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June 27, 2024

Primont (Thorold/Welland) Inc.
c/o Ian G. MacPherson, P. Eng.
Vice President, Land Development
9130 Leslie Street, Suite 301
Richmond Hill, Ontario L4B 0B9

Re: Hydrogeologic Study and Wetland Water Balance, 436 Quaker Road, Welland,
and Lot 228/Part Lot 174, Thorold, ON

Dear Mr. MacPherson,

1.0 Introduction and Background Information

Terra-Dynamics Consulting Inc. respectfully submits this DRAFT Hydrogeologic Study and Wetland Water Balance of 436 Quaker Road Welland, and Lot 228/Part Lot 174, Thorold (the Site, Figure 1, see attachments). The rectangular 60.8 hectare Site is located at the northwest corner of Quaker Road and First Avenue, within both the City of Welland (southern part of Site) and south of an unopened Merritt Road allowance within the City of Thorold (northern part of Site) (Figures 1 and 2, see attachments). This report has been completed as part of planning for future residential development of the currently agricultural lands. No tile-drainage is mapped for the Site (OMAFRA, 2023).

The Ministry of Natural Resources and Forestry (MNRF) have mapped at the Site approximately 17 hectares of Provincially Significant Wetland (PSW) associated with the Niagara Street Cataract Road Woodlot Wetland Complex (MNRF, 2009), this includes (Figure 2, see attachments):

1. 5.2 hectares of swamp along Quaker Road and First Avenue in the southeast corner of the Site,
2. 8.2 hectares of swamp in the northern portion of the Site, and
3. 3.6 hectares of marsh in the northeast corner of the Site close to Cataract Road.

A Wetland Water Balance was completed to:

1. Ensure no negative impacts to the natural heritage system; and

2. Inform future stormwater management design at the Site in such a manner that pre-development wetland water balance conditions are maintained.

The wetland water balance assessment evaluated the pre-development hydrologic regime of the Provincially Significant Wetland areas on-site associated with the Niagara Street Cataract Road Woodlot Wetland Complex (MNRF, 2009) as well as additional wetland vegetation mapped by GEI Consultants (2022).

2.0 Methodology

Primary tasks completed as part of the Hydrogeology Study and Wetland Water Balance included:

A. Submission of a Water Balance Terms of Reference (Appendix A) to the Niagara Peninsula Conservation Authority (NPCA) and Niagara Region for review and comment. NPCA indicated they were satisfied (Appendix A) with the submission of an Updated Water Balance Terms of Reference reflecting a response to initial NPCA comments on the proposed Terms of Reference, however, as of the date of this report, no response was received from Niagara Region.

B. Initial characterization of the physical setting was completed using published information from the following government agencies: (i) the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), (ii) the Ministry of Natural Resources and Forestry (MNRF), (iii) the Ministry of the Environment, Conservation and Parks (MECP), (iv) the Niagara Peninsula Conservation Authority (NPCA), and (v) the Ontario Geological Survey (OGS);

C. Field investigations to refine site conditions have included:

   (i) 2021 and 2022 geotechnical borehole investigations including laboratory soil grain-size analyses;

   (ii) Construction of thirteen groundwater monitoring wells between 2021 and 2022;

   (iii) Installation of eighteen wetland staff gauges deployed with water level dataloggers monitoring from July 2022 to November 2023, as well as wetland soil hand-augering;

   (iv) Seasonal manual groundwater level measurements at 13 locations from May 2022 to November 2023, and water level dataloggers deployed at four monitoring wells from May 2022 to November 2023;

   (v) Hydraulic testing of groundwater monitoring wells at 11 selected locations; and

   (vi) Tow Path Drain surface water level monitoring at four locations from August to November 2023.

D. Modelling of pre-development monthly water balance conditions through consideration of: surface water catchments, land cover, soils, climate normals and wetland hydroperiods in order to inform future site design.

3.0 Physical Setting

According to historical aerial photos, most of the Site was cleared for farming in 1934. Aerial photos indicate that areas of the north-central and southeast portions of the Site had gradually become re-vegetated by 2000, similar to the extent of the vegetation in 2016 (Niagara Navigator, 2023).

The Site is flat-lying with ground surface at approximately 185 metres above sea level (m ASL) along the western boundary sloping to both the northeast at 182 m ASL and the southwest at 181 m ASL, (Figure 2, see attachments), with little to no slope, being less than 1% slope on average.

The Site is regionally located on the Haldimand Clay Plain (Chapman and Putnam, 1984) described in the NPCA Port Robinson Subwatershed Study (part of the Site is within that study area, Figure 1, see attachments), as a physical feature that "…*prevents significant infiltration to depth*…" (NPCA, 1999). However, the upgradient Fonthill Kame-Delta Complex also plays a role in the hydrology of the Site as it

"*is a thick deposit consisting mainly of permeable sand and gravel which provides a significant groundwater flow system within the surrounding clay plain*" (Blackport et al, 2005). This is discussed in Section 3.5 and visualized in Figure 3.

3.1 Surface Water

3.1.1 Watershed and Catchments

Overall drainage of the Site is split approximately between two subwatersheds (Figure 1, see attachments): (i) Port Robinson West (NPCA, 1999) - northern part of the Site and, (ii) the Tow Path Drain Subwatershed Catchment – southern part of the Site. The drainage divide between these two subwatersheds roughly parallels the municipal boundary between the City of Thorold to the north and the City of Welland to the south (Figure 2, see attachments). The Port Robinson West, and Tow Path Drain Subwatersheds, are 1,409 ha and 503 ha in size, respectively, consequently the Site is 2% of the Port Robinson Subwatershed (~29 ha), and 6% of the Toe Path Drain Subwatershed (~32 ha).

On-site surface water drainage can be further refined into four pre-development catchments (Figure 4): (i) Singer's Drain West; (ii) Singer's Drain East, (iii) Tow Path Drain North; and (iv) Tow Path Drain South.

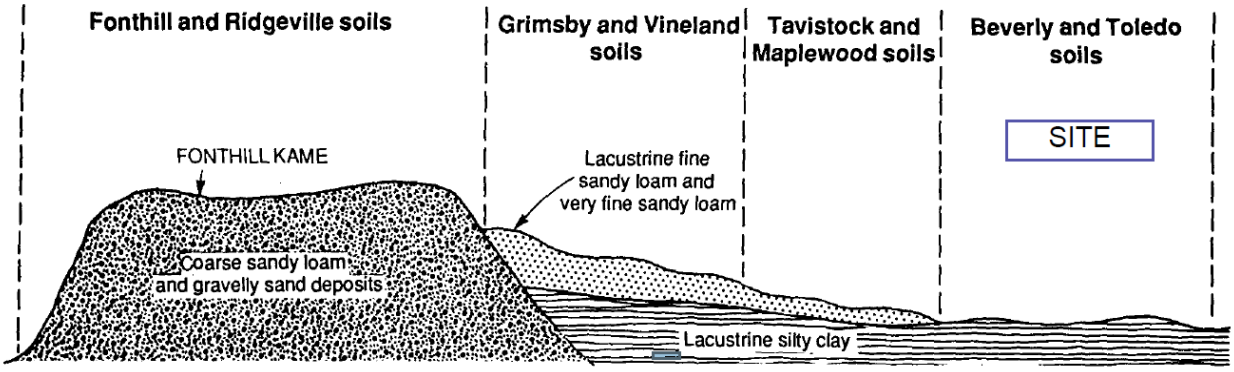


Figure 3 – Schematic landscape cross-section showing the relationship of soils on the Fonthill Kame-Delta Complex and its southern slopes (Kingston and Presant, 1989)

3.1.2 Watercourses

Within the northern part of the Site, i.e. flowing to Singer's Drain, are two watercourses that begin off-site to the west of Rice Road (Figure 2, see attachments), and meet within the Provincially Significant Wetland (PSW) north of the Site, and eventually outlet north of the Site at Cataract Road. NPCA (2017) have previously mapped the northern watercourse as ephemeral and the southern watercourse as intermittent or ephemeral (Figure 2, see attachments). No baseflow was identified for these two watercourses at Rice Road during 2003 surface water monitoring completed as part of the Fonthill Kame-Delta Complex study (Blackport et al, 2005).

Within the southern part of the Site, i.e. flowing to Tow Path Drain, are also two watercourses, that meet within the PSW on-site, and flow roughly west to east from Rice Road and Quaker Road, outletting at First Avenue (Figure 2, see attachments). NPCA (2017) have previously mapped these two

watercourses as ephemeral, potentially becoming intermittent close to 1st Avenue. No baseflow was identified at upstream Rice Road during 2003 and 2004 surface water monitoring completed as part of the Fonthill Kame-Delta Complex study (Blackport et al, 2005). Investigations in 2018 by Aquafor Beech (2019) also identified dry conditions upstream of the Site (at the more southern watercourse) and intermittent conditions at 1st Avenue. These results correspond with more recent reporting for this portion of the Tow Path Drain that:

> "*throughout the length of the drain no signs of groundwater inputs were noted and flows in the drain are entirely dependent on precipitation surface water inputs within its catchment…the drain supports ephemeral flows with minimal flows during the spring freshet and ending by May…the drain flows through… a shallow 1-1.5 m wide straight dug channel/ditch with a shallow U shaped channel morphology…does not provide permanent fish habitat*" (Beacon Environmental, 2022).

A series of four surface water staff gauges (SG-101, SG-102, SG-103 and SG-104) were installed on-site along Tow Path Drain in August 2023 (Figure 2, see attachments and Appendix F) and equipped with water level datalogger pressure transducers recording at 15-minutes intervals. The surface water monitoring was completed in addition to the original Terms of Reference (Appendix A). Clayey soils were observed beneath Tow Path Drain during the installation of the gauges via hand-augering completed to between 0.7-0.8 metres below ground surface. During the monitoring period (i.e. mid-August to mid-November 2023) August monthly precipitation was well-above average, while September, October and November monthly precipitation were well-below average (Table 1, see attachments). Water level monitoring of Tow Path Drain indicated surface water is only present intermittently as shown by dry conditions following precipitation events (Appendix F). Nearby groundwater levels were below ground surface during this monitoring period (BH21-13 and BH21-14) further confirming no groundwater discharge to surface water and an intermittent surface water classification consistent with other's investigations. Water levels at the nearby wetlands were observed to rise following precipitation events (Appendix C). After precipitation events, the water levels at nearby wetlands responded one of two ways:

(i) Where generally water depths were 10 cm or less, diurnal evapotranspiration water level fluctuations and dry/intermittent conditions after rain events (SW-2, SW-3, SW-4, SW-5 and SW-9); or

(ii) Where water depths were greater than 10 cm, diurnal transpiration fluctuations overlaid on a gradual decline, similar to predicted evaporation rates (Schroeter & Associates, 2007) (SW-6 and SW-8).

Wetlands near the Tow Path Drain are primarily sustained by precipitation (Sections 3.6.2 and 4.2), not sustained by backflow retained in the Tow Path Drain, as shown in September 2023 when limited standing water was still present at wetland gauges (i.e. SW-3, SW-4, SW-5, SW-6, SW-8 and SW-9, Appendix E) while dry conditions were observed downgradient at SG-102 and SG-103 (Appendix F).

Surface water flows were measured to decrease downstream on August 10, 2023 (Table 2). This indicated a losing reach and this is presumed to be as a result of infiltration of surface water and/or water uptake of adjacent vegetation.

Table 2 - 2023 Tow Path Drain Surface Water Flow Measurements (L/s)

Date/Station	SG-101	SG-102	SG-103	SG-104
August 10	No flow	2.3	2.2	1.8
September 6	Dry	Dry	Dry	Dry
October 3	Dry	Dry	Dry	Dry
October 23	Dry	No flow*	Dry	No flow*
November 20	No flow*	No flow*	No flow*	0.6

Note: * - water present but not flowing

Staff gauge SG-102 was removed by wildlife or vandalism in November 2023.

3.2 Soils

The Site soils are mapped as silty clays: (i) Toledo – Loamy Phase, and (ii) Beverly – Loamy Phase, with (iii) a small portion of Berrien soils (Figure 4, see attachments), details include (Kingston and Presant, 1989):

i. Toledo Loamy Phase: silty clay texture (Table 3), (38% of site, 23.1 ha in northern part of Site and 2.26 ha in the southern part of the Site), poorly drained, slowly permeable, water levels stay near the surface much of the year, relatively high water-holding capacity and moderate to high surface runoff (HSG D, Table 4). The Singer's Drain PSW is perched on these low permeability soils.

ii. Beverly Loamy Phase: silty clay texture (Table 3), (50% of site, 30.3 ha in central to southern part of Site), imperfectly drained, moderately to slowly permeable, water occupies the surface horizons for a period of time each year and is prolonged where subsoil has been overcompacted by heavy machinery, water-holding capacity ranges from medium to high, and surface runoff is moderate to high, (HSG C, Table 4).

iii. Berrien: 40 to 100 cm sandy sediments over silty clay (Table 3), (6% of Site, 3.9 ha in southeast corner of Site), imperfectly drained, rapidly permeable but water perches because of underlying clayey soils, and slow surface runoff (HSG C, Table 4). However sandy sediments were not encountered during hand-augering in this area in 2023.

iv. 6% of the Site's soils are not mapped (NM, Figure 4, see attachments) but are likely partially Toledo loamy phase and partially Beverly loamy phase, as silty clay/clayey silt/silt was recorded at boreholes within (i.e. BH21-3 and BH22-01) or immediately adjacent (e.g. BH21-16 and BH22-03) these areas (Section 3.3, Appendix B).

The Tow Path Drain PSW is mostly underlain by Berrien and Beverly loamy phase (soils >90%, i.e. HSG C) with <10% Toledo loamy phase (HSG D).

Table 3 – Horizon C Grain-size Analyses Summary[1]

Soil Name/Location	Sand%	Silt%	Clay%	Texture[2]
Beverly – Loamy Phase	7	49	44	Silty Clay
Toledo – Loamy Red Phase	9	50	41	
Berrien	8	46	46	

Note: [1] - Kingston and Presant, 1989, [2] - Texture as per Fetter (1994)

Table 4 - Hydrologic Soil Groups (USDA, 1986)

HSG Group	Soil description
A	sand, loamy sand or sandy loam
B	silt loam or loam
C	sandy clay loam
D	clay loam, silty clay loam, sandy clay, silty clay or clay

3.3 Surficial Geology

The Ontario Geological Survey (OGS) have mapped the Site as being covered by a layer of low permeability soils (clayey silt to silty clay) (Feenstra, 1984). This general characterization was confirmed by two geotechnical investigations of the Site (DS Consultants, 2022 and Soil-Mat Engineers and Consultants, 2023). These geotechnical investigations involved sixteen boreholes in 2021 and another sixteen boreholes in 2022 (Figure 2, see attachments). The boreholes are summarized on two geologic cross-sections (Figures 5 and 6, see attachments) which show the Site as underlain by silty clay to clayey silt, with some limited seams of fine sand to silt. It is noted that 0.5 m of silty sand was noted at surface at three locations in the northwest part of the Site (BH21-1, BH21-2 and BH21-12) overlying the clayey silt to silty clay aquitard and is shown on the north-south section (Figure 5, see attachments). The at-surface silty clay to clayey silt that covers most of the Site is often underlain by a sandy silt to silt at 5-6 metres below ground surface (m BGS). Most of the geotechnical boreholes were completed to between 7 and 8 m BGS. Four deep boreholes were also completed (i.e. 20 to 36 m BGS) without encountering bedrock but confirming that the underlying soils consist of silty clay, silt/sandy silt and clayey silt till. The thickness of the overburden ranges between 45 to 40 m, across the Site from west to east, respectively (NPSPA, 2013).

3.4 Bedrock

The Site is underlain by two bedrock formations, (i) Lockport Formation dolostone – northwest part of the Site, and (ii) Guelph Formation dolostone – the southeast part of the Site (NPSPA, 2013).

3.5 Hydrogeologic Setting

The Site is located on the Haldimand Clay plain which is a regional aquitard (Gartner Lee Limited, 1987). This aquitard consists of the Upper Whittlesey, Halton, Lower Whittlesey and Wentworth Aquitards (Burt, 2016). An aquitard is "*a low-permeability geologic unit that can store groundwater, but that transmits groundwater slowly*" (Niagara Peninsula Source Protection Authority, 2013). Upgradient of the Site is the Fonthill Kame-Delta Complex (Figure 7, schematic below) which is a regional groundwater recharge area (NPCA and AquaResource Inc., 2010).

The Port Robinson Subwatershed Study (NPCA, 1999) previously described the hydrostratigraphy as follows (the numbered bullets below correspond with the numbers on schematic Figure 7 as modified from NPCA, 1999):

1. *The upper end of the subwatershed consists of permeably (sandy) deposits which often extend to bedrock;*
2. *The eastern part of the subwatershed is relatively flat, and is predominantly underlain by aquitard (clay) materials, with sandy pockets;*
3. *A thin, sand aquifer unit may separate the aquitard (Unit 2) from bedrock. This unit may be hydraulically connected to the sand deposits to the west;*
4. *The subwatershed is underlain by dolostone bedrock;*
5. *Precipitation falling within the western half of the subwatershed, could (a) runoff, (b) recharge radially from the topographic height, to the deeper aquifer units, such as bedrock, or the lower sand, or (c) discharge to surface in the vicinity of the clay contact, providing baseflow to area tributaries; and*
6. *The majority of precipitation falling within the eastern half of the subwatershed, will become runoff, rather than infiltration, however the limited precipitation that does infiltrate is expected to discharge to local tributaries.*

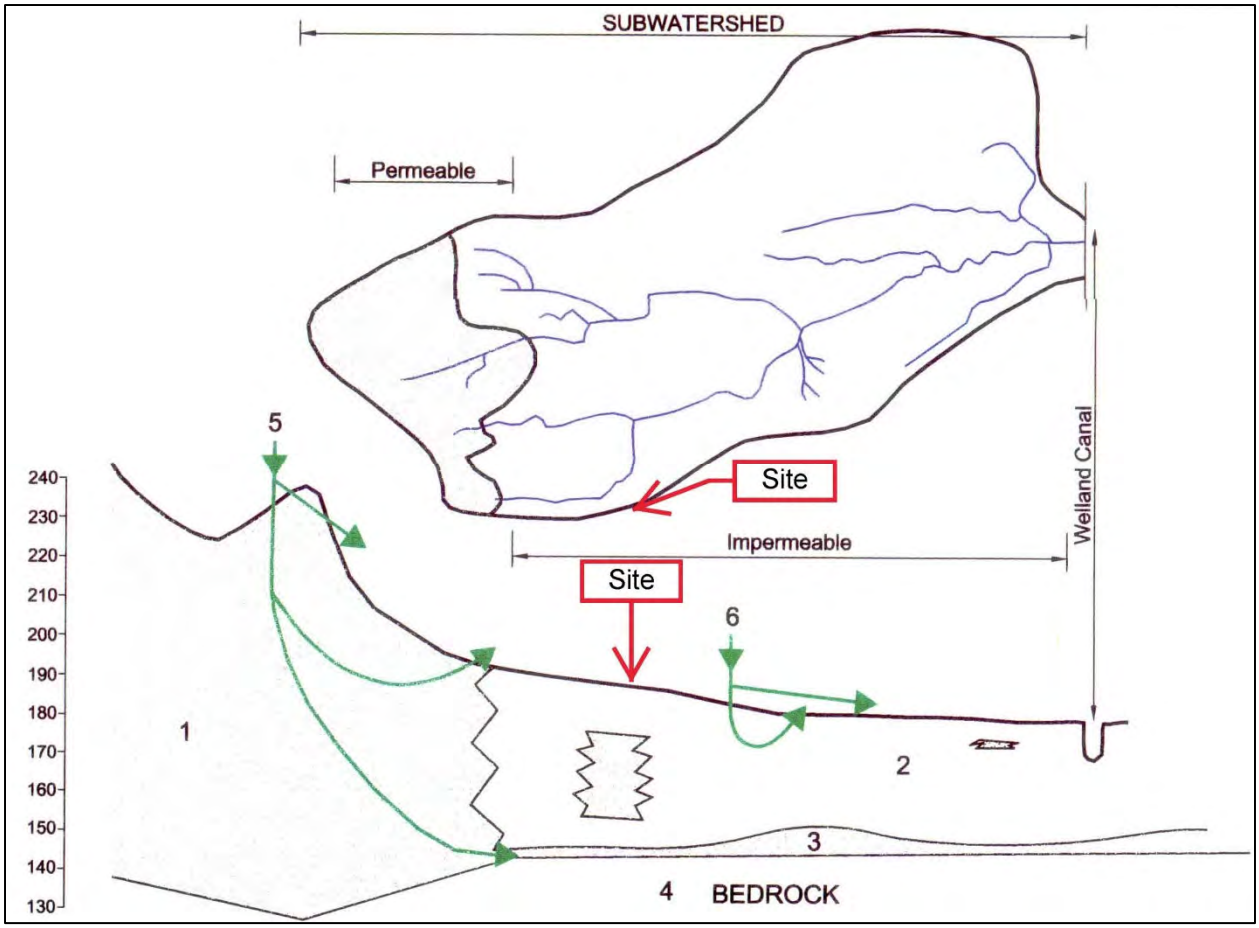


Figure 7 - Conceptual Hydrostratigraphy (modified after NPCA, 1999, section numbers are explained in Section 3.5)

3.5.1 Overburden Aquitard

The hydraulic conductivity of the regional Haldimand Clay Plain overburden aquitard is reported as $7x10^{-7}$ m/s, or less (GLL, 1987). Hydraulic conductivity testing at the Site generally confirmed similar or lower hydraulic conductivities with an average value of $3x10^{-9}$ m/s, with two minor exceptions in the northeast portion of the Site (i.e. BH21-1 and BH21-6) that had slightly higher values which is inferred at these locations to be as a result of fine sand or silt seams.

Two methods were used to determine on-site hydraulic conductivities:

(i) Laboratory grain size analyses and the Excel-tool HydrogeoSieveXL (Devlin, 2015); and
(ii) Hydraulic conductivity of select monitoring wells previously constructed on-site as part of the geotechnical investigations (Figure 2, see attachments).

These results are presented in Table 5 (below) and the analyses are provided in Appendix C.

Table 5 – Hydraulic Conductivity Analyses

Geologic Unit(s)	Location	Hydraulic Conductivity (m/s)	Depth (m BGS)	Analysis Method
Poorly sorted clay with fines	BH22-2	$1x10^{-9}$	5	Devlin (2015)
	BH22-1	$4x10^{-8}$	5	
	BH22-3	$1x10^{-9}$	5	
	BH21-2	$6x10^{-9}$	3	
	BH21-3	$1x10^{-9}$	3	
	BH21-6	$3x10^{-9}$	3	
	BH21-8	$3x10^{-10}$	3	
	BH21-9	$5x10^{-10}$	3	
	BH21-11	$1x10^{-9}$	3	
	BH21-13	$3x10^{-10}$	3	
	BH21-14	$5x10^{-10}$	3	
	BH21-16	$1x10^{-9}$	3	
Silty Clay with fine sand seams or Silt with some sand	BH21-1	$5x10^{-7}$	4.1-6.1	Bouwer and Rice (1989)
	BH21-2	$4x10^{-9}$	3.1-6.1	
	BH21-6	$3x10^{-7}$		
Silty Clay	BH21-3	$3x10^{-9}$	3.1-6.1	
	BH21-11	$1x10^{-9}$		
	BH21-13	$4x10^{-9}$		
	BH21-14	$1x10^{-8}$		
	BH21-16	$4x10^{-10}$		
	BH22-02	$4x10^{-8}$		
	BH22-03	$2x10^{-9}$		
	MW-11	$8x10^{-9}$		
Geometric Mean		$3x10^{-9}$		

Note: BGS - Below ground surface

The infiltration rates of the on-site soils are calculated as less than 15 mm/hour according to the relationship between soil hydraulic conductivity (Appendix C) and infiltration rate as provided by Credit Valley Conservation (2012). Consequently, the native soils are considered unsuitable for infiltration trenches, soakaway pits and pervious pipes (MECP, 2003).

3.5.2 Overburden Groundwater Flow

The regional groundwater table was previously modelled as towards the Site from the Fonthill Kame-Delta Complex groundwater recharge area (Blackport & Associates, and Waterloo Hydrogeologic Inc., 2005). Groundwater flow in the water table is generally from northwest to southeast as shown on Figure 8 (see attachments) for November 2022. The horizontal gradient in November 2022 was low at approximately 0.005 to 0.008 m/m.

3.5.3 Overburden Groundwater Levels

Manual groundwater level measurements were collected seasonally at thirteen monitoring wells (Figure 2, see attachments, DS Consultants, 2022). The monitoring wells are generally screened in silty clay between 3.1 to 6.1 m BGS (Appendix B). Manual groundwater level measurements (Table 6, see attachments) were collected in spring, summer and fall of 2022 and 2023. Water level dataloggers were deployed collecting measurements every 15-minutes at four monitoring wells MW21-01, MW21-03, M21-13 and MW21-14.

The 'spring-high' groundwater levels were measured very close to surface in April, 2023 as generally less than 1 m BGS (Figure 9, see attachments). In August, 2022, the depth to groundwater increased across the Site from west to east from ~1 m BGS to 2.5 m BGS despite '*Abnormally dry to moderate*' drought climate conditions reported by Agriculture Canada (2023) for August 2022.

The greatest seasonal groundwater level variations were noted for the downgradient monitoring locations, while less seasonal variation was noted for the upgradient western locations (Figures 10, 11 and 12, see attachments). Dampened seasonal variation for the upgradient western locations is inferred to be as a result of horizontal groundwater recharge from the Fonthill Kame-Delta Complex Recharge Area to the Site. Observations from the groundwater levels include:

1. Upgradient western groundwater levels showed similar limited seasonal variation between spring season highs and summer season lows of 0.5 to 0.8 m (i.e. MW21-1, MW21-2, MW21-6 and MW21-11).
2. Downgradient eastern groundwater levels showed similar greater seasonal variation between spring season highs and fall season lows of 1.1 to 2.7 m (i.e. MW21-3, MW21-8, MW21-9, MW21-13 and MW21-4).

Observations from the water level dataloggers in the four groundwater monitoring wells include (Appendix D):

i. Monitor MW21-01 (west/upgradient): The groundwater level in the monitoring well was consistently above ground surface, at above 184.3 m ASL except during the summer and early fall seasons, however, there were not ponded conditions at surface. With only about 0.5 m of seasonal

change from spring to August 2022, it is believed the fine sand seams noted on the borehole log receive lateral recharge from the Fonthill Kame-Delta Complex as limited drawdown only occurred during the summer growing season.

ii. Monitor MW21-13 (located mid-site): The groundwater level showed a distinct seasonal decline of about 2.5 m from the spring season to October 2022, with groundwater level recovery beginning in the fall season of 2022, with some responsiveness to precipitation noted.

iii. Monitor MW21-03 (located downgradient/east): A seasonal decline of groundwater levels of about 1 m from spring to October 2022, with groundwater level recovery beginning in the season of fall 2022 with limited responsiveness to precipitation events.

iv. Monitor MW21-14 (located in the southwest): A seasonal decline of groundwater levels of about 1.5 m from the spring season to August/October 2022, with groundwater level recovery completed before winter 2023, and was very responsive to precipitation events.

Monitoring wells BH21-16 and BH22-03 were decommissioned by a licensed Ontario water well contractor in May 2023 in order to accommodate activities on-site.

3.5.3 Bedrock Aquifer

The confined dolostone bedrock aquifer underlying the Site is the primary local supply for private wells that may be located west, north or east of the Site as Niagara Region has mapped the Welland portion of the Site and south as part of the municipally serviced area. Regional groundwater flow modelling completed for NPCA of the Fonthill Kame-Delta Complex (Blackport et al, 2005) maps the bedrock potentiometric surface as flowing from the west towards the Site. Additional regional contouring of the potentiometric surface of the bedrock aquifer (and other water wells completed greater than 15 metres below ground surface) map it as west (176 m ASL) to east (175.5 m ASL) across the Site, with a groundwater divide to the north (175 m ASL) and south (174.5 m ASL) similar to the surface water divides (WHI, 2005). This suggests a downwards vertical gradient at the Site between the overburden water table and the bedrock aquifer.

3.6 Wetlands

The Site includes 17 ha of the Provincially Significant Niagara Street Cataract Road Woodlot Wetland Complex (MNRF, 2009), mapped to cover 27% of the Site (Figure 2, see attachments). The MNRF have described that the "*dominant wetland type …* (is) *swamp, situated through a slough forest ecosystem. A slough forest ecosystem is characteristic of the Haldimand and Niagara Clay plain physiographic regions and consists of shallow to deep depressions…*" (MNRF, 2009). It is noted an area of marsh was also mapped by the MNRF in the northeast corner of the Site. General information regarding the Provincially Significant Wetlands mapped by the MNRF at the Site are summarized in Table 7. For example, the wetlands have been mapped as Palustrine wetlands, based upon having intermittent or no inflow, and either permanent or intermittent outflow and may rely on rainfall and some overland flow (MNRF, 2014).

Table 7 – Provincially Significant Wetland Information (MNRF, 2009)

Area	Size (ha)	Type	Dominant Vegetation	Wetland Hydrology	Soils
North Swamp Singers Drain	7.84	Swamp	Red maple	Palustrine	Clay/Loam
North Marsh Singers Drain	3.62	Marsh	Broadleaf cattail	Palustrine	Clay/Loam
South Toe Path Drain	5.21	Swamp	Rice cut grass	Palustrine	Clay/Loam

Additional wetland vegetation at the Site has been mapped by GEI Consultants (2022) and is summarized in Section 3.6.1 with respect to their Ecological Land Classifications and shown on Figure 13 (see attachments). It is our understanding the wetland extents were staked in June 28, 2021 with the Niagara Peninsula Conservation Authority (NPCA) and Niagara Region.

3.6.1 Wetland Ecological Land Classification (ELC) Mapping

The Wetland Ecological Land Classifications (ELCs) from GEI Consultants (2022) are summarized below in Table 8 with the associated wetland monitoring staff gauges listed and shown on Figure 13 (see attachments). However, it is our understanding that the wetlands monitored by staff gauges SW-1, SW-2, SW-13 and SW-14 are not being kept as part of the development plan.

Table 8 – Wetland Ecological Land Classifications (ELCs)

ELC	Description	Hydrologic Sensitivity*	Staff Gauges
MAS2-1	Cattail Mineral Shallow Marsh	Medium	SW-1, SW-13, SW-14, SW-15
SWT2-9	Grey Dogwood Mineral Thicket Swamp	Low**	SW-2, SW-17
SWD3-3/ CUW1/ SWT2-8/ CUT1-1	Swamp Maple Mineral Deciduous Swamp/ Mineral Cultural Woodland/ Silky Dogwood Mineral Thicket Swamp/ Sumac Cultural Thicket	Medium	SW-3, SW-7
SWT2-8/ MAM2-10	Silky Dogwood Mineral Thicket Swamp/ Forb Mineral Meadow Marsh	Medium/ Low	SW-16
SWT2-8/ MAS2-1	Silky Dogwood Mineral Thicket Swamp/ Cattail Mineral Shallow Marsh	Medium	SW-4, SW-5, SW-6, SW-8, SW-9,
MAM2-10/ MAS2-11	Forb Mineral Meadow Marsh/Dry and European Reed Shallow Marsh	Low**	SW-10, SW-11, SW-12
SWD3-2	Silver Maple Mineral Deciduous Swamp	Medium	SW-18

Notes: * - Wetland Sensitivity from TRCA (2017), ** - ELC not listed in TRCA (2017) and assigned based upon previous investigations in the Niagara Peninsula and/or correspondence with GEI

3.6.2 Wetland Water Level/Hydroperiod Monitoring

A hydroperiod is defined as "*the seasonal pattern of the water level of a wetland…It characterizes each type of wetland, and the constancy of its pattern from year to year ensures a reasonable stability for that wetland. It defines the rise and fall of a wetland's surface and subsurface water by integrating all of the inflows and outflows"* (Mitsch and Gosselink, 2007).

Eighteen wetland water level staff gauges were installed by Terra-Dynamics between May 10 and 24, 2022 to monitor wetland hydroperiods at locations chosen by GEI Ecological Staff (Figure 13, see attachments, Appendix E Location Photos). During installation of the staff gauges, silty clay soils were confirmed to be between 0.4 and 0.5 m BGS by hand-augering at each of the eighteen locations.

Manual water level measurements began at all locations in the spring season of 2022 on May 24, with some locations also monitored earlier on May 10, 2022 (Table 9, see attachments). Water level data loggers were deployed at each staff gauge beginning July 21, 2022 to measure water levels at 15-minute intervals, and the water level plots are located in Appendix E. The staff gauges for wetland water level monitoring were constructed with well-points that allowed measurement of both surface water levels and shallow water levels to 0.1 m below ground surface.

Surface water was present at each monitored wetland staff gauge on May 10, 2022 with three locations becoming dry by May 24, 2022 (SW-2, SW-5 and SW-16) (Table 9, see attachments), following three months of below average precipitation (Table 1, see attachments). The wetland hydrographs from July 2022 to November 2023 using the water level datalogger information are presented in Appendix E. The primary influence of precipitation in supplying water to the wetlands is supported in comparison of the water levels to the monthly wetland water balance modelling (Section 4.2).

The observed wetland hydrographs at the Site were fairly similar in overall patterns over the July 2022 to November 2023 monitoring period (Appendix E). These perched surface water level patterns are summarized below:

a) Summer 2022: Dry during Summer 2022,
b) Fall 2022: Surface water levels recovered in Fall 2022,
c) Winter 2022-2023: Surface water levels maintained
d) Spring 2023: Surface water levels declined to dry
e) Summer 2023: Mostly wet conditions attributed to above-average July/August precipitation (Table 1, see attachments).
f) Fall 2023: Surface water level decline and recovery. It is noted that as of the November 20, 2023 datalogger download, recovery was not yet noted at SW-5, SW-9 or SW-10.

Mitsch and Gosselink (2007) report that the "*hydroperiods of many bottomland hardwood forests and swamps have distinct periods of surface flooding in the winter and early spring due to snow and ice conditions followed by spring floods but otherwise have a water table that can be a meter or more below the surface*" (Figure 14), this characterization appears reasonable for the wetlands at the Site.

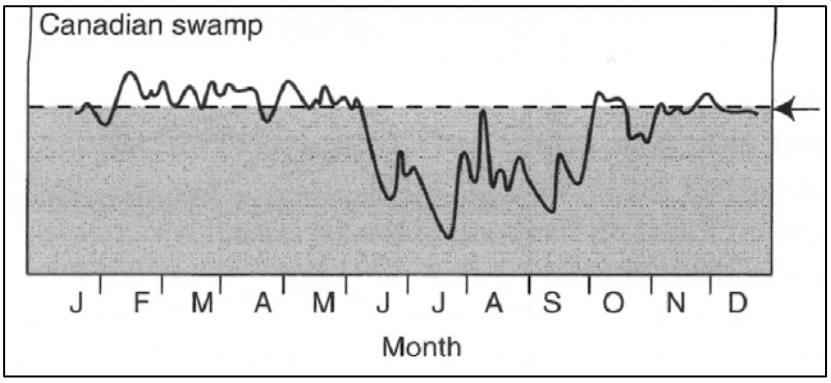


Figure 14 – Canadian Swamp Hydroperiod (Mitsch and Gosselink, 2007)
Note: arrow indicates wetland ground surface

3.6.3 Wetland Characterization

The wetlands are proposed classified as a *surface water depression wetlands* (Figure 15) (Mitsch and Gosselink, 2007).

A surface water depression wetland is summarized as a: "*wetland…dominated by surface runoff and precipitation, with little groundwater outflow due to a layer of low-permeability soils*…". Low permeability silty clay soils have been noted beneath the wetlands as per this description.

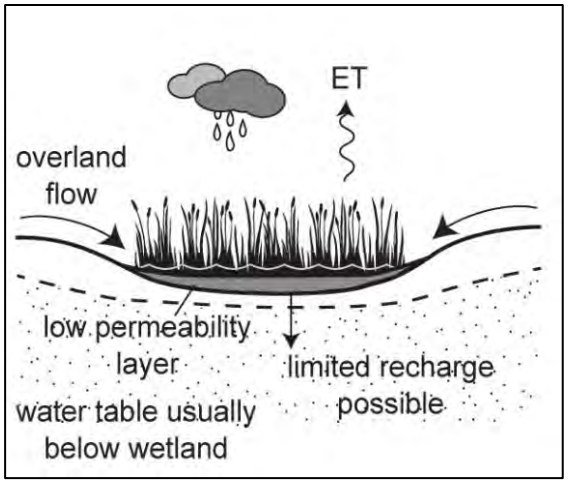


Figure 15 - Surface water depression wetland (Mitsch and Gosselink, 2007)

3.6.3 Soil Water Holding Capacity

The wetlands are primarily underlain by Hydrologic Soil Group (HSG) C soils with the northern wetlands underlain by HSG D or a combination of C/D soils (Section 3.2). The wetlands underlain by HSG C are assigned a soil water holding capacity (SWHC) of 400 mm, where underlain by HSG D 350 mm, and where underlain by HSG C/D 375 mm. These SWHC values are based upon previous swamp wetland values used by NPCA in their water budgeting study (AquaResource Inc. and NPCA, 2009).

3.6.4 Wetland Surface Water Catchments

As described in Section 3.1.1, and shown on Figure 4, the Site can be subdivided into four catchments: (i) Singer's Drain West, (ii) Singer's Drain East, (iii) Tow Path Drain North and (iv) Tow Path Drain South.

Smaller catchments were not modelled as the wetland water level monitoring (Section 3.6.2) and wetland modelling (Section 4.2) support precipitation as the primary source of water sustaining the wetlands.

3.7 Pre-development Subwatershed Water Balance Modelling

NPCA previously completed pre-development water balance modelling for 1991-2005, as part of provincial water budgeting for the source water protection program (AquaResource Inc. and NPCA, 2009). This modelling was completed at 1-hour time steps with a filled-in meteorological dataset including solar radiation and a crop coefficient for improved calculation of evapotranspiration. The modelling used lumped parameter catchments incorporating data such as soils, land cover and slope.

The Site is located within two NPCA modelled catchments: (i) Beaversdam Shriners Creek Welland Canal North W320 (BDSC_WCN_W320) and (ii) Central Welland River Tow Path Drain W100 (CWR_TPD_W100) (Figure 1, see attachments). It was determined that the modelled results for Catchment BDSC_WCN_W320 best suit the Site for application with respect to pre-development water balance conditions (i.e. slope, soils, land cover and evapotranspiration).

Modelled annual and monthly water balance results were obtained for Catchment BDSC_WCN_W320 (Tables 10 and 11, respectively, without decimal places) (AquaResource Inc. and NPCA, 2009). The annual surplus as shown on Table 10 is precipitation minus evapotranspiration, i.e. the water available for runoff and recharge.

Table 10 - Water Balance 15-year (1991-2005) Averages

Catchment	Precipitation	Actual Evapotranspiration	Annual Surplus	Infiltration*	Recharge	Runoff
	(mm/year)					
BDSC_WCN_W310	968	650	318	76	38	242
CWR_TPD_W100	968	469	499	97	49	401

Notes: * - Infiltration is interflow plus recharge

Table 11 - Monthly Runoff and Infiltration (Catchment BDSC_WCN_W310)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Runoff (mm)	38	27	54	45	17	9	3	3	4	3	18	20
Infiltration (mm)	13	12	23	16	5	1	0	0	0	0	3	7

4.0 Wetland Water Balance Assessment

A monthly wetland water balance assessment has been completed for the Site's wetlands, as informed by the Conservation Authority Guidelines for Development Applications (Conservation Ontario, 2013) and TRCA's guidance for water balances (2012).

It is noted that the MECP (2003) water balance approach is typically concerned with the evaluation of post-development to prevent (i) increased runoff, and/or (ii) reduction in groundwater recharge. However, given the current wetland characterization, any on-site water surplus contribution to hydrologic function with respect to the wetlands is via additional surface water flow, not groundwater discharge. Consequently, the purpose of the pre-development on-site water balance assessment modelling is to evaluate if runoff maintains monthly saturated conditions at the wetlands.

4.1 Monthly Water Balance Example

An example of water balance modelling from the University of Waterloo is shown below (Figure 16). Annual groundwater recharge begins in the fall following '*soil water utilization*' and '*deficit*' in the summer. Soil water utilization corresponds with evapotranspiration exceeding the precipitation supply. Annual groundwater recharge occurs during the same time period that groundwater levels rise. However, in this example it is noted that the soil water holding capacity (SWHC) modelled was only 100 mm compared to the higher SWHC 350 to 400 mm for the on-site wetlands (Section 3.6.3) which retain a greater amount of water.

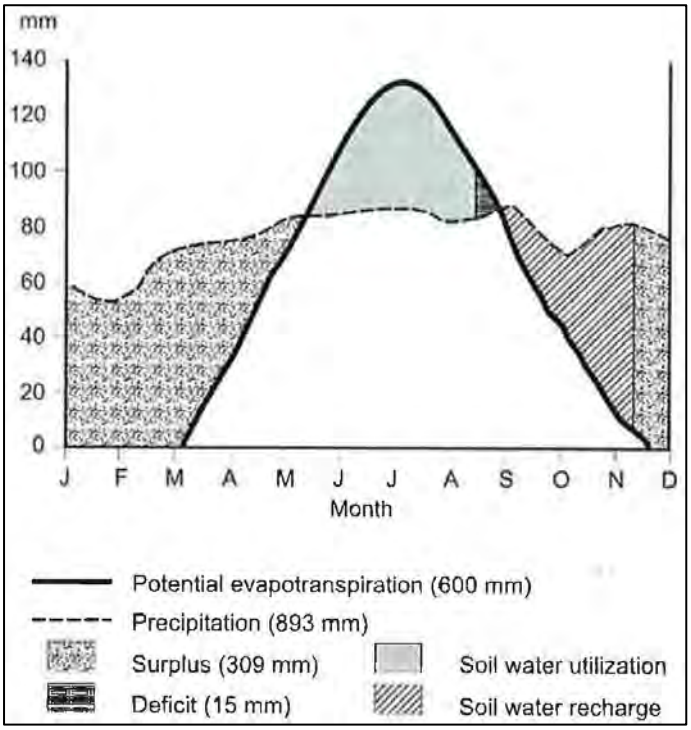


Figure 16 – Brantford Average Water Balance (Sanderson, 2004)

4.2 Wetland Monthly Water Balance

A monthly water balance for the wetlands was completed using the U.S. Geological Survey (USGS) Monthly Water Balance Model (McCabe and Markstrom, 2007), which only considers direct precipitation to the wetland as a water supply. For temperature and precipitation, three time intervals were modelled for the three soil water holding capacities identified (Section 3.6.3) (a) climate normal inputs (1981-2010) from Welland Station ID 6139445 (Environment Canada, 2023a), (b) 2022, and (c) 2023. Monthly wetland water balance modelling results are presented in a series of attached tables for (a) the climate normals (Tables 12a, 12b and 12c), (b) 2022 (Tables 13a, 13b and 13c) and (c) 2023 (Tables 14a, 14b and 14c).

In summary, the average/climate normal results (1981-2010) were:

1. Potential evapotranspiration exceeded precipitation for June, July and August, i.e. soil water utilization occurred on average;
2. Soil water holding capacities were less than saturated for the months of June to October; and
3. Soil water recharge occurred in September and October.

These conditions are presented below in Tables 15a, 15b and 15c:

Table 15a –Average Monthly Wetland Water Balance (mm), HSG C (SWHC 400 mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation (mm)	78	61	70	75	85	83	86	82	97	89	99	92
Evapotranspiration (mm)	10	12	21	40	72	106	122	97	60	32	17	11
Soil Moisture (mm)	400	400	400	400	400	**373**	**333**	**314**	**346**	**398**	400	400
Soil Water [1] Depletion (mm)	0	0	0	0	0	**27**	**67**	**86**	**54**	**2**	0	0

Notes: [1] Difference between the SWHC and the modelled soil moisture

Table 15b – Average Monthly Wetland Water Balance (mm), HSG D (SWHC 350 mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation (mm)	78	61	70	75	85	83	86	82	97	89	99	92
Evapotranspiration (mm)	10	12	21	40	72	106	122	97	60	32	17	11
Soil Moisture (mm)	350	350	350	350	350	**323**	**283**	**265**	**297**	**349**	350	350
Soil Water [1] Depletion (mm)	0	0	0	0	0	**27**	**67**	**85**	**53**	**1**	0	0

Notes: [1] Difference between the SWHC and the modelled soil moisture

Table 15c – Average Monthly Wetland Water Balance (mm), HSG C/D (SWHC 375 mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation (mm)	78	61	70	75	85	83	86	82	97	89	99	92

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration (mm)	10	12	21	40	72	106	122	97	60	32	17	11
Soil Moisture (mm)	375	375	375	375	375	**348**	**308**	**289**	**321**	**374**	375	375
Soil Water [1] Depletion (mm)	0	0	0	0	0	**27**	**67**	**86**	**54**	**1**	0	0

Notes: [1] Difference between the SWHC

The monthly soil water modelling of 2022 and 2023 (Tables 13/14, attached) differed from average conditions as a function of the primary influence of precipitation not being average (Table 1, attached):

1. Potential evapotranspiration exceeded precipitation earlier in May 2022 and 2023 (below average precipitation), and later in September 2023 (below average precipitation) but not in July/August (above average precipitation);
2. Soil water holding capacities were also less than saturated for May 2022 and 2023 (below average precipitation) but not less than saturated for August 2023 (above average precipitation);
3. Soil water recharge occurred earlier in July 2023 (above average precipitation) but not in September 2023 (below average precipitation).

The 2022 and 2023 modelled results reasonably match the observed wetland hydroperiod monitoring water levels (Appendix F), further supporting the primary role of precipitation in sustaining the wetland hydroperiods. It is noted that the hydrographs extend to November 20, 2023 prior to most of the November 2023 precipitation recharging to a "surplus" condition (Tables 14a/14b).

4.3 Wetland Water Balance Assessment

The extensive investigation and monitoring program and water balance modelling support the wetlands at the Site being supported primarily by precipitation. Consequently, development of the Site is not predicted to negatively affect the wetland hydroperiods as long as the proposed Environmental Impact Study buffers are observed.

4.4 Wetland Risk Evaluation

4.4.1 Magnitude of Hydrological Change

TRCA's wetland risk evaluation (2017) decision tree (Figure 17) includes four key hydrological change criteria:

1) Impervious cover in catchment;
2) Change in catchment size;
3) Dewatering; and
4) Impact to recharge areas.

The magnitude of hydrological change assessment was completed of the proposed southern development within the City of Welland of about 30.2 hectares.

(1) The amount of impervious cover within the areas proposed for development in Tow Path Drain South is calculated to be between 10 and 25% (A.T. McLaren Limited, 2024, WalterFedy, 2024a, Appendix G). Development of Tow Path Drain North as proposed (A.T. McLaren Limited, 2024 and WalterFedy, 2024a, Appendix G) is calculated to be greater than 25%.

(2) The post-development surface water catchments are proposed as follows: (a) Tow Path Drain North: 9% reduction in catchment area and (d) Tow Path Drain South: no reduction in catchment area (WALTERFEDY, 2024b).

(3) Construction dewatering is not expected to affect wetlands due to the low permeability of the soils on-site (Section 3.5.1). The aquitard underlying the Site is generally of sufficiently low permeability that groundwater control pumping methods are likely not feasible (Preene, 2020). However, an exception to this may be the northwest corner of the Site where the most permeable materials were identified at-surface and in the water table. Development in this area may require exclusion methods (e.g. cut-off collars for municipal servicing) to prevent long-term dewatering of adjacent wetlands.

(4) No impacts to wetland recharge areas are predicted as TRCA (2017) defines this as "*replacement of existing soils with significantly less permeable materials*" and the on-site soils are already of low permeability. In addition, there are no locally significant recharge areas to be impacted as these are defined by TRCA (2017) as "*highly porous sedimentary deposits or otherwise having high hydraulic conductivity*".

"*The highest magnitude category with one or more criteria satisfied determines the potential magnitude of change*" with the magnitude thresholds of less than 10% change as low, 10-25% as medium and greater than 25% as high (TRCA, 2017). Hydrologic risk is assigned based upon the magnitude of impervious cover to be introduced in upgradient catchment areas; medium in Tow Path Drain South and high in Tow Path Drain North. However, as discussed in Section 4.3.2, negative hydrologic impacts to the downgradient wetlands are not predicted with the implementation of wetland buffers as recommended by GEI in their future Environmental Impact Study.

4.4.2 Sensitivity of the Wetlands

The risk assignment (Figure 17) is to consider the type of wetlands, and their hydrological sensitivity (TRCA, 2017) which is tabulated in Table 6. None of the wetlands were classified as high hydrologic sensitivity, however, some were classified as medium (i.e. Cattail Mineral Shallow Marsh, Swamp Maple Mineral Deciduous Swamp, Silky Dogwood Mineral Thicket Swamp, Silver Maple Mineral Deciduous Swamp) and others as low (i.e. Grey Dogwood Mineral Thicket Swamp, Forb Mineral Meadow Marsh).

4.4.3 Risk Assignment

As per Figure 17, a medium risk is assigned based upon (i) either a high or medium magnitude of hydrological change, and (ii) a medium wetland sensitivity. The TRCA recommended study, modelling and mitigation requirements are:

(i) Pre-development monitoring as outlined in the Wetland Water Balance Monitoring Protocol (TRCA, 2016).

- Pre-development monitoring has occurred and informed the conceptual model and impact assessment for the Site.

(ii) Continuous hydrological modelling at daily aggregated to weekly resolution.

- Existing modelling (completed at 1-hour time steps) completed by NPCA was utilized for this report (AquaResource Inc. and NPCA, 2009) as part of a monthly analysis. Re-visiting this modelling to extract weekly results would not provide discernable benefit.

(iii) Design of a mitigation plan to maintain the wetland water balance, in some cases an interim mitigation plan may also be required.

- Mitigation is not indicated to be required as precipitation is the primary water supply for the wetlands. EIS proposed buffers are predicted to be sufficient to maintain pre-development conditions for the wetlands.

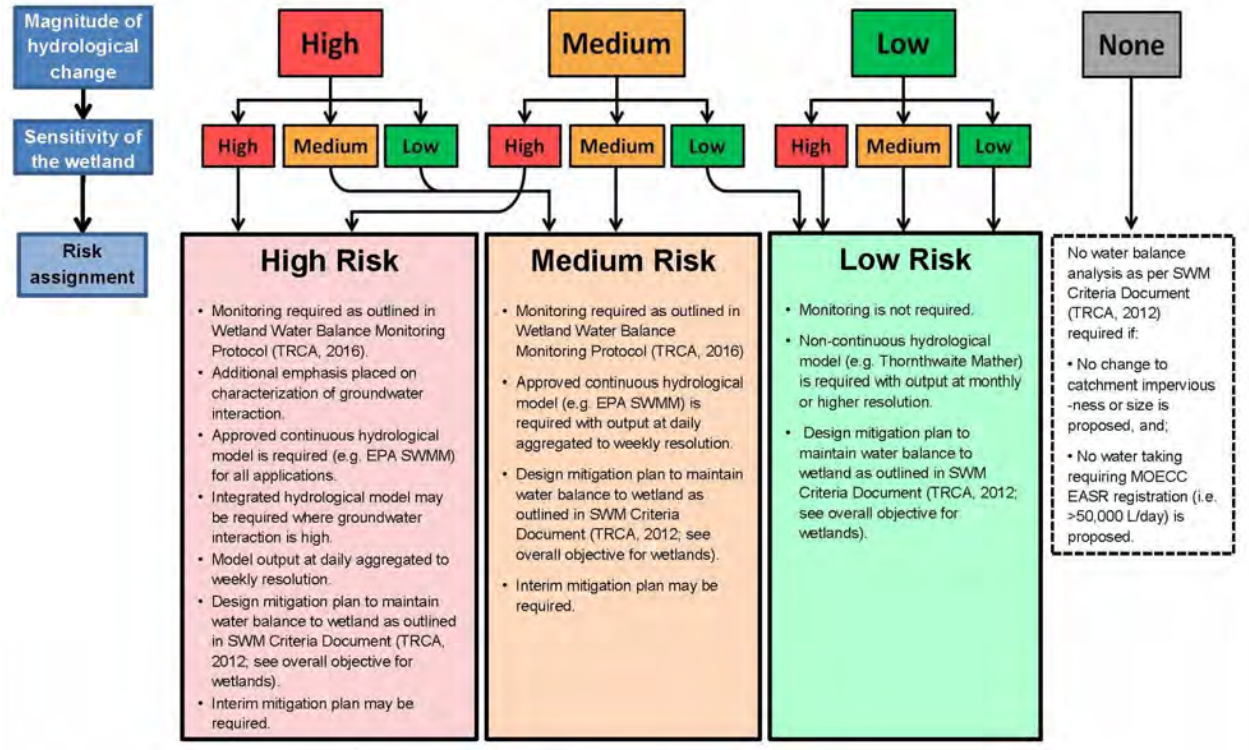


Figure 17 - Wetland Risk Evaluation Decision Tree (TRCA, 2017)

5.0 Key Hydrologic Areas and Features

The Niagara Region Official Plan (2022) lists under Policy 3.1.10.1 that:

Development or site alteration shall not be permitted unless it can demonstrated that it will not have negative impacts on:

a. the quantity and quality of water in key hydrologic areas, key hydrologic features, sensitive surface water features, and sensitive ground water features;

b. *the hydrologic functions of key hydrologic areas, key hydrologic features, sensitive surface water features, and sensitive groundwater features;*
c. *the interaction and linkage between key hydrologic areas, key hydrologic features, sensitive surface water features, and sensitive groundwater features and other components of the natural environment system;*
d. *the natural hydrologic characteristics of watercourses such as base flow, form and function, and headwater drainage areas;*
e. *natural drainage systems and shorelines areas; and*
f. *flooding or erosion.*

Key hydrologic areas have been defined as "*Significant groundwater recharge areas, highly vulnerable aquifers, and significant surface water contribution areas that are necessary for the ecological and hydrologic integrity of a watershed*"

Key Hydrologic Features have been defined as "*Permanent streams, intermittent streams, inland lakes and their littoral zones, seepage areas and springs and wetlands*" (Niagara Region, 2022).

5.1 Highly Vulnerable Aquifers (HVAs)

There are no Highly Vulnerable Aquifers (HVAs) mapped at the Site. It is noted that potential HVAs are mapped adjacent to the Site, however, these are related to potential historical water wells requiring decommissioning at those lands (NPCA, 2011). The off-site HVA mapping has no bearing on development at the Site. However, it should be noted that as monitoring wells at the Site are no longer required, they must be decommissioned by a licensed water well contractor (MECP, 2023).

5.2 Significant Groundwater Recharge Areas (SGRAs)

Significant Groundwater Recharge Areas (SGRAs) have been mapped at the Site which were mapped based upon prescribed Technical Rules for source water protection studies (MECP, 2009). However, site-level investigations have confirmed the Site as underlain by a low permeability aquitard unsuitable for on-site infiltration activities (i.e. <15 mm/hour infiltration and often high water table conditions). No negative impacts to the ecological and hydrologic integrity of the watershed are predicted and additional groundwater recharge mitigation measures are not required.

The NPCA SGRA mapping was intended as a screening layer to be informed by site-level investigations. NPCA had recommended two levels of SGRA significance (NPCA, 2009) however that is not currently reflected in SGRA mapping. Two levels of significance were recommended as the Source Protection Committee chose an MECP SGRA threshold that is very low and includes clayey silt where infiltration may not be suitable. During development of the Niagara Peninsula Source Protection Plan, no policies were included for SGRAs (NPSPC, 2014).

5.3 Key Hydrologic Features

No negative impacts to the Tow Path Drain are predicted as it has been identified as intermittent and having no baseflow or groundwater inputs.

No negative impacts to the wetlands are predicted as they are primarily sustained by precipitation.

6.0 Conclusions and Recommendations

6.1 Conclusions

The following conclusions are provided:

1. The Site is 60.8 hectares in area. Within the Site the Ministry of Natural Resources & Forestry have mapped Provincial Significant Swamp Wetland associated with the Niagara Street Cataract Road Woodlot Wetland Complex, and GEI Consultants have also mapped additional non-PSW wetlands at the Site. The coverage of wetlands on-site mapped by GEI is currently 27.2 hectares, with 17 hectares being provincially significant (63%).

2. The Site is located on the Haldimand Clay Plain, a regional thick aquitard of silty clay/clayey silt soils and downgradient of the Fonthill Kame-Delta Complex which is considered a regional groundwater recharge area.

3. Native soils are low permeability and not suitable for infiltration trenches, soakaway pits or pervious pipes.

4. Surface water drainage is almost evenly split and roughly along the municipal boundary with flow to the north and Thorold via Singer's Drain, and flow to the south and Welland via Tow Path Drain.

5. Watercourse monitoring at the Site has identified intermittent or ephemeral conditions.

6. Shallow groundwater flow is generally from northwest to southeast across the Site. The high water table in the spring season of 2023 was generally less than 1 m below natural ground surface while during August, 2022 the depth to the water table increased from west to east.

7. Groundwater levels are consistently above ground surface at monitoring well BH21-01 in the northwest corner of the Site. With only about 0.5 m of seasonal change in summer 2022, it is believed fine sand seams receive lateral recharge from the upgradient/off-site Fonthill Kame-Delta Complex.

8. The wetlands are on low permeability silty clay, consisting of surface water depression wetlands.

9. Wetland water levels monitored at eighteen locations, selected by GEI Consultants, since the summer season of 2022 resemble published hydroperiods for Canadian swamps and reasonably match modelled monthly water balance results for being sustained by precipitation alone.

10. A monthly water balance for the wetlands identified, on average, potential evapotranspiration as exceeding precipitation for June, July and August, with soil water holding capacities less than saturated also in September and October.

11. Pre-development monthly water balance modelling reasonably matches wetland water level monitoring supporting the conceptual model of palustrine wetlands (e.g. intermittent or no inflow) supported primarily by precipitation.

12. The Toronto Region Conservation Authority wetland risk screening tool assigned a 'potential' medium risk to the hydrological and ecological integrity of the wetlands, based upon either a high or medium magnitude of hydrological change and medium wetland sensitivity. However, the risk protocol does not include scoping precipitation supplied wetlands.

13. Residential development of the Site should not negatively impact the hydrology of the wetlands because the wetlands are primarily supplied by precipitation and therefore implementation of buffers as prescribed in the Environmental Impact Study should be sufficient.

14. No negative impacts to to the ecological and hydrologic integrity of the watershed are predicted and additional groundwater recharge mitigation measures are not required.

6.2 Recommendations

The following recommendations are provided:

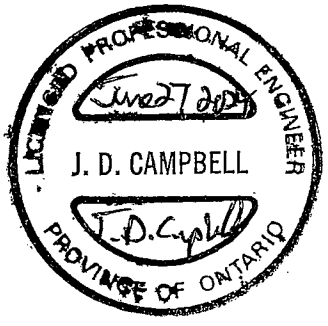
1. Evaluate continuance of the wetland and surface water monitoring programs at the Site following acceptance of this report by NPCA and Niagara Region; and

2. Decommission the on-site monitoring wells once no longer required using a licensed in Ontario water well contractor.

We trust this information is sufficient for your present needs. Please do not hesitate to contact us if you have any questions.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.



