2022 Darlington Nuclear Groundwater Monitoring Program Results

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Revision Summary

Revision Number	Date	Comments
000	2023-07-21	Initial issue.

Executive Summary

Darlington Nuclear Generating Station (DNGS) has a mature and robust groundwater monitoring program in place to address the following primary objectives:

1. Confirm predominant on-site groundwater flow characteristics at the DNGS site;

2. Monitor changes to on-site groundwater quality to ensure timely detection of inadvertent releases to groundwater; and

3. Ensure that there are no adverse off-site impacts from DNGS groundwater.

In 2022, groundwater samples were collected as per the Sampling and Analysis Plan developed for the site, from a total of 81 sampling locations.

The findings in 2022 with respect to the above objectives are:

1. The predominant shallow groundwater flow patterns at the site remain unchanged in 2022 from historical groundwater flow interpretations. Outside of the protected area, groundwater generally is inferred to flow from the north to the south, towards Lake Ontario. Inside the protected area and in the vicinity of the powerhouse, groundwater is inferred to flow west and north towards the Forebay. Further south of the powerhouse, groundwater is inferred to flow toward Lake Ontario.

2. Groundwater quality data collected from key areas at DNGS indicate that tritium concentrations have remained relatively constant over time, which points to consistent environmental performance. Groundwater monitoring will continue in these areas.

3. In 2022, there were no indications of adverse off-site impacts from chemical or radiological constituents in groundwater associated with the DNGS. Tritium concentrations at perimeter groundwater monitoring locations remained very low. Municipal drinking water samples collected from downstream Water Supply Plants as part of the annual Ontario Power Generation DNGS Environmental Monitoring Program were well below the Ontario Drinking Water Quality Objective for tritium of 7,000 Bq/L.

1.0 INTRODUCTION

Ontario Power Generation (OPG), Darlington Nuclear Generating Station (DNGS), has a mature and robust annual groundwater monitoring program in place. The program examines the chemical, radiological, and physical characteristics of the groundwater beneath the site.

The specific objectives of this program are:

1. **Objective 1**: Confirm predominant on-site groundwater flow characteristics at the DNGS site;
2. **Objective 2:** Monitor changes to on-site groundwater quality to ensure timely detection of inadvertent releases to groundwater; and
3. **Objective 3:** Ensure that there are no adverse off-site impacts from DNGS groundwater.

This report presents groundwater data collected at DNGS for the period from January 1st to December 31st, 2022 and the associated interpretation of this data.

2.0 2022 PROGRAM DESIGN

The design of the DNGS groundwater monitoring program is risk-based in nature. The 2022 groundwater Sampling and Analysis Plan (SAP) was developed to meet the three objectives listed above.

The 2022 SAP specified the sampling locations, the frequency of sampling, (e.g., quarterly, annually), and the parameters for analysis.

The methodology used to collect data and subsequently draw conclusions for each objective is discussed in further detail below.

2.1 Objective 1 Methodology

Detailed interpretation of groundwater flow conditions beneath the DNGS was first carried out in 2010. On an annual basis, a set of water levels is collected from groundwater monitoring wells across the site such that OPG has a continued and robust understanding of groundwater flow patterns at the site.

In the second quarter of 2022 (Q2 2022), water level readings were collected from selected monitoring locations across the site. The data was subsequently used to calculate the groundwater elevations at each monitoring well location and generate groundwater elevation contours. Horizontal groundwater flow directions and gradients were interpreted from those contours.

2.2 Objective 2 Methodology

In 2022, groundwater samples were collected from a total of 81 monitoring wells, as shown in Figure 1 and Figure 2. The monitoring wells are distinguished by location, being:

- the protected area, near the reactor buildings;
- the controlled area, farther away from the reactor buildings but within the fence; and
- the site perimeter.

Groundwater samples were collected by qualified technicians. Prior to sample collection, each monitoring well was purged to remove standing water, ensuring that groundwater representative of the hydrogeological unit (see Section 3.1) in which the well is installed was collected. Tritium concentrations were analyzed in the majority of the samples. Petroleum hydrocarbons (PHCs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations were analyzed in samples collected from a subset of monitoring wells in the monitoring well network. All chemical analyses were done by Bureau Veritas, accredited by the Canadian Association for Laboratory Accreditation (CALA).

The groundwater conditions and quality data generated from the sampling program were subsequently evaluated to support previous conclusions, identify adverse trends, and/or demonstrate no adverse off-site impacts.

2.3 Objective 3 Methodology

The sampling of groundwater monitoring wells at the site boundary was performed to confirm that there are no adverse off-site impacts from constituents in groundwater associated with the DNGS. The site perimeter wells are shown in Figure 1. The methodology for groundwater collection and analysis, as well as for data evaluation, was the same for the site perimeter wells as what is described above for Objective 2.

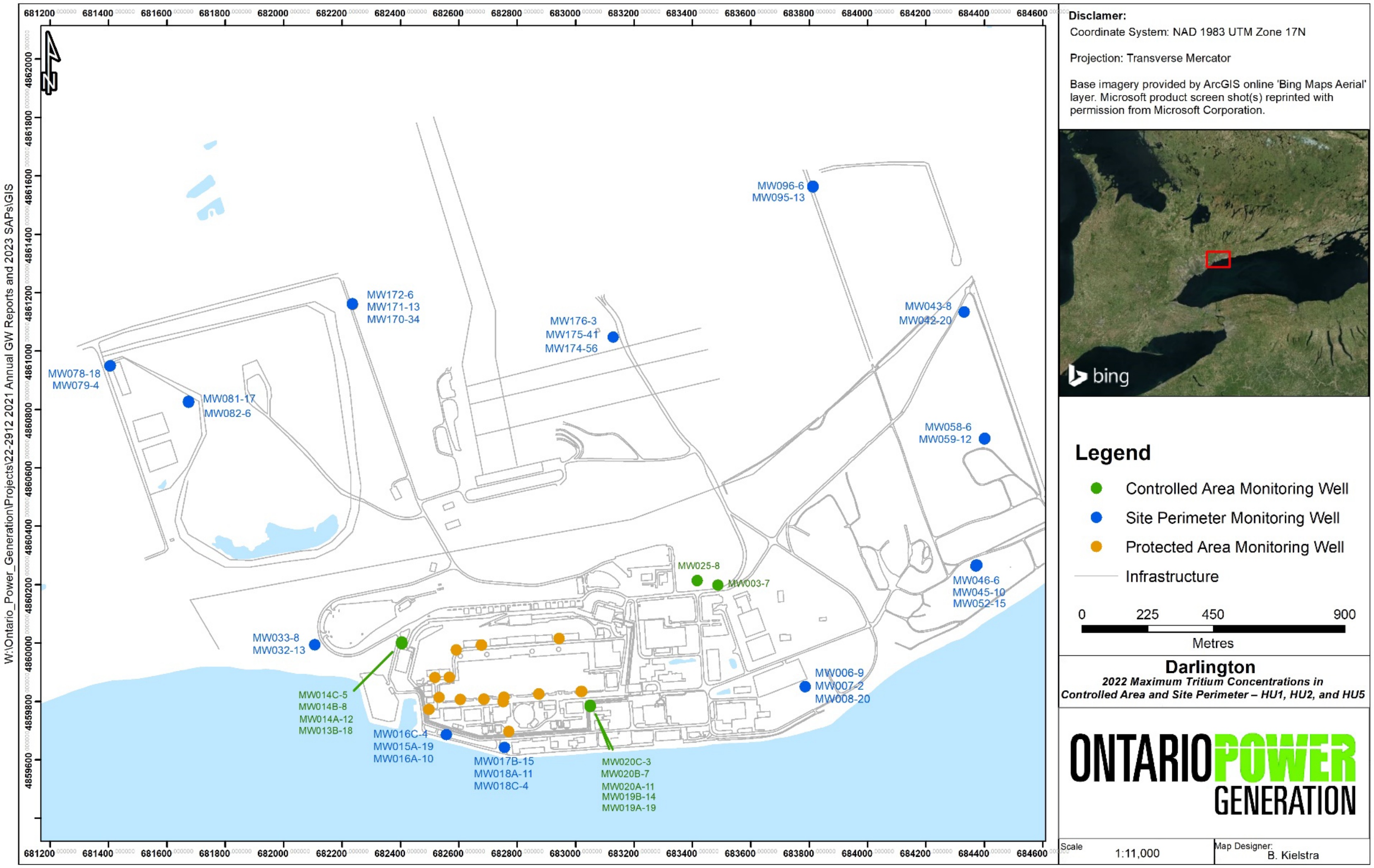


Figure 1: 2022 Monitoring Locations – Controlled Area and Site Perimeter Monitoring Wells

