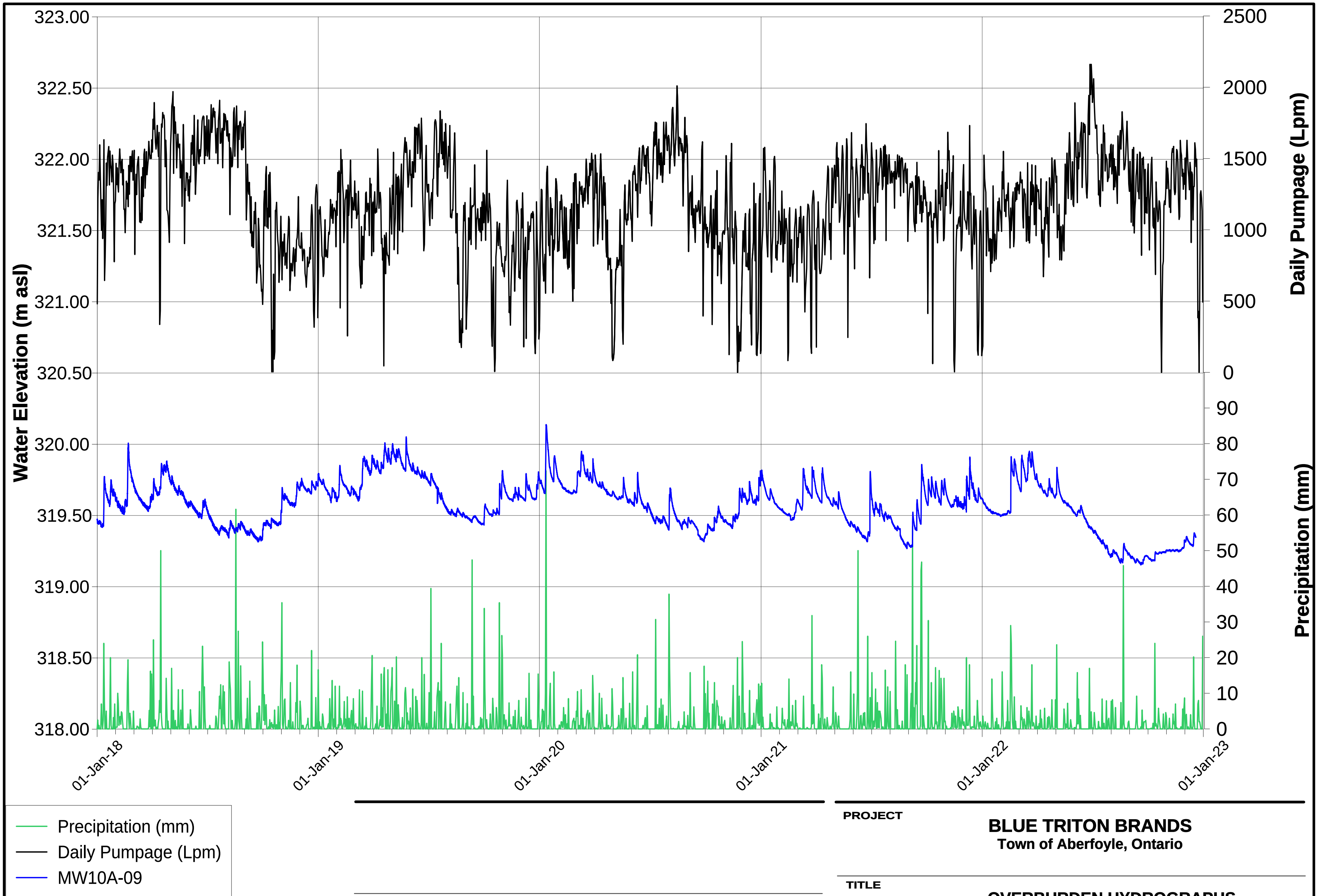
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D33



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

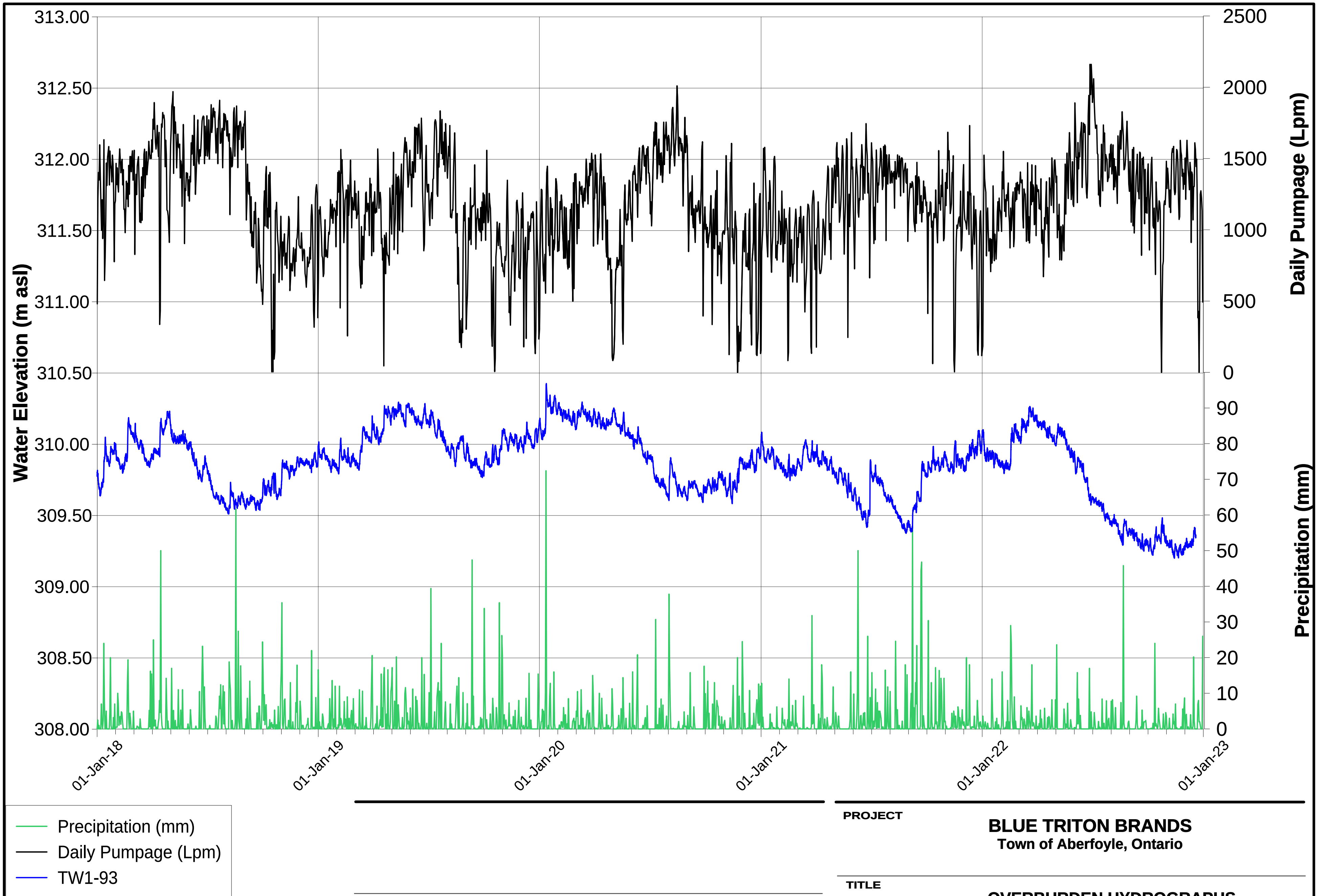
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D34



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

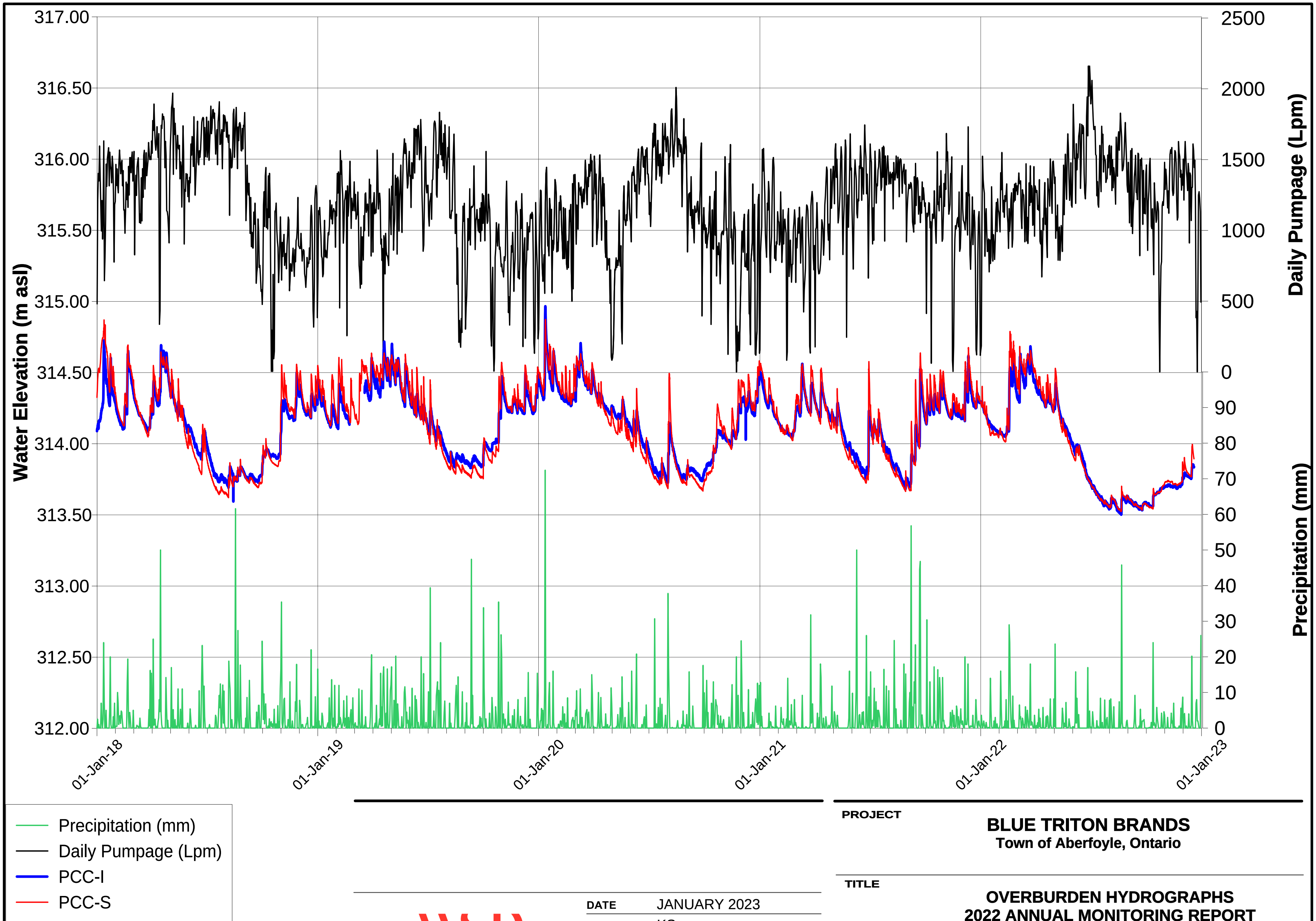
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D35



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

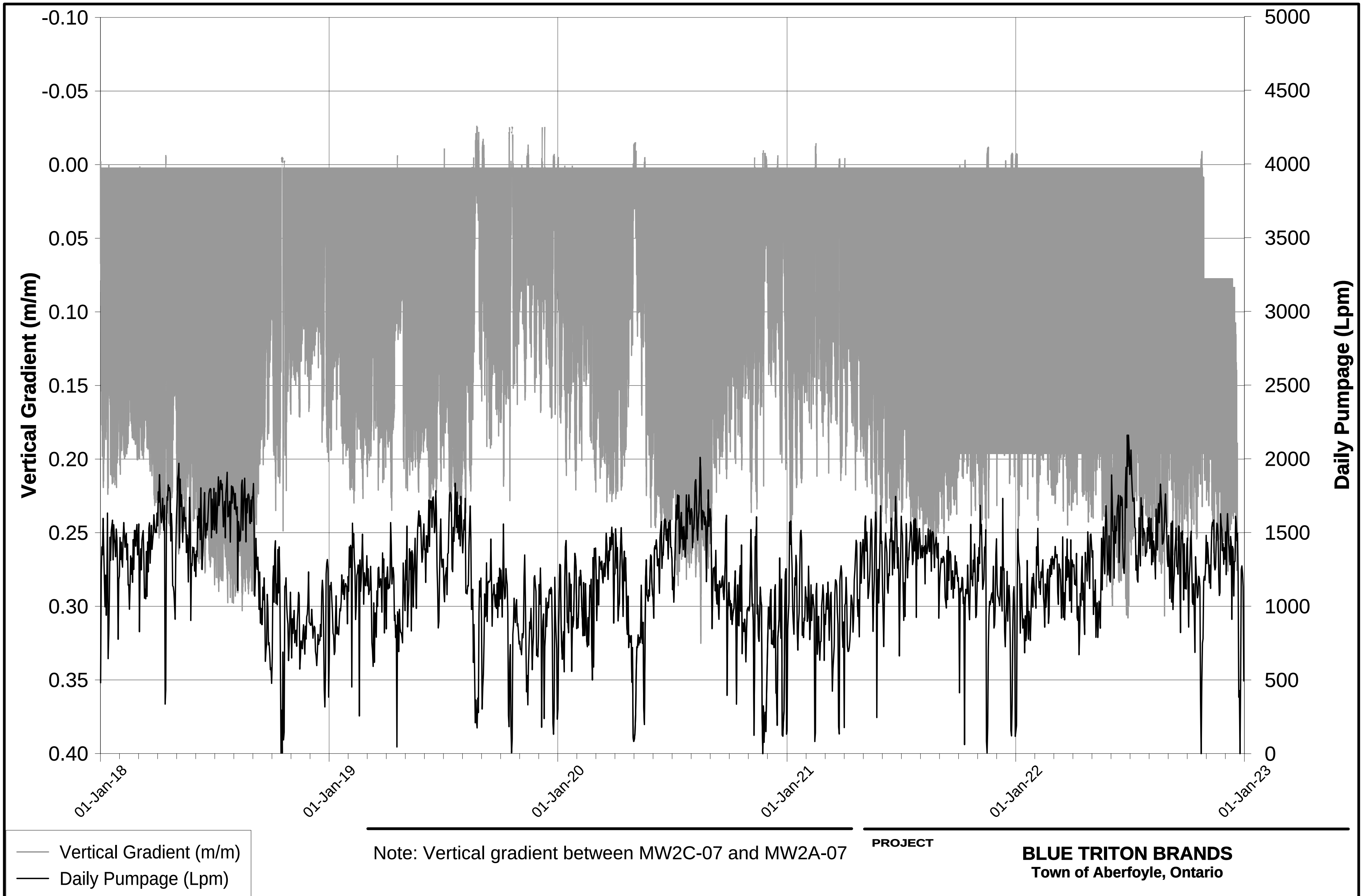
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D36



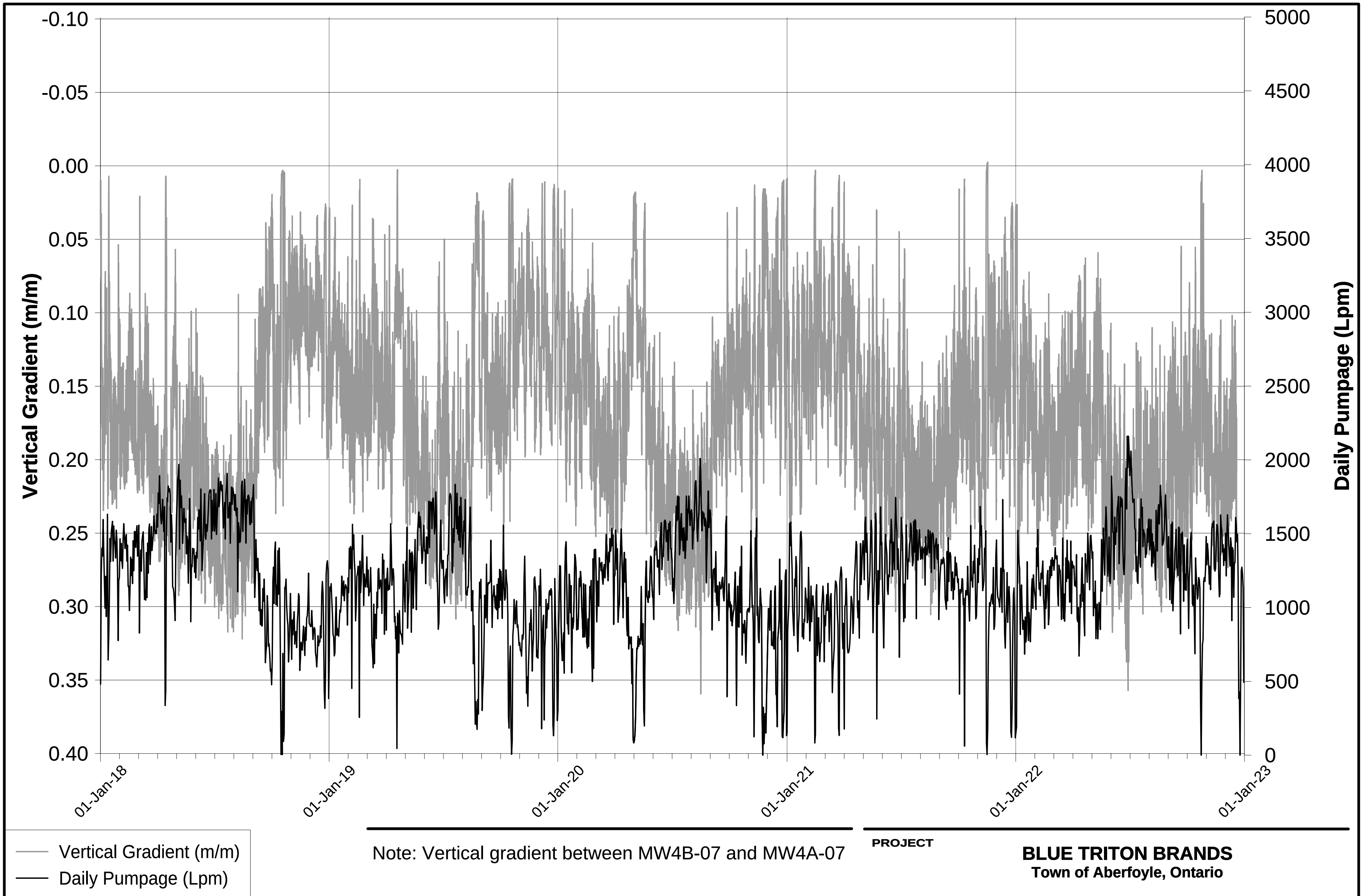
Note: Vertical gradient between MW2C-07 and MW2A-07

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
MW2-07 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D37



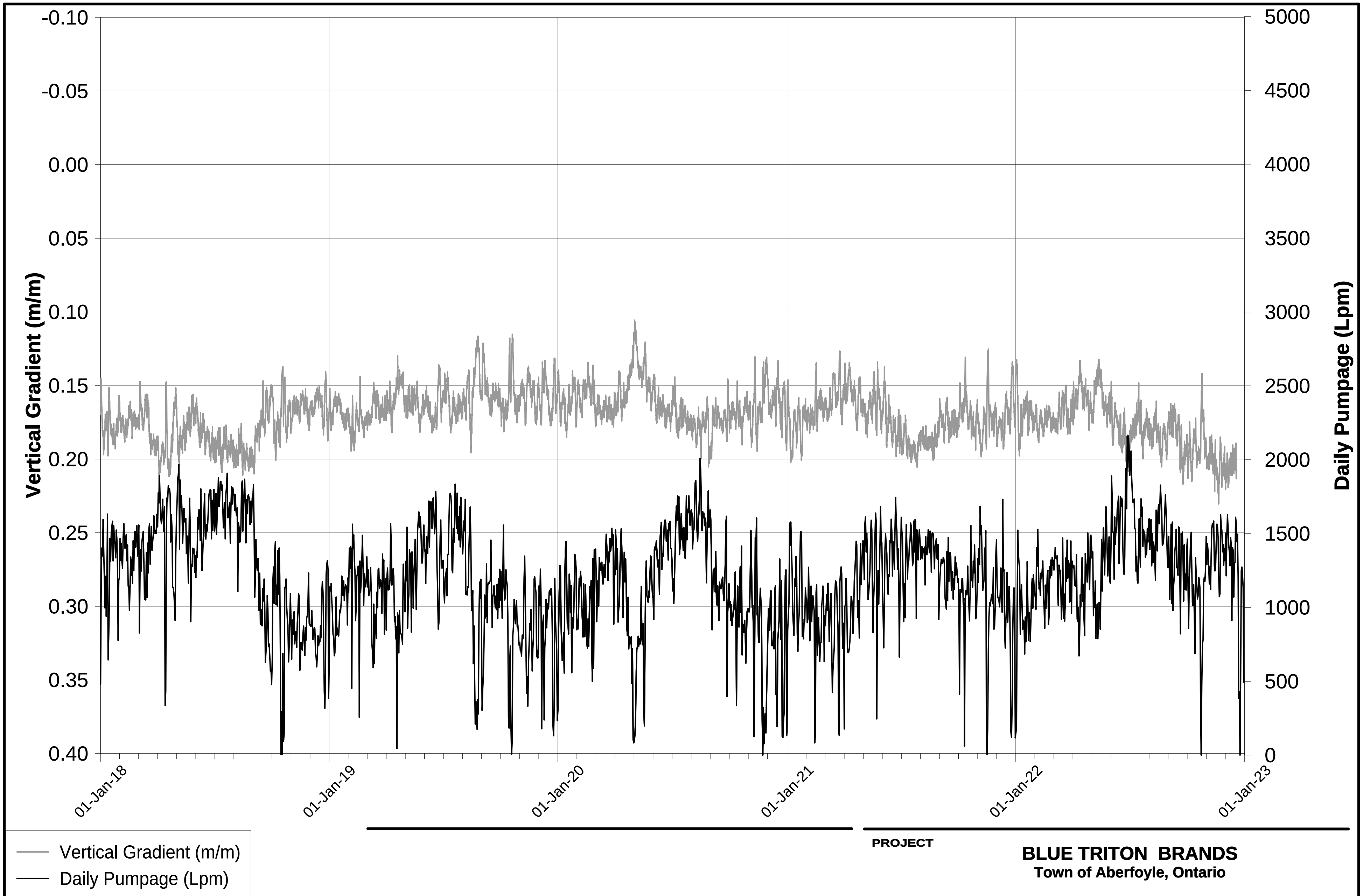
Note: Vertical gradient between MW4B-07 and MW4A-07

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
MW4-07 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

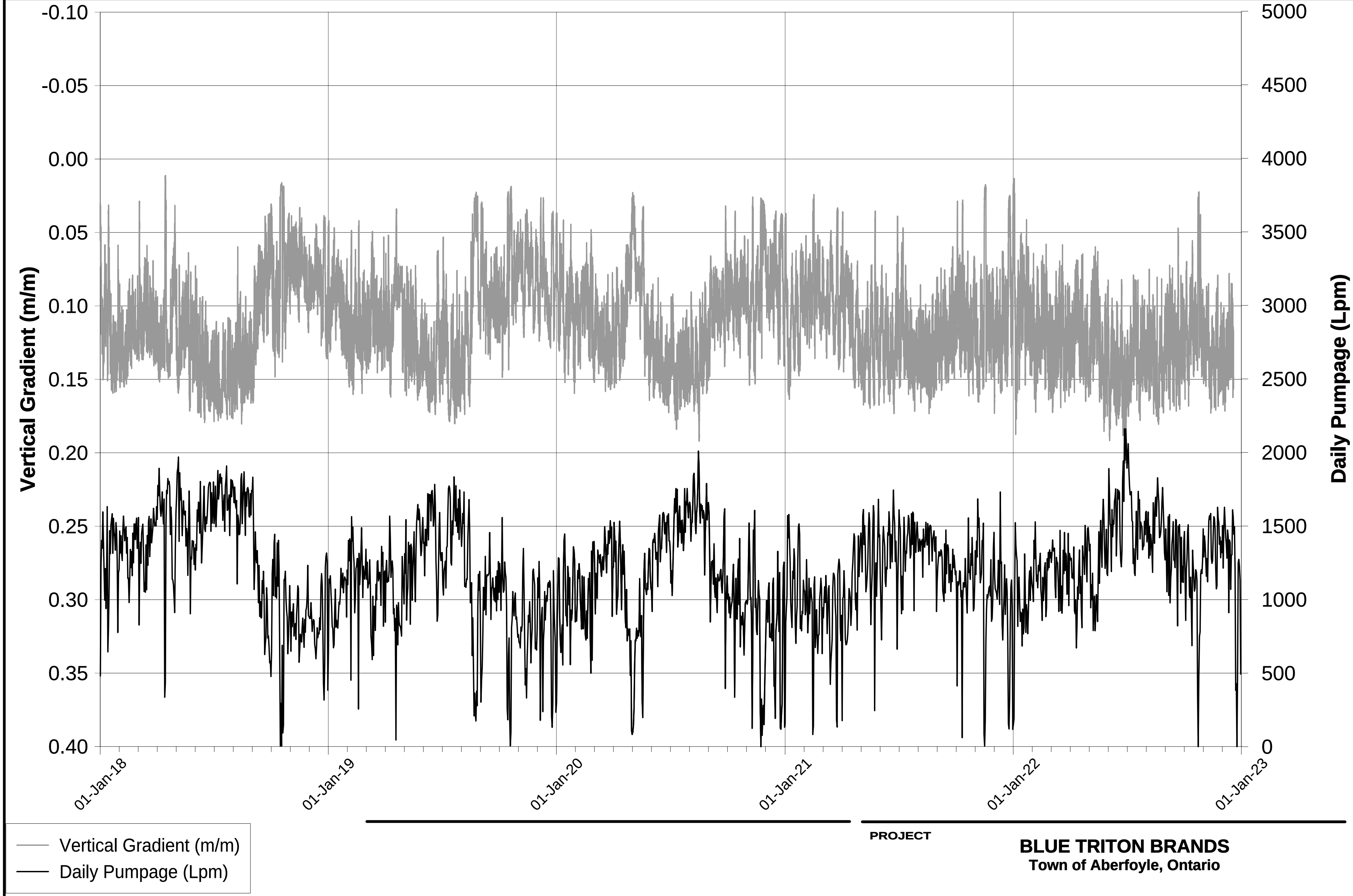
DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D38



PROJECT	**BLUE TRITON BRANDS** **Town of Aberfoyle, Ontario**
TITLE	**MW6-08 VERTICAL GRADIENT** **2022 ANNUAL MONITORING REPORT**
PROJECT NO.	20449101 (1100)
REV	A
FIGURE	D39

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

BLUE TRITON BRANDS

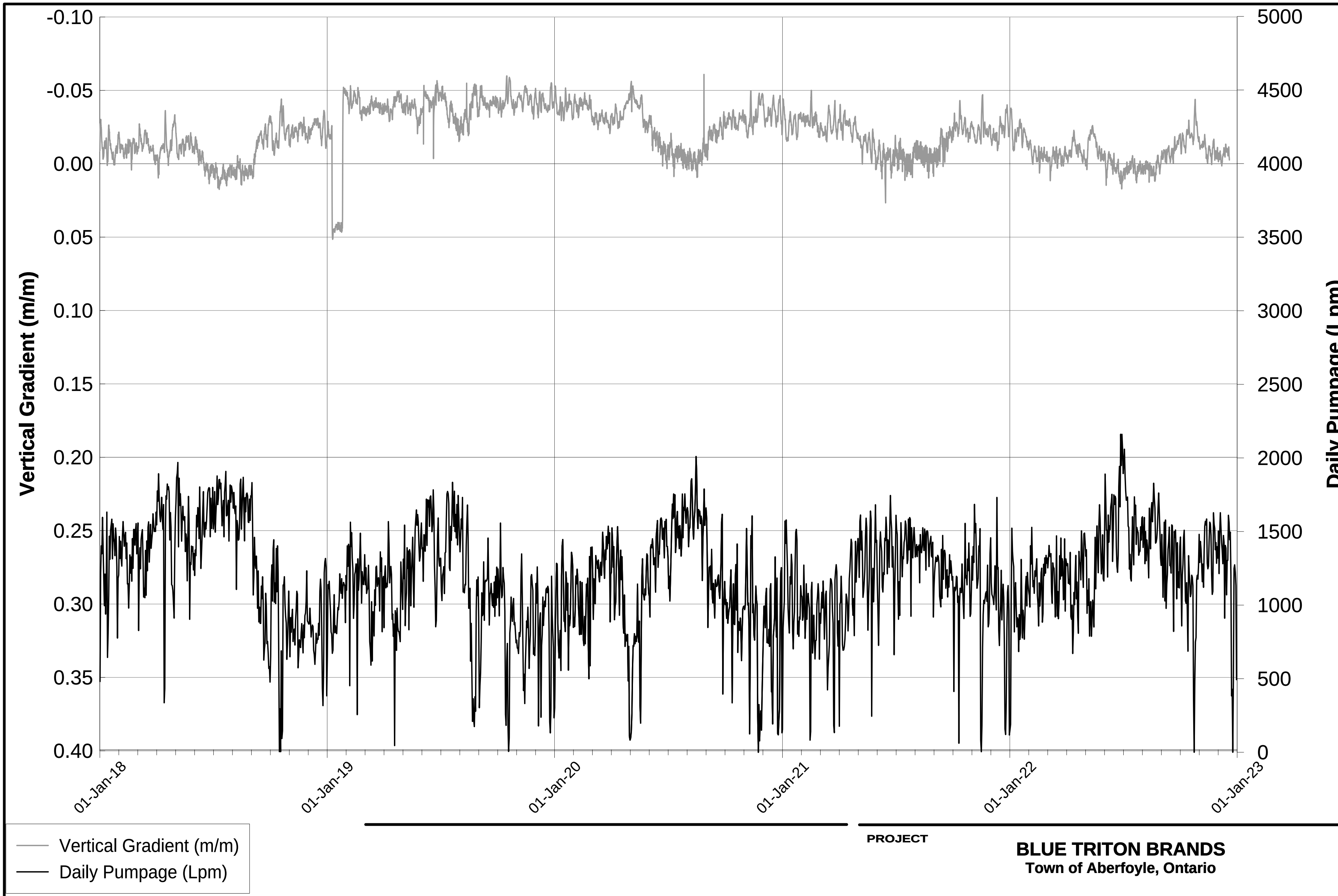
Town of Aberfoyle, Ontario

TITLE

MW7-08 VERTICAL GRADIENT

2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D40

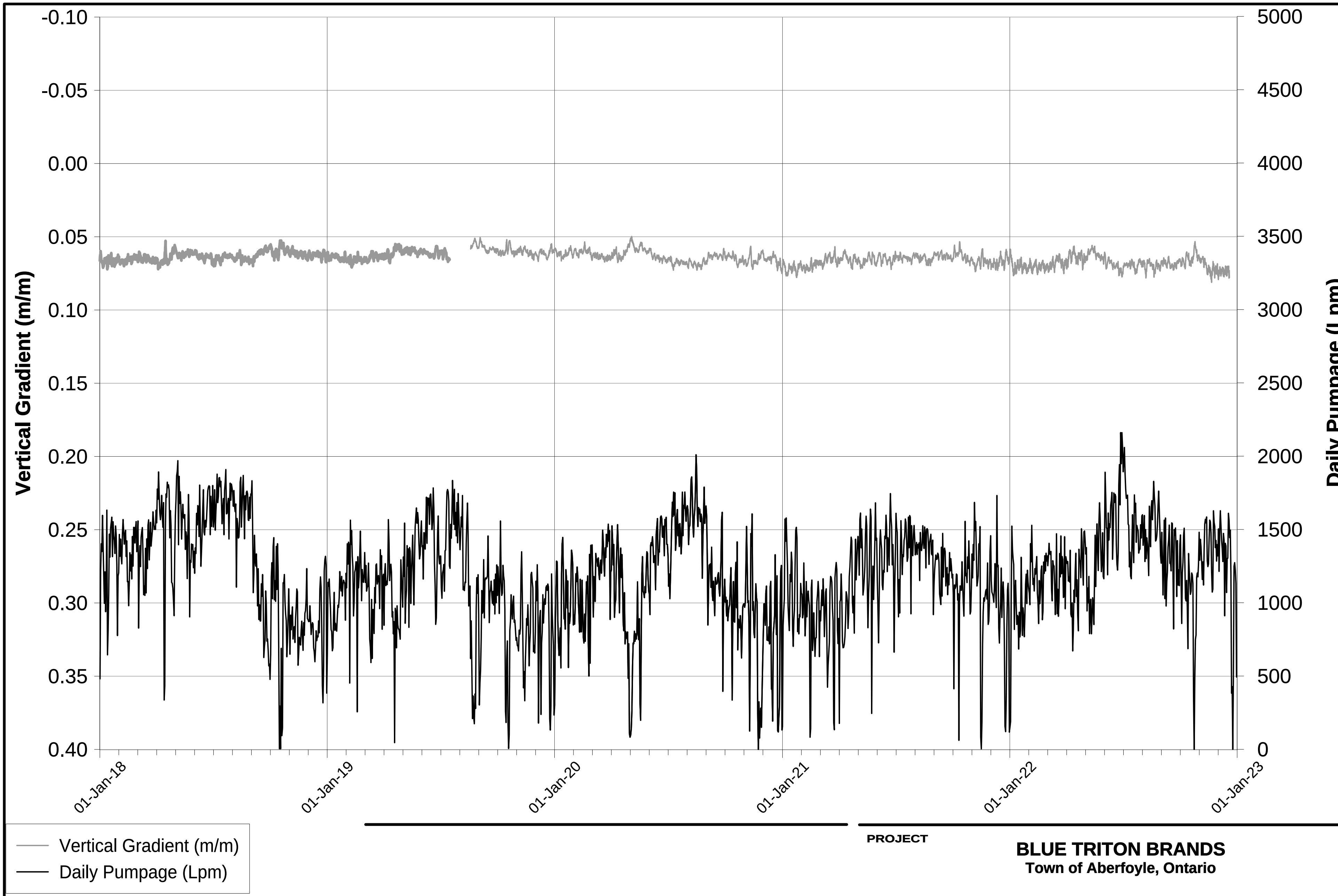


DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
MW8-08 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D41



Note: Vertical gradient between MW10B-09 and MW10C-09

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

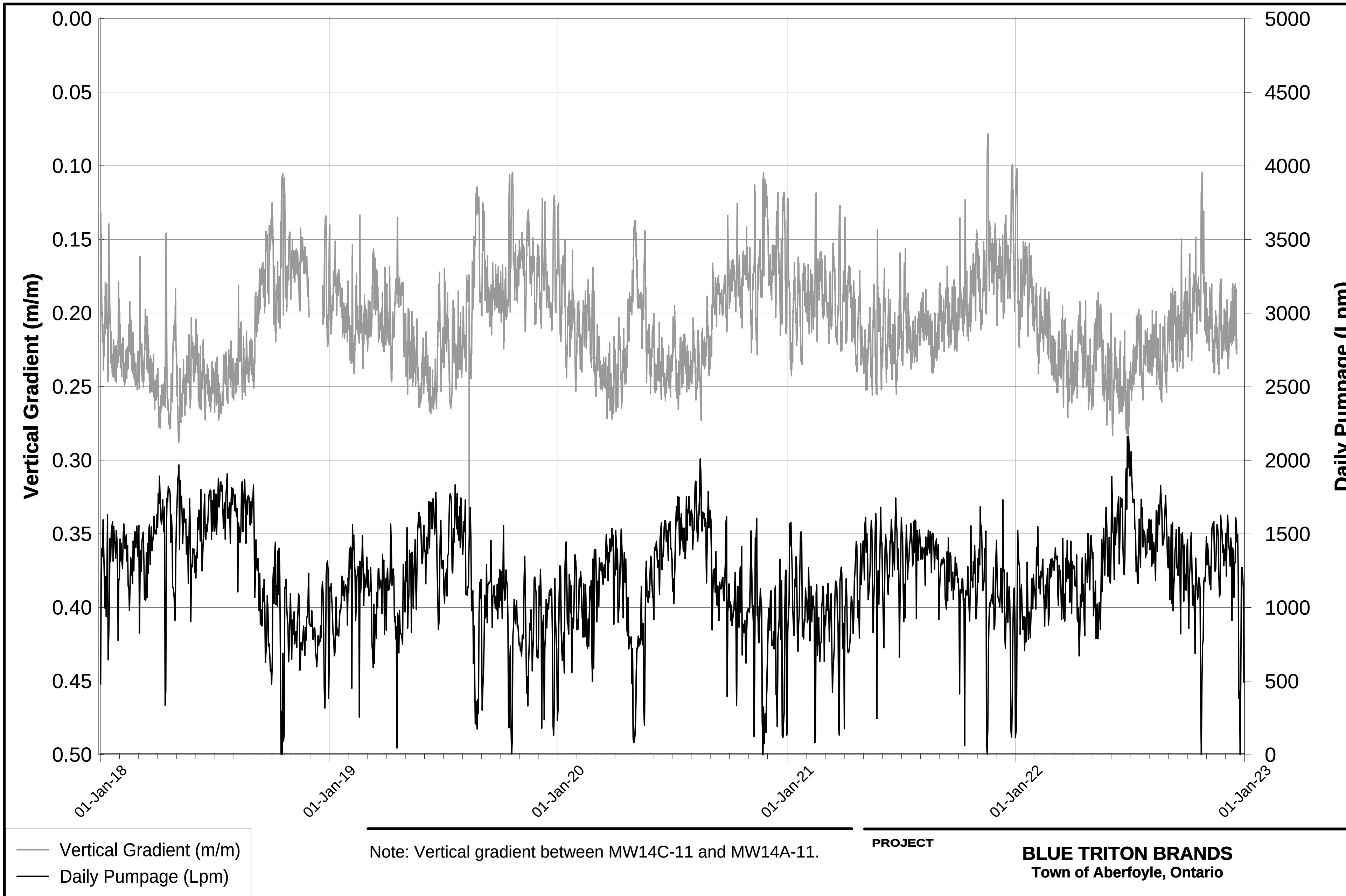
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MW10-09 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D42



Note: Vertical gradient between MW14C-11 and MW14A-11.

PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

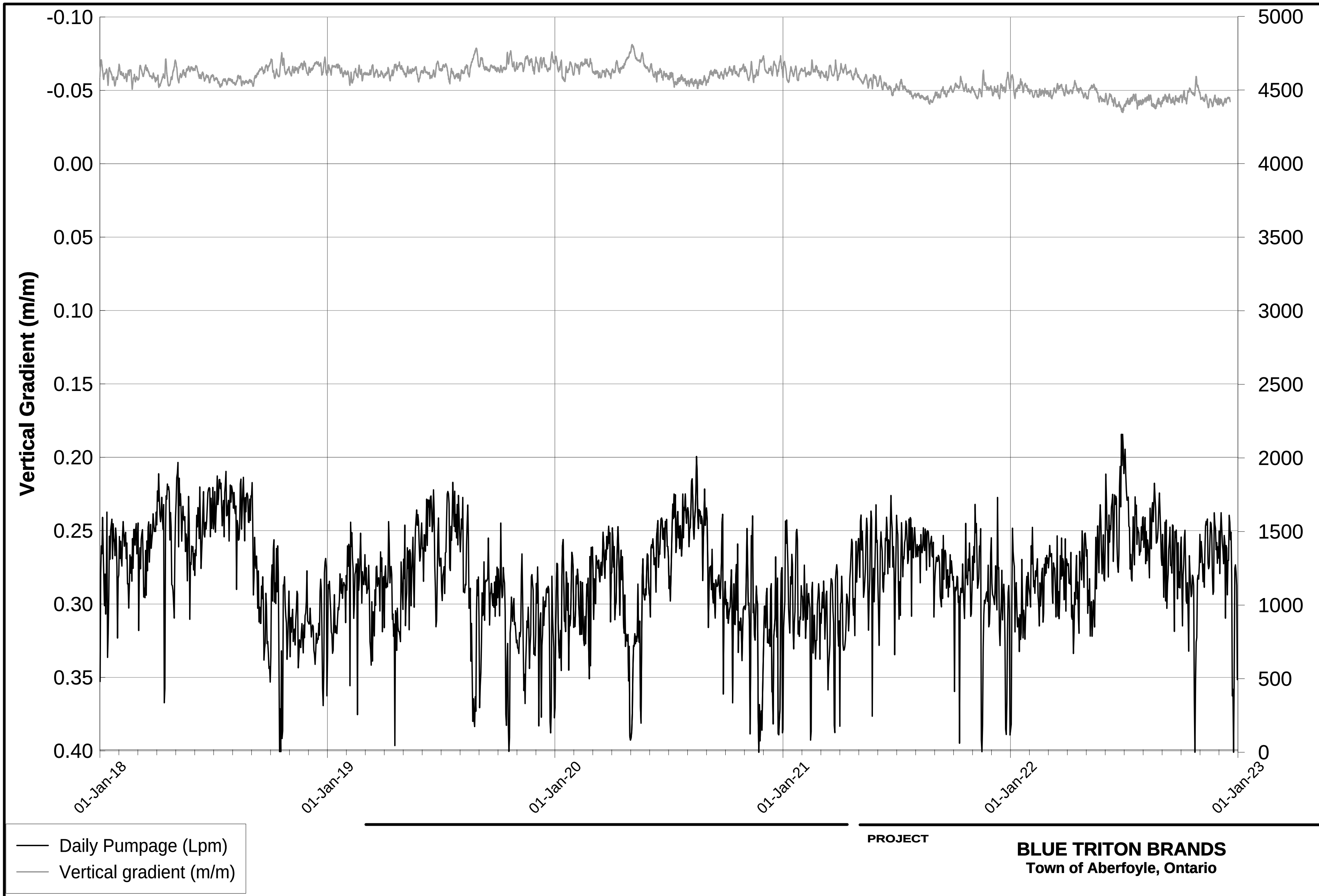
TITLE

MW14-11 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D43



wsp	DATE	JANUARY 2023	
	DESIGN	KS	
	REVIEW	GP	
	APPROVED	GP	

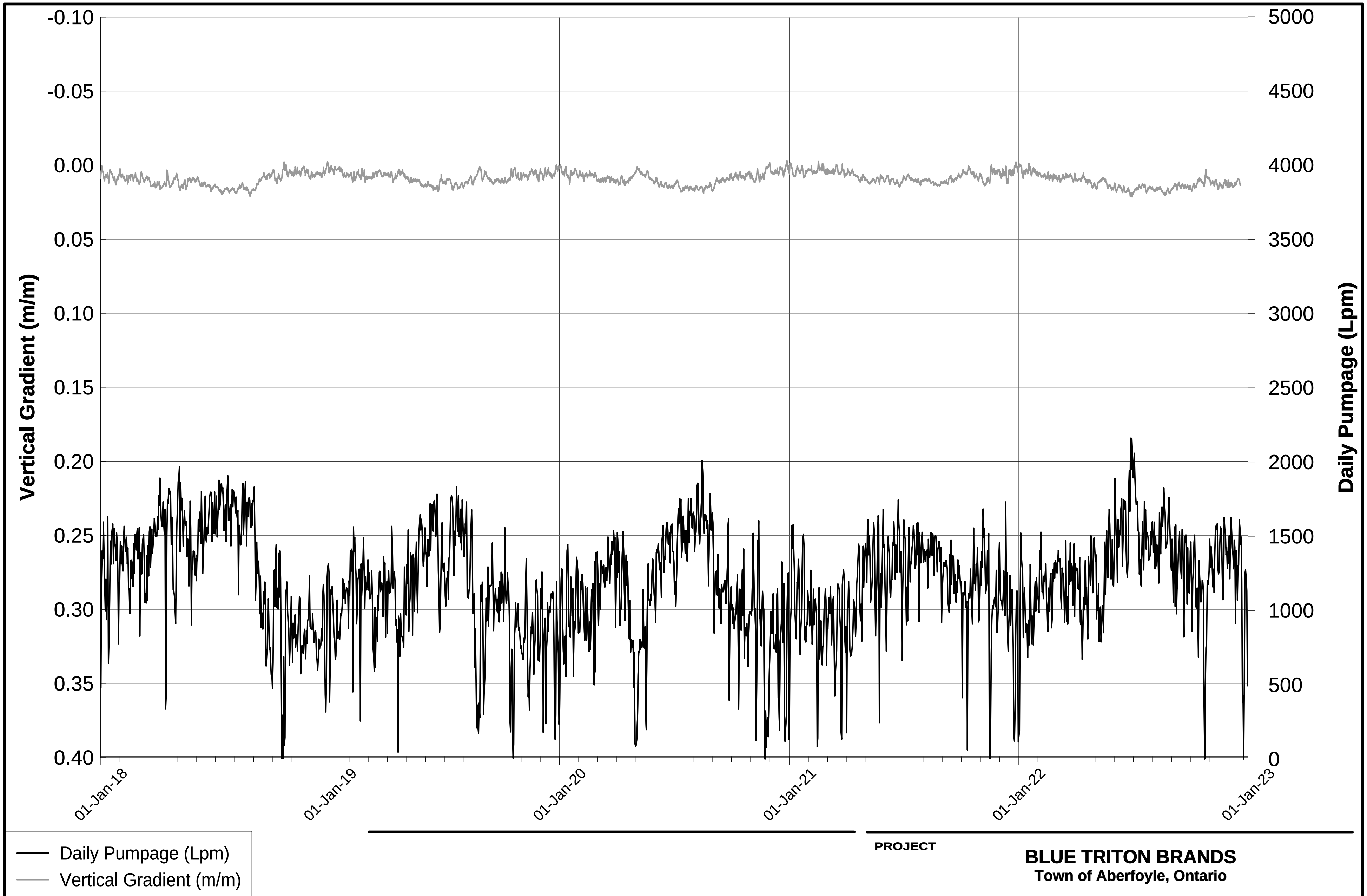
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MW15-12 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D44



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

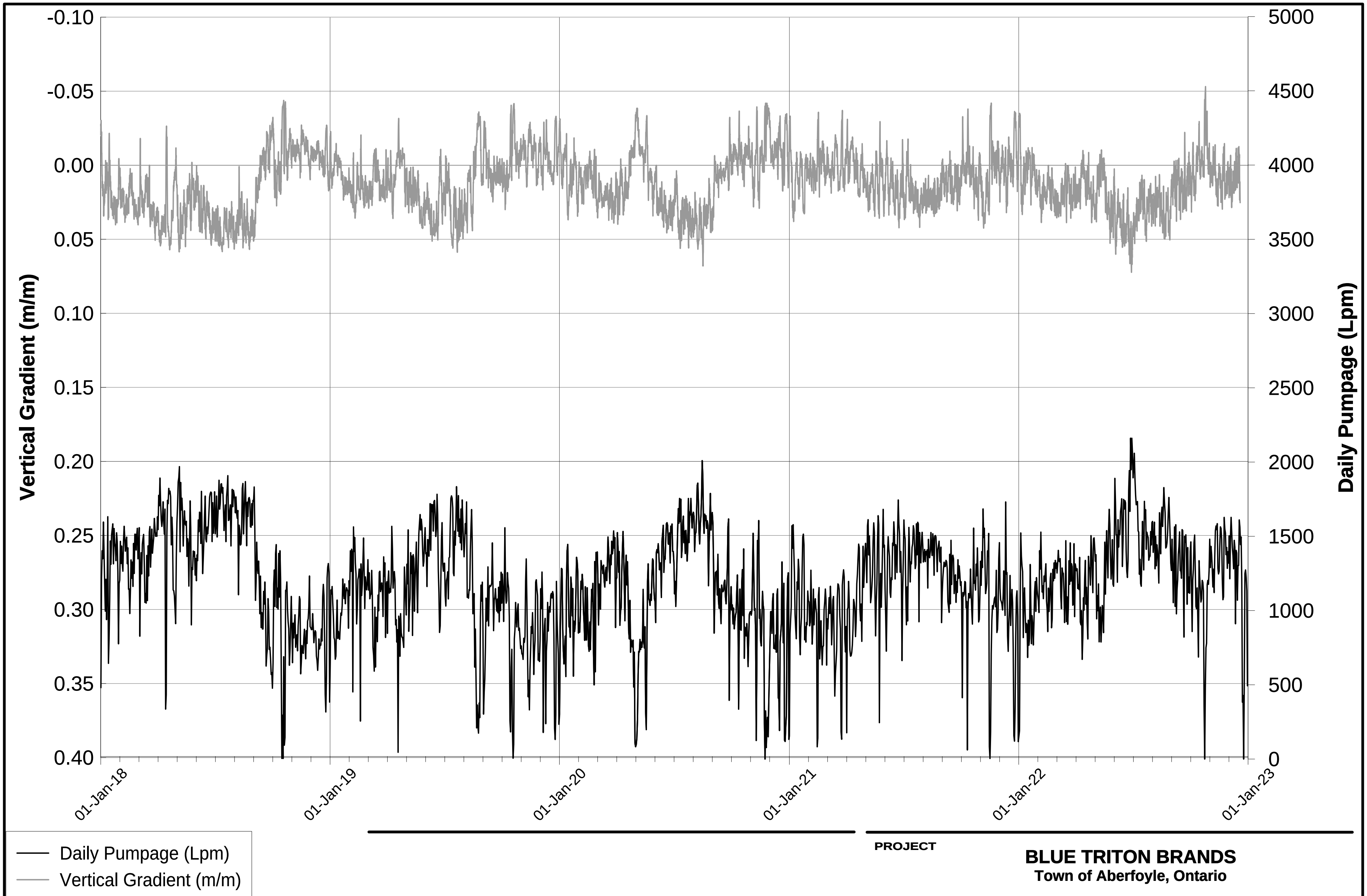
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MW16-12 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D45



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

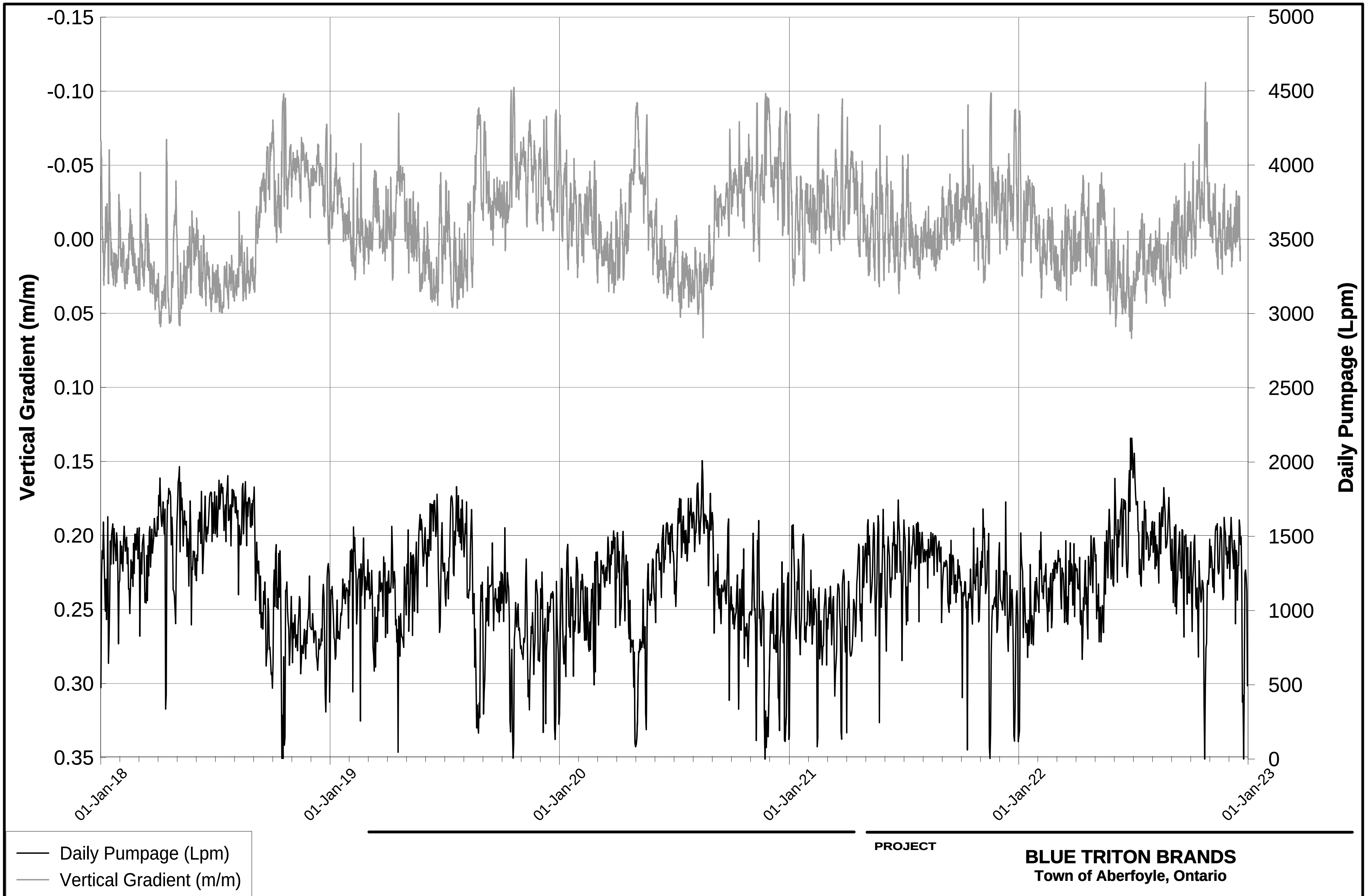
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MW17-12 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D46