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cc. Daniel Stummer, Primont (Thorold/Welland) Inc.
Eric Salembier, WALTERFEDY
Antonette Zimic/Rick Hubbard, GEI

Attachments
Figure 1 – Location of Subject Lands
Figure 2 – Site Details
Figure 4 – Soils and Surface Water Catchments
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Figure 6 – Hydrogeologic Cross-Section West-East B-B'
Figure 8 – Water Table Flow, November 2022
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Appendix A – Terms of Reference
Appendix B – Borehole and Monitoring Well Logs
Appendix C – Hydraulic Conductivity Analyses
Appendix D – Groundwater Datalogger Charts
Appendix E – Wetland Monitoring
Appendix F – Tow Path Drain Surface Water Monitoring
Appendix G – Supporting Information

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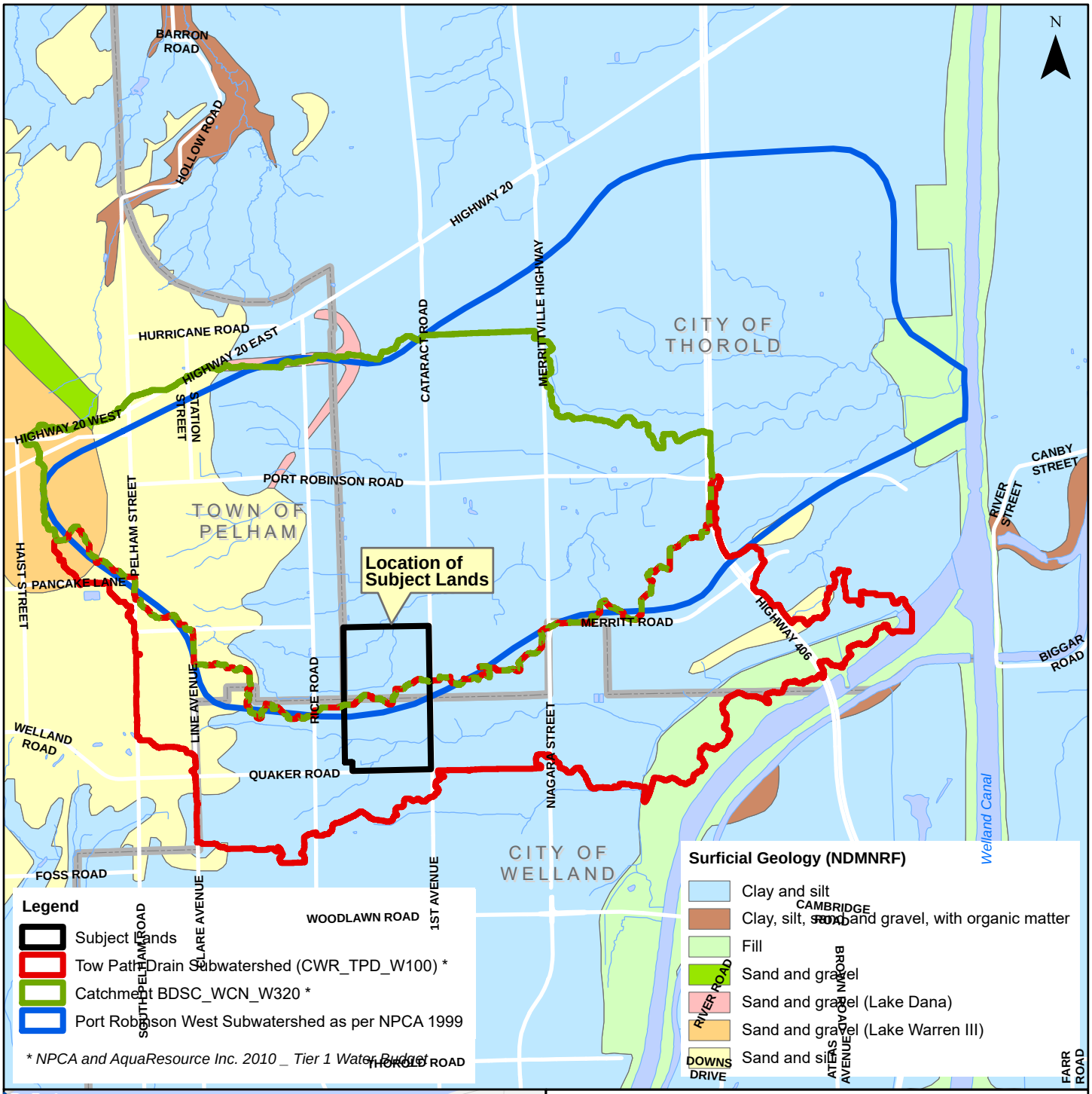

Location of Subject Lands

Hydrogeologic Study and
Wetland Water Balance
436 Quaker Road, Welland and
Lot 228/Part Lot 174, Thorold, ON
Primont (Thorold/Welland) Inc.

Terra-Dynamics Consulting Inc.

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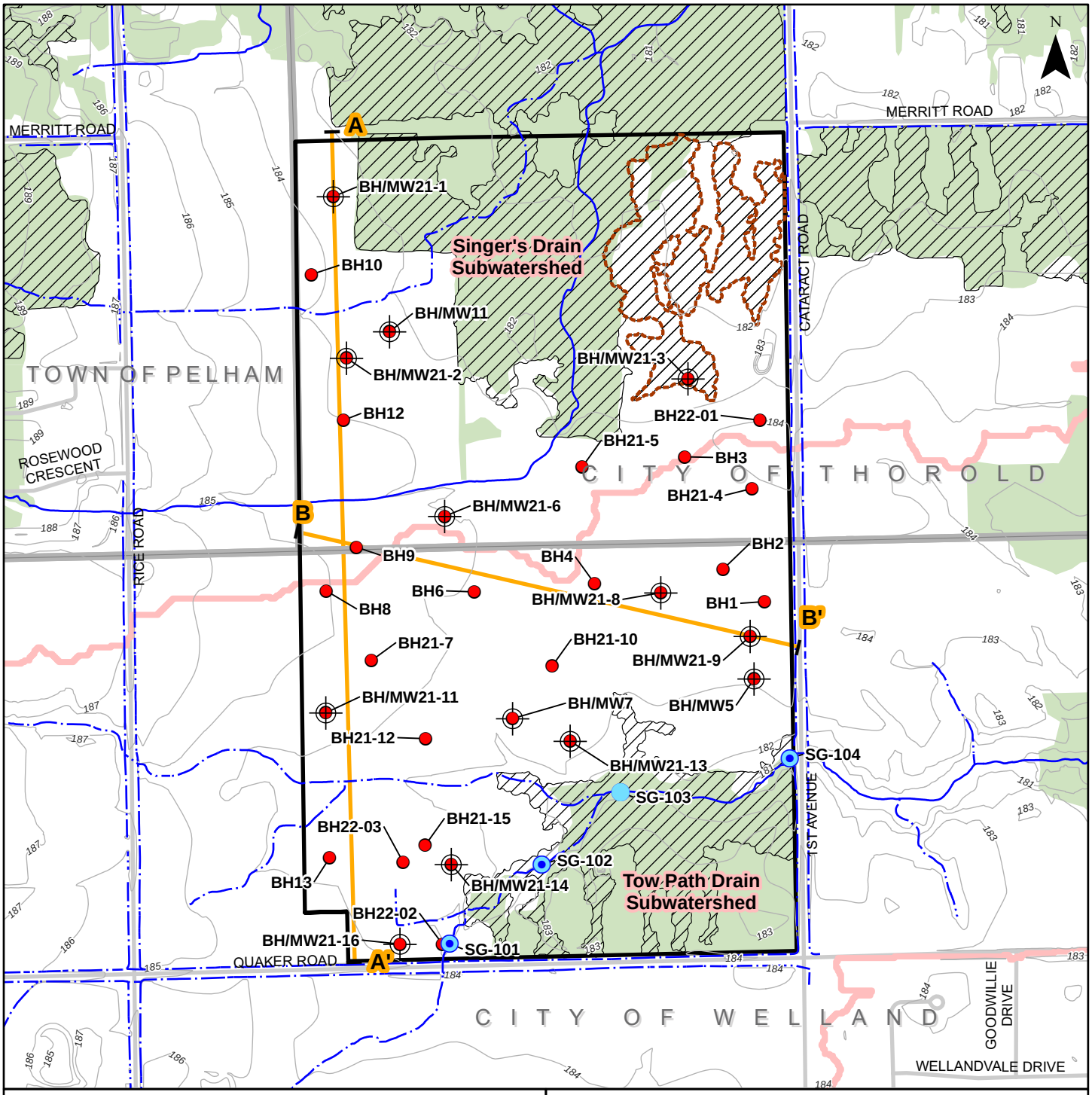
Figure 1

Path: H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\gis\mxd\Figure 1 Location of Subject Lands.mxd Revised: March 11, 2024



- Subject Lands
- Borehole
- Monitoring Well
- Staff Gauge
- Marsh Area
- Subwatershed Boundary
- Niagara Street Cataract Road Woodlot Wetland Complex Provincially Significant Wetlands (MNRF)
- Ground Surface Contour (NPCA)
- Geologic Cross-section

NPCA Watercourse Permanency

- Ephemeral
- Intermittent or Ephemeral

Site Details

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland and
Lot 228/Part Lot 174, Thorold, ON
Primont (Thorold/Welland) Inc.

TDC Terra-Dynamics Consulting Inc.

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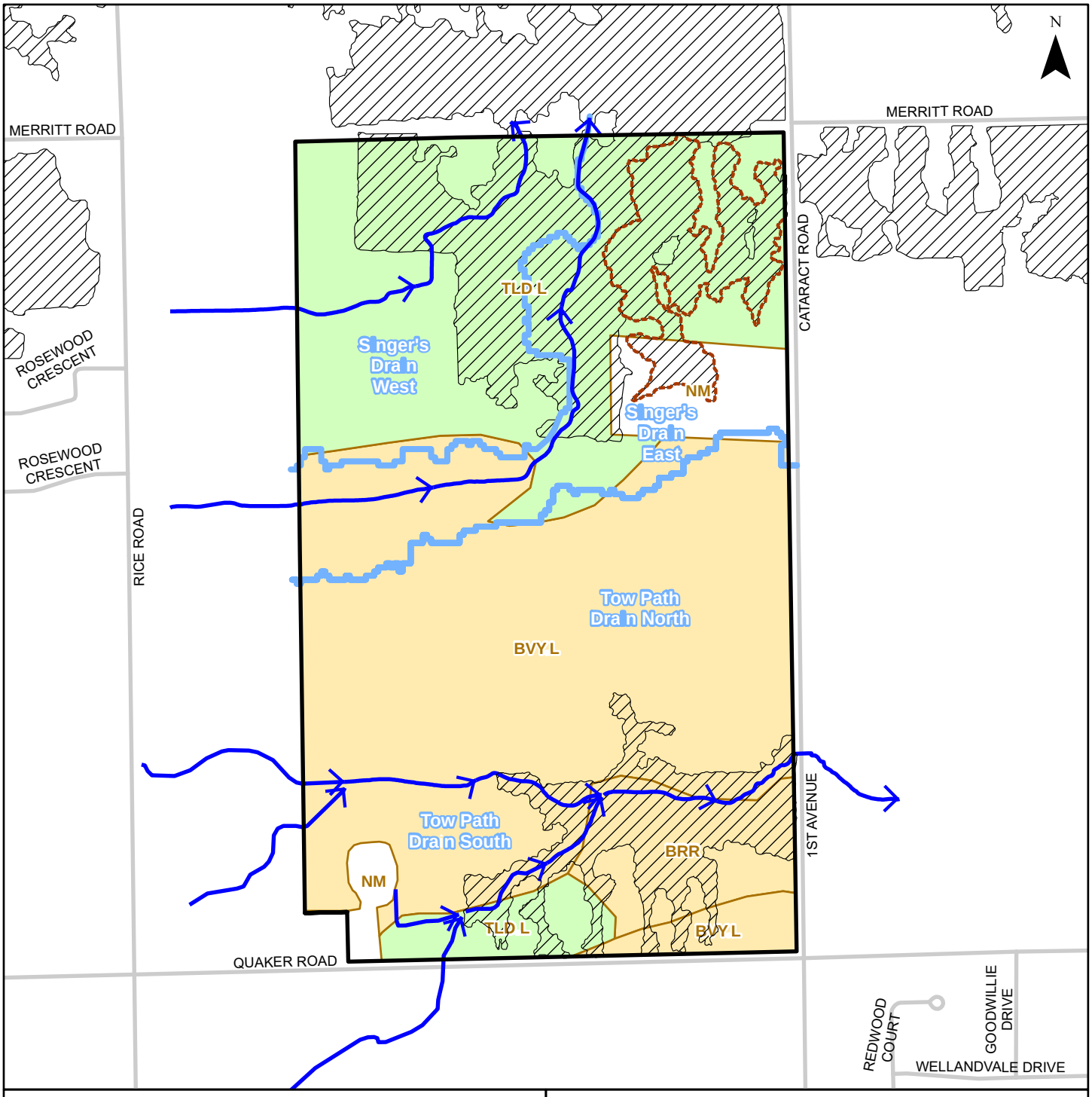
Figure 2

Path: H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\gis\mxd\Figure 2 Site Details.mxd Revised: March 11, 2024



Legend

- Subject Lands
- Surface Water Flow Direction
- Catchment Areas
- Niagara Street Cataract Road Woodlot Wetland Complex Provincially Significant Wetlands (MNRF)
- Marsh Area (MNRF)

Soils (OMAFRA)

BRR	Berrien	TLD.L	Toledo - Loamy Phase
BVY.L	Beverly - Loamy Phase	NM	Not Mapped

Hydrologic Soil Group (OMAFRA)

C D

Soils and Surface Water Catchments

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland and
Lot 228/Part Lot 174, Thorold, ON
Primont (Thorold/Welland) Inc.

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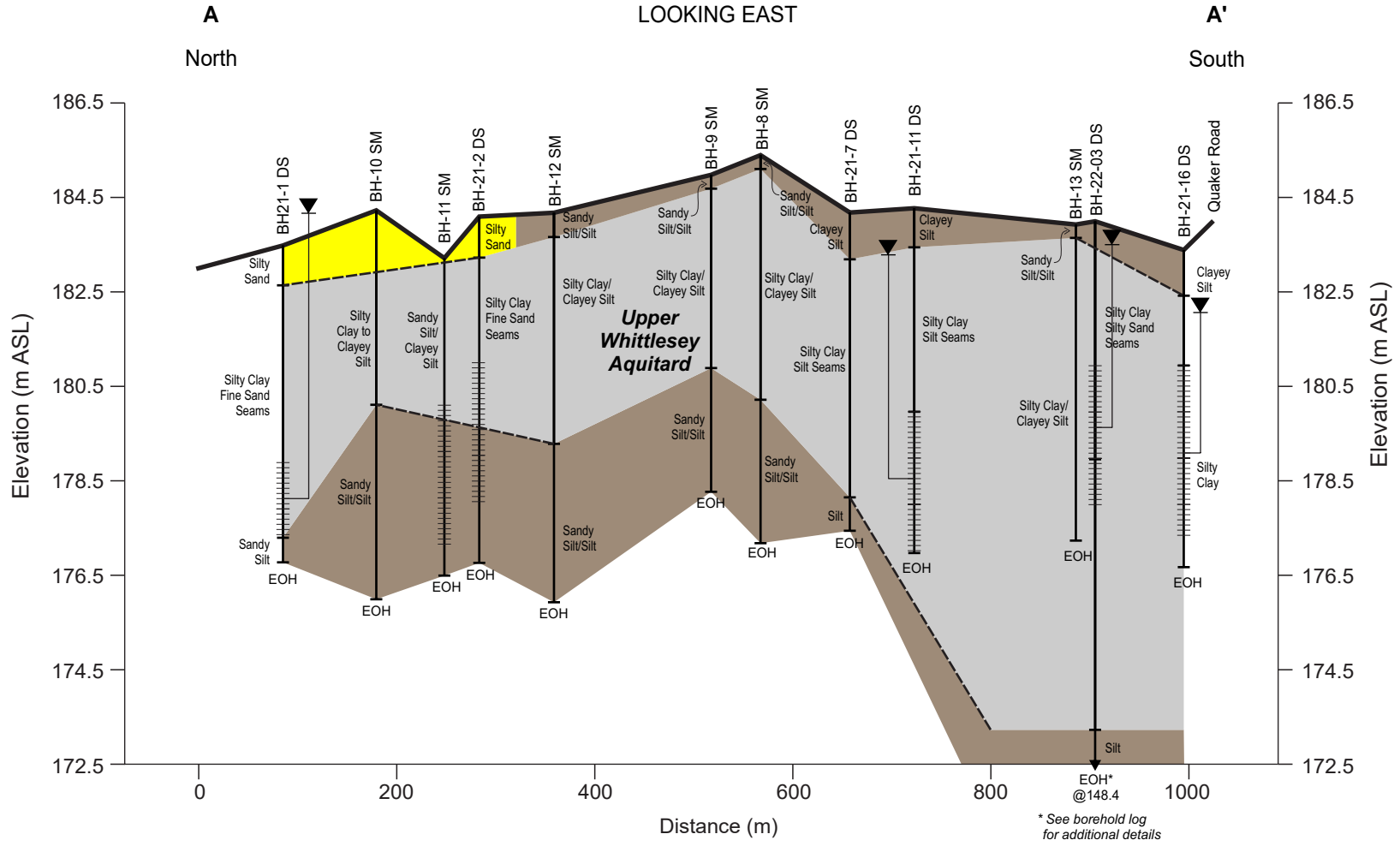
Figure 4

Path: H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\gis\mxd\Figure 4 Soils and Catchments.mxd Revised: March 11, 2024



EOH End of Hole

Well Screen

Groundwater Level (Nov. 9, 2022)

Silt

Clay

Sand

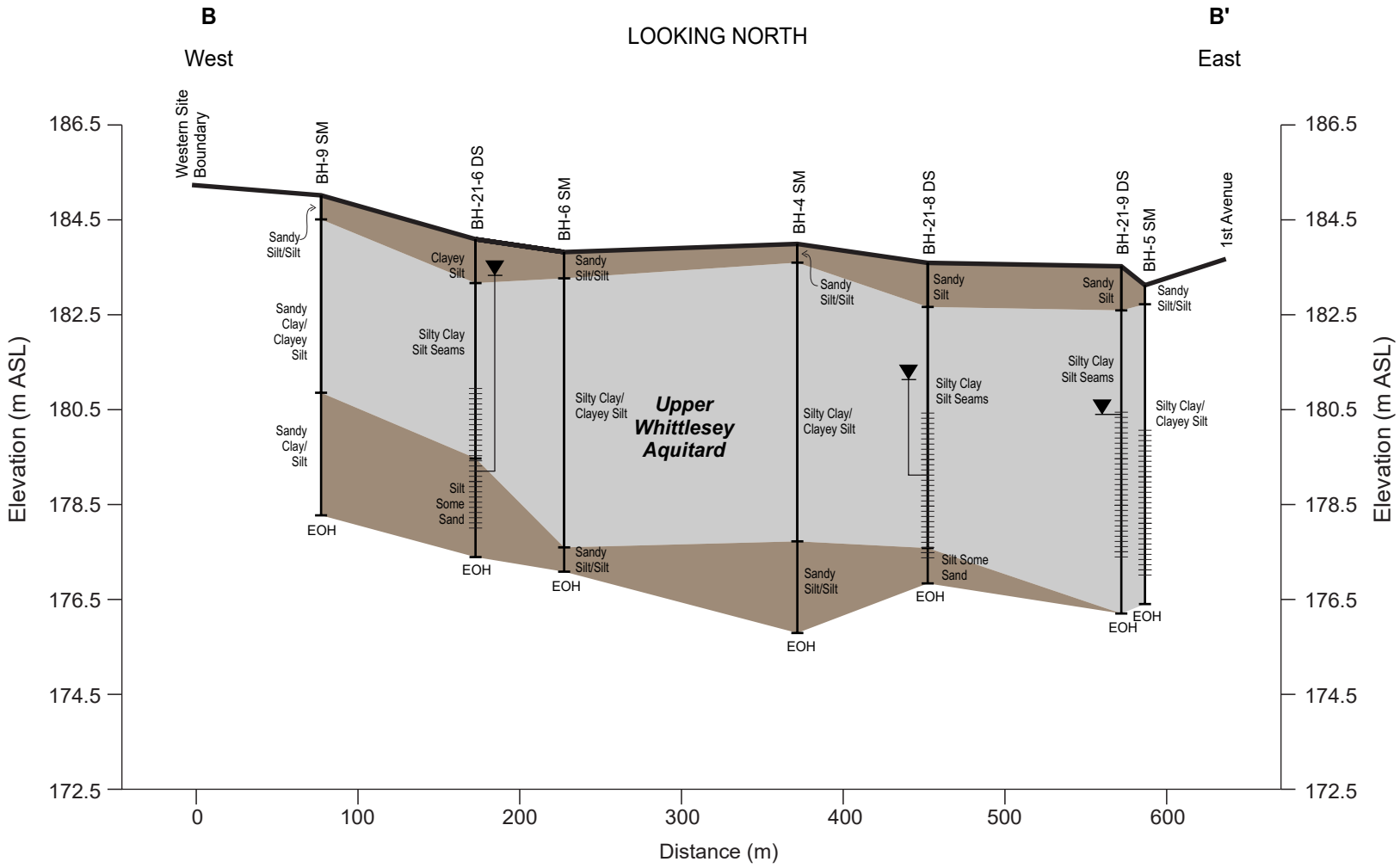
North-South Geologic Cross-section, Looking East

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland
Lot 228/Part Lot 174, Thorold, ON

TDC Terra-Dynamics Consulting Inc.

Figure 5

H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\corel\Figure 5 Hydrogeologic Cross-section north-south.cdr May 8, 2024



EOH End of Hole

Well Screen

Groundwater Level (Nov. 9, 2022)

Silt

Clay

West-East Geologic Cross-section, Looking North

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland
Lot 228/Part Lot 174, Thorold, ON

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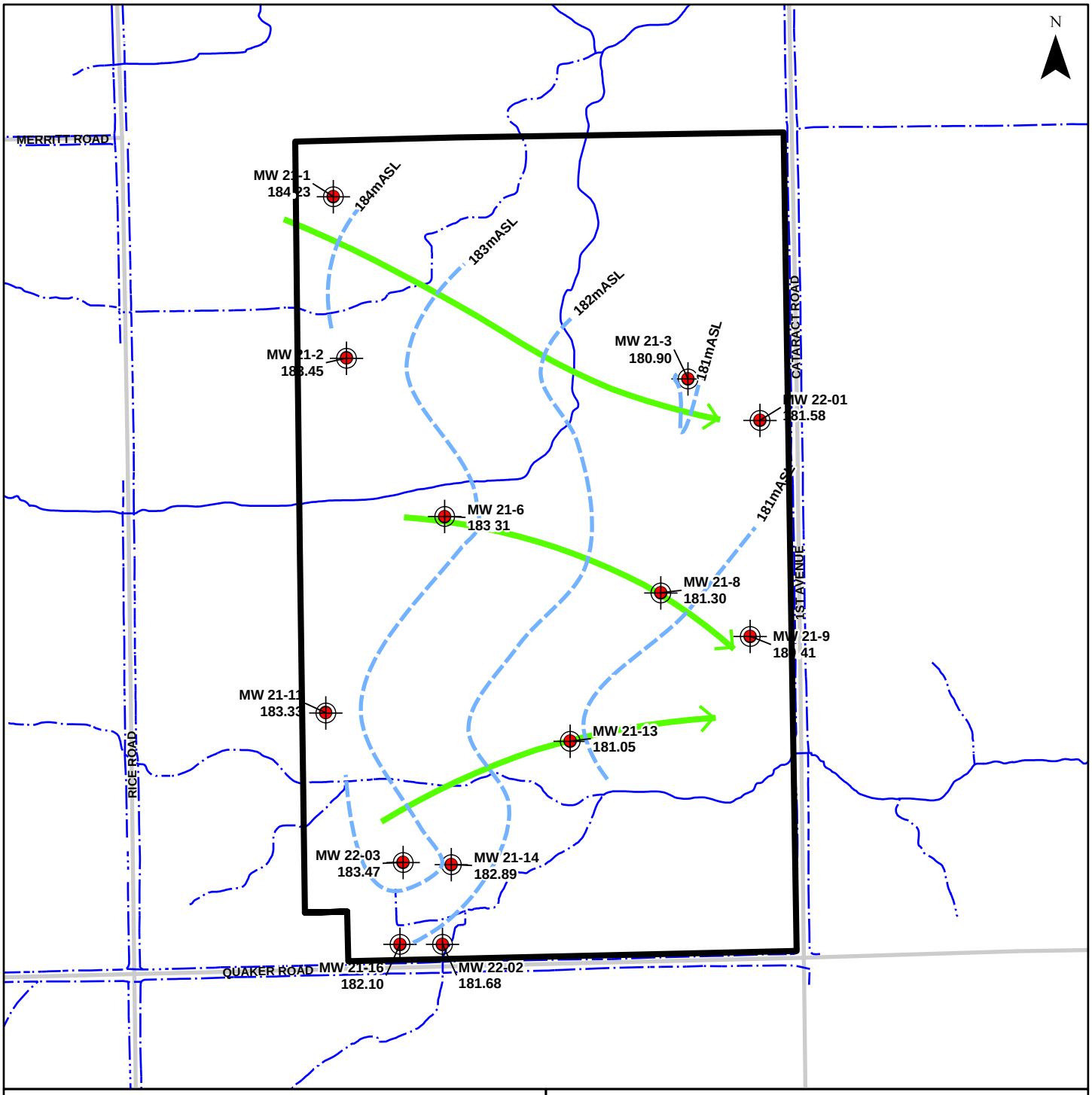
Figure 6

H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\corel\Figure 6 Hydrogeologic Cross-section west-east.cdr May 8, 2024



Legend

- Subject Lands
- Monitoring Well Location and Groundwater Elevation (m ASL)
- Groundwater Flow Direction
- Water Table Elevation Contours (mASL)

NPCA Watercourse Permanency

- Ephemeral
- Intermittent or Ephemeral

Water Table Flow, November 2022

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland and
Lot 228/Part Lot 174, Thorold, ON
Primont (Thorold/Welland) Inc.

Terra-Dynamics Consulting Inc.

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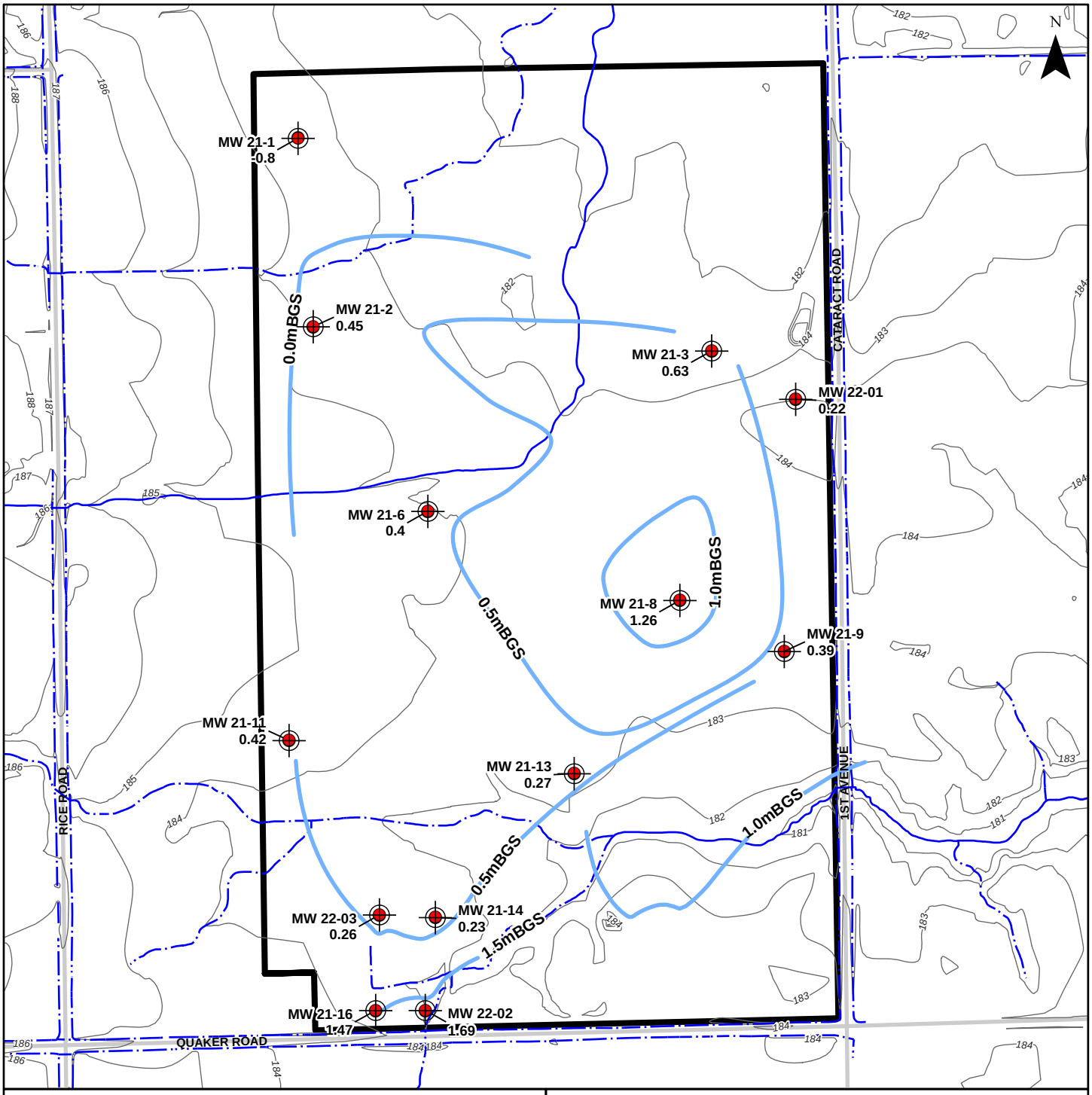
Figure 8

Path: H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\gis\mxd\Figure 8 Water Table Flow.mxd Revised: March 11, 2024



Legend

- Subject Lands
- Monitoring Well Location and Depth to Water Table (m)
- Depth to Water Table (mBGS)
- Ground Surface Contour (NPCA)

NPCA Watercourse Permanency

- Ephemeral
- Intermittent or Ephemeral

Depth to Water Table, April 2023

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland and
Lot 228/Part Lot 174, Thorold, ON
Primont (Thorold/Welland) Inc.

Terra-Dynamics Consulting Inc.

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Figure 9

Path: H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\gis\mxd\Figure 9 Depth to Water Table.mxd Revised: March 11, 2024

Figure 10 - Western Upgradient Manual Groundwater Levels

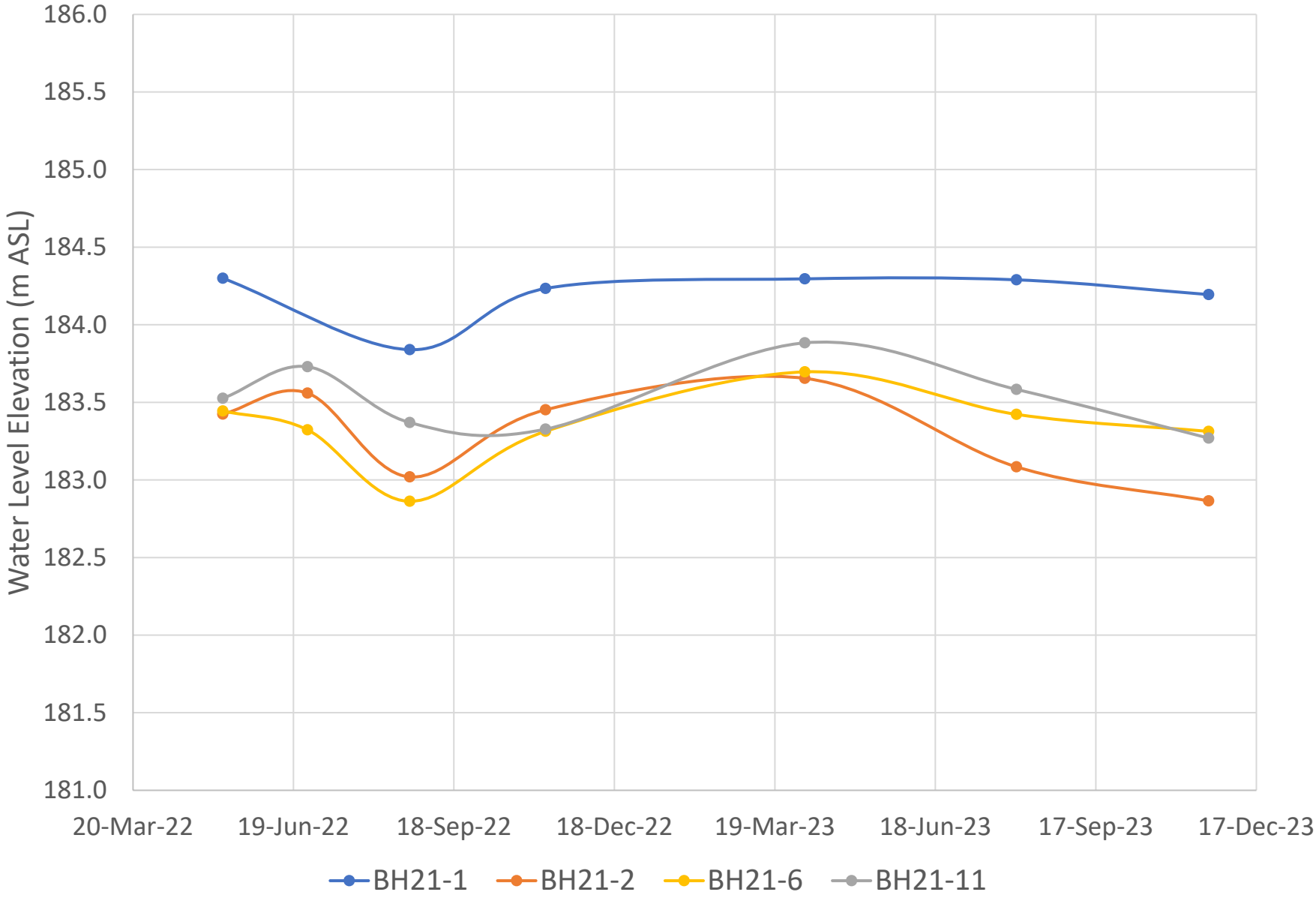


Figure 11 - Eastern Downgradient Manual Groundwater Levels

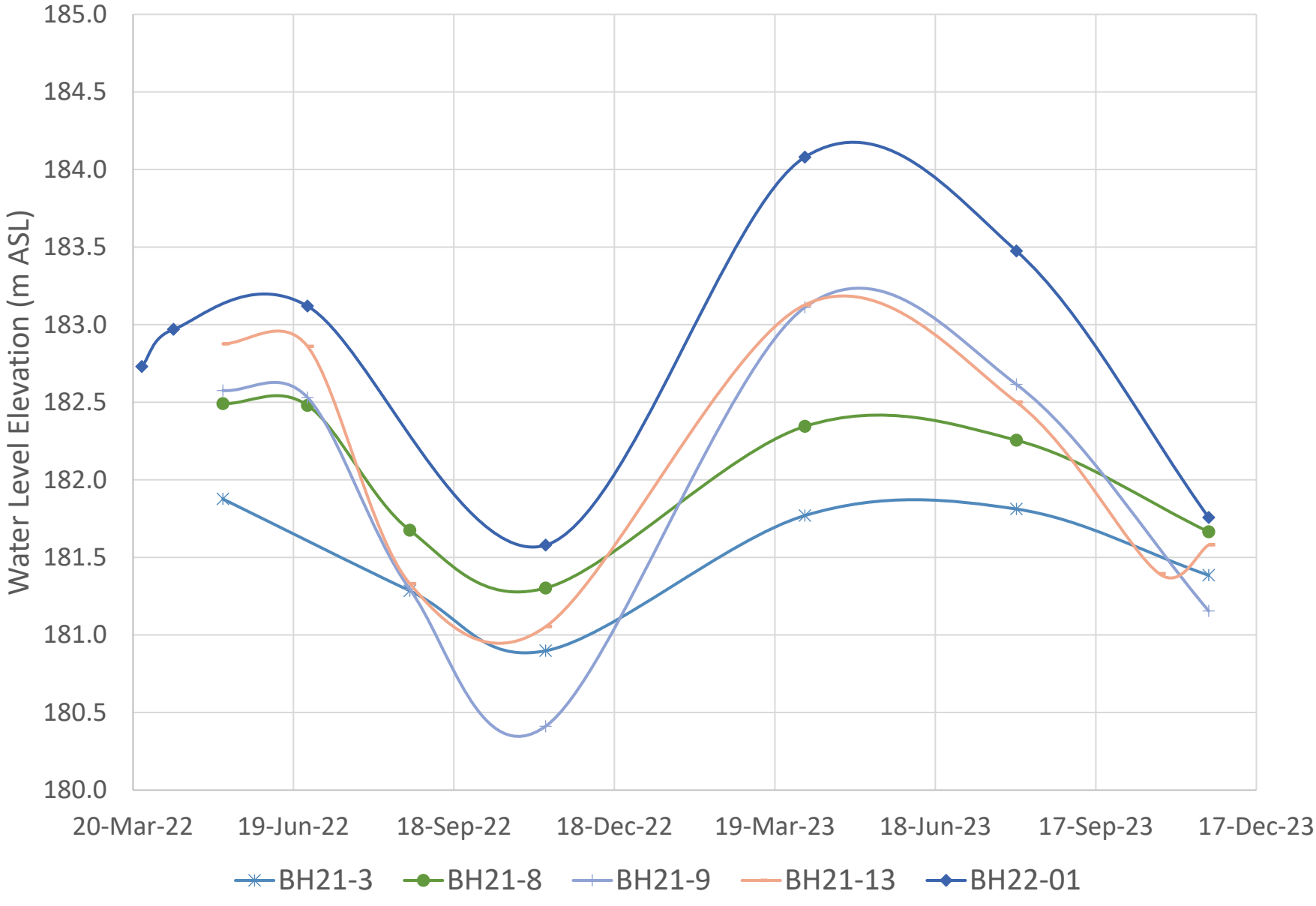
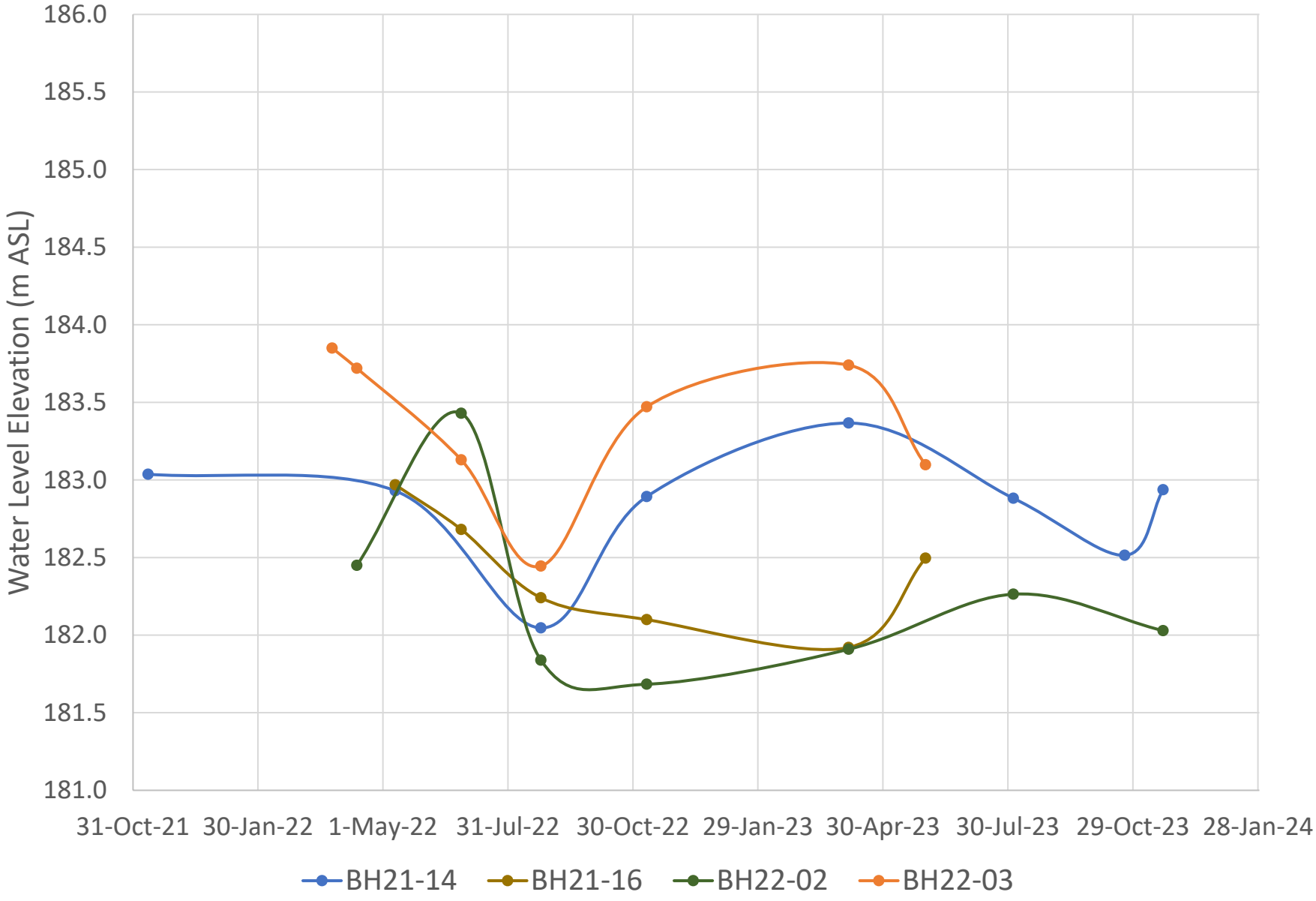
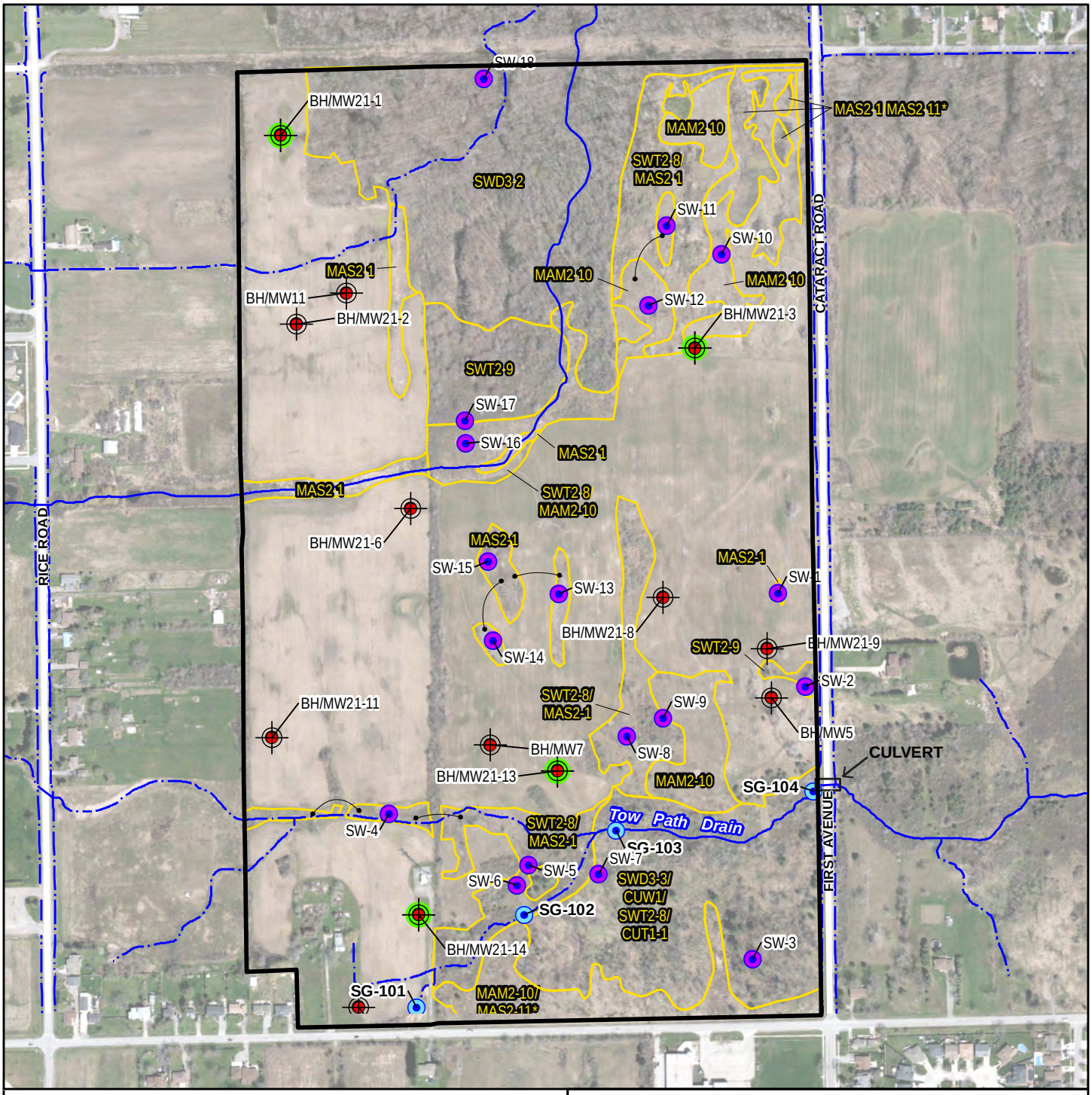


Figure 12 - Southwest Manual Groundwater Levels





Subject Lands
Monitoring Well with Logger
Monitoring Well
ELC Wetland
Wetland Monitoring Location
Staff Gauge
Watercourse (NPCA)
Ephemeral
Intermittent or Ephemeral

Ecological Land Classification (GEI, 2022)

ELC Code	ELC Name
CUT1-1	Sumac Cultural Thicket
CUW1	Mineral Cultural Woodland
MAM2-10	Forb Mineral Meadow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
MAS2-11*	Southern Arrow-wood Mineral Thicket Swamp
SWD3-2	Silver Maple Mineral Deciduous Swamp
SWD3-3	Swamp Maple Mineral Deciduous Swamp
SWT2-8	Silky Dogwood Mineral Thicket Swamp
SWT2-9	Gray Dogwood Mineral Thicket Swamp

Wetland and Surface Water Monitoring

Hydrogeologic Study and Wetland Water Balance
436 Quaker Road, Welland and
Lot 228/Part Lot 174, Thorold, ON
Primont (Thorold/Welland) Inc.

TDC Terra-Dynamics Consulting Inc.

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Figure 13

Path: H:\TERRA_DYNAMICS\9647 - TD 436 Quaker Rd\gis\mxd\Figure 13 Wetland and Surface Water Monitoring.mxd Revised: March 13, 2024

Table 1
Welland-Pelham Precipitation Analyses

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sum
Average* Precipitation (mm)	78.2	61.3	69.7	75.4	85.2	82.9	85.9	82.4	96.8	89.3	98.5	92	998
2021 Welland-Pelham	40.9	47.7	35.2	48.4	39.8	52.2	163.3	63.1	177	124.6	67.1	65.2	925
1-month Average +/-	52%	78%	51%	64%	47%	63%	190%	77%	183%	140%	68%	71%	93%
3-Month Average +/-	67%	67%	59%	64%	54%	58%	101%	111%	152%	136%	130%	92%	
2022 Welland-Pelham	62.1	99.7	59.2	53.4	63.7	72.6	72.5	51.2	86	107.5	104.9	64.4	897
1-month Average +/-	79%	163%	85%	71%	75%	88%	84%	62%	89%	120%	106%	70%	90%
3-Month Average +/-	72%	98%	106%	103%	77%	78%	82%	78%	79%	91%	105%	99%	
2023 Welland-Pelham	86.8	68.6	109.8	98.1	34.6	74.4	163	138.7	30.1	62.9	53.6	110.3	1031
1-month Average +/-	111%	112%	158%	130%	41%	90%	190%	168%	31%	70%	54%	120%	114%
3-Month Average +/-	99%	98%	127%	134%	105%	85%	107%	150%	125%	86%	52%	81%	

Notes: * - Welland Environment Canada (1981-2010, ID 6139445), Grey shading - monthly value between 95-105%, Blue shading >105%, Orange < 95%

Table 6
Monitoring Well Details and Water Levels

Well I.D.	Ground Elevation (m ASL)	Stick-Up (m)	TOC Elevation (m ASL)	Well Depth Below TOC (m)	Well Depth below ground (m)	Date	Water level (m below TOC)	Water Level below ground (m)	Water Level Elevation (m ASL)
BH21-1	183.5	0.82	184.32	6.17	5.35	10-May-22	0.02	-0.80	184.30
						24-Aug-22	0.48	-0.34	183.84
						9-Nov-22	0.09	-0.73	184.23
						5-Apr-23	0.02	-0.80	184.30
						3-Aug-23	0.03	-0.79	184.29
						20-Nov-23	0.13	-0.70	184.20
BH21-2	184.1	0.80	184.90	7.26	6.46	11-Nov-21	1.50	0.70	183.40
						10-May-22	1.48	0.68	183.42
						27-Jun-22	1.34	0.54	183.56
						24-Aug-22	1.88	1.08	183.02
						9-Nov-22	1.45	0.65	183.45
						5-Apr-23	1.25	0.45	183.66
						3-Aug-23	1.82	1.02	183.09
						20-Nov-23	2.04	1.24	182.87
BH21-3	182.4	0.82	183.22	7.12	6.31	10-May-22	1.34	0.52	181.88
						24-Aug-22	1.93	1.12	181.29
						9-Nov-22	2.32	1.50	180.90
						5-Apr-23	1.45	0.63	181.77
						3-Aug-23	1.40	0.59	181.81
						20-Nov-23	1.83	1.02	181.39
BH21-6	184.1	0.82	184.92	5.49	4.67	11-Nov-21	1.36	0.54	183.56
						10-May-22	1.48	0.66	183.44
						27-Jun-22	1.60	0.78	183.32
						24-Aug-22	2.06	1.24	182.86
						9-Nov-22	1.61	0.79	183.31
						5-Apr-23	1.23	0.40	183.70
						3-Aug-23	1.50	0.68	183.42
						20-Nov-23	1.61	0.79	183.31
BH21-8	183.6	0.85	184.45	6.42	5.57	11-Nov-21	2.22	1.37	182.23
						10-May-22	1.95	1.11	182.49
						27-Jun-22	1.97	1.12	182.48
						24-Aug-22	2.77	1.93	181.68
						9-Nov-22	3.14	2.30	181.30
						5-Apr-23	2.10	1.26	182.35
						3-Aug-23	2.19	1.35	182.26
						20-Nov-23	2.78	1.94	181.67
BH21-9	183.5	0.94	184.44	7.24	6.30	11-Nov-21	1.19	0.25	183.25
						10-May-22	1.86	0.92	182.58
						27-Jun-22	1.91	0.97	182.53
						24-Aug-22	3.14	2.21	181.30
						9-Nov-22	4.02	3.09	180.41
						5-Apr-23	1.32	0.39	183.11
						3-Aug-23	1.82	0.89	182.62
						20-Nov-23	3.28	2.35	181.16

Table 6
Monitoring Well Details and Water Levels

Well I.D.	Ground Elevation (m ASL)	Stick-Up (m)	TOC Elevation (m ASL)	Well Depth Below TOC (m)	Well Depth below ground (m)	Date	Water level (m below TOC)	Water Level below ground (m)	Water Level Elevation (m ASL)
BH21-11	184.3	0.68	184.98	6.99	6.31	10-May-22	1.45	0.77	183.53
						27-Jun-22	1.25	0.57	183.73
						24-Aug-22	1.61	0.93	183.37
						9-Nov-22	1.65	0.97	183.33
						5-Apr-23	1.10	0.42	183.88
						3-Aug-23	1.40	0.72	183.58
						20-Nov-23	1.71	1.03	183.27
BH21-13	183.4	0.82	184.22	7.13	6.31	11-Nov-21	1.37	0.55	182.85
						10-May-22	1.34	0.52	182.88
						27-Jun-22	1.36	0.54	182.86
						24-Aug-22	2.89	2.07	181.33
						9-Nov-22	3.17	2.35	181.05
						5-Apr-23	1.09	0.27	183.13
						3-Aug-23	1.72	0.90	182.50
						23-Oct-23	2.83	2.01	181.40
						20-Nov-23	2.64	1.82	181.58
BH21-14	183.6	0.89	184.49	7.15	6.26	11-Nov-21	1.45	0.56	183.04
						10-May-22	1.56	0.67	182.93
						24-Aug-22	2.44	1.55	182.05
						9-Nov-22	1.59	0.71	182.89
						5-Apr-23	1.12	0.23	183.37
						3-Aug-23	1.61	0.72	182.88
						23-Oct-23	1.97	1.09	182.52
						20-Nov-23	1.55	0.66	182.94
BH21-16	183.4	0.93	184.33	7.20	6.27	10-May-22	1.36	0.43	182.97
						27-Jun-22	1.65	0.72	182.68
						24-Aug-22	2.09	1.16	182.24
						9-Nov-22	2.23	1.30	182.10
						5-Apr-23	2.41	1.48	181.92
						31-May-23	1.84	0.90	182.50
BH22-01	184.3	1.14	185.44	7.12	5.99	25-Mar-22	2.71	1.57	182.73
						12-Apr-22	2.47	1.33	182.97
						27-Jun-22	2.32	1.18	183.12
						24-Aug-22	5.38	4.25	180.06
						9-Nov-22	3.86	2.72	181.58
						5-Apr-23	1.36	0.22	184.08
						3-Aug-23	1.96	0.83	183.48
						20-Nov-23	3.68	2.54	181.76
BH22-02	183.6	0.95	184.55	7.10	6.16	12-Apr-22	2.10	1.15	182.45
						27-Jun-22	1.12	0.17	183.43
						24-Aug-22	2.71	1.76	181.84
						9-Nov-22	2.87	1.92	181.68
						5-Apr-23	2.64	1.69	181.91
						3-Aug-23	2.29	1.34	182.26
						20-Nov-23	2.52	1.57	182.03

Table 6
Monitoring Well Details and Water Levels

Well I.D.	Ground Elevation (m ASL)	Stick-Up (m)	TOC Elevation (m ASL)	Well Depth Below TOC (m)	Well Depth below ground (m)	Date	Water level (m below TOC)	Water Level below ground (m)	Water Level Elevation (m ASL)
BH22-03	184.0	1.01	185.01	7.10	6.10	25-Mar-22	1.16	0.15	183.85
						12-Apr-22	1.29	0.28	183.72
						27-Jun-22	1.88	0.87	183.13
						24-Aug-22	2.56	1.56	182.45
						9-Nov-22	1.53	0.53	183.47
						5-Apr-23	1.27	0.26	183.74
						31-May-23	1.91	0.90	183.10
SM MW-5	183.1	1.34	184.46	7.54	6.20	5-Apr-23	1.43	0.09	183.04
SM MW-7	183.5	1.13	184.65	6.82	5.69	5-Apr-23	2.93	1.80	181.72
SM MW-11	183.2	1.17	184.40	7.10	5.93	5-Apr-23	0.69	-0.49	183.72
SG-101		0.55		0.78	0.22	10-Aug-23	0.53	N/A	
						6-Sep-23	0.00	N/A	
						3-Oct-23	0.00	N/A	
						23-Oct-23	0.00	N/A	
						20-Nov-23	0.54	N/A	
SG-102		0.54		0.78	0.24	10-Aug-23	0.43	N/A	
						6-Sep-23	0.00	N/A	
						3-Oct-23	0.00	N/A	
						23-Oct-23	0.50	N/A	
						20-Nov-23	0.43	N/A	
SG-103		0.56		0.79	0.23	10-Aug-23	0.40	N/A	
						6-Sep-23	0.00	N/A	
						3-Oct-23	0.00	N/A	
						23-Oct-23	0.00	N/A	
						20-Nov-23	0.42	N/A	
SG-104		0.54		0.78	0.24	10-Aug-23	0.43	N/A	
						6-Sep-23	0.00	N/A	
						3-Oct-23	0.00	N/A	
						23-Oct-23	0.51	N/A	
						20-Nov-23	0.45	N/A	

Table 9 - Early Manual Wetland Water Level Measurements

Location ID	Soil Type	Depth May 10, 2022 (m)	Depth May 24, 2022 (m)	Depth July 21, 2022 (m)
SW-1	Silty Clay	0.13	0.07	0.00
SW-2	Silty Clay	0.14	0.00	0.00
SW-3	Silty Clay	N/A	0.14	0.06
SW-4	Silty Clay	0.05	0.03	0.00
SW-5	Silty Clay	0.04	0.00	0.00
SW-6	Silty Clay	0.13	0.30	0.02
SW-7	Silty Clay	0.07	0.12	0.00
SW-8	Silty Clay	N/A	0.13	0.00
SW-9	Silty Clay	N/A	0.03	0.00
SW-10	Silty Clay	N/A	0.02	0.00
SW-11	Silty Clay	0.16	0.08	0.00
SW-12	Silty Clay	0.14	0.06	0.03
SW-13	Silty Clay	0.18	0.05	0.00
SW-14	Silty Clay	0.26	0.29	0.00
SW-15	Silty Clay	0.17	0.27	0.00
SW-16	Silty Clay	0.05	0.00	0.00
SW-17	Silty Clay	0.20	0.05	0.00
SW-18	Silty Clay	0.30	0.18	0.01

TABLE 12a

400 mm USGS Wetland Monthly Water Balance (1981-2010)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	78.2	9.7	45.6	400	9.7	0	31.3	45.6	50.9	Surplus
February	61.3	11.6	48.1	400	11.6	0	31.3	48.1	50.2	Surplus
March	69.7	21.3	68.1	400	21.3	0	8.8	68.1	61.2	Surplus
April	75.4	39.6	40.8	400	39.6	0	0	40.8	53.4	Surplus
May	85.2	71.6	9.3	400	71.6	0	0	9.3	33.7	Surplus
June	82.9	105.8	-27.1	372.9	105.8	0	0	0	18.9	Soil Water Utilization
July	85.9	124.8	-43.2	332.6	121.9	2.9	0	0	11.7	Soil Water Utilization
August	82.4	100.9	-22.6	313.9	97.1	3.8	0	0	7.8	Soil Water Utilization
September	96.8	60.2	31.7	345.6	60.2	0	0	0	6.7	Soil Water Recharge
October	89.3	32.2	52.6	398.2	32.2	0	0	0	5.4	Soil Water Recharge
November	98.5	17.2	76.4	400	17.2	0	0	74.6	42.7	Surplus
December	92	10.9	67.9	400	10.9	0	10.1	67.9	55.9	Surplus
Sum	997.6				599.1				398.5	

TABLE 12b

350 mm USGS Wetland Monthly Water Balance (1981-2010)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	78.2	9.7	45.6	350	9.7	0	31.3	45.6	51	Surplus
February	61.3	11.6	48.1	350	11.6	0	31.3	48.1	50.3	Surplus
March	69.7	21.3	68.1	350	21.3	0	8.8	68.1	61.2	Surplus
April	75.4	39.6	40.8	350	39.6	0	0	40.8	53.4	Surplus
May	85.2	71.6	9.3	350	71.6	0	0	9.3	33.7	Surplus
June	82.9	105.8	-27.1	323	105.8	0	0	0	18.9	Soil Water Utilization
July	85.9	124.8	-43.2	283	121.5	3.3	0	0	11.7	Soil Water Utilization
August	82.4	100.9	-22.6	265	96.5	4.3	0	0	7.8	Soil Water Utilization
September	96.8	60.2	31.7	297	60.2	0	0	0	6.7	Soil Water Recharge
October	89.3	32.2	52.6	349	32.2	0	0	0	5.4	Soil Water Recharge
November	98.5	17.2	76.4	350	17.2	0	0	75.5	43.1	Surplus
December	92	10.9	67.9	350	10.9	0	10.1	67.9	56.2	Surplus
Sum	997.6				598.1				399.4	

TABLE 12c

375 mm USGS Wetland Monthly Water Balance (1981-2010)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	78.2	9.7	45.6	375	9.7	0	31.3	45.6	51	Surplus
February	61.3	11.6	48.1	375	11.6	0	31.3	48.1	50.2	Surplus
March	69.7	21.3	68.1	375	21.3	0	8.8	68.1	61.2	Surplus
April	75.4	39.6	40.8	375	39.6	0	0	40.8	53.4	Surplus
May	85.2	71.6	9.3	375	71.6	0	0	9.3	33.7	Surplus
June	82.9	105.8	-27.1	347.9	105.8	0	0	0	18.9	Soil Water Utilization
July	85.9	124.8	-43.2	307.8	121.7	3.1	0	0	11.7	Soil Water Utilization
August	82.4	100.9	-22.6	289.3	96.8	4	0	0	7.8	Soil Water Utilization
September	96.8	60.2	31.7	321	60.2	0	0	0	6.7	Soil Water Recharge
October	89.3	32.2	52.6	373.7	32.2	0	0	0	5.4	Soil Water Recharge
November	98.5	17.2	76.4	375	17.2	0	0	75	42.9	Surplus
December	92	10.9	67.9	375	10.9	0	10.1	67.9	56	Surplus
Sum	997.6				598.6				398.9	

TABLE 13a

400 mm USGS Wetland Monthly Water Balance (2022)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	62.1	7.9	11.9	400	7.9	0	41.7	11.9	29.8	Surplus
February	99.7	11.2	75.1	400	11.2	0	52.9	75.1	54.4	Surplus
March	59.2	22.9	80.3	400	22.9	0	6.2	80.3	68.9	Surplus
April	53.4	38.4	18.6	400	38.4	0	0	18.6	45.1	Surplus
May	63.7	80.1	-19.5	380.5	80.1	0	0	0	24.4	Soil Water Utilization
June	72.6	104.5	-35.6	346.6	102.8	1.7	0	0	14.2	Soil Water Utilization
July	72.5	122.5	-53.6	300.2	115.3	7.2	0	0	8.9	Soil Water Utilization
August	51	104.7	-56.2	258	90.6	14	0	0	5.2	Soil Water Utilization
September	86	60.2	21.5	279.4	60.2	0	0	0	5.6	Soil Water Recharge
October	107.5	31.2	70.9	350.3	31.2	0	0	0	6	Soil Water Recharge
November	104.9	18.2	81.5	400	18.2	0	0	31.8	21.5	Surplus
December	64.4	11.9	46.7	400	11.9	0	3.3	46.7	34	Surplus
Sum	897				590.7				318	

TABLE 13b

350 mm USGS Wetland Monthly Water Balance (2022)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	62.1	7.9	11.9	350	7.9	0	41.7	11.9	29.9	Surplus
February	99.7	11.2	75.1	350	11.2	0	52.9	75.1	54.4	Surplus
March	59.2	22.9	80.3	350	22.9	0	6.2	80.3	68.9	Surplus
April	53.4	38.4	18.6	350	38.4	0	0	18.6	45.1	Surplus
May	63.7	80.1	-19.5	330.5	80.1	0	0	0	24.4	Soil Water Utilization
June	72.6	104.5	-35.6	296.9	102.5	2	0	0	14.2	Soil Water Utilization
July	72.5	122.5	-53.6	251.4	114.4	8.1	0	0	8.9	Soil Water Utilization
August	51	104.7	-56.2	211	88.8	15.8	0	0	5.2	Soil Water Utilization
September	86	60.2	21.5	232.5	60.2	0	0	0	5.6	Soil Water Recharge
October	107.5	31.2	70.9	303.4	31.2	0	0	0	6	Soil Water Recharge
November	104.9	18.2	81.5	350	18.2	0	0	34.8	23	Surplus
December	64.4	11.9	46.7	350	11.9	0	3.3	46.7	34.7	Surplus
Sum	897				587.7				320.3	

TABLE 13c

375 mm USGS Wetland Monthly Water Balance (2022)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	62.1	7.9	11.9	375	7.9	0	41.7	11.9	29.9	Surplus
February	99.7	11.2	75.1	375	11.2	0	52.9	75.1	54.4	Surplus
March	59.2	22.9	80.3	375	22.9	0	6.2	80.3	68.9	Surplus
April	53.4	38.4	18.6	375	38.4	0	0	18.6	45.1	Surplus
May	63.7	80.1	-19.5	355.5	80.1	0	0	0	24.4	Soil Water Utilization
June	72.6	104.5	-35.6	321.7	102.7	1.9	0	0	14.2	Soil Water Utilization
July	72.5	122.5	-53.6	275.7	114.9	7.6	0	0	8.9	Soil Water Utilization
August	51	104.7	-56.2	234.4	89.8	14.9	0	0	5.2	Soil Water Utilization
September	86	60.2	21.5	255.9	60.2	0	0	0	5.6	Soil Water Recharge
October	107.5	31.2	70.9	326.8	31.2	0	0	0	6	Soil Water Recharge
November	104.9	18.2	81.5	375	18.2	0	0	33.2	22.2	Surplus
December	64.4	11.9	46.7	375	11.9	0	3.3	46.7	34.3	Surplus
Sum	897				589.4				319.1	

TABLE 14a

400 mm USGS Wetland Monthly Water Balance (2023)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	86.8	12.4	67.2	400	12.4	0	7.2	67.2	52.5	Surplus
February	68.6	13.3	50	400	13.3	0	10.3	50	51.9	Surplus
March	109.8	22.1	89.3	400	22.1	0	4	89.3	74.2	Surplus
April	98.1	42.9	54.3	400	42.9	0	0	54.3	66.8	Surplus
May	34.6	64	-31.2	368.8	64	0	0	0	32.7	Soil Water Utilization
June	74.4	102.6	-31.9	339.4	100.1	2.5	0	0	19.2	Soil Water Utilization
July	163	122.5	32.4	371.7	122.5	0	0	0	15.9	Soil Water Recharge
August	138.7	91.9	39.9	400	91.9	0	0	11.6	16.6	Surplus
September	30.1	63.3	-34.7	365.3	63.3	0	0	0	6.3	Soil Water Utilization
October	62.9	36.5	23.3	388.6	36.5	0	0	0	5.6	Soil Water Recharge
November	53.6	16.5	34.5	400	16.5	0	0	23	15.4	Surplus
December	110.3	14.4	90.3	400	14.4	0	0	90.3	57	Surplus
Sum	1030.9				599.9				414.1	

TABLE 14b

350 mm USGS Wetland Monthly Water Balance (2023)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	86.8	12.4	67.2	350	12.4	0	7.2	67.2	52.9	Surplus
February	68.6	13.3	50	350	13.3	0	10.3	50	52.1	Surplus
March	109.8	22.1	89.3	350	22.1	0	4	89.3	74.3	Surplus
April	98.1	42.9	54.3	350	42.9	0	0	54.3	66.9	Surplus
May	34.6	64	-31.2	318.8	64	0	0	0	32.7	Soil Water Utilization
June	74.4	102.6	-31.9	289.7	99.8	2.8	0	0	19.2	Soil Water Utilization
July	163	122.5	32.4	322.1	122.5	0	0	0	15.9	Soil Water Recharge
August	138.7	91.9	39.9	350	91.9	0	0	12	16.8	Surplus
September	30.1	63.3	-34.7	315.3	63.3	0	0	0	6.4	Soil Water Utilization
October	62.9	36.5	23.3	338.6	36.5	0	0	0	5.6	Soil Water Recharge
November	53.6	16.5	34.5	350	16.5	0	0	23	15.4	Surplus
December	110.3	14.4	90.3	350	14.4	0	0	90.3	57.1	Surplus
Sum	1030.9				599.6				415.3	

TABLE 14c

375 mm USGS Wetland Monthly Water Balance (2023)

Date	P	PET	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Comments
January	86.8	12.4	67.2	375	12.4	0	7.2	67.2	52.7	Surplus
February	68.6	13.3	50	375	13.3	0	10.3	50	52	Surplus
March	109.8	22.1	89.3	375	22.1	0	4	89.3	74.2	Surplus
April	98.1	42.9	54.3	375	42.9	0	0	54.3	66.8	Surplus
May	34.6	64	-31.2	343.8	64	0	0	0	32.7	Soil Water Utilization
June	74.4	102.6	-31.9	314.6	100	2.7	0	0	19.2	Soil Water Utilization
July	163	122.5	32.4	346.9	122.5	0	0	0	15.9	Soil Water Recharge
August	138.7	91.9	39.9	375	91.9	0	0	11.8	16.7	Surplus
September	30.1	63.3	-34.7	340.3	63.3	0	0	0	6.4	Soil Water Utilization
October	62.9	36.5	23.3	363.6	36.5	0	0	0	5.6	Soil Water Recharge
November	53.6	16.5	34.5	375	16.5	0	0	23	15.4	Surplus
December	110.3	14.4	90.3	375	14.4	0	0	90.3	57.1	Surplus
Sum	1030.9				599.8				414.7	

Appendix A

Terms of Reference

Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

August 2, 2022

Niagara Peninsula Conservation Authority
250 Thorold Road West, 3rd Floor
Welland, ON L3C 3W2

Re: Updated Water Balance Terms of Reference, Residential Subdivision, 436 Quaker Road, Welland, and Lot 228 /Part Lot 174, Thorold, ON

1.0 Introduction and Background Information

Terra-Dynamics Consulting Inc. respectfully submits this updated Terms of Reference (TofR) responding to comments provided by the Niagara Peninsula Conservation Authority on the TofR submitted April 13, 2022. This TofR is to complete a Site, and wetland feature-based, water balance assessment for the proposed Primont Homes Welland/Thorold Residential Subdivisions. It is our understanding the Site is approximately 64 hectares in size within the City of Welland and the Town of Thorold, and includes 436 Quaker Road in Welland, and Lot 228 and Part Lot 174, Town of Thorold.