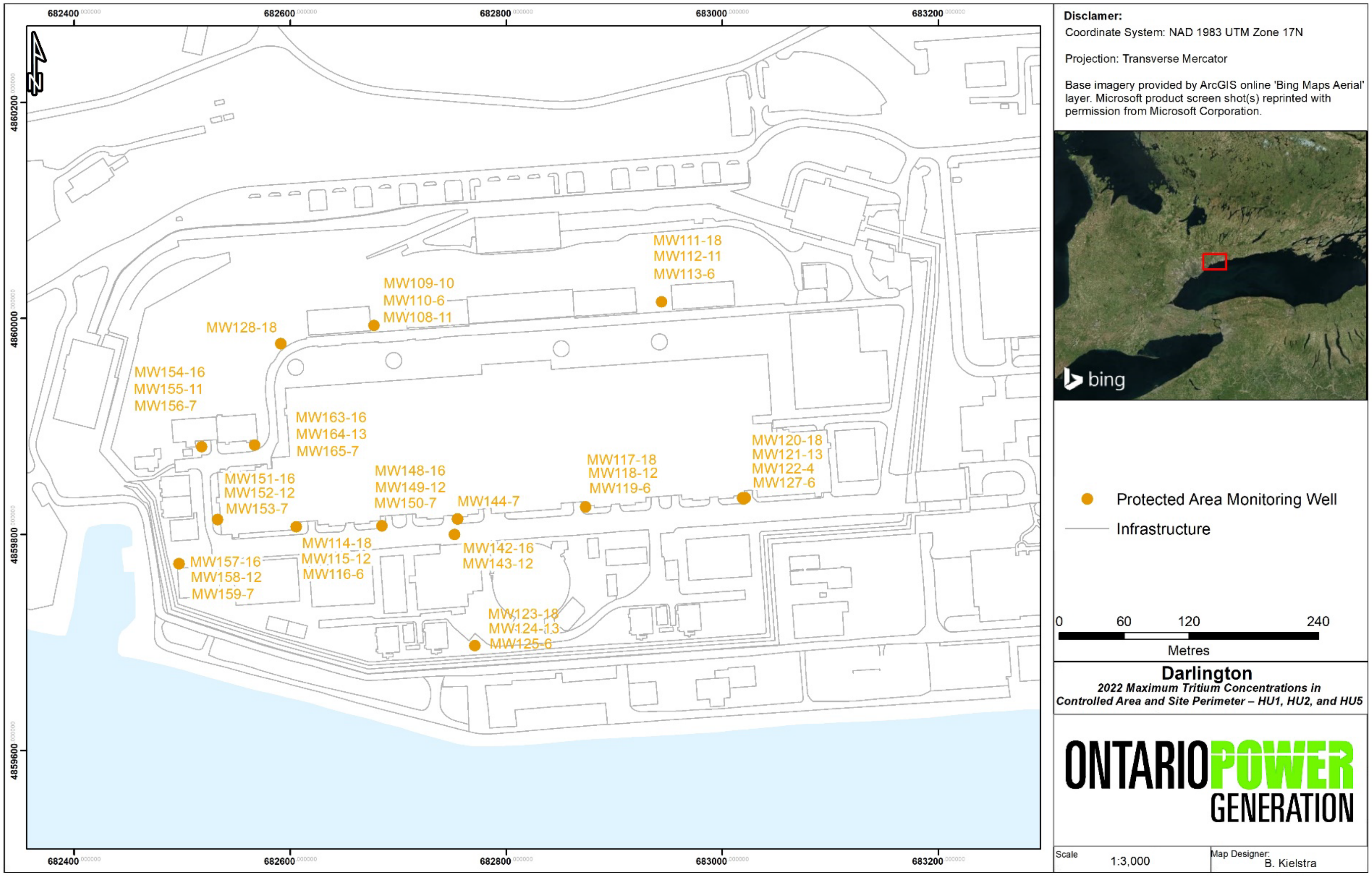


Figure 2: 2022 Monitoring Locations – Protected Area Monitoring Wells

3.0 2022 PROGRAM RESULTS

3.1 Objective 1 Results

The predominant groundwater flow patterns remain unchanged in 2022 from the historical interpretations of groundwater flow conditions.

DNGS's groundwater flow systems are categorized into three hydrostratigraphic units (HU) based on previous hydrogeological investigations:

- Fill/Upper Till (Water Table; HU 1);
- Interglacial Deposits (HU 2); and
- Shallow Bedrock (HU 5).

Monitoring wells are also installed within the deep bedrock (HU 6) at the DNGS. Groundwater level measurements were collected from the wells installed in each of HU 1, HU 2 and HU 5 and are used to develop groundwater contour maps, from which flow directions are inferred. Figure 3 shows the inferred groundwater flow directions across the DNGS site at the water table in the fill/upper till (HU 1). Within the protected area, groundwater levels vary to a limited extent over space (i.e., are typically within 1 m of each other), and groundwater flow directions are influenced by the infrastructure, the Forebay intake channel and Lake Ontario. As such, an overall interpretation of groundwater flow directions in that area is shown with the red arrows in Figure 3. The daily average water elevation on May 9,10 and 11, 2022 of 75.2 masl in Lake Ontario was obtained from the International Joint Commission (2023).

The predominant groundwater flow patterns are summarized as follows:

- In general, groundwater on the site in HU 1 flows from north to south and is inferred to discharge in Lake Ontario.
- The northeastern portion of the DNGS site has a component of groundwater flow directed to the east, and then southeast towards Lake Ontario.
- General flow in the interglacial deposits (HU 2) and the shallow bedrock (HU 5) are similar to that at the water table in the fill/upper till (HU 1) described above.
- Groundwater flow direction is complex within the protected area in HU 1, HU 2, and HU 5 due to site infrastructure as detailed below:
    - The powerhouse extends to bedrock and acts as a barrier to groundwater flow; therefore, groundwater flow at the water table on the north side of the powerhouse may not be connected to or may be poorly connected to groundwater flow at the water table on the south side of the powerhouse.

- Groundwater on the west side of the powerhouse is interpreted to discharge into the Forebay Channel as the Condenser Cooling Water pumps lower the Forebay Channel water level, creating a hydraulic gradient directed to the Forebay Channel.
- On the south side of the powerhouse, groundwater flows from the east to the Forebay Channel; however, a component of that groundwater flow is directed to Lake Ontario.

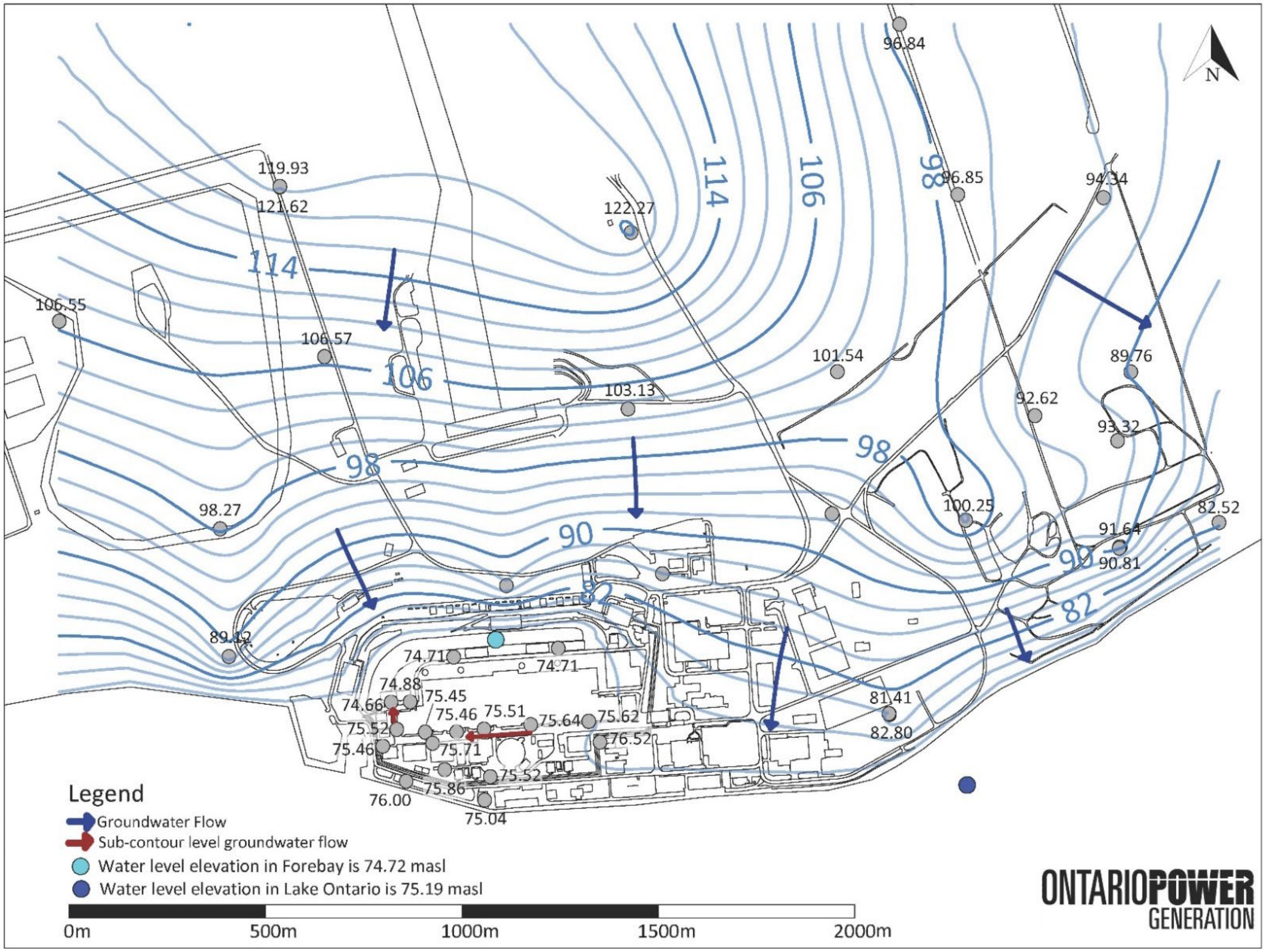


Figure 3: 2022 Inferred Shallow Groundwater (HU 1) Flow Direction

3.2 Objective 2 Results

Within the protected area, and to a lesser extent outside of that, tritium concentrations in groundwater will have a background contribution from tritium air emissions associated with DNGS operations. Tritium in air emissions enter groundwater through the infiltration of wet deposition/precipitation. OPG carried out a precipitation sampling program that spanned two years (February 2009 to March 2011) in which tritium was sampled in the collected rainwater at twelve (12) locations within the protected area (CH2M Hill, 2011). Tritium concentrations in precipitation showed variability over time and space, as would be expected with changing seasonal weather conditions. The maximum concentration measured in precipitation was 1,924 Bq/L (CH2M Hill, 2011). This value is considered to appropriately bound expected background water quality conditions concerning tritium in groundwater within the protected area.