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

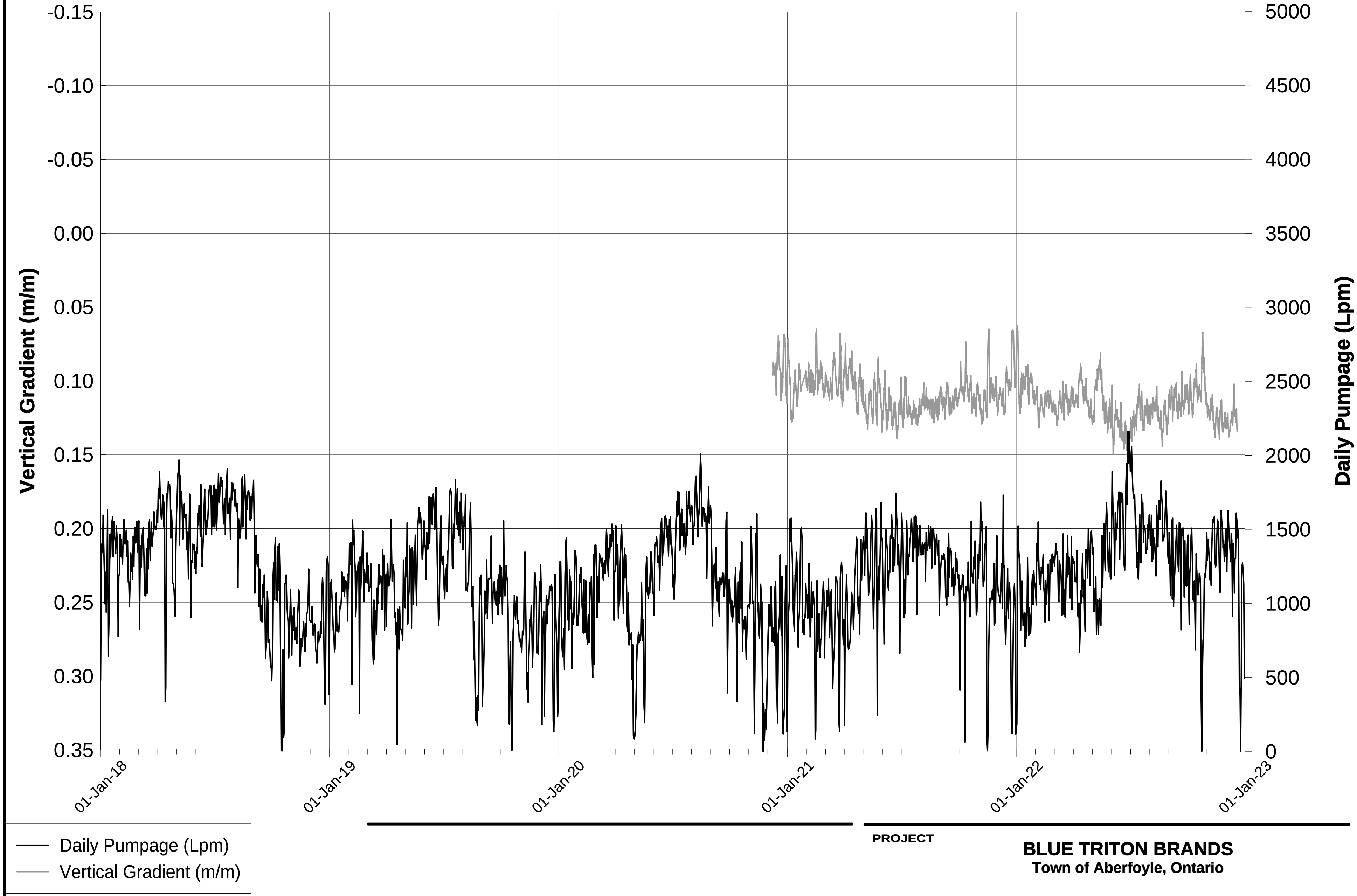
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

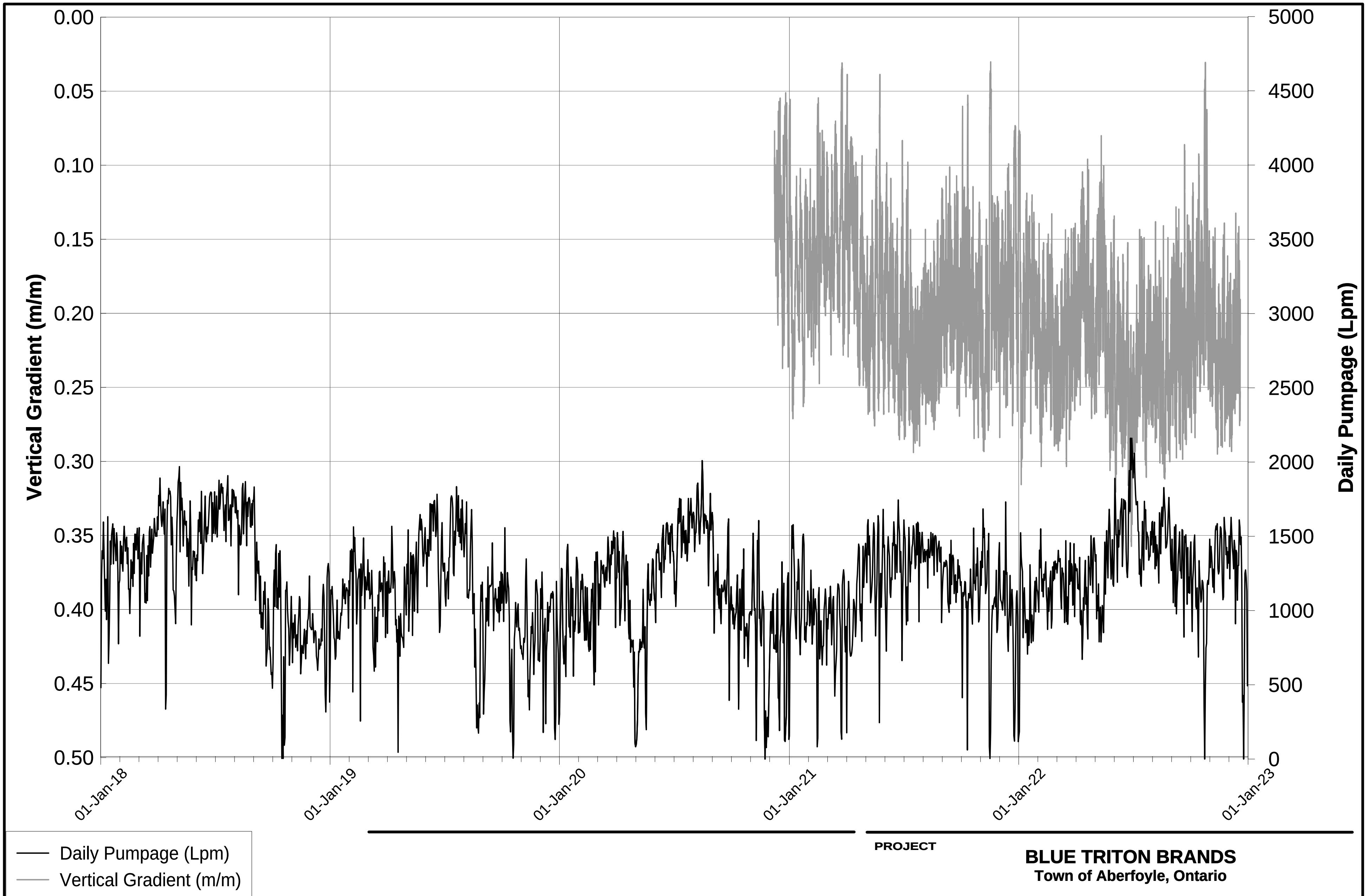
MW18-12 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D47



PROJECT	**BLUE TRITON BRANDS** Town of Aberfoyle, Ontario
TITLE	**MW19-18 VERTICAL GRADIENT 2022 ANNUAL MONITORING REPORT**
PROJECT NO.	20449101 (1100)
REV	A
FIGURE	D48

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

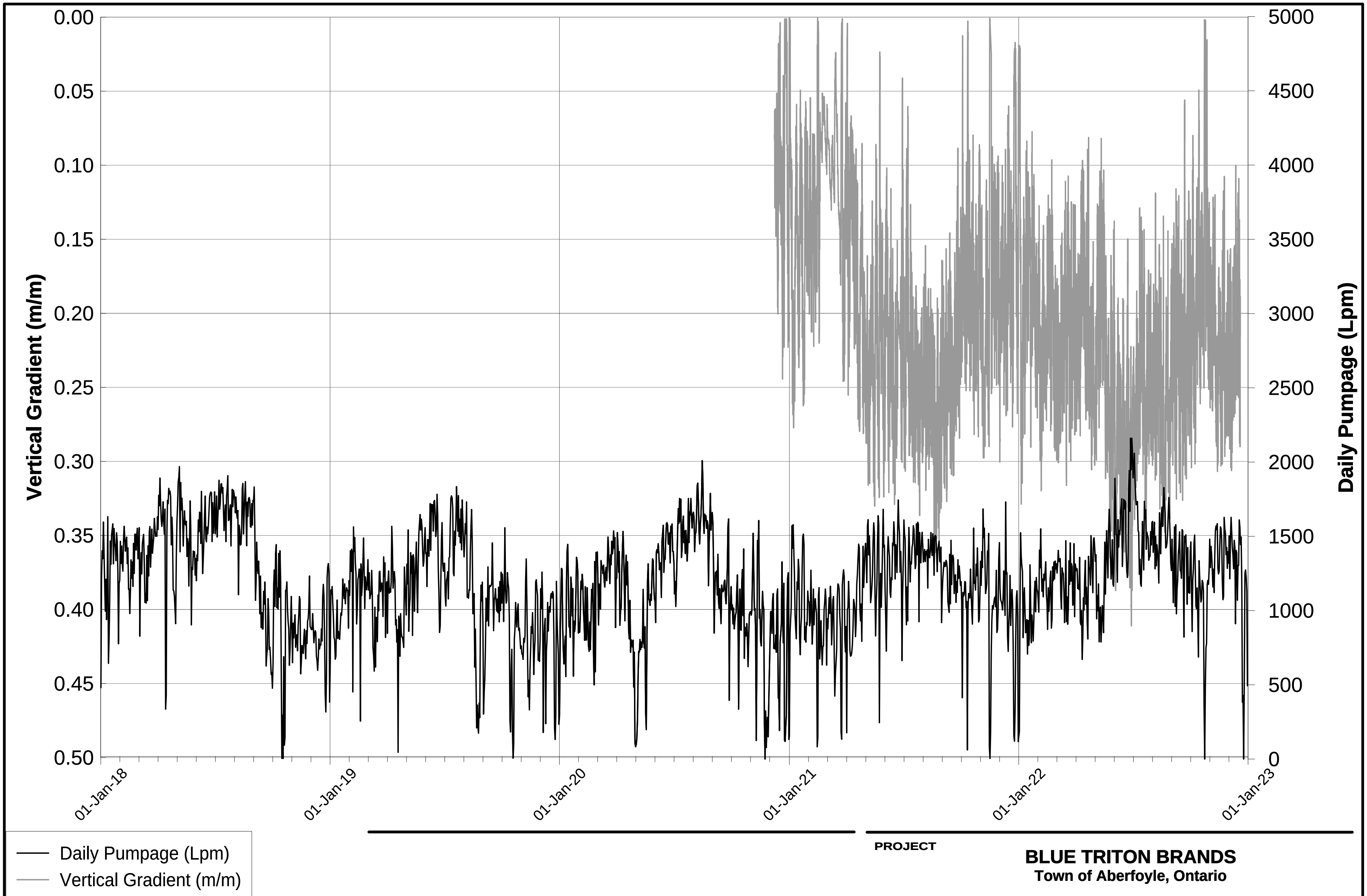
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MW20-19 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D49



PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MW21-18 VERTICAL GRADIENT
2022 ANNUAL MONITORING REPORT

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D50

TABLE D1
Manual Groundwater Elevations
2022 Annual Report

Date	Water Level (masl)							
	TW3-80	MW2A-07	MW2B-07	MW2C-07	MW2D-07	MW2E-07	MW4A-07	MW4B-07
22/23-Mar-2022	303.03	307.59	308.63	311.18	311.93	311.87	309.20	312.12
22/23-Jun-2022	305.14	308.67	309.36	310.96	311.48	311.37	308.37	311.92
22/23-Sep-2022	301.60	305.99	310.26	310.26	311.16	311.18	308.29	311.44
19/20-Dec-2022	300.82	305.87	307.15	310.34	311.29	311.35	307.65	311.27

TABLE D1
Manual Groundwater Elevations
2022 Annual Report

Date	Water Level (masl)							
	MW4C-07	MW6A-08	MW6B-08	MW7A-08	MW7B-08	MW8A-08	MW8B-08	MW10A-09
22/23-Mar-2022	312.19	315.76	318.66	310.07	311.56	317.61	317.51	319.84
22/23-Jun-2022	311.93	315.18	318.19	308.82	310.50	317.01	317.04	319.45
22/23-Sep-2022	311.50	314.50	318.07	308.04	309.94	316.98	316.84	319.16
19/20-Dec-2022	311.35	314.66	318.35	308.62	310.33	317.17	317.13	319.34

TABLE D1
Manual Groundwater Elevations
2022 Annual Report

Date	Water Level (masl)							
	MW10B-09	MW10C-09	MW10D-09	MW14A-11	MW14B-11	MW14C-11	MW15A-12	MW15B-12
22/23-Mar-2022	319.86	317.16	316.52	310.27	314.33	315.18	310.70	308.83
22/23-Jun-2022	319.57	316.72	316.01	309.40	313.55	314.29	310.04	308.70
22/23-Sep-2022	319.33	316.40	315.62	308.82	313.26	313.54	309.84	308.34
19/20-Dec-2022	319.39	316.14	315.37	309.00	313.23	313.58	309.88	308.41

TABLE D1
Manual Groundwater Elevations
2022 Annual Report

Date	Water Level (masl)							
	MW16A-12	MW16B-12	MW17A-12	MW17B-12	MW18A-12	MW18B-12	MW-D	MW-I
22/23-Mar-2022	307.16	307.36	308.37	308.91	308.22	308.22	311.34	311.30
22/23-Jun-2022	306.96	307.48	307.89	308.77	307.48	307.78	310.80	310.77
22/23-Sep-2022	306.58	307.01	307.27	307.96	306.85	307.00	310.56	310.54
19/20-Dec-2022	306.29	306.70	307.03	307.73	306.80	306.92	310.35	310.28

TABLE D1
Manual Groundwater Elevations
2022 Annual Report

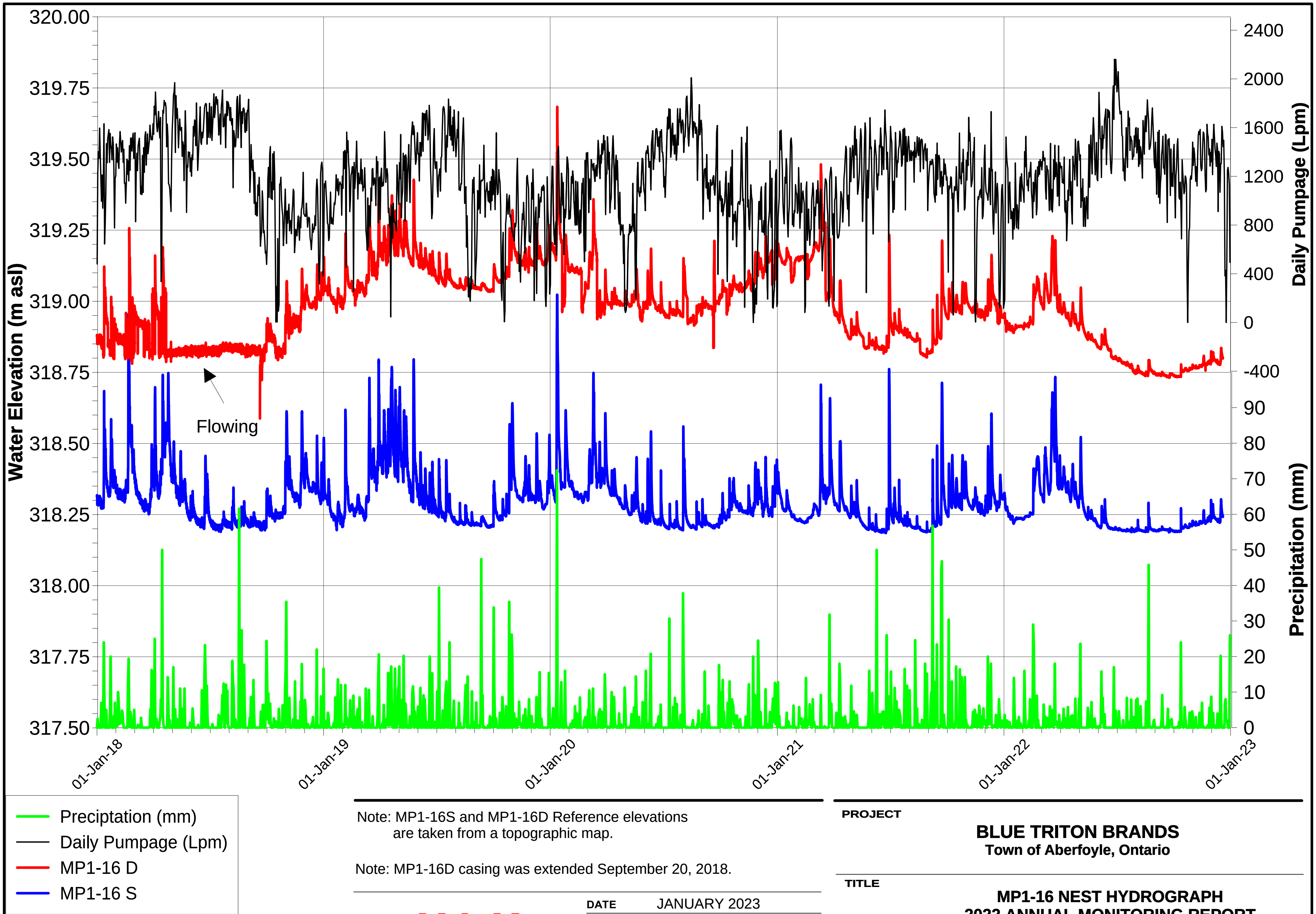
Date	Water Level (masl)							
	MW-S	PCC-D	PCC-I	PCC-S	TW1-93	TW2-11	PW5 Meadows of Aberfoyle	#125 Brock S. (Y Well)
22/23-Mar-2022	311.55	314.84	314.50	314.56	310.19	309.91	310.02	311.79
22/23-Jun-2022	310.91	314.12	313.84	313.81	309.76	309.32	309.30	311.66
22/23-Sep-2022	310.53	313.77	313.54	313.54	309.34	308.64	309.11	311.24
19/20-Dec-2022	310.90	314.11	313.83	313.89	309.36	308.74	308.64	311.09

TABLE D1
Manual Groundwater Elevations
2022 Annual Report

Date	Water Level (masl)					
	MW19-18-4	MW19-18-7	MW20-19-5	MW20-19-7	MW21-18-3	MW21-18-4
22/23-Mar-2022	313.030	315.63	309.38	311.99	308.94	311.55
22/23-Jun-2022	311.770	314.82	307.94	310.75	308.53	311.26
22/23-Sep-2022	311.900	314.46	307.97	310.67	307.98	310.87
19/20-Dec-2022	311.980	315.04	307.76	310.71	307.42	310.75

APPENDIX E

Surface Water Level Monitoring



Note: MP1-16S and MP1-16D Reference elevations are taken from a topographic map.

Note: MP1-16D casing was extended September 20, 2018.

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

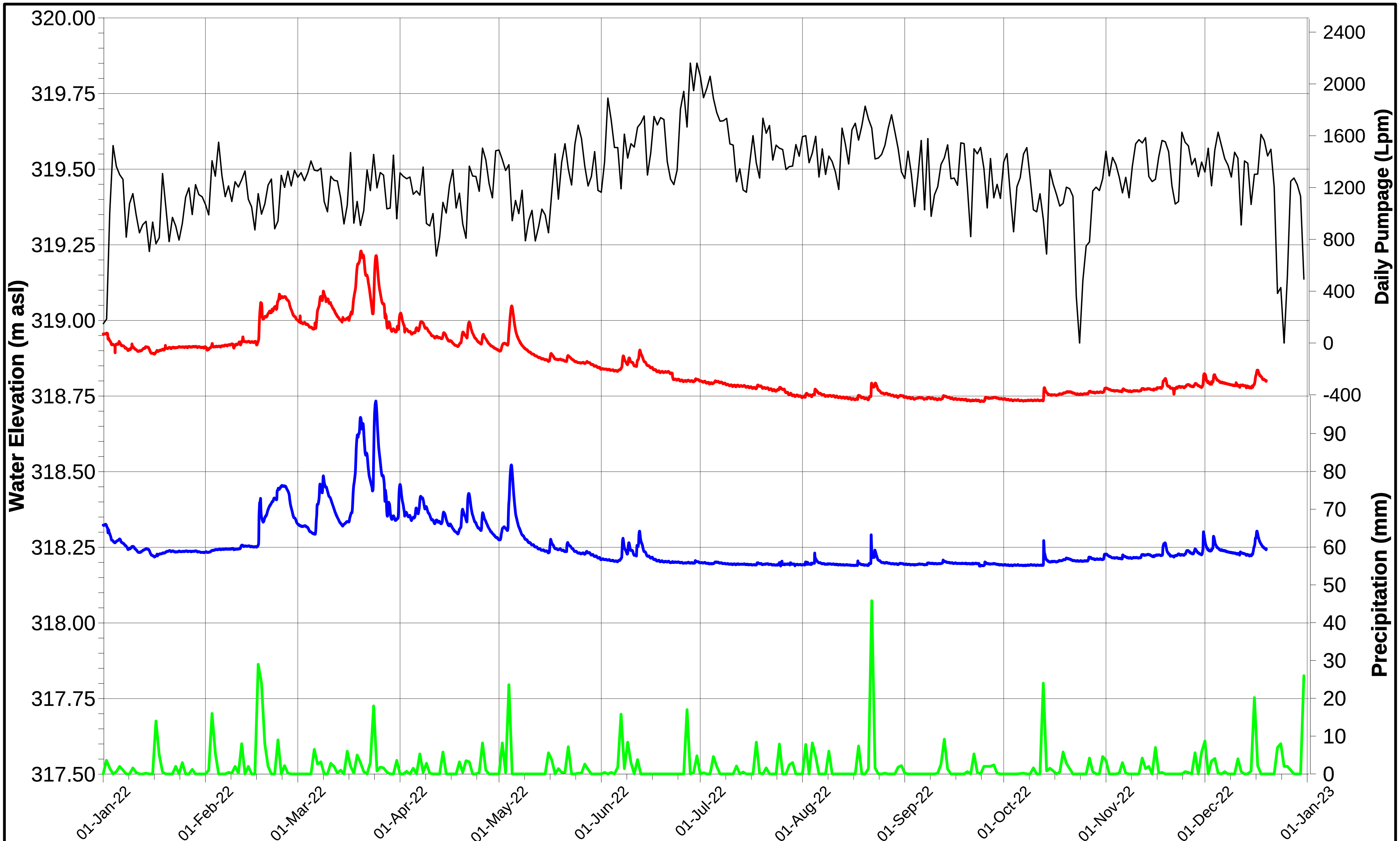
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP1-16 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E1a



Preciptation (mm)
Daily Pumpage (Lpm)
MP1-16 D
MP1-16 S

Note: MP1-16S and MP1-16D Reference elevations are taken from a topographic map.

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

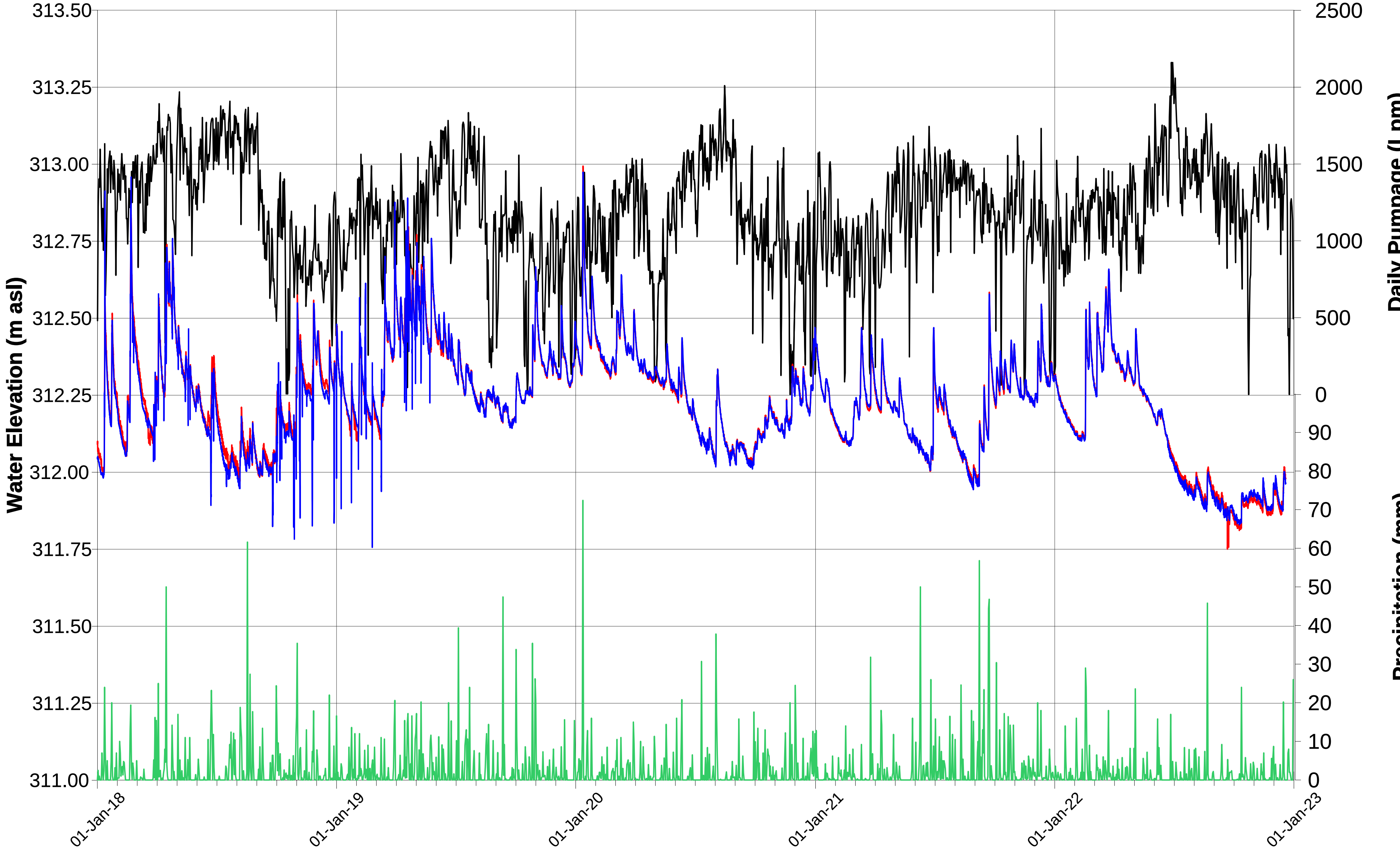
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP1-16 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E1b



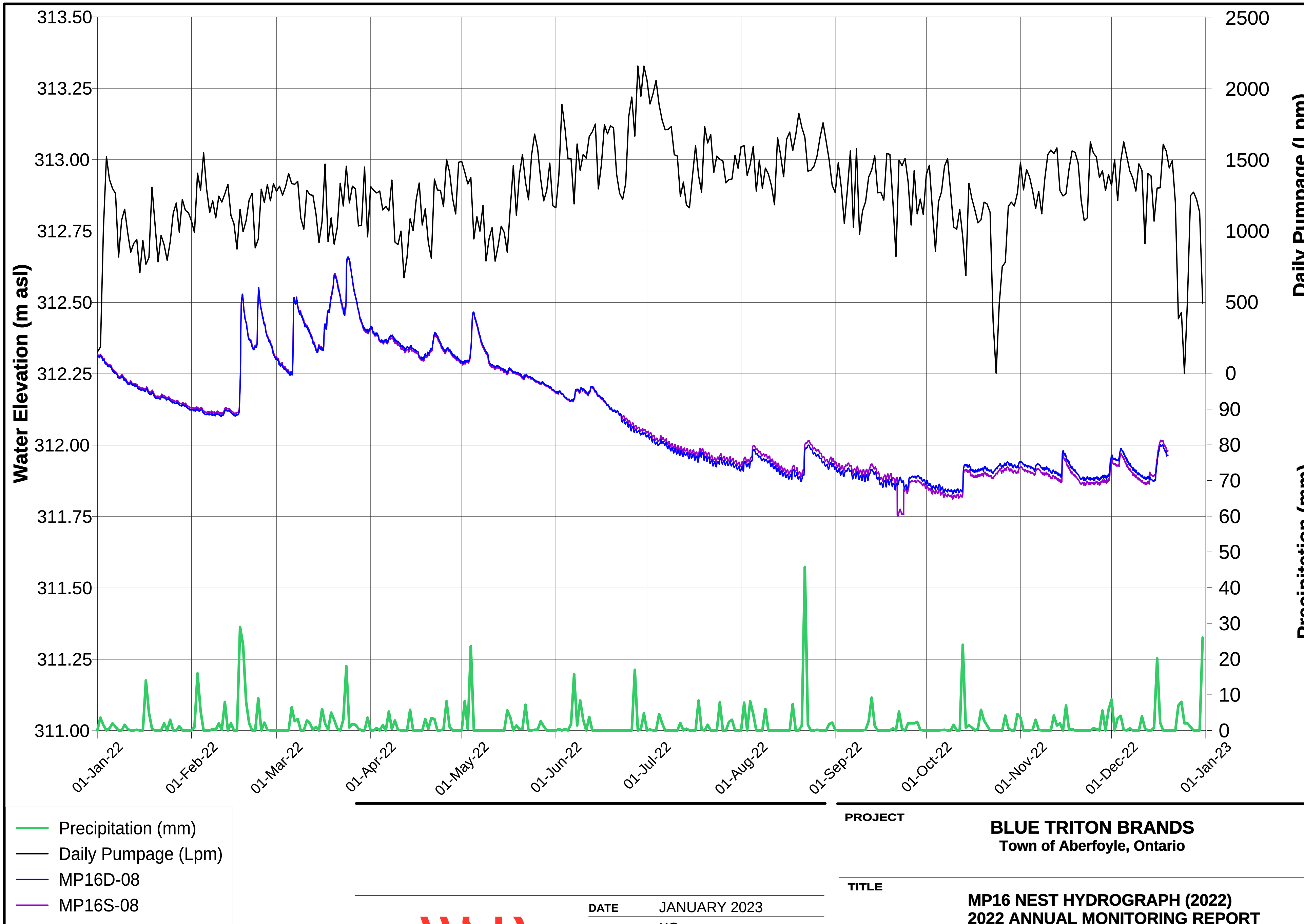
Note: Roundabout constructed on Brock Road starting on May 21, 2019

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
MP16 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E2a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

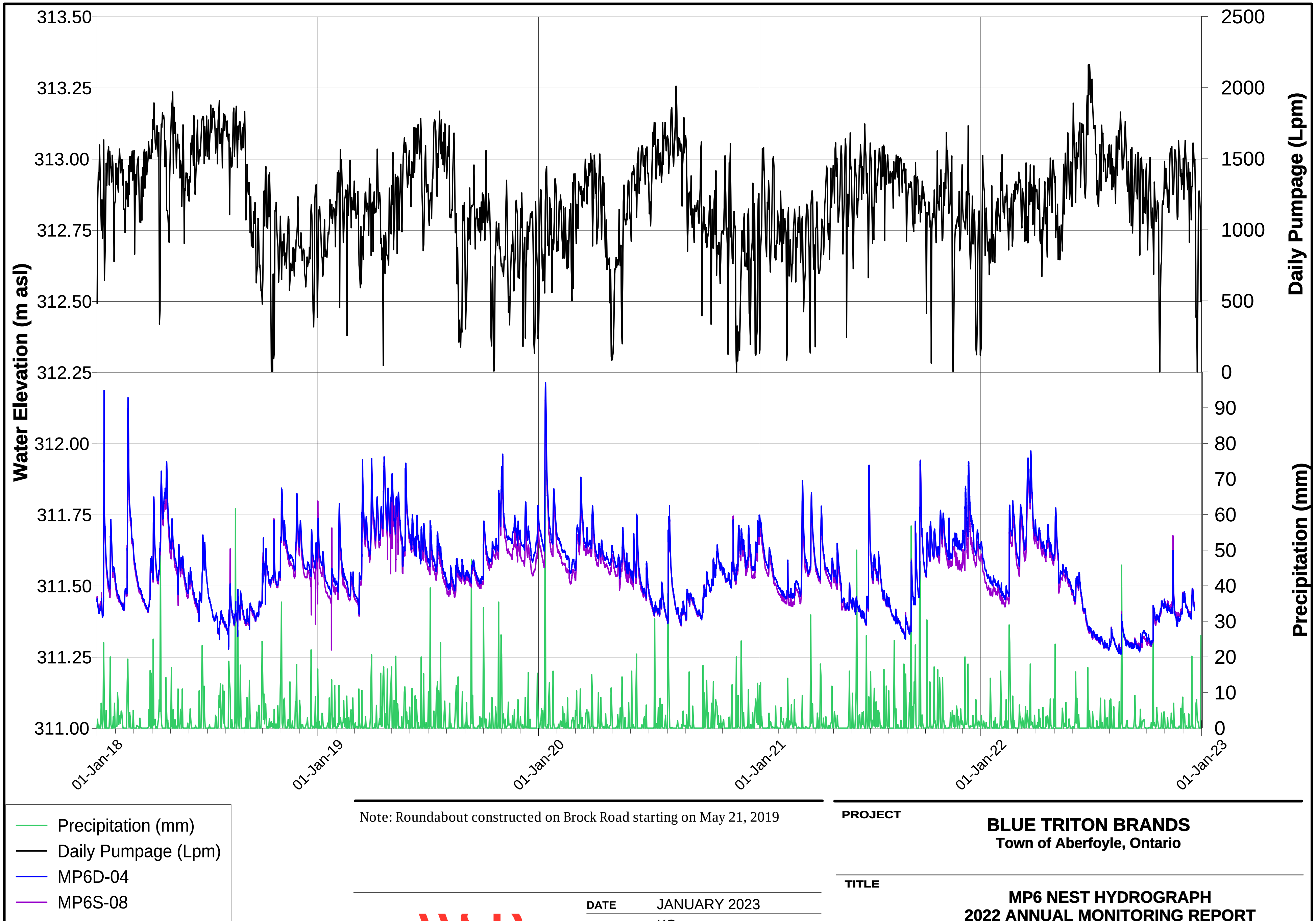
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP16 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E2b



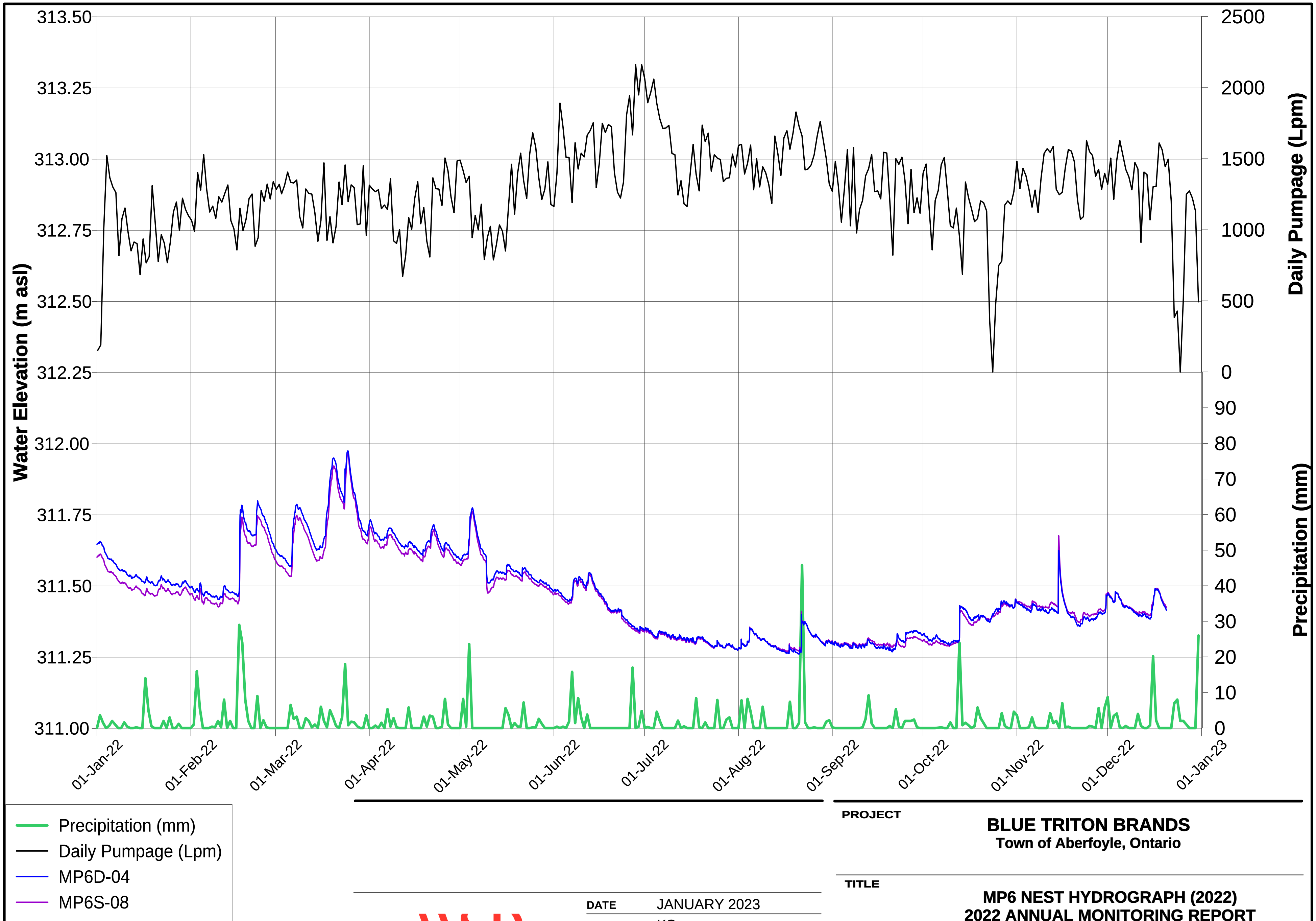
Note: Roundabout constructed on Brock Road starting on May 21, 2019

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
MP6 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E3a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

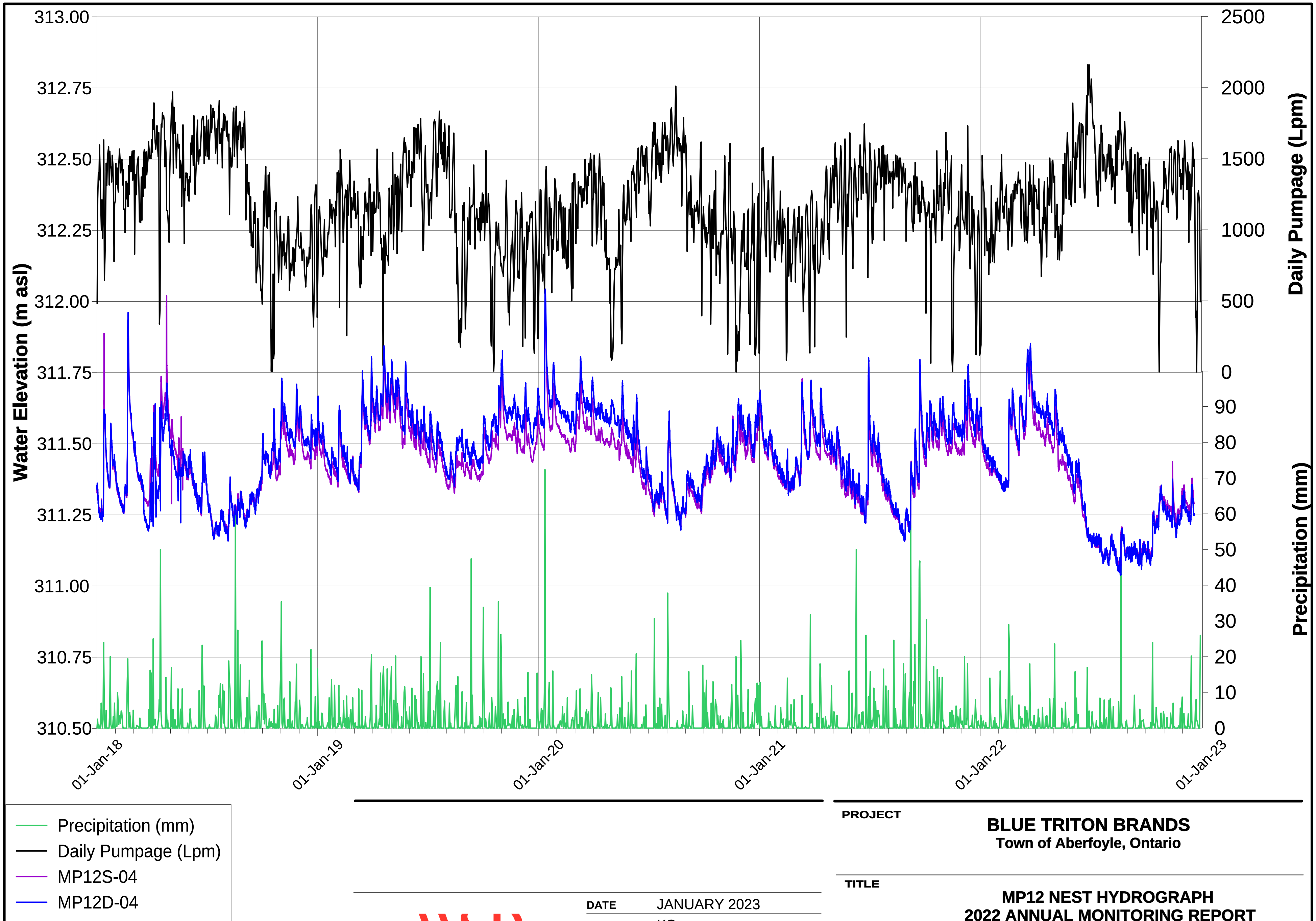
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP6 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E3b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP12 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E4a

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

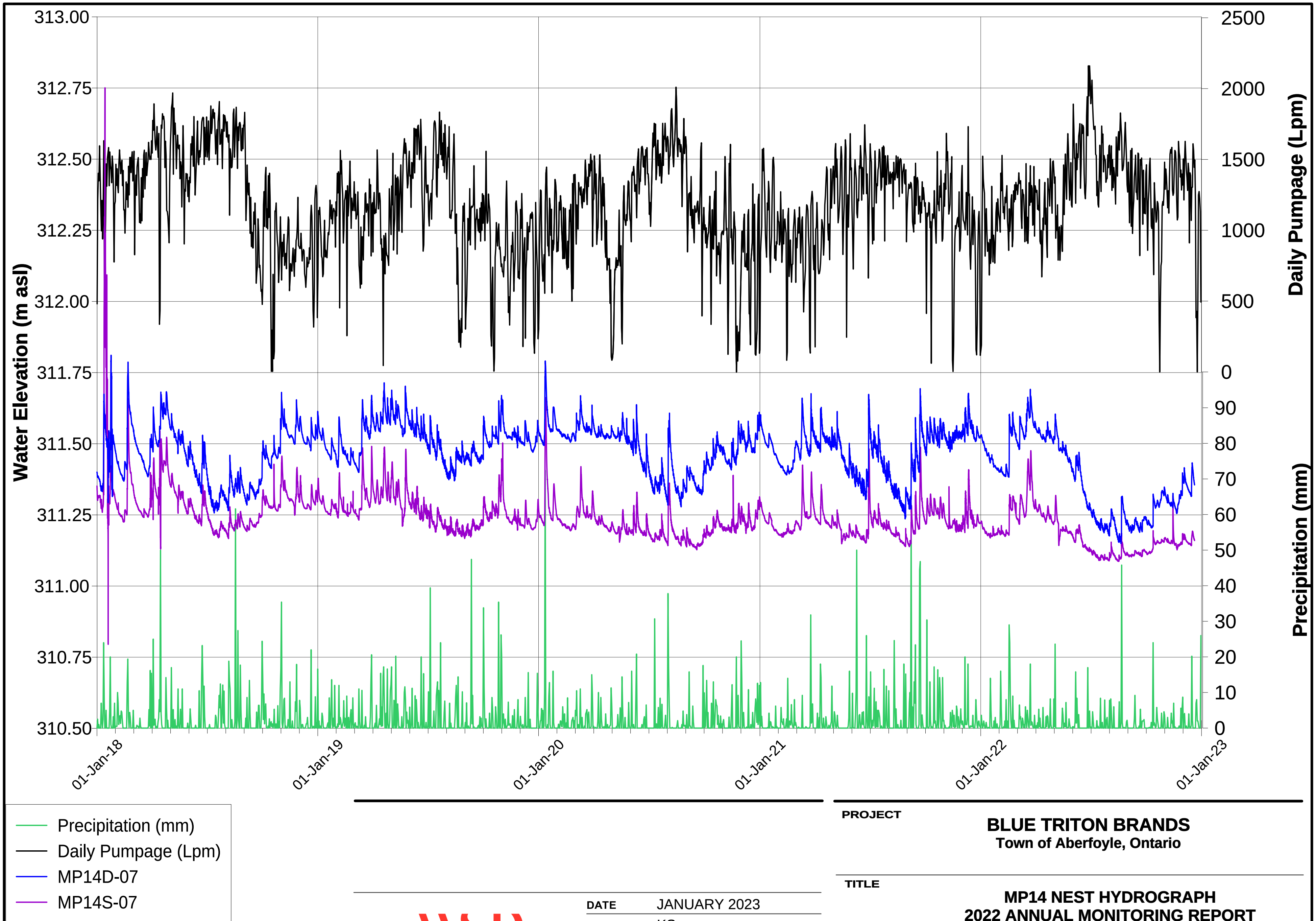
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP12 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E4b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

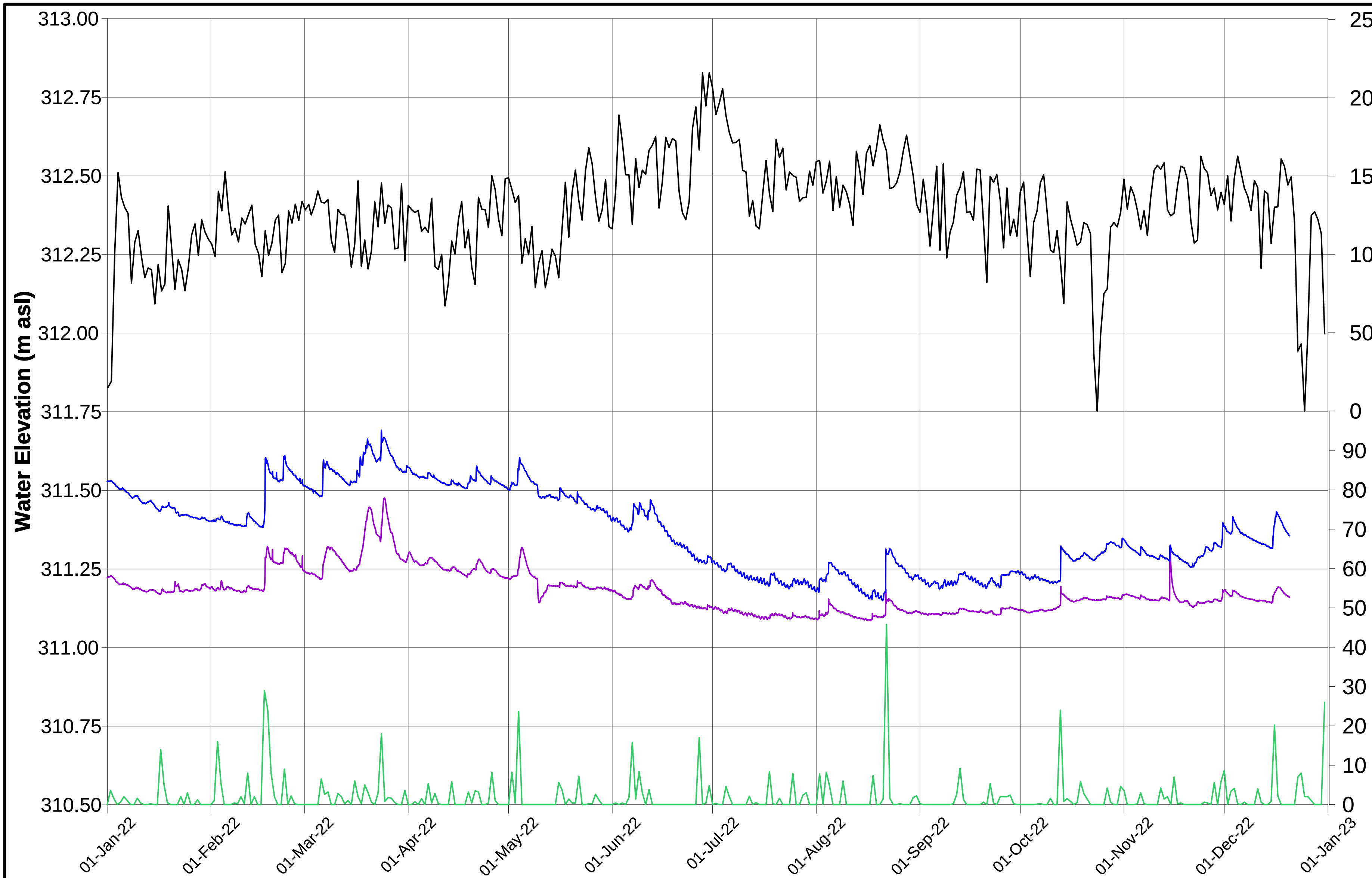
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP14 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E5a



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

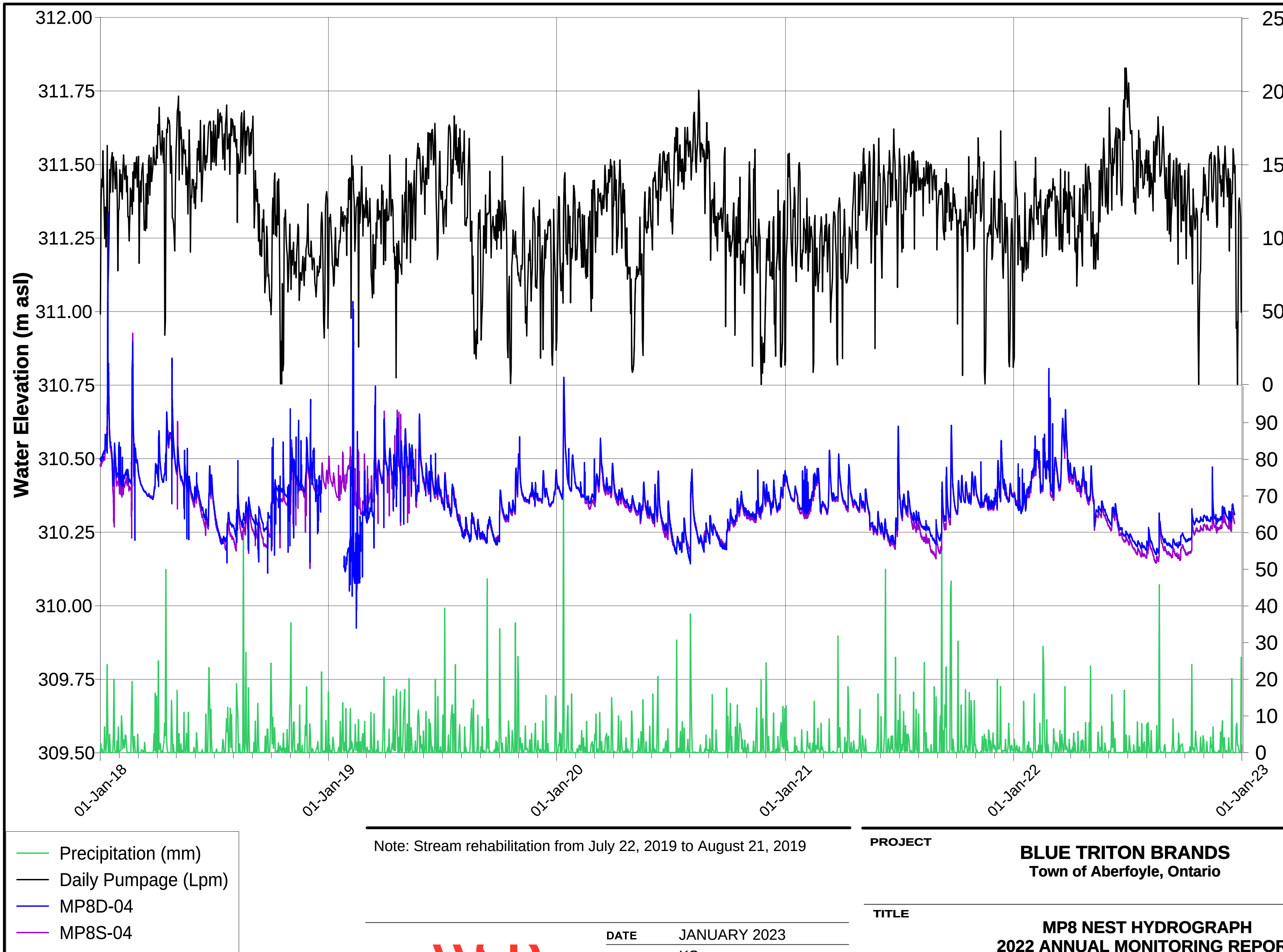
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP14 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E5b