The Ministry of Natural Resources and Forestry (MNRF) have mapped approximately 17 hectares of provincially significant wetland at the Site associated with the Niagara Street Cataract Road Woodlot Wetland Complex (MNRF, 2009) including:

1. 5.2 hectares of swamp along Quaker Road and First Avenue in the southeast corner of the Site,
2. 8.2 hectares of swamp in the northern portion of the Site, and
3. 3.6 hectares of marsh in the northeast corner of the Site along Cataract Road.

This scope of work is based upon our experience with the NPCA, and Niagara Region, requiring water balances and our experience studying Niagara's physical environment. Our current understanding of the study requirements are detailed below after a review of information provided by Walter Fedy including a geotechnical investigation report (DS Consultants, 2021), a Conceptual Wetland Restoration Plan (GEI Consultants, 2022) and discussions with GEI Consultants biologists.

2.0 Water Balance Scope of Work

A water balance assessment, both Site and feature-based wetland, will be completed to:

1. Ensure no negative impacts to the natural heritage system;

2. Inform stormwater management design at the Site in such a manner that pre-development water balance conditions are maintained for all wetlands in the Natural Heritage System Designation. A detailed water balance will be required as part of a stormwater management plan submission; and

3. PSW Wetlands be conserved, with the successful matching of pre- and post-development water balances, as best as practical.

Our water balance will address these requirements and be completed following the Conservation Authority Guidelines for Hydrogeological Assessments (see attached Table 1, Conservation Ontario, 2013) and include (i) a description of pre-development conditions, (ii) impact assessment and (iii) recommended mitigation measures for a subdivision on municipal servicing.

The feature-based wetland water balance assessment will evaluate the pre-development hydrologic regime of the Provincially significant wetland areas on-site associated with the Niagara Street Cataract Road Woodlot Wetland Complex (MNRF, 2009).

2.2.1 Field Investigation

Wetland hydroperiod characterization from hydrologic field monitoring includes a year of monitoring at the following locations (Figure 1):

a) eighteen (18) wetland monitoring staff gauges with datalogging pressure transducers (water level loggers);
b) datalogging pressure transducers (water level loggers) installed in four (4) on-site shallow monitoring wells (BH21-1, BH21-3, BH21-13 and BH21-14) constructed by DS Consultants (2021) corresponding with the three primary MNRF wetland polygons; and
c) installation of a barometric pressure data logger to correct for barometric pressure changes on water levels.

Groundwater levels will also be manually measured at the existing on-Site ten (10) monitoring wells in the spring, summer and fall seasons.

Hydraulic conductivity testing will be completed of the four monitoring wells with datalogging pressure transducers installed adjacent the wetlands and compared to hydraulic conductivities calculated from grain-size analyses completed during the geotechnical analyses.

2.2.2 Water Balance/Wetland Modelling

The water balance assessment will use existing long-term water balance modelling by NPCA (AquaResource Inc. and Niagara Peninsula Conservation Authority (NPCA), 2009). This modelling was completed at an hourly interval over a fifteen-year period (1991-2005) providing baseline pre-development water balance values. This approach exceeds the minimum requirements for a “low risk” water balance (Figure 2). Results will be refined using information obtained during the geotechnical investigation and our own field investigations to further refine the hydrogeological characterization.

A water balance model will be completed for the wetland using the United States Geological Survey (USGS) Thornthwaite Monthly Water Balance (McCabe and Markstrom, 2007). The model provides:

i. A number of adjustable parameters for calibration of pre-development conditions to Niagara Peninsula Conservation Authority (NPCA) water balance modelling (AquaResource Inc. and NPCA, 2009); and

ii. A monthly water balance, as this is commonly sufficient detail for assessing wetland hydrologic function during summer months on low permeability soils.

Pre- and post-development wetland catchments will be determined, mapped and used for the wetland water balance analyses.

2.2.4 Wetland Risk Evaluation

Since early 2021, NPCA has been requiring water balances conform to the guidelines (2012), monitoring protocols (2016) and risk evaluations (2017) developed by the Toronto Region Conservation Authority (TRCA). This work program will exceed the requirements for "low risk" evaluation as specified by the TRCA and include a risk evaluation (Figure 2, 2017).

2.2.5 Mitigation

The post-development water balance will consider the proposed storm drainage plan and recommendations provided for the Stormwater Management Plan to improve post-development water management completing the water balance requirement for a "mitigation plan" (Figure 2, TRCA, 2017). It is expected that a mitigation plan can be developed to avoid any requirements for new continuous water balance modelling.

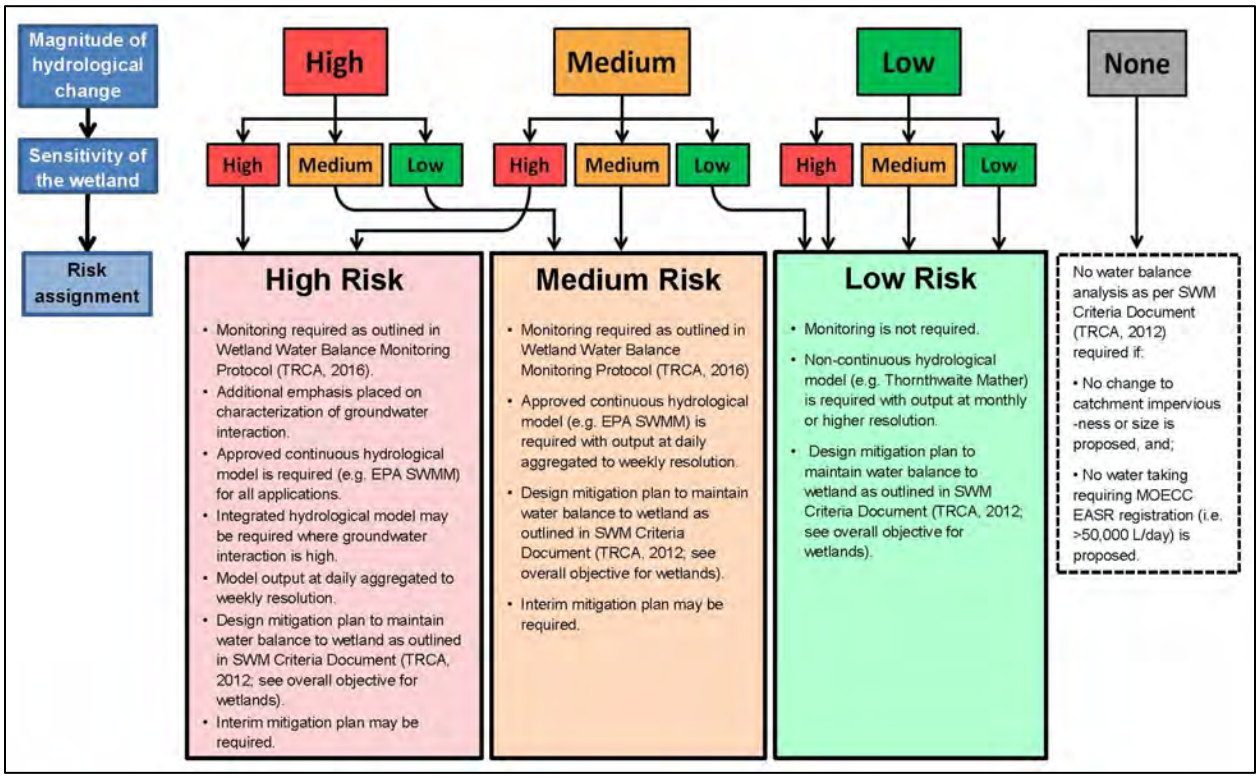
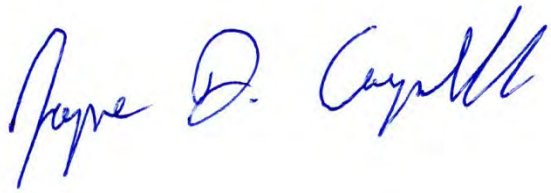


Figure 2 – Wetland Risk Evaluation Decision Tree (TRCA, 2017)

We trust this information is sufficient for your present needs. Thank you for the opportunity to submit this proposed Terms of Reference. Please do not hesitate to contact us if you have any questions.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.



Jayme D. Campbell, P. Eng.
Senior Water Resources Engineer

cc. Eric Salembier, WalterFedy

Attachments
Figure 1 – Monitoring Locations
Table 1 – Hydrogeological Assessment Check List intended to Support Development Applications

7.0 References

AquaResource Inc. and Niagara Peninsula Conservation Authority (NPCA), 2009. Water Availability Study for the Central Welland River, Big Forks Creek, and Beaverdams Shriners Creeks Watershed Plan Areas, Niagara Peninsula Source Protection Area.

Conservation Ontario, 2013. Hydrogeological Assessment Submissions, Conservation Authority Guidelines for Development Applications.

DS Consultants Ltd., 2022. Report on Preliminary Geotechnical Investigation, Quaker Road and First Avenue, Welland, Ontario. Prepared for Primont Homes.

GEI Consultants, 2022. Conceptual Wetland Restoration Plan for removal of unevaluated wetlands on lands owned by Primont Homes within the City of Welland and City of Thorold, Ontario. Prepared for Ian MacPherson, Primont Homes.

McCabe, G.J., and Markstrom, S.L., 2007. A monthly water-balance model driven by a graphical user interface. U.S. Geological Survey Open-File report 2007-1008, 6p.

Ministry of Natural Resources and Forestry (MNRF), 2009. Niagara Street – Cataract Road Wetland Complex, Wetland Evaluation Edition 3rd.

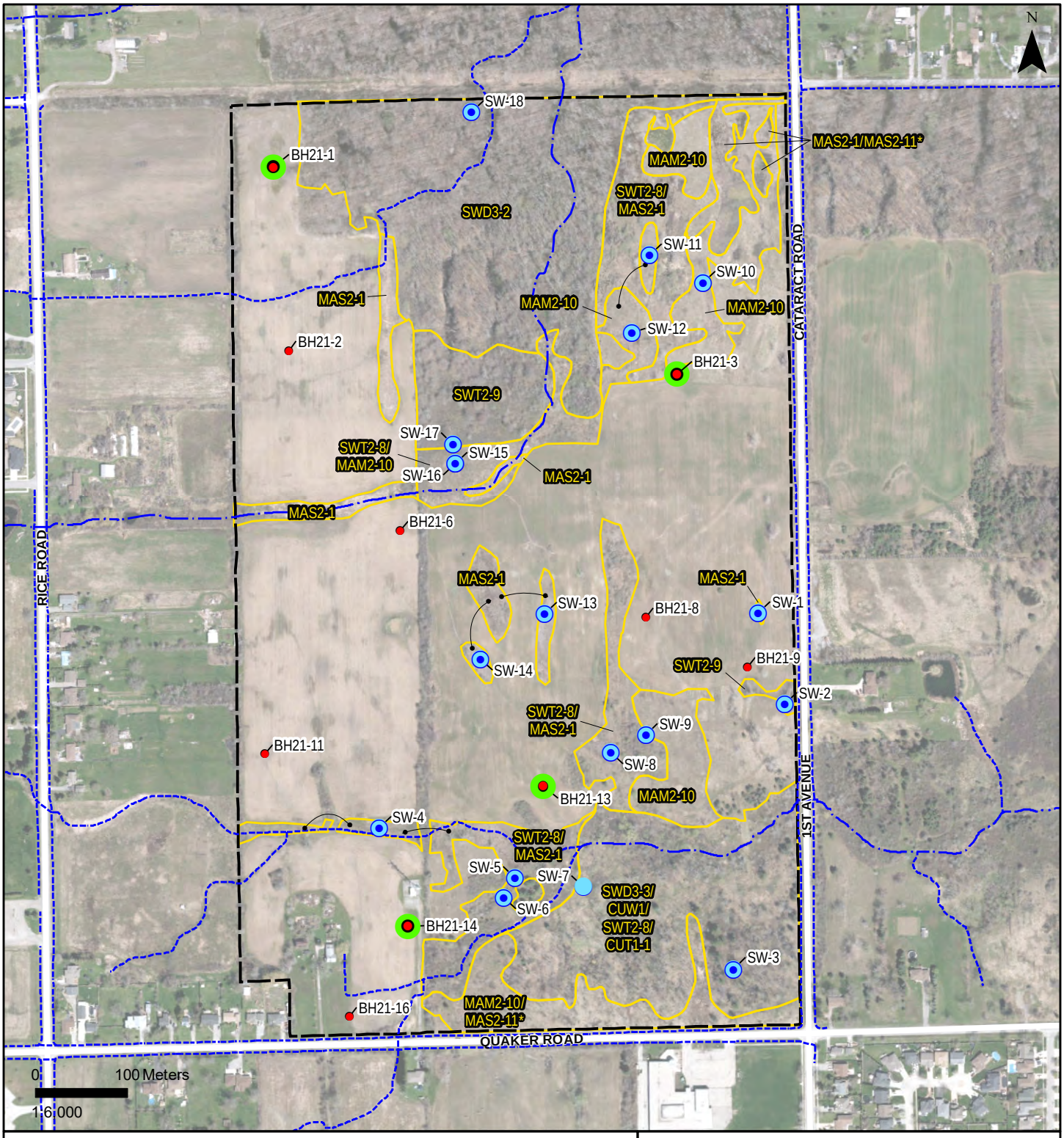
Niagara Peninsula Conservation Authority, 2022. RE: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference. E-mail from Nicholas Godfrey (Watershed Planner) to Jayme Campbell (Senior Water Resource Engineer).

Niagara Peninsula Conservation Authority and AquaResource Inc., 2010. Niagara Peninsula Tier 1 Water Budget and Water Quantity Stress Assessment Final Report, Niagara Peninsula Source Protection Area.

Toronto and Region Conservation Authority (TRCA), 2017. Wetland Water Balance Risk Evaluation.

Toronto and Region Conservation Authority (TRCA), 2016. Wetland Water Balance Monitoring Protocol.

Toronto and Region Conservation Authority (TRCA), 2012. Water Balance Guidelines for the Protection of Natural Features.



Subject Lands
Monitoring Well
Monitoring Well and Datalogger
ELC Wetland
Wetland Monitoring Location
Watercourse (NPCA)
Ephemeral
Intermittent or Ephemeral

ELC Code	ELC Name
CUT1-1	Sumac Cultural Thicket
CUW1	Mineral Cultural Woodland
MAM2-10	Forb Mineral Meadow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
MAS2-11*	Southern Arrow-wood Mineral Thicket Swamp
SWD3-2	Silver Maple Mineral Deciduous Swamp
SWD3-3	Swamp Maple Mineral Deciduous Swamp
SWT2-8	Silky Dogwood Mineral Thicket Swamp
SWT2-9	Gray Dogwood Mineral Thicket Swamp

Monitoring Locations

Water Balance, 436 Quaker Rd, Welland and Lot 228/Lot 174, Thorold, ON
Primont Homes

TDC Terra-Dynamics Consulting Inc.

Figure 1

Path: H:\TERRA_DYNAMICS\9563 - TD Primont\gis\mxd\Figure 1 Monitoring Locations.mxd Revised: August 2, 2022

Table 1: Hydrogeological Assessment Check List intended to Support Development Applications

Groundwater Assessment	Master Environmental Servicing Plan or Equivalent	Environmental Assessment (EA)	Site Plan Commercial, Institutional, or Industrial	Subdivision or Condominium Development		Single lot Residential	Dewatering
				Municipal Servicing	Private Servicing		
1. EXISTING CONDITIONS:							
Introduction and background	☐	☐	☐	☐	☐	☐	☐
Site location and description	☐	☐	☐	☐	☐	☐	☐
Description of: • Topography & Drainage • Physiography • Geology & Soils	☐	☐	☐	☐	☐	☐	☐
Test pits/Boreholes	☐	☐	☐	☐	☐	GNR	☐
Monitoring Wells	☐	☐	☐	☐	☐	GNR	☐
Private Well Survey	☐	☐	☐	☐	☐	GNR	☐
Hydrostratigraphy/Hydrogeology: • Aquifer properties • Groundwater Levels • Groundwater flow direction	☐	☐	☐	☐	☐	☐	☐
Description of surface water features and functions	☐	☐	☐	☐	☐	☐	☐
Water Taking Permit details	GNR	GNR	GNR	GNR	GNR	GNR	☐
Water Quality	☐	☐	☐	☐	☐	GNR	☐
D-5-5 (Water Supply)	GNR	GNR	GNR	GNR	☐	GNR	GNR

Groundwater Assessment	Master Environmental Servicing Plan or Equivalent	Environmental Assessment (EA)	Site Plan Commercial, Institutional, or Industrial	Subdivision or Condominium Development		Single lot Residential	Dewatering
				Municipal Servicing	Private Servicing		
2. IMPACT ASSESSMENT:							
Groundwater Levels	☐	☐	☐	☐	☐	GNR	☐
Pumping Tests*	☐	☐	GNR	GNR	☐	GNR	☐
Groundwater Discharge (Baseflow)	☐	☐	☐	☐	☐	GNR	☐
Water Balance	☐	☐	☐	☐	☐	GNR	GNR
Groundwater Quality	☐	☐	☐	☐	☐	GNR	☐
D-5-4 (Onsite Sewage Systems)	GNR	GNR	GNR	GNR	☐	GNR	GNR
3. MITIGATION MEASURES:							
Maintenance of Infiltration/Recharge	☐	☐	☐	☐	☐	GNR	GNR
Maintenance Groundwater Quality	☐	☐	☐	☐	☐	GNR	☐
Monitoring Program	☐	☐	☐	☐	☐	GNR	☐
Contingency Plans**	GNR	GNR	GNR	☐	☐	GNR	☐

NOTES: This table outlines the type of planning application and associated requirements most commonly required by Conservation Authorities in the review of Hydrogeological Assessments. This table is not a complete list of all types of applications dealt with by each Conservation Authority nor is the checklist appropriate for every development situation. Individual Conservation Authorities should be consulted with for specific requirements.

☐ - *Recommended*
GNR – Generally Not Required
** Where development is municipally serviced, these tests will be necessary on a case by case basis (sensitive aquifer/ aquatic considerations).*
***May be scoped, Contingency Plans will not be needed in most cases.*

jcampbell@terra-dynamics.com

From: Taran Lennard <tlennard@npca.ca>
Sent: August 9, 2022 12:46 PM
To: jcampbell@terra-dynamics.com
Cc: 'Eric Salembier'
Subject: RE: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference

Hi Jayme,

The previous comments have been addressed to the satisfaction of NPCA. Staff do not offer further comment on the ToR for the Water Balance.

Thank you.

Taran Lennard
Watershed Planner
Niagara Peninsula Conservation Authority (NPCA)
250 Thorold Road West, 3rd Floor | Welland, ON L3C 3W2
Tel: 905-788-3135 | extension 277
email: tlennard@npca.ca

NPCA Watershed Explorer

From: jcampbell@terra-dynamics.com <jcampbell@terra-dynamics.com>
Sent: Tuesday, August 2, 2022 3:27 PM
To: Taran Lennard <tlennard@npca.ca>
Cc: Sarah Mastroianni <smastroianni@npca.ca>; 'Eric Salembier' <esalembier@walterfedy.com>
Subject: RE: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference

Good afternoon Taran,

Please find attached the updated water balance Terms of Reference with the additional information requested by NPCA.

Jayme D. Campbell, P.Eng.

Senior Water Resource Engineer
Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2, St. Catharines, Ontario L2M 4W3
Phone: 289-407-0915
https://terra-dynamics.com/

Common sense solutions to environmental challenges

From: Nicholas Godfrey <ngodfrey@npca.ca>
Sent: May 25, 2022 1:07 PM
To: jcampbell@terra-dynamics.com
Cc: Taran Lennard <tlennard@npca.ca>
Subject: RE: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference

Good afternoon Jaymee,

Our office has reviewed the Terms of Reference and offers the following comments:

1. The Terms of Reference has identified that 4 wetland monitoring staff gauges and 4 shallow groundwater monitoring wells (BH21-1, BH21-3, BH21-13 and BH21-14) will be established and/or instrumented with datalogging pressure transducers within the study area. Please provide a figure which identifies the proposed monitoring locations.
2. The Terms of Reference has identified that 10 existing monitoring wells will be manually monitored in spring, summer, and fall, please include the location of these wells on a figure.
3. The Terms of Reference does not specify the intended duration of monitoring. Please identify the duration of monitoring.
4. The Terms of Reference does not discuss catchments of the wetlands present within the study area. Pre and post development catchments must be clearly identified and documented in the report and within a figure.

Please let me know if you have any questions.

Best,

Nicholas Godfrey, M.A.
Watershed Planner
Niagara Peninsula Conservation Authority (NPCA)
250 Thorold Road West, 3rd Floor, Welland, ON, L3C 3W2
905-788-3135, ext. 278
ngodfrey@npca.ca
www.npca.ca

From: jcampbell@terra-dynamics.com <jcampbell@terra-dynamics.com>
Sent: April 19, 2022 10:31 AM

To: 'Eric Salembier' <esalembier@walterfedy.com>
Cc: Sarah Mastroianni <smastroianni@npca.ca>; Nicholas Godfrey <ngodfrey@npca.ca>
Subject: FW: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference

Good morning Eric,

Would you be able to answer Sarah's question?
Thank you.

Jayme D. Campbell, P.Eng.
Senior Water Resource Engineer
Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2, St. Catharines, Ontario L2M 4W3
Phone: 289-407-0915
https://terra-dynamics.com/

Common sense solutions to environmental challenges

From: Sarah Mastroianni <smastroianni@npca.ca>
Sent: April 19, 2022 10:23 AM
To: Nicholas Godfrey <ngodfrey@npca.ca>
Cc: jcampbell@terra-dynamics.com
Subject: FW: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference

Hi Nick,

As discussed, please take the lead on this one for the NPCA.

Jayme, I don't actually see a file number internally for this one (and Jessica is no longer here to ask), did this one have a municipal preconsultation meeting that you know of?

Thanks.

Sarah Mastroianni
Manager, Planning and Development
Niagara Peninsula Conservation Authority (NPCA)
250 Thorold Road West, 3rd Floor **|** Welland, ON L3C 3W2
Tel: 905-788-3135 **|** extension 249
smastroianni@npca.ca
www.npca.ca

NPCA Watershed Explorer

For mapping on features regulated by the NPCA please go to our GIS webpage at https://gis-npca-camaps.opendata.arcgis.com/ and utilize our Watershed Explorer App or GIS viewer.

To send NPCA staff information regarding a potential violation of Ontario Regulation 155/06 please go to the NPCA Enforcement and Compliance webpage at https://npca.ca/administration/enforcement-compliance.

From: jcampbell@terra-dynamics.com <jcampbell@terra-dynamics.com>
Sent: Wednesday, April 13, 2022 1:23 PM
To: 'Lampman, Cara' <Cara.Lampman@niagararegion.ca>; Adam.Boudens@niagararegion.ca; Sarah Mastroianni <smastroianni@npca.ca>
Cc: 'Eric Salembier' <esalembier@walterfedy.com>
Subject: Primont Homes Welland/Thorold Hydrogeological Water Balance Terms of Reference

Good afternoon Sarah, Cara and Adam,

Please find attached a proposed hydrogeology water balance terms of reference regarding Primont Homes Welland/Thorold Residential Subdivisions for your review and comment.

If you have any questions regarding the attached please feel free to contact me directly.

Jayme D. Campbell, P.Eng.
Senior Water Resource Engineer
Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2, St. Catharines, Ontario L2M 4W3
Phone: 289-407-0915
https://terra-dynamics.com/

Common sense solutions to environmental challenges

Due to the COVID-19 pandemic, the NPCA has taken measures to protect staff and public while providing continuity of services. The NPCA main office is open by appointment only with limited staff, please refer to the Staff Directory and reach out to the staff member you wish to speak or meet with directly. Our Conservation Areas are currently open, but may have modified amenities and/or regulations.

Updates regarding NPCA operations and activities can be found at Get Involved NPCA Portal, or on social media at NPCA's Facebook Page & NPCA's Twitter page.

Appendix B

Borehole and Monitoring Well Logs

LOG OF BOREHOLE BH21-1

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765685 E 641199

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-29-2021

REF. NO.: 21-339-300
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.5											
0.0 / 183.2	**TOPSOIL**: 300 mm										
0.3 / 182.7	**SILTY SAND**: disturbed/reworked, trace organics, brown, moist, loose	1	SS	5		183					
0.8	**SILTY CLAY**: trace sand, fine sand seams, brown, very moist to moist, very stiff to firm	2	SS	13	▽ W.L. 182.2 m Nov. 11, 2021						
		3	SS	20		182			225		
		4	SS	17		181			175		
	grey below 3m	5	SS	14					150		
						180					
	wet, firm below 4.6m	6	SS	6		179					0 5 56 40
			VANE			178	+ 1.8				
177.4											
6.1 / 176.8	**SANDY SILT**: trace gravel, trace clay, brown, wet, compact	7	SS	16		177					4 26 63 8
6.7	**END OF BOREHOLE**										

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	1.26
May 10, 2022	-0.8

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH21-2

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site

CLIENT: Primont Homes

PROJECT LOCATION: Welland, Ontario

DATUM: Geodetic

BOREHOLE LOCATION: See Drawing 1 N 4765487 E 641216

DRILLING DATA

Method: Solid Stem Augers

Diameter: 150 mm

Date: Oct-29-2021

REF. NO.: 21-339-300

ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	ELEVATION
184.1					184
0.0 / 183.8	**TOPSOIL**: 300 mm	1	SS	4	
0.3 / 183.3	**SILTY SAND**: disturbed/reworked, trace organics, brown, moist, loose				
0.8	**SILTY CLAY**: fine sand seams, brown, moist to very moist, very stiff to firm	2	SS	16	183
		3	SS	21	
	very moist below 2.3m	4	SS	9	182
	grey below 3m	5	SS	8	181
	firm below 4.6m	6	SS	4	180
			VANE		179
	silt layers, trace gravel	7	SS	6	178
176.8			VANE		177
7.3	**END OF BOREHOLE**				

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date: Water Level(mbgl):
Nov. 11, 2021 0.7
May 10, 2022 0.68
June 27, 2022 0.54

GROUND WATER CONDITIONS: W. L. 183.5 m Nov 11, 2021; W. L. 183.42 m May 10, 2022

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100; +2.5; +>100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa): 225; 150; 100

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	0	67	33

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-3

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765461 E 641631

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"
182.4				
0.0 / 182.0	**TOPSOIL**: 350 mm	1	SS	4
0.4 / 181.5	**CLAYEY SILT**: disturbed/reworked, trace organics, brown, moist, firm			
0.9	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist to very moist, very stiff to firm	2	SS	14
		3	SS	18
	grey, very moist below 2.3m	4	SS	17
		5	SS	11
	wet, firm below 4.6m	6	SS	7
			VANE	
		7	SS	4
			VANE	
175.1				
7.3	**END OF BOREHOLE**			

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	0.35
May 10, 2022	0.52

GROUND WATER CONDITIONS: W1 182.1 m Nov 11, 2021; W1 182.0 m May 10, 2022

ELEVATION: 182, 181, 180, 179, 178, 177, 176

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
+7.0 +3.0

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	2	48	50

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-4

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765324 E 641710

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.1										
0.0 / 183.8	**TOPSOIL**: 300 mm		1	SS	2		184			
0.3 / 183.2	**CLAYEY SILT**: disturbed/reworked, trace organics, brown, moist, soft		2	SS	19		183	175		
0.9	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist, very stiff		3	SS	27		182	225		
			4	SS	27			225		
	grey below 3m		5	SS	19		181	175		
179.5							180			
4.6	**SILT**: reddish brown, moist, compact to dense		6	SS	20		179	225		
177.4			7	SS	36		178			
6.7	**END OF BOREHOLE**									

Notes:
1. Borehole dry upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-5

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765353 E 641503

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.9										
0.0 / 183.6	**TOPSOIL**: 300 mm		1	SS	5		183			
0.3 / 183.1	**CLAYEY SILT**: disturbed/reworked, trace organics, brown, moist, firm									
0.8	**SILT**: some clay, trace sand, brown, moist, compact		2	SS	19		182			
			3	SS	20					
			4	SS	23		181			
	grey below 3m		5	SS	24			225		
			6	SS	20		180			
	wet		7	SS	18		179	225		
177.2							178	150		
6.7	**END OF BOREHOLE**									

Notes:
1. Borehole wet at 6m depth during drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-6

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765297 E 641336

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-28-2021

REF. NO.: 21-339-300
ENCL NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
184.1 / 0.0	**TOPSOIL**: 300 mm			
183.8 / 0.3	**CLAYEY SILT**: disturbed/reworked, trace organics, brown, moist, firm	1	SS	5
183.2 / 0.9	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist to very moist, very stiff to firm	2	SS	17
		3	SS	13
	grey, very moist below 3m	4	SS	20
		5	SS	7
			VANE	
179.5 / 4.6	**SILT**: some sand, trace clay, grey, wet, compact	6	SS	26
		7	SS	28
177.4 / 6.7	**END OF BOREHOLE**			

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	0.54
May 10, 2022	0.66
June 27, 2022	0.78

GROUND WATER CONDITIONS: W. L. 183.6 m Nov 11, 2021; W. L. 183.5 m May 10, 2022; W. L. 183.3 m Jun 27, 2022

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa): 200

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
181	0	2	56	41
179	0	14	81	5

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-7

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765120 E 641247

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-28-2021

REF. NO.: 21-339-300
ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.2												
0.0 / 183.9	**TOPSOIL**: 300 mm											
0.3 / 183.3	**CLAYEY SILT**: disturbed/reworked, trace organics, brown, moist, soft		1	SS	3		184					
0.9	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist to very moist, very stiff to firm		2	SS	15		183					
			3	SS	24					225		
			4	SS	16		182			225		
	grey, very moist, stiff below 3m		5	SS	9		181			75		
	firm below 4.6m		6	SS	7		180					
				VANE			179	+				
178.2												
6.0 / 177.5	**SILT**: some sand, brown, wet, compact		7	SS	28		178					
6.7	**END OF BOREHOLE**											

Notes:
1. Borehole wet at 6m depth during drilling.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-8

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765201 E 641601

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE	WATER CONTENT (%) PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.6											
0.0 / 183.3	**TOPSOIL**: 300 mm										
0.3 / 182.7	**SANDY SILT**: disturbed/reworked, trace topsoils, brown, moist, loose	1	SS	7		183					
0.9	**SILTY CLAY**: silt seams/layers, brown, moist, hard to firm	2	SS	18	▽ W. L. 182.5 m May 27, 2022 W. L. 182.2 m Nov 11, 2021						
		3	SS	32		182					
		4	SS	16		181					
	grey, very moist, firm below 3m	5	SS	5							0 0 34 66
			VANE			180	+ 3.0				
		6	SS	4		179					
177.6			VANE			178	+ 5.0				
6.0	**SILT**: some sand, trace clay, brown, wet, compact	7	SS	10		177					
176.9											
6.7	**END OF BOREHOLE**										

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	1.37
May 10, 2022	1.11
June 27, 2022	1.12

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3 , × 3 : Numbers refer to Sensitivity ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-9

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765147 E 641707

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
183.5				
0.0 / 183.2	**TOPSOIL**: 300 mm	1	SS	5
0.3	**SANDY SILT**: disturbed/reworked, trace topsoils, brown, moist, loose			
182.6		2	SS	23
1 0.9	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist, very stiff to firm			
		3	SS	20
2		4	SS	10
3	grey, firm below 3m	5	SS	6
			VANE	
4	wet below 4.6m	6	SS	4
5			VANE	
6		7	SS	6
7			VANE	
176.2				
7.3	**END OF BOREHOLE**			

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date: Water Level(mbgl):
Nov. 11, 2021 0.25
May 10, 2022 -0.5
June 27, 2022 0.97

W. L. 184.0 m May 10, 2022
W. L. 183.3 m Nov. 11, 2021
W. L. 182.6 m Jun 27, 2022

DYNAMIC CONE PENETRATION RESISTANCE PLOT
SHEAR STRENGTH (kPa)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)

METHANE AND GRAIN SIZE DISTRIBUTION (%)				
GR	SA	SI	CL
0	3	41	56

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-10

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765113 E 641466

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
183.7						
0.0 / 183.4	**TOPSOIL**: 300 mm	1	SS	6		
0.3 / 182.9	**CLAYEY SILT**: disturbed/reworked, trace topsoils, brown, moist, firm					183
0.8	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist, very stiff to firm	2	SS	21		
		3	SS	21		182
		4	SS	12		
						181
	grey, wet, firm below 3m	5	SS	4		
			VANE			180
		6	SS	5		179
			VANE			178
177.7						
6.0 / 177.0	**SANDY SILT**: brown, wet, compact	7	SS	12		177
6.7	**END OF BOREHOLE**					

Notes:
1. Borehole wet below 3m depth during drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-11

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site

CLIENT: Primont Homes

PROJECT LOCATION: Welland, Ontario

DATUM: Geodetic

BOREHOLE LOCATION: See Drawing 1 N 4765056 E 641193

DRILLING DATA

Method: Solid Stem Augers

Diameter: 150 mm

Date: Oct-27-2021

REF. NO.: 21-339-300

ENCL NO.: 12

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
184.3 / 0.0	**TOPSOIL**: 450 mm	1	SS	4
183.8 / 0.5	**CLAYEY SILT**: disturbed/reworked, trace topsoil, brown, moist, firm			
183.5 / 0.8	**SILTY CLAY**: trace sand, silt seams/layers, brown, moist to very moist, very stiff to firm	2	SS	14
		3	SS	18
	very moist, stiff below 2.3m	4	SS	11
	grey below 3m	5	SS	10
	wet, firm below 4.6m	6	SS	4
			VANE	
	silt layers	7	SS	7
177.0			VANE	
177.0 / 7.3	**END OF BOREHOLE**			

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	3.47
May 10, 2022	0.77
June 27, 2022	0.57

GROUND WATER CONDITIONS: W. L. 183.7 m Jun 27, 2022; W. L. 183.34 m May 10, 2022; W. L. 180.8 m Nov 11, 2021

ELEVATION: 184, 183, 182, 181, 180, 179, 178

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100; 2.3; 3.0

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	3	48	50

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-12

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site

CLIENT: Primont Homes

PROJECT LOCATION: Welland, Ontario

DATUM: Geodetic

BOREHOLE LOCATION: See Drawing 1 N 4765024 E 641312

DRILLING DATA

Method: Solid Stem Augers

Diameter: 150 mm

Date: Oct-28-2021

REF. NO.: 21-339-300

ENCL NO.: 13

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
183.8							
0.0 / 183.5	**TOPSOIL**: 300 mm		1	SS	5		
0.3 / 183.0	**SILTY SAND**: disturbed/reworked, trace topsoil, brown, moist, loose						
0.8	**SILTY CLAY**: trace sand, brown, moist to very moist, very stiff to firm		2	SS	16		183
			3	SS	26		182
	stiff below 2.3m		4	SS	14		
	grey, wet, firm below 3m		5	SS	6		181
				VANE			180
			6	SS	6		179
				VANE			178
			7	SS	7		177
176.5				VANE			
7.3	**END OF BOREHOLE**						

Notes:
1. Borehole wet below 3m depth during drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-13

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4765022 E 641489

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-27-2021

REF. NO.: 21-339-300
ENCL NO.: 14

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	ELEVATION
183.4					
0.0 / 183.1	**TOPSOIL**: 300 mm	1	SS	7	183
0.3 / 182.6	**CLAYEY SILT**: disturbed/reworked, trace topsoil, brown, moist, firm				
0.8	**SILTY CLAY**: trace sand, brown, moist to very moist, very stiff to soft	2	SS	15	182
		3	SS	20	
	stiff below 2.3m	4	SS	12	181
	grey, wet, firm below 3m	5	SS	5	180
			VANE		
		6	SS	6	179
			VANE		178
	soft	7	SS	3	177
176.7					
6.7	**END OF BOREHOLE**				

GROUND WATER CONDITIONS: W. L. 182.8 m May 10, 2022 / Nov 11, 2021

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
+6.0
+2.5

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)
41

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	3	37	60

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	0.55
May 10, 2022	0.52
June 27, 2022	0.54

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH21-14

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site

CLIENT: Primont Homes

PROJECT LOCATION: Welland, Ontario

DATUM: Geodetic

BOREHOLE LOCATION: See Drawing 1 N 4764872 E 641346

DRILLING DATA

Method: Solid Stem Augers

Diameter: 150 mm

Date: Oct-28-2021

REF. NO.: 21-339-300

ENCL NO.: 15

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
183.6				
0.0 / 183.3	**TOPSOIL**: 300 mm			
0.3 / 182.8	**CLAYEY SILT**: disturbed/reworked, trace topsoil, brown, wet, firm	1	SS	4
0.8	**SILTY CLAY**: trace sand, trace gravel, brown, moist to very moist, very stiff to soft	2	SS	13
		3	SS	18
	stiff below 2.3m	4	SS	13
	grey, firm below 3m	5	SS	6
			VANE	
	wet below 4.6m	6	SS	3
			VANE	
	soft	7	SS	3
176.3			VANE	
7.3	**END OF BOREHOLE**			

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	0.56
May 10, 2022	0.67

GROUND WATER CONDITIONS: W 183.1 m Nov 11, 2021; W 183.0 m May 10, 2022

ELEVATION: 183, 182, 181, 180, 179, 178, 177

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

3.5 2.2 5.0

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
1	6	36	57

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-15

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4764896 E 641312

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-28-2021

REF. NO.: 21-339-300
ENCL NO.: 16

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
184.1 / 0.0	**TOPSOIL**: 300 mm			
183.8 / 0.3	**CLAYEY SILT**: disturbed/reworked, trace topsoil, brown, wet, firm	1	SS	5
183.3 / 0.8	**SILTY CLAY**: trace sand, trace gravel, brown, moist to very moist, very stiff to soft	2	SS	17
		3	SS	23
		4	SS	17
		5	SS	11
	grey, wet, soft below 4.6m	6	SS	3
			VANE	
		7	SS	4
176.8			VANE	
176.8 / 7.3	**END OF BOREHOLE**			

Notes:
1. Borehole wet below 4.6m during drilling.

GROUND WATER CONDITIONS

ELEVATION: 184, 183, 182, 181, 180, 179, 178, 177

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

3.0

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH21-16

PROJECT: Preliminary Geotechnical Investigation, Welland Thorold Site
CLIENT: Primont Homes
PROJECT LOCATION: Welland, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4764776 E 641281

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Oct-28-2021

REF. NO.: 21-339-300
ENCL NO.: 17

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
183.4				
0.0 / 182.8	**TOPSOIL**: 600 mm	1	SS	4
0.6 / 182.4	**CLAYEY SILT**: disturbed/reworked, trace topsoil, brown, wet, firm	2	SS	11
1.0	**SILTY CLAY**: trace sand, trace gravel, brown, moist to very moist, very stiff to firm	3	SS	18
	stiff below 2.3m	4	SS	9
	grey, firm below 3m	5	SS	5
			VANE	
		6	SS	5
			VANE	
176.7		7	SS	6
6.7	**END OF BOREHOLE**			

Notes:

1. 50mm dia. monitoring well installed upon completion.
2. Water Level Readings:

Date:	Water Level(mbgl):
Nov. 11, 2021	4.43
May 10, 2022	0.54
June 27, 2022	0.72

ELEVATION: 183, 182, 181, 180, 179, 178, 177

W. L. 182.9 m May 10, 2022
W. L. 182.7 m Jun 27, 2022
W. L. 179.0 m Nov 11, 2021

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	0	49	51

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 21-339-300 BOREHOLE LOGS.GPJ DS.GDT 22-7-19

LOG OF BOREHOLE BH22-01

PROJECT: Additional Geotechnical Investigation
CLIENT: Primont Homes
PROJECT LOCATION: Quaker Road and First Avenue, Welland, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Figure 1 N 4765406.469 E 641715.248

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200 mm
Date: Mar-08-2022

REF. NO.: 21-339-302
ENCL NO.: 18

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.3							184	
184.0 0.3	**TOPSOIL**: 350 mm		1	SS	11			
183.4 0.9	**SILT:** some topsoil, disturbed/reworked, trace sand, brown, moist, stiff		2	SS	41			
182.0 2.3	**SILT TO SILTY CLAY:** trace gravel, brown, moist, hard		3	SS	33			
4			4	SS	40			
179.7 4.6	**SILT:** some sand, brown, moist, dense to very dense		5	SS	67			
6 178.3 6.0	**CLAYEY SILT**: trace gravel, trace sand, brown, wet, hard		6	SS	39			1 3 82 14
	SILT: trace clay, brown, wet, dense to compact		7	SS	31			
8			8	SS	33			0 0 92 8
10			9	SS	17			
			10	SS	28			
12 172.1 12.2	**SILTY CLAY:** brown, wet, very stiff		11	SS	20			
170.6								
14 13.7	**SILT:**trace sand, clay seams, grey, wet, compact		12	SS	19			
16			13	SS	20			
			14	SS	25			
18 166.0 18.3	**CLAYEY SILT TILL:** grey, wet, very stiff to hard		15	SS	20			
20			16	SS	19			
22			17	SS	40			
			18	SS	50/ 125mm			
24 159.9 24.4	**CLAYEY SILT TO SILT:** brown, wet, hard							
26								
28			19	SS	50/ / 125mm			0 0 88 12
30 153.8 30.5	**SILTY CLAY TILL:** brown, moist, hard		20	SS	47			
32								
34			21	SS	69			
148.7 35.6	**END OF BOREHOLE**		22	SS	69			

Notes:
1) 50 mm dia. monitoring well installed upon completion.
2) Water Levels Readings:

Date	Water Level (mbgs)
Mar. 25, 2022	1.57
April 12, 2022	1.33
June 27, 2022	1.18

W. L. 183.1 m
W. L. 182.7 m
Mar 25, 2022

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ε=3% Strain at Failure

LOG OF BOREHOLE BH22-02

PROJECT: Additional Geotechnical Investigation

CLIENT: Primont Homes

PROJECT LOCATION: Quaker Road and First Avenue, Welland, ON

DATUM: Geodetic

BOREHOLE LOCATION: See Figure 1 N 4764772.797 E 641331.348

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Mar-02-2022

REF. NO.: 21-339-302

ENCL NO.: 19

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.6												
183.2 0.4	**TOPSOIL**: 400 mm		1	SS	3							
182.7 0.9	**SILTY CLAY:** disturbed/reworked, brown, moist, soft		2	SS	17		W. L. 183.4 m Jun 27, 2022					
2	**SILTY CLAY**: with silt seams, trace gravel, brown, moist to wet, very stiff to firm		3	SS	20		182					
			4	SS	12							
4			5	SS	9		180					
	layer of silt, grey, wet, loose		6	SS	4			2.0				0 0 51 49
6				VANE			178					
176.0			7	SS	4							
8 7.6	**SILT:** some sand, with clay seams/layers, brown, wet, loose		8	SS	8		176					
			9	SS	4		174					
10			10	SS	5							
12			11	SS	8		172					
169.9												
14 13.7	**SILTY CLAY:** trace to some gravel, reddish brown, moist, very stiff to hard		12	SS	15		170					
16			13	SS	16		168					
			14	SS	23		166					
18			15	SS	31							
163.8												
20 19.8	**CLAYEY SILT TO SILT:** trace sand, some clay, brown, moist, hard		16	SS	54		164					1 3 84 12
22			17	SS	55		162					
160.7												
22.9	**CLAYEY SILT TILL**: brown, moist, hard to very stiff		18	SS	37		160					
24			19	SS	43							
26			20	SS	46		158					
			21	SS	25		156					
28			22	SS	18		154					
30			23	SS	28							
32			24	SS	25		152					
			25	SS	39		150					
34												
148.0			26	SS	33		148					
35.6	**END OF BOREHOLE**											

Notes:

1) 50 mm dia. monitoring well installed at 6.10 mbgs upon completion.

2) Water Levels Readings:

Date	Water Level (mbgs)
Mar. 25, 2022	Not Accessible
April 12, 2022	1.15
June 27, 2022	0.17

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 22-339-302 QUAKER RD AND FIRST AV - COPY.GPJ DS.GDT 22-7-22

LOG OF BOREHOLE BH22-03

PROJECT: Additional Geotechnical Investigation
CLIENT: Primont Homes
PROJECT LOCATION: Quaker Road and First Avenue, Welland, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Figure 1 N 4764874.239 E 641283.907

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200 mm
Date: Mar-03-2022

REF. NO.: 21-339-302
ENCL NO.: 20

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
184.0 / 0.0	**TOPSOIL** 300 mm, over	1	SS		
183.1 / 0.9	disturbed/reworked clayey silt to sandy silt	2	SS	10	
	SILTY CLAY: reddish brown, with silty sand seams/layers, trace gravel, moist to very moist, very stiff to soft	3	SS	22	
		4	SS	21	
		5	SS	11	
	with layer of silty sand, grey below 3 m	6	SS	7	
	wet, firm below 4.6m		VANE		
	layer of wet, very loose silty sand at 7.6 m	7	SS	2	
173.3			VANE		
10.7	**SILT:** with clay seams, brown, wet, loose to compact	8	SS	6	
		9	SS	19	
		10	SS	23	
		11	SS	14	
167.2					
16.8	**CLAYEY SILT TILL:** some sand, some gravel, brown, moist, very stiff to hard	12	SS	27	
		13	SS	68	
164.2		14	SS	81	
19.8	**SANDY SILT:** trace clay, brown, moist to wet, very dense	15	SS	77	
		16	SS	64	
156.5					
27.5	**CLAYEY SILT TILL:** trace gravel, brown, moist, hard to very stiff	17	SS	59	
		18	SS	61	
		25	SS	18	
148.4		26	SS	38	
35.6	**END OF BOREHOLE**				

Notes:
1) 50 mm dia. monitoring well installed at 6.10 mbgs upon completion.
2) Water Levels Readings:

Date	Water Level (mbgs)
Mar. 25, 2022	0.15
April 12, 2022	0.28
June 27, 2022	0.87

W. L. 183.8 m Mar. 25, 2022
W. L. 183.4 m Apr. 12, 2022
W. L. 183.1 m Jun. 27, 2022

DYNAMIC CONE PENETRATION RESISTANCE PLOT
SHEAR STRENGTH (kPa)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	0	1	54	45
	0	28	67	5

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

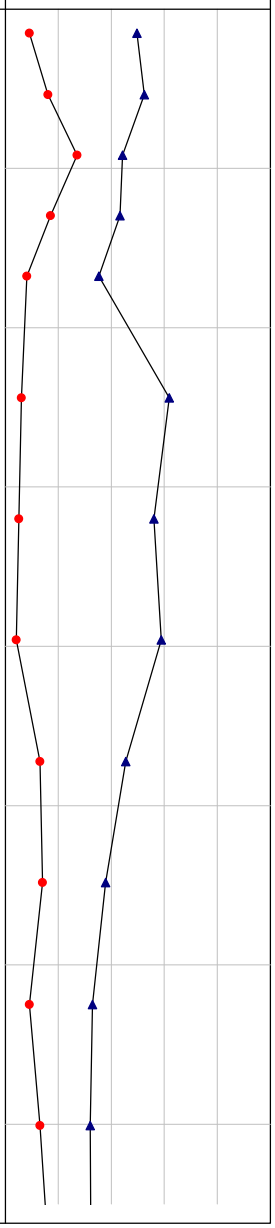
DS SOIL LOG 22-339-302 QUAKER RD AND FIRST AV - COPY.GPJ DS.GDT 22-7-22

Log of Borehole No. 1

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765186
Client: Primont (Thorold/Welland) Inc.
E: 641731

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.32	Ground Surface							
		Topsoil Approximately 200 millimetres of topsoil.	SS	1	3,3,6,8	9		<1.0	
3 / 1		**Silty Clay/Clayey Silt** Brown to reddish brown, some organics in upper levels, firm to very stiff.	SS	2	7,7,9,13	16		>4.5	
6 / 2			SS	3	7,11,16,19	27		>4.5	
9 / 3			SS	4	5,7,10,13	17		2.5	
11 / 3	179.82	Transition in colour to grey.	SS	5	4,3,5,6	8		1.5	
16 / 5			SS	6	3,2,4,5	6		<1.0	
21 / 6			SS	7	2,2,3,4	5		<1.0	
26 / 8			SS	8	1,2,2,4	4		<1.0	
28 / 8	174.64	**Sandy Silt/Silt** Reddish brown, occasional gravel, loose to very dense.							
30 / 9			SS	9	6,6,7,8	13			
36 / 11			SS	10	6,7,7,6	14			
41 / 12			SS	11	3,3,6,7	9			
46 / 14			SS	12	4,6,7,10	13			

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: December 07, 2022
Hole Size: 200 Millimetres
Drilling Contractor: Elements Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road · Hamilton, Ontario · L8E 2Z3
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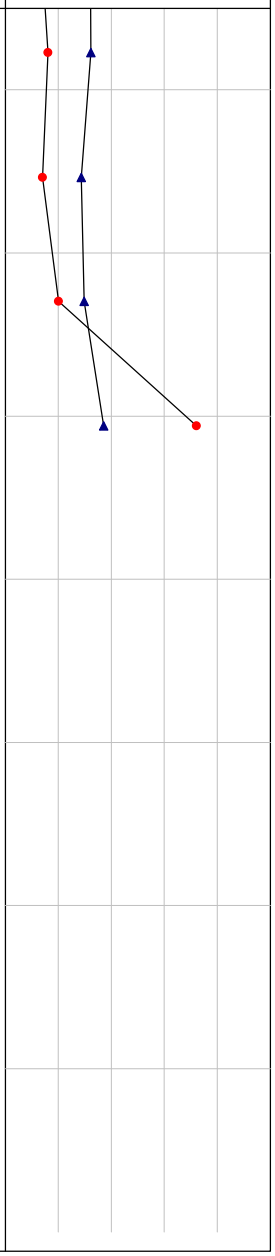
Log of Borehole No. 1

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765186
Client: Primont (Thorold/Welland) Inc.
E: 641731

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
16					SS	13	4,6,10,12	16			
17					SS	14	6,6,8,8	14			
18					SS	15	5,7,13,16	20			
19											
20	162.90				SS	16	9,24,48,50/5"	72			
21			End of Borehole								
22			NOTES:								
23			1. Borehole was advanced using solid stem auger equipment on December 07, 2022 to termination at a depth of 20.4 metres.								
24			2. Borehole was recorded as open and 'Dry' upon completion and backfilled as per Ontario Regulation 903.								
25			3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
26											
27											
28											
29											

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: December 07, 2022
Hole Size: 200 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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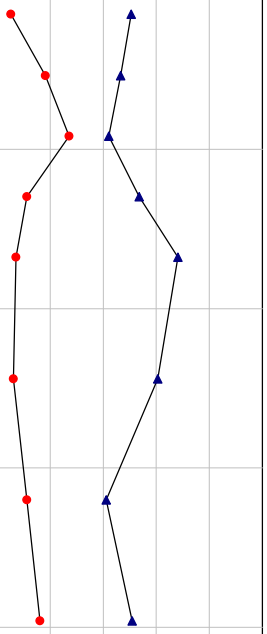
Log of Borehole No. 2

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765226
Client: Primont (Thorold/Welland) Inc.
E: 641680

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.26	Ground Surface							
0 / 0	182.96	**Topsoil** Approximately 300 millimetres of topsoil.	SS	1	2,2,3,5	5		2.0	
3 / 1		**Silty Clay/Clayey Silt** Brown, occasional gravel, firm to very stiff.	SS	2	5,7,11,14	18		>4.5	
6 / 2			SS	3	6,11,16,21	27		>4.5	
7 / 2	180.83	Transition in colour to grey.	SS	4	4,5,6,7	11		1.0	
10 / 3			SS	5	4,3,4,6	7		1.5	
16 / 5	177.93		SS	6	2,3,3,5	6		<1.0	
18 / 6		**Sandy Silt/Silt** Reddish brown, compact.	SS	7	5,5,6,10	11			
26 / 8	175.04		SS	8	4,7,9,9	16			
27 / 8		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 06, 2022 to termination at a depth of 8.2 metres.

2. Borehole was recorded as caved to 6.0 metres and 'Wet' at a depth of 4.8 metres below the existing ground surface upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 06, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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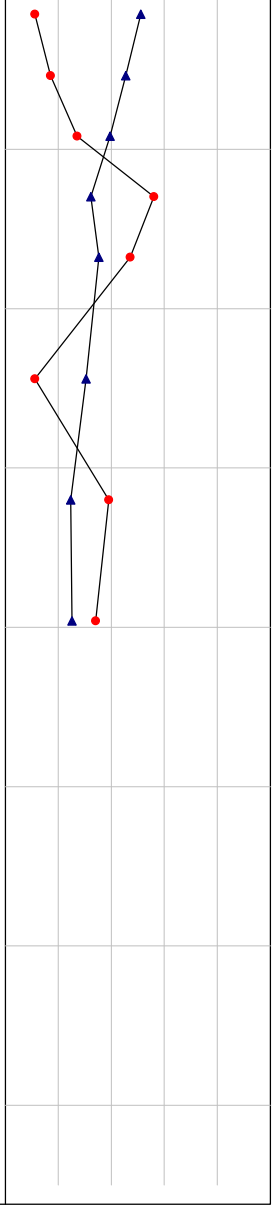
Log of Borehole No. 3

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765364
Client: Primont (Thorold/Welland) Inc.
E: 641633

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.80	Ground Surface							
0–2 / 0–1		**Topsoil** Approximately 200 millimetres of topsoil.	SS	1	3,4,7,5	11		>4.5	
			SS	2	5,7,10,12	17		>4.5	
2 / 1	181.60	**Silty Clay/Clayey Silt** Brown, occasional gravel, firm to very stiff.	SS	3	8,11,16,22	27		>4.5	
		Sandy Silt/Silt Reddish brown, more silt content with depth, trace clay, compact to dense.	SS	4	22,26,30,44	56			
3 / 1			SS	5	21,23,24,20	47			
5 / 2			SS	6	5,6,5,8	11			
7 / 2			SS	7	7,17,22,22	39			
8 / 2	175.58		SS	8	13,16,18,23	34			
		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 06, 2022 to termination at a depth of 8.2 metres.