The groundwater quality data collected from the key areas at DNGS in 2022 indicate that tritium concentrations in groundwater have remained stable over time, as shown in the graphs provided in the section below. Tritium concentrations are below the expected background level. The stability of the tritium concentrations in groundwater points to the consistency of environmental performance with respect to water quality across the site.

3.2.1 Protected Area Groundwater Quality

In 2022, 38 monitoring wells were sampled in the protected area to assess tritium concentrations and temporal behaviour.

Previously, the presence of elevated tritium in groundwater in the protected area was attributed to the Injection Water Storage Tank (IWST) spill. This release occurred southwest of Unit 0 in December 2009. Overall, the highest tritium concentrations in groundwater from monitoring wells within the Protected Area have declined since the spill, and support the interpretation that there have been no new sources of tritium in groundwater since that time.

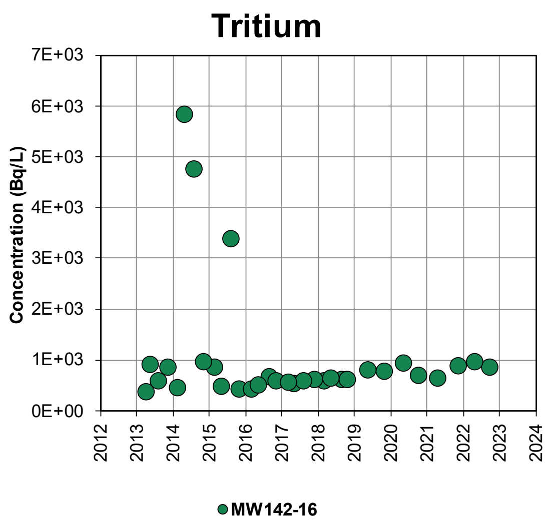
Tritium concentrations across the protected area are discussed in more detail in the following sections. Analytical results for all wells sampled are provided in Appendix A, Table A-1 and tritium concentrations are summarized in Figure 4 for HU 1, HU 2 and HU 5. For Figure 4, to simplify the presentation of data, and as a conservative approach, the annual maximum tritium concentration at each well is presented.

For ease of discussion, the protected area groundwater results are sub-divided into five smaller areas: Unit 2 (U2) area, West Fueling Facility Auxiliary (WFFA) area, Emergency Power Generator (EPG) Fuel Management Building area, Emergency Power Service (EPS) Building area and the northern side of the powerhouse. The locations of groundwater monitoring wells discussed in the Sections below are shown in Figure 4.

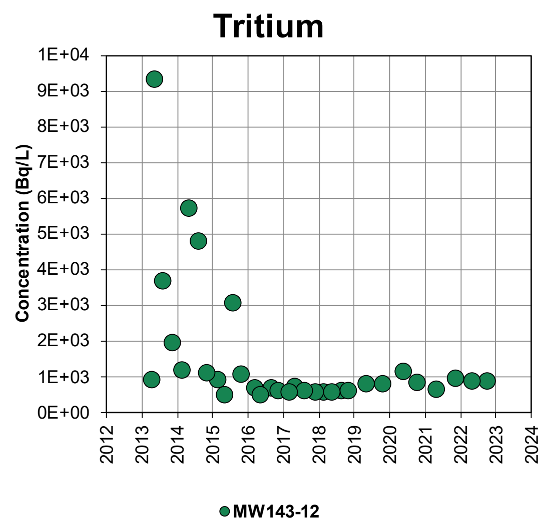
U2 Area

Tritium concentrations in groundwater, resulting from the historical IWST spill that occurred in the area southwest of Unit 0 and in the vicinity of U2, are declining. In 2022, the highest tritium concentration measured in groundwater sampled from the monitoring well nest consisting of

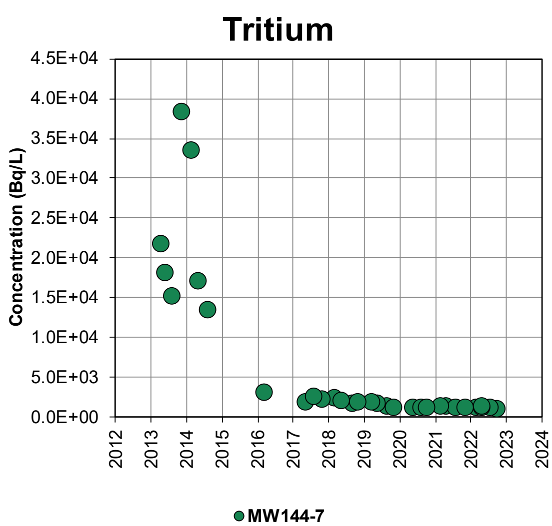
MW142-16 (HU 5), MW143-12 (HU 2) and MW144-7 (HU 1) was 1,110 Bq/L. The concentrations in all of the wells in this cluster have declined to values below the expected background value (i.e., 1,924 Bq/L). Graphs 1 to 3 depict tritium concentrations over time for these three groundwater monitoring wells.



Graph 1: MW142-16 Tritium Data



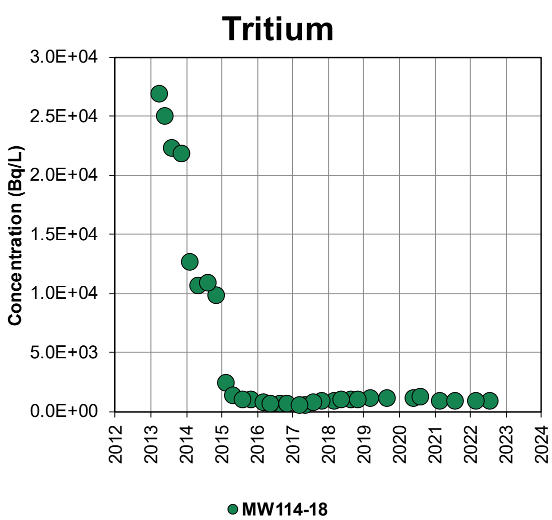
Graph 2: MW143-12 Tritium Data



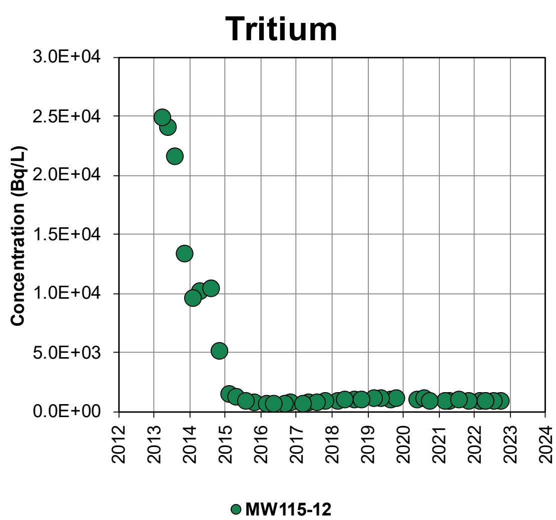
Graph 3: MW144-7 Tritium Data

WFFA Area

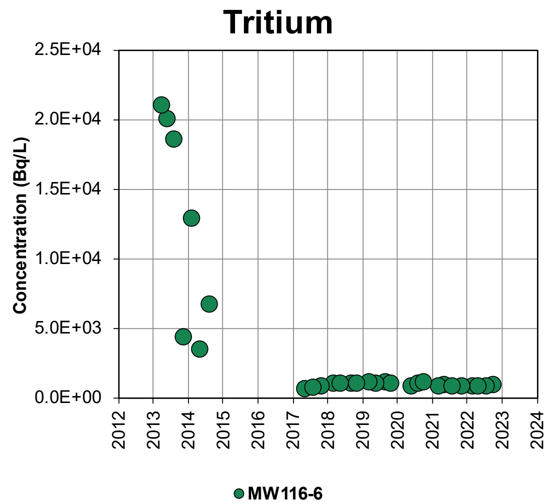
Based on historical results, tritium in groundwater from the IWST spill area was inferred to flow along the southern wall of the powerhouse to the west (Figure 3). The monitoring well cluster consisting of MW114-18 (HU 5), MW115-12 (HU 2) and MW116-6 (HU 1), is located in the vicinity of the WFFA. The maximum tritium concentration in this cluster of three monitoring wells was 840 Bq/L in 2022. Tritium concentrations in these wells peaked in 2013 and decreased below the expected background value by 2016. Concentrations in these wells have remained below the background level since 2016, as is shown in Graphs 4 to 6. Tritium concentrations in groundwater have shown similar behaviour in the monitoring well cluster further west, consisting of MW151-16 (HU 5) and MW152-12 (HU 2), as shown in Graphs 7 and 8. Maximum tritium concentrations in those wells were 800 Bq/L in 2022. The concentrations at these monitoring wells are generally lower than the tritium concentrations measured in U2 Area.