Note: Stream rehabilitation from July 22, 2019 to August 21, 2019

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

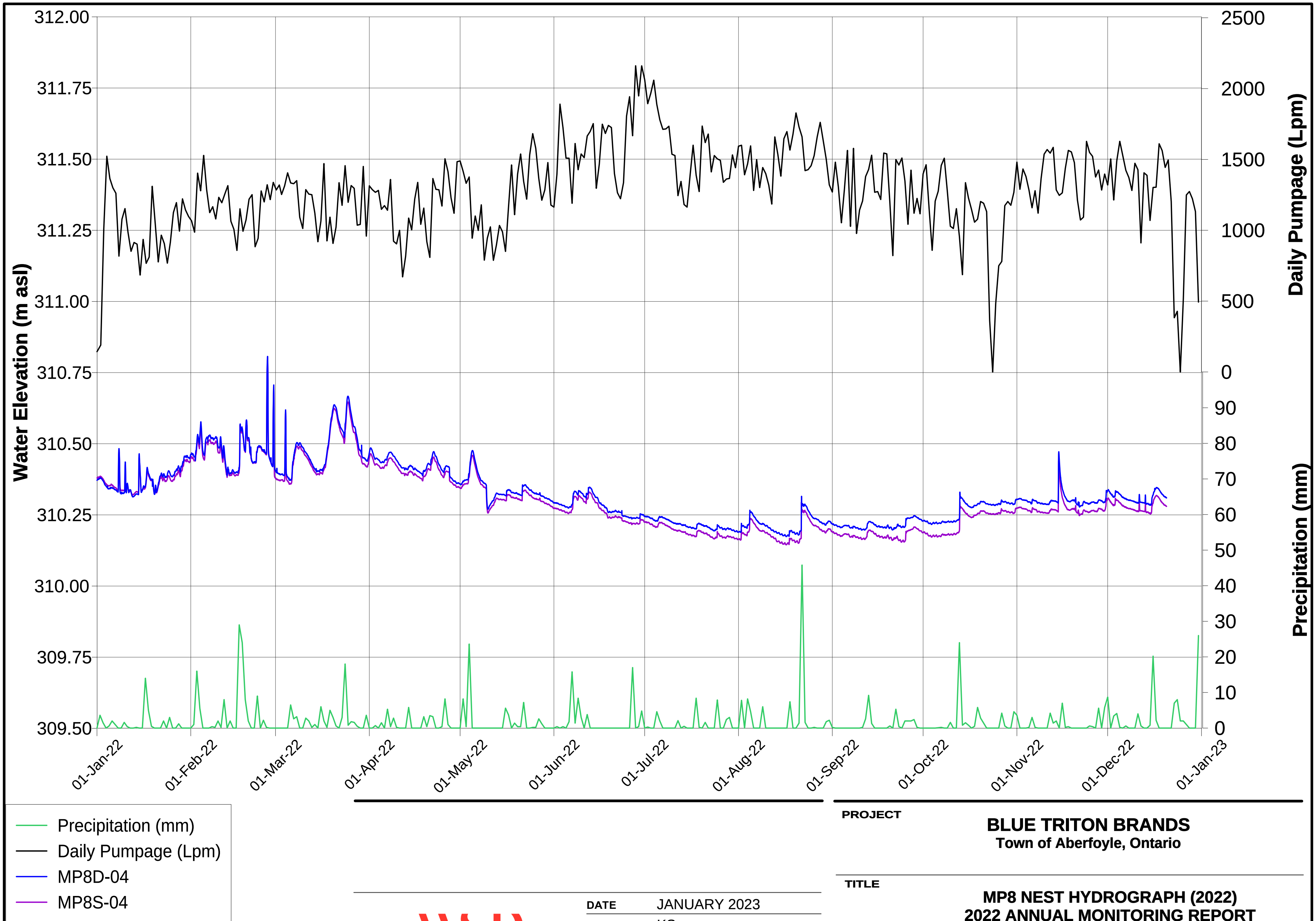
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP8 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E6a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

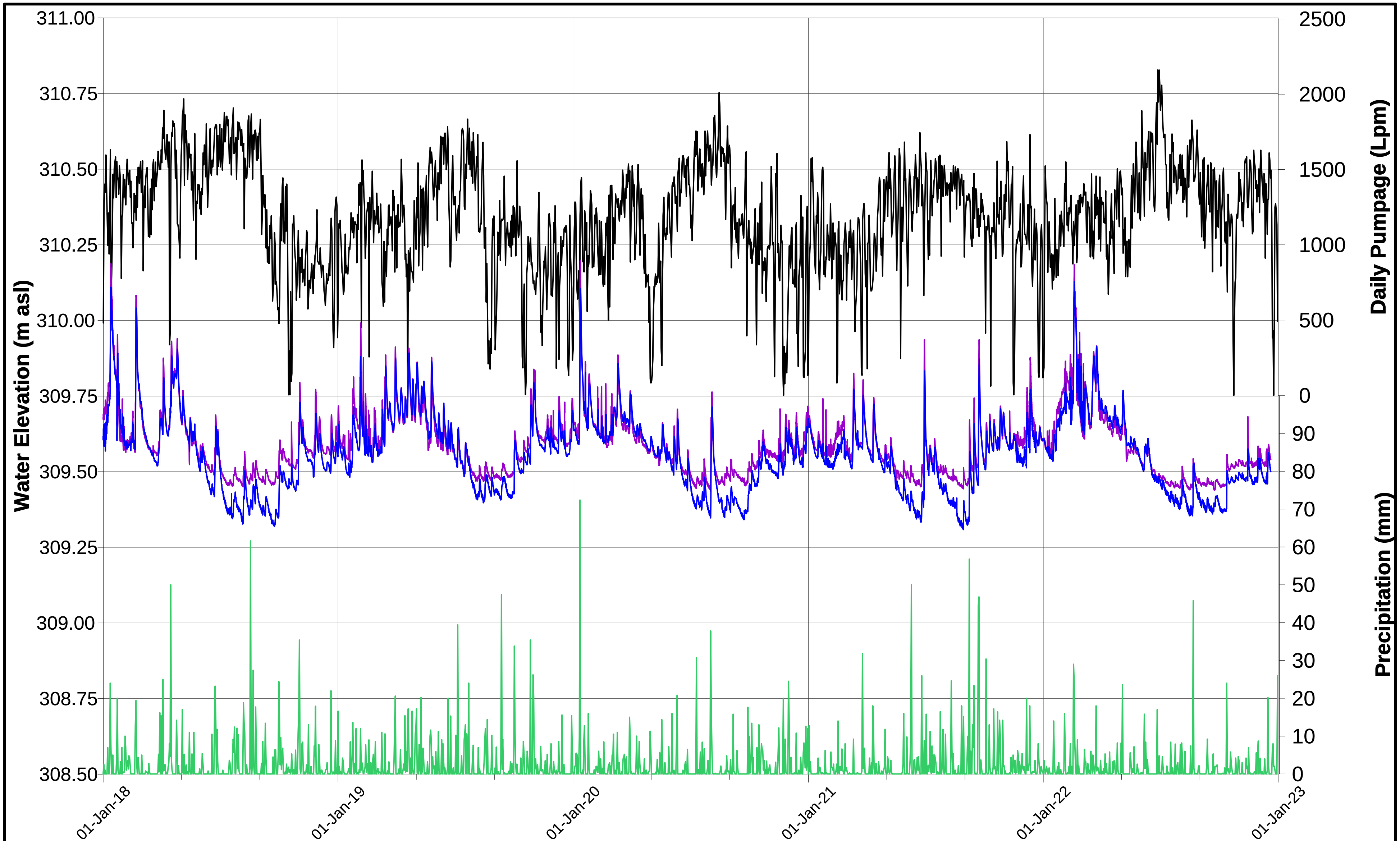
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP8 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E6b



Note: Stream rehabilitation from July 22, 2019 to August 21, 2019

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

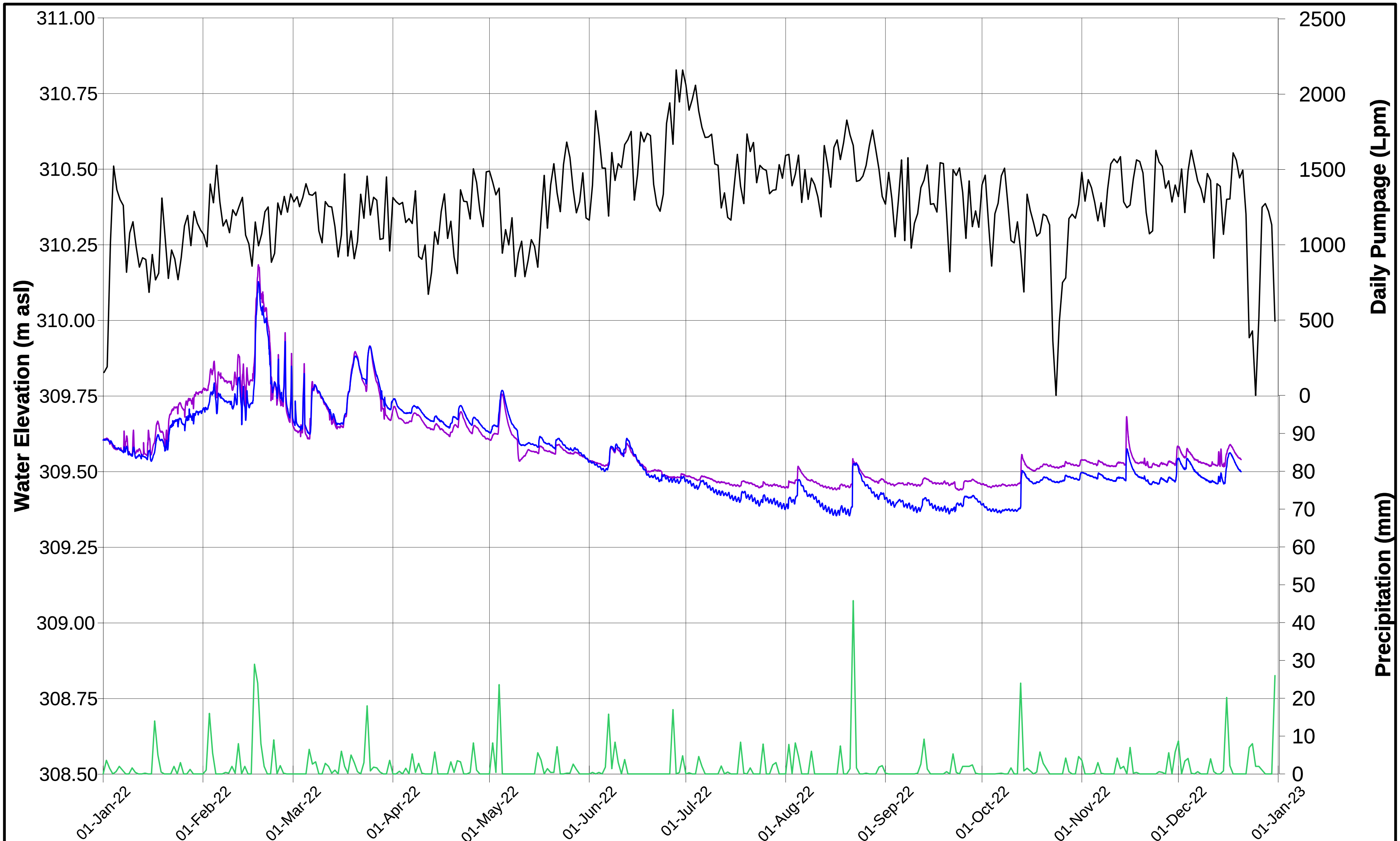
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP17 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E7a



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

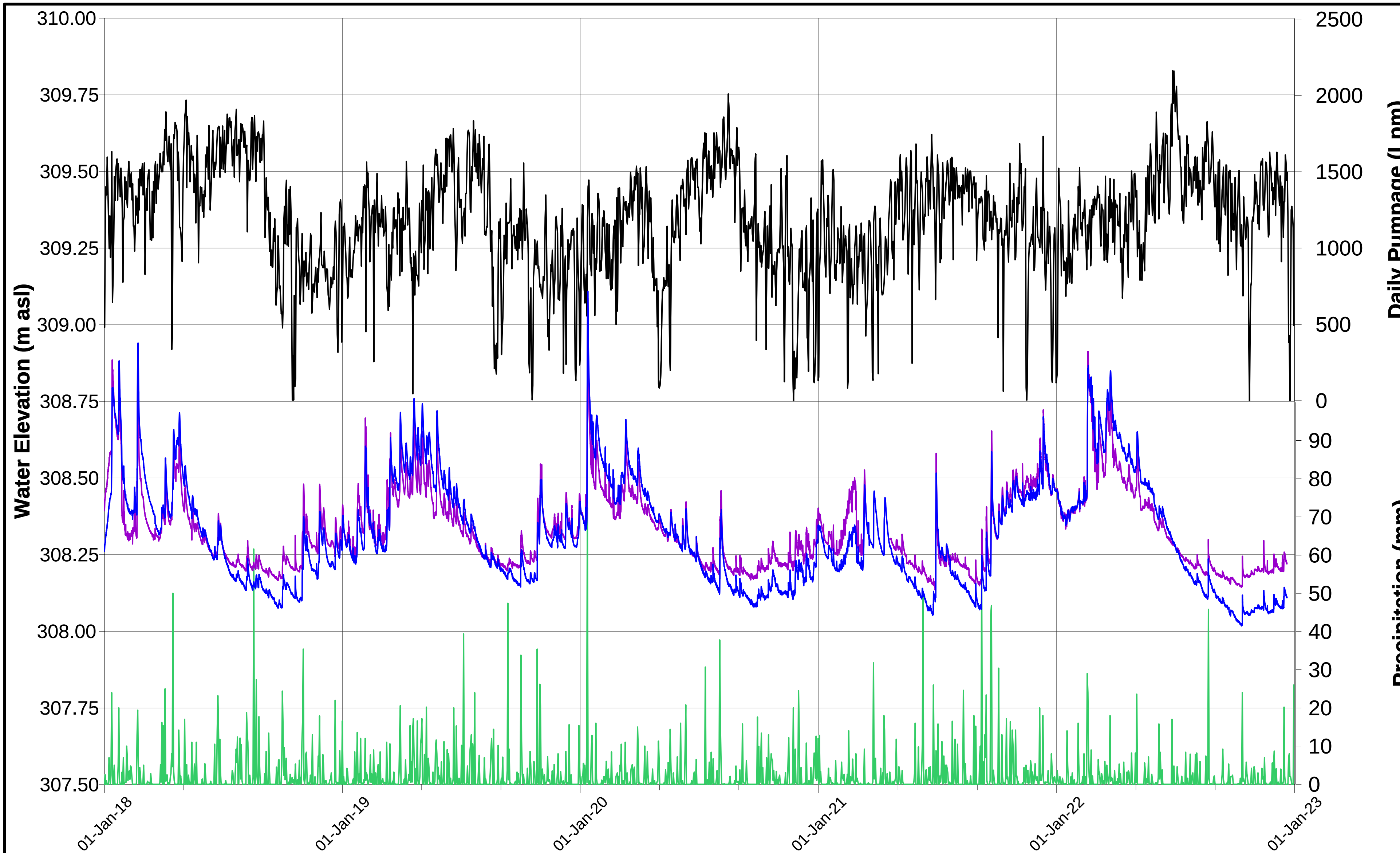
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP17 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E7b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

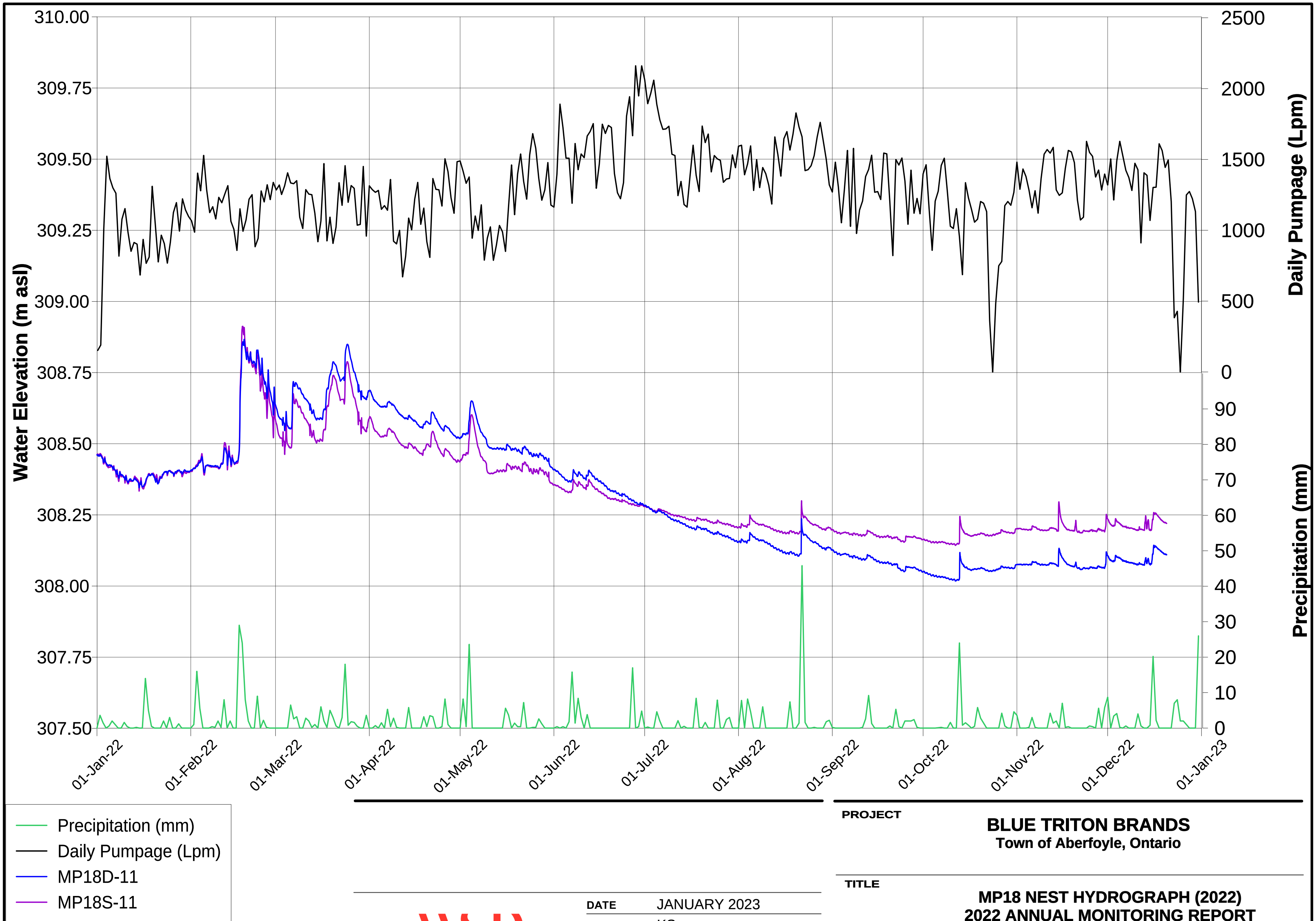
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP18 NEST HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E8a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

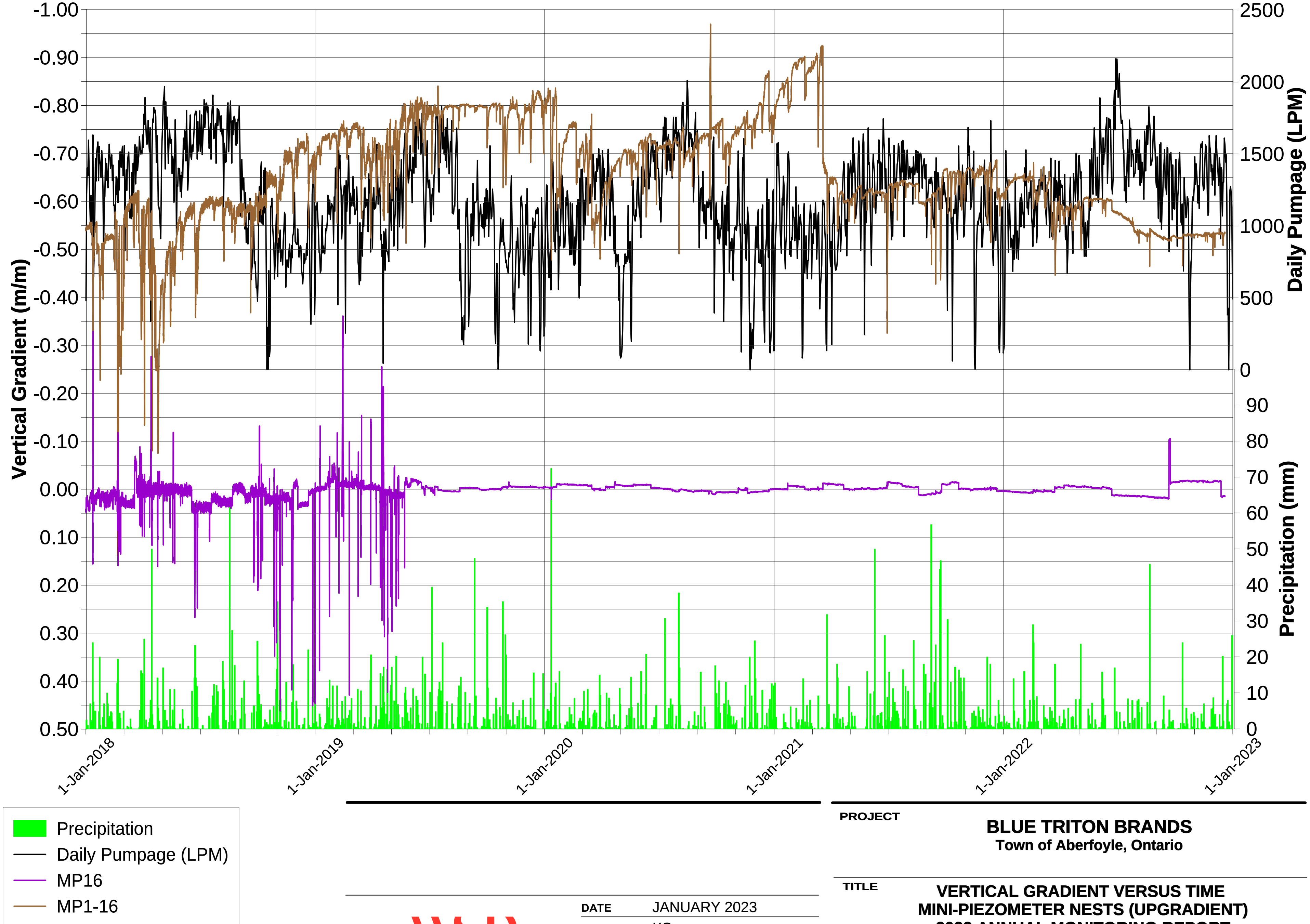
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

MP18 NEST HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E8b



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

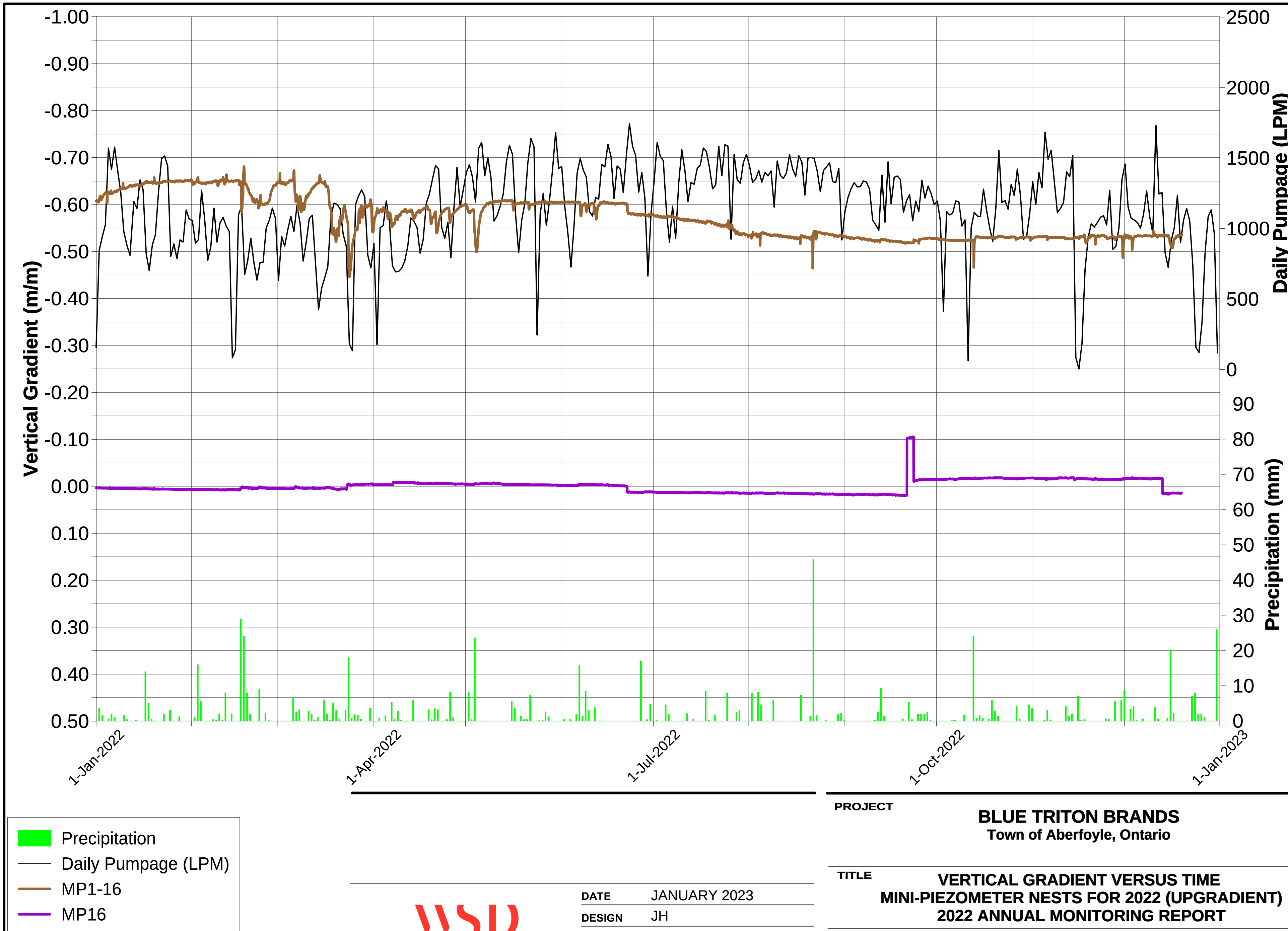
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (UPGRADIENT)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E9a



DATE	JANUARY 2023
DESIGN	JH
REVIEW	GP
APPROVED	GP

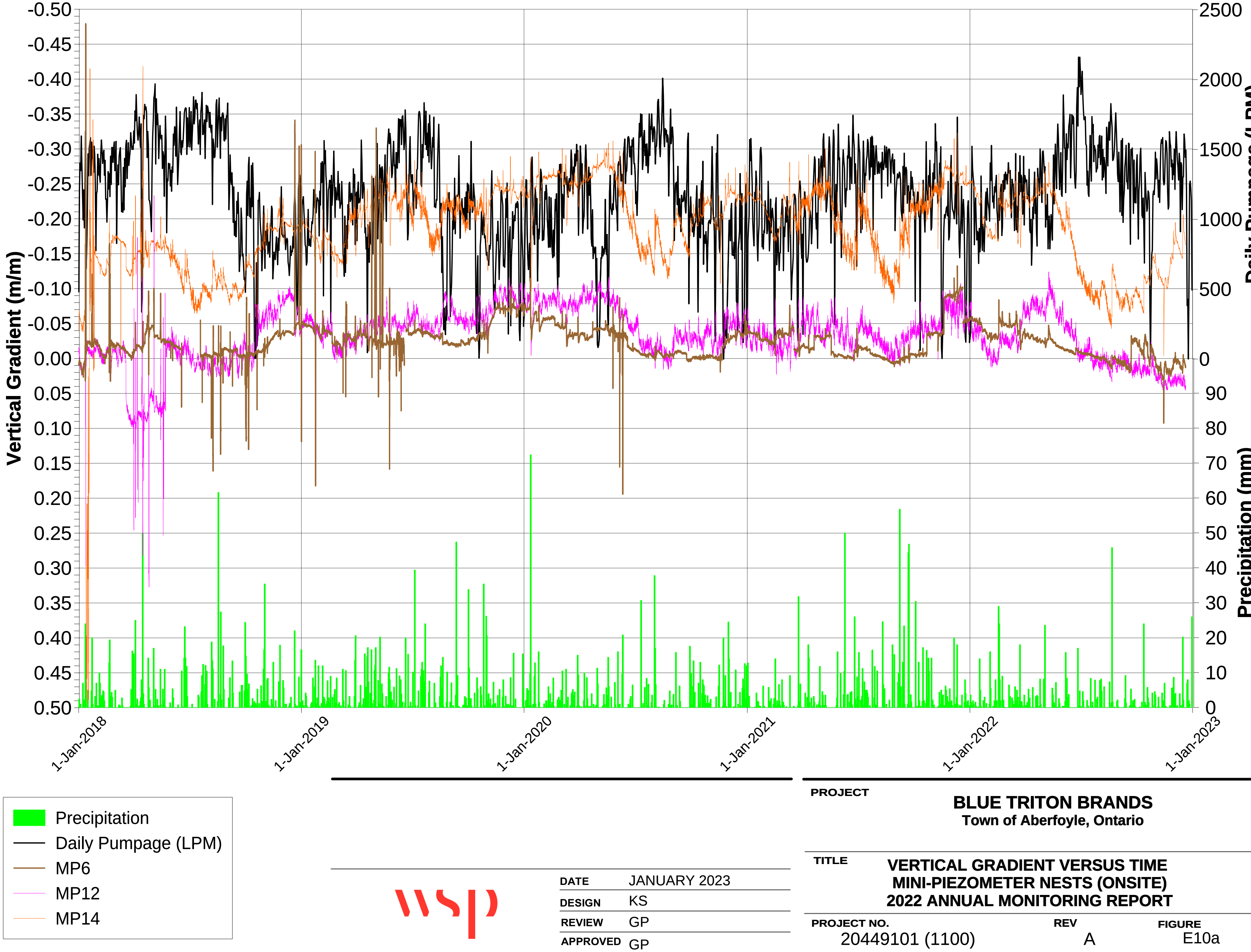
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS FOR 2022 (UPGRADIENT)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E9b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (ONSITE)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E10a

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

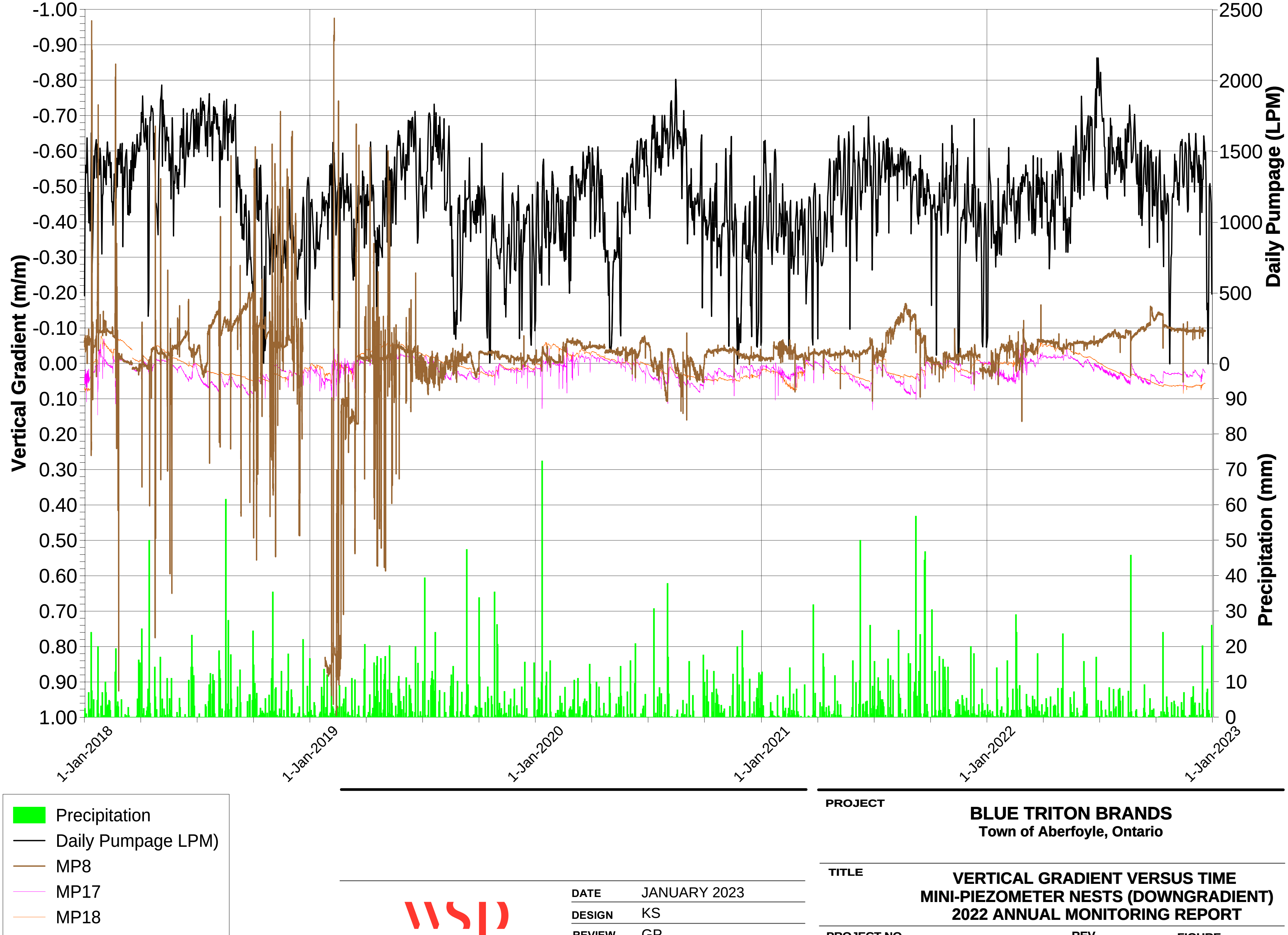
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS FOR 2022 (ONSITE)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E10b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (DOWNGRADIENT)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E11a

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

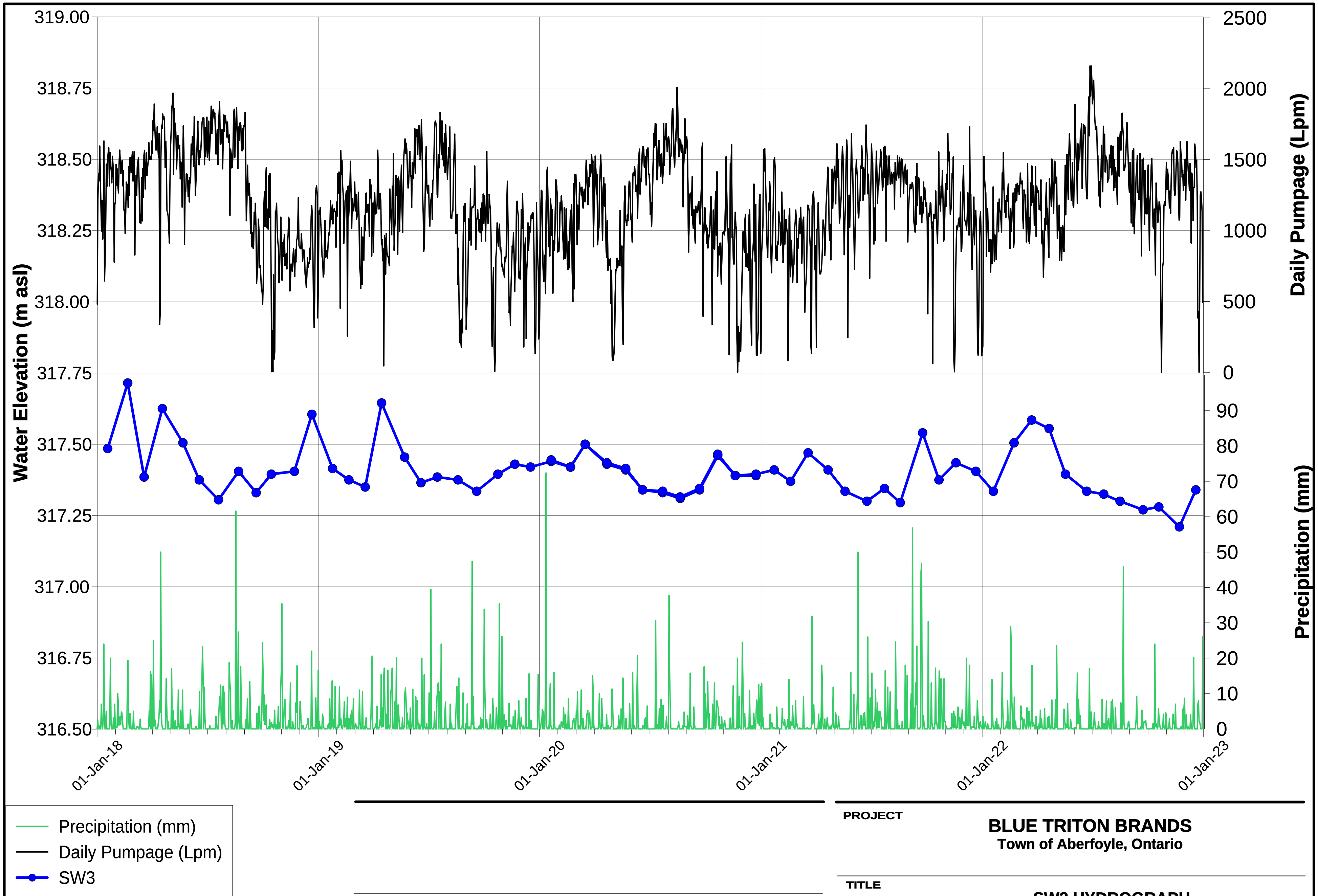
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS FOR 2022 (DOWNGRADIENT)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E11b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

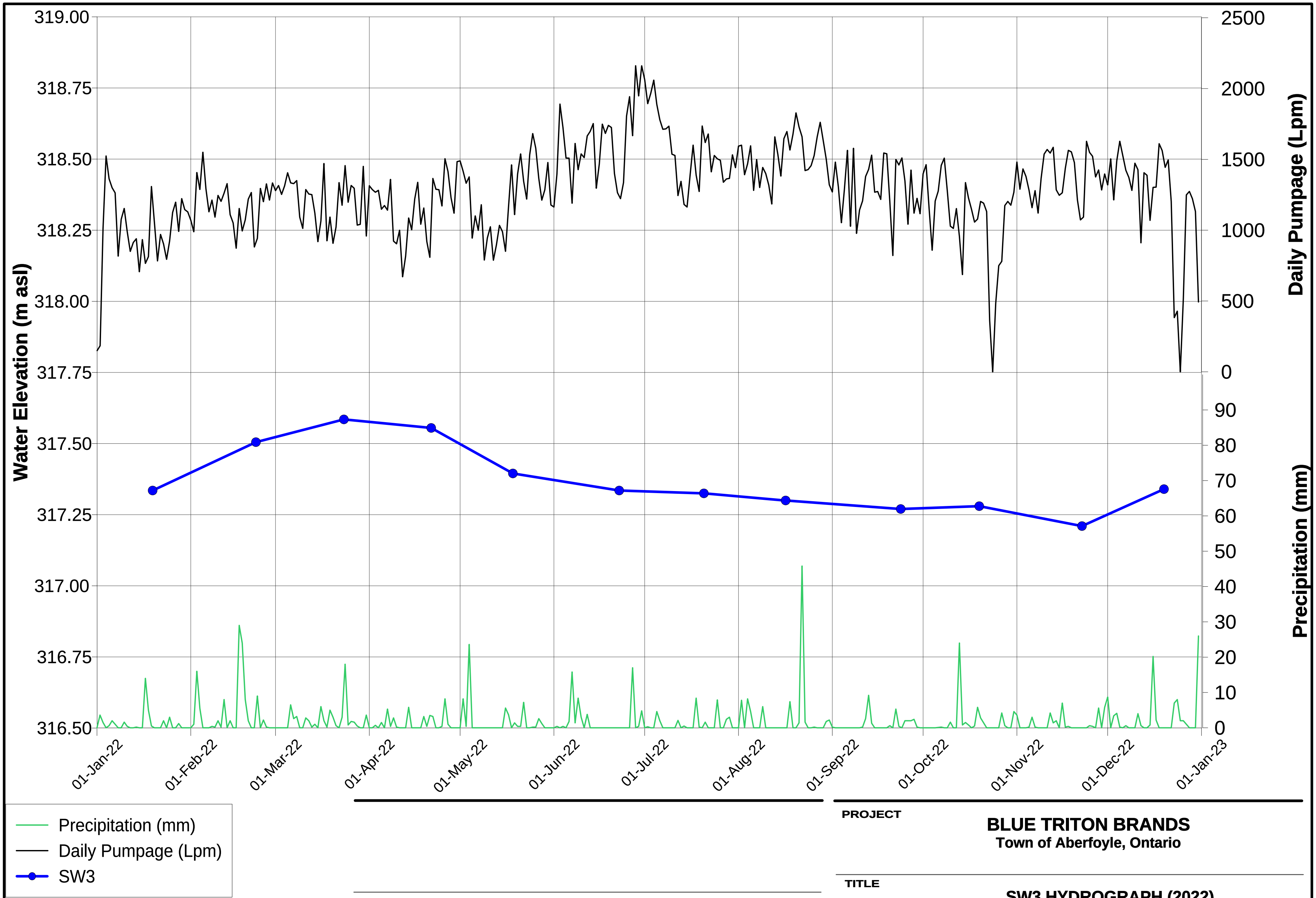
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW3 HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E12a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

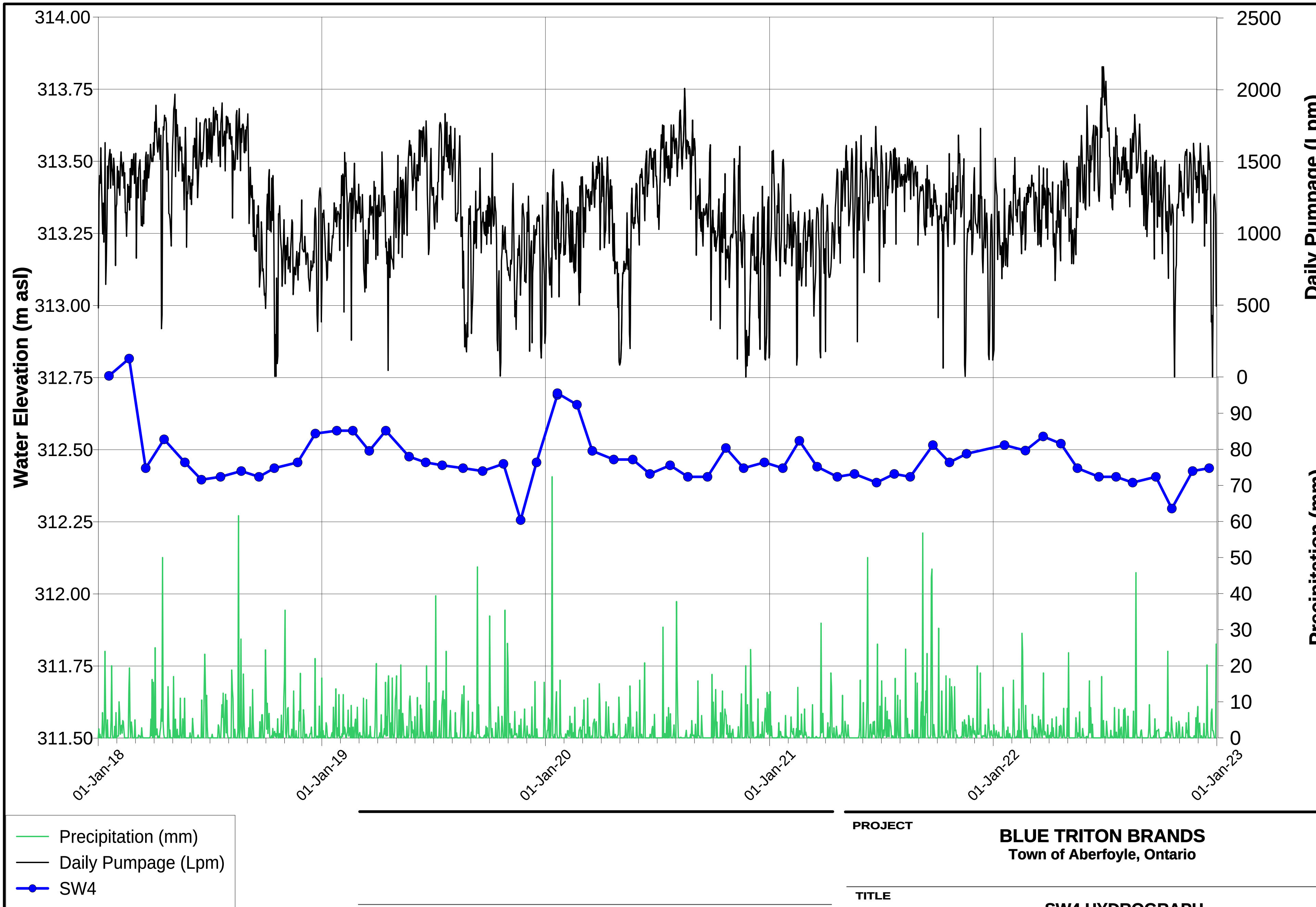
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW3 HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E12b



wsp

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

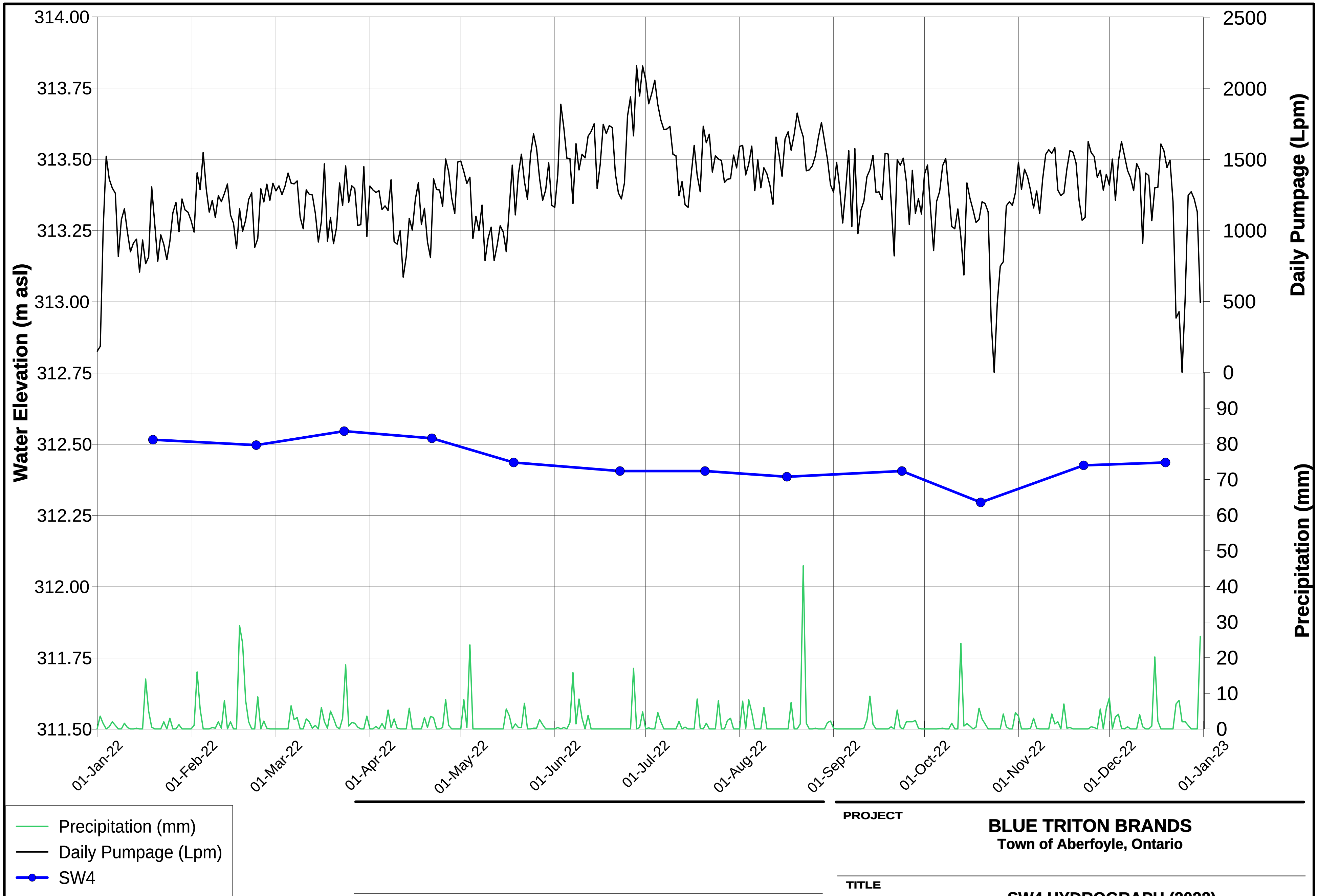
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW4 HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E13a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

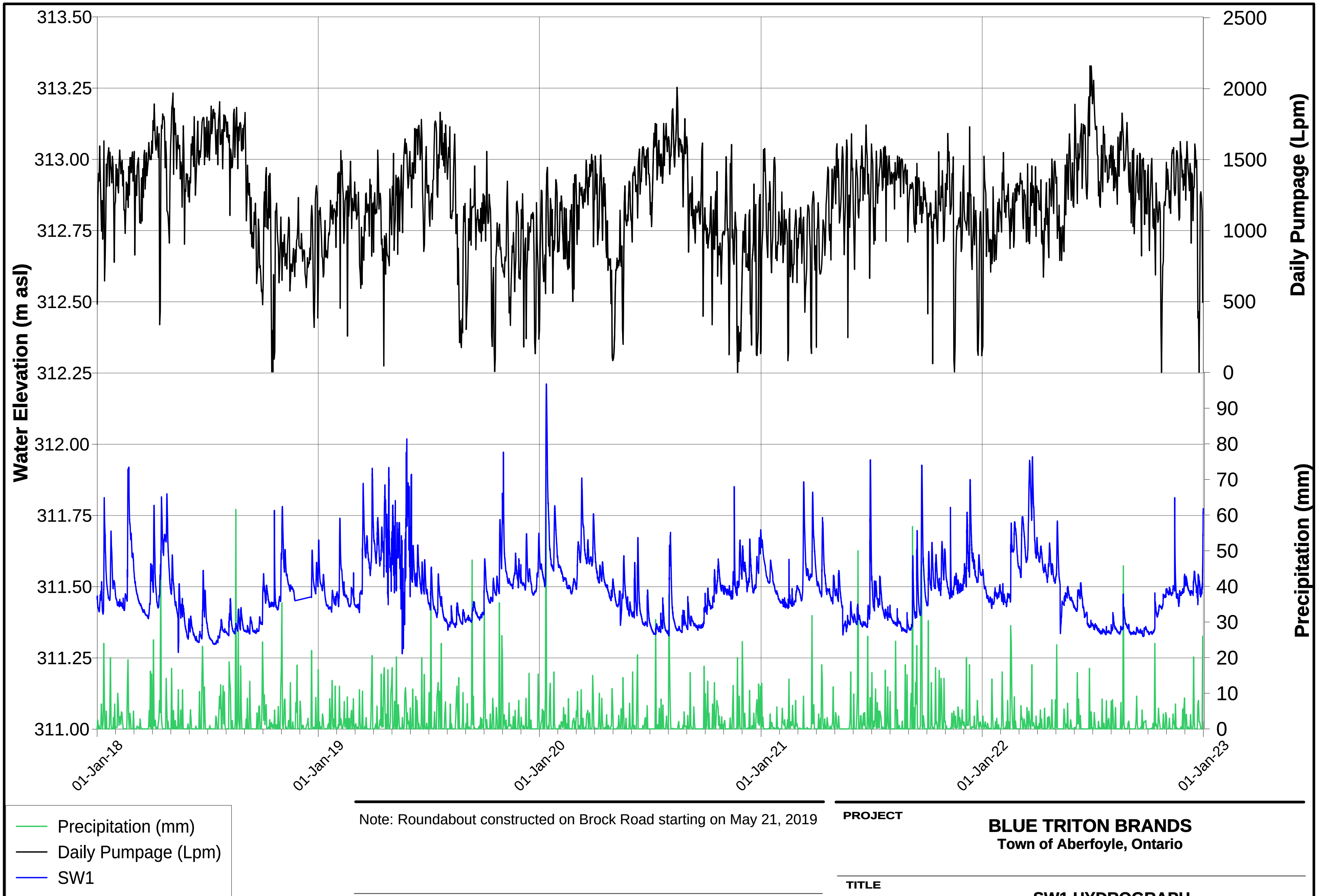
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW4 HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E13b



