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Summary Report

To :	Nick Colucci, Director	Date :	June 1, 2020
	Town of Erin, Infrastructure Services	Re. :	Monthly Monitoring Report
From :	Andrew Pentney		Groundwater Monitoring Report
CC :	Triton Engineering	Project :	Station Street Dam Monitoring

The following is a summary report regarding the monitoring completed to date as part of the *Groundwater Monitoring and Mitigation Plan, Reconstruction of Station Street and Replacement of Station Street Bridge (Structure 2064) and Dam Control Structure, Hillsburgh* (May 23, 2019).

Monitoring Locations

As per the monitoring plan the following monitors were installed on April 20, 2020:

- Hillsburgh Pond (stilling well)
- 3 drive-point piezometers at locations around the perimeter of the Pond

The monitoring locations are shown on the attached **Figure 1**, as surveyed by Triton Engineering.

The drive-point piezometers were installed by hand into the shallow sediments along the perimeter of the pond, and allow a comparison of the pond levels to the water table elevations immediately adjacent to the pond at those locations.

Monitor DP1 was deepened on April 30, 2020 in order to intercept the water table.

According to data collected as part of this program, the commencement of construction related pond lowering began on May 12, 2020.

Monitoring Completed

Water level monitoring is completed through occasional manual measurements and on an hourly basis by transducer/dataloggers installed at each location. At most locations water level monitoring began on April 20, 2010. At DP1 water level monitoring began on April 30, 2020. Water level monitoring to date represents pre-construction baseline data. The monitor installation details are provided on the attached **Table 1**.

Routine manual water level monitoring occurred on May 15, 2020 and May 27, 2020. A hydrograph showing measured water level elevations to date is attached as **Figure 2**. Reported precipitation (rainfall) at the Environment Canada Fergus Shand Dam weather station (closest monitoring station) is additionally plotted on **Figure 2** for comparison purposes.

Water quality samples can be obtained from the Pond, DP1 and DP3. Monitor DP2 is installed in fine grain sediments that do not "produce" sufficient water to obtain representative samples.

Water quality sampling occurred on April 24th and May 4th, prior to construction activities in order to provide baseline data. Samples were also obtained on May 27th, after construction began.

Water quality sampling results to date are summarized on the attached **Table 2**. We note that the water quality results from the May 27th sample event are not yet available; these results will be summarized in the next status report.

Observations

With recently obtained monitor elevations, direct water level comparisons can now be made from location to location, allowing for a determination of groundwater-surface water interaction, as follows:

- Water levels collected to date at DP1 show that the water table along the southeast (downgradient) edge of the pond is significantly lower than the pond (approx. 1.5 m difference), indicating recharge conditions and groundwater flow away from the pond in this location.
- Water levels at DP2 are observed to be higher than the pond level. This indicates groundwater flow toward and into the pond in this area (likely extending along the northwest edge).
- Baseline water levels collected at DP3 indicate that the water table was below the pond level, indicating recharge conditions and groundwater flow away from the pond in this area (likely extending from the creek inflow to the dam).
- Prior to construction activities the pond level declined by approximately 3cm. Construction activities have lowered the pond level by approximately 0.84 m. To date the magnitude of pond lowering needed for construction activities is less than anticipated. Water levels at the pond have reached their expected lowest level, and are intended to be maintained at the current level over the upcoming construction period. We understand water levels within the pond are expected to be raised slightly at some point this summer.
- The peak water level responses to the rainfall events on April 29th/30th and May 17th were delayed at all monitoring locations, which suggests the response was associated primarily with increased streamflow entering the pond.
- DP1 is noted have no significant response to recharge events. This is likely due to the significant water level separation at this location. Prior to pond lowering a total water level decline of approximately 11 cm was observed (over 9 days). Since pond lowering a water level decline of approximately 0.29 cm was observed (over 17 days). In general, the post construction water level trend at DP1 is consistent with the pre-construction trend, however water levels are approximately 10 lower.
- At DP2 a total water level decline of approximately 4 cm was observed (over 18 days) prior to pond lowering. Since pond lowering a water level decline of approximately 0.14 cm was observed (over 17 days). The estimated water level effect at DP2 associated with the pond lowering is approximately 10 cm. Creek inflows may be helping to maintain water levels in this area, and reducing impacts.
- At DP3 a total water level decline of approximately 10 cm was observed (over 18 days) prior to pond lowering. Since pond lowering a water level decline of approximately 0.27 cm was observed (over 17 days). The estimated water level effect at DP3 associated with the pond lowering is approximately 17 cm. Water level elevations at DP3 are now slightly above the pond level.
- To date water table changes associated with pond lowering are relatively minor.