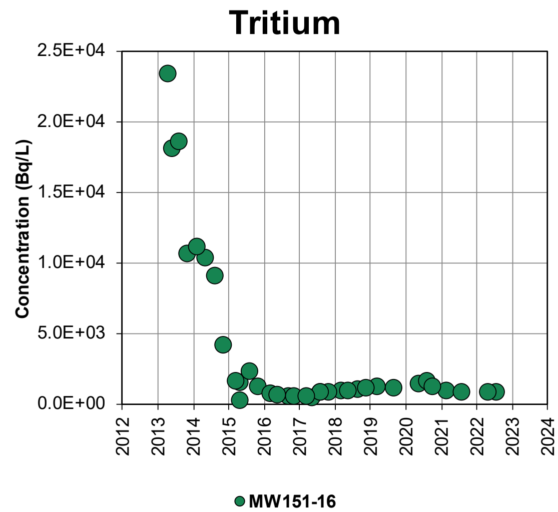
Graph 4: MW114-18 Tritium Data



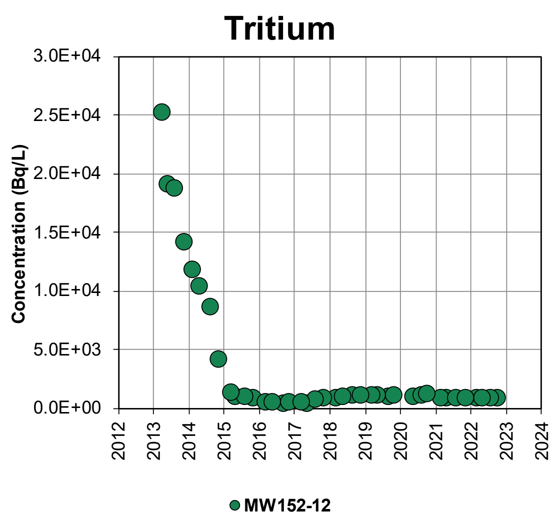
Graph 5: MW115-12 Tritium Data



Graph 6: MW116-6 Tritium Data



Graph 7: MW151-16 Tritium Data



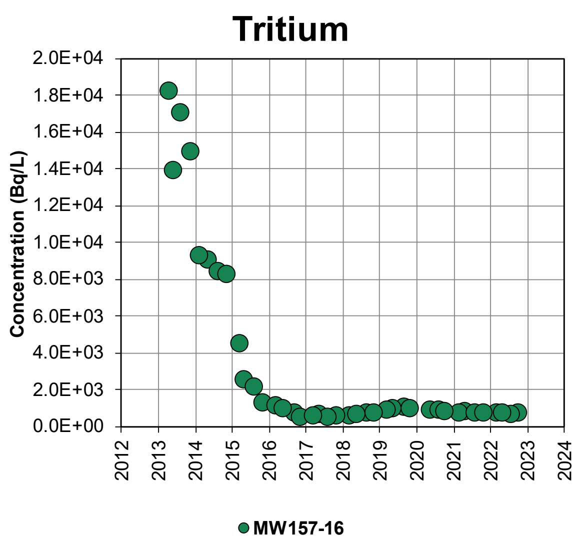
Graph 8: MW152-12 Tritium Data

EPG Fuel Management Building Area

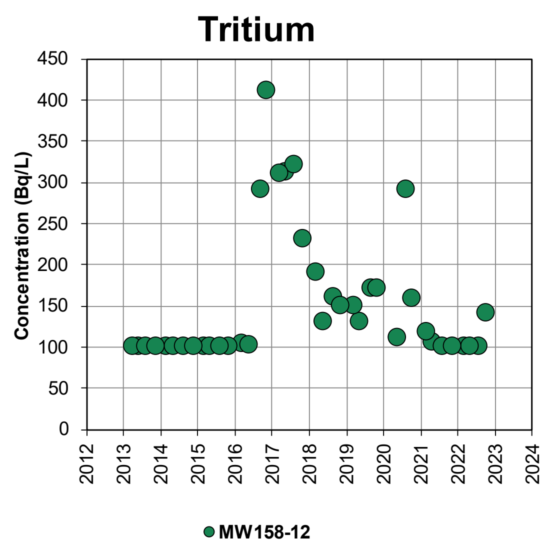
A small component of groundwater influenced by the IWST tritium release migrated to the west towards the EPG area in the upper bedrock.

At MW157-16, which is screened in the upper bedrock (HU 5), tritium concentrations in groundwater have decreased in the same manner as in the WFFA area over time, as is shown in Graph 9. In 2022, the maximum tritium concentration in groundwater collected from MW157-16 was 700 Bq/L.

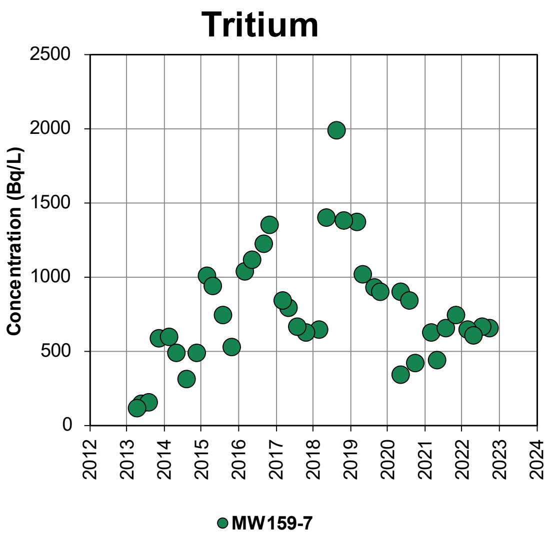
There are two shallower wells clustered with MW157-16. Monitoring well MW158-12 is screened in the interglacial deposits (HU 2) and tritium concentrations in groundwater in this well have historically been below detection limit (< 100 Bq/L) before 2016. In 2016, there was a marginal increase in tritium concentrations in this well, which has been attributed to dewatering activities leading to increased connectivity between groundwater in the bedrock and overburden. The tritium concentrations in MW158-12 since 2016 have been below the expected background value and in 2022 were generally below the detection limit for tritium in groundwater (i.e., 100 Bq/L). Tritium concentrations over time in MW158-12 are shown in Graph 10. Tritium concentrations in MW159-7, which is screened across the water table (HU 1), have overall declined since higher concentrations were observed in 2018 (Graph 11).



Graph 9: MW157-16 Tritium Data



Graph 10: MW158-12 Tritium Data

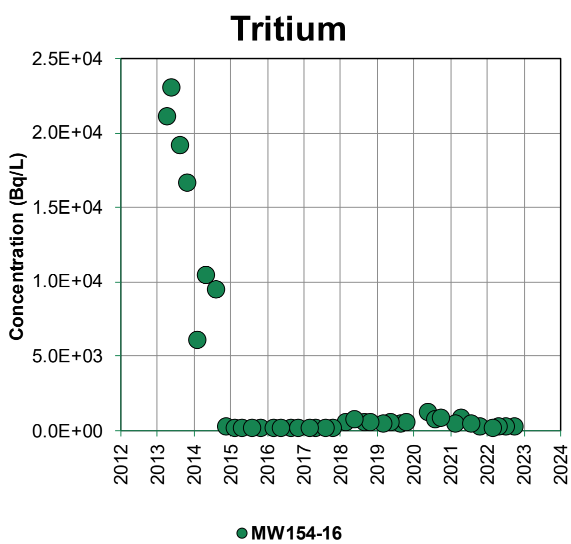


Graph 11: MW159-7 Tritium Data

<u>EPS Building Area</u>

Groundwater is also inferred to flow to the west of the WWFA area towards the EPS building and discharge into the Forebay Channel (Figure 3). Tritium concentrations in groundwater associated with the IWST spill peaked in the EPS Building area in 2012 at 26,500 Bq/L in monitoring well MW154-16 (HU 5) (CH2M hill 2014), which have since declined. The maximum tritium concentration in 2022 in MW154-16 was 210 Bq/L and is below the expected background value (Graph 12). Tritium concentrations in groundwater have been below 900 Bq/L since 2013 in shallower wells MW155-11(HU 2) and MW156-7(HU 1), located adjacent to MW154-16. Tritium concentrations historically remaining below the expected background value in these wells indicate that tritiated groundwater associated with the IWST spill has not migrated into the shallower hydrostratigraphic units in this area.

The slow discharge of groundwater into the Forebay Channel is diluted by the large inflow of lake water and the Forebay water quality is monitored before it is discharged back to Lake Ontario.



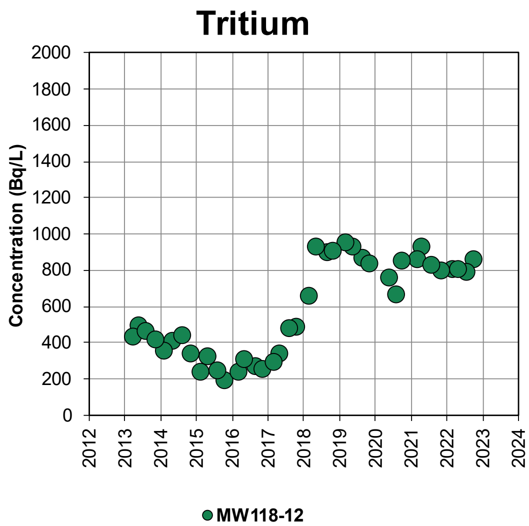
Graph 12: MW154-16 Tritium Data

<u>Northern Side of Powerhouse</u>

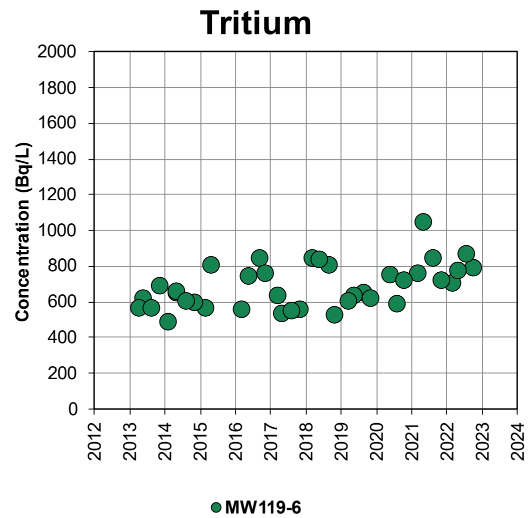
In monitoring wells located on the northern side of the Powerhouse (Figure 3), tritium concentrations ranged from <100 Bq/L to 300 Bq/L in 2022, and are within expected background values.