2. Borehole was recorded as open and 'Dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 06, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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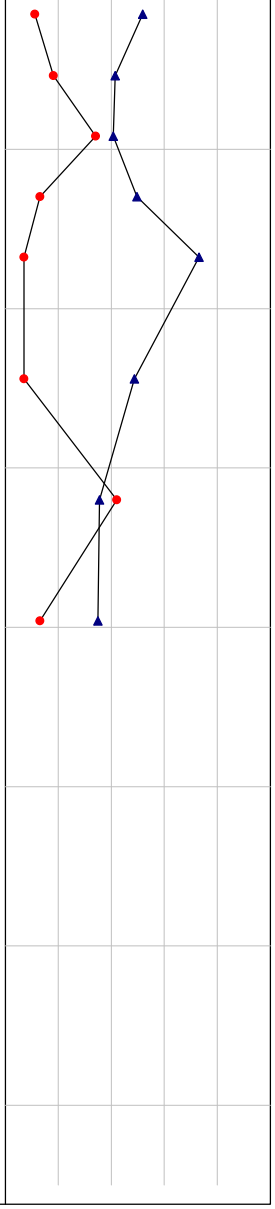
Log of Borehole No. 4

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765208
Client: Primont (Thorold/Welland) Inc.
E: 641522

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.54	Ground Surface							
0–3 / 0–1		**Topsoil** Approximately 200 millimetres of topsoil.	SS	1	4,5,6,8	11		>4.5	
		Silty Clay/Clayey Silt Brown, firm to hard.	SS	2	5,7,11,16	18		>4.5	
6–9 / 2			SS	3	8,15,19,25	34		>4.5	
			SS	4	5,6,7,10	13		2.0	
9 / 3	180.65	Transition in colour to grey.							
10–13 / 3–4			SS	5	3,3,4,5	7		<1.0	
16–19 / 5			SS	6	2,3,4,4	7		<1.0	
20 / 6	177.30	**Sandy Silt/Silt** Reddish brown, trace clay, compact to dense.	SS	7	5,20,22,28	42			
26 / 8	175.32		SS	8	6,6,7,7	13			
27 / 8		End of Borehole							



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 06, 2022 to termination at a depth of 8.2 metres.

2. Borehole was recorded as open and 'Dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 06, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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Log of Borehole No. 5

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765091
Client: Primont (Thorold/Welland) Inc.
E: 641718

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.12	Ground Surface							
		Topsoil Approximately 200 millimetres of topsoil.	SS	1	1,1,1,4	2		>4.5	
		Silty Clay/Clayey Silt Brown to reddish brown, firm to very stiff.	SS	2	6,8,11,17	19		>4.5	
			SS	3	5,8,11,17	19		>4.5	
			SS	4	5,6,8,10	14		>4.5	
			SS	5	3,3,4,4,	7		<1.0	
13 / 4	179.01	Transition in colour to grey.							
			SS	6	3,2,3,3	5		<1.0	
21 / 6	176.42		SS	7	2,2,2,4	4		<1.0	
		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on December 07, 2022 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'Dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed and the following groundwater level readings have been measured:
January 3 2023 : 0.83 metres

Drill Method: Solid Stem Augers
Drill Date: December 07, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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Log of Borehole No. 6

Project No: SM 220530-G
Project: Proposed Residential Development
Location: Quaker Road & First Avenue, Welland
Client: Primont (Thorold/Welland) Inc.

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4765198
E: 641374

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		183.83	Ground Surface							
0	0		**Topsoil** Approximately 200 millimetres of topsoil.	SS	1	2,4,5,7	9		>4.5	
3	1		**Silty Clay/Clayey Silt** Brown, firm to very stiff.	SS	2	5,8,11,14	19		>4.5	
6	2			SS	3	6,9,19,22	28		>4.5	
9	3	181.09	Transition in colour to grey.	SS	4	4,5,5,6	10		1.0	
10	3			SS	5	2,3,4,5	7		<1.0	
16	5			SS	6	2,2,3,5	5		<1.0	
20	6	177.59								
21	6	177.13	**Sandy Silt/Silt** Reddish brown, compact.	SS	7	5,7,12,17	19			
22	7		End of Borehole							

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on December 08, 2022 to termination at a depth of 6.7 metres.

2. Borehole was recorded as 'Wet' at a depth of 5.9 metres below the existing ground surface upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 08, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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Log of Borehole No. 7

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765042
Client: Primont (Thorold/Welland) Inc.
E: 641421

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.52	Ground Surface							
0 / 0	183.27	**Topsoil** Approximately 250 millimetres of topsoil.	SS	1	1,3,5,6	8		>4.5	
3 / 1		**Silty Clay/Clayey Silt** Brown, firm to very stiff.	SS	2	5,7,12,18	19		>4.5	
7 / 2			SS	3	6,12,14,18	26		>4.5	
10 / 3			SS	4	5,6,7,10	13		2.0	
12 / 4			SS	5	3,4,4,7	8		2.0	
13 / 4	179.41	Transition in colour to grey.							
16 / 5			SS	6	2,3,4,5	7		<1.0	
20 / 6	177.43	**Sandy Silt/Silt**							
21 / 6	176.82	Reddish brown, compact.	SS	7	8,9,9,9	18			
23 / 7		End of Borehole							

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on December 08, 2022 to termination at a depth of 6.7 metres.

2. Borehole was recorded as caved to 5.9 metres and 'Dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed and the following groundwater level readings have been measured:
January 3 2023 : 1.6 metres

Drill Method: Solid Stem Augers
Drill Date: December 08, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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Log of Borehole No. 8

Project No: SM 220530-G
Project: Proposed Residential Development
Location: Quaker Road & First Avenue, Welland
Client: Primont (Thorold/Welland) Inc.

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4765199
E: 641192

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	184.94	Ground Surface							
0–4 / 0–1		**Topsoil** Approximately 200 millimetres of topsoil. **Silty Clay/Clayey Silt** Brown, occasional gravel, firm to very stiff.	SS	1	2,3,4,6	7		2.0	
			SS	2	4,7,7,12	14		4.0	
			SS	3	5,9,15,20	24		>4.5	
			SS	4	4,6,10,15	16		>4.5	
			SS	5	6,7,9,10	16		4.0	
13 / 4	180.83	Transition in colour to grey.							
16 / 5	179.76	**Sandy Silt/Silt** Reddish brown, compact.	SS	6	4,4,7,11	11		1.5	
			SS	7	4,9,12,17	21			
26 / 8	176.72		SS	8	6,7,9,9	16			
		End of Borehole							

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on December 08, 2022 to termination at a depth of 8.2 metres.

2. Borehole was recorded as caved to 7.3 metres and 'Wet' at a depth of 6.7 metres below the existing ground surface upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 08, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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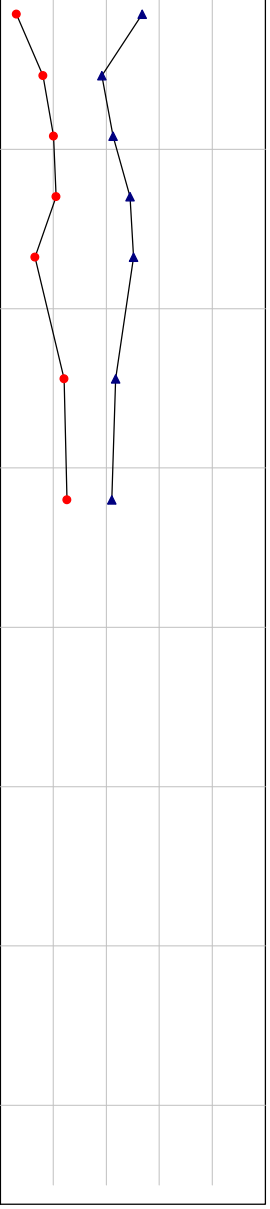
Log of Borehole No. 9

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765253
Client: Primont (Thorold/Welland) Inc.
E: 641229

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
	184.05	Ground Surface								
0 / 0	183.75	**Topsoil** Approximately 300 millimetres of topsoil.		SS	1	2,2,4,6	6		4.0	
3 / 1		**Silty Clay/Clayey Silt** Brown, firm to very stiff.		SS	2	6,7,9,11	16		>4.5	
6 / 2				SS	3	7,9,11,14	20		>4.5	
9 / 3				SS	4	5,9,12,17	21		>4.5	
12 / 4	180.40			SS	5	4,6,7,8	13		<1.0	
	179.94	Transition in colour to grey.								
15 / 5		**Sandy Silt/Silt** Reddish brown, compact.		SS	6	5,11,13,16	24			
21 / 6	177.35			SS	7	7,11,14,21	25			
23 / 7		End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 08, 2022 to termination at a depth of 6.7 metres.

2. Borehole was recorded as caved to 5.4 metres and 'Wet' at a depth of 5.3 metres below the existing ground surface upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 08, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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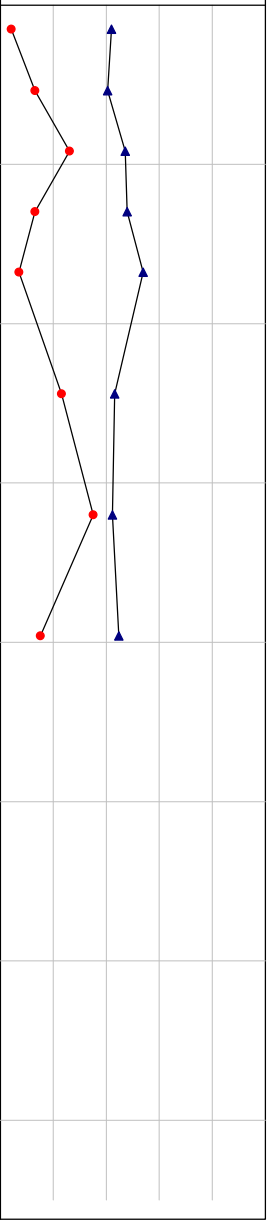
Log of Borehole No. 10

Project No: SM 220530-G
Project: Proposed Residential Development
Location: Quaker Road & First Avenue, Welland
Client: Primont (Thorold/Welland) Inc.

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4765588
E: 641174

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	184.23	Ground Surface							
0–4 / 0–1		**Topsoil** Approximately 200 millimetres of topsoil.	SS	1	2,1,3,4	4		1.5	
		Silty Clay/Clayey Silt Brown, some organics in upper levels, firm to very stiff.	SS	2	4,6,7,11	13		>4.5	
4–8 / 1–2			SS	3	5,11,15,18	26		>4.5	
			SS	4	5,6,7,9	13		2.5	
8–11 / 2–3	180.73		SS	5	2,3,4,5	7		1.0	
12–13 / 3–4	180.12	Transition in colour to grey.							
13–26 / 4–8		**Sandy Silt/Silt** Reddish brown, compact to dense.	SS	6	6,11,12,14	23			
			SS	7	10,16,19,24	35			
			SS	8	6,6,9,10	15			
26–27 / 8	176.01	End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 09, 2022 to termination at a depth of 8.2 metres.

2. Borehole was recorded as caved to 6.4 metres and 'Wet' at a depth of 5.7 metres below the existing ground surface upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 09, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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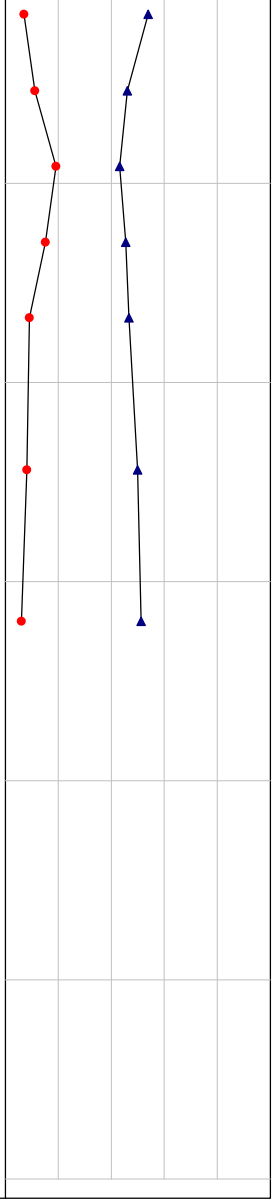
Log of Borehole No. 11

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4765518
Client: Primont (Thorold/Welland) Inc.
E: 641270

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.23	Ground Surface							
0 / 0		**Topsoil** Approximately 200 millimetres of topsoil.	SS	1	2,2,5,5	7		2.0	
1 / 0		**Silty Clay/Clayey Silt** Brown, some organics in upper levels, firm to very stiff.	SS	2	3,4,7,11	11		>4.5	
2 / 1			SS	3	4,7,12,16	19		>4.5	
3 / 1	180.64	Transition in colour to grey.	SS	4	4,7,8,10	15		2.5	
4 / 2			SS	5	3,4,3,7	9		2.0	
5 / 2			SS	6	3,3,5,7	8		1.5	
6 / 3	176.53	End of Borehole	SS	7	2,3,3,4	6		<1.0	

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 09, 2022 to termination at a depth of 6.7 metres.

2. Borehole was recorded as 'Wet' at a depth of 5.4 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed and the following groundwater level readings have been measured:
January 3 2023 : 0.0 metres

Drill Method: Solid Stem Augers
Drill Date: December 09, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road · Hamilton, Ontario · L8E 2Z3
T: 905.318.7440 · TF: 800.243.1922 · F: 905.318.7455
www.soil-mat.ca · E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: IC
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 12

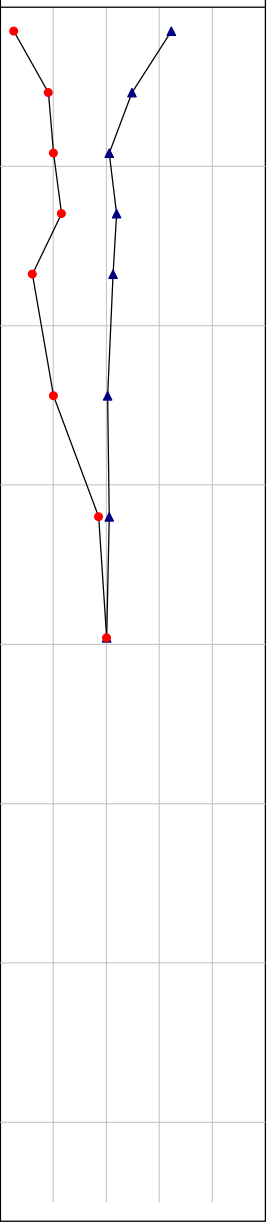
Project No: SM 220530-G
Project: Proposed Residential Development
Location: Quaker Road & First Avenue, Welland
Client: Primont (Thorold/Welland) Inc.

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4765409
E: 641213

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	184.19	Ground Surface							
0–3 / 0–1		**Topsoil** Approximately 200 millimetres of topsoil.	SS	1	0,2,3,5	5		1.5	
		Silty Clay/Clayey Silt Brown, firm to very stiff.	SS	2	5,8,10,13	18		>4.5	
3–6 / 1–2			SS	3	5,8,12,16	20		>4.5	
			SS	4	6,10,13,16	23		>4.5	
10 / 3	180.84	Transition in colour to grey.	SS	5	4,5,7,7	12		1.5	
15 / 4	179.32	**Sandy Silt/Silt** Reddish brown, compact to dense.	SS	6	3,5,15,19	20		1.5	
20–25 / 6–7			SS	7	12,16,21,25	37			
26 / 8	175.97	End of Borehole	SS	8	12,14,26,28	40			

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 09, 2022 to termination at a depth of 8.2 metres.

2. Borehole was recorded as open and 'Dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 09, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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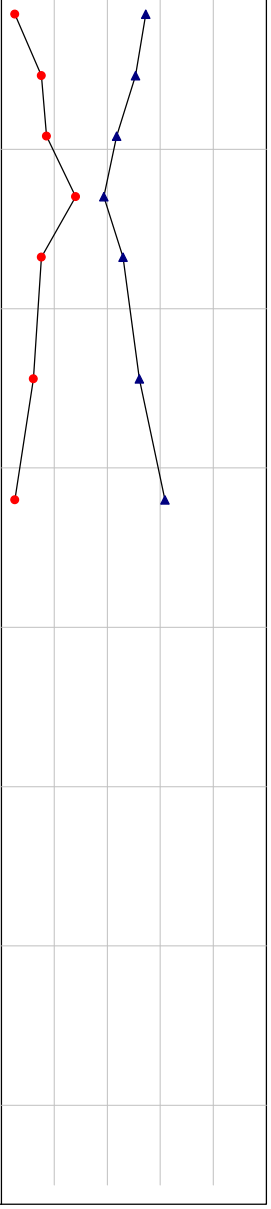
Datum: Geodetic
Field Logged by: IC
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 13

Project No: SM 220530-G
Project Manager: Ian Shaw, P.Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Quaker Road & First Avenue, Welland
UTM Coordinates - N: 4764871
Client: Primont (Thorold/Welland) Inc.
E: 641196

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	183.94	Ground Surface								
0–5 / 0–1.5		**Topsoil** Approximately 200 millimetres of topsoil.		SS	1	0,2,3,6	5		1.5	
		Silty Clay/Clayey Silt Brown, firm to very stiff.		SS	2	5,7,8,11	15		>4.5	
				SS	3	7,7,10,15	17		>4.5	
				SS	4	6,12,16,19	28		>4.5	
				SS	5	4,7,8,11	15		3.0	
16 / 5	178.76	Transition in colour to grey.		SS	6	3,4,8,8	12		<1	
21 / 6.4	177.24			SS	7	2,2,3,4	5		<1	
22 / 6.7		End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on December 09, 2022 to termination at a depth of 6.7 metres.

2. Borehole was recorded as 'Wet' at a depth of 5.6 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: December 09, 2022
Hole Size: 150 Millimetres
Drilling Contractor: Elements Drilling Ltd.

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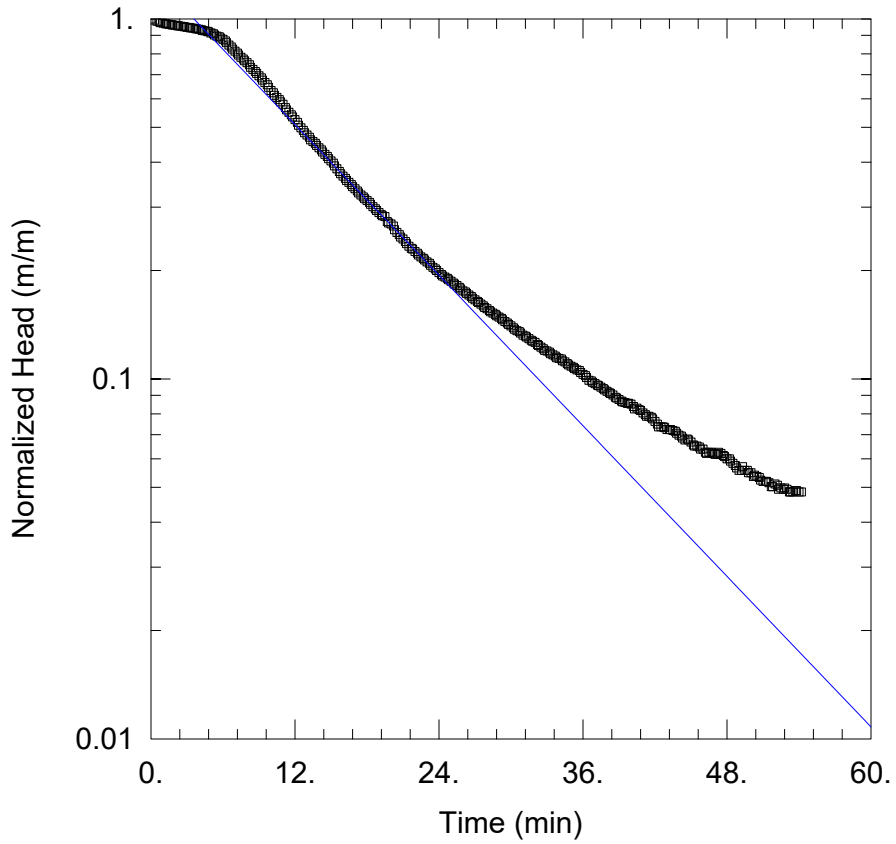
Datum: Geodetic
Field Logged by: IC
Checked by: IS
Sheet: 1 of 1

Appendix C

Hydraulic Conductivity Analyses



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_01_new_2023.aqt
Date: 05/16/23 Time: 15:01:11

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-1
Test Date: May 10, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

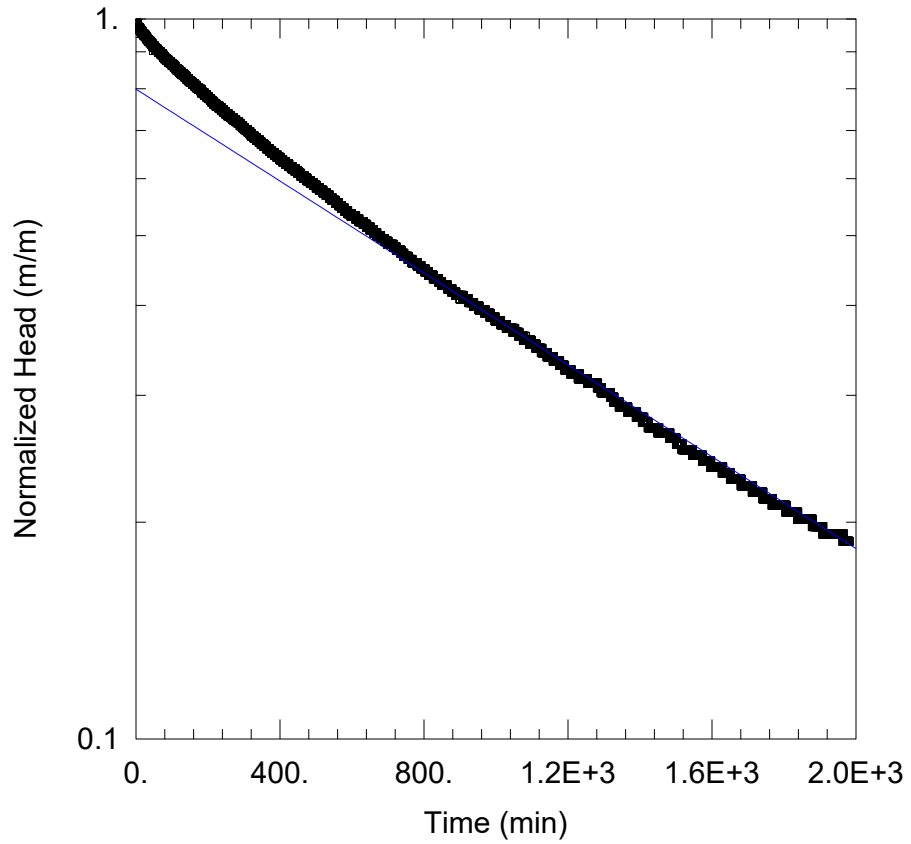
K = 4.831E-7 m/sec
y0 = 3.131 m

AQUIFER DATA

Saturated Thickness: 7.96 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-1)

Initial Displacement: 2.35 m
Total Well Penetration Depth: 7.96 m
Casing Radius: 0.0254 m
Static Water Column Height: 7.96 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_02.aqt
Date: 05/16/23 Time: 16:09:23

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-02
Test Date: May 10, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

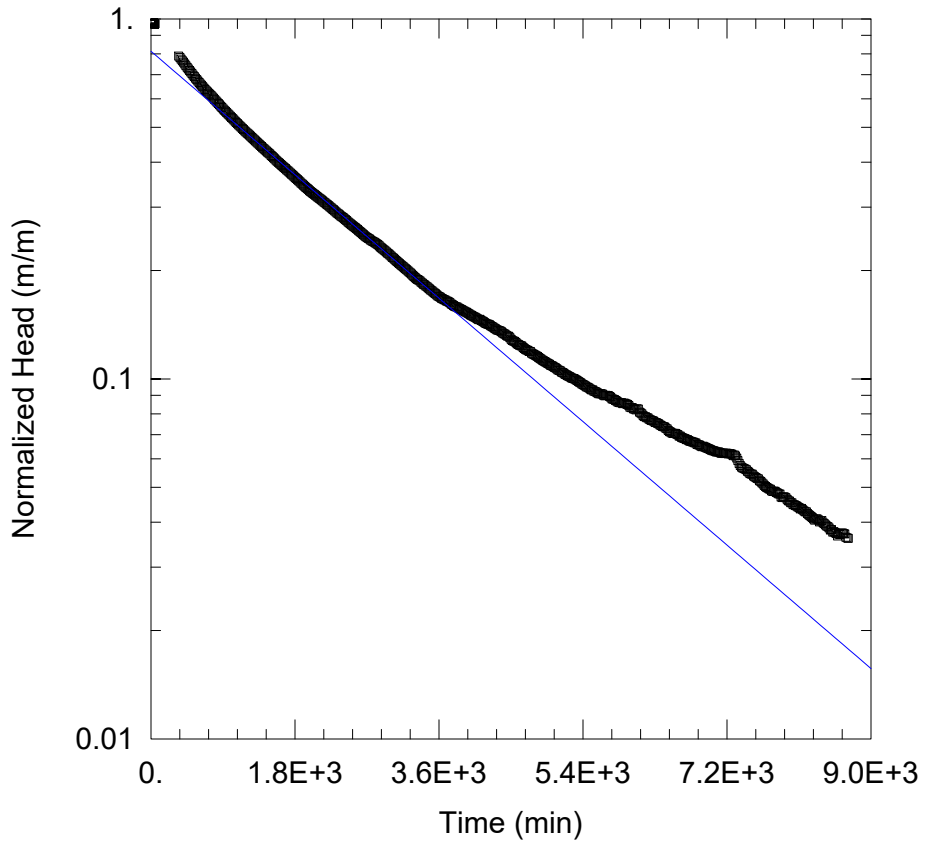
K = 4.131E-9 m/sec
y0 = 1.741 m

AQUIFER DATA

Saturated Thickness: 5.47 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-02)

Initial Displacement: 2.18 m
Total Well Penetration Depth: 5.47 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.47 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_3.aqt
Date: 05/08/23 Time: 10:16:51

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-3
Test Date: November 9, 2022

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

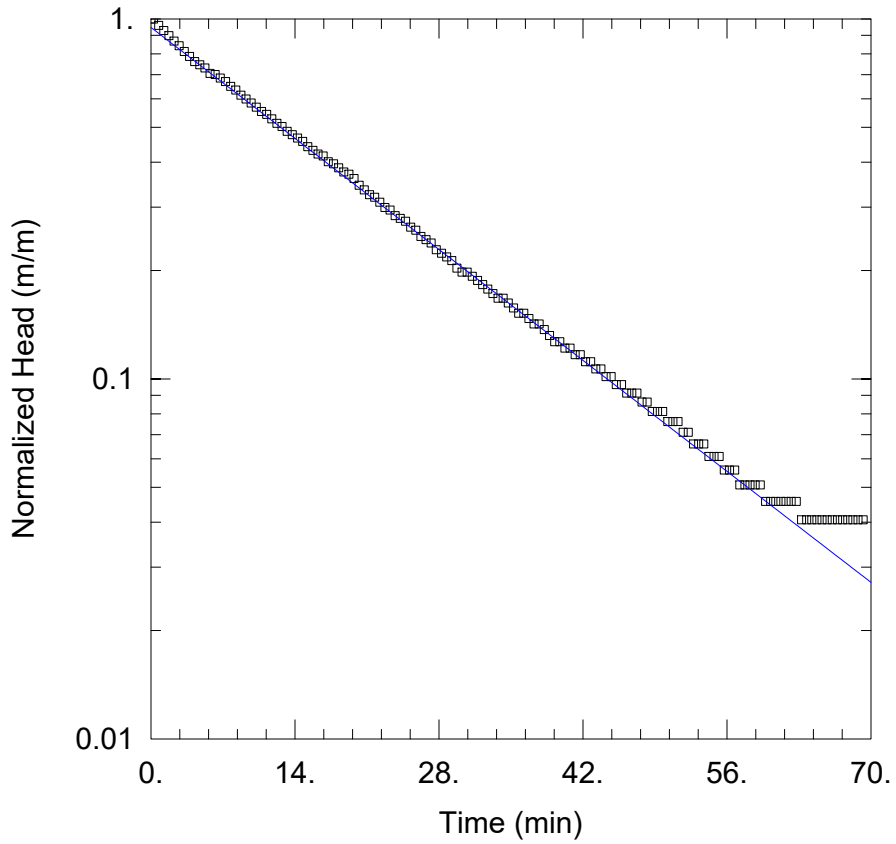
K = 2.611E-9 m/sec
y0 = 1.596 m

AQUIFER DATA

Saturated Thickness: 4.552 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-3)

Initial Displacement: 1.963 m
Total Well Penetration Depth: 4.55 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.552 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_06.aqt
Date: 05/16/23 Time: 15:57:15

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-06
Test Date: May 10, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

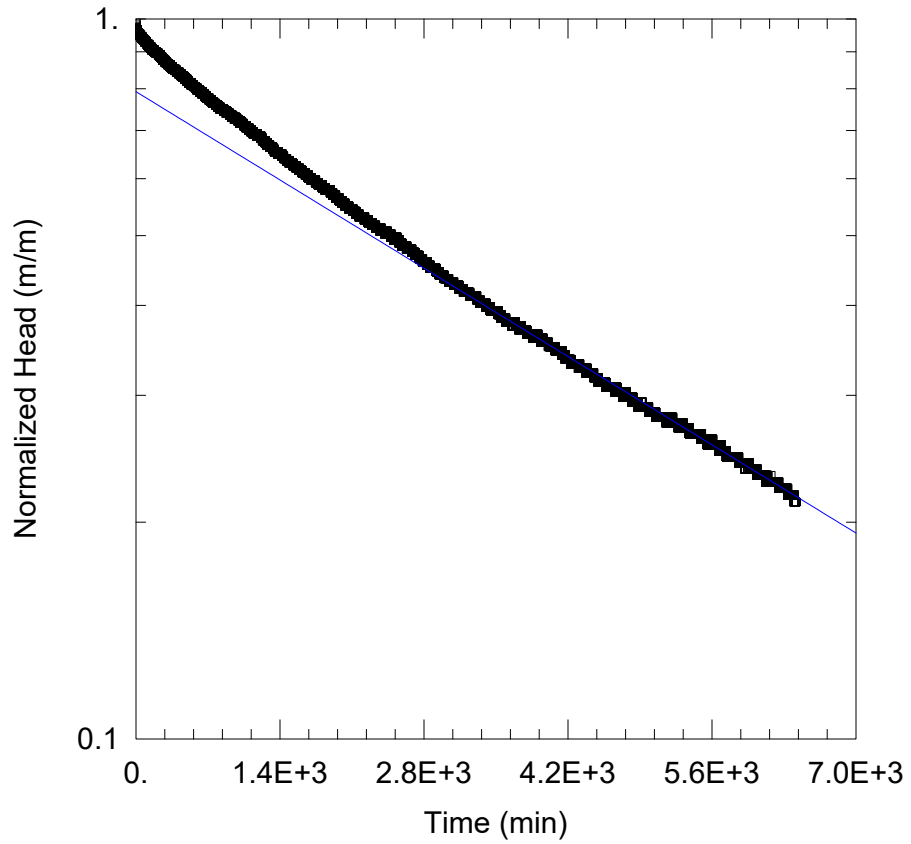
K = 2.858E-7 m/sec
y0 = 1.866 m

AQUIFER DATA

Saturated Thickness: 5.54 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-06)

Initial Displacement: 1.97 m
Total Well Penetration Depth: 5.54 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.54 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_11.aqt
Date: 05/16/23 Time: 15:42:38

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-11
Test Date: May 10, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

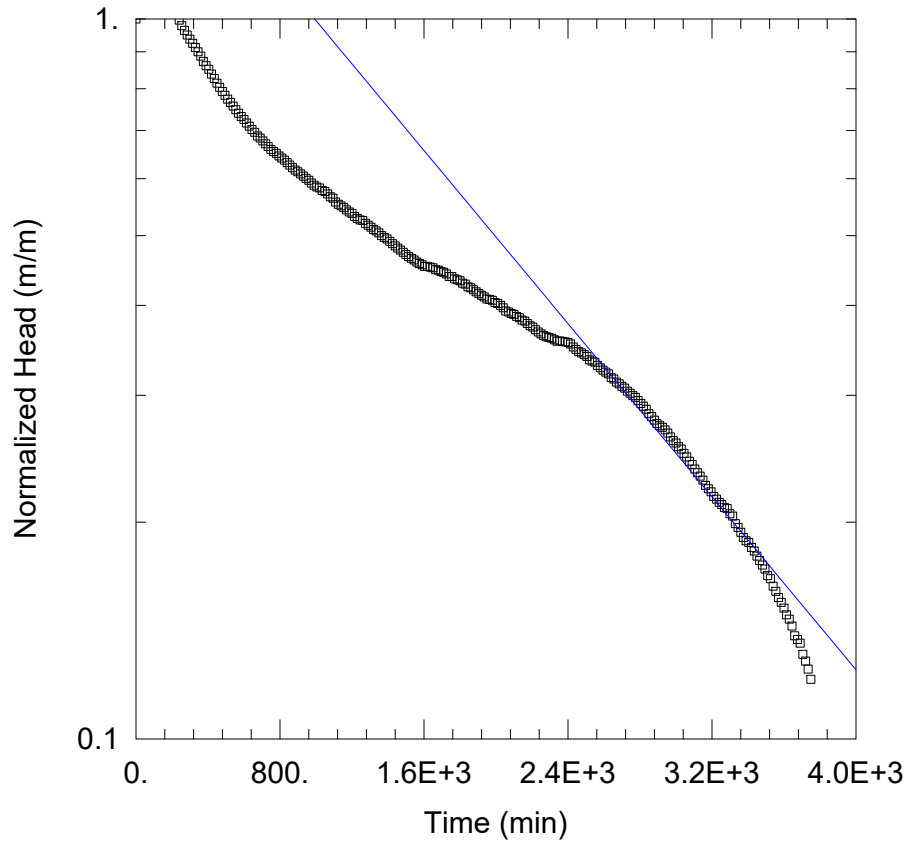
K = 1.179E-9 m/sec
y0 = 1.672 m

AQUIFER DATA

Saturated Thickness: 6.75 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-11)

Initial Displacement: 2.11 m
Total Well Penetration Depth: 6.75 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.75 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_13.aqt
Date: 05/08/23 Time: 10:07:41

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-13
Test Date: November 9, 2022

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

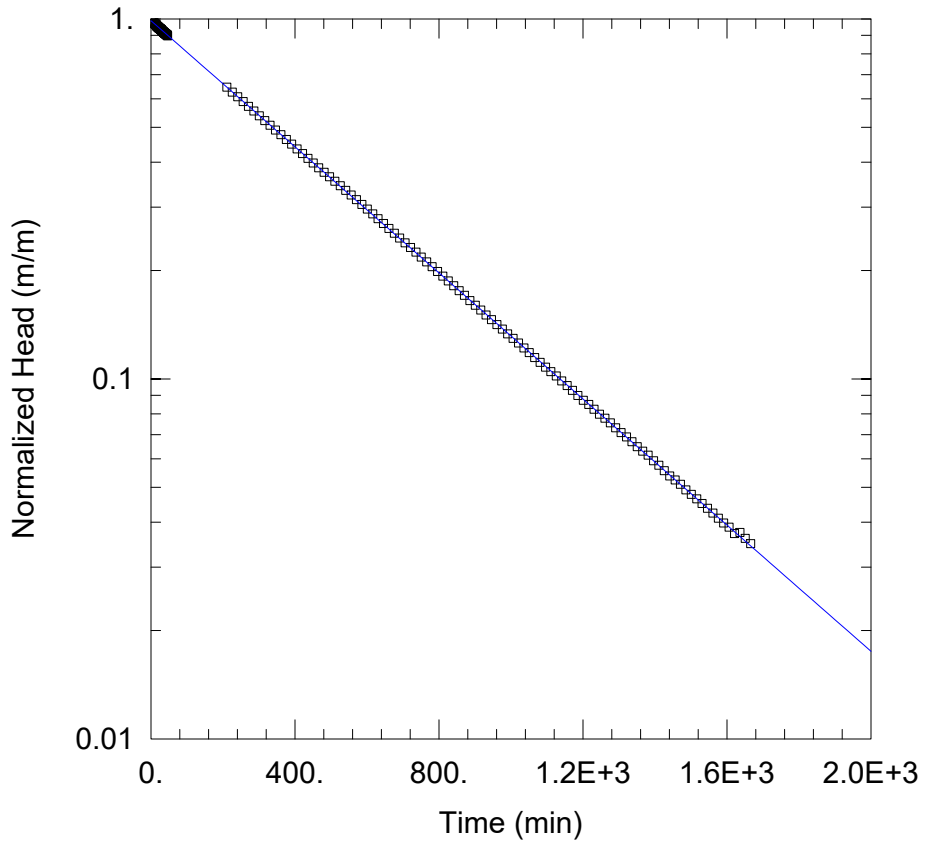
K = 3.617E-9 m/sec
y0 = 0.9899 m

AQUIFER DATA

Saturated Thickness: 3.801 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-13)

Initial Displacement: 0.4983 m
Total Well Penetration Depth: 3.801 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.801 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_14.aqt
Date: 05/08/23 Time: 09:50:10

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-14
Test Date: November 9, 2022

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

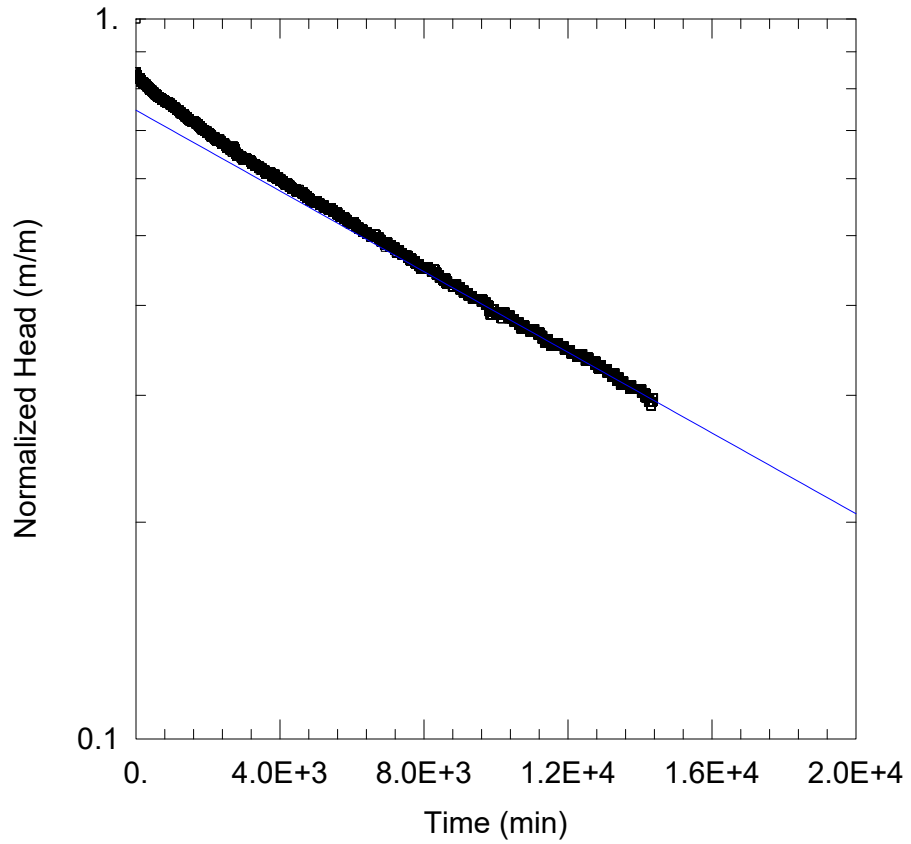
K = 1.132E-8 m/sec
y0 = 2.166 m

AQUIFER DATA

Saturated Thickness: 5.38 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-14)

Initial Displacement: 2.191 m
Total Well Penetration Depth: 5.433 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.38 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH21_16.aqt
Date: 05/17/23 Time: 11:24:15

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH21-16
Test Date: May 5, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

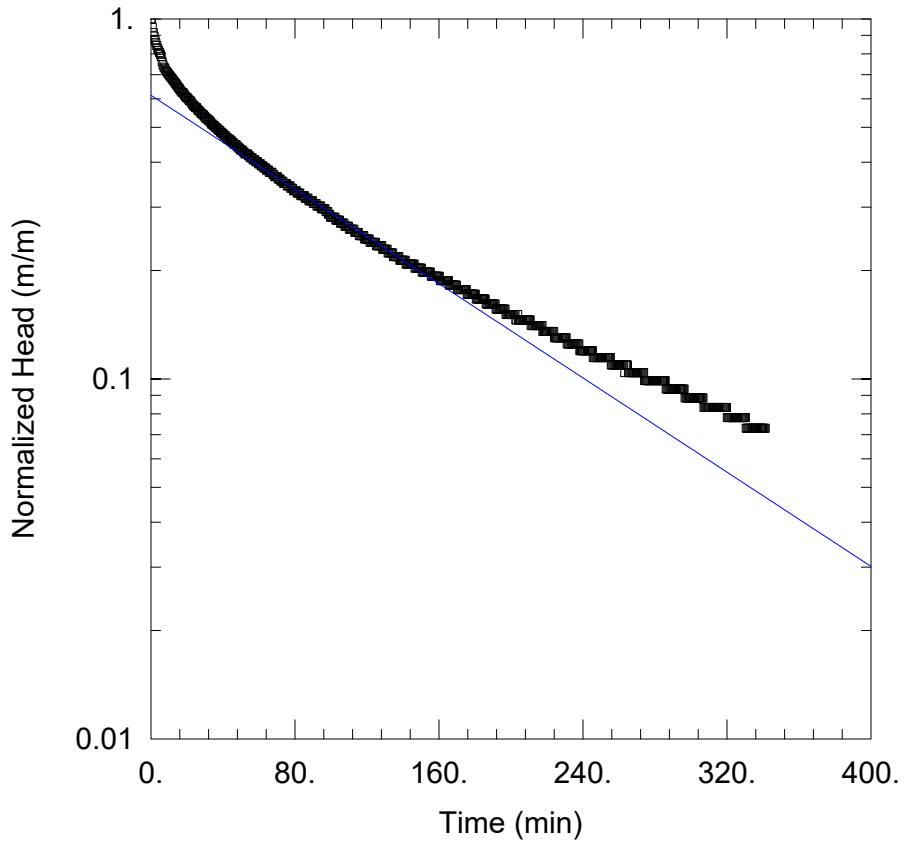
K = 3.583E-10 m/sec
y0 = 1.83 m

AQUIFER DATA

Saturated Thickness: 5.13 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH21-16)

Initial Displacement: 2.45 m
Total Well Penetration Depth: 5.13 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.13 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH22_02.aqt
Date: 05/17/23 Time: 10:41:00

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH22-02
Test Date: May 5, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

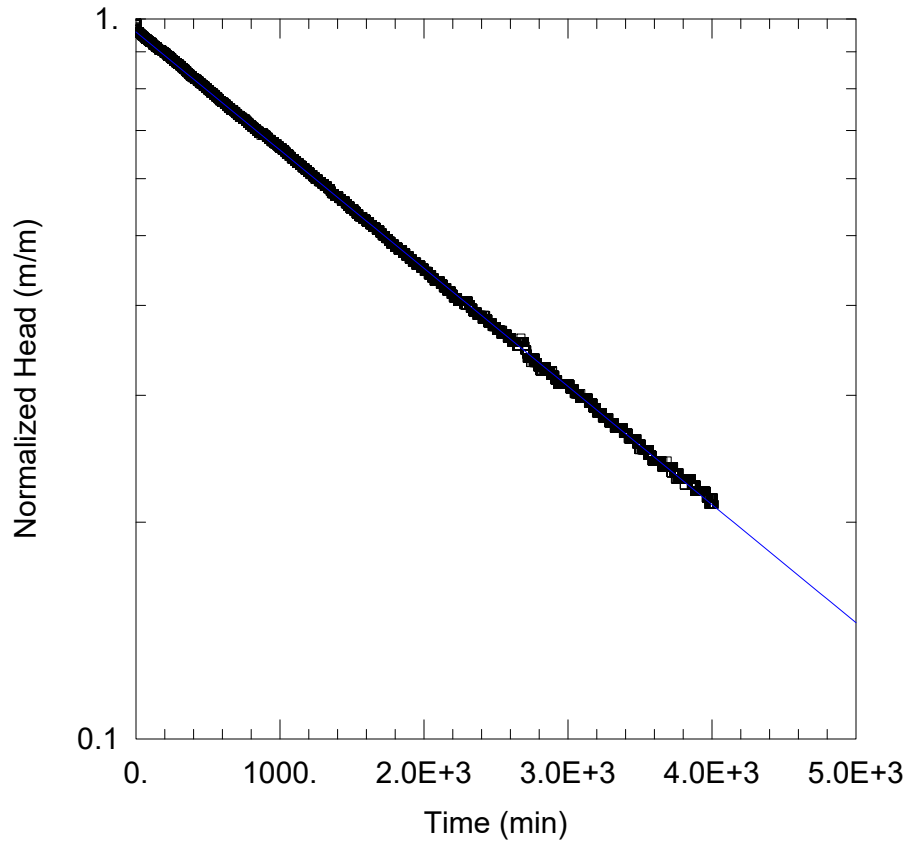
K = 4.158E-8 m/sec
y0 = 1.178 m

AQUIFER DATA

Saturated Thickness: 4.97 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH22-02)

Initial Displacement: 1.92 m
Total Well Penetration Depth: 4.97 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.97 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\BH22_03.aqt
Date: 05/17/23 Time: 10:49:31

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: BH22-03
Test Date: May 5, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

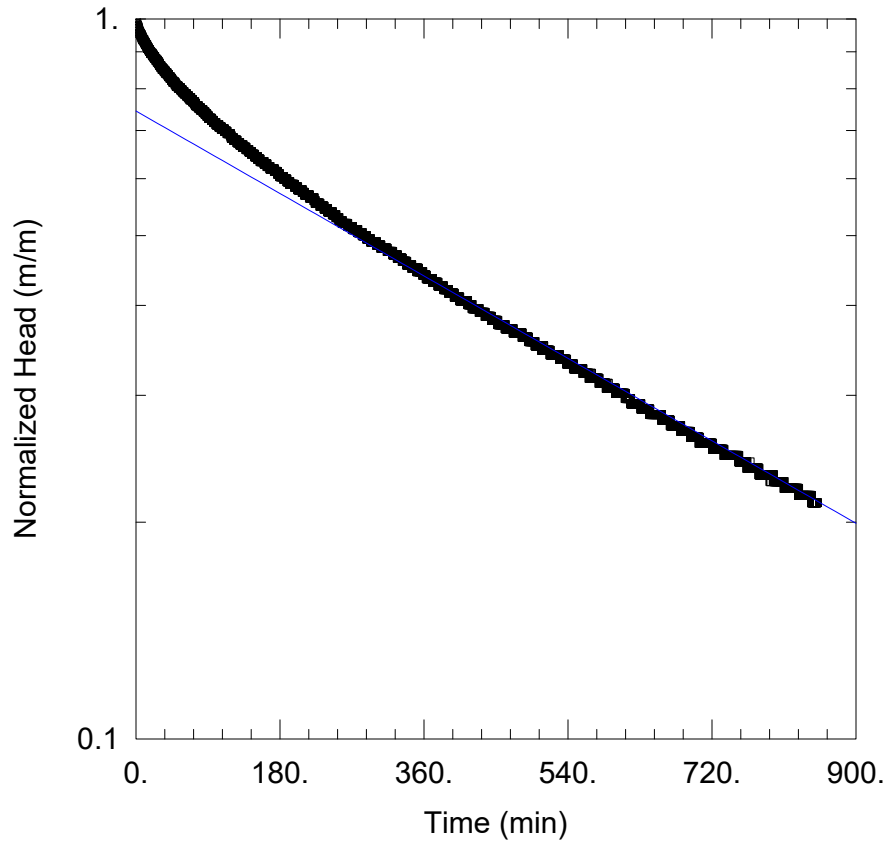
K = 2.151E-9 m/sec
y0 = 2.129 m

AQUIFER DATA

Saturated Thickness: 5.84 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH22-03)

Initial Displacement: 2.22 m
Total Well Penetration Depth: 5.84 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.84 m
Screen Length: 3.05 m
Well Radius: 0.075 m



BAIL-DOWN RECOVERY

Data Set: C:\...\MW11_SM.aqt
Date: 05/17/23 Time: 11:36:55

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Primont (Welland/Thorold) Inc.
Location: Welland/Thorold, ON
Test Well: MW-11 SM
Test Date: May 10, 2023

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 8.132E-9 m/sec
y0 = 1.424 m

AQUIFER DATA

Saturated Thickness: 6.31 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-11 SM)

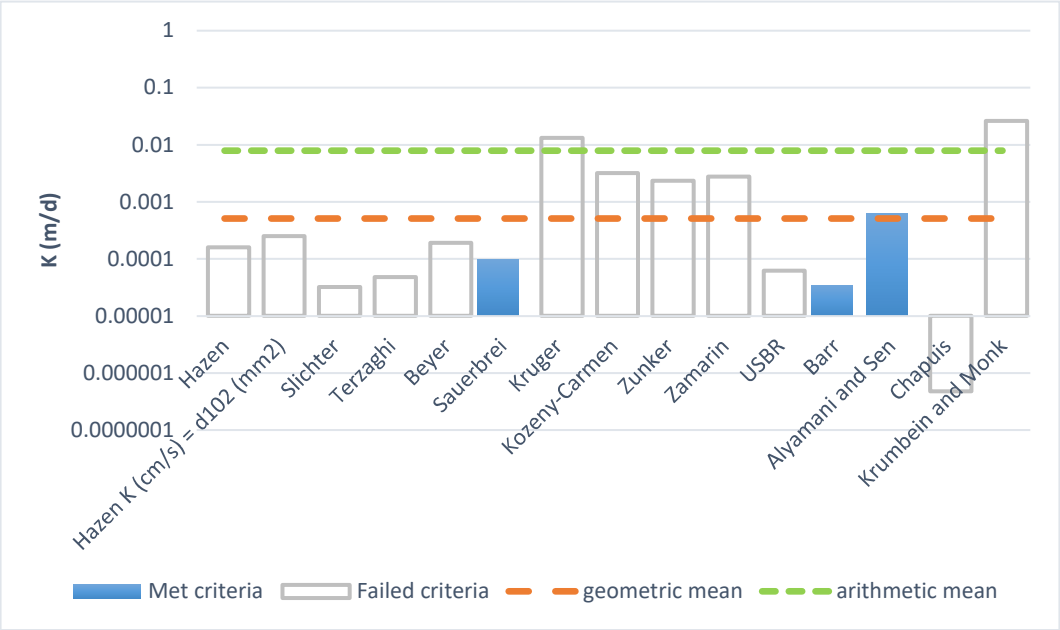
Initial Displacement: 2.02 m
Total Well Penetration Depth: 6.31 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.31 m
Screen Length: 3.05 m
Well Radius: 0.075 m

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-2 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



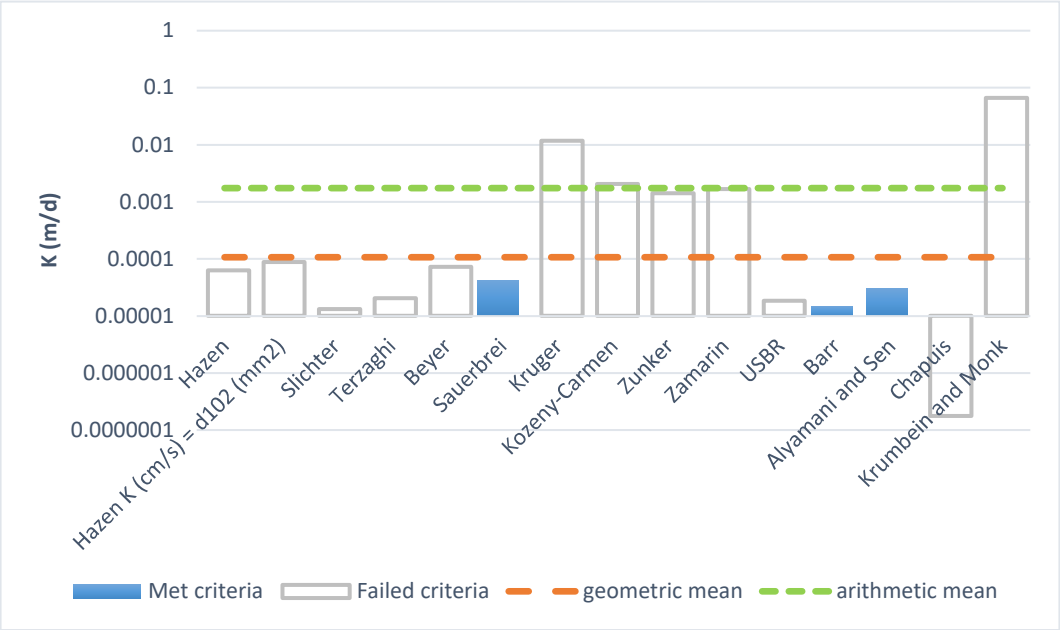
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.E-07	2.E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	3.E-07	3.E-09	0.00	
Slichter	4.E-08	4.E-10	0.00	
Terzaghi	6.E-08	6.E-10	0.00	
Beyer	2.E-07	2.E-09	0.00	
Sauerbrei	1.E-07	1.E-09	0.00	
Kruger	2.E-05	2.E-07	0.01	
Kozeny-Carmen	4.E-06	4.E-08	0.00	
Zunker	3.E-06	3.E-08	0.00	
Zamarin	3.E-06	3.E-08	0.00	
USBR	7.E-08	7.E-10	0.00	
Barr	4.E-08	4.E-10	0.00	
Alyamani and Sen	7.E-07	7.E-09	0.00	
Chapuis	6.E-10	6.E-12	0.00	
Krumbein and Monk	3.E-05	3.E-07	0.03	
Shepherd	4.E-05	4.E-07	0.03	
geometric mean	6.E-07	6.E-09	0.00	
arithmetic mean	9.E-06	9.E-08	0.01	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-3 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



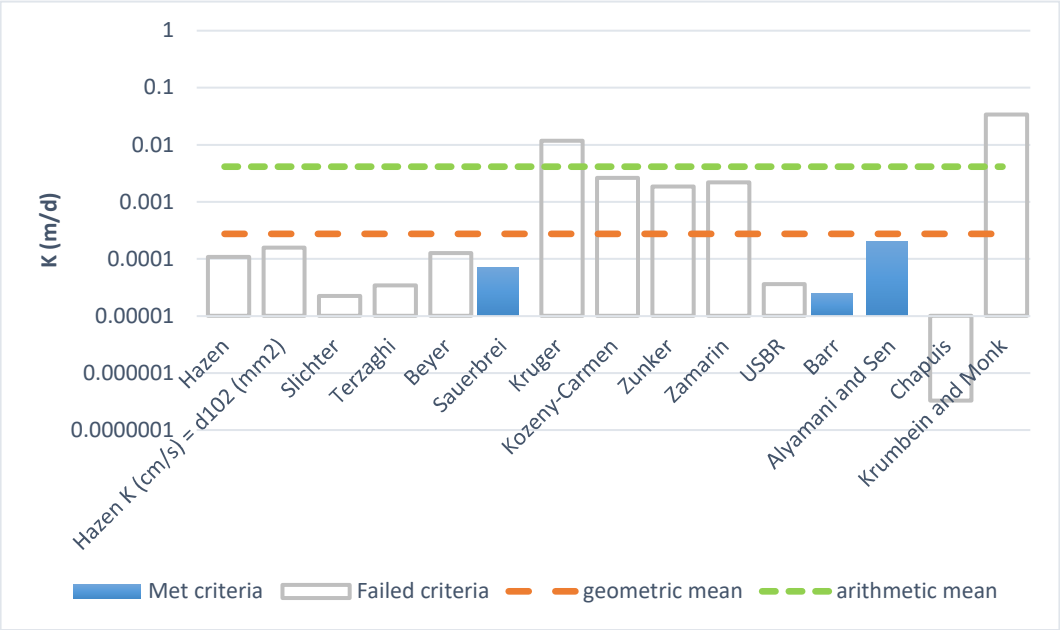
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.E-08	7.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.E-07	1.E-09	0.00	
Slichter	2.E-08	2.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	8.E-08	8.E-10	0.00	
Sauerbrei	5.E-08	5.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	4.E-08	4.E-10	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	8.E-05	8.E-07	0.07	
Shepherd	8.E-06	8.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-6 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



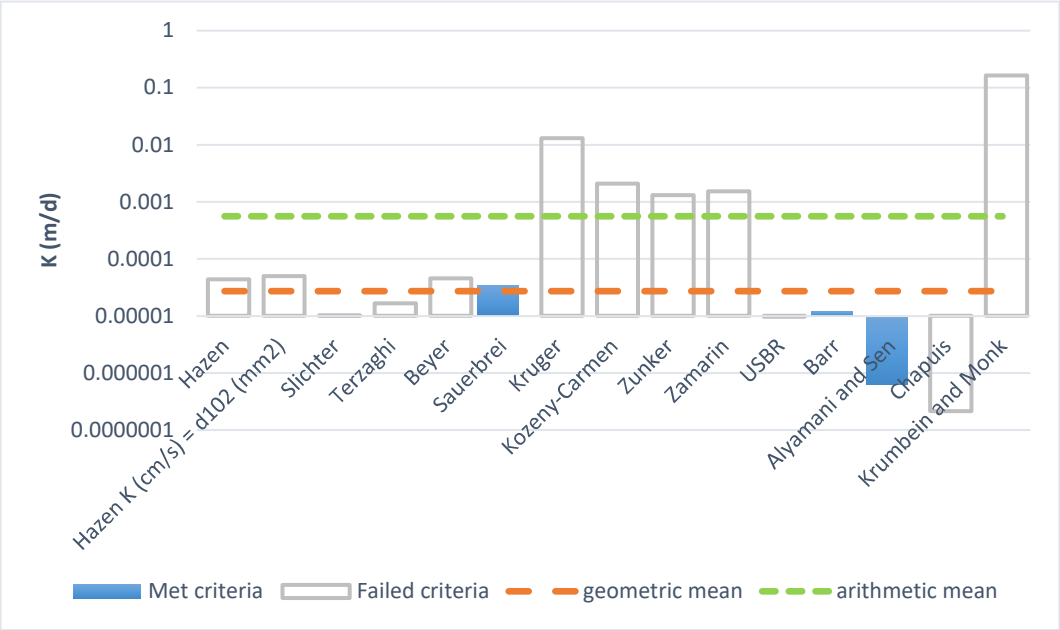
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.E-07	1.E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	2.E-07	2.E-09	0.00	
Slichter	3.E-08	3.E-10	0.00	
Terzaghi	4.E-08	4.E-10	0.00	
Beyer	1.E-07	1.E-09	0.00	
Sauerbrei	8.E-08	8.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	3.E-06	3.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	3.E-06	3.E-08	0.00	
USBR	4.E-08	4.E-10	0.00	
Barr	3.E-08	3.E-10	0.00	
Alyamani and Sen	2.E-07	2.E-09	0.00	
Chapuis	4.E-10	4.E-12	0.00	
Krumbein and Monk	4.E-05	4.E-07	0.03	
Shepherd	2.E-05	2.E-07	0.02	
geometric mean	3.E-07	3.E-09	0.00	
arithmetic mean	5.E-06	5.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-8 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