- The creek inflow exerts some control on water table levels along the north edge of the pond, which may moderate potential effects that may be associated with the reconstruction activities.

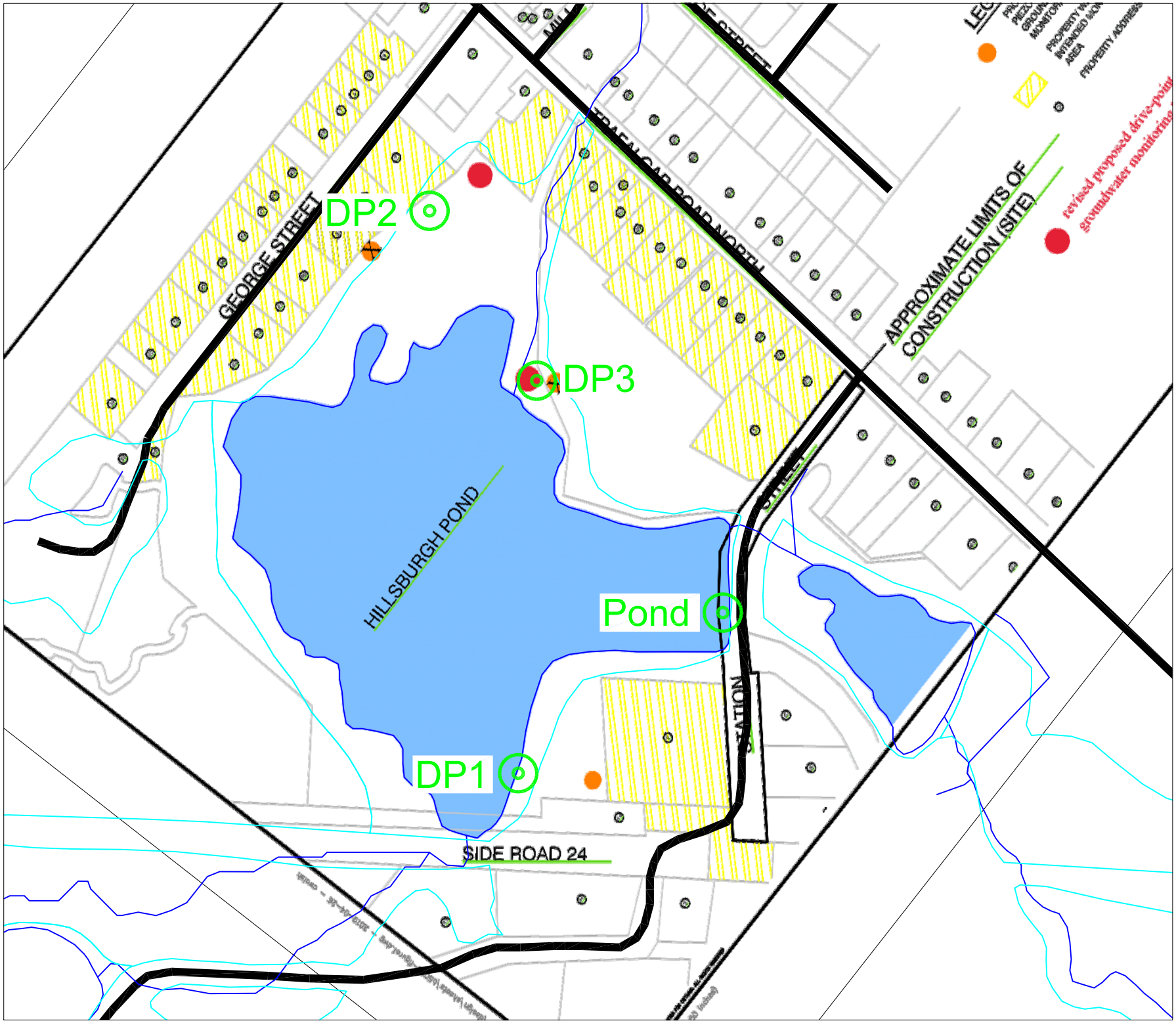
Summary

The monitoring completed to date establishes baseline pre-construction conditions, and initial ongoing-construction conditions at, and near, the pond. Further monitoring will continue to help assess conditions during (and after) construction activities. The monitoring schedule includes weekly checks of the pond level and biweekly water level and water quality sampling at the monitoring locations. Monthly reports will also continue to be prepared during construction to update the monitoring results and assess groundwater conditions at, and near, the pond.

Sincerely,

Andrew Pentney, P.Geo.
Senior Hydrogeologist
Groundwater Science Corp.