<u>South of Powerhouse – Units 3 and 4</u>

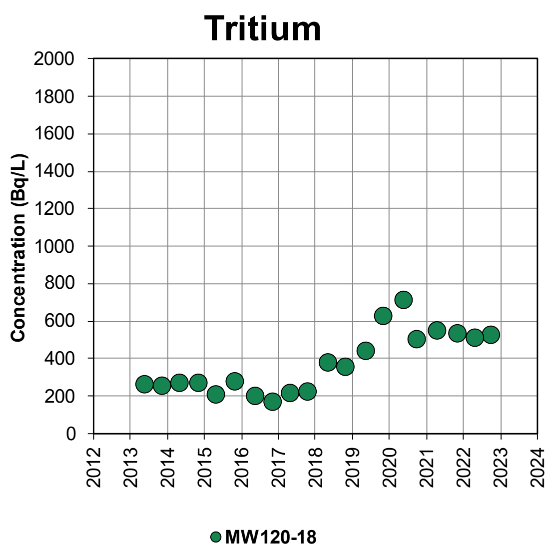
In the vicinity of Unit 3 and Unit 4, which are located in the inferred upgradient groundwater flow direction from the IWST spill, tritium concentrations remain below the expected background value. Tritium concentrations in groundwater over time are shown for well clusters MW118-12 (HU 2) and MW119-6 (HU 1), located south of the powerhouse near Unit 3, and MW120-18 (HU 5), MW121-13 (HU 2), MW122-4 (HU 1) and MW127-6 (HU 1), located south of the powerhouse in the area of Unit 4. Graphs 13 through 18 display the concentrations of tritium at the above-mentioned groundwater monitoring wells.



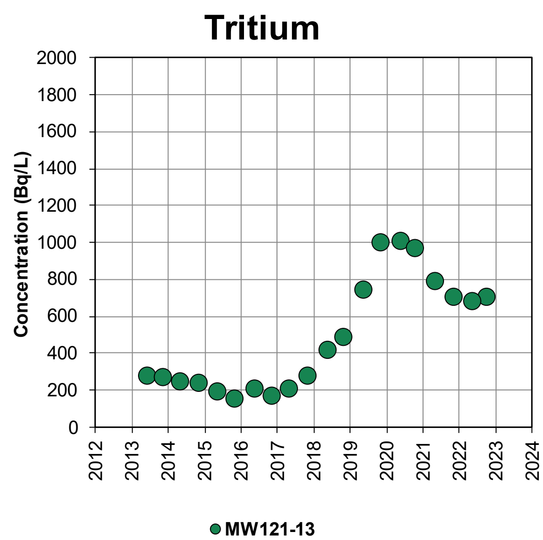
Graph 13: MW118-12 Tritium Data



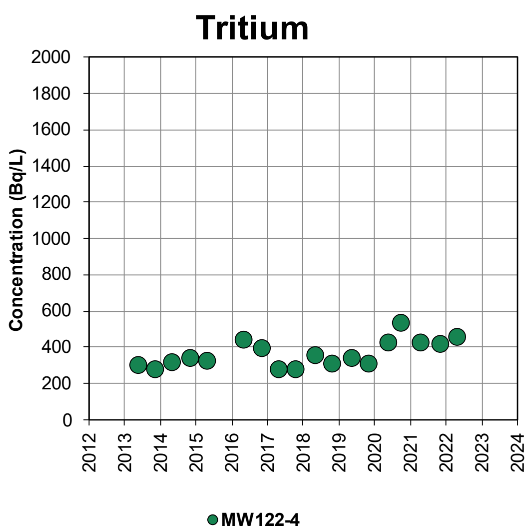
Graph 14: MW119-6 Tritium Data



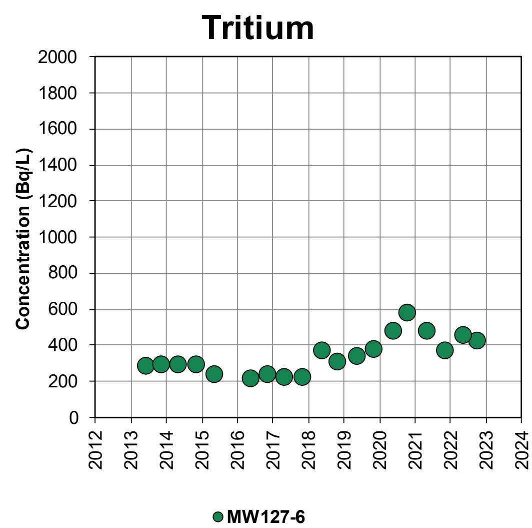
Graph 15: MW120-18 Tritium Data



Graph 16: MW121-13 Tritium Data



Graph 17: MW122-4 Tritium Data



Graph 18: MW127-6 Tritium Data

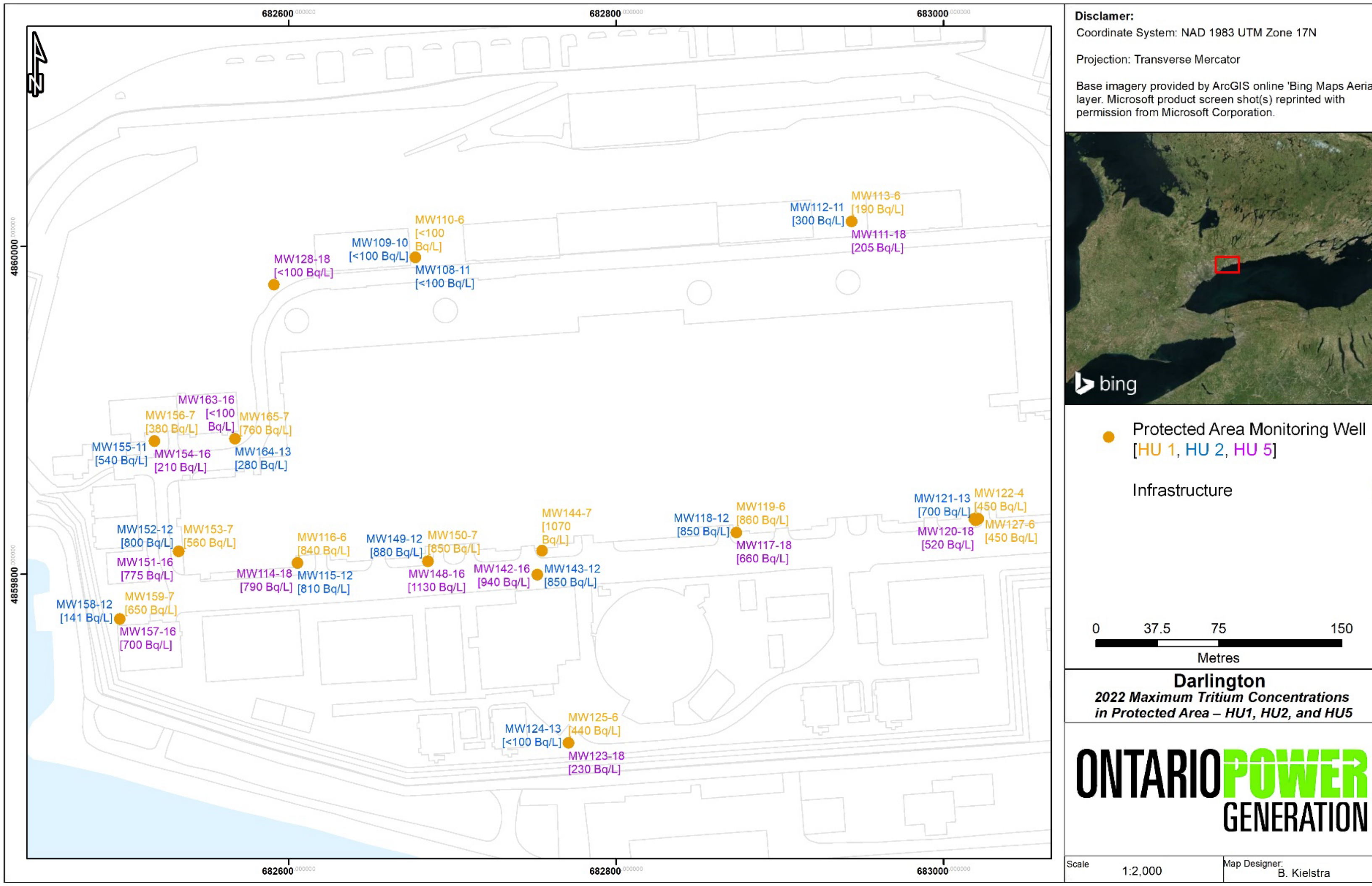


Figure 4: 2022 Maximum Tritium Concentrations in Protected Area - HU 1, HU 2 and HU 5

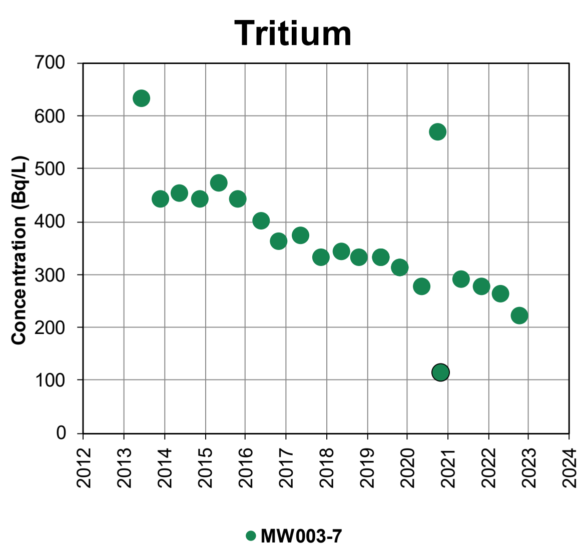
3.2.2 Controlled Area Groundwater Quality

In 2022, eleven (11) monitoring wells were sampled in the controlled area to assess tritium concentrations in groundwater and trends, if any, in those concentrations.