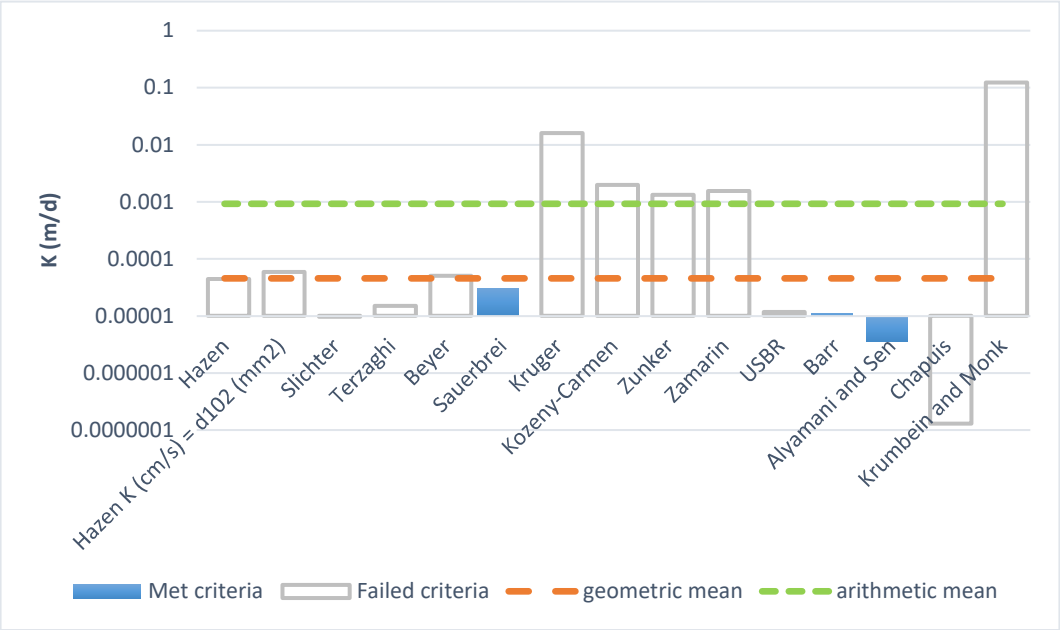
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.E-08	5.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	6.E-08	6.E-10	0.00	
Slichter	1.E-08	1.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	5.E-08	5.E-10	0.00	
Sauerbrei	4.E-08	4.E-10	0.00	
Kruger	2.E-05	2.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	1.E-08	1.E-10	0.00	
Barr	1.E-08	1.E-10	0.00	
Alyamani and Sen	7.E-10	7.E-12	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	2.E-04	2.E-06	0.16	
Shepherd	3.E-06	3.E-08	0.00	
geometric mean	3.E-08	3.E-10	0.00	
arithmetic mean	6.E-07	6.E-09	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-9 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



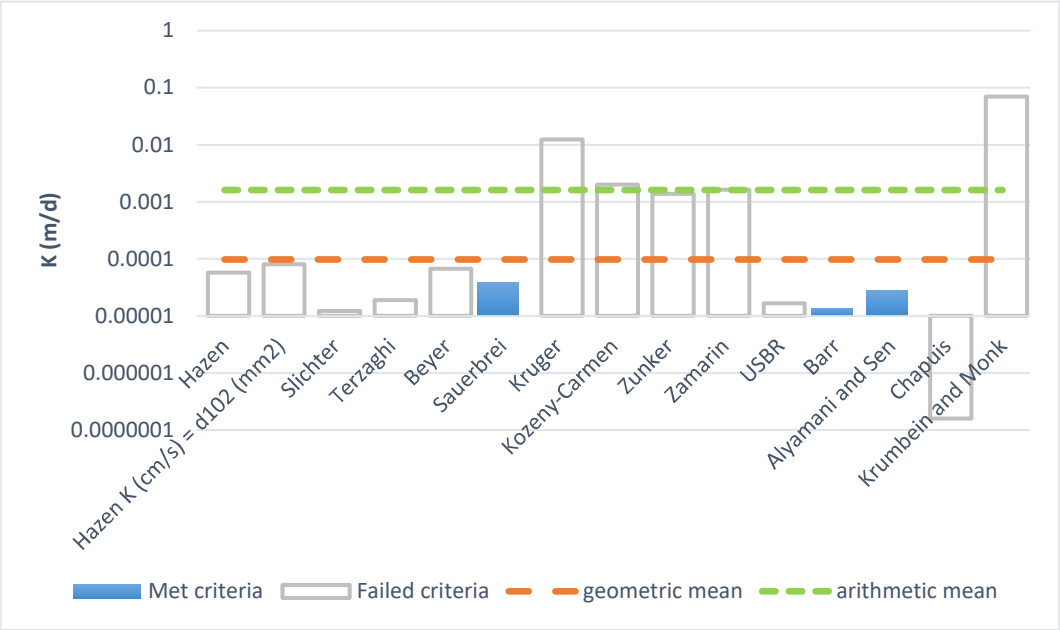
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.E-08	5.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	7.E-08	7.E-10	0.00	
Slichter	1.E-08	1.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	6.E-08	6.E-10	0.00	
Sauerbrei	4.E-08	4.E-10	0.00	
Kruger	2.E-05	2.E-07	0.02	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	1.E-08	1.E-10	0.00	
Barr	1.E-08	1.E-10	0.00	
Alyamani and Sen	4.E-09	4.E-11	0.00	
Chapuis	1.E-10	1.E-12	0.00	
Krumbein and Monk	1.E-04	1.E-06	0.12	
Shepherd	4.E-06	4.E-08	0.00	
geometric mean	5.E-08	5.E-10	0.00	
arithmetic mean	1.E-06	1.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-11 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



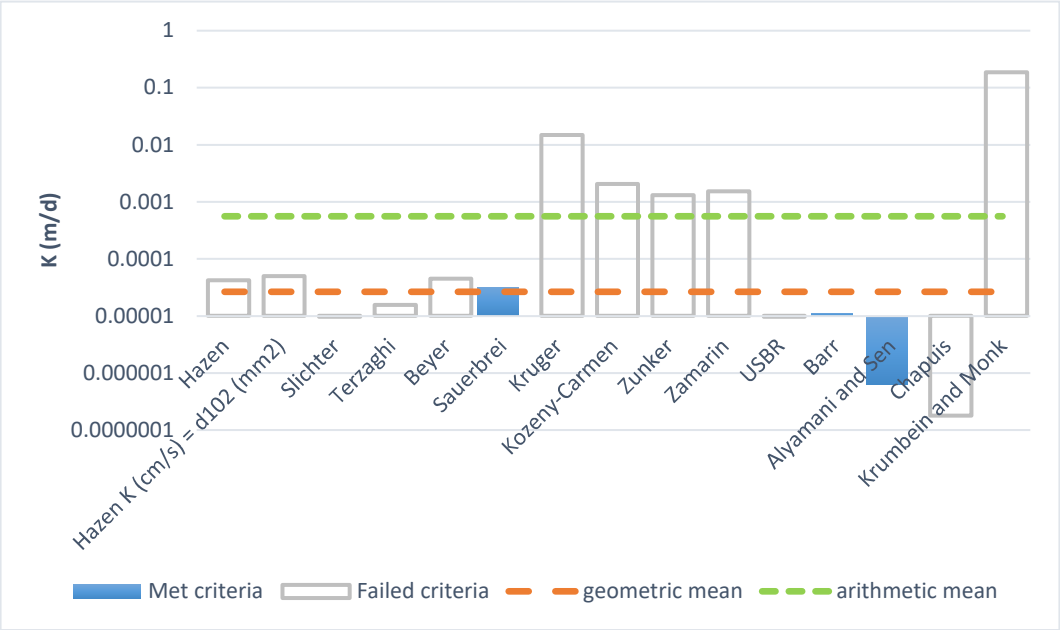
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.E-08	7.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	9.E-08	9.E-10	0.00	
Slichter	1.E-08	1.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	8.E-08	8.E-10	0.00	
Sauerbrei	4.E-08	4.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	3.E-08	3.E-10	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	8.E-05	8.E-07	0.07	
Shepherd	7.E-06	7.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-13 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



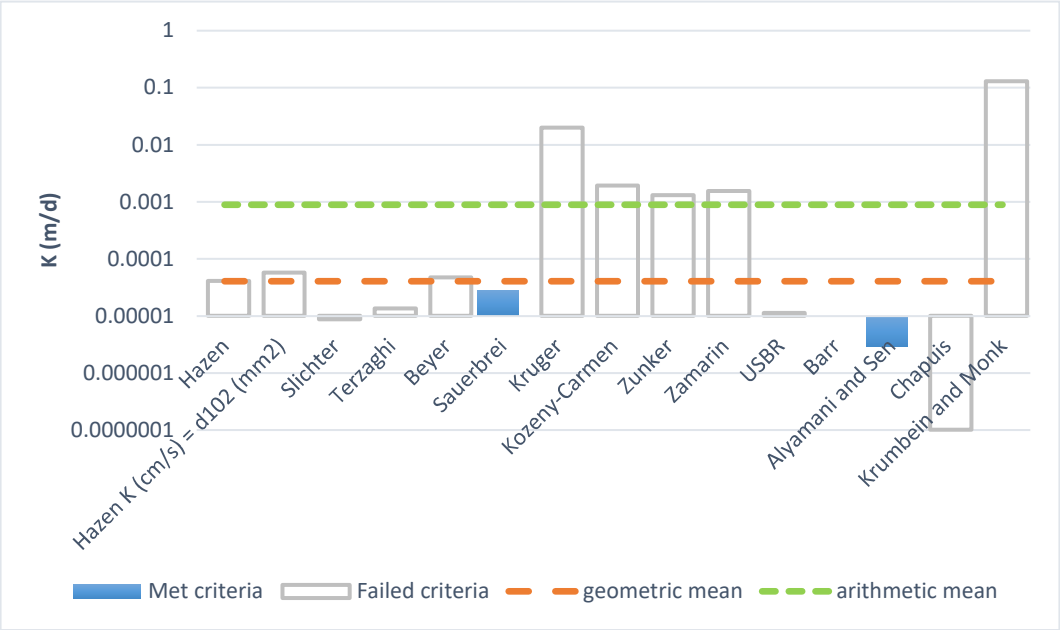
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.E-08	5.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	6.E-08	6.E-10	0.00	
Slichter	1.E-08	1.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	5.E-08	5.E-10	0.00	
Sauerbrei	4.E-08	4.E-10	0.00	
Kruger	2.E-05	2.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	1.E-08	1.E-10	0.00	
Barr	1.E-08	1.E-10	0.00	
Alyamani and Sen	7.E-10	7.E-12	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	2.E-04	2.E-06	0.19	
Shepherd	3.E-06	3.E-08	0.00	
geometric mean	3.E-08	3.E-10	0.00	
arithmetic mean	6.E-07	6.E-09	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-14 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



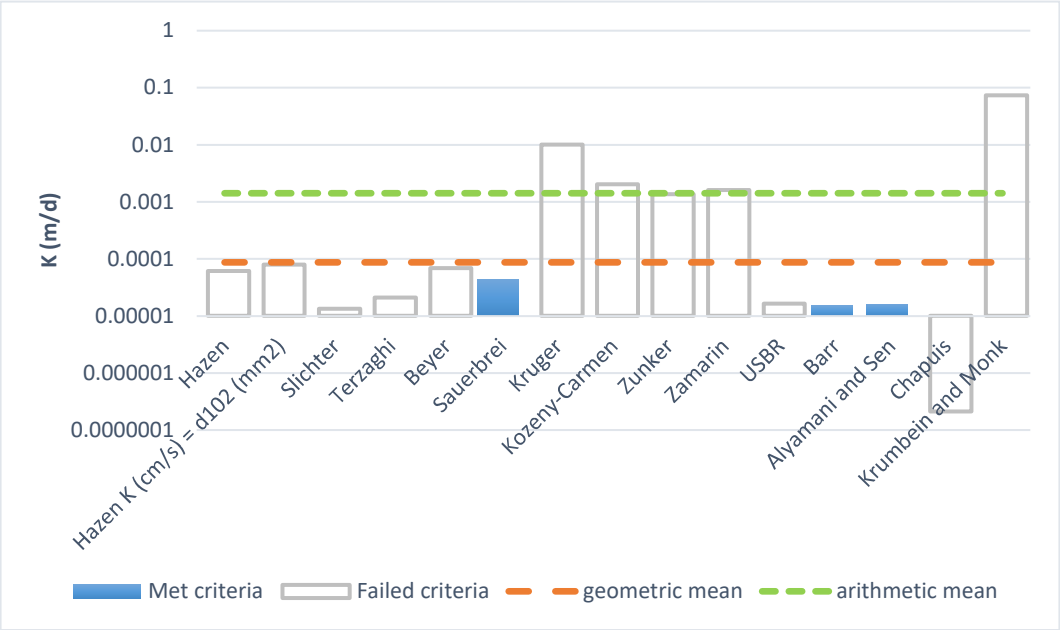
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.E-08	5.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	7.E-08	7.E-10	0.00	
Slichter	1.E-08	1.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	5.E-08	5.E-10	0.00	
Sauerbrei	3.E-08	3.E-10	0.00	
Kruger	2.E-05	2.E-07	0.02	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	1.E-08	1.E-10	0.00	
Barr	1.E-08	1.E-10	0.00	
Alyamani and Sen	3.E-09	3.E-11	0.00	
Chapuis	1.E-10	1.E-12	0.00	
Krumbein and Monk	2.E-04	2.E-06	0.13	
Shepherd	4.E-06	4.E-08	0.00	
geometric mean	5.E-08	5.E-10	0.00	
arithmetic mean	1.E-06	1.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH21-16 SS5 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



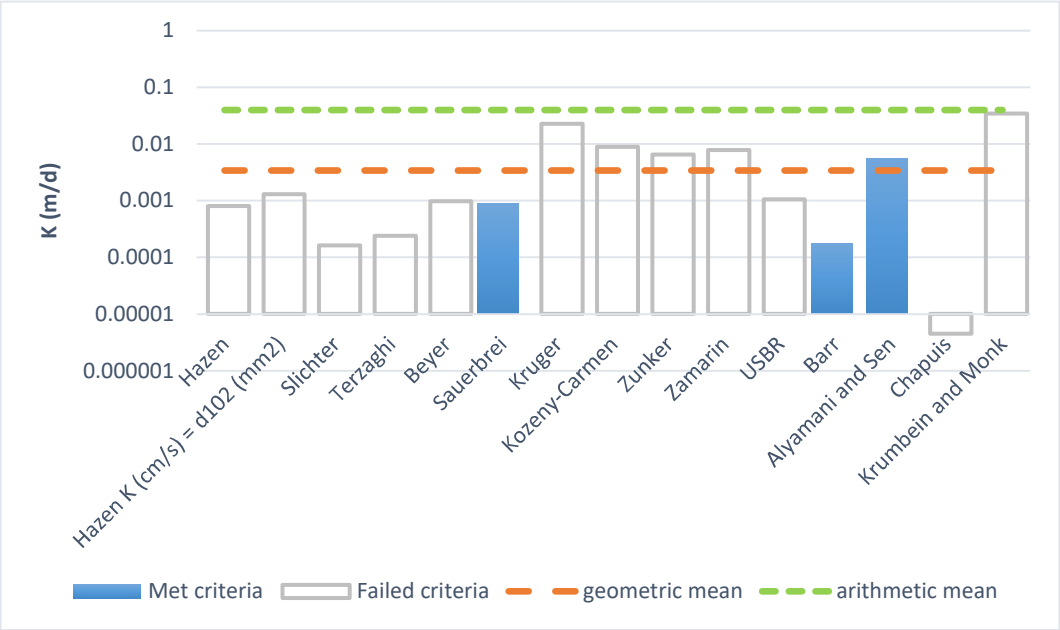
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.E-08	7.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	9.E-08	9.E-10	0.00	
Slichter	2.E-08	2.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	8.E-08	8.E-10	0.00	
Sauerbrei	5.E-08	5.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	2.E-08	2.E-10	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	8.E-05	8.E-07	0.07	
Shepherd	7.E-06	7.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH22-1 SS6 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



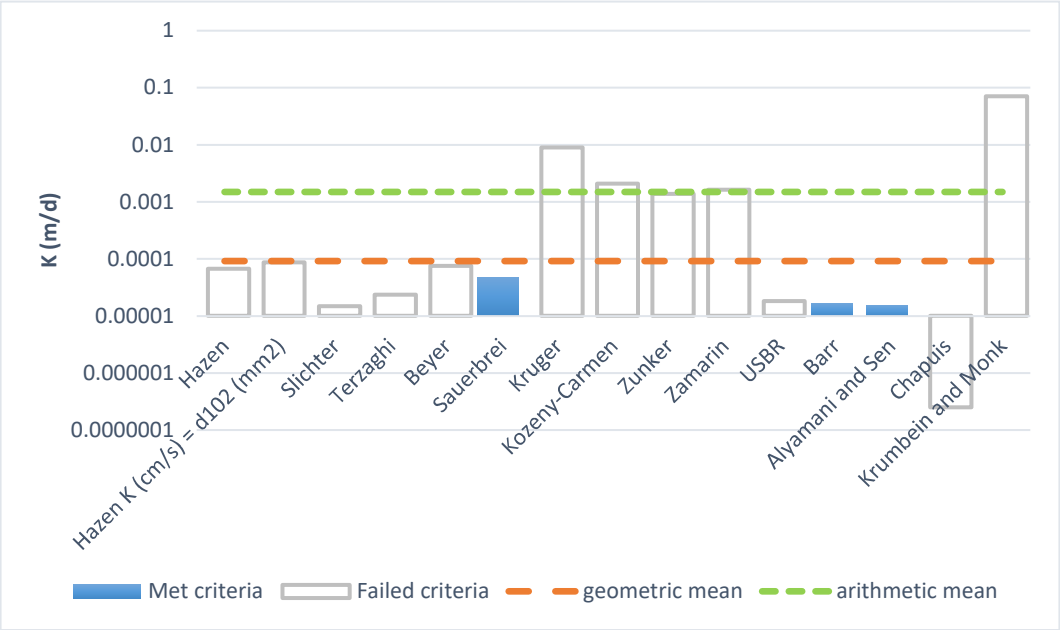
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	9.E-07	9.E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.E-06	1.E-08	0.00	
Slichter	2.E-07	2.E-09	0.00	
Terzaghi	3.E-07	3.E-09	0.00	
Beyer	1.E-06	1.E-08	0.00	
Sauerbrei	1.E-06	1.E-08	0.00	
Kruger	3.E-05	3.E-07	0.02	
Kozeny-Carmen	1.E-05	1.E-07	0.01	
Zunker	8.E-06	8.E-08	0.01	
Zamarin	9.E-06	9.E-08	0.01	
USBR	1.E-06	1.E-08	0.00	
Barr	2.E-07	2.E-09	0.00	
Alyamani and Sen	6.E-06	6.E-08	0.01	
Chapuis	5.E-09	5.E-11	0.00	
Krumbein and Monk	4.E-05	4.E-07	0.03	
Shepherd	2.E-04	2.E-06	0.15	
geometric mean	4.E-06	4.E-08	0.00	
arithmetic mean	5.E-05	5.E-07	0.04	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH22-2 SS6 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



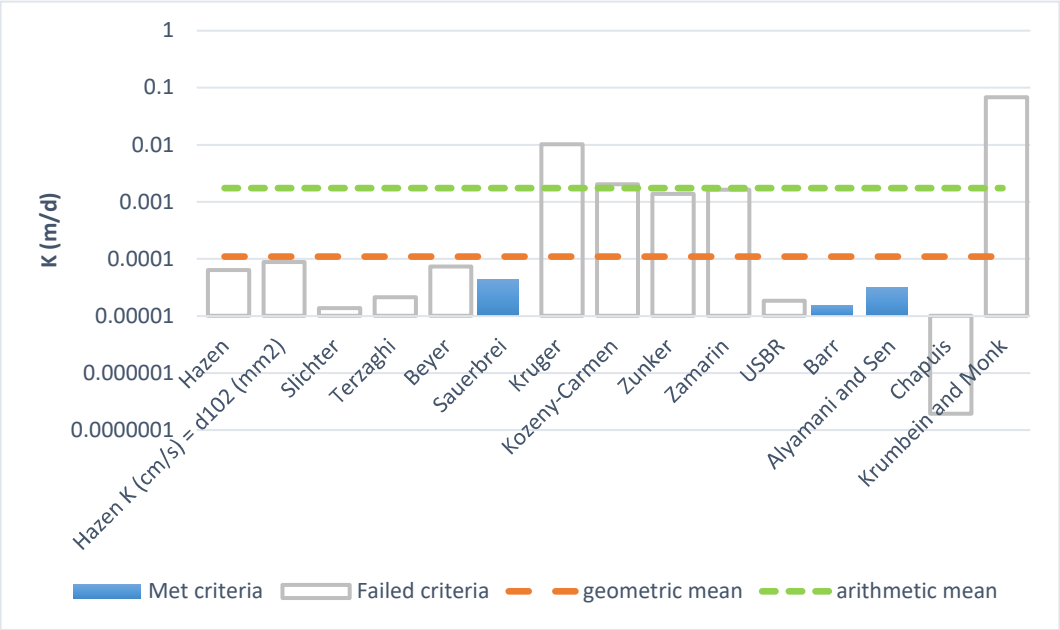
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.E-08	8.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.E-07	1.E-09	0.00	
Slichter	2.E-08	2.E-10	0.00	
Terzaghi	3.E-08	3.E-10	0.00	
Beyer	9.E-08	9.E-10	0.00	
Sauerbrei	6.E-08	6.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	2.E-08	2.E-10	0.00	
Chapuis	3.E-10	3.E-12	0.00	
Krumbein and Monk	8.E-05	8.E-07	0.07	
Shepherd	7.E-06	7.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

K from Grain Size Analysis Report Date: 26-Apr-23

Sample Name: BH22-3 SS6 Primont Homes, Welland

Mass Sample (g): 100 T (oC) 20

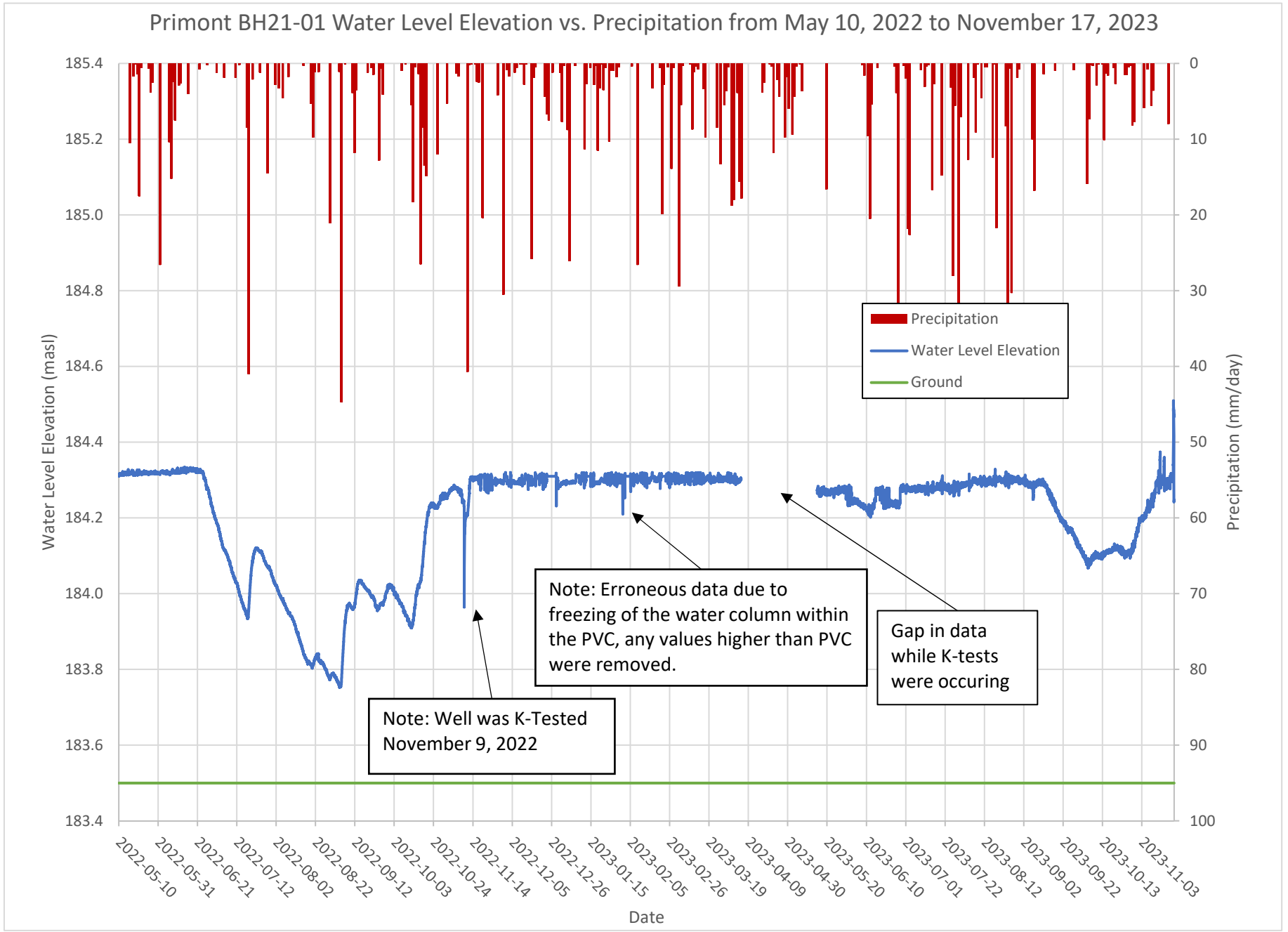
Poorly sorted clay with fines

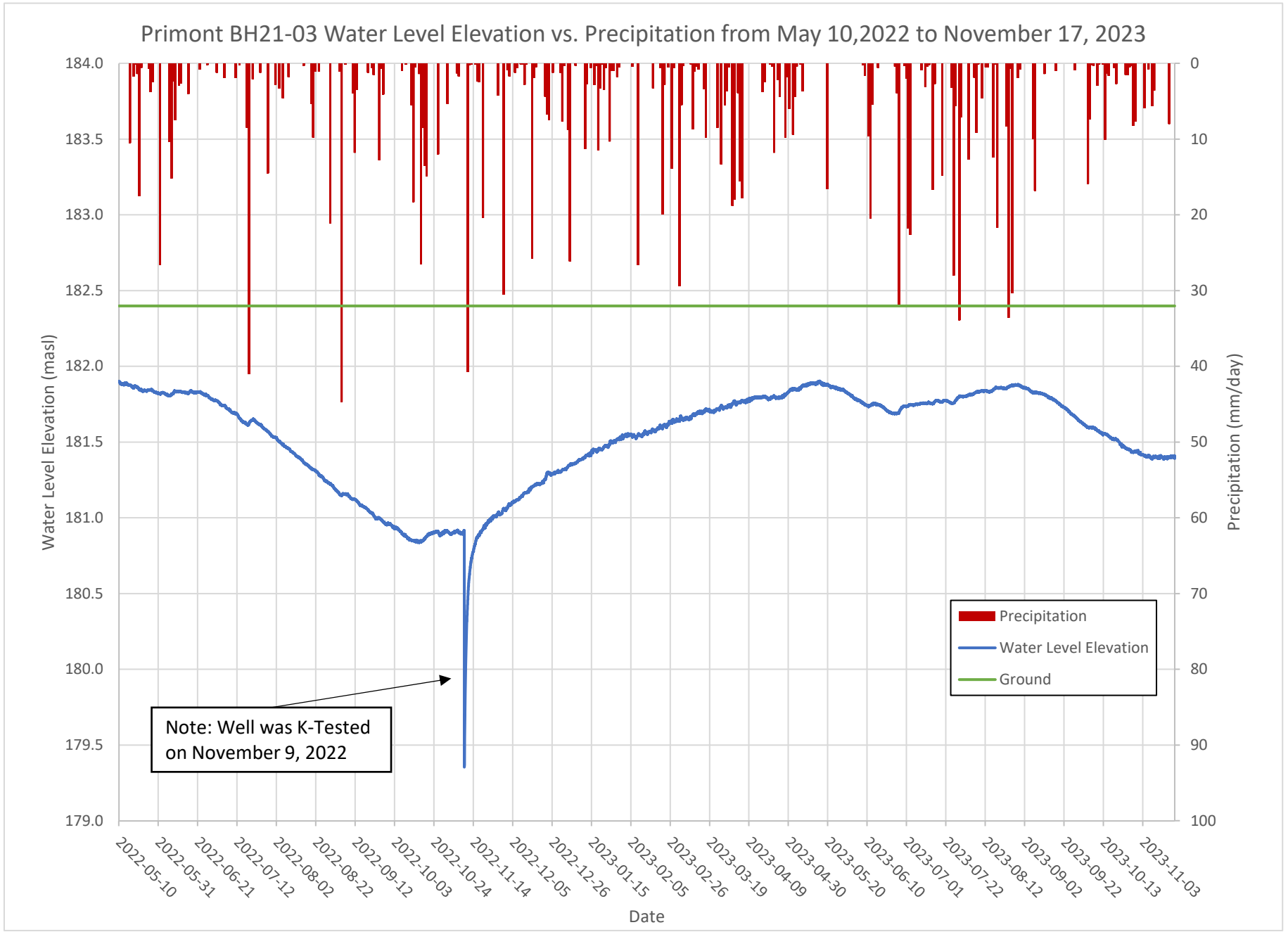


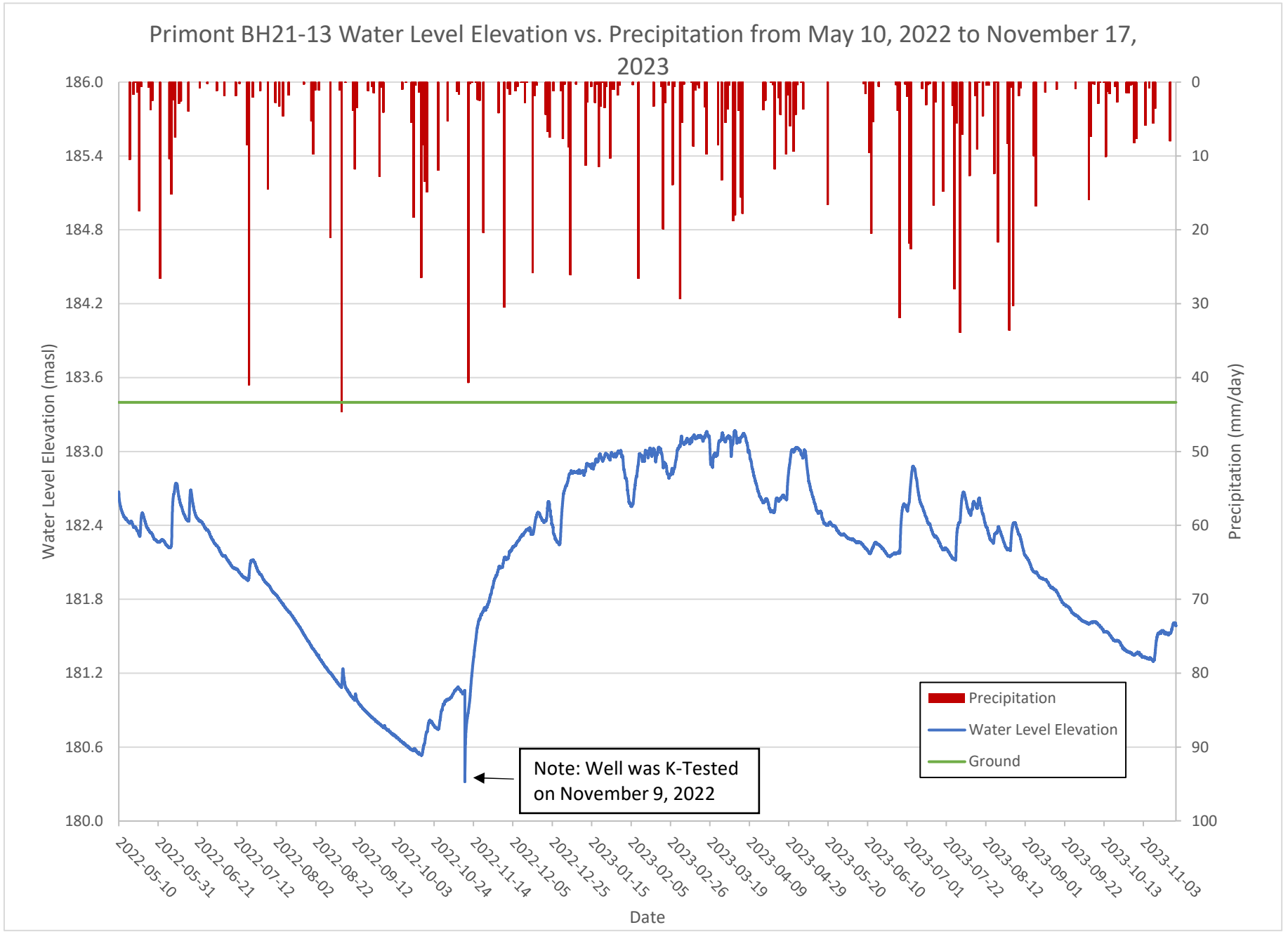
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.E-08	7.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.E-07	1.E-09	0.00	
Slichter	2.E-08	2.E-10	0.00	
Terzaghi	2.E-08	2.E-10	0.00	
Beyer	8.E-08	8.E-10	0.00	
Sauerbrei	5.E-08	5.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	4.E-08	4.E-10	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	8.E-05	8.E-07	0.07	
Shepherd	8.E-06	8.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

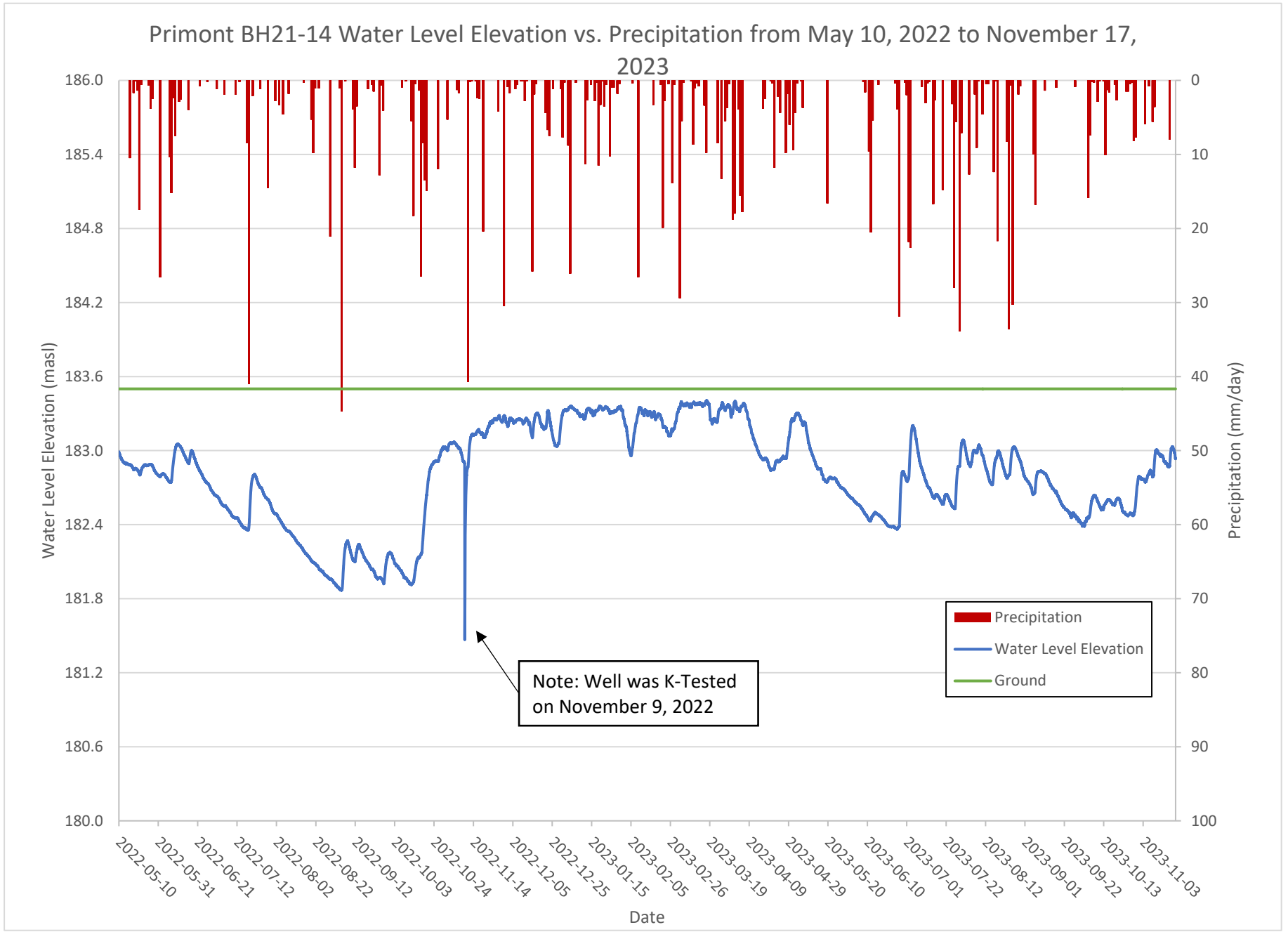
Appendix D

Groundwater Datalogger Charts


Primont BH21-01 Water Level Elevation vs. Precipitation from May 10, 2022 to November 17, 2023
Water Level Elevation (masl)
Precipitation (mm/day)
Date
Precipitation
Water Level Elevation
Ground
Note: Erroneous data due to freezing of the water column within the PVC, any values higher than PVC were removed.
Gap in data while K-tests were occuring
Note: Well was K-Tested November 9, 2022
185.4
185.2
185.0
184.8
184.6
184.4
184.2
184.0
183.8
183.6
183.4
0
10
20
30
40
50
60
70
80
90
100
2022-05-10
2022-05-31
2022-06-21
2022-07-12
2022-08-02
2022-08-22
2022-09-12
2022-10-03
2022-10-24
2022-11-14
2022-12-05
2022-12-26
2023-01-15
2023-02-05
2023-02-26
2023-03-19
2023-04-09
2023-04-30
2023-05-20
2023-06-10
2023-07-01
2023-07-22
2023-08-12
2023-09-02
2023-09-22
2023-10-13
2023-11-03


Primont BH21-03 Water Level Elevation vs. Precipitation from May 10,2022 to November 17, 2023
Water Level Elevation (masl)
Precipitation (mm/day)
Date
184.0
183.5
183.0
182.5
182.0
181.5
181.0
180.5
180.0
179.5
179.0
0
10
20
30
40
50
60
70
80
90
100
2022-05-10
2022-05-31
2022-06-21
2022-07-12
2022-08-02
2022-08-22
2022-09-12
2022-10-03
2022-10-24
2022-11-14
2022-12-05
2022-12-26
2023-01-15
2023-02-05
2023-02-26
2023-03-19
2023-04-09
2023-04-30
2023-05-20
2023-06-10
2023-07-01
2023-07-22
2023-08-12
2023-09-02
2023-09-22
2023-10-13
2023-11-03
Precipitation
Water Level Elevation
Ground
Note: Well was K-Tested on November 9, 2022


Primont BH21-13 Water Level Elevation vs. Precipitation from May 10, 2022 to November 17, 2023
Water Level Elevation (masl)
Precipitation (mm/day)
Date
186.0
185.4
184.8
184.2
183.6
183.0
182.4
181.8
181.2
180.6
180.0
0
10
20
30
40
50
60
70
80
90
100
2022-05-10
2022-05-31
2022-06-21
2022-07-12
2022-08-02
2022-08-22
2022-09-12
2022-10-03
2022-10-24
2022-11-14
2022-12-05
2022-12-25
2023-01-15
2023-02-05
2023-02-26
2023-03-19
2023-04-09
2023-04-29
2023-05-20
2023-06-10
2023-07-01
2023-07-22
2023-08-12
2023-09-01
2023-09-22
2023-10-13
2023-11-03
Note: Well was K-Tested on November 9, 2022
Precipitation
Water Level Elevation
Ground


Primont BH21-14 Water Level Elevation vs. Precipitation from May 10, 2022 to November 17, 2023
Water Level Elevation (masl)
Precipitation (mm/day)
Date
186.0
185.4
184.8
184.2
183.6
183.0
182.4
181.8
181.2
180.6
180.0
0
10
20
30
40
50
60
70
80
90
100
2022-05-10
2022-05-31
2022-06-21
2022-07-12
2022-08-02
2022-08-22
2022-09-12
2022-10-03
2022-10-24
2022-11-14
2022-12-05
2022-12-25
2023-01-15
2023-02-05
2023-02-26
2023-03-19
2023-04-09
2023-04-29
2023-05-20
2023-06-10
2023-07-01
2023-07-22
2023-08-12
2023-09-01
2023-09-22
2023-10-13
2023-11-03
Precipitation
Water Level Elevation
Ground
Note: Well was K-Tested on November 9, 2022

Appendix E

Wetland Monitoring

Primont Site Visit April 5, 2023

SW-1

- Top Dp-> Water=32.5cm
- Depth at DP=28.5cm
- Temp=8.6 Cond=208

SW-2

- Top Dp-> Water=60.3cm
- Depth at DP=4cm (small pool)
- Temp=11.25 Cond=455us

SW-3

- Top Dp-> Water=49.5cm
- Depth at DP=18.5cm
- Temp=10.5 Cond=305us

SW-4

- Top Dp-> Water=59.5cm
- Depth at DP=5.5cm
- Temp=9.5 Cond=98us

SW-5

- Top Dp-> Water=60.2cm
- Depth at DP=8.5cm
- Temp=11.9 Cond=64us

SW-6

- Top Dp-> Water=30.5m
- Depth at DP=31.5cm
- Temp=9.5 Cond=58us

SW-7

- Top Dp-> Water=52.4cm
- Depth at DP=16cm
- Temp=10.2 Cond=310us

SW-8

- Top Dp-> Water=37cm
- Depth at DP=19.5cm
- Temp=7.3 Cond=120us

SW-9

- Top Dp-> Water=54.4cm
- Depth at DP=8cm
- Temp=10.3 Cond=132us

SW-10

- Top Dp-> Water=53.2cm
- Depth at DP= 7.9cm
- Temp=7.7 Cond=125

SW-11

- Top Dp-> Water= 48.8cm
- Depth at DP=10.5cm
- Temp=7.8 Cond=264us

SW-12

- Top Dp-> Water=50.3cm
- Depth at DP=10.4cm
- Temp=7.5 Cond=154us

SW-13

- Top Dp-> Water=53.5m
- Depth at DP=8.5cm
- Temp=7.5 Cond=82us0

SW-14

- Top Dp-> Water=39.5cm
- Depth at DP=27.2cm
- Temp= 8.6 Cond=80us

SW-15

- Top Dp-> Water=36.5cm
- Depth at DP=25cm
- Temp=9.3 Cond=77us

SW-16

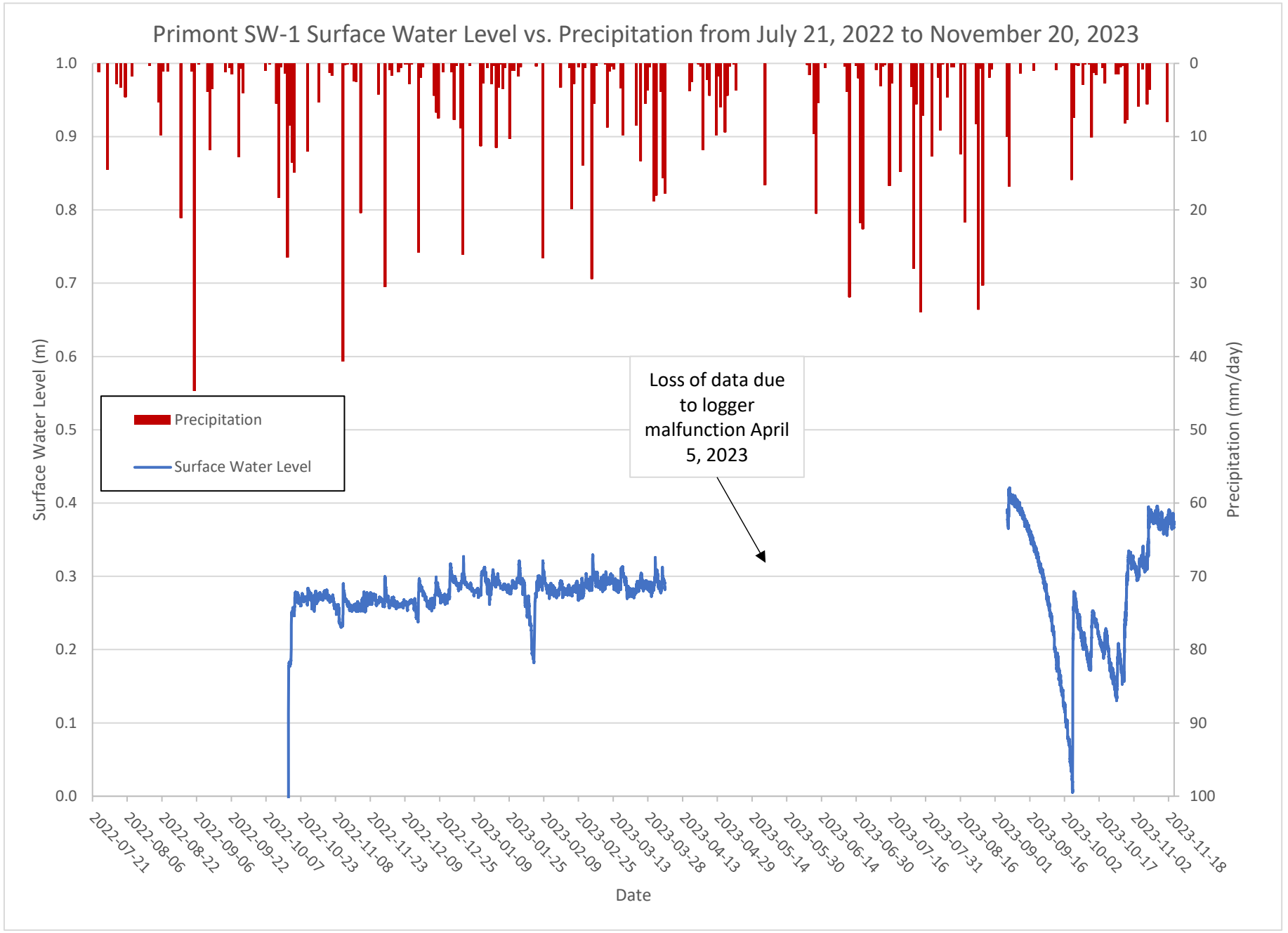
- Top Dp-> Water=62cm
- Depth at DP=7cm
- Temp= 8.5 Cond=153us

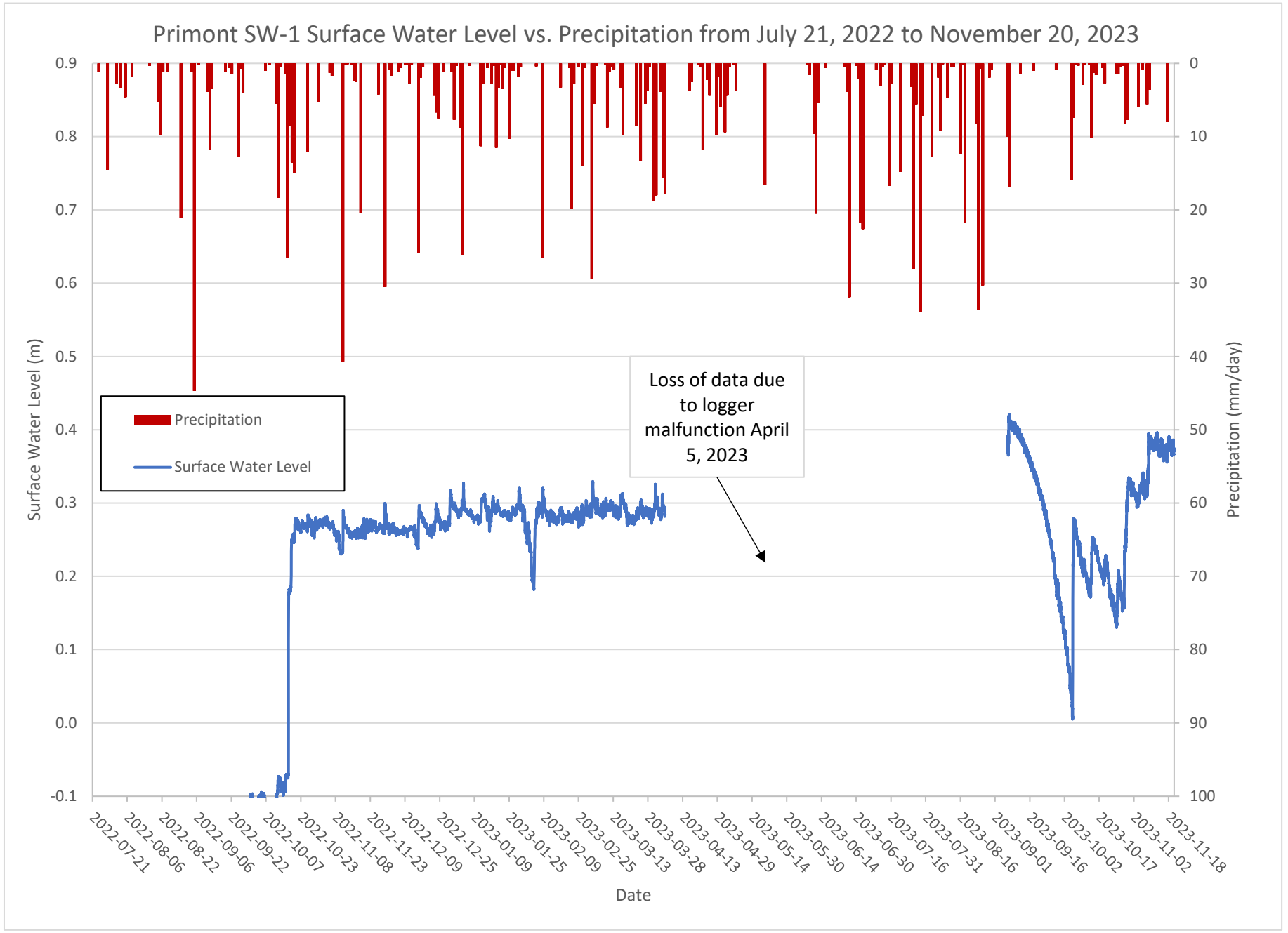
SW-17

- Top Dp-> Water=58cm
- Depth at DP=7.5cm
- Temp= 7.8 Cond=6us

SW-18

- Top Dp-> Water=36.3cm
- Depth at DP=21.6cm
- Temp= 7.3 Cond=46us


Primont SW-1 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18


Primont SW-1 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
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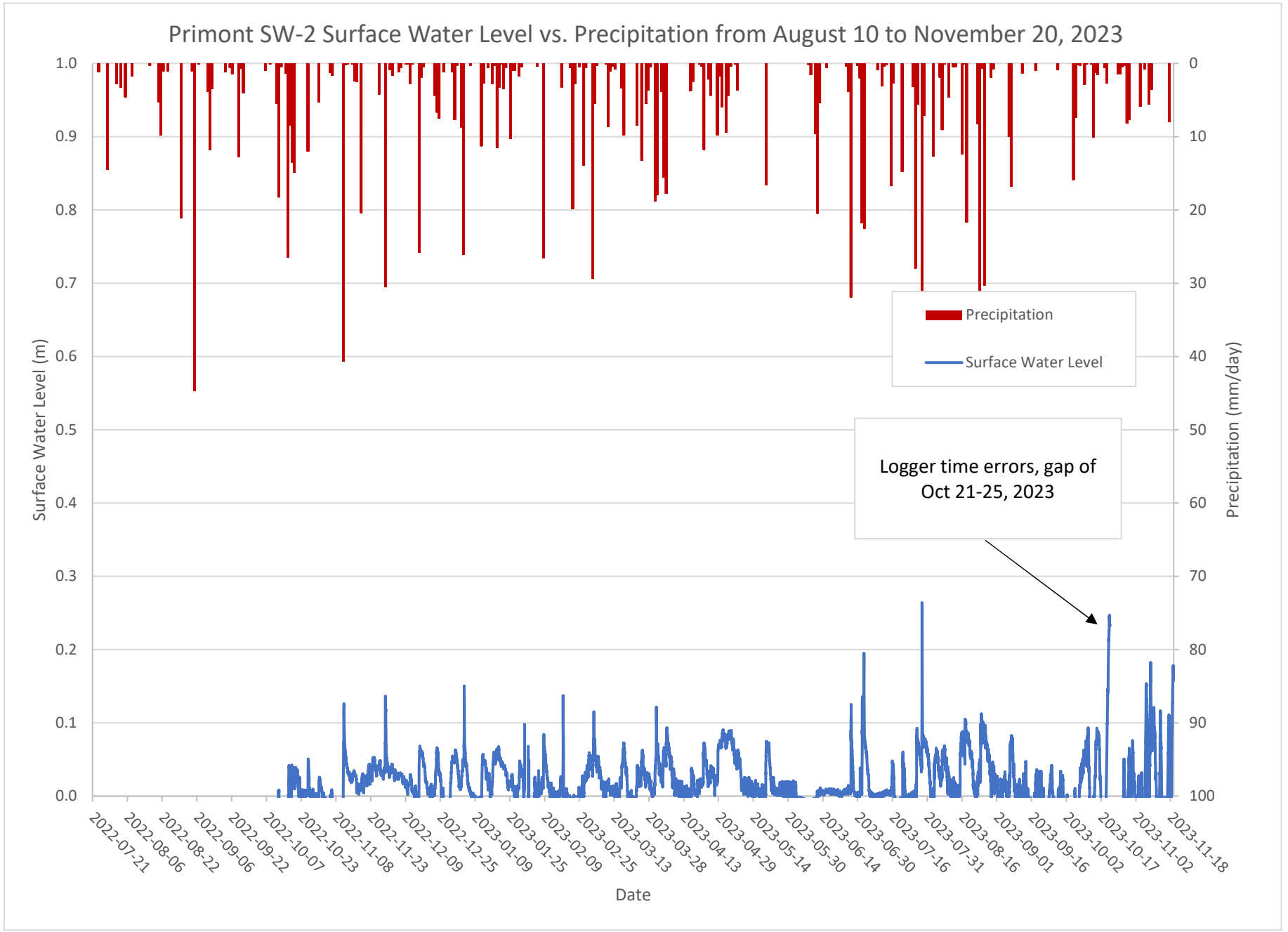
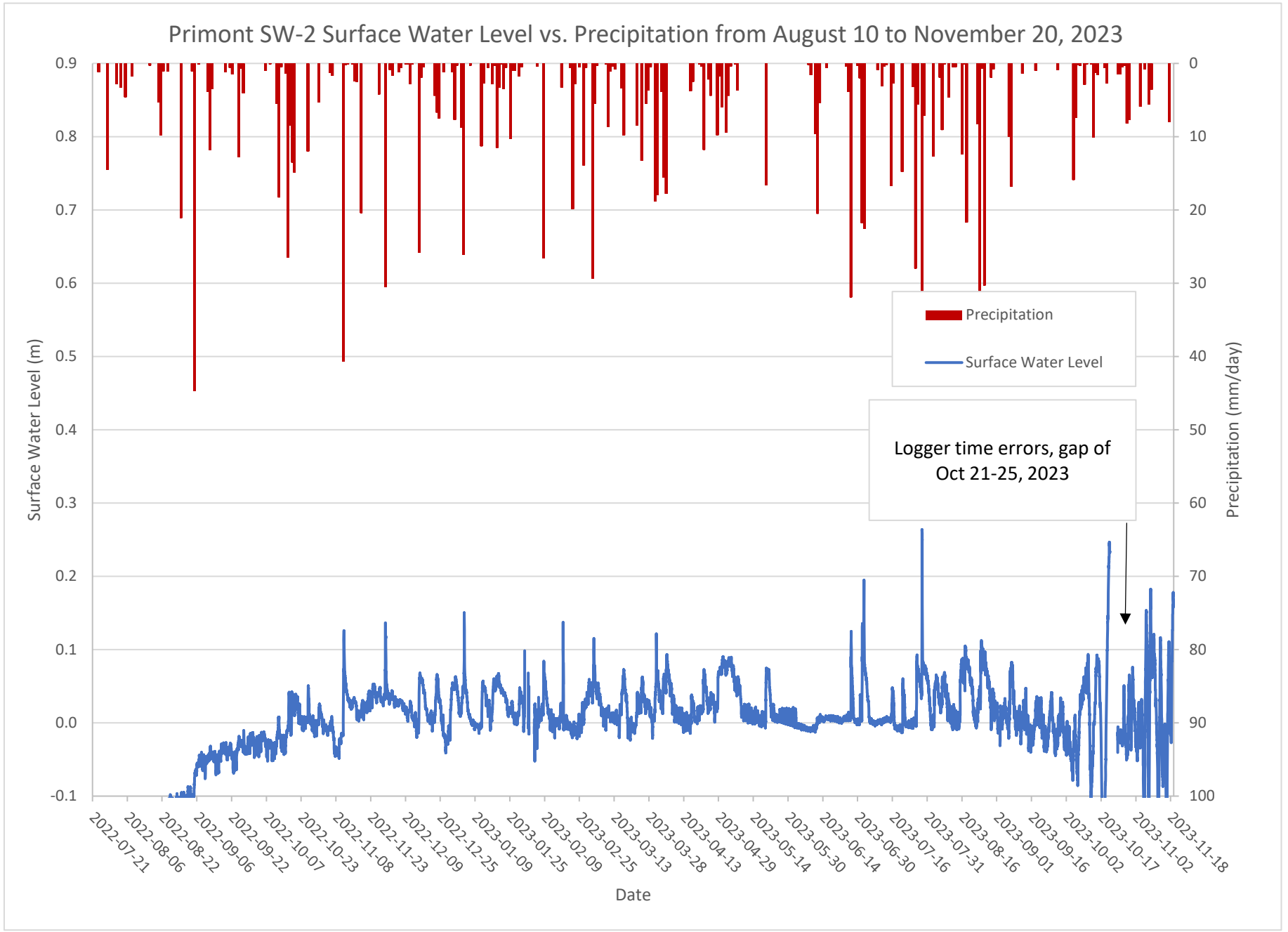
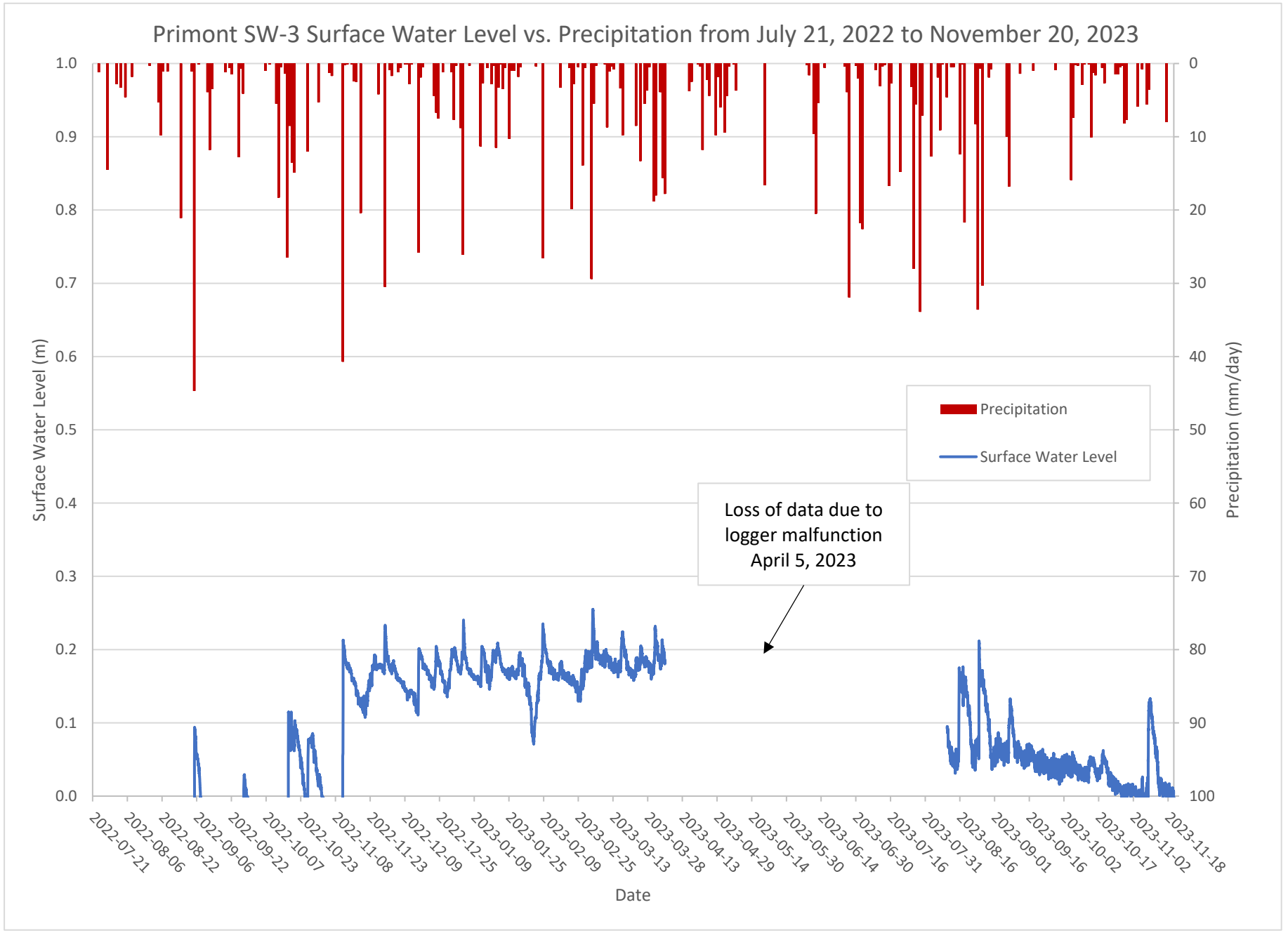
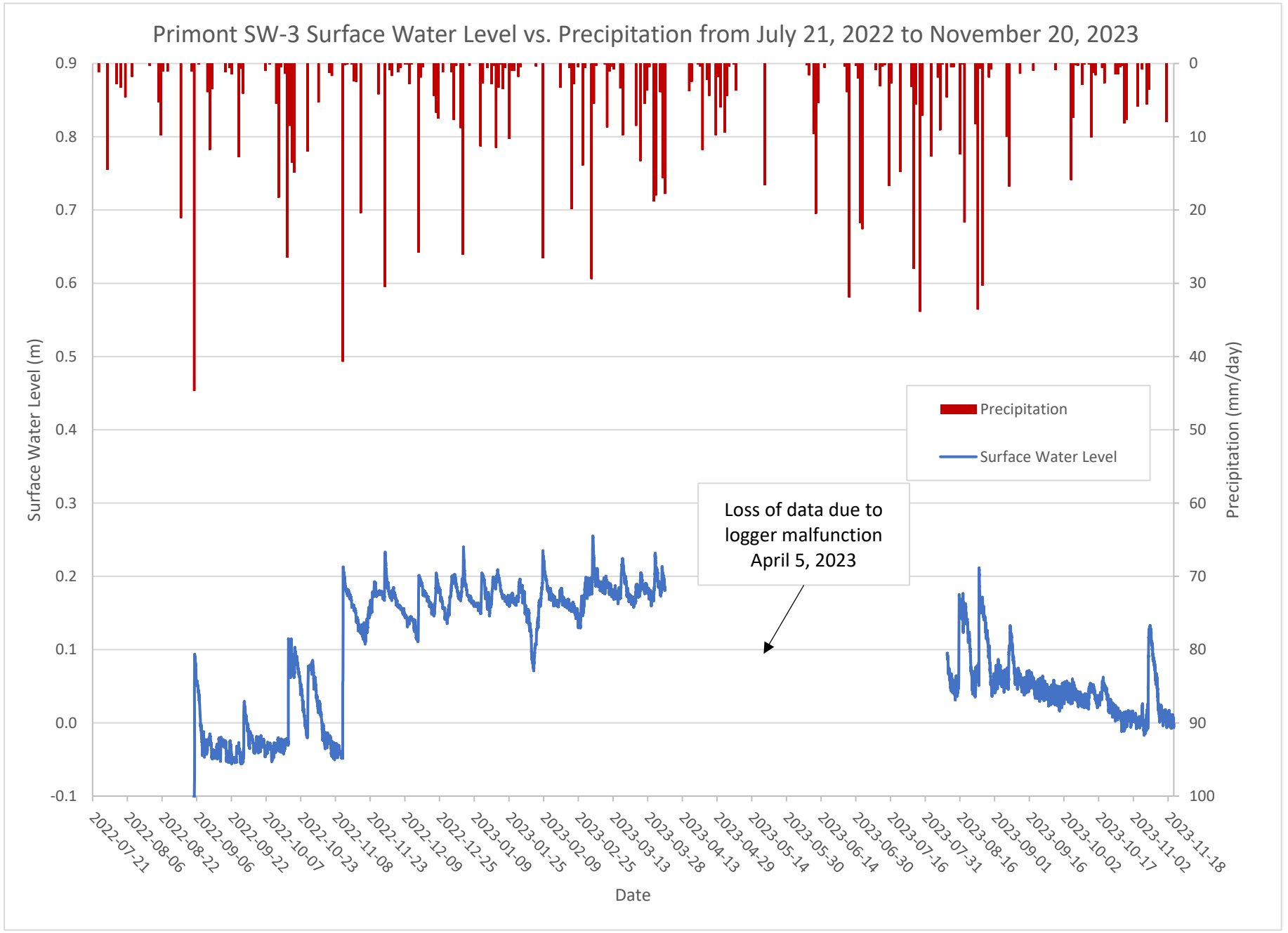
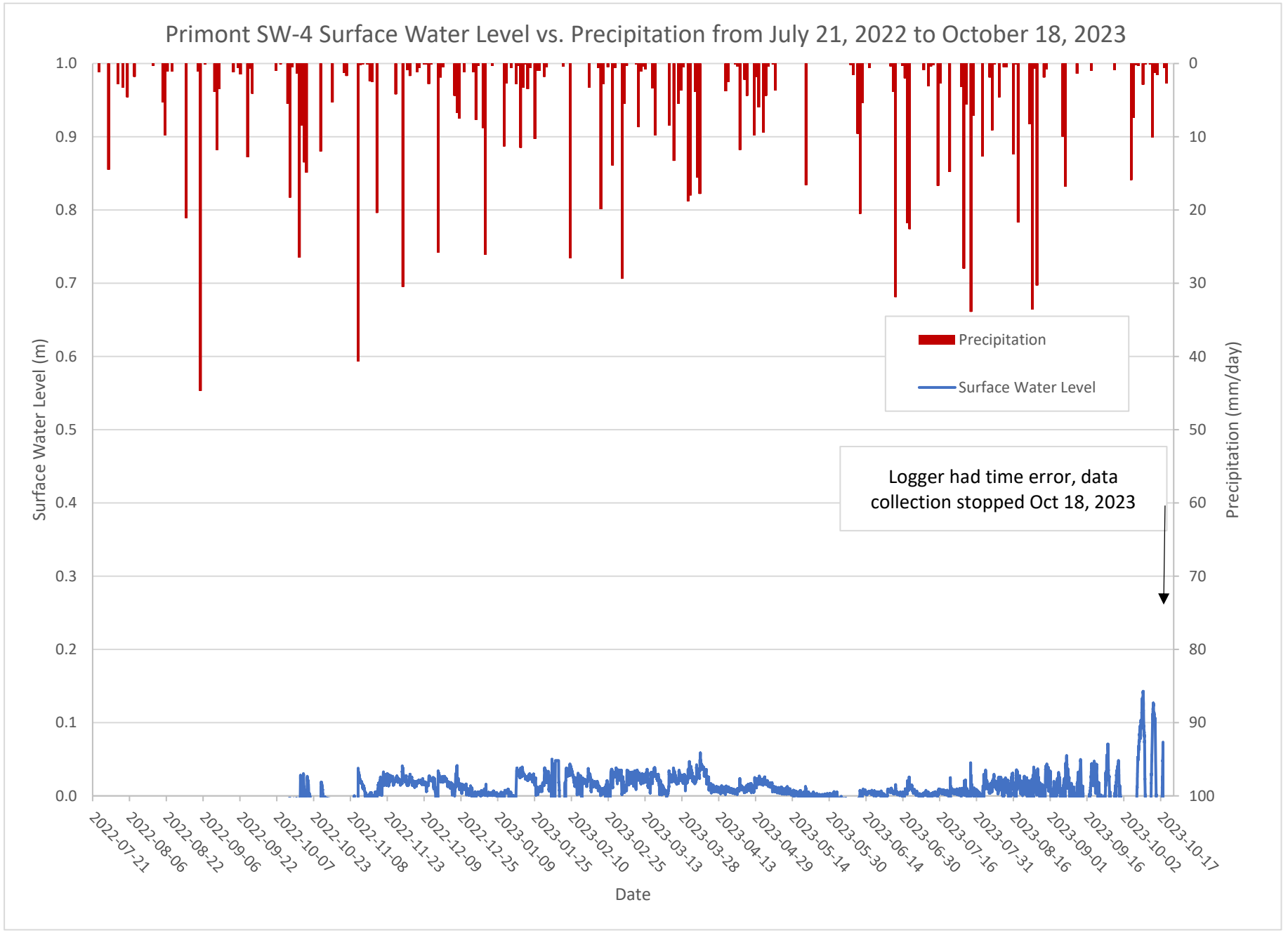
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