Note: Roundabout constructed on Brock Road starting on May 21, 2019

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

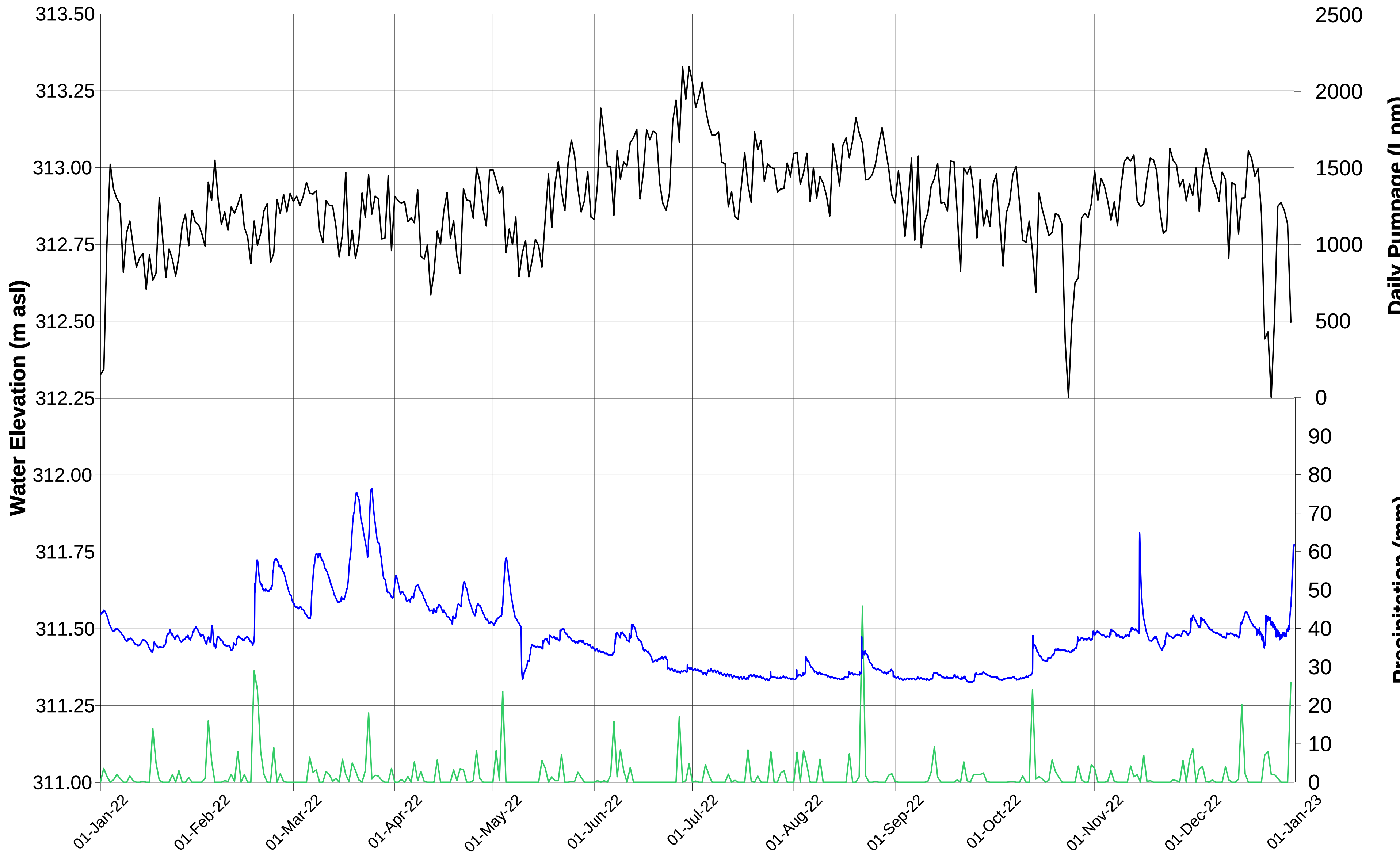
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW1 HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E14a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

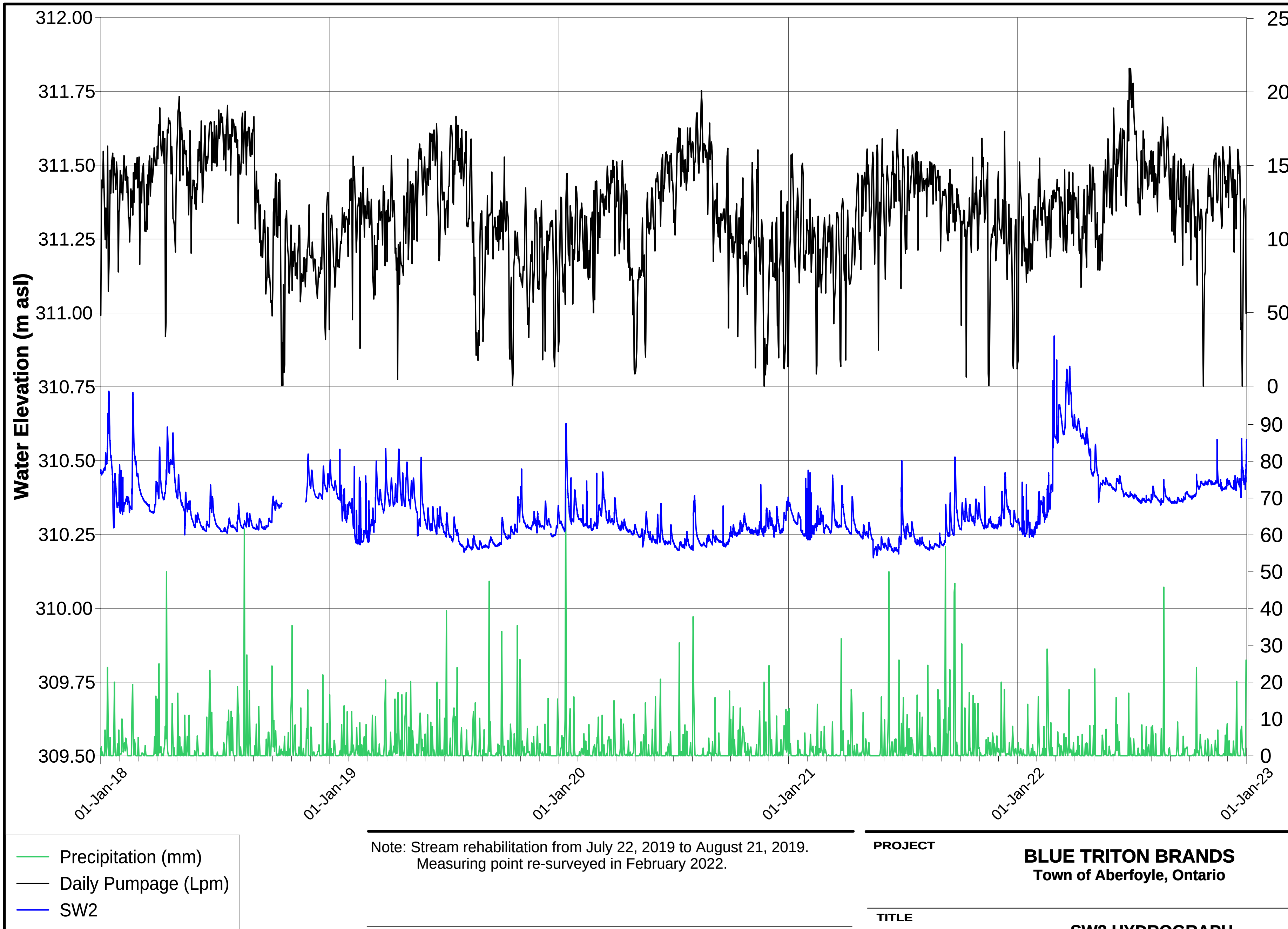
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW1 HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E14b



Note: Stream rehabilitation from July 22, 2019 to August 21, 2019.
Measuring point re-surveyed in February 2022.

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

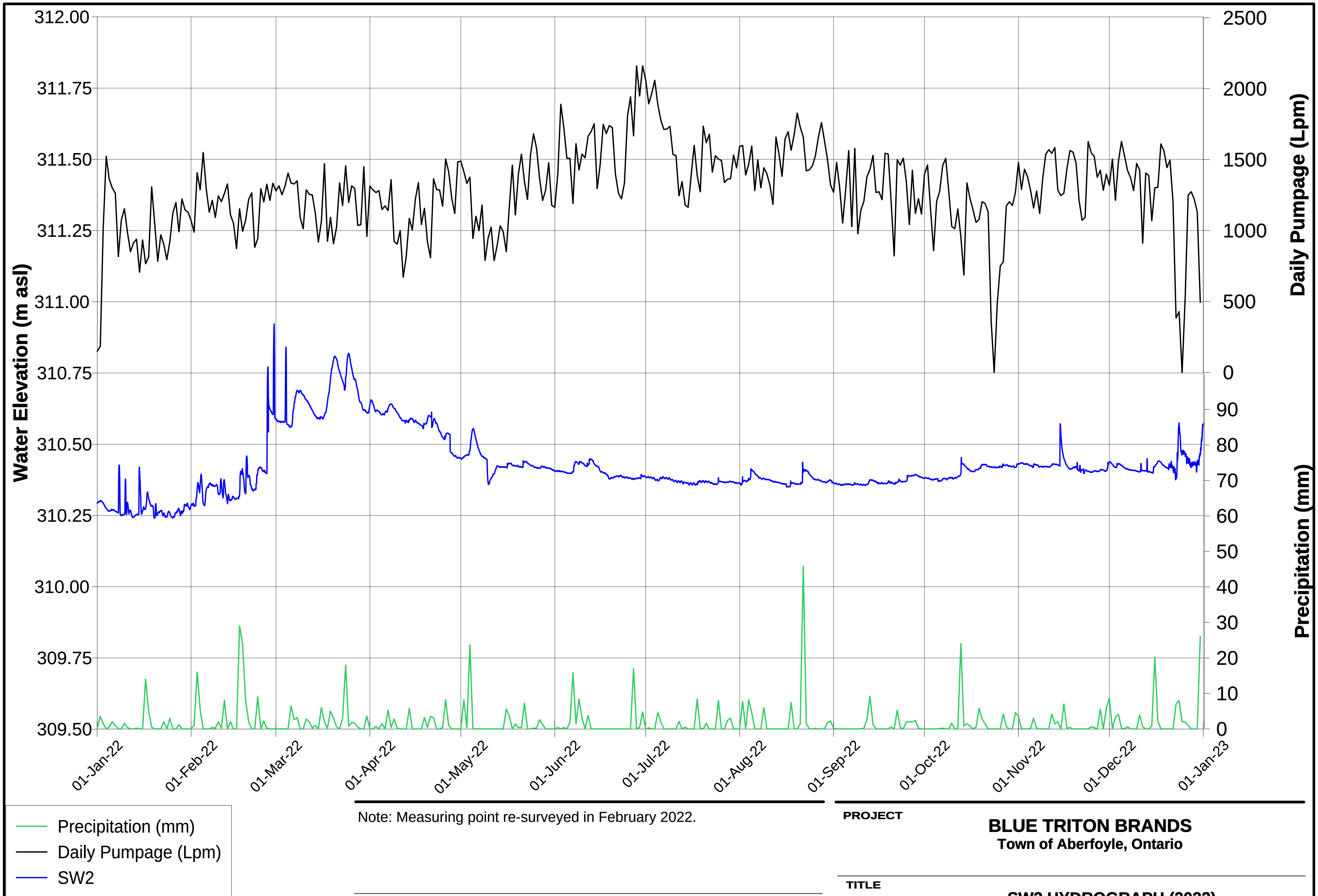
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW2 HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E15a



Note: Measuring point re-surveyed in February 2022.

DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

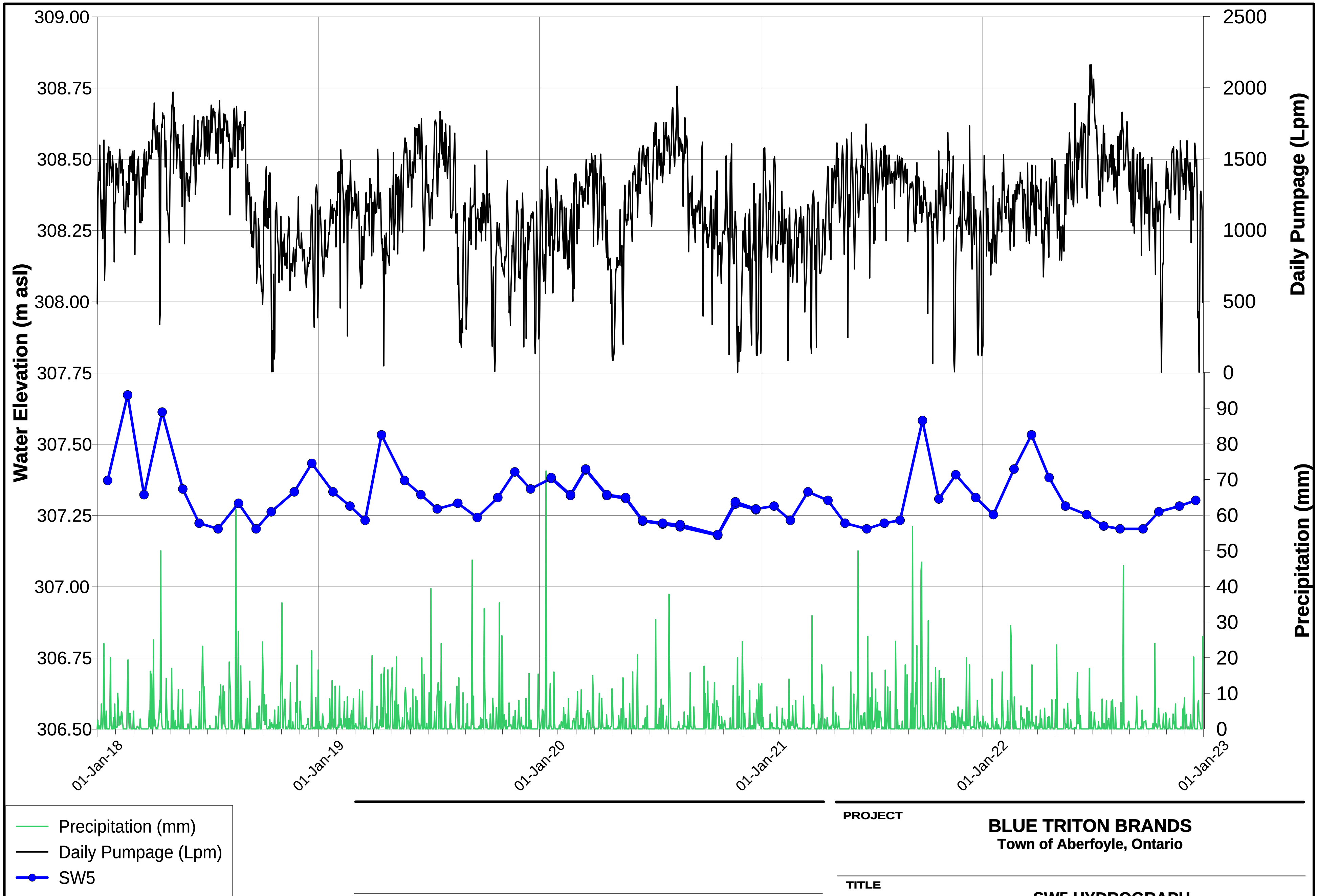
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW2 HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E15b



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

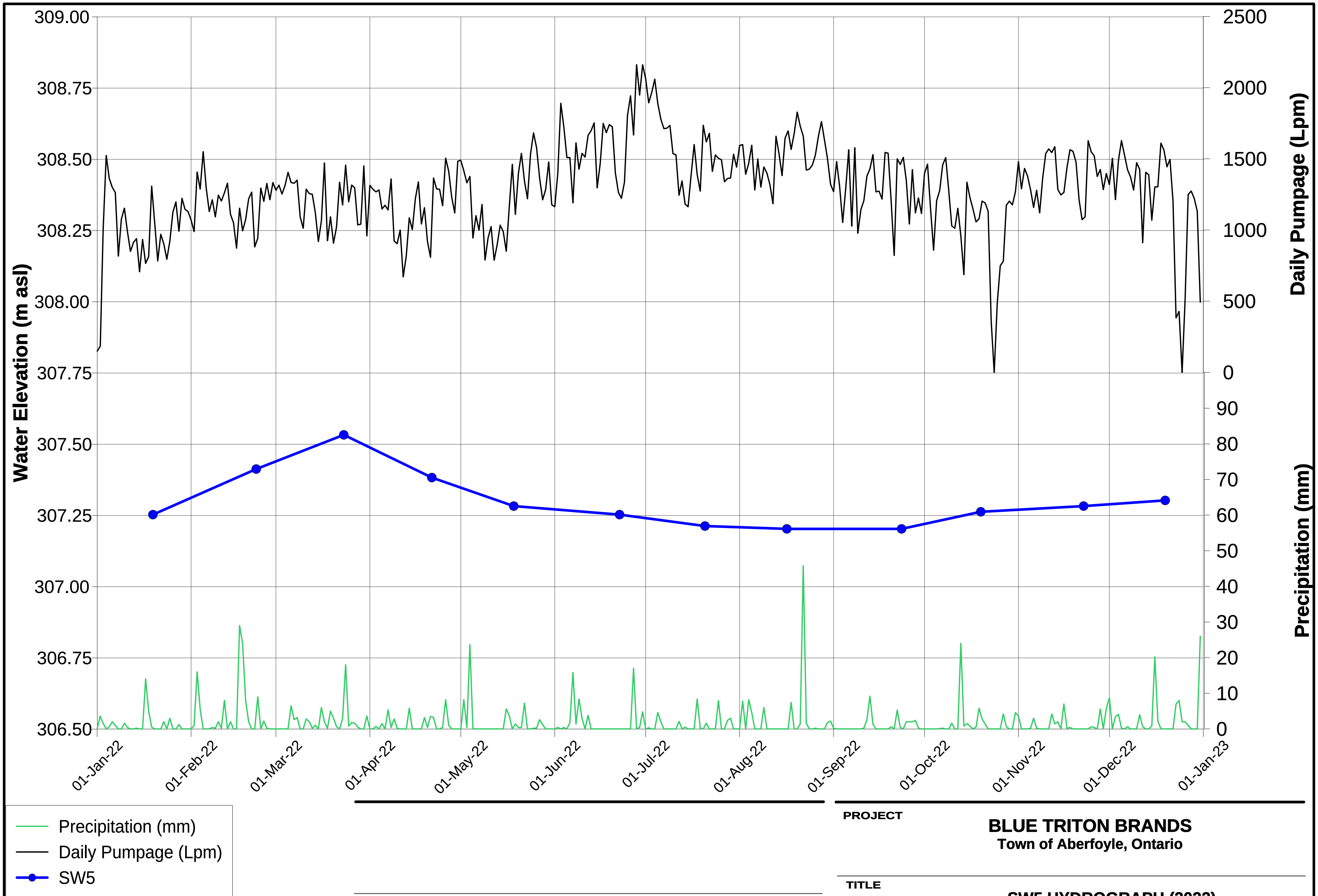
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW5 HYDROGRAPH
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E16a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SW5 HYDROGRAPH (2022)
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E16b

TABLE E1
Manual Surface Water Elevations (Mini Piezometers)
2022 Annual Report

Date	Water Level (masl)							
	MP1D-16	MP1S-16	MP16D-08	MP16S-08	MP6D-04	MP6S-08	MP12D-04	MP12S-04
22/23-Mar-2022	319.05	318.48	312.45	312.46	311.84	311.81	311.71	311.69
22/23-Jun-2022	318.82	318.20	312.10	312.10	311.41	311.41	311.29	311.25
22/23-Sep-2022	318.73	318.19	311.87	311.89	311.31	311.31	311.09	311.10
19/20-Dec-2022	318.80*	318.24	311.96	311.98	311.41	311.42	311.25	311.29

* Water frozen

TABLE E1
Manual Surface Water Elevations (Mini Piezometers)
2022 Annual Report

Date	Water Level (masl)							
	MP14D-07	MP14S-07	MP8D-04	MP8S-04	MP17D-11	MP17S-11	MP18D-11	MP18S-11
22/23-Mar-2022	311.59	311.36	310.56	310.54	309.81	309.80	308.72	308.65
22/23-Jun-2022	311.31	311.14	310.26	310.24	309.47	309.50	308.31	308.29
22/23-Sep-2022	311.22	311.11	310.21	310.17	309.38	309.46	308.07	308.17
19/20-Dec-2022	311.36*	311.16	310.31	310.28	309.50	309.54	308.11	308.22

* Water frozen

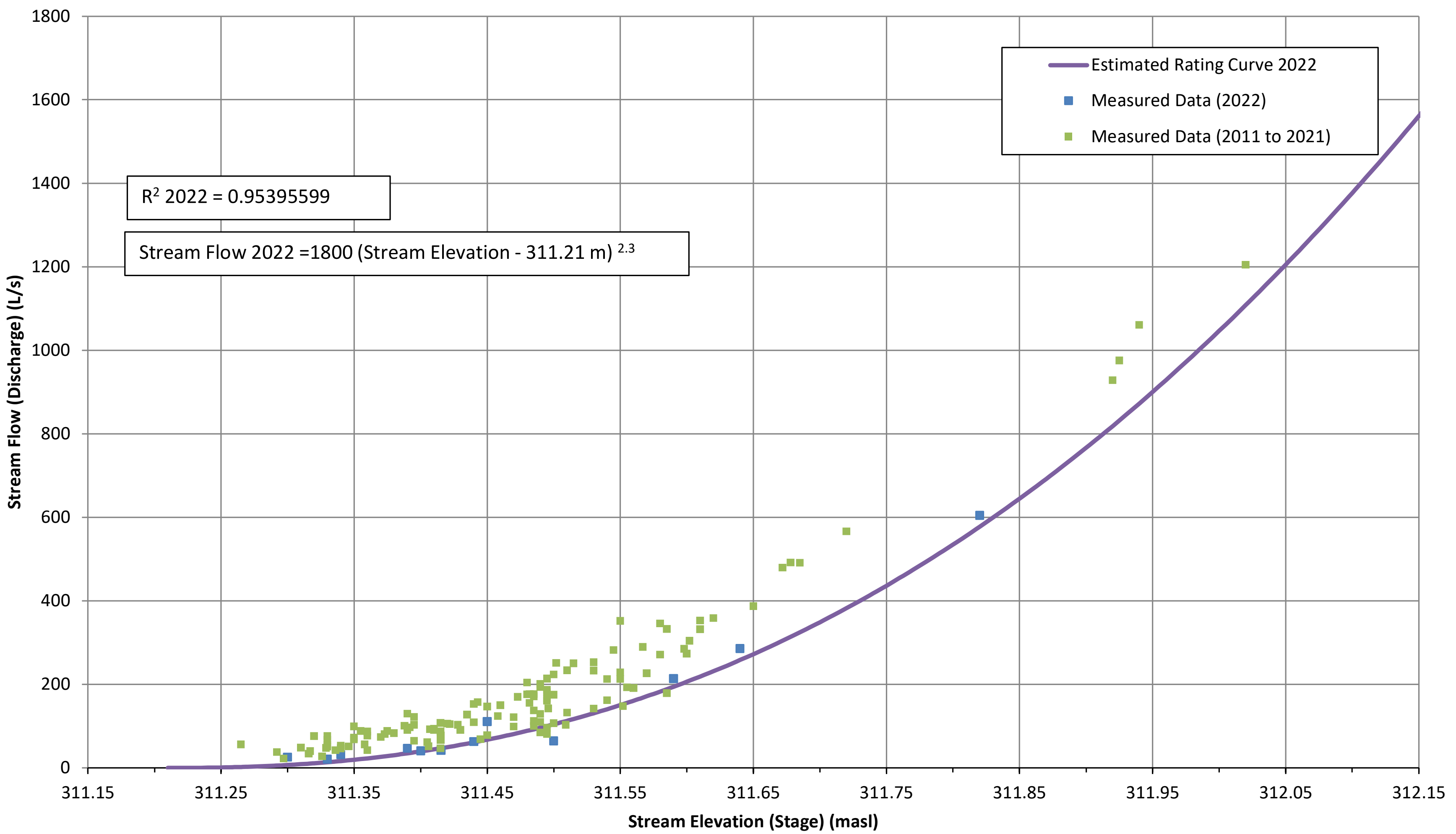
TABLE E2
Manual Surface Water Elevations (Surface Water Stations)
2022 Annual Report

Date	Water Level (masl)				
	SW1	SW2	SW3	SW4	SW5
19-Jan-22	311.44	310.28*	317.34	312.51*	307.25
22-Feb-2022	311.64	310.30	317.51	312.50	307.41
22/23-Mar-2022	311.82	310.74	317.59	312.55	307.53
21-Apr-2022	311.59	310.54	317.56	312.52	307.38
18-May-2022	311.45	310.43	317.40	312.44	307.28
22/23-Jun-2022	311.40	310.49	317.34	312.41	307.25
20-Jul-2022	311.30	310.38	317.33	312.41	307.21
16-Aug-2022	311.34	310.35	317.30	312.39	307.20
22/23-Sep-2022	311.35	310.37	317.27	312.41	307.20
19-Oct-2022	311.42	310.42	317.28	312.30	307.26
22-Nov-2022	311.39	310.39	317.21	312.43	307.28
19/20-Dec-2022	311.50	310.41	317.34	312.44	307.30

* Water frozen

APPENDIX F

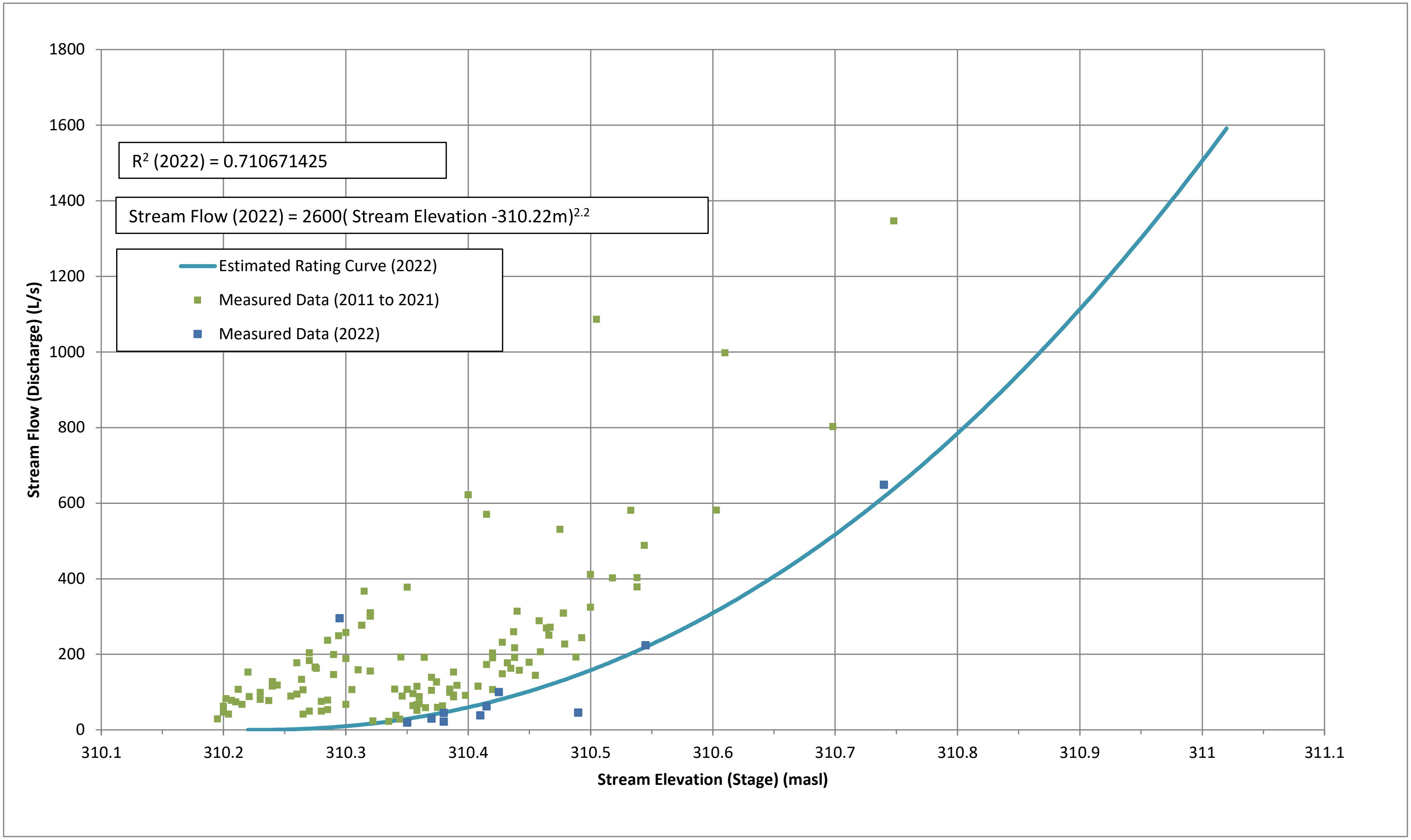
Surface Water Flow Monitoring



2022 Data Notes:
In 2022, the range of water levels recorded during manual flow measurements (and used to determine the stage-discharge relationship) = ~311.30 to 311.82 masl. The full range of water levels recorded in 2022 = ~311.325 to 311.96 masl.

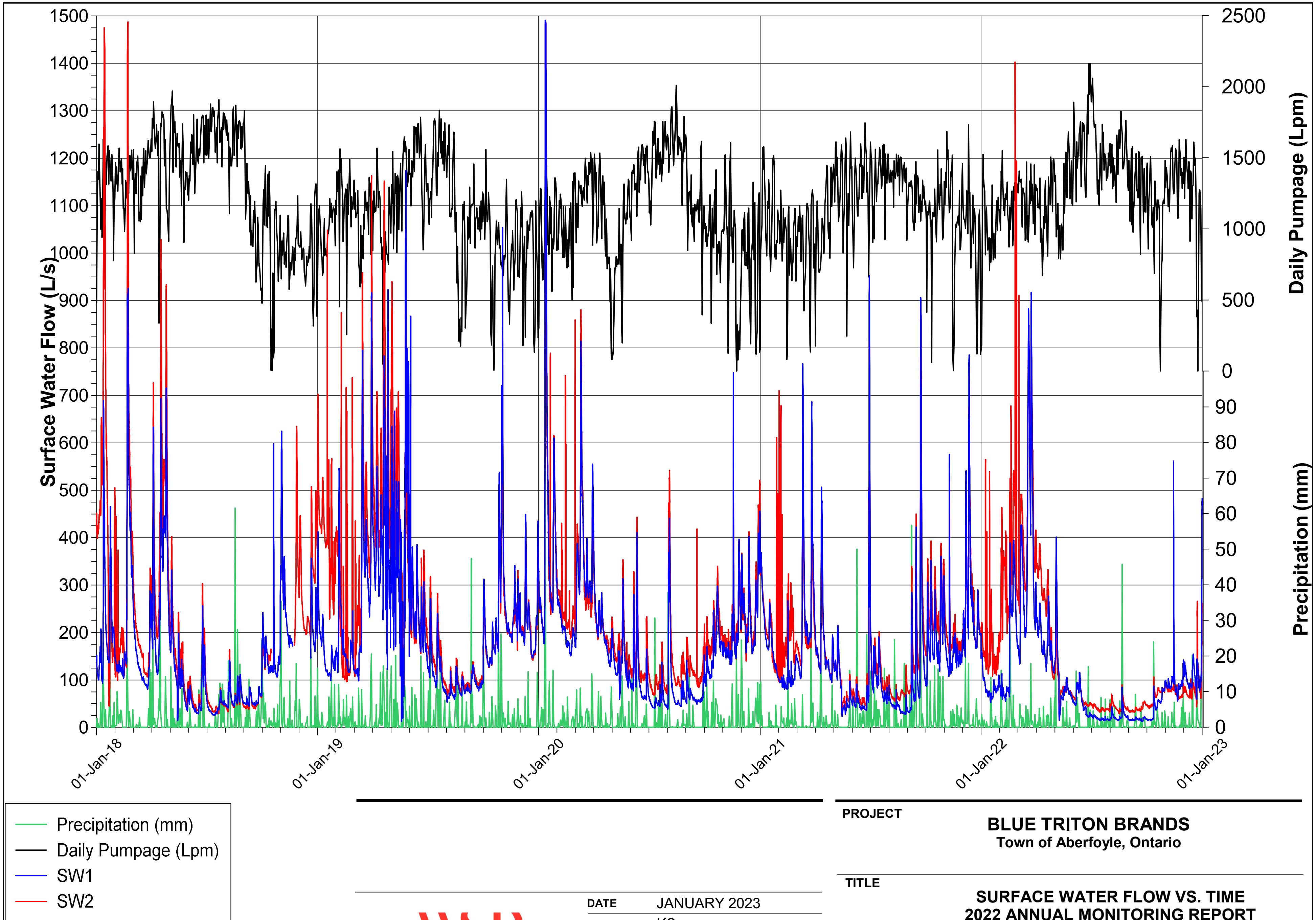
wsp

Figure. F1
STAGE-DISCHARGE MEASUREMENTS FOR SW1 (2022)
2022 ANNUAL MONITORING REPORT
BLUE TRITON BRANDS
Aberfoyle, Ontario



2022 Data Notes:
In 2022, the range of water levels recorded during manual flow measurements = 310.30 to 310.74 masl. The full range of water levels recorded in 2022 = ~310.24 to 310.92 masl.

Figure. F2
STAGE-DISCHARGE MEASUREMENTS FOR SW2 (2022)
2022 ANNUAL MONITORING REPORT
BLUE TRITON BRANDS
Aberfoyle, Ontario



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

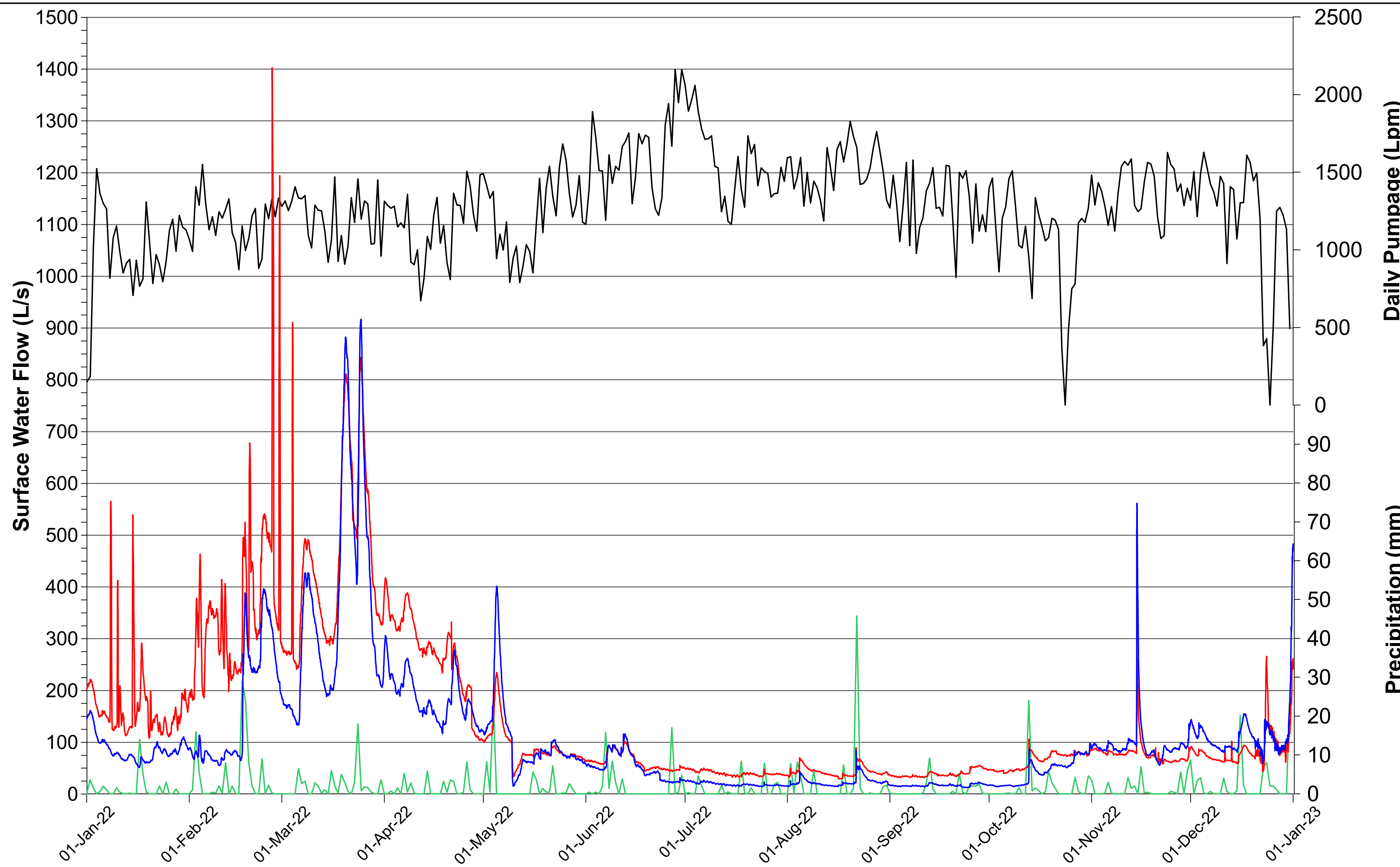
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SURFACE WATER FLOW VS. TIME
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	F3a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

wsp

PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

SURFACE WATER FLOW VS. TIME (2022)
2022 ANNUAL MONITORING REPORT

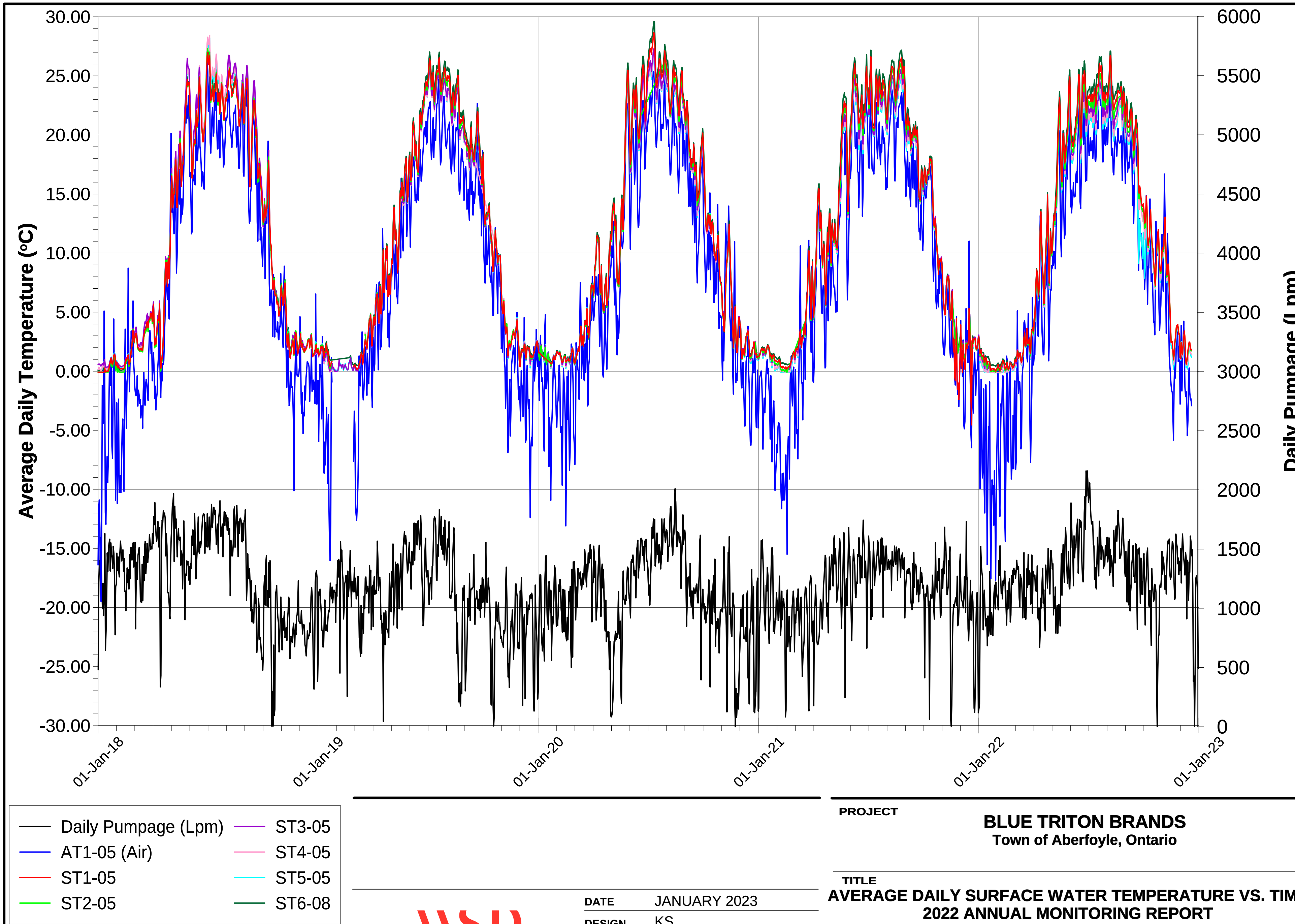
PROJECT NO.	REV	FIGURE
20449101 (1100)	A	F3b

TABLE F1
Surface Water Flow
2022 Annual Report

DATE	SW-1 Flow (L/sec)	SW-2 Flow (L/sec)
19-Jan-22	62.3	Frozen
22-Feb-22	285.3	295.0
22-Mar-22	604.5	648.5
21-Apr-22	213.2	223.5
18-May-22	110.6	99.8
23-Jun-22	40.4	45.8
20-Jul-22	25.6	21.3
16-Aug-22	20.5	19.5
22-Sep-22	31.1	30.1
19-Oct-22	41.3	38.5
22-Nov-22	46.6	45.0
20-Dec-22	64.1	62.1

APPENDIX G

Stream Temperature Monitoring



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

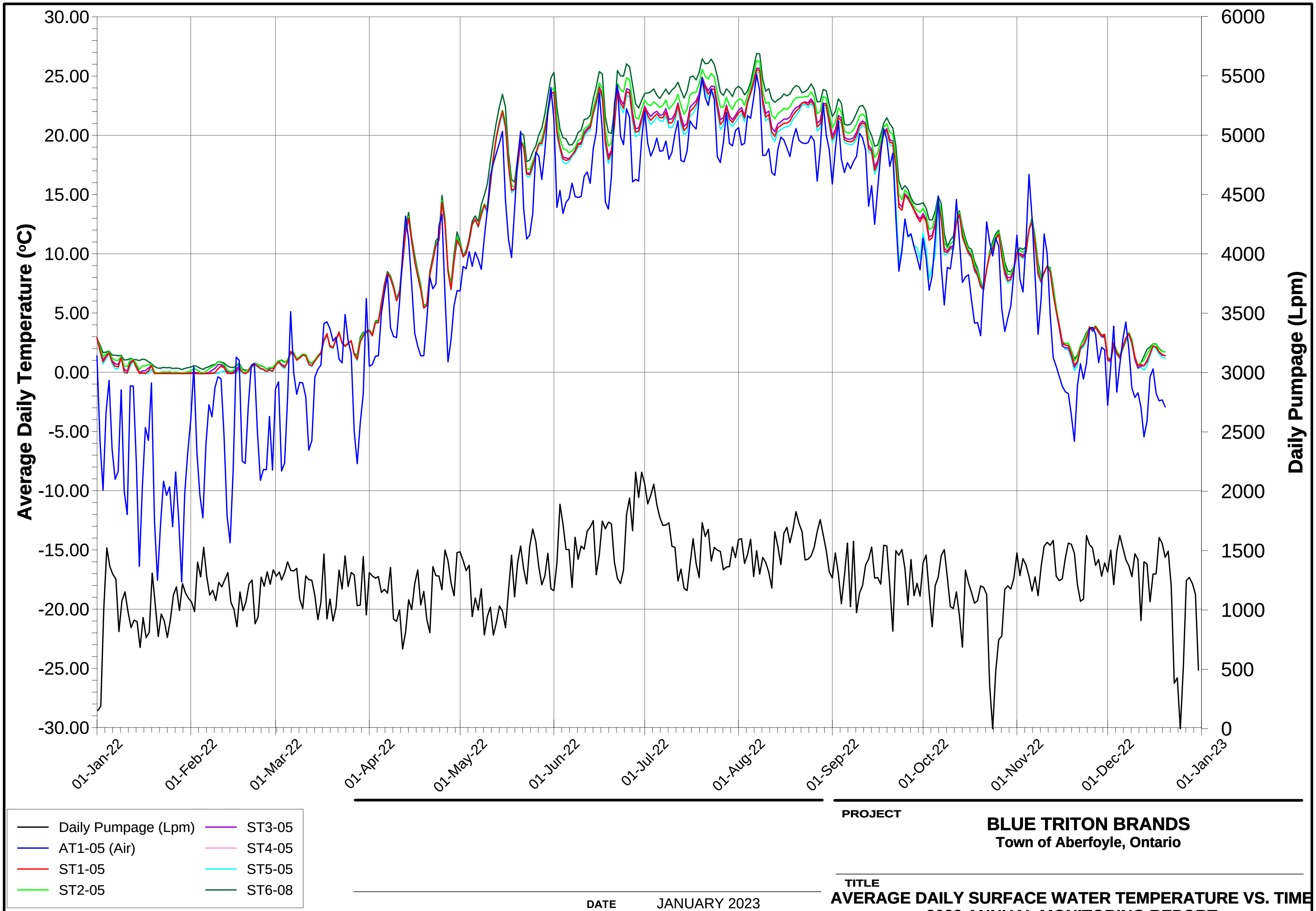
PROJECT

BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE

AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	G1a



DATE	JANUARY 2023
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
BLUE TRITON BRANDS
Town of Aberfoyle, Ontario

TITLE
AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME
2022 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	G1b

Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2022

Prepared for Blue Triton Brands

Prepared by Cam Portt and Jim Reid

C. Portt and Associates

January 2023

Table of Contents

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List of Figures

Introduction

Condition 4.4 of the Permit to Take Water (PTTW Number 1763-8FXR29) issued to Nestlé Waters Canada (Nestlé), now Blue Triton Brands (Blue Triton), by the Ontario Ministry of Environment (MOE, now Ministry of Environment, Conservation and Parks) on April 29, 2011, required that Nestlé review the appropriateness of the methodology of their water temperature monitoring program in Aberfoyle Creek (the Nestlé program). C. Portt and Associates conducted that review for Nestlé and made a number of recommendations (Portt, 2011). The recommendations of the review were accepted by the MOE and were to be incorporated commencing in the 2012 field season (letter from Carl Slater, MOE, to Don DeMarco, Nestlé, October 26, 2011). One of those recommendations was that historical and future temperature data be analyzed using ThermoStat software, which has been developed to evaluate the thermal suitability of Ontario streams for thermal guilds for individual species of fishes in order to provide insight into the ecological implications of the current temperature regime. The monitoring is now required under Condition 4.4 of PTTW 3133-C5BUH9. Subsequently, the results of these analyses have been reported annually (Portt and Reid, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021). This report presents the results of the analyses of the 2022 data, together with the data from previous years.

Methods

Water temperature is monitored at the sediment-water interface at six locations in Aberfoyle Creek (Figure 1) using Tidbit© V2 and MX2203 temperature loggers manufactured by Onset Computer Corporation. (http://www.onsetcomp.com/products/data-loggers/utbi-001 or mx2203). The loggers have an accuracy of ±0.2°C between 0°C and 50°C and drift is 0.1°C per year. Monitoring at Stations 1 – 5 began in 2005; monitoring at Station 6, which is the station furthest upstream, began in 2008. The data are logged at half-hour intervals.

The data were analyzed using ThermoStat Version 3.1 temperature analysis software (Jones and Schmidt, http://people.trentu.ca/ nicholasjones/thermostat.htm). ThermoStat calculates the thermal suitability for individual fish species based on laboratory determined optimal and lethal temperatures, compiled by Hasnain et al. (2010), and the water temperature record.

Hasnain *et al*. (2010) provide the following definitions for the temperature criteria:

Optimum growth temperature (OGT)*: The optimum growth temperature is that which supports the highest growth rate in an experiment where separate groups of fish are exposed to one of a set of constant temperatures under ad libitum feeding conditions. The range of these constant temperatures is chosen so that reduced growth is observed at both extremes (McCauley and Casselman 1980 cited in Wismer and Christie 1987, Jobling 1981).*

Final temperature preferendum (FTP)*: Final temperature preferendum is that towards which fish gravitate when exposed to an 'infinite' temperature range (Giattina and Garton 1982 cited in Wismer and Christie 1987). Two methods are used to determine FTP: the gravitation method and the acclimation method (Jobling 1981). The gravitation method involves exposing fish to a temperature gradient until they* *gravitate towards a specific temperature. The acclimation method extends the gravitation method by carrying out repeated 'gravitation trials' with fish acclimated to progressively higher temperatures. The preferred temperature exhibited in each trial is then plotted against the acclimation temperature and the FTP is the temperature at which the best fit line for these data crosses the line of equality (Jobling 1981). An informal survey of a subset of the original sources indicated that most estimates were determined via the gravitation method. FTP estimates obtained using both methods were compiled in the database.*

Upper incipient lethal temperature (UILT)*: The upper incipient lethal temperature is that at which 50% of the fish in an experimental trial survive for an extended period (Spotila et al. 1979, Jobling 1981, Wismer and Christie 1987). Testing for UILT involves placing groups of fish in separate baths, each held at a different constant temperature, using a sufficiently wide range of constant temperatures that rapid mortality is observed in some baths whereas slow incomplete mortality occurs in others (Spotila et al. 1979).*

Critical thermal maximum (CTMax)*: The critical thermal maximum is an indicator of 'thermal resistance' and is defined as the temperature at which a fish loses its ability to maintain a 'normal' upright posture in the water (loss of equilibrium; Jobling 1981). It is determined by exposing fish in a tank to steadily increasing water temperatures (typically at a rate of 1 °C min-1) and noting the temperature at which the fish exhibit spasms and loss of equilibrium (Jobling 1981, Wismer and Christie 1987). Remaining at, or above, CTMax results in mortality (Jobling 1981, Wismer and Christie 1987).*

Thermal indices that reflect suitability are calculated based on the temperature record for a location and the laboratory derived criteria (Table 1). The proportion of the June through August temperature measurements that are within ±2 °C of the optimal or preferred temperature and the proportion of the June through August temperature measurements that equal or exceed the lethal threshold temperatures are expressed as a percentage of the total number of temperature measurements during this period. Because the temperature measurements occurred at fixed intervals, this percentage of measurements is equivalent to the percentage of the time from June 1st through August 31st that the temperature conditions are met.

Table 1. Indices used to evaluate the thermal suitability for individual fish species.

Optimal Range Indices	
%OGT	Percent of temperature measurements within ±2°C of the optimal growth temperature. Higher values indicate better conditions, to a theoretical maximum of 100%.
%FTP	Percent of temperature measurements within ±2°C of the final temperature preferendum. Higher values indicate better conditions, to a theoretical maximum of 100%.
Lethal Threshold Indices	
%>UILT	Percent of temperature measurements that equal or exceed the upper incipient lethal temperature. Lower values indicate better conditions. 0% is optimum.
%>CTmax	Percent of temperature measurements that equal or exceed the critical thermal maximum. Lower values indicate better conditions. 0% is optimum.

Not all the temperature criteria are available from the scientific literature (Hasnain et al, 2010) and, therefore, some of the thermal suitability indices cannot be calculated for some species. The temperature criteria that were available and used by ThermoStat for the fish species that were captured in Aberfoyle Creek during electrofishing conducted in 2008 are presented in (Table 2), together with the number of individuals of each species that was captured on each of the two sampling dates.

Table 2. Number of individuals of each species that were captured by electrofishing Aberfoyle Creek on January 31 and September 24, 2008 and the temperature criteria that are available from the scientific literature, from Hasnain et al (2010), and are used by ThermoStat to calculate thermal indices.

Common name	Scientific name	Number of individuals captured Sampling date		Temperature criteria available from the scientific literature			
		01/31/2008	09/24/2008	OGT	FTP	UILT	CTmax
blacknose dace	*Rhinichthys atratulus*	25	29	na[1]	19.6	28.6	30.2
bluntnose minnow	*Pimephales notatus*	3	2	26.2	24.1	31.5	29.9
brook trout	*Salvelinus fontinalis*	1	0	14.2	14.8	24.9	29.3
brown trout	*Salmo trutta*	4	3	12.6	15.7	25.0	28.3
common shiner	*Luxilus cornutus*	96	36	22.0	21.9	30.4	31.2
common white sucker	*Catostomus commersonii*	49	76	25.5	23.4	27.8	31.6
creek chub	*Semotilus atromaculatus*	154	353	na	24.9	29.1	33.0
johnny darter	*Etheostoma nigrum*	59	52	na	na	na	na
largemouth bass	*Micropterus salmoides*	0	3	26.6	28.6	31.9	38.4
pumpkinseed	*Lepomis gibbosus*	2	10	25.0	27.7	31.7	37.6
rainbow darter	*Etheostoma caeruleum*	3	28	na	19.9	na	32.1
rock bass	*Ambloplites rupestris*	9	37	28.4	24.9	33.9	36.0

1. na indicates that the temperature metric was not available.