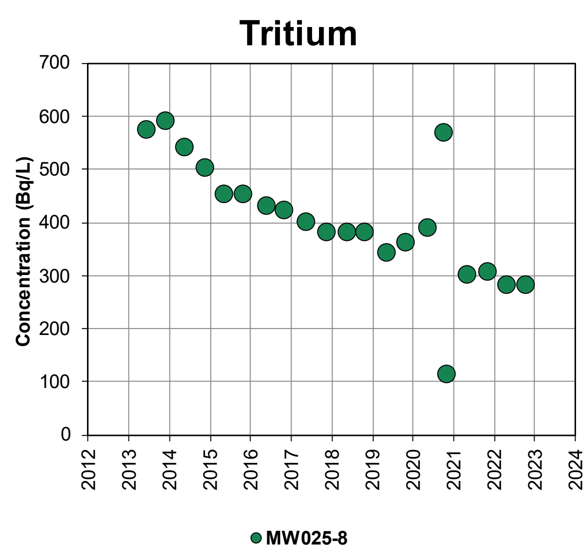
Tritium concentrations in groundwater monitoring wells inside the controlled area wells are within historical ranges.

The presence of tritium at MW003-7 (HU 2) and MW025-8 (HU 1) is mainly attributed to a past spill from the building effluent lagoon in 2001. Corrective actions to address this spill were implemented. Groundwater quality monitoring results indicate that tritium concentrations have been declining (Graphs 19 and 20).

The results are further presented in Appendix A, Table A-2 and summarized in Figure 5 for HU 1, HU 2 and HU 5. In Figure 5, the annual maximum tritium concentration is presented for each set of monitoring well clusters.



Graph 19: MW003-7 Tritium Data



Graph 20: MW025-8 Tritium Data

3.2.3 Petroleum Hydrocarbons and BTEX in Groundwater

In 2022, groundwater quality monitoring was conducted in the vicinity or downgradient of the EPG, Standby Generators and the Construction Boilerhouse, to detect underground fuel oil piping leaks.

Eleven (11) monitoring wells were sampled for PHCs and BTEX and their analytical results were compared to the Ministry of the Environment, Conservation and Parks

(MECP) Table 3 Standard: “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act” for 2011, Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition. This comparison was conducted for assessment purposes only, because the standards are used as a best management practice in this case.

In 2022, most groundwater quality results were non-detect with respect to PHCs and BTEX. Where detected, concentrations of PHCs and BTEX met the MECP Table 3 Site Conitions Standards for PHCs and BTEX. The exceptions are summarized as follows:

- At MW142-16 (HU 5), benzene was measured at a concentration of 69 µg/L in Q3 2022 which is above the standard of 44 µg/L. Historically, PHC and BTEX concentrations in the shallow bedrock at the DN Site can be above the screening criteria because of the naturally occurring hydrocarbons in the petroliferous calcareous shale of the lower 2 to 3 m of the Blue Mountain formation (formerly known as the Whitby formation). As such, PHC concentrations in the shallow bedrock are not considered COPCs due to their natural occurrence, and will not be monitored further.

- At MW143-12 (HU 2), PHC F2 and F3 were detected at concentrations above their respective standards in 2020. PHC F3 concentrations in groundwater at this well declined to concentrations below the standard (i.e., 500 µg/L) in 2021 and 2022. The PHC F2 concentration in this well in Q2 2022 was 180 µg/L, which is marginally above the standard for this parameter of 150 µg/L. Monitoring well MW143-12 is located on a roadway and, in addition to what has been outlined above, had shown some exceedances for PHC parameters in past years. PHC concentration fluctuations in groundwater at MW143-12 may be associated with the well integrity and not a result of Site operations and has been recommended for decommissioning.

The analytical results for PHCs and BTEX are presented in Appendix A, Table A-3.

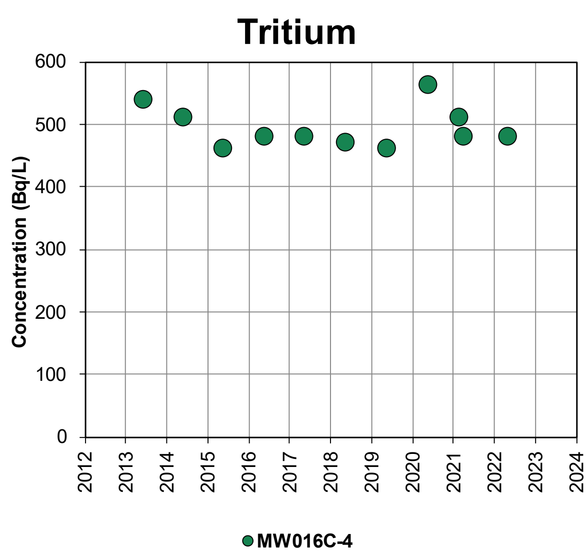
3.3 Objective 3 Results

In 2022, thirty (30) monitoring wells located at the property boundary were sampled in Q2. The results are summarized in Appendix A, Table A-4. Maximum measured tritium concentrations in each of the perimeter wells are shown in Figure 5.

Of all the perimeter wells, tritium concentrations only exceeded detection limits in 2022 in groundwater sampled from MW016C-4 (HU 1). Monitoring well MW016C-4 is located at the southern perimeter of the station. Tritium concentrations in this well are shown in Graph 21, and in Q2 2022 the tritium concentration in groundwater at this location was 480 Bq/L. Given the proximity of this well to the protected area and the screening depth of this well at the water table (HU 1), it is expected that the observed concentrations of tritium can be attributed to inputs from atmospheric deposition.

Tritium concentrations in groundwater in two perimeter monitoring wells, MW033-8 (HU 1) and MW079-4 (HU 1) had been above the detection limit in 2021. Tritium concentrations in both of these wells decreased to non-detect values in 2022. Overall, low tritium concentrations at site-perimeter locations indicate that the potential for adverse impacts to off-site groundwater quality from groundwater quality beneath the DNGS is low to negligible.

As part of the annual OPG DNGS Environmental Monitoring Program, municipal drinking water samples are collected from the downstream Water Supply Plants (WSPs). In 2022, the data from that sampling program demonstrated that the annual average tritium concentration in water at each WSP was well below the Ontario Drinking Water Quality Objective for tritium of 7,000 Bq/L. These results further support the conclusion that the potential for groundwater quality beneath DNGS to adversely impact off-site water quality is negligible.



Graph 21: MW016C-4 Tritium Data

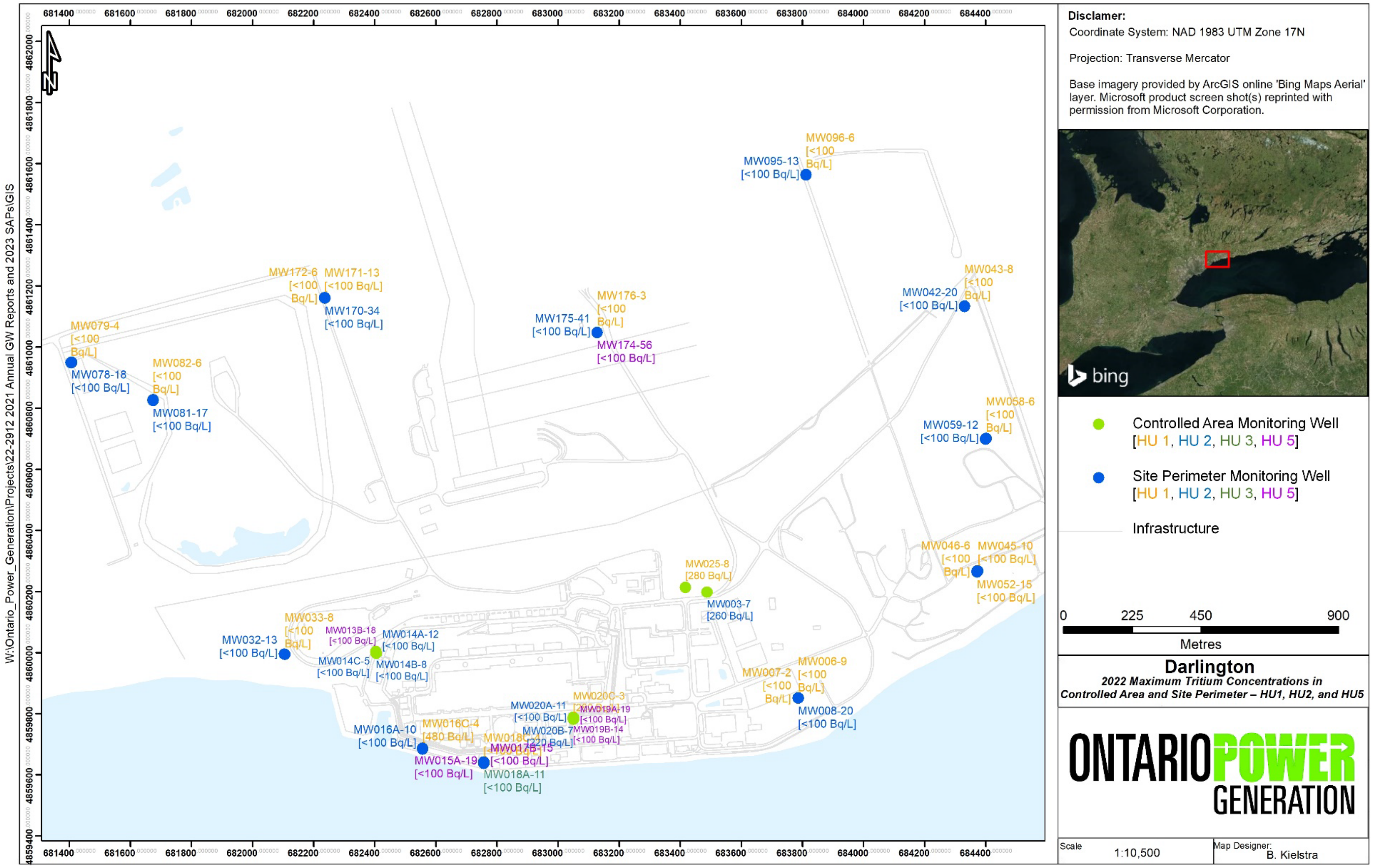


Figure 5: 2022 Maximum Tritium Concentrations in Controlled Area and Site Perimeter – HU 1, HU 2, HU 3 and HU 5

4.0 2022 QUALITY ASSURANCE AND QUALITY CONTROL

The Quality Assurance and Quality Control for the groundwater monitoring program encompasses all activities associated with the field sample collection, laboratory analysis and laboratory quality control. The objective is to provide confidence in the interpretation of the DNGS groundwater monitoring data through a systematic and documented process.