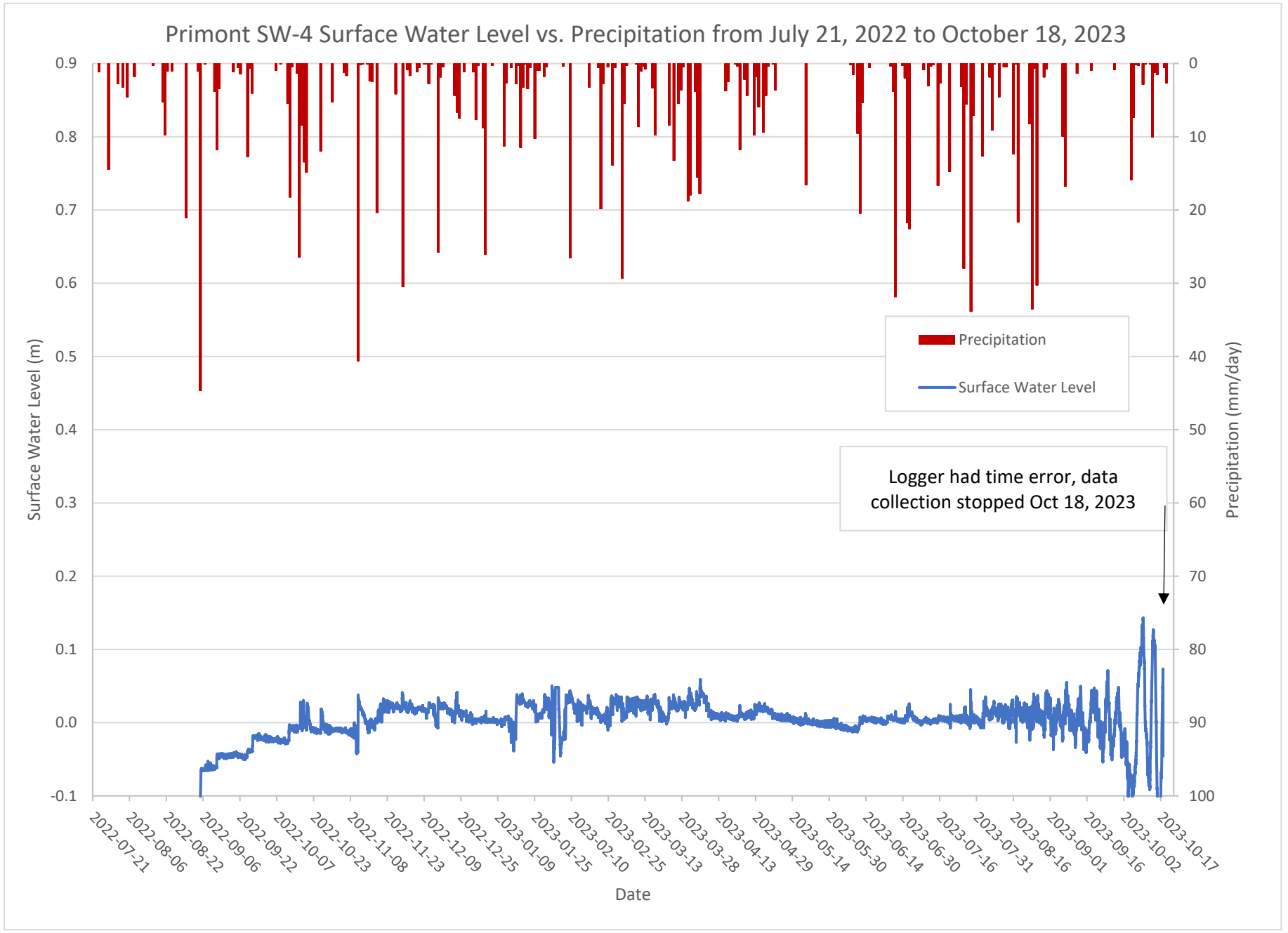

Primont SW-2 Surface Water Level vs. Precipitation from August 10 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger time errors, gap of Oct 21-25, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

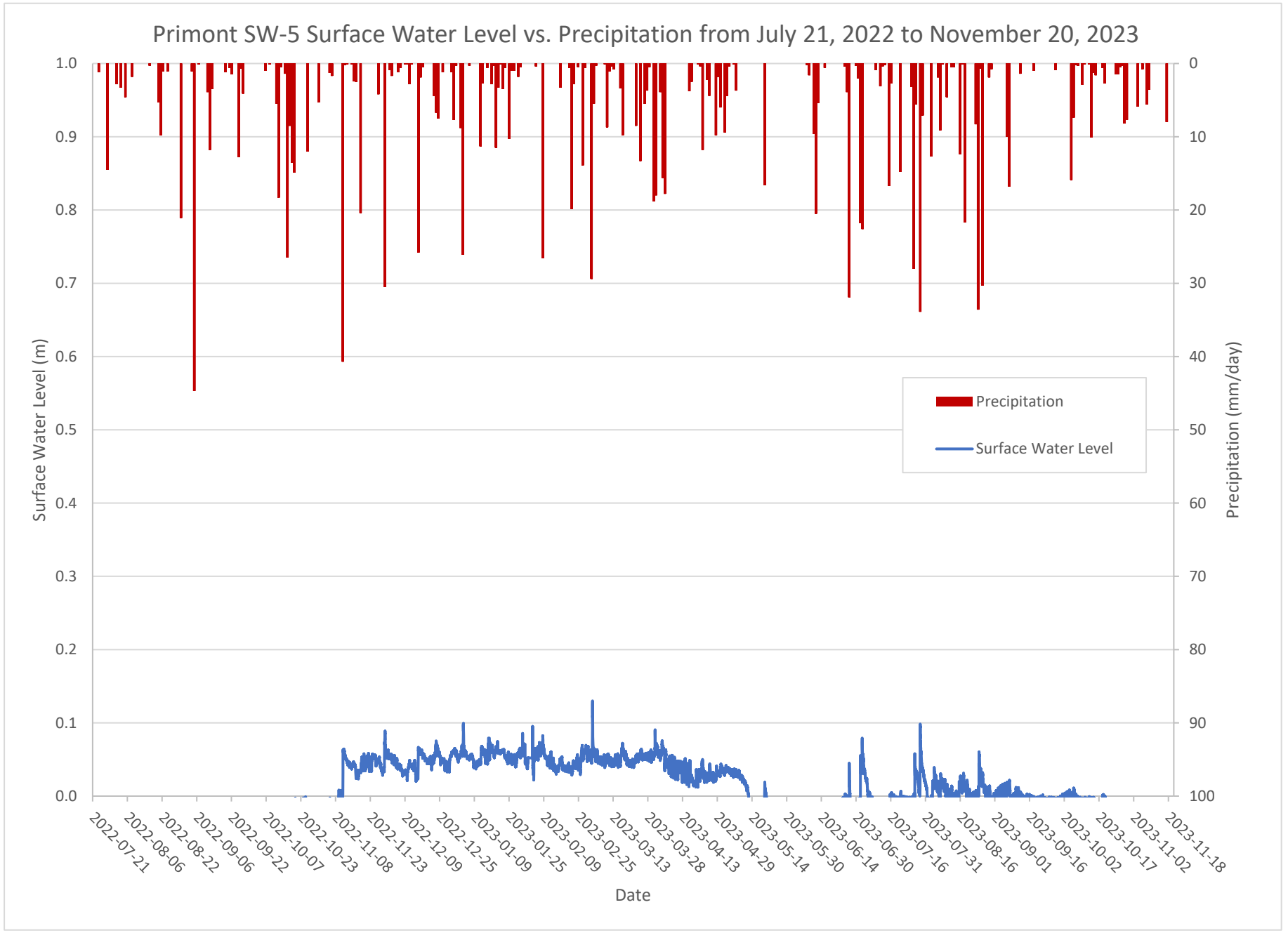

Primont SW-2 Surface Water Level vs. Precipitation from August 10 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger time errors, gap of Oct 21-25, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

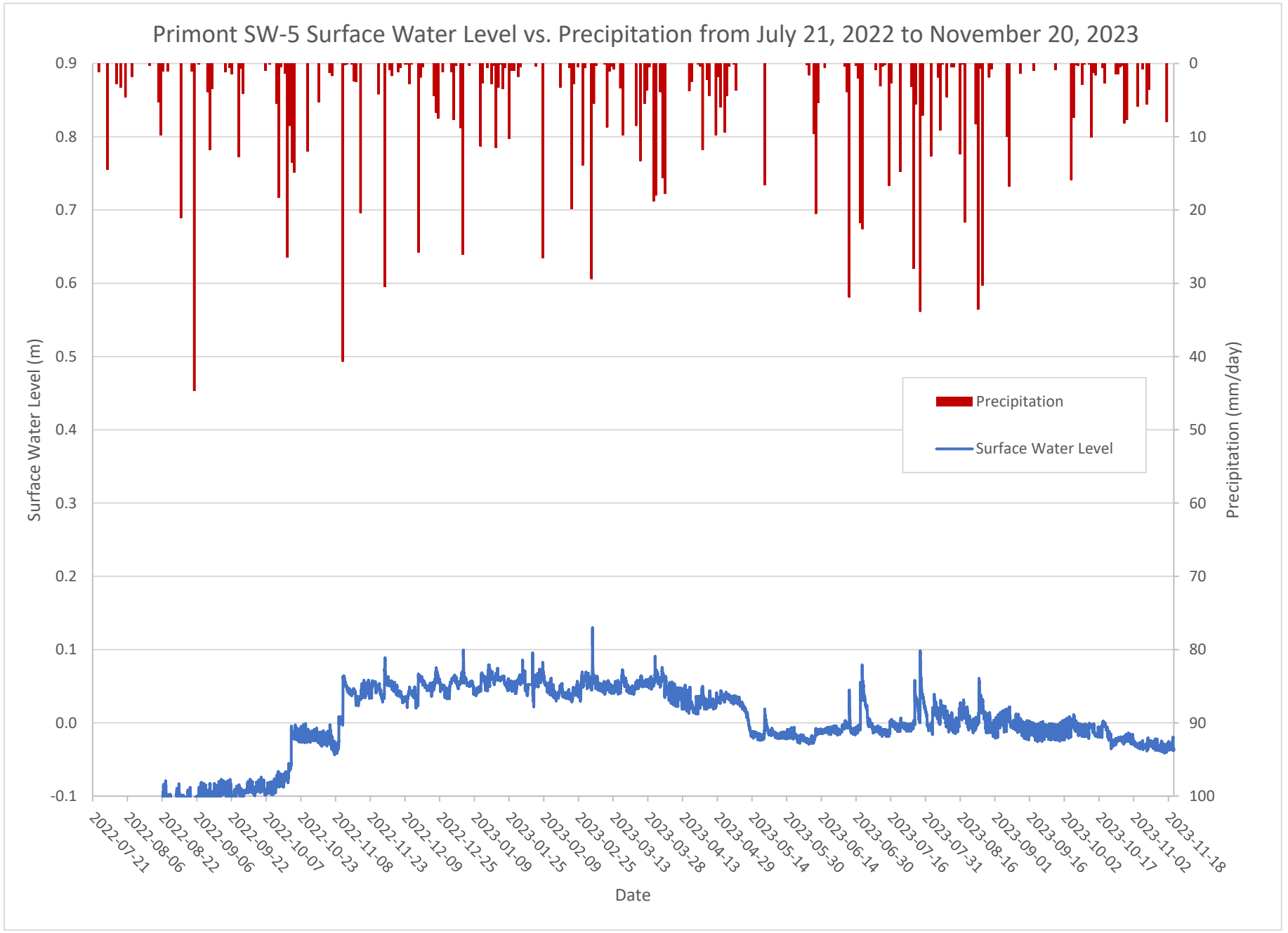

Primont SW-3 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
Date
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

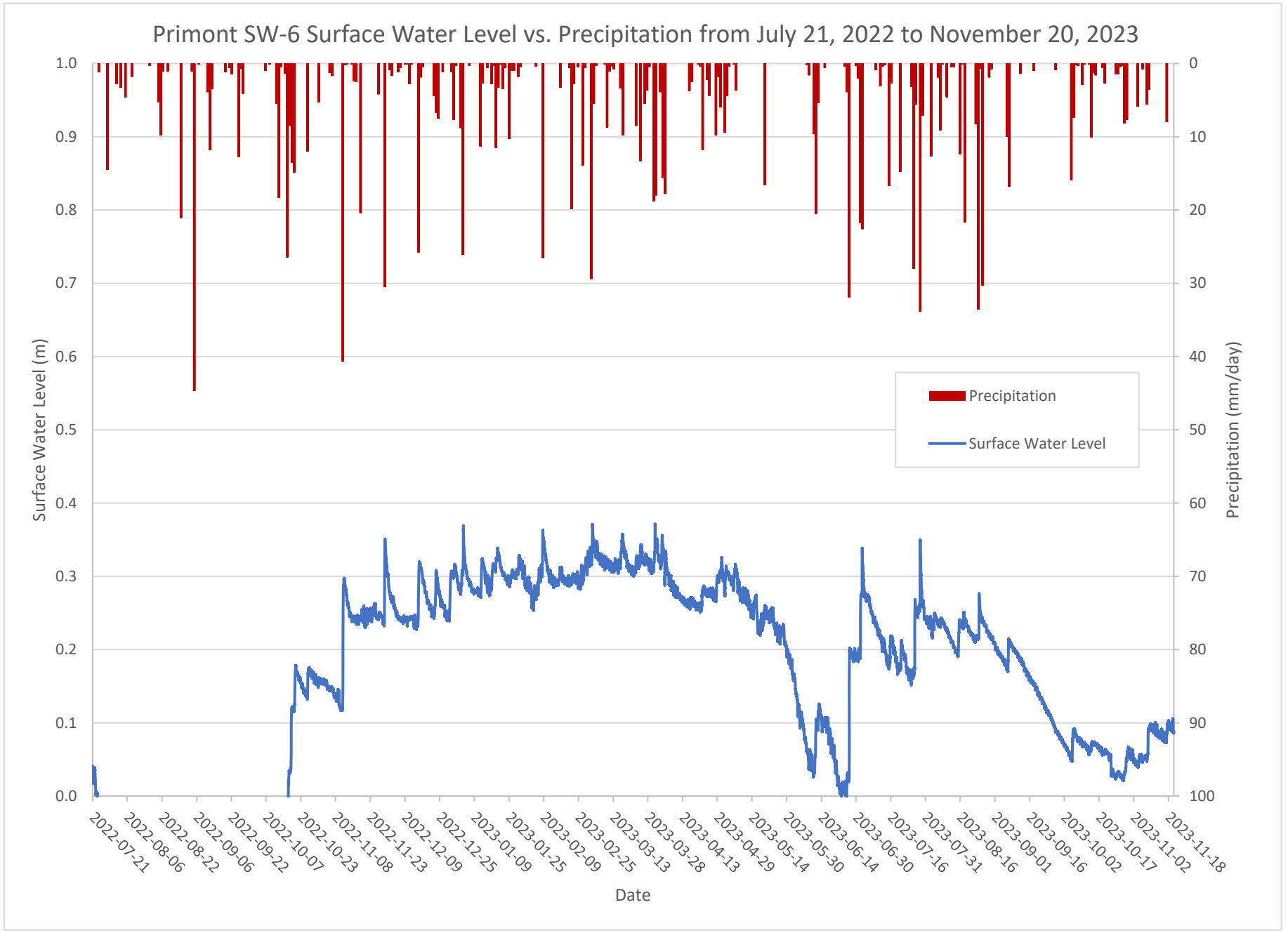

Primont SW-3 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

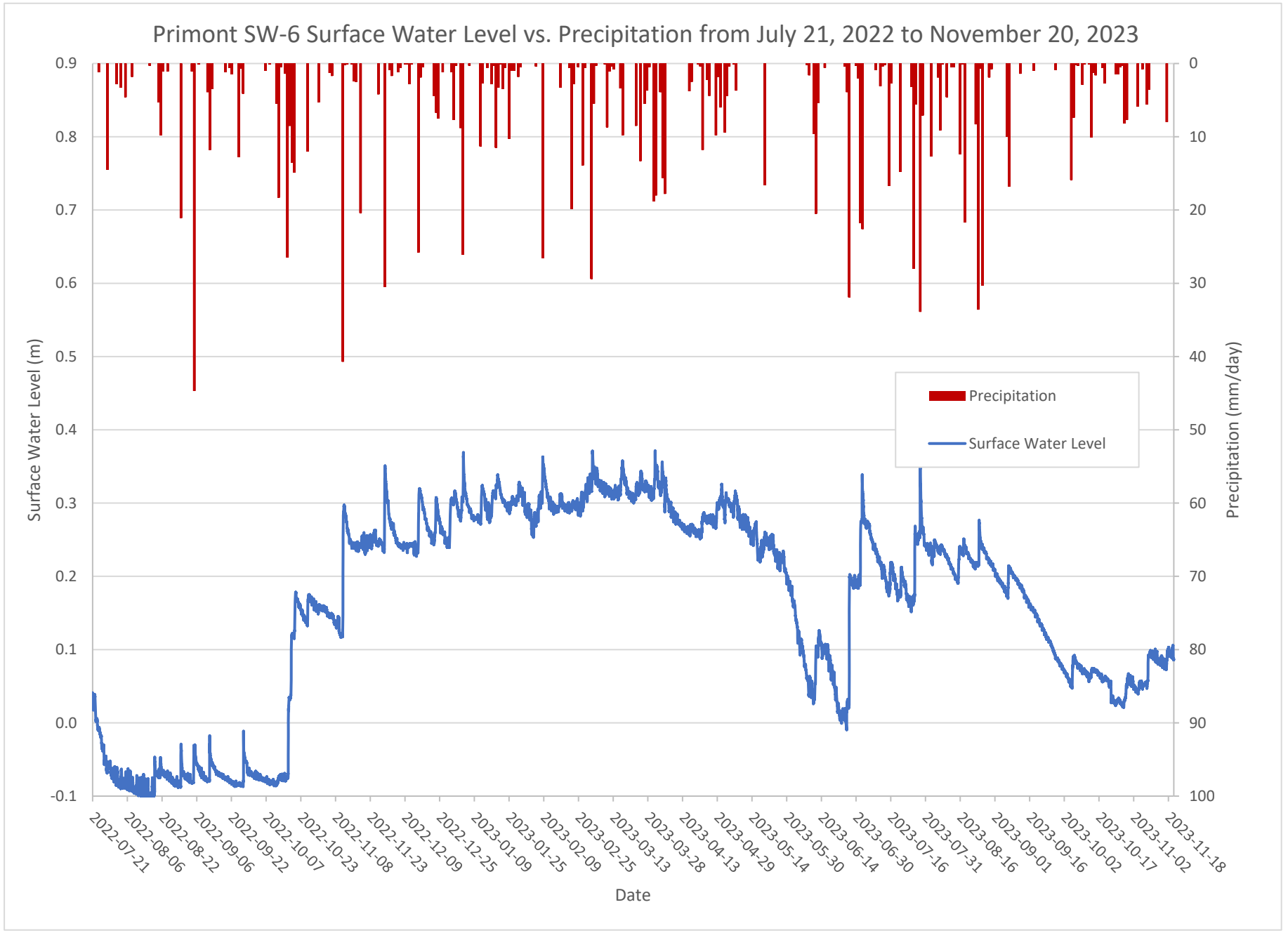

Primont SW-4 Surface Water Level vs. Precipitation from July 21, 2022 to October 18, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger had time error, data collection stopped Oct 18, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17

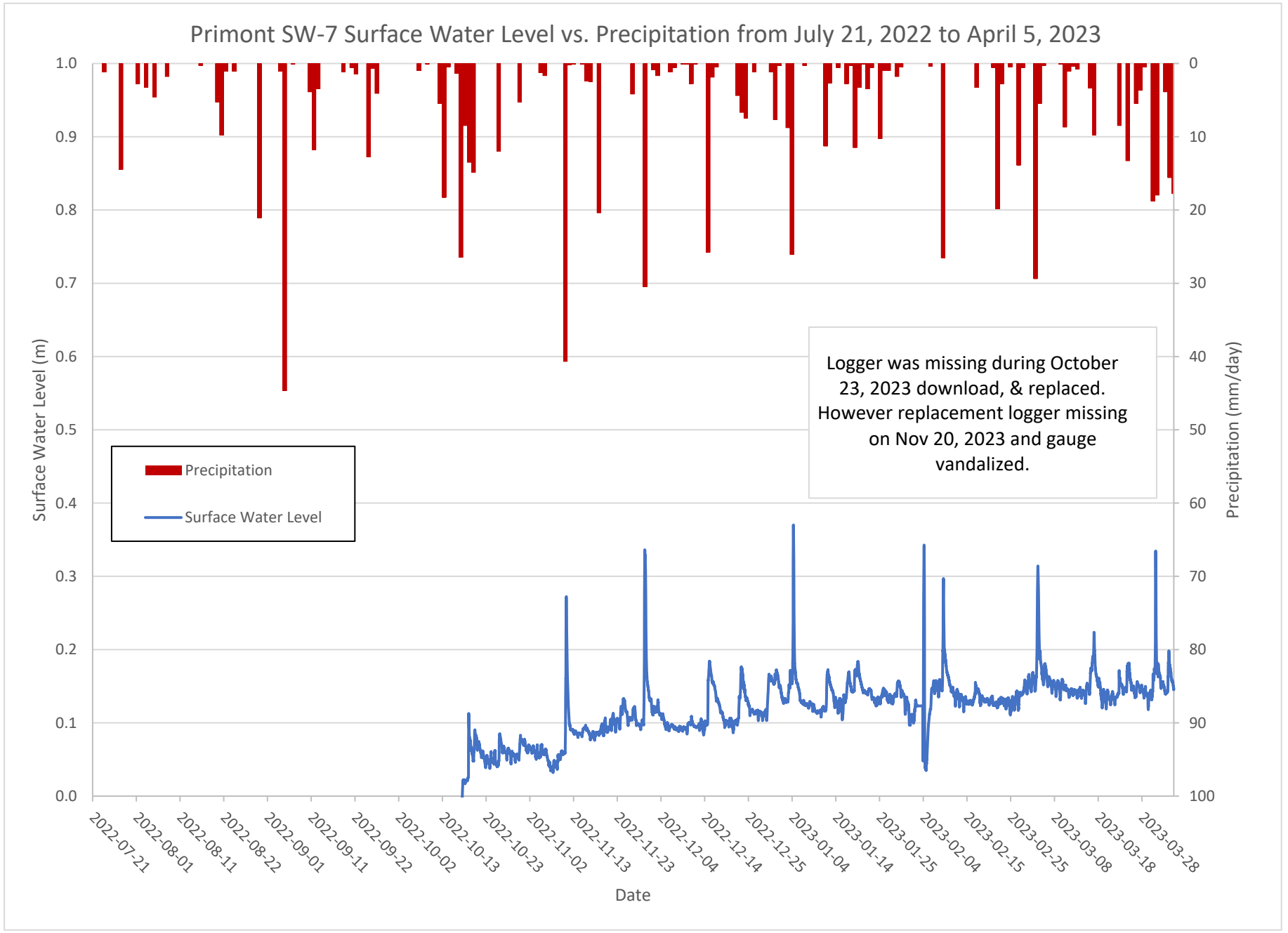

Primont SW-4 Surface Water Level vs. Precipitation from July 21, 2022 to October 18, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Logger had time error, data collection stopped Oct 18, 2023
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17

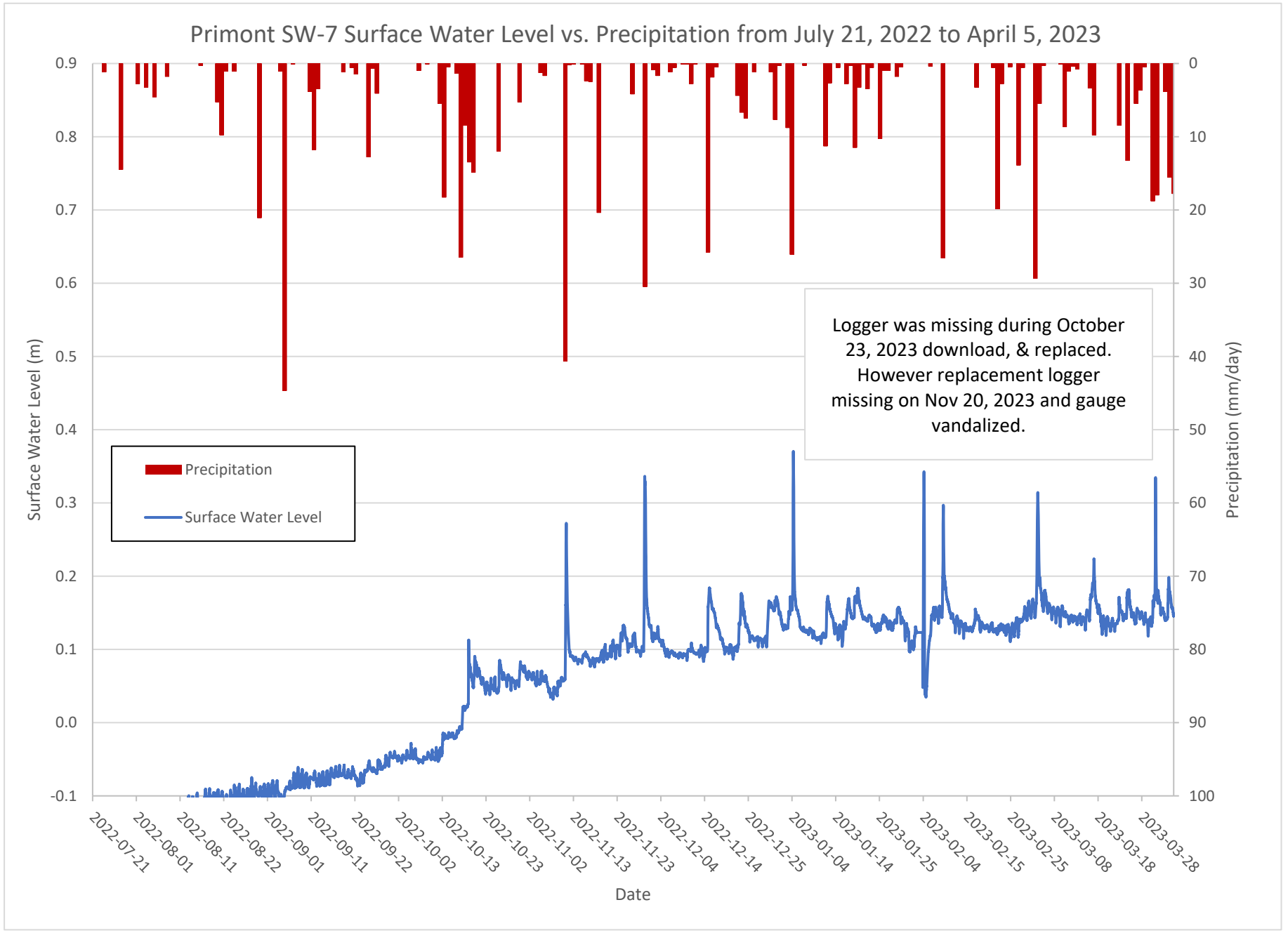

Primont SW-5 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

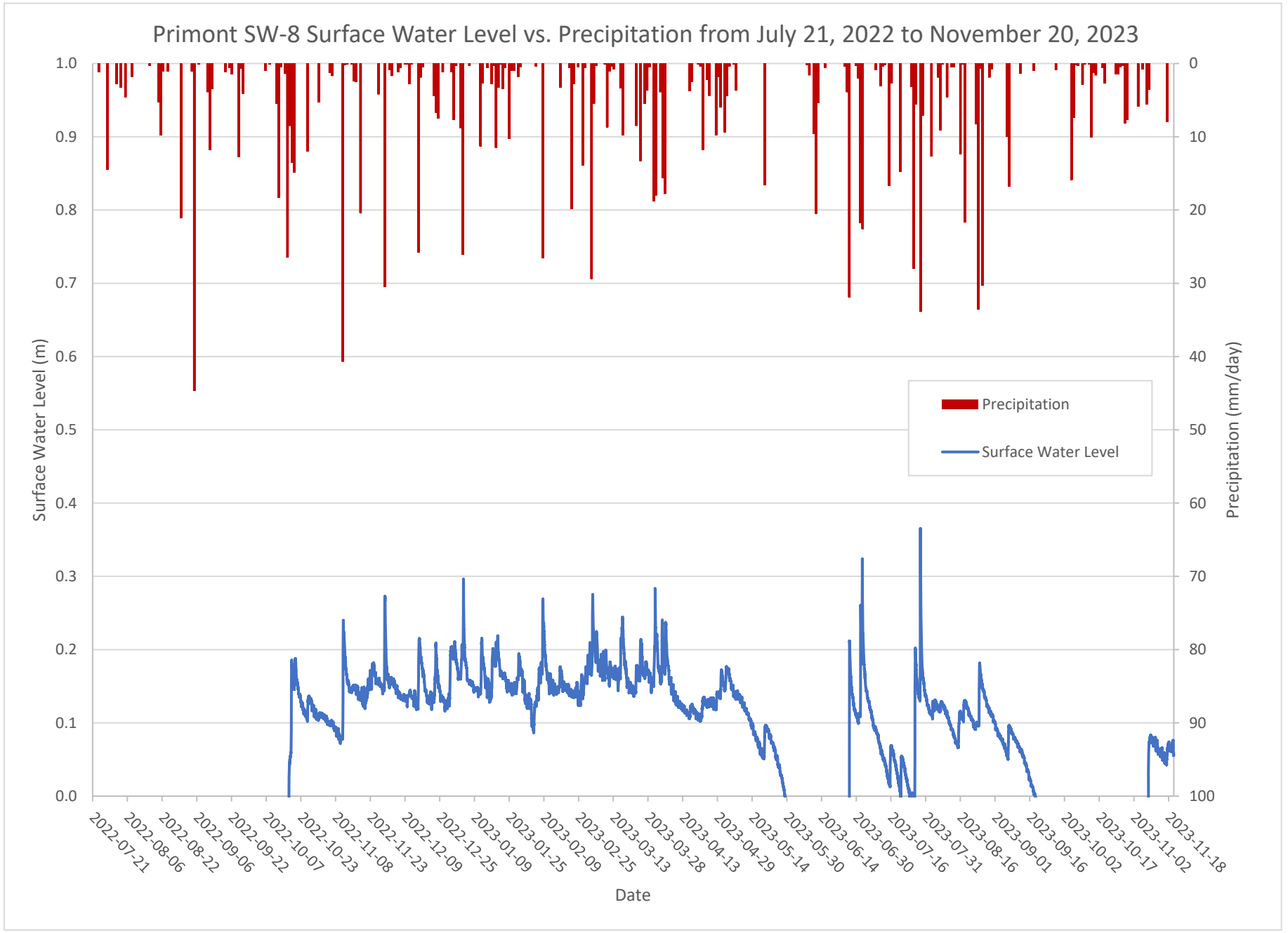

Primont SW-5 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

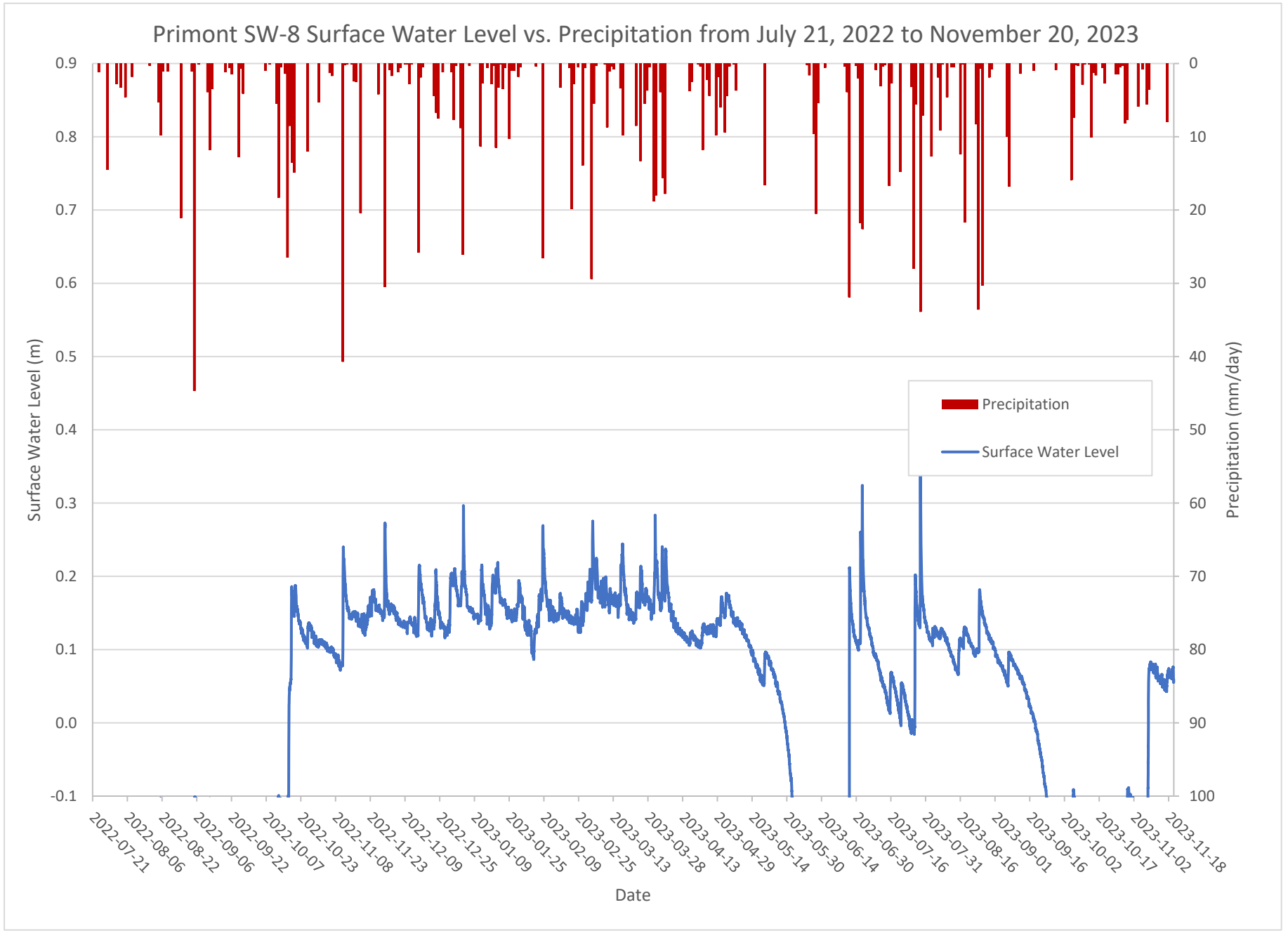

Primont SW-6 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

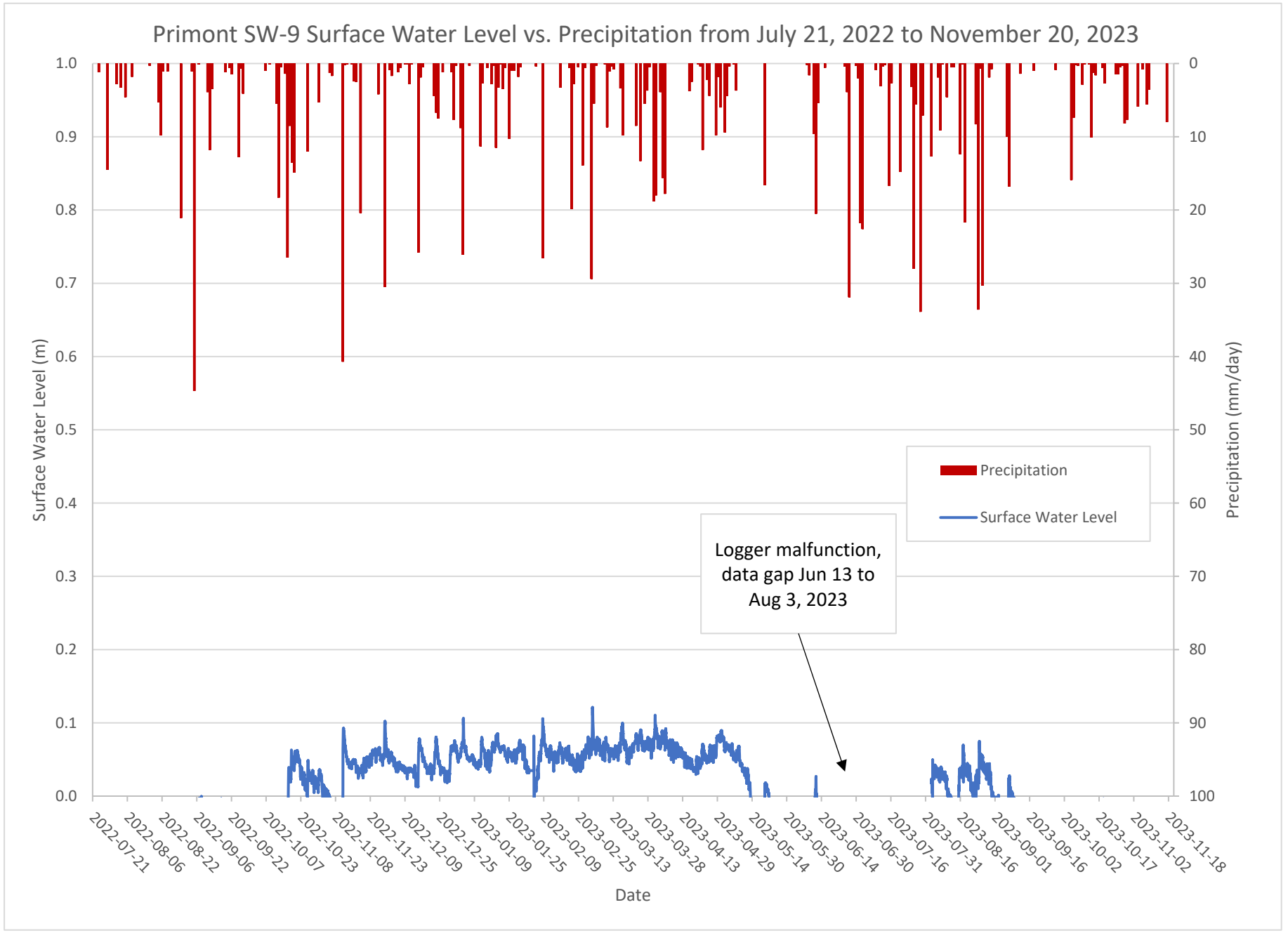

Primont SW-6 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

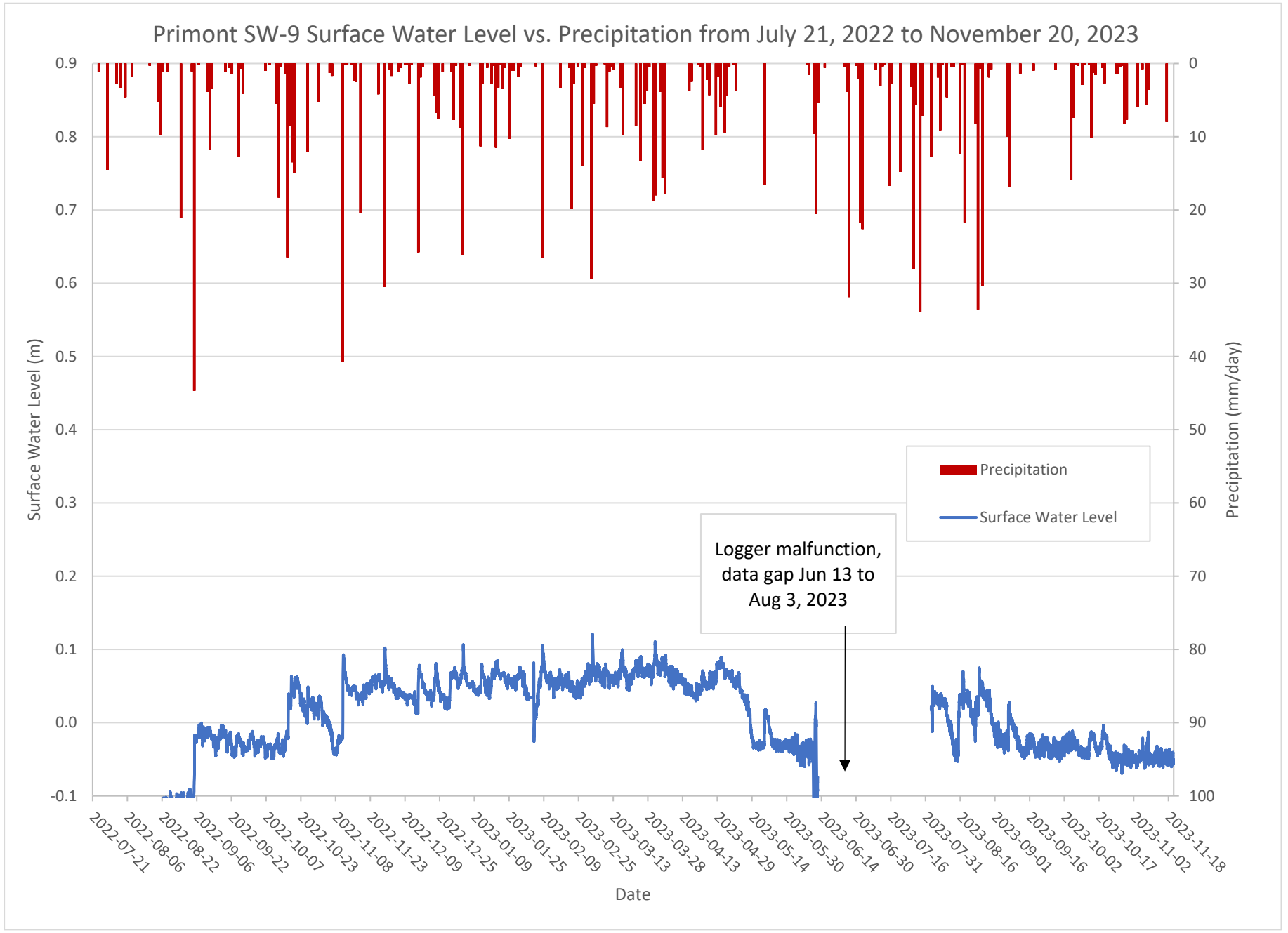

Primont SW-7 Surface Water Level vs. Precipitation from July 21, 2022 to April 5, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger was missing during October 23, 2023 download, & replaced. However replacement logger missing on Nov 20, 2023 and gauge vandalized.
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-01
2022-08-11
2022-08-22
2022-09-01
2022-09-11
2022-09-22
2022-10-02
2022-10-13
2022-10-23
2022-11-02
2022-11-13
2022-11-23
2022-12-04
2022-12-14
2022-12-25
2023-01-04
2023-01-14
2023-01-25
2023-02-04
2023-02-15
2023-02-25
2023-03-08
2023-03-18
2023-03-28

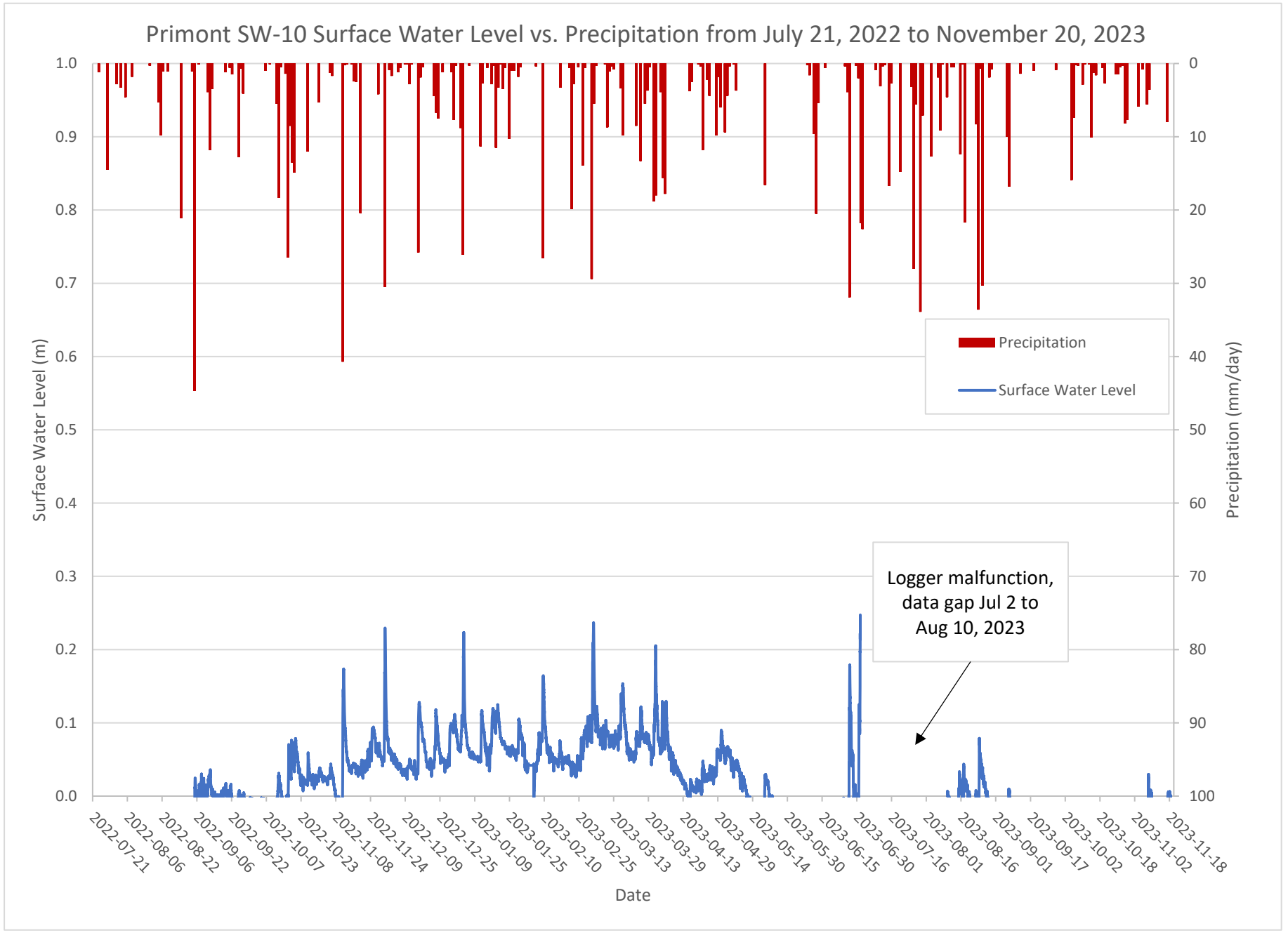

Primont SW-7 Surface Water Level vs. Precipitation from July 21, 2022 to April 5, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger was missing during October 23, 2023 download, & replaced. However replacement logger missing on Nov 20, 2023 and gauge vandalized.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-01
2022-08-11
2022-08-22
2022-09-01
2022-09-11
2022-09-22
2022-10-02
2022-10-13
2022-10-23
2022-11-02
2022-11-13
2022-11-23
2022-12-04
2022-12-14
2022-12-25
2023-01-04
2023-01-14
2023-01-25
2023-02-04
2023-02-15
2023-02-25
2023-03-08
2023-03-18
2023-03-28

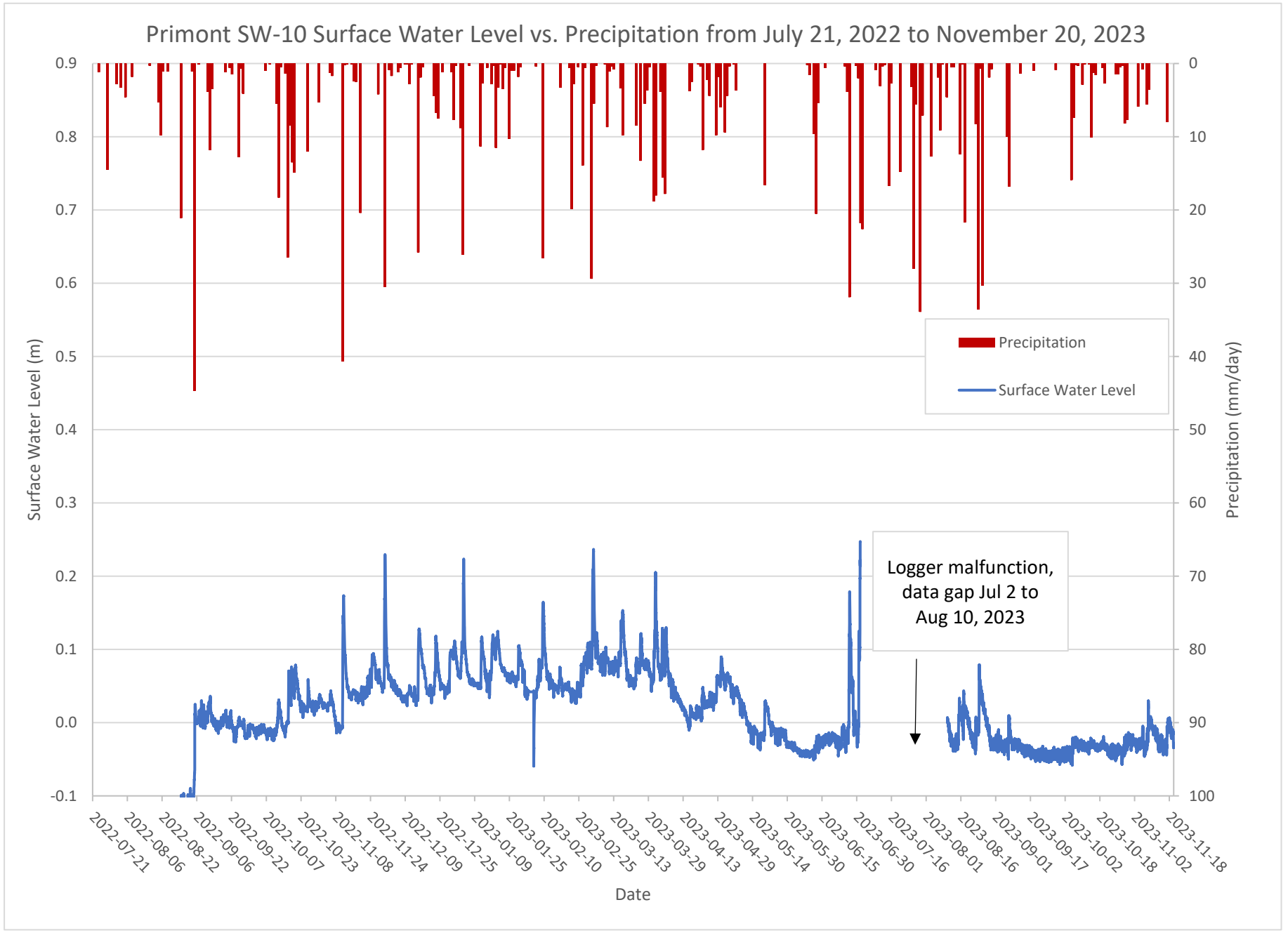

Primont SW-8 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

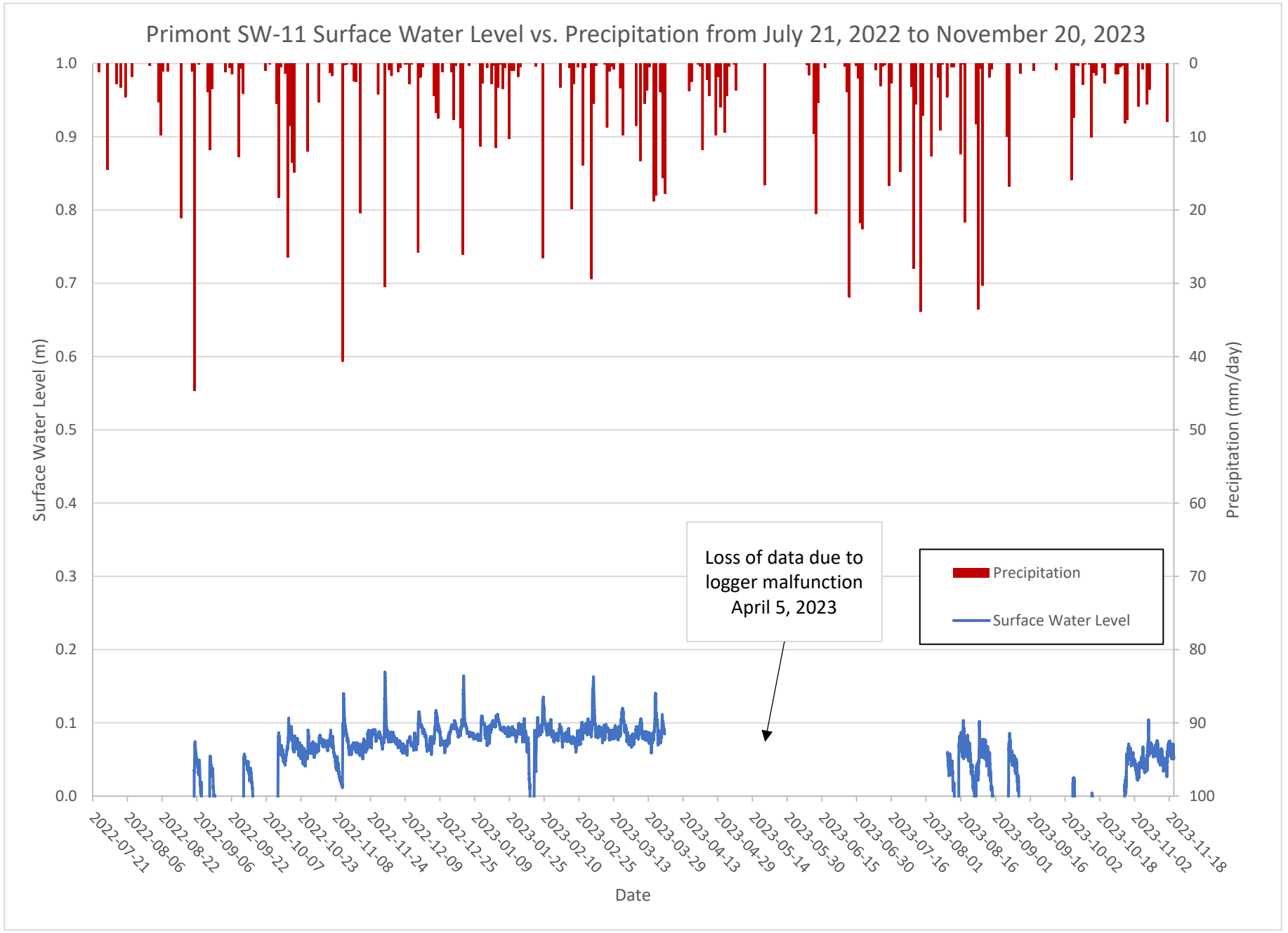

Primont SW-8 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

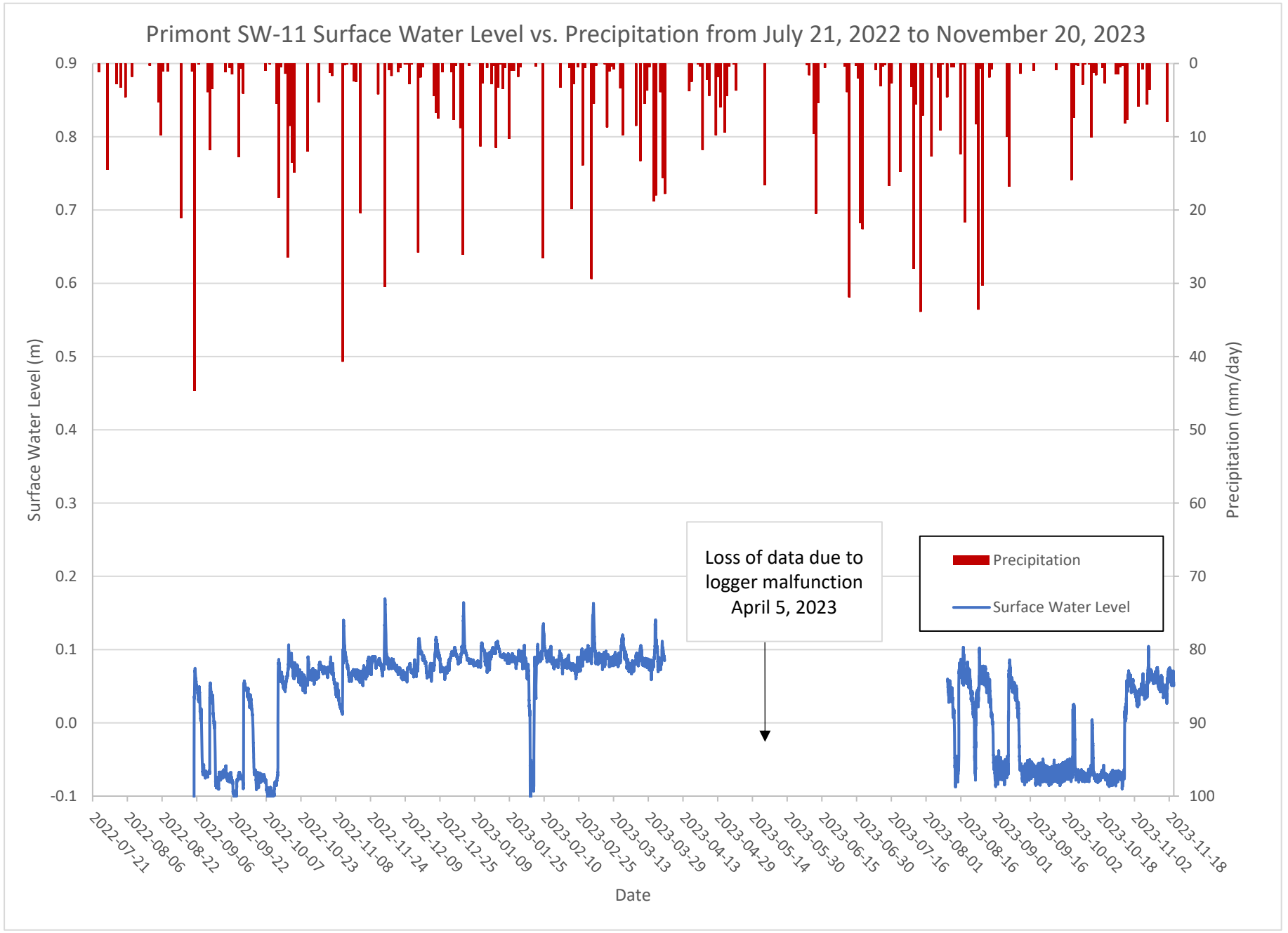

Primont SW-9 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger malfunction, data gap Jun 13 to Aug 3, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