The water temperature data were analyzed for each year at each monitoring location, excluding cases for which a significant portion of the potential temperature measurements was missing for the June through August period. Temperature logging at Sites 1 through 5 began on July 1, 2005; consequently, 2006 is the first year for which thermal suitability indices were calculated. Temperature logging at Site 6 began on May 15, 2008, so there are no thermal suitability indices for that site prior to 2008. There are significant gaps in the summer temperature data for Site 4 in 2010, so the thermal suitability indices were not calculated. Approximately 3.5 days of data were missing for Sites 2 and 3, at the end of August in 2010, and 9.5 hours of data for June 1 were missing for Site 1 in 2010; it was assumed that these amounts of missing data would not materially alter the calculated thermal suitabilities. There are no gaps in the summer temperature data series after 2010.

The mean air temperature at the Guelph Turfgrass weather station, which is the closest Environment Canada weather station to the site, was calculated for the period June 1 through August 31 for the years 2007- 2009 and 2011-2021. The weather station began operating during the summer of 2006, and there are missing data during June of 2010, so the June – August mean could not be calculated for those years. The relationship between mean June – August air temperature and mean June – August water temperature was explored graphically and using regression analyses.

Results

Graphs of the thermal suitability indices are presented in Figure 2 (%>UILT), Figure 3 (%>CTmax), Figure 4 (%FTP) and Figure 5 (%OTG). The indices values are presented in Appendix A. Summer water temperatures are highest at the most upstream location, which is closest to the Aberfoyle Mill pond, and decrease with distance downstream. This is reflected in the thermal indices, which improve from upstream to downstream for species that require cold temperatures and improve from downstream to upstream for species that require warm temperatures. Mean June – August air temperature was 19.02 °C in 2022, which is intermediate for the period 2007 – 2022 (Figure 6). This is reflected in the thermal suitability indices.

Lethal temperatures are arguably the most critical thermal factor in determining fish distributions. If lethality occurs, other factors such as growth are immaterial. It is clear from Figure 2 that brook trout and brown trout are the species whose upper incipient lethal temperature is equaled or exceeded most frequently from June 1st to August 31st; in the warmest years, at the warmest site (Site 6), the %>UILT exceeds 40% for those species. The upper incipient lethal temperature is also exceeded, but infrequently, for blacknose dace, common shiner, creek chub and white sucker. In 2022, the upper incipient lethal temperature for brook trout and brown trout was exceeded 26% and 24% of the time, respectively, at the farthest upstream station and 3% of the time for brook trout and for brown trout at the station farthest downstream. In 2022, the *CTMax* was exceeded only for brown trout and only at the most upstream stations (Figure 3).

The percentage of the time, from June 1st to August 31st, that water temperature is within 2°C of the final temperature preferendum (%FTP) is lowest for brown trout and brook trout, which have the lowest preferred temperatures, at all sites in all years (Figure 4; Table 2). The next lowest %FTP values, in most years, are for pumpkinseed and largemouth bass (Figure 4), which have the highest preferred temperatures (Table 2). In 2022, as in past years, the %FTP was highest for species with intermediate temperature requirements.

The percentage of the time, from June 1st to August 31st, that water temperature was within 2°C of the optimal temperature for growth (%OGT) is presented in Figure 5. The lowest %OGT values are for brown trout and brook trout, which have the lowest optimum temperature for growth among the species that occur in this portion of Aberfoyle Creek (Table 2). In 2022, %OGT was zero for brown trout at all sites and also zero for brook trout except at Sites 4 and 5, where it was 0.4 and 0.1, respectively. The next lowest value was for rock bass, which is the species with the highest optimum temperature for growth (Table 2). As in previous years, the highest mean %OGT in 2022 was for species with intermediate optimum temperatures for growth.

The mean June – August water temperature at each monitoring location is plotted versus mean June – August air temperature at the Guelph Turfgrass Institute in Figure 6. Mean June – August water temperature decreases in a downstream direction through the Blue Triton property (Figure 6). This is also evident in the plots of the temperature indices (Figures 2 – 5). For example, the percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (%>UILT) for brook trout decreases with distance downstream (Figure 2).

As Figure 6 illustrates, the mean June – August water temperature is highly correlated with the mean June – August air temperature. The regressions shown are two-stage polynomials. At the three furthest upstream sites, mean June – August air temperature accounts for nearly 95% of the variation in mean June – August water temperature. The rate of increase in water temperature with air temperature tends to decrease in a downstream direction, as does the proportion of the variation accounted for (the r^2). The relationship between mean air temperature and mean water temperature was consistent with previous years at the three upstream sites, but mean water temperature was less than predicted from the equations at the three downstream sites.

Discussion

The 2022 fish suitability results were consistent with those of previous years. In the reach of Aberfoyle Creek that flows through the Blue Triton property, some species (i.e. largemouth bass, rock bass) are limited by low temperatures and the individuals that occur there probably originate from the mill pond that is just upstream. Brook trout and brown trout, conversely, are limited by high temperatures that exceed their upper incipient lethal temperature frequently during the summer (Figure 2) and often exceed their preferred temperature and their optimum temperature for growth (Figure 5), even in cool summers. The 2022 results continue to support the previously expressed opinion that water temperature is the principal factor limiting trout abundance in the Blue Triton reach of Aberfoyle Creek, which was based on an analysis by C. Portt using the thermal suitability model of Wehrly et al. (2007) and presented in the Response to Technical Stakeholders' Comments on the TW3-80 Permit Renewal Application (Distributed: March 4, 2011).

The data continue to demonstrate a strong correlation between mean June – August air temperature and mean water temperature in Aberfoyle Creek, however, at the three furthest downstream sites, 2022 mean summer water temperatures were lower than predicted based on the relationship with mean air temperature. The summer of 2022 was dry and average stream flow during the June-August period was the lowest during the period for which there are temperature data. The second largest negative deviation from the expected stream temperature was in 2007, which was also a low flow year. During the summer, the water flowing into the Aberfoyle Branch from the upstream mill pond is warm and cools as it flows downstream. It is plausible that the rate of cooling is higher when flow volumes are low; less water contains less thermal mass and the ratio of water volume to area for potential heat loss would be lower. To investigate this further, the residuals (observed minus expected) from the water temperature versus air temperature regression were plotted against mean summer stream flow (Figure 7). No relationship between mean daily flow and the residuals is evident. Therefore, if low flow is a factor, it is not the only factor involved. Regardless, it remains clear that any study that attempts to link changes in water temperature over time to causative factors must take year-to-year differences in air temperature into account.

Conclusions

In 2022, mean summer (June – August) air temperature was intermediate among those observed during the period 2007 – 2022. The overall pattern of water temperature suitability for the fish species found in the Aberfoyle Branch of Mill Creek from Brock Road downstream through the Blue Triton property in 2022 are consistent with previous years. Water temperatures during the June 1 – August 31 period are usually too warm for coldwater species such as brook trout and brown trout and too cold for warmwater species such as largemouth bass. The water temperatures during this period are most favourable for species such as common shiner which have intermediate thermal requirements. During the summer, the water in the mill pond upstream from Brock Road becomes warm and, although the creek temperature decreases with distance downstream, it frequently exceeds the ultimate upper incipient lethal temperature for brook trout and brown trout at the furthest downstream temperature monitoring site.

The relationships between air temperature and water temperature were consistent with those observed in previous years at the three upstream sites but the 2022 stream temperatures were lower than predicted from the mean water temperature versus mean air temperature relationship at the three downstream sites. Stream flow in 2022 was the lowest during the period for which temperature data are available but the data do not demonstrate a relationship between flow and residuals of the water temperature versus air temperature relationship.

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Figure 1. Temperature logging locations used in the Blue Triton monitoring program in Aberfoyle Creek.

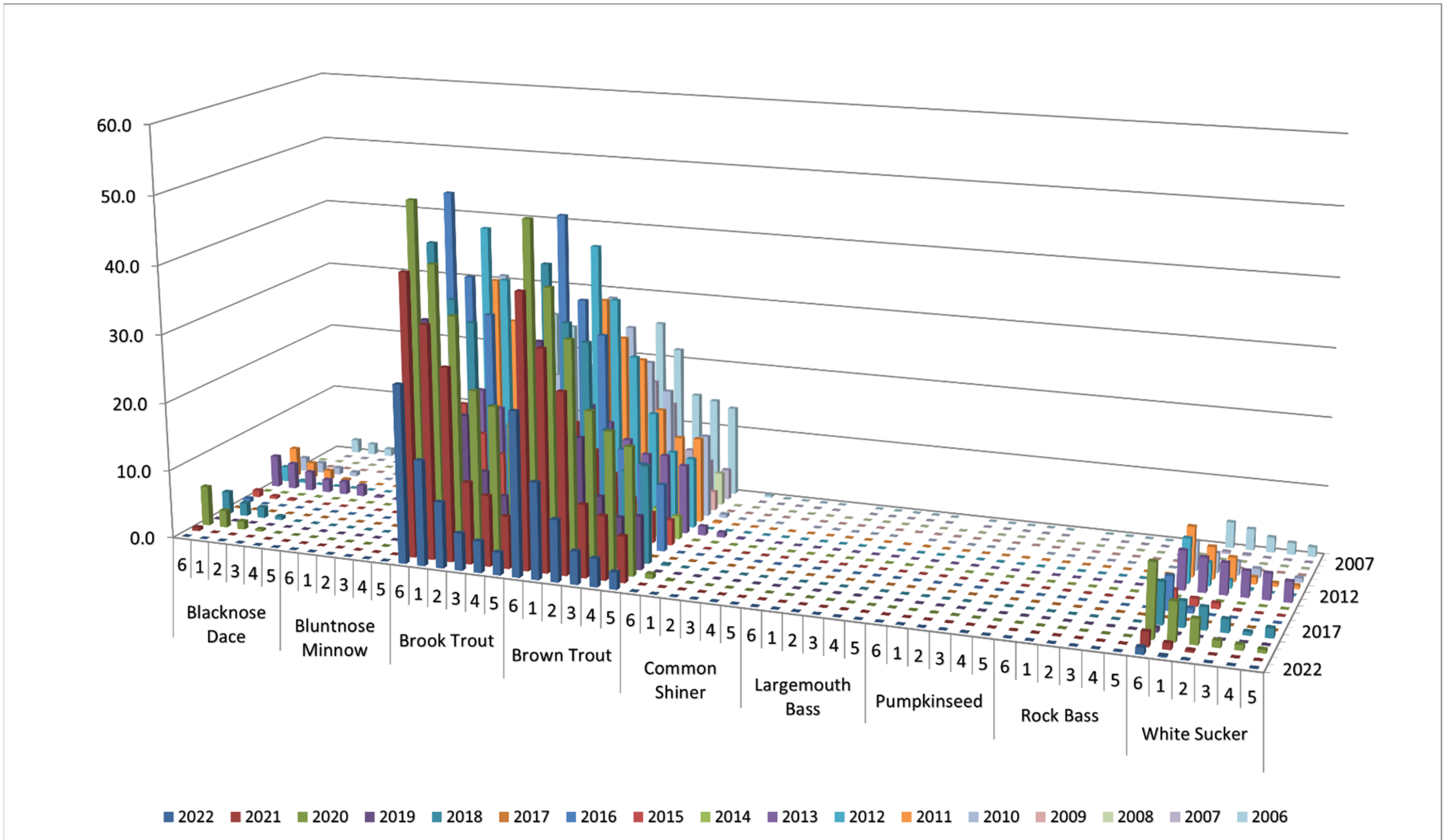

Figure 2. Percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (%>UILT) during the period June 1 to August 31, by species, station, and year.

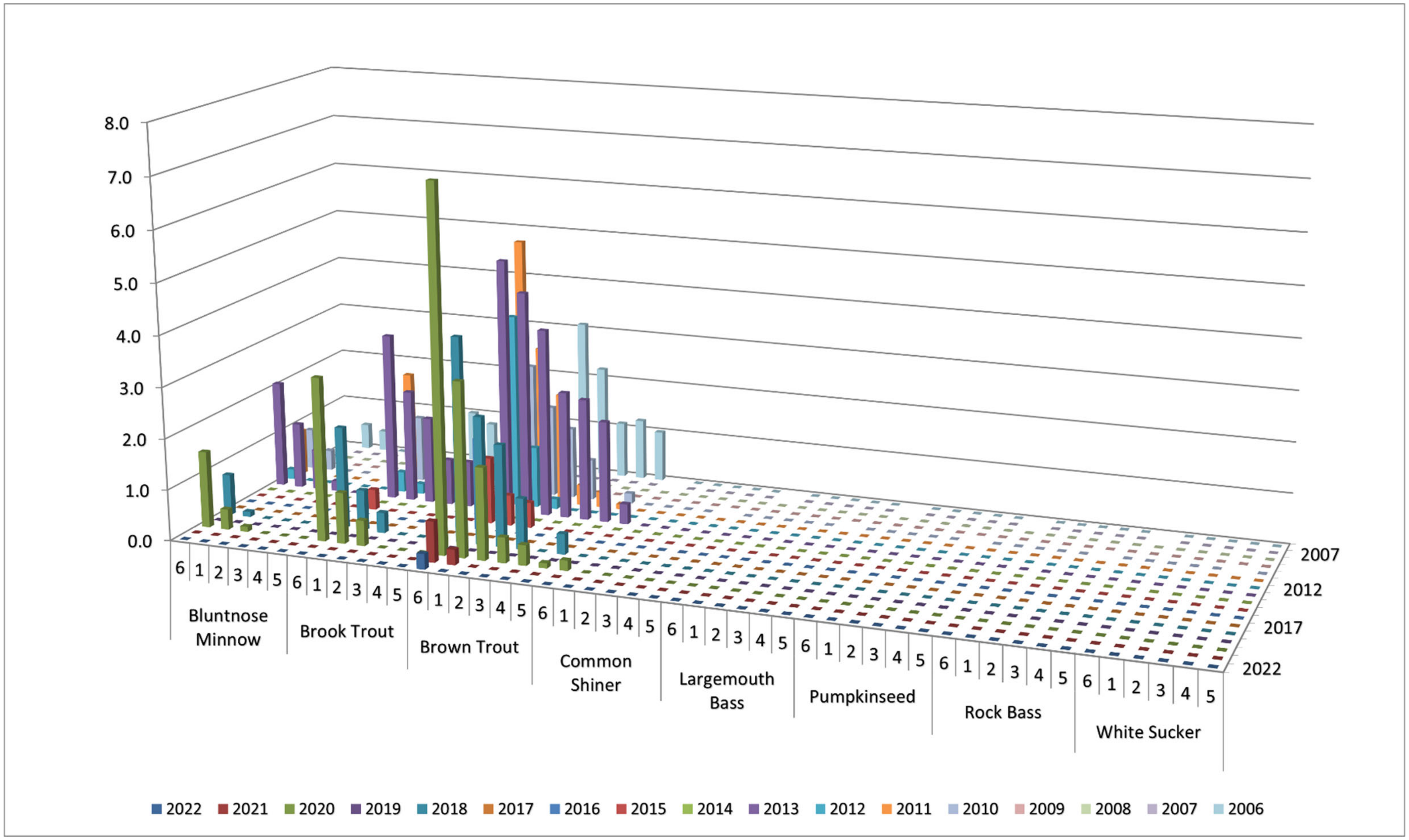

Figure 3. Percent of temperature measurements that exceed the critical thermal maximum temperature (%>CTmax) during the period June 1 to August 31, by species, station, and year.

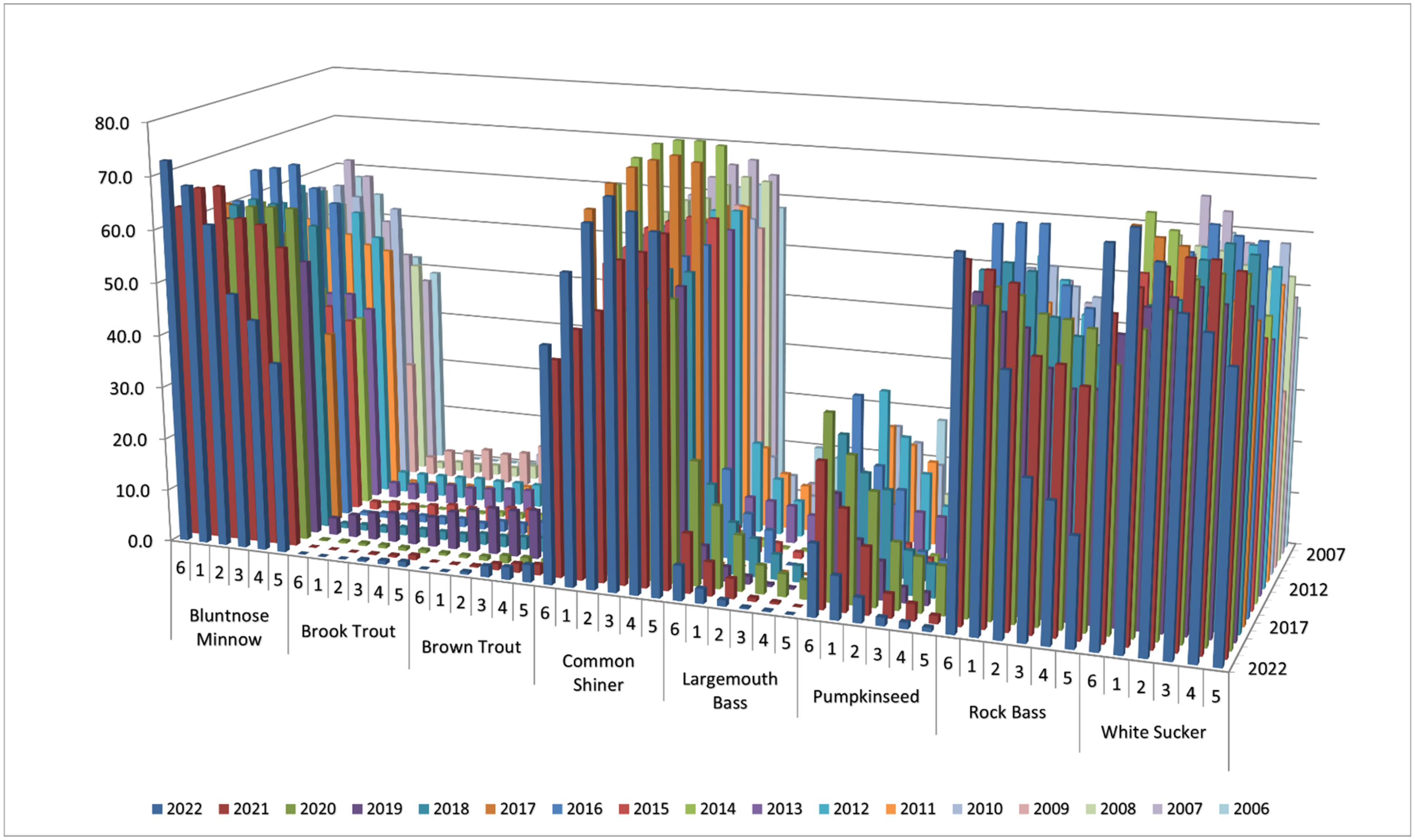

Figure 4. Percent of temperature measurements within ±2°C of the final temperature preferendum (%FTP) during the period June 1 to August 31, by species, station, and year.

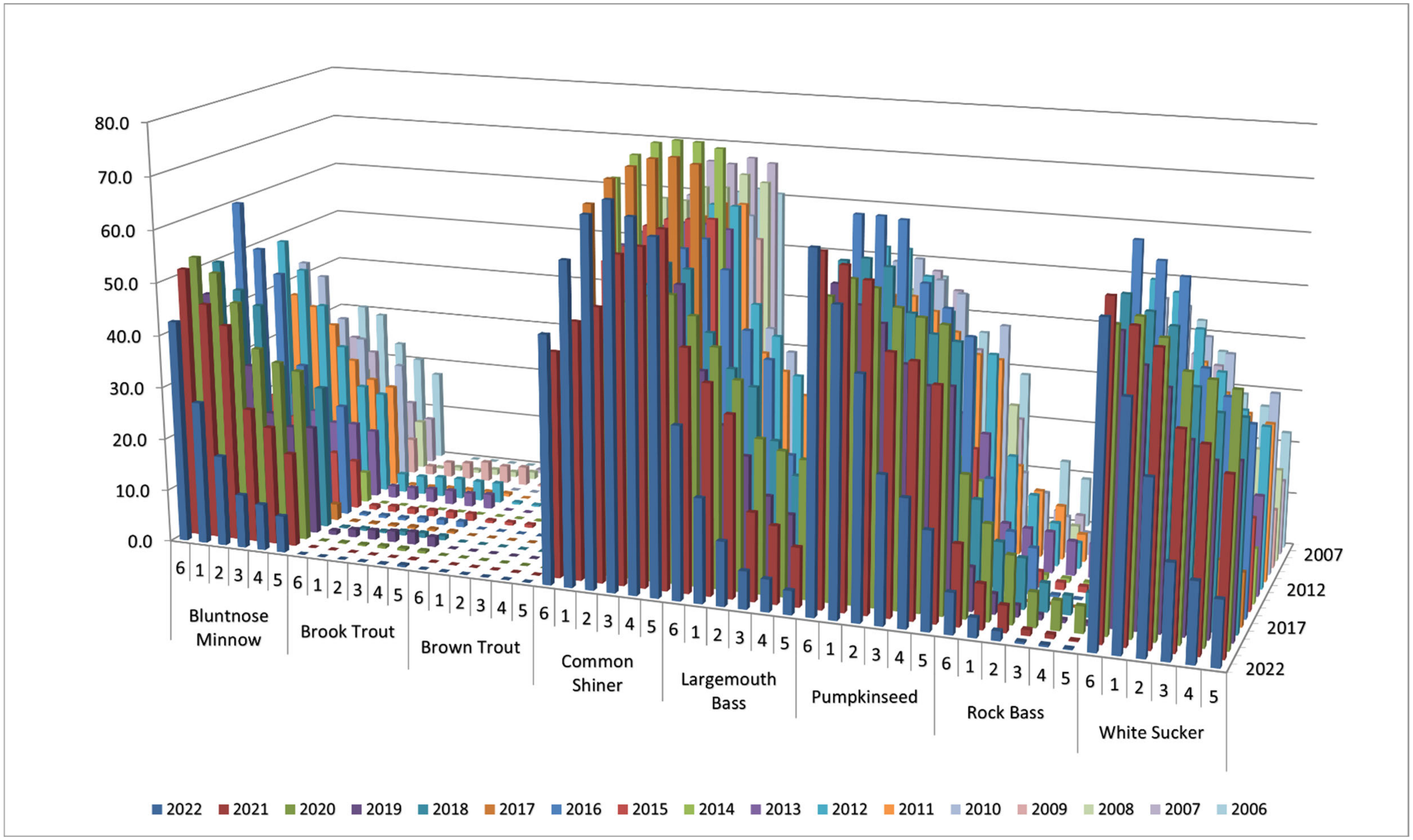

Figure 5. Percent of temperature measurements within ±2°C of the optimal temperature for growth (%OTG) during the period June 1 to August 31, by species, station, and year.

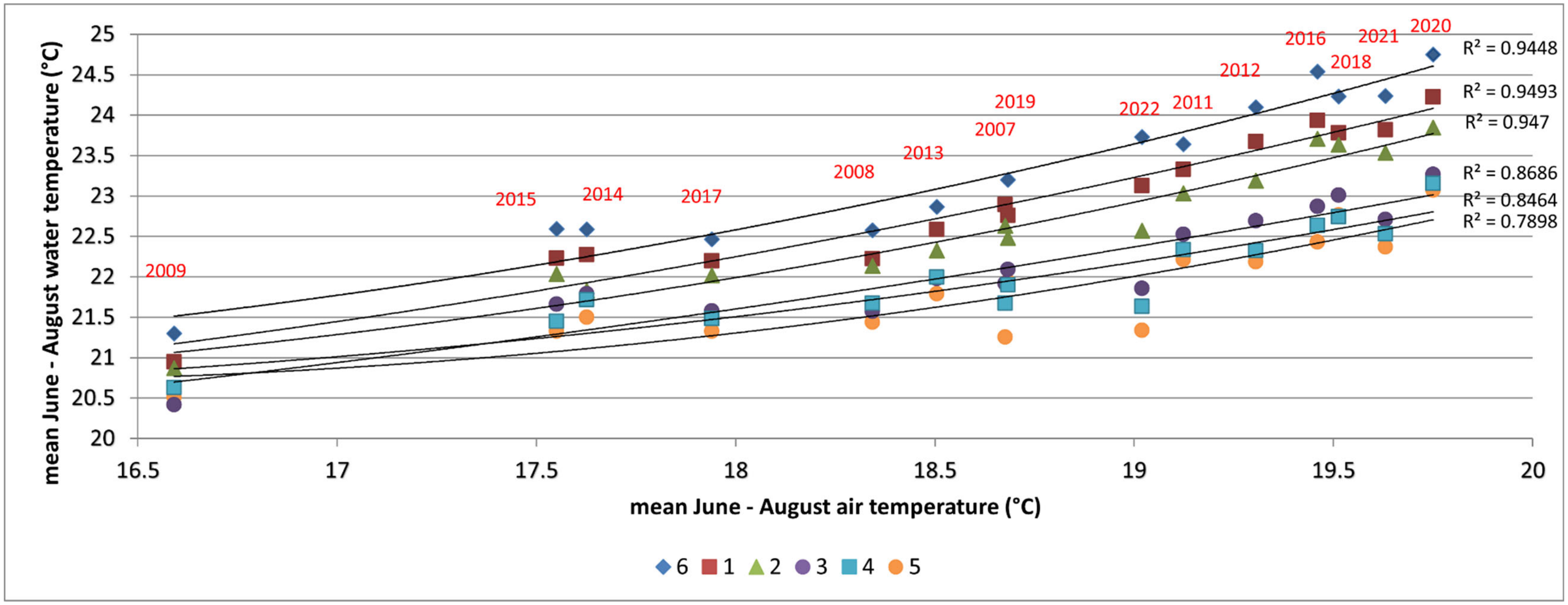

Figure 6. Plot of the mean June 1 - August 31 water temperature at each site versus mean June 1 – August 31 air temperature at the Guelph Turfgrass Institute weather station, by year. The lines and R^2 values are for second order polynomial regressions.

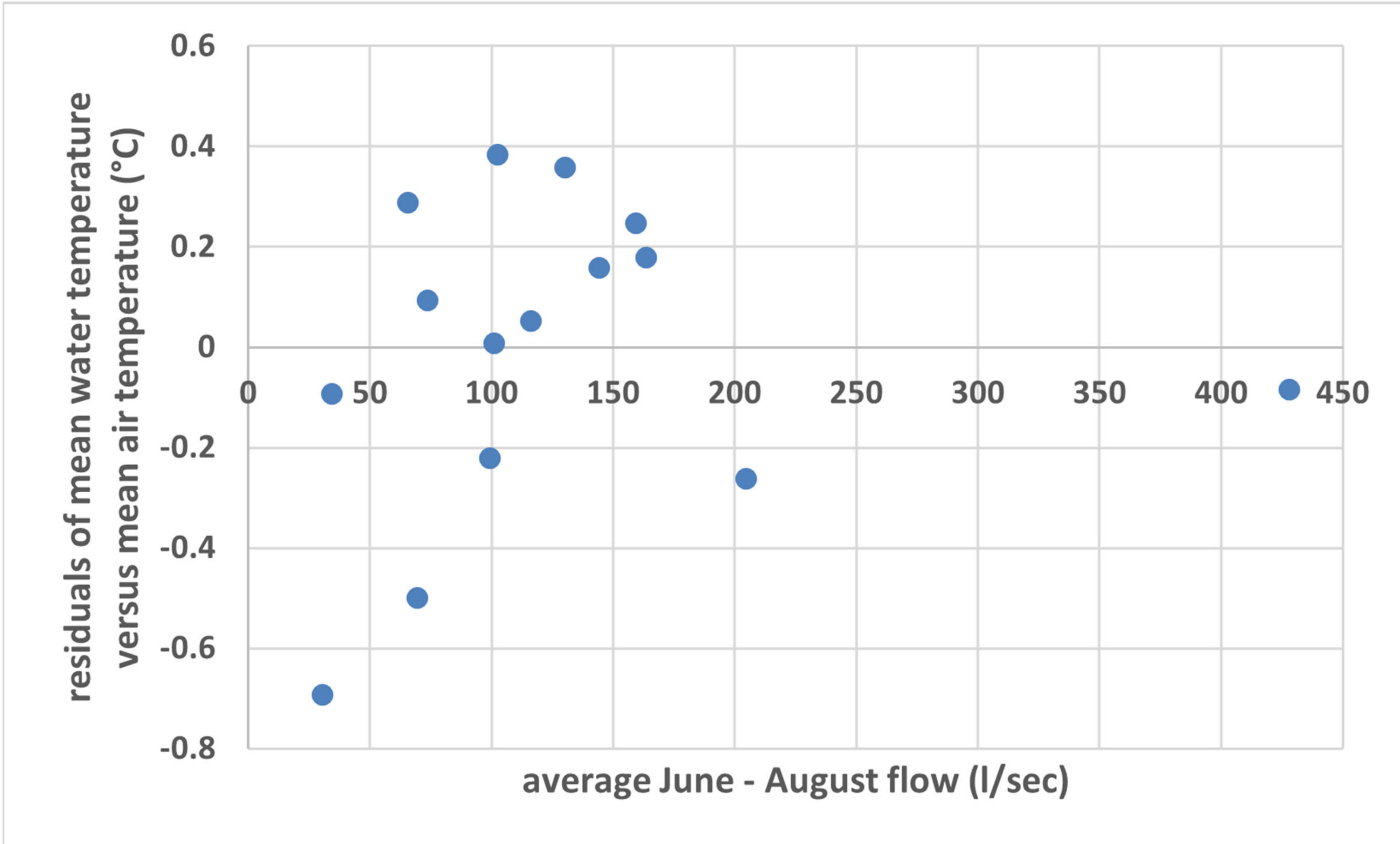

Figure 7. Residuals (observed minus expected) for regression of mean June-August water temperature at the furthest downstream monitoring site versus mean stream flow for the same period.

APPENDIX A

Thermal suitability indices

	Percent of temperature measurements within ±2°C of the optimum growth temperature (%OGT)																		
	Year																		
Species	Station	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Blunt-nose Minnow	6	42.5	51.6	53.0	45.0	50.3	20.9	60.1	27.0	18.2	23.2	49.2	37.4	43.1	12.3	26.2			37.0
	1	27.3	45.2	50.3	36.5	45.2	14.0	51.4	21.3	13.0	19.3	43.7	35.3	40.6	8.5	19.3	25.0	30.5	31.2
	2	17.3	41.5	44.9	31.7	42.5	10.6	46.8	17.3	8.5	16.2	36.8	31.9	32.2	7.2	19.3	22.2	29.1	27.4
	3	10.2	25.7	36.4	22.8	30.9	5.5	29.0	13.2	7.9	14.2	28.7	24.9	28.3	5.9	11.7	15.1	23.3	20.2
	4	8.8	22.6	34.1	20.5	27.4	4.5	24.9	10.7	7.0	14.3	20.9	21.3		7.0	11.9	12.1	20.3	17.3
	5	7.0	17.9	32.8	20.7	27.4	3.1	21.6	9.4	5.9	13.2	19.7	20.1	23.5	6.9	9.5	9.0	17.5	16.1
	Mean	18.9	34.1	41.9	29.5	37.3	9.8	39.0	16.5	10.1	16.7	33.2	28.5	33.5	8.0	16.3	16.7	24.1	24.7
Brook Trout	6	0.0	0.0	0.0	0.8	0.2	0.1	0.4	0.8	0.0	2.3	3.6	0.2	0.0	1.7	0.2			0.7
	1	0.0	0.0	0.2	1.5	0.4	0.2	0.5	1.1	0.0	2.4	3.5	0.2	0.0	2.9	0.7	0.0	0.0	0.9
	2	0.0	0.0	0.3	1.8	0.3	0.3	0.5	1.0	0.0	2.6	3.8	0.4	0.0	3.2	0.6	0.0	0.0	0.9
	3	0.0	0.0	0.5	2.1	0.8	0.4	0.9	1.2	0.0	2.7	3.9	0.5	0.0	3.8	1.1	0.1	0.0	1.1
	4	0.1	0.0	0.5	2.4	0.9	0.4	1.0	1.3	0.0	2.6	3.8	0.5		3.4	1.0	0.2	0.0	1.2
	5	0.4	0.1	0.5	1.9	0.8	0.4	1.1	1.4	0.0	2.8	3.9	0.6	0.0	3.6	1.4	0.7	0.1	1.2
	Mean	0.1	0.0	0.3	1.8	0.6	0.3	0.7	1.1	0.0	2.6	3.8	0.4	0.0	3.1	0.8	0.2	0.0	1.0
Brown Trout	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.4	0.0	0.0	0.3	0.0			0.1
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.1
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.1
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.1
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0		0.6	0.0	0.0	0.0	0.1
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.5	0.0	0.0	0.6	0.1	0.0	0.0	0.1
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.4	0.0	0.0	0.5	0.0	0.0	0.0	0.1
Common Shiner	6	46.6	42.4	33.7	37.6	35.4	66.0	29.5	53.7	68.5	55.0	36.4	47.3	44.8	63.9	60.0			48.2
	1	60.3	48.3	38.3	43.0	41.6	70.9	38.8	56.7	73.1	57.7	43.1	51.0	47.0	60.8	59.8	60.1	56.3	52.9
	2	68.7	51.3	43.7	46.5	43.3	73.4	42.4	60.9	75.6	59.1	51.8	53.4	54.8	62.8	62.7	67.1	61.5	56.9
	3	71.6	61.1	51.6	53.4	52.9	75.1	55.8	62.4	76.3	60.1	56.8	59.7	56.7	51.4	62.9	66.8	60.5	60.2
	4	68.9	62.8	52.9	54.6	57.2	75.6	58.1	62.7	76.2	60.1	63.1	62.5		57.9	65.7	68.2	61.4	62.6
	5	65.7	66.2	53.6	54.5	56.4	74.6	60.2	63.0	75.3	59.4	63.0	62.6	59.6	54.2	64.4	67.4	60.7	62.2

	Mean	63.6	55.4	45.6	48.3	47.8	72.6	47.5	59.9	74.2	58.6	52.4	56.1	52.6	58.5	62.6	65.9	60.1	57.3
Large-mouth Bass	6	32.4	45.4	50.1	39.1	45.1	14.8	54.8	20.6	13.4	17.5	44.6	34.2	38.0	9.0	19.6			31.9
	1	19.6	39.4	44.8	29.4	38.8	8.6	43.9	16.5	9.1	15.1	38.8	31.0	33.7	6.8	15.1	19.9	26.6	26.1
	2	12.1	34.1	39.2	24.1	35.8	6.1	38.8	13.6	6.2	13.4	31.5	26.6	26.5	4.4	14.8	18.7	25.5	22.5
	3	7.1	16.6	28.9	17.1	26.2	2.7	21.2	9.5	5.6	11.3	22.3	20.4	22.7	4.3	8.9	12.1	20.2	15.6
	4	6.1	14.6	27.1	14.1	20.1	1.9	18.1	7.7	5.3	11.3	15.8	16.9		5.2	8.9	9.3	17.6	12.9
	5	4.5	11.1	25.9	14.3	21.2	1.1	15.7	6.4	4.7	10.2	15.0	16.3	18.0	4.6	7.0	6.4	15.3	12.1
	Mean	13.6	26.9	36.0	23.0	31.2	5.9	32.1	12.4	7.4	13.1	28.0	24.2	27.8	5.7	12.4	13.3	21.0	20.0
Pump-kinseed	6	66.0	64.5	55.7	57.0	60.2	42.9	66.8	42.5	39.8	39.5	57.5	47.5	53.0	23.4	45.8			49.7
	1	56.5	62.4	59.1	53.5	60.9	36.0	66.8	38.3	33.2	36.5	57.4	47.6	53.8	18.3	38.3	48.8	46.8	47.4
	2	44.8	60.1	57.8	50.6	59.7	32.6	66.4	35.8	23.5	33.0	52.6	45.1	50.1	15.4	38.2	45.3	43.6	44.4
	3	27.4	47.9	54.7	43.7	51.8	23.5	55.3	29.3	23.3	28.2	46.3	41.5	47.8	13.7	29.0	34.1	36.5	37.9
	4	23.7	46.7	53.3	40.2	48.4	21.5	51.1	26.6	21.4	28.6	41.8	37.6		14.4	29.5	27.2	32.6	34.7
	5	18.4	42.9	52.4	40.5	47.4	18.7	46.3	24.6	17.4	25.1	39.0	37.0	42.4	14.2	25.0	21.2	28.9	32.7
	Mean	39.5	54.1	55.5	47.6	54.7	29.2	58.8	32.9	26.4	31.8	49.1	42.7	49.4	16.6	34.3	35.3	37.7	41.0
Rock Bass	6	7.7	15.1	26.3	8.2	19.3	0.2	20.7	5.5	3.1	8.5	20.1	17.1	14.6	1.6	5.4			11.8
	1	3.7	8.4	17.9	3.8	12.0	0.0	11.3	3.3	1.9	8.0	13.1	12.7	11.1	1.0	2.5	3.8	12.4	7.7
	2	1.8	5.0	12.7	2.2	9.5	0.0	8.7	3.0	1.0	7.8	8.2	10.2	6.9	0.8	2.5	3.3	9.3	5.7
	3	0.4	1.1	6.5	1.0	5.4	0.0	0.4	1.4	0.8	6.5	4.9	5.2	4.2	0.2	0.5	1.4	6.5	2.9
	4	0.4	0.8	5.5	0.6	3.6	0.0	0.1	1.1	0.5	6.5	1.7	4.2		0.3	0.5	0.6	6.0	2.1
	5	0.2	0.2	5.0	0.6	4.6	0.0	0.1	0.8	0.2	5.7	2.3	3.3	2.5	0.3	0.2	0.1	4.7	1.9
	Mean	2.4	5.1	12.3	2.7	9.1	0.0	6.9	2.5	1.3	7.2	8.4	8.8	7.9	0.7	1.9	1.8	7.8	5.3
White Sucker	6	58.2	60.8	55.0	52.9	58.3	34.0	65.9	36.6	30.4	33.6	55.3	44.6	50.0	18.0	37.3			45.2
	1	45.1	56.1	56.7	47.3	55.6	26.9	62.6	32.0	23.7	30.0	53.3	43.0	48.9	15.0	27.5	37.0	42.4	41.1
	2	31.8	52.8	53.4	43.8	53.4	22.4	60.1	28.0	15.7	25.8	47.0	39.9	43.6	12.8	28.5	35.1	36.8	37.4
	3	17.5	39.3	48.0	35.1	43.2	14.1	44.4	22.4	14.9	20.8	39.5	34.6	40.8	9.5	19.4	21.9	29.0	29.8
	4	14.8	37.1	47.0	31.9	39.1	11.7	39.7	18.9	12.8	21.1	32.9	31.2		10.8	21.1	18.9	27.0	26.7
	5	12.1	32.4	45.7	32.3	38.7	10.0	35.3	17.2	10.3	18.7	30.3	29.7	34.2	11.1	17.5	14.2	22.3	25.0
	Mean	29.9	46.4	51.0	40.6	48.1	19.9	51.3	27.6	18.0	25.0	43.1	37.2	43.5	12.9	25.2	25.4	31.5	34.1

Percent of temperature measurements within ±2°C of the final temperature preferendum (%FTP)																			
		Year																	
Species	Station	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Black-nose Dace	6	13.8	11.5	10.9	17.8	13.7	27.4	9.2	28.0	26.7	26.9	10.2	21.6	21.1	51.1	30.5			21.9
	1	19.3	15.1	14.1	20.4	16.1	33.2	12.0	33.3	31.4	30.7	12.9	24.7	22.5	57.2	35.1	24.9	24.8	25.5
	2	28.3	17.9	16.3	23.5	17.0	35.5	13.6	36.1	42.3	34.0	17.1	28.4	24.8	53.2	34.1	26.7	26.5	27.9
	3	39.1	27.4	20.8	28.1	22.0	42.2	20.6	41.7	42.0	38.9	22.9	34.1	29.2	59.9	40.2	37.8	37.7	34.1
	4	43.4	28.4	21.5	31.0	23.9	43.9	24.1	45.0	43.9	38.6	27.4	36.4		58.4	39.6	41.2	42.2	36.4
	5	48.7	31.0	22.1	31.4	24.7	46.6	26.9	46.9	48.7	42.1	30.9	38.9	34.1	59.7	43.3	49.8	48.4	39.1
	Mean	32.1	21.9	17.6	25.4	19.6	38.1	17.7	38.5	39.2	35.2	20.2	30.7	26.3	56.6	37.1	36.1	35.9	31.0
Blunt-nose Minnow	6	72.8	63.4	53.7	57.8	57.3	60.8	60.5	54.3	58.7	51.1	57.0	52.0	57.4	33.9	56.3			55.3
	1	68.4	67.2	58.9	59.9	61.6	55.3	66.8	50.5	52.9	48.1	60.7	53.2	58.8	28.9	53.8	62.2	58.0	56.1
	2	61.4	67.8	60.8	58.7	63.0	51.8	67.5	48.0	43.0	44.9	59.9	51.5	59.5	26.6	52.5	59.1	54.6	54.3
	3	48.7	62.1	63.5	55.2	62.4	41.9	68.4	43.3	42.3	40.5	57.6	50.7	57.5	23.6	47.4	50.0	47.6	50.9
	4	44.1	61.2	63.7	52.5	60.7	40.5	64.1	40.1	40.9	40.7	56.2	48.9		23.4	46.1	43.4	42.0	48.3
	5	36.3	57.2	63.7	52.8	58.8	36.9	61.5	37.6	37.1	38.0	51.5	48.0	55.6	22.6	42.3	38.3	39.0	46.3
	Mean	55.3	63.2	60.7	56.2	60.6	47.9	64.8	45.6	45.8	43.9	57.2	50.7	57.8	26.5	49.7	50.6	48.2	51.8
Brook Trout	6	0.0	0.0	0.2	3.2	0.9	0.3	0.6	1.5	0.0	2.9	3.9	0.8	0.0	3.5	1.2			1.4
	1	0.0	0.0	0.4	4.3	1.1	0.4	0.9	1.8	0.0	3.0	3.9	0.8	0.0	5.2	1.7	0.2	0.0	1.5
	2	0.0	0.0	0.5	5.1	1.2	0.5	1.0	1.8	0.0	3.4	4.0	1.0	0.0	5.5	1.6	0.3	0.0	1.6
	3	0.4	0.2	0.6	5.6	1.5	0.8	1.3	2.1	0.1	3.7	4.1	1.2	0.0	6.3	1.9	0.5	0.1	1.9
	4	0.7	0.4	0.6	6.3	1.6	0.8	1.4	2.6	0.1	3.6	4.3	1.2		5.8	1.8	1.7	0.2	2.2
	5	1.0	0.9	0.6	5.7	1.6	1.4	1.6	2.5	0.3	3.8	4.2	1.2	0.0	6.5	2.6	3.8	0.4	2.3
	Mean	0.4	0.3	0.5	5.0	1.3	0.7	1.1	2.1	0.1	3.4	4.1	1.0	0.0	5.5	1.8	1.3	0.1	1.8
Brown Trout	6	0.0	0.0	0.5	7.2	1.6	0.8	1.2	2.9	0.8	4.2	4.3	2.3	0.7	8.3	3.8			2.8
	1	0.0	0.1	0.5	8.1	2.1	1.1	2.0	3.4	0.9	4.4	4.3	2.3	0.6	9.7	4.5	2.6	0.2	2.9
	2	0.5	0.3	0.8	8.8	2.1	1.4	2.0	3.5	1.2	4.8	4.8	2.6	1.1	10.1	4.7	2.8	0.4	3.2
	3	2.1	1.2	1.4	8.8	2.4	3.2	2.7	3.9	1.4	5.4	5.0	3.1	1.4	11.6	5.6	4.0	1.0	3.9
	4	2.4	1.7	1.5	9.3	2.6	3.4	2.9	4.1	1.4	5.4	5.4	3.1		10.5	5.1	5.0	1.6	4.2
	5	3.3	2.0	1.6	8.9	2.6	4.1	3.4	4.4	1.8	5.9	5.3	3.3	2.1	11.8	5.9	6.6	2.8	4.5

	Mean	1.4	0.9	1.1	8.5	2.2	2.3	2.4	3.7	1.3	5.0	4.9	2.8	1.2	10.3	4.9	4.2	1.2	3.6
Com-mon Shiner	6	44.6	40.9	32.7	36.8	34.3	65.0	28.1	53.2	67.2	54.2	34.8	46.0	43.9	62.5	57.2			3.6
	1	58.1	46.8	37.3	42.0	40.0	70.0	37.1	56.6	72.5	56.9	41.5	50.3	46.2	60.8	59.8	60.1	56.3	46.9
	2	67.2	50.5	42.2	45.3	42.1	73.2	40.7	60.5	75.4	59.1	50.7	52.6	53.0	62.8	60.5	63.9	58.9	52.1
	3	72.1	60.0	50.0	52.3	52.1	74.8	54.0	62.0	76.3	60.4	55.9	59.1	55.7	56.5	63.4	66.6	61.4	55.7
	4	69.7	61.7	51.7	53.9	56.0	75.9	56.6	63.1	76.4	60.3	61.9	62.0		60.5	65.2	67.8	62.2	60.0
	5	66.5	65.3	52.8	54.1	55.8	74.9	59.0	63.1	75.8	59.3	62.1	62.1	58.9	56.3	64.6	65.1	57.9	62.3
	Mean	63.0	54.2	44.5	47.4	46.7	72.3	45.9	59.8	73.9	58.4	51.2	55.4	51.5	59.9	61.8	64.7	59.3	61.7
Creek Chub	6	67.1	64.9	55.9	57.4	60.4	44.9	66.8	43.9	42.1	40.5	57.4	47.9	53.6	23.3	45.2			56.6
	1	58.2	63.4	59.6	54.3	62.0	38.1	67.3	39.4	34.8	37.7	58.0	48.4	54.3	18.1	38.3	48.8	45.0	50.3
	2	47.7	61.5	58.5	51.9	60.8	34.3	67.4	37.1	25.3	33.9	53.8	45.8	50.8	19.2	38.0	44.9	43.0	48.0
	3	29.4	49.3	55.6	45.2	53.1	25.7	56.8	30.9	24.9	29.4	47.8	42.9	49.1	13.7	29.0	34.1	36.5	45.4
	4	25.9	48.3	55.0	41.9	50.1	23.1	53.1	27.8	23.3	30.0	43.5	38.6		16.2	32.1	30.1	34.1	39.0
	5	20.2	44.9	53.8	42.2	48.8	20.5	48.4	25.9	18.9	26.9	40.4	38.4	43.9	14.9	26.7	21.2	28.9	36.5
	Mean	41.4	55.4	56.4	48.8	55.9	31.1	60.0	34.2	28.2	33.1	50.2	43.7	50.3	17.6	34.9	35.8	37.5	34.0
Large-mouth Bass	6	6.6	11.3	23.5	6.3	16.7	0.1	17.1	4.8	2.4	8.0	17.5	15.4	12.4	1.1	4.4			42.1
	1	2.8	6.4	15.6	2.8	9.9	0.0	9.0	2.9	1.4	7.7	10.8	10.7	9.1	0.5	2.5	3.8	10.0	10.1
	2	1.2	3.8	10.6	1.5	7.3	0.0	6.3	2.5	0.3	7.2	6.9	8.7	5.4	0.5	1.8	2.7	8.3	6.4
	3	0.3	0.7	5.4	0.5	4.8	0.0	0.1	1.2	0.3	5.8	3.7	4.2	3.6	0.2	0.5	1.4	6.5	4.6
	4	0.2	0.4	4.3	0.3	3.1	0.0	0.0	0.7	0.2	5.7	1.1	3.3		0.2	0.2	0.4	5.4	2.4
	5	0.0	0.0	3.6	0.4	3.7	0.0	0.0	0.5	0.0	5.1	1.5	2.6	2.1	0.1	0.2	0.1	4.7	1.7
	Mean	1.9	3.8	10.5	2.0	7.6	0.0	5.4	2.1	0.8	6.6	6.9	7.5	6.5	0.4	1.6	1.7	7.0	1.5
Pump-kinseed	6	13.6	27.3	34.9	18.9	28.6	3.4	33.6	9.8	5.4	10.0	30.1	22.1	21.0	3.6	9.4			4.4
	1	8.2	19.1	27.6	10.8	21.9	0.7	20.8	6.3	3.9	9.7	21.6	18.9	18.2	2.7	5.6	8.1	18.1	18.4
	2	4.7	12.6	21.4	7.3	19.2	0.1	16.7	5.2	2.2	8.7	14.9	16.0	14.2	2.3	5.9	8.0	14.0	13.4
	3	1.6	4.5	12.6	2.9	8.4	0.0	5.5	2.9	2.1	8.2	9.0	10.2	9.7	0.7	2.2	3.1	9.8	10.5
	4	1.2	3.2	10.4	2.4	6.3	0.0	4.3	2.1	2.0	8.2	5.3	7.7		0.9	2.5	2.4	9.1	5.7
	5	0.8	1.5	9.2	2.5	6.9	0.0	2.4	1.6	1.6	7.8	5.7	6.3	5.5	0.6	1.0	0.8	6.8	4.5
	Mean	5.0	11.4	19.4	7.5	15.2	0.7	13.9	4.7	2.9	8.8	14.4	13.5	13.7	1.8	4.4	4.5	11.6	3.8
Rainbow Darter	6	15.8	14.3	13.5	19.2	15.7	33.4	10.6	32.7	32.2	31.0	12.9	25.4	23.7	52.3	31.5			9.2
	1	23.5	18.8	16.8	23.1	18.5	39.1	14.4	37.8	38.4	34.7	15.9	28.1	25.6	60.5	37.5	29.1	29.4	24.9
	2	32.0	21.6	19.2	26.0	19.4	41.4	16.3	41.7	49.7	38.2	21.0	32.5	28.8	57.5	36.8	31.4	31.9	29.2
	3	44.2	31.7	23.8	31.7	25.6	49.7	23.9	47.1	49.9	43.6	27.9	38.4	33.7	62.3	45.2	42.5	42.7	32.1
	4	48.3	32.5	24.8	33.5	28.4	51.6	28.0	50.1	51.5	43.3	31.9	41.1		62.2	43.7	46.5	46.8	38.7
	5	54.8	35.8	25.2	33.8	29.6	53.9	31.3	52.1	55.6	45.7	35.6	42.9	37.4	63.2	49.0	54.7	52.3	41.1

	Mean	36.4	25.8	20.6	27.9	22.9	44.9	20.8	43.6	46.2	39.4	24.2	34.7	29.8	59.7	40.6	40.8	40.6	43.6
Rock Bass	6	67.1	64.9	55.9	57.4	60.4	44.9	66.8	43.9	42.1	40.5	57.4	47.9	53.6	23.3	45.2			35.1
	1	58.2	63.4	59.6	54.3	62.0	38.1	67.3	39.4	34.8	37.7	58.0	48.4	54.3	18.1	38.3	48.8	45.0	50.3
	2	47.7	61.5	58.5	51.9	60.8	34.3	67.4	37.1	25.3	33.9	53.8	45.8	50.8	19.2	38.0	44.9	43.0	48.0
	3	29.4	49.3	55.6	45.2	53.1	25.7	56.8	30.9	24.9	29.4	47.8	42.9	49.1	13.7	29.0	34.1	36.5	45.4
	4	25.9	48.3	55.0	41.9	50.1	23.1	53.1	27.8	23.3	30.0	43.5	38.6		16.2	32.1	30.1	34.1	39.0
	5	20.2	44.9	53.8	42.2	48.8	20.5	48.4	25.9	18.9	26.9	40.4	38.4	43.9	14.9	26.7	21.2	28.9	36.5
	Mean	41.4	55.4	56.4	48.8	55.9	31.1	60.0	34.2	28.2	33.1	50.2	43.7	50.3	17.6	34.9	35.8	37.5	34.0
White Sucker	6	70.5	57.7	47.9	52.2	50.5	69.2	51.1	59.1	69.0	57.1	52.3	54.7	56.2	43.5	59.9			42.1
	1	73.3	62.4	54.4	57.2	56.5	67.4	60.2	57.9	66.1	55.5	57.5	56.1	58.4	38.1	58.2	66.7	60.3	55.7
	2	67.9	66.2	58.1	59.2	57.8	66.2	64.3	56.9	58.3	52.8	61.7	55.4	61.1	35.8	57.6	64.1	59.3	58.3
	3	59.7	68.0	63.5	61.3	65.0	59.3	69.4	53.9	58.3	49.7	62.7	56.1	61.6	32.2	55.3	58.5	54.7	58.4
	4	56.9	68.0	64.8	58.7	68.1	57.4	67.7	51.3	57.2	50.0	62.7	57.0		33.6	54.8	54.0	49.7	58.1
	5	51.6	66.4	65.1	58.7	66.5	54.4	67.1	49.3	52.3	47.1	59.1	55.0	61.6	33.4	53.8	49.0	46.1	57.0
	Mean	63.3	64.8	59.0	57.9	60.7	62.3	63.3	54.7	60.2	52.0	59.3	55.7	59.8	36.1	56.6	58.5	54.0	55.3

Percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (%>UILT)																			
		Year																	
Species	Station	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Black-nose Dace	6	0.0	0.5	5.8	0.0	3.3	0.0	0.6	1.0	0.0	4.7	2.2	4.3	2.0	0.0	0.0			1.7
	1	0.0	0.0	2.5	0.0	1.9	0.0	0.0	0.4	0.0	3.8	0.3	2.3	1.5	0.0	0.0	0.0	2.0	0.9
	2	0.0	0.0	1.2	0.0	1.6	0.0	0.0	0.2	0.0	2.8	0.0	1.4	1.0	0.0	0.0	0.0	1.6	0.6
	3	0.0	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.0	1.9	0.0	0.3	0.6	0.0	0.0	0.0	1.1	0.3
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0		0.0	0.0	0.0	0.8	0.2
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.1
	Mean	0.0	0.1	1.6	0.0	1.2	0.0	0.1	0.3	0.0	2.8	0.4	1.4	1.0	0.0	0.0	0.0	1.2	0.6
Blunt-nose Minnow	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brook Trout	6	25.9	41.1	50.6	33.0	43.4	10.6	49.4	17.8	9.9	18.4	42.0	33.6	33.7	7.9	17.7			29.2
	1	15.3	33.9	41.8	23.5	35.5	5.9	37.5	13.6	7.1	15.9	34.5	27.7	29.1	4.9	11.6	17.1	25.4	22.8
	2	9.6	28.1	34.7	19.7	32.4	3.4	32.2	10.8	5.0	13.9	26.3	24.4	23.7	3.5	11.2	15.5	23.7	19.3
	3	5.4	11.9	24.3	11.8	20.6	1.2	16.1	7.3	4.8	11.5	17.8	17.1	19.3	3.1	7.2	9.8	17.8	12.6
	4	4.6	10.3	22.3	8.5	14.6	0.4	13.8	5.1	4.5	11.5	12.4	13.1		3.4	7.0	6.8	15.4	9.9
	5	3.3	7.6	20.3	9.3	15.7	0.1	11.0	4.1	3.9	10.5	11.2	13.3	13.0	2.9	5.3	4.5	13.3	9.1
	Mean	10.7	22.2	32.3	17.6	27.0	3.6	26.7	9.8	5.9	13.6	24.0	21.5	23.8	4.3	10.0	10.7	19.1	17.0
Brown Trout	6	23.8	39.8	49.2	31.4	41.7	9.2	47.4	16.7	9.1	17.7	40.6	32.0	31.7	7.0	15.6			27.8
	1	14.0	32.1	39.9	22.1	33.6	5.3	35.5	12.9	6.5	15.4	32.9	26.6	27.5	4.9	11.6	17.1	25.4	21.8
	2	9.0	26.3	32.9	18.2	31.1	2.8	30.7	9.7	4.6	13.1	24.7	23.6	22.5	3.5	10.0	13.9	21.6	18.1
	3	4.8	10.6	23.1	10.0	18.8	0.8	14.4	6.4	4.4	11.2	16.5	16.3	18.4	2.2	5.3	7.0	14.8	11.3
	4	4.1	9.3	20.5	7.3	13.2	0.2	12.5	4.5	4.3	11.3	11.0	12.4		2.9	6.0	5.6	14.2	9.0
	5	2.5	6.7	18.6	7.8	14.2	0.0	9.8	3.7	3.4	10.1	10.3	12.5	12.1	2.8	4.8	4.5	13.3	8.4

	Mean	9.7	20.8	30.7	16.1	25.4	3.1	25.1	9.0	5.4	13.1	22.7	20.6	22.4	3.9	8.9	9.6	17.9	15.9
Common Shiner	6	0.0	0.0	0.7	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.5	0.0	0.0			0.2
	1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0
Creek Chub	6	0.0	0.1	3.9	0.0	2.3	0.0	0.0	0.6	0.0	3.6	0.6	2.9	1.5	0.0	0.0			1.1
	1	0.0	0.0	1.3	0.0	1.2	0.0	0.0	0.0	0.0	2.5	0.2	1.2	0.9	0.0	0.0	0.0	1.0	0.5
	2	0.0	0.0	0.7	0.0	0.6	0.0	0.0	0.0	0.0	2.0	0.0	0.4	0.4	0.0	0.0	0.0	0.9	0.3
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.1	0.0	0.0	0.0	0.7	0.1
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0		0.0	0.0	0.0	0.4	0.1
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	1.0	0.0	0.7	0.0	0.0	0.1	0.0	1.9	0.1	0.8	0.6	0.0	0.0	0.0	0.6	0.4
Large-mouth Bass	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pumpkin-seed	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rock Bass	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Sucker	6	1.0	2.1	10.6	0.6	6.0	0.0	4.9	2.0	0.0	5.7	6.5	7.3	4.3	0.0	0.4			3.6
	1	0.2	0.9	5.6	0.1	3.7	0.0	0.7	1.1	0.0	5.0	3.4	4.7	2.9	0.0	0.0	0.3	3.8	2.0
	2	0.0	0.3	3.6	0.0	3.2	0.0	0.0	0.8	0.0	4.6	1.2	3.5	2.0	0.0	0.0	0.2	3.1	1.4
	3	0.0	0.0	1.0	0.0	1.9	0.0	0.0	0.1	0.0	3.8	0.2	1.0	1.3	0.0	0.0	0.0	2.2	0.7
	4	0.0	0.0	0.8	0.0	0.5	0.0	0.0	0.0	0.0	3.8	0.0	0.5		0.0	0.0	0.0	1.7	0.5
	5	0.0	0.0	0.5	0.0	1.4	0.0	0.0	0.0	0.0	3.0	0.0	0.5	0.6	0.0	0.0	0.0	1.4	0.5
	Mean	0.2	0.6	3.7	0.1	2.8	0.0	0.9	0.7	0.0	4.3	1.9	2.9	2.2	0.0	0.1	0.1	2.4	1.4

Percent of temperature measurements that exceed the critical thermal maximum temperature (%>Ctmax)																			
		Year																	
Species	Station	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Black-nose Dace	6	0.0	0.0	1.0	0.0	0.4	0.0	0.0	0.0	0.0	1.7	0.1	0.3	0.7	0.0	0.0			0.3
	1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.1
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1
Blunt-nose Minnow	6	0.0	0.0	1.5	0.0	0.8	0.0	0.0	0.0	0.0	2.1	0.2	0.9	0.8	0.0	0.0			0.5
	1	0.0	0.0	0.4	0.0	0.1	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.4	0.0	0.0	0.0	0.5	0.2
	2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.7	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.1
Brook Trout	6	0.0	0.0	3.2	0.0	2.0	0.0	0.0	0.4	0.0	3.3	0.4	2.3	1.3	0.0	0.0			0.9
	1	0.0	0.0	1.0	0.0	0.8	0.0	0.0	0.0	0.0	2.2	0.2	0.6	0.9	0.0	0.0	0.0	1.0	0.4
	2	0.0	0.0	0.5	0.0	0.4	0.0	0.0	0.0	0.0	1.7	0.0	0.4	0.4	0.0	0.0	0.0	0.8	0.3
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0		0.0	0.0	0.0	0.1	0.1
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.8	0.0	0.5	0.0	0.0	0.1	0.0	1.6	0.1	0.6	0.5	0.0	0.0	0.0	0.4	0.3
Brown Trout	6	0.3	0.8	7.1	0.0	4.0	0.0	1.8	1.3	0.0	5.0	3.8	5.2	2.6	0.0	0.0			2.3
	1	0.0	0.3	3.4	0.0	2.5	0.0	0.0	0.6	0.0	4.4	1.2	3.1	1.8	0.0	0.0	0.0	3.1	1.3
	2	0.0	0.0	1.8	0.0	2.0	0.0	0.0	0.5	0.0	3.7	0.2	2.2	1.4	0.0	0.0	0.0	2.2	0.9
	3	0.0	0.0	0.5	0.0	1.0	0.0	0.0	0.0	0.0	2.5	0.0	0.4	0.8	0.0	0.0	0.0	1.1	0.4
	4	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.3		0.0	0.0	0.0	1.2	0.3
	5	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.0	2.0	0.0	0.1	0.2	0.0	0.0	0.0	1.0	0.2

	Mean	0.1	0.2	2.2	0.0	1.7	0.0	0.3	0.4	0.0	3.3	0.9	1.9	1.4	0.0	0.0	0.0	1.7	0.9
Common Shiner	6	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Creek Chub	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Large-mouth Bass	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pumpkin-seed	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Darter	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rock Bass	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Sucker	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX H

Biological Monitoring

GUIDING SOLUTIONS IN THE
NATURAL ENVIRONMENT

2022 Biological Monitoring Program
Blue Triton Brands
Aberfoyle Property

Prepared For:

Blue Triton Brands

Prepared By:

Beacon Environmental Limited

Date:	*Project:*
February 2023	**216114.1**

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Figures

Tables

Appendices

1. Introduction

Beacon Environmental Limited (Beacon) and C. Portt and Associates were retained by Blue Triton Brands to undertake terrestrial and aquatic monitoring at the company's Aberfoyle property located at 101 Brock Road South in the Township of Puslinch (**Figure 1**). A Site Context Map is included as **Figure 2**. The biological monitoring program for the property was initiated in 2007 as a condition of a Ministry of Environment, Conservation and Parks (MECP) Permit to Take Water (PTTW) (#7043-74BL3K) for the onsite wells that service their bottling operations. Biological monitoring remains a condition of the current PTTW (#3133-C5BUH9).

Condition 4.4 of the PTTW states:

> *The Permit Holder shall undertake wetland monitoring and redd surveys as recommended in "2010 Biological Monitoring Program Final Report" by C. Portt and Associates* dated January 28, 2011. Results from the wetland and redd surveys shall be submitted to the Director as a part of the annual monitoring report…*
>
> *Note: Authorship of the 2010 report should be attributed to Dougan & Associates and C. Portt and Associates.

The objectives of the biological monitoring program are to:

- Characterize existing aquatic, wetland and terrestrial resources; and
- Document potential long-term changes to the site's biological resources.

Existing or baseline biological conditions on the Aberfoyle property were established through surveys and inventories completed between 2007 and 2009 which fulfilled the first objective. To achieve the second objective, there has been ongoing biological monitoring with annual reports submitted to the MECP as per the PTTW conditions. The type and frequency of biological monitoring is variable and based on the recommendations provided in each year's annual monitoring report.

Between 2007 and 2022, biological monitoring has included the following:

- Electrofishing surveys of Aberfoyle Creek; [C. Portt & Associates];
- Salmonid spawning (redd) surveys of Aberfoyle Creek; [C. Portt & Associates];
- Ecological Land Classification (ELC);
- Vascular plant surveys;
- Permanent vegetation monitoring plot surveys;
- Amphibian call surveys;
- Breeding bird surveys;
- Odonate (dragonfly/damselfly) surveys;
- Owl surveys;
- Turtle surveys;
- Marsh surveys (assessment of surface hydrology); and
- Invasive species mapping - Common Reed.

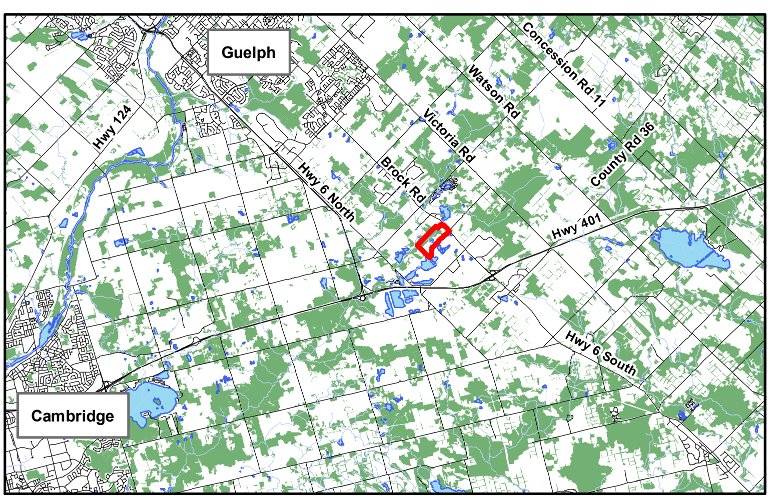
Biological monitoring completed on the property between 2007 and 2022 is summarized in **Table 1**.

Table 1. Summary of Biological Monitoring Program (2007-2022)

Year	Aquatic			Vegetation				Wildlife				
	Electrofishing	Habitat characterization	Spawning (*i.e.* Redd) surveys	Ecological Land Classification (ELC) mapping	Vegetation plot sampling	Marsh surveys	Invasive species mapping	Nocturnal amphibian call monitoring	Breeding bird surveys	Owl surveys	Basking Turtle surveys	Odonate surveys
2007			X	X								
2008	X		X	X	X			X	X			
2009		X	X	X		X	X	X	X			
2010			X		X	X	X	X	X	X	X	X
2011			X			X	X	X	X	X	X	X
2012			X								X	X
2013			X		X	X	X					
2014			X		X							
2015			X					X	X		X	
2016			X		X		X	X	X		X	
2017			X				X	X	X		X	
2018			X					X	X		X	
2019			X	X	X			X	X		X	
2020			X					X	X		X	
2021			X					X	X		X	
2022			X					X	X		X	

The 2021 Aberfoyle Biological Monitoring Program Report (Beacon 2022) recommended that core wildlife monitoring (amphibian, reptiles and birds) be completed in 2022. Additionally, it recommended salmonid spawning surveys in Aberfoyle Creek will be conducted as required in 2022 by C. Portt and Associates. The recommended biological monitoring was completed in 2022. Beacon completed core wildlife monitoring and C. Portt and Associates completed salmonid spawning (redd) surveys of Aberfoyle Creek.

This annual report includes a comprehensive summary of the biological monitoring program and data collected between 2007 and 2022. The report describes the methods and findings of the various monitoring activities and compares data from prior years to identify potential changes or trends in selected monitoring parameter or indicators over the long term.



Site Location	Figure 1
Aberfoyle 2022 Biological Monitoring Program	
BEACON ENVIRONMENTAL	Project: 216114.1 Last Revised: January 2023
Client: Blue Triton Brands	Prepared by: SZ Checked by: KU
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Site Context

Figure 2

Aberfoyle 2022 Biological Monitoring Program

Legend

- Subject Property
- Wetlands
- Watercourse

BEACON ENVIRONMENTAL

Project: 216114.1

Last Revised: January 2023

Client: Blue Triton Brands

Prepared by: SZ
Checked by: KU

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2. Methods

2.1 Aquatic Survey

C. Portt and Associates has surveyed Aberfoyle Creek for evidence of Brown Trout (*Salmo trutta*) or Brook Trout (*Salvelinus fontinalis*) spawning, from its confluence with Mill Creek upstream to the limit of the Blue Triton Brands property (**Figure 2**) annually, beginning in 2007. In 2022, the surveys were conducted on November 2 and November 15. On these dates, this entire reach of the creek was walked and searched for spawning fish or areas of disturbed substrate that could be indicative of salmonid spawning.

2.2 Vegetation Surveys

2.2.1 Ecological Land Classification

Ecological communities associated with the subject property were classified in accordance with the Ecological Land Classification System for Southern Ontario (ELC) (Lee *et al*. 1998). ELC is the provincial standard for classifying ecological communities. Ecological communities are classified based on their biophysical parameters such as vegetation composition and structure as well as physical site conditions such as topography, slope, soil, moisture and drainage. Information on these parameters is collected from each polygon to confirm the appropriate classification using the ELC community catalogue.

Ecological communities were initially described and mapped by Dougan & Associates in the fall 2007. As the mapping was more than ten years old, Beacon reviewed the boundaries of the various ecological communities on July 23, 2019, to confirm their classifications, adjust boundaries and update the mapping where necessary.

ELC classification and mapping is generally conducted only once a decade as the rate of vegetation change is relatively slow and was therefore not repeated in 2022.

2.2.2 Floristic Surveys

A floristic survey of the property was initially completed by Dougan & Associates in the fall of 2007 to establish baseline conditions and develop a checklist of vascular plants for the subject property. The checklist has been variably amended over the years based on data collected from the vegetation plots and incidental observations. To update this checklist, Beacon completed a floristic survey of the subject property on July 23, 2019.

Floristic surveys are generally completed every five to ten years as the rate of vegetation change is relatively slow and were therefore not repeated in 2022.

2.2.3 Vegetation Plot Sampling

To monitor changes to vegetation resources on the property over time, six permanent vegetation sampling plots were established in 2007 in representative wetland communities. The UTM coordinates for each plot in NAD83 are provided in **Table 2** and mapped on **Figure 3**.

Table 2. Locations of Permanent Vegetation Monitoring Plots

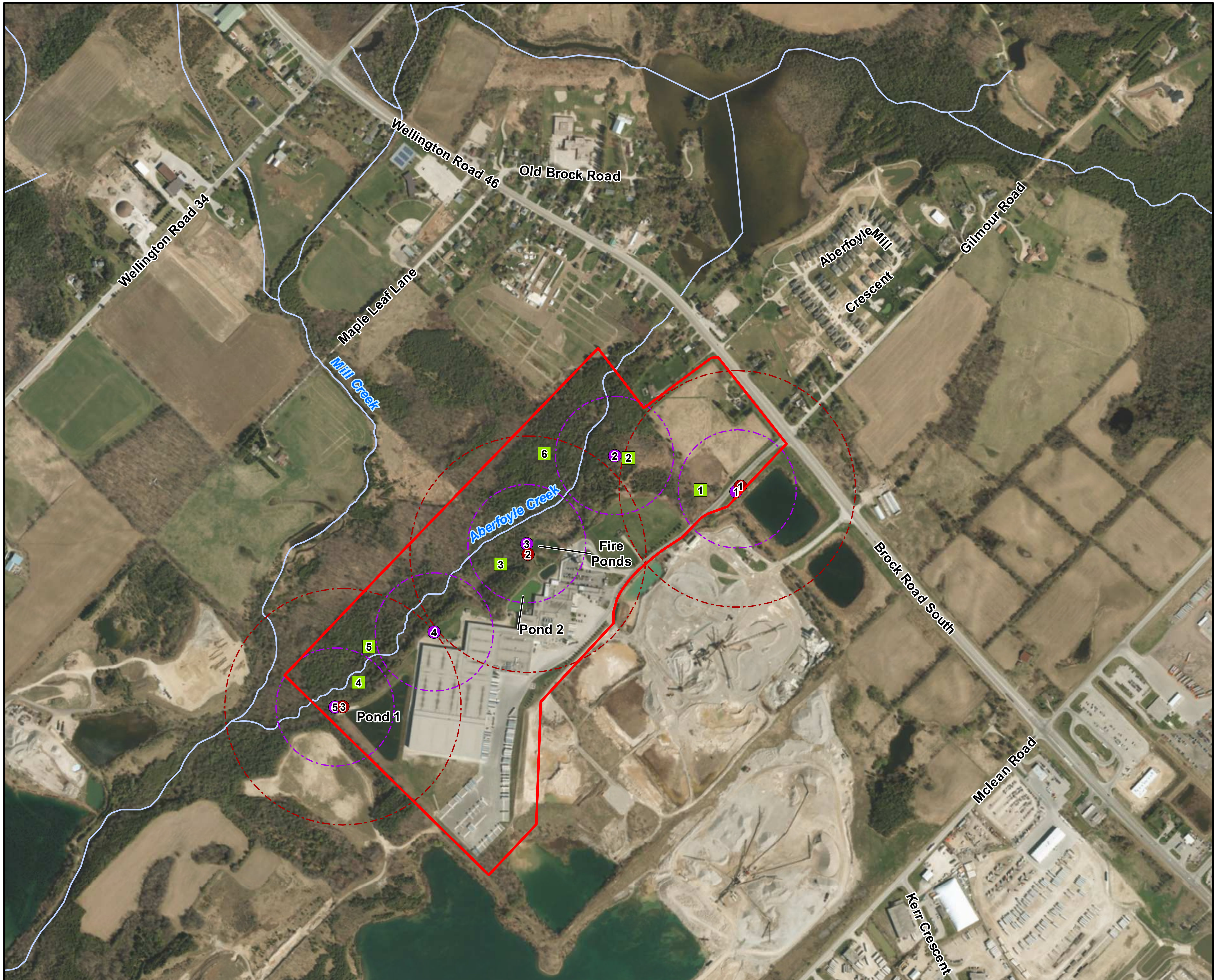
Plot No.	UTM Zone	UTM Easting	UTM Northing
1	17T	569227	4812889
2	17T	569075	4812948
3	17T	568804	4812731
4	17T	568500	4812482
5	17T	568500	4812482
6	17T	568892	4812956

The vegetation plots are circular and 100 m^2 in area. The centre of each plot is marked with a steel T-bar. The plots were sampled in the summers of 2008, 2010, 2013, 2014, 2017 and 2019. No plot sampling occurred in 2022. A handheld GPS is used to locate the plots. The outer boundaries of each sample plot were delineated by attaching a 5.64 m length of rope to the T-bar centre post and temporarily marking the plot perimeter with flagging tape Within each sampling plot, information is collected on the composition and structure of the vegetation, by estimating the cover abundance at various height classes.

Vegetation data collection methods follow the standardized vegetation sampling protocols of the Ecological Land Classification System (ELC) for Southern Ontario (Lee *et al*. 1998). Within each plot, all observed species are documented, and the percent cover estimated by assigning a cover value of 1-4 (1) <10%; 2) 10-25%; 3) 25-60%; and 4) >60%) to each species for each vegetation layer it occurs in. Vegetation layers corresponded with the following height classes 1) <0.5 m; 2) 0.5-2 m; 3) 2-10 m, and 4) >10 m).

As in previous sampling years, vegetation plot data was subjected to a Floristic Quality Assessment (FQA) and provides a metric for monitoring change over time (Oldham *et al*., 1995). The FQA is determined from total number of species (species richness) in a given area (e.g. sampling plot) and summing their conservatism values. Species conservatism is considered a measure of "*the degree of faithfulness a plant displays to a specific habitat or set of environmental conditions*" (Oldham *et al*., 1995). More conservative species display a higher degree of fidelity to particular habitats or ecological conditions and are relatively intolerant of disturbance. Less conservative species tend to be habitat generalists and more tolerant of disturbance. In Ontario, plant species have been assigned a coefficient of conservatism value (CC) value ranging from 0-10. A description of how these values were assigned is provided below:

- 0-3: Species found in a wide variety of habitats including disturbed sites;
- 4-6: Species found in specific habitats, but tolerate moderate disturbance;
- 7-8: Species found in advanced successional communities with minor disturbance; or
- 9-10: Species found in high quality natural areas and/or limited to a narrow range of environmental conditions.



Monitoring Stations and Survey Locations

Figure 3

Aberfoyle 2022 Biological Monitoring Program

Legend

- Subject Property
- Watercourse
- Vegetation Monitoring Station
- Amphibian Call Monitoring Station (with 250 m radius)
- Breeding Bird Monitoring Station (with 125 m radius)

Note: Basking Turtle Surveys were conducted at Pond 1, Pond 2 and the Fire Ponds

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The FQA is used to establish a Floristic Quality Index (FQI) value. Generally speaking, higher FQI values are indicative of higher floristic quality and lower levels of disturbance, whereas lower FQI values indicate poorer quality and higher disturbance. FQI values were determined for each of the six monitoring plots by calculating the mean CC for each plot and multiplying it by the square root of the total number of species. FQI values were calculated using both the total number of species per plot and for native species only. The FQI values were then used to compare changes over time both within and among vegetation plots.

In addition to the FQI, a Wetness Index was also calculated for each plot and the site as a whole. Each plant species in Ontario has been assigned a Coefficient of Wetness (CW) based on their probability of occurring in wetlands. CW values range from -5 to 5. Species with negative CW values favour wetter conditions and typically occur in wetlands; species with positive CW values prefer drier conditions and tend to occur in uplands. The Wetness Index is calculated by averaging the CW values of each species observed in the plot. A Wetness Index for the site was obtained by averaging the CW of each plot. The wetness index could potentially be used as an indicator of hydrological changes.

The 2020 monitoring report recommended vegetation plot sampling resume in 2022, however as the rate of observed vegetation change is relatively slow, it is recommended that this sampling occur in 2024 instead.

2.2.4 Marsh Vegetation Surveys

Marsh surveys were undertaken by Dougan & Associates in 2009, 2010, 2011 and 2013. The purpose of these surveys was to check moisture levels and to confirm these classifications of ELC communities. This was done by determining the approximate depth of standing water (if present) versus the presence of saturated soil, moist soil or dry soil. This level of detail is sufficient to differentiate a Shallow Marsh and a Meadow Marsh within the ELC system (Lee *et al.* 1998). A key difference between the two communities is the presence of standing water for much or all of the growing season within a Shallow Marsh compared to the seasonally flooded meadow marsh. However, this level of detail is not sufficient for correlating long term trends with any degree of certainty, as moisture levels in wetlands vary seasonally and annually depending on factors such as precipitation, average temperature, etc. For these reasons, the marsh surveys have not been repeated.

2.2.5 Invasive Species Mapping

There are several colonies of Common Reed (*Phragmites australis*) present on the subject property. Common Reed is a highly invasive non-native plant species that is known to displace native wetland vegetation. Since 2007, the colonies on the property have been observed to be expanding. Colonies of Common Reed were originally mapped in several locations on the property in 2009, 2010, 2011, and 2013 by Dougan & Associates to track changes in the size of the colonies. The edges of the colonies were mapped using a high-resolution GPS. The Common Reed colonies were re-surveyed and mapped again by Beacon in 2016 and 2017 using an RTK (Real-Time-Kinematic) GPS to facilitate comparison with prior years. The Common Reed colonies were not surveyed in 2022.

Common Reed is ubiquitous in the adjacent landscape. It is prevalent in roadside ditches next to the property and is also present on neighbouring properties. The species is very difficult to control. The most effective control method is chemical treatment using herbicide. While such treatments are considered safe and pose minimal risk to the environment when appropriately applied, Blue Triton

Brands has elected not to implement a treatment program due to the proximity of the colonies to the production well (TW3-80). Common Reed will continue to be monitored and alternative management approaches researched to inform potential future management actions.

2.3 Wildlife Surveys

2.3.1 Amphibian Surveys

Amphibian call surveys were undertaken to estimate the species richness, abundance, and location of frog and toad populations associated with the subject property. Because there is variation in the breeding periods during which different frog or toad species (anurans) are calling and detectable, surveys were completed at three different periods between April and June to ensure coverage of the full range of early to late breeding species. These surveys were conducted by Dougan and Associates in 2008, 2009, 2010 and 2011, and then by Beacon annually between 2015 and 2022.

In 2022, Beacon conducted surveys on April 25, May 11, and June 24 using the survey protocols developed for the Marsh Monitoring Program (MMP) (Bird Studies Canada, 2009). On each occasion the subject property was visited at least 0.5 hours after sunset during suitable weather conditions to listen for calling frogs and toads at three (3) permanent monitoring stations that were established in 2008. The locations of these monitoring stations are illustrated in **Figure 3**. Amphibians observed or heard calling in other locations on the property during these and other surveys were also recorded as incidental observations.

Surveys were conducted using the point count method whereby the surveyor stands at a set point or station for a specific period of time and records all species that can be heard calling within the sample area. A minimum of three minutes was spent listening at each station. The approximate locations of calling amphibians were noted on a standard MMP data sheet and chorus activity for each species was assigned a call code as follows:

- 0 - No calls;
- 1 - Individuals of one species can be counted, calls not simultaneous;
- 2 - Calls of one species simultaneous, numbers can be reliably estimated; or
- 3 - Full chorus, calls continuous and overlapping, individuals indistinguishable.

In addition to recording species and call levels, weather conditions (i.e., air temperature, precipitation, wind speed, and cloud cover) at the time of survey were also recorded. Weather conditions for the 2022 surveys are summarized in **Table 3**.

Table 3. Amphibian Survey Details

	Survey 1	Survey 2	Survey 3
Date:	April 25, 2022	May 11, 2022	June 24, 2022
Start time:	8:45 pm	9:05 pm	9:35 pm
Temperature:	11°C	20°C	25°C
Wind speed:	3 – 5 km/h	3 – 5 km/h	6 - 11 km/h
Cloud cover:	100%	10%	0%
Precipitation:	Drizzle	None	None

2.3.2 Breeding Bird Surveys

Breeding bird surveys were undertaken in 2022 by Beacon to document the diversity and abundance of avian populations associated with the subject property. Previous surveys were completed in 2008, 2009, 2010 and 2011 by Dougan & Associates. Beacon completed surveys annually between 2015 and 2022.

There are five permanent point count stations that were established in 2008 that provide coverage for the majority of the property. Each point count station is positioned so the observer can detect calling birds up to a distance of 125 m. The locations of the point count stations are illustrated in **Figure 3**. A handheld GPS was used to locate the plots.

A modified point count methodology, based on protocols established for the Ontario Breeding Bird Atlas for point counts (Cadman *et al.* 2007), Forest Bird Monitoring Program (CWS, 2006) and a standard method recommended for monitoring songbird populations in the Great Lakes Region (Howe *et al.* 1997), was utilized to complete breeding bird surveys. The following is a detailed description of the modified approach utilized to complete these surveys:

- Surveys should be conducted a minimum of one week apart (CWS 2006);
- Point count stations will be at least 250 m apart (Howe *et al.* 1997 & CWS 2006);
- Since the Blue Triton Brands property in Aberfoyle is relatively small, a randomized site selection approach will not be required. The majority of natural features on the site are covered by the five- point count station survey areas;
- Survey duration for each point count is 10 minutes, consistent with the Forest Bird Monitoring Program (CWS 2006) and Howe *et al.* (1997) and is not restricted to forested habitats;
- The location of each individual adult bird is recorded on a field sheet as per the layout and symbols used by the Forest Bird Mapping Protocol (CWS 2006) or Howe *et al.* (1997). Bird flying overhead (i.e., not directly associating with the survey area) or otherwise not showing any breeding evidence will be distinguished from the other breeding birds;
- Observations recorded on the field maps are transferred into a summary table. All birds observed or heard within suitable habitat are assumed to be breeding; and
- Breeding evidence is documented according to the Ontario Breeding Bird Atlas protocols (Cadman *et al.* 2007).

Birds observed between the point count surveys are noted separately on a field map to help ensure that no bird species present on the property are missed as the point count circles do not cover the entire property.

Weather conditions (i.e., air temperature, precipitation, wind speed, and cloud cover) at the time of survey were recorded (see **Table 4**).

Table 4. Breeding Bird Survey Details

	Survey 1	Survey 2
Date:	June 9, 2022	June 20, 2022
Start time:	6:46 am	6:35 am
End Time:	8:12 am	8:00 am
Temp:	12°C	14°C
Wind:	1 - 6 km/h	1 – 6 km/h
Cloud cover:	100%	100%
Precipitation:	None	None

2.3.3 Owl Surveys

Owl surveys were not part of the original biological monitoring program, however in August 2009, Barred Owl (*Strix varia*) was reported from the northeast portion of the subject property by Dougan & Associates. To confirm this record, two surveys were completed in 2010 and an additional survey was completed in 2011. The survey consisted of broadcasting Barred Owl calls using a portable compact disc (CD) player. In 2011, Northern Saw-whet Owl (*Aegolius acadicus*) calls were also broadcast prior to the Barred Owl calls. A period of silence was included following each series of calls to allow the surveyor to listen for a response. The surveys were completed from two stations in forested habitats in the vicinity of the original observation. No additional owl surveys have been undertaken since 2011.

2.3.4 Basking Turtle Survey

The ponds on the subject property are known to support populations of Midland Painted Turtle (*Chrysemys picta marginata*) and Snapping Turtle (*Chelydra serpentina*).

Midland Painted Turtle is listed federally as a Special Concern species. Snapping Turtle is listed both federally and provincially as a Special Concern species. Snapping Turtle was originally observed in the large pond near the western property boundary in 2008, which is labelled as Pond 1 on **Figure 3**.

To monitor populations of turtles, basking surveys were completed by Dougan & Associates annually between 2010 and 2012, and by Beacon annually between 2015 and 2022.

In 2022, basking turtle surveys on the property were primarily focused on Pond 1; brief surveys of the other ponds were also completed. The surveys consist of slowly walking along the outer edge of the ponds using binoculars to scan the perimeter and other potential basking sites within the pond. Surveys were completed in mid-May and mid-September between 8:00 am and 5:00 pm during sunny periods when the air temperature was greater than water temperature and after inclement weather. Surveys, including weather conditions, are included in **Table 5**.

Table 5. Basking Turtle Survey Details

	Survey 1	Survey 2	Survey 3
Date:	May 5, 2022	May 24, 2022	September 20, 2022
Start time:	10:40 am	11:00 am	10:45 am
End time:	12:10 pm	12:30 pm	12:00 pm
Temp:	13°C	16°C	18 °C
Wind Speed:	6-11 km/h	1 – 6 km/h	1-6 km/h
Cloud cover:	15%	10%	60%
Precipitation:	None	None	None

2.3.5 Odonate Surveys

While not included in the original monitoring program, it was felt that baseline surveys for dragonflies and damselfly surveys could be used to supplement the baseline biological data available for the site. In 2010, 2011 and 2012, Dougan & Associates conducted odonate surveys for select habitats on the subject property, while in 2009 they were recorded incidentally. Surveys were informally conducted during ideal weather conditions simultaneously to turtle basking surveys using a net. Any individuals caught were immediately examined with a 10x (power) hands lens and then released following identification. No individuals were collected, and no microscopic analysis was conducted. When needed, identifications were confirmed using Jones (2008) and Lam (2004). The surveys were brief, and the findings were not considered a comprehensive list of species potentially present. No additional odonate surveys have been undertaken since 2012.

2.3.6 Other Wildlife Observations

Other wildlife species observations and habitat encountered over the course of the 2022 field season were recorded as incidental observations. When encountered, the species and locations of the wildlife were noted.

3. Results

3.1 Aquatic Survey

No evidence of salmonid spawning was observed along Aberfoyle Creek on the subject property in 2022. This is consistent with the findings of previous surveys completed annually from 2007 through 2021.

3.2 Vegetation Surveys

No vegetation surveys were conducted in 2022. The discussion presented below provides a summary of previous surveys. It is expected that vegetation plot sampling surveys will be conducted again in 2024 and floristic and ELC surveys will be conducted in 2028.

3.2.1 Ecological Land Classification Mapping

No significant changes to any of the ecological communities were observed during the 2019 review, however minor adjustments were made to the boundaries of several communities. The changes are as follows:

- ELC unit 22 changed from Cultural Woodland (CUW1) to Fresh-Moist White Cedar Coniferous Forest (FOC 4-1) due to increased size and dominance of Eastern White Cedar; and
- ELC Unit 11 changed from Mineral Meadow Marsh (MAM2) to Cattail Mineral Shallow Marsh/Reed Canary Grass Mineral Meadow Marsh (MAS2-1/MAM2-2) due to a shift in dominance of cattails and reed canary grass.

The revised ELC mapping is presented in **Figure 4** and a table summarizing the various ecological communities in presented in **Appendix A**.

3.2.2 Flora

Floristic surveys completed between 2007 and 2019 have documented a total of 255 vascular plant species. Of these, 242 have been determined to the species level and 13 could only be determined to genus for various reasons. An updated checklist is provided in **Appendix B.** Of the species identified, 56 are considered non-native to Ontario and represents 23% of the total site flora. Native species are ranked S4 or S5 by the NHIC, indicating that they are generally common and secure in Ontario.

Two regionally rare and six regionally uncommon species have been documented on the subject property, which are summarized in **Table 6**.

Table 6. Regionally Rare and Uncommon Plants Species

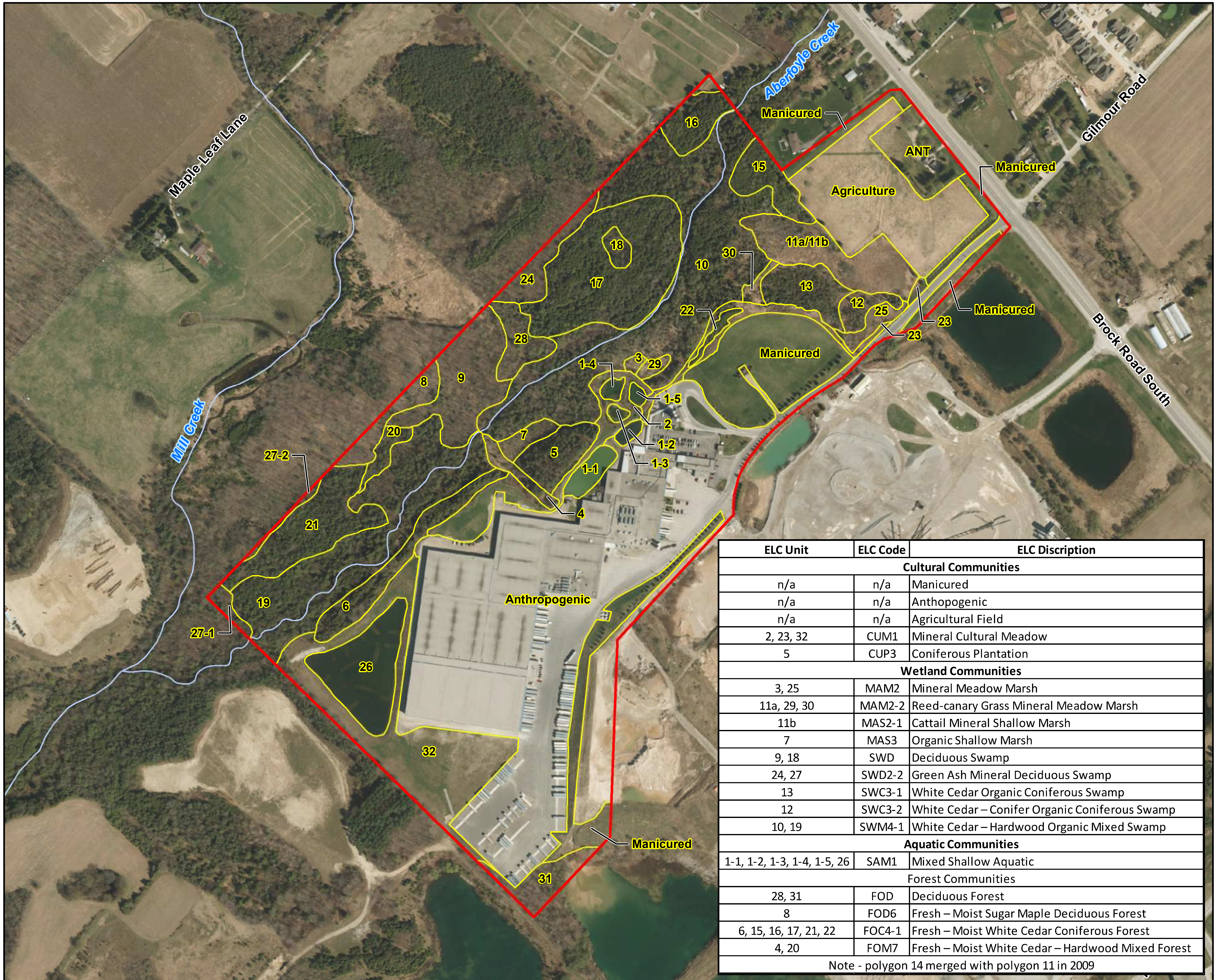
Scientific Name	Common Name	Region Status[1]
Asplenium platyneuron	Ebony Spleenwort	Rare
Brachyelytrum erectum	Long-awned Wood Grass	Rare
Symphyotrichum urophyllum	Arrow-leaved Aster	Uncommon
Cardamine pensylvanica	Pennsylvania Bitter-cress	Uncommon
Equisetum sylvaticum	Woodland Horsetail	Uncommon
Cinna latifolia	Slender Wood Reedgrass	Uncommon
Ranunculus pensylvanicus	Bristly Crowfoot	Uncommon
Symphyotrichum pilosum	Frost Aster	Uncommon

[1]Draft Wellington Country Vascular Plant List (Cecile 2017)

ELC Vegetation Communities

Figure 4

Aberfoyle 2022 Biological Monitoring Program



ELC Unit	ELC Code	ELC Discription
Cultural Communities		
n/a	n/a	Manicured
n/a	n/a	Anthopogenic
n/a	n/a	Agricultural Field
2, 23, 32	CUM1	Mineral Cultural Meadow
5	CUP3	Coniferous Plantation
Wetland Communities		
3, 25	MAM2	Mineral Meadow Marsh
11a, 29, 30	MAM2-2	Reed-canary Grass Mineral Meadow Marsh
11b	MAS2-1	Cattail Mineral Shallow Marsh
7	MAS3	Organic Shallow Marsh
9, 18	SWD	Deciduous Swamp
24, 27	SWD2-2	Green Ash Mineral Deciduous Swamp
13	SWC3-1	White Cedar Organic Coniferous Swamp
12	SWC3-2	White Cedar – Conifer Organic Coniferous Swamp
10, 19	SWM4-1	White Cedar – Hardwood Organic Mixed Swamp
Aquatic Communities		
1-1, 1-2, 1-3, 1-4, 1-5, 26	SAM1	Mixed Shallow Aquatic
Forest Communities		
28, 31	FOD	Deciduous Forest
8	FOD6	Fresh – Moist Sugar Maple Deciduous Forest
6, 15, 16, 17, 21, 22	FOC4-1	Fresh – Moist White Cedar Coniferous Forest
4, 20	FOM7	Fresh – Moist White Cedar – Hardwood Mixed Forest
Note - polygon 14 merged with polygon 11 in 2009		

Legend

- Subject Property
- ELC Communities
- Watercourse

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Project: 216114.1

Last Revised: January 2023

Client: Blue Triton Brands

Prepared by: SZ
Checked by: KU

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3.2.3 Vegetation Plot Sampling

A total of 115 plants were recorded from the six vegetation plots in 2019, including five that were identified to genus. Of the 110 species identified, 85 (85%) are native, and 16 (15%) are considered non-native in Ontario. The proportion of native/non-native is similar to previous years with 88% native in 2008, 87% in 2010, 85% in 2013, 87% in 2014, and 92% in 2016. **Photograph 1** shows a portion of Plot 5 that was surveyed in 2019.

Data for individual vegetation plots has not been included in this report but is on file with Beacon.

Photograph 1. Representative Photograph of Plot 5 on August 12, 2019

3.2.3.1 Floristic Quality Assessment

FQA values for each plot between 2008 and 2019 is summarized in **Table 7**. A comparison of FQA values averaged across all plots is provided in **Table 8.** Species richness is noticeably lower in 2008 compared to the following five monitoring years. The data show a spike in species richness and a corresponding increase in FQI between 2008 and 2010. After 2010, the numbers decrease somewhat and generally level off between 2013 and 2019.

Table 7. FQA Summary by Plot for 2008-2019

Plot	Variable/ Parameter	2008	2010	2013	2014	2016	2019
1	Total Species	22	52	41	44	39	35
	Native Species	19	43	31	36	31	30
	Introduced Species	3	9	10	8	8	5
	Wetness Index	-2.18	-2.33	-1.24	-1.93	-1.49	-2.26

Plot	Variable/ Parameter	2008	2010	2013	2014	2016	2019
	Mean Total CC	3.32	2.98	2.20	2.65	2.59	3.17
	Mean Native CC	3.84	3.60	2.90	3.51	3.26	3.60
	Total FQI	15.56	21.49	13.86	17.55	16.17	18.76
	Native FQI	16.75	23.64	16.16	21.09	18.15	19.72
2	Total Species	30	53	40	41	41	41
	Native Species	27	48	34	38	34	35
	Introduced Species	3	5	6	5	7	6
	Wetness Index	-1.93	-2.52	-1.73	-1.93	-1.61	-1.78
	Mean Total CC	3.23	3.88	3.08	3.32	3.1	3.12
	Mean Native CC	3.59	3.51	3.62	3.78	3.74	3.66
	Total FQI	17.71	25.55	18.14	21.24	19.85	19.99
	Native FQI	18.67	26.85	21.09	22.67	21.81	21.64
3	Total Species	23	62	47	50	48	47
	Native Species	20	55	39	45	42	41
	Introduced Species	3	7	8	6	7	6
	Wetness Index	-1.09	-1.86	-1.26	-2.18	-2.10	-1.89
	Mean Total CC	3.26	3.60	3.21	3.62	3.42	3.57
	Mean Native CC	3.75	4.05	3.97	4.11	3.90	4.10
	Total FQI	15.64	28.45	20.36	25.60	23.7	24.5
	Native FQI	16.77	30.33	24.18	27.29	27.27	26.24
4	Total Species	17	30	28	31	37	39
	Native Species	15	27	25	29	32	34
	Introduced Species	2	3	3	3	5	4
	Wetness Index	-0.29	-1.63	-1.61	-1.42	-1.27	-1.33
	Mean Total CC	4.00	4.17	3.82	4.10	3.97	3.92
	Mean Native CC	4.53	4.63	4.28	4.54	4.59	4.50
	Total FQI	16.49	22.82	18.92	22.81	24.13	24.5
	Native FQI	17.56	24.06	21.4	24.00	25.98	26.24
5	Total Species	21	46	37	36	41	47
	Native Species	19	39	33	34	36	42
	Introduced Species	2	7	4	3	5	5
	Wetness Index	-1.19	-0.48	-0.95	-0.75	-1.15	-1.26
	Mean Total CC	4.05	3.85	3.78	3.88	3.71	3.77
	Mean Native CC	4.47	4.54	4.24	4.33	4.27	4.21
	Total FQI	18.55	26.10	21.6	23.27	23.74	25.82
	Native FQI	19.50	28.34	24.37	24.89	25.32	27.31
6	Total Species	16	29	26	28	24	24
	Native Species	14	21	20	22	19	20
	Introduced Species	2	8	6	6	5	4
	Wetness Index	-1.00	0.21	-0.46	-0.32	-0.1	-0.63
	Mean Total CC	3.06	2.45	2.62	2.86	2.92	2.71
	Mean Native CC	3.50	3.38	3.40	3.64	3.68	3.25
	Total FQI	12.25	13.18	12.85	15.12	14.31	13.27
	Native FQI	13.10	15.49	15.21	17.06	16.04	14.53

Table 8. Comparison of Floristic Quality Assessment scores averaged across all plots, 2008-2019

Parameter	2008	2010	2013	2014	2016	2019
Average Total Species Richness	21.50	45.33	36.50	38.33	38.33	38.83
Average Native Species richness	19.00	38.83	30.33	34.00	32.33	33.67
Average Non-native Species Richness	2.50	6.50	6.17	5.17	6	5.16
Average Wetness Index	-1.28	-1.44	-1.21	-1.42	-1.29	-1.52
Average Native CC	3.95	3.95	3.74	3.99	3.90	3.89
Average Total CC	3.49	3.49	3.12	3.41	3.28	3.38
Average Native FQI	17.06	24.79	20.40	22.83	22.1	22.61
Average Total FQI	16.03	23.04	17.62	20.93	20.31	21.14

The fluctuations in the floristic parameters could be attributed to various environmental factors such as precipitation, herbivory, competition from dominant species, and natural dieback, which can vary on a seasonal and annual basis. Based on the monitoring data available, it is not possible to directly attribute the observed changes to specific environmental factors or variables. Some of the variability observed is likely attributable to observer bias, especially in plots where certain species occur in low numbers and can be easily overlooked or are not reliably detected.

Overall, there have been some minor shifts in species composition and abundance from year-to-year, which is to be expected within a dynamic natural environment. The general composition and structure of the vegetation within the plots have not changed substantially and the observed changes are within the expected range of natural variation for the wetland community types present.

3.2.4 Marsh Vegetation Surveys

As part of the ELC confirmation work completed by Dougan & Associates in 2009, marshes on the subject property were assessed and recorded, and some ELC was updated from 2008 to 2009. These surveys were again conducted by Dougan & Associates in 2010, 2011 and 2013 (not in 2012). The resulting predominant vegetation species and the biophysical characteristics of each marsh surveyed have been included in Dougan and Associates' annual monitoring reports.

In 2010, the overall conditions that had been recorded in 2009 had not changed substantially. However, ELC Unit 7 (**Figure 4**) appeared drier due to lack of deep standing water and a new moisture gradient was observed in ELC Unit 29. No changes or re-classifications to ELC communities were made in 2010.

Again, the hydrologic conditions and vegetation composition observed in 2011 were not significantly different from 2010. Common Reed had spread, but the abundance of hydrophilic species (which would be indicative of changing wetland conditions) did not significantly change. No changes or re-classifications to ELC communities were made in 2010.

The conditions of the marshes observed in 2013 were slightly drier in comparison to what was noted in 2010 and 2011. Dougan & Associates attributed these changes to the much lower than average level of precipitation in 2012 and the slightly lower than average precipitation in 2013. No changes or re-classifications to ELC communities were made in 2013.

Dougan & Associates note that ELC Units 3, 29, 5 and 6 are impacted by discharge of water from the complex of small ponds west of the parking lot. The water level in these ponds are being artificially regulated, which could explain fluctuations. Dougan & Associates also noted that the variation in vegetation in marshes could also be a result of plant responses to variations in weather patterns and environmental conditions rather than permanent trends.

3.2.5 Invasive Species Mapping

Since monitoring was initiated on the property, colonies of Common Reed have been slowly expanding (**Figure 5**). Patch sizes were recorded in 2013, 2016 and 2017 (**Table 9)**.

Table 9. Comparison of Common Reed Patch Size between 2013, 2016 and 2017

Colony	Size (m^2)			Difference (m^2)	Difference (%)
	2013	2016	2017		
A	172.28	254.43	255.04	0.61	0.24%
B	1,698.69	1,813.99	1,964.49	150.50	8.30%
C	1,920.17	1,401.47	2,886.44	266.24	10.16%
D	1,511.74	1,218.73	-	-	-
E	3,095.25	1,913.31	2,439.94	526.63	27.52%
F	1,061.60	202.67	123.36	-79.31	-39.13%
G	101.73	84.08	118.58	34.50	41.03%
H	-	127.31	162.44	35.13	27.59%
I	-	4.92	7.55	2.63	53.46%
J	-	25.05	18.73	-6.32	-25.23%
K	-	1,655.91	1,456.14	199.77	-12.06%
L	-	182.24	210.49	28.25	15.50%
M	-	-	16.77	-	-
N	-	-	70.55	-	-
O	-	-	132.15	-	-
P	-	-	62.52	-	-
Q	-	-	6.23	-	-
Total	**9,561.46**	**8,884.11**	**9,931.42**	**1,047.31**	**11.79%**

Common Reed Colony Locations

Figure 5

Aberfoyle 2022 Biological Monitoring Program

Legend

- Subject Property
- Common Reed Colonies (December 2017)
- Common Reed Colonies (December 2017)
- Common Reed Colonies (2016)
- Common Reed Colonies (December 2017)

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Project: 216114.1

Last Revised: January 2023

Client: Blue Triton Brands

Prepared by: SZ
Checked by: KU

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Monitoring of the Common Reed colonies in 2016 revealed a decrease in the rate of expansion of these colonies, but an increase in the colony size was observed in 2017. Between these two years, the following changes in Common Reed on the property were documented:

- Notable increases in colonies B, C (which has now joined with colony D), E and K;
- Small increases in colonies A, G, H, I and L;
- Small decreases in colonies F and J;
- Five new colonies, M through Q, were identified; and
- 32 additional points that were too small to map as polygons were identified.

The change in cover of Common Reed on the subject property increased by 1,047.31 m^2, or 11.79% between 2016 and 2017. The Common Reed cover in 2017 was similar to that of the patch size recorded in 2013. It is anticipated that Common Reed will continue to spread throughout suitable open habitat on the property. An area being invaded by Common Reed is shown in **Photograph 2**.

Photograph 2. Common Reed within Colony E on December 18, 2017

3.3 Wildlife Surveys

3.3.1 Breeding Amphibians

Three anuran species were recorded from three stations on the subject property during the 2022 nocturnal amphibian call surveys. Species include American Toad (*Anaxyrus americanus*), Green Frog (*Lithobates clamitans*), and Spring Peeper (*Pseudacris crucifer*). The findings of these amphibian breeding surveys are summarized in **Table 10**.

The primary amphibian breeding area on the property is the group of two to three small ponds/shallow aquatic features ("fire ponds") located just west of the parking lot. In 2022, no water was observed in the west fire pond and no amphibians were observed there.

Some indication of amphibian breeding was also observed in Pond 1 and the pond at Brock Road S, which is just east of the property. No indication of amphibian breeding was observed in Pond 2 in 2022.

Amphibians observed incidentally in 2022 during other field surveys included: Northern Leopard Frog (*Lithobates pipiens*) and American Bullfrog (*Lithobates catesbeianus*).

Table 10. Breeding Amphibian Survey Results (2022)

Location (Figure 3)	Round 1 (April 25, 2022)	Round 2 (May 11, 2022)	Round 3 (June 24, 2022)
1	No calls	SPPE – 1(1)	GRFR – 2(11) GRFR*
2	SPPE – 3	SPPE – 3	GRFR – 1(5)
3	SPPE*	AMTO – 1(1)	GRFR – 2(9)

* = Call recorded from outside of station area
AMTO = American Toad, GRFR = Green Frog, SPPE = Spring Peeper
Code 0 - No calling
Code 1 - Individuals can be counted; calls not simultaneous. Estimated number of individuals indicated in brackets
Code 2 - Calls distinguishable; some simultaneous calling. Estimated number of individuals indicated in brackets
Code 3 - Full chorus; calls continuous and overlapping.