4.1 Quality Assurance Program for Laboratories

Bureau Veritas is accredited with ISO 17025 by the Standards Council of Canada for environmental tests. The methodology for analysis including detection limits for many conventional parameters in groundwater is governed by criteria established in the MECP's "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act". Bureau Veritas has a Quality Assurance Department, which routinely monitors procedures and processes by way of compliance audits, quality system audits and method audits to ensure compliance with accreditation and regulatory requirements. Bureau Veritas is also accredited by the Standards Council of Canada for radiological tests, including analysis of tritium concentrations in water.

4.2 Quality Control Results

Duplicates, field blanks, and trip blanks were collected at a prescribed frequency to measure sampling and analytical performance.

In 2022, field duplicate samples were collected from fifteen (15) monitoring locations. The 2012 groundwater monitoring program design specifies that a field duplicate must be collected for every 10 samples collected and this requirement was met for the samples collected in 2022. The analytical results and calculated relative percentage differences (RPD) were evaluated to understand the sampling precision. RPDs are calculated where the sample and field duplicate are both measured at concentrations above five times the detection limit. All sample pairs meeting this criterion showed an RPD below 20 percent (%). As such, the field technique and the analytical methods employed by the laboratory analytical were determined to be reproducible and reliable.

Field blanks and trip blanks were part of the quality program where PHCs and BTEX were measured. All field blank results were non-detect for those parameters. Therefore, no significant contamination of samples by those parameters occurred during the sample collection process. Similarly, PHCs and BTEX were at non-detect levels in all trip blank samples analyzed indicating that there was no contamination of the samples by those parameters during handling and transportation.

The QA/QC calculations and results discussed above are presented in Appendix A, Table A-5 and Table A-6.

5.0 SUPPLEMENTARY STUDIES AND AUDITS

There were no supplementary studies related to DNGS groundwater initiated in 2022. There were no audits completed on the DNGS groundwater program in 2022.

6.0 CSA N288.7 UPDATE

OPG's DNGS is in compliance with Canadian Standards Association (CSA) N288.7, "Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills", as of December 31, 2022. OPG informed the Canadian Nuclear Safety Commission (CNSC) of this compliance (NK38-CORR-00531-24026).

7.0 NOMENCLATURE OF SAMPLING LOCATIONS

Sampling Location Type	Identifier	Explanation of Nomenclature
Monitoring Well	MW*XXX*-*YY*	*XXX* represents a unique identifier *YY* represents the depth of the monitoring well in metres

8.0 ACRONYMS AND UNITS

μCi/kg	Micro curie per Kilogram
Bq/L	Becquerel per Litre
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DNGS	Darlington Nuclear Generating Station
EMP	Environmental Monitoring Program
EPG	Emergency Power Generator
EPS	Emergency Power Service
HU	Hydrostratigraphic Unit
IWST	Injection Water Storage Tank
MECP	Ministry of Environment, Conservation and Parks
MW	Monitoring Well
OPG	Ontario Power Generation Inc.
PHC	Petroleum Hydrocarbon
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percentage Difference
SAP	Sampling and Analysis Plan
WFFA	West Fueling Facility Auxiliary
WSP	Water Supply Plant

9.0 REFERENCES

CH2M Hill, 2011. Geological and Hydrogeological Environment Technical Support Document Darlington Nuclear Generating Station Refurbishment and Continued Operation Environmental Assessment. Report No. NK38- REP- 07730–10003. December.

IJC, 2023. International Lake Ontario-St. Lawrence River Board- Lake Ontario Daily Mean Water Levels 2021-2022 [WWW Document]. Int. Jt. Comm. Int. Lake Ont.-St Lawrence River Board. February. URL https://ijc.org/en/loslrb/watershed/water-levels

Appendix A: Tables A-1 to A-6

Table A-1: 2022 DNGS Protected Area Tritium Results

Sample Location Name	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
MW108-11	--	<100	--	<100
MW109-10	--	<100	--	<100
MW110-6	<100	<100	<100	<100
MW111-18	--	205	--	151
MW112-11	--	300	--	280
MW113-6	--	190	--	190
MW114-18	790	--	790	--
MW115-12	780	760	810	810
MW116-6	770	760	740	840
MW117-18	390	--	660	--
MW118-12	800	800	780	850
MW119-6	700	770	860	780
MW120-18	--	500	--	520
MW121-13	--	675	--	700
MW122-4	--	450	--	NA
MW127-6	--	450	--	420
MW123-18	230	200	210	200
MW124-13	<100	<100	<100	<100
MW125-6	440	420	400	<100
MW128-18	--	<100	--	<100
MW142-16	--	940	--	840
MW143-12	--	830	--	850
MW144-7	1,040	1,070	930	890
MW148-16	NA	1,130	--	--
MW149-12	830	835	840	880
MW150-7	800	780	760	850
MW151-16	NA	775	750	--
MW152-12	770	780	730	800
MW153-7	550	530	490	560
MW154-16	<100	200	210	180
MW155-11	540	500	470	470
MW156-7	380	360	320	360
MW157-16	660	690	630	700
MW158-12	100	<100	<100	141
MW159-7	630	590	650	640

Sample Location Name	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
MW163-16	<100	<100	<100	<100
MW164-13	150	280	250	220
MW165-7	720	710	720	760

Notes:

NA denotes that sample could not be collected and the result is not available. MW122-4 was inaccessible in Q4 2022; MW148-16 and MW151-16 were sampled in Q2 2022 rather than Q1 due to health and safety concerns.

--- denotes that samples were not required

< denotes that result is below the laboratory method detection limit value shown

Table A-2: 2022 DNGS Controlled Area Tritium Results

Sample Location Name	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
MW003-7	--	260	--	220
MW013B-18	--	<100	--	<100
MW014A-12	--	<100	--	<100
MW014C-5	--	<100	--	<100
MW014B-8	--	<100	--	<100
MW019A-19	--	<100	--	<100
MW019B-14	--	<100	--	<100
MW020A-11	--	<100	--	<100
MW020B-7	--	200	--	220
MW020C-3	--	280	--	<100
MW025-8	--	280	--	280

Notes:

--- denotes that samples were not required

< denotes that result is below the laboratory method detection limit value shown

Table A-3: 2022 DNGS BTEX and Petroleum Hydrocarbon Results

Parameter	Unit	MECP Table 3 SCS	MW020C-3	MW020B-7	MW020A-11
			Q2	Q2	Q2
Benzene	Bq/L	44	<0.2	<0.2	<0.2
Toluene	Bq/L	18,000	<0.2	<0.2	0.24
Ethylbenzene	Bq/L	2,300	<0.2	<0.2	<0.2
o-Xylene	Bq/L	--	<0.2	<0.2	<0.2
p+m-Xylene	Bq/L	--	<0.4	<0.4	<0.4
Total Xylenes	Bq/L	4,200	<0.4	<0.4	<0.4
F1 (C6-C10) - BTEX	Bq/L	750	<25	<25	<25
F2 (C10-C16 Hydrocarbons)	Bq/L	150	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	Bq/L	500	<200	<200	<200
F4 (C34-C50 Hydrocarbons)	Bq/L	500	<200	<200	<200

Parameter	Unit	MECP Table 3 SCS	MW110-6			
			Q1	Q2	Q3	Q4
Benzene	Bq/L	44	<0.2	<0.2	<0.2	<0.2
Toluene	Bq/L	18,000	<0.2	<0.2	<0.2	<0.2
Ethylbenzene	Bq/L	2,300	<0.2	<0.2	<0.2	<0.2
o-Xylene	Bq/L	--	<0.2	<0.2	<0.2	<0.2
p+m-Xylene	Bq/L	--	<0.4	<0.4	<0.4	<0.4
Total Xylenes	Bq/L	4,200	<0.4	<0.4	<0.4	<0.4
F1 (C6-C10) - BTEX	Bq/L	750	<25	<25	<25	<25
F2 (C10-C16 Hydrocarbons)	Bq/L	150	<100	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	Bq/L	500	<200	<200	<200	<200

Parameter	Unit	MECP Table 3 SCS	MW110-6			
			Q1	Q2	Q3	Q4
F4 (C34-C50 Hydrocarbons)	Bq/L	500	<200	<200	<200	<200