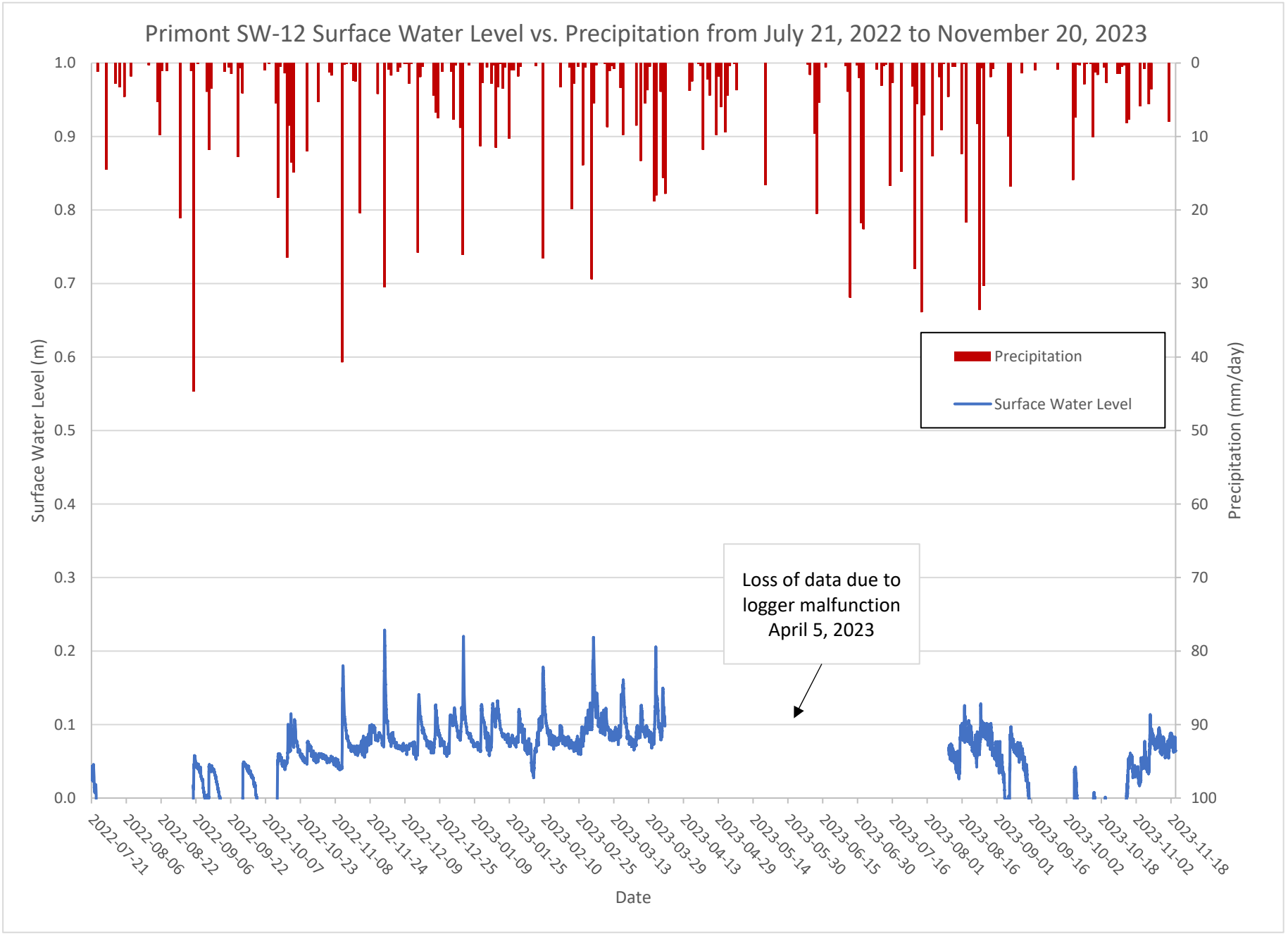

Primont SW-9 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger malfunction, data gap Jun 13 to Aug 3, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-14
2023-06-30
2023-07-16
2023-07-31
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-17
2023-11-02
2023-11-18

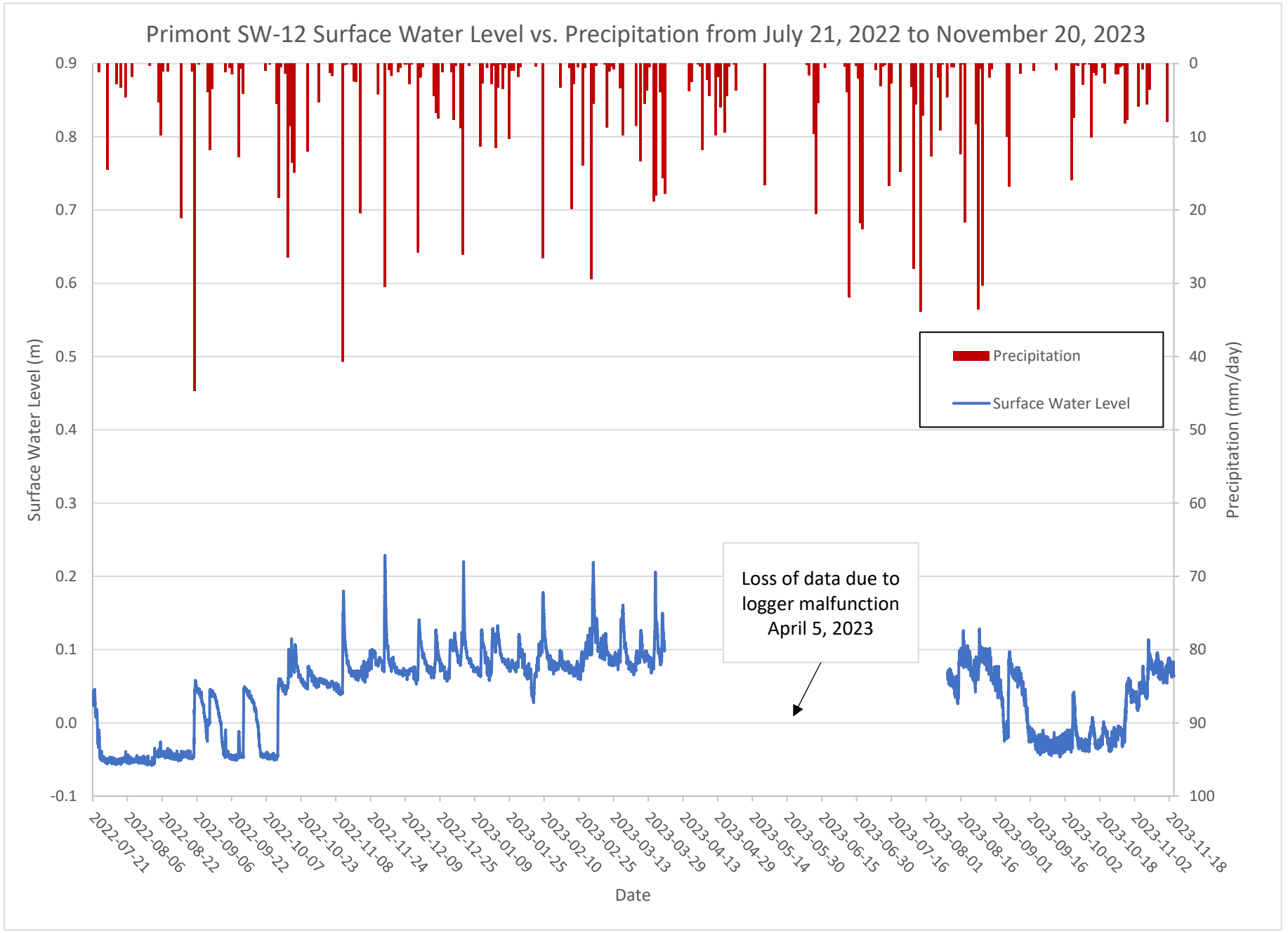

Primont SW-10 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Logger malfunction, data gap Jul 2 to Aug 10, 2023
Date
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-02
2023-11-18

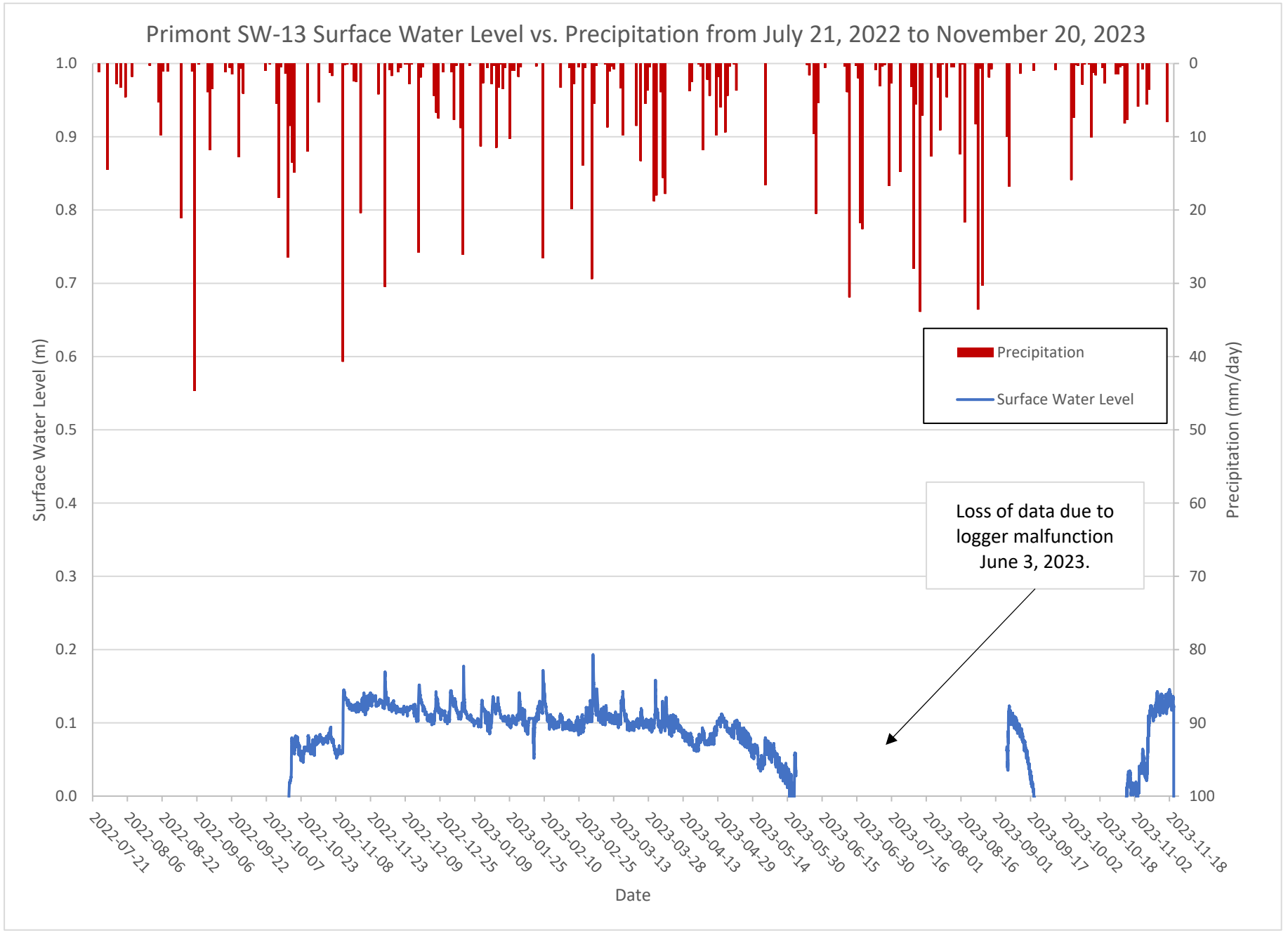

Primont SW-10 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Logger malfunction, data gap Jul 2 to Aug 10, 2023
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-02
2023-11-18

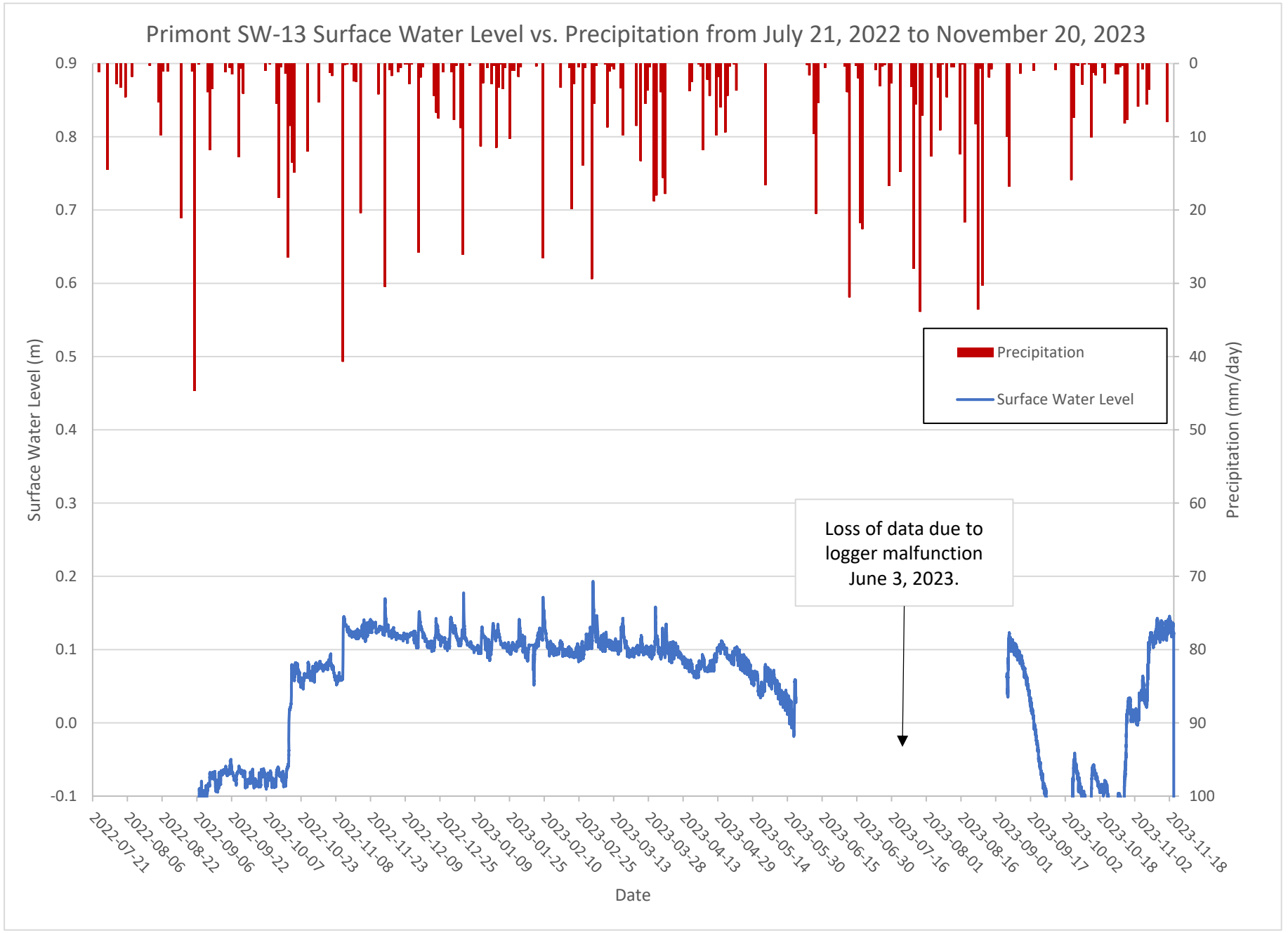

Primont SW-11 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Loss of data due to logger malfunction April 5, 2023
Precipitation
Surface Water Level
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-18
2023-11-02
2023-11-18

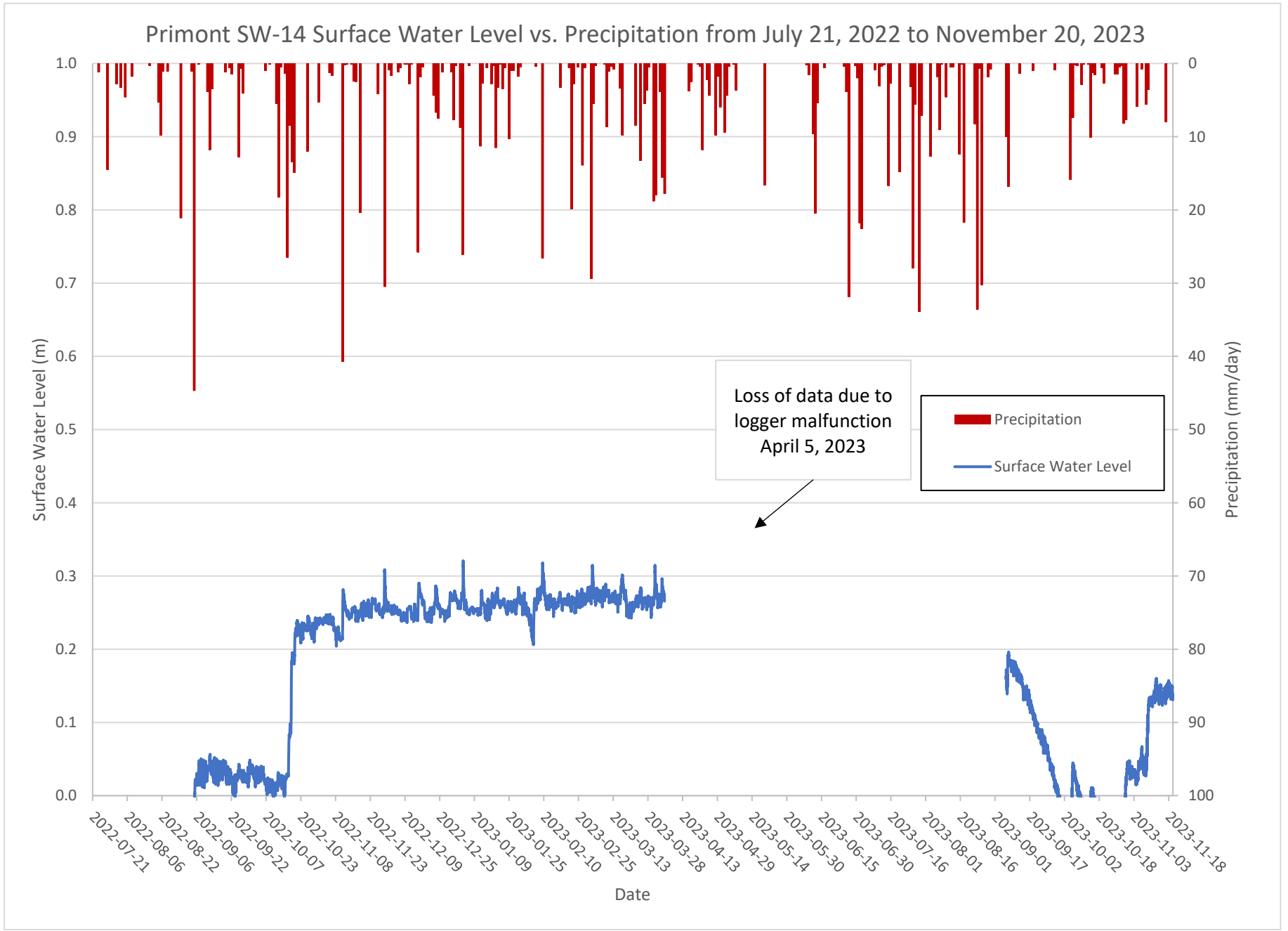

Primont SW-11 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Loss of data due to logger malfunction April 5, 2023
Precipitation
Surface Water Level
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-18
2023-11-02
2023-11-18

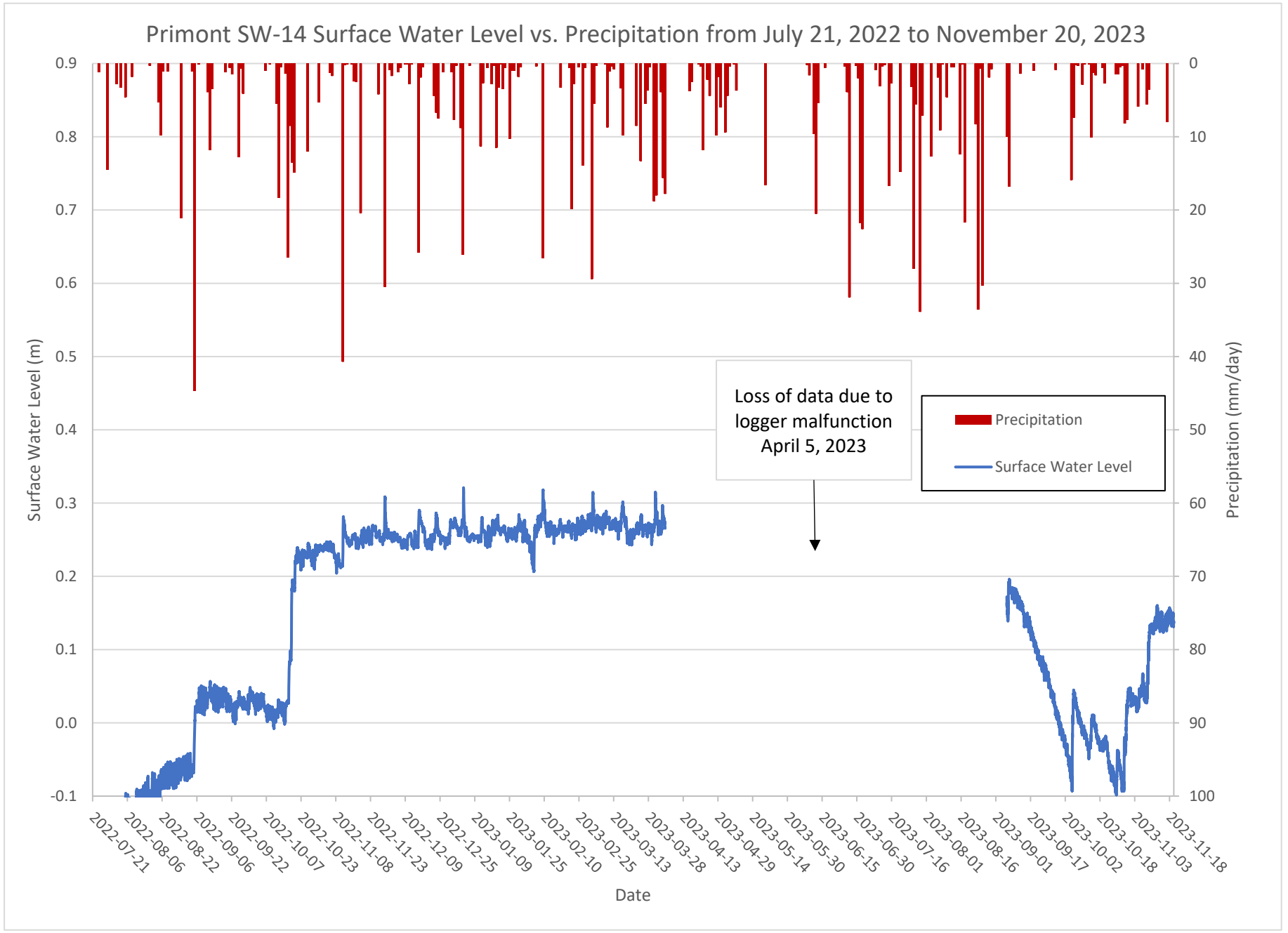

Primont SW-12 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
Date
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-18
2023-11-02
2023-11-18

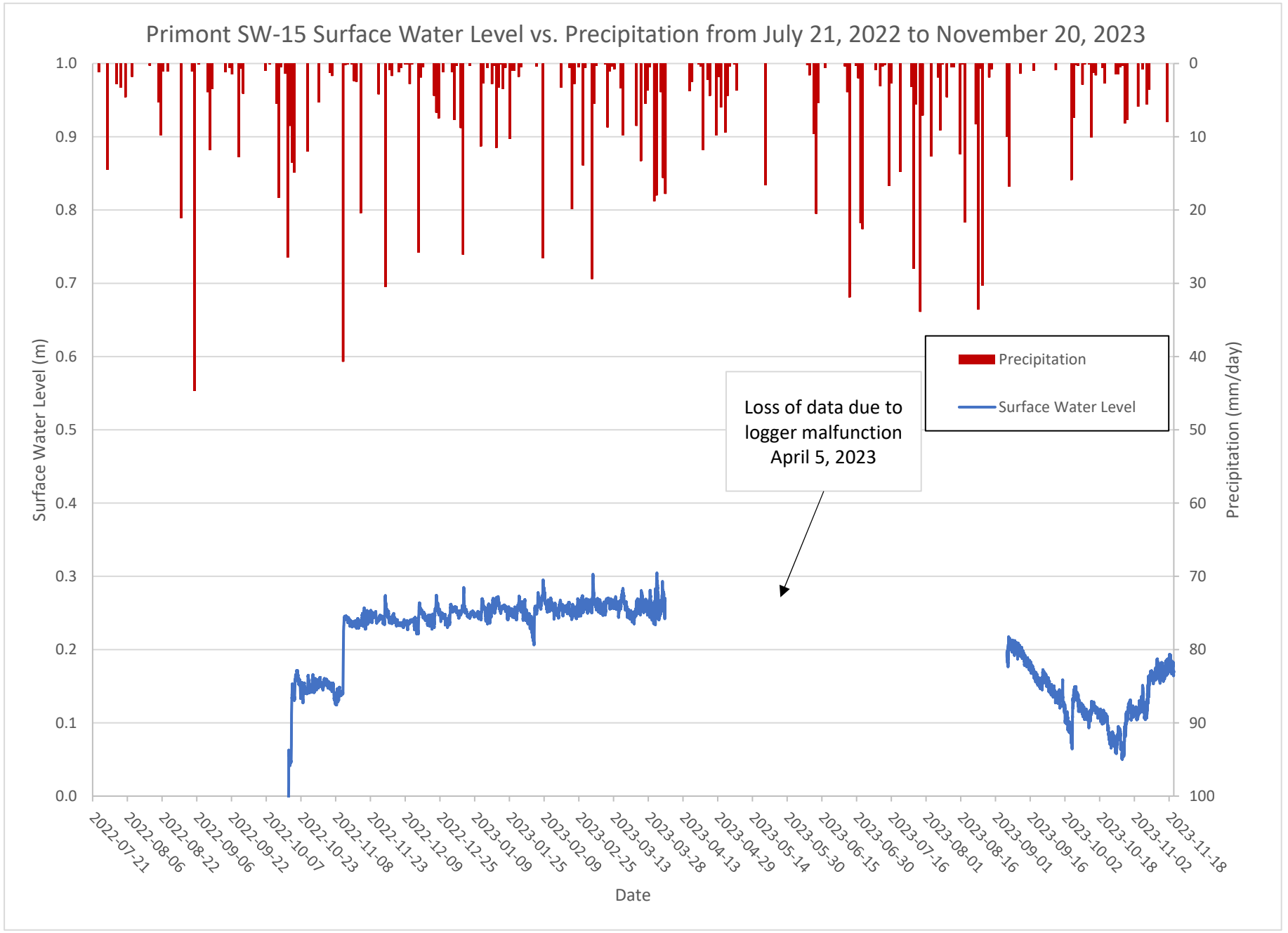

Primont SW-12 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-18
2023-11-02
2023-11-18

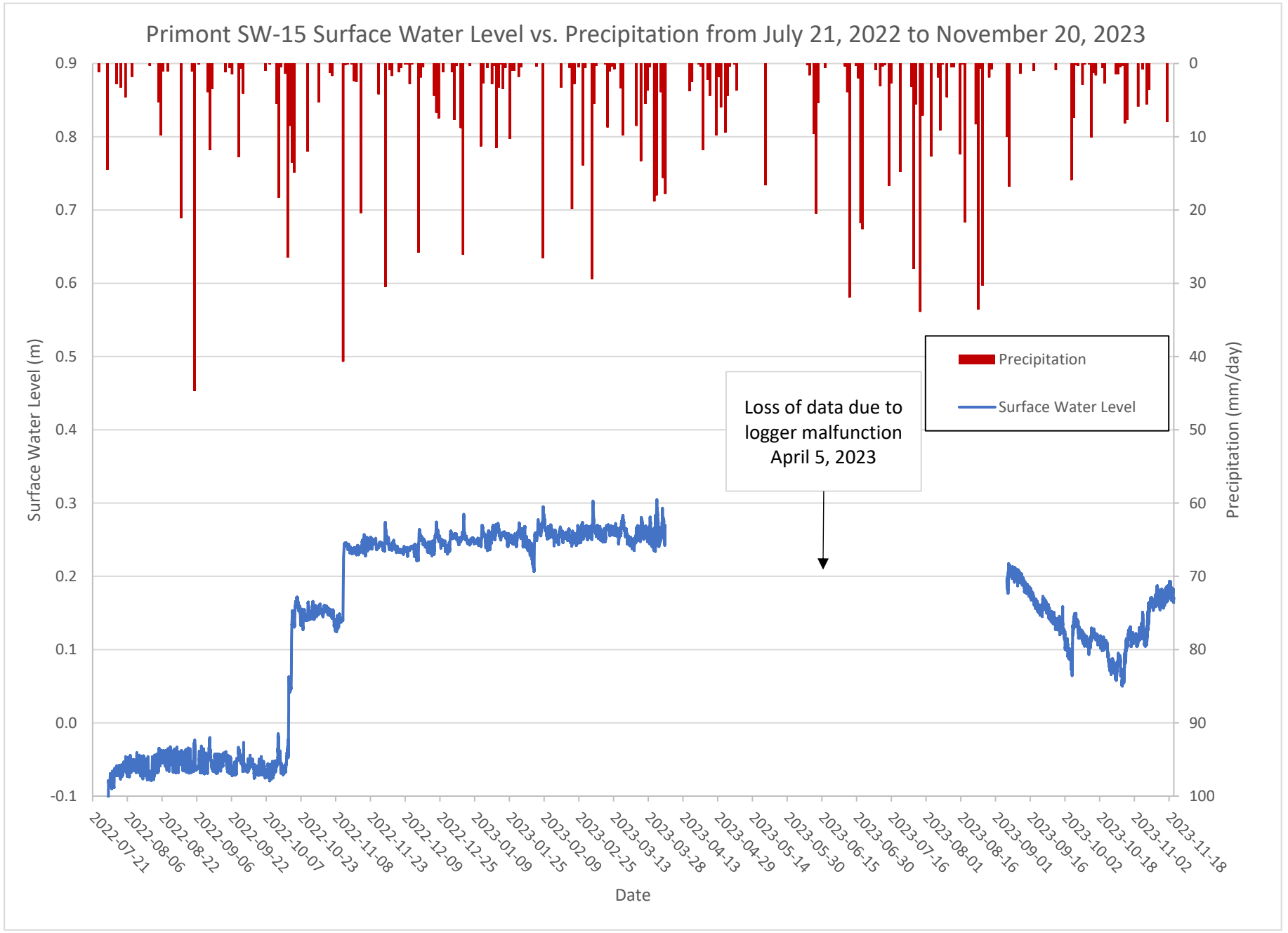

Primont SW-13 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Loss of data due to logger malfunction June 3, 2023.
Date
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-02
2023-11-18

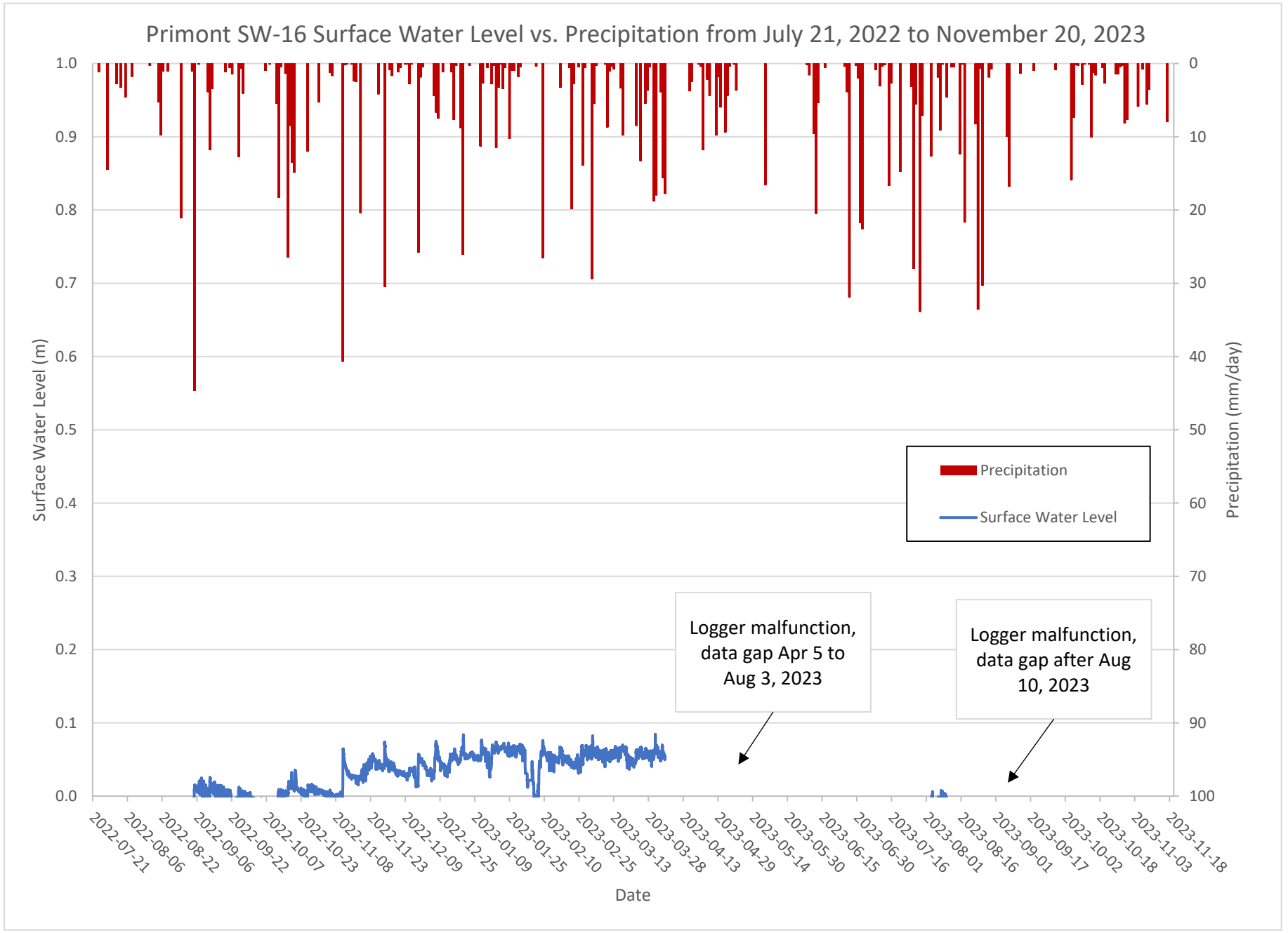

Primont SW-13 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Precipitation
Surface Water Level
Loss of data due to logger malfunction June 3, 2023.
Date
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-02
2023-11-18

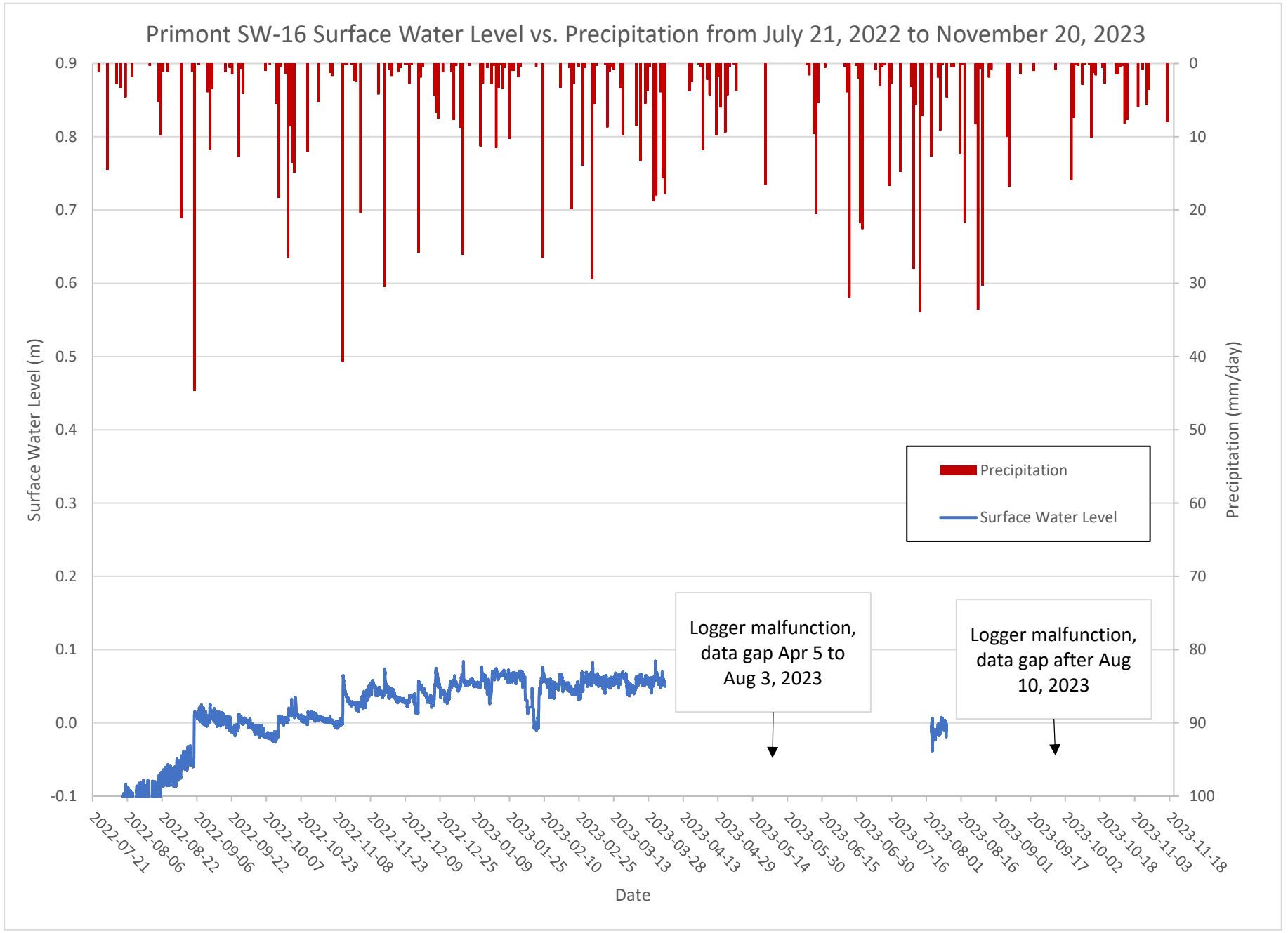

Primont SW-14 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Loss of data due to logger malfunction April 5, 2023
Precipitation
Surface Water Level
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18

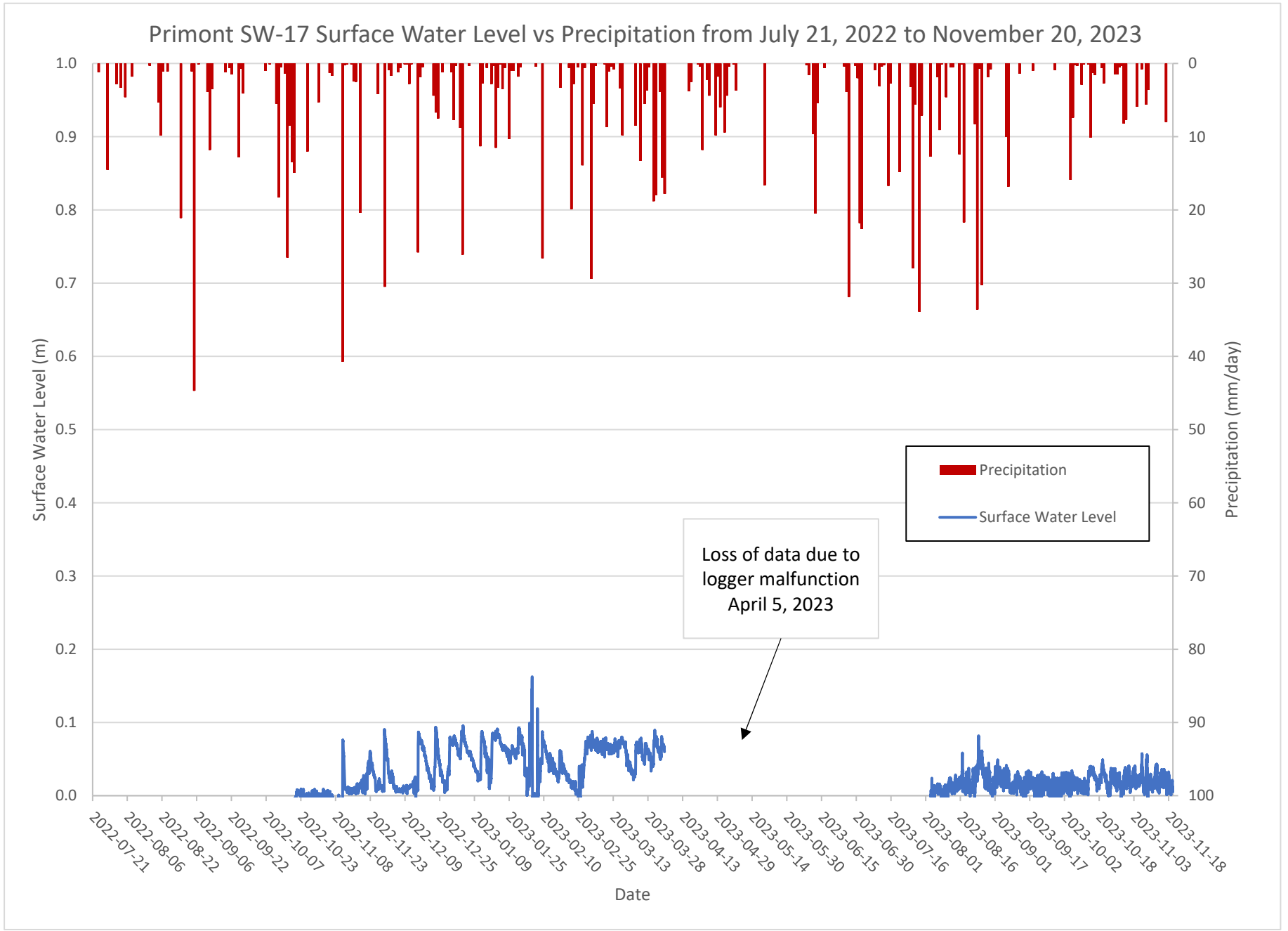

Primont SW-14 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Loss of data due to logger malfunction April 5, 2023
Precipitation
Surface Water Level
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18

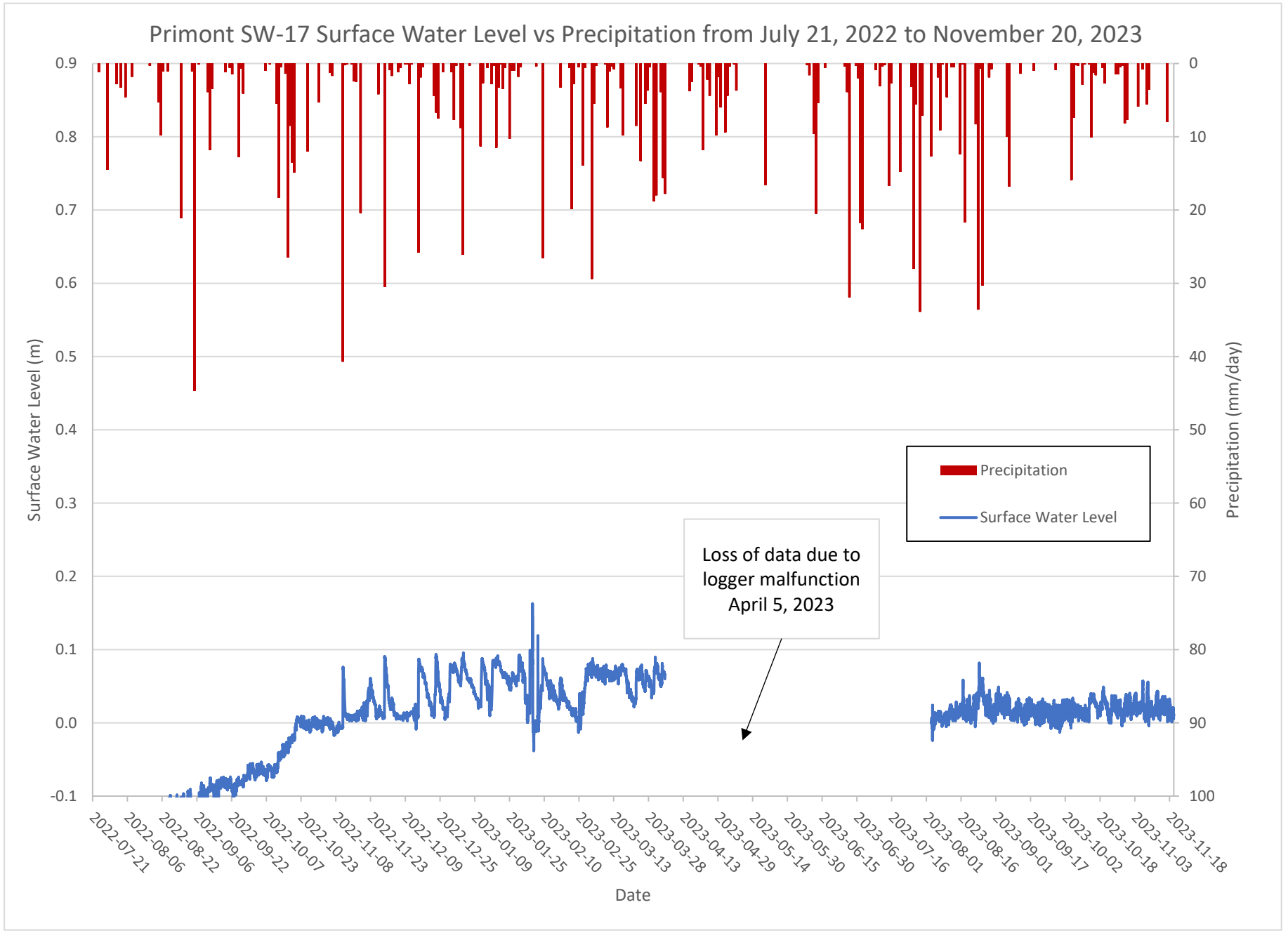

Primont SW-15 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-18
2023-11-02
2023-11-18

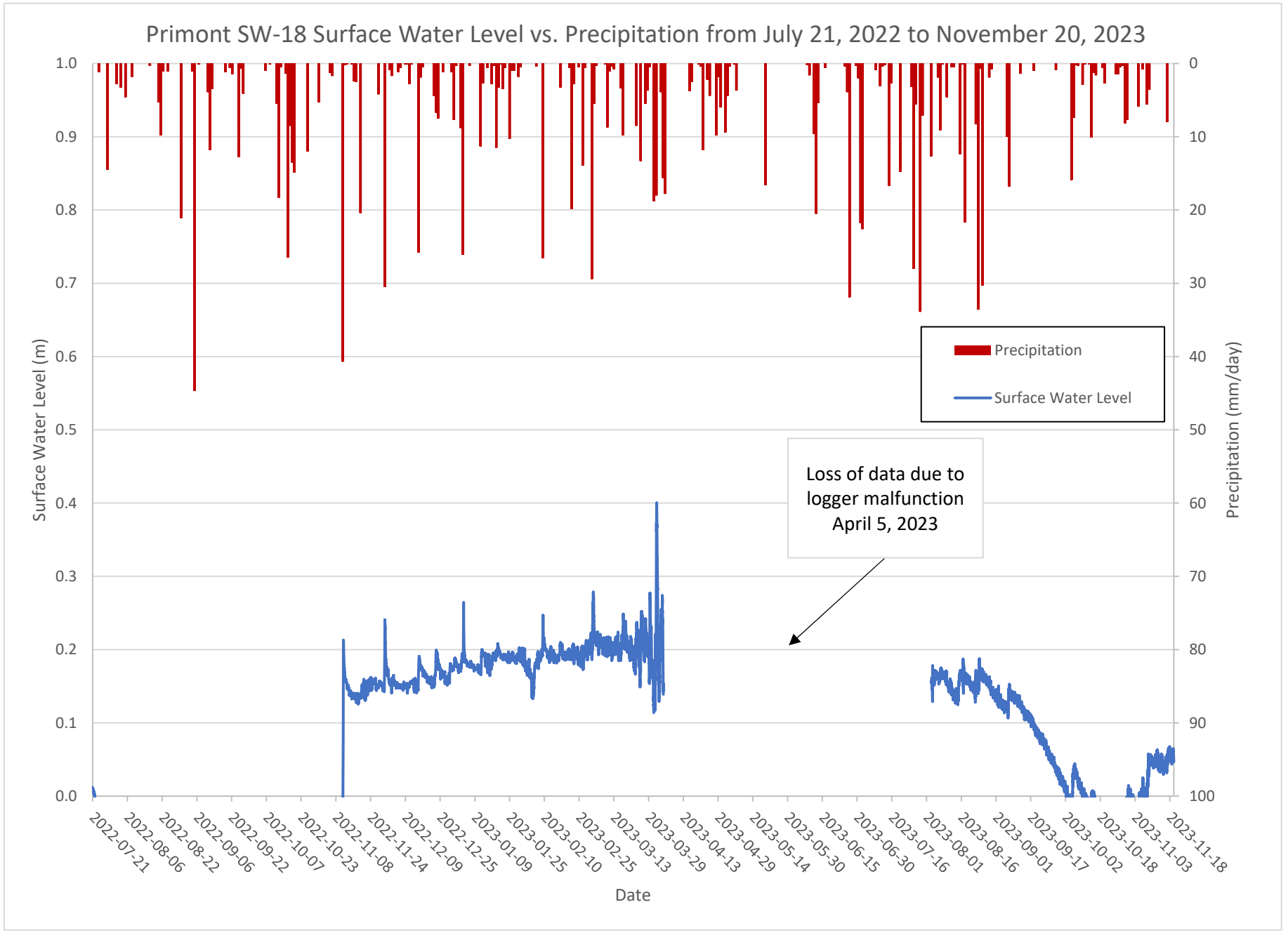

Primont SW-15 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-09
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-16
2023-10-02
2023-10-18
2023-11-02
2023-11-18

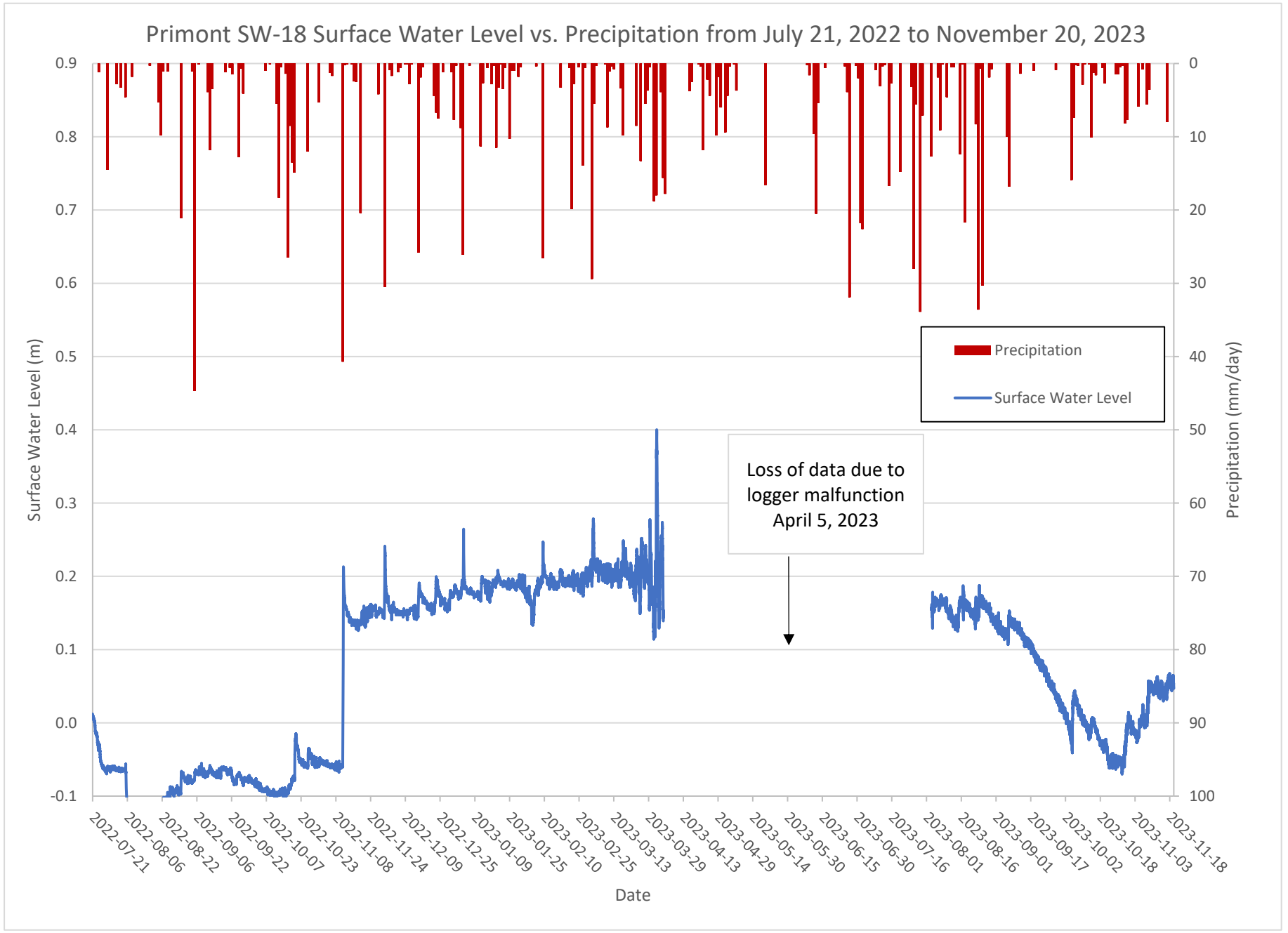

Primont SW-16 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger malfunction, data gap Apr 5 to Aug 3, 2023
Logger malfunction, data gap after Aug 10, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18


Primont SW-16 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Logger malfunction, data gap Apr 5 to Aug 3, 2023
Logger malfunction, data gap after Aug 10, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18


Primont SW-17 Surface Water Level vs Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18


Primont SW-17 Surface Water Level vs Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-23
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-28
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18


Primont SW-18 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18


Primont SW-18 Surface Water Level vs. Precipitation from July 21, 2022 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/day)
Date
Precipitation
Surface Water Level
Loss of data due to logger malfunction April 5, 2023
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
10
20
30
40
50
60
70
80
90
100
2022-07-21
2022-08-06
2022-08-22
2022-09-06
2022-09-22
2022-10-07
2022-10-23
2022-11-08
2022-11-24
2022-12-09
2022-12-25
2023-01-09
2023-01-25
2023-02-10
2023-02-25
2023-03-13
2023-03-29
2023-04-13
2023-04-29
2023-05-14
2023-05-30
2023-06-15
2023-06-30
2023-07-16
2023-08-01
2023-08-16
2023-09-01
2023-09-17
2023-10-02
2023-10-18
2023-11-03
2023-11-18

Appendix F

Tow Path Drain Surface Water Monitoring

Tow Path Drain Staff Gauges, Welland, Ontario

SG-101 (October 23, 2023)

Photo taken at 12:00 facing to the North.