Attached: Figure 1, Figure 2
Table 1, Table 2

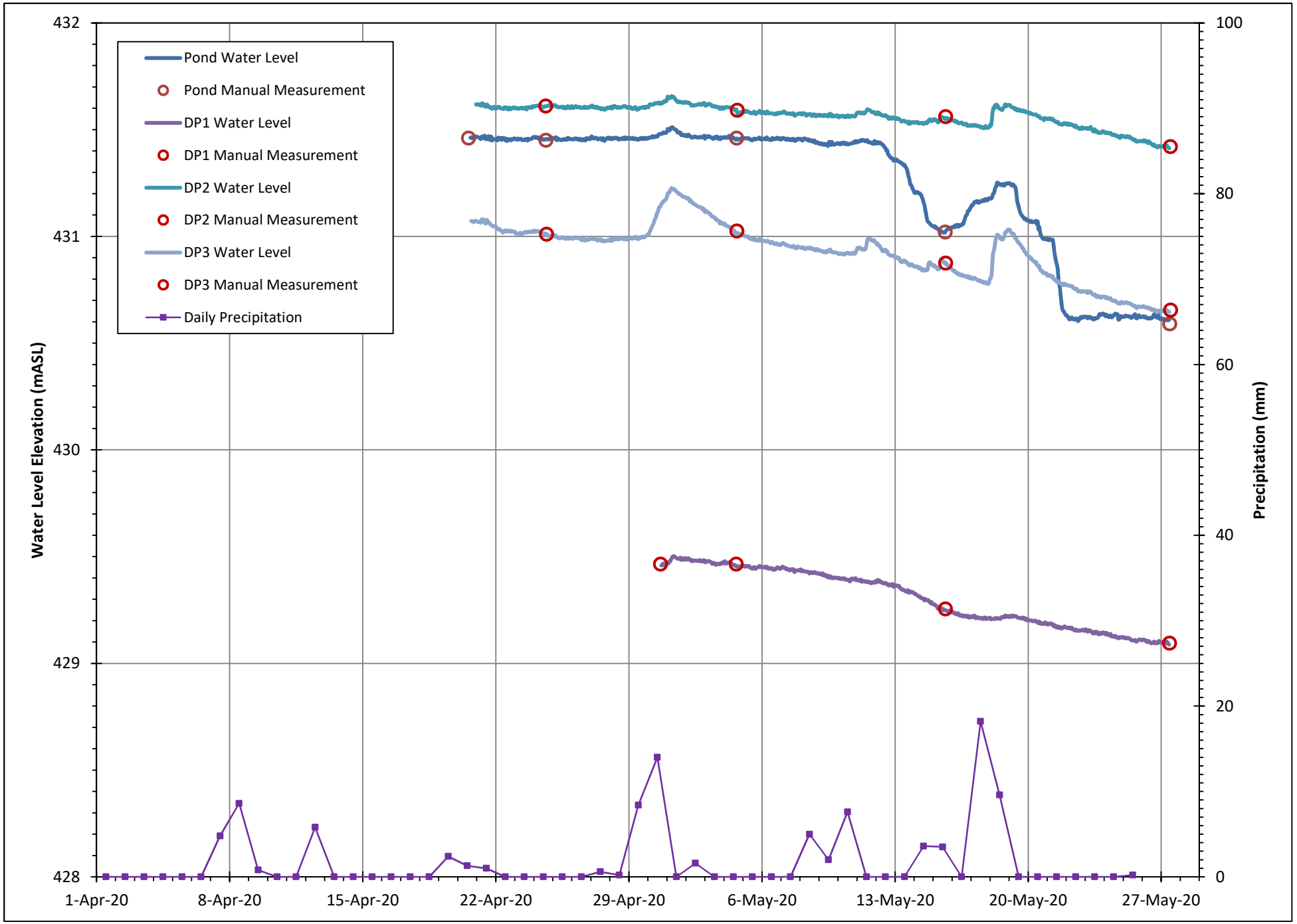


Legend

DP1 Dam monitor

Figure 1

Station Street Dam
Monitoring Network



Town of Erin
Station Street Dam Reconstruction

Figure 2: Water Level Hydrograph

Groundwater Science Corp
Monitoring Program

Location	Type	As Installled			Elevations	
		Total Depth (mBTOP)	Stick-Up (mAGS)	Screen Lenth (m)	Ground Surface (mASL)	Top of Pipe (mASL)
Pond	stilling well	1.90	1.90	1.00	430.46	432.36
DP1	piezometer	4.09	1.22	0.30	431.57	432.79
DP2	piezometer	2.21	0.42	0.30	431.62	432.13
DP3	piezometer	2.84	1.26	0.30	431.36	432.70

Notes: mBTOP = metres below top of pipe
mAGS = metres above ground surface
mASL = metres above sea level

Sample Location:		POND	POND
Date:		24-Apr-2020	4-May-2020
Parameter	Units	Water	Water
Anions and Nutrients			
Bromide (Br)	mg/L	<0.10	<0.10
Chloride (Cl)	mg/L	24.7	25.9
Fluoride (F)	mg/L	0.045	0.047
Nitrate (as N)	mg/L	3.20	3.03
Nitrite (as N)	mg/L	0.014	0.020
Sulfate (SO4)	mg/L	18.1	18.7
Total Metals			
Aluminum (Al)-Total	mg/L	0.0680	0.2350
Antimony (Sb)-Total	mg/L	<0.00010	0.00021
Arsenic (As)-Total	mg/L	0.00025	0.00039
Barium (Ba)-Total	mg/L	0.0342	0.0416
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	<0.000050	<0.000050