Due to lower-than-average rainfall in 2022, amphibian breeding activity appeared generally lower than previous years (2008-2011 and 2015-2020). Additionally, some species heard in previous years were not heard during the 2022 surveys (Gray Tree Frog [*Hyla versicolor*] and Wood Frog [*Lithobates sylvaticus*]).

Results of amphibian breeding surveys are shown in **Table 11**. Spring Peeper and Green Frog have been observed each year monitoring has been completed. American Toad has been heard every year since 2016. Gray Tree Frog has been observed in all years except 2022. Wood Frog has been observed in 2008, from 2015 to 2017, and from 2019 to 2021. Northern Leopard Frog was incidentally observed in many years, and was documented calling during the nocturnal amphibian surveys at Pond 1 in 2015, 2016, 2017 and 2019. American Bullfrog was observed incidentally near Pond 1 in 2021 and on the access road near the pond that is east of the property (Station 1) in 2022. Previously, American Bullfrog had been heard calling in 2017 and 2019 within the pond just east of the property.

Table 11. Breeding Amphibian Monitoring Results (2008–2022)

Year	SPPE	GRTR	GRFR	CHFR	WOFR	AMTO	NLFR	BUFR
2008	X	X	X	X	X	-	-	-
2009	X	X	X	-	-	-	-	-
2010	X	X	X	-	-	-	X*	-
2011	X	X	X	X	X	X	-	-
2015	X	X	X	-	X	-	X*	X*
2016	X	X	X	-	X	X	X*	-
2017	X	X	X	-	X	X	X	X
2018	X	X	X	-	-	X	-	-
2019	X	X	X	-	X*	X	X	X
2020	X	X	X	-	X	X	-	X*
2021	X	X	X	-	X	X	-	X*
2022	X	-	X	-	-	X	X*	X*

SPPE = Spring Peeper, GRTR = Gray Treefrog, GRFR = Green Frog, CHFR = Western Chorus Frog, WOFR = Wood Frog, AMTO = American Toad, NLFR = Northern Leopard Frog, BUFR = American Bullfrog
* Indicates species observed incidentally and not recorded during amphibian monitoring surveys (from 2015 onward)

Overall, the results of these surveys have been relatively consistent with minor variations from year-to-year, which are to be expected based on the types of habitat present on the property and daily/annual species variations. Adult anurans are very mobile and often travel over upland areas to find suitable habitats.

3.3.2 Breeding Birds

A total of 36 species of birds (**Appendix C**) was documented on and directly adjacent to the subject property in 2022. Of the 36 species documented, 31 exhibited evidence of breeding and are considered to be breeding on the subject property.

During the field surveys in 2022, species that were observed flying or foraging over the property, or observed during migration and not considered to be breeding on the property, included: Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperi*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), European Starling (*Sturnus vulgaris*) and Common Grackle (*Quiscalus quiscula*). These species were either observed flying overhead or were using the property to forage (e.g., swallow species).

Of the 31 species that exhibited breeding evidence, two are species that have conservation status. Eastern Wood-Pewee (*Contopus virens*), which is designated as Special Concern under the federal *Species at Risk Act* (2002) and provincial *Endangered Species Act* (2007), was recorded on the property during the 2022 breeding bird survey for the first time since the 2019 breeding bird survey. Eastern Meadowlark (*Sturnella magna*), which is designated as Threatened federally and provincially, was recorded on the property during the 2022 breeding bird survey for the first time since the 2009 breeding bird survey conducted by Dougan and Associates. All species have a conservation rank of S5 (Secure) or S4 (Apparently Secure) (NHIC 2022).

Eastern Wood-Pewee is a common breeding bird species for the property in Aberfoyle and is often associated with wooded features. In 2022 Eastern Wood-Pewee was heard singing at breeding bird monitoring station 3.

Eastern Meadowlark breeds in a variety of grassland habitats including hayfields, pasturelands and weedy meadows. In 2022 this species was incidentally heard calling outside of a monitoring station in the weedy meadow near Pond 1. Although this is a relatively small suitable patch of habitat, this species will on occasion choose small areas to breed.

Six of the 31 bird species that displayed some level of breeding evidence on the property are considered to be "priority landbird species" in Bird Conservation Region (BCR) 13, the Lower Great Lakes – St. Lawrence Plain. Priority species are those that meet Partners in Flight criteria for Species of Continental or Regional Importance, because of high conservation concern / vulnerability and/or high stewardship responsibility scores (OPIF 2008). Species include:

- Northern Flicker (*Colaptes auratus);*
- Eastern Wood-Pewee;
- Eastern Kingbird (*Tyrannus tyrannus*);
- Savannah Sparrow (*Passerculus sandwichensis*);
- Eastern Meadowlark; and
- Baltimore Oriole (*Icterus galbula*).

Northern Flicker was heard calling from breeding bird monitoring stations 3 and 5, and also incidentally during the September basking turtle survey. Eastern Kingbird was heard calling from breeding bird monitoring stations 1 and 3 and also incidentally in the open areas of the property along the eastern property boundary and in the meadow by Pond 1. One Savannah Sparrow was recorded incidentally along the eastern property boundary during the first 2022 breeding bird survey. One Baltimore Oriole was recorded singing from breeding bird monitoring station 1.

Eight of the 31 breeding bird species are considered significant in Wellington County (Dougan & Associates 2009). These species include:

- Northern Flicker;
- Eastern Wood-Pewee;
- Eastern Kingbird;
- Black-and-White Warbler (*Mniotilta varia*);
- American Redstart (*Setophaga ruticilla*);
- Savannah Sparrow;
- Eastern Meadowlark; and
- Baltimore Oriole.

One Black-and-White Warbler was recorded at breeding bird monitoring station 2. An American Redstart was recorded incidentally during the second 2022 breeding bird survey in the deciduous forest at the southeastern edge of the property.

Four of the 31 breeding bird species observed in 2022 are considered area-sensitive. Area-sensitive species require larger areas of suitable habitat in order to sustain their populations (OMNR 2000) and are therefore considered more sensitive to habitat loss and fragmentation. These species include:

- Black-and-White Warbler;
- American Redstart;
- Savannah Sparrow; and
- Eastern Meadowlark.

Black-and-White Warbler and American Redstart are associated with the forested habitats on the property. Savannah Sparrow and Eastern Meadowlark are associated with the open areas on the property.

The number of breeding and total birds recorded each year through the monitoring surveys is shown in **Table 12**.

Table 12. Breeding Bird Monitoring Results (2008-2021)

Monitoring Year	Number of Total Bird Species	Number of Breeding Bird Species
2008	40	34
2009	45	39
2010	48	36
2011	50	38
2015	39	33
2016	48	40
2017	51	37
2018	39	32
2019	44	34
2020	47	35
2021	44	32
2022	36	31

The lower number of total birds is due to a decrease in incidental observations of migrating waterfowl, raptor flyovers and foraging swallow species from what was observed in previous years. Breeding bird species that were not recorded this year were primarily woodland species that breed in the forested habitat north of the plant. Birds in this area can be difficult to hear from the point count stations if wind levels are towards the higher end of what is permitted for breeding bird surveys.

However, the overall results of the breeding bird surveys in 2022 are similar to the results of breeding bird surveys that were completed in previous years at the site. Differences in the results of these surveys can be attributed to daily and annual species variations.

3.3.3 Owl Surveys

During the two Barred Owl surveys conducted in 2010, Barred Owl was not recorded. However, during the second owl survey in 2010 on July 27, a Northern Saw-whet Owl was recorded calling continuously for 5 minutes in the northeast corner. The Ontario Breeding Bird Atlas states that this species breeds in a variety of forest types but is most abundant in coniferous forests (Cadman *et al*. 2007). Therefore, the Blue Triton Brands Aberfoyle property provides suitable habitat for this owl species. Northern Saw-whet Owl is considered locally rare in Wellington County (Dougan and Associates 2009) and ranked as "secure" (S5) by NHIC (2022).

As a result of this record, the 2011 field surveys included broadcasting calls for Northern Saw-whet Owls, as discussed in **Section 2.3.3**. However, in 2011, no owls were heard during the survey, and no formal owl surveys or incidental observations of owls have occurred since.

3.3.4 Basking Turtle Survey

The results of the basking turtle surveys are shown below in **Table 13**. Pond locations are shown on **Figure 3.**

Table 13. Basking Turtle Survey Results (2022)

	Survey 1 (May 5, 2022)			Survey 2 (May 24, 2022)			Survey 3 (September 20, 2022)		
	Pond 1	***Pond 2***	***Fire Ponds***	***Pond 1***	***Pond 2***	***Fire Ponds***	***Pond 1***	***Pond 2***	***Fire Ponds***
Midland Painted Turtle (*Chrysemys picta marginata*)	10	0	0	11	0	1	6	0	0
Snapping Turtle (*Chelydra serpentina*)	1	0	0	1	1	1	0	0	0

The majority of the turtles that were observed on the subject property were Midland Painted Turtles, most of which were observed in Pond 1 and one was observed in the Fire Ponds (**Figure 3**). This species is not considered significant at the local (Dougan & Associates 2009), regional (Plourde *et al*. 1989), or provincial (NHIC 2022) level. In April 2018, COSEWIC updated this species' status to Special Concern due to loss of wetlands in Ontario; on April 23, 2021, the *Species at Risk Act* (2002) added Midland Painted Turtle to Schedule 1 with the Special Concern status.

The number of Midland Painted Turtles seen in 2018-2022 is lower than what has previously been recorded (refer to **Table 14**). This is likely due to the establishment of Common Reed and willows around the edge of Pond 1, which is reducing basking opportunities.

One Snapping Turtle was observed basking along the edges of Pond 1 during the first turtle basking survey. This basking behaviour is typical for Snapping Turtles, which typically only leave the water to migrate between suitable habitats or to lay their eggs. Additionally, as has been noted in previous years, Snapping Turtle nests were observed adjacent to Pond 1. In 2019, Blue Triton Brands staff indicated that Snapping Turtle are frequently observed nesting in the gravel around the ponds.

A summary of the basking turtle survey results from the Blue Triton Brands monitoring program on the Aberfoyle property are shown below in **Table 14**.

Table 14. Basking Turtle Monitoring Results (2008-2022)

Year	Snapping Turtle*	Midland Painted Turtle*
2008	1	0
2010	0	8 (5)
2011	1	38 (23)
2015	2 (1)	80 (36)
2016	5 (4)	42 (23)
2017	5	44 (25)
2018	1	30 (13)
2019	4 (2)	34 (22)
2020	6	34 (17)
2021	3 (2)	34 (21)
2022	4 (1)	28 (11)

* Maximum number observed per survey event are noted in parentheses.

3.3.5 Odonate Surveys

Baseline odonate surveys were completed by Dougan & Associates in 2010 and 2011 in the vicinity of Pond 1. The following taxa were observed:

- Common Green Darner - *Anax junius;*
- Northern/Vernal Bluet - *Enallagma annexum/E. vernale;*
- Rainbow Bluet - *Enallagma antennatum;*
- Boreal Bluet - *Enallagma boreale;*
- Marsh Bluet - *Enallagma erbium;*
- Unidentified Bluet species - *Enallagma sp.;*
- Eastern Pondhawk - *Erythemis simplicicollis;*
- Eastern Forktail - *Ischnura verticalis;*
- Dot-tailed Whiteface - *Leucorrhinia intacta;* and
- Unidentified Spreadwing species - *Sympetrum sp.*

Additionally, Canada Darner and Eastern Pondhawk were noted incidentally in 2009.

Dougan & Associates note that this list is likely quite conservative since the survey was focussed in the Pond 1 area, and there are likely many other taxa present on the subject property. Common Green Darner, Boreal Bluet, Marsh Bluet, Eastern Pondhawk, Eastern Forktail and Dot-tailed Whiteface are ranked as "secure" (S5) while Rainbow Bluet, Northern Bluet and Vernal Bluet are ranked as "apparently secure" (S4) (NHIC 2022). Both Northern and Vernal Bluets are also considered Significant in Wellington County (Dougan & Associates 2009).

No additional odonate surveys are proposed in the near future.

3.3.6 Other Wildlife Species Observations

Other wildlife that were recorded on the subject property during the 2022 field season included:

- Eastern Gray Squirrel (*Sciurus carolinensis*);
- Eastern Cottontail (*Sylvilagus floridanus*); and
- Eastern Chipmunk (*Tamias striatus*).

These incidental wildlife observations are similar to those noted in previous years.

4. Conclusion and Recommendations

This annual monitoring report describes the methods and findings of the 2022 biological monitoring field programs for the Blue Triton Brands Aberfoyle property. Aquatic and terrestrial monitoring completed in 2022 included:

- Salmonid spawning (redd) surveys in Aberfoyle Creek;
- Amphibian breeding surveys;
- Breeding bird surveys; and
- Turtle basking surveys.

Consistent with the required aquatic monitoring program, salmonid spawning surveys were completed along Aberfoyle Creek in 2022 by C. Portt and Associates. No evidence of spawning was observed. These findings are consistent with those of previous years (2007-2021).

Amphibian breeding surveys completed in 2022 documented three species and two additional species documented incidentally. These findings are consistent with previous survey years and there are no significant changes to the resident breeding populations.

Breeding bird surveys were completed in 2022. Thirty-one (31) species were noted to be breeding on the property, which is consistent with numbers observed in 2018 and 2021. These numbers are average in comparison to other years and are consistent with normal year to year variation.

Turtle basking surveys of the pond habitats on site were completed in 2022 and confirmed that Painted Turtle and Snapping Turtle are actively using the site for basking, breeding and over-wintering. While the survey methodologies employed have been standardized, year to year variation in numbers observed remains relatively high.

Floristic surveys of the property were completed in 2019 to update the overall plant species checklist which was last updated in 2011. A total of 255 species were documented. Over 77% of the species present are considered native to Ontario and reflects the quality of the ecological communities present.

In 2019, ecological communities on the subject property were verified and ELC mapping updated. The last update was in 2009. No significant changes were observed to warrant re-classification; however the boundaries of several communities were adjusted slightly.

Monitoring of vegetation in the six permanent sampling plots located in select wetland communities was completed in 2019. The data indicate that while there have been minor shifts in species composition and abundance from year-to-year, that most of this variation is attributable to sampling biases and does not reflect changes related to altered hydrology or disturbance; although there is some evidence to suggest compositional changes in some plots are related to expansion of Common Reed colonies.

No vegetation surveys were conducted in 2022. It is expected that vegetation plot surveys will be conducted again in 2024 and ELC and floristic surveys will resume in 2028.

In summary, the findings suggest that there have not been any significant changes to the various terrestrial and aquatic parameters being monitored on the Aberfoyle property. Species richness, abundance, and distribution are generally within the range expected and attributable to natural variation and succession. The subject property continues to support high quality terrestrial and wetland habitats that support a diverse range of native wildlife. The aquatic environment is strongly influenced by the thermal loading from the Aberfoyle Mill Pond.

Based on findings of the 2022 biological monitoring program, we recommend that Core wildlife monitoring (amphibian, reptiles and birds) be completed in 2023. Additionally, Salmonid spawning surveys in Aberfoyle Creek should be conducted as required in 2023 by C. Portt and Associates.

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Appendix A

Key Biophysical Attributes of the Vegetation Communities in the Study Area

Appendix A

Key Biophysical Attributes of the Vegetation Communities in the Study Area[1]

Unit.	1	2	3	4	5
ELC Code	**SAM1**	**CUM1**	**MAM2**	**FOM7**	**CUP3**
Vegetation Type	Mixed Shallow Aquatic Ecosite	Mineral Cultural Meadow Ecosite	Mineral Shallow Marsh Ecosite	Fresh-Moist White Cedar - Hardwood Mixed Forest Ecosite	Coniferous Plantation Ecosite
Overstorey Composition	*Salix sp*	*Thuja occidentalis, Populus tremuloides, Populus deltoides ssp. deltoides,*	*Alnus incana spp. rugosa, Thuja occidentalis, Sambucus nigra ssp. Canadensis, Fraxinus pennsylvanica, Fraxinus nigra*	*Acer rubrum, Acer negundo, Fraxinus pennsylvanica, Thuja occidentalis, Populus tremuloides, Salix amygdaloides*	*Pinus strobes, Pinus sylvestris, Thuja occidentalis, Betula papyrifera, Prunus serotina, Acer saccharum var. saccharum, Carya cordiformis, Fraxinus americana, Rhamnus cathartica, Lonicera tatarica*
Understorey Composition	*Polygonum hydropiper, Rumex crispus, Schoenoplectus tabernaemontani, Typha angustifolia, Verbena hastata*	*Salix eriocephala, Rhamnus cathartica, Lonicera tatarica, Salix purpurea, Cornus sericea ssp. sericea, Vitis riparia, Rubus idaeus ssp. Idaeus, Salix exigua*	*Ribes triste Cornus sericea ssp. sericea*	*Cornus sericea ssp. sericea, Salix sp, Rubus idaeus ssp. idaeus*	*Rubus idaeus ssp. idaeus, Prunus virginiana var. virginiana*
Groundcover Composition	*Lemna minor*	*Solidago Canadensis, Daucus carota, Aster sp, Symphyotrichum novae-angliae, Asclepias syriaca, Echium vulgare, Achillea millefolium var. millefolium, Oenothera biennis, Tussilago farfara, Verbascum Thapsus, Fragaria virginiana ssp. Virginiana, Anemone sp, Trifolium sp*	*Typha latifolia,Carex stricta,Solanum dulcamara, Phalaris arundinacea, Thalictrum dioicum, Laportea canadensis, Mentha sp, Solidago rugosa ssp. Rugosa, Onoclea sensibilis, Carex intumescens, Eupatorium maculatum var. maculatum, Eupatorium perfoliatum, Symphyotrichum puniceum var. puniceum, Impatiens capensis, Lysimachia thyrsiflora, Ranunculus hispidus var. hispidus, Glyceria striata, Leersia oryzoides, Carex sp*	*Equisetum arvense, Tussilago farfara, Phalaris arundinacea*	*Asarum canadense Solidago flexicaulis Maianthemum canadense Tussilago farfara Eurybia macrophylla Carex granularis Sanguinaria canadensis*
Diameter Range	N/A	N/A	1	1– 2	2– 3
Structural Diversity	1	1	2	2	2
Canopy Closure	N/A	1	1	2(3)	3
Relative Age	2	1	2	2	2
Soil Texture	L	L	Om 15/ L	L – rip/rap	LfS
Drainage Class	3	1	3	1	1
Slope Class	1	1	1	2	2– 3
Topographic Class	1	1	2	1	1
Botanical Quality	1	1	2	1	1

[1] *Appendix A is based off the 2011 Biological Monitoring Program - Final Report (Dougan & Associates 2012) with minor updates from work done by Beacon in 2019.*

Unit.	6	7	8	9	10
ELC Code	**FOC4-1**	**MAS3**	**FOD6**	**SWD**	**SWM4-1**
Vegetation Type	Fresh-Moist White Cedar Coniferous Forest	Organic Shallow Marsh Ecosite	Fresh-Moist Sugar Maple Deciduous Forest Ecosite	Deciduous Swamp	White Cedar - Hardwood Organic Mixed Swamp
Overstorey Composition	*Thuja occidentalis Fraxinus pennsylvanica Acer saccharum var. saccharum*	*Thuja occidentalis, Betula papyrifera, Ulmus americana, Fraxinus nigra, Betula alleghaniensis, Acer saccharum var.saccharum Fraxinus pennsylvanica, Acer rubrum, Prunus serotina, Carpinus caroliniana ssp. virginiana, Tilia americana,*	*Acer saccharum var. saccharum, Ostrya virginiana, Tilia americana, Thuja occidentalis, Betula alleghaniensis, Betula papyrifera, Tsuga canadensis, Fagus grandifolia, Fraxinus pennsylvanica, Fraxinus americana*	*Fraxinus nigra Populus tremuloides Betula alleghaniensis Acer rubrum Tilia americana Thuja occidentalis Fraxinus pennsylvanica Fagus grandifolia*	*Thuja occidentalis, Populus tremuloides, Fraxinus pennsylvanica, Ulmus americana, Fraxinus nigra, Betula papyrifera, Betula alleghaniensis, Acer rubrum,*
Understorey Composition	*Sambucus racemosa var. racemosa Cornus alternifolia Ribes sp*	*Cornus sericea ssp. sericea, Rubus pubescens, Parthenocissus vitacea, Sambucus nigra ssp. canadensis*	-	*Sambucus nigra ssp. canadensis, Cornus sericea ssp. sericea*	*Rhamnus cathartica, Rubus idaeus ssp. idaeus, Salix petiolaris, Amelanchier alnifolia, Hamamelis virginiana, Cornus sericea ssp. sericea, Sambucus nigra ssp. canadensis, Parthenocissus vitacea, Lonicera dioica, Prunus virginiana var. virginiana, Cornus alternifolia, Alnus incana spp. rugosa, Frangula alnus, Cornus racemosa, Rubus pubescens, Prunus serotina,*
Groundcover Composition	*Cystopteris bulbifera Tussilago farfara Carex communis Asarum canadense Onoclea sensibilis*	*Phragmites australis, Thelypteris palustris var. pubescens, Carex hystericina, Solanum dulcamara, Scirpus atrovirens, Epilobium hirsutum, Onoclea sensibilis, Cicuta maculata, Bidens frondosa, Typha latifolia, Sium suave, Rorippa nasturtium-aquaticum, Lycopus americanus, Agrostis stolonifera*	*Carex pensylvanica, Onoclea sensibilis, Solidago flexicaulis, Tussilago farfara, Polystichum acrostichoides, Caulophyllum thalictroides, Asarum canadense, Anemone acutiloba, Carex pedunculata*	*Phalaris arundinacea Carex sp Solidago rugosa ssp. rugosa Onoclea sensibilis, Boehmeria cylindrica Carex lupulina Euonymus obovata*	*Solanum dulcamara,Agrimonia gryposepala, Thalictrum dioicum, Onoclea sensibilis, Oxalis stricta, Carex eburnean, Cystopteris bulbifera, Pilea pumila, Viola sororia, Clematis virginiana, Echinocystis lobata, Lysimachia thyrsiflora, Circaea lutetiana ssp. canadensis,, Phalaris arundinacea, Aster puniceus var. puniceus, Anemone virginiana var. cylindroidea, Dryopteris carthusiana, Echinocystis lobata*
Diameter Range	3	1	2– 3	2– 3	2– 3
Structural Diversity	2	2	2	2	2
Canopy Closure	3	1	3	3	3
Relative Age	2	2	2	2	2
Soil Texture	LfS	Om/SiL	L	L	O/L
Drainage Class	2	3	2	3	3
Slope Class	2(3)	1	1– 2	1	1
Topographic Class	2	2	1	2	2
Botanical Quality	2	2	2	2	3

Unit.	11	12	13	14-merged with Polygon 11 in 2009	15
ELC Code	**MAS2-1/MAM2-2**	**SWC3-2**	**SWC3-1**	**SWT2**	**FOC4-1**
Vegetation Type	Cattail Mineral Shallow Marsh/Reed Canary Grass Mineral Meadow Marsh	White Cedar - Conifer Organic Coniferous Swamp	White Cedar Organic Coniferous Swamp	Mineral Thicket Swamp Ecosite	Fresh-Moist White Cedar Coniferous Forest
Overstorey Composition	*Populus tremuloides, Thuja occidentalis*	*Thuja occidentalis Larix laricina*	*Thuja occidentalis, Populus balsamifera ssp. balsamifera Larix laricina, Betula papyrifera*	*Thuja occidentalis*	*Thuja occidentalis*
Understorey Composition	*Rhamnus cathartica Salix sp Salix petiolaris Ribes sp Cornus sericea ssp. sericea*	*Lonicera tatarica*	*Parthenocissus vitacea Lonicera tatarica*	*Salix sp Parthenocissus vitacea*	-
Groundcover Composition	*Typha latifolia, Phalaris arundinacea, Solidago canadensis var. scabra Tussilago farfara, Lysimachia thyrsiflora, Solanum dulcamara, Equisetum arvense, Carex hystericina, Carex stipata Aster puniceus var. puniceus, Eupatorium maculatum var. maculatum, Caltha palustris, Onoclea sensibilis, Impatiens capensis, Poa sp, Schoenoplectus tabernaemontani, Cicuta maculate, Carex stricta*	*Carex stricta, Carex pellita Dryopteris carthusiana Thelypteris palustris var. pubescens, Osmunda cinnamomea, Galium aparine, Equisetum arvense, Aster sp, Typha latifolia, Tussilago farfara, Fragaria virginiana ssp. virginiana, Caltha palustris, Solidago canadensis var. scabra, Thalictrum pubescens, Cypripedium parviflorum, Phragmites australis, Onoclea sensibilis*	*Equisetum arvense, Tussilago farfara, Onoclea sensibilis Galium aparine, Solanum dulcamara, Carex stipata, Phalaris arundinacea, Aster puniceus var. puniceus Thalictrum pubescens Dryopteris carthusiana, Caltha palustris, Eupatorium perfoliatum, Impatiens capensis, Eupatorium maculatum var. maculatum, Carex rosea, Cypripedium parviflorum, Taraxacum officinale*	*Typha latifolia Aster puniceus var. puniceus Phalaris arundinacea Solanum dulcamara Carex stipata Cicuta maculata Impatiens capensis Lysimachia thyrsiflora Onoclea sensibilis Thalictrum pubescens Asclepias syriaca Typha angustifolia*	-
Diameter Range	N/A	1– 2	2– 3	1	3
Structural Diversity	2	2	2	2	2
Canopy Closure	N/A	2– 3	3	1	3
Relative Age	2	2	2	2	2
Soil Texture	L	Om	Om	L	LfS
Drainage Class	3	3	3	3	2
Slope Class	1	1	1	1	1
Topographic Class	2	2	2	2	2
Botanical Quality	2	2	2	2	2

Unit.	16	17	18	19	20
ELC Code	**FOC4-1**	**FOC4-1**	**SWD**	**SWM4-1**	**FOM7**
Vegetation Type	Fresh-Moist White Cedar Coniferous Forest	Fresh-Moist White Cedar Coniferous Forest	Deciduous Swamp	White Cedar - Hardwood Organic Mixed Swamp	Fresh-Moist White Cedar - Hardwood Mixed Forest Ecosite
Overstorey Composition	*Thuja occidentalis*	*Thuja occidentalis, Pinus strobus Populus tremuloides, Betula papyrifera, Prunus serotina Picea abies, Abies balsamea*	*Fraxinus nigra Rubus idaeus ssp. idaeus* *Rubus pubescens Parthenocissus vitacea Rhamnus cathartica Thuja occidentalis Vitis riparia* *Frangula alnus Populus tremuloides*	*Species composition similar to unit 10*	*Thuja occidentalis, tilia americana, Acer saccharum ssp saccharum, Ostrya virginiana, Tsuga canadensis*
Understorey Composition	-	*Prunus virginiana var. virginiana Rhamnus cathartica*	-	-	*Acer saccharum ssp saccharum*
Groundcover Composition	-	*Carex flacca, Danthonia spicata, Solidago nemoralis*	*Anemone canadensis Solanum dulcamara Geum sp* *Thalictrum pubescens Circaea lutetiana ssp. canadensis Arisaema triphyllum ssp. triphyllum* *Galium sp* *Solidago rugosa ssp. rugosa*	-	*Carex pensylvanica, Dryopteris carthusiana, Asarum canadense*
Diameter Range	2– 3	2– 3	1– 2	2– 3	2– 3
Structural Diversity	1	1	2	2	2
Canopy Closure	3	3	2	3	3
Relative Age	2	2	1	2	2
Soil Texture	L	L	L	O/L	L
Drainage Class	1	1	3	3	2
Slope Class	1	1	1	1	1– 2
Topographic Class	2	2	2	2	2
Botanical Quality	2	2	2	3	2

Unit.	21	22	23	24	25
ELC Code	**FOC4-1**	**FOC4-1**	**CUM1**	**SWD2-2**	**MAM2**
Vegetation Type	Fresh-Moist White Cedar Coniferous Forest	Fresh-Moist White Cedar Coniferous Forest	Mineral Cultural Meadow Ecosite	Red Ash Mineral Deciduous Swamp	Common Reed Mineral Meadow Marsh
Overstorey Composition	*Populus tremuloides Thuja occidentalis Fraxinus pennsylvanica Fraxinus americana Acer saccharum var. saccharum Betula alleghaniensis*	*Thuja occidentalis, Betula papyrifera Salix fragilis, Populus balsamifera ssp. balsamifera, Populus tremuloides,*	*Acer negundo*	-	*Populus balsamifera ssp. balsamifera Acer negundo*
Understorey Composition	-	*Salix purpurea, Cornus sericea ssp. sericea, Lonicera tatarica*	*Rhamnus cathartica, Rubus idaeus ssp. idaeus, Vitis riparia*	-	*Vitis riparia, Parthenocissus vitacea*
Groundcover Composition	*Solidago canadensis*	*Equisetum arvense, Solidago canadensis, Tussilago farfara, Taraxacum officinale*	*Solidago canadensis var. scabra, Echium vulgare, Linaria vulgaris, Thlaspi arvense, Equisetum arvense, Symphyotrichum novae-angliae, Bromus inermis ssp. pumpellianus, Leucanthemum vulgare, Solidago canadensis, Arctium minus, Lotus corniculatus, Daucus carota, Cirsium arvense, Rumex crispus, Tussilago farfara, Anemone canadensis, Asclepias syriaca, Trifolium repens*	-	*Phalaris arundinacea Rumex crispus Anemone canadensis, Ranunculus acris, Phragmites australis*
Diameter Range	2– 3	2– 3	N/A	2– 3	N/A
Structural Diversity	1	2	1	2	1
Canopy Closure	3	3	N/A	3	N/A
Relative Age	2	2	1	2	1
Soil Texture	L	L	L	L	L
Drainage Class	1	1	1	3	2
Slope Class	1	2	1– 2	1	1
Topographic Class	2	2	1	2	1
Botanical Quality	2	2	1	2	1

Unit.	26	27	28	29	30
ELC Code	**SAM1**	**SWD2-2**	**FOD**	**MAM2-2**	**MAM2-2**
Vegetation Type	Mixed Shallow Aquatic Ecosite	Green Ash Mineral Deciduous Swamp	Deciduous Forest	Reed Canary-grass Mineral Meadow Marsh	Reed Canary-grass Mineral Meadow Marsh
Overstorey Composition	*Salix exigua*	*Fraxinus pensylvanica, Fraxinus nigra, Ulmus americana, Betula allegheniensis, Tilia Americana, Populus tremuloides*	*Fraxinus pensylvanica, Populus tremuloides, Thuja occidentalis, Pinus strobus*	*Thuja occidentalis, Fraxinus nigra*	-
Understorey Composition	-	*Rubus idaeus ssp melanolasius, Rhamnus cathyartica, Sambucus canadensis, Thuja occidentalis, Viburnum trilobum (R)*	*Thuja occidentalis, Cornus sericea ssp sericea, Rhamnus frangula, abies balsamea*	*Cornus sericea ssp sericea, Rubus idaeus ssp strigosus, Thuja occidentalis*	-
Groundcover Composition	*Coronilla varia, Poa sp Achillea millefolium var. millefolium, Typha latifolia, Juncus effusus ssp. solutes, Silene vulgaris, Melilotus officinalis Rumex crispus, Schoenoplectus tabernaemontani, Ranunculus sceleratus var. sceleratus*	*Onoclea sensibilis, Solidago rugosa, Clematis virginiana, Cystopteris bulbifera*	*Carex pensylvanica, Solidago canadensis var. scabra, Pteridium aquilinum, solidago rugosa, Solanum dulcamara, Solidago rugosa*	*Phalaris arundinacea -D, Symphyotrichum lateriflorum var. angustifolium, Eupatorium maculatum, Aster puniceus, Carex sp.,*	*Phalaris arundinacea -D, Aster puniceus-A, Typha angustifolia,Typha latifolia, Symphyotrichum lanceolatum var. lanceolatum, Cyperipedium parviflorum var. makasin*
Diameter Range	N/A	2	1,2 (3)	1	1
Structural Diversity	1	2	2	1	1
Canopy Closure	N/A	3	3	1	1
Relative Age	1	2	1– 2	1	1
Soil Texture	L	L	L	L	L
Drainage Class	3	2– 3	1	2– 3	2– 3
Slope Class	1	1	1	1	1
Topographic Class	1	1	1	1	1
Botanical Quality	2	2	2	2	2

Unit.	31	32
ELC Code	**FOD**	**CUM1**
Vegetation Type	Deciduous Forest Remnant	Cultural Meadow
Overstorey Composition	*Acer saccharum ssp saccharum, Tilia americana*	-
Understorey Composition	-	-
Groundcover Composition	-	Some areas manicured turf, some areas seeded; *Medicago sativa, Melilotus sp, Daucus carota*
Diameter Range	2	1
Structural Diversity	1	1
Canopy Closure	3	1
Relative Age	2	1
Soil Texture	L	L
Drainage Class	1	1
Slope Class	1	1
Topographic Class	1	1
Botanical Quality	2	1

LEGEND
Diameter Range (1 = <15 cm dbh.; 2 = 15 – 30 cm dbh.; 3 = >30 cm dbh.)
Structural Diversity (1 = strata 1 & 2; 2 = >2 strata; 3 = > 3 strata, old growth)
Canopy Closure (1 = <25%; 2 = 25– 50%; 3 = >50%)
Relative Age (1 = immature; 2 = mature; 3 = old growth)
Soil Texture (sand/silt/clay/org)
Drainage Class (1 = well-drained; 2 = imperfectly drained (1 – 3 mottles); 3 = poorly drained (>3 mottles)
Slope Class (1 = <10%; 2 = 10– 25%; 3 = >25%)
Topographic Class (1 = uniform; 2 = uneven; 3 = high variability (hummocky)
Botanical Quality (1 = disturbed, exotics; 2 = low diversity; 3 = high diversity (sig spp. present)
Edge Abbreviations: ( ) represent localized condition; D = Dominant (51– 100%); A = Abundant (21– 50%); F = Frequent (11– 20%); O = Occasional (5– 10%); S = Scarce (<5%)

Appendix B

Flora Checklist

Appendix B

Flora Checklist

Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Alisma triviale	Northern Water-plantain	1	-5	S5	-
Sagittaria latifolia	Broadleaf Arrowhead	4	-5	S5	-
Toxicodendron rydbergii	Western Poison Ivy	0	0	S5	-
Cicuta bulbifera	Bulb-bearing Water-hemlock	5	-5	S5	-
Cicuta maculata	Spotted Water-hemlock	6	-5	S5	-
Daucus carota	Queen Anne's Lace	0	5	SNA	-
Hydrocotyle americana	American Water-pennywort	7	-5	S5	-
Sium suave	Hemlock Water-parsnip	4	-5	S5	-
Apocynum androsaemifolium ssp. *androsaemifolium*	Spreading Dogbane	3	5	S5	-
Arisaema triphyllum ssp. *triphyllum*	Jack-in-the-pulpit	5	-2	S5	-
Aralia nudicaulis	Wild Sarsaparilla	4	3	S5	-
Asarum canadense	Wild Ginger	6	5	S5	-
Asclepias incarnata ssp. *incarnata*	Swamp Milkweed	6	-5	S5	-
Asclepias syriaca	Common Milkweed	0	5	S5	-
Asplenium platyneuron	Ebony Spleenwort	6	3	S4	R
Achillea millefolium var. *occidentalis*	Wooly Yarrow	0	3	S5	-
Ambrosia trifida	Great Ragweed	0	-1	S5	-
Bidens frondosa	Devil's Beggar's Ticks	3	-3	S5	-
Cichorium intybus	Chicory	0	5	SNA	-
Cirsium vulgare	Bull Thistle	0	4	SNA	-
Erigeron philadelphicus var. *philadelphicus*	Philadelphia Fleabane	1	-3	S5	-
Eupatorium perfoliatum	Common Boneset	2	-4	S5	-
Euthamia graminifolia	Grass-leaved Goldenrod	2	-2	S5	-
Eutrochium maculatum var. *maculatum*	Spotted Joe-pye Weed	3	-5	S5	-
Hieracium sp.	Hawkweed Species	0	0	-	-
Lactuca biennis	Tall Blue Lettuce	6	0	S5	-
Lactuca sp.	Lettuce Species	0	0	-	-
Leucanthemum vulgare	Oxeye Daisy	0	5	SNA	-
Solidago altissima var. altissima	Tall Goldenrod	1	3	S5	-
Solidago canadensis	Canada Goldenrod	1	3	S5	-
Solidago flexicaulis	Broad-leaved Goldenrod	6	3	S5	-
Solidago gigantea	Smooth Goldenrod	4	-3	S5	-
Solidago nemoralis var. *nemoralis*	Field Goldenrod	2	5	S5	-
Solidago rugosa ssp. *rugosa*	Rough Goldenrod	4	-1	S5	-
Sonchus arvensis ssp. *arvensis*	Field Sowthistle	0	1	SNA	-

Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Sonchus asper ssp. *asper*	Spiny-leaf Sowthistle	0	0	SNA	-
Symphyotrichum lanceolatum ssp. *lanceolatum*	Panicled Aster	3	-3	S5	-
Symphyotrichum lateriflorum var. *lateriflorum*	Calico Aster	3	-2	S5	-
Symphyotrichum novae-angliae	New England Aster	2	-3	S5	-
Symphyotrichum pilosum var. *pilosum*	Hairy Aster	4	2	S5	U
Symphyotrichum puniceum var. *puniceum*	Purple-stemmed Aster	6	-5	S5	-
Symphyotrichum urophyllum	Arrow-leaved Aster	6	5	S4	U
Taraxacum officinale	Common Dandelion	0	3	SNA	-
Tussilago farfara	Colt's Foot	0	3	SNA	-
Impatiens capensis	Spotted Jewel-weed	4	-3	S5	-
Caulophyllum giganteum	Blue Cohosh	-	-	S5	-
Caulophyllum thalictroides	Blue Cohosh	6	5	S5	-
Alnus incana ssp. *rugosa*	Speckled Alder	6	-5	S5	-
Betula alleghaniensis	Yellow Birch	6	0	S5	-
Betula papyrifera	Paper Birch	2	2	S5	-
Carpinus caroliniana ssp. *virginiana*	American Hornbeam	6	0	S5	-
Echium vulgare	Common Viper's-bugloss	0	5	SNA	-
Hackelia virginiana	Virginia Stickseed	5	1	S5	-
Myosotis laxa	Small Forget-me-not	6	-5	S5	-
Myosotis scorpioides	True Forget-me-not	0	-5	SNA	-
Symphytum officinale ssp. *officinale*	Common Comfrey	0	5	SNA	-
Cardamine diphylla	Broad-leaved Toothwort	7	5	S5	-
Cardamine pensylvanica	Pennsylvania Bitter-cress	6	-4	S5	U
Rorippa nasturtium-aquaticum	True Watercress	0	-5	SNA	-
Thlaspi arvense	Field Penny-cress	0	5	SNA	-
Lobelia siphilitica	Great Blue Lobelia	6	-4	S5	-
Lonicera tatarica	Tartarian Honeysuckle	0	3	SNA	-
Sambucus canadensis	Common Elderberry	5	-2	S5	-
Sambucus nigra	Eupopean Elderberry	-	-	SNA	-
Viburnum opulus	Guelder-rose Viburnum	0	0	SNA	-
Silene vulgaris	Maiden's Tears	0	5	SNA	-
Euonymus obovatus	Running Strawberry-bush	6	5	S5	-
Hypericum perforatum	St. John's-wort	0	5	SNA	-
Convolvulus arvensis	Field Bindweed	0	5	SNA	-
Cornus alternifolia	Alternate-leaf Dogwood	6	5	S5	-
Cornus racemosa	Gray Dogwood	2	-2	S5	-
Cornus sericea ssp. *sericea*	Red-osier Dogwood	2	-3	S5	-
Echinocystis lobata	Wild Mock-cucumber	3	-2	S5	-
Thuja occidentalis	Northern White Cedar	4	-3	S5	-
Carex bebbii	Bebb's Sedge	3	-5	S5	-

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Carex bromoides	Brome-like Sedge	7	-4	S5	-
Carex communis	Fibrous-root Sedge	6	5	S5	-
Carex flacca	Heath Sedge	0	0	SNA	-
Carex flava	Yellow Sedge	5	-5	S5	-
Carex gracillima	Graceful Sedge	4	3	S5	-
Carex granularis	Meadow Sedge	3	-4	S5	-
Carex hystericina	Porcupine Sedge	5	-5	S5	-
Carex intumescens	Bladder Sedge	6	-4	S5	-
Carex lupulina	Hop Sedge	6	-5	S5	-
Carex pedunculata	Longstalk Sedge	5	5	S5	-
Carex pellita	Woolly Sedge	4	-5	S5	-
Carex pensylvanica	Pennsylvania Sedge	5	5	S5	-
Carex radiata	Stellate Sedge	4	5	S5	-
Carex sp.	Sedge Species	0	0	-	-
Carex stipata	Stalk-grain Sedge	3	-5	S5	-
Carex stricta	Tussock Sedge	4	-5	S5	-
Carex vulpinoidea	Fox Sedge	3	-5	S5	-
Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	5	-5	S5	-
Scirpus atrovirens	Woolgrass Bulrush	3	-5	S5	-
Pteridium aquilinum var. *latiusculum*	Bracken Fern	2	3	S5	-
Athyrium filix-femina var. *angustum*	Lady-fern	4	0	S5	-
Cystopteris bulbifera	Bulblet Fern	5	-2	S5	-
Dryopteris carthusiana	Spinulose Wood Fern	5	-2	S5	-
Dryopteris cristata	Crested Wood Fern	7	-5	S5	-
Dryopteris intermedia	Evergreen Wood Fern	5	0	S5	-
Dryopteris marginalis	Marginal Wood Fern	5	3	S5	-
Matteuccia struthiopteris var. *pensylvanica*	Ostrich Fern	5	-3	S5	-
Onoclea sensibilis	Sensitive Fern	4	-3	S5	-
Polystichum acrostichoides	Christmas Fern	5	5	S5	-
Equisetum arvense	Field Horsetail	0	0	S5	-
Equisetum sylvaticum	Woodland Horsetail	7	-3	S5	U
Coronilla varia	Crown-vetch	0	5	SNA	-
Lotus corniculatus	Bird's-foot Trefoil	0	1	SNA	-
Medicago lupulina	Black Medic	0	1	SNA	-
Trifolium repens	White Clover	0	2	SNA	-
Trifolium sp.	Clover Species	0	0	-	-
Fagus grandifolia	American Beech	6	3	S5	-
Geranium maculatum	Wild Geranium	6	3	S5	-
Geranium robertianum	Herb-robert	0	5	S5	-
Ribes cynosbati	Prickly Gooseberry	4	5	S5	-

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Ribes triste	Swamp Red Currant	6	-5	S5	-
Iris versicolor	Blueflag	5	-5	S5	-
Carya cordiformis	Bitternut Hickory	6	0	S5	-
Juglans nigra	Black Walnut	5	3	S4?	-
Juncus effusus ssp. *solutus*	Soft Rush	4	-5	S5	-
Galeopsis tetrahit	Brittle-stem Hempnettle	0	5	SNA	-
Lycopus americanus	American Bugleweed	4	-5	S5	-
Lycopus uniflorus	Northern Bugleweed	5	-5	S5	-
Mentha arvensis	Corn Mint	3	-3	S5	-
Nepeta cataria	Catnip	0	1	SNA	-
Prunella vulgaris ssp. *lanceolata*	Self-heal	5	5	S5	-
Prunella vulgaris ssp. *vulgaris*	Common Heal-all	0	0	SNA	-
Scutellaria galericulata	Hooded Skullcap	6	-5	S5	-
Scutellaria lateriflora	Mad Dog Skullcap	5	-5	S5	-
Scutellaria sp.	Skullcap Species	0	0	-	-
Lemna minor	Lesser Duckweed	2	-5	S5	-
Allium tricoccum	Wild Leek	7	2	S5	-
Maianthemum canadense	Wild-lily-of-the-valley	5	0	S5	-
Maianthemum stellatum	Starflower False Solomon's Seal	6	1	S5	-
Polygonatum pubescens	Downy Solomon's Seal	5	5	S5	-
Trillium grandiflorum	White Trillium	5	5	S5	-
Trillium sp.	Trillium Species	0	0	-	-
Lythrum salicaria	Slender-spike Loosestrife	0	-5	SNA	-
Fraxinus nigra	Black Ash	7	-4	S5	-
Fraxinus pennsylvanica	Green Ash	3	-3	S5	-
Circaea lutetiana ssp. *canadensis*	Enchanter's Nightshade	3	3	S5	-
Epilobium hirsutum	Great-hairy Willow-herb	0	-4	SNA	-
Epilobium parviflorum	Small-flower Willow-herb	0	3	SNA	-
Epilobium sp.	Willow-herb Species	0	0	-	-
Cypripedium parviflorum	Small Yellow Lady's-slipper	7	-1	S5	-
Epipactis helleborine	Eastern Helleborine	0	5	SNA	-
Osmunda cinnamomea	Cinnamon Fern	7	-3	S5	-
Oxalis stricta	Upright Yellow Wood Sorrel	0	3	S5	-
Sanguinaria canadensis	Bloodroot	5	4	S5	-
Abies balsamea	Balsam Fir	5	-3	S5	-
Larix laricina	American Larch	7	-3	S5	-
Pinus nigra	Black Pine	0	-5	SNA	-
Pinus strobus	Eastern White Pine	4	3	S5	-
Tsuga canadensis	Eastern Hemlock	7	3	S5	-
Plantago lanceolata	English Plantain	0	0	SNA	-

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Plantago major	Nipple-seed Plantain	0	-1	SNA	-
Agrostis gigantea	Redtop	0	0	SNA	-
Brachyelytrum erectum	Long-awned Wood Grass	7	5	S4S5	R
Bromus ciliatus	Fringed Brome	6	-3	S5	-
Bromus inermis ssp. *inermis*	Smooth Brome	0	5	SNA	-
Cinna latifolia	Slender Wood Reedgrass	7	-4	S5	U
Danthonia spicata	Poverty Oat-grass	5	5	S5	-
Echinochloa crusgalli	Barnyard Grass	0	-3	SNA	-
Elymus hystrix	Bottle-brush Grass	5	5	S5	-
Elymus repens	Quack Grass	0	3	SNA	-
Elymus virginicus var. *virginicus*	Virginia Wild-rye	5	-2	S5	-
Glyceria grandis	American Manna Grass	5	-5	S4S5	-
Glyceria striata	Fowl Manna Grass	3	-5	S5	-
Leersia oryzoides	Rice Cutgrass	3	-5	S5	-
Phalaris arundinacea	Reed Canary Grass	0	-4	S5	-
Phleum pratense	Timothy	0	3	SNA	-
Phragmites australis ssp. australis	European Common Reed	0	-4	SNA	-
Poa palustris	Fowl Bluegrass	5	-4	S5	-
Poa pratensis ssp. *pratensis*	Kentucky Bluegrass	0	1	SNA	-
Schizachne purpurascens ssp. *purpurascens*	Purple Oat	6	2	S5	-
Polygonum hydropiper	Water-pepper	4	-5	SNA	-
Rumex crispus	Curly Dock	0	-1	SNA	-
Rumex orbiculatus	Water Dock	6	-5	S4S5	-
Lysimachia ciliata	Fringed Loosestrife	4	-3	S5	-
Lysimachia thyrsiflora	Water Loosestrife	7	-5	S5	-
Trientalis borealis ssp. *borealis*	Northern Starflower	6	-1	S5	-
Adiantum pedatum	Northern Maidenhair-fern	7	1	S5	-
Actaea pachypoda	White Baneberry	6	5	S5	-
Anemone acutiloba	Sharp-lobed Hepatica	6	5	S5	-
Anemone canadensis	Canada Anemone	3	-3	S5	-
Anemone virginiana var. *virginiana*	Virginia Anemone	4	5	S5	-
Aquilegia canadensis	Wild Columbine	5	1	S5	-
Caltha palustris	Marsh Marigold	5	-5	S5	-
Clematis virginiana	Virginia Virgin-bower	3	0	S5	-
Ranunculus abortivus	Kidney-leaved Buttercup	2	-2	S5	-
Ranunculus acris	Tall Buttercup	0	-2	SNA	-
Ranunculus hispidus var. *caricetorum*	Swamp Buttercup	5	-5	S5	-
Ranunculus pensylvanicus	Bristly Crowfoot	3	-5	S5	U
Ranunculus recurvatus var. *recurvatus*	Hooked Crowfoot	4	-3	S5	-
Ranunculus sp.	Buttercup Species	0	0	-	-

Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Thalictrum dioicum	Early Meadowrue	5	2	S5	-
Thalictrum pubescens	Tall Meadowrue	5	-2	S5	-
Frangula alnus	Glossy Buckthorn	0	-1	SNA	-
Rhamnus cathartica	Buckthorn	0	0	SNA	-
Agrimonia gryposepala	Tall Hairy Agrimony	2	2	S5	-
Fragaria virginiana	Wild Stawberry	2	1	S5	-
Geum canadense	White Avens	3	0	S5	-
Geum laciniatum	Rough Avens	4	-3	S4	-
Geum sp.	Avens Species	0	0	-	-
Geum urbanum	Clover-root	0	5	SNA	-
Malus sp.	Apple Species	0	0	-	-
Prunus serotina	Wild Black Cherry	3	3	S5	-
Rubus idaeus ssp. *strigosus*	Wild Red Raspberry	0	-2	S5	-
Rubus pubescens	Dwarf Raspberry	4	-4	S5	-
Spiraea alba	Narrow-leaved Meadow-sweet	3	-4	S5	-
Galium aparine	Cleavers	4	3	S5	-
Galium asprellum	Rough Bedstraw	6	-5	S5	-
Galium palustre	Marsh Bedstraw	5	-5	S5	-
Galium sp.	Bedstraw Species	0	0	-	-
Populus balsamifera ssp. *balsamifera*	Balsam Poplar	4	-3	S5	-
Populus deltoides ssp. *deltoides*	Eastern Cottonwood	-	-	S5	-
Populus tremuloides	Quaking Aspen	2	0	S5	-
Salix alba	White Willow	0	-3	SNA	-
Salix bebbiana	Bebb's Willow	4	-4	S5	-
Salix discolor	Pussy Willow	3	-3	S5	-
Salix eriocephala	Heart-leaved Willow	4	-3	S5	-
Salix exigua	Sandbar Willow	3	-5	S5	-
Salix fragilis	Crack Willow	0	-1	SNA	-
Salix petiolaris	Meadow Willow	3	-4	S5	-
Salix purpurea	Basket Willow	0	-3	SNA	-
Salix sp.	Willow Species	0	0	-	-
Acer negundo	Manitoba Maple	0	-2	S5	-
Acer platanoides	Norway Maple	0	5	SNA	-
Acer rubrum	Red Maple	4	0	S5	-
Acer saccharinum	Silver Maple	5	-3	S5	-
Acer saccharum var. *saccharum*	Sugar Maple	4	3	S5	-
Acer x freemanii	Freeman's Maple	-	0	S5	-
Mitella nuda	Naked Bishop's-cap	6	-3	S5	-
Tiarella cordifolia	Heart-leaved Foam-flower	6	1	S5	-
Chelone glabra	Turtlehead	7	-5	S5	-

Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Verbascum thapsus	Common Mullein	0	5	SNA	-
Veronica anagallis-aquatica	Brook-pimpernell	0	-5	SNA	-
Veronica officinalis	Common Speedwell	0	5	SNA	-
Smilax herbacea	Smooth Herbaceous Greenbrier	5	0	S4	-
Solanum dulcamara	Climbing Nightshade	0	0	SNA	-
Thelypteris palustris var. *pubescens*	Marsh Fern	5	-4	S5	-
Tilia americana	American Basswood	4	3	S5	-
Typha angustifolia	Narrow-leaved Cattail	3	-5	S5	-
Typha latifolia	Broad-leaf Cattail	3	-5	S5	-
Ulmus americana	American Elm	3	-2	S5	-
Ulmus pumila	Siberian Elm	0	5	SNA	-
Boehmeria cylindrica	False Nettle	4	-5	S5	-
Laportea canadensis	Wood Nettle	6	-3	S5	-
Pilea pumila	Canada Clearweed	5	-3	S5	-
Urtica dioica ssp. *gracilis*	Slender Stinging Nettle	2	-1	S5	-
Verbena hastata	Blue Vervain	4	-4	S5	-
Viola sororia	Woolly Blue Violet	4	1	S5	-
Viola sp.	Violet Species	0	0	-	-
Parthenocissus vitacea	Thicket Creeper	3	3	S5	-
Vitis riparia	Riverbank Grape	0	-2	S5	-

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c - SRANK (from Natural Heritage Information Centre) for breeding status if: S1 (Critically Imperiled), S2 (Imperiled),S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure) SNA (Not applicable…'because the species is not a suitable target for conservation activities'; includes non-native species); last updated approximately 2019
d - Draft Wellington County Vascular Plant List (Cecile 2017). Status only shown if: R = Rare, U = Uncommon

BEACON ENVIRONMENTAL

Appendix C

Breeding Bird Checklist (2022)

Appendix C

Breeding Bird Checklist (2022)

Common Name	Scientific Name	Status: National Species at Risk COSEWIC [a]	Status: Species at Risk in Ontario Listing [b]	Status: Provincial breeding season SRANK [c]	Status: Wellington Regional Status [d]	Status: Area-sensitive (OMNR) [e]	2022-05-05 Incidentals	2022-05-24 Incidentals	2022-09-20 Incidentals	June 9, 2022: PCS #1	June 9, 2022: PCS #2	June 9, 2022: PCS #3	June 9, 2022: PCS #4	June 9, 2022: PCS #5	June 9, 2022: Incidentals	June 20, 2022: PCS #1	June 20, 2022: PCS #2	June 20, 2022: PCS #3	June 20, 2022: PCS #4	June 20, 2022: PCS #5	June 20, 2022: Incidentals
Great Blue Heron	*Ardea herodias*			S4	S,R		F	F												F	
Green Heron	*Butorides virescens*			S4																1	
Canada Goose	*Branta canadensis*			S5			X								8						
Cooper's Hawk	*Accipiter cooperi*			S4	S	A									F						
Killdeer	*Charadrius vociferus*			S5																	2
Mourning Dove	*Zenaida macroura*			S5											3						1
Downy Woodpecker	*Picoides pubescens*			S5														1			
Northern Flicker	*Colaptes auratus*			S4	S				X									1		2	
Eastern Wood-Pewee	*Contopus virens*	SC	SC	S4	S													1			
Great Crested Flycatcher	*Myiarchus crinitus*			S4								1	2								
Eastern Kingbird	*Tyrannus tyrannus*			S4	S										1	1		1			1
N. Rough-winged Swallow	*Stelgidopteryx serripennis*			S4											F					F	F
Blue Jay	*Cyanocitta cristata*			S5							1		1								
American Crow	*Corvus brachyrhynchos*			S5					X		1	1				1					
Black-capped Chickadee	*Poecile atricapillus*			S5					X		3			1			2	1			
House Wren	*Troglodytes aedon*			S5						1						1			1		
Marsh Wren	*Cistothorus palustris*			S4									1								
American Robin	*Turdus migratorius*			S5					X	1			1	2		1			2	1	4
Gray Catbird	*Dumetella carolinensis*			S4							1	2								1	
Cedar Waxwing	*Bombycilla cedrorum*			S5						1	1										
European Starling	*Sturnus vulgaris*			SE											F				F		F
Red-eyed Vireo	*Vireo olivaceus*			S5									1								
Yellow Warbler	*Setophaga petechia*			S5						2				2		2					2
Black-and-white Warbler	*Mniotilta varia*			S5	S	A					1										
American Redstart	*Setophaga ruticilla*			S5	S	A															1
Common Yellowthroat	*Geothlyphis trichas*			S5								1									
Northern Cardinal	*Cardinalis cardinalis*			S5							2	1							1		
Indigo Bunting	*Passerina cyanea*			S4												1		1	1		
Savannah Sparrow	*Passerculus sandwichensis*			S4	S	A									1						
Song Sparrow	*Melospiza melodia*			S5						2		1	3	1	3		2	2		1	3
Red-winged Blackbird	*Agelaius phoeniceus*			S4			F			4			3	4	1	4			2	5	5
Eastern Meadowlark	*Sturnella magna*	THR	THR	S4	S	A									1						
Common Grackle	*Quiscalus quiscula*			S5											F						
Brown-headed Cowbird	*Molothrus ater*			S4															1		
Baltimore Oriole	*Icterus galbula*			S4	S											1					
American Goldfinch	*Spinus tristis*			S5						1	1	F	F			1	1	F		F	2

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b - Species at Risk in Ontario List (as applies to ESA) as designated by COSSARO (Committee on the Status of Species at Risk in Ontario): END = Endangered, THR = Threatened, SC = Special Concern

c - SRANK (from Natural Heritage Information Centre) for breeding status if: S1 (Critically Imperiled), S2 (Imperiled),S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure) SNA (Not applicable…'because the species is not a suitable target for conservation activities'; includes non-native species); last updated approximately 2022

d - Significant Wildlife List for Wellington County from the City of Guelph Natural Heritage Strategy, Volume 2 (Dougan & Associates with Snell and Cecile 2009), last updated by the City of Guelph 2012. Status only shown if: S = Significant, R = Rare

Note that the following designations were excluded from this list:

** = Only habitats that support or have recently supported active nests should be considered significant;

† = Bank Swallow: Significant only when found nesting in colonies equal to or greater than 100. However, recent OBBA data for Wellington County should be reviewed to see if this is appropriate.