SG-102 (October 23, 2023)

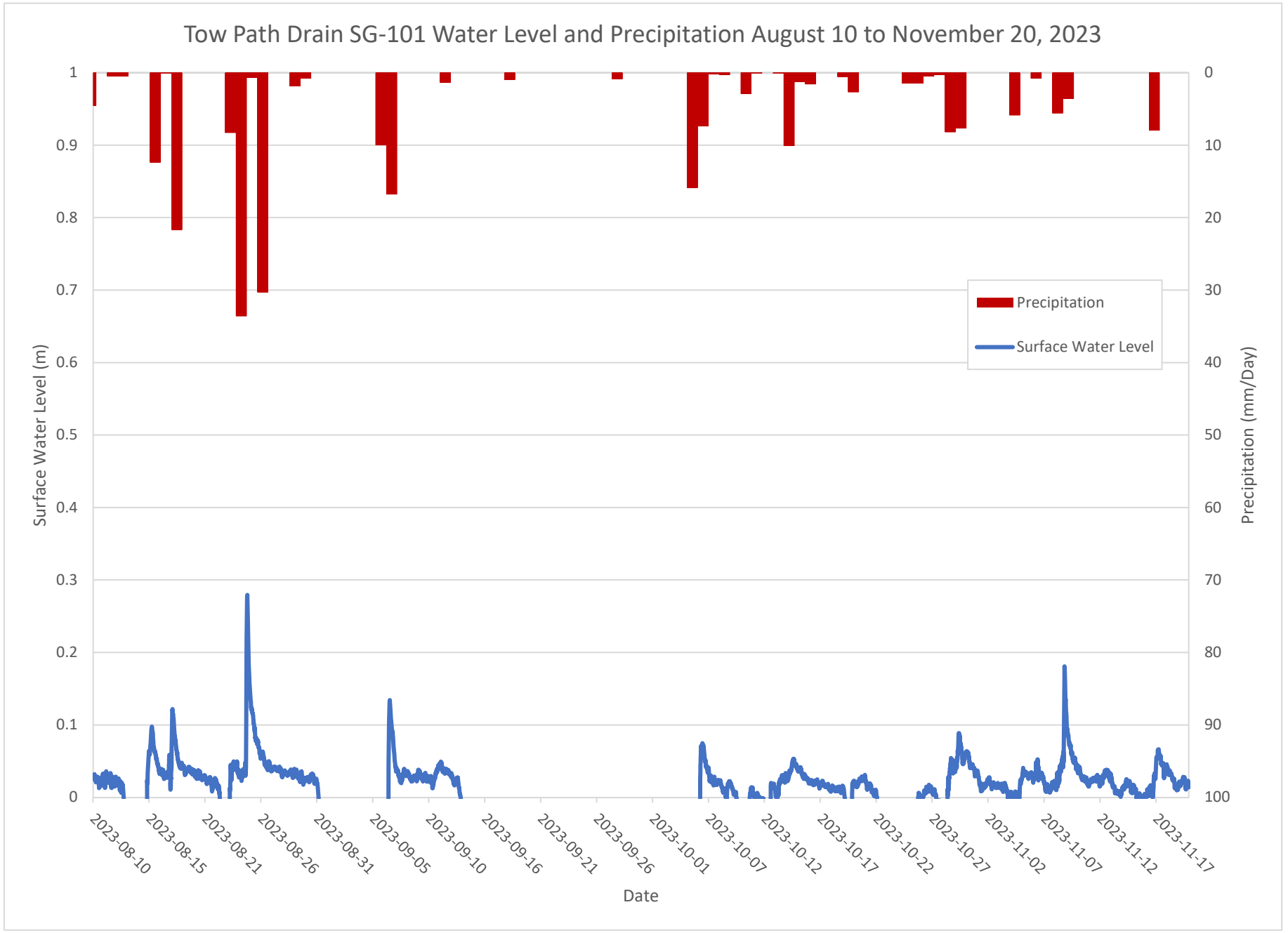
Photo taken at 10:20 facing the West.

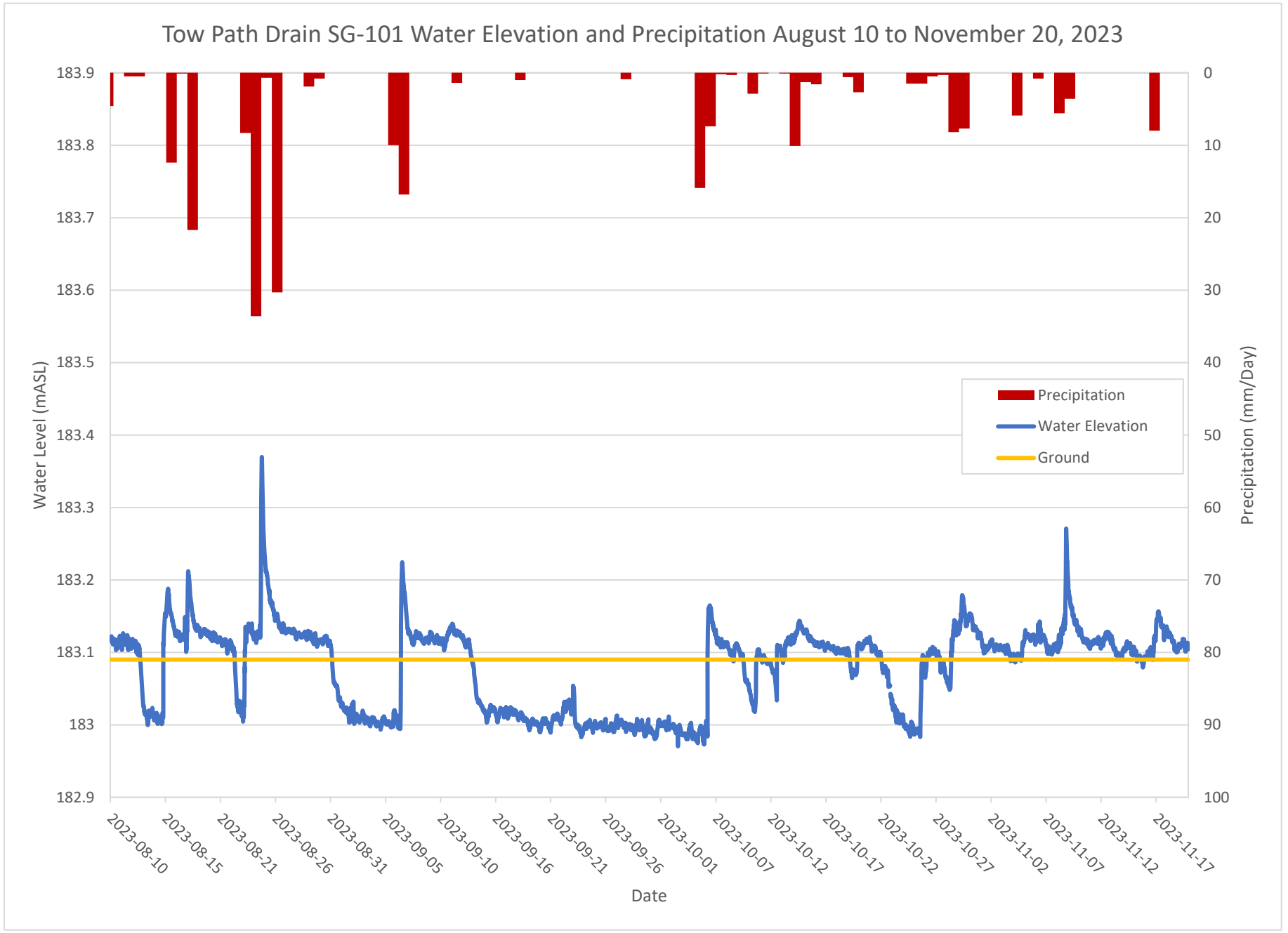
SG-103 (October 23, 2023)

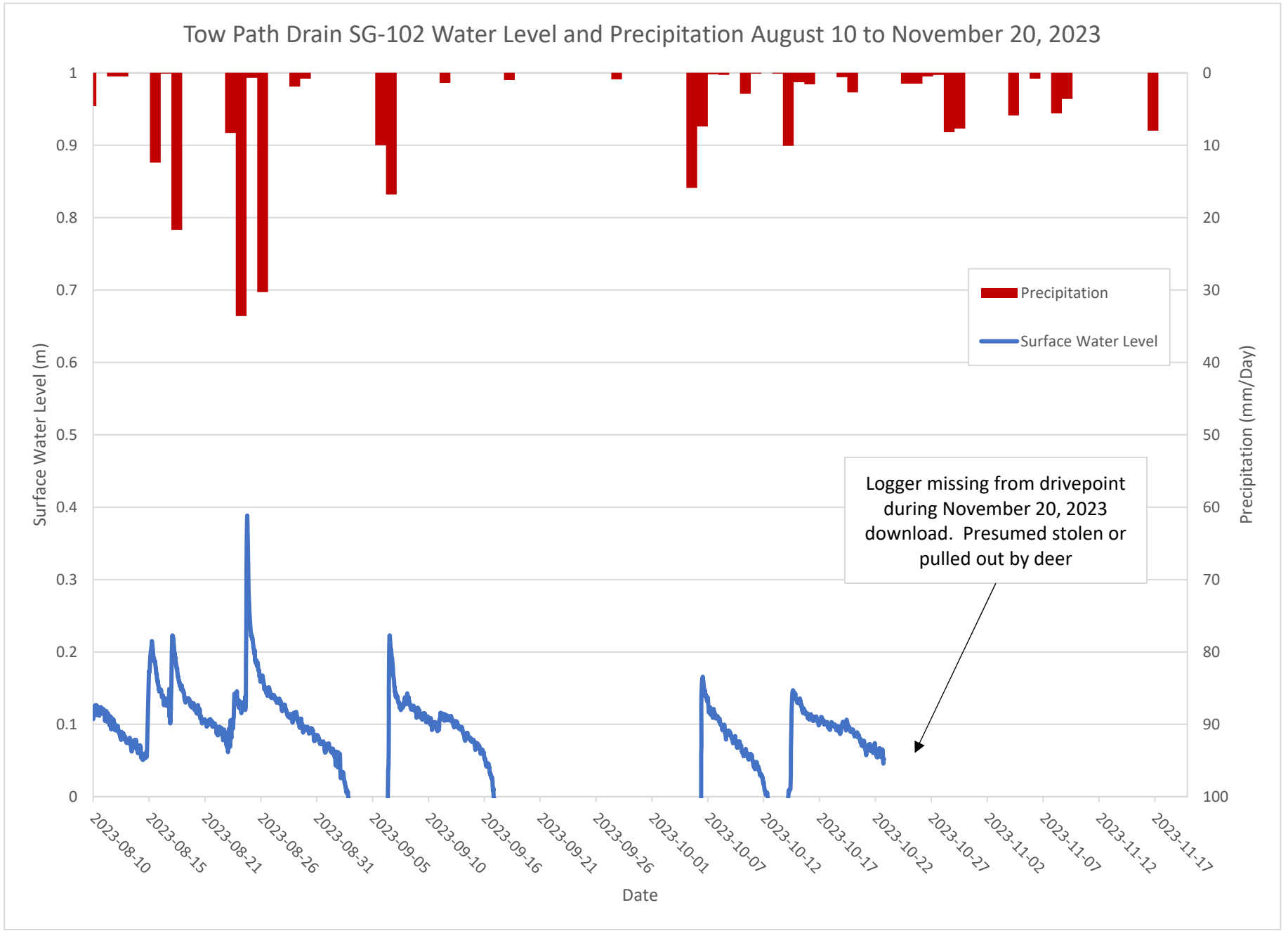
Photo taken at 10:50 facing the West.

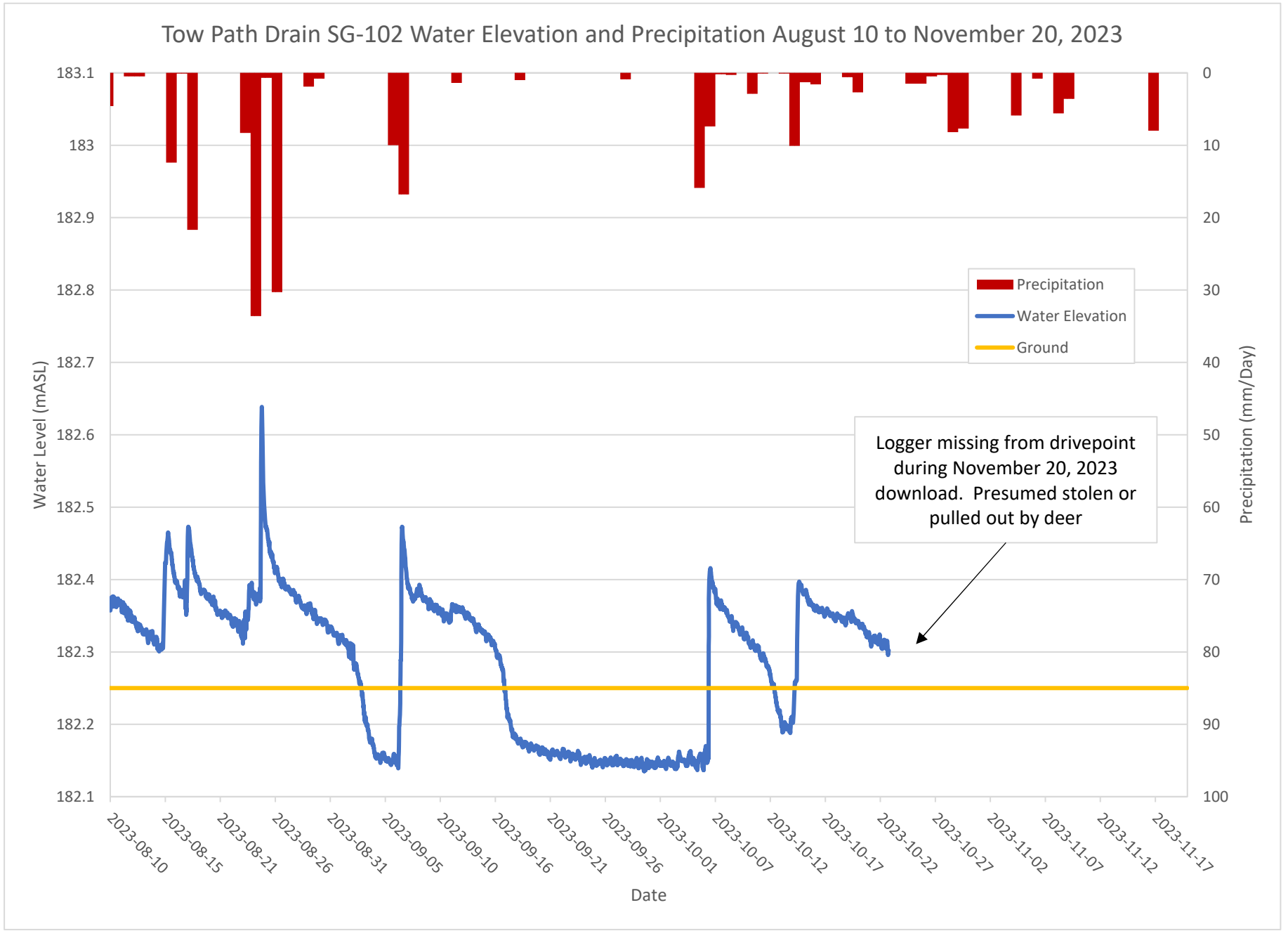
SG-104 (October 23, 2023)

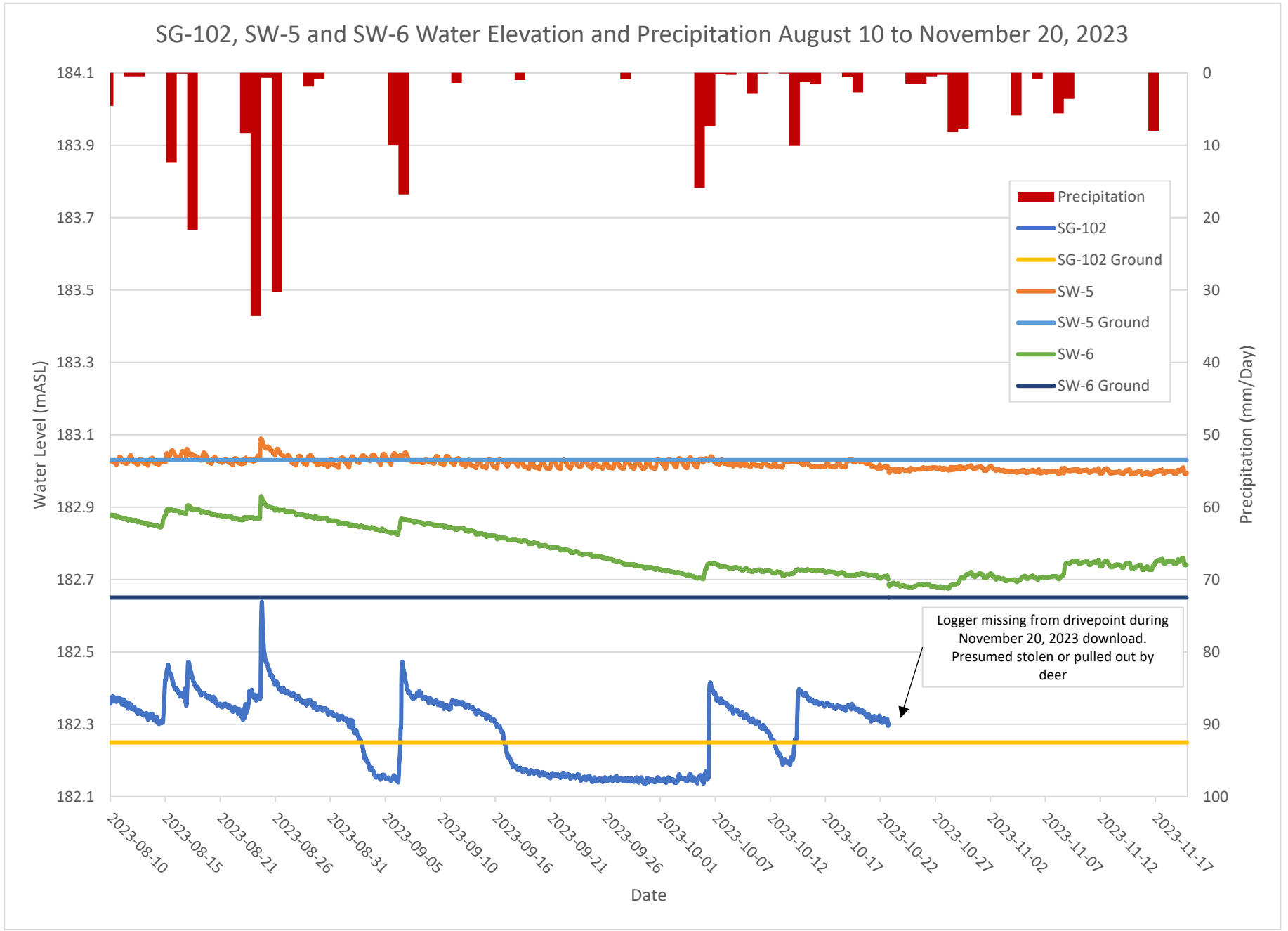
Photo taken at 11:40 facing the South.

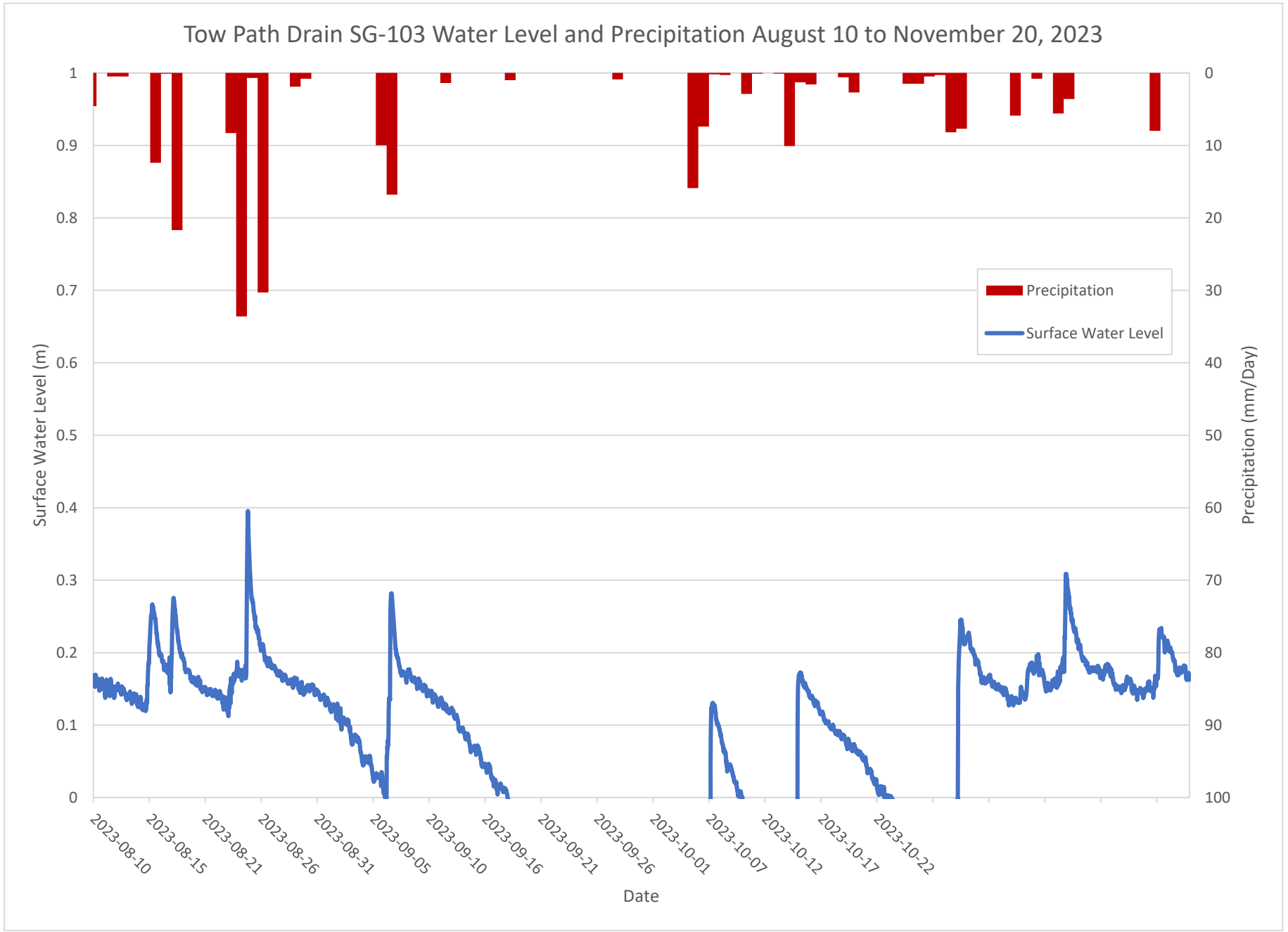

Tow Path Drain SG-101 Water Level and Precipitation August 10 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/Day)
Precipitation
Surface Water Level
Date
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17

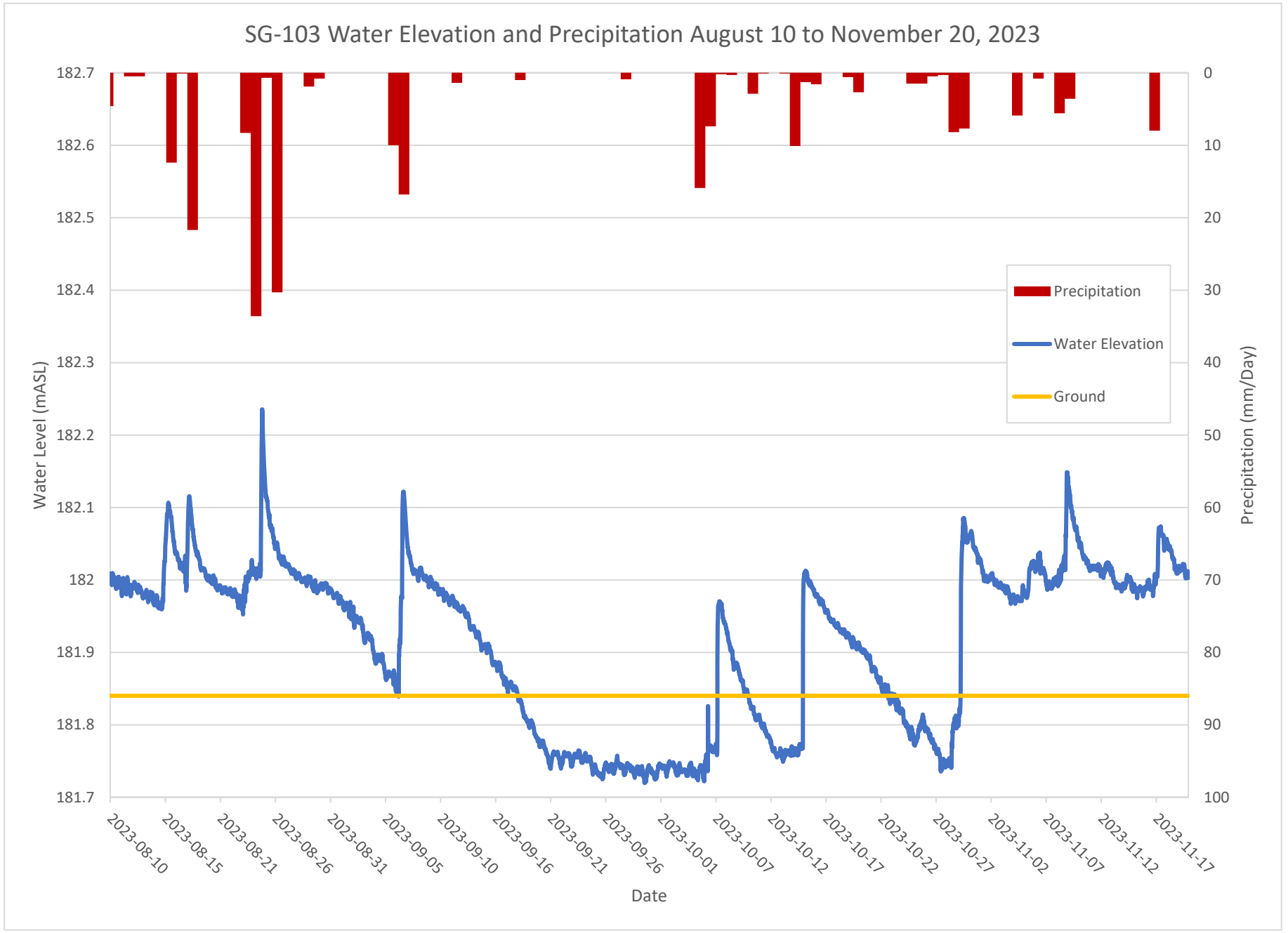

Tow Path Drain SG-101 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
Water Elevation
Ground
183.9
183.8
183.7
183.6
183.5
183.4
183.3
183.2
183.1
183
182.9
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17

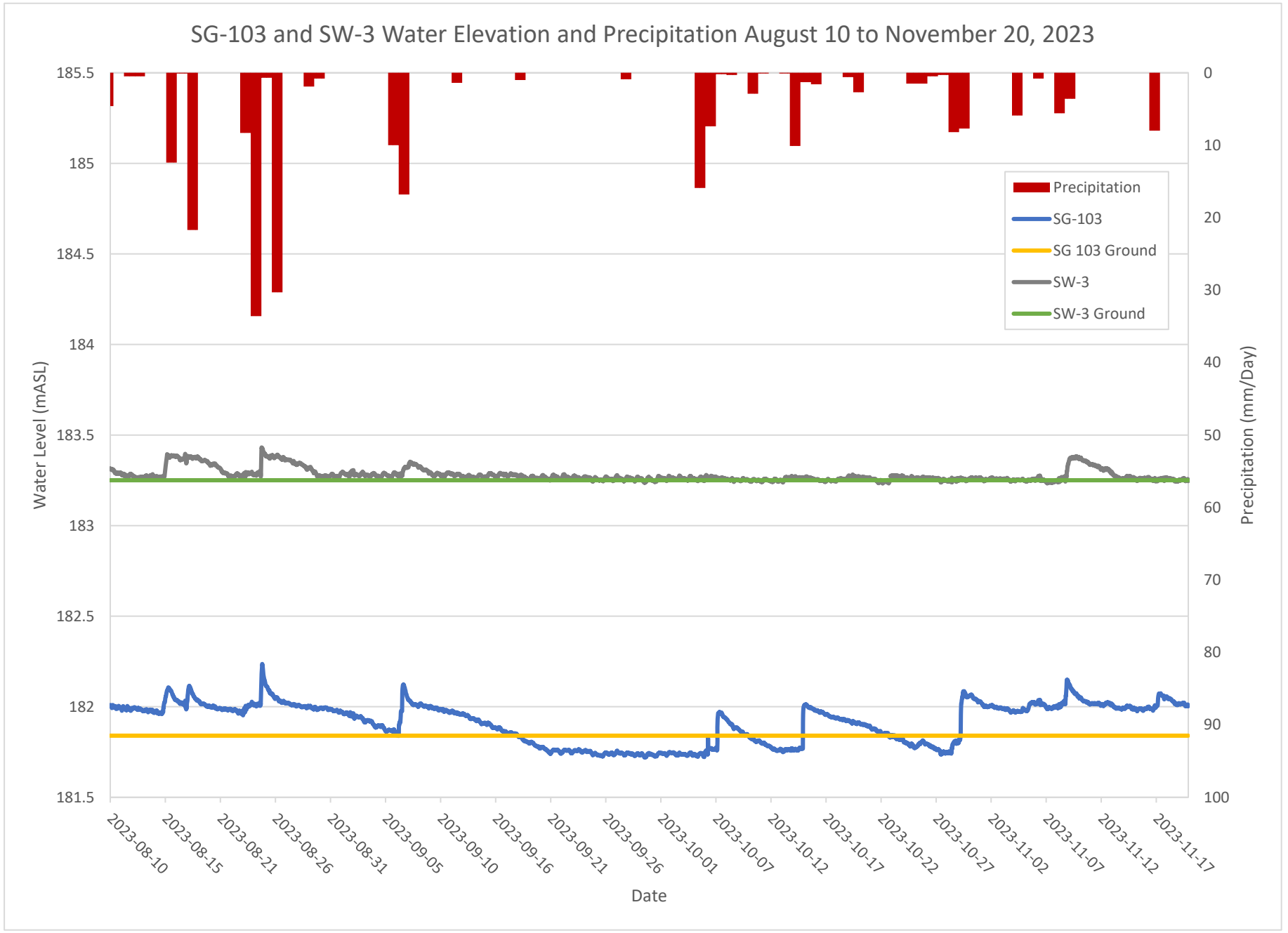

Tow Path Drain SG-102 Water Level and Precipitation August 10 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/Day)
Date
Precipitation
Surface Water Level
Logger missing from drivepoint during November 20, 2023 download. Presumed stolen or pulled out by deer
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17

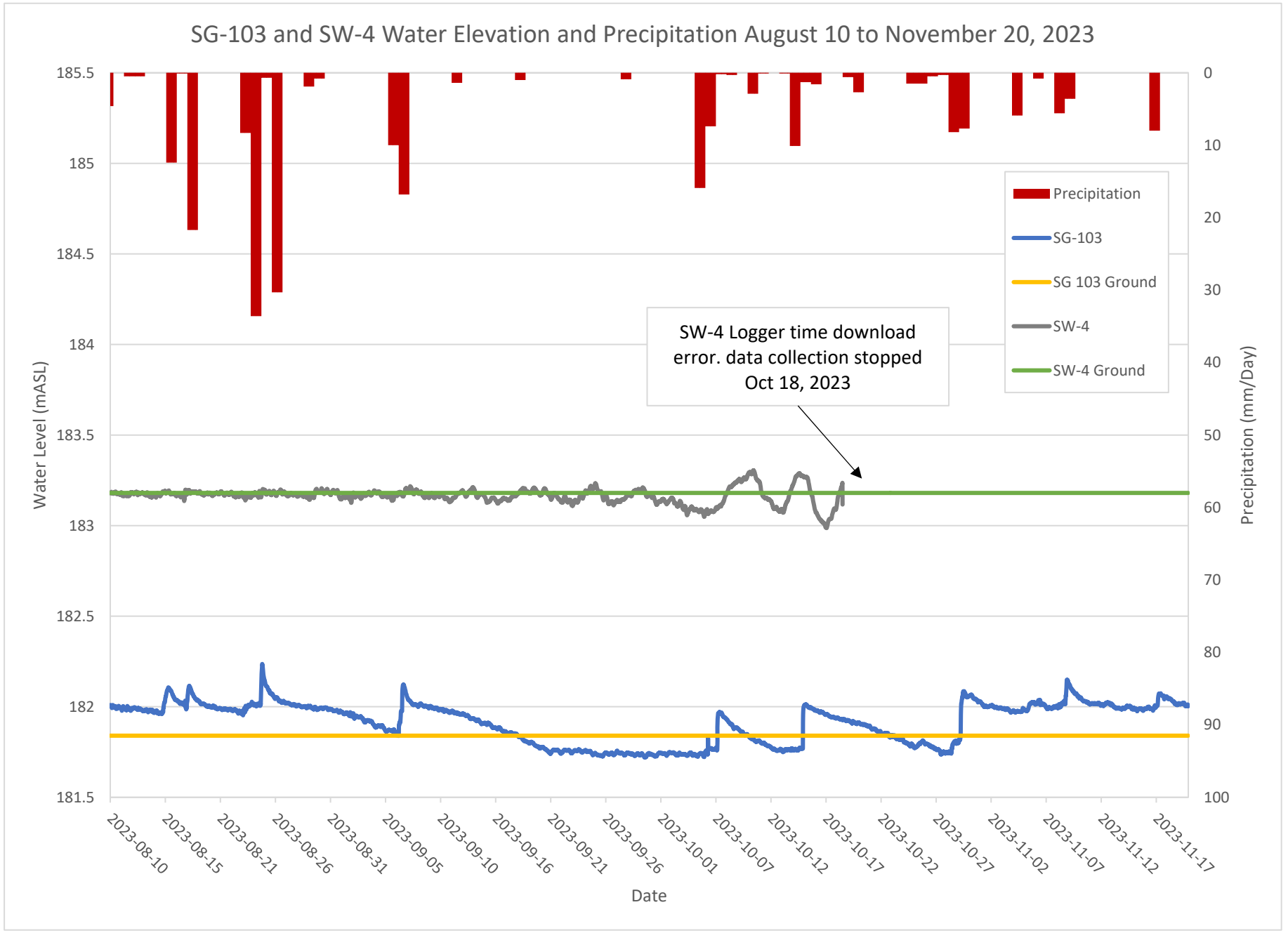

Tow Path Drain SG-102 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
Water Elevation
Ground
Logger missing from drivepoint during November 20, 2023 download. Presumed stolen or pulled out by deer
183.1
183
182.9
182.8
182.7
182.6
182.5
182.4
182.3
182.2
182.1
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17

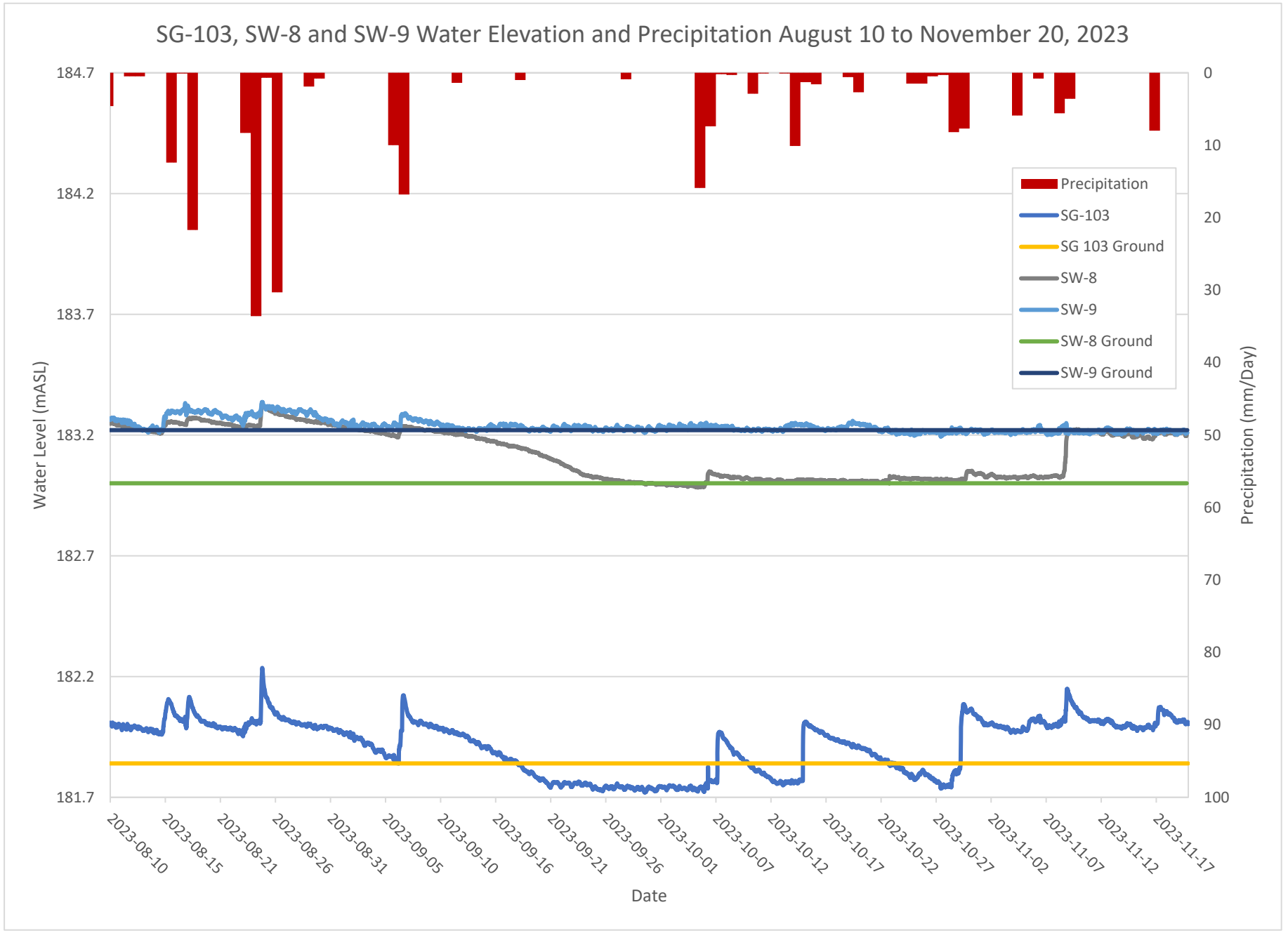

SG-102, SW-5 and SW-6 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
SG-102
SG-102 Ground
SW-5
SW-5 Ground
SW-6
SW-6 Ground
Logger missing from drivepoint during November 20, 2023 download. Presumed stolen or pulled out by deer
184.1
183.9
183.7
183.5
183.3
183.1
182.9
182.7
182.5
182.3
182.1
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17

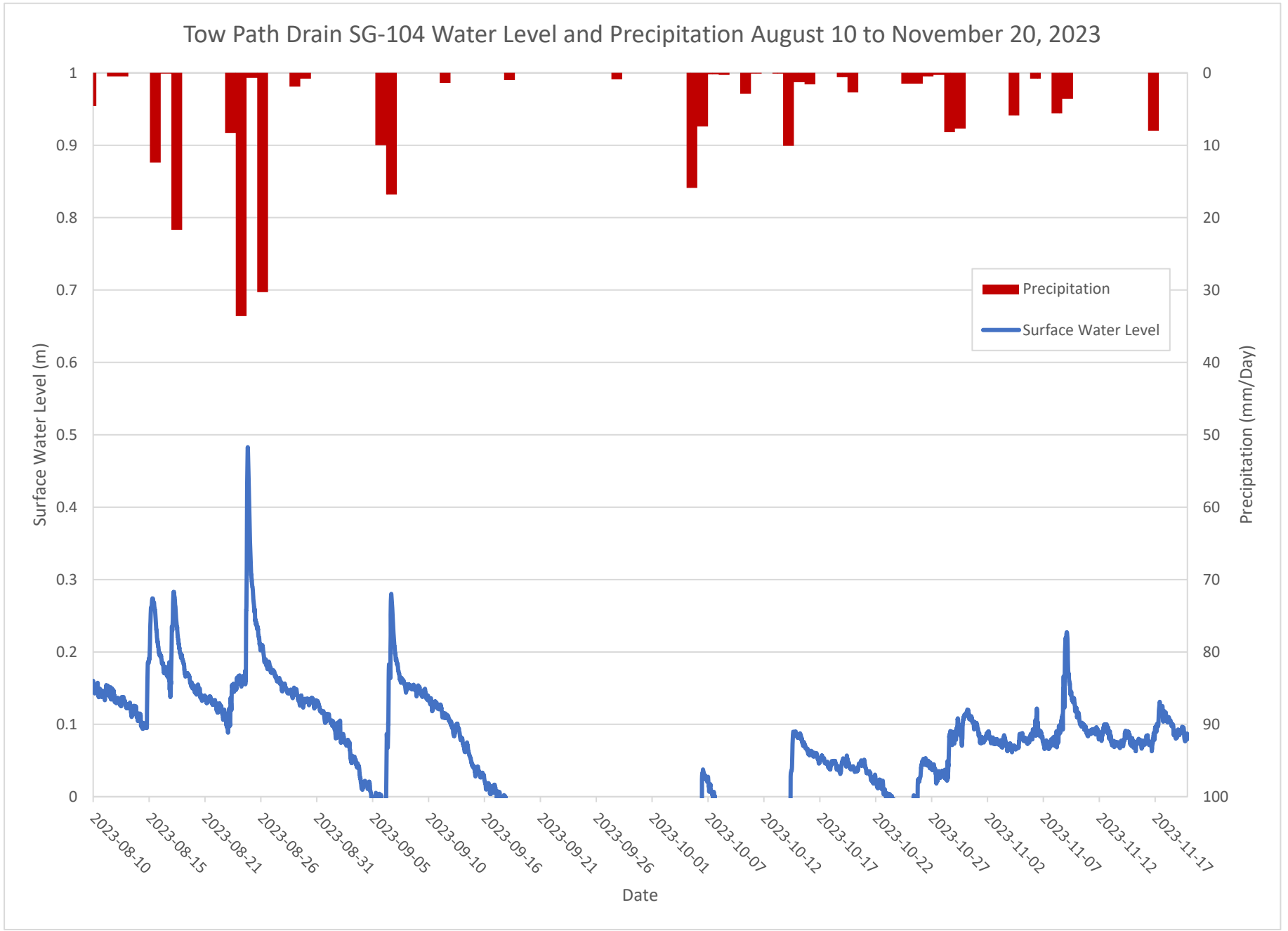

Tow Path Drain SG-103 Water Level and Precipitation August 10 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/Day)
Precipitation
Surface Water Level
Date
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22

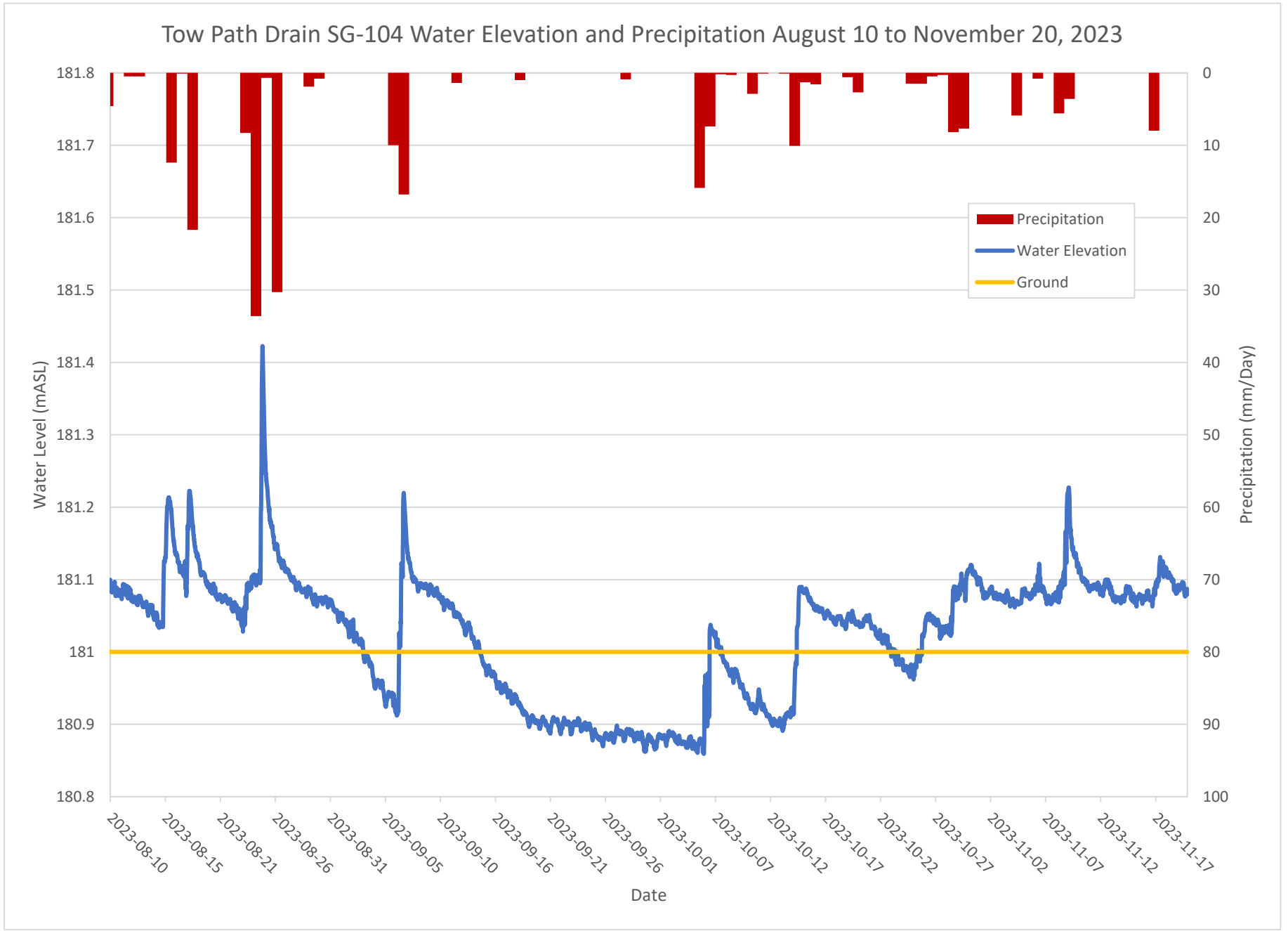

SG-103 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
182.7
182.6
182.5
182.4
182.3
182.2
182.1
182
181.9
181.8
181.7
Precipitation (mm/Day)
0
10
20
30
40
50
60
70
80
90
100
Precipitation
Water Elevation
Ground
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17
Date

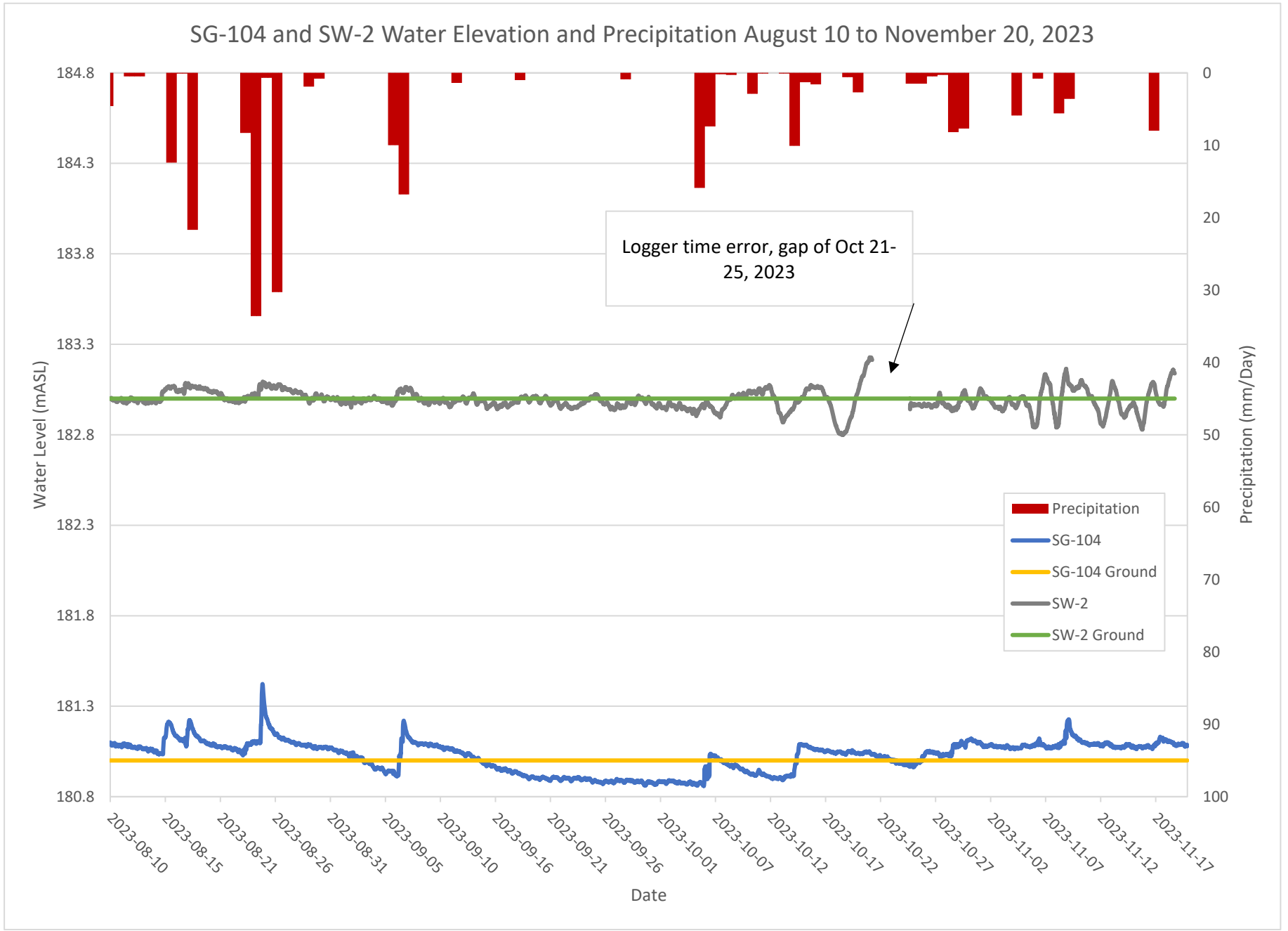

SG-103 and SW-3 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
SG-103
SG 103 Ground
SW-3
SW-3 Ground
185.5
185
184.5
184
183.5
183
182.5
182
181.5
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17


SG-103 and SW-4 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
SG-103
SG 103 Ground
SW-4
SW-4 Ground
SW-4 Logger time download error. data collection stopped Oct 18, 2023
185.5
185
184.5
184
183.5
183
182.5
182
181.5
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17


SG-103, SW-8 and SW-9 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
SG-103
SG 103 Ground
SW-8
SW-9
SW-8 Ground
SW-9 Ground
184.7
184.2
183.7
183.2
182.7
182.2
181.7
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17


Tow Path Drain SG-104 Water Level and Precipitation August 10 to November 20, 2023
Surface Water Level (m)
Precipitation (mm/Day)
Precipitation
Surface Water Level
Date
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17


Tow Path Drain SG-104 Water Elevation and Precipitation August 10 to November 20, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
Water Elevation
Ground
181.8
181.7
181.6
181.5
181.4
181.3
181.2
181.1
181
180.9
180.8
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17


SG-104 and SW-2 Water Elevation and Precipitation August 10 to November 20, 2023
Logger time error, gap of Oct 21-25, 2023
Water Level (mASL)
Precipitation (mm/Day)
Date
Precipitation
SG-104
SG-104 Ground
SW-2
SW-2 Ground
184.8
184.3
183.8
183.3
182.8
182.3
181.8
181.3
180.8
0
10
20
30
40
50
60
70
80
90
100
2023-08-10
2023-08-15
2023-08-21
2023-08-26
2023-08-31
2023-09-05
2023-09-10
2023-09-16
2023-09-21
2023-09-26
2023-10-01
2023-10-07
2023-10-12
2023-10-17
2023-10-22
2023-10-27
2023-11-02
2023-11-07
2023-11-12
2023-11-17

Appendix G

Supporting Information

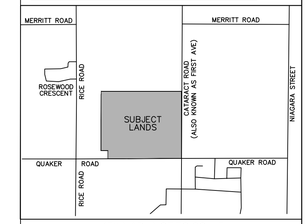
DRAFT PLAN OF SUBDIVISION

PRIMONT
(THOROLD / WELLAND) INC.

PART OF TOWNSHIP LOTS 174 AND 228,
GEOGRAPHIC TOWNSHIP OF THOROLD,
IN THE CITY OF WELLAND, REGIONAL
MUNICIPALITY OF NIAGARA

SCALE 1:1000 METRIC

20 10 0 20 40 60 metres



KEY MAP - NOT TO SCALE

INFORMATION REQUIRED

UNDER SECTION 51 (17) OF THE PLANNING ACT, R.S.O. 1990, c.P.13
AS AMENDED FEBRUARY 21, 2024

(a) - AS SHOWN
(b) - AS SHOWN
(c) - AS SHOWN
(d) - AS LISTED BELOW
(e) - AS SHOWN
(f) - AS SHOWN
(g) - AS SHOWN
(h) - MUNICIPAL WATER
(i) - CLAY LOAM
(j) - AS SHOWN
(k) - MUNICIPAL SANITARY AND STORM SEWERS
(l) - AS SHOWN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

SIGNED _____

ROB A. McLAREN, O.L.S
A.T.McLAREN LIMITED

DATE _____

OWNER'S CERTIFICATE

I HEREBY CONSENT TO THE FILING OF THIS PLAN

SIGNED _____

DATE _____

LAND USE SCHEDULE

LAND USE	LOTS/BLOCKS	UNITS	AREA
LOW DENSITY RESIDENTIAL (FREEHOLD)	BLOCKS 2-5, 10-14, 16, 19, 20-24, 26, 29, & 33	245-275±	6.127± Ha.
LOW DENSITY RESIDENTIAL (CONDOMINIUM)	BLOCK 1	44±	1.167± Ha.
MEDIUM DENSITY RESIDENTIAL	BLOCK 30	422±	1.109± Ha.
PARK LAND	BLOCK 17		0.749± Ha.
OPEN SPACE	BLOCKS 6, 15, 25		0.101± Ha.
STORM WATER MANAGEMENT	BLOCKS 7, 18, & 31		1.808± Ha.
ENVIRONMENTAL AREA	BLOCKS 27 & 28		14.547± Ha.
CHANNEL	BLOCKS 8 & 9		0.592± Ha.
ROADS, RESERVES & WIDENINGS	STREETS A, B, C, D, E, F, G, & H AND BLOCKS 32, 33, 34 & 35		3.937± Ha.
TOTAL		711-741±	30.118± Ha.

METRIC NOTE:

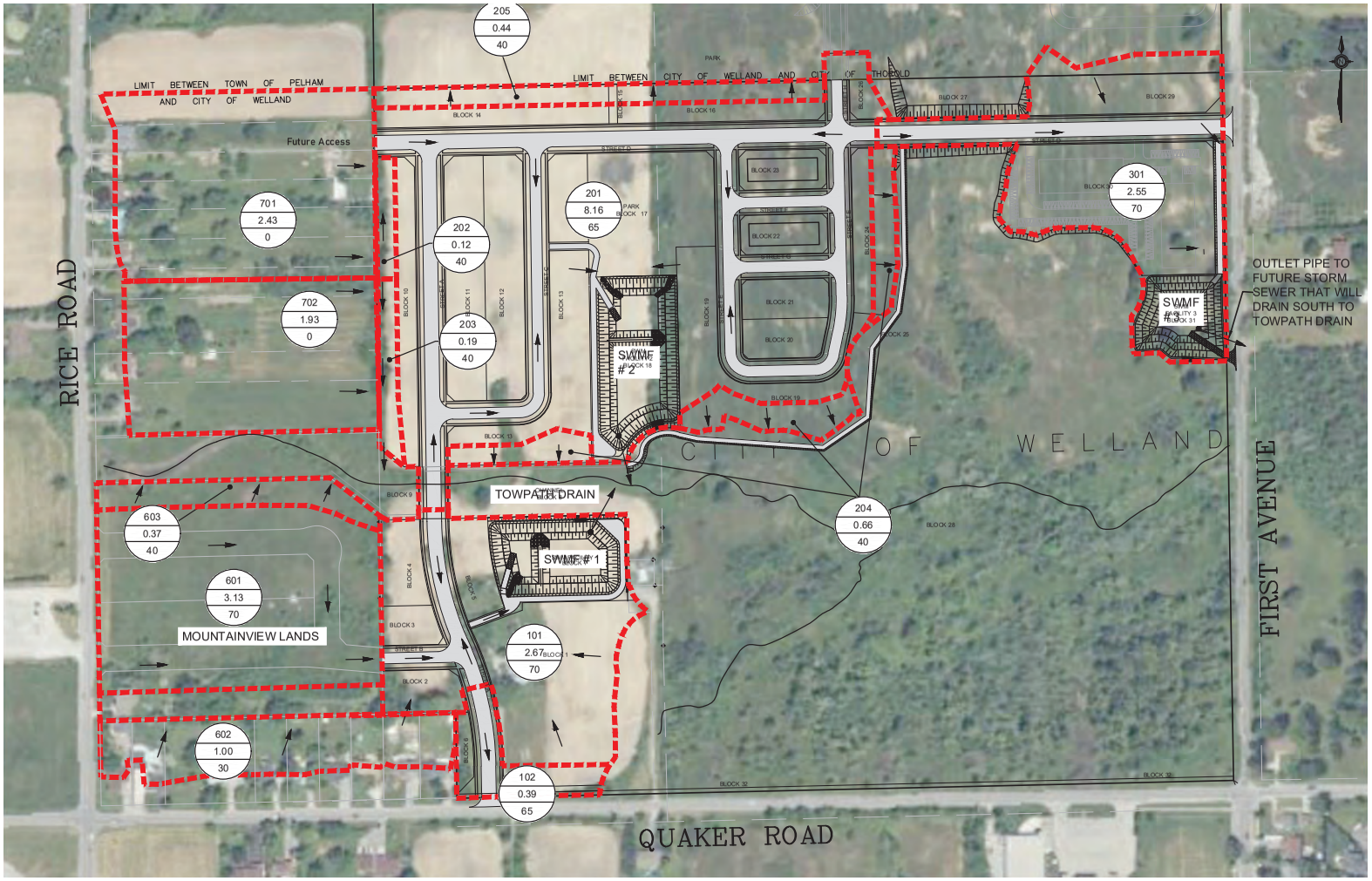
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

No.	DESCRIPTION	DATE	BY
2	UPDATED STORMWATER BLOCKS	JUNE 13, 2024	KM
1	ORIGINAL DRAWING	MARCH 15,2024	KM

REVISIONS

A.T. McLaren Limited
LEGAL AND ENGINEERING SURVEYS
69 JOHN STREET SOUTH, SUITE 230
HAMILTON, ONTARIO, L8N 2B9
PHONE (905) 527-8559 FAX (905) 527-0032

Drawn	Checked	Crew Chief	Scale	Dwg.No.
KM	RBM	SM	1:1000	36920-DP



P:\2022\0091\10\05-DSGN\CIVL\Storm\SDAP\2022-0091-10 SDAP; Layout1; None; Eric Solembier; 2024-04-05 12:01:02 PM

PROJECT:
436 QUAKER ROAD
WELLAND

TITLE:
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN
WELLAND

WALTERFEDY
HAMILTON OFFICE
20 Hughson Street South, Suite 1000, Hamilton, Ontario, L8N 2A1
T: 289.799.3547 Toll Free: 800.685.1378 walterfedy.com

SCALE:	N.T.S	DATE:	2024-04-05
DRAWN BY:	ES	PROJECT NO.:	2022-0091-10
CHECKED BY:	JO	FILE:	2022-0091-10 SDAP

SHEET NO.:

FIG 7.2