Boron (B)-Total	mg/L	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.0000076	0.0000275
Calcium (Ca)-Total	mg/L	69.2	73.5
Cesium (Cs)-Total	mg/L	<0.000010	0.000022
Chromium (Cr)-Total	mg/L	<0.00050	0.0008
Cobalt (Co)-Total	mg/L	<0.00010	0.00013
Copper (Cu)-Total	mg/L	0.00060	0.00110
Iron (Fe)-Total	mg/L	0.108	0.377
Lead (Pb)-Total	mg/L	0.000297	0.001100
Lithium (Li)-Total	mg/L	0.0021	0.0015
Magnesium (Mg)-Total	mg/L	21.2	20.3
Manganese (Mn)-Total	mg/L	0.0122	0.0394
Molybdenum (Mo)-Total	mg/L	0.000263	0.000294
Nickel (Ni)-Total	mg/L	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	<0.050	<0.050
Potassium (K)-Total	mg/L	1.09	1.04
Rubidium (Rb)-Total	mg/L	0.00071	0.00099
Selenium (Se)-Total	mg/L	0.000141	0.000149
Silicon (Si)-Total	mg/L	3.82	3.65
Silver (Ag)-Total	mg/L	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	11.7	11.3
Strontium (Sr)-Total	mg/L	0.117	0.124
Sulfur (S)-Total	mg/L	7.01	6.42
Tellurium (Te)-Total	mg/L	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.00028	0.00025
Titanium (Ti)-Total	mg/L	0.00318	0.00842
Tungsten (W)-Total	mg/L	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.000524	0.000488
Vanadium (V)-Total	mg/L	<0.00050	0.00086
Zinc (Zn)-Total	mg/L	0.0139	0.0865
Zirconium (Zr)-Total	mg/L	<0.00020	<0.00020