Parameter	Unit	MECP Table 3 SCS	MW142-16	MW143-12		MW144-7
			Q3	Q2	Q3	Q2
Benzene	Bq/L	44	67.0	10	22	<0.2
Toluene	Bq/L	18,000	1.1	0.62	0.96	<0.2
Ethylbenzene	Bq/L	2,300	1.9	0.62	0.4	<0.2
o-Xylene	Bq/L	--	0.76	0.3	0.38	<0.2
p+m-Xylene	Bq/L	--	4.9	6.6	2.5	<0.4
Total Xylenes	Bq/L	4,200	5.7	6.9	2.8	<0.4
F1 (C6-C10) - BTEX	Bq/L	750	240	260	140	<25
F2 (C10-C16 Hydrocarbons)	Bq/L	150	<100	180	<100	<100
F3 (C16-C34 Hydrocarbons)	Bq/L	500	<200	390	<200	<200
F4 (C34-C50 Hydrocarbons)	Bq/L	500	<200	<200	<200	<200

Parameter	Unit	MECP Table 3 SCS	MW158-12	MW159-7	MW161-12	MW162-7
			Q2	Q2	Q2	Q2
Benzene	Bq/L	44	0.64	<0.2	<0.2	<0.2
Toluene	Bq/L	18,000	<0.2	<0.2	<0.2	0.0000
Ethylbenzene	Bq/L	2,300	<0.2	<0.2	<0.2	<0.2
o-Xylene	Bq/L	--	<0.2	<0.2	<0.2	<0.2
p+m-Xylene	Bq/L	--	<0.4	<0.4	<0.2	<0.4
Total Xylenes	Bq/L	4,200	<0.4	<0.4	<0.4	0.0000
F1 (C6-C10) - BTEX	Bq/L	750	27	<25	<25	<25
F2 (C10-C16 Hydrocarbons)	Bq/L	150	<100	<100	<100	<100

Parameter	Unit	MECP Table 3 SCS	MW158-12	MW159-7	MW161-12	MW162-7
			Q2	Q2	Q2	Q2
F3 (C16-C34 Hydrocarbons)	Bq/L	500	<200	<200	<200	<200
F4 (C34-C50 Hydrocarbons)	Bq/L	500	<200	<200	<200	<200

Notes:

Sample results are in µg/L
Highlighted results are above the standard values in MECP Table 3 SCS

< denotes that result is below the laboratory method detection limit value shown

Table A-4: 2022 DNGS Perimeter Tritium Results

Sample Location Name	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
MW006-9	--	<100	--	--
MW007-2	--	<100	--	--
MW008-20	--	<100	--	--
MW015A-19	--	<100	--	--
MW016A-10	--	<100	--	--
MW016C-4	--	480	--	--
MW017B-15	--	<100	--	--
MW018A-11	--	<100	--	--
MW018C-4	--	<100	--	--
MW032-13	--	<100	--	--
MW033-8	--	<100	--	--
MW042-20	--	<100	--	--
MW043-8	--	<100	--	--
MW045-10	--	<100	--	--
MW046-6	--	<100	--	--
MW052-15	--	<100	--	--
MW058-6	--	<100	--	--
MW059-12	--	<100	--	--
MW078-18	--	<100	--	--
MW079-4	--	<100	--	--
MW081-17	--	<100	--	--
MW082-6	--	<100	--	--
MW095-13	--	<100	--	--
MW096-6	--	<100	--	--
MW170-34	--	<100	--	--
MW171-13	--	<100	--	--
MW172-6	--	<100	--	--
MW174-56	--	<100	--	--
MW175-41	--	<100	--	--
MW176-3	--	<100	--	--

Notes:

--- denotes that samples were not required

< denotes that result is below the laboratory method detection limit value shown

Table A-5: 2022 DNGS Quality Control Results – Duplicate Samples and Relative Percent Differences (RPD)

Location	Parameter	Sample Date	Sample Values		RPD (%)
			Duplicate	Primary	
MW009-15	Benzene	16-Mar-2022	<0.2	<0.2	NC
	Ethylbenzene		<0.2	<0.2	NC
	F1 (C6-C10)		<25	<25	NC
	F1 (C6-C10) - BTEX		<25	<25	NC
	F2 (C10-C16 Hydrocarbons)		<100	<100	NC
	F3 (C16-C34 Hydrocarbons)		<200	<200	NC
	F4 (C34-C50 Hydrocarbons)		<200	<200	NC
	o-Xylene		<0.2	<0.2	NC
	p+m-Xylene		<0.4	<0.4	NC
	Toluene		<0.2	<0.2	NC
	Total Xylenes		<0.4	<0.4	NC
	Tritium		34	35	NC
MW110-6	Benzene	05-Aug-2022	<0.2	<0.2	NC
	Ethylbenzene		<0.2	<0.2	NC
	F1 (C6-C10)		<25	<25	NC
	F1 (C6-C10) - BTEX		<25	<25	NC
	F2 (C10-C16 Hydrocarbons)		<100	<100	NC
	F3 (C16-C34 Hydrocarbons)		<200	<200	NC
	F4 (C34-C50 Hydrocarbons)		<200	<200	NC
	o-Xylene		<0.2	<0.2	NC
	p+m-Xylene		<0.4	<0.4	NC
	Toluene		<0.2	<0.2	NC
	Total Xylenes		<0.4	<0.4	NC
	Tritium		<100	<100	NC
	Benzene	21-Oct-2022	<0.2	<0.2	NC
	Ethylbenzene		<0.2	<0.2	NC
	F1 (C6-C10)		<25	<25	NC
	F1 (C6-C10) - BTEX		<25	<25	NC
	F2 (C10-C16 Hydrocarbons)		<100	<100	NC
	F3 (C16-C34 Hydrocarbons)		<200	<200	NC
	F4 (C34-C50 Hydrocarbons)		<200	<200	NC
	o-Xylene		<0.2	<0.2	NC

Location	Parameter	Sample Date	Sample Values		RPD (%)
			Duplicate	Primary	
	p+m-Xylene		<0.4	<0.4	NC
	Toluene		<0.2	<0.2	NC
	Total Xylenes		<0.4	<0.4	NC
	Tritium		<100	<100	NC
MW142-16	Benzene	20-Oct-2022	70	67	4.4
	Ethylbenzene		2	2	11.1
	F1 (C6-C10)		330	320	3.1
	F1 (C6-C10) - BTEX		250	240	4.1
	F2 (C10-C16 Hydrocarbons)		<100	<100	NC
	F3 (C16-C34 Hydrocarbons)		<200	<200	NC
	F4 (C34-C50 Hydrocarbons)		<200	<200	NC
	o-Xylene		1	1	1.3
	p+m-Xylene		5	5	4.1
	Toluene		1	1	0.0
	Total Xylenes		6	6	1.8
MW143-12	Benzene	20-Oct-2022	23	22	4.4
	Ethylbenzene		0.4	0.4	0.0
	F1 (C6-C10)		180	170	5.7
	F1 (C6-C10) - BTEX		150	140	6.9
	F2 (C10-C16 Hydrocarbons)		<100	<100	NC
	F3 (C16-C34 Hydrocarbons)		<200	<200	NC
	F4 (C34-C50 Hydrocarbons)		<200	<200	NC
	o-Xylene		0.4	0.4	NC
	p+m-Xylene		3	3	0.0
	Toluene		1	1	0.0
	Total Xylenes		3	3	3.5
MW025-8	Tritium	24-Oct-2022	280	280	0.0
MW052-15	Tritium	25-May-2022	<100	<100	NC
MW079-4	Tritium	12-May-2022	<100	<100	NC
MW111-18	Tritium	17-May-2022	200	210	4.9
	Tritium	18-Oct-2022	152	150	1.3
MW115-12	Tritium	17-Mar-2022	780	780	0.0
MW118-12	Tritium	17-Mar-2022	800	800	0.0
	Tritium	18-May-2022	780	820	5.0
	Tritium	04-Aug-2022	750	780	3.9
	Tritium	19-Oct-2022	820	880	7.1

Location	Parameter	Sample Date	Sample Values		RPD (%)
			Duplicate	Primary	
MW121-13	Tritium	19-May-2022	690	660	4.4
	Tritium	19-Oct-2022	730	670	8.6
MW149-12	Tritium	17-Mar-2022	860	830	3.6
	Tritium	18-May-2022	860	810	6.0
	Tritium	04-Aug-2022	840	840	0.0
	Tritium	20-Oct-2022	900	860	4.5
MW151-16	Tritium	18-May-2022	780	770	1.3
	Tritium	03-Aug-2022	720	750	4.1
MW171-13	Tritium	24-May-2022	<100	<100	NC
MW175-14	Tritium	24-May-2022	<100	<100	NC

Notes:

NC - Not calculated as sample results are below detection

< denotes that result is below the laboratory method detection limit

Table A-6: 2022 DNGS Quality Control Results – Trip and Filed Blank Sample Results

Sample Type	Parameter	Sample Result (µg/L)			
		Q1[a]	Q2[b]	Q3[a]	Q4[a]
Field Blank	Benzene	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	<0.2	<0.2	<0.2	<0.2
	F1 (C6-C10) - BTEX	<25	<25	<25	<25
	o-Xylene	<0.2	<0.2	<0.2	<0.2
	p+m-Xylene	<0.4	<0.4	<0.4	<0.4
	Toluene	<0.2	<0.2	<0.2	<0.2
	Total Xylenes	<0.4	<0.4	<0.4	<0.4
Trip Blank	Benzene	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	<0.2	<0.2	<0.2	<0.2
	F1 (C6-C10) - BTEX	<25	<25	<25	<25
	o-Xylene	<0.2	<0.2	<0.2	<0.2
	p+m-Xylene	<0.4	<0.4	<0.4	<0.4
	Toluene	<0.2	<0.2	<0.2	<0.2
	Total Xylenes	<0.4	<0.4	<0.4	<0.4

Notes:

< denotes that result is below the laboratory method detection limit

[a] Field Blanks were collected in the vicinity of MW110-6

[b] Field Blanks were collected in the vicinity of MW159-7 and MW020A-11