† = Cliff Swallow: Significant only when found nesting in colonies equal to or greater than 8. However, recent OBBA data for Wellington County should be reviewed to see if this is appropriate.

‡ = Being small and secretive, these species are often overlooked. When more information is collected, it is possible that they may not merit significant species status in the future.

o= Habitat protection should be considered only when larval habitat is present at or in close proximity to where adults were documented.

Δ = Considered significant at present, but may prove to be too common to be so regarded in the future.

e - Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 p plus appendices.

Beacon Breeding Status classifications:

- breeding pair

F- foraging/flyover

x- Species observed not breeding

APPENDIX I

Technical Memoranda: Analysis of Potential Recharge at the Blue Triton Brands Aberfoyle Facility SWB Model 2022 Update and TW3-80 Drawdown Analysis

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

Memorandum

Date: January 27, 2023

From: Xiaomin Wang and Christopher Neville

To: Greg Padusenko, WSP

Project: SSP-994-33

Subject: **Analysis of potential recharge at the BlueTriton Brands Aberfoyle facility SWB model 2022 update**

Overview

S.S. Papadopulos & Associates, Inc. (SSP&A) has applied the SWB model of the United States Geological Survey to estimate potential recharge in the Aberfoyle area during 2022. The analysis has been conducted to support the assessment of the likely variability in potential recharge and its distribution across the area around the production well TW3-80 at the Aberfoyle facility.

The results of the first SWB analysis for the Aberfoyle area were presented in the 2018 Aberfoyle Annual Monitoring Report (Golder Associates, March 2019). The analysis covered the years 2008 through 2018. The SWB analyses have subsequently been updated for the 2019 through 2022 Aberfoyle Annual Monitoring Reports (Golder Associates, March 2020, March 2021 and March 2022). Climate data from the Kitchener-Waterloo Airport station were specified for the analyses for the years 2018-2020. Prior to conducting the analysis for conditions in 2021, it was judged that the data from Kitchener-Waterloo Airport station were not representative. The analysis for the 2021 Annual Monitoring Report used 2021 climate data from the Grand River Conservation Authority (GRCA) Shade's Mills climate station. The climate data from the Shade's Mills climate station has been specified for the analysis of 2022 conditions. In addition, for consistency a complete analysis of potential recharge between 2008 and 2022 has been developed here specifying data exclusively from the Shade's Mills station.

In 2022 the total reported precipitation was 682 mm. The annual potential recharge estimated with the SWB model is about 85 mm. The results of the updated analysis are consistent with the general trends inferred from the analyses for 2008-2021.

1. Introduction

In March 2019, S.S. Papadopulos & Associates, Inc. (SSP&A) applied the SWB model to estimate potential recharge to the water table over the area surrounding the Nestlé Waters Canada (now BlueTriton Brands) Aberfoyle facility. The SWB is a simplified Soil-Water Balance code developed by the United States Geological Survey (Westenbroek et al., 2010). The results of the analyses with 2008-2018 precipitation data were presented in the 2018 Aberfoyle Annual Monitoring Report (Golder Associates, March 2019). The SWB analyses have subsequently been updated with precipitation data from 2019 to 2021, with results presented in the corresponding Aberfoyle Annual Monitoring Reports (Golder Associates, March 2020, March 2021 and March 2022). This memorandum documents the results of the SWB analyses applied with 2022 daily precipitation and temperature data. The 2022 daily precipitation and temperature data are derived from the Shade's Mills climate station provided by the Grand River Conservation Authority. In the March 2022 report, analyses for 2008-2020 incorporated climate data from the Kitchener-Waterloo climate station; while the 2021 analysis incorporated climate data from the Shade's Mills station. In this memorandum, the analyses for 2008-2020 are updated with climate data from a consistent source, Shade's Mills climate station.

The SWB model refers consistently to "recharge". Following the guidance of Dr. Hugh Whiteley, the quantity that is reported as "recharge" should be interpreted as "potential recharge" (H. Whiteley, written communication December 7, 2021). Potential recharge is that portion of the precipitation that has moved downward across the earth surface plane (i.e., infiltration) and that has the potential to eventually recharge the water table (H. Whiteley, written communication December 7, 2021). The interval between the bottom of the root zone and the top of the water table is not considered in the SWB analysis. For cases in which the water table is close to the bottom of the root zone, the results of the SWB model should approximate the annual recharge. For cases in which there is a significant travel time between the bottom of the root zone and the water table, the SWB results may not match actual groundwater recharge rates in time or in space.

This memorandum consists of seven main sections:

1. Introduction [this section];
2. SWB conceptual model;
3. SWB model input;
4. Sources of input data for the Aberfoyle area;
5. SWB model update; and
6. Potential recharge calculated for 2022.

7. References.

2. SWB conceptual model

The SWB model implements a modified Thornthwaite-Mather soil-water balance analysis (Westenbroek et al., 2010). The SWB model estimates each component of the soil-water balance for daily timesteps. Model outputs may be daily, monthly, or annual values of infiltration, along with estimates of interception, snow cover, runoff, potential and actual evapotranspiration. The spatial distributions of these quantities are calculated over time using a gridded data structure.

As indicated in the introduction, the documentation of the SWB model refers to infiltration. This nomenclature will be retained here, recognizing that "infiltration" is more correctly interpreted as "potential recharge". The SWB model calculates infiltration with a modified Thornthwaite-Mather soil-water accounting method (Thornthwaite and Mather, 1957). Infiltration is calculated as the difference between the change in soil moisture and sources and sinks:

$$infiltration = (precip + snowmelt + inflow) - (interception + outflow + ET) - \Delta\, soil\ moisture$$

The descriptions of the terms in the water balance are presented below, following the terminology of the documentation of the SWB model:

Precip – daily values of precipitation using ASCII or Surfer grid formats;

Snowmelt – daily values of snowmelt calculated based on air temperature of daily mean, maximum and minimum;

Inflow – daily values of water inflow into a cell calculated over a flow-direction grid derived from a digital elevation model;

Interception – daily values of rainfall trapped and used by vegetation, calculated by use of a "bucket" approach assuming a user-specified amount which varies from different land-use types and seasons;

Outflow – daily values of water outflow from a cell calculated based on curve number rainfall-runoff relation (Cronshey and others, 1986), soil type and runoff conditions;

ET – daily values of evapotranspiration. There are five methods included in the SWB code. The simplest method is Thornthwaite and Mather (1957) requiring only daily maximum and minimum air temperature. The Thornthwaite-Mather method contains functions considering daylight length, radiation, sunset angle for the estimation of potential evapotranspiration; and

Δ soil moisture – daily values of the amount of water held in soil storage for a given cell calculated based on the Thornthwaite and Mather (1957) procedure.

3. SWB model input

The datasets required for the application of the SWB model are listed below.

Gridded (ESRI ASCII or Surfer)
Land-use classification
Hydrologic soil group
Flow direction
Available soil-water capacity
Tabular
Climate data (e.g. precipitation and temperature)
Soil and land use property lookup table
Soil-water retention table (Thornthwaite and Mather, 1957)

A text model control file must be prepared for running the SWB code and the following additional information is required:

- Model domain, grid size;
- Growing season start and end;
- Initial soil moisture;
- Initial snow cover;
- Runoff calculation and routing method;
- Evapotranspiration method; and
- Output options.

Optional inputs for *ET* methods other than Thornthwaite and Mather (1957) and Hargreaves and Samani (1985) include daily average wind speed in m/s, average relative humidity in percent, maximum relative humidity in percent and percentage of possible sunshine.

4. Sources of input data for the Aberfoyle area

The limits of the area considered in the analysis are shown in Figure 1. The area has been selected to extend northeast beyond the expected limits of the capture zone of the Aberfoyle facility production well TW3-80, and southwest to the Sideroad 10 stream gauge on Mill Creek.

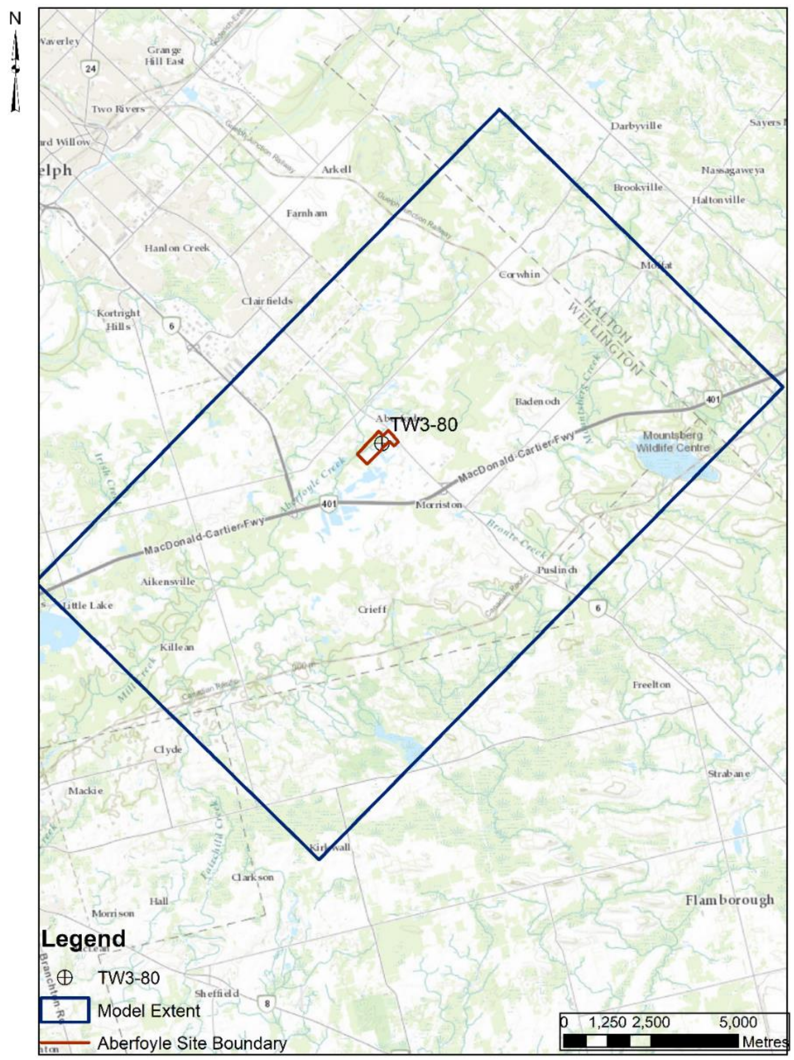

Figure 1. Model limits

Climate data

Two types of climate data are required: daily precipitation and temperature (minimum, maximum and average). Both sets of data are obtained from the climate station at Shade's Mills, monitored by the Grand River Conservation Authority. When data are missing from the station, gaps are filled using the daily precipitation data from the Kitchener/Waterloo (KW) Station.

Land cover data

Land cover data are obtained from the Southern Ontario Land Resource Information System (SOLRIS v2) mapping compiled by OMNRF (2015).
https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home

Flow direction data

Flow direction data are obtained from the Ontario Integrated Hydrology Data (OMNRF, 2012).
https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home

Hydrologic soil type data

Hydrologic soil groups are used to estimate runoff from precipitation. The classification of soils within the study area has been obtained using the Ontario Data - Soil Survey Complex created by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA, 2012).
https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home

Soil-water capacity data

The soil-water capacity data are specified based on the textures of the surficial soils. The description of the soil textures, 'A' horizon, are provided in the field named "ATEXTURE1" of the Soil Survey Complex Data obtained from the OMAFRA website. A lookup table relating soil-water capacity and soil texture is reproduced below (Earthfx, 2016; Table 8.11).

Table 8.11: Soils mapping based parameters lookup table.

"A" Horizon Texture	Description	Proportion	PRMS Soil Type	Wilting Point (wp)	Field Capacity (Fc)	Porosity (n)	Plant Available Water (PAW)	Sat Hydraulic Conductivity (mm/hr)
SIL	Silt Loam	27%	Loam	0.14	0.32	0.48	0.18	12.2
L	Loam	22%	Loam	0.13	0.27	0.46	0.14	18.6
SL	Sandy Loam	15%	Sand	0.08	0.18	0.45	0.10	50.3
CL	Clay Loam	11%	Clay	0.21	0.35	0.47	0.14	16.7
Unclassified	Unclassified	8.7%	Loam	0.13	0.26	0.40	0.13	9.3
LS	Loamy Sand	5.9%	Loam	0.06	0.12	0.46	0.06	91.3
FSL	Fine Sandy Loam	3.5%	Loam	0.09	0.21	0.45	0.12	42.0
ORG	Organic	3.3%	Clay	0.16	0.34	0.65	0.18	2.1
GL	Gravelly Loam	1.9%	Sand	0.05	0.11	0.42	0.05	12.4
SICL	Silty Clay Loam	0.51%	Loam	0.21	0.38	0.51	0.17	5.9
FS	Fine Sand	0.14%	Sand	0.03	0.08	0.46	0.05	110.0
LFS	Loamy Fine Sand	0.12%	Loam	0.07	0.14	0.45	0.07	72.5
GS	Gravelly Sand	0.11%	Sand	0.02	0.05	0.41	0.03	76.0
VFSL	Very Fine Sandy Loam	0.08%	Loam	0.13	0.25	0.45	0.12	19.5
GSL	Gravelly Sandy Loam	0.01%	Sand	0.00	0.00	0.43	0.00	33.5

Soil and land use property lookup table

The soil and land use property lookup table is developed with the following procedure:

- Obtain the land use description provided by SOLRIS v2, e.g., Forest – tree cover > 60%;
- Download the Land Use Code (LU) "LU_lookup_WISCLAND_w_forested_hillslope.txt" from the USGS website;
- Based on the land description, obtain the SCS number, maximum infiltration rates, interception storage values and depth of root zone from the USGS table; and
- Integrate all the information into a new lookup table for the Aberfoyle analysis.

5. SWB model update

The SWB model version 1.0.0 was applied previously to estimate potential recharge over the area surrounding the Aberfoyle facility for 2008-2021. The United States Geological Survey (USGS) compiled SWB version 1.0.0 on November 10, 2012 ("SWB_2012"). The USGS referred to an updated version of the program, version 2.0, at the website https://pubs.er.usgs.gov/publication/tm6A59. However, the link to download the program did not actually work and the USGS has never made version 2.0 available.

A newer version of the SWB program, version 1.2, can be found via the following link: https://www.sciencebase.gov/catalog/item/5d1281b1e4b0941bde56eafb. This specific version ("SWB_2019") was compiled in March 2019 and the main difference from the previous version of the model is the inclusion of the irrigation module. SWB Version 1.2 has been applied for the analysis of the 2022 climate data. Prior to conducting the analysis for the 2022 data, the consistency of the results from SWB versions 1.0.0 and 1.2 has been assessed. This has been accomplished by repeating the analyses for the 2021 climate data with both versions of the SWB model.

The SWB_2019 model was applied for the 2021 Aberfoyle recharge analysis using the same input data applied for the SWB_2012 model. There are some differences between the input requirements for the SWB_2012 and SWB_2019 models. For example, the reference column in the lookup table has to be removed and the potential ET binary output is no longer an option.

The annual potential recharge for 2021 estimated with the SWB_2012 model was about 150 mm. The annual potential recharge estimated with the SWB_2019 model is about 170 mm. The SWB_2019 model predicts higher potential recharge rates during the hot summer months, as indicated with the green box shown in Figure 2.

The calculated distributions of annual potential recharge for 2021 using the SWB_2012 and the SWB_2019 models are shown in Figure 3 and Figure 4, respectively. Noting the overall difference of 20 mm, the results from the SWB_2019 model are generally consistent with the SWB_2012 model. The SWB_2019 model will be used for the analyses of 2022 data and subsequent years. This switch is motivated by our concern that the USGS will no longer support the older version of the software and that the SWB_2019 version is more computationally efficient.

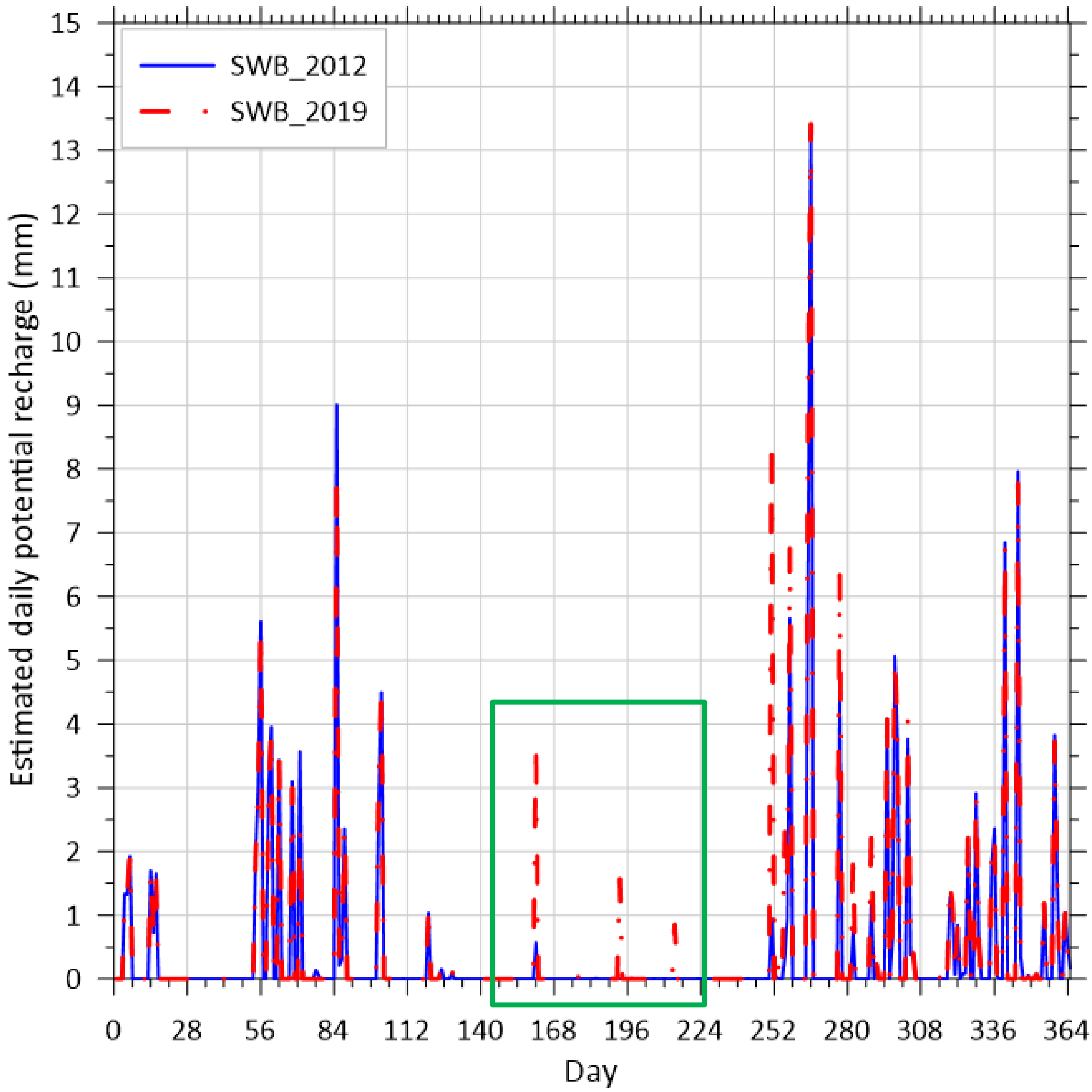

Figure 2. Estimated daily potential recharge over the study area using the SWB_2012 and SWB_2019 models

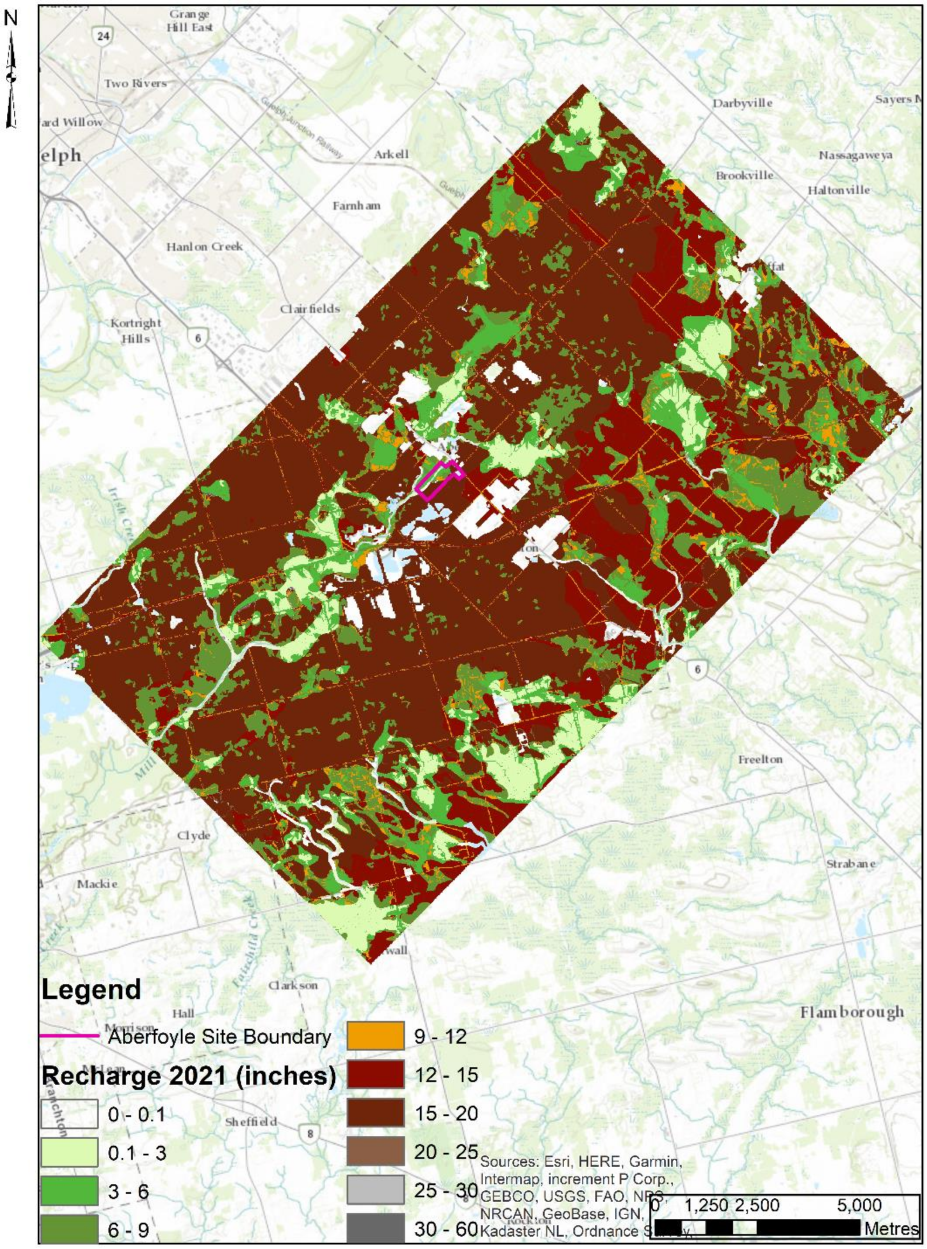

Figure 3. Calculated distribution of annual potential recharge for 2021, SWB_2012 model

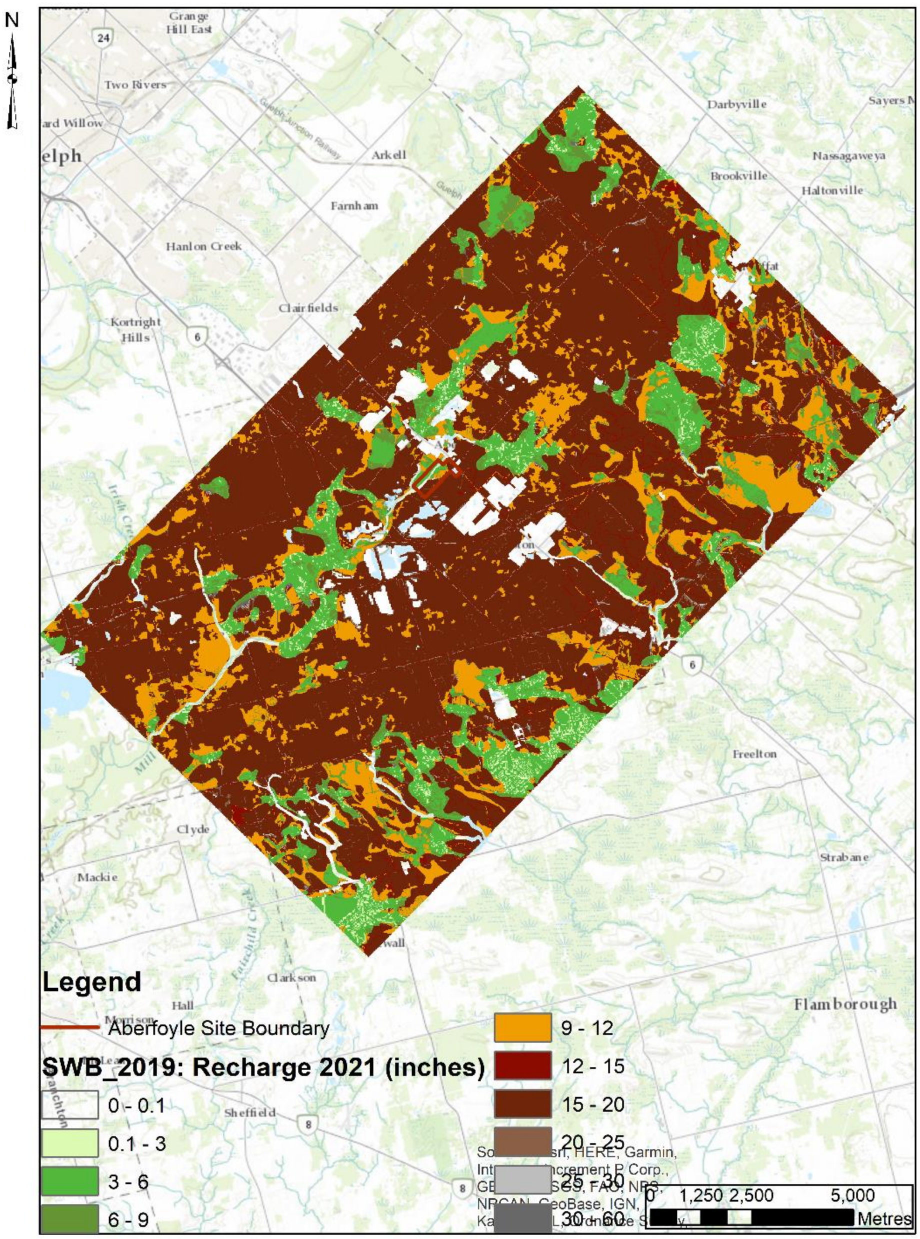

Figure 4. Calculated distribution of annual potential recharge for 2021, SWB_2019 model

6. SWB results for the Aberfoyle area for 2022

The calculated distribution of annual potential recharge for 2022 is shown in Figure 5. The distribution of estimated daily potential recharge values over the study area are shown in Figure 6.

The annual total precipitation and the annual total potential recharge values estimated with the SWB model from previous analyses are tabulated below. The estimates of potential recharge have been developed with a consistent precipitation record from the GRCA Shade's Mills climate station. Over the 15-year period of the analyses, the estimated annual potential recharge has varied over a relatively wide range, from about 85 mm to 221 mm. Values of estimated potential annual recharge are plotted against the total annual precipitation in Figure 7. As shown in the figure, the estimated annual potential recharge for 2022 follows the general trend of the results for previous years. The potential recharge for 2022 is the lowest estimated over the 15-year period.

Year	Annual total precipitation (mm)	Annual potential recharge (mm)
2008	1200.8	218.0
2009	1011.0	165.9
2010	921.5	144.7
2011	1023.9	202.2
2012	807.1	97.7
2013	1108.1	199.8
2014	898.7	171.3
2015	839.4	117.1
2016	937.8	127.0
2017	1091.8	210.3
2018	1048.6	221.2
2019	1058.9	205.1
2020	856.5	130.7
2021	1022.8	165.3
2022	682.3	84.8
Mean	967.3	164.1
Median	1011.0	165.9

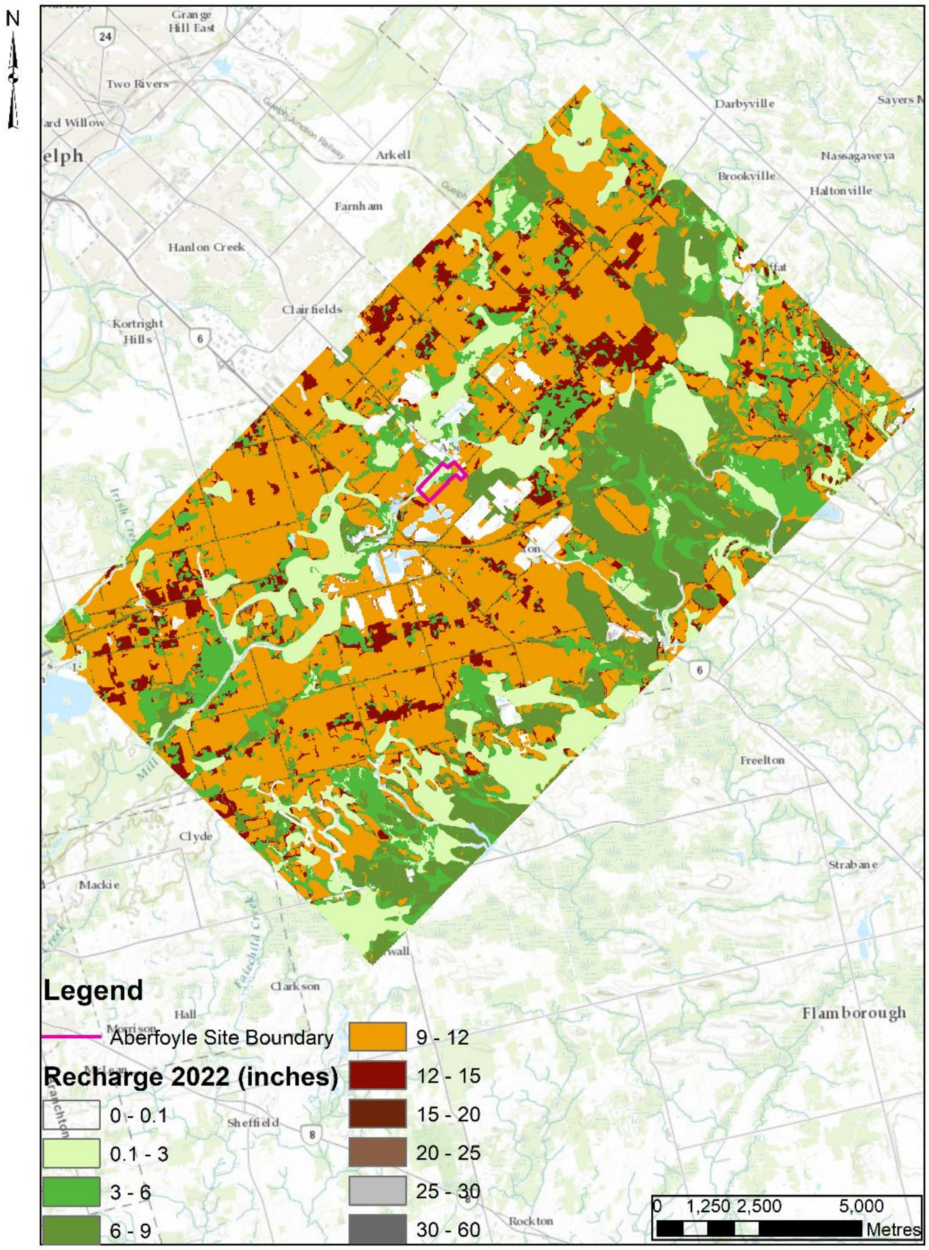

Figure 5. Calculated distribution of annual potential recharge for 2022

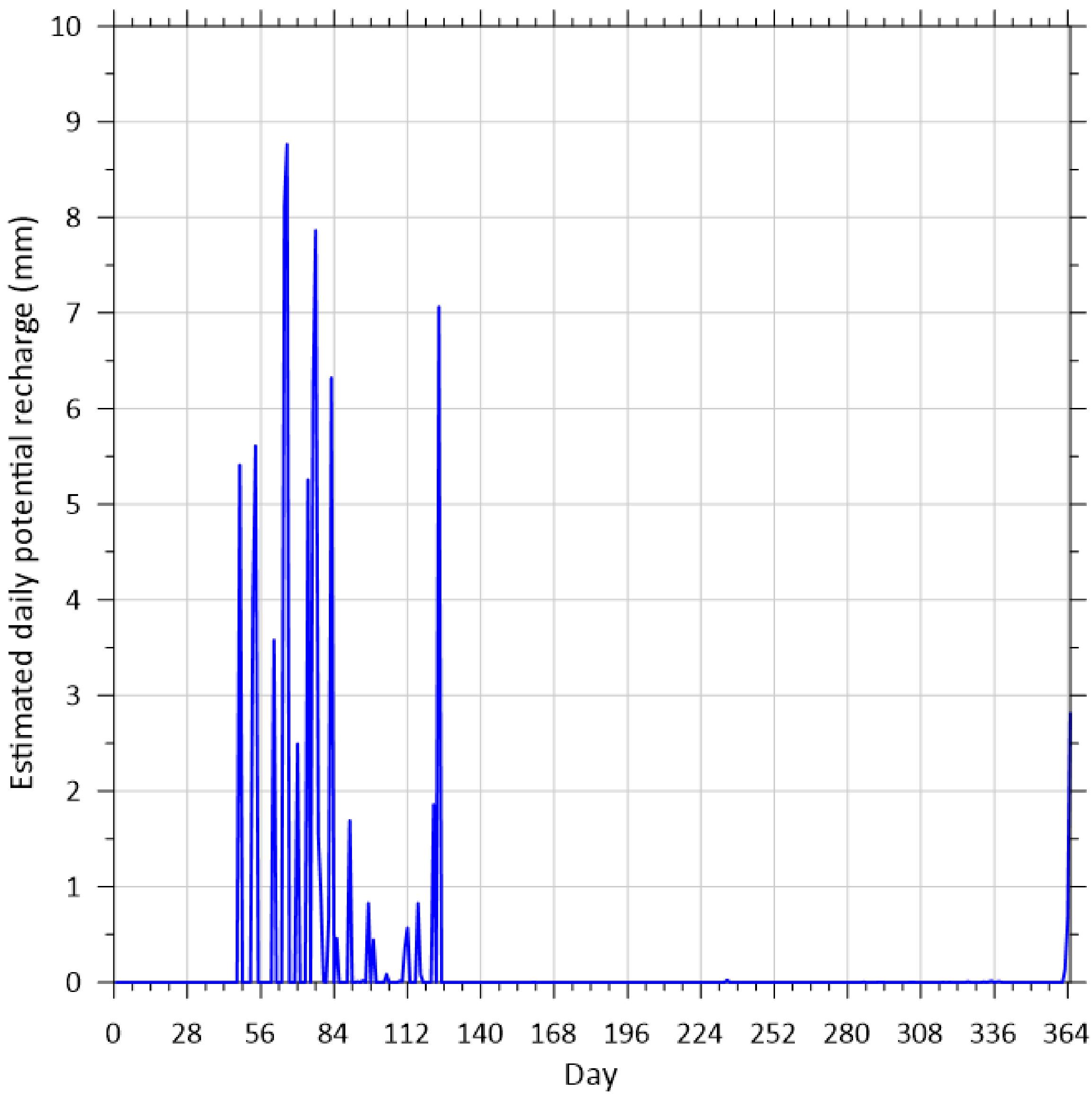

Figure 6. Estimated daily potential recharge over the study area

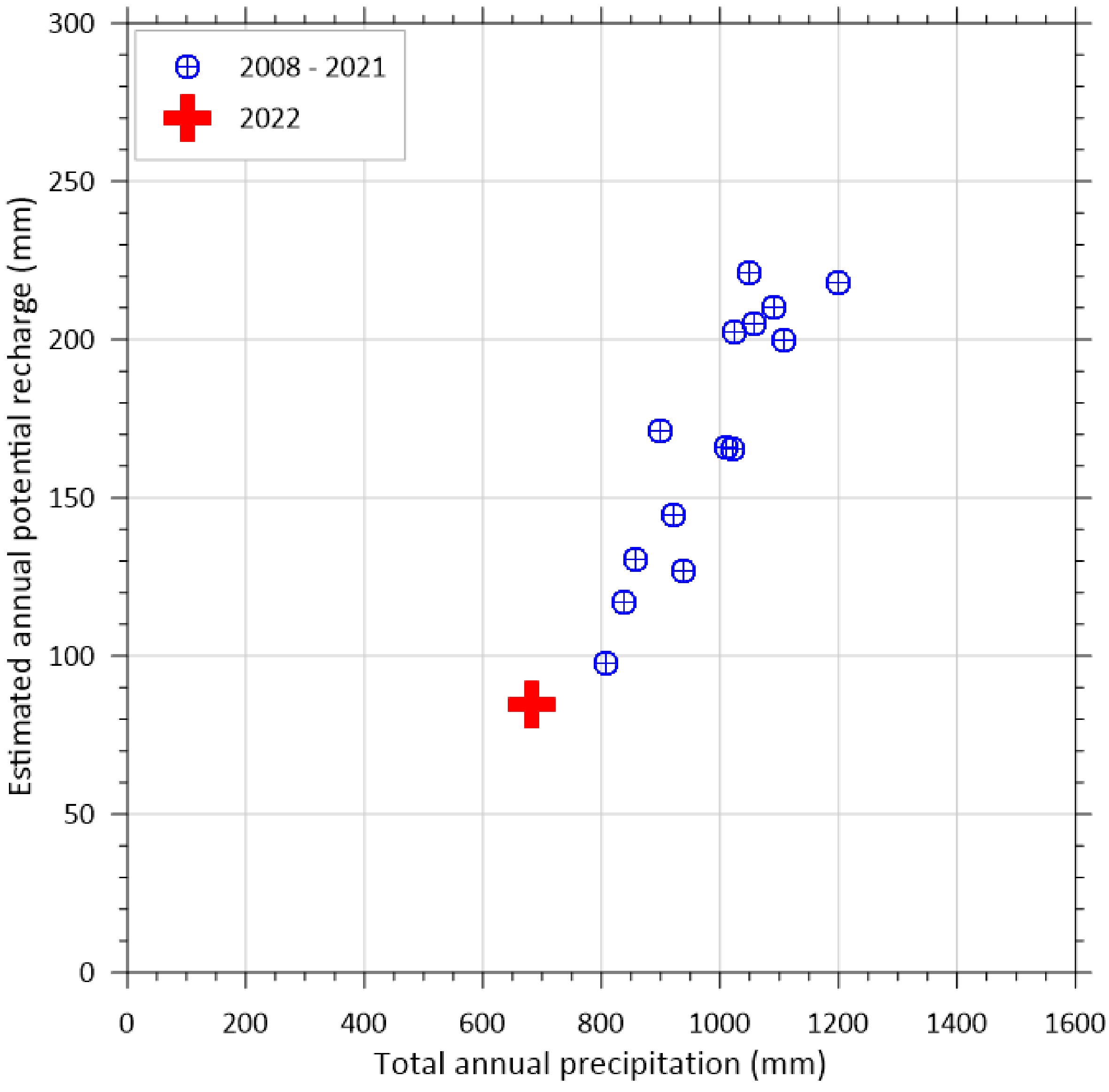

Figure 7. Relationship between estimated annual potential recharge and precipitation

7. References

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Westenbroek, S.M., V.A. Kelson, W.R. Dripps, R.J. Hunt, and K.R. Bradbury, 2010: SWB—A Modified Thornthwaite-Mather Soil-Water-Balance code for estimating groundwater recharge, U.S. Geological Survey Techniques and Methods 6–A31, 60 p.

TECHNICAL MEMORANDUM

DATE February 6, 2023 **Project No.** 20449101

TO Andreanne Simard, Ph.D., Natural Resource Manager
Blue Triton Brands

CC John Piersol, Chris Neville

FROM Greg Padusenko **EMAIL gregory.padusenko@wsp.com**

TW3-80 DRAWDOWN ANALYSIS

Withdrawals from well TW3-80 by Blue Triton Brands (Blue Triton) are authorized by Permit to Take Water (PTTW) number 3133-C5BUH9. Water levels have consistently been presented as hydrographs that simultaneously present up to five years of daily pumping data from TW3-80, daily precipitation, and daily water level data (Figure D1a in Annual Report). Because water levels at TW3-80 can vary up to 15 m each day, the TW3-80 hydrograph illustrates both the daily maximum and daily minimum levels rather than each hourly measurement. The hydrographs are effective for enabling a rapid, qualitative assessment of multiple years of data, graphically illustrating the degrees of daily, seasonal, and annual variability. Furthermore, long-term trends in aquifer capacity can be noted in the multi-year hydrographs, and the absence of clear declining trends in water levels is a significant line of evidence that the aquifer is being sustainably managed.

However, a qualitative review of the hydrographs is limited in its ability to support the interpretation of long-term trends, and to distinguish between potential causes of water level changes. The pumping rate of TW3-80 is the primary influence on the water level in TW3-80. Other factors such as aquifer recharge and nearby competing withdrawals also influence water levels, but the degrees to which they contribute to water level changes cannot be distinguished by visual inspection. The following analysis has been completed to quantitatively determine the degree to which TW3-80 pumping rates affect water levels at TW3-80.

TW3-80 Annual Withdrawal Volumes

Annual water withdrawals from well TW3-80 increased each year from 2011 through 2016, before decreasing in 2017 through 2019. The water takings from 2019 to 2021 are similar but have increased slightly over the three years. The water taking in 2022 increased compared to the previous three years and is similar to the volume taken in 2018. Figure 4.1 in the Annual Report shows a graph of the annual pumpage since 2001.

To quantitatively demonstrate the degree to which the water levels are directly related to pumping rates, the following analysis evaluates the relationship between monthly pumping rates with monthly average water levels in TW3-80.

Analysis

The TW3-80 transducer dataset extends from September 2005 through December 2022. Hourly water level measurements for the entire dataset were averaged each day and then assembled in monthly averages. Months in which fewer than 20 days of water levels were recorded, due to periodic data gaps related to transducer failure, are excluded from the analysis. Daily groundwater withdrawal data from TW3-80 are aggregated as monthly totals. The monthly averaged water levels are plotted against average monthly pumping on Figure 1.

Figure 1 illustrates the inverse linear relationship between the monthly TW3-80 pumping rate, and the average monthly water levels in TW3-80. Based on a regression of 201 months of data, every 100 L/min increase in pumping results in a 0.62 m decline in water level. Most individual data points do not fall directly on the regressed line, meaning that variables other than the pumping rate influence the TW3-80 water level; however, 186 of the 201 data points (93%) are within 1 m of the expected water level, defined by the regression.

The regression goodness of fit (r^2 statistic) may be used to assess the ability of the regression relation to explain the relationship between the pumping level and the pumping rate. The r^2 value of 0.89 means that the monthly average pumping rate accounts for 89% of the variation in the monthly average TW3-80 water level. The 11% balance is understood to be caused by the other external variables, such as variations in vertical flow into the deep bedrock and other nearby groundwater withdrawals.

Effect of Precipitation

It is very challenging to quantitatively describe the relationship between precipitation and aquifer water levels, as precipitation is not the same as recharge which in turn is not the same as flow into the Lower Bedrock Aquifer. The relationship between precipitation and aquifer recharge is seasonally variable, with most recharge occurring in late winter and early spring, after the ground surface thaws and before plant transpiration becomes significant. The relationship between precipitation and aquifer recharge is not linear either, as unusually intense precipitation is likely to increase runoff, and not enhance recharge. Additionally, aquifer recharge (or the lack thereof during a drought) to the deep aquifer is not instantaneous, such that relating precipitation in a discrete month is unlikely to have a good correlation to the average water level in that same month.

However, the data illustrated on Figure 1 suggest that variations in aquifer recharge (and by extension, precipitation) have no greater than about +/-1 m effect on aquifer water levels. As stated, 186 of 201 data points in this regression are within +/-1 m of the regressed line. This means that even under drought conditions and significant precipitation deficits, the deep aquifer is affected by no greater than 1 m beyond what is predicted based only on the monthly pumping.

Conclusions

Changes in groundwater withdrawals from TW3-80 account for 89% of the influence on changes in water levels measured at TW3-80. For each 100 L/min change in the monthly average pumping rate, water levels are predicted to change by 0.62 m. The effects of precipitation deficits that have been observed, affecting recharge volumes to the Lower Bedrock Aquifer, have been inferred to have no greater impact than about 1 m of additional decline on TW3-80 water levels.

WSP Canada Inc.

GRP/JAP/

Attachments: Figure 1

https://golderassociates.sharepoint.com/sites/139500/project files/6 deliverables/aberfoyle/2022 annual report/draft/app i technical memo/memo info/20449101 tm aberfoyle tw3-80 drawdown 6feb2023.docx

APPENDIX A

Figure 1

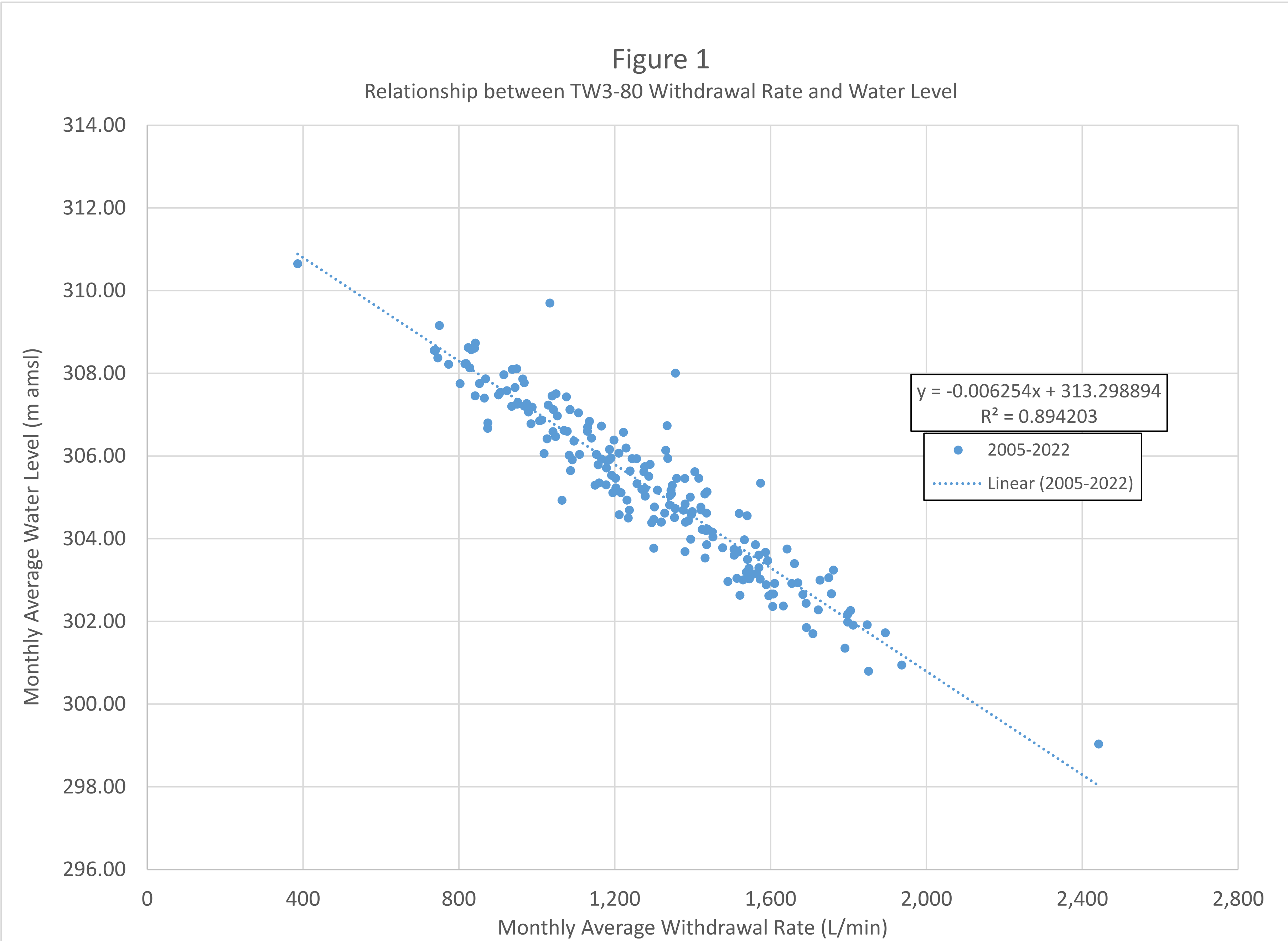
Figure 1
Relationship between TW3-80 Withdrawal Rate and Water Level
y = -0.006254x + 313.298894
R² = 0.894203
2005-2022
Linear (2005-2022)
Monthly Average Water Level (m amsl)
Monthly Average Withdrawal Rate (L/min)
314.00
312.00
310.00
308.00
306.00
304.00
302.00
300.00
298.00
296.00
0
400
800
1,200
1,600
2,000
2,400
2,800

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