Sample Location:		DP1	DP3	DP3
Date:		4-May-2020	24-Apr-2020	4-May-2020
Parameter	Units	Water	Water	Water
Anions and Nutrients				
Bromide (Br)	mg/L	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	26.6	20.9	21.4
Fluoride (F)	mg/L	0.050	0.055	0.055
Nitrate (as N)	mg/L	3.070	0.060	<0.020
Nitrite (as N)	mg/L	<0.010	<0.010	<0.010
Sulfate (SO4)	mg/L	18.4	32.7	32.7
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	<0.0050	0.0058	<0.0050
Antimony (Sb)-Dissolved	mg/L	<0.00010	<0.00010	0.00011
Arsenic (As)-Dissolved	mg/L	0.00018	0.00088	0.00507
Barium (Ba)-Dissolved	mg/L	0.0352	0.0750	0.0664
Beryllium (Be)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.0000255	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved	mg/L	68.5	85.5	88.3
Cesium (Cs)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	<0.00010	0.00150	0.00043
Copper (Cu)-Dissolved	mg/L	0.00053	<0.00020	<0.00020
Iron (Fe)-Dissolved	mg/L	<0.010	<0.010	7.94
Lead (Pb)-Dissolved	mg/L	<0.000050	0.000135	<0.000050
Lithium (Li)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	mg/L	19.1	19.0	18.0
Manganese (Mn)-Dissolved	mg/L	0.009	0.849	0.878
Molybdenum (Mo)-Dissolved	mg/L	0.00029	0.00106	0.00075
Nickel (Ni)-Dissolved	mg/L	0.00099	0.00450	0.01330
Phosphorus (P)-Dissolved	mg/L	<0.050	<0.050	0.057
Potassium (K)-Dissolved	mg/L	1.090	0.768	0.441
Rubidium (Rb)-Dissolved	mg/L	0.00053	0.00097	0.00051
Selenium (Se)-Dissolved	mg/L	0.00018	<0.000050	0.000056
Silicon (Si)-Dissolved	mg/L	3.74	5.51	6.43
Silver (Ag)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	13.7	11.6	10.0
Strontium (Sr)-Dissolved	mg/L	0.122	0.124	0.129
Sulfur (S)-Dissolved	mg/L	6.7	12.2	11.0
Tellurium (Te)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010
Thorium (Th)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	<0.00030	0.00030	0.00034
Tungsten (W)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.000588	0.000185	0.000081
Vanadium (V)-Dissolved	mg/L	<0.00050	<0.00050	0.0016
Zinc (Zn)-Dissolved	mg/L	0.43	3.43	0.59
Zirconium (Zr)-Dissolved	mg/L	<0.00020	<0.00020	0.00032

Table 2: Water Quality Results